Modbus Communication Manual
V7 and V74X Drives

Drive Models: CIMR-V7AM* (V7), CIMR-V7CU* (V74X)

Document Number TM.V7.11

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Warnings and Cautions

This Section provides warnings and cautions pertinent to this product that if not heeded, may result in personal injury, fatality, or equipment damage. Yaskawa is not responsible for consequences of ignoring these instructions.

⚠ WARNING

YASKAWA manufactures component parts that can be used in a wide variety of industrial applications. The selection and application of YASKAWA products remains the responsibility of the equipment designer or end user. YASKAWA accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and to fail safely under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to that part's safe use and operation. Any warnings provided by YASKAWA must be promptly provided to the end user. YASKAWA offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the YASKAWA manual. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED. YASKAWA assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

⚠ WARNING

- Read and understand this manual before installing, operating, or servicing this drive. All warnings, cautions, and instructions must be followed. All activity must be performed by qualified personnel. The drive must be installed according to this manual and local code.
- Do not connect or disconnect wiring while the power is on. Do not remove covers or touch circuit boards while the power is on. Do not remove or insert the digital operator while power is on.
- Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. Status indicator LEDs and Digital Operator display will be extinguished when the DC bus voltage is below 50 VDC. To prevent electric shock, wait at least 5 minutes after all indicators are OFF and measure DC bus voltage and verify that it is at a safe level.
- Do not perform a withstand voltage test on any part of the unit. This equipment uses sensitive devices and may be damaged by high voltage.
- The drive is not suitable for circuits capable of delivering more than the specified RMS symmetrical amperes. Install adequate branch short circuit protection per applicable codes. Refer to the specification. Failure to do so may result in equipment damage and/or personal injury.
- Do not connect unapproved LC or RC interference suppression filters, capacitors, or over voltage protection devices to the output of the drive. Capacitors may generate peak currents that exceed drive specifications.
- To avoid unnecessary fault displays, caused by contactors or output switches placed between drive and motor, auxiliary contacts must be properly integrated into the control logic circuit.
- YASKAWA is not responsible for any modification of the product made by the user, doing so will void the warranty. This product must not be modified.
- Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.
- To meet CE directives, proper line filters and proper installation are required.
- Some drawings in this manual may be shown with protective covers or shields removed, to describe details. These must be replaced before operation.
- Observe Electrostatic Discharge Procedures when handling the drive and drive components to prevent ESD damage.
- The attached equipment may start unexpectedly upon application of power to the drive. Clear all personnel from the drive, motor and machine area prior to applying power. Secure covers, couplings, shaft keys, machine beds and all safety equipment before energizing the drive.
- Do not attempt to disassemble this unit. There are no user serviceable parts. Disassembling this unit will void any and all warranties.

Introduction

This manual is intended as a parameter access quick reference guide for the Yaskawa model V7 drive. It describes how to connect the V7 drive to an RS-232, RS-422 or RS-485 network and access parameters and their values. It lists the available parameters, their addresses, limits, available selections and default values. Refer to the ***V7 and V74X Drive User Manual*** for detailed parameter information.

This document pertains to the V7 drive. In this document, the word “inverter”, “ac drive” and “drive” may be used interchangeably.

For details on installation and operation of the V7 drive, refer to the ***V7 and V74X Drive User Manual***. All manuals and support files are available on the CD that came with the V7 drive and are also available for download at **www.yaskawa.com**.

V7 and V74X Drive User Manual document reference **TM.V7.01**

V7 Drive Parameter Access Technical Manual document reference **TM.V7.11**

Table of Contents

Notes:

Chapter 1 - Connections

This chapter describes how to connect the V7 drive to an RS-232, RS-422 or RS-485 network.

Connection Check Sheet

The following is a quick reference guide to connect and configure the V7 drive for network communications. Make a copy of this page and check-off each item as it is completed. For detailed information please refer to the detailed sections that follow. Note that serial (RS-485) communications is not available when a serial communications card is installed.

- ☐ **1:** Unpack the V7 drive and verify that all components are present and undamaged.
- ☐ **2:** Connect power to the V7 drive and verify that the V7 drive functions correctly. This includes running the V7 drive from the operator keypad. Refer to the ***V7 and V74X Drive User Manual*** for information on connecting and operating the V7 drive.
- ☐ **3:** Remove power from the V7 drive and wait for the charge lamp to be completely extinguished. Wait at least five additional minutes for the V7 drive to be completely discharged. Measure the DC bus voltage and verify that it is at a safe level.
- ☐ **4:** Connect the V7 drive to an RS-232 network. *Note: It is not possible to use the drive's keypad and an RS-232 connection at the same time.*
  - ☐ **4.1:** Remove the V7 drive's operator keypad.
  - ☐ **4.2:** Connect the RJ-45 port on the front of the V7 drive to the controller serial port. Use a DB9 to RJ-45 adapter with a standard Ethernet CAT-5 patch cable or use Yaskawa cable UWR00468-2. **Do NOT connect this cable to an Ethernet port** on the controller, as damage to the controller and/or V7 drive may result. Refer to *Figure 1.2 – RS-232 Connections.*
  - ☐ **4.3:** Verify that the controller communications parameters match the V7 drive's communications parameters. Refer to *Table 1.1 – RS-232 (RJ-45 port) Communication Parameters* for a list of default V7 drive communication parameters.
  - ☐ **4.4:** Reapply power to the V7 drive.
- ☐ **5:** Connect the V7 drive to an RS-422/RS-485 network.
  - ☐ **5.1:** Remove the V7 drive's terminal cover.
  - ☐ **5.2:** Connect the controller to the S+/S- and R+/R- terminals on the V7 drive's terminal block as shown in *Figure 1.3 RS-422/RS-485 Connections.*
  - ☐ **5.3:** If this device is either the first or last device on the network, set the network termination switch, SW2, to the ON position.
  - ☐ **5.4:** Reapply power to the V7 drive.
  - ☐ **5.5:** Set the V7 drive communication parameters to match those of the controller. Refer to *Table 1.2 –Baud Rate, Table 1.3 –Parity* and *Table 1.4 – RTS.*
  - ☐ **5.6:** Set the node address of the V7 drive.
- ☐ **6:** Verify that the V7 drive and controller are communicating and that the exchanged data is valid.

Verify Operation

Connect power to the V7 drive and verify that the V7 drive functions properly. This includes running the V7 drive from the operator keypad. Refer to the ***V7 and V74X Drive User Manual***, for information on connecting and operating the V7 drive.

Remove power from the V7 drive and wait for the charge lamp to be completely extinguished. Wait at least five additional minutes for the V7 drive to be completely discharged. Measure the DC bus voltage and verify that it is at a safe level.

Remove the operator keypad and terminal cover.

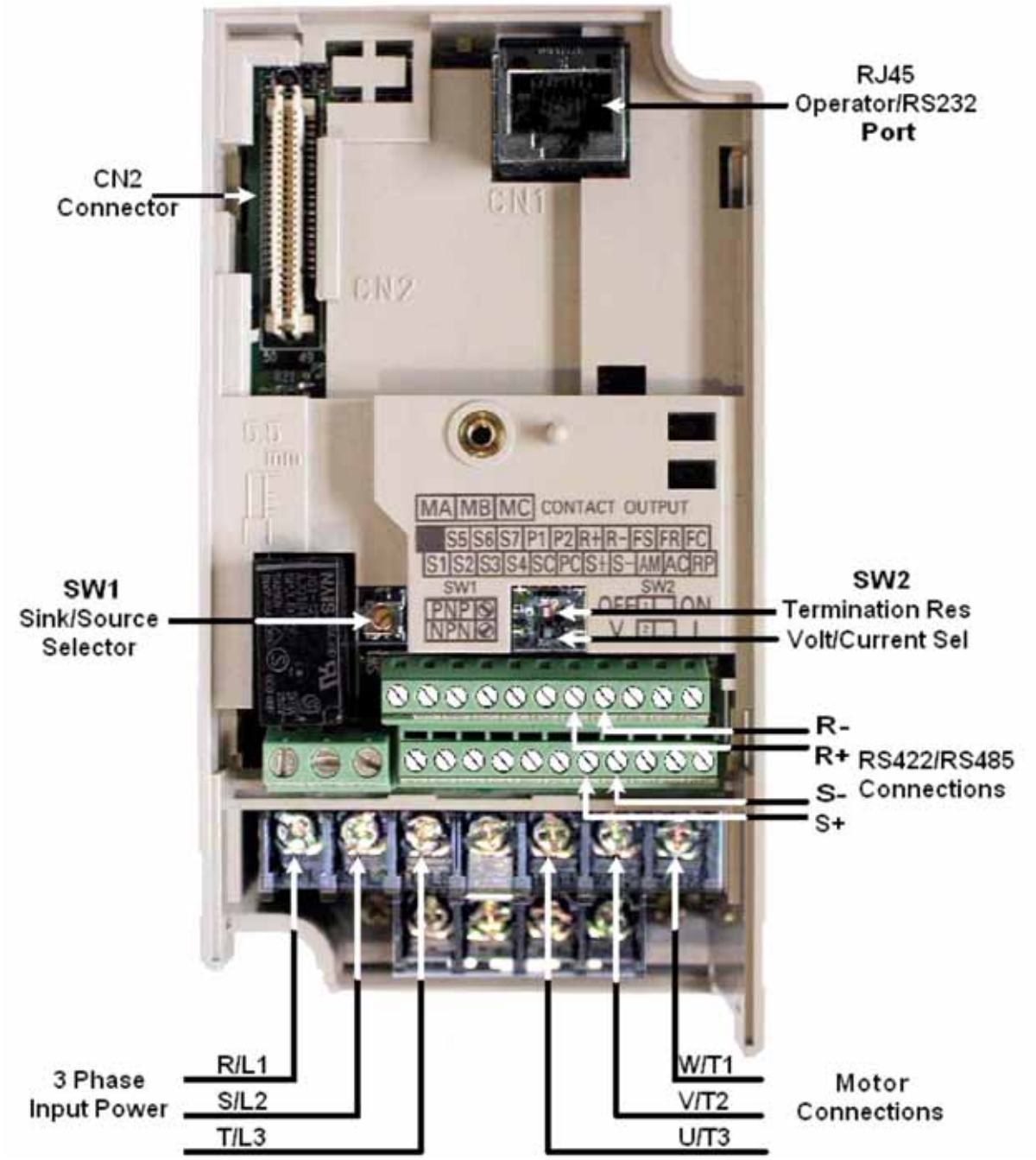

Figure 1.1 Connection Diagram

Network Connections

The following describes how to connect the V7 drive to an RS-232, RS-422 and RS-485 network. For detailed information please refer to the appropriate sections of this manual or the ***V7 and V74X Drive User Manual.***

► RS-232 Network

The RS-232 network is a single ended network with limited data transmission rates and cable lengths. The V7 drive RS-232 data transmission is fixed at 9600bps, no parity, 8 data bits and 1 stop bit. The maximum cable length is 50 ft (16m). It is recommended that Yaskawa cable UWR00468-2 be used. *Note: It is not possible to use the drive's keypad and an RS-232 connection at the same time.*

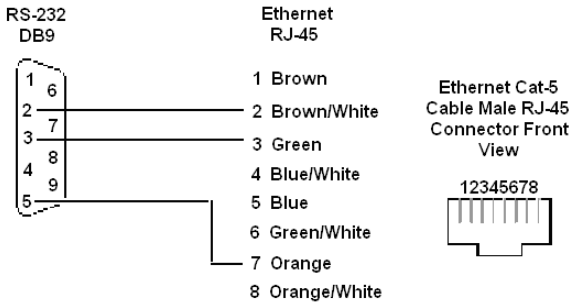

Figure 1.2 RS-232 Network Connection

► RS-422/RS-485 4-Wire Network

RS-422/RS-485 4-wire networks allow for longer cable lengths, maximum 4000 ft (1200 m), and are more immune to noise than RS-232 networks because of their balanced line drivers. RS-422/RS-485 4-wire communication does not require RTS (request to send) control. See parameter n157. Set the Termination Resistor SW2 switch to ON (slide the switch to the right) for each RS-422 device and the last RS-485 device on the network.

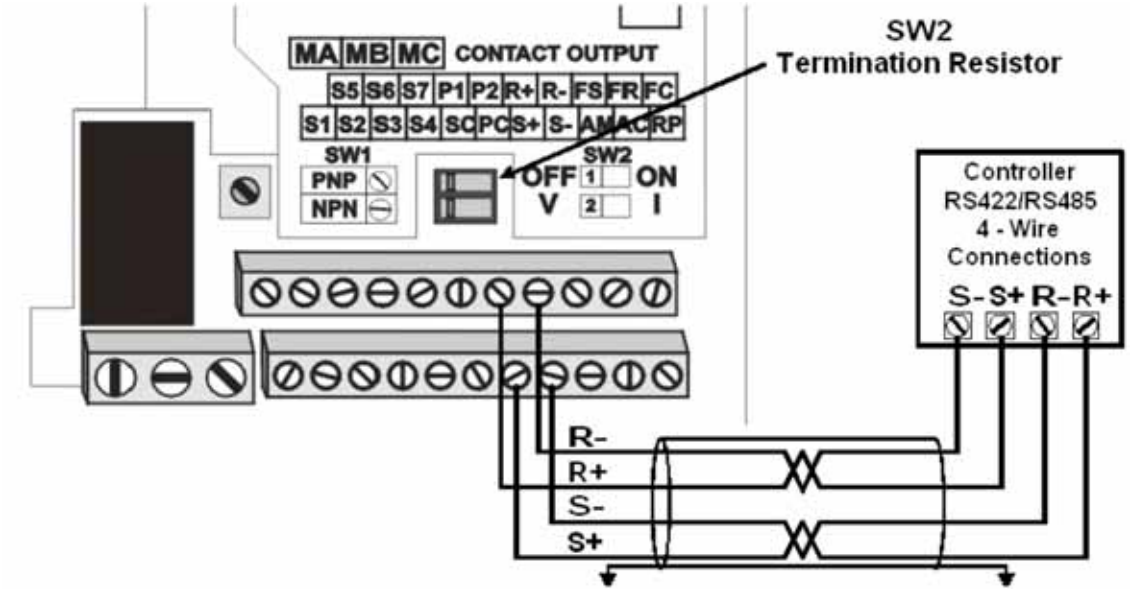

Figure 1.3 RS-422/RS-485 4-Wire Network Connection

► RS-485 2-Wire Network

RS-485 2-wire networks can be either single or multi-drop networks, with each slave device on the network assigned a unique node address. A maximum of 31 devices may reside on any network segment before a repeater is required. The maximum segment length is 4000 ft (1200 m). Set the Termination Resistor SW2 switch to ON (slide the switch to the right) on the last device on the network. RS-485 2-wire communication requires RTS (request to send) control. See parameter n157.

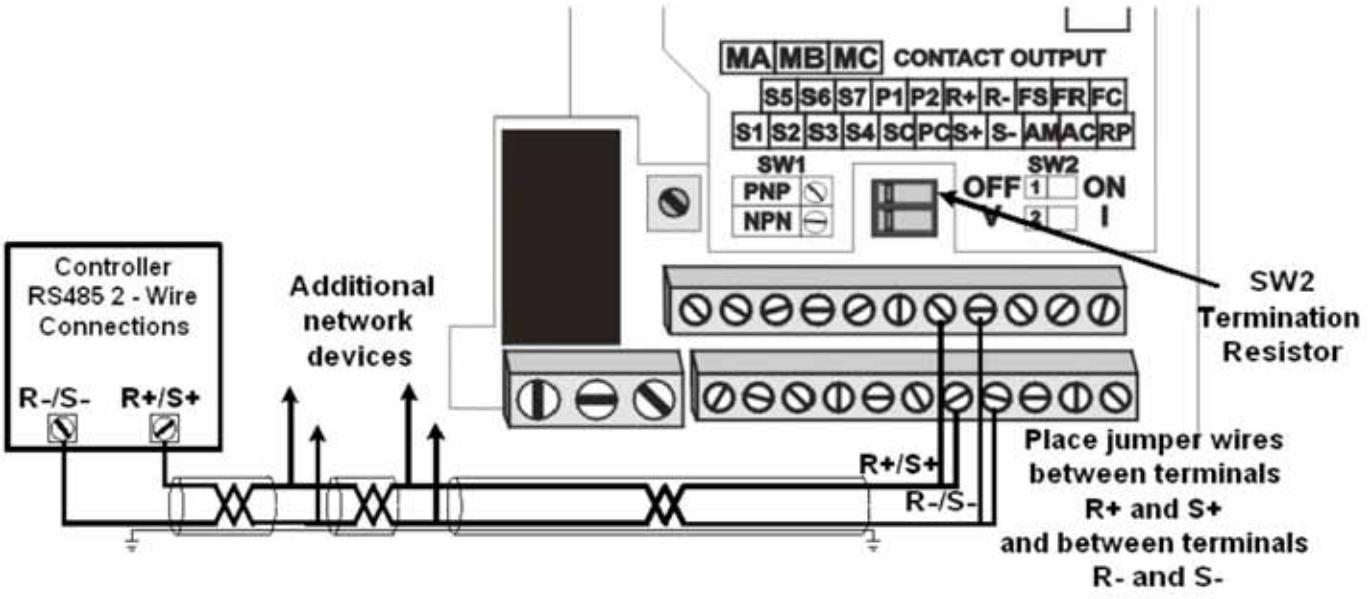

Figure 1.4 RS-485 2–Wire Network Connection

Communication Parameters

These communication parameters affect communication through RS-232, RS-422 and RS-485 networks. The RS-232 communication parameters cannot be changed. Also, the node address is ignored when communicating via RS-232.

All communications parameters can only be changed via the drive keypad.

Note: The drive's power must be cycled before changes to these parameters will be recognized.

► RS-232 Communications

The RS-232 communication parameters are fixed at the values shown below. Although the node address is ignored, a node address of 1 is typically used by the master when communicating to the V7 drive in this method.

Table 1.1 RS-232 (RJ-45 port) Communication Parameters

Value	Description
Baud rate	9600
Parity	None
Stop Bits	1
Node Address	N/A

► RS-422/RS-485 Communication

- **Node Address – n153**. The node address is set through V7 drive parameter n153. When communicating via RS-422 or RS-485, a unique node address between 0 and 20h (32 dec), inclusive, must be entered. The default V7 drive address is 1Fh (31 dec). The address is always entered as a hexadecimal number (refer to the conversion chart in Chapter 4). Address 0 is typically reserved for global messages.
- **Baud rate – n154**. Select the baud rate that matches the controller's communication configuration.

Table 1.2 Baud Rate – Parameter n154

Value	Description
0	1200bps
1	2400bps
2	4800bps
3	9600bps (Default Setting)
4	19,200bps

- **Parity – n155**. Select the parity that matches the controller's communication configuration.

Table 1.3 Parity – Parameter n155

Value	Description
0	None (Default Setting)
1	Even
2	Odd

- **Serial Communication Send Delay – n156**. A delay can be inserted before the V7 drive responds to a command message. This allows for slower communication devices to switch their transceiver state in order to get ready to receive a message. A value of 5 ~ 65 ms can be inserted, 5ms being the default.
- **RTS Control – n157**. This parameter determines whether RTS is continually asserted (disabled) or asserted only during send (enabled). RTS must be enabled for use with RS-485 2-wire communication.

Table 1.4 RTS Control – Parameter n157

Value	Description
0	Disable (always ON) (Default Setting)
1	Enable (ON only during send)

Run/Stop Method and Frequency Reference

The Run/Stop and Frequency Reference commands can originate from network communication, the keypad potentiometer, external terminals, or an option card. Parameter n003 (Operation Method Selection) allows the selection of the origin of the Run/Stop command. Parameter n004 (Reference Selection) allows the selection of the origin of the Frequency Reference command. The Run/Stop and Frequency Reference commands may have different settings. For example, the Run/Stop command may be set to External Terminals (n003 = 1) while the Frequency Reference command may be set to Built-in Modbus RTU Communication (n004=6).

► Run/Stop Source

Table 1.5 Run/Stop Method Selection	
n003	Operation Method Selection (Run/Stop)
0	Keypad
1	Terminal Strip (Default Setting)
2	Built-in Modbus RTU (Keypad RJ-45 Jack or R+/-, S+/- Terminals)
3	Option Card (EtherNet/IP, Modbus TCP/IP, DeviceNet, Profibus DP, etc.)

► Frequency Reference Source

Table 1.6 Frequency Reference Source Selection	
n004	Frequency Reference Selection
0	Keypad Potentiometer (Default Setting)
1	Frequency Reference 1 (n024)
2	Voltage Reference (0 ~ 10VDC) (Terminal FR) (Default Setting)
3	Current Reference (4 ~ 20mA) (Terminal FR)
4	Current Reference (0 ~ 20mA) (Terminal FR)
5	Pulse Train (Terminal RP)
6	Built-in Modbus RTU (Keypad RJ-45 Jack or R+/-, S+/- Terminals)
7	Multi-Function Analog Input (0 ~ 10VDC) (Auxiliary Connector on Keypad)
8	Multi-Function Analog Input (4 ~ 20mA) (Auxiliary Connector on Keypad)
9	Option Card (EtherNet/IP, Modbus TCP/IP, DeviceNet, Profibus DP, etc.)

Verify Communication

The following is a quick reference guide for Modbus communication to the V7 drive. Make a copy of this page and check-off each item as it is completed. For detailed information please refer to the detailed sections that follow.

☐ **1: RS-232 Communication.**

☐ **1.1:** Verify that the correct cable is used to connect the controller to the V7 drive.

☐ **1.2:** Verify that the controller is set for RS-232 communications and that the communication cable is connected to the correct communication port.

☐ **1.3:** Record the controller communication parameters.

Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

☐ **1.4:** Record the V7 drive communication parameters (n154, n155, n156).

Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

☐ **1.5:** Verify that the communication parameters match.

☐ **2: RS-422/RS-485 Communication.**

☐ **2.1:** Verify that the V7 drive is connected correctly.

☐ **2.2:** Verify that the controller is set for RS-422/RS-485 communication and that the communication cable is connected to the correct communication port.

☐ **2.3:** Record the controller communication parameters.

Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

☐ **2.4:** Record the V7 drive communication parameters (n154, n155, n156).

Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

☐ **2.5:** Verify that the communication parameters match.

☐ **2.6:** Verify that parameter n157 (RTS) is set to enable.

☐ **2.7:** Verify that parameter n153 (Node Address) is set to the correct, unique, hexadecimal value and that it matches the node address required by the controller.

Controller Node Address _____ **V7 Drive Node Address** _____

☐ **3:** Send a command message to the V7 drive from the controller and verify the data of the command and response messages.

☐ **3.1:** Verify the contents of the command message.

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

☐ **3.2:** Verify the contents of the response message.

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

Notes:

Chapter 2 - Message Formats

This chapter provides information on the message (telegram) contents and configuration.

Protocol

The parameter access method supported by the V7 drive is a subset of the Modbus♦ communication protocol, which Yaskawa refers to as MEMOBUS. The G7 drive supports Modbus functions 3, 6, 8 and 10h. The message format varies depending upon the function code of the message. For each function code, there is a command message from the master and a response message from the slave. The following sections review the format of the command and response messages for each function.

► Message Functions Supported

The following table lists the function codes available and their minimum and maximum lengths.

Table 2.1 Supported Function Codes

Function Code	Function	Command Message		Response Message (Normal)	
		Minimum (bytes)	Maximum (bytes)	Minimum (bytes)	Maximum (bytes)
3h (3 dec)	Read Multiple Registers	8	8	7	21
6h (6 dec)	Write Single Register	8	8	8	8
8h (8 dec)	Loop-Back Test	8	8	8	8
10h (16 dec)	Write Multiple Registers	11	41	8	8

Read Multiple Registers – Function Code 03H

The Read Multiple Register function is used to read the contents of from one to eight consecutive registers. The formats of the read command and response messages are shown below.

► Read Multiple Registers Command Message

Table 2.2 Read Command Message

Description		Data
Slave Address		02h
Function Code		03h
Starting Register	Upper	00h
	Lower	20h
Quantity	Upper	00h
	Lower	04h
CRC-16	Upper	45h
	Lower	F0h

Each V7 drive slave address is set via parameter n153. Valid slave addresses must be in the range of 1 to 20 hex (1 to 32 dec) and entered as a hexadecimal number. No two slaves may have the same address. The master addresses the slave by placing the slave address in the Slave Address field of the message. In the command message above, the slave is addressed at 02h. Broadcast address 0 is not valid for register read commands.

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

The starting register is the address of the first register to be read. In the command message above the starting register address is 20h (0020h).

The quantity indicates how many consecutive registers are to be read. The quantity may range from 1 to 8 registers. If an invalid quantity is entered, error code 03h is returned in a fault response message. In this example, four consecutive registers are to be read: 20h, 21h, 22h and 23h.

A CRC-16 value is generated from a calculation including the message slave address, function code, starting register and quantity. 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 CRC-16 of the command message. If the two CRC-16 values are identical and the Slave Address is correct, the slave processes command message. If the two CRC-16 values are not identical, the slave will discard the command message and not respond.

If the command message has a valid slave address, function code, starting register, and quantity, the slave will respond with a normal response message. If the command message has an invalid function code, starting register, and/or quantity, the slave will respond with a fault response message. If the command message has an invalid slave address or CRC-16, no response will be returned.

► Read Multiple Registers Normal Response Message

Table 2.3 Read Normal Response Message		
Description		Data
Slave Address		02h
Function Code		03h
Number of Data Bytes		08h
Starting Register	Upper	17h
	Lower	70h
Next Register	Upper	17h
	Lower	70h
Next Register	Upper	01h
	Lower	09h
Last Register	Upper	00h
	Lower	00h
CRC-16	Upper	38h
	Lower	ACh

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 number of registers read times 2, since there are two bytes of data in each register.

The starting register is the address of the first register read.

The data section of the response message contains the data for the registers requested read. In this case registers 20h, 21h, 22h and 23h. Their data is 20h = 1770h, 21h = 1770h, 22h = 0109h and 23h = 0h.

► Read Multiple Registers Fault Response Message

Table 2.4 Read Fault Response Message		
Description		Data
Slave Address		02h
Function Code		83h
Error Code		02h
CRC-16	Upper	30h
	Lower	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 the logical OR of 80h and 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 02h in the error code field of this fault response message indicates that the command message requested data be read from an invalid register. Refer to section *Error Codes*, *Table 2-14*, for more information on returned error codes.

Write Single Register – Function Code 06H

The Write Single Register function allows the writing of data to one register only.

► Write Single Register Command Message

Table 2.5 Write Command Message

Description		Data
Slave Address		01h
Function Code		06h
Register Address	Upper	00h
	Lower	01h
Data	Upper	00h
	Lower	03h
CRC-16	Upper	98h
	Lower	H0B

Each V7 drive slave address is set via parameter n153. Valid slave addresses must be in the range of 1 to 20 hex (1 to 32 dec) and entered as a hexadecimal number. No two slaves may have the same address. The master addresses the slave by placing the slave address in the Slave Address field of the message. In the command message above, the slave is addressed at 01h. Broadcast address 0 is valid for register write commands.

By setting the slave address to zero (0) in the command message, the master can send a message to all the slaves on the network simultaneously. This is called simultaneous broadcasting. In a simultaneous broadcast message there is no response message.

The function code of this message is 06h (write single register).

In the command message above the register address is 01h (0001h).

The data section contains the data to be that written.

A CRC-16 value is generated from a calculation including the message slave address, function code, starting register, quantity, number of data bytes and all register data. 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 CRC-16 of the command message. If the two CRC-16 values are identical and the slave address is correct, the slave processes command message. If the two CRC-16 values are not identical, the slave will discard the command message and not respond.

If the command message has a valid slave address, function code, register address and data, the slave will respond with a normal response message. If the command message has an invalid function code, register address and/or data, the slave will respond with a fault response message. If the command message has an invalid slave address or CRC-16, no response will be returned.

► Write Single Register Normal Response Message

Table 2.6 Write Registers Normal Response Message		
Description		Data
Slave Address		01h
Function Code		06h
Register Address	Upper	00h
	Lower	01h
Data	Upper	00h
	Lower	03h
CRC-16	Upper	98h
	Lower	0Bh

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

In the response message above the register address is 01h (0001h).

► Write Single Register Fault Response Message

Table 2.7 Write Registers Fault Response Message		
Description		Data
Slave Address		01h
Function Code		86h
Error Code		21h
CRC-16	Upper	82h
	Lower	78h

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 the logical OR of 80h and the original function code of 06h. 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 21h in the error code field of this fault response message indicates that the command message data to be written was invalid for that register. Refer to the section *Error Codes, Table 2-14*, for more information on returned error codes.

Loop-Back Test – Function Code 08H

The Loop-Back Test is used to verify that the communications parameters for the V7 drive have been set correctly and that the connection is correct. The message should be constructed exactly as shown below. If everything is set and connected correctly, the received response will match the response shown below.

► 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.

Table 2.8 Loop-Back Command Message

Description		Data
Slave Address		01h
Function Code		08h
Test Code	Upper	00h
	Lower	00h
Data	Upper	A5h
	Lower	37h
CRC-16	Upper	DAh
	Lower	8Dh

Each V7 drive slave address is set via parameter n153. Valid slave addresses must be in the range of 1 to 20 hex (1 to 32 dec) and entered as a hexadecimal number. No two slaves may have the same address. The master addresses the slave by placing the slave address in the slave address field of the message. In the command message above, the slave is addressed at 01h. Broadcast address 0 is not valid for Loop-Back test commands.

The function code of this message is 08h (Loop-Back test).

The test code must be set to 0000h. 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 values.

A CRC-16 value is generated from a calculation including the message slave address, function code, test code, and data. 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 CRC-16 of the command message. If the two CRC-16 values are identical and the slave address is correct, the slave processes command message. If the two CRC-16 values are not identical, the slave will discard the command message and not respond.

If the command message has a valid slave address, function code, test code, data and CRC-16, the slave will respond with the normal response message. If the command message has an invalid function code, test code, and/or data, the slave will respond with a fault response message. If the command message has an invalid slave address or CRC-16, no response will be returned.

► Loop-Back Normal Response

The normal Loop-Back Test response is identical the command message.

Table 2.9 Loop-Back Normal Response Message

Description		Data
Slave Address		01h
Function Code		08h
Test Code	Upper	00h
	Lower	00h
Data	Upper	A5h
	Lower	37h
CRC-16	Upper	DAh
	Lower	8Dh

► Loop-Back Fault Response

Table 2.10 Loop-Back Fault Response Message

Description		Data
Slave Address		01h
Function Code		88h
Error Code		01h
CRC-16	Upper	87h
	Lower	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 the logical OR of 80h and 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. Refer to the section *Error Codes, Table 2-14*, for more information on returned error codes.

Write Multiple Registers – Function Code 10H

The Write Multiple Register function allows the writing of data to from one to sixteen consecutive registers.

► Write Multiple Registers Command Message

Table 2.11 Write Command Message		
Description		Data
Slave Address		01h
Function Code		10h
Starting Register	Upper	00h
	Lower	01h
Quantity	Upper	00h
	Lower	02h
Number of Data Bytes		04h
First Register Data	Upper	00h
	Lower	01h
Next Register Data	Upper	02h
	Lower	58h
CRC-16	Upper	63h
	Lower	39h

Each V7 drive slave address is set via parameter n153. Valid slave addresses must be in the range of 1 to 20 hex (1 to 32 dec) and entered as a hexadecimal number. No two slaves may have the same address. The master addresses the slave by placing the slave address in the Slave Address field of the message. In the command message above, the slave is addressed at 01h. Broadcast address 0 is valid for register write commands.

By setting the slave address to zero (0) in the command message, the master can send a message to all the slaves on the network simultaneously. This is called simultaneous broadcasting. In a simultaneous broadcast message there is no response message.

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

The starting register is the address of the first register to be written. In the command message above the starting register address is 01h (0001h).

The quantity indicates how many consecutive registers are to be written. The quantity may range from 1 to 16 registers. If an invalid quantity is entered, error code of 03h is returned in a fault response message. In this command message there are two consecutive registers to be written: 01h (Operation Command) and 02h (Frequency Reference).

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

The data section contains the data for each register to be that written in the order in which they are to be written.

A CRC-16 value is generated from a calculation including the message slave address, function code, starting register, quantity, number of data bytes and all register data. 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 CRC-16 of the command message. If the two CRC-16 values are identical and the slave address is correct, the slave processes command message. If the two CRC-16 values are not identical, the slave will discard the command message and not respond.

If the command message has a valid slave address, function code, starting register, quantity, number of data bytes and data, the slave will respond with a normal response message. If the command message has an invalid function code, starting register, quantity, number of data bytes and/or data, the slave will respond with a fault response message. If the command message has an invalid slave address or CRC-16, no response will be returned.

► Write Multiple Registers Normal Response Message

Table 2.12 Write Registers Normal Response Message		
Description		Data
Slave Address		01h
Function Code		10h
Starting Register	Upper	00h
	Lower	01h
Quantity	Upper	00h
	Lower	02h
CRC-16	Upper	10h
	Lower	08h

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

The starting register is the address of the first register written. In the response message above the starting register address is 01h (0001h).

The quantity indicates how many consecutive registers were written. In this case the quantity is 2.

► Write Multiple Registers Fault Response Message

Table 2.13 Write Registers Fault Response Message		
Description		Data
Slave Address		01h
Function Code		90h
Error Code		02h
CRC-16	Upper	CDh
	Lower	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 the logical OR of 80h and 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 02h in the error code field of this fault response message indicates that the command message requested data to be written to an invalid register. Refer to the section Error *Codes, Table 2-14*, for more information on returned error codes.

No Response

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

1. In broadcasting of data (slave address 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 it takes longer than 2 seconds to send a message.
5. When the time interval between characters exceeds 3.5ms.
6. When the command message data length is not proper.

Error Codes

Table 2-14 Fault Codes

Code	Fault	Description
1	Function Error	Invalid or unsupported function code in command message
2	Invalid Register	Invalid register address
3	Invalid Number of Registers	Invalid command message quantity
21	Data Limits Exceeded	The write command message data is out range for the requested register
22	Write Failure	The register to be written is write protected

CRC-16 Calculation

The last two bytes of a message contain the CRC-16 (Cyclical Redundancy Check). The CRC-16 is one method for verifying the validity of the message contents and is part of the protocol. The CRC-16 field checks the contents of the entire message, regardless of any parity check method used for the individual characters of the message.

The CRC-16 field is a 16-bit binary value consisting of two 8 bit bytes. The CRC-16 value is calculated by the transmitting device, which appends the CRC-16 to the message. The receiving device recalculates a CRC-16 during receipt of the message, and compares this calculated value to the value received in the transmitted CRC-16 field. If the two values are not equal, the entire message is invalid.

Detailed examples of a CRC-16 generation using Quick Basic and C are shown below.

► CRC-16 Calculation Example in 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&)
```

Figure 2.1 CRC-16 Calculation in Quick Basic

► CRC-16 Calculation Example - C

```
void    getMBCRC(char *, int, char *)                   // function prototype
void    getMBCRC(char *buf, int bufLen, char *crc) {    // Function name and parameter list returning a void
                                                        // *buf     pointer to character array used to calculate CRC
                                                        // bufLen number of characters to calculate CRC for
                                                        // *crc     pointer to the array that contains the calculated CRC
unsigned long crc_0 = 0xffff;                           // Declare and initialize variables
unsigned long crc_1 = 0x0000;                           // Declare and initialize variables
int i,j;                                                // Declare and initialize variables
        for (i=0; i<bufLen; i++) {                      // Loop through characters of input array
                crc_0 ^= ((unsigned long)buf[i] & 0x00ff);      // XOR current character with 0x00ff
                for (j=0;j<8;j++) {                     // Loop through characters bits
                        crc_1 = (crc_0 >> 1) & 0x7fff;  // shift result right one place and store
                        if (crc_0 & 0x0001)             // if pre-shifted value bit 0 is set
                                                        crc_0 = (crc_1 ^ 0xa001);       // XOR the shifted value with 0xa001
                        else                            // if pre-shifted value bit 0 is not set
                                                        crc_0 = crc_1;          // set the pre-shifted value equal to the shifted value
                        }       // End for loop - Loop through characters bits
                }               // End for loop - Loop through characters of input array
        crc[0] = (unsigned char)((crc_0/256) & 0x00ff);         // Hi byte
        crc[1] = (unsigned char)(crc_0 & 0x00ff);               // Lo byte
return;                                                 // Return to calling function
}                                                       // End of CRC calculation function
```

Figure 2.2 CRC-16 Calculation in C

Notes:

Chapter 3 - Troubleshooting

This chapter describes some basic troubleshooting methods for serial communications.

General Information

Please fill-in the information on this and the following pages prior to contacting customer support. If customer support is necessary, please have the information below available.

- ☐ 1. V7 Drive Model CIMR-_____
- ☐ 2. Input_____VAC_____Hz
- ☐ 3. Serial Number_____
- ☐ 4. Control Board ETC-_____
- ☐ 5. Software ID (U-10)_____
- ☐ 6: Initialization Type (2 or 3 wire control) _____
- ☐ 7: Specification Type_____

Please provide a sketch of the network in the space below.

Figure 3.1 Connection Sketch

RS-232 Communication

The following is a quick reference guide for troubleshooting RS-232 communication to the V7 drive. Make a copy of the following pages and check-off each item as it is completed. For detailed information on the RS-232 standard please refer to ***EIA RS-232-C***. or later revision. For information on the V7 drive RS-232 interface, refer to previous sections of this manual.

☐ **1:** For RS-232 communication.

☐ **1.1:** Verify that the correct cable is used to connect the controller to the V7 drive.

☐ **1.2:** Verify that the controller is set for RS-232 communication and that the communication cable is connected to the correct communication port.

☐ **1.3:** Record the controller communication parameters.

Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

☐ **1.4:** Record the V7 drive communication parameters (n154, n155, n156).

Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

☐ **1.5:** Verify that the communication parameters match.

☐ **2:** Check the controller RS-232 wiring requirements.

☐ **2.1:** CTS(Clear to Send)/RTS(Ready to Send) jumper required on the controller end?

☐ **2.2:** DTR(Data Terminal ready)/DSR(Data Set Ready)/RLSD(Receive Line Signal Detector) jumper required on the controller end?

☐ **2.3:** TxD(Transmit Data)/RxD(Receive Data) connections are made correctly.

☐ **3:** Send a message from the controller to the V7 drive.

☐ **3.1:** Connect an oscilloscope between the V7 drive RxD and GND.

☐ **3.1.1:** Verify that the message pulse train exists and contains the correct number of pulses. Refer to the chapter Message Formats for information on the message contents.

☐ **3.1.2:** Verify that he signal levels adhere to the RS-232 standard.

☐ **3.2:** Insert a data analyzer in the RS-232 circuit and capture the message sent by the controller in a hexadecimal format. Record the command message below.

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

☐ **3.3:** Verify that the contents of the message adheres to the protocol format as described previously.

☐ **3.3.1:** Verify that the node address is valid.

☐ **3.3.2:** Verify that the function code is valid.

☐ **3.3.3:** Verify that the register address is valid.

☐ **3.3.4:** Verify that the number of data bytes is correct is valid.

☐ **3.3.5:** Verify that the CRC is correctly calculated.

☐ **3.3.6:** Verify that the message requires a response.

☐ **4:** Verify the contents of the response message.

☐ **4.1:** Connect an oscilloscope between the controller RxD and GND.

☐ **4.1.1:** Verify that the message pulse train exists and contains the correct number of pulses. Refer to the chapter Message Formats for information on the message contents.

☐ **4.1.2:** Verify that he signal levels adhere to the RS-232 standard.

☐ **4.2:** Capture the response message sent by the controller in a hexadecimal format and record it below.

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

☐ **4.3:** Verify that the contents of the message adhere to the protocol format as described previously.

☐ **4.3.1:** Verify that the node address is valid.

☐ **4.3.2:** Verify that the function code is valid.

☐ **4.3.4:** Verify that the number of data bytes is correct is valid.

☐ **4.3.3:** Verify that the register address is valid.

☐ **4.3.4:** Verify that the CRC is correctly calculated.

RS-422/RS-485 Communication

The following is a quick reference guide for troubleshooting RS-422/RS-485 communication to the V7 drive. Make a copy of the following pages and check-off each item as it is completed. For detailed information on the RS-422/RS-485 standard please refer to ***EIA RS-422-A*** or later revision. For information on the V7 drive RS-422/RS-485 interface, refer to previous sections of this manual.

☐ **1:** For RS-422/RS-485 communication.

- ☐ **1.1:** Verify that the correct cable is used to connect the controller to the V7 drive.
- ☐ **1.2:** Verify that the controller is set for RS-422 or RS-485 communication and that the communication cable is connected to the correct communication port.
- ☐ **1.3:** Record the controller communication parameters.
- ☐ **1.4:** Verify that the polarity of the signal wires is correct (+ to + and - to -).

  Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

- ☐ **1.5:** Record the V7 drive communications parameters (n154, n155, n156).

  Baud Rate _____ **Parity**_____ **Data Bits**_____ **Stop Bits**_____ **Protocol**_____

- ☐ **1.6:** Verify that the communication parameters match.
- ☐ **1.7:** Verify that V7 drive parameter n157 (RTS) is set to 1 (Enable).
- ☐ **1.8:** Verify that V7 drive parameter n153 (Node Address) is set to the correct, unique, hexadecimal value and that it matches the node address required by the controller.

☐ **2:** Check the controller RS-422/RS-485 wiring requirements.

- ☐ **2.1:** The controller transmit terminals are connected to the V7 drive receive terminals and the receive terminals connected to the V7 drive transmit terminals.
- ☐ **2.2:** The transmit and receive connection polarities are correct.
- ☐ **2.3:** The controller either asserts RTS when transmitting or utilizes send detect circuitry.
- ☐ **2.4:** The network is terminated only at the beginning and end of each network segment.
- ☐ **2.5:** There are no more than 31 devices on any network segment, including the controller and repeater.

☐ **3:** Verify that the V7 drive passes the self-test as described in the following section.

☐ **4:** Send a message from the controller to the V7 drive.

☐ **4.1:** Connect an oscilloscope between the V7 drive's R+ and R- terminals for RS-422/RS-485 4-wire networks or between terminals R+/S+ and R-/S- for RS-485 2-wire networks.

☐ **4.1.1:** Verify that the message pulse train exists and contains the correct number of pulses. Refer to the chapter Message Formats for information on the message contents.

☐ **4.1.2:** Verify that the signal levels adhere to the RS-422/RS-485 standard.

☐ **4.2:** Insert a data analyzer in the RS-422/RS-485 circuit and capture the message sent by the controller in a hexadecimal format Record the command message below.

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

☐ **4.3:** Verify that the contents of the message adhere to the Modbus format as described previously.

☐ **4.3.1:** Verify that the node address is valid.

☐ **4.3.2:** Verify that the function code is valid.

☐ **4.3.3:** Verify that the register address is valid.

☐ **4.3.4:** Verify that the number of data bytes is correct is valid.

☐ **4.3.5:** Verify that the CRC is correctly calculated.

☐ **4.3.6:** Verify that the message requires a response.

☐ **5:** Verify the contents of the response message.

☐ **5.1:** Connect an oscilloscope between the controller R+ and R- terminals for RS-422 and RS-485 4-Wire networks or between terminals R+/S+ and R-/S- for RS-485 2-wire networks.

☐ **5.1.1:** Verify that the message pulse train exists and contains the correct number of pulses. Refer to the chapter Message Formats for information on the message contents.

☐ **5.1.2:** Verify that he signal levels adhere to the RS-422/RS-485 standard.

☐ **5.2:** Capture the response message in hexadecimal format and record it below.

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

[_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____] [_____]

☐ **5.3:** Verify that the contents of the message adhere to the Modbus format as described previously.

☐ **5.3.1:** Verify that the node address is valid.

☐ **5.3.2:** Verify that the function code is valid.

☐ **5.3.3:** Verify that the register address is valid.

☐ **5.3.4:** Verify that the number of data bytes is correct is valid.

☐ **5.3.5:** Verify that the CRC is correctly calculated.

RS-422/RS-485 Self-Test

The V7 drive can perform a self-test of the RS-422/RS-485 communication interface. To perform the self-test:

- Apply power to the V7 drive.
- Set parameter n056 to 35 (communication self-test). Terminal S7 must be used.
- Remove power from the V7 drive and wait for the charge lamp to be completely extinguished. Wait at least five additional minutes for the drive to be completely discharged. Measure the DC bus voltage and verify that it is at a safe level.
- Connect jumper wires to the following V7 drive control terminals:
    - Connect S+ to R+
    - Connect S- to R-
    - Connect S7 to SC
- Reapply power to the V7 drive.

Successful Self-Test

- The frequency reference is displayed on the digital operator if the communications interface is functioning normally.

Unsuccessful Self-Test

- If “CE” is displayed on the keypad, the communications interface is not functioning properly. Contact the factory for assistance.

Notes:

Chapter 4 - V7 Drive Parameters

This chapter describes the V7 drive parameters, their addressing, limits and dependencies.

Command Registers (Read / Write) for Modbus RTU

Command registers are those used to control the operation of the V7 drive either through a network interface (option card) or via serial communication (defined as Modbus built into the drive's keypad port or terminal strip). These registers are available during an active Run command. It should be noted that multi-function digital inputs that are commanded over a communication network are logically OR'd with their physical digital input terminal counterpart.

The "Address" column contains the register address in hexadecimal format. V7 drive registers are always referred to in hexadecimal format. The "Function" column contains the register name. The "Bit" and "Description" columns contain the list of available bits for that register and a short description of each. If the "Bit" column is empty, the register contains word data and individual bits have no meaning.

Please note that these Command Registers are different from those used in the CM091 Modbus TCP/IP Ethernet Option Kit. Refer to the section toward the end of this chapter for more information on Modbus TCP/IP.

Table 4.1 Command Registers (Read / Write)

Address	Function	Bit	Description
0000h	Reserved	-	Reserved
0001h	Digital Input Command	0h	Run Command (0: Stop, 1: Run)
		1h	Forward Reverse (0: Forward, 1: Reverse)
		2h	External Fault
		3h	Fault Reset
		4h	Multi-Function Digital Input Terminal S1 (n050)
		5h	Multi-Function Digital Input Terminal S2 (n051)
		6h	Multi-Function Digital Input Terminal S3 (n052)
		7h	Multi-Function Digital Input Terminal S4 (n053)
		8h	Multi-Function Digital Input Terminal S5 (n054)
		9h	Multi-Function Digital Input Terminal S6 (n055)
		Ah	Multi-Function Digital Input Terminal S7 (n056)
		Bh ~ Fh	Reserved
0002h	Frequency Reference	-	Scaled via parameter n152
0003h ~ 008h	Reserved	-	Reserved
0009h	Digital Output Command	0h	Multi-Function Digital Output Terminal (MA, MB, MC)
		1h	Multi-Function Digital Output Terminal (P1, PC)
		2h	Multi-Function Digital Output Terminal (P2, PC)
		3h ~ Fh	Reserved
000Ah ~ 001Fh	Reserved	-	Reserved

Simultaneous Broadcast Registers (Write only)

Broadcast Registers are those registers used to control the simultaneous operation of multiple devices either through a network interface (option card) or via Modbus RTU communication. These registers are available during drive Run.

The “Address” column contains the register address in hexadecimal format. Drive registers are always referenced in hexadecimal format. The “Function” column contains the register name. The “Bit” and “Description” columns contain the list of available bits for that register and a short description of each. If the “Bit” column is empty, the register contains word data and individual bits are meaningless.

Table 4.2 Broadcast Registers (Write only)

Address	Function	Bit	Description
0000h	Reserved	-	Reserved
0001h	Digital Input Command	0h	Run Command (0: Stop, 1: Run)
		1h	Direction Command (0: Forward, 1: Reverse)
		2h	Reserved
		3h	Reserved
		4h	External Fault
		5h	Fault Reset
		6h ~ Fh	Reserved
0002h	Frequency Reference	-	30,000 = 100% **

Note: ** This value must be sent to the drive as a hexadecimal value. Example: 4096 = 1000h. The scaling is fixed at 30,000 = 100% and is not affected by parameter n152. It is affected by the maximum output frequency (n011) of the drive receiving the command. Simply it is ((decimal frequency reference) / 30,000) x n011).

Example: Send 1000h to drive. 1000h = 4096 decimal. (4096 x 100%) / 30,000 = 13.65%. If the drive’s maximum frequency is 60Hz, then the frequency reference command to the drive is 60Hz x 13.65% or 8.19Hz.

Monitor Registers (Read only)

The following table lists monitor parameters for the V7 drive. These parameters are used to monitor V7 drive information and cannot be written.

- The “Address” column contains the register addresses for that parameter in hexadecimal format. V7 drive registers are always referred to in hexadecimal format.
- The “Function” column contains the register name.
- The “Bit” column contains the list of available bits for that register. If the “Bit” column is empty, the register contains word data and the individual bits are meaningless.
- The “Description” column contains a short description of each register or register bit.
- Reserved registers and data are meaningless and should be ignored

Table 4.3 Monitor Registers

Address	Function	Bit	Description
0020h	Status Signal 1	0h	During Run
		1h	Reverse Direction
		2h	Inverter Ready
		3h	Fault
		4h	Data Set Error
		5h	Multi-function Digital Output Terminal MA~MC (1: Closed)
		6h	Multi-function Digital Output Terminal P1, PC (1: Closed)
		7h	Multi-function Digital Output Terminal P2, PC (1: Closed)
		8h ~ Fh	Reserved
0021h	Fault Content 1	0h	Overcurrent (OC)
		1h	Overvoltage (OV)
		2h	Inverter Overload (OL2)
		3h	Inverter Overheat (OH)
		4h ~ 5h	Reserved
		6h	PID Feedback (FbL)
		7h	External Fault (EF, EF0) or Emergency Stop (STP)
		8h	Hardware Fault (Fxx)
		9h	Motor Overload (OL1)
		Ah	Overtorque Detection (OL2)
		Bh	Undertorque Detection (OL3)
		Ch	Undervoltage (UV1)
		Dh	Control Power Supply Fault (UV2)
		Eh	Modbus Communications Timeout (CE)
		Fh	Operator Connection Fault (oPA)
0022h	Data Link Status	0h	During Data Write
		1h ~ 2h	Reserved
		2h	Reserved
		3h	Limit Fault
		4h	Matching Fault
		5h ~ Fh	Reserved
0023h	Frequency Reference (scaling via n152) (U-01)		
0024h	Output Frequency (scaling via n152) (U-02)		
0025h	Reserved		
0026h	Reserved		
0027h	Output Current (0.1A) (U-03)		
0028h	Output Voltage (1VAC) (U-04)		
0029h ~ 002Ah	Reserved		

Table 4.3 Monitor Registers			
Address	Function	Bit	Description
002Bh	Digital Input Status	0h	Multi-function Digital Input Terminal S1 (1: Closed)
		1h	Multi-function Digital Input Terminal S2 (1: Closed)
		2h	Multi-function Digital Input Terminal S3 (1: Closed)
		3h	Multi-function Digital Input Terminal S4 (1: Closed)
		4h	Multi-function Digital Input Terminal S5 (1: Closed)
		5h	Multi-function Digital Input Terminal S6 (1: Closed)
		6h	Multi-function Digital Input Terminal S7 (1: Closed)
		7h ~ Fh	Reserved
002Ch	Status Signal 2	0h	During Run
		1h	Zero Speed
		2h	Speed Agree
		3h	Alarm
		4h	Frequency Detection 1
		5h	Frequency Detection 2
		6h	Inverter Ready
		7h	Undervoltage Detection
		8h	Baseblock
		9h	Frequency Reference Source (0: Network, 1: n004)
		Ah	Run Command Source (0: Network, 1: n003)
		Bh	Overtorque Detection
		Ch	Undertorque Detection
		Dh	Fault Retry
		Eh	Fault
		Fh	Communication Timeout
002Dh	Digital Output Status	0h	Multi-function Digital Output Terminal MA~MC (1: Closed)
		1h	Multi-function Digital Output Terminal P1, PC (1: Closed)
		2h	Multi-function Digital Output Terminal P2, PC (1: Closed)
		3h ~ Fh	Reserved
002Eh	Reserved		
002Fh	Frequency Reference Bias (0.1%)		
0030h	Reserved		
0031h	DC Bus Voltage (1VDC) (U-05)		
0032h	Torque Monitor (1%) (U-08)		
0033h ~ 0036h	Reserved		
0037h	Output Power (0.1kW) (U-11)		
0038h	PID Feedback (0.1%) (U-16)		
0039h	PID Input (1%) (U-17)		
003Ah	PID Output (0.1%) (U-18)		
003Bh ~ 00Ch	Reserved		
003Dh	Modbus Error	0h	CRC Error
		1h	Data Length Error
		2h	Not Used
		3h	Parity Error
		4h	Overrun Error
		5h	Framing Error
		6h	Timeout
		7h ~ Fh	Not Used
003Eh ~ 00FFh	Reserved		

Parameters (Read/Write)

The following table lists user accessible parameters for the V7 drive.

- The “Parameter” column contains the parameter name.
- The “Address” column contains the register address in hexadecimal format. V7 drive registers are always referred in hexadecimal format.
- The “Function” column refers to the text name of the parameter, a short description.
- The “Data” column contains the available selections for those parameters whose value is selected from a list. If the Data column is empty, that parameter’s value is entered as a number within the limits shown in the Description column.
- The “Description” column contains:
  - The name of the selection if the Data column is not empty
  - The upper and lower limits of the data that can be entered for that parameter

Notes:

- Parameter defaults are listed for the standard V7 drive (CIMR-V7AM*).
- All parameters are sent and received as whole numbers regardless of how they are represented in the **Description** column or their increment. For example, parameter n019, Acc Time 1, has limits of 0.0 ~ 600.0 seconds with an increment of 0.1 seconds. If parameter n019 is read and a value of 600 returned, the actual value is 60.0 seconds. If parameter n019 is to be set to 30 seconds, a value of 300 (30.0 seconds) must be sent.

Table 4.4 Read/Write Registers

Paramtr	Address	Function	Data	Description	Default
n001	0101h	Password / Initialization Selection	0	n001 Can Be Read And Set; n002-n179 Read Only	1
			1	n001-n039 Can Be Read And Set	
			2	n001-n067 Can Be Read And Set	
			3	n001-n113 Can Be Read And Set	
			4	n001-n179 Can Be Read And Set	
			5	Reserved	
			6	Clear Fault Record Only	
			7 ~ 9	Reserved	
			10	2-Wire Initialization (YEA)	
			11	3-Wire Initialization (YEA)	
n002	0102h	Control Method Selection	0	V/F Control	0
			1	Open Loop Vector, (Modbus RTU or Keypad)	
			2	Open Loop Vector (Modbus TCP/IP)	
n003	0103h	Run/Stop Source Selection	0	Keypad	1
			1	Terminal Strip	
			2	Built-in Modbus RTU (Keypad RJ-45 Jack or R+/-, S+/- Terminals)	
			3	Option Card (EtherNet/IP, Modbus TCP/IP, DeviceNet, Profibus DP, etc.)	
n004	0104h	Frequency Reference Source Selection	0	Keypad Potentiometer (Default Setting)	2
			1	Frequency Reference 1 (n024)	
			2	Voltage Reference (0 ~ 10VDC) (Terminal FR)	
			3	Current Reference (4 ~ 20mA) (Terminal FR)	
			4	Current Reference (0 ~ 20mA) (Terminal FR)	
			5	Pulse Train (Terminal RP)	
			6	Built-in Modbus RTU (Keypad RJ-45 Jack or R+/-, S+/- Terminals)	
			7	Multi-Function Analog Input (0 ~ 10VDC) (Auxiliary Connector on Keypad)	
			8	Multi-Function Analog Input (4 ~ 20mA) (Auxiliary Connector on Keypad)	
			9	Option Card (EtherNet/IP, Modbus TCP/IP, DeviceNet, Profibus DP, etc.)	
n005	0105h	Stopping Method Selection	0	Ramp To Stop	0

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
			1	Coast To Stop	
n006	0106h	Reverse Prohibit Selection	0	Reverse Run Enabled	0
			1	Reverse Run Disabled	
n007	0107h	Stop Key Function Selection	0	Stop Key Enabled	0
			1	Stop Key Is Active Only When n003 Is Set From Digital Operator	
n008	0108h	Keypad Frequency Reference Source	0	Frequency Reference From Digital Operator Potentiometer	0
			1	Frequency Reference From n024	
n009	0109h	Frequency Reference Enter Button Requirement	0	Enter Button Required To Accept New Reference	0
			1	Enter Button Not Required To Accept Reference	
n010	010Ah	Operator Connection Detection Selection	0	Disabled	0
			1	Enabled (oPA Fault Detected)	
n011	010Bh	Maximum Output Frequency	50.0 - 400.0Hz		60.0
n012	010Ch	Maximum Voltage	0.1 - 255.0 (230V drive) 0.2 - 510.0 (460V drive)		230 460
n013	010Dh	Base Frequency	0.2 - 400.0Hz		60
n014	010Eh	Midpoint Frequency	0.1 - 399.9Hz		Control Method
n015	010Fh	Midpoint Voltage	0.1 - 255.0 (230V drive) 0.2 - 510.0 (460V drive)		Control Method
n016	0110h	Minimum Frequency	0.1 - 10.0Hz		Control Method
n017	0111h	Minimum Voltage	0.1 - 255.0 (230V drive) 0.2 - 510.0 (460V drive)		Control Method
n018	0112h	Accel / Decel Time Unit Selection	0	0.1sec	0
			1	0.01sec	
n019	0113h	Accel Time 1	000.0 – 999.9 or 1000 – 6000sec, (n018 = 0) 00.00 – 99.99 or 100.0 – 600.0sec, (n018 = 1)		10.0
n020	0114h	Decel Time 1	000.0 – 999.9 or 1000 – 6000sec, (n018 = 0) 00.00 – 99.99 or 100.0 – 600.0sec, (n018 = 1)		10.0
n021	0115h	Accel Time 2	000.0 – 999.9 or 1000 – 6000sec, (n018 = 0) 00.00 – 99.99 or 100.0 – 600.0sec, (n018 = 1)		10.0
n022	0116h	Decel Time 2	000.0 – 999.9 or 1000 – 6000sec, (n018 = 0) 00.00 – 99.99 or 100.0 – 600.0sec, (n018 = 1)		10.0
n023	0117h	S-Curve Selection	0	No S-Curve	0
			1	0.2sec	
			2	0.5sec	
			3	1.0sec	
n024	0118h	Frequency Reference 1	0.00 - 9.99hz or 100.0 - 400.0Hz		6.00
n025	0119h	Frequency Reference 2	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n026	011Ah	Frequency Reference 3	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n027	011Bh	Frequency Reference 4	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n028	011Ch	Frequency Reference 5	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n029	011Dh	Frequency Reference 6	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n030	011Eh	Frequency Reference 7	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n031	011Fh	Frequency Reference 8	0.00 - 9.99hz or 100.0 - 400.0Hz		0.00
n032	0120h	Jog Frequency Reference	0.00 - 9.99hz or 100.0 - 400.0Hz		6.00
n033	0121h	Frequency Reference Upper Limit	0.0 - 110%		100.0
n034	0122h	Frequency Reference Lower Limit	0.0 - 110%		0.0
n035	0123h	Frequency Reference Unit Selection (For Keypad)	0	0.01 Hz (< 100Hz); 0.1Hz (>=100Hz)	0
			1	0.1%	
			2 ~ 39	RPM (Enter motor poles)	

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
			40 ~ 3999	User Setting	
n036	0124h	Motor Rated Current	0-150% of Drive Rated Output Current		kVA
n037	0125h	Electronic Motor Overload Protection	0	Vector Motor (TENV, TEBC)	0
			1	Standard Motor (TEFC)	
			2	Disabled	
n038	0126h	Motor Overload Protection Time Constant	1 – 60min		8
n039	0127h	Cooling Fan Operation Selection	0	Operates Only When drive Is Running	0
			1	Operates With Power Is On	
n040	0128h	Motor Rotation Selection	0	CCW	0
			1	CW	
n041	0129h	Accel Time 3	0.0 - 999.9 , 1000 - 6000sec		10.0
n042	012Ah	Decel Time 3	0.0 - 999.9 , 1000 - 6000sec		10.0
n043	012Bh	Accel Time 4	0.0 - 999.9 , 1000 - 6000sec		10.0
n044	012Ch	Decel Time 4	0.0 - 999.9 , 1000 - 6000sec		10.0
n045	012Dh	Frequency Reference Bias	0.00 - 99.99%		0.00
n046	012Eh	Frequency Reference Bias Accel/Decel Rate Selection	0	Increase or decrease the bias value by the Accel/Decel time currently selected	0
			1	Adjust the bias by Accel Time 4 and Decel Time 4 (n044)	
n047	012Fh	Freq Ref Bias Operation Mode Selection	0	Holds the bias value as Up Command 2 or Down Command	0
			1	Operates Normally	
n048	0130h	Frequency Reference Bias Value	0.0 - 100.0%		0.0
n049	0131h	Analog Frequency Reference Change Level	0.1 - 100.0%		1.0
n050	0132h	Digital Input Terminal S1 Function Selection	0	Forward/Reverse Selection (Terminal S3, n052 only) (3-wire Sequence)	1
			1	Run Forward (2-wire Sequence)	
			2	Run Reverse (2-wire Sequence)	
			3	External Fault (N.O. Contact)	
			4	External Fault (N.C. Contact)	
			5	Fault Reset	
			6	Multi-Step Speed Reference 1	
			7	Multi-Step Speed Reference 2	
			8	Multi-Step Speed Reference 3	
			9	Multi-Step Speed Reference 4	
			10	Jog Reference	
			11	Accel/Decel Time Select 1	
			12	External Baseblock (N.O. Contact)	
			13	External Baseblock (N.C. Contact)	
			14	Speed Search From Maximum Output Frequency	
			15	Speed Search From Frequency Reference	
			16	Accel/Decel Hold	
			17	Local/Remote Switch	
			18	Network/Terminal Control Switchover	
			19	Emergency Stop (Fault, N.O. Contact, Stop Method n005)	
			20	Emergency Stop (Alarm, N.O. Contact, Stop Method n005)	
			21	Emergency Stop (Fault, N.C. Contact, Stop Method n005)	
			22	Emergency Stop (Alarm, N.C. Contact, Stop Method n005)	
			23	PID Cancel	
			24	PID Integral Reset	
			25	PID Integral Hold	
			26	Overheat Pre-Alarm 1	

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
			27	Accel/Decel Time Select 2	
			28 ~ 33	Not Used	
			34	Up/Down Function	
			35	RS-422/RS-485 Self-test (Can only be set in Terminal S7, n056)	
n051	0133h	Digital Input Terminal S2 Function Selection	Same As Parameter n050		2
n052	0134h	Digital Input Terminal S3 Function Selection	Same As Parameter n050		3
n053	0135h	Digital Input Terminal S4 Function Selection	Same As Parameter n050		5
n054	0136h	Digital Input Terminal S5 Function Selection	Same As Parameter n050		6
n055	0137h	Digital Input Terminal S6 Function Selection	Same As Parameter n050		7
n056	0138h	Digital Input Terminal S7 Function Selection	Same As Parameter n050		10
n057	0139h	Digital Output Terminal MA ~MC Function Selection	0	Fault	0
			1	During Run	
			2	Speed Agree	
			3	Zero Speed	
			4	Frequency Detection 1 (Fout ≤ n095)	
			5	Frequency Detection 2 (Fout ≥ n095)	
			6	Overtorque Detection (N.O. Contact)	
			7	Overtorque Detection (N.C. Contact)	
			8 ~ 9	Reserved	
			10	Minor Fault (Alarm)	
			11	Baseblock	
			12	Local (Keypad) Control	
			13	Inverter Ready	
			14	During Fault Retry	
			15	Undervoltage	
			16	Reverse Direction	
			17	Speed Search	
			18	Not Used (Terminal to be controlled by network communication)	
			19	PID Feedback Loss	
			20	Frequency Reference Loss Detection (N.O. Contact)	
			21	Over Heat Pre-Alarm (OH3) (N.O. Contact)	
n058	013Ah	Digital Output P1 ~ PC Function Selection	Same As Parameter n057		1
n059	013Bh	Digital Output P2 ~ PC Function Selection	Same As Parameter n057		2
n060	013Ch	Analog Input Terminal FR Gain	0 - 255%		100
n061	013Dh	Analog Input Terminal FR Bias	±100%		0
n062	013Eh	Analog Input Terminal FR Filter Time	0.00 - 2.00sec (0.00sec = Disabled)		0.10
n063	013Fh	Reserved			
n064	0140h	Frequency Reference Loss Detection Selection	0	No Detection	0
			1	Continue to Run at 80% of Maximum Frequency (n011)	
n065	0141h	Output Monitor Terminal AM Signal Type Selection	0	Analog Monitor Output (0 - +10VDC, 2mA maximum)	0
			1	Pulse Monitor Output (see technical manual for ratings)	
n066	0142h	Output Monitor Terminal AM Function Selection	0	Output Frequency (100% = Max Output Frequency)	0
			1	Output Current (100% = Drive Rated Current)	
			2	DC Bus Voltage (100% = 400/800VDC)	

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
			3	Torque (100% = Drive Rated Torque)	
			4	Output Power (100% = Drive Rated kW)	
			5	Output Voltage (100% = n012)	
			6	Frequency Reference (100% = n011)	
n067	0143h	Output Monitor Terminal AM Gain	0.00 - 2.00		1.00
n068	0144h	Aux Analog Input Terminal CN2 (0-10VDC) Gain	0 - 255%		100
n069	0145h	Aux Analog Input Terminal CN2 (0-10VDC) Bias	±100%		0
n070	0146h	Aux Analog Input Terminal CN2 (0-10VDC) Filter Time	0.00 - 2.00sec (0.00sec = Disabled)		0.10
n071	0147h	Aux Analog Input Terminal CN2 (4-20mA) Gain	0 - 255%		100
n072	0148h	Aux Analog Input Terminal CN2 (4-20mA) Bias	±100%		0
n073	0149h	Aux Analog Input Terminal CN2 (4-20mA) Filter Time	0.00 - 2.00sec (0.00sec = Disabled)		0.10
n074	014Ah	Pulse Input Terminal RP Gain	0 - 255%		100
n075	014Bh	Pulse Input Terminal RP Bias	±100%		0
n076	014Ch	Pulse Input Terminal RP Filter Time	0.00 - 2.00sec (0.00sec = Disabled)		0.10
n077	014Dh	Aux Analog Input Terminal CN2 Function Selection	0	Disabled	0
			1	Frequency Reference (FREF2) (n004 = 7 or 8)	
			2	Frequency Reference Gain (FGAIN)	
			3	Frequency Reference Bias (FBIAS)	
			4	Output Voltage Bias (VBIAS)	
n078	014Eh	Aux Analog Input Terminal CN2 Signal Type Selection	0	0 - 10VDC	0
			1	4 - 20mA	
n079	014Fh	Aux Analog Input Terminal CN2 Bias	0 - 50% (100% = n011)		10
n080	0150h	Carrier Frequency Selection	1 ~ 4	Carrier Frequency (set value x 2.5kHz)	4
			7 ~ 9	1 - 2.5kHz (Synchronous)	
n081	0151h	Momentary Power Loss Recovery Selection	0	Disabled	0
			1	Operation Continues (within 2sec powerloss window)	
			2	Operation Continues (for length of CPU power) (no fault output)	
n082	0152h	Auto-Fault Restart Retries	0 - 10 Attempts		0
n083	0153h	Prohibit Frequency 1	0.00 - 9.99Hz or 100.0 - 400.0Hz (0.00 = Disabled)		0.00
n084	0154h	Prohibit Frequency 2	0.00 - 9.99Hz or 100.0 - 400.0Hz (0.00 = Disabled)		0.00
n085	0155h	Prohibit Frequency 3	0.00 - 9.99Hz or 100.0 - 400.0Hz (0.00 = Disabled)		0.00
n086	0156h	Prohibit Frequency Deadband	0.00 - 25.50Hz (0.00Hz = n083-n085 Disabled)		0.00
n087	0157h	Elapsed Time Function Selection	0	Operation Time Elapses When Power Is On.	0
			1	Operation Time Elapses When drive Is Running	
n088	0158h	Elapsed Time Initial Value	0 - 9999hr		0
n089	0159h	DC Injection Current Level	0 - 100% (0% = Baseblock)		50
n090	015Ah	DC Injection Time at Stop	0.0 - 25.5sec (0.0sec = Disabled)		0.5
n091	015Bh	DC Injection Time at Start	0.0 - 25.5sec (0.0sec = Disabled)		0.0
n092	015Ch	Stall Prevention During	0	Enabled	0

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
		Decel Selection	1	Disabled	
n093	015Dh	Stall Prevention During Accel Level	30 - 200% (200% = Disabled)		170
n094	015Eh	Stall Prevention During Run Level	30 - 200% (200% = Disabled)		160
n095	015Fh	Frequency Detection Level	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n096	0160h	Overtorque Detection (OL3) Response Selection	0	Disabled	0
			1	Detection at Speed Agree, Operation Continues	
			2	Detection at Speed Agree, Coast To Stop	
			3	Detection During Run, Operation Continues	
			4	Detection During Run, Coast To Stop	
n097	0161h	Overtorque Detection (OL3) Method Selection	0	Detected By Output Torque (OLV mode only, n002 = 1 or 2)	0
			1	Detected By Output Current	
n098	0162h	Overtorque Detection (OL3) Level	30 - 200%		160
n099	0163h	Overtorque Detection (OL3) Delay Time	0.1 - 10.0sec		0.1
n100	0164h	Up/Down Memory Hold Selection	0	Frequency Reference is not Stored at Powerloss	0
			1	Frequency Reference is Stored at Powerloss	
n101	0165h	Speed Search Decel Time	0.1 - 10.0sec		2.0
n102	0166h	Speed Search Detection Level	0 - 200%		150
n103	0167h	Torque Compensation Gain	0.0 - 2.5		1.0
n104	0168h	Torque Compensation Filter Time	0.0 - 25.5sec (0.0sec = Disabled)		Control Method
n105	0169h	Torque Compensation Iron Loss	0.0 - 999.9W or 1000 - 6550W		kVA
n106	016Ah	Motor Rated Slip	0.0 - 20.0Hz		kVA
n107	016Bh	Motor Line-To-Line Resistance	0.000 - 9.999Ω or 10.00 - 65.50Ω		kVA
n108	016Ch	Motor Leakage Inductance	0.00 - 99.99mh or 100.0 - 655.0mh		kVA
n109	016Dh	Torque Limiter	0 - 250% (OLV mode only, n002 = 1 or 2)		150
n110	016Eh	Motor No-Load Current	0 - 99%		kVA
n111	016Fh	Slip Compensation Gain	0.0 - 2.5		Control Method
n112	0170h	Slip Compensation Filter Time	0.0 - 25.5sec (0.0sec = Disabled)		Control Method
n113	0171h	Slip Compensation During Regeneration Selection	0	Disabled	0
			1	Enabled	
n114	0172h	Reserved			
n115	0173h	Stall Prevention During Run (Above Base Speed) Selection	0	Disabled (Level = n094)	0
			1	Enabled (Level at Fmax = n094 x 0.4)	
n116	0174h	Stall Prevention Accel/Decel Time Selection	0	Use Active Accel/Decel Time (Based on Multi-function Digital Inputs)	0
			1	Always Use Accel/Decel Time 2 (n021, n022)	
n117	0175h	Undertorque (UL3) Detection Response Selection	0	Disabled	0
			1	Detection at Speed Agree, Operation Continues	
			2	Detection at Speed Agree, Coast To Stop	
			3	Detection During Run, Operation Continues	
			4	Detection During Run, Coast To Stop	
n118	0176h	Undertorque Detection Level	0 ~ 200%		10
n119	0177h	Undertorque Detection Delay Time	0.1 ~ 10.0sec		0.1
n120	0178h	Frequency Reference 9	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n121	0179h	Frequency Reference 10	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
n122	017Ah	Frequency Reference 11	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n123	017Bh	Frequency Reference 12	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n124	017Ch	Frequency Reference 13	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n125	017Dh	Frequency Reference 14	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n126	017Eh	Frequency Reference 15	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n127	017Fh	Frequency Reference 16	0.00 - 9.99Hz or 100.0 - 400.0Hz		0.00
n128	0180h (01D3h for Modbus TCP/IP Option)	PID Control Selection	0	PID Disabled	0
			1	PID (D = Feed Forward)	
			2	PID (D = Feedback)	
			3	Reference + PID (D = Feed Forward)	
			4	Reference + PID (D = Feedback)	
			5	Inverted PID (D = Feed Forward)	
			6	Inverted PID (D = Feedback)	
			7	Reference + Inverted PID (D = Feed Forward)	
			8	Reference + Inverted PID (D = Feedback)	
n129	0181h (01D4h for Modbus TCP/IP Option)	PID Feedback Gain	0.00 - 10.00		1.00
n130	0182h	PID Proportional Gain	0.0 - 25.0 (0.0 Disables P Control)		1.0
n131	0183h	PID Integral Time	0.0 - 360.0sec (0.0sec Disables I Control)		1.0
n132	0184h	PID Derivative Time	0.00 - 2.50sec (0.00sec Disables D Control)		0.00
n133	0185h	PID Offset Adjustment	±100% (100% = n011)		0
n134	0186h	PID Integral Limit	0 - 100% (100% = n011)		100
n135	0187h	PID Output Filter Time	0.0 - 10.0sec		0.0
n136	0188h	PID Feedback Loss Detection	0	Disabled	0
			1	Operation Continues, Fbl Alarm	
			2	Drive Shuts Down, Fbl Fault	
n137	0189h	PID Feedback Loss Detection Level	0 - 100% (100% = n011)		0
n138	018Ah	PID Feedback Loss Detection Delay Time	0.0 - 25.5sec		1.0
n139	018Bh	Energy-Saving Control	0	Disabled	0
			1	Enabled (Must Be In V/F Control Mode, n002 = 0)	
n140	018Ch	Energy-Saving Coefficient K2	0.0 - 999.9 or 1000 - 6550		kVA
n141	018Dh	Energy-Saving Voltage Lower Limit at 60hz	0 - 120%		50
n142	018Eh	Energy-Saving Voltage Lower Limit at 6 Hz	0 - 25%		12
n143	018Fh	Power Supply Average Time	1 - 200 (1 = 24msec)		1
n144	0190h	Search Voltage Limiter	1 - 100%		0
n145	0191h	Search Step at 100%	0.1 - 10.0%		0.5
n146	0192h	Search Step at 5%	0.1 - 10.0%		0.2
n147	0193h	Motor Rated Voltage	150.0 - 255.0VAC 300.0 - 510.0VAC		200.0 400.0
n148	0194h	Save UV1 and UV2 to EEPROM	0	Do not save UV1 and UV2	0
			1	Save UV1 and UV2	
n149	0195h	Pulse Input Scaling	100 - 3300 (1 - 33kHz)		2550
n150	0196h	Pulse Monitor Output Frequency	0	1440Hz = n011	0
			1	Output Frequency x 1	

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
			6	Output Frequency x 6	
			12	Output Frequency x 12	
			24	Output Frequency x 24	
			36	Output Frequency x 36	
			40	1440 Hz = Frequency Reference	
			41	Frequency Reference x 1	
			42	Frequency Reference x 6	
			43	Frequency Reference x 12	
			44	Frequency Reference x 24	
			45	Frequency Reference x 36	
n151	0197h	Modbus Time Out Detection Selection	0	Coast To Stop	0
			1	Ramp To Stop Using n020	
			2	Ramp To Stop Using n022	
			3	Operation Continues Alarm	
			4	Disabled	
n152	0198h	Frequency Reference Unit Selection (For Modbus RTU and TCP/IP)	0	1 = 0.1Hz	0
			1	1 = 0.01Hz	
			2	30,000 = n011	
			3	1 = 0.1%	
n153	0199h	Modbus RTU Slave Address	0 - 31 decimal		0
n154	019Ah	Modbus RTU Baud Rate Selection	0	2400bps	2
			1	4800bps	
			2	9600bps	
			3	19,200bps	
n155	019Bh	Modbus RTU Parity Selection	0	Even Parity	2
			1	Odd Parity	
			2	No Parity	
n156	019Ch	Modbus RTU Send Delay Time	0 - 65msec		10
n157	019Dh	Modbus RTU RTS Control Selection	0	Enabled (RS-485 2-wire)	0
			1	Disabled (RS-422 and RS-485 4-wire)	
n158	019Eh	Energy Saving Control Motor Code	0 - 70		kVA
n159	019Fh	Energy-Saving Voltage Upper Limit at 60Hz	0 - 120%		120
n160	01A0h	Energy-Saving Voltage Upper Limit at 6Hz	0 - 25%		16
n161	01A1h	Search Power Supply Detect Hold Width	0 - 100%		10
n162	01A2h	Power Factor Detection Filter Time	0 - 255 (1 = 4ms)		5
n163	01A3h	PID Output Gain	0.0 - 25.0		1.0
n164	01A4h	PID Feedback Source Selection	0	0 - 10VDC (Terminal FR)	0
			1	4 - 20mA (Terminal FR)	
			2	0 - 20mA (Terminal FR)	
			3	0 - 10VDC (Terminal CN2 on Keypad)	
			4	4 - 20mA (Terminal CN2 on Keypad)	
			5	Pulse Input (Terminal RP)	
n165	01A5h	Reserved			
n166	01A6h	Input Phase Loss Detection Level	0 - 100%		0
n167	01A7h	Input Phase Loss Detection Delay Time	0 - 255sec		0

Table 4.4 Read/Write Registers					
Paramtr	Address	Function	Data	Description	Default
n168	01A8h	Output Phase Loss Detection Level	0 - 100%		0
n169	01A9h	Output Phase Loss Detection Delay Time	0.0 - 2.0sec		0.0
n170	01AAh	Enter Command Selection (Modbus Only)	0	Accept Enter Command Only When Drive Is Stopped	0
			1	Always Accept Enter Command	
n171	01ABh	Frequency Bias Upper Limit	0.0 - 100.0		100.0
n172	01ACh	Frequency Bias Lower Limit	0.0 - -99.99		0.00
n173	01ADh	DC Injection Proportional Gain	1 ~ 999		83
n174	01AEh	DC Injection Integral Time	1 ~ 250sec		25
n175	01AFh	Carrier Frequency Reduction at Low Speed and High Load	0	Disabled	0
			1	Enabled (If Fout ≤ 5Hz and Iout ≥ 110% , Carrier Frequency is Reduced to 2.5kHz)	
n176	01B0h	Keypad Parameter Read/Copy Function Selection	rdy	Ready	rdy
			rEd	Read Executes	
			CPy	Copy Executes	
			vFy	Verify Executes	
			vA	Drive Capacity Displayed	
			Sno	Software Number Displayed	
n177	01B1h	Keypad Parameter Read/Copy Prohibit Selection	0	Read Prohibited	0
			1	Read Allowed	
n178	01B2h	Fault History	Four Newest Faults Are Displayed		-
n179	01B3h	Drive Software Number	Last Four Digits Of Software Number Is Displayed (U-10)		-

Modbus TCP/IP Option Interface (Read / Write)

(Only for use with the CM092 Modbus TCP/IP Option Kit)

- The Modbus TCP/IP Option Card CM092 differs slightly from Modbus RTU in its register structure. The CM092 card has a different set of Command registers and additional monitor registers. However, all Monitor and Parameter registers listed earlier in this chapter can also be accessed over Modbus TCP/IP. Please note that parameters n128 and n129 have a Modbus TCP/IP specific address. Parameter n002 has a Modbus TCP/IP specific setting. Other Modbus TCP/IP protocol specific items include:
- A maximum of 10 simultaneous connections are allowed.
- The Run Command and Frequency Reference may only be accessed through UNIT ID 1. While the drive is in remote RUN mode, the Run command must be continually refreshed within the Timeout setting in the configuration webpage. This can be set from 100 ms to 30 sec. If the Run command is not refreshed within the set time, an EF0 fault will occur. Refer to the appropriate drive manual for information on EF0 and setting the appropriate drive response. If a UNIT ID 1 connection is active, the NS/CON LED will blink at approximately a 500 ms cycle.
- The TCP/IP connection must be refreshed within 60 seconds. If it is not refreshed within 60 seconds, the connection will be closed.
- This implementation of Modbus TCP/IP supports Modbus functions 3 (read multiple registers), 6 (write single register) and 16 (write multiple registers).

Table 4.5 Modbus TCP/IP Option Interface

Address	Function	Bit	Description
0001h	Digital Input Command	0h	Multi-Function Digital Input Terminal S1 (n050) (Default: Run Forward)
		1h	Multi-Function Digital Input Terminal S2 (n051) (Default: Run Reverse)
		2h	Multi-Function Digital Input Terminal S3 (n052) (Default: External Fault EF3)
		3h	Multi-Function Digital Input Terminal S4 (n053) (Default: Fault Reset)
		4h	Multi-Function Digital Input Terminal S5 (n054) (Default: Multi-step Speed 1)
		5h	Multi-Function Digital Input Terminal S6 (n055) (Default: Multi-step Speed 2)
		6h	Multi-Function Digital Input Terminal S7 (n056) (Default: Jog Reference)
		7h	Reserved
		8h	External Fault (EF0)
		9h	Fault Reset
		Ah ~Dh	Reserved
		Eh	Clear Fault History
		Fh	External Base Block
0002h	Frequency Reference Command	-	Scaled via n152
0009h	Multi-function Digital Output Command	0h	Multi-Function Digital Output Terminal (MA, MB, MC)
		1h	Multi-Function Digital Output Terminal (P1, PC)
		2h	Multi-Function Digital Output Terminal (P2, PC)
2000h	Status Word	0h	During Run
		1h	Zero Speed
		2h	Reverse Direction
		3h	Fault Reset
		4h	Speed Agree
		5h	Drive Ready
		6h	Minor Fault (Alarm)
		7h	Major Fault
		8h	OPE Fault
		9h	Power Loss Ride Thru
		Ah	Local Mode
		Bh	Multi-Function Digital Output Terminal (MA, MB, MC)
		Ch	Multi-Function Digital Output Terminal (P1, PC)

Table 4.5 Modbus TCP/IP Option Interface			
Address	Function	Bit	Description
		Dh	Multi-Function Digital Output Terminal (P2, PC)
		Eh ~ Fh	Reserved
2001h	Output Frequency	-	U-02 (scaled via n152)
2002h	Torque Monitor (Open Loop Vector only)	-	U-08 (1%) (OLV mode only, n002 = 1 or 2)
2003h	Reserved	-	Reserved
2004h	Frequency Monitor	-	U-01 (scaled via n152)
2005h	Frequency Output	-	U-02 (scaled via n152)
2006h	Output Current	-	U-03 (0.1A)
2007h	Pulse Input (RP terminal) Value	-	
2008h	DC Bus Voltage	-	U-05 (1VDC)
2009h	Error Signal 1	0h	Reserved
		1h	UV1 Main Circuit Undervoltage
		2h	UV2 Control Power Undervoltage
		3h	Reserved
		6h	OC Overcurrent
		7h	OV Overvoltage
		8h	OH Overheat
		9h	Reserved
		Ah	OL1 Motor Overload
		Bh	OL2 Drive Overload
		Ch	OL3 Overtorque Detection
		Dh ~ Eh	Reserved
200Ah	Error Signal 2	0h	EF3 External Fault Terminal S3
		1h	EF4 External Fault Terminal S4
		2h	EF5 External Fault Terminal S5
		3h	EF6 External Fault Terminal S6
		4h	EF7 External Fault Terminal S7
		5h ~ Ch	Reserved
		Dh	oPA Operator Disconnected
		Eh ~ Fh	Reserved
200Bh	Error Signal 3	0h	CE Communications Fault
		1h	BUS Option Fault
		2h ~ 5h	Reserved
		6h	EF0 Option External Fault
		8h	UL3 Undertorque Detection
		9h ~ Eh	Reserved
		Fh	Fxx Hardware Fault
200Ch	Reserved	-	Reserved
200Dh	Digital Input Terminal Status	0h	Digital Input Terminal S1 (0:Open, 1:Closed)
		1h	Digital Input Terminal S2 (0:Open, 1:Closed)
		2h	Digital Input Terminal S3 (0:Open, 1:Closed)
		3h	Digital Input Terminal S4 (0:Open, 1:Closed)
		4h	Digital Input Terminal S5 (0:Open, 1:Closed)
		5h	Digital Input Terminal S6 (0:Open, 1:Closed)
		6h	Digital Input Terminal S7 (0:Open, 1:Closed)
		7h ~ Eh	Reserved
200Eh	Analog Input (Terminal FR) Value	-	0.1VDC
200Fh	Reserved	-	Reserved
2010h	Drive Software ID	-	Last four digits of drive software number (U-10)

ENTER/ACCEPT Command (Write Only)

Caution

The following section describes the usage of the ACCEPT and ENTER commands, which are necessary when writing to certain registers in the V7 drive.

When data is written to a Command register (0000h ~ 0009h) in the V7, the data is activated as soon as it is written, but will be gone when power is lost (volatile memory or RAM). When data is written to a Parameter register in the V7 (0101h ~ 01B3h), the data goes into a temporary off-line memory area. The drive will essentially ignore the off-line memory area until it is told to use it. In order to get the drive to use this data, an ACCEPT or ENTER command needs to be issued. If power is lost prior to an ACCEPT or ENTER command being issued, the data is lost. Using this temporary storage area is a good way to pre-load several parameter changes, and then activating them all at once.

Both the ACCEPT and the ENTER commands will activate the data contained in the off-line memory area. The ACCEPT command simply activates all of the data in the off-line memory area, but if power is lost, all of the changes will be lost. The ACCEPT command can be performed as many times as needed. An ACCEPT command is performed by writing a value of zero to address 0910h.

The ENTER command will activate the data in the off-line memory area AND store it to nonvolatile (EEPROM) memory. Once the ENTER command is issued, the data will be retained even if the power is lost. **Excessive use of the ENTER command can cause the V7 drive to fail.** The nonvolatile memory allows approximately 100,000 ENTER commands. An ENTER command is performed by writing a value of zero to address 0900h.

Table 4.6 Enter/Accept Command

Address	Function	Data	Description
910	ACCEPT	0	Transfer data to active RAM. Data will be lost at power down. Unlimited usage.
900	ENTER	0	Transfers data to non-volatile storage. Data will survive power loss. Limited to 100,000 writes.

Chapter 5 - User Notes

This chapter allows the user to enter information specific to their application.

Parameter Record

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n001	0101h	Password / Initialization Selection	1		
n002	0102h	Control Method Selection	0		
n003	0103h	Run/Stop Source Selection	1		
n004	0104h	Frequency Reference Source Selection	2		
n005	0105h	Stopping Method Selection	0		
n006	0106h	Reverse Prohibit Selection	0		
n007	0107h	Stop Key Function Selection	0		
n008	0108h	Keypad Frequency Reference Source	0		
n009	0109h	Frequency Reference Enter Button Requirement	0		
n010	010Ah	Operator Connection Detection Selection	0		
n011	010Bh	Maximum Output Frequency	60		
n012	010Ch	Maximum Voltage	230		
n013	010Dh	Base Frequency	60		
n014	010Eh	Midpoint Frequency	Control Method		
n015	010Fh	Midpoint Voltage	Control Method		
n016	0110h	Minimum Frequency	Control Method		
n017	0111h	Minimum Voltage	Control Method		
n018	0112h	Accel / Decel Time Unit Selection	0		
n019	0113h	Accel Time 1	10		
n020	0114h	Decel Time 1	10		
n021	0115h	Accel Time 2	10		
n022	0116h	Decel Time 2	10		
n023	0117h	S-Curve Selection	0		
n024	0118h	Frequency Reference 1	6		
n025	0119h	Frequency Reference 2	0		

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n026	011Ah	Frequency Reference 3	0		
n027	011Bh	Frequency Reference 4	0		
n028	011Ch	Frequency Reference 5	0		
n029	011Dh	Frequency Reference 6	0		
n030	011Eh	Frequency Reference 7	0		
n031	011Fh	Frequency Reference 8	0		
n032	0120h	Jog Frequency Reference	6		
n033	0121h	Frequency Reference Upper Limit	100		
n034	0122h	Frequency Reference Lower Limit	0		
n035	0123h	Frequency Reference Unit Selection (For Keypad)	0		
n036	0124h	Motor Rated Current	kVA		
n037	0125h	Electronic Motor Overload Protection	0		
n038	0126h	Motor Overload Protection Time Constant	8		
n039	0127h	Cooling Fan Operation Selection	0		
n040	0128h	Motor Rotation Selection	0		
n041	0129h	Accel Time 3	10		
n042	012Ah	Decel Time 3	10		
n043	012Bh	Accel Time 4	10		
n044	012Ch	Decel Time 4	10		
n045	012Dh	Frequency Reference Bias	0		
n046	012Eh	Frequency Reference Bias Accel/Decel Rate Selection	0		
n047	012Fh	Freq Ref Bias Operation Mode Selection	0		
n048	0130h	Frequency Reference Bias Value	0		
n049	0131h	Analog Frequency Reference Change Level	1		
n050	0132h	Digital Input Terminal S1 Function Selection	1		
n051	0133h	Digital Input Terminal S2 Function Selection	2		

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n052	0134h	Digital Input Terminal S3 Function Selection	3		
n053	0135h	Digital Input Terminal S4 Function Selection	5		
n054	0136h	Digital Input Terminal S5 Function Selection	6		
n055	0137h	Digital Input Terminal S6 Function Selection	7		
n056	0138h	Digital Input Terminal S7 Function Selection	10		
n057	0139h	Digital Output Terminal MA ~MC Function Selection	1		
n058	013Ah	Digital Output P1 ~ PC Function Selection	1		
n059	013Bh	Digital Output P2 ~ PC Function Selection	2		
n060	013Ch	Analog Input Terminal FR Gain	100		
n061	013Dh	Analog Input Terminal FR Bias	0		
n062	013Eh	Analog Input Terminal FR Filter Time	0.1		
n063	013Fh	Reserved	-		
n064	0140h	Frequency Reference Loss Detection Selection	0		
n065	0141h	Output Monitor Terminal AM Signal Type Selection	0		
n066	0142h	Output Monitor Terminal AM Function Selection	0		
n067	0143h	Output Monitor Terminal AM Gain	1		
n068	0144h	Aux Analog Input Terminal CN2 (0-10VDC) Gain	100		
n069	0145h	Aux Analog Input Terminal CN2 (0-10VDC) Bias	0		
n070	0146h	Aux Analog Input Terminal CN2 (0-10VDC) Filter Time	0.1		
n071	0147h	Aux Analog Input Terminal CN2 (4-20mA) Gain	100		
n072	0148h	Aux Analog Input Terminal CN2 (4-20mA) Bias	0%		
n073	0149h	Aux Analog Input Terminal CN2 (4-20mA) Filter Time	0.1		
n074	014Ah	Pulse Input Terminal RP Gain	100		
n075	014Bh	Pulse Input Terminal RP Bias	0		
n076	014Ch	Pulse Input Terminal RP Filter Time	0.1		

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n077	014Dh	Aux Analog Input Terminal CN2 Function Selection	0		
n078	014Eh	Aux Analog Input Terminal CN2 Signal Type Selection	0		
n079	014Fh	Aux Analog Input Terminal CN2 Bias	10		
n080	0150h	Carrier Frequency Selection	46		
n081	0151h	Momentary Power Loss Recovery Selection	0		
n082	0152h	Auto-Fault Restart Retries	0		
n083	0153h	Prohibit Frequency 1	0		
n084	0154h	Prohibit Frequency 2	0		
n085	0155h	Prohibit Frequency 3	0		
n086	0156h	Prohibit Frequency Deadband	0		
n087	0157h	Elapsed Time Function Selection	0		
n088	0158h	Elapsed Time Initial Value	0		
n089	0159h	DC Injection Current Level	50		
n090	015Ah	DC Injection Time at Stop	0.5		
n091	015Bh	DC Injection Time at Start	0		
n092	015Ch	Stall Prevention During Decel Selection	0		
n093	015Dh	Stall Prevention During Accel Level	170		
n094	015Eh	Stall Prevention During Run Level	160		
n095	015Fh	Frequency Detection Level	0		
n096	0160h	Overtorque Detection (OL3) Response Selection	0		
n097	0161h	Overtorque Detection (OL3) Method Selection	0		
n098	0162h	Overtorque Detection (OL3) Level	160		
n099	0163h	Overtorque Detection (OL3) Delay Time	0.1		
n100	0164h	Up/Down Memory Hold Selection	0		
n101	0165h	Speed Search Decel Time	2		
n102	0166h	Speed Search Detection Level	150		

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n103	0167h	Torque Compensation Gain	1		
n104	0168h	Torque Compensation Filter Time	Control Method		
n105	0169h	Torque Compensation Iron Loss	kVA		
n106	016Ah	Motor Rated Slip	kVA		
n107	016Bh	Motor Line-To-Line Resistance	kVA		
n108	016Ch	Motor Leakage Inductance	kVA		
n109	016Dh	Torque Limiter	150		
n110	016Eh	Motor No-Load Current	kVA		
n111	016Fh	Slip Compensation Gain	Control Method		
n112	0170h	Slip Compensation Filter Time	Control Method		
n113	0171h	Slip Compensation During Regeneration Selection	0		
n114	0172h	Reserved	-		
n115	0173h	Stall Prevention During Run (Above Base Speed) Selection	0		
n116	0174h	Stall Prevention Accel/Decel Time Selection	0		
n117	0175h	Undertorque (UL3) Detection Response Selection	0		
n118	0176h	Undertorque Detection Level	10		
n119	0177h	Undertorque Detection Delay Time	0.1		
n120	0178h	Frequency Reference 9	0		
n121	0179h	Frequency Reference 10	0		
n122	017Ah	Frequency Reference 11	0		
n123	017Bh	Frequency Reference 12	0		
n124	017Ch	Frequency Reference 13	0		
n125	017Dh	Frequency Reference 14	0		
n126	017Eh	Frequency Reference 15	0		
n127	017Fh	Frequency Reference 16	0		
n128	0180h	PID Control Selection	0		

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n129	0181h	PID Feedback Gain	1		
n130	0182h	PID Proportional Gain	1		
n131	0183h	PID Integral Time	1		
n132	0184h	PID Derivative Time	0		
n133	0185h	PID Offset Adjustment	0		
n134	0186h	PID Integral Limit	100		
n135	0187h	PID Output Filter Time	0		
n136	0188h	PID Feedback Loss Detection	0		
n137	0189h	PID Feedback Loss Detection Level	0		
n138	018Ah	PID Feedback Loss Detection Delay Time	1		
n139	018Bh	Energy-Saving Control	0		
n140	018Ch	Energy-Saving Coefficient K2	kVA		
n141	018Dh	Energy-Saving Voltage Lower Limit at 60hz	50		
n142	018Eh	Energy-Saving Voltage Lower Limit at 6 Hz	12		
n143	018Fh	Power Supply Average Time	1		
n144	0190h	Search Voltage Limiter	0		
n145	0191h	Search Step at 100%	0.5		
n146	0192h	Search Step at 5%	0.2		
n147	0193h	Motor Rated Voltage	200		
n148	0194h	Save UV1 and UV2 to EEPROM	0		
n149	0195h	Pulse Input Scaling	2550		
n150	0196h	Pulse Monitor Output Frequency	0		
n151	0197h	Modbus Time Out Detection Selection	0		
n152	0198h	Frequency Reference Unit Selection (For Modbus RTU and TCP/IP)	0		
n153	0199h	Modbus RTU Slave Address	0		
n154	019Ah	Modbus RTU Baud Rate Selection	2		
n155	019Bh	Modbus RTU Parity Selection	210		

Table 5.1 Parameter Record					
Parameter	Address	Function	Default	User Value	Notes
n156	019Ch	Modbus RTU Send Delay Time	10		
n157	019Dh	Modbus RTU RTS Control Selection	0		
n158	019Eh	Energy Saving Control Motor Code	kVA		
n159	019Fh	Energy-Saving Voltage Upper Limit at 60Hz	120		
n160	01A0h	Energy-Saving Voltage Upper Limit at 6Hz	16		
n161	01A1h	Search Power Supply Detect Hold Width	10		
n162	01A2h	Power Factor Detection Filter Time	5		
n163	01A3h	PID Output Gain	1		
n164	01A4h	PID Feedback Source Selection	0		
n165	01A5h	Reserved	-		
n166	01A6h	Input Phase Loss Detection Level	0		
n167	01A7h	Input Phase Loss Detection Delay Time	0		
n168	01A8h	Output Phase Loss Detection Level	0		
n169	01A9h	Output Phase Loss Detection Delay Time	0		
n170	01AAh	Enter Command Selection (Modbus Only)	0		
n171	01ABh	Frequency Bias Upper Limit	100.0		
n172	01ACh	Frequency Bias Lower Limit	0.0		
n173	01ADh	DC Injection Proportional Gain	83		
n174	01AEh	DC Injection Integral Time	25		
n175	01B0h	Carrier Frequency Reduction at Low Speed and High Load	0		
n176	01B1h	Keypad Parameter Read/Copy Function Selection	rdy		
n177	01B2h	Keypad Parameter Read/Copy Prohibit Selection	0		
n178	01B3h	Fault History	-		
n179	01B4h	Drive Software Number	-		

Notes:

Enter the current application parameter data and any relevant notes.

Hex/Dec Conversion Table

Table 5.2 – Hexadecimal-Decimal Conversion									
Hex	**Dec**	**Hex**	**Dec**	**Hex**	**Dec**	**Hex**	**Dec**	**Hex**	**Dec**
0	0	34	52	68	104	9C	156	D0	208
1	1	35	53	69	105	9D	157	D1	209
2	2	36	54	6A	106	9E	158	D2	210
3	3	37	55	6B	107	9F	159	D3	211
4	4	38	56	6C	108	A0	160	D4	212
5	5	39	57	6D	109	A1	161	D5	213
6	6	3A	58	6E	110	A2	162	D6	214
7	7	3B	59	6F	111	A3	163	D7	215
8	8	3C	60	70	112	A4	164	D8	216
9	9	3D	61	71	113	A5	165	D9	217
A	10	3E	62	72	114	A6	166	DA	218
B	11	3F	63	73	115	A7	167	DB	219
C	12	40	64	74	116	A8	168	DC	220
D	13	41	65	75	117	A9	169	DD	221
E	14	42	66	76	118	AA	170	DE	222
F	15	43	67	77	119	AB	171	DF	223
10	16	44	68	78	120	AC	172	E0	224
11	17	45	69	79	121	AD	173	E1	225
12	18	46	70	7A	122	AE	174	E2	226
13	19	47	71	7B	123	AF	175	E3	227
14	20	48	72	7C	124	B0	176	E4	228
15	21	49	73	7D	125	B1	177	E5	229
16	22	4A	74	7E	126	B2	178	E6	230
17	23	4B	75	7F	127	B3	179	E7	231
18	24	4C	76	80	128	B4	180	E8	232
19	25	4D	77	81	129	B5	181	E9	233
1A	26	4E	78	82	130	B6	182	EA	234
1B	27	4F	79	83	131	B7	183	EB	235
1C	28	50	80	84	132	B8	184	EC	236
1D	29	51	81	85	133	B9	185	ED	237
1E	30	52	82	86	134	BA	186	EE	238
1F	31	53	83	87	135	BB	187	EF	239
20	32	54	84	88	136	BC	188	F0	240
21	33	55	85	89	137	BD	189	F1	241
22	34	56	86	8A	138	BE	190	F2	242
23	35	57	87	8B	139	BF	191	F3	243
24	36	58	88	8C	140	C0	192	F4	244
25	37	59	89	8D	141	C1	193	F5	245
26	38	5A	90	8E	142	C2	194	F6	246
27	39	5B	91	8F	143	C3	195	F7	247
28	40	5C	92	90	144	C4	196	F8	248
29	41	5D	93	91	145	C5	197	F9	249
2A	42	5E	94	92	146	C6	198	FA	250
2B	43	5F	95	93	147	C7	199	FB	251
2C	44	60	96	94	148	C8	200	FC	252
2D	45	61	97	95	149	C9	201	FD	253
2E	46	62	98	96	150	CA	202	FE	254
2F	47	63	99	97	151	CB	203	FF	255
30	48	64	100	98	152	CC	204	100	256
31	49	65	101	99	153	CD	205		
32	50	66	102	9A	154	CE	206		
33	51	67	103	9B	155	CF	207		

Notes:

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