Application Note - Changing Drive Parameters via Modbus

Application Overview

The Modbus Protocol is a messaging structure developed by Modicon in 1979. It is used to establish master-slave/client-server communication between intelligent devices. It is a standard, truly open and the most widely used network protocol in industrial environments. Modbus has been implemented on Yaskawa drives to transfer discrete/analog I/O and register data to PLCs. Industry analysts have reported over 7 million Modbus nodes in North America and Europe alone.

The purpose of this application note is to guide users on how to properly write to the drive parameters over Modbus. The application note will take into account the ENTER command, parameter sequence and dependencies as it relates to control method, drive kVA and V/f settings to name a few.

Application Highlights

The drive keypad is typically used as the interface to access drive parameters for programming. A typical drive installation is mounted in a panel where the keypad is either on the panel door or left on the drive. If the keypad remains on the drive, the user does not have access when the drive is powered on. The user must wear PPE to open up a powered panel to access the keypad.

Drives now are being added to networks where they can be controlled and monitored remotely. The network will also allow the user to program, verify and change parameters without having to access the keypad. A PLC, for example, can store specific parameters for each drive on the network and load them when necessary.

Application Challenges

When the drive keypad is utilized to enter parameters, the Enter button is pressed to accept the changes and store the settings into the EEPROM. There are similar steps to save the parameter changes when writing the settings over Modbus.

Parameter H5-11 (Comm ENTER Command Mode) will determine if an ENTER command will be required when parameter changes are written over Modbus. The ENTER command can be thought of as the same procedure as pressing the Enter button on the keypad.

If H5-11 is at the default setting of "0" (ENTER Command Required), the ENTER command must be written over Modbus to accept the change. The drive supports two types of ENTER commands to save the parameter changes.

- The Modbus register 900H is for the ENTER command to write the changes to EEPROM, while simultaneously updating the RAM. The parameter changes are retained after a drive power cycle/loss.

- The Modbus register 910H is for the ENTER command (typically referred to as ACCEPT command) to write the changes to the RAM, but not the EEPROM. The parameter changes are no longer available after a drive power cycle/loss.

- A value of 0 must be written to 900H or 910H to enable the ENTER command

If H5-11 is set to a value of "1" (ENTER Command Not Required), the ENTER command will not be required after a parameter change over Modbus. The ENTER command is automatically written after each parameter write.

The order of parameters that are written over Modbus and when the ENTER command is applied, must be taken into account. There are parameter dependencies that can be affected if the parameter changes are not done in the correct order. The incorrect programming of the drive can have adverse effects of the drive performance. Unlike making changes with the keypad, the correct sequence and order are performed in the background to ensure the parameter dependencies are correct.

Application Requirements

The H5 parameter group (Modbus Communication) must be set prior to communicating to the PLC over Modbus. Refer to the Network Communications section of the technical manual for details regarding wiring, programming and communication specifications.

- GA Series drives can be programmed without 3 phase supply using DriveWizard Industrial or DriveWizard Mobile

- 1000 Series drives requires 3 phase supply for programming with DriveWizard Industrial or the keypad

Table 1 will outline the order in which parameters must be written over Modbus and when the ENTER command must be applied. The parameter priority level will ensure that the correct dependencies are changed in drive.

Table 1: Parameter Priority Level

Priority Level	Modbus Register	Parameter	Parameter Description
1	508H	O2-04	Drive Model (KVA) Selection
2	102H	A1-02	Control Method Selection
3	319H	E3-01	Motor 2 Control Mode Selection
ENTER Command/H5-11=1			
4	302H	E1-03	V/f Pattern Selection
5	223H	C6-01	ND/HD selection
ENTER Command/H5-11=1			
6	4EFH	L8-38	Carrier Frequency Reduction
7	224H	C6-02	Carrier Frequency Selection
8	329H	E5-01	PM Motor Code Selection
ENTER Command/H5-11=1			
9	225H	C6-03	Carrier Frequency Upper Limit
10	304H	E1-05	Max Output Voltage
11	31BH	E3-05	Motor 2 Max Output Voltage
ENTER Command/H5-11=1			
12	300H	E1-01	Input AC Supply Voltage
13	303H	E1-04	Max Output Frequency
ENTER Command/H5-11=1			
14	502H	O1-03	Frequency Display Unit Selection
15	1E2H	B5-20	PID Unit Selection
16	209H	C1-10	Accel/Decel Rate Frequency
ENTER Command/H5-11=1			
17	520H	O1-10	User Units Max Value
18	1FEH	B5-38	PID User Unit Display Scaling

Priority Level	Modbus Register	Parameter	Parameter Description
ENTER Command/H5-11=1			
19	308H	E1-09	Min Output Frequency
20	311H	E2-04	Motor Pole Count
21	294H	D3-01	Jump Frequency 1
22	295H	D3-02	Jump Frequency 2
23	296H	D3-03	Jump Frequency 3
24	297H	D3-04	Jump Frequency Width
25	280H~288H 28BH~292H	D1-xx	Frequency Reference
26		Parameter settings other than No1-No26	
ENTER Command/H5-11=1			

The list of parameters that will be changed over Modbus should be compared to the priority level for the parameters in Table 1. After comparing the list of parameters, it may require moving specific parameters to ensure the dependencies are set properly.

Implementation

For GA Series drives, function code 67H sub function code 10EH provides the ability to write to nonconsecutive Modbus registers. The nonconsecutive Modbus registers in Table 1 will require the use of function code 67H. The user can decide if the ENTER command will be written using register 900H or 910H or program H5-11=1, automatically write the ENTER command.

For 1000 Series drives, function code 67H is not available consequently function code 10H must be used. Function code 10H requires consecutive Modbus register when writing to more than one register. Multiple write commands must be utilized due to the nonconsecutive Modbus registers listed in Table 1. It will be advantageous to program H5-11=1 to automatically write the ENTER command after each parameter write.

The ENTER command will require a minimum wait time before proceeding to the next parameter write. The minimum wait time will vary based on the number of parameter writes and the type of ENTER command selected (EEPROM vs RAM). The range will be a minimum of 200ms to maximum of 5s.

The maximum number of ENTER command writes to the EEPROM is 100,000. The number of writes to the EEPROM must be considered for applications that load parameters to the drive upon power up. If and when the 100,000 is reached, parameter changes are no longer possible.

The Modified Parameters menu can be used to verify that there are no unexpected parameter changes after completing the changes over Modbus. When the user has gained experience with the procedure, it may not be necessary to review the Modified Parameters menu.

Troubleshooting

Busy Write Protected

The drive keypad will flash "Busy Write Protected" when the drive is placed into operation mode and a run command or speed reference is sent via Modbus. The alarm is triggered due to a parameter change without an ENTER command to accept the change.

- Check and verify the parameter write sequence to ensure that the ENTER command was included.

- If H5-11 was used for the ENTER command, verify that the setting was a "1" and a power cycle was performed to accept the change.

    – GA Series drives: H5-20=1 will reload parameter without requiring a power cycle

PLC Message Errors

Function Code Error 01H

The function code selected was incorrect when trying to read or write to the drive.

- If function code 10H was used to write to the drive, verify the Modbus registers are consecutive.

- For nonconsecutive Modbus registers use function code 67H sub function code 10EH (GA Series only).

Register Number Error 02H

A Modbus write to a register that does not exist or was not available.

- Double check the register number using the drive tech manual.

- If the register was not available, compare the parameter changes with Table 1 to follow the priority level. An incorrect parameter order can lead to an unavailable register.

Data Setting Error 21H

A Modbus write to a register was outside of the allowable setting range.

- The parameters listed in Table 1 ensures that the dependencies are applied appropriately when following the priority level.

- Compare the parameter write order with Table 1.

Write Mode Error 22H

The drive was in run mode while attempting to write to a parameter.

- The parameter cannot be changed during run.

- A write function code was selected for a read-only Modbus register.

Write Error During Parameter Process 24H

The PLC attempted to write to a parameter while processing a previous parameter write.

- The drive did not complete processing the ENTER command from a previous parameter write when the PLC attempted the next parameter write.

- Add a time delay between ENTER commands to allow the drive to process the parameter write.