YASKAWA

GPD 515/G5 Modbus® RTU Technical Manual

Technical References

Refer to the following publications for further information about the GPD 515/G5:

- GPD 515/G5 Technical Manual
  Publication TM 4515

- GPD 515/G5 RS-232C/485 Interface Card Installation Sheet
  Publication 02Y00025-0401

Refer to the following Modicon publication for technical information on Modbus RTU protocol:

- Modicon Modbus Protocol Reference Guide
  Publication PI-MBUS-300 Rev. D

Technical Support

Technical Support Center-

Provide telephone assistance related to installation, start-up, programming, and troubleshooting drives and communication products. For technical phone support call 1-800-541-0939.

CONTENTS

	Technical References / Technical Support	**i**
	Contents	**1**
Chapter 1	**GPD 515/G5 and Serial Communication**	**1-1**
	Introduction to GPD 515 Modbus RTU Communication	1-2
	Standard RS-232D Serial Communication	1-2
	The RS-232D to RS-485 Converter Board	1-3
	Figure 1-1. The CM085 Board	1-3
Chapter 2	**RS-232D Serial Communication**	**2-1**
	RS-232D Serial Communication	2-2
	Figure 2-1. RS-232D Pin-out at 6CN Connector	2-2
Chapter 3	**Installation of CM085 Board**	**3-1**
	Installation Procedure	3-2
	Figure 3-1. Position of the CM085 Board on the GPD 515 Drive	3-2
Chapter 4	**Wiring of the CM085 Board**	**4-1**
	Connection of Multiple Drives	4-2
	Figure 4-1. Interconnection Diagram	4-2
	Wiring Instructions	4-3
	Figure 4-2. Twisted Shielded Wire Termination	4-3
	Table 4-1. Functions of Terminal Block TC1	4-3
	Table 4-2. Applicable Wire Sizes for Terminal Block TC1	4-3
	Terminating Resistors	4-4
	Figure 4-3. SW1 Location on the CM085 Board	4-4
Chapter 5	**Setting GPD 515 Parameters for Communication**	**5-1**
	Run/Stop and Frequency Selection	5-2
	Communication Set up Parameters	5-3
	“ENTER” Command	5-5
Chapter 6	**The Message Format**	**6-1**
	Message Functions	6-2
	Read Multiple Registers - 03h	6-3
	Loop-back Test - 08h	6-6
	Write Multiple Registers - 10h	6-8
	No Response Message	6-11
	CRC-16	6-11
Chapter 7	**Registers**	**7-1**
	Simultaneous Broadcast Registers	7-2
	Command Registers	7-3
	Monitor Registers	7-4
	Drive Parameter Registers	7-7
	Special Registers	7-17

Chapter 8 **Error Codes and Troubleshooting** **8-1**
Communication Error (CE) 8-2
Modbus Error Codes 8-2
Figure 8-1. Response Message (Fault) 8-2
GPD Failure Codes 8-3

Chapter 9 **Command Priority** **9-1**
Command Priority 9-2
Table 9-1. Set up for Serial Communication Control 9-3
Table 9-2. Set up for External Terminals Control 9-4
Table 9-3. Set up for Digital Operator Control 9-5
Table 9-4. Set up for Option Board Control 9-6

Appendix A **Product Specifications** **A-1**

Appendix B **Spare Parts List** **B-1**

Chapter 1
GPD 515/G5 and Serial Communication

- Introduction to GPD 515/G5 Modbus RTU Communication
- Standard RS-232D Serial Communication
- The RS-232D to RS-485 Converter Board
- *Figure 1-1. The CM085 Board*

Note: The AC Drive referenced in this manual may be named GPD 515, G5, or GPD 515/G5. These are physically the same drive. This manual will use the name GPD 515 hereafter.

Introduction to GPD 515 Modbus RTU Communication

This manual describes the set-up and protocol for Modbus Communication. The GPD 515 offers RS-232D serial communication as a standard, and RS-485 as an option.

The Modbus RTU protocol requires that the controller communicates using a master-slave technique, in which only one device (the master) can initiate transactions. The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested. The GPD 515 drive must act in the slave mode.

A complete understanding of drive programming and operation is required before attempting serial communication operation. A full discussion of programming and operation is covered in the GPD 515 technical manual TM 4515.

GPD 515 / Modbus RTU Specifications

The data that may be sent or received from the drive consists of:

-Run Command
-Frequency Reference
-Fault Contents
-Drive Status
-Drive Parameter Settings

The following table illustrates whether the serial communication specifications are fixed or user selectable. If the specification is fixed, the fixed value is shown in the last column. If the specification is selectable, the range of allowed values is shown in the last column.

Communication Specification	Fixed or Selectable	Range
Baud Rate	Selectable	2400, 4800, or 9600 bps
Data Bit	Fixed	8
Parity	Selectable	None, Even, or Odd
Stop Bit	Fixed	1
Nodes	RS-232D	point-to-point only
Nodes	Selectable for RS-485	maximum of 31 nodes

Standard RS-232D Serial Communication

The GPD 515 drive offers RS-232D serial communications as a standard feature of the drive. RS-232D has a maximum transmission distance of 50 feet. RS-232D only allows point-to-point communications. The specifications for wiring and pin outs for RS-232D are given in Chapter 2.

The RS-232D to RS-485 Converter Board

The GPD 515 offers RS-485 serial communications as an option. RS-485 allows a maximum transmission distance of 4000 feet. RS-485 allows multidrop (multiple devices) communication.

To obtain RS-485 communications an optional converter board must be purchased. This RS-232D to RS-485 Converter Board is represented by the MagneTek part number CM085.

Read this manual thoroughly before installation, operation, maintenance, and inspection of the CM085 Option Board.

CAUTION
The CM085 option board employs CMOS technology which may be damaged by static electricity. Use proper electrostatic discharge (ESD) procedures when handling this board.

The CM085 board is used to convert the drive's RS-232D standard function to offer RS-485 interface. The following diagram illustrates the CM085 board. (The figure is not actual size.)

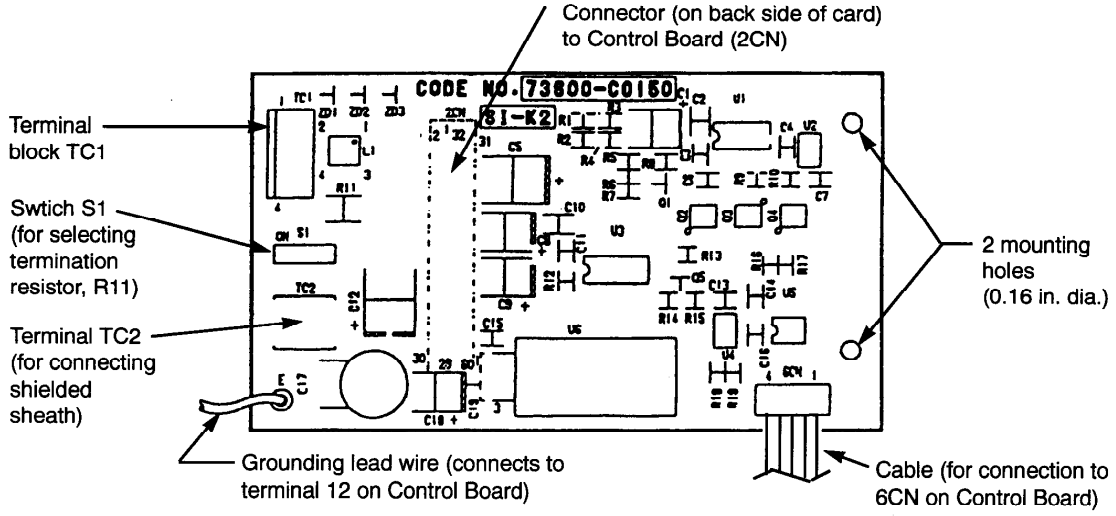


Figure 1-1. The CM085 Board

Chapter 2
RS-232D Serial Communication

- RS-232D Serial Communication
- *Figure 2-1. RS-232D Pin-out at 6CN Connector*

RS-232D Serial Communication

RS-232D Serial Communication is accessed through connector 6CN on the GPD 515ís control board. Pin 1 on the 6CN connector is for the transmission of data, Pin 2 is for the receipt of data, and pin 4 is for the ground connection. The RS-232D pin out is shown in the diagram below.

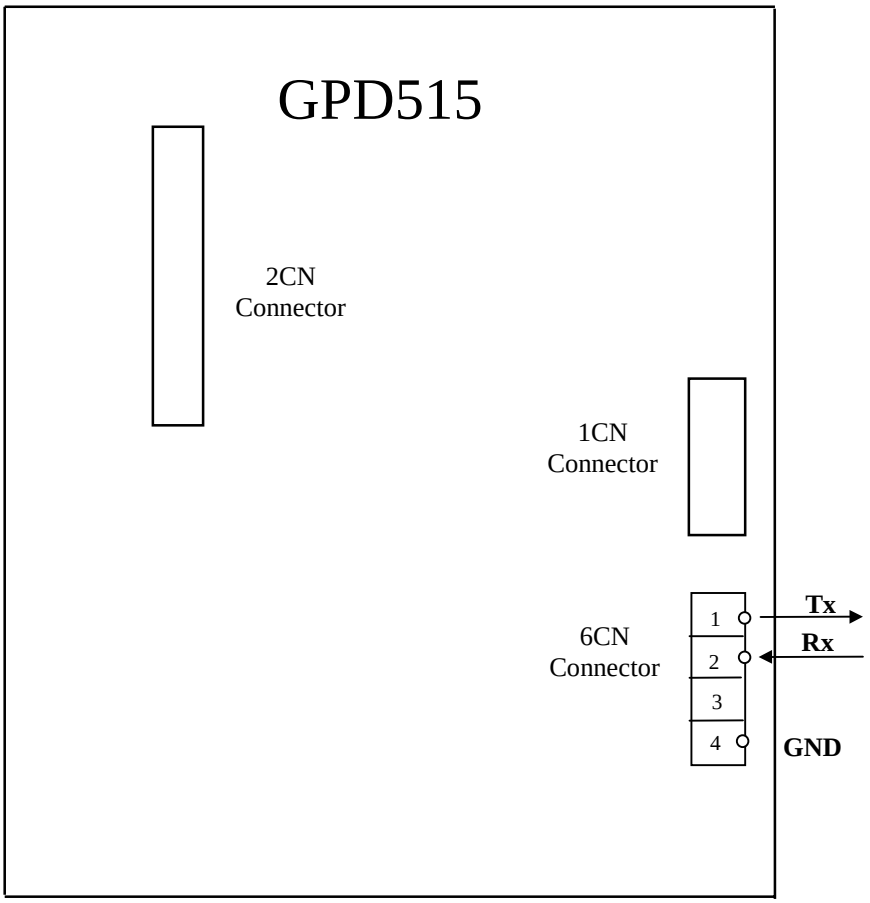


Figure 2-1. RS-232D Pin-out at 6CN Connector

Cable Specifications:

-cable should be a shielded, thin twisted wire 22-28 AWG

-cable pinout is as follows:

Computer - 9 Pin Female D shell	GPD 515 Connector for 6CN
3 - Tx	2 - Rx
2 - Rx	1 - Tx
5 - GND	4 - GND

-pinout for devices other than a computer (PC), such as a PLC, may vary.

Chapter 3
Installation of the CM085 Board

- Installation Procedure
- *Figure 3-1. Position of the CM085 Board on the GPD 515 Drive*

Installation Procedure

These procedures should be followed when installing the CM085 board into the GPD 515 drive.

1. Turn the main power OFF to the drive. Remove the front cover of the drive to verify that the CHARGE lamp is off.

2. Position the CM085 board onto the control board of the drive, lining up the 2CN connector on the CM085 board with the 2CN connector on the control board of the drive.

3. Position the two spacer holes on the right side of the CM085 board with the plastic stand-offs on the control board. Snap the CM085 board onto the stand-offs tightly.

4. Plug the 6CN cable from the CM085 board into location 6CN on the control board.

5. Connect the green wire (labeled ëEí) from the CM085 board to terminal 12 on the drive.

6. After installing the CM085 board onto the drive, connect with peripheral devices and replace the cover of the drive.

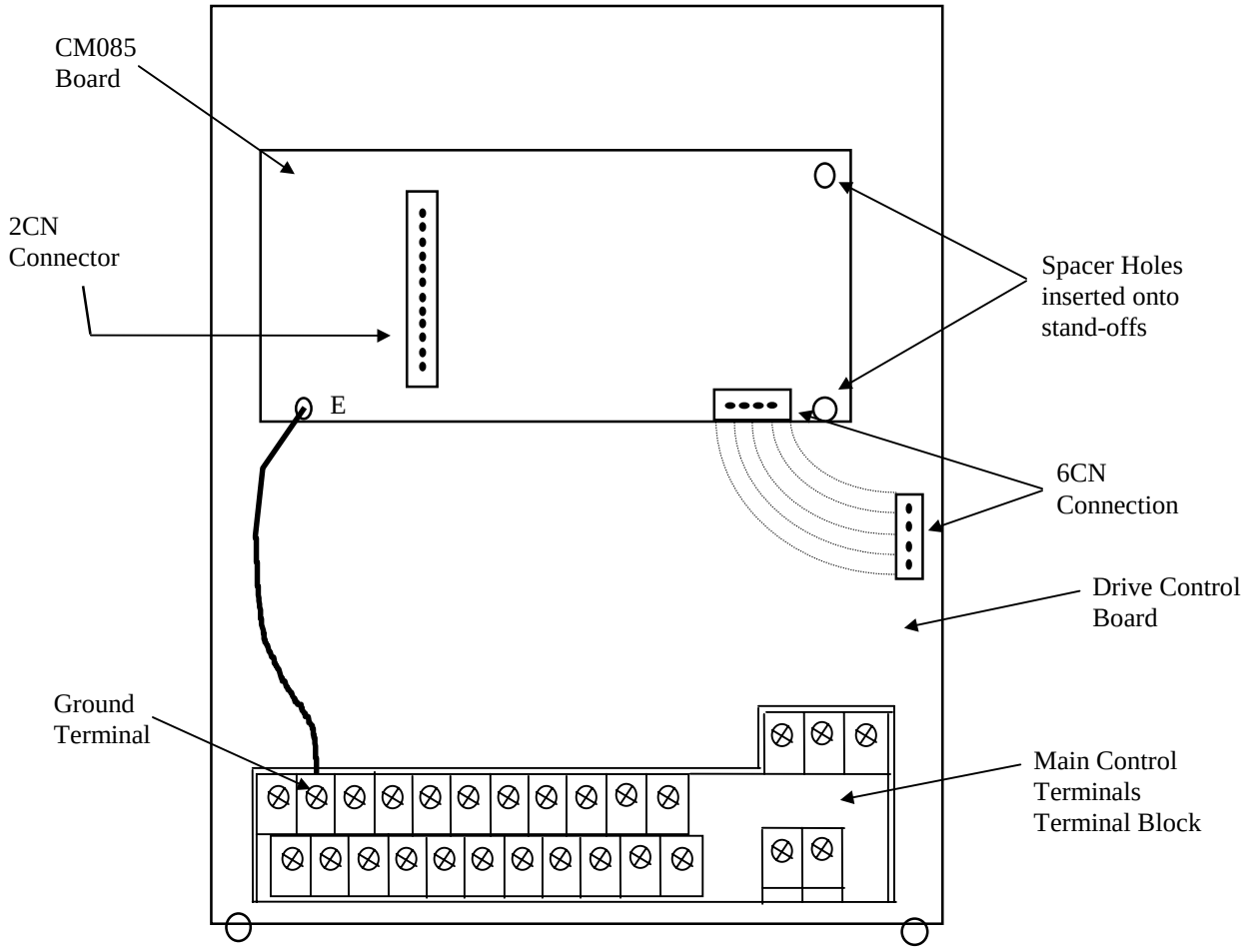


Figure 3-1. Position of the CM085 Board on the GPD 515 Drive

Chapter 4
Wiring of the CM085 Board

- Connection of Multiple Drives
- *Figure 4-1. CM085 Connection Diagram*
- Wiring Instructions
- *Figure 4-2. Shielded Wire Termination*
- *Table 4-1. Functions of Terminal Block TC1*
- *Table 4-2. Applicable Wire Sizes for Terminal Block TC1*
- Terminating Resistor
- *Figure 4-3. SW1 Location on the CM085 Board*

Connection of Multiple Drives

With the RS-485/RS-422 Conversion Board (CM085) multiple drives may be connected together for a multiple drive communication system. The following diagram illustrates the connection between multiple CM085 boards.

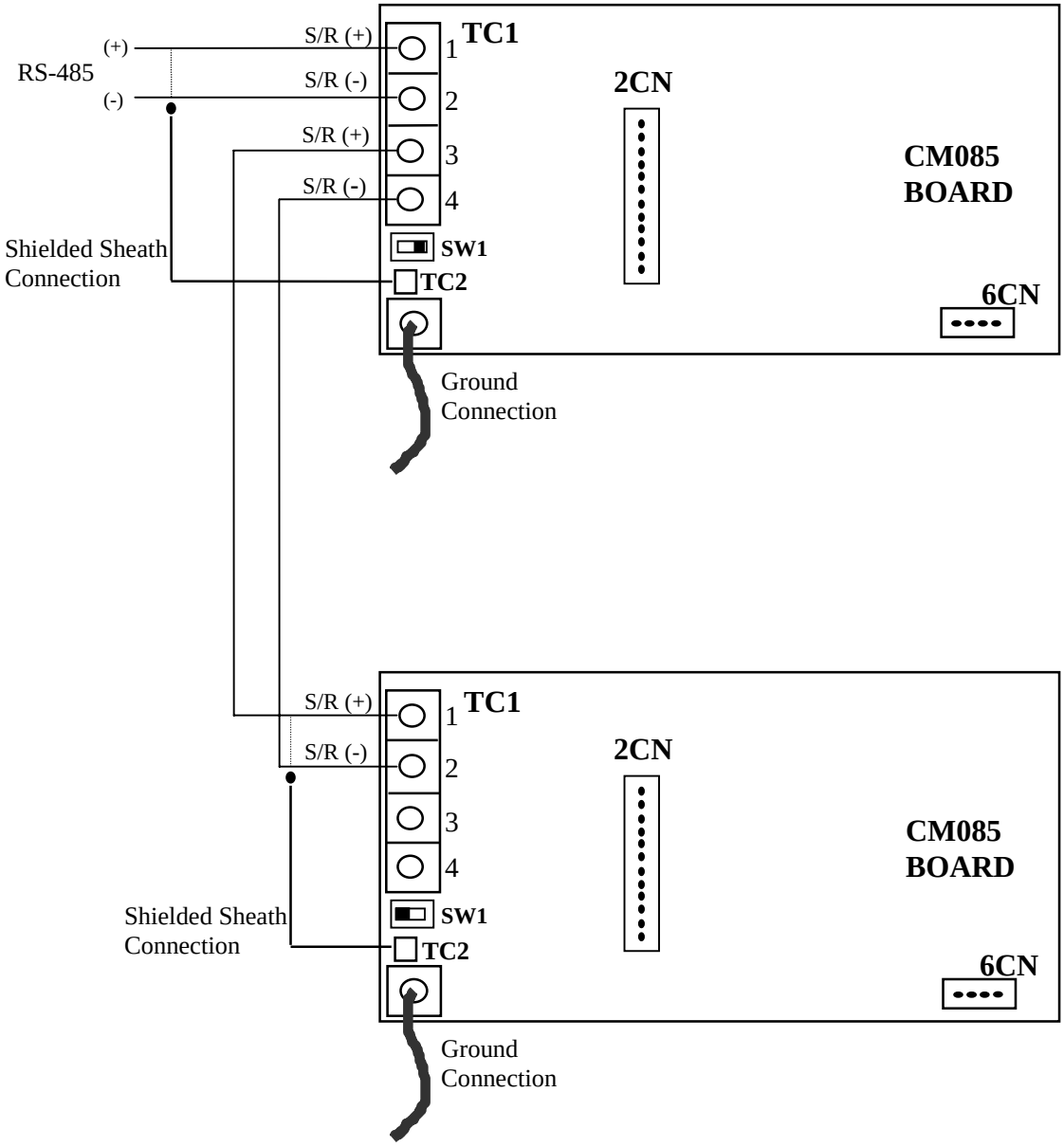


Figure 4-1. Interconnection Diagram

1. Locate terminal block at TC1 on the CM085 board. (See Figure 1-1 in this manual.) TC1 should have 4 terminal locations (1, 2, 3 and 4) on it.

2. A twisted shielded wire should be used for connection to TC1. The shielded wire should be separated and connected per the drawing below to eliminate interference due to noise.

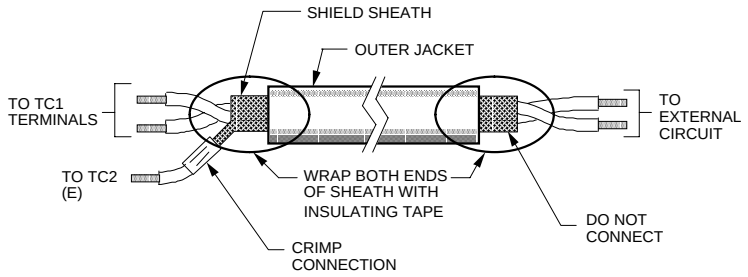


Figure 4-2. Shielded Wire Termination

3. The function terminal block TC1 is described in the table below.

Table 4-1. Functions of Terminal Block TC1

Terminal Block Symbol	Pin No.	Functions		Remarks
TC1	1	S/R (+)	RS-485 input/output (+)	Use as input at parallel connection
	2	S/R (-)	RS-485 input/output (-)	
	3	S/R (+)	RS-485 input/output (+)	Use as output at parallel connection
	4	S/R (-)	RS-485 input/output (-)	
TC2	Shield connection terminal			-

4. It is important that an appropriate wire size is selected. When the wire gauge is too thick, it may apply pressure to the CM085 board and cause failure. When the wire gauge is too thin, it may lead to imperfect contact or a break in the wire. The table below indicates the suggested wire size to be used at TC1.

Table 4-2. Applicable Wire Sizes for Terminal Block TC1

	[mm^2]	**AWG**	**I [A]**	**VAC [V]**
Twisted wire	1.0	16	12	125
Single wire	1.5	16	12	125
UL	-	22-16	10	300
CSA	-	28-16	10	300
CSA	-	28-16	10	150

5. When stripping the wire end to be connected at TC1, approximately 5.5 mm of wire should be exposed to make a good connection.

Note: Avoid sources of electric interference capable of inducing noise into the cable. Communication and signal wiring should be kept separate from power wiring. If communication or signal wiring must cross power wiring, it must cross at a right angle.

Terminating Resistor

Dip Switch SW1 is located on the lower right hand corner of the CM085 board. (See Figure 4-3 below) When SW1 is on, a termination resistor (100 Ohms) is connected between S/R (+) and S/R (-).

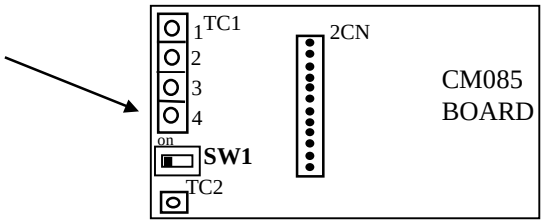
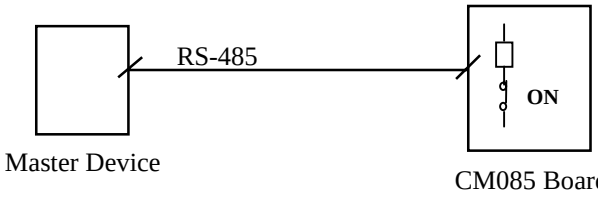
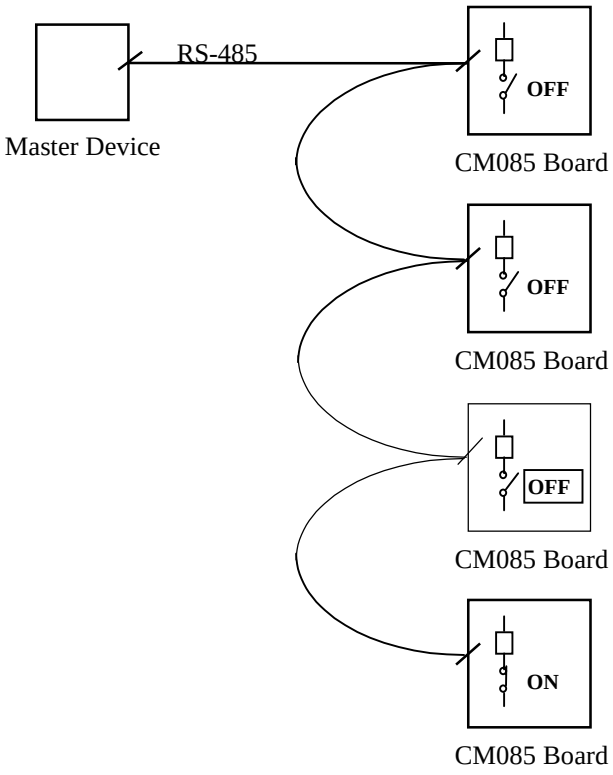


Figure 4-3. SW1 Location on the CM085 Board

For one-to-one connections of the CM085 card and a master device set SW1 to ON as shown below.



If multiple CM085 cards are connected to a master device, set SW1 on the last CM085 board to ON as shown below.



Chapter 5
Setting GPD 515 Parameters for Communication

- Run/Stop and Frequency Selection
- Communication Set up Parameters
- ìENTERî Command

Run/Stop and Frequency Selection

The run/stop commands and frequency reference command can originate from serial communication, the Digital Operator, the external terminals, or an option board. The origin of the run/stop command does not have to be the same as the origin for the frequency reference command. Parameter b1-01 (Reference Selection) allows you to set up the origin of the frequency reference, and parameter b1-02 (Operatoin Mode Selection) sets the origin of the run/stop commands. Parameter b1-01 is Modbus register number 180h, and b1-02 is Modbus register 181h. The charts shown below illustrate the possible frequency reference and run/stop selections.

Parameter b1-01 (180h) Setting	**Frequency Reference Selection**
0	Digital Operator
1	External Terminals
2	Serial Communication
3	Option board

The default setting of parameter b1-01 is ë1í.

Parameter b1-02 (181h) Setting	**Operation Method Selection (Run/Stop)**
0	Digital Operator
1	External Terminals
2	Serial Communication
3	Option board

The default setting of parameter b1-02 is ë1í.

Serial Communication Set up Parameters

The GPD 515 has parameters used for the set up of serial communication. These communication set up parameters are H5-01 through H5-05 and o2-09.

Parameter H5-01 - Serial Communication Station Address

Parameter H5-01 (or Modbus Register 41Ch) is used to set the Modbus slave address of the GPD 515 drive. The slave address can be any number from 1 to 1F in hexadecimal (or 1 to 31 decimal). Two nodes may not have the same address. The default setting for parameter H5-01 is ë1Fíh.

Parameter H5-02 - Serial Communication Baud Rate Selection

Parameter H5-02 (or Modbus Register 41Dh) is used to select the baud rate. The table below indicates the baud rates that may be selected.

Setting Value (in hex)	Baud Rate Selection
0	1200 bps
1	2400 bps
2	4800 bps
3	9600 bps

The default setting of parameter H5-02 is ë3í.

Parameter H5-03 - Serial Communication Parity Selection

Parameter H5-03 (or Modbus Register 41Eh) is used to select the parity . The table below indicates the parity that may be selected.

Setting Value (in hex)	Parity Selection
0	No parity
1	Even parity
2	Odd parity

The default setting of parameter H5-03 is ë0í.

Communication Error (CE)

A communication error can occur only after communication has been established between the master and the drive. The drive waits for the master to initiate communication.

The message data is always checked for CRC, parity, overrun, framing, and overflow. If the data has discrepancies in any of these areas a communication error will occur. If the drive does not receive a message (addressed to its appropriate slave address set up in H5-01) within a period of 2 seconds, a time-out occurs. A time-out can also cause a communication error if it is enabled (see parameter H5-05).

Parameters H5-04 and H5-05 are the set up parameters that determine how the drive will respond to a communication error.

Parameter H5-04 - Stopping Method after Serial Communication Error

Parameter H5-04 (or Modbus Register 41Fh) is used to determine the method of stopping the motor if there is a communication error. The table below indicates the stopping methods that can be used when a communication error occurs.

Setting Value (in hex)	Stopping Method
0	Decelerate to stop
1	Coast to stop
2	Fast Stop
3	Alarm Only / Continue Operation

The default setting of parameter H5-04 is ë3í.

Parameter H5-05 - Serial Fault Detection Selection

Parameter H5-05 (or Modbus Register 420h) is used to enable or disable the Time-out detection. The table below indicates how to enable or disable the communication error.

Setting Value (in hex)	Time-out Detection Selection
0	disabled
1	enabled

The default setting of parameter H5-05 is '1'.

Parameter o2-09 - Initial Mode Select

Parameter o2-09 (or Modbus Register 50Dh) determines the Modbus Register Address of the operational signals register and frequency reference register. Set this parameter to ë1í so that the Modbus Register Addresses of the Operation Signal register is 001h and the Frequency Reference register is 002h. The Modbus Register Address for Operation Signals is 00h and the Frequency Reference register is 01h for flach software versions previous to '1024' and CPU version '20'.

The default setting for parameter o2-09 is '0'.

Note: Power must be cycled to the drive,
to make the serial communication set up parameters effective.

ìENTERî Command

The GPD 515 has two types of memory: ëVolatileí and ëNon-Volatileí. Data held in the Volatile memory will be lost when power is removed from the drive. Data held in Non-Volatile memory will be retained when power is removed from the drive. Different types of registers are stored in different areas of memory.

Command Data:
The command registers (000h to 00Fh) are stored in Volatile memory. When writing to a command register the new data becomes active immediately. In the case of a power loss all data stored in these registers will not be retained.

Monitor Data:
The monitor registers (010h to 01Fh) are stored in Volatile memory. These registers can not be written to (read only registers). Any data read from the monitor registers will not be retained during a power loss situation.

Parameter Data:
The parameter registers (100h to 50Dh) are stored in Non-Volatile memory. When writing new data to parameter registers, an ëENTERí command must be given for the new data to become active.

There are two different types of ëENTER' commands, 'ACCEPT' and 'ENTER'. For an 'ACCEPT', write the value '0' to Modbus register FFDDh. This causes data to become "active". If a power loss occurs, the data will not be retained. For an 'ENTER', write the value '0' to Modbus register FFFDh. This causes data to become "active" and saves the date to Non-Volatile memory. If a power loss occurs, the data will be retained.

Some Parameter Data registers may be written to while the drive is running. These parameters are called run operative parameters. For a list of these paremeters, refer to Appendix A, Table A1-11 of the GPD 515 technical manual (TM 4515).

All other Parameter Data registers may only be written to when the drive is stopped. These are called non-run operative parameters.

If new data is written to any parameter serially, and is not followed by an 'ENTER' command, a "Busy Write Protected" message will flash on the Digital Operator display if an attempt is then made to change a parameter using the Digital Operator.

The same message will be displayed if an attempt is made to change a parameter via the Digital Operator while the contents of the 'ENTER' command register is any value other than '0'.

NOTE
Use the 'ENTER' (FFFDh) command only when necessary! The life of the EEPROM (Non-Volatile memory) on the GPD 515 will support a finite number of operations. This means that the 'ENTER' command, value '0' written to register FFFDh, can only be used a maximum of a 100,000 times to store data in the EEPROM. After the specified number of operations, the EEPROM may fault **(ERR)** requiring the GPD 515 control board to be replaced.

Chapter 6
The Message Format

- Message Functions
- Read Multiple Registers
- Loop Back Test
- Write Multiple Registers
- No Response Message
- CRC-16

Message Functions

In communicating to the GPD 515 drive via Modbus RTU, there are three message functions available. The master specifies the function to be executed by the slave according to the function code. The following table shows the types of function codes available, and the length (quantity) and contents of the message according to the function.

Function Code (hex)	Function	Command Message		Response Message (Normal)	
		min. (bytes)	max. (bytes)	min. (bytes)	max. (bytes)
3	Read Multiple Registers	8	8	7	37
8	Loop-back test	8	8	8	8
10	Write Multiple Registers	11	41	8	8

The message format varies depending upon the function of the message. For each function, there is a command message from the master and a response message initiated from the slave. The following sections review the format of the command message and the response message for each function.

Read Multiple Registers - 03h

The multiple register read function (03h) allows the master to request information from the slave. The command message of a multiple register read is structured as shown below.

Command Message

SLAVE ADDRESS		02h
FUNCTION CODE		03h
START-ING REGISTER NO.	UPPER	00h
	LOWER	20h
QTY.	UPPER	00h
	LOWER	04h
CRC-16	LOWER	45h
	UPPER	F0h

Each GPD 515ís slave address is set in advance by the drive parameter H5-01. Valid slave addresses must be in the range of 1 to 31 decimal (1 to 1F hex). No two slaves may have the same address. The master addresses the slave by placing the slave address in the address field of the message. In the command message above, the slave is addressed at 2.

The function code of this message is 03h (read multiple registers).

The starting number is the first register to be read. In the command message above the starting register is 20h, indicating that the first register is the Frequency Reference. A listing of the GPD 515ís registers is shown in Chapter 7, Registers.

The quantity indicates how many consecutive registers are to be read. The quantity may range from 1 to 16 registers. If the quantity is greater than 16, an error code of ë3í is returned in the fault response message. In this command message there is four consecutive registers to be read: 20h-Frequency Reference, 21h-Output Frequency, 22h-Output Current, and 23h-Control Method.

A CRC-16 value is generated from a calculation using the values of the address, function code, and data sections of the message. The procedure for calculating a CRC-16 is described at the end of this chapter. When the slave receives the command message it calculates a CRC-16 value and compares it to the one in CRC-16 field of the command message. If these two CRC-16 values are the same the slave has received the proper command message. If the two CRC-16 values are not the same the slave will not respond.

If the command message has a valid slave address, function code, starting register, and quantity value, the slave will respond with a normal response message. If the command message has an invalid slave address, function code, starting register, and/or quantity the slave will respond with a fault response message.

Normal Response Message

SLAVE ADDRESS		02h
FUNCTION CODE		03h
NO. OF DATA BYTES		08h
START-ING REGISTER CONTENTS	UPPER	17h
	LOWER	70h
NEXT REGISTER CONTENTS	UPPER	17h
	LOWER	70h
NEXT REGISTER CONTENTS	UPPER	01h
	LOWER	09h
NEXT REGISTER CONTENTS	UPPER	00h
	LOWER	00h
CRC-16	LOWER	38h
	UPPER	ACh

The starting register, 20h (Frequency Reference), has a value of 1770h or 6000 dec. (60.00 Hz)

The next register, 21h (Output Frequency), has a value of 1770h or 6000 dec. (60.00 Hz).

The next register, 22h (Output Current), has a value of 109h or 265 dec. (drive rating / 8192).

The next register, 23h (Control Method), has a value of 00h or 0 dec. (V/f Control).

The normal response message contains the same slave address and function code as the command message, indicating to the master which slave is responding and to what type of function it is responding.

The number of data bytes is the number of data bytes returned in the response message. The number of data bytes is actually the quantity (in the command message) times 2, since there are two bytes of data in each register.

The data section of the response message contains 8 upper and 8 lower bits of data for each register that has been read from the drive.

A CRC-16 value is generated from a calculation using the values of the address, function code, number of data bytes, and register data sections of the message. The procedure for calculating a CRC-16 value is described at the end of this chapter. How the response message is handled by the master depends on what master is used. When the master receives the response message it should calculate a CRC-16 value and compare it to the one in the CRC-16 field of the response message. If these two CRC-16 values are the same the master has received the proper response message.

Fault Response Message

SLAVE ADDRESS		02h
80h + FUNC. CODE		83h
ERROR CODE		02h
CRC-16	LOWER	30h
	UPPER	F1h

The fault response message contains the same slave address as the command message, indicating to the master which slave is responding.

The function code of a fault response message is actually a value of 80h plus the original function code of 03h. This indicates to the master that the message is a fault response message, instead of a normal response message.

The error code indicates where the error occurred in the command message. The value of 2h in the error code field of this fault response message, indicates that the command message requested data be read from an invalid register. A complete listing of the error codes is shown in Chapter 8, Troubleshooting and Error Codes.

A CRC-16 value is generated from a calculation using the values of the address, function code, and error code sections of the message. The procedure for calculating a CRC-16 value is described at the end of this chapter. How the response message is handled by the master depends on what master is used. When the master receives the fault response message it should calculate a CRC-16 value and compare it to the one in the CRC-16 field of the fault response message. If these two CRC-16 values are the same the master has received the proper fault response message.

Loop-back Test - 08h

The loop-back test function (08h) is used for checking signal transmission between master and slaves. The command message format is shown below.

Command Message

SLAVE ADDRESS		01h
FUNCTION CODE		08h
TEST CODE	UPPER	00h
	LOWER	00h
DATA	UPPER	A5h
	LOWER	37h
CRC-16	LOWER	DAh
	UPPER	8Dh

Each GPD 515ís slave address is set in advance by the drive parameter H5-01. Valid slave addresses must be in the range of 1 to 31 decimal (1 to 1F hex). No two slaves may have the same address. The master addresses the slave by placing the slave address in the address field of the message. In the command message above, the slave is addressed at 1.

The function code of this message is 08h (loop-back test).

The test code must be set to ë0000í. This function specifies that the data passed in the command message is to be returned (looped back) in the response message.

The data section contains arbitrary data values. These data values are used to verify that the slave receives the correct data.

A CRC-16 value is generated from a calculation using the values of the address, function code, test code, and data sections of the message. The procedure for calculating a CRC-16 is described at the end of this chapter. When the slave receives the command message it calculates a CRC-16 value and compares it to the one in CRC-16 field of the command message. If these two CRC-16 values are the same the slave has received the proper command message. If these two CRC-16 values are not the same the slave does not respond.

If the command message has a valid slave address, function code, test code, and data value, the slave will respond with a normal response message. If the command message has an invalid slave address, function code, test code, and/or data value the slave will respond with a fault response message.

Normal Response Message

SLAVE ADDRESS		01h
FUNCTION CODE		08h
TEST CODE	UPPER	00h
	LOWER	00h
DATA	UPPER	A5h
	LOWER	37h
CRC-16	LOWER	DAh
	UPPER	8Dh

A normal response message for the loop-back test should be identical to the command message.

Fault Response Message

SLAVE ADDRESS		01h
80h + FUNC. CODE		88h
ERROR CODE		01h
CRC-16	LOWER	87h
	UPPER	C0h

The fault response message contains the same slave address as the command message, indicating to the master which slave is responding.

The function code of a fault response message is actually a value of 80h plus the original function code of 08h. This indicates to the master that the message is a fault response message, instead of a normal response message.

The error code indicates where the error occurred in the command message. A complete listing of the error codes is shown in Chapter 8, Troubleshooting and Error Codes.

A CRC-16 value is generated from a calculation using the values of the address, function code, and data sections of the message. The procedure for calculating a CRC-16 value is described at the end of this chapter. How the response message is handled by the master depends on what master is used. When the master receives the fault response message it should calculate a CRC-16 value and compare it to the one in the CRC-16 field of the fault response message. If these two CRC-16 values are the same the master has received the proper fault response message.

Write Multiple Registers - 10h

The multiple register write function (10h) allows the master to write data to the driveís registers. The multiple register write message format is shown below.

Command Message

SLAVE ADDRESS		01h
FUNCTION CODE		10h
START-ING REGISTER NO.	UPPER	00h
	LOWER	01h
QTY.	UPPER	00h
	LOWER	02h
NO. OF DATA BYTES		04h
DATA TO FIRST REGISTER	UPPER	00h
	LOWER	01h
DATA TO NEXT REGISTER	UPPER	17h
	LOWER	70h
CRC-16	LOWER	6Dh
	UPPER	B7h

The first register, 01h (Operation Command) has a value of 01h or 1 dec. (forward run command)

The next register, 02h (Frequency Reference) has a value of 1770h or 6000 dec. (60.00 Hz)

Each GPD 515ís slave address is set in advance by the drive parameter H5-01. Valid slave addresses must be in the range of 1 to 31 decimal (1 to 1F hex). No two slaves may have the same address. The master addresses the slave by placing the slave address in the address field of the message. In the command message above, the slave is addressed at 1.

By setting the slave address to zero (0) in the address section of the message, the master can send operation signals (register 1h) and frequency reference (register 2h) to all slaves on the network. The master can send a single transmission to all the slaves simultaneously. This is called simultaneous broadcasting. In a simultaneous broadcast message all of the slaves on the network act upon one message. Simultaneous Broadcast registers are shown in Chapter 7, Registers (page 7-2).

The function code of this message is 10h (write multiple registers).

The starting register number is the first register to be written to. In the command message above the starting number is 01h, indicating that the first register is the frequency reference. A listing of the GPD 515ís registers is shown in Chapter 7, Registers.

The quantity indicates how many consecutive registers are to be written to. The quantity may range from 1 to 16 registers. If the quantity is greater than 16, an error code of ë3í is returned in the fault response message. In this command message there is two consecutive registers to be written to: 01h-Operation Command and 02h- Frequency Reference.

The number of data bytes is the number of bytes of data to be written to the drive. The number of data bytes is actually the quantity times 2, since there are two bytes of data in each register.

The data section of the response message contains 8 upper and 8 lower bits of data for each register that is being written to.

A CRC-16 value is generated from a calculation using the values of the address, function code, starting register number, quantity, number of data bytes, and data sections of the message. The procedure for calculating a CRC-16 is described at the end of this chapter. When the slave receives the command message it calculates a CRC-16 value and compares it to the one in CRC-16 field of the command message. If these two CRC-16 values are the same the slave has received the proper command message. If these two CRC-16 values are not the same the slave does not respond.

If the command message has a valid slave address, function code, starting register number, quantity, number of data bytes, and data values, the slave will respond with a normal response message. If the command message has an invalid slave address, function code, starting register number, quantity, number of data bytes, and/or data values the slave will respond with a fault response message.

Normal Response Message

SLAVE ADDRESS		01h
FUNCTION CODE		10h
START-ING REGISTER NUMBER	UPPER	00h
	LOWER	01h
QTY.	UPPER	00h
	LOWER	02h
CRC-16	LOWER	10h
	UPPER	08h

The normal response message contains the same slave address and function code as the command message, indicating to the master which slave is responding and to what type of function it is responding.

The starting number is the first register that was written to. In the response message above the starting number is 01h, indicating that the first register is the operation command.

The quantity indicates how many consecutive registers were written to.

A CRC-16 value is generated from a calculation using the values of the address, function code, starting register number, and quantity value of the message. The procedure for calculating a CRC-16 value is described at the end of this chapter. How the response message is handled by the master depends on what master is used. When the master receives the response message it should calculate a CRC-16 value and compare it to the one in the CRC-16 field of the response message. If these two CRC-16 values are the same the master has received the proper response message.

Fault Response Message

SLAVE ADDRESS		01h
80h + FUNC. CODE		90h
ERROR CODE		02h
CRC-16	LOWER	CDh
	UPPER	C1h

The fault response message contains the same slave address as the command message, indicating to the master which slave is responding.

The function code of a fault response message is actually a value of 80h plus the original function code of 10h. This indicates to the master that the message is a fault response message, instead of a normal response message.

The error code indicates where the error occurred in the command message. The value of 2h in the error code field of this fault response message, indicates that the command message requested data to be written to an invalid register. A complete listing of the error codes is shown in Chapter 8, Troubleshooting and Error Codes.

A CRC-16 value is generated from a calculation using the values of the address, function code, and error code sections of the message. The procedure for calculating a CRC-16 value is described at the end of this chapter. How the response message is handled by the master depends on what master is used. When the master receives the fault response message it should calculate a CRC-16 value and compare it to the one in the CRC-16 field of the response message. If these two CRC-16 values are the same the master has received the proper response message.

No Response Message

The slave disregards the command message and does not return the respond message in the following cases:

1. In simultaneous broadcasting of data (slave address field is 0), all slaves execute but do not respond.
2. When a communication error (overrun, framing, parity, or CRC-16) is detected in the command message.
3. When the slave address in the command message does not coincide with the address set in the slave.
4. When the command message data length is not proper.

CRC-16

At the end of the message, the data for CRC error checking is sent in order to detect errors in signal transmission. In Modbus RTU, the error check is conducted in the form of a CRC-16 (Cyclical Redundancy Check). The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message.

The CRC field is two bytes, containing 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

The CRC is started by first preloading a 16-bit register to all 1ís. Then a process begins of applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit (if one is used) do not apply to the CRC.

During generation of the CRC, each 8-bit character is exclusive ëORíed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB is a 1, the register is then exclusive ëORíed with a preset, fixed value (A001h). If the LSB is a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ëORíed with the registerís current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value.

For applications using a host computer, a detailed example of a CRC generation using Quick Basic is shown on the following page.

Typical CRC-16 Calculation Program in Quick Basic:

```
crcsum# = &HFFFF&
crcshift# = &H0&
crcconst# = &HA001&

CLS
PRINT "**************************************************"
PRINT
PRINT "              CRC-16 calculator"
PRINT
PRINT "**************************************************"
PRINT "If entering data in hex, preceed the data with '&H'"
PRINT "       Example:  32decimal = 20hex = &H20"
PRINT "**************************************************"
PRINT

INPUT "Enter the number of bytes in the message: ", maxbyte

FOR bytenum = 1 TO maxbyte STEP 1
      PRINT "Enter byte "; bytenum; ":":
      INPUT byte&
      byte& = byte& AND &HFF&
      crcsum# = (crcsum# XOR byte&) AND &HFFFF&
      FOR shift = 1 TO 8 STEP 1
            crcshift# = (INT(crcsum# / 2)) AND &H7FFF&
            IF crcsum# AND &H1& THEN
                  crcsum# = crcshift# XOR crcconst#
            ELSE
                  crcsum# = crcshift#
            END IF
      NEXT shift
NEXT bytenum

lower& = crcsum# AND &HFF&
upper& = (INT(crcsum# / 256)) AND &HFF&

PRINT "Lower byte (1st) = ", HEX$(lower&)
PRINT "Upper byte (2nd) = ", HEX$(upper&)
```

CRC-16 Calculation Example:

A two byte message for a read-out of a specified coil status is as follows.

0000 0010	Slave Address = 2
0000 0111	Function Code = 7

The actual CRC calculation would look like this:

CRCTMP	FLAG	
1111 1111 1111 1111		Initial Value
0000 0010		Slave Address
1111 1111 1111 1101		Result of EX
OR		
0111 1111 1111 1110	1	Shift #1
1010 0000 0000 0001		CRC-16
constant A001h		
1101 1111 1111 1111		Result of EX
OR		
0110 1111 1111 1111	1	Shift #2
1010 0000 0000 0001		CRC-16
constant A001h		
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		CRC-16
constant A001h		
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		CRC-16
constant A001h		
1000 0100 1111 1110		Result of EX
OR		
0100 0100 0111 1111	0	Shift #7
0010 0001 0011 1111	1	Shift #8
1010 0000 0000 0001	CRC-16 constant A001h	
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		CRC-16
constant A001h		
1110 0000 1001 1101		Result of EX
OR		
0111 0000 0100 1110	1	Shift #2
1010 0000 0000 0001		CRC-16
constant A001h		
1101 0000 0100 1111		Result of EX
OR		
0110 1000 0010 0111	1	Shift #3
1010 0000 0000 0001		CRC-16
constant A001h		
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		CRC-16
constant A001h		
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
1 2 | 4 1		
CRC-16 (Upper 8) | CRC-16 (Lower 8)		

After calculating the CRC-16 upper and lower values they are inserted into the message format as shown below.

0000 0010	Slave Address = 2
0000 0111	Function Code = 7
0100 0001	CRC-16 Lower = 41h
0001 0010	CRC-16 Upper = 12h

Chapter 7
Registers

- Simultaneous Broadcast Registers
- Command Registers
- Monitor Registers
- Drive Parameter Registers
- Special Registers

Simultaneous Broadcast Registers (Write only)

REGISTER (in hex)	FUNCTION	BIT NO.	DATA SET	DESCRIPTION
001*	Operational Signals	0	0	Stop
			1	Run
		1	0	Forward Run
			1	Reverse Run
		2		not used
		3		not used
		4	1	External Fault
		5	1	Fault Reset
		6		not used
		7		not used
002*	Frequency Reference			Frequency Reference (6000 = 100%) **(1)**

Notes:

1. Scaling depends on the setting of o1-03.

* Set parameter o2-09 to '1' so that the Modbus Register Address of the Operation Signals register is 01h and the Frequency Reference register is 02h. The Modbus Register Address for Operation Signals register is 00h and the Frequency Reference is 01h for flash software versions previous to '1024' and CPU version '20'.

Command Registers (Read / Write)

REGISTER (in hex)	FUNCTION	BIT NO.	DESCRIPTION
001*	Operational Signals	0	Forward operation
		1	Reverse Operation
		2	Closed External Terminal 3
		3	Closed External Terminal 4
		4	Closed External Terminal 5
		5	Closed External Terminal 6
		6	Closed External Terminal 7
		7	Closed External Terminal 8
002*	Frequency Reference / Output Frequency		1 Hz / 100 **(1)**
003			
004			
005	Not Supported		will return zeros
006	Not Supported		will return zeros
007	Analog Output 1 Setting		–10V / –660 to +10V / +660 analog output on terminals 21 & 22 **(5)**
008	Analog Ouptut 2 Setting		–10V / –660 to +10V / +660 analog output on terminals 22 & 23 **(6)**
009	Contact Output Setting	0	Multi-function Contact Output (terminals 9 & 10): “closed” **(2)**
		1	Multi-function Contact Output (terminals 25 & 27): “closed” **(3)**
		2	Multi-function Contact Output (terminals 26 & 27): “closed” **(4)**
		3	not used
		4	not used
		5	not used
		6	Fault Contact code
		7	Fault Contact state (effective only when bit 6 = ‘1’)
00A-00Fh	Reserved		return all zeros

Notes:

1. Desired frequency of 35.75 Hz requires a value of 3575 in register data code 002h. Scaling depends on the setting of o1-03.
2. Effective when H2-01 = 0Fh.
3. Effective when H2-02 = 0Fh.
4. Effective when H2-03 = 0Fh.
5. Effective when H4-01 = 1Fh.
6. Effective when H4-04 = 1Fh.

* Set parameter o2-09 to ‘1’ so that the Modbus Register Address of the Operation Signals register is 01h and the Frequency Reference register is 02h. The Modbus Register Address for Operation Signals register is 00h and the Frequency Reference is 01h for flash software versions previous to ‘1024’ and CPU version ‘20’.

REGISTER (in hex)	FUNCTION	BIT NO.	DESCRIPTION
010h	Status Signal	0	Run Command
		1	At zero speed
		2	Reverse Operation
		3	Reset Signal Input
		4	Speed Agreed
		5	Drive Ready
		6	Minor Fault
		7	Major Fault
		8-15	will return zeros
011h	Drive Fault Contents	0	oPE Error
		1	not used
		2	Program Mode
		3	1CN Status:
		4	**01**=JVOP132 / **00**=JVOP130(std. operator) / **11**=Personal Computer / **10**=JVOP100
		5-15	not used
012h	oPE No.		oPE Error Code (oPE01=1, oPE02=2, oPE03=3, oPE06=6, oPE10=10, oPE11=11)
013h	not used		will return zeros
014h	Fault Content 1	0	Fuse Blown (FU)
		1	DC Bus Undervoltage (UV1)
		2	Control Power Supply Undervoltage (UV2)
		3	Main Circuit Answerback (UV3)
		4	Short Circuit (SC)
		5	Ground Fault (GF)
		6	Overcurrent (oC)
		7	Overvoltage (oV)
		8	Heatsink Overtemperature (oH)
		9	Drive Overheat (oH1)
		10	Motor Overload (oL1)
		11	Drive Overload (oL2)
		12	Overtorque 1 (oL3)
		13	Overtorque 2 (oL4)
		14	Dynamic Braking Transistor (RR)
		15	Dynamic Braking Resistor (RH)

REGISTER (in hex)	FUNCTION	BIT NO.	DESCRIPTION
015h	Fault Content 2	0	External Fault 3 (EF3)
		1	External Fault 4 (EF4)
		2	External Fault 5 (EF5)
		3	External Fault 6 (EF6)
		4	External Fault 7 (EF7)
		5	External Fault 8 (EF8)
		6	not used
		7	Overspeed (oS)
		8	Speed Deviation (DEV)
		9	PG Open (PGo)
		10	Input Phase Loss (PF)
		11	Output Phase Loss (LF)
		12	DCCT Fault (CF)
		13	Operator Disconnected (OPR)
		14	EEPROM Write-in Fault (ERR)
		15	not used
016h	Fault Content 3	0	Modbus Communication Error (CE)
		1	not used
		2	not used
		3	not used
		4	Control Fault (CF)
		5	Zero Servo Fault (SVE)
		6-15	not used
017h	CPF Content 1	0	not used
		1	not used
		2	CPF02 Fault
		3	CPF03 Fault
		4	CPF04 Fault
		5	CPF05 Fault
		6	CPF06 Fault
		7-15	not used

REGISTER (in hex)	FUNCTION	BIT NO.	DESCRIPTION
018h	CPF Content 2	0	CPF20 Fault
		1	CPF21 Fault
		2	CPF22 Fault
		3	CPF23 Fault
		4-15	not used
019h	Minor Fault Content 1	0	Undervoltage Detection (UV)
		1	Overvoltage Detection (oV)
		2	Heatsink Overtemperature (oH)
		3	Drive Overheat Alarm (oH1)
		4	Overtorque 1 Detection (oL3)
		5	Overtorque 2 Detection (oL4)
		6	2-wire Sequence Input Fault (EF)
		7	During External Baseblock (BB)
		8	External Fault 3 (EF3)
		9	External Fault 4 (EF4)
		10	External Fault 5 (EF5)
		11	External Fault 6 (EF6)
		12	External Fault 7 (EF7)
		13	External Fault 8 (EF8)
		14	Cooling Fan Fault (FAN)
		15	Overspeed (oS)
01Ah	Minor Fault Content 2	0	Speed Deviation (DEV)
		1	PG Open (PGo)
		2	Operator Disconnected (OPR)
		3	Modbus Communication Error (CE)
		4	not used
		5	not used
		6	Motor Overload (oL1)
		7	Drive Overload (oL2)
		8-15	not used

Drive Parameter Registers (U1-XX / Monitor Only)

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	BIT NO.	LIMITS / DESCRIPTION
020h	U1-01	Frequency Reference	Frequency Reference of drive (0.1 Hz) **(1)**		
021h	U1-02	Output Frequency	Output Frequency of drive (0.1 Hz) **(1)**		
022h	U1-03	Output Current	Drive rating / 8192		
023h	U1-04	Control Method	0		V/f Control
			1		V/f with PG Feedback
			2		Open Loop Vector
			3		Flux Vector
024h	U1-05	Motor Speed	Motor Speed (in 0.1 Hz)		
025h	U1-06	Output Voltage	Output Voltage (in 0.1 V)		
026h	U1-07	DC Bus Voltage	DC Bus Voltage (in 1 V)		
027h	U1-08	Output Power	Output Power (in 0.1 kW)		
028h	U1-09	Torque Reference	Torque Reference (in 0.1%)		
029h	U1-10	Input Terminal Status		0	Input Terminal 1 closed
				1	Input Terminal 2 closed
				2	Input Terminal 3 closed
				3	Input Terminal 4 closed
				4	Input Terminal 5 closed
				5	Input Terminal 6 closed
				6	Input Terminal 7 closed
				7	Input Terminal 8 closed
02Ah	U1-11	Output Terminal Status		0	Control Circuit terminals 9 & 10: ìClosedî
				1	Control Circuit terminals 25 & 27: ìClosedî
				2	Control Circuit terminals 26 & 27: ìClosedî
				3-6	not used
				7	Control Circuit terminals 18 & 20: ìClosedî

Notes (for this page only):

1. Scaling depends on setting of o1-03.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	BIT NO.	LIMITS / DESCRIPTION
02Bh	U1-12	Operation Status		0	Run
				1	Zero-Speed
				2	Reverse Run
				3	Reset Signal Input
				4	Speed Agree
				5	Drive Operation Ready
				6	Minor Fault
				7	Major Fault
02Ch	U1-13	Elapsed Time	hours		
02Dh	U1-14	Software No. (CPU ID No.)	software version number		
02Eh	U1-15	Control Circuit Term 13 Input Voltage	Input voltage signal at terminal 13 (+10V / +100.0% ~ -10V / -100.0%)		
02Fh	U1-16	Control Circuit Term 14 Input Voltage	Input voltage or mAmp signal at terminal 14 (+10V / +100.0% ~ -10V / -100.0%) or (4mA / 0.0% ~ 20mA / 100.0%)		
030h	U1-17	Control Circuit Term 16 Input Voltage	Input voltage signal at terminal 16 (+10V / +100.0% ~ -10V / -100.0%)		
031h	U1-18	Motor Secondary Current (Iq)	Motor Secondary Current-Iq (0.1%)		
032h	U1-19	Motor Exciting Current (Id)	Motor Rated Primary Current-Id (0.1%)		
033h	U1-20	Output Frequency after Soft-start	Max. Output Frequency (0.01 Hz)		
034h	U1-21	Automatic Speed Regulator (ASR) Input	ASR Input (0.01%)		
035h	U1-22	Automatic Speed Regulator (ASR) Output	ASR Output (0.01%)		
036h	U1-23	Speed Deviation Regulator Input	Speed Deviation Regulator Input (0.01%)		
037h	U1-24	PID Feedback Amount	PID Feedback Amount (0.01%)		
038h	U1-25	DI - 16 H Input Status	displays an input value according to the setting of F3-01		
039h	U1-26	Output Voltage Reference Vq	Output Voltage-Vq (0.1V)		
03Ah	U1-27	Output Voltage Reference Vd	Output Voltage-Vd (0.1V)		
03Bh	U1-28	Software No. CPU	processor version number		
03Dh	U1-32	ACR Output q Axis	ASR Output q Axis (0.1%)		
03Eh	U1-33	ACR Output d Axis	ASR Output d Axis (0.1%)		
03Fh	U1-34	OPE Detected	parameter setting error		

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	BIT NO.	LIMITS / DESCRIPTION
080h	U2-01	Current Fault	Code of current fault **(1)**		
081h	U2-02	Last Fault	Code of second to current fault **(1)**		
082h	U2-03	Frequency Ref. at Fault	Frequency Reference at the time of the current fault (0.0 to 400.0 Hz)		
083h	U2-04	Output Frequency at Fault	Output Frequency at the time of current fault (0.0 to 400.0 Hz)		
084h	U2-05	Output Current at Fault	Output Current at the time of current fault (drive rating /8192)		
085h	U2-06	Motor Speed at Fault	Motor Speed at the time of current fault (in 0.1 Hz)		
086h	U2-07	Output Voltage at Fault	Output Voltage at the time of current fault (in 0.1 V)		
087h	U2-08	DC Bus Voltage at Fault	Output Voltage at the time of current fault (in 1 V)		
088h	U2-09	Output kWatts at Fault	Output Power at the time of current fault (in 0.1 kW)		
089h	U2-10	Torque Reference at Fault	Torque Reference at the time of current fault (in 0.1%)		
08Ah	U2-11	Input Terminal Status at Fault		0	Input Terminal 1 closed at time of fault
				1	Input Terminal 2 closed at time of fault
				2	Input Terminal 3 closed at time of fault
				3	Input Terminal 4 closed at time of fault
				4	Input Terminal 5 closed at time of fault
				5	Input Terminal 6 closed at time of fault
				6	Input Terminal 7 closed at time of fault
				7	Input Terminal 8 closed at time of fault
08Bh	U2-12	Output Terminal Status at Fault		0	Control Circuit terminals 9 & 10: ìClosedî
				1	Control Circuit terminals 25 & 27: ìClosedî
				2	Control Circuit terminals 26 & 27: ìClosedî
				3-6	not used
				7	Control Circuit terminals 18 & 20: ìClosedî

Notes (for this page only):

1. List of Drive Error Codes can be found in Chapter 8, Error Codes and Troubleshooting.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	BIT NO.	LIMITS / DESCRIPTION
08Ch	U2-13	Drive Status at Fault		0	Running at the time of fault
				1	Zero-Speed at the time of fault
				2	Reverse Running at the time of fault
				3	Reset Signal Input at the time of fault
				4	Speed Agree at the time of fault
				5	Drive Operation Ready at the time of fault
				6	Minor Fault
				7	Major Fault
08Dh	U2-14	Elapsed Time at Fault	Elapsed Time at the time of fault (in hrs.)		
090h	U3-01	Last Fault	Code of the most recent fault **(1)**		
091h	U3-02	Fault Message 2	Code of the second to most recent fault **(1)**		
092h	U3-03	Fault Message 3	Code of the third to most recent fault **(1)**		
093h	U3-04	Fault Message 4	Code of the fourth to most recent fault **(1)**		
094h	U3-05	Elapsed Time 1	Elapsed Time at the most recent fault occurrence		
095h	U3-06	Elapsed Time 2	Elapsed Time at the second to most recent fault occurrence		
096h	U3-07	Elapsed Time 3	Elapsed Time at the third to most recent fault occurrence		
097h	U3-08	Elapsed Time 4	Elapsed Time at the fourth to most recent fault occurrence		

Notes (for this page only):
1. List of Drive Error Codes can be found in Chapter 8, Error Codes and Troubleshooting.

Drive Parameter Registers (Read/Write)

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
100h	A1-00	Language Selection	0	English	0
			1	Japanese	
101h	A1-01	Parameter Access Level	0	Monitor Only	2
			1	User Program	
			2	Quick-start	
			3	Basic	
			4	Advanced	
102h	A1-02	Control Method Selection	0	V/f Control	2
			1	V/f with PG Feedback	
			2	Open Loop Vector	
			3	Flux Vector	
103h	A1-03	Initialize Parameters	0000	No Initialize	0000
			1110	User Initialize	
			2220	2-wire Initialize	
			3330	3-wire Initialize	
104h	A1-04	Enter Password	0000 to 9999		0000

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
180h	b1-01	Reference Selection	0	Digital Operator	1
			1	Terminal	
			2	Serial Communication	
			3	Option PCB	
181h	b1-02	Operation Method Selection	0	Digital Operator	1
			1	Terminal	
			2	Serial Communication	
			3	Option PCB	
182h	b1-03	Stopping Method Selection	0	Ramp to Stop	0
			1	Coast to Stop	
			2	DC Injection to Stop	
			3	Coast with Timer	
183h	b1-04	Reverse Operation Prohibit	0	Enable Reverse Operation	0
			1	Disable Reverse Operation	
184h	b1-05	Zero Speed Operation (level determined by E1-09)	0	Run at Frequency Reference	0
			1	Stop	
			2	Run at Min. Frequency (E1-09)	
			3	Run at Zero Speed	
185h	b1-06	Logic Input Scan Rate	0	2ms - 2 scans	1
			1	5ms - 2 scans	
186h	b1-07	Local / Remote RUN Selection	0	Cycle External Run	0
			1	Accept External Run	
187h	b2-01	DC Injection Braking Start Frequency	0.0 to 10.0 Hz		0.5
188h	b2-02	DC Injection Braking Current	0 - 100%		50
189h	b2-03	DC Injection Braking Time at Start	0.00 - 10.00 seconds		0.00
18Ah	b2-04	DC Injection Braking Time at Stop	0.00 - 10.00 seconds		0.00
18Bh-18Dh		*Reserved*			

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
18Eh	b3-01	Speed Search Selection	0	Disabled	0
			1	Enabled	
18Fh	b3-02	Speed Search Current	0 to 200%		150
190h	b3-03	Speed Search Decel Time	0.0 to 10.0 seconds		2.0
191h		*Reserved*			
192h	b4-01	Timer Function ON-Delay Time	0.0 to 300.0 seconds		0.0
193h	b4-02	Timer Function OFF-Delay Time	0.0 to 300.0 seconds		0.0
194h	b5-01	PID Control Mode Selection	0	Disabled	0
			1	Enabled (D=Feedback)	
			2	Enabled (D=Feed Forward)	
195h	b5-02	PID Proportional Gain	0.00 to 10.00		1.00
196h	b5-03	PID Integral Time	0.0 to 360.0 seconds		1.0
197h	b5-04	PID Integral Limit	0.0 to 100.0%		100.0
198h	b5-05	PID Differential Time	0.00 to 10.00 seconds		0.00
199h	b5-06	PID Output Limit	0.0 to 100.0%		100.0
19Ah	b5-07	PID Offset Adjustment	-100.0 to +100.0%		0.0
19Bh	b5-08	PID Primary Delay	0.00 to 10.00 seconds		0.00
19Ch	b6-01	Dwell Frequency at Start	0.0 to 400.0 Hz		0.0
19Dh	b6-02	Dwell Time at Start	0.0 to 10.0 seconds		0.0
19Eh	b6-03	Dwell Frequency at Stop	0.0 to 400.0 Hz		0.0
19Fh	b6-04	Dwell Time at Stop	0.0 to 10.0 seconds		0.0
1A0h	b7-01	Droop Control Gain	0.0 to 100.0		0.0
1A1h	b7-02	Droop Control Delay Time	0.03 to 2.00 seconds		0.05
1A2h	b8-01	Energy Saving Gain	0 to 100%		80
1A3h	b8-02	Energy Saving Frequency	0.0 to 400.0 Hz		0.0
1A4h	b9-01	Zero-Servo Gain	0 to 100		5
1A5h	b9-02	Zero-Servo Completion Width	0 to 16383		10

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
200h	C1-01	Acceleration Time 1	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
201h	C1-02	Deceleration Time 1	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
202h	C1-03	Acceleration Time 2	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
203h	C1-04	Deceleration Time 2	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
204h	C1-05	Acceleration Time 3	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
205h	C1-06	Deceleration Time 3	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
206h	C1-07	Acceleration Time 4	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
207h	C1-08	Deceleration Time 4	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
208h	C1-09	Fast Stop Deceleration Time	0.00 to 600.00 or 0.0 to 6000.0 seconds **(1)**		10.0 **(1)**
209h	C1-10	Accel / Decel Time Setting Unit	0	0.01 seconds	1
			1	0.1 seconds	
20Ah	C1-11	Accel / Decel Time Switching Freq.	0.0 to 400.0 Hz		0.00
20Bh	C2-01	S-curve Characteristic at Accel Start	0.0 to 2.50 seconds		0.20
20Ch	C2-02	S-curve Characteristic at Accel End	0.0 to 2.50 seconds		0.20
20Dh	C2-03	S-curve Characteristic at Decel Start	0.0 to 2.50 seconds		0.20
20Eh	C2-04	S-curve Characteristic at Decel End	0.0 to 2.50 seconds		0.20
20Fh	C3-01	Slip Compensation Gain	0.0 to 2.5		**(2)**
210h	C3-02	Slip Compensation Primary Delay Time	0 to 10000 msec.		**(2)**
211h	C3-03	Slip Compensation Limit	0 to 250%		200
212h	C3-04	Slip Compensation Selection during Regeneration	0	Disabled	0
			1	Enabled	

Notes (for this page only):
1. Values are dependent upon C1-10 setting.
2. Initial setting differs depending on the Control Method (A1-02).

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
213h	C4-01	Torque Compensation Gain	0.00 to 2.50		1.00
214h	C4-02	Torque Compensation Time Constant	0 to 10000		**(1)**
215h	C5-01	ASR Proportional Gain 1	0.00 to 300.00		**(1)**
216h	C5-02	ASR Integral Time 1	0.0000 to 10.000 seconds		**(1)**
217h	C5-03	ASR Proprotional Gain 2	0.00 to 300.00		**(1)**
218h	C5-04	ASR Integral Time 2	0.0000 to 10.000 seconds		**1)**
219h	C5-05	Automatic Speed Regulator (ASR) Output Limit	0.0 to 20.0%		5.0
21Ah	C5-06	ASR Primary Delay Time	0.000 to 0.500 seconds		0.004
21Bh	C5-07	ASR Switching Frequency	0.0 to 400.0 Hz		0.0
21Ch	C6-01	Carrier Frequency Upper Limit	0.4 to 15.0 kHz **(2)**		15.0 **(2)**
21Dh	C6-02	Carrier Frequency Lower Limit	0.4 to 15.0 kHz **(2)**		15.0 **(2)**
21Eh	C6-03	Carrier Frequency Proportional Gain	00 to 99 **(2)**		00 **(2)**
21Fh	C7-01	Hunting Prevention Selection	0, 1		1
220h	C7-02	Hunting Prevention Gain	0.00 to 2.50		1.00
221h		*Reserved*			
222-229h		*Reserved*			
22Ah	C8-08	AFR Gain	0.00 to 10.00		1.00
22B-23Fh		*Reserved*			
240h	C8-30	Carrier in Tune	0	Fc = 2kHz	0
			1	Fc = C6-01	

Notes (for this page only):

1. Initial value differs depending on the Control Method (A1-02).
2. Setting range and initial value differ depending on the drive capacity and Control Method.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
280h	d1-01	Frequency Reference 1	0.00 to 400.00 Hz **(1)**		0.00
281h	d1-02	Frequency Reference 2	0.00 to 400.00 Hz **(1)**		0.00
282h	d1-03	Frequency Reference 3	0.00 to 400.00 Hz **(1)**		0.00
283h	d1-04	Frequency Reference 4	0.00 to 400.00 Hz **(1)**		0.00
284h	d1-05	Frequency Reference 5	0.00 to 400.00 Hz **(1)**		0.00
285h	d1-06	Frequency Reference 6	0.00 to 400.00 Hz **(1)**		0.00
286h	d1-07	Frequency Reference 7	0.00 to 400.00 Hz **(1)**		0.00
287h	d1-08	Frequency Reference 8	0.00 to 400.00 Hz **(1)**		0.00
288h	d1-09	Jog Frequency Reference	0.00 to 400.00 Hz **(1)**		6.00
289h	d2-01	Frequency Reference Upper Limit	0.0 to 110.0%		100.0
28Ah	d2-02	Frequency Reference Lower Limit	0.0 to 100.0 %		0.0
28Bh	d3-01	Critical Frequency Rejection 1	0.0 to 400.0 Hz		0.0
28Ch	d3-02	Critical Frequency Rejection 2	0.0 to 400.0 Hz		0.0
28Dh	d3-03	Critical Frequency Rejection 3	0.0 to 400.0 Hz		0.0
28Eh	d3-04	Critical Frequency Rejection Width	0.0 to 20.0 Hz		1.0
28Fh	d4-01	Frequency Reference Hold Function Selection	0	Disabled	0
			1	Enabled	
280h	d4-02	Speed Limits	0 to 100%		25
291h	d5-01	Torque Control Selection	0	Speed Control	0
			1	Torque Control	
292h	d5-02	Torque Reference Delay Time	0 to 1000 msec.		0
293h	d5-03	Speed Limit Selection	1	Analog Input (term. 13 & 14)	1
			2	d5-04 setting	
294h	d5-04	Speed Limit	–120 to +120%		0
295h	d5-05	Speed Limit Bias	0 to 120%		10
296h	d5-06	Speed/Torque Control Switching Timer	0 to 1000 msec.		0

Notes (for this page only):

1. Scaling depends on the setting of o1-03.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
300h	E1-01	Input Voltage Setting	155 to 255V (230V unit) 310 to 510V (460V unit)		230 460
301h	E1-02	Motor Selection	0	General Purpose Motor (TEFC)	0
			1	Blower Cooled Motor (TENV or TEBC)	
302h	E1-03	V/f Pattern Selection	0 to Eh	15 preset V/f patterns	Fh
			Fh	Custom Pattern (using E1-04 to E1-10)	
303h	E1-04	Maximum Oootput Frequency	50.0 to 400.0 Hz		60.0
304h	E1-05	Maximum Voltage	0.0 to 255.0V (230V unit) 0.0 to 510.0V (460V unit)		230.0 460.0
305h	E1-06	Maximum Voltage Frquency	0.0 to 400.0 Hz		60.0
306h	E1-07	Mid. Output Frequency	0.0 to 400.0 Hz		**(1)**
307h	E1-08	Mid. Output Frqeuency Voltage	155 to 250V (230V unit) 310 to 510V (460V unit)		**(1)**
308h	E1-09	Min. Output Frequency	0.0 to 400.0 Hz		**(1)**
309h	E1-10	Min. Output Frequency Voltage	155.0 to 255.0V (230V unit) 310.0 to 510.0V (460V unit)		**(1)**
30Ah	E1-11	Mid. Frequency B	0.0 to 400.0 Hz		0.0
30Bh	E1-12	Mid. Voltage B	0.0 to 255.0 VAC		0.0
30Ch	E1-13	Base Voltage	0.0 to 255.0 VAC		0.0
30Dh		*Reserved*			
30Eh	E2-01	Motor Rated Current	0.00 to 99.99 or 100.0 to 1500.0 Amps		**(2)**
30Fh	E2-02	Motor Rated Slip	0.00 to 20.00 Hz		**(2)**
310h	E2-03	Motor no-Load Current	0.00 to 99.99 or 100.0 to 1500.0 Amps		**(2)**
311h	E2-04	Number of Motor Poles	2 to 48 poles		4
312h	E2-05	Motor Line-to-Lline Resistance	0.000 to 65.000 Ohms		**(2)**

Notes (for this page only):

1. Initial value differs depending on the Control Method (A1-02).
2. Initial value differs depending on drive capacity.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
313h	E2-06	Motor Leakage Inductance	0.0 to 30.0%		**(2)**
314h	E2-07	Motor Iron-core Saturation Coefficient 1	0.00 to 0.50		0.50
315h	E2-08	Motor Iron-core Saturation Coefficient 2	0.00 to 0.75		0.75
316h	E2-09	Motor Mechanical Loss	0.0 to 10.0%		0.0
317h	E3-01	Motor 2 Control Method Selection	0	V/f Control	2
			1	V/f with PG Feedback	
			2	Open Loop Vector	
			3	Flux Vector	
318h	E4-01	Motor 2 Max. Output Frequency	50.0 to 400.0 Hz		7
319h	E4-02	Motor 2 Maximum Voltage	0.0 to 255.0V (230V unit) 0.0 to 510.0V (460V unint)		230.0 460.0
31Ah	E4-03	Motor 2 Max. Voltage Frequency	0.0 to 400.0 Hz		60.0
31Bh	E4-04	Motor 2 Mid. Output Frequency	0.0 to 400.0 Hz		**(1)**
31Ch	E4-05	Motor 2 Mid. Output Freq. Voltage	0.0 to 255.0V (230V unit) 0.0 to 510.0V (460V unint)		**(1)**
31Dh	E4-06	Motor 2 Min. Output Frequency	0.0 to 400.0 Hz		**(1)**
31Eh	E4-07	Motor 2 Min. Output Freq. Voltage	0.0 to 255.0V (230V unit) 0.0 to 510.0V (460V unint)		**(1)**
31Fh	E5-01	Motor 2 Rated Current	0.00 to 99.99 or 100.0 to 1500.0 Amps		**(2)**
320h	E5-02	Motor 2 Rated Slip	0.00 to 20.00 Hz		**(2)**
321h	E5-03	Motor 2 No-Load Current	0.00 to 99.99 or 100.0 to 1500.0 Amps		**(2)**
322h	E5-04	Motor 2 Number of Poles	2 to 48 poles		4
323h	E5-05	Motor w Line-to-Line Resistance	0.000 to 65.000 Ohms		**(2)**
324h	E5-06	Motor 2 Leakage Inductance	0.0 to 30.0%		**(2)**

Notes (for this page only):
1. Initial value differs depending on the Control Method (A1-02).
2. Initial value differs depending on drive capacity (o2-04).

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
380h	F1-01	Encoder (PG) Constant	0 to 60000 ppr		600
381h	F1-02	Operation Selection at PG Open Circuit	0	Ramp to Stop	1
			1	Coast to Stop	
			2	Fast-Stop	
			3	Alarm Only	
382h	F1-03	Operation Selection at Overspeed	0	Ramp to Stop	1
			1	Coast to Stop	
			2	Fast-Stop	
			3	Alarm Only	
383h	F1-04	Operation Selection at Speed Deviation	0	Ramp to Stop	3
			1	Coast to Stop	
			2	Fast-Stop	
			3	Alarm Only	
384h	F1-05	PG Rotation	0	Counter-clockwise	0
			1	Clockwise	
385h	F1-06	PG Division Rate (PG Pulse Monitor)	1 to 132 (effective only with PG-B2 control board)		1
386h	F1-07	Integral Value during Accel/Decel Selection	0	Disabled	0
			1	Enabled	
387h	F1-08	Overspeed Detection Level	0 to 120%		115
388h	F1-09	Overspeed Detection Delay Time	0.0 to 2.0 seconds		**(1)**
389h	F1-10	Excessive Speed Deviation Detection Level	0 to 50%		10
38Ah	F1-11	Excessive Speed Deviation Detection Delay Time	0.0 to 10.0 seconds		0.5
38Bh	F1-12	Number of PG Gear Teeth 1	0 to 1000		0
38Ch	F1-13	Number of PG Gear Teeth 2	0 to 1000		0
397h	F1-14	PG Open Detection Time	0 to 10.0 seconds		2.0

Notes (for this page only):
1. Initial value differs depending on the control method (A1-02).

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
38Dh	F2-01	AI-14 Bi-polar or Uni-polar Input Selection	0	3-channel Individual	0
			1	3-channel Addition	
38Eh	F3-01	DI-16 Digital Input Option	0	BCD 1%	0
			1	BCD 0.1%	
			2	BCD 0.01%	
			3	BCD 1 Hz	
			4	BCD 0.1 Hz	
			5	BCD 0.01 Hz	
			6	BCD (5DG) 0.01 Hz	
			7	Binary	
38Fh	F4-01	AO-08/AO-12 Channel 1 Monitor Select.	1 to 33h **(1)**		2
390h	F4-02	AO-08/AO-12 Channel 1 Gain	0.00 to 2.50		1.00
391h	F4-03	AO-08/AO-12 Channel 2 Monitor Select.	1 to 33h **(1)**		3
392h	F4-04	AO-08/AO-12 Channel 2 Gain	0.00 to 2.50		0.50
393h	F5-01	DO-02 Channel 1 Output Selection	0 to Fh		0
394h	F5-02	DO-02 Channel 2 Output Selection	0 to Fh		1
395h	F6-01	DO-08 Output Mode Selection	0	8-channel Individual	0
			1	Binary Output	
396h	F7-01	PO-36F Frequency Multiple Selection	0	1 x Output Frequency	1
			1	6 x Output Frequency	
			2	10 x Output Frequency	
			3	12 x Output Frequency	
			4	36 x Output Frequency	

Notes:
1. Range shown is for flash software version ‘1030’ and CPU version ‘30’. Range differs for previous versions.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
400h	H1-01	Multi-function Input (terminal 3)	0 to 77h		24h
401h	H1-02	Multi-function Input (terminal 4)	0 to 77h		14h
402h	H1-03	Multi-function Input (terminal 5)	0 to 77h		3 (or 0) **(1)**
403h	H1-04	Multi-function Input (terminal 6)	0 to 77h		4 (or 3) **(1)**
404h	H1-05	Multi-function Input (terminal 7)	0 to 77h		6 (or 4) **(1)**
405h	H1-06	Multi-function Input (terminal 8)	0 to 77h		8 (or 6) **(1)**
406h	H2-01	Multi-function Output (term. 9 & 10)	0 to 37h		0
407h	H2-02	Multi-function Output (term. 25-27)	0 to 37h		1
408h	H2-03	Multi-function Output (term. 26-27)	0 to 37h		2
409h	H3-01	Auto Speed Reference Signal Level Selection (term. 13)	0	0 to 10 V DC	0
			1	-10 to +10 V DC	
40Ah	H3-02	Auto Speed Reference Signal Gain	0.0 to 1000.0%		100.0
40Bh	H3-03	Auto Speed Reference Signal Bias	-100.0 to +100.0%		0.0
40Ch	H3-04	Multi-function Analog Input 1 Signal Level Selection (term. 16)	0	0 to 10 V DC	0
			1	-10 to +10 V DC	
40Dh	H3-05	Multi-function Analog Input 1 Select.	0 to 1Fh		0
40Eh	H3-06	Multi-function Analog Input 1 Gain	0.0 to 1000.0%		100.0
40Fh	H3-07	Multi-function Analog Input 1 Bias	-100.0 to +100.0%		0.0
410h	H3-08	Multi-function Analog Input 2 Signal Level Selection (term. 14)	0	0 to 10 V DC	2
			1	-10 to +10 V DC	
			2	4 to 20 mA	
411h	H3-09	Multi-function Analog Input 2 Select.	0 to 1Fh		1Fh
412h	H3-10	Multi-function Analog Input 2 Gain	0.0 to 1000.0%		100.0
413h	H3-11	Multi-function Analog Input 2 Bias	-100.0 to +100.0%		0.0
414h	H3-12	Analog Input Filter Time Constant	0.00 to 2.00 seconds		0.00

Notes:
1. Initial value in the parentheses are values obtained at a 3-wire initialization.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
415h	H4-01	Multi-function Analog Monitor 1 Selection (terminal 21)	1 to 31h		2
416h	H4-02	Multi-function Analog Monitor 1 Gain	0.00 to 2.50		1.00
417h	H4-03	Multi-function Analog Monitor 1 Bias	-10.0 to +10.0%		0.0
418h	H4-04	Multi-function Analog Monitor 2 Selection (terminal 23)	1 to 31h		3
419h	H4-05	Multi-function Analog Monitor 2 Gain	0.00 to 2.50		0.50
41Ah	H4-06	Multi-function Analog Monitor 2 Bias	-10.0 to +10.0%		0.0
41Bh	H4-07	Multi-function Analog Monitor Signal Level Selection (terminal 21 & 23)	0	0 to 10 V DC	0
			1	-10 to +10 V DC	
41Ch	H5-01	Serial Communication Address	0 to 1Fh		1Fh
41Dh	H5-02	Serial Communication Baud Rate	0	1200 bps	3
			1	2400 bps	
			2	4800 bps	
			3	9600 bps	
41Eh	H5-03	Serial Communication Parity Selection	0	No Parity	0
			1	Even Parity	
			2	Odd Parity	
41Fh	H5-04	Stopping Method after Serial Communication Error	0	Ramp to Stop	3
			1	Coast to Stop	
			2	Fast-Stop	
			3	Alarm Only	
420h	H5-05	Communication Error (CE) Detection Selection	0	Disabled	1
			1	Enabled	

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
480h	L1-01	Motor Overload Protection Selection	0	Disabled	1
			1	Enabled	
481h	L1-02	Motor Overload Protection Time Constant	0.1 to 5.0 minutes		1.0
482h	L2-01	Momentary Power Loss Detection Selection	0	Disabled	0
			1	Power Loss Ride-thru	
			2	CPU Power Active	
483h	L2-02	Momentary Power Loss Ride-thru Time	0.0 to 2.0 seconds		**(1)**
484h	L2-03	Momentary Power Loss Minimum Base Block Time	0.0 to 5.0 seconds		**(1)**
485h	L2-04	Momentary Power Loss Recovery Ramp Time	0.0 to 2.0 seconds		0.3
486h	L2-05	Undervoltage Detection Level	150 to 210V (230V unit) 300 to 420V (460V unit)		190 380
487h	L2-06	KEB Frequency	0.0 to 100.0%		0.0
488h	L3-01	Stall Prevention Selection during Acceleration	0	Disabled	1
			1	General-purpose	
			2	Intelligent **(2)**	
489h	L3-02	Stall Prevention Level during Accel	0 to 200%		170
48Ah	L3-03	Stall Prevention Level during Accel (CHP)	0 to 100%		**(3)**
48Bh	L3-04	Stall Prevention Selection during Deceleration	0	Disabled	1
			1	General-purpose	
			2	Intelligent **(2)**	
48Ch	L3-05	Stall Prevention Selection during Running	0	Disabled	1
			1	Decel time 1	
			2	Decel time 2	

Notes (for this page only):
1. Initial value differs depending on drive capacity.
2. When Vector Control (A1-02 = 2 or 3) is selected, set value 2 (intelligent) cannot be used.
3. Initial value differs depending on control method (A1-02).

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
48Dh	L3-06	Stall Prevention Level during Running	30 to 200%		160
48E-48Fh		*Reserved*			
490h	L4-01	Speed Coincidence Frequency	0.0 to 400.0 Hz		0.0
491h	L4-02	Speed Coincidence Width	0.0 to 20.0 Hz		2.0
492h	L4-03	Speed Coincidence Frequency (+/-)	-400.0 to +400.0 Hz		0.0
493h	L4-04	Speed Coincidence Width (+/-)	0.0 to 20.0 Hz		2.0
494h	L4-05	Frequency Reference Loss Detection	0	Stop	0
			1	Run at 80% of Frequency Reference	
495h	L5-01	Number of Auto Restart Attempts	0 to 10		0
496h	L5-02	Auto Restart Operation Selection	0	No Fault Relay	0
			1	Fault Relay Active	
497h	L5-03	Fault Restart Time	0.5 to 180.0 seconds		10.0
498h	L6-01	Torque Detection Selection 1	0	Disabled	0
			1	Detected during Speed Agree (operation continues)	
			2	Detected during Running (operation continues)	
			3	Detected during Speed Agree (drive faults)	
			4	Detected during Running (drive faults)	
499h	L6-02	Torque Detection Level 1	0 to 300%		150
49Ah	L6-03	Torque Detection Time 1	0.0 to 10.0 seconds		0.1
49Bh	L6-04	Torque Detection Selection 2	0	Disabled	0
			1	Detected during Speed Agree (operation continues)	
			2	Detected during Running (operation continues)	
			3	Detected during Speed Agree (drive faults)	
			4	Detected during Running (drive faults)	

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
49Ch	L6-05	Torque Detection Level 2	0 to 300%		150
49Dh	L6-06	Torque Detection Time 2	0.0 to 10.0 seconds		0.1
49Eh	L7-01	Forward Torque Limit	0 to 300%		200
49Fh	L7-02	Reverse Torque Limit	0 to 300%		200
4A0h	L7-03	Forward Regenerative Torque Limit	0 to 300%		200
4A1h	L7-04	Reverse Regenerative Torque Limit	0 to 300%		200
4A2-4A3h		*Reserved*			
4A4h	L8-01	Internal Dynamic Braking Resistor Protection	0	Not Provided	0
			1	Provided	
4A5h	L8-02	oH (Overheat) Protection Alarm Level	50 to 110 °C		100
4A6h	L8-03	Operation Selection after oH (Overheat) Pre-alarm	0	Ramp to Stop	3
			1	Coast to Stop	
			2	Fast-stop	
			3	Alarm Only	
4A7h		*Reserved*			
4A8h	L8-05	Input Open-phase Protection Selection	0	Disabled	0
			1	Enabled	
4A9h		*Reserved*			
4AAh	L8-07	Output Open-phase Protection Selection	0	Disabled	0
			1	Enabled	
4AB-4B1h		*Reserved*			

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
500h	o1-01	Monitor Selection	4 to 28, 32, 33 **(2)**		6
501h	o1-02	Monitor Selection after Power-up	1	Frequency Reference	1
			2	Output Frequency	
			3	Output Current	
			4	Selected Monitor	
502h	o1-03	Digital Operator Display Selection	0 to 39999		0
503h	o1-04	Digital Operator Display Units	0	Hz	0
			1	RPM	
504h	o1-05	Parameter / Address Display Selection	0	Parameter Number	0
			1	Modbus Address	
505h	o2-01	LOCAL / REMOTE Key Selection	0	Disabled	1
			1	Enabled	
506h	o2-02	STOP Key Function during Remote Run	0	Disabled	1
			1	Enabled	
507h	o2-03	User Parameter Default Value	0	Disabled	0
			1	Set Default	
			2	Clear all	
508h	o2-04	kVA Selection (Drive Model No.)	0 to FFh		**(1)**
509h	o2-05	Digital Operator ìMotor Operated Potî	0	Drive accepts freq. after ENTER key	0
			1	Drive accepts freq. immediately	

Notes (for this page only):

1. Not initialized. Initial value differs depending on the drive capacity.
2. Range shown is for flash software version‘1030’ and CPU version ‘30’. Range differs for previous versions.

REGISTER (in hex)	PARAMETER	PARAMETER FUNCTION	PARAMETER SETTING	LIMITS / DESCRIPTION	INITIAL VALUE
50Ah	o2-06	Operation Selection when Digital Operator is disconnected	0	Disabled (operation continues)	0
			1	Enabled (motor coast to stop; fault)	
50Bh	o2-07	Elapsed Operating Hour Timer Set	0 to 65535 hours		-
50Ch	o2-08	Elapsed Operating Hour Timer Selection	0	Timer active when power applied to drive	0
				Timer active when drive is in run mode	
50Dh	o2-09	Initialization Mode Selection	0	Japanese Spec.	1
			1	American Spec.	
			2	European Spec.	

Special Registers (Read / Write)

REGISTER (in hex)	FUNCTION	DATA SET	DESCRIPTION
FFDDh	ACCEPT	0	Activates newly written data
FFFDh	ENTER	0	Activates newly written data and saves to Non-Volatile memory

Chapter 8
Error Codes and Troubleshooting

- Communication Error (CE)
- Modbus Error Codes
- *Figure 8-1. Fault Response Message*
- GPD 515 Failure Codes

Communication Error

Once the data, sent from the master device, is received the drive, the received data is checked for CRC, parity, overrun, framing, and receiving buffer overflow. If all checked items pass, the data has been received normally. A communication error is declared if any of the checked data does not pass. A time-out detection can also cause a communication error. A time-out occurs if the drive does not receive a valid message addressed to itself within two seconds. A time-out will only cause a communication error if enabled by parameter H5-05 (as shown below).

H5-04 Setting	Description
0	Time-out detection disabled.
1	Time-out detection enabled.

The default setting of H5-05 is ë1í.

The GPD 515 drive will operate according to the setting of parameter H5-04 when a communication error (CE) occurs. The settings of H5-04 are as follows:

H5-04 Setting	Description
0	Deceleration to stop, and the Digital Operator flashes ëCEí.
1	Coast to stop, and the Digital Operator flashes ëCEí.
2	Deceleration to stop (C1-09), and the Digital Operator flashes ëCEí.
3	Operation continues, and the Digital Operator flashes ëCEí.

The default setting of H5-04 is ë3í.

Modbus Error Codes

If there is an error in the command message, an error code will be returned in the response message. A fault response message is structured as follows:

SLAVE ADDRESS		xxh
80h + FUNC. CODE		xxh
ERROR CODE		03h
CRC-16	UPPER	xxh
	LOWER	xxh

Figure 8-1. Fault Response Message

The following table indicates the fault code for the specific type of fault that occurred.

Error Code	Name	Fault Content
01h	Function Error	Function Code other than 3, 8, or 10 (hex)
02h	Register No. Error	Unregistered Register Number
03h	No. of Registers	Number of registers > 16
21h	Data Setting Error	Attempted to write beyond register‘s data limits
22h	Write-in Error	Write function is disabled for specified register

GPD 515 Fault Codes

The GPD 515 drive can have a drive fault, such as undervoltage, overload, external fault, etc. When a drive failure occurs, it can be classified as an alarm, a minor fault, or a major fault. The drive reacts differently with each type of failure. An alarm displays a warning indication, however operation continues. Minor faults allow continued operation, and a contact will close only if one of the multi-function outputs is set up as a minor fault contact. The major faults cause the motor to coast to stop, and the fault signal output is present at terminals 18-20.

The GPD 515‘s parameters U2-01 (Current Fault), U2-02 (Last Fault), and U3-01 through U3-04 (Last Fault; Fault Message 2, 3, & 4) each display a fault code representing the drive failure. The following table indicates the abbreviation displayed on the Digital Operator and the hexadecimal code viewed in drive parameters U2-01, U2-02 and U3-01 when a specific drive failure occurs. The table also indicates whether the drive failure is an A – alarm, m – minor fault, or M – major fault.

Drive Failure	Digital Operator Display	Hexadecimal Code	Alarm, minor fault, or Major Fault
DC Bus Fuse Open	PUF	1	M
DC Bus Undervoltage	UV1	2	A
CTL PS Undervoltage	UV2	3	A
MC Answerback	UV3	4	A
Short Circuit	SC	5	M
Ground Fault	GF	6	M
Overcurrent	oC	7	M
Overvoltage	oV	8	M
Heatsink Overtemperature	oH	9	M
Drive Overheat	oH1	A	M
Motor Overload	oL1	B	M
Drive Overload	oL2	C	M
Overtorque 1	oL3	D	M
Overtorque 2	oL4	E	M
Dynamic Braking Transistor	RR	F	M
Dynamic Braking Resistor	RH	10	M
External Fault 3	EF3	11	M
External Fault 4	EF4	12	m
External Fault 5	EF5	13	m
External Fault 6	EF6	14	m
External Fault 7	EF7	15	m
External Fault 8	EF8	16	m
Reserved		17	-
Overspeed	oS	18	M
Speed Deviation	DEV	19	m
PG Open	PGo	1A	M
Input Phase Loss	PF	1B	M
Output Phase Loss	LF	1C	M
DCCT Fault	CF	1D	M
Operator Disconnected	-	1E	m
EEPROM R/W Error	ERR	1F	m
Reserved		20	-
Modbus Com Error	CE	21	M
Reserved		22 - 24	-
Control Fault	CPFxx	25	M
Zero Servo Fault	SVE	26	M

Note: Further detail on drive failures can be found in Chapter 6 of technical manual TM 4515.

Chapter 9
Command Priority

- Command Priority
- *Table 9-1. Set up for Serial Communication Control*
- *Table 9-2. Set up for External Terminal Control*
- *Table 9-3. Set up for Digital Operator Control*
- *Table 9-4. Set up for Option PC Board Control*

Command Priority

The setting of parameter b1-02 determines the origin of operation commands. This was discussed in detail in Chapter 5, Setting GPD 515 Parameters for Communication. Some commands may be accessed by a source other than the one set up by parameter b1-02, as illustrated in the Tables 9-1, -2, -3, and -4 on the following pages.

How to use the Command Priority Tables:

First, determine the source of control you wish to use for your GPD 515 drive. Then b1-02 should be set up for the desired control you have chosen. (See the table below for parameter settings.) Select the appropriate Command Priority table on the following pages based upon what type of operation your drive is set up for.

Operation Commands			
b1-02	**Run/Stop from:**	**Use Table:**	**On page #:**
3	Option PC Board	9-4	9-6
2	Serial Communication	9-1	9-3
1	External Terminals	9-2	9-4
0	Digital Operator	9-3	9-5

The left hand column of the Command Priority tables is the source of the command (serial communication, external terminals, and the Digital Operator). The middle column lists the functions or commands, and the right most column indicates whether the functions are operational or not available from each source.

Table 9-1: Set up for Serial Communication Control

This table indicates the functions or commands that can be accessed via serial communication, external terminals, or the Digital Operator when the drive is set up for serial communication (b1-02 = 2). The ìOî indicates that the function is Operable from that source, and ìn/aî indicates that the function is not available from that source.

From	Register	Bit No.	Data Description	Function Availability
SERIAL COMM.	001h	0	Run Forward	O
		1	Run Reverse	O
		2	Multi-function Input (terminal 3)	O
		3	Multi-function Input (terminal 4)	O **(1)**
		4	Multi-function Input (terminal 5)	O
		5	Multi-function Input (terminal 6)	O
		6	Multi-function Input (terminal 7)	O
		7	Multi-function Input (terminal 8)	O
		8-15	unused	—
	007h	0-15	Analog Output 1 Setting	O **(6)**
	008h	0-15	Analog Output 2 Setting	O **(7)**
	009h	0	Multi-function Output (terminal 9 & 10)	O **(3)**
		1	Multi-function Output (terminal 25 & 27)	O **(4)**
		2	Multi-function Output (terminal 26 & 27)	O **(5)**
		3-5	unused	—
		6	Fault Contact (terminal 18 & 20)	O
		7	Fault Contact Closed (effective when bit 6 =1)	O
EXTERNAL TERMINALS	Forward Run (2 wire); Run Command (3 wire)			n/a
	Reverse Run (2 wire); Stop Command (3 wire)			n/a
	multi-function input terminal 3			**(2)**
	multi-function input terminal 4			**(2)**
	multi-function input terminal 5			**(2)**
	multi-function input terminal 6			**(2)**
	multi-function input terminal 7			**(2)**
	multi-function input terminal 8			**(2)**
DIGITAL OPERATOR	Run Command			n/a
	Stop Command			O **(8)**
	Reverse Run Command			n/a
	Local / Remote			O **(9)**
	Jog Command			n/a
	Fault Reset			O **(1)**

Notes:

1. Fault Reset (Multi-function Input terminal 4 default setting) is only effective when run command received serially is ì0î while in stopped condition.
2. The availability of the multi-function input terminals vary depending upon the settings of H1-01, H1-02, H1-03, H1-04, H1-05, H1-06 (the multi-function input settings), and A1-02 (Control Method). See technical manual TM 4515.
3. Effective when H2-01 is ì0Fî.
4. Effective when H2-02 is ì0Fî.
5. Effective when H2-03 is ì0Fî.
6. Effective when H4-01 is ì1Fî.
7. Effective when H4-04 is ì1Fî.
8. Effective when o2-02 is ì1î.
9. Effective when o2-01 is ì1î.

Table 9-2: Set up for External Terminals Control

This table indicates the functions or commands that can be accessed via serial communication, external terminals, or the Digital Operator when the drive is set up for external terminal control (b1-02 = 1). The ìOî indicates that the function is Operable from that source, and ìn/aî indicates that the function is not available from that source.

From	Register	Bit No.	Data Description	Function Availability
SERIAL COMM.	001h	0	Run Forward	n/a
		1	Run Reverse	n/a
		2	Multi-function Input (terminal 3)	O
		3	Multi-function Input (terminal 4)	O **(1)**
		4	Multi-function Input (terminal 5)	O
		5	Multi-function Input (terminal 6)	O
		6	Multi-function Input (terminal 7)	O
		7	Multi-function Input (terminal 8)	O
		8-15	unused	—
	007h	0-15	Analog Output 1 Setting	n/a
	008h	0-15	Analog Output 2 Setting	n/a
	009h	0	Multi-function Output (terminals 9 & 10)	n/a
		1	Multi-function Output (terminals 25 & 27)	n/a
		2	Multi-function Output (terminals 26 & 27)	n/a
		3-5		—
		6	Fault Contact (terminals 18 & 20)	n/a
		7	Fault Contact Closed (effective when bit 6=1)	n/a
EXTERNAL TERMINALS	Forward Run (2 wire); Run Command (3 wire)			O
	Reverse Run (2 wire); Stop Command (3 wire)			O
	multi-function input terminal 3			**(2)**
	multi-function input terminal 4			**(2)**
	multi-function input terminal 5			**(2)**
	multi-function input terminal 6			**(2)**
	multi-function input terminal 7			**(2)**
	multi-function input terminal 8			**(2)**
DIGITAL OPERATOR	Run Command			n/a
	Stop Command			O **(3)**
	Reverse Run Command			n/a
	Local / Remote			O **(4)**
	Jog Command			n/a
	Fault Reset			O **(1)**

Notes:

1. Fault Reset (Multi-function Input terminal 4 default setting) is only effective only when external terminal satisfies the following conditions:
   2 wire mode - Both forward run (term. 1) and reverse run (term. 2) commands are closed, or open in stopped condition.
   3 wire mode - Run command (term. 1) or stop command (term. 2) is open in stopped condition.
2. The availability of the multi-function input terminals vary depending upon the setting of A1-02 (Control Method). See technical manual TM 4515.
3. Effective only when o2-02 is ì1î.
4. Effective when o2-01 is î1î.

Table 9-3: Set up for Digital Operator Control

This table indicates the functions or commands that can be accessed via serial communication, external terminals, or the digital operator when the driveís parameter b1-02 is set up for digital operator control (b1-02 = 0). The ìOî indicates that the function is Operable from that source, and ìn/aî indicates that the function is not available from that source.

From	Register	Bit No.	Data Description	Function Availability
SERIAL COMM.	001h	0	Run Forward	n/a
		1	Run Reverse	n/a
		2	Multi-function Input (terminal 3)	O
		3	Multi-function Input (terminal 4)	O **(1)**
		4	Multi-function Input (terminal 5)	O
		5	Multi-function Input (terminal 6)	O
		6	Multi-function Input (terminal 7)	O
		7	Multi-function Input (terminal 8)	O
		8-15	unused	—
	007h	0-15	Analog Output 1 Setting	n/a
	008h	0-15	Analog Output 2 Setting	n/a
	009h	0	Multi-function Output 1	n/a
		1	Multi-function Output 2	n/a
		2	Multi-function Output 3	n/a
		3-5	unused	—
		6	Fault Contact (terminals 18 & 20)	n/a
		7	Fault Contact Closed (effective when bit 6=1)	n/a
EXTERNAL TERMINALS	Forward Run (2 wire); Run Command (3 wire)			n/a
	Reverse Run (2 wire); Stop Command (3 wire)			n/a
	multi-function input terminal 3			**(2)**
	multi-function input terminal 4			**(2)**
	multi-function input terminal 5			**(2)**
	multi-function input terminal 6			**(2)**
	multi-function input terminal 7			**(2)**
	multi-function input terminal 8			**(2)**
DIGITAL OPERATOR	Run Command			O
	Stop Command			O
	Reverse Run Command			O
	Local / Remote			n/a
	Jog Command			O **(3)**
	Fault Reset			O **(1)**

Notes:

1. Fault Reset (Multi-function Input terminal 4 default setting) is only effective only when in stopped condition.
2. The availability of the multi-function input terminals vary depending upon the settings of H1-01, H1-02, H1-03, H1-04, H1-05, H1-06 (the multi-function input settings), and A1-02 (Control Method). See technical manual TM4515.
3. The jog command is only effective when in the stop condition.

Table 9-4: Set up for Option PC Board Control

This table indicates the functions or commands that can be accessed via serial communication, external terminals, or the Digital Operator when the drive is set up for option PC board control (b1-02 = 3). The ìOî indicates that the function is Operable from that source, and ìn/aî indicates that the function is not available from that source.

From	Register	Bit No.	Data Description	Function Availability
SERIAL COMM.	001h	0	Run Forward	O
		1	Run Reverse	O
		2	Multi-function Input (terminal 3)	O
		3	Multi-function Input (terminal 4)	O **(1)**
		4	Multi-function Input (terminal 5)	O
		5	Multi-function Input (terminal 6)	O
		6	Multi-function Input (terminal 7)	O
		7	Multi-function Input (terminal 8)	O
		8-15	unused	—
	007h	0-15	Analog Output 1 Setting	O **(6)**
	008h	0-15	Analog Output 2 Setting	O **(7)**
	009h	0	Multi-function Output (terminal 9 & 10)	O **(3)**
		1	Multi-function Output (terminal 25 & 27)	O **(4)**
		2	Multi-function Output (terminal 26 & 27)	O **(5)**
		3-5	unused	—
		6	Fault Contact (terminal 18 & 20)	O
		7	Fault Contact Closed (effective when bit 6 =1)	O
EXTERNAL TERMINALS	Forward Run (2 wire); Run Command (3 wire)			n/a
	Reverse Run (2 wire); Stop Command (3 wire)			n/a
	multi-function input terminal 3			**(2)**
	multi-function input terminal 4			**(2)**
	multi-function input terminal 5			**(2)**
	multi-function input terminal 6			**(2)**
	multi-function input terminal 7			**(2)**
	multi-function input terminal 8			**(2)**
DIGITAL OPERATOR	Run Command			n/a
	Stop Command			O **(8)**
	Reverse Run Command			n/a
	Local / Remote			O **(9)**
	Jog Command			n/a
	Fault Reset			O **(1)**

Notes:

1 Fault Reset (Multi-function Input terminal 4 default setting) is only effective when run command received via option board is ì0î while in stopped condition.
2. The availability of the multi-function input terminals vary depending upon the settings of H1-01, H1-02, H1-03, H1-04, H1-05, H1-06 (the multi-function input settings), and A1-02 (Control Method). See technical manual TM 4515.
3. Effective when H2-01 is ì0Fî.
4. Effective when H2-02 is ì0Fî.
5. Effective when H2-03 is ì0Fî.
6. Effective when H4-01 is ì1Fî.
7. Effective when H4-04 is ì1Fî.
8. Effective when o2-02 is ì1î.
9. Effective when o2-02 is ì1î.

Appendix A
Product Specifications

The following table indicates the environmental specifications for the CM085 Board.

(CM085) RS-232 to RS-485 Converter Board for GPD 515	
Ambient Temperature	–10 to +40 degrees C (+14 to +104 degrees F)
Storage Temperature	–20 to +60 degrees C (–4 to +140 degrees F)
Relative Humidity	90% noncondensing
Altitude	3300 feet
Vibration	1G at less than 20 Hz, 0.2 G at 20 - 50 Hz

Appendix B
Spare Parts List

Description	Source	Part Number
GPD 515 / Modbus RTU		
RS-232 to RS-485 Converter Board	Yaskawa	CM085
RS-232 Connector Kit for 6CN	Yaskawa	CM087
GPD 515 / Modbus RTU Technical Manual	Yaskawa	TM 4025
Miscellaneous		
GPD 515 Technical Manual	Yaskawa	TM 4515

GPD 515/G5 Modbus RTU

Yaskawa technical support *is available to provide telephone assistance for* ***installation, programming, & troubleshooting*** *of Yaskawa drives. All support is available during normal business hours. Emergency breakdown support is available on a 24 hour / 7 day basis.*

Help us help you. When you call, please have the following information available.

- *Have this manual at hand. The support associate will refer to it.*
- *Drive model and all nameplate data.*
- *Motor type, brand, and all nameplate data.*

For Troubleshooting, additional information may be required.

- *Power distribution information (type – delta, wye; power factor correction; other major switching devices used; voltage fluctuations)*
- *Installation wiring (separation of power & control wire; wire type/class used; distance between drive and motor, grounding.*
- *Use of any devices between the drive & motor (output chokes, etc.).*

Please phone us at 1-800-541-0939 for technical support.

Additional technical information is available at www.drives.com.

YASKAWA
Yaskawa Electric America, Inc.
16555 W. Ryerson Road
New Berlin, WI 53151
(800) 541-0939, (262) 782-0200, Fax (262) 782-3418
www.drives.com • www.yaskawa.com