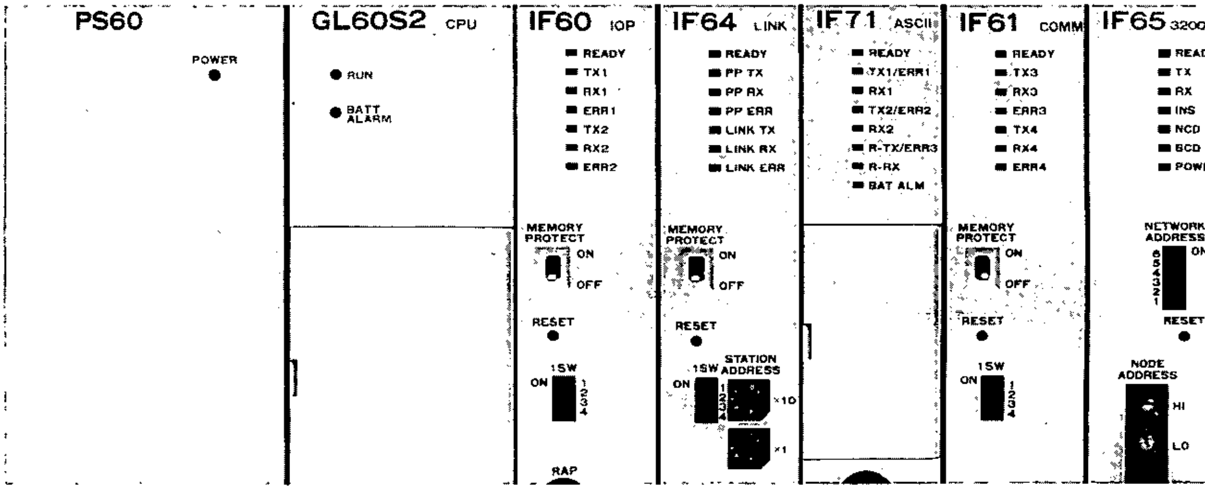
MEMOBUS
DESCRIPTIVE INFORMATION

INDUSTRIAL COMMUNICATION SYSTEM

FOR MEMOCON-SC GL60S / U84 / U84S / GL20 / R84H-M



YASKAWA

SIE-C815-13.60E

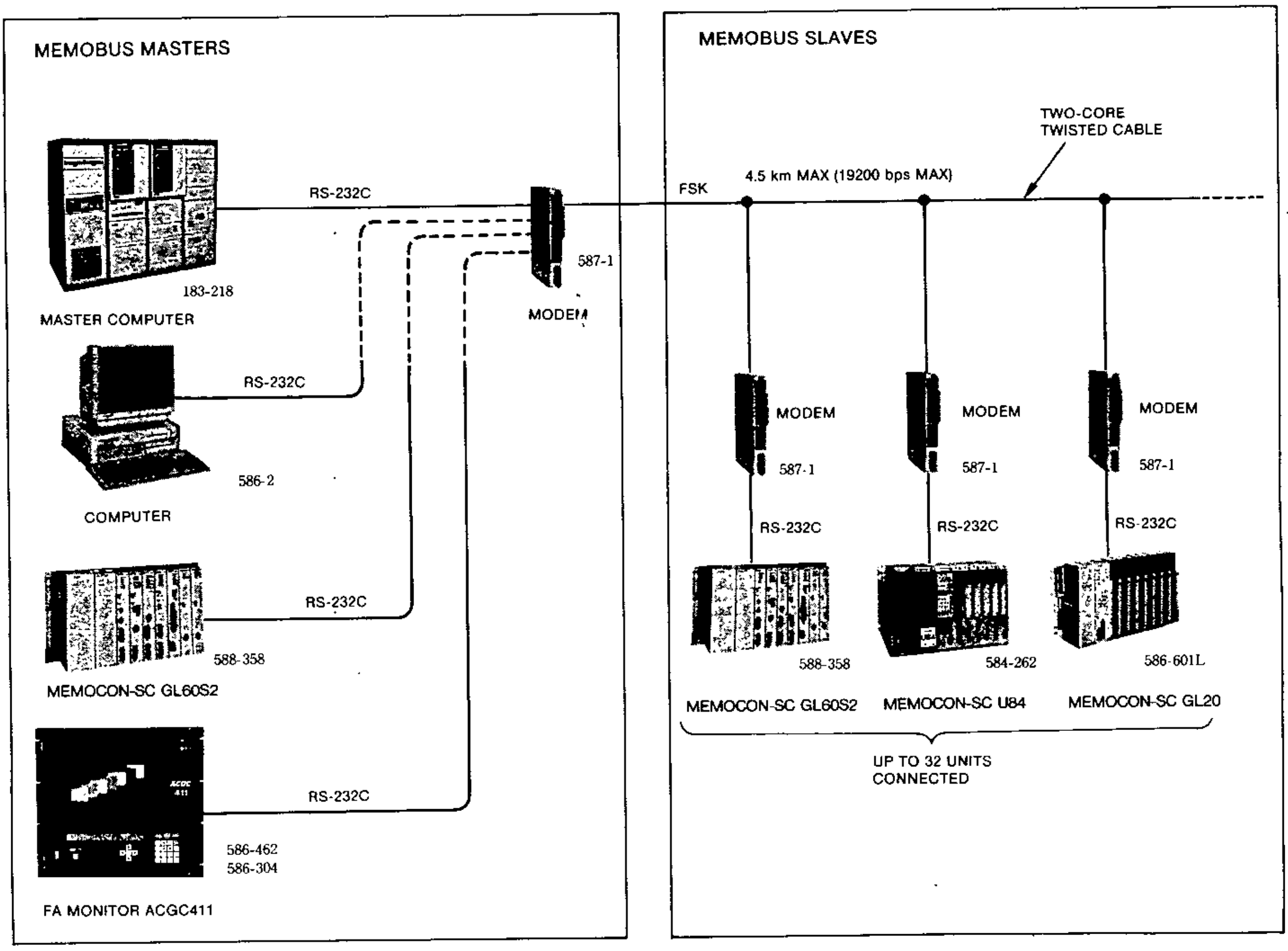
OVERVIEW OF MEMOBUS

The MEMOBUS programmable controller is an internal plant transmission system compatible with the following systems: MEMOCON-SC GL70H, GL60H, GL60S, S0, S1, S2, S3, GL40S1, S2, S3, U84, U84S, GL40S, GL20, and R84H-M.

MEMOBUS is designed to be used as a single master unit compatible with the following computers: ACGC, P150, GL70H, GL60H, GL60S, GL40S, U84 etc.

Transmission between master and slave (serial transmission) is controlled according to the master program with the master initiating communication and the slave responding.
When the master sends a signal out to one slave, all other slaves with pre-registered address numbers receive the transmission to carry out designated functions and answer back to the master. In this way, the master is able to read and change coil conditions and register contents of machines in various locations, and control and monitor a wide variety of production systems.

MEMOBUS transmission protocol (MEMOBUS message) is extremely simple and easy to understand with a format allowing the slave to be used with any function.
In addition, with the exception of the GL20, R84H-M models, the MEMOBUS can be used with all other models as a master and a mutual signal communication programmable controller.



NOTES FOR SAFE OPERATION

Read these manuals thoroughly before use of MEMOCON-SC. In these manuals, NOTES FOR SAFE OPERATION are classified as "WARNING" and "CAUTION."

⚠ WARNING	: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
⚠ CAUTION	: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

Even items described in ⚠ CAUTION may result in a vital accident in some situations. In either case, follow these important notes.

The following shows the symbol of prohibition.

⃠ PROHIBITION	: Specifies prohibited handling.

After reading these manuals, keep them readily available for those using the equipment.

1 INSTALLATION

⚠ CAUTION

- The installation environment must meet the environmental conditions given in the product catalog and manuals.
  Using the MEMOCON-SC in environments subject to high temperatures, high humidity, excessive dust, corrosive gases, vibration, or shock can lead to electric shock, fire, or faulty operation.

  Do not use the MEMOCON-SC in the following locations.

  - Locations subject to direct sunlight or ambient temperatures not between 0 and 55℃.
  - Locations subject to relative humidity in excess of 95%, rapid changes in humidity, or condensation.
  - Locations subject to corrosive or flammable gas.
  - Locations that would subject the MEMOCON-SC to direct vibration or shock.
  - Locations subject to contact with water, oil, chemicals, etc.

- Install products correctly according to the instructions.
  Improper installation may result in accidents or malfunctions.
- Do not allow wire clippings or other foreign matter to enter the MEMOCON-SC.
  Foreign matter can cause fires, product failure, or malfunctions.

2 WIRING

⚠ CAUTION

- Wiring must be performed by qualified personnel.
  Mistakes in wiring can cause fires, product failure, or malfunctions.

INSERT THE INTERFACE CABLES PROPERLY

- Insert the connectors of the various interface cables that are connected to MEMOCON-SC into the communication parts and secure them properly.
  Failure to observe this instruction may result in malfunctions.

3 PRECAUTION UPON USE

⚠ CAUTION

- Operations such as RUN, STOP, forced output, and program change during operation must be carried out with care.
  Operational errors may damage the machine or cause accidents.

TURNING POWER ON/OFF WHEN USING MODEM

- If the slave power unit is turned ON or OFF with the modem ON, the modem outputs a signal for 10 ms through the 2-core twisted cable. This signal will cause a transmission error for other modems in operation.
  To avoid this problem, turn ON the slave first before turning the modem ON, and turn OFF the slave after turning the modem OFF. Or, turn ON/OFF both at the same time.

4 MAINTENANCE

⃠ PROHIBITION

- Do not attempt to disassemble or modify the MEMOCON-SC in any way.
  Doing so can cause fires, product failure, or malfunctions.

⚠ CAUTION

- Attaching, installing or removing other modules is only to be made after the power is turned OFF.
  Otherwise, electric shock, malfunction or breakdown will result.

5 GENERAL PRECAUTION

- MEMOCON-SC was not designed or manufactured for use in devices or systems that concern peoples' lives.
  Users who intend to use the product described in this manual for special purposes such as devices or systems relating to transportation, medical, space aviation, atomic power control, or underwater use must contact YASKAWA representatives beforehand.
- This product has been manufactured under strict quality control guidelines. However, if this product is to be installed in any location in which a failure of MEMOCON-SC involves a life and death situation or in a facility where failure may cause a serious accident, safety devices must be installed to minimize the likelihood of any accident.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all product to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
  A new version of the manual will be re-released under a revised document number when any changes are made.
- Contact your YASKAWA representative listed on the back of this manual to order a new manual whenever this manual is damaged or lost.
  Please provide the document number listed on the front cover of this manual when ordering.
- Contact your YASKAWA representative listed on the back of this manual to order new nameplates whenever a nameplate becomes worn or damaged.
- YASKAWA cannot make any guarantee for products which have been modified.
  YASKAWA assumes no responsibility for any injury or damage caused by a modified product.

OVERVIEW OF MANUAL

- This manual describes the functional specifications of MEMOBUS. Read this manual carefully in order to use MEMOBUS properly. Also, keep this manual in a safe place so that it can be used whenever necessary.

- Refer to the following manuals as necessary.

	Document Title	Document Number	Content
CPU Module	MEMOCON-SC GL60S DESCRIPTIVE INFORMATION	SIE-C815-14.1	Describes system configuration devices and their functions, specifications, application methods, etc., for the GL60S.
	MEMOCON GL40S DESCRIPTIVE INFORMATION	SIE-C815-15.1	Describes system configuration devices and their function, specifications, application methods, etc., for the GL40S.
	MEMOCON-SC GL60H/ GL70H DESCRIPTIVE INFORMATION	SIE-C815-17.1	Describes system configuration devices and their functions, specifications,application methods, etc., for the GL60H/GL70H.
Man/Machine Interface	MEMOCON-SC GL60S P150 PROGRAMMING PANEL DESCRIPTIVE INFORMATION	SIE-C815-14.2	Describes functions, specifications, application methods, etc., for the P150 Programming Panel.
	MEMOCON-SC GL60S P150 PROGRAMMING PANEL DESCRIPTIVE INFORMATION	SIE-C815-14.3	Describes the SFC function, specifications, application methods, etc., for the P150 Programming Panel.

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1. INTRODUCTION

The MEMOBUS is an industrial data communication system applicable to the programmable controllers Memocon-SC GL60S, S0, S1, S2, S3, U84, U84J, U84S, GL20 and R84H-M (hereafter abbreviated to GL60S, U84, GL20, R84H-M).

The MEMOBUS system is comprised of one master unit (computer, ACGC, P150, programming panel, U84) and up to 32 slave units (GL60S, U84, GL20, and/or R84H-M).

Transmission (serial) between the master and slave units is controlled by programs held in the master unit. The master unit initiates transmission and the slave units respond to it.

The master unit communicates with one slave unit at a time. Each slave unit is given an address code and the master unit refers to an access address for a specific slave unit. The slave unit which has received a command from the master unit executes the designated function and responds to the master unit.

In this way, the master unit can detect the states of coils and read or rewrite the contents of registers of the slave units which may be disbursed in various locations so that centralized monitoring and control becomes possible over a wide production area.

The transmission protocol of the MEMOBUS system is called the MEMOBUS message. It is very simple and easy to understand, is usable for any slave unit of GL60S, U84, GL20, and R84H-M and it is designed with a common format.

Any computer may become the master unit only if it is provided with an RS-232C port. The GL60S and U84 can function as the master unit and communication is possible with the programmable controller.

Described below are the specifications of the MEMOBUS, system configuration, connections, setting up transmission parameters, and communication protocol.

2. SPECIFICATIONS

2.1 SPECIFICATIONS OF TRANSMISSION

(1) Transmission Mode: Half duplex, asynchronous

- Between master/slave unit and modem: RS-232C
- Between modems: Frequency shift keying (FSK)

(2) MEMOBUS Master Unit: Any one of computer, ACGC, P150, GL60S, and U84

(3) MEMOBUS Slave Units: Up to 32 GL60S, U84, GL20, and/or R84H-M

(4) Communication Protocol: MEMOBUS message

(5) Transmission Rate: 50-19200 baud (user selectable)

(6) Transmission Mode: RTU mode, ASCII mode (user selectable)

(7) Data Format: RS-232C

- Data: 8 bits (RTU mode), 7 bits (ASCII mode)(user selectable)
- Parity check: Even parity, odd parity, no parity (user selectable)
- Stop bit (s): 1 bit, 2 bits (user selectable)

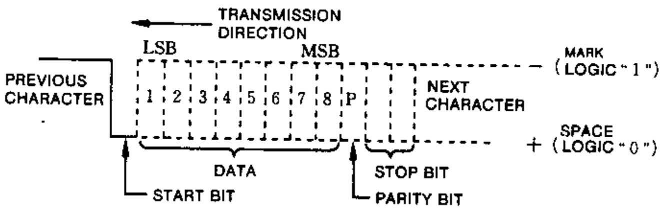


Fig. 2.1 Data Format

(8) Error Check: CRC-16 (RTU mode), LRC (ASCII mode)

(9) Distance of Communication: 4.5km max

(10) Transmission Cable: Two-core twisted cable (RG-108/U or equivalent)
Characteristic impedance—100Ω at 100kHz

2.2 SPECIFICATIONS OF MODEM

(1) Modulation: FSK (50kHz, 80kHz)

(2) Transmission Output Voltage: $6V_{P-P}$ at 100kHz, 100Ω load

(3) Receiving Input Voltage: $100mV_{P-P}$ minimum at 100kHz

(4) Source Power: 85—121VAC, 47.5—63Hz, 10VA

2.3 GENERAL SPECIFICATIONS

(1) Ambient Temperature: 0 to+55℃ (+5 to+40℃ for P150)

(2) Storage Temperature: −20 to+85℃(−20 to+60℃ for P150)

(3) Humidity: 5 to 95% R. H. (no condensing)(20 to 80% R. H. for P150)

(4) Vidration Resistance: In compliance with JIS*C 0911 ⅡB class 3 (except for P150)

(5) Grounding Resistance: 100Ω or less

2.4 FUNCTIONS

2.4.1 General Functions

(1) Reading out Coil State

(2) Reading out Input Relay State

(3) Reading out Contents of Holding Register

(4) Reading out Contents of Input Register

(5) Changing Paticular Coil State

(6) Changing Coil State

(7) Writing in Holding Register

(8) Loopback Test

2.4.2 Exclusive Functions for GL60S

(1) Reading out Specified Link Relay State

(2) Reading out Constant Register

(3) Reading out Passing Register

(4) Reading out Link Register

(5) Reading out Extension Register

(6) Reading out Step State

(7) Changing Specified Link Relay State

(8) Writing in Specified Constant Register

(9) Writing in Specified Link Register

(10) Writing in Specified Extension Register

(11) Changing Multi-link Relay State

(12) Writing in Multi-constart Register

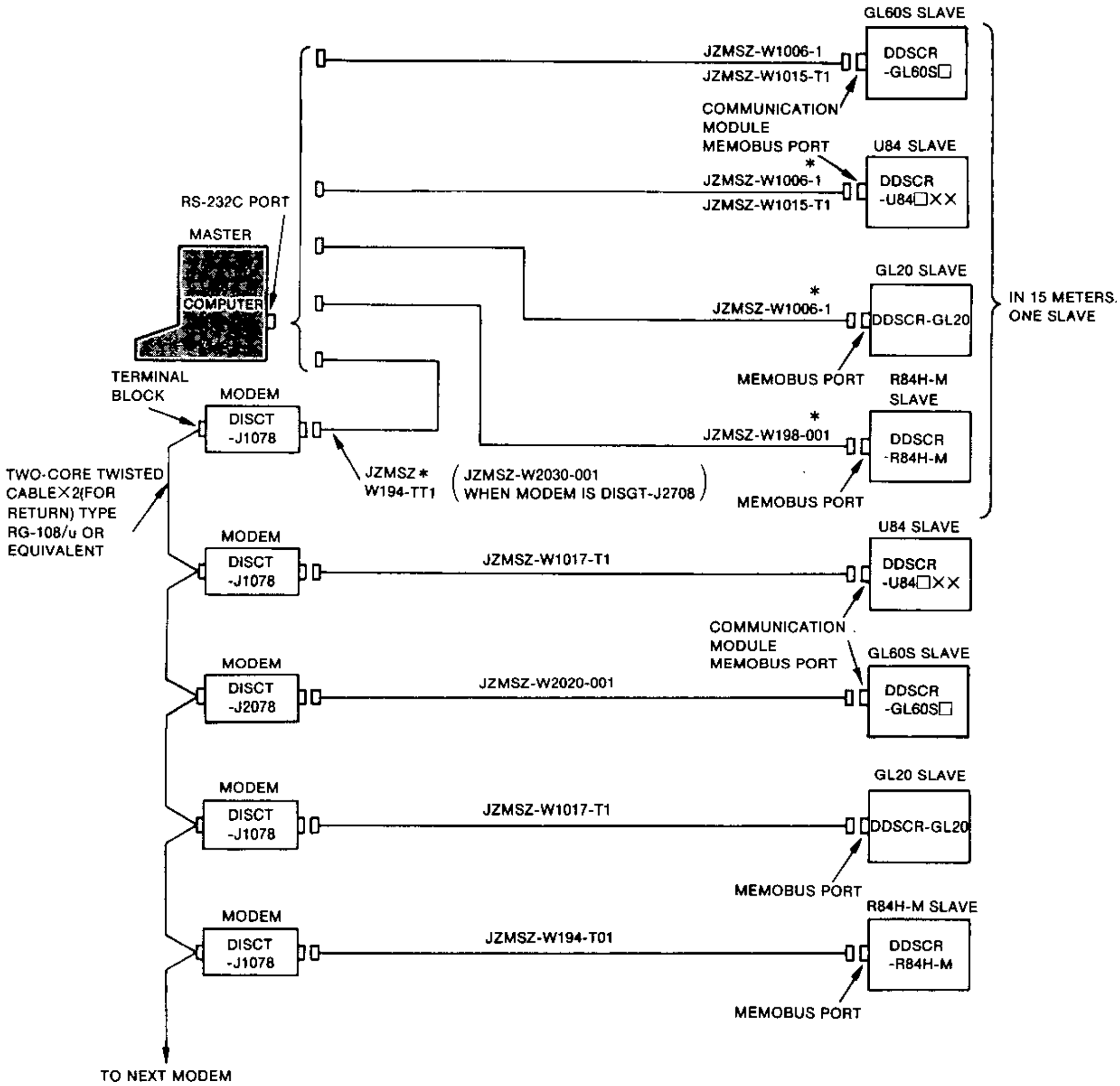
(13) Writing in Multi-link Register

(14) Writing in Multi-extension Register

3. SYSTEM CONFIGURATIONS

3.1 COMPUTER MASTER

The programs controlling communication according to MEMOBUS messages must be stored in advance in the computer. The modems are to be connected with two-core twisted cables, each core providing one-way transmission. No extra devices are needed for branching a cable since it is connected via a terminal block.

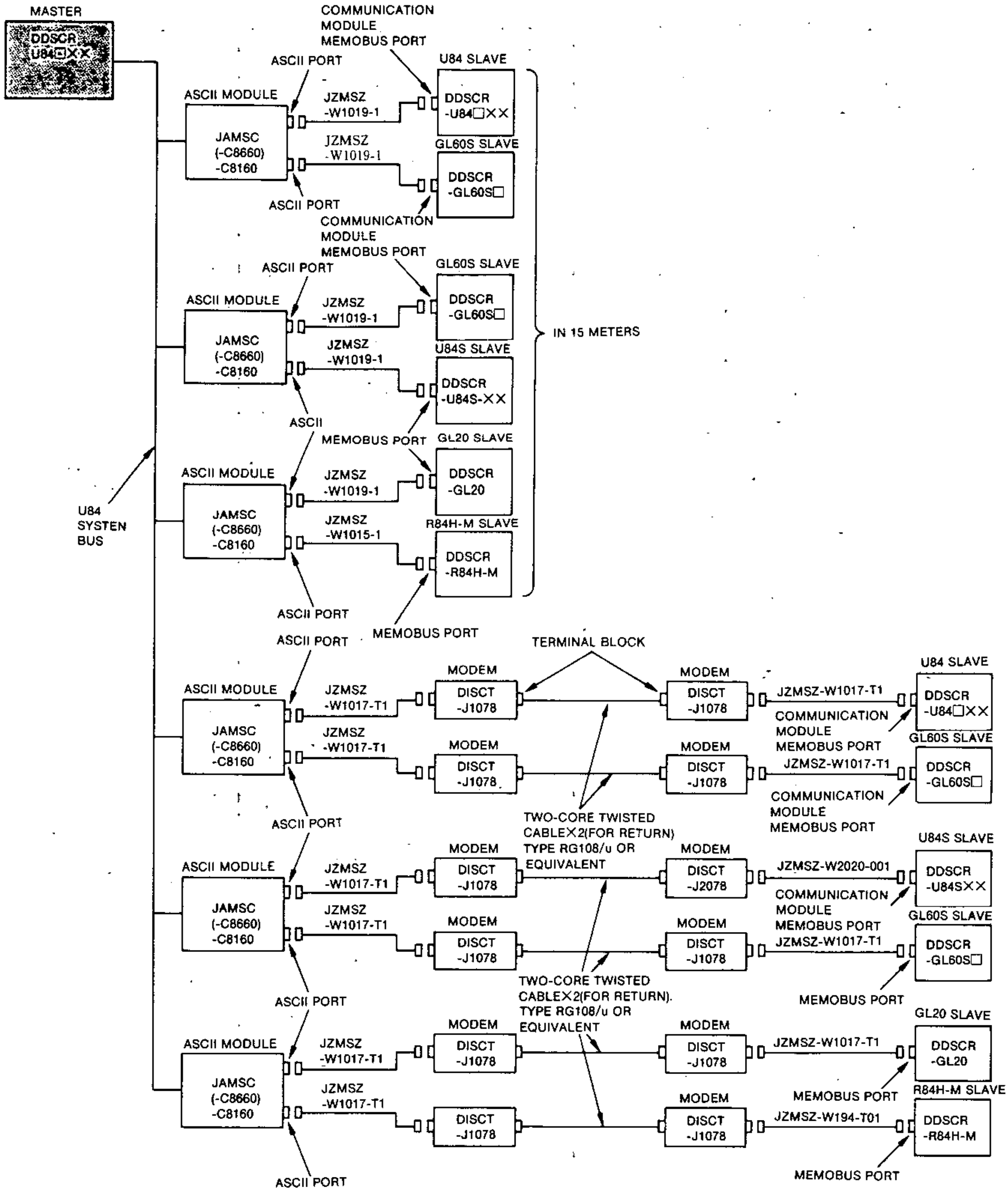


* Depending on the computer, the cables shown here may not be compatible with the connectors.

Fig. 3.1 Configuration with Computer Master

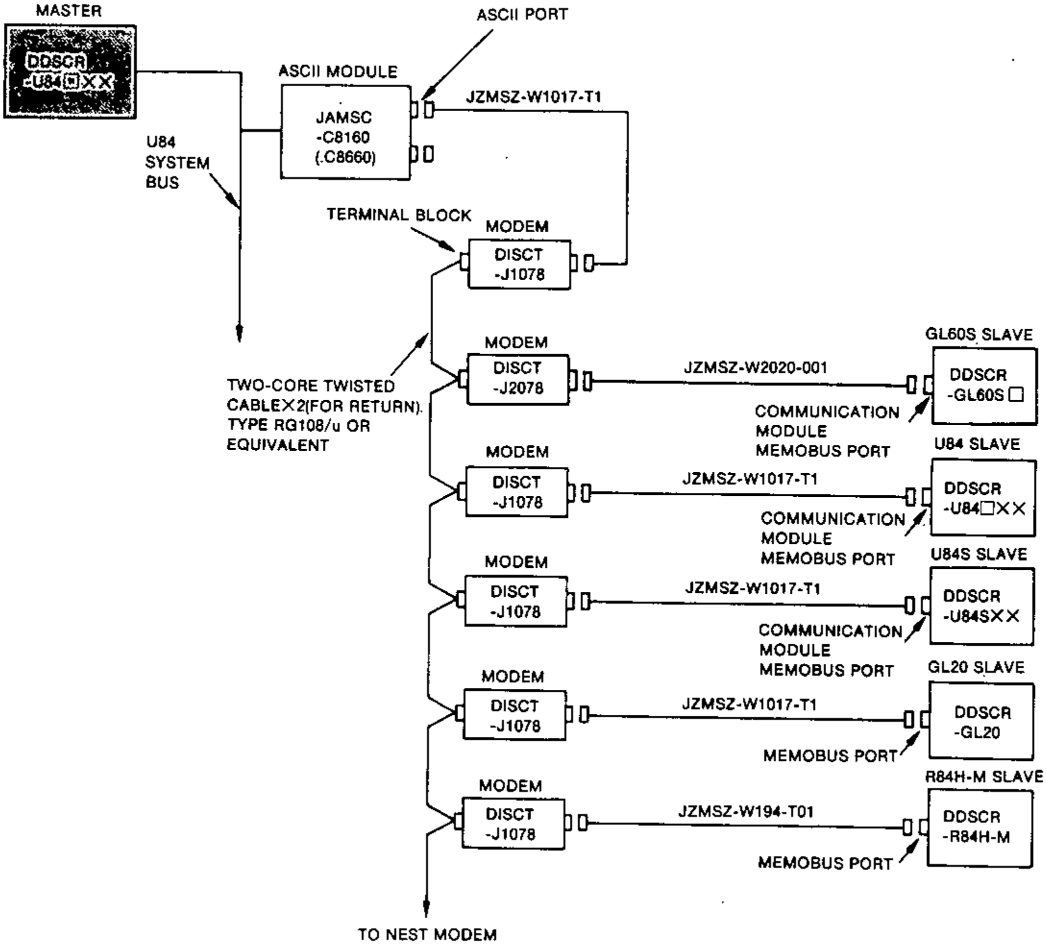
3.2 U84 MASTER

The ladder diagram of U84 generates MEMOBUS messages and the ASCII module (C8160) or (C8660) is used to perform communication through its ASCII port.



(a) One Slave Unit Connected to an ASCII Port

Fig. 3.2 Configuration with U84 Master



(b) Multiple Slave Units Connected to an ASCII Port

3.3 P150/P140 MASTER

Basic communication is performed between P150 (P140) and U84 (GL60S) using MEMOBUS messages. Therefore, P150 can be considered as a computer.

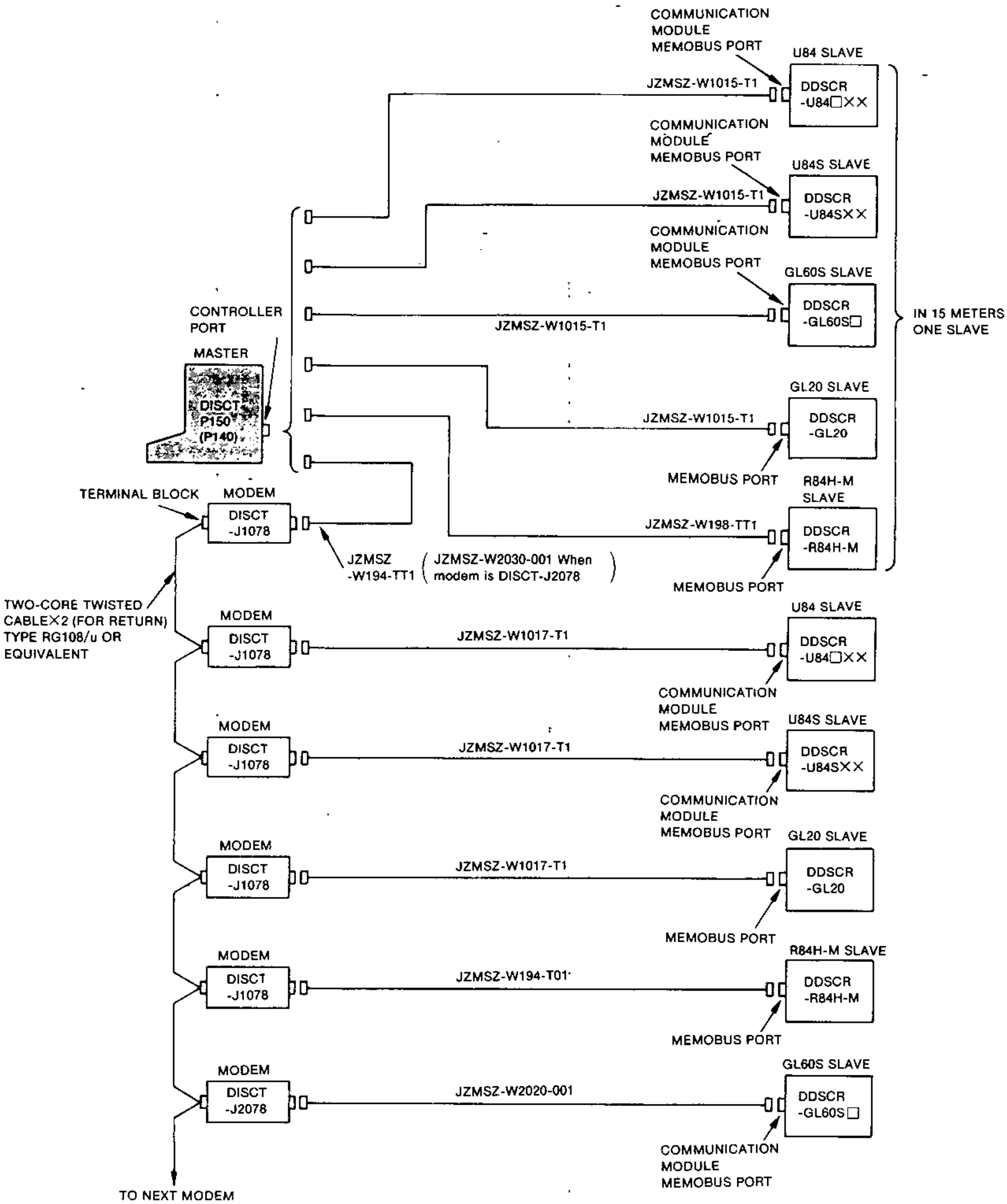
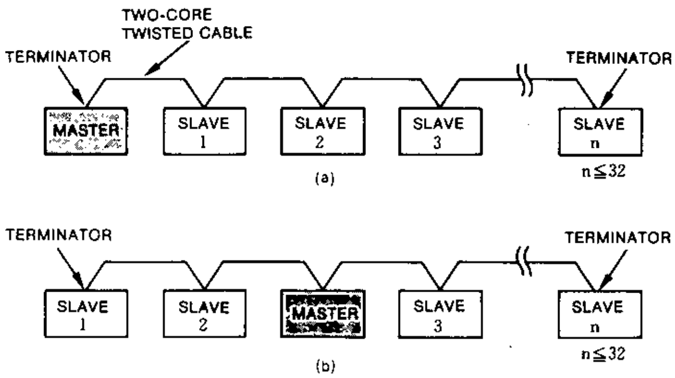


Fig. 3.3 Configuration with P150/P140 Master

3.4 PRECAUTIONS FOR BUILDING A SYSTEM

(1) Be sure to connect all the units in series, Fig. 3.4 (a). The master unit may be located anywhere in the communication line of the units, Fig. 3.4 (b). Be sure to terminate both ends of the line of units with terminators.



Note: Modem is ommited in these illustrations

Fig. 3.4

(2) No modem is necessary when only one slave unit is involved and is not more than 15 meters from the master unit. Modems become necessary when more than one slave unit is involved or when one is more than 15 meters from the master unit, Fig. 3.5

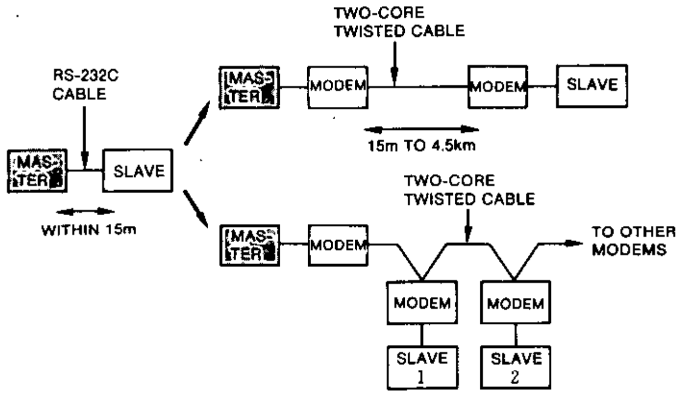


Fig. 3.5

(3) In the cases of U84 master, the configuration of Fig. 3.2 (a) provides higher efficiency for communication, than that of Fig. 3.2 (b) because communication will be performed in parallel.

(4) When starting or stopping power to modem, a spurious signal will be induced into the two-core twisted cable momentarily (not longer than 1 ms) and, therefore, if communication is performed between other modems at that moment, an error will result.

A communication error may also possibly result from other external noises. The master unit should therefore be controlled by software to reattempt communication when it has detected an error.

3.4 PRECAUTIONS FOR BUILDING A SYSTEM (Cont'd)

If a message of master unit is externally disturbed during transmission, no slave unit will return messages. To cope with this problem, the master unit should have a timer which permits reattempting communication when a time-out error has been detected.

(5) If a slave unit is turned on or off while modem power is on, the modem will produce a spurious signal which will be induced into the two-core twisted cable (for tens of milliseconds). To prevent this interference, use the following sequences:

- Power ON —Turn on the slave unit, then turn on the modem.
- Power OFF—Turn off the modem, then turn off the slave unit, or turn off the modem and the slave unit simultaneously.

Refer to Fig. 3.6.

You can remove the RS-232C cable connecting the modem and slave unit before turning the slave on or off: no problem arises even if the modem is on.

(6) Slave units connectd to the same master unit must be set up for the same communication parameters, except for addresses. The same address cannot be given to more than one slave unit.

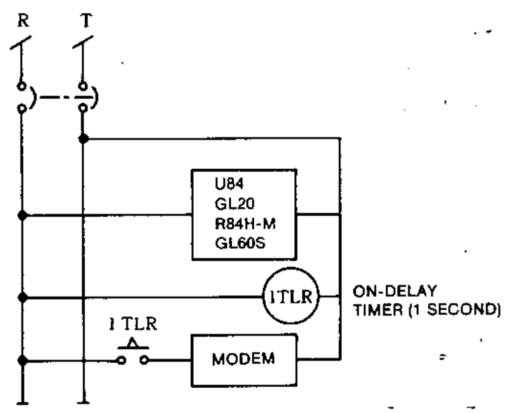


Fig. 3.6 Power Sequence Concept (J1078, 478)

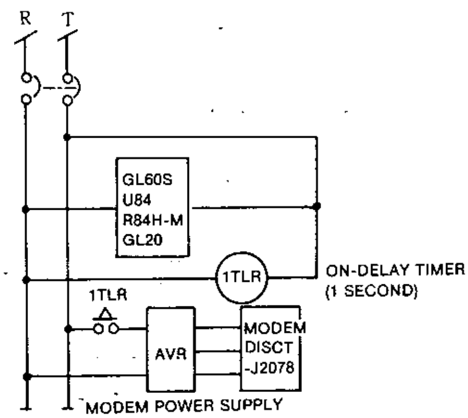


Fig. 3.7 Power Sequence Concept (J2078)

(7) It is impossible to connect the programming panel P180 and MEMOBUS simultaneously for R84H-M and GL20.

(8) Memocon-SC184, 184H, 484, R84, and R84H without the MEMOBUS interface can not be used with the MEMOBUS system.

4. CONNECTIONS OF UNITS

4.1 CONNECTIONS BETWEEN MODEMS

(1) J478 MODEM

Be sure to use tow-core twisted cables (RG-108/u or equivalent) for transmission between modems. Connect the cables to the terminal block provided on the front panel of modem.

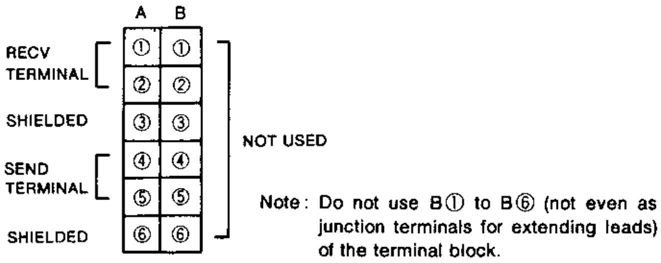


Fig. 4.1 Terminal Block

When connecting the two-core twisted cables to a modem, connect master side send terminals (SEND) all to slave side receive terminal (RECV) and slave side send terminals (SEND) to the master side receive terminals (RECV) as shown in Fig. 4.2.

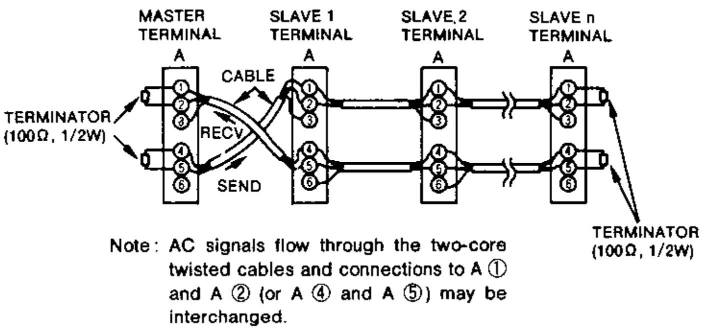


Fig. 4.2 Connection of Two-core Twisted Cables

To branch a two-core twisted cable, connect the leads of another cable to pressure terminals as shown in Fig. 4.3. Provide both ends of the two-core twisted cable with terminators (100Ω, 1/2W), Fig. 4.4.

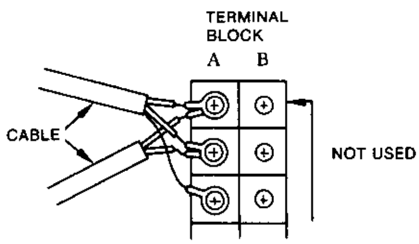


Fig. 4.3 Branching Two-core Twisted Cables

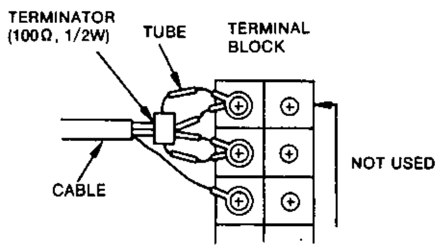
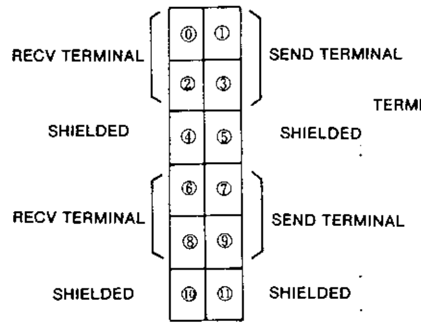


Fig. 4.4 Terminator

4.1 CONNECTIONS BETWEEN MODEMS (Cont'd)

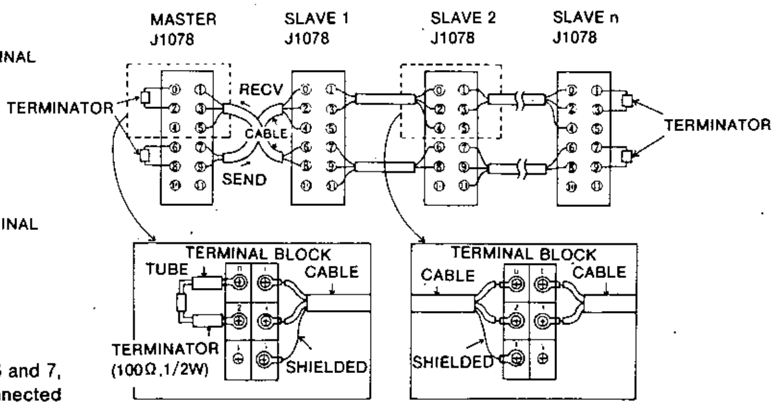
(2) J1078 MODEM

As shown in Fig. 4.6, for connection of two-core twisted sheilded cable, connect all send terminals (SEND) at the master side with receive terminals at the slave side. Then gather all send terminals at the slave side to connect with receive terminals (RECV) at the master side.



Note: Terminal blocks 0 and 1, 2 and 3, 6 and 7, 8 and 9, 4 and 5, 10 and 11 are connected in J1078.

Fig. 4.5 Terminal Block

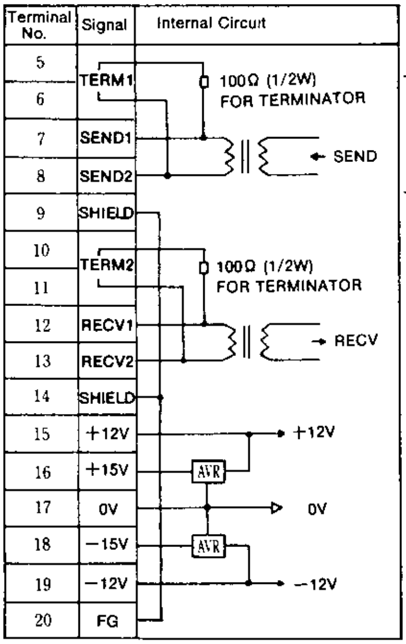


Note:
1. Two signal lines of two-core twisted cable do not have polarity.
2. Both ends of two-core twisted cable are provided additionally with terminators (min. 100Ω,1/2W or more).
3. J1078 at the master side can be located in any place on the same line; not specially required to be in the end.
4. J478 and J1078 can be used in the same system.

Fig. 4.6 Connection of Two-core Twisted Shielded Cables

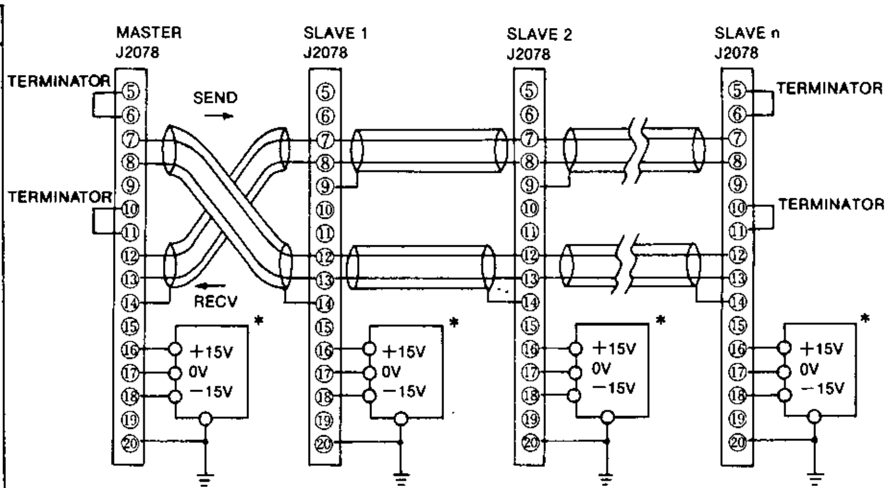
(3) J2078 MODEM

As shown in Fig. 4.7, for connection of two-core twisted sheilded cable, connect all send terminals (SEND) at the master side with receive terminals at the slave side. Then gather all send terminals at the slave side to connect with receive terminals (RECV) at the master side.



Do not use terminals ① to ④.

Fig. 4.7 Terminal Block



* External power supply: +15V ±5% (200mA), −15V±5% (100mA) or +12V±5% (200mA), −12V±5% (100mA) modem logical power supply

Note:

1. Two signal lines of two-core twisted cable do not have polarity.
2. Both ends of two-core twisted cable are provided additionally with terminators (min. 100Ω, 1/2W or more).
3. J2078 at the master side can be located in any place on the same line; not specially required to be in the end.

Fig. 4.8 Typical Connection between Modems

5. SETTING COMMUNICATION PARAMETERS

5.1 SETTING COMMUNICATION PARAMETERS OF U84 SLAVE

Set the communication parameters of U84 slave via the register access panel (RAP) of the communication module. The U84's communication module is provided with two MEMIBUS slave ports and communication parameters are set independently for them.

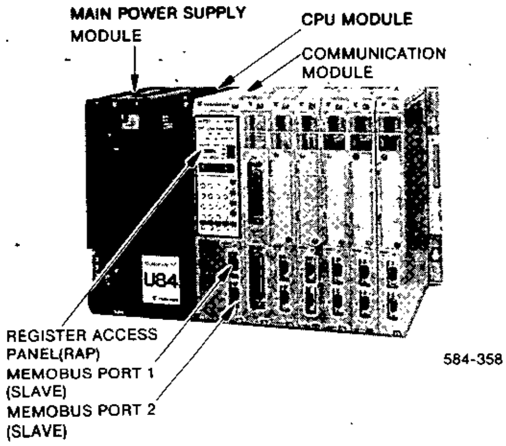


Fig. 5.1 **MEMOBUS Ports and Register Access Panel**

(1) Displaying of Communication Parameters

It is possible to display a paramater communication between the communication module and device (the programming panel, etc.) connected to a port by entering a specified number which is described below. 6 and 000 are fixed.

Particular Number

6	X	0	0	0	Y

X: Port number

X=1···MEMOBUS port 1

X=2···MEMOBUS port 2

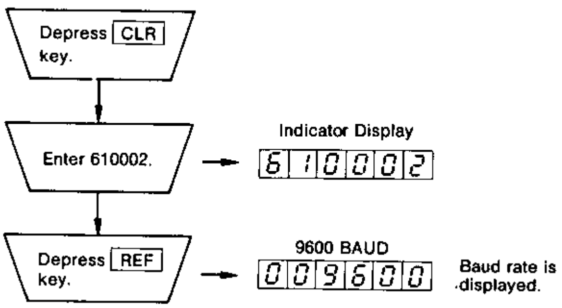
Y: See Table 5.1.

Table 5. 1

Y = 1	Slave address 1 to 247 (default: 1)
Y = 2	Baud rate (default: 9600 baud) 150, 300, 600, 1200, 2400, 4800, 9600, or 19200
Y = 3	Parity check enabled/disabled (default: enabled) EnAbLE ... Parity check enabled dISAbL ... Parity check disabled
Y = 4	Parity type (default: even parity) EUEn... Even parity odd ... Odd parity
Y = 5	Number of stop bits: 1 or 2 (default: 1 bit)
Y = 6	Communication mode (default: RTU mode) bbbbbb... RTU mode ASCII ... ASCII mode
Y = 7	Preset value of port delay timer (default: 0): 0 to 255 (correspond to 0 to 2550 ms). U84 delays response for this time interval.

• Sample Operation

Operate as follows to display the baud rate of MEMOBUS port 1, for example.



The value of Y is increased by one each time NEXT key is depressed.

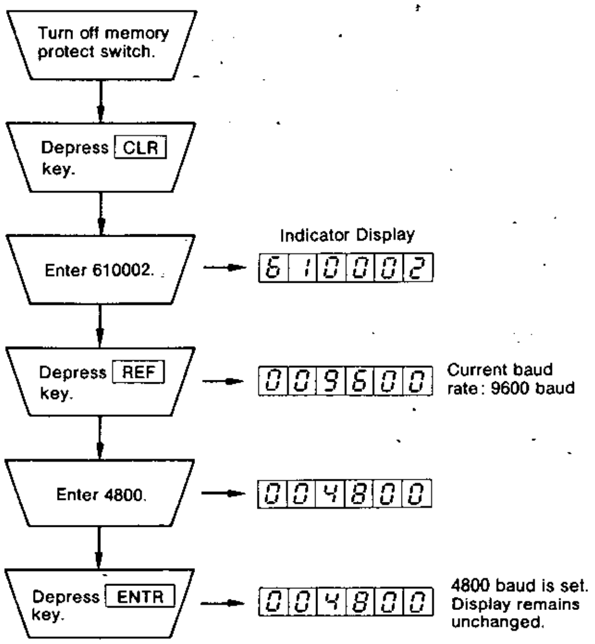
(2) Setting or Altering of Communication Parameters

(a) To set a slave address or baud rate, enter the number to be set and depress ENTR key. Then the number is set.

5.1 SETTING COMMUNICATION PARAMETERS OF U84 SLAVE (Cont'd)

• Sample Operation

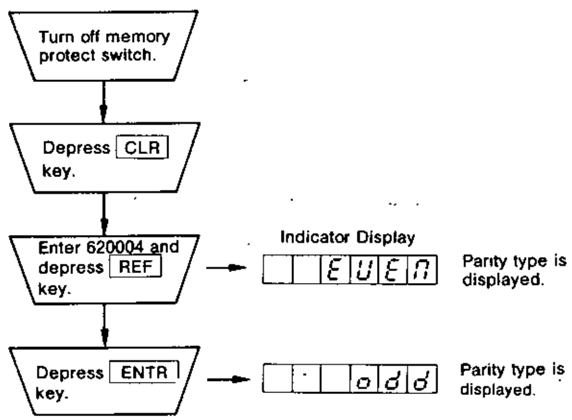
To alter the baud rate of the MEMOBUS port 1 to 4800:



(b) For other parameters, it is not necessary to set any number. Depress ENTR key only. Then one of two choices changes to the other.

• Sample Operation

To change even partity of the MEMOBUS port 1 to odd:



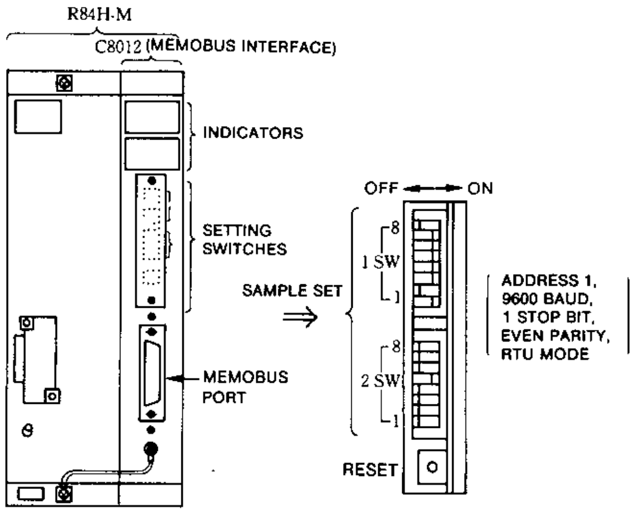
NOTE

Set all of the communication parameters (except the addresses) of the slave units connected to the same master unit equally.

Never assign the same adress to more than one slave unit.

5.2 SETTING COMMUNICATION PARAMETERS OF R84H-M SLAVE

The R84H-M is provided with two switches to set the communication parameters, Fig. 5.2. Remove the front switch cover when setting communication parameters.



Note :
1. Except when setting baud rate, be sure to push the reset switch after changing a switch setting.
2. Set all of the communication parameters (except the addresses) of the slave units connected to the same master unit equally.

Fig. 5.2 Paramater Setting Switches of R84H-M

(1) Address Setting

Table 5. 2 Address Setting

SW	Address	OFF	ON
1 SW-8	Address 1 (2^0)	1	0
1 SW-7	Address 2 (2^1)	2	0
1 SW-6	Address 4 (2^2)	4	0
1 SW-5	Address 8 (2^3)	8	0
1 SW-4	Address 16 (2^4)	16	0
1 SW-3	Address 32 (2^5)	32	0

Note:
1. Weighted values (2^n) are assigned to switches 1SW-8 to 1SW-3, respectively, and the sum of the weighted values of the switches turned off become an address number.
2. Address numbers may range from 1 to 63. Never assign the same address to more than one slave unit.

Table 5. 3 Sample Address Setting

Address No. to be Set	Switch Settings
1	1SW-8: OFF, 1SW-7 to 1SW-3: ON
2	1SW-7: OFF, 1SW-8 and 1SW-6 to 1SW-3: ON
3	1SW-8 and 1SW-7: OFF, 1SW-6 to 1SW-3: ON
7	1SW-8 to 1SW-6: OFF, 1SW-5 to 1SW-3: ON
15	1SW-8 to 1SW-5: OFF, 1SW-4 and 1SW-3: ON
32	1SW-3: OFF, 1SW-8 to 1SW-4: ON

(2) Parameter Data Format Setting

Table 5. 4 Parameter Data Format Setting

SW No.	Parameter	OFF	ON
2SW-8	Number of stop bits	1 bit	2 bit
2SW-7	Parity enabled/disabled	Enabled	Disabled
2SW-6	Even/odd parity	Even	Odd

(3) Baud Rate Setting

Table 5. 5 Baud Rate Setting

2SW-2	2SW-3	2SW-4	2SW-5	Baud Rate
0	0	0	0	50
0	0	0	1	75
0	0	1	0	110
0	0	1	1	134.5
0	1	0	0	150
0	1	0	1	300
0	1	1	0	600
0	1	1	1	1200
1	0	0	0	1800
1	0	0	1	2000
1	0	1	0	2400
1	0	1	1	3600
1	1	0	0	4800
1	1	0	1	7200
1	1	1	0	9600
1	1	1	1	19200

Note: 2SW-1 is not used.

(1: OFF
0: ON)

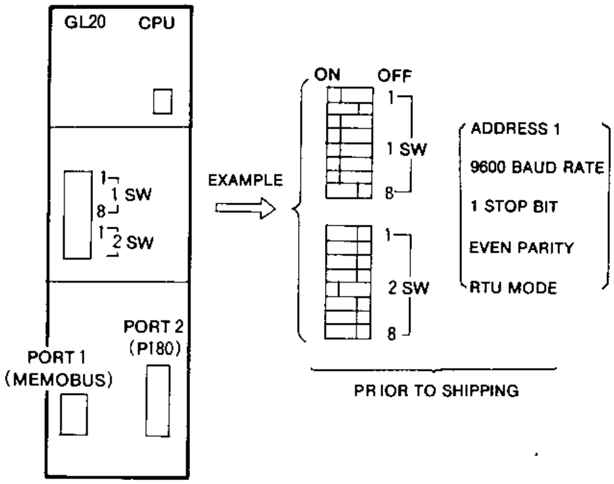
(4) Parameter Mode Setting

Table 5. 6 Parameter Mode Setting

1SW-1	1SW-2	Mode
ON	ON	ASCII (7 bits)
ON	OFF	RTU (8 bits)
OFF	ON	Not used.
OFF	OFF	Test (self diagnosis)

Note: Refer to Section 11. 4 for self diagnosis.

5.3 SETTING COMMUNICATION PARAMETERS OF GL20 SLAVE



(1) Address Setting

Table 5. 7 Address Setting

SW No.	Address	
1SW-3	Address 32 (2^5)	OFF
1SW-4	Address 16 (2^4)	OFF
1SW-5	Address 8 (2^3)	OFF
1SW-6	Address 4 (2^2)	OFF
1SW-7	Address 2 (2^1)	OFF
1SW-8	Address 1 (2^0)	OFF

5.3 SETTING COMMUNICATION PARAMETERS OF GL20 SLAVE (Cont'd)

(2) Parameter Data Format Setting

Table 5. 8 Parameter Data Format Setting

SW No.	Setting I·tems	OFF	ON
2SW-8	No. of stop bits	1	2
2SW-7	Parity provided	Yes	No
2SW-6	Even/odd parity	Even	Odd

(3) Baud Rate Setting

Table 5. 9 Baud Rate Setting

2SW-1	2SW-2	2SW-3	2SW-4	2SW-5	Baud Rate
(OFF)	(ON)	(OFF)	(OFF)	(OFF)	(1200)*
ON	OFF	ON	OFF	ON	2400
OFF	OFF	OFF	OFF	ON	9600
OFF	OFF	OFF	OFF	OFF	19200

* Setting 1200 baud rate is optional. For details, contact YASKAWA representative.

(4) Parameter Mode Setting

Table 5. 10 Parameter Mode Setting

1SW-1	1SW-2	Mode
ON	ON	ASCII (7 bits)
ON	OFF	RTU (8 bits)
OFF	ON	Not used
OFF	OFF	Test (Self-diagnosis)

Note:
1. For setting parameter conditions, remove the front switch cover.
2. Each 1SW-8 to 1SW-3 has significance (2^n).
   The sum of each significance of the switch when being off is an address number.
3. For address number, 1 to 63 can be set. However, do not set the same number for two slaves or more.
4. After changing setting switches, depress the reset switch, except in the case of setting baud rate.

6. COMMUNICATION PROTOCOL

Communication between the master and slave units is controlled by programs held in the master unit. In all cases, the master unit initiates data transmission and a slave unit will respond to it. When master unit begins data transmission, it sends a set of data (query message) to a slave unit in a fixed sequence. Upon receiving the query message, the slave unit decodes it, takes the necessary action and then returns data (response message) to the master unit.

6.1 MESSAGE FORMAT

The message consists of four parts : slave address, function code, data, and error check code, which are always transmitted in this sequence. Fig. 6. 1 shows the format of the message.

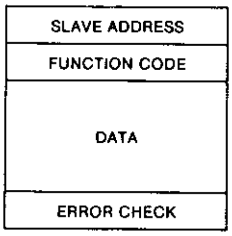


Fig. 6.1 Format of Message

(1) Slave Address

This is a number in a range of 1 to 247 (1 to 63 for R84H-M ,GL20 slave units) which is preset for every slave unit. The master unit communicates with only one slave unit at a time. Although all connected slave units receive the query message sent from the master unit, only the slave unit having the slave address coinciding with the query message accepts the message.

NOTE

1. The slave address "0" can be used with some function codes (see Table 6.1) so that all slave units accept the query message regardless of their preset addresses. In this case, no slave units return a response message to the master unit after execution.
2. The range of address numbers depends on the type of slave unit. It is 1 to 247 for GL60S and U84, and 1 to 63 for R84H-M and GL20.

6.1 MESSAGE FORMAT (Cont'd)

Table 6. 1 Function Codes

Function Code (Hexadecimal)	Function	Maximum Number of Data in a Message			Maximum Number of Data in a Scan			
		GL60S, U84, U84S	R84H-M	GL20	U84, U84S	R84H-M	GL20	GL60S
1_H	Reading out coil state	2000(976)	256	256	64	32	32	2000
2_H	Reading out input relay state	2000(976)	256	256	64	32	32	2000
3_H	Reading out holding register contents	125(61)	125(61)	125(61)	32	16	16	125
4_H	Reading out input register contents	125(61)	32	32	32	16	16	125
5_H*	Changing state of single coil	1	1	1	1(in 2scans)	1(in 2scans)	1(in 2scans)	1(in 2scans)
6_H*	Writing in single holding register	1	1	1	1	1	1	1
7_H	Reading out paticular coil state	8	8	8	8	8	8	8
8_H	Loopback test	—	—	—	—	—	—	—
F_H*	Changing multi-coil states	800	—	—	64(in 2scans)	—	—	800
10_H*	Writing in multi-holding registers	100(59)	—	—	32	—		100

* Slave address "0" can be specified.

Note:

1. All functions above can be executed even if a memory protect switch of slave unit is ON.
2. Function codes F_H and 10_H cannot be applied to R84H-M and 684H.
3. Numbers in ( ) indicate those for ASCII mode.

(2) Function Code

The master unit specifies function to be executed to a slave unit using function code. Table 6.1 summarizes the function codes.

(3) Data

After setting the function, the master unit sends the data needed to execute the function to the slave unit. Data depends on the function. For detail, refer to the description of the message format given for each function.

Note that the coil, input relay, input register, and holding register are identified by relative numbers relating to their reference numbers. The value of the last four digits (minus 1) of the reference number is used for GL60S and U84, and of the last three digits (minus 1) of the reference number is used for R84H-M and GL20 (see Table 6.2).

Table 6. 2 Reference Number and Relative Number

Elements	Reference Number		Relative Number	
	GL60S, U84	R84H-M, GL20	GL60S, U84	R84H-M, GL20
Coil	0XXXX	0XXX	0XXXX-1	0XXX-1
Input Relay	1XXXX	1XXX	1XXXX-10001	1XXX-1001
Input Register	3XXXX	3XXX	3XXXX-30001	3XXX-3001
Holding Register	4XXXX	4XXX	4XXXX-40001	4XXX-4001

Note: Relative numbers are used in messages.

(4) Error Check Code

The message ends with data for detecting errors (wrong bits) in the contents of the message which may possibly occur during transmission. The MEMOBUS system employs different methods of error detection, CRC-16 (Cyclic Redundancy Check) and LRC (Longitudinal Redundancy Check), depending on whether in RTU and ASCII modes. Refer to Sections 7.11 and 8.4 for details.

6.2 COMMUNICATION MODES

There are two modes of communication between the master and slave units: RTU (Remote Terminal Unit) and ASCII modes. The communication mode is defined by the number of data bits, 7 or 8, when setting the communication parameters. The capability (speed) of the master unit is the major factor in selecting a mode. RTU mode is selected when the data processing speed of the master unit is comparatively fast and ASCII mode in other cases.

In both modes, the communication procedures are the same. In ASCII mode, marks are needed to indicate the beginning and end of a message; each 8 bit data of RTU mode is divided into two ASCII characters of 7 bits before transmission, and the method of error detection varies from that used in RTU mode. Table 6.3 summarizes the differences between the two modes.

Table 6. 3 Differences between RTU and ASCII Modes

Item	RTU Mode	ASCII Mode
Number of Data Bits	8 (binary)	7 (ASCII)
Message Start Mark	Unnecessary	: (colon)
Message End Mark	Unnecessary	CR/LF (carriage return/line feed)
Message Length	N	2N + 1
Data Time Interval	24 bits' time or less	1s or less
Error Detection	CRC-16	LRC

Note: With U84, the data time interval is less than 1 second, even in RTU mode.

NOTE

In the query message of the master unit, the time interval between adjacent data should not exceed the data time interval specified above. If the interval is too large, the slave unit regards that transmission as having ended and ignores the message because the format is wrong.

6.3 SLAVE UNIT RESPONSE

Receiving a query massage from the master unit, the slave unit examines it and, when valid, moves the query message from the receive buffer to the execution buffer. If invalid, the slave unit ignores the message and takes no action. Processing is done in interrupt mode up to that time.

At the end of that scan, the query message is decoded and executed. Then the slave unit prepares a response message and moves it to the transmit buffer. If the query message is defective (for example, an illegal function code is referred to), the slave unit does not execute it, but rather creates a message identifying the defect and enters it in the transmit buffer.

When the response message is prepared in the transmit buffer, the slave unit calls for interrupt and sends the message to the master unit.

(1) Normal Response
With the functions of changing the state of a coil and writing in a holding register and loopback, the slave unit responds with the same message as the query message.

With the functions of changing multi-coil states and writing in multi-holding registers, the slave unit returns part of the multi-query message (slave address, function code, starting number, and the number of coils or holding registers) as the response message.

In the response message of the reading-out functions, the slave address and function code are the same as in the query message and the data read out is appended.

(2) Response to Defective Message
If the query message is defecive (except in the case of transmission error), the slave unit takes no action and returns the response message shown in Fig. 6.2.

The master unit can determine whether or not the query message it has sent has been executed, by examining the function code involved in the response message. If it detects an error, it should further examine the error code that follows the function code (see Table 6.4).

SLAVE ADDRESS	
1 FUNCTION CODE	FUNCTION CODE +80H
ERROR CODE	ANY ONE OF 1, 2, 3 AND 11_H
ERROR CHECK	

Fig. 6.2 Response to a Wrong Query Message

Table 6. 4 Error Codes

Error Code	Meaning
1	Invalid function code
2	Coil/input relay/register number wrong (out of range)
3	Number of elements of coils/input relays/registers wrong (out of range)
17_H*	CRC-16 or LRC error

* Applicable only to U84 and GL60S.

(3) No Response

In the cases noted below, the slave unit ignores the query message and does not respond. When the slave address is "0" with a writing function, all slave units execute the query message but do not respond.

- A transmission error (overrun, framing, parity, CRC-16, or LRC) is found in the query message. In case of CRC-16 or LRC error with U84, the response shown in Fig. 6.2 will be made.
- The slave address given in the query message differs from the address assigned to the slave unit.
- The time interval between adjacent data in the query message is too long: 24 bits' time (1 second or more with GL60S and U84) in RTU mode, and 1 second or more in ASCII mode.

NOTE

A time should be prepared to monitor responses in the master unit and retransmit the same query message if no response is received within a certain time. The time limit should normally be 3 to 5 seconds.

6.4 REQUIRED TIME FOR SIGNAL TRANSMISSION

Required time for a signal transmission in the MEMOBUS system can be calculated from the following seven related times. If more than one slave is connected to the same port on the master, calculate the required time for a signal transmission for each slave and add the results.

(1) Query Message Transmission Processing Time by Master

This time interval comprises the time during which the master constructs a query message and then prepares it at a communication port. In case of a U84 master and a 584 master, the time interval depends on the scan time of each master.

- U84 master: 1-2 scan times
- 584 master: 2-3 scan times

(2) Delay Time of Modem (Master Side)

This time interval comprises the time from the modem receiving RTS from the master to the time when the modem sends CTS to the master. With a J478 [(J1078), (J2078)] modem the delay time is up to 5 ms.

(3) Query Message Transmission Time

To calculate the time, use the equation below. Number of bits per character is the sum of the number of data bits (7 or 8 bits), start bits (1 bit), stop bits (1 or 2 bits), and parity bits (0 or 1 bit).

Transmission time=

$$\frac{\text{Number of characters of query message} \times \text{Number of bits per character} \times 1000}{\text{Baud rate}} \text{ (ms)}$$

(4) Slave Processing Time

This time interval comprises the time from a slave receiving processing a query message sent from the master to the time when the slave prepares a response message to the master at MEMOBUS port.

This time depends on the scan time of the slave and on assigned numbers (number of coils, input relays, input registers, and holding registers) in a query message.

6.4 REQUIRED TIME FOR SIGNAL TRANSMISSION (Cont'd)

· Divide a specified number in a query message by a maximum number which can be processed within one scan as shown in Table 6.1. Decimal numbers should be converted to the next whole number.

For example, reading out 100 holding registers for U84 slave is as follows:

Processing time=100/32=3.125→4 scan time

(5) Delay Time of Modem (Slave Side)
This time interval consists of the time from the modem receiving RTS from a slave to the time when the modem returns CTS to the slave. In the case of J478 [(J1078), (J2078)] modem the delay time is up to 5 ms.

(6) Response Message Transmission Time
The following equation, which is the same as that of the calculation of query message transmission time, should be used.

Transmission time=

$$\frac{\text{Number of characters of query message} \times \text{Number of bits per character} \times 1000}{\text{Braud rate}} \text{ (ms)}$$

(7) Response Message Processing Time by Master
This is the time required to process a response message from a slave by the master. In case of U84 master, the time depends on the scan time of each master.

• U84 master: 1-2 scan times

7. MESSAGE FORMAT (RTU MODE)

In RTU mode, the message format should be as shown in Fig. 7.1.

The data length and contents vary with the function. The formats of the query and response messages are described below according to the functions. Table 7.1 summarizes the message lengths of the functions.

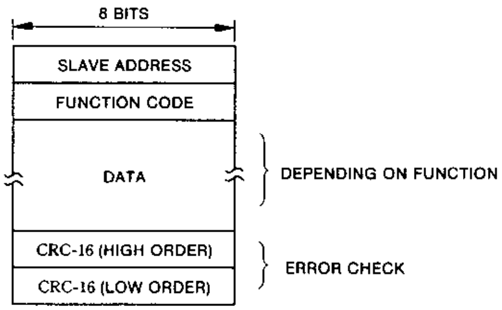


Fig. 7.1 Message Format in RTU Mode

Table 7.1 Message Lengths in RTU Mode

Function Code (Hexadecimal)	Function	Query Message						Response Message					
		Minimum			Maximum			Minimum			Maximum		
		GL60S U84	R84H-M	GL20	GL60S U84	R84H-M	GL20	GL60S U84	R84H-M	GL20	GL60S U84	R84H-M	GL20
1_H	Reading out coil state	8	8	8	8	8	8	6	6	6	255	37	37
2_H	Reading out input relay state	8	8	8	8	8	8	6	6	6	255	37	37
3_H	Reading out holding register contents	8	8	8	8	8	8	7	7	7	255	255	255
4_H	Reading out input register contents	8	8	8	8	8	8	7	7	7	255	69	69
5_H	Changing state of single coil	8	8	8	8	8	8	8	8	8	8	8	8
6_H	Writing in single holding register	8	8	8	8	8	8	8	8	8	8	8	8
7_H	Reading out paticular coil state	4	4	4	4	4	4	5	5	5	5	5	5
8_H	Loopback test	8	8	8	8	8	8	8	8	8	8	8	8
F_H	Changing multi-coil state	10	—	—	109	—	—	8	—	—	8	—	—
10_H	Writing in multi-holding register	11	—	—	209	—	—	8	—	—	8	—	—

7.1 READING OUT COIL STATES $[01_H]$

(1) Function

The states of coils whose numbers are continuous will be read out when the number of coils and the starting number are designated.

The data includes the states of eight coils, arranged in the order of the coil numbers, in the response message. LSB of the data indicates the state of the coil having the smallest number.

When the number of coils is a multiple of eight, MSB of the last data represents the state of the last coil. Otherwise, the redandunt bits (MSBs) of the last data are all 0's.

7.1 READING OUT COIL STATES [01_H] (Cont'd)

(2) The following shows examples where the states of a total of 37 (25_H) coils among coils 20 (14_H) to 56 from slave 2.

• Query Message

SLAVE ADDRESS		0 2 H	
FUNCTION CODE		0 1 H	
STARTING No.	HIGH ORDER	0 0 H	FIRST COIL NO.−1
	LOW ORDER	1 3 H	
QUANTITY	HIGH ORDER	0 0 H	1 to 2000 (U84) 1 to 256 (GL20, R84H-M)
	LOW ORDER	2 5 H	
CRC-16	HIGH ORDER	0 C H	
	LOW ORDER	2 7 H	

• Response Message (Normal)

SLAVE ADDRESS		0 2 H	
FUNCTION CODE		0 1 H	
NO. OF DATA ITEMS		0 5 H	$\left[\frac{N+7}{8}\right]$*
FIRST 8-COIL STATE		C D H	
NEST 8-COIL STATE		6 B H	
NEST 8-COIL STATE		B 2 H	
NEST 8-COIL STATE		0 E H	
NEST 8-COIL STATE		1 B H	
CRC-16	HIGH ORDER	0 4 H	
	LOW ORDER	F F H	

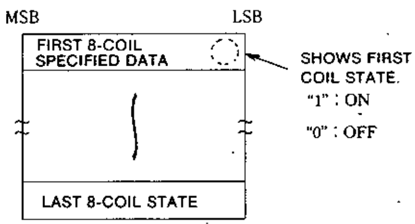
• Response Message (Abnormal)

SLAVE ADDRESS		0 2 H
FUNCTION CODE		8 1 H
ERROR CODE		0 2 H
CRC-16	HIGH ORDER	3 1 H
	LOW ORDER	9 1 H

*N shows the number of input relays. $\left[\frac{N+7}{8}\right]$ is the largest integer that does not exceed $\frac{N+7}{8}$.

Note:

1. The following shows arrangement and indecations of the data items.



2. With R84H-M and 684H, states of the output coils (0001-0256) and internal coils (0257-0512) cannot be read out using a single message. If the starting number is 200, for example, the number of coils must not be greater than 55.

7.2 READING OUT INPUT RELAY STATES 〔02_H〕

(1) Function

The states of input relays whose numbers are continuos will be read out when the number of input relays and the starting number are designated.

The data includes the states of eight input relays, arranged in the order of the input relay numbers, in the response message. LSB of the data indicates the state of the input relay having the smallest number.

When the number of input relays is a multiple of eight, MSB of the last data represents the state of the last input relay. Othewise, the redandunt bits (MSBs) of the last data are all 0's.

(2) The following shows examples where the states of a total of 22 input relays among 10197 to 10218 (1197 to 1218) are read out from slave 2. ($197=C5_H$, $22=16_H$)

· Query Message

SLAVE ADDRESS		02_H	
FUNCTION CODE		02_H	
STARTING NO	HIGH ORDER	00_H	FIRST RELAY NO. −1 −10001 (1001)
	LOW ORDER	$C4_H$	
QUANTITY	HIGH ORDER	00_H	1 to 2000 (U84) 1 to 256 (GL20, R84H-M)
	LOW ORDER	16_H	
CRC-16	HIGH ORDER	$B8_H$	
	LOW ORDER	$0A_H$	

· Response Message (Normal)

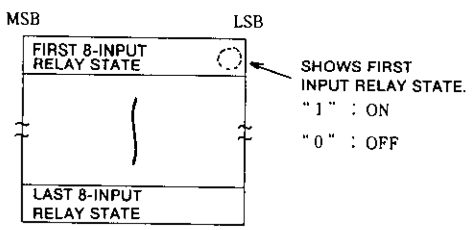
SLAVE ADDRESS		02_H	
FUNCTION CODE		02_H	
NO. OF DATA ITEMS		03_H	$\left[\frac{N+7}{8}\right]$*
FIRST 8-INPUT RELAY STATE		AC_H	
NEXT 8-INPUT RELAY STATE		DB_H	
NEXT 8-INPUT RELAY STATE		35_H	
CRC-16	HIGH ORDER	22_H	
	LOW ORDER	BB_H	

· response Message (Abnormal)

SLAVE ADDRESS		02_H
80_H + FUNCTION CODE		82_H
ERROR CODE		03_H
CRC-16	HIGH ORDER	$F0_H$
	LOW ORDER	$A1_H$

*N shows the number of input relays. $\left[\frac{N+7}{8}\right]$ is the largest integer that does not exceed $\frac{N+7}{8}$.

Note: The following shows arrangement and indications of the data items.



7.3 READING OUT CONTENTS OF HOLDING REGISTERS [03_H]

(1) Function

The contents of holding registers whose numbers are continuous will be read out when the number of holding registers and the starting number are designated.

The contents of the holding registers are entered in the response message as data, divided into two parts: the high order eight bits and the low order 8 bits, arranged in the order of the register numbers.

(2) The following shows examples where the content of total 3 holding registers among 40108 to 40110 (4108 to 4110) are read out. ($108=6C_H$)

• Query Message

SLAVE ADDRESS		02_H	
FUNCTION CODE		03_H	
STARTING No.	HIGH ORDER	00_H	FIRST HOLDING REGISTER NUMBER −40001 (4001)
	LOW ORDER	$6B_H$	
QUANTITY	HIGH ORDER	00_H	1 to 125
	LOW ORDER	03_H	
CRC-16	HIGH ORDER	74_H	
	LOW ORDER	24_H	

• Response Message (Normal)

SLAVE ADDRESS		02_H	
FUNCTION CODE		03_H	
No. OF DATA ITEMS		06_H	NO. OF HOLDING REGISTERS×2
FIRST HOLDING REGISTER CONTENTS	HIGH ORDER	02_H	
	LOW ORDER	$2B_H$	
NEXT HOLDING REGISTER CONTENTS	HIGH ORDER	00_H	
	LOW ORDER	00_H	
NEXT HOLDING REGISTER CONTENTS	HIGH ORDER	00_H	
	LOW ORDER	63_H	
CRC-16	HIGH ORDER	50_H	
	LOW ORDER	48_H	

• Response Message (Abnormal)

SLAVE ADDRESS		02_H
80_H + FUNCTION CODE		83_H
ERROR CODE		03_H
CRC-16	HIGH ORDER	$F1_H$
	LOW ORDER	31_H

Note: The following shows arrangement and indications of the data items.

MSB — LSB
FIRST HOLDING REGISTER HIGH ORDER 8-BIT
FIRST HOLDING REGISTER LOW ORDER 8-BIT
⋮
LAST HOLDING REGISTER HIGH ORDER 8-BIT
LAST HOLDING REGISTER LOW ORDER 8-BIT

7.4 READING OUT CONTENTS OF INPUT REGISTERS [04_H]

(1) Function

The contents of input registers whose numbers are continuous will be read out when the number of input registers and the starting number are designated.

The contents of the input registers are entered in the response message as data, divided into two parts: the high order eight bits and the low order eight bits, arranged in the order of the register numbers.

(2) The following shows examples where the content of input register 30009 (3009) are read out from slave 21 (15_H).

・Query Message

SLAVE ADDRESS		15_H	
FUNCTION CODE		04_H	
STARTING NO.	HIGH ORDER	00_H	FIRST INPUT REGISTER NO. −30001 (3001)
	LOW ORDER	08_H	
QUANTITY	HIGH ORDER	00_H	1 to 125 (U84) 1 to 32 (GL20, R84H-M)
	LOW ORDER	01_H	
CRC-16	HIGH ORDER	$B3_H$	
	LOW ORDER	$1C_H$	

・Response Message (Normal)

SLAVE ADDRESS		15_H	
FUNCTION CODE		04_H	
NO OF DATA ITEMS		02_H	NO OF INPUT REGISTERS×2
INPUT REGISTER CONTNTES	HIGH ORDER	05_H	
	LOW ORDER	39_H	
CRC-16	HIGH ORDER	$4A_H$	
	LOW ORDER	71_H	

・Response Message (Abnormal)

SLAVE ADDRESS		15_H
80_H + FUNCTION CODE		84_H
ERROR CODE		03_H
CRC-16	HIGH ORDER	43_H
	LOW ORDER	05_H

Note: The following shows arrangement and indications of the data items.

MSB	LSB
FIRST INPUT REGISTER HIGH ORDER 8-BIT	
FIRST INPUT REGISTER LOW ORDER 8-BIT	
⁞	
LAST INPUT REGISTER HIGH ORDER 8-BIT	
LAST INPUT REGISTER LOW ORDER 8-BIT	

7.5 CHANGING STATE OF SINGLE COIL [05_H]

(1) Function

A designated coil will be put into a designated state (ON or OFF).

(2) The following shows examples where the states of coil 00173 (9173) are changed from slave 3 (173=AD $_H$).

• Query Message

SLAVE ADDRESS		0 3 H	
FUNCTION CODE		0 5 H	
COIL NO.	HIGH ORDER	0 0 H	COIL NO.−1
	LOW ORDER	A C H	
SPECIFED STATE	HIGH ORDER	F F H	"FFOO". ON "0000": OFF
	LOW ORDER	0 0 H	
CRC-16	HIGH ORDER	4 D H	
	LOW ORDER	F 9 H	

• Response Message (Normal)

SLAVE ADDRESS		0 3 H	
FUNCTION CODE		0 5 H	
COIL NO.	HIGH ORDER	0 0 H	COIL NO −1
	LOW ORDER	A C H	
SPECIFED STATE	HIGH ORDER	F F H	"FFOO": ON "0000": OFF
	LOW ORDER	0 0 H	
CRC-16	HIGH ORDER	4 D H	
	LOW ORDER	F 9 H	

• Response Message (Abnormal)

SLAVE ADDRESS		0 3 H
80H + FUNCTION CODE		8 5 H
ERROR CODE		0 3 H
CRC-16	HIGH ORDER	A 3 H
	LOW ORDER	5 1 H

Note:

1. When "0" is set slave address, all slave execute this command. However, any slave will not send response message back after execution. Therefore, master should read out coil state again to check before the execution.
2. Normally, use coil to be changed, in DISABLE. The command can be executed even in ENABLE, however, coil states will be renewed with internal logic reading results.

7.6 WRITING IN SINGLE HOLDING REGISTER [06_H]

(1) Function

Designated data will be written into a designated holding register.

(2) The following shows examples of write-in to holding register 40136 (4136) of slave 5.

· Query Message

SLAVE ADDRESS		0 5 H
FUNCTION CODE		0 6 H
HOLDING REGISTER NO	HIGH ORDER	0 0 H
	LOW ORDER	8 7 H
WRITE-IN DATA	HIGH ORDER	0 3 H
	LOW ORDER	9 E H
CRC-16	HIGH ORDER	B 9 H
	LOW ORDER	3 F H

HOLDING REGISTER NO −40001 (4001)

ANY DESIRED DATA

· Response Message (Normal)

SLAVE ADDRESS		0 5 H
FUNCTION CODE		0 6 H
HOLDING REGISTER NO.	HIGH ORDER	0 0 H
	LOW ORDER	8 7 H
WRITE-IN DATA	HIGH ORDER	0 3 H
	LOW ORDER	9 E H
CRC-16	HIGH ORDER	B 9 H
	LOW ORDER	3 F H

HOLDING REGISTER NO. −40001 (4001)

ANY DESIRED DATA

· Response Message (Abnormal)

SLAVE ADDRESS		0 5 H
80H + FUNCTION CODE		8 6 H
ERROR CODE		0 3 H
CRC-16	HIGH ORDER	4 3 H
	LOW ORDER	A 0 H

Note:

1. The following shows arrangement and indications of the data items.

MSB	LSB
WRITE-IN DATA HIGH ORDER 8-BIT	
WRITE-IN DATA LOW ORDER 8-BIT	

2. When "0" is set to slave address, all slaves execute this command. However, any slave will not send response message back after execution. Therefore, master should read out coil state again to check before the execution.

7.7 READING OUT STATES OF PARTICULAR COILS [07_H]

(1) Function

The states of eight fixed coils will be read. The coils are 00001 to 00008 when the slave unit is U84, and 0257 to 0264 when the slave unit is GL20 or R84H-M.

LSB of the data of the response message indicates the state of coil 00001 (0257) and MSB the state of coil 00008 (0264).

(2) The following shows examples of read-out of specified coils of slave 1.

• Query Message

SLAVE ADDRESS		01_H
FUNCTION CODE		07_H
CRC-16	HIGH ORDER	41_H
	LOW ORDER	$E2_H$

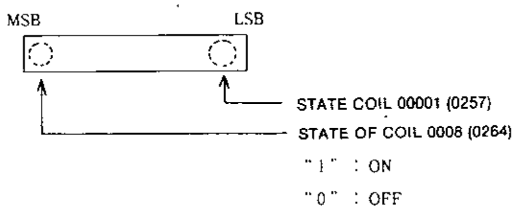
• Response Message (Normal)

SLAVE ADDRESS		01_H
FUNCTION CODE		07_H
SPECIFIED COIL STATE		$6D_H$
CRC-16	HIGH ORDER	$E3_H$
	LOW ORDER	DD_H

• Response Message (Abnormal)

SLAVE ADDRESS		01_H
80_H + FUNCTION CODE		87_H
ERROR CODE		03_H
CRC-16	HIGH ORDER	03_H
	LOW ORDER	$F1_H$

Note: The following shows arrangement and indications of the data items.



7.8 LOOPBACK TEST [08_H]

(1). Function

The query message will be returned directly as the response message. This function permits checking communication between the master and slave units.

(2) The following shows examples of loopback test with slave 2.

• Query Message

SLAVE ADDRESS		02_H	
FUNCTION CODE		08_H	
TEST CODE	HIGH ORDER	00_H	SET TEST CODE TO "00"
	LOW ORDER	00_H	
DATA	HIGH ORDER	$A5_H$	ANY DESIRED DATA
	LOW ORDER	37_H	
CRC-16	HIGH ORDER	DA_H	
	LOW ORDER	BE_H	

• Response Message (Normal)

SLAVE ADDRESS		02_H	
FUNCTION CODE		08_H	
TEST CODE	HIGH ORDER	00_H	SET TEST CODE TO "00"
	LOW ORDER	00_H	
DATA	HIGH ORDER	$A5_H$	ANY DESIRED DATA
	LOW ORDER	37_H	
CRC-16	HIGH ORDER	DA_H	
	LOW ORDER	BE_H	

• Response Message (Abnormal)

SLAVE ADDRESS		02_H
80_H + FUNCTION CODE		88_H
ERROR CODE		01_H
CRC-16	HIGH ORDER	77_H
	LOW ORDER	$C0_H$

Note: Set test code to "00"

7.9 CHANGING STATES OF MULTI-COILS (ONLY FOR U84 SLAVE) 〔OF_H〕

(1) Function

When the number of coils and the starting number are designated, the states of the coils will be changed to (ON or OFF), even when they are disabled.

The data includes the new states, ON and/or OFF, of eight coils arranged in the order of their numbers. LSB of the data indicates the state of the coil having the smallest number.

When the number of coils is a multiple of eight, MSB of the last data represents the state of the last coil. Otherwise, the slave unit ignores the redandunt bits (MSBs) of the last data.

If the slave address is "0" in the query message, all slave units execute this function but none of them return response messages. The master unit should therefore read out the state of the coils afterward to make sure that the function has been actually executed.

(2) The following shows examples where the states of total 10 coils among coil 00020 to 00029 of slave 1 are changed. ($20=14_H$, $10=A_H$)

· Query Message

SLAVE ADDRESS		01_H	
FUNCTION CODE		$0F_H$	
STARTING NO.	HIGH ORDER	00_H	FIRST RELAY NO −1
	LOW ORDER	13_H	
NO OF COILS	HIGH ORDER	00_H	1 to 800 (U84)
	LOW ORDER	$0A_H$	
NO. OF DATE ITEMS		02_H	$\left[\frac{N+7}{8}\right]$*
FIRST 8-COIL SPECIFIED DDATA		00_H	
NEXT 8-COIL SPECIFIED DDATA		00_H	
CRC-16	HIGH ORDER	$E7_H$	
	LOW ORDER	$9B_H$	

· Response Message (Normal)

SLAVE ADDRESS		01_H
FUNCTION CODE		$0F_H$
STARTING NO.	HIGH ORDER	00_H
	LOW ORDER	13_H
NO. OF COILS	HIGH ORDER	00_H
	LOW ORDER	$0A_H$
CRC-16	HIGH ORDER	24_H
	LOW ORDER	09_H

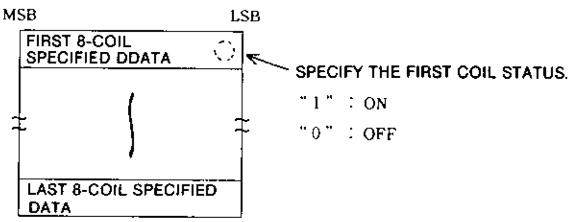
· Response Message (Abnormal)

SLAVE ADDRESS		01_H
80_H + FUNCTION CODE		$8F_H$
ERROR CODE		02_H
CRC-16	HIGH ORDER	$C5_H$
	HIGH ORDER	$F1_H$

* N shows the number of input relays. $\left[\frac{N+7}{8}\right]$ is the largest integer that does not exceed $\frac{N+7}{8}$

Note :

1. The following shows arrangement and indications of the data items.



2. When "0" is set to slave or address, all slaves execute this command. However, any slave will not send response message back after execution. Therefore, master should read out coil state again to check before the execution. (Coil should be in DESABLE. Otherwise the execution cannot be checked.)

7.10 WRITING IN HOLDING REGISTERS (ONLY FOR U84 SLAVE) 〔10_H〕

(1) Function

When the number of holding registers and the starting number are designated, given data will be written into them.

Write data should be entered in the query in the order of holding register numbers, with the high order 8 bits followed by the low order 8 bits.

If the slave address is "0" in the query message, all slave units execute this function but none of them return response messages. The master unit should therefore read out the contents of the holding registers afterward to make sure that the function has been actually executed.

(2) The following shows examples of write-in to a total of 2 registers of holding registers 40135 to 40137 (4136 to 4137) of slave 1 ($136=88_H$)

• Query Message

SLAVE ADDRESS		0 1 H	
FUNCTION CODE		1 0 H	
STARTING NO.	HIGH ORDER	0 0 H	FIRST HOLDING REGISTER NO. −40001 (4001)
	LOW ORDER	8 7 H	
QUANTITY	HIGH ORDER	0 0 H	1 ~ 100 (U84)
	LOW ORDER	0 2 H	
NO. OF DATE ITEMS		0 4 H	HOLDING REGISTER NO.X2
DATE TO FIRST REGISTER	HIGH ORDER	0 0 H	
	LOW ORDER	0 A H	
DATE TO NEXT REGISTER	HIGH ORDER	0 1 H	
	LOW ORDER	0 2 H	
CRC-16	HIGH ORDER	1 A H	
	LOW ORDER	7 A H	

• Response Message (Normal)

SLAVE ADDRESS		0 1 H
FUNCTION CODE		1 0 H
STARTING NO.	HIGH ORDER	0 0 H
	LOW ORDER	8 7 H
QUANTITY	HIGH ORDER	0 0 H
	LOW ORDER	0 2 H
CRC-16	HIGH ORDER	F 1 H
	LOW ORDER	E 1 H

• Response Message (Abnormal)

SLAVE ADDRESS		0 1 H
80H + FUNCTION CODE		9 0 H
ERROR CODE		0 2 H
CRC-16	HIGH ORDER	C D H
	LOW ORDER	C 1 H

Note:

1. The following shows arrangement and indications of the data items.

MSB LSB

HIGH-ORDER 8 BITS TO FIRST REGISTER
LOW-ORDER 8 BITS TO FIRST REGISTER
⁝
HIGH-ORDER 8 BITS TO LAST REGISTER
LOW-ORDER 8 BITS TO LAST REGISTER

2. When "0" is set to any slave or address, all slaves execute this command. However, no slave will send a response message back after execution. Therefore, master should read out coil state again to check before execution.

7.11 CALCULATING CRC-16 CODE

The CRC-16 code is calculated as the remainder (16 bits) when all 8-bit data, from the slave address to the last data of the message, are joined in series as shown in Fig. 7.2 and the resulting number is divided by the 17-bit number, 1 1000 0000 0000 0101.

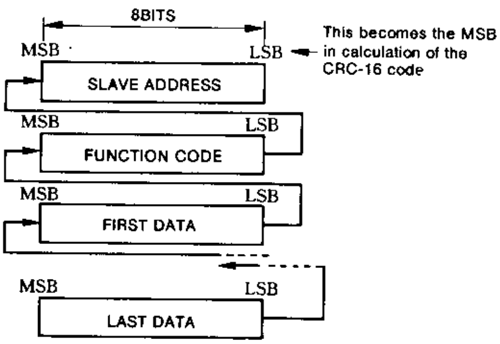


Fig. 7. 2 Calculating the CRC-16 Code

NOTE

1 Initialize the remainder to-1 (all 16 bits to l's) in the MEMOBUS system, unlike ordinary initialization to 0.
2 The LSB of the slave address becomes the MSB of long divided and the MSB of the last data becomes LSB.
3 Even for the response message of a stave unit, calculate the CRC-16 code and compare it with that of the response message.

(1) How to calculate CRC-16 Code
Perform the following procedures

(a) Initialize all the 16 bits of the remainder to 1's.

(b) Exclusive OR (EX. OR) the slave address and the remainder.

(c) Shift the result one bit to the right until "1" is moved out.

(d) Exclusive OR the result with the least significant 16 bits (1000 0000 0000 0101) of the constant divider.

(e) Shift the result eight bits to the right and, if "1" is moved out, finally, perform EX. OR operation for the result with the constant used in Step(d). Then perform EX. OR operation for result with the next 8 bits (function code) .

(f) Repeat the above steps until the last data is reached.

(g) Place the high-order 8 bits (actually low order) of the 16-bit result then the low-order 8 bits (actually high order) in the last part of the query message.

7.11 CALCULATING CRC-16 CODE (Cont'd)

(2) Sample Program of CRC-16 Code Calculation

10 XMT(1)=& H2: XMT(2)=& H7: N=2	• Message data
20 GOSUB ∗CRC16	• To CRC-16 calculation routine
30	
40	
50	
100 ∗CRC16	• CRC-16 calculation started
110 CRCTMP=&HFFFF	• Initial set
120 FOR 1=1 TO N	• N: No. of data items excluding CRC-16
130 CRCTMP=CRCTMP XOR XMT(1)	
140 FOR J=1 TO 8	• No. of shifts
150 CT=CRCTMP AND & HI	• Check for bits moved-out after shift
160 IF CRCTMP<0 THEN CH=1 ELSE CH=0: GOTO 180	• CH=1: All bits are 1.
170 CRCTMP=CRCTMP AND & H7FFF	
180 CRCTMP=CRCTMP ¥2	• Right 1-bit shift
190 IF CH=1 THEN CRCTMP=CRCTMP OR & H4000	
200 IF CT=1 THEN CRCTMP=CRCTMP XOR & HA001	• When moved-out bit is 1
210 NEXT J. 1	
220 IF CRCTMP<0 THEN CL=1: CRCTMP =CRCTMP AND & H7FFF ELSE CL=0	
230 C1 = CRCTMP AND &HFF: C2 = (CRCTMP AND & H7F00) ¥256	
240 IF CL=1 THEN C2=C2 OR & H80	
250 XMT (N+1) =C1: XMT (N+2) =C2	• Decimal (CRC-16) C1 in high order, C2 in low order
260 XMT $ (N+1) =HEX $ (XMT (N+1))	• When converted to hexadecimal (high order)
270 XMT $ (N+2) =HEX $ (XMT (N+2))	• When converted to hexadecimal (low order)
280 RETURN	

For Fig. 7.3, CRC-16 calculation process is shown in Fig. 7.4 and the calculated result in Fig. 7.5.

0000	0010	SLAVE ADDRESS (2)
0000	0111	FUNCTION CODE (7)

(READING OUT PARTICULAR COIL STATE)

Fig. 7.3 Message Example

CRCTMP				FLAG	
1111	1111	1111	1111		INITIAL SET
		0000	0010		DEVICE ADDRESS
1111	1111	1111	1101		RESULT OF EX. OR
0111	1111	1111	1110	1	SHIFT 1
1010	0000	0000	0001		
1101	1111	1111	1111		RESULT OF EX. OR
0110	1111	1111	1111	1	SHIFT 2
1010	0000	0000	0001		
1100	1111	1111	1110		RESULT OF EX. OR
0110	0111	1111	1111	0	SHIFT 3
0011	0011	1111	1111	1	SHIFT 4
1010	0000	0000	0001		
1001	0011	1111	1110		RESULT OF EX. OR
0100	1001	1111	1111	0	SHIFT 5
0010	0100	1111	1111	1	SHIFT 6
1010	0000	0000	0001		
1000	0100	1111	1110		RESULT OF EX. OR
0100	0010	0111	1111	0	SHIFT 7
0010	0001	0011	1111	1	SHIFT 8
1010	0000	0000	0001		
1000	0001	0011	1110		RESULT OF EX. OR
		0000	0111		FUNCTION CODE
1000	0001	0011	1001		RESULT OF EX OR
0100	0000	1001	1100	1	SHIFT 1
1010	0000	0000	0001		
1110	0000	1001	1101		RESULT OF EX. OR
0111	0000	0100	1110	1	SHIFT 2
1010	0000	0000	0001		
1101	0000	0100	1111		RESULT OF EX. OR
0110	1000	0010	0111	1	SHIFT 3
1010	0000	0000	0001		
1100	1000	0010	0110		RESULT OF EX. OR
0110	0100	0001	0011	0	SHIFT 4
0011	0010	0000	1001	1	SHIFT 5
1010	0000	0000	0001		
1001	0010	0000	1000		RESULT OF EX. OR
0100	1001	0000	0100	0	SHIFT 6
0010	0100	1000	0010	0	SHIFT 7
0001	0010	0100	0001	0	SHIFT 8
12		41			
CRC−16 (LOW ORDER)		CRC−16 (HIGH ORDER)			

Fig. 7.4 CRC-16 Code Calculating Process

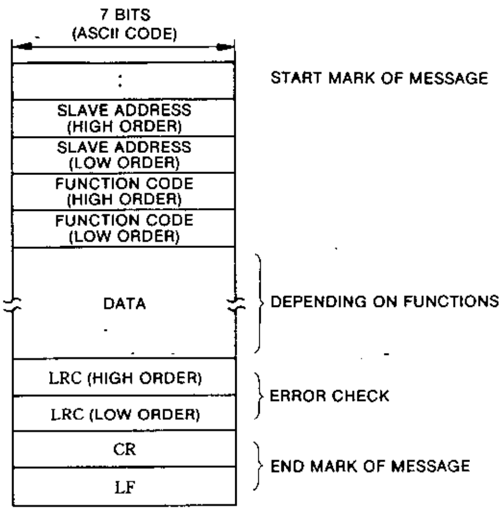
0000	0010	SLAVE ADDRESS
0000	0111	FUNCTION CODE
0100	0001	CRC-16 (HIGH ORDER)
0001	0010	CRC-16 (LOW ORDER)

Note: Proper care should be taken for making high order and low order of CRC-16.

Fig. 7.5 Calculated Result of CRC-16 Code

8. MESSAGE FORMAT (ASCII MODE)

Regardless of the ASCII and RTU modes, the message is configured in order of the slave address, function code, data, and error check code. The differences are as follows. In ASCII mode, marks, respectively, indicating the start and end of a message are needed. 8-bit data is divided into two ASCII characters (7 bits each) and transmitted. An error check is performed by LRC. Fig. 8.1 shows the message format of ASCII mode.



Note: The meanings of high and low orders are not the same as those in the description of RTU mode.
The high-and low-order parts are, respectively, 7-bit ASCII codes converted from the high-and low-order 4 bits of the 8-bit data in RTU mode.

Fig. 8.1 Message Format of ASCII Mode

The data length and contents depend on the function as in the RTU mode. Table 8.1 shows the message lengths of the Functions.

Table 8. 1 Message Lengths in ASCII Mode

Function Code (Hexadecimal)	Function	Instruction Message						Response Message					
		Minimum			Maximum			Minimum			Maximum		
		GL60S U84	R84H-M	GL20	GL60S U84	R84H-M	GL20	GL60S U84	R84H-M	GL20	GL60S U84	R84H-M	GL20
1_H	Reading out coil state	17	17	17	17	17	17	13	13	13	255	75	75
2_H	Reading out input relay state	17	17	17	17	17	17	13	13	13	255	75	75
3_H	Reading out holding register contents	17	17	17	17	17	17	15	15	15	255	255	255
4_H	Reading out input register contents	17	17	17	17	17	17	15	15	15	255	139	139
5_H	Changing state of single coil	17	17	17	17	17	17	17	17	17	17	17	17
6_H	Writing in single holding register	17	17	17	17	17	17	17	17	17	17	17	17
7_H	Reading out paticular coil state	9	9	9	9	9	9	11	11	11	11	11	11
8_H	Loopback test	17	17	17	17	17	17	17	17	17	17	17	17
F_H	Changing multi-coil state	21	—	—	219	—	—	17	—	—	17	—	—
10_H	Writing in multi-holding register	23	—	—	255	—	—	17	—	—	17	—	—

Note: Each value given above is the number of 7-bit ASCII characters, from " : " at the top of LF at end, of a message. The message length is longer in ASCII mode (double or more) than in RTU mode. Therefore, care should be taken to prevent excessive capacity from overflowing the master unit receive buffer.

8.1 SENDING QUERY MESSAGE

(1) Prepare a query message just as in RTU mode. Refer to Sections 7.1 to 7.10 as appropriate to the function code. It is not necessary to calculate the CRC-16 code.

(2) Calculate the LRC code. Refer to Section 7.4.

(3) Convert the data (8 bits) to two ASCII characters (7 bits). Divide the data, from the slave address to LRC at the end, into the high order 4 bits and the low order 4 bits. Then convert each into an ASCII character and arrange in the order of high order, then low order (Fig. 8.2).

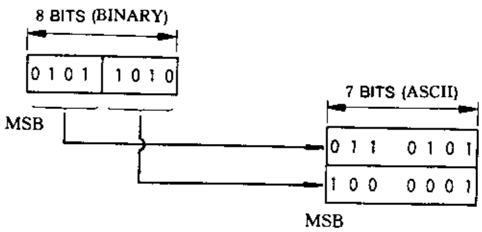


Fig. 8.2 Sample Binary-to-ASCII Conversion

(4) Place " : " before the slave address (high order) and "CR" then "LF" after the LRC code (low order) and send the result (from " : "to "LF") to the slave unit in that order.

NOTE

The slave unit waits until it receives "LF" (for a delay of up to 1 second after receiving "CR"). If the slave unit responds too early, the master unit cannot receive the message properly. A solution to this problem is to delay the transmission of "LF".

Table 8.2. shows the relationships between the binary numbers (4 bits) and the ASCII codes (7 bits).

When the master unit is GL605 or U84 (PC master) , it performs binary-to-ASCII conversion automatically.

Table 8. 2 Relationships between Binary Numbers (4 bits) and ASCII Codes (7 bits)

Binary	ASCII		Binary	ASCII	
0000	011	0000	1000	011	1000
0001	011	0001	1001	011	1001
0010	011	0010	1010	100	0001
0011	011	0011	1011	100	0010
0100	011	0100	1100	100	0011
0101	011	0101	1101	100	0100
0110	011	0110	1110	100	0101
0111	011	0111	1111	100	0110

8.1 SENDING QUERY MESSAGE (Cont'd)

NOTE

Prepare a timer counting up to a limit of 3 to 5 seconds in the master unit, and start the timer immediately after sending out a query message. If no response message comes back from the slave unit after the time limit has been reached, retransmit the same query message. Repeat the same steps for a few times (3 to 5 times) , if necessary.

8.2 RECEIVING RESPONSE MESSAGE

Receiving the query message from the master unit, the slave unit examines it, executes the specific function, then returns a response message to the master unit.

The master unit should receive the response message from the slave unit by the following procedure.

(1) Immediately after sending out a query message, be ready to receive a response message from the slave unit.

(2) When a response messaage which begins with" : "and ends with "LF" has come from the slave unit, make sure it begins with " : " then convert the data (ASCII character) to a binary numbers (4 bits).

Arrange the 4-bit numbers in such a way that the high order is followed by the low order (Fig. 8. 3) . LRC (low order) is the last data to be converted to a binary number. Make sure that only "CR" and "LF" are present, but do not include them in conversion.

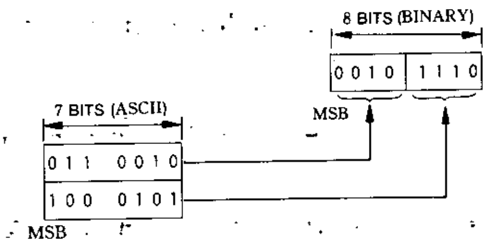


Fig. 8.3 Sample ASCII-to-Binary Conversion

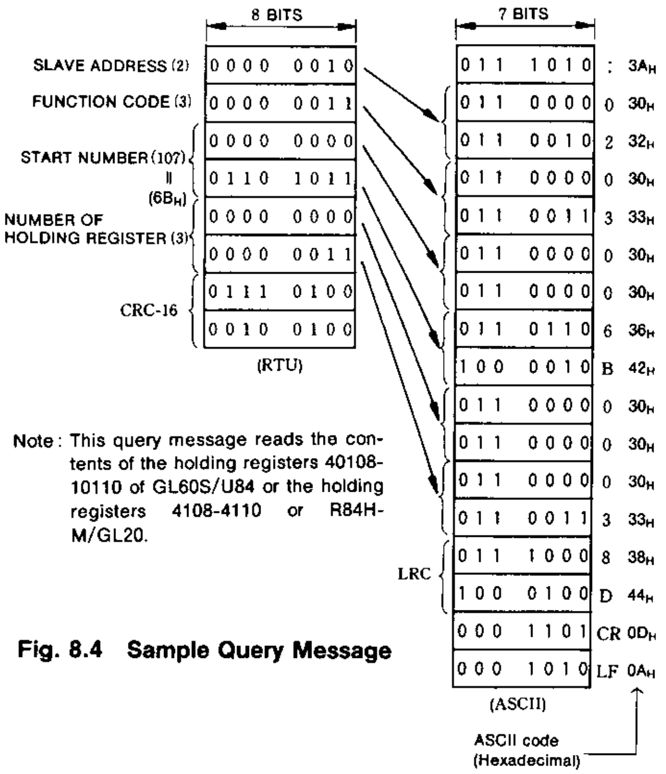
(3) Add up all 8-bit data from the slave address to LRC (ignore the carry) and make sure the result is "0".

NOTE

When the master unit is GL60S or U84 (PC master), it performs ASCII-to-binary conversion automatically.

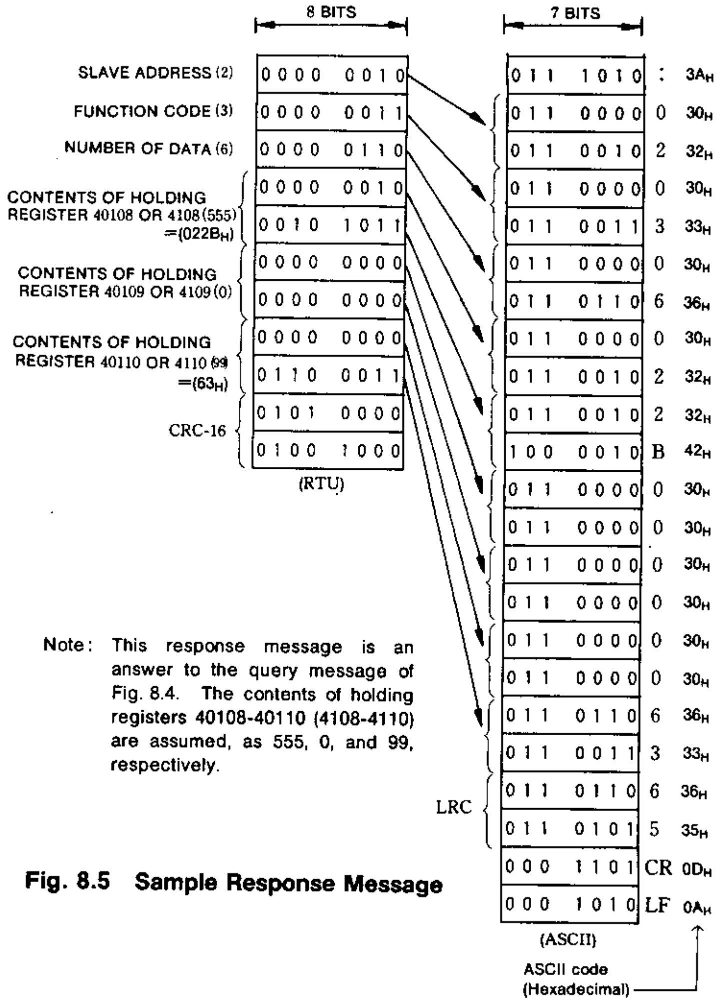
8.3 SAMPLE MESSAGES

Figs. 8.4 and show sample messages of the function to read out the contents of some holding registers in RTU and ASCII modes.



Note: This query message reads the contents of the holding registers 40108-10110 of GL60S/U84 or the holding registers 4108-4110 or R84H-M/GL20.

Fig. 8.4 Sample Query Message



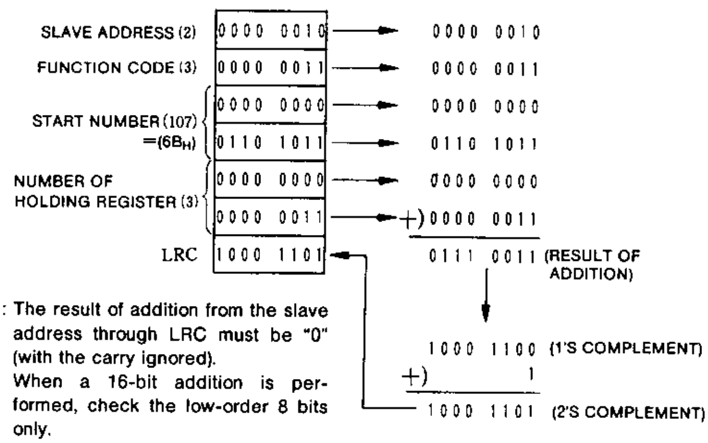
Note: This response message is an answer to the query message of Fig. 8.4. The contents of holding registers 40108-40110 (4108-4110) are assumed, as 555, 0, and 99, respectively.

Fig. 8.5 Sample Response Message

8.4 CALCULATING LRC CODE

The LRC code is calculated before binary-to-ASCII conversion in the same date format (exclusive of CRC-16) as in the RTU mode. " :, ""CR", and "LF" are not involved in the calculation.

The LRC code is obtained as the 2's complement of the result of addition, with the carry ignored, of the slave address through the last data. LRC code is 2's complement of the result. Fig. 8.6 shows how to calculate the LRC code for the query message shown in Fig. 8.4.



Note: The result of addition from the slave address through LRC must be "0" (with the carry ignored). When a 16-bit addition is performed, check the low-order 8 bits only.

Fig. 8.6 Calculating LRC Code

9. U84 MASTER (PC MASTER)

The U84 can be used as the master unit of the MEMOBUS system. In such a configuration, the ASCII module (JAMSC-C8160) should be included, as shown in Fig. 9.1

In the U84 master configuration, the format of the messages exchanged between the master and slave units are the same as previously described.

The U84 master unit sends instruction messages to slave units by write instruction and receives response messages from slave units by read instructions. Use of the U84 as the master unit of the MEMOBUS system is descibed below.

NOTE

In the U84 master configuration, the ASCII module calculates the CRC-16 or LRC code and attaches it to the query message and also checks the CRC-16 or LRC included in the receive message.

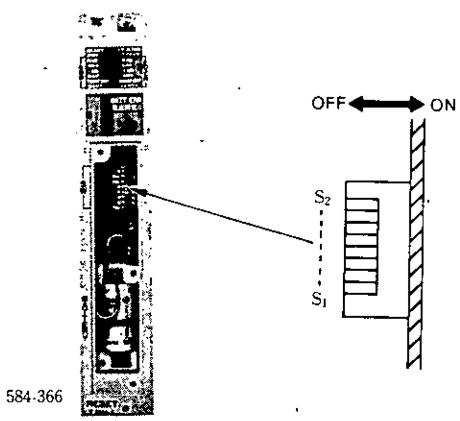
9.1 SWITCH SETTING FOR ASCII PORT

The U84, the master unit of a MEMOBUS system, communicates with slave units via an ASCII port of the ASCII module. Various conditional settings for the ASCII port are required in the same way as when ASCII equipment such as a serial printer or a CRT display are connected to a master.

9.1.1 Setting Port Number and Transmission Mode

To set the port number and transmission mode, remove the front cover of the ASCII module and set an 8-bit DIP switch as appropriate.

When setting of DIP switch is changed, turn on and then off the power supply. For U84 ASCII module, depress reset PB for resetting.



Note: Be sure to turn off S_7 and S_8

Fig. 9.1 DIP Switch for Setting the Port Number and Transmission Mode of ASCII Module

(1) Port Number

S1 and S2 of the DIP switch set the module number of the ASCII module. Then the port number is set as shown in Table 9.1.

Table 9. 1 Setting the Port Number

S_1	S_2	Module Number	Port Number	
			ODD Port	EVEN Port
OFF	OFF	1	1	2
ON	OFF	2	3	4
OFF	ON	3	5	6
ON	ON	4	7	8

Note: Never assign the same number to different ASCII module.

(2) Tansmission Mode

S3 and S4 of the DIP switch set the transmission mode of an odd port, and S5 and S6 set that of an even port.

Table 9. 2 Setting the Transmission Mode

ODD Port			EVEN Port		
S_3	S_4	Transmission Mode	S_5	S_6	Transmission Mode
OFF	OFF	ASCII device mode	OFF	OFF	ASCII device mode
ON	OFF	MEMOBUS mode (LRC)	ON	OFF	MEMOBUS mode (LRC)
ON	ON	MEMOBUS mode (CRC)	ON	ON	MEMOBUS mode (CRC)

Note:

1. Be sure to select MEMOBUS mode (LRC or CRC).
2. MEMOBUS mode (LRC) is ASCII mode and MEMOBUS mode (CRC) is RTU mode.

9.1.2 Setting Communication Parameters

Setting the communication parameters is performed P150 programming panel ASCII programmer. Set the following for each ASCII port.

- Parity Check ("NO PAR "/" PARITY")
  Select "PARITY" if parity is checked and "NO PAR" if parity is not checked.
- Even or odd parity ("EVEN"/"ODD")
  Select "EVEN" for even parity and "ODD" for odd parity.
- Number of stop bits ("1STOP"/"2STOP")
  Select "1STOP" (1-stop bit) or "2STOP" (2-stop bits).

9.1.2. Setting Communication Parameters (Cont'd)

- Number of data bits ("# OF DATA BITS")
  Select 7 or 8, consistent with the selection of transmission mode.
  In RTU mode: 8 bits
  In ASCII mode: 7 bits
- Baud rate ("BAUD RATE")
  Select any one of 150, 300, 600, 1200, 2400, 4800, 9600, or 19200.
- Keyboard/non-keyboard ("KBD"/"NON-KBD")
  Be sure to select non-keyboard ("NON-KBD").

9.2 STORING ASCII MESSAGES

The U84 master unit sends query messages to slave units by write commands and receives response messages from slave units by read commands.

The write and read commands, repectively, use ASCII messages that specify the format, order of arrangement, and number of data to be sent or received.

The ASCII messages are provided by P150 ASCII programmer.

The ASCII messages used in the U84 master configuration vary in RTU and ASCII modes, in the query and response messages, depending on the type of function and the number of data.

NOTE

- In the U84 master configuration, no ASCII message is needed for the CRC-16 code (in RTU mode), the LRC code or " : "at the top (in ASCII mode) in the query or response messages.

9.2.1 ASCII Messages in RTU Mode

The ASCII messages of RTU mode are written in the "A" format. Tables 9.3 and 9.4 show the ASCII messages of the query and response messages.

Table 9. 3 ASCII Messages for Query Messages (Write Commands) in RTU Mode

Function Code	ASCII Message	Remarks	
1, 2, 3, 4, 5, 6, 8	6A	—	
7	2A	—	
FH	7A, mA	$m = [\frac{M+7}{8}]$	(M≦792)
	7A, 98A, 2A		(793≦M≦800)
10H	7A, nA	n = 2N	(N≦49)
	7A, 98A, nA	n = 2 (N−49)	(50≦N≦98)
	7A, 98A, 98A, nA	n = 2 (N−98)	(99≦N≦100)

Note:

1. m and n are integers calculated, respectively from M (number of coils) and N (number of holding registers). Vary the ASCII message according to the magnitudes of M and N.
2. $[\frac{M+7}{8}]$ is the largest of the integers that do not exceed $\frac{M+7}{8}$.
3. The upper limits of M and N are 800 and 100, respectively.

Table 9. 4 ASCII Messages for Response Messages (Read Commands) in ASCII Mode

Function Code	ASCII Message	Remarks	
1, 2	3A, mA	$m = [\frac{M+7}{8}]$	(M≦792)
	3A, 98A, mA	$m = [\frac{M+7}{8}]-98$	(793≦M≦1568)
	3A, 98A, 98A, mA	$m = [\frac{M+7}{8}]-196$	(1569≦M≦2000)
3, 4	3A, nA	n = 2N	(N≦49)
	3A, 98A, nA	n = 2 (N−49)	(50≦N≦98)
	3A, 98A, 98A, nA	n = 2 (N−98)	(99≦N≦125)
5, 6, 8, FH, 10H	6A	—	
7	3A	—	

Note:

1. m and n are integers calculated, respectively from M (number of coils or input relays) and N (number of input or holding registers). Vary the ASCII message according to the magnitudes of M and N.
2. $[\frac{M+7}{8}]$ is the largest of the integers that do not exceed $\frac{M+7}{8}$.
3. The upper limits of M and N are 800 and 59, respectively.

9.2.2 ASCII Messages in ASCII Mode

The ASCII messages of ASCII mode are written in the "H" format. Tables 9.5 and 9.6 show the ASCII messages of the query and response messages.

Table 9. 5 ASCII Messages for Query Messages (Write Commands) in ASCII Mode

Function Code	ASCII Message	Remarks
1, 2, 3, 4, 5, 6, 8	6H2	—
7	2H2	—
FH	mH2	$m=[\frac{M+7}{8}]+7$ ($M \leqq 736$)
	8H2, mH2	$m=[\frac{M+7}{8}]-1$ ($737 \leqq M \leqq 800$)
10H	7H2, nH4	n = N

Note:

1. m and n are the integers calculated, respectively from M (number of coils) and N (number of holding registers). Vary the ASCII message according to the magnitudes of M and N.
2. $[\frac{M+7}{8}]$ is the largest of the integers that do not exceed $\frac{M+7}{8}$.
3. The upper limits of M and N are 800 and 59, respectively.

Table 9. 6 ASCII Messages for Response Messages (Read Commands) in ASCII Mode

Function Code	ASCII Message	Remarks
1, 2	mH2	$m=[\frac{M+7}{8}]+3$ ($M \leqq 768$)
	4H2, mH2	$m=[\frac{M+7}{8}]-1$ ($769 \leqq M \leqq 976$)
3, 4	3H2, nH4	n = N
5, 6, 8, FH, 10H	6H2	—
7	3H2	—

Note:

1. m and n are integers calculated, respectively from M (number of coils or input relays)and N (number of input or holding registers) Vary the ASCII message according to the magnituders of M and N.
2. $[\frac{M+7}{8}]$ is the largest of the integers that do not exceed $\frac{M+7}{8}$.
3. The upper limits of M and N are 976 and 61, respectively, with U84. The limits are 256 and 61 (32 for input registers) with R84H-M and GL20.

9.3 CREATING LADDER CIRCUITS FOR U84 MASTER CONFIGURATION

To use the U84 master unit of the MEMOBUS system, it is necessary to create programs that control communication with slave units with ladder circuits.

The ladder circuits needed for the U84 master configuration are shown below. In actual applications, consider the following examples when creating circuits.

9.3.1 Message Transmit/Receive Circuit

The query message goes out on a write command and the response message comes in a read command. Execute the write command followed immediately by the read command. Fig. 9.2 outlines the circuit.

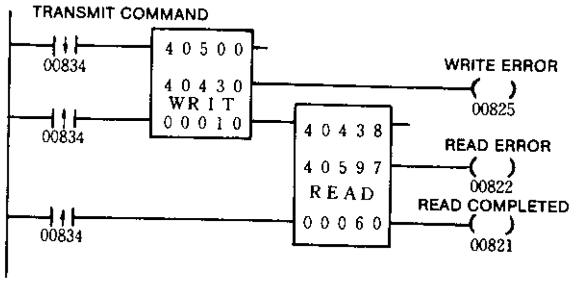


Fig. 9.2 Sample transmit /Receive Circuit for Message

Even when there are various kinds of query messages, use a common transmit/receive circuit and change query message by using block move before executing a write command.

Decide the size of the write and read query (10 and 60 in the example of Fig. 9.2) by taking into consideration the longest message. Even if the size is large, only the number of data specified with the ASCII message can be processed.

(1) Transmitting Query Messages
Reading out the contents of holding registers 40108 to 40110 of U84 (4108 to 4110 with R84H-M or GL20) is explained below.

Store the query message in a register table in advance. Fig. 9.3 shows how the query message is stored.

40400	0 2	0 3	SLAVE ADDRESS (2), FUNCTION CODE (3)
40401	0 0	6 B	FIRST HOLDING REGISTER NUMBER: 40001 (4001)
40402	0 0	0 3	NUMBER OF HOLDING REGISTER: 3

Note:
1. The numbers written in the registers are hexadecimal.
2. ASCII message "6A" is used.

(a)RTU Mode

40400	0 0 0 2	SLAVE ADDRESS (2)
40401	0 0 0 3	FUNCTION CODE (3)
40402	0 0 0 0	FIRST HOLDING REGISTER NUMBER: 40001 (4001)
40403	0 0 6 B	
40404	0 0 0 0	NUMBER OF HOLDING REGISTER: 3
40405	0 0 0 3	

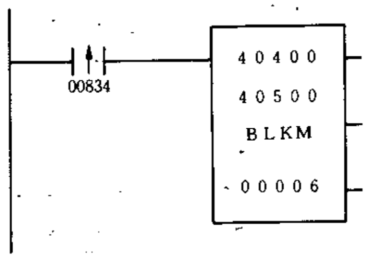
Note:
1. The numbers written in the registers are hexadecimal.
2. ASCII message "6H2" is used.

(b)ASCII Mode

Fig. 9.3 Sample Storage of Query Message

9.3.1 Message Transmit/Receive Circuit (Cont'd)

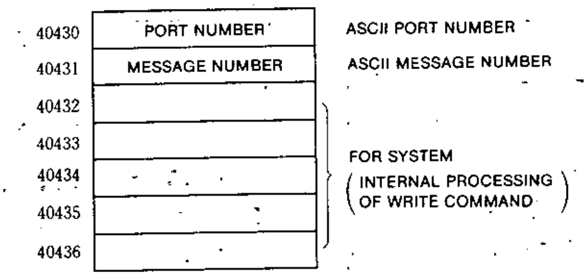
Move the query message to the source table of write commands before executing the write command (Fig. 9.4).



Note: Select 00003 as the size of BLKM in RTU mode and 00006 in ASCII mode.

Fig. 9.4 Circuit for Moving Query Message

Assign seven holding registers to the destination of the write command. Before executing the write command put the ASCII port number in the top register and the ASCII message number in the next register (second from the top).



Note: Any holding register can be used but it cannot be shared with another write or read command.

Fig. 9.5 Destination of Write Command

When coil 834 is turned on, the circuit of Fig. 9.2 aborts the write and read commands at the transitional contact (OFF to ON) because execution of the write or read command would hang up and other commands would not be accepted if there should be a transmission error. As coil 834 is turned off, execution of the write command is started by the transitional contact (ON to OFF).

NOTE

1. In RTU mode, the contents of the source table (6 characters) are transmitted to the slave unit serially according to the specification of "6A." The ASCII module calculates the CRC-16 code and attaches it to the data.
2. In ASCII mode, " : " is transmitted to the slave unit at the top of the ASCII message, followed by the contents of the source table (two hex digits by six: 12 characters in total) according to the specification of "6H2," after being converted to ASCII codes (7 bits). The LRC code is calculated by the ASCII module and attached to the data. Finally, "CR" and "LF" are transmitted.

(2) Receiving Response Messages

Assign seven holding registers to the source of the read command. Before executing the read command, set the ASCII port number in the top register and the ASCII message number in the next register (second from the top).

40438	PORT NUMBER	ASCII PORT NUMBER
40439	MESSAGE NUMBER	ASCII MESSAGE NUMBER
40440		FOR SYSTEM (INTERNAL PROCESSING OF READ COMMAND)
40441		
40442		
40443		
40444		

Note: Any holding register can be used but it cannot be shared with another write or read command.

Fig. 9.6 Source of Read Command

In the circuit shown in Fig. 9.2, when transmission of the query message ends, the output at the bottom of the write command is turned on (for only one scan) and execution of the read command starts.

The response message from the slave unit is converted to the fromat specified with an ASCII message by the read command, then stored in the destination table of the read command.

Described below is the way a response message associated with a query message is received in RTU and ASCII modes.

- RTU mode

  Consider reception using the ASCII message of "3A, 6A". The slave address, function code, and the number of data are stored in the destination table according to the specification of "3A".

  The number of data enter the MSBs of the register.

  Next, the contents of the holding registers enter the destination table according to the specification of "6A".

  Finally receiving CRC-16, the ASCII module checks if the received response message is correct or not. The received response message is shown in Fig. 9.7.

40597	0 2	0 3	SLAVE ADDRESS (2), FUNCTION CODE (3)
40598	0 6	0 0	NUMBER OF DATA (6)
40599	0 2	2 B	CONTENT OF HOLDING REGISTER 40108 OR 4108 (555)
40600	0 0	0 0	CONTENT OF HOLDING REGISTER 40109 OR 4109 (0)
40601	0 0	6 3	CONTENT OF HOLDING REGISTER 40110 OR 4110 (99)

Note: The numbers written in the register are hexadecimal.

Fig. 9.7 Received Response Message (RTU Mode)

9.3.1 Message Transmit/Receive Circuit (Cont'd)

- ASCII mode

Consider reception using the ASCII message of "3H2, 3H4" Data reception begins when the ASCII module recognizes that " : ", which tops the response message, has come from the slave unit.

The slave address, function code, and the number of data (two ASCII characters each), converted to two hex codes each, according to the specification of "H2," enter the destination table in that sequence.

Then, ASCII characters, converted to hex digits according to the specification of "H4," are stored the destination table, in groups of four characters.

The ASCII module checks the two ASCII characters representing LRC.

Upon receiving "CR" and "LF," execution of the read command ends and bottom output is turned on (only for one scan). The received response message is shown in Fig. 9.8.

40597	0	0	0	2	SLAVE ADDRESS (2)
40598	0	0	0	3	FUNCTION CODE (3)
40599	0	0	0	6	NUMBER OF DATA (6)
40600	0	2	2	B	CONTENT OF HOLDING REGISTER 40108 OR 4108 (555)
40601	0	0	0	0	CONTENT OF HOLDING REGISTER 40109 OR 4109 (0)
40602	0	0	6	3	CONTENT OF HOLDING REGISTER 40110 OR 4110 (99)

Note: The numbers written in the registers are hexadecimal.

Fig. 9.8 Received Response Message (ASCII Mode)

9.3.2. Circuit Rearranging of Received Data (Coil and Input Relay States)

When the states of coils and input relays are received, they are arranged in an order (MSB is associated with the smallest number) different from that of the U84 memory.

Fig. 9.9 shows the arrangement of data when the states of 80 coils or input relays are received with the circuit of Fig. 9.2.

RTU MODE ↓	ASCII MODE ↓	MSB	
40599	(40600)	8-1	16-9
40600	(40601)	24-17	32-25
40601	(40602)	40-33	48-41
40602	(40603)	56-49	64-57
40603	(40604)	72-65	80-73

Note: "1" is associated with the coil or input relay having the smallest number.

Fig. 9.9 Data Arrangement when Receiving the States of Coils or Input Relays

The arrangement shown in Fig. 9.9 is inconvenient for calculation. Therefore, a twist command (TWST) is used to rearrange the data. Fig. 9.11 shows the result of rearrangement of data.

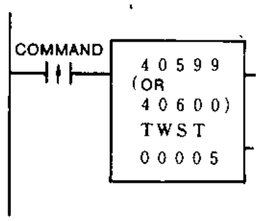


Fig. 9.10 Circuit Rearranging Received Date (States of Coils and Input Relays)

40599 (40600)	1-8	9-16
40600 (40601)	17-24	25-32
40601 (40602)	33-40	41-48
40602 (40603)	49-56	57-64
40603 (40604)	65-72	73-80

Fig. 9.11 Result of Rearrangement of Received Data (States of Coils and Input Relays)

9.3.3 Error Detection Circuit

Be sure to provide the U84 master unit with an error detection circuit and, if an error has been detected during communication between the master and slave units, reinitiate communication from the beginning.

(1) Types of Errors

The following errors may occur.

- Error during execution of a write command
- Error during execution of a read command (including CRC-16/LRC error)
- No response error

(2) Errors during Execution of Write/Read commands

The write/read command checks for errors during execution and, if an error is detected, turns on the middle output for one scan.

Coils 825 and 822 in Fig. 9.2 turn on for one scan when an error has been detected during execution of the write or read command, respectively.

9.3.3 Error Detection Circuit (Cont'd)

(3) No Response Error

Let the circuit shown in Fig. 9.12 monitor the time taken unitl a query message is received. If no response is received after the timer has counted up to the limit, consider it as a no-response error.

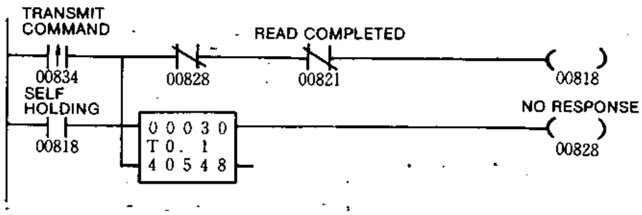


Fig. 9.12 No-Response Detection Circuit

(4) Error Counter

It is convenient to prepare error counters, each of which counts various kinds of errors separately (see Fig. 9.13).

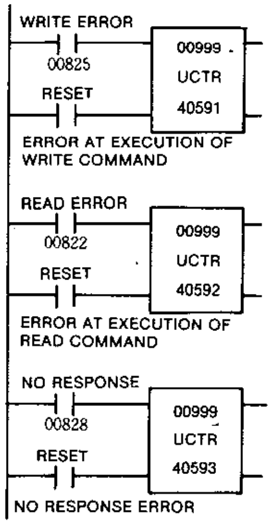


Fig. 9.13 Sample Error Counter

9.3.4 Circuit to Retransmit Command Messages

If communication to a slave unit has failed, let the master unit send the same query message again to the slave unit.

An error would rarely occur twice in a row. But, for safety, the system should be designed to permit retransmission of the query message 3 to 5 times. Prepare a counter for this purpose.

(1) Retransmission Command Circuit

Issue the command to send the query message again with a delay of 2 to 3 seconds after detection of the error. Once the count of retransmissions has reached a predetermined limit, do not execute any further retransmissions. Fig. 9.14 shows the circuit that orders retransmission.

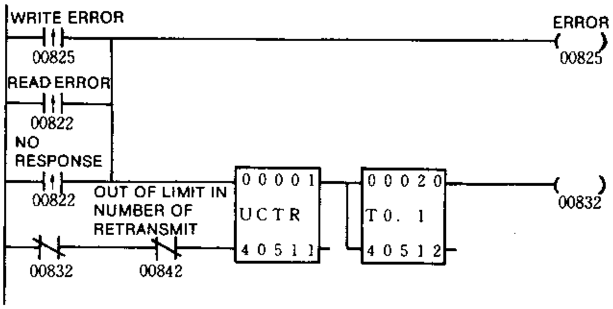


Fig. 9.14 Circuit for Ordering Retrasmission of Query Message

(2) Retransmission Command Counter

Communication with another slave unit becomes impossible if retransmission is repeated unlimitedly when errors occur repeatedly.

To prevent this, prepare a counter like that shown in Fig. 9.15, so that retransmission be prohibited after the counter has reached a limit.

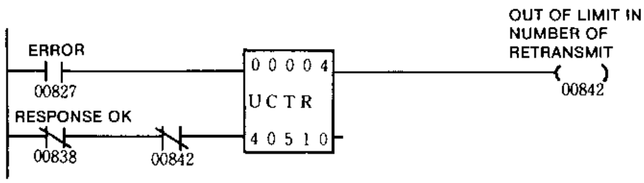


Fig. 9.15 Retrasmission Command Counter Circuit

In this example, if errors continue four times, the counter reaches its limit and coil 842 is turned on so that the retransmission command (shown in Fig. 9.14) is not executed.

10. HANDLING AND MAINTENANCE OF EQUIPMENT

10.1 MODEM (TYPE DISCT-J1078, J2078, J478)

(1) General

A modem consists of a modulator which converts digital signals (RS-232C) to 50 kHz and 80 kHz analog signals and a demodulator which converts these analog signals to digital signals (RS-232C).(Fig. 11.1).

Logic "1" (− 12V) of digital signal is called "Mark" and logic "0" (+ 12V) is called "Space". They correspond to 50 kHz and 80 kHz analog signals, respectively.

Digital Signal		Analog Signal
Logic "1" (−12V): Mark	←→	50 kHz
Logic "0" (+12V): Space	←→	80 kHz

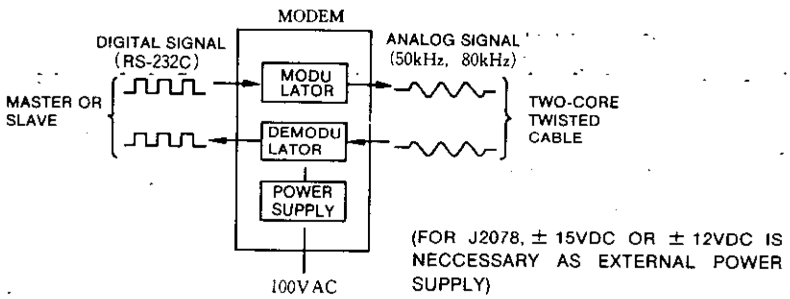


Fig. 10.1 Modem Block Diagram

(2) Installation

(a) J1078

Fig. 10.2 shows the J1078 modem. J1078 can be installed in any slot (one span) on a mounting base for 1000 series I/Os.

A panel-mounted type is also available by using a metal fitting. Be sure to install J1078 vertically as shown in Fig. 11.3.

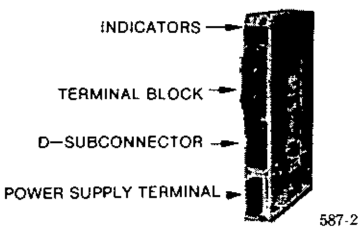


Fig. 10.2 J1078 Modem

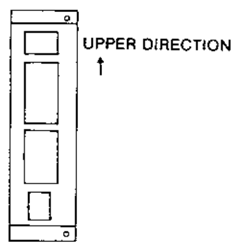


Fig. 10.3 J1078 Mounting Direction

(b) J478

Fig. 10.4 shows the J478 modem.

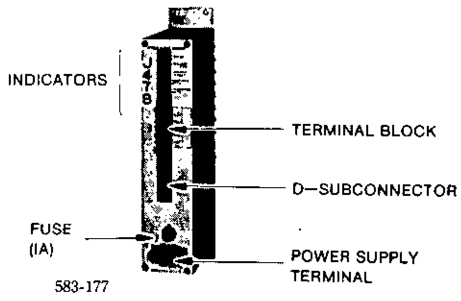


Fig. 10.4 J478 Modem

J478 is a panel-mounted type of module and is fixed with four M6 screws. J478 should be installed vertically as shown in Fig. 10.5.

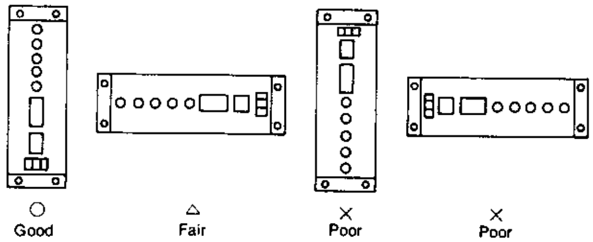
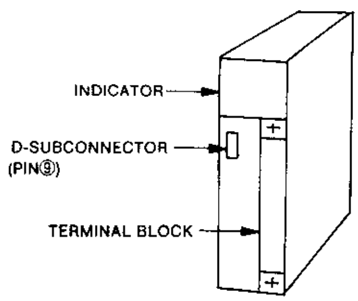


Fig. 10.5 J478 Mounting Direction

(c) J2078

Fig. 10.6 shows the J2078 modem. J2078 can be installed in any slot (one span) on a mounting base for 2000 series I/Os.

A panel-mounted type is also available by using a metal fitting. Be sure to install J2078 vertically as shown in Fig.10.7.



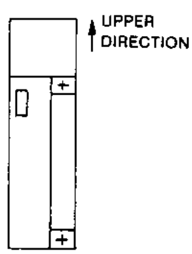


Fig. 10.6 J2078 Modem **Fig. 10.7 J2078 Mounting Direction**

10.1 MODEM (TYPE DISCT-J1078, J2078 J478) (Cont'd)

(3) Connection

• Power supply terminal

100 VAC is applied to the "AC INPUT" pin at the power supply terminal. "GND" terminal should be grounded with 100 Ω or less of grounding resistance.
±15 VDC or ±12 VDC is required for J2078 external power supply.

• Terminal block

Two-core twisted cable (RG108/U or equivalent) should be used for the terminal block. Refer to "4.1 CONNECTIONS BETWEEN MODEMS" for details.

• D-subconnector

Standard D-subconnector (DB-25P connector) is used for the connection between a modem a master (or slave). Signal level is EIA standard RS-232C.
For J2078, pin⑨ is used.

Note: Pins of ⑨ to ⑲ and ㉑ to ㉕ are not used.

(a) J478, J1078

Note: Pin ⑧ is not used

(b) J2078

Fig. 10.8 RS-232C Cable Connection

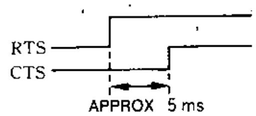


Fig. 10.9 CTS Signal Response Time

(4) Indicators

Table 10. 1 Indicators

(a) J478, J1078

Indicator	Description
POWER	J478 logical power supply is normal.
REQUEST TO SEND (RTS)	RST signals from a master or a slave are logic " 1 " (+12 V).
CARRIER DETECT (CAR)	Carry signals or data have arrived at a receive terminal. At this time, CAR (Carry detection) signals are logic " 1 " (+12 V).
RECEIVED DATA (RXD)	Data are being received from the receive terminal. This indicator lights at logic " 0 ".
TRANSMITTED DATA (TXD)	Data are being transmitted from the transmit terminal. The indicator lights at logic " 0 ".

(b) J2078

Indicator	Description
POWER	Normally external power supply (±15V or ±12V) is input.
REQUEST TO SEND (RTS)	RTS signals from a master or a slave are logic "1".
TRANSMITTED DATA (TXD)	Data are being transmitted from the transmit terminal. The indicator lights at logic " 1 ".
RECEIVED DATA (RXD)	Data are being received from the receive terminal. The indicator lights at logic " 1 ".

10.2 R84H-M CPU MODULE (TYPE DDSCR-R84H-M)

(1) General

There are two types of Memocon-SC R84H CPU modules. One is R84H-M, provided with MEMOBUS interface (C8012), and the other is R84H without the interface.

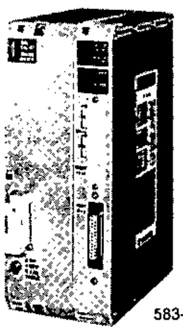


Fig. 10.10 R84H-M CPU Module

10.2 R84H-M CPU MODULE (TYPE DDSCR-R84H-M) (Cont'd)

NOTE

1. CPU module R84H-M can be used as MEMOBUS slave. However, it cannot be used as MEMOBUS master.
2. CPU module cannot be changed from R84H type to R84H-M type.

(2) Installation

R84H-M is installed on an exclusive mounting base. Refer to "Memocon-SC R84H Designer's Reference Manual" (SIE-C815-9.4) for details.

(3) Connection

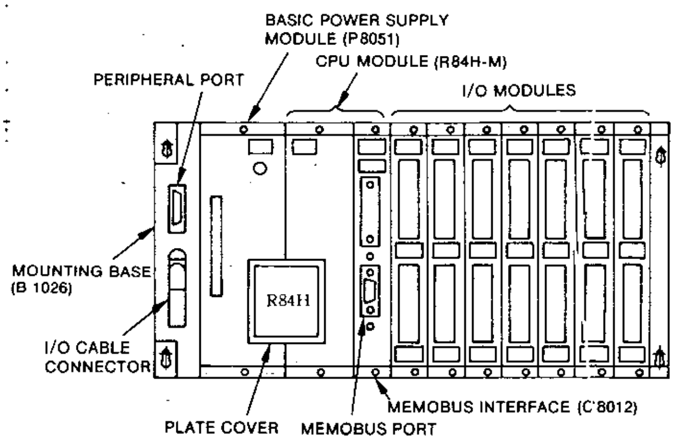


Fig. 10.11 Memocon-SC R84H-M Slave

- Power supply terminal
  Remove the plate cover and connect 100 VAC to the "100 VAC" terminal of the basic power supply module (P8051). "GND" terminal should be grounded with 100 Ω or less of grounding resistance.

- Peripheral port
  Peripheral units such as programming panels P180 or P100 is connected to this port.

- MEMOBUS port
  Modems or MEMOBUS masters are connected to this port.

NOTE

Both Peripheral port and MEMOBUS port use D-subconnectors (DB25S).

(4) Indicators

Table 10. 2 R84H-M Indicators

Indicator	Description
POWER ON	Lights when MEMOBUS interface (C8012) is proper.
COM ACTIVE	Lights when communicating between C8012 and external devices.
I/F ERROR	Lights when any error occurs during communication between C8012 and CPU.
COM ERROR	Lights when any error occurs during communication between C8012 and external devices.

(5) Maintenance

For the maintenance of R84H-M, refer to "Momocon-SC R84H Maintenance Manual" (SIE-C815-9.1).

10.3 GL20 CPU MODULE (TYPE DDSCR-GL20)

(1) General

Standard Memocon-SC GL20 is provided with MEMOBUS interface.

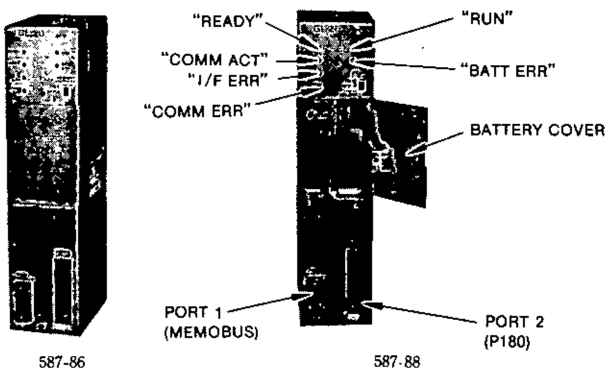


Fig. 10.12 GL20 CPU Module

(2) Installation

GL20S is installed on an exclusive mounting base. refer to "Memocon-SC GL20 User's Manual, Design and Maintenance" (SIE-C815-13.1) for details.

(3) Connection

- Power supply terminal
  Connect 100VAC between power terminals "R" and "T". "GND" terminal should be grounded with 100 Ω or less of the grounding resistance.

- PORT 1 (MEMOBUS)
  Modems or MEMOBUS masters are connected to this port: D-subconnector pin 9.

- PORT 2 (P180)
  Peripheral units such as programming panels P180 or P100 is connected to this port.

(4) Indicator

"I/F Error" indicator may be lit while coil status is displayed by using P150. However, it can be disregarded since this does not indicate any data transmission error.

(5) Maintenance

Refer to "Memocon-SC GL20 User's Manual, Desigh and Maintenance" (SIE-C815-13.1) for details.

10.3 GL20 CPU MODULE (TYPE DDSCR-GL20) (Cont'd)

Table 10. 3 GL20 MEMOBUS Indicators

Indicator	Description
READY	Lights when GL20 MEMOBUS interface is proper.
COMM ACT	Lights when communicating with master.
I/F ERR	Lights when an error occurs during data transmission with GL20 mainframe.
COMM ERR	Lights when an error occurs during data transmission with master.

10.4 SELF-DIAGNOSIS OF MEMOBUS INTERFACE

R84H-M and GL20 MEMOBUS interface perform various self-diagnosis (power up check) when power is applied or the reset switch located below the setting switches is pressed. If the result of self-diagnosis is correct, then MEMOBUS interface indicators light for a short time (from bottom to top) and at the final stage only the "POWER ON" indicator (R84H-M) or the "READY" indicator (GL20) lights. MEMOBUS interface repeats the same self-diagnosis thereafter.

If setting switches 1SW-1 and 1SW-2 (C8021) are both set to OFF position, then test mode is activated. In this mode MEMOBUS interface repeats self-diagnosis only and, as long as the result is correct, the same lighting pattern as that in power up check will be repeated. During test mode, MEMOBUS interface does not respond to any message from the master.

If any error is detected during self-diagnosis, then MEMOBUS interface indicators flicker to indicate the type of error. At the time, 4 indicators are combined in a particular way to indicate a specific error code. These indicators do not indicate original meanings but indicate particular error types at the time.

To reset this state, turn the power supply OFF and ON, or press the reset switch of MEMOBUS interface. If an error is corrected, then MEMOBUS interface performs self-reset and returns automatically to normal. (It starts from the power up check.)

NOTE

Open circuit between pin 4 and pin 5 of MEMOBUS port in the test mode causes asynchornous bus failure. Therefore, in the test mode, the two pins should be connected together.

If setting switches 1SW-1 and 1SW-2 are set to OFF and ON positions, respectively, then it also causes asynchronous bus failure.

Table 10. 4 C8012 Error Codes

"POWER ON"	"COM ACT"	"I/F ERR"	"COMM ERR"	Error Contents
0	0	0	1	C8012 CPU failure
0	0	1	0	Prallel port failure (Data transmission part to GL20 mainframe)
0	0	1	1	Asynchronous bus failure (Data transmission part to external devices)
0	1	0	0	Defective Timer
0	1	0	1	
0	1	1	0	
0	1	1	1	Defective ROM
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	Defective RAM
1	1	0	1	
1	1	1	0	
1	1	1	1	

Note: 0—Indicator OFF
1—Indicator blinking

Table 10. 5 GL20 Error Codes

"READY"	"COM ACT"	"I/F ERR"	"COMM ERR"	Error Contents
0	0	0	1	S475 CPU failure
0	0	1	0	Parallel port failure (Data transmission part to GL20 mainframe)
0	0	1	1	Asynchronous bus failure (Data transmission part to MEMOBUS)
0	1	0	0	Defective Timer
0	1	0	1	
0	1	1	0	
0	1	1	1	Defective ROM
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	Defective RAM
1	1	0	1	
1	1	1	0	
1	1	1	1	

Note: 0—Indicator OFF
1—Indicator blinking

10.5 TROUBLESHOOTING

(1) U84 MEMOBUS Port Buffer Contents Check

If signal transmission to a slave cannot be accomplished properly (i.e. no response from a slave, transmission error), check the contents of the receiving buffer and the transmitting buffer of the communication module.

By entering the following specified number into RAP of the communication module, the contents of MEMOBUS port buffer can be checked. "7" and "0" in the specified number are constant.

NOTE

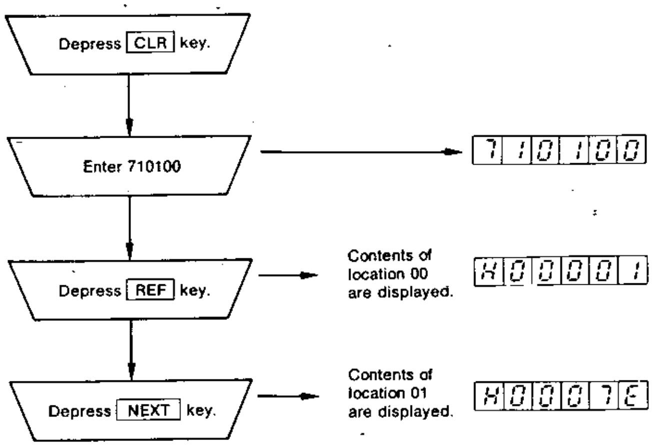
Query massage from the master is stored in the receiving buffer.
Response massage to the master is stored in transmitting buffer.

7XOYZZ

- ZZ — Buffer Address (hex): ZZ=00-FF
- Y — Selects Transmitting or Receiving Buffer: Y=0 Receiving buffer, Y=1 Transmitting buffer
- X — Port Number

X=1 Port 1
X=2 Port 2

Operate as follows to display the content of transmitting buffer of port 1 for example.



- The data is displayed in form at first.
- The buffer address ZZ is incremented (decremented) by one every time you push NEXT (PREV).

(2) R84H-M MEMOBUS Interface Troubleshooting

Table 10. 6 MEMOBUS Interface C8012 Troubleshooting List

Conditions	Possible Cause	Corrective Action
R84H-M indicators do not light at all even if power is applied to R84H-M.	AC power does not come.	Check AC power supply
	Blown fuse	Replace fuse.
	Defective power supply module (JRMSP-P8051).	Replace power supply module.
	Short-circuited power in CPU or C8012	Replace R84H-M unit.
C8012 indicators do not light at all even if the power is applied to R84H-M. (CPU indicators are ON.)	Poor connection of C8012 flat cable connector.	Reinsert connector.
	Defective C8012	Replace R84H-M unit.
Only indicator "I/F ERROR" blinks during a self-diagnosis operation.	Poor connection of C8012 flat cable connector.	Reinsert connector.
	Defective C8012	Replace R84H-M unit.
	Defective CPU	
Indicators "I/F ERROR" and "COM ERROR" blink during a self-diagnosis operation.	Wrong setting of 1SW	Check setting of 1SW.
	Poor connection between MEMOBUS port and RS-232C cable.	Check RS-232C cable connection.
	Defective C8012	Replace R84H-M unit.
Only indicator "COM ERROR" blinks during a self-diagnosis operation.	Defective C8012	Replace R84H-M unit.
Defective timer, ROM, or RAM are detected during a self-diagnosis operation.	Defective C8012	Replace R84H-M unit.
The result of self-diagnosis is normal, but C8012 does not communicate with MEMOBUS master.	MEMOBUS master's software defective	Check software.
	Wrong setting of C8012 communication parameters.	Check setting switch.
	Poor connection between MEMOBUS port and RS-232C cable.	Check RS-232C cable connection.
	Poor connection of two-core twisted cable.	Check two-core twisted cable connection.
	Defective modem	Replace modem.
Transmission error or no-response error occur frequently.	External noise	• Check wiring of two-core twisted cables and RS-232C cables. • Check grounding.
	Not provided with terminator for two-core twisted cables.	Install terminator.
	Poor connection of RS-232C cable and two-core twisted cable.	Check cable connections.
	Two or more slaves respond at same time.	Check address switch.
	Defective modem	Replace modem.
Indicator "COM ERROR" lights.	Error in CRC-16 check or LRC check	Check master software.

Note: When C8012 indicator blinks, depress the reset switch of the C8012 after analizing the situation.
If it blinks again, institute the troubleshooting procedures above.

10.5 TROUBLESHOOTING (Cont'd)

(3) GL20 MEMOBUS Interface Troubleshooting

Table 10. 7 GL20 MEMOBUS Interface Troubleshooting List

Conditions	Possible Cause	Corrective Action
GL20 indicators do not light at all even if power is applied to GL20.	AC power does not come.	Check AC power supply
	Circuit protector tripping	Reset.
	Defective power supply module (JRMSP-PS20).	Replace power supply module.
	Short-circuited logical power in CPU.	Replace CPU.
MEMOBUS interface indicators do not light at all even if the power is applied to GL20. (CPU indicators are ON.)	Defective MEMOBUS interface	Replace CPU.
Only indicator "I/F ERROR" blinks during a self-diagnosis operation.	Defective CPU	Replace CPU.
Indicators "I/F ERROR" and "COM ERROR" blink during a self-diagnosis operation.	Wrong setting of 1SW	Check setting of 1SW.
	Poor connection between MEMOBUS port and RS-232C cable.	Check RS-232C cable connection.
	Defective CPU	Replace CPU.
Only indicator "COM ERROR" blinks during a self-diagnosis operation.	Defective CPU	Replace CPU.
Defective timer, ROM, or RAM are detected during a self-diagnosis operation.	Defective CPU	Replace CPU.
The result of self-diagnosis is normal, but S475 does not communicate with MEMOBUS master.	MEMOBUS master's software defective	Check software.
	Wrong setting of communication parameters.	Check setting switch.
	Poor connection between MEMOBUS port and RS-232C cable.	Check RS-232C cable connection.
	Poor connection of two-core twisted cable.	Check two-core twisted cable connection.
	Defective modem	Replace modem.
Transmission error or no-response error occur frequently.	External noise	• Check wiring of two-core twisted cables and RS-232C cables. • Check grounding.
	Not provided with terminator for two-core twisted cables.	Install terminator.
	Poor connection of RS-232C cable and two-core twisted cable.	Check cable connections.
	Two or more slaves respond at same time.	Check address switch.
	Defective modem	Replace modem.
Indicator "COM ERROR" lights.	Error in CRC-16 check or LRC check	Check master software.

Note: When S475 indicator blinks, depress the reset switch of the S475 after analizing the situation. If it blinks again, institute the troubleshooting procedures above.

11. WIRING

(1) RS-232C Cables

The length of RS-232C cable which connects modem to other devices should be as short as possible (up to 15 meters) . RS-232C cable should not be stored in the same duct with other power lines or control lines.

They should be stored in separate ducts or should be wired independently. RS-232C cable can be stored with analog signal lines or transmission cables in the same duct.

(2) Two-core Twisted Cables

For panel wiring, two-core twisted cables should not be stored in the same duct with power supply lines or control lines. They should be stored in separate ducts or should be wired independently. However, two-core twisted cables can be stored with analog signal lines or transmission lines in the same duct.

For the panel wiring, the cables should be stored in a pit. If they are stored in a pit, other power supply lines or control lines should be stored in a separate pit. If these cables and lines are stored in the same pit, then the cable should first be run in a conduit.

Both ends of the conduit should be grounded. If the cables have to be stored in the same pit with power lines, the power lines and the conduit should be separated as far as possible by separating trays. The cables can be stored with analog lines or transmission lines in the same pit.

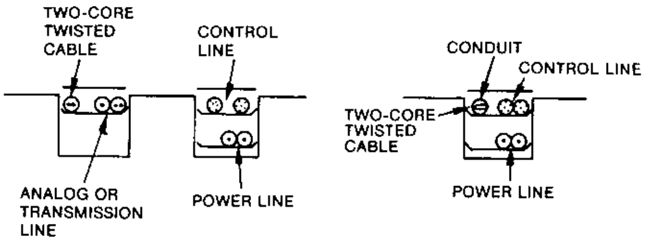


Fig. 11.1 Wiring of Two-core Twisted Cable

Whether the shielding of two-core twisted cable should be single-side grounded or double-side grounded depends on the nature of external noise. Normally, single-side grounding should be employed. Double-side grounding should be used if it produces better results. In case of single-side grounding, either side can be grounded. In general, reception side is recommended. See Fig. 4.2.

APPENDIX A SAMPLE MEMOBUS MESSAGES

1. Reading-out States of Coils 00020-00056 (0020-0056)

(1)Query Message

ADDRESS | FUNCTION | START NO. | NO. OF COILS | CRC

02	01	00	13	00	25	0C	27

(RTU)

COLON | ADDRESS | FUNCTION | START NO | NO. OF COILS | LRC

:	0	2	0	1	0	0	1	3	0	0	2	5	C	5	CR	LF
3A	30	32	30	31	30	30	31	33	30	30	32	35	43	35	0D	0A

(ASCII)

(2)Response Message

ADDRESS | FUNCTION | NO OF DATA | COIL STATES | CRC

02	01	05	CD	6B	B2	0E	1B	04	FF

(RTU)

COLON | ADDRESS | FUNCTION | NO. OF DATA | COIL STATES | LRC

:	0	2	0	1	0	5	C	D	6	B	B	2	0	E	1	B	E	5	CR	LF
3A	30	32	30	31	30	35	43	44	36	42	42	32	30	45	31	42	45	35	0D	0A

(ASCII)

2. Reading-out States of Input Relays 10197-10218 (1197-1218)

(1)Query Message

ADDRESS | FUNCTION | START NO. | NO. OF COILS | CRC

02	02	00	C4	00	16	B8	0A

(RTU)

COLON | ADDRESS | FUNCTION | START NO. | NO. OF COILS | LRC

:	0	2	0	2	0	0	C	4	0	0	1	6	2	2	CR	LF
3A	30	32	30	32	30	30	43	34	30	30	31	36	32	32	0D	0A

(ASCII)

(2)Response Message

ADDRESS | FUNCTION | NO. OF DATA | INPUT RELAY STATES | CRC

02	02	03	AC	DB	35	22	BB

(RTU)

COLON | ADDRESS | FUNCTION | NO. OF DATA | INPUT RELAY STATES | LRC

:	0	2	0	2	0	3	A	C	D	B	3	5	3	D	CR	LF
3A	30	32	30	32	30	33	41	43	44	42	33	35	33	44	0D	0A

(ASCII)

3. Reading-out Contents of Holding Registers 40108-40110 (4108-4110)

(1)Query Message

ADDRESS | FUNCTION | START NO. | NO. OF COILS | CRC

02	03	00	6B	00	03	74	24

(RTU)

COLON | ADDRESS | FUNCTION | START NO. | NO. OF COILS | LRC

:	0	2	0	3	0	0	6	B	0	0	0	3	8	D	CR	LF
3A	30	32	30	33	30	30	36	42	30	30	30	33	38	44	0D	0A

(ASCII)

(2)Response Message

ADDRESS | FUNCTION | NO. OF DATA | CONTENTS OF HOLDING REGISTER | CRC

02	03	06	02	2B	00	00	00	63	50	48

(RTU)

COLON | ADDRESS | FUNCTION | NO. OF DATA | CONTENTS OF HOLDING REGISTER | LRC

:	0	2	0	3	0	6	0	2	2	B	0	0	0	0	0	0	6	3	6	5	CR
3A	30	32	30	33	30	36	30	32	32	42	30	30	30	30	30	30	36	33	36	35	0D

(ASC

4. Reading-out Contents of Input Register 30009 (3009)

(1)Query Message

ADDRESS | FUNCTION | START NO | NO. OF COILS | CRC

15	04	00	08	00	01	B3	1C

(RTU)

COLON | ADDRESS | FUNCTION | START NO. | NO. OF COILS | LRC

:	1	5	0	4	0	0	0	8	0	0	0	1	D	E	CR	LF
3A	31	35	30	34	30	30	30	38	30	30	30	31	44	45	0D	0A

(ASCII)

(2)Response Message

ADDRESS | FUNCTION | NO. OF DATA | CONTENTS OF INPUT REGISTER | CRC

15	04	02	05	39	4A	71

(RTU)

COLON | ADDRESS | FUNCTION | NO. OF DATA | CONTENTS OF INPUT REGISTER | LRC

:	1	5	0	4	0	2	0	5	3	9	A	7	CR	LF
3A	31	35	30	34	30	32	30	35	33	39	41	37	0D	0A

(ASCII)

5. Changing States of Coil 00173(0173)

(1)Query Message

ADDRESS | FUNCTION | COIL NO | SPECIFYING STATES | CRC

03	05	00	AC	FF	00	4D	F9

(RTU)

COLON | ADDRESS | FUNCTION | COIL NO. | SPECIFYING STATES | LRC

	0	3	0	5	0	0	A	C	F	F	0	0	4	D	CR	LF
3A	30	33	30	35	30	30	41	43	46	46	30	30	34	44	0D	0A

(2)Response Message

Same as that of query message.

6. Writing-in Holding Register 40136 (4136)

(1)Query Message

ADDRESS | FUNCTION | HOLDING REGISTER NO | WRITING DATA | CRC

05	06	00	87	03	9E	B9	3F

(RTU)

COLON | ADDRESS | FUNCTION | HOLDING REGISTER NO. | WRITING DATA | LRC

:	0	5	0	6	0	0	8	7	0	3	9	E	C	D	CR	LF
3A	30	35	30	36	30	30	38	37	30	33	39	45	43	44	0D	0A

(ASCII)

(2)Response Message

Same as that of query message.

7. Reading-out States of Particular Coil

(1)Query Message

ADDRESS	FUNCTION	CRC	
01	07	41	E2

(RTU)

COLON	ADDRESS		FUNCTION		LRC		CR	LF
:	0	1	0	7	F	8	CR	LF
3A	30	31	30	37	46	38	0D	0A

(ASCII)

(2)Response Message

ADDRESS	FUNCTION	COIL STATES	CRC	
01	07	6D	E3	DD

(RTU)

COLON	ADDRESS		FUNCTION		COIL STATES		LRC		CR	LF
:	0	1	0	7	6	D	8	B	CR	LF
3A	30	31	30	37	36	44	38	42	0D	0A

(ASCII)

8. Loopback Test

(1)Query Message

ADDRESS	FUNCTION	TEST CODE		DATA		CRC	
02	08	00	00	A5	37	DA	BE

(RTU)

COLON	ADDRESS		FUNCTION		TEST CODE				DATA				LRC		CR	LF
:	0	2	0	8	0	0	0	0	A	5	3	7	1	A	CR	LF
3A	30	32	30	38	30	30	30	30	41	35	33	37	31	41	0D	0A

(ASCII)

(2)Response Message

Same as that of query message.

9. Changing States of Coils 00020-00029

(1)Query Message

ADDRESS	FUNCTION	START NO.		NO. OF COILS		NO. OF DATA	SPECIFYING STATES		CRC	
01	0F	00	13	00	0A	02	00	00	E7	9B

(RTU)

COLON	ADDRESS		FUNCTION		START NO.				NO OF COILS				NO. OF DATA		SPECIFYING STATES				LRC		CR	LF
:	0	1	0	F	0	0	1	3	0	0	0	A	0	2	0	0	0	0	D	1	CR	LF
3A	30	31	30	46	30	30	31	33	30	30	30	41	30	32	30	30	30	30	44	31	0D	0A

(ASCII)

(2)Response Message

ADDRESS	FUNCTION	START NO.		NO. OF COILS		CRC	
01	0F	00	13	00	0A	24	09

(RTU)

COLON	ADDRESS		FUNCTION		START NO.				NO. OF COILS				LRC		CR	LF
:	0	1	0	F	0	0	1	3	0	0	0	A	D	3	CR	LF
3A	30	31	30	46	30	30	31	33	30	30	30	41	44	33	0D	0A

(ASCII)

10. Writing-in Holding Registers 40136-40137

(1)Query Message

ADDRESS	FUNCTION	START NO.		NO. OF COILS		NO. OF DATA	WRITING DATA				CRC	
01	10	00	87	00	02	04	00	0A	01	02	1A	7A

(RTU)

COLON	ADDRESS		FUNCTION		START NO.				NO. OF COILS				NO. OF DATA		WRITING DATA								LRC		CR	LF
:	0	1	1	0	0	0	8	7	0	0	0	2	0	4	0	0	0	A	0	1	0	2	5	5	CR	LF
3A	30	31	31	30	30	30	38	37	30	30	30	32	30	34	30	30	30	41	30	31	30	32	35	35	0D	0A

(ASCII)

(2)Response Message

ADDRESS	FUNCTION	START NO.		NO. OF COILS		CRC	
01	10	00	87	00	02	F1	E1

(RTU)

COLON	ADDRESS		FUNCTION		START NO.				NO. OF COILS				LRC		CR	LF
:	0	1	1	0	0	0	8	7	0	0	0	2	6	6	CR	LF
3A	30	31	31	30	30	30	38	37	30	30	30	32	36	36	0D	0A

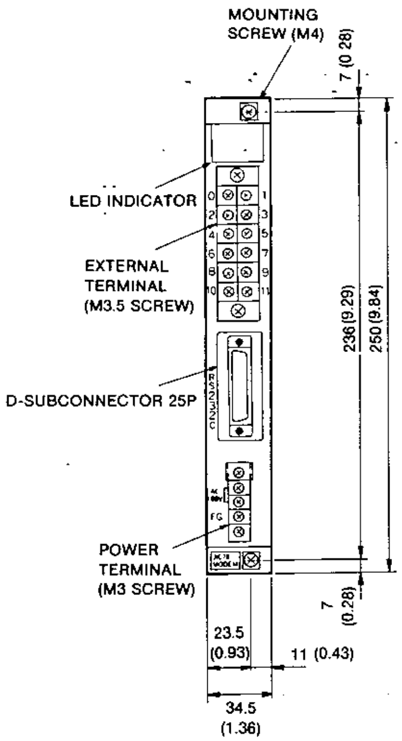
(ASCII)

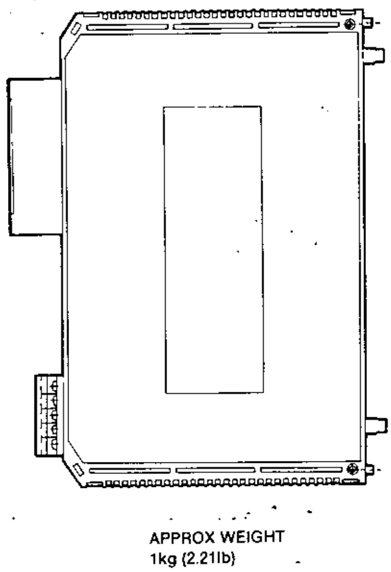
APPENDIX B MEMOBUS CABLE SPECIFICATIONS

Type JZMSZ-	Length m (inch)	Applications
W1006-1	5 (19.7)	• Between computer and GL60S, U84, GL20.
W1006-2	15 (59.1)	
W1015-1	2.5 (9.8)	• Between GL60S, U84 and R84H-M.
W1015-2	15 (59.1)	
W1017-1	5 (19.7)	• Between GL60S, U84, GL20 and J1078 modem.
W1017-2	15 (59.1)	
W1019-1	5 (19.7)	• Between GL60S, U84 and GL60S, U84.
W1019-2	15 (59.1)	
W194-001	2.5 (9.8)	• Between R84H-M and J478 modem.
W194-T01	2.5 (9.8)	• Between R84H-M and J1078 modem.
W194-TT1	2.5 (9.5)	• Between P150 and J1078 modem.
W198-TT1	2.5 (9.8)	• Between P150 and R84H-M.
W2020-001	2.5 (9.8)	• Between GL60S, U84, GL20 and J2078 modem.
W2030-001	2.5 (9.8)	• Between P150 and J2078 modem.

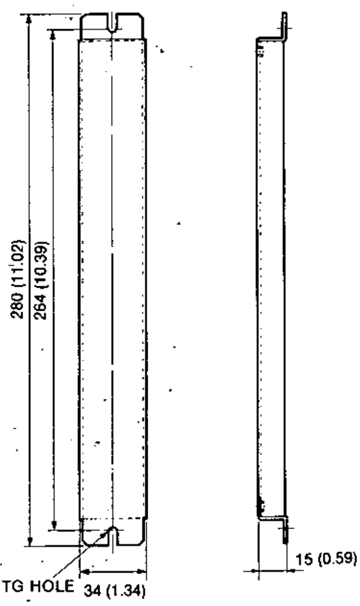
APPENDIX C DIMENSIONS in mm (inch)

(1) Modem (Type DISCT-J1078)

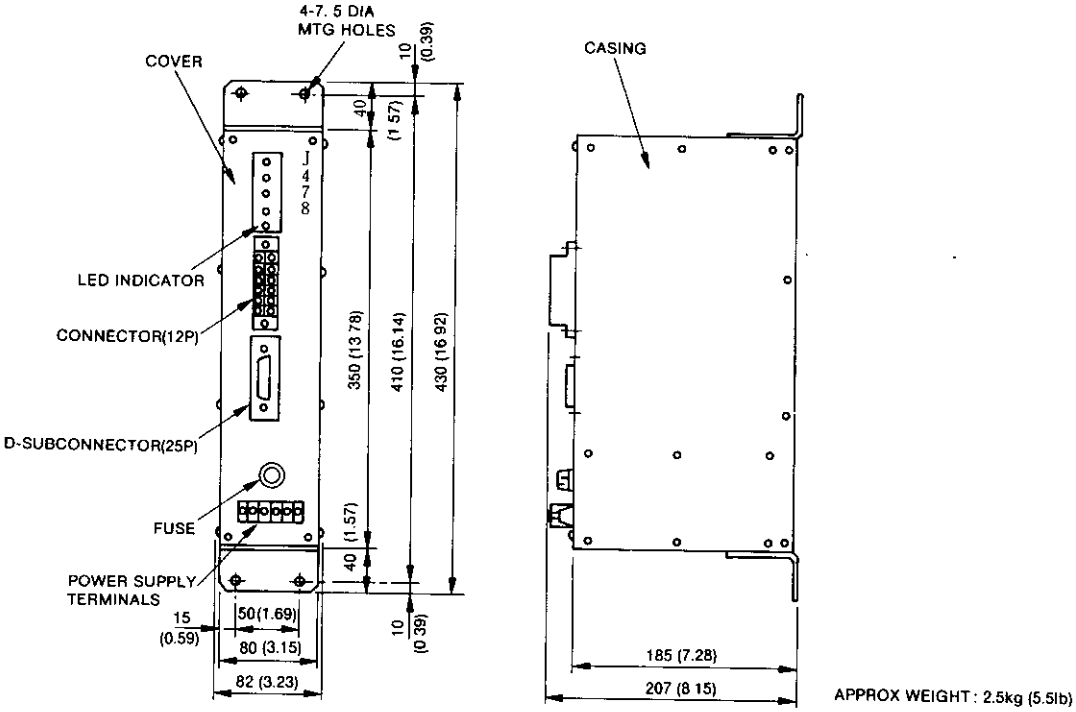




Note: When I/O support (DF8303994) is required for stand-alone installation, contact your YASKAWA representative.

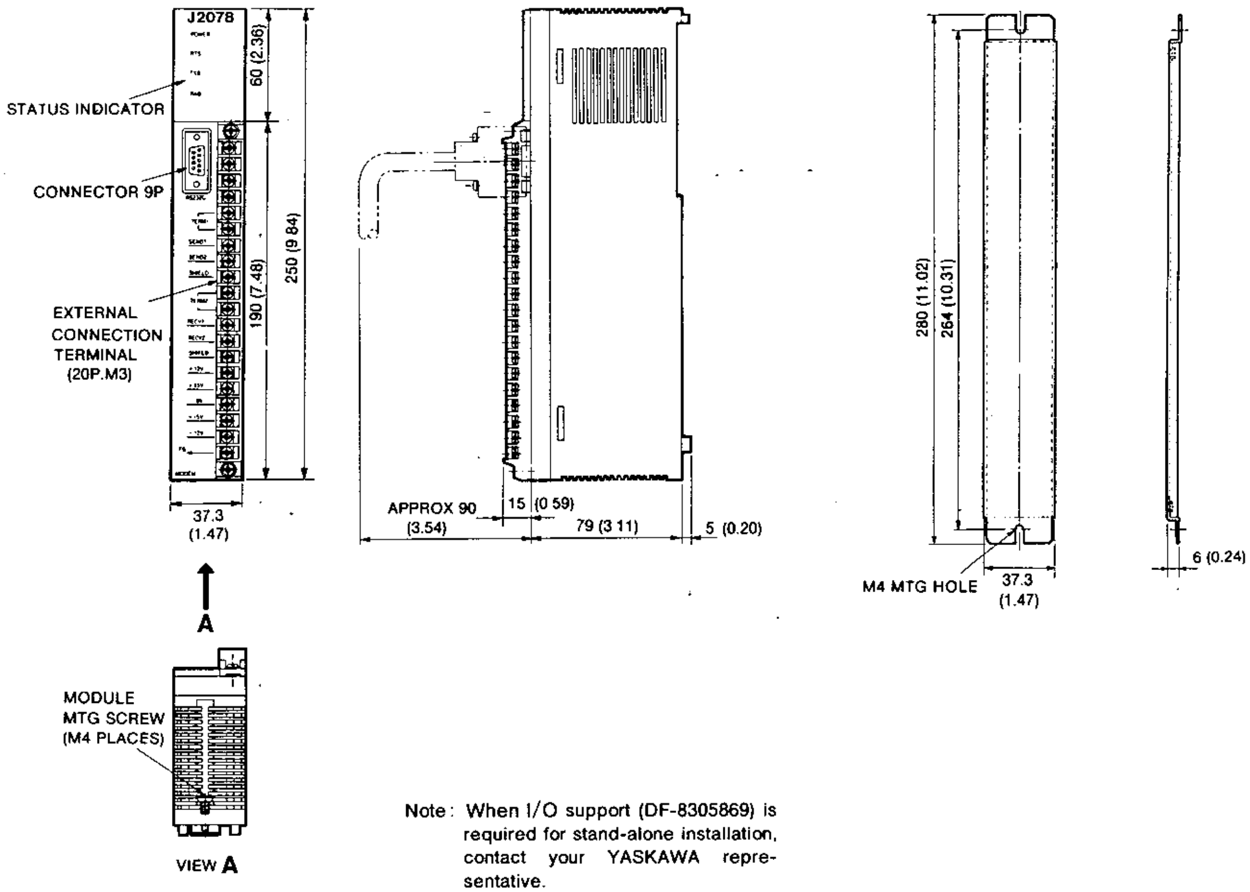


(2) Modem (Type DISCT-J478)



APPENDIX C DIMENSIONS in mm (inch) (Cont'd)

(3) Modem (Type DISCT-J2078)



Note: When I/O support (DF-8305869) is required for stand-alone installation, contact your YASKAWA representative.

APPROX WEIGHT: 0.6kg (1.3lb)

MEMOBUS
DESCRIPTIVE INFORMATION

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