

# Appendix: C

## **MEMOBUS/Modbus Communications**

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### C.1 MEMOBUS/Modbus Configuration

Drives can be controlled from a PLC or other master device via serial communications using the MEMOBUS/Modbus protocol. MEMOBUS/Modbus communications can be configured using one master (PLC) and up to 255 slaves. The drive has slave functionality only, and serial communication is normally initiated from the master and responded to by the slaves.

The master communicates with the specified slave drive. The address or node for each slave must be set prior so the master can communicate with the slave at that address. A slave that receives a command from the master will perform the specified function and send a response back to the master.

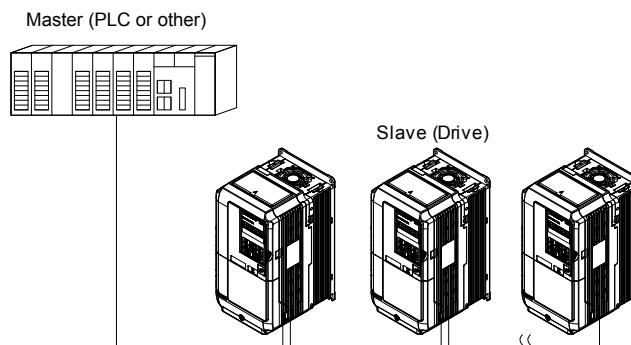


Figure C.1 Connecting Multiple Drives to a PLC

## C.2 Communication Specifications

MEMOBUS/Modbus specifications appear in [Table C.1](#):

Table C.1 MEMOBUS/Modbus Communications Specifications

Item	Specifications	
Interface	RS-422, RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communication Parameters	Communication Speeds Available	1.2; 2.4; 4.8; 9.6; 19.2; 38.4; 57.6; 76.8; 115.2 kbps
	Data length	8-bit (fixed)
	Parity	Select even, odd, or none
	Stop bit	1-bit (fixed)
Protocol	MEMOBUS/Modbus (using RTU mode only)	
Maximum Number of Slaves	31 drives (RS-485)	

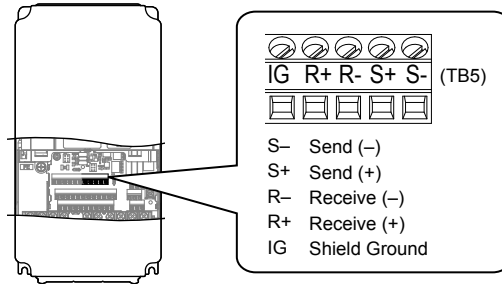
### C.3 Connecting to a Network

This section explains how to connect the drive to a MEMOBUS/Modbus network and the network termination required for a connection.

#### ◆ Network Cable Connection

Follow the instructions below to connect the drive to a MEMOBUS/Modbus network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminals TB5 for MEMOBUS/Modbus.



**Figure C.2 Serial Communications Cable Connection Terminals (TB5)**

**Note:** Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

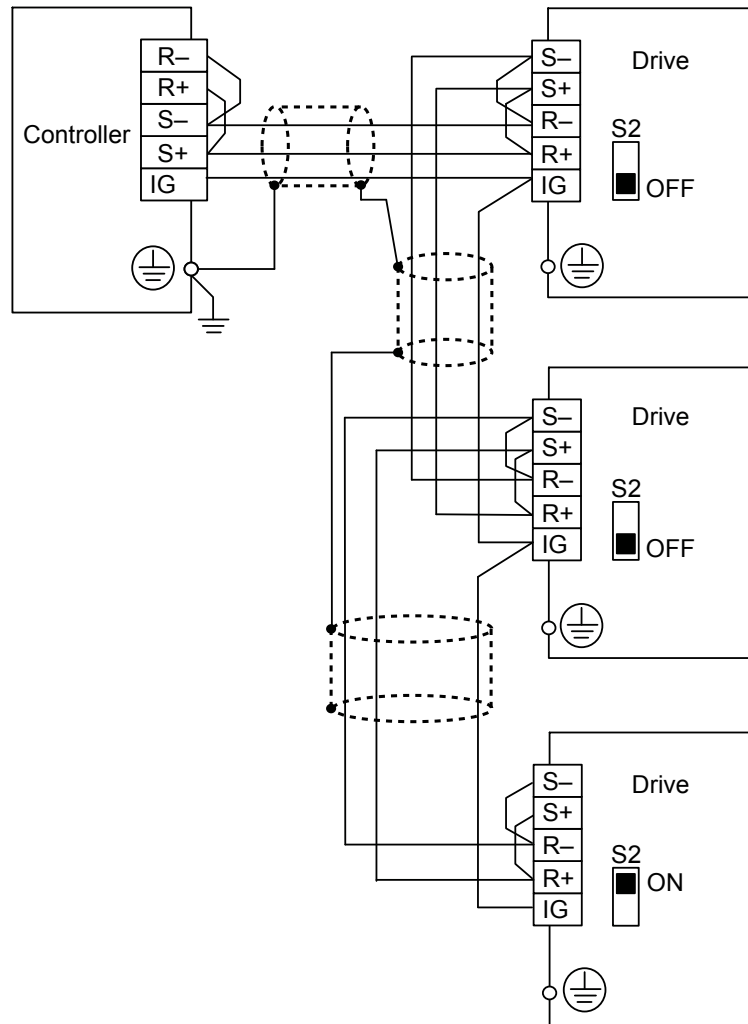
2. Check or set the termination resistor selection at all slaves. Use the description in [Network Termination](#) on page 706 for slaves that are A1000 drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

## ◆ Wiring Diagram for Multiple Connections

*Figure C.3* and *Figure C.4* explain the wiring diagrams for multiple connections using MEMOBUS/Modbus communication.

### ■ RS-485 Interface

**Note:** The isolated ground (IG) connection is optional but strongly recommended to improve network immunity to electrical interference.



**Figure C.3 RS-485 Interface**

- Note:**
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
  2. Set H5-07 to 1 when using the RS-485 interface.

### ■ RS-422 Interface

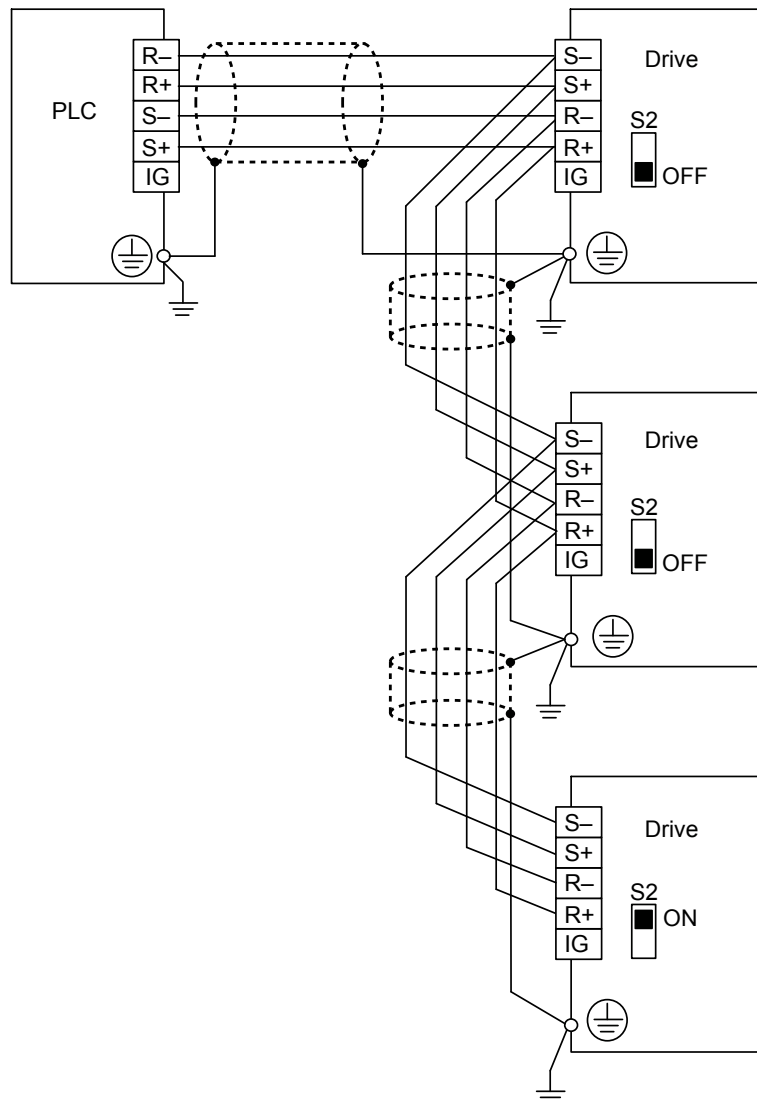


Figure C.4 RS-422 Interface

- Note:**
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
  2. Set H5-07 to 1 when using the RS-422 interface in a multi-drop circuit.  
Set H5-07 to 0 when using the RS-422 interface in a point-to-point circuit.

### ◆ Network Termination

The two ends of the MEMOBUS/Modbus network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S2. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S2 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

## C.4 MEMOBUS/Modbus Setup Parameters

### ◆ MEMOBUS/Modbus Serial Communication

Changes to MEMOBUS/Modbus communications settings become effective after restarting the drive.

#### ■ H5-01: Drive Slave Address

Sets the drive slave address used for communications.

**Note:** Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FF <1>	1F

<1> If the address is set to 0, no response will be provided during communications.

Each slave drive must be assigned a unique slave address for serial communications to work. Setting H5-01 to any value besides 0 assigns the drive its address in the network. Slave addresses do not need to be assigned in sequential order, but no two drives may share the same address.

#### ■ H5-02: Communication Speed Selection

Sets the MEMOBUS/Modbus communications speed.

**Note:** Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	3

**Setting 0: 1200 bps**

**Setting 1: 2400 bps**

**Setting 2: 4800 bps**

**Setting 3: 9600 bps**

**Setting 4: 19200 bps**

**Setting 5: 38400 bps**

**Setting 6: 57600 bps**

**Setting 7: 76800 bps**

**Setting 8: 115200 bps**

#### ■ H5-03: Communication Parity Selection

Sets the parity used for communications.

**Note:** Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

**Setting 0: No parity**

**Setting 1: Even parity**

**Setting 2: Odd parity**

## C.4 MEMOBUS/Modbus Setup Parameters

### ■ H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after CE	0 to 3	3

**Setting 0: Ramp to stop (uses the deceleration time currently enabled)**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop**

**Setting 3: Alarm only (continue operation)**

### ■ H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

**Setting 0: Disabled**

No communication error detection. The drive continues operation.

**Setting 1: Enabled**

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

### ■ H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

**Note:** Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

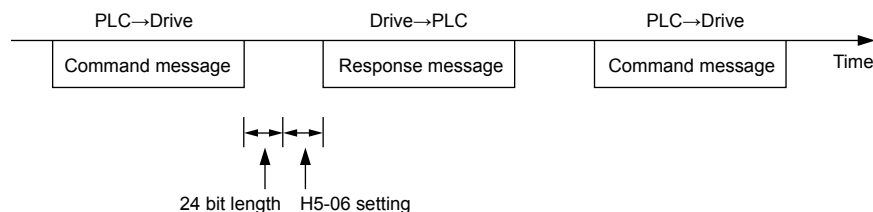


Figure C.5 Drive Transmit Wait Time Setting

### ■ H5-07: RTS Control Selection

Enables or disables RTS control.

**Note:** Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

**Setting 0: Disabled. RTS is always on.**

Use this setting with point-to-point RS-422 communications.

**Setting 1: Enabled. RTS switches while sending.**

Use this setting with RS-485 communications or when using multi-drop RS-422 communications.

### ■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault Detection Time	0.0 to 10.0 s	2.0 s



### ■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

**Setting 0: 0.1 V units**

**Setting 1: 1 V units**

### ■ H5-11: Communications Enter Function Selection

Selects whether an Enter command is necessary to change parameter values via MEMOBUS/Modbus communications. [Refer to Enter Command on page 732.](#)

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

**Setting 0: Parameter changes applied and saved in drive on Enter command input**

Parameter changes are applied on Enter command input and saved in EEPROM in the drive if 0900H in the Enter command is set to 0. Input the Enter command only after completion of all of the parameter changes.

**Setting 1: Parameter changes applied immediately and saved in drive on Enter command input**

Parameter changes are applied as soon as they are made. The parameter changes are saved to EEPROM in the drive when an Enter command with 0900H set to 0 is input.

### ■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to MEMOBUS/Modbus communications (b1-02, b1-16 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

**Setting 0: FWD/Stop, REV/Stop**

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

**Setting 1: Run/Stop, FWD/REV**

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive. Setting bit 1 changes the direction.

### ■ H5-17: Operation Selection when Unable to Write into EEPROM

Selects the operation to be carried out when attempting to write data into EEPROM by MEMOBUS/Modbus communications but writing into EEPROM is not enabled. There is normally no need to change this parameter from the default value.

No.	Name	Setting Range	Default
H5-17	Operation Selection when Unable to Write into EEPROM	0, 1	0

**Setting 0: Cannot write into EEPROM**

**Setting 1: Write in RAM only**

### ■ H5-18: Filter Time Constant for Motor Speed Monitoring

Sets the filter time constant for monitoring the motor speed from MEMOBUS/Modbus communications and communication options. Applicable MEMOBUS/Modbus registers are: 3EH, 3FH, 44H, ACH, and ADH

**Note:** This parameter is not available in models 4A0930 and 4A1200.

No.	Name	Setting Range	Default
H5-18	Filter Time Constant for Motor Speed Monitoring	0 to 100 ms	0 ms

## C.5 Drive Operations by MEMOBUS/Modbus

The drive operations that can be performed by MEMOBUS/Modbus communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

### ◆ Observing the Drive Operation

PLCs can perform the following actions with MEMOBUS/Modbus communications:

- observe drive status and drive control terminal status
- read and write parameters (not H5-□□)
- reset faults
- set multi-function inputs

**Note:** Input settings from the input terminals (S1 to S8) and from MEMOBUS/Modbus communications are both linked by a logical OR operation.

### ◆ Controlling the Drive

Select an external reference and adjust the parameters in [Table C.2](#) accordingly to start and stop the drive or set the frequency reference using MEMOBUS/Modbus communications.

**Table C.2 Setting Parameters for Drive Control from MEMOBUS/Modbus**

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Selection 1	2
	b1-02	Run Command Selection 1	2
External Reference 2	b1-15	Frequency Reference Selection 2	2
	b1-16	Run Command Selection 2	2

*Refer to b1-01: Frequency Reference Selection 1 on page 205 and Refer to b1-02: Run Command Selection 1 on page 206 for details on external reference parameter selections. Refer to Setting 2: External Reference 1/2 Selection on page 300 for instructions on selecting external references 1 and 2.*

## C.6 Communications Timing

To prevent a communications overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

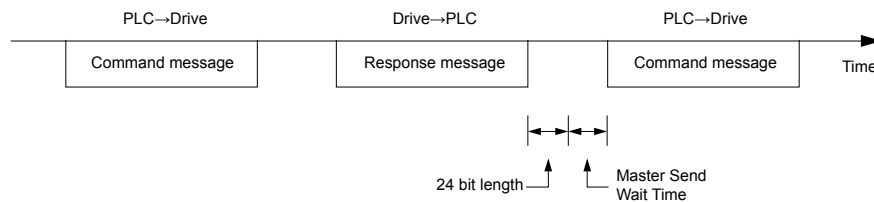
### ◆ Command Messages from Master to Drive

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in [Table C.3](#).

**Table C.3 Minimum Wait Time for Sending Messages**

Command Type	Example	Minimum Wait Time
1	<ul style="list-style-type: none"> <li>Control command (Run, Stop)</li> <li>Set inputs/outputs</li> <li>Read monitors and parameter values</li> </ul>	5 ms <a href="#">&lt;1&gt;</a>
2	Write parameters	H5-06 = 0: 50 ms H5-06 = 1: 200 ms <a href="#">&lt;1&gt;</a>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <a href="#">&lt;1&gt;</a>
4	Enter with storage to drive EEPROM after initialization	5 s

[<1>](#) If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

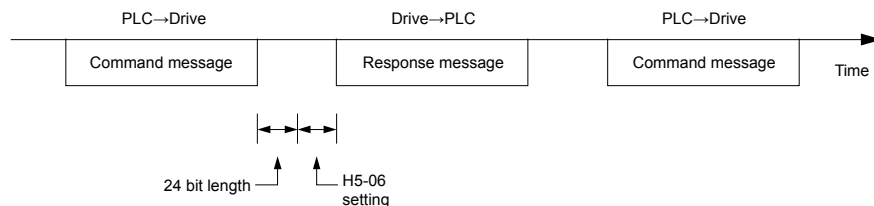


**Figure C.6 Minimum Wait Time for Sending Messages**

Set a timer in the master to check how long it takes for the slave drive(s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

### ◆ Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes overrun in the master.



**Figure C.7 Minimum Response Wait Time**

## C.7 Message Format

### ◆ Message Content

In MEMOBUS/Modbus communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets depends on the command (function) content.

SLAVE ADDRESS
FUNCTION CODE
DATA
ERROR CHECK

### ◆ Slave Address

The slave address in the message defines the node the message is sent to. Use addresses between 0 and FF (hex). If a message with slave address 0 is sent (broadcast), the command from the master will be received by all slaves. The slaves do not provide a response to a broadcast type message.

### ◆ Function Code

The three types of function codes are shown in the table below.

Function Code	Function Name	Data Length (bytes)			
		Command Message		Response Message	
		Minimum	Maximum	Minimum	Maximum
03H	Read MEMOBUS/Modbus registers	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write to multiple MEMOBUS/Modbus registers	11	41	8	8

### ◆ Data

Configure consecutive data by combining the MEMOBUS/Modbus register address (test code in case of a loopback test) and the data the register contains. The data length changes depending on the command details.

A drive MEMOBUS/Modbus register always has a data length of two bytes. Data written into drive registers must also always have a length of two bytes. Register data read out from the drive will always consist of two bytes.

### ◆ Error Check

The drive uses a CRC-16 (cyclic redundancy check, checksum method) for checking data validity. Use the procedure described below when calculating the CRC-16 checksum for command data or when verifying response data.

#### ■ Command Data

When the drive receives data, it calculates the CRC-16 checksum from the data and compares it to the CRC-16 value received within the message. Both must match before a command is processed.

An initial value of FFFFH (i.e., all 16 bits equal 1) must be used for CRC-16 calculations in the MEMOBUS/Modbus protocol.

Calculate the CRC-16 checksum using the following steps:

1. The starting value is FFFFH.
2. Perform an XOR operation of this value and the slave address.
3. Right shift the result.
4. When the overflow bit of the shift operation becomes 1, perform an XOR operation of the result from step 3 above and the fix value A001H.
5. Repeat steps 3 and 4 until eight shift operations have been performed.
6. After eight shift operations, perform an XOR operation with the result and the next data in the message (function code, register address, data). Continue with steps 3 to 5 until the last data has been processed.
7. The result of the last shift or XOR operation is the checksum.

The example in [Table C.4](#) shows the CRC-16 calculation of the slave address 02H and the function code 03H, yielding the result D140H.

**Note:** This example does not show the calculation for a complete MEMOBUS/Modbus command. Normally data would follow in the calculation.

**Table C.4 CRC-16 Checksum Calculation Example**

Description	Calculation	Overflow	Description	Calculation	Overflow
Initial Value (FFFFH)	1111 1111 1111 1111		Function Code 03H	0000 0000 0000 0011	
Address 02H	0000 0000 0000 0010		XOR w result	1000 0001 0011 1101	
XOR w initial value	1111 1111 1111 1101		Shift 1	0100 0000 1001 1110	1
Shift 1	0111 1111 1111 1110	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1110 0000 1001 1111	
XOR result	1101 1111 1111 1111		Shift 2	0111 0000 0100 1111	1
Shift 2	0110 1111 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1101 0000 0100 1110	
XOR result	1100 1111 1111 1110		Shift 3	0110 1000 0010 0111	0
Shift 3	0110 0111 1111 1111	0	Shift 4	0011 0100 0001 0011	1
Shift 4	0011 0011 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1001 0100 0001 0010	
XOR result	1001 0011 1111 1110		Shift 5	0100 1010 0000 1001	0
Shift 5	0100 1001 1111 1111	0	Shift 6	0010 0101 0000 0100	1
Shift 6	0010 0100 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1000 0101 0000 0101	
XOR result	1000 0100 1111 1110		Shift 7	0100 0010 1000 0010	1
Shift 7	0100 0010 0111 1111	0	XOR w A001H	1010 0000 0000 0001	
Shift 8	0010 0001 0011 1111	1	XOR result	1110 0010 1000 0011	
XOR w A001H	1010 0000 0000 0001		Shift 8	0111 0001 0100 0001	1
XOR result	1000 0001 0011 1110		XOR w A001H	1010 0000 0000 0001	
Perform operations with next data (function code)			XOR result	1101 0001 0100 0000	
			CRC-16	1101 0001 0100 0000	
				D 1 4 0 (Lower) (Upper)	
			Continue from here with next data.		

## ■ Response Data

Perform a CRC-16 calculation on the response message data as described above as a validation check. The result should match the CRC-16 checksum received within the response message.

## C.8 Message Examples

Below are some examples of command and response messages.

### ◆ Reading Drive MEMOBUS/Modbus Register Contents

Using the function code 03H (Read), a maximum of 16 MEMOBUS/Modbus registers can be read out at a time.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		02H	Slave Address		02H	Slave Address		02H
Function Code		03H	Function Code		03H	Function Code		83H
Starting No.	Upper	00H	Data Quantity		08H	Error Code		03H
	Lower	20H	1st storage register	Upper	00H	CRC-16	Upper	F1H
Data Quantity	Upper	00H		Lower	65H		Lower	31H
	Lower	04H	Next storage register	Upper	00H			
CRC-16	Upper	45H		Lower	00H			
	Lower	F0H	Next storage register	Upper	00H			
				Lower	00H			
			Next storage register	Upper	01H			
				Lower	F4H			
			CRC-16	Upper	AFH			
				Lower	82H			

### ◆ Loopback Test

Function code 08H performs a loopback test that returns a response message with exactly the same content as the command message. The response message can be used to check communications between the master and slave. User-defined test code and data values can also be set.

The following table shows a message example when performing a loopback test with the slave 1 drive.

Command Message			Response Message		
Slave Address		01H	Slave Address		01H
Function Code		08H	Function Code		08H
Test Code	Upper	00H	Test Code	Upper	00H
	Lower	00H		Lower	00H
Data	Upper	A5H	Data	Upper	A5H
	Lower	37H		Lower	37H
CRC-16	Upper	DAH	CRC-16	Upper	DAH
	Lower	8DH		Lower	8DH

## ◆ Writing to Multiple Registers

Function code 10H allows the user to write multiple drive MEMOBUS/Modbus registers with one message. This process works similar to reading registers, in that the address of the first register to be written and the data quantity are set in the command message. The data to be written must be consecutive so that the register addresses are in order, starting from the specified address in the command message. The data order must be high byte then lower byte.

The following table shows an example of a message where a forward operation has been set with a frequency reference of 60.00 Hz for the slave 1 drive.

If parameter values are changed using the Write command, an Enter command may be necessary to activate or save the data depending on the setting of H5-11. [Refer to H5-11: Communications Enter Function Selection on page 709](#) and [Refer to Enter Command on page 732](#) for detailed descriptions.

Command Message			Response Message (normal)			Response Message (fault)					
Slave Address		01H	Slave Address		01H	Slave Address		01H			
Function Code		10H	Function Code		10H	Function Code		90H			
Starting No.	Upper	00H	Starting No.	Upper	00H	Error Code		02H			
	Lower	01H		Lower	01H	CRC-16	Upper	CDH			
Data Quantity	Upper	00H	Data Quantity	Upper	00H		Lower	C1H			
	Lower	02H		Lower	02H						
Number of Bytes		04H	CRC-16	Upper	10H						
Starting Data	Upper	00H		Lower	08H						
	Lower	01H									
Next Data	Upper	17H									
	Lower	70H									
CRC-16	Upper	63H									
	Lower	39H									

**Note:** Double the number of the data quantity for the number of bytes in the command message.

## C.9 MEMOBUS/Modbus Data Table

The tables below list all MEMOBUS/Modbus data.

The MEMOBUS register hex addresses for parameters are listed beginning on page [559](#).

### ◆ Command Data

It is possible to both read and write command data.

**Note:** Bits that are not used should be set to 0. Refrain from writing to reserved registers.

**Table C.5 Command Register Data**

Register No.	Contents	
0000H	Reserved	
0001H	Operation Commands and Multi-function Inputs	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Forward Run) H5-12 = 1: Run Command (0 = Stop, 1 = Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Reverse Run) H5-12 = 1: Forward/Reverse (0 = Forward, 1 = Reverse)
	bit 2	External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input 1 Function is ComRef when H1-01 = 40 (Forward/Stop). <b>Note:</b> When the bit at ComCtrl is turned on, commands from MEMOBUS/Modbus communications take control of the operation. However, when a communications option card is connected, that option card is given priority.
	bit 5	Multi-Function Input 2 Function is ComCtrl when H1-02 = 41 (Reverse/Stop).
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B	Multi-Function Input 8
	bit C to F	Reserved
0002H	Frequency Reference	Units are determined by parameter o1-03.
0003H	Output voltage gain/ Unit: 0.1% Range: 20 (2.0%) to 2000 (200.0%), Default when power on: 1000 (100.0%)	
0004H	Torque Reference/Torque Limit, 0.1% units, signed (Usable only if Torque Control is enabled)	
0005H	Torque Compensation, 0.1% units, signed (Usable only if Torque Control is enabled)	
0006H	PID Target, 0.01% units, signed	
0007H	Analog Output Terminal FM Setting (10 V / 4000 H)	
0008H	Analog Output Terminal AM Setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Digital Outputs	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 5	Reserved
	bit 6	Enables the function in bit 7
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
000AH	Pulse Output Terminal MP Setting, 1 Hz units, Setting Range: 0 to 32000	
000BH to 000EH	Reserved	



Register No.	Contents
000FH	Control Selection Setting
	bit 0 Reserved
	bit 1 PID Setpoint Input
	bit 2 Torque reference / torque limit input (enables the setting from MEMOBUS/Modbus)
	bit 3 Torque compensation input (enables the setting from MEMOBUS/Modbus)
	bit 4 to B Reserved
	bit C Enable Terminal S5 Input for Broadcast Data
	bit D Enable Terminal S6 Input for Broadcast Data
	bit E Enable Terminal S7 Input for Broadcast Data
	bit F Enable Terminal S8 Input for Broadcast Data
0010H to 001AH	Reserved
001BH	Analog Monitor Option AO-A3 Analog Output 1 (10 V/4000 H)
001CH	Analog Monitor Option AO-A3 Analog Output 2 (10 V/4000 H)
001DH	Digital Output Option DO-A3 Output (Binary)
001EH to 001FH	Reserved

## ◆ Monitor Data

Monitor data can be read only.

Register No.	Contents
0020H	Drive Status 1
	bit 0 During Run
	bit 1 During Reverse
	bit 2 Drive Ready
	bit 3 Fault
	bit 4 Data Setting Error
	bit 5 Multi-Function Contact Output 1 (terminal M1-M2)
	bit 6 Multi-Function Contact Output 2 (terminal M3-M4)
	bit 7 Multi-Function Contact Output 3 (terminal M5-M6)
	bit 8 to bit D Reserved
	bit E When ComRef has been enabled
	bit F When ComCtrl has been enabled
0021H	Fault Contents 1
	bit 0 Overcurrent (oC), Ground fault (GF)
	bit 1 Drive Overheat Warning (ov)
	bit 2 Drive Overload (oL2)
	bit 3 Overheat 1 (oH1), Drive Overheat Warning (oH2)
	bit 4 Dynamic Braking Transistor Fault (rr), Braking Resistor Overheat (rH)
	bit 5 Reserved
	bit 6 PID Feedback Loss (FbL / FbH)
	bit 7 EF to EF8: External Fault
	bit 8 CPF□□: Hardware Fault (includes oFx)
	bit 9 Motor Overload (oL1), Overtorque Detection 1/2 (oL3/oL4), Undertorque Detection 1/2 (UL3/UL4)
	bit A PG Disconnected (PGo), PG Hardware Fault (PGoH), Overspeed (oS), Speed Deviation (dEv)
	bit B Main Circuit Undervoltage (Uv)
	bit C DC Bus Undervoltage (Uv1), Control Power Supply Voltage Fault (Uv2), Undervoltage 3 (Uv3)
	bit D Output Phase Loss (LF), Input Phase Loss (PF)
	bit E MEMOBUS/Modbus Communication Error (CE), Option Communication Error (bUS)
	bit F External Digital Operator Connection Fault (oPr)

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
0022H	Data Link Status	
	bit 0	Writing data or switching motors
	bit 1	Reserved
	bit 2	
	bit 3	Upper or lower limit error
	bit 4	Data conformity error
	bit 5	Writing to EEPROM
	bit 6	0: Write into EEPROM. 1: Write in RAM only. <b>Note:</b> Enabled only when H5-17 = 1.
	bit 7 to bit F	Reserved
0023H	Frequency Reference </>	
0024H	Output Frequency </>	
0025H	Output Voltage Reference, 0.1 V units (units are determined by parameter H5-10)	
0026H	Output Current <b>Note:</b> Display is in the following units: 2A0004 to 2A0040 and 4A0002 to 4A0023: 0.01 A 2A0056 to 2A0415 and 4A0031 to 4A0675: 0.1 A 4A0930 and 4A1200: 1 A	
0027H	Output Power	
0028H	Torque Reference	
0029H	Fault Contents 2	
	bit 0	Output Short Circuit or IGBT Fault (SC)
	bit 1	Ground Fault (GF)
	bit 2	Input Phase Loss (PF)
	bit 3	Output Phase Loss (LF)
	bit 4	Braking Resistor Overheat (rH)
	bit 5	Reserved
	bit 6	Motor Overheat 2 (PTC input) (oH4)
	bit 7 to bit F	Reserved
002AH	Alarm Contents 1	
	bit 0, 1	Reserved
	bit 2	Forward/Reverse Run Command Input Error (EF)
	bit 3	Drive Baseblock (bb)
	bit 4	Overtorque Detection 1 (oL3)
	bit 5	Heatsink Overheat (oH)
	bit 6	Drive Overheat Warning (ov)
	bit 7	Undervoltage (Uv)
	bit 8	Internal Fan Fault (FAn)
	bit 9	MEMOBUS/Modbus Communication Error (CE)
	bit A	Option Communication Error (bUS)
	bit B	Undertorque Detection 1/2 (UL3/UL4)
	bit C	Motor Overheat (oH3)
	bit D	PID Feedback Loss (FbL, FbH)
	bit E	Reserved
	bit F	Serial Communication Transmission Error (CALL)

Register No.	Contents	
002BH	Input Terminal Status	
	bit 0	Terminal S1 Closed
	bit 1	Terminal S2 Closed
	bit 2	Terminal S3 Closed
	bit 3	Terminal S4 Closed
	bit 4	Terminal S5 Closed
	bit 5	Terminal S6 Closed
	bit 6	Terminal S7 Closed
	bit 7	Terminal S8 Closed
	bit 8 to bit F	Reserved
002CH	Drive Status 2	
	bit 0	During Run
	bit 1	Zero Speed
	bit 2	Speed Agree
	bit 3	User Speed Agree
	bit 4	Frequency Detection 1
	bit 5	Frequency Detection 2
	bit 6	Drive Ready
	bit 7	During Undervoltage
	bit 8	During Baseblock
	bit 9	Frequency Reference from Operator Keypad
	bit A	Run Command from Operator Keypad
	bit B	Over/Undertorque Detection 1, 2
	bit C	Frequency Reference Loss
	bit D	During Fault Restart
	bit E	Fault
	bit F	Communication Timeout
002DH	Output Terminal Status	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 6	Reserved
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
002EH	Reserved	
002FH	Frequency Reference Bias (from Up/Down 2 Function), 0.1% units	
0030H	Reserved	
0031H	DC Bus Voltage, 1 Vdc units	
0032H	Torque Reference (U1-09), 1% units	
0033H	Reserved	
0034H	Product Code 1 [ASCII], Product Type (A0 for A1000)	
0035H	Product Code 2 [ASCII], Region Code	
0036H, 0037H	Reserved	
0038H	PID Feedback, 0.1% units, unsigned, 100% / max. output frequency	
0039H	PID Input, 0.1% units, signed, 100% / max. output frequency	
003AH	PID Output, 0.1% units, signed, 100% / max. output frequency	
003BH, 003CH	Reserved	

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
003DH	Communications Error Contents <3>	
	bit 0	CRC Error
	bit 1	Data Length Error
	bit 2	Reserved
	bit 3	Parity Error
	bit 4	Overflow Error
	bit 5	Framing Error
	bit 6	Timeout
	bit 7 to bit F	Reserved
003EH	Output Frequency	r/min <4>
003FH		0.01% units
0040H to 004AH	Used for various monitors U1-□□. <i>Refer to U: Monitors on page 646</i> for parameter details.	
004BH	Drive status (U1-12)	
	bit 0	During Run
	bit 1	During Zero Speed
	bit 2	During Reverse Run
	bit 3	During Fault Reset Signal Input
	bit 4	During Speed Agree
	bit 5	Drive Ready
	bit 6	Alarm
	bit 7	Fault
	bit 8	During Operation Error (oPE□□)
	bit 9	During Momentary Power Loss
	bit A	Motor 2 selected
	bit B	Reserved
	bit E	ComRef status, NetRef status
	bit F	ComCtrl status, NetCtrl status
004CH to 007EH	Used for monitors U1-□□, U4-□□, U5-□□ and U6-□□. <i>Refer to U2: Fault Trace on page 649</i> and <i>Refer to U3: Fault History on page 650</i> for parameter details.	
007FH	Minor Fault Code, <i>Refer to Alarm Register Contents on page 731</i> for Minor Fault codes.	
0080H to 0097H	Used for monitors U2-□□, U3-□□. <i>Refer to U: Monitors on page 646</i> for parameter details and <i>Refer to Fault Trace Contents on page 729</i> for register value descriptions.	
0098H, 0099H	U4-01 (Cumulative Operation Time) Example: When U4-01 (Cumulative Operation Time) is 12345 hours, then 0098H = 1234 and 0099H = 5.	
009AH, 009BH	U4-03 (Cooling Fan Operation Time) Example: When U4-03 (Cooling Fan Operation Time) is 12345 hours, then 009AH = 1234 and 009BH = 5.	
009CH to 00AAH	Reserved	
00ABH	Drive Rated Current <2>	
00ACH	Motor Speed (U1-05)	r/min units <4>
00ADH		0.01% units
00AEH, 00AFH	Reserved	

Register No.	Contents	
00B0H	Option Code Connected to CN5-A	Register contains ASCII code of the option card. AI-A3 = 0003H AO-A3 = 0004H DI-A3 = 0001H DO-A3 = 0002H PG-B3 = 0011H PG-RT3 = 0023H PG-X3 = 0012H SI-B3 = 1002H SI-C3 = 5343H SI-EM3 = 1005H SI-EN3 = 1006H SI-ES3 = 1001H SI-ET3 = 1004H SI-N3 = 534EH SI-P3 = 5350H SI-S3 = 5353H SI-T3 = 5354H SI-W3 = 1003H
00B1H	Reserved	
00B2H	Option Code Connected to CN5-B	
00B3H	Option Code Connected to CN5-C	
00B4H	Reserved	
00B5H	Frequency Reference After Soft-starter (U1-16)	r/min units <4>
00B6H		0.01% units
00B7H	Frequency Reference	r/min <4>
00B8H		0.01% units
00B9H to 00BEH	Reserved	
00BFH	Lists the last two digits of operation error code oPE□□.	
00C0H	Fault Contents 3	
	bit 1	DC Bus Undervoltage (Uv1)
	bit 2	Control Power Supply Undervoltage (Uv2)
	bit 3	Undervoltage 3 (Soft-Charge Bypass Circuit Fault) (Uv3)
	bit 4	Output Short-Circuit or IGBT Fault (SC)
	bit 5	Ground Fault (GF)
	bit 6	Overcurrent (oC)
	bit 7	Drive Overheat Warning (ov)
	bit 8	Heatsink Overheat (oH)
	bit 9	Overheat 1 (oH1)
	bit A	Motor Overload (oL1)
	bit B	Drive Overload (oL2)
	bit C	Overtorque Detection 1 (oL3)
	bit D	Overtorque Detection 2 (oL4)
	bit E	Dynamic Braking Transistor Fault (rr)
	bit F	Braking Resistor Overheat (rH)

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00C1H	Fault Contents 4	
	bit 0	External Fault at input terminal S3 (EF3)
	bit 1	External Fault at input terminal S4 (EF4)
	bit 2	External Fault at input terminal S5 (EF5)
	bit 3	External Fault at input terminal S6 (EF6)
	bit 4	External Fault at input terminal S7 (EF7)
	bit 5	External Fault at input terminal S8 (EF8)
	bit 6	Internal Fan Fault (FAn)
	bit 7	Overspeed (os)
	bit 8	Excessive Speed Deviation (dEv)
	bit 9	PG Disconnected (PGo)
	bit A	Input Phase Loss (PF)
	bit B	Output Phase Loss (LF)
	bit C	Motor Overheat (PTC input) (oH3)
	bit D	External Digital Operator Connection Fault (oPr)
	bit E	EEPROM Write Error (Err)
	bit F	Motor Overheat Fault (PTC input) (oH4)
00C2H	Fault Contents 5	
	bit 0	MEMOBUS/Modbus Communication Error (CE)
	bit 1	Option Communication Error (bUS)
	bit 2, 3	Reserved
	bit 4	Control Fault (CF)
	bit 5	Zero Servo Fault (SvE)
	bit 6	Option External Fault (EF0)
	bit 7	PID Feedback Loss (FbL)
	bit 8	Undertorque Detection 1 (UL3)
	bit 9	Undertorque Detection 2 (UL4)
	bit A	High Slip Braking Overload (oL7)
	bit B to E	Reserved
	bit F	Hardware Fault (includes oFx)
00C3H	Fault Contents 6	
	bit 0	Reserved
	bit 1	Z Pulse Fault (dv1)
	bit 2	Z Pulse Noise Fault Detection (dv2)
	bit 3	Inversion Detection (dv3)
	bit 4	Inversion Prevention Detection (dv4)
	bit 5	Output Current Imbalance (LF2)
	bit 6	Pullout Detection (STo)
	bit 7	PG Hardware Fault (PGoH)
	bit 8	MECHATROLINK Watchdog Timer Error (E5)
	bit 9	Reserved
	bit A	Too many speed search restarts (SEr)
	bit B to F	Reserved

Register No.	Contents	
00C4H	Fault Contents 7	
	bit 0	PID Feedback Loss (FbH)
	bit 1	External Fault 1, input terminal S1 (EF1)
	bit 2	External Fault 2, input terminal S2 (EF2)
	bit 3	Mechanical Weakening Detection 1 (oL5)
	bit 4	Mechanical Weakening Detection 2 (UL5)
	bit 5	Current Offset Fault (CoF)
	bit 6, 7	Reserved
	bit 8	DriveWorksEZ Fault (dWFL)
	bit 9	EEPROM Memory DriveWorksEZ Data Error (dWF1)
	bit A to B	Reserved
	bit C	Output Voltage Detection Fault (voF)
	bit D	Braking Resistor Fault (rF)
	bit E	Braking Transistor Overload Fault (boL)
	bit F	Motor Overheat (NTC Input) (oH5)
00C5H	Fault Contents 8	
	bit 0	LSO Fault (LSO)
	bit 1	Node Setup Fault (nSE)
	bit 2	Thermistor Disconnect (THo)
	bit 3 to 9	Reserved
	bit A	Initial Polarity Estimation Timeout (dv7)
	bit B to D	Reserved
	bit E	Power Unit Output Phase Loss 3 (LF3)
	bit F	Current Unbalance (UnbC)
00C6H	Fault Contents 9	
	bit 0	Gate Drive Board Undervoltage (Uv4)
	bit 1 to F	Reserved
00C7H	Reserved	
00C8H	Alarm Contents 2	
	bit 0	Undervoltage (Uv)
	bit 1	Drive Overheat Warning (ov)
	bit 2	Heatsink Overheat (oH)
	bit 3	Drive Overheat Warning (oH2)
	bit 4	Overtorque 1 (oL3)
	bit 5	Overtorque 2 (oL4)
	bit 6	Forward/Reverse Run Command Input Errorr (EF)
	bit 7	Drive Baseblock (bb)
	bit 8	External Fault 3, input terminal S3 (EF3)
	bit 9	External Fault 4, input terminal S4 (EF4)
	bit A	External Fault 5, input terminal S5 (EF5)
	bit B	External Fault 6, input terminal S6 (EF6)
	bit C	External Fault 7, input terminal S7 (EF7)
	bit D	External Fault 8, input terminal S8 (EF8)
	bit E	Internal Fan Fault (FAn)
	bit F	Overspeed (oS)

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00C9H	Alarm Contents 3	
	bit 0	Speed Deviation (dEv)
	bit 1	PG Disconnected (PGo)
	bit 2	External Digital Operator Connection Fault (oPr)
	bit 3	MEMOBUS/Modbus Communication Error (CE)
	bit 4	Option Communication Error (bUS)
	bit 5	Serial Communication Transmission Error (CALL)
	bit 6	Motor Overload (oL1)
	bit 7	Drive Overload (oL2)
	bit 8	Reserved
	bit 9	Option Card External fault (EF0)
	bit A	Motor 2 Switch command input during run (rUn)
	bit B	Reserved
	bit C	Serial Communication Transmission Error (CALL)
	bit D	Undertorque Detection 1 (UL3)
	bit E	Undertorque Detection 2 (UL4)
	bit F	MEMOBUS/Modbus Communication Test Mode Error (SE)
00CAH	Alarm Contents 4	
	bit 0	Reserved
	bit 1	Motor Overheat 1 (PTC Input) (oH3)
	bit 2 to 5	Reserved
	bit 6	PID Feedback Loss (FbL)
	bit 7	PID Feedback Loss (FbH)
	bit 9	Drive Disabled (dnE)
	bit A	PG Disconnected (PGo)
	bit B to F	Reserved
00CBH	Alarm Contents 5	
	bit 0	MECHATROLINK Watchdog Timer Error (E5)
	bit 1	Station Address Setting Error (AEr)
	bit 2	MECHATROLINK Comm. Cycle Setting Error (CyC)
	bit 3	High Current Alarm (HCA)
	bit 4	Cooling Fan Maintenance Time (LT-1)
	bit 5	Soft Charge Bypass Relay Maintenance Time (LT-2)
	bit 6	Reserved
	bit 7	SI-S EEPROM Error (EEP)
	bit 8	External Fault 1 (input terminal S1) (EF1)
	bit 9	External Fault 2 (input terminal S2) (EF2)
	bit A	Safe Disable Input (HbbF)
	bit B	Safe Disable Input (Hbb)
	bit C	Mechanical Weakening Detection 1 (oL5)
	bit D	Mechanical Weakening Detection 2 (UL5)
	bit E, F	Reserved



Register No.	Contents	
00CCH	Alarm Contents 6	
	bit 0	Output Voltage Detection Fault (VoF)
	bit 1	IGBT Maintenance Time (90%) (TrPC)
	bit 2	Capacitor Maintenance Time (LT-3)
	bit 3	IGBT Maintenance Time (50%) (LT-4)
	bit 4	Braking Transistor Overload Fault (boL)
	bit 5 to 6	Reserved
	bit 7	Motor Overheat (NTC Input) (oH5)
	bit 8	DriveWorksEZ Fault (dWAL)
	bit 9 to B	Reserved
	bit C	Thermistor Disconnect (THo)
	bit D to F	Reserved
00CDH to 00CFH	Reserved	
00D0H	CPF Contents 1	
	bit 0, 1	Reserved
	bit 2	A/D Conversion Error (CPF02)
	bit 3	PWM Data Fault (CPF03)
	bit 4, 5	Reserved
	bit 6	EEPROM Memory Data Error (CPF06)
	bit 7	Terminal Board Connection Error (CPF07)
	bit 8	EEPROM Serial Communications Fault (CPF08)
	bit 9, A	Reserved
	bit B	RAM Fault (CPF11)
	bit C	FLASH Memory Fault (CPF12)
	bit D	Watchdog Circuit Exception (CPF13)
	bit E	Control Circuit Fault (CPF14)
	bit F	Reserved
00D1H	CPF Contents 2	
	bit 0	Clock Fault (CPF16)
	bit 1	Timing Fault (CPF17)
	bit 2	Control Circuit Fault (CPF18)
	bit 3	Control Circuit Fault (CPF19)
	bit 4	Hardware fault at power up (CPF20)
	bit 5	Hardware fault at communication start up (CPF21)
	bit 6	A/D Conversion Fault (CPF22)
	bit 7	PWM Feedback Fault (CPF23)
	bit 8	Drive Unit Signal Fault (CPF24)
	bit 9	Terminal board is not properly connected. (CPF25)
	bit A	ASIC BB Circuit Error (CPF26)
	bit B	ASIC PWM Setting Register Error (CPF27)
	bit C	ASIC PWM Pattern Error (CPF28)
	bit D	ASIC On-delay Error (CPF29)
	bit E	ASIC BBON Error (CPF30)
	bit F	ASIC Code Error (CPF31)

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00D2H	CPF Contents 3	
	bit 0	ASIC Start-up Error (CPF32)
	bit 1	Watch-dog Error (CPF33)
	bit 2	ASIC Power/Clock Error (CPF34)
	bit 3	External A/D Converter Error (CPF35)
	bit 4 to 7	Reserved
	bit 8	Control Circuit Error (CPF40)
	bit 9	Control Circuit Error (CPF41)
	bit A	Control Circuit Error (CPF42)
	bit B	Control Circuit Error (CPF43)
	bit C	Control Circuit Error (CPF44)
	bit D	Control Circuit Error (CPF45)
	bit E, F	Reserved
00D3H to 00D7H	Reserved	
00D8H	oFA0□ Contents (CN5-A)	
	bit 0	Option Compatibility Error (oFA00)
	bit 1	Option not properly connected (oFA01)
	bit 2 to 4	Reserved
	bit 5	A/D Conversion Error (oFA05)
	bit 6	Option Response Error (oFA06)
	bit 7 to F	Reserved
00D9H	oFA1□ Contents (CN5-A)	
	bit 0	Option RAM Fault (oFA10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFA11)
	bit 2	Drive Receive CRC Error (oFA12)
	bit 3	Drive Receive Frame Error (oFA13)
	bit 4	Drive Receive Abort Error (oFA14)
	bit 5	Option Receive CRC Error (oFA15)
	bit 6	Option Receive Frame Error (oFA16)
	bit 7	Option Receive Abort Error (oFA17)
	bit 8 to F	Reserved
00DAH to 00DBH	Reserved	
00DBH	oFA3□ Contents (CN5-A)	
	bit 0	Comm. ID Error (oFA30)
	bit 1	Model Code Error (oFA31)
	bit 2	Sumcheck Error (oFA32)
	bit 3	Comm. option timeout waiting for response (oFA33)
	bit 4	MEMOBUS Timeout (oFA34)
	bit 5	Drive timeout waiting for response (oFA35)
	bit 6	CI Check Error (oFA36)
	bit 7	Drive timeout waiting for response (oFA37)
	bit 8	Control Command Selection Error (oFA38)
	bit 9	Drive timeout waiting for response (oFA39)
	bit A	Control Response Selection 1 Error (oFA40)
	bit B	Drive timeout waiting for response (oFA41)
	bit C	Control Response Selection 2 Error (oFA42)
	bit D	Drive timeout waiting for response (oFA43)
	bit E, F	Reserved

Register No.	Contents	
00DCH	oFb0□ Contents (CN5-B)	
	bit 0	Option compatibility error (oFb00)
	bit 1	Option not properly connected (oFb01)
	bit 2	Same type of option card already connected (oFb02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFb05)
	bit 6	Option Response Error (oFb06)
	bit 7 to F	Reserved
00DDH	oFb1□ Contents (CN5-B)	
	bit 0	Option RAM Fault (oFb10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFb11)
	bit 2	Drive Receive CRC Error (oFb12)
	bit 3	Drive Receive Frame Error (oFb13)
	bit 4	Drive Receive Abort Error (oFb14)
	bit 5	Option Receive CRC Error (oFb15)
	bit 6	Option Receive Frame Error (oFb16)
	bit 7	Option Receive Abort Error (oFb17)
	bit 8 to F	Reserved
00DEH to 00DFH	Reserved	
00E0H	oFb3□ Contents (CN5-B)	
	bit 0	Comm. ID Error (oFb30)
	bit 1	Model Code Error (oFb31)
	bit 2	Sumcheck Error (oFb32)
	bit 3	Comm. option timeout waiting for response (oFb33)
	bit 4	MEMOBUS Timeout (oFb34)
	bit 5	Drive timeout waiting for response (oFb35)
	bit 6	CI Check Error (oFb36)
	bit 7	Drive timeout waiting for response (oFb37)
	bit 8	Control Command Selection Error (oFb38)
	bit 9	Drive timeout waiting for response (oFb39)
	bit A	Control Response Selection 1 Error (oFb40)
	bit B	Drive timeout waiting for response (oFb41)
	bit C	Control Response Selection 2 Error (oFb42)
	bit D	Drive timeout waiting for response (oFb43)
	bit E, F	Reserved
00E1H	oFC0□ Contents (CN5-C)	
	bit 0	Option compatibility error (oFC00)
	bit 1	Option not properly connected (oFC01)
	bit 2	Same type of option card already connected (oFC02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFC05)
	bit 6	Option Response Error (oFC06)
	bit 7 to F	Reserved

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00E2H	oFC1□ Contents (CN5-C)	
	bit 0	Option RAM Fault (oFC10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFC11)
	bit 2	Drive Receive CRC Error (oFC12)
	bit 3	Drive Receive Frame Error (oFC13)
	bit 4	Drive Receive Abort Error (oFC14)
	bit 5	Option Receive CRC Error (oFC15)
	bit 6	Option Receive Frame Error (oFC16)
	bit 7	Option Receive Abort Error (oFC17)
	bit 8 to F	Reserved
00E3H	Reserved	
00E4H	oFC5□ Contents (CN5-C)	
	bit 0	Encoder Option AD Conversion Error (oFC50)
	bit 1	Encoder Option Analog Circuit Error (oFC51 )
	bit 2	Encoder Communication Timeout (oFC52 )
	bit 3	Encoder Communication Data Error (oFC53)
	bit 4	Encoder Error (oFC54)
	bit 5	Resolver Error (oFC55)
	bit 6 to F	Reserved
00E5H to 00FAH	Reserved	
00FBH	Output Current	
00FFH	Reserved	

<1> Parameter o1-03, Digital Operator Display Selection, determines the units.

<2> Display is in the following units:

2A0004 to 2A0040, 4A0002 to 4A0023, and 5A0007 to 5A0017: 0.01 A units.

2A0056 to 2A0415, 4A0031 to 4A0675, and 5A0022 to 5A0242: 0.1 A units.

4A0930 and 4A1200: 1 A units.

<3> Communication error contents are saved until the fault is reset.

<4> Set the number of motor poles to parameter E2-04, E4-04, or E5-04 depending on the motor being used.

### ◆ Broadcast Messages

Data can be written from the master to all slave devices at the same time.

The slave address in a broadcast command message must be set to 00H. All slaves will receive the message, but will not respond.

Register No.	Contents	
0001H	Digital Input Command	
	bit 0	Forward Run (0: Stop 1: Run)
	bit 1	Direction Command (0: Forward, 1: Reverse)
	bit 2, 3	Reserved
	bit 4	External Fault
	bit 5	Fault Reset
	bit 6 to B	Reserved
	bit C	Multi-Function Digital Input S5
	bit D	Multi-Function Digital Input S6
	bit E	Multi-Function Digital Input S7
	bit F	Multi-Function Digital Input S8
0002H	Frequency Reference	30000/100%

## ◆ Fault Trace Contents

The table below shows the fault codes that can be read out by MEMOBUS/Modbus commands from the U2-□□ monitor parameters.

**Table C.6 Fault Trace / History Register Contents**

Fault Code	Fault Name	Fault Code	Fault Name
0002H	DC Bus Undervoltage (Uv1)	0036H	Output Current Imbalance (LF2)
0003H	Control Power Supply Voltage Fault (Uv2)	0037H	Pullout Detection (Sto)
0004H	Undervoltage 3 (Uv3)	0038H	PG Hardware Fault (PGoH)
0005H </>	Output Short-Circuit or IGBT Fault (SC)	0039H	MECHATROLINK Watchdog Timer Error (E5)
0006H	Ground Fault (GF)	003BH	Too Many Speed Search Restarts (SEr)
0007H	Overcurrent (oC)	0041H	PID Feedback Loss (FbH)
0008H	Drive Overheat Warning (ov)	0042H	External Fault 1, Input Terminal S1 (EF1)
0009H	Heatsink Overheat (oH)	0043H	External Fault 2, Input Terminal S2 (EF2)
000AH	Overheat 1 (oH1)	0044H	Mechanical Weakening Detection 1 (oL5)
000BH	Motor Overload (oL1)	0045H	Mechanical Weakening Detection 2 (UL5)
000CH	Drive Overload (oL2)	0046H	Current Offset Fault (CoF)
000DH	Overtorque Detection 1 (oL3)	0047H	PLC Detection Error 1 (PE1)
000EH	Overtorque Detection 2 (oL4)	0048H	PLC Detection Error 2 (PE2)
000FH	Dynamic Braking Transistor (rr)	0049H	DriveWorksEZ Fault (dWFL)
0010H	Braking Resistor Overheat (rH)	004AH </>	EEPROM Memory DriveWorksEZ Data Error (dWF1)
0011H	External Fault at Input Terminal S3 (EF3)	004DH	Output Voltage Detection Fault (voF)
0012H	External Fault at Input Terminal S4 (EF4)	004EH	Braking Resistor Transistor Fault (rF)
0013H	External Fault at Input Terminal S5 (EF5)	004FH	Braking Transistor Overload Fault (boL)
0014H	External Fault at Input Terminal S6 (EF6)	0050H	Motor Overheat (NTC Input) (oH5)
0015H	External Fault at Input Terminal S7 (EF7)	0051H	LSO Fault (LSO)
0016H	External Fault at Input Terminal S8 (EF8)	0052H	Node Setup Fault (nSE)
0017H	Internal Fan Fault (FAn)	0053H	Thermistor Disconnect (THo)
0018H	Overspeed (oS)	005BH </>	Initial Polarity Estimation Timeout (dv7)
0019H	Speed Deviation (dEv)	005FH	Power Unit Output Phase Loss 3 (LF3)
001AH	PG Disconnect (PGo)	0060H	Current Unbalance (UnbC)
001BH	Input Phase Loss (PF)	0061H	Power Supply Module Undervoltage (Uv4)
001CH	Output Phase Loss (LF)	0083H	A/D Conversion Error (CPF02)
001DH	Motor Overheat (PTC input) (oH3)	0084H	PWM Data Fault (CPF03)
001EH	Digital Operator Connection (oPr)	0087H	EEPROM Memory Data Error (CPF06)
001FH	EEPROM Write Error (Err)	0088H	Terminal Board Connection Error (CPF07)
0020H	Motor Overheat (PTC input) (oH4)	0089H	EEPROM Serial Communication Fault (CPF08)
0021H	MEMOBUS/Modbus Communication Error (CE)	008CH	RAM Fault (CPF11)
0022H	Option Communication Error (bUS)	008DH	Flash Memory Circuit Exception (CPF12)
0025H	Control Fault (CF)	008EH	Watchdog Circuit Exception (CPF13)
0026H	Zero-Servo Fault (SvE)	008FH	Control Circuit Fault (CPF14)
0027H	Option External Fault (EF0)	0091H	Clock Fault (CPF16)
0028H	PID Feedback Loss (FbL)	0092H	Timing Fault (CPF17)
0029H	Undertorque Detection 1 (UL3)	0093H	Control Circuit Fault (CPF18)
002AH	Undertorque Detection 2 (UL4)	0094H	Control Circuit Fault (CPF19)
002BH	High Slip Braking Overload (oL7)	0095H	Hardware Fault at Power Up (CPF20)
0030H	Hardware Fault (including oFx)	0096H	Hardware Fault at Communication Start Up (CPF21)
0032H	Z Pulse Fault (dv1)	0097H	A/D Conversion Fault (CPF22)
0033H	Z Pulse Noise Fault Detection (dv2)	0098H	PWM Feedback Fault (CPF23)
0034H	Inversion Detection (dv3)	0099H	Drive Unit Signal Fault (CPF24)
0035H	Inversion Prevention Detection (dv4)	009AH	Terminal Board is Not Properly Connected. (CPF25)

## C.9 MEMOBUS/Modbus Data Table

Fault Code	Fault Name	Fault Code	Fault Name
009BH	ASIC BB Circuit Error (CPF26)	0206H	A/D Conversion Error (oFb05)
009CH	ASIC PWM Setting Register Error (CPF27)	0207H	Option Response Error (oFb06)
009DH	ASIC PWM Pattern Error (CPF28)	0211H	Option RAM Fault (oFb10)
009EH	ASIC On-delay Error (CPF29)	0212H	Option Operation Mode Fault (SLMOD) (oFb11)
009FH	ASIC BBON Error (CPF30)	0213H	Drive Receive CRC Error (oFb12)
00A0H	ASIC Code Error (CPF31)	0214H	Drive Receive Frame Error (oFb13)
00A1H	ASIC Start-up Error (CPF32)	0215H	Drive Receive Abort Error (oFb14)
00A2H	Watch-dog Error (CPF33)	0216H	Option Receive CRC Error (oFb15)
00A3H	ASIC Power/Clock Error (CPF34)	0217H	Option Receive Frame Error (oFb16)
00A4H	External A/D Converter Error (CPF35)	0218H	Option Receive Abort Error (oFb17)
00A9H	Control Circuit Error (CPF40)	0231H	Comm. ID Error (oFb30)
00AAH	Control Circuit Error (CPF41)	0232H	Model Code Error (oFb31)
00ABH	Control Circuit Error (CPF42)	0233H	Sumcheck Error (oFb32)
00ACH	Control Circuit Error (CPF43)	0234H	Comm. option Timeout Waiting for Response (oFb33)
00ADH	Control Circuit Error (CPF44)	0235H	MEMOBUS Timeout (oFb34)
00AEH	Control Circuit Error (CPF45)	0236H	Drive Timeout Waiting for Response (oFb35)
0101H	Option Compatibility Error (oFA00)	0237H	CI Check Error (oFb36)
0102H	Option Not Properly Connected (oFA01)	0238H	Drive Timeout Waiting for Response (oFb37)
0106H	A/D Conversion Error (oFA05)	0239H	Control Command Selection Error (oFb38)
0107H	Option Response Error (oFA06)	023AH	Drive Timeout Waiting for Response (oFb39)
0111H	Option RAM Fault (oFA10)	023BH	Control Response Selection 1 Error (oFb40)
0112H	Option Operation Mode Fault (SLMOD) (oFA11)	023CH	Drive Timeout Waiting for Response (oFb41)
0113H	Drive Receive CRC Error (oFA12)	023DH	Control Response Selection 2 Error (oFb42)
0114H	Drive Receive Frame Error (oFA13)	023EH	Drive Timeout Waiting for Response (oFb43)
0115H	Drive Receive Abort Error (oFA14)	0301H	Option Compatibility Error (oFC00)
0116H	Option Receive CRC Error (oFA15)	0303H	Option Not Properly Connected (oFC01)
0117H	Option Receive Frame Error (oFA16)	0304H	Same Type of Option Card Already Connected (oFC02)
0118H	Option Receive Abort Error (oFA17)	0306H	A/D Conversion Error (oFC05)
0131H	Comm. ID Error (oFA30)	0307H	Option Response Error (oFC06)
0132H	Model Code Error (oFA31)	0311H	Option RAM Fault (oFC10)
0133H	Sumcheck Error (oFA32)	0312H	Option Operation Mode Fault (SLMOD) (oFC11)
0134H	Comm. Option Timeout Waiting for Response (oFA33)	0313H	Drive Receive CRC Error (oFC12)
0135H	MEMOBUS Timeout (oFA34)	0314H	Drive Receive Frame Error (oFC13)
0136H	Drive Timeout Waiting for Response (oFA35)	0315H	Drive Receive Abort Error (oFC14)
0137H	CI Check Error (oFA36)	0316H	Option Receive CRC Error (oFC15)
0138H	Drive Timeout Waiting for Response (oFA37)	0317H	Option Receive Frame Error (oFC16)
0139H	Control Command Selection Error (oFA38)	0318H	Option Receive Abort Error (oFC17)
013AH	Drive Timeout Waiting for Response (oFA39)	0351H	Encoder Option AD Conversion Error (oFC50)
013BH	Control Response Selection 1 Error (oFA40)	0352H	Encoder Option Analog Circuit Error (oFC51)
013CH	Drive Timeout Waiting for Response (oFA41)	0353H	Encoder Communication Timeout (oFC52)
013DH	Control Response Selection 2 Error (oFA42)	0354H	Encoder Communication Data Error (oFC53)
013EH	Drive Timeout Waiting for Response (oFA43)	0355H	Encoder Error (oFC54)
0201H	Option Compatibility Error (oFb00)	0356H	Resolver Error (oFC55)
0202H	Option Connection Error (oFb01)		
0203H	Same Type of Option Card Already Connected (oFb02)		

<1> Available in drive software versions PRG: 1015 and later.

<2> Available in drive software versions PRG: 1018 and later.

## ◆ Alarm Register Contents

The table below shows the alarm codes that can be read out from MEMOBUS/Modbus register 007FH.

**Table C.7 Alarm Register 007FH Contents**

Fault Code	Fault Name	Fault Code	Fault Name
0001H	Undervoltage (Uv)	0022H	Motor Overheat (oH3)
0002H	Drive Overheat Warning (ov)	0027H	PID Feedback Loss (FbL)
0003H	Heatsink Overheat (oH)	0028H	PID Feedback Loss (FbH)
0004H	Drive Overheat Warning (oH2)	002AH	Drive Disabled (dnE)
0005H	Overtorque 1 (oL3)	002BH	PG Disconnected (PGo)
0006H	Overtorque 2 (oL4)	0031H	MECHATROLINK Watchdog Timer Error (E5)
0007H	Forward/Reverse Run Command Input Error (EF)	0032H	Station Address Setting Error (AEr)
0008H	Drive Baseblock (bb)	0033H	MECHATROLINK Comm. Cycle Setting Error (CyC)
0009H	External Fault 3, input terminal S3 (EF3)	0034H	High Current Alarm (HCA)
000AH	External Fault 4, input terminal S4 (EF4)	0035H	Cooling Fan Maintenance Time (LT-1)
000BH	External Fault 5, input terminal S5 (EF5)	0036H	Capacitor Maintenance Time (LT-2)
000CH	External Fault 6, input terminal S6 (EF6)	0038H	SI-S EEPROM Error (EEP)
000DH	External Fault 7, input terminal S7 (EF7)	0039H	External Fault (input terminal S1) (EF1)
000EH	External Fault 8, input terminal S8 (EF8)	003AH	External Fault (input terminal S2) (EF2)
000FH	Internal Fan Fault (FAn)	003BH	Safe Disable Input (HbbF)
0010H	Overspeed (oS)	003CH	Safe Disable Input (Hbb)
0011H	Speed Deviation (dEv)	003DH	Mechanical Weakening Detection 1 (oL5)
0012H	PG Disconnected (PGo)	003EH	Mechanical Weakening Detection 2 (UL5)
0014H	MEMOBUS/Modbus Communication Error (CE)	003FH	PLC Alarm (PA1)
0015H	Option Communication Error (bUS)	0040H	PLC Alarm (PA2)
0016H	Serial Communication Transmission Error (CALL)	0041H	Output Voltage Detection Fault (voF)
0017H	Motor Overload (oL1)	0042H	IGBT Maintenance Time (90%) (TrPC)
0018H	Drive Overload (oL2)	0043H	Soft Charge Bypass Relay Maintenance Time (LT-3)
001AH	Option Card External Fault (EF0)	0044H	IGBT Maintenance Time (50%) (LT-4)
001BH	Motor Switch command input during run (rUn)	0045H	Braking Transistor Overload (boL)
001DH	Serial Communication Transmission Error (CALL)	0048H	Motor Overheat (NTC Input) (oH5)
001EH	Undertorque Detection 1 (UL3)	0049H	DriveWorksEZ Fault (dWAL)
001FH	Undertorque Detection 2 (UL4)	004DH	Thermistor Disconnect (THo)
0020H	MEMOBUS/Modbus Communication Test Mode Error (SE)		



## C.10 Enter Command

When writing parameters to the drive from the PLC using MEMOBUS/Modbus communication, parameter H5-11 determines whether an Enter command must be issued to enable these parameters. This section describes the types and functions of the Enter commands.

### ◆ Enter Command Types

The drive supports two types of Enter commands as shown in [Table C.8](#). An Enter command is enabled by writing 0 to register numbers 0900H or 0910H. It is only possible to write to these registers; attempting to read from these registers will cause an error.

**Table C.8 Enter Command Types**

Register No.	Description
0900H	Simultaneously writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM. Parameter changes remain after cycling power.
0910H	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.

**Note:** The EEPROM can only be written to 100,000 times, so it is recommended to limit the number of times writing to the EEPROM. The Enter command registers are write-only and if these registers are read, the register address will be invalid (Error code: 02H). An Enter command is not required when reference or broadcast data are sent to the drive.

### ◆ Enter Command Settings when Upgrading the Drive

When replacing previous Yaskawa drive models with the A1000 and keeping the MEMOBUS/Modbus communications settings, set parameter H5-11 in accordance with the Enter command configuration in the older drive. H5-11 determines whether an Enter command is necessary to activate parameter changes in the drive.

- If upgrading from a G7 or F7 series drive to an A1000, set parameter H5-11 to 0.
- If upgrading from a V7 series drive to an A1000, set parameter H5-11 to 1.

### ■ H5-11 and the Enter Command

An enter command is not required when writing registers 0000H to 001FH. Changes to those registers take effect immediately, independent of the setting in parameter H5-11.

H5-11 Settings	H5-11 = 0	H5-11 = 1
Drive being replaced	G7, F7	V7
How parameter settings are enabled	When the Enter command is received from the master.	As soon as the value is changed.
Upper/lower limit check	Upper/lower limit check is performed, taking the settings of related parameters into account.	Checks only the upper/lower limits of the parameters that were changed.
Default value of related parameters	Not affected. The settings of related parameters remain unchanged. They must be changed manually if needed.	Default settings of related parameters are changed automatically.
Error handling when setting multiple parameters	Data is accepted even if one setting is invalid. The invalid setting will be discarded. No error message occurs.	Error occurs if only one setting is invalid. All data that was sent are discarded.



## C.11 Communication Errors

### ◆ MEMOBUS/Modbus Error Codes

A list of MEMOBUS/Modbus errors appears below.

When an error occurs, remove whatever caused the error and restart communications.

Error Code	Error Name
	Cause
01H	Function Code Error
	Attempted to set a function code from a PLC other than 03H, 08H, and 10H.
02H	Register Number Error
	<ul style="list-style-type: none"> <li>A register number specified in the command message does not exist.</li> <li>Attempted to send a broadcast message using other register numbers than 0001H or 0002H.</li> </ul>
03H	Bit Count Error
	<ul style="list-style-type: none"> <li>Read data or write data is greater than 16 bits. Invalid command message quantity.</li> <li>In a write message, the “Number of Data Items” contained within the message does not equal twice the amount of data words (i.e., the total of Data 1+ Data 2, etc.).</li> </ul>
21H	Data Setting Error
	<ul style="list-style-type: none"> <li>Control data or parameter write data is outside the allowable setting range.</li> <li>Attempted to write a contradictory parameter setting.</li> </ul>
22H	Write Mode Error
	<ul style="list-style-type: none"> <li>During run, the user attempted to write a parameter that cannot be written to during run.</li> <li>During an EEPROM memory data error (CPF06), the master attempted to write to a parameter other than A1-00 to A1-05, E1-03, or o2-04.</li> <li>Attempted to write to read-only data.</li> </ul>
23H	DC Bus Undervoltage Write Error
	During an undervoltage situation, the master attempted to write to parameters that cannot be written to during undervoltage.
24H	Write Error During Parameter Process
	Master attempted writing to the drive while the drive was processing parameter data.
25H	Writing into EEPROM Disabled
	An attempt was made to write data into EEPROM by MEMOBUS/Modbus communications when writing EEPROM is not possible. (When this error code occurs, an error message is displayed and the drive continues operation.)

### ◆ Slave Not Responding

In the following situations, the slave drive will ignore the command message sent from the master, and not send a response message:

- When a communications error (overrun, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the drive do not match (remember to set the slave address for the drive using H5-01).
- When the gap between two blocks (8-bit) of a message exceeds 24 bits.
- When the command message data length is invalid.

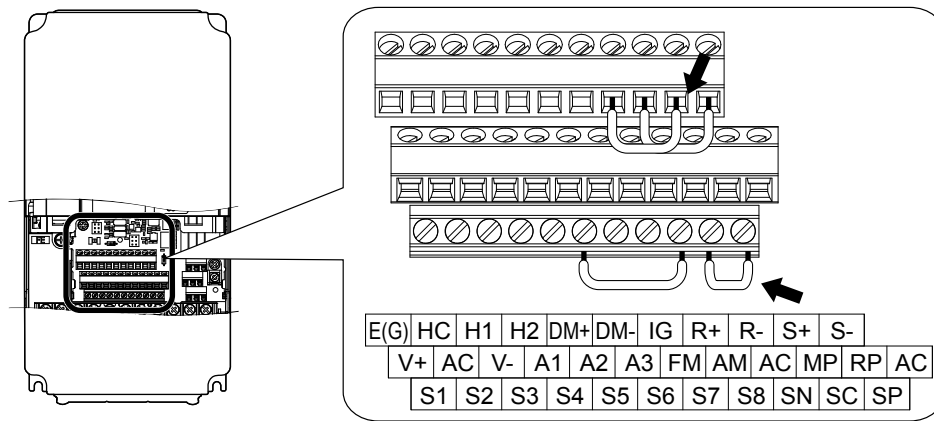
**Note:** If the slave address specified in the command message is 00H, all slaves execute the write function, but do not return response messages to the master.

## C.12 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function, use the following procedure.

**DANGER! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least one minute after all indicators are OFF and measure the DC bus voltage level to confirm safe level.

1. Turn on the power to the drive.
2. Note the present terminal S6 function selection setting (H1-06) and set it for the communications test mode (H1-06 = 67).
3. Turn off the power to the drive.
4. With the power off, wire the drive as shown in [Figure C.8](#), connecting terminals R+ and S+, R- and S-, and S6 and SN.



**Figure C.8 Terminal Connections for Communication Self-Diagnostics**

5. Verify that terminals SC to SP are connected by wire jumper.
6. Turn the power to the drive back on.
7. During normal operation, the drive will display "PASS" to indicate that the communications test mode is operating normally.  
When a fault occurs, the drive will display "CE" on the keypad display.
8. Turn off the power supply.
9. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SN. Reset jumper SC to SP to its original position and set terminal S6 to its original function.
10. Return to normal operation.