Minarik

Variable Speed AC Motor Drives

AC300/400 Series

Modbus Control Operation Manual

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1.0 Scope

This document is intended to define the specifics required for serial communication with Minarik Corporation Standard AC300/400 Series drives for control, status monitoring, and programming parameters. A familiarity with normal drive capabilites and operations is assumed. If this is not the case, please refer to the appropriate Minarik Installation and Operation manual as necessary.

2.0 Modbus ® Details

A. Minarik Drives running the Modbus communcation protocol use the RTU (Remote Terminal Unit) transmission mode and are slaves only. Therefore, the device communicating with the drives must be a Modbus Master. The baud rate is 9600, no parity (two stop bits). The bit sequence is:

	Data									
Start bit	1	2	3	4	5	6	7	8	Stop bit	Stop bit

B. At this time the Minarik drives do not support the broadcast function of the protocol.

C. IMPORTANT NOTE: Modbus 3X and 4X Registers are numbered starting at 1. However, when transmitted to a slave over the serial link, the actual address transmitted is one less. This is because the addresses are numbered starting from 0. Minarik register numbers are also numbered starting from 0. Therefore, Minarik register numbers always correspond exactly with the address transmitted. As a result, MODBUS REGISTER NUMBERS ARE ALWAYS ONE GREATER THAN MINARIK REGISTER NUMBERS. WHENEVER THE WORDS “REGISTER xx” APPEAR, THE “MINARIK REGISTER xx” IS BEING REFERENCED and the Modbus Register number will be one larger. In some instances we may show both for clarity. For example: “Register #24 (Modbus Register #25)...”

D. The function codes supported by Minarik drives are:
   1. 03 - Read Holding Register (4X references). In general we can read only one register at a time. However, there are a few limited exceptions.

      Exception One:
      a. Register #24 (Modbus Register #25) Drive Status must be read as a group of 6 words.

      Exception Two:
      Minarik uses a method of reading a group of related registers that may not be consecutive within the drive memory map. When this is done for the registers below, the response from the drive will be for the number of words requested but will not be with consecutive registers.

b. Register #100 (Modbus Register #101), Fault history, should be read as a group of 4 words.
c. Register #101 (Modbus Register #102), Software version, should be read as a group of 4 words.

2. 04 - Read Input Register (3X references). As with function 03, we read one register at a time except where noted.
3. 06 - Preset Single Register (4X references). Write single register.
4. 16 - Preset Multiple Registers (4X references). Although the function is for multiple registers, we will accept only a single register to be written.
5. Note: Since we do not differentiate between 4X and 3X references, function codes 03 and 04 are treated identically.

E. Exception codes:
01 - Command rejected, Illegal function.
02 - No such register.
03 - Data out of range.
04 - Wrong data format.
06 - Slave device busy. In Keypad Programming mode, cannot write registers.

F. The Minarik drive will most nearly conform to the Modicon ® Micro 84 in capabilities. This may be of importance when configuring networks for DDE Servers.

G. Modbus and Modicon are registered trademarks of Schneider Electric. For more information about the Modbus Protocol please refer to the Modicon Modbus Protocol Reference Guide. The 24 hours support telephone number from Schneider Electric is 1-800-468-5342.

3.0 Universal Registers

Minarik Corporation sells several drive families. Currently the AC300/400 Series and AC200 Series of Minarik drives support Modbus based communications. Since the two families of drives have quite different parameters and size ranges, the parameter (register) definitions are in many cases quite different. In order to facilitate communication in a network with a mix of drive types, certain Minarik register locations have been made universal among Minarik drives. While their locations are consistent, their contents may vary as defined in the following table:

Minarik Reg #	Function
1	Drive Control (WRITE ONLY) Not all drives will have all control functions, but when the function is available it will be at a defined bit location within Register #1. Drive Family and register Configuration Number dependent.
19	Drive Family (READ ONLY) This register is CONSISTENT AMONG ALL MINARIK DRIVES: - 65 -- AC300/400 Series - 66 -- AC200 Series
21	Drive Size (READ ONLY). Code to identify Power (HP/KW) and Line Voltage of the drive. Family dependent. For the AC200 Series it always reads zero.
24	Drive Status (READ ONLY). Various operational variables.
48	Unlock Control (WRITE ONLY).
49	Unlock Writing of registers (WRITE ONLY).
50	Parameter Configuration Number (READ ONLY).

4.0 Data Internal and External Representation

A. All registers are 16 bits. The data within these registers can take on the following forms:
   1. Individual bit commands (16 per register).
      Example: Register #1 (Modbus Register #2).
   2. Individual bit flags (16 per register)
      Example: Register #22. (AC200 Series).
   3. A concatenation of two 8 bit unsigned integers.
   4. A 16 bit unsigned integare. This unsigned integer could in turn represent many different types of data with various scaling rules and units, which are defined by the DATA TYPE of the register.

B. Data Types
   Data passed in registers across the Modbus communcations link are always in INTERNAL units. The drive itself may show the information in alternate DISPLAYED units. For example: drive speeds are always stored internally as hundredths of a Hz but the drive may display that speed in terms of RPM's using programmed conversion factors.

The data type PID (on the AC400 only) requires explanation. The internal range of any data with a PID is 0 to 35736. Many different variables could be controlled in a PID system (pressure, temperature, flow, etc.). To simplify drive calculation, the drive programmer enters the type and range of the controlled variable (actually it is the range of the feedback device that we are scaling) and this range is mapped into the internal range of 0 to 35736. For example, if the feedback device measured 0 to 200 PSI, then 0 PSI is 0 internal units, and 200 PSI is 35736 internal units. To command a set-point of 100 PSI the LOCAL PID command (Register #41) could be written with the value 17868 (35736*100/200). Thus to control PID operations using real world units, the Modbus Master must have knowledge of the range of the feedback device. The following are examples of the internal units used on the AC300/400 Series:

Type	Unit	Example
SPEED	.01 Hz	60 Hz = 6000
TIME	.1 Sec	30.0 Sec = 300

See Programming Parameter List

5.0 Minarik Drive Parameters

Registers #0 through #50 (Modbus Registers #1 to #51) are reserved for Configuration and Control. Registers #51 though #260 (Modbus Registers #52 to #261) are reserved for the Drives' Programming Mode Parameters. Programming Mode Parameters are the parameters that can be accessed from the local keypad on the drive. There is a direct correspondence between the Drive Programming Mode Parameter number and the Minarik Register number (and consequently, the Modbus register number):

Minarik Register # = (MC Programming Parameter #) + 51
Modbus Register # = (MC Programming Parameter #) + 52

The entries in Table 1 are based on AC300/400 Series Drive Software #213-037 Revision AA (Parameter Configuration = 118). If a later revision of software were to change definitions, drive operation could be seriously affected. This will be identified for a given drive by examining Register #50 (Parameter configuration Number). The number displayed at power up on drive display can also identify it. If it is not 118, writing to any register on the drive MUST NOT BE ATTEMPTED unless your Controller has been setup to support the new configuration.

6.0 AC300/400 Operational Details

A. Serial Address
   All Minarik drives have a Serial Address Parameter that must be programmed prior to attempting to operate the serial interface (Programming Parameter #58 / Minarik Register #109).

B. Serial Communications Parameter

1. All Minarik drives have a Serial Communications Parameter that governs the operation of the Serial Link. On AC300/400 drives this is #57 SERIAL LINK (register #108).

2. Prior to attempting to communicate with the drive, the Serial Communications Parameter must be appropriately programmed. Please refer to the AC300 or AC400 Installation and Operation Manual for a detailed explanation for programming the drive parameters.

   1, DISABLE ← *default*
   2, W / TIMER
   3, W / OUT TIMER

3. Programming parameter #57 (Serial) to "W / TIMER" enables serial communications with a watchdog timer. If there is no serial activity (read or write) for more than 10 seconds, serial control will turn off and the drive will stop.

4. Programming parameter #57 (Serial) to "W / O TIMER" enables serial communications without a watchdog timer. However, after 10 seconds of no serial activity, serial control can be turned off by issuing a STOP command from any source. Please refer to the AC300 and AC400 Installation and Operation Manual for more information.

C. Unlocking and Locking Controls

1. A write to Register #48 (Unlock Controls) with a value of 0 will unlock controls. This enables the writing of Register #1 - the Drive Control Register.
2. If Register #48 (Unlock Controls) is written with a value that is the Drive's Programming Password, then in addition to Register #1 (Drive Control), writing to all other writeable registers is enabled (e.g.: register #52 -- Preset Speed #1). The factor default password for AC300/400 drives is 19.
3. Once Register #48 (Unlock Controls) has been written, Controls are unlocked until Register #1 bit 1 (Lock Bit) has been written, Watchdog timeout occurs.
4. Writing to Register #1 (Drive Control) with bit 1 set will Lock both Controls and Parameters (prevents writing to any register).
5. The serial drive control can be unlocked only when it is in LOCAL control mode and the drive is not in programming mode.
6. When LOCK is asserted, the drive drops out of SERIAL control and reverts back to the previous source of control.
7. Even though drive might be locked, and thus parameters and control cannot be written, parameters and status can always be read. See section G on Page 8.

D. Unlocking and Locking Programming Parameters only

1. Writing to any writeable register other than #1 can be enabled by writing the Drive's Programming Password to Register #49 (Unlock Paramters). This would be done when Drive Control (start, stop, etc.) and keypad speed control (reg. #40) is not required.
2. The factory default password is 19.
3. Once Register #49 (Unlock Parameters) has been written, the writing of parameter registers is unlocked until Register #1 bit 1 (Lock Bit) has been set.

E. Watchdog Timer

1. All Minarik drives are equipped with a Serial Link "Watchdog Timer". If the Modbus Master wishes to control the drive (start, stop, forward, reverse, etc.) it must first "Unlock Controls" (See section C on Page 6). If the Watchdog Timer is enabled and controls have been unlocked, the Master MUST PERIODICALLY COMMUNICATE with the drive or the timer will timeout. A Watchdog timeout forces the drive to stop because it is assumed that the failure of periodic communications with the drive could be a loss of the serial link with the accompanying loss of ability to command the drive to stop. The Watchdog Timer does not operate unless Controls have been UNLOCKED via Register #48, or parameters wiritng have been unlocked via Register #49. In case of unlocking parameters only, watchdog timer will disable write permission but will not stop the drive.

2. Watchdog Timer Controls
   a) For some applications, it is inappropriate to shut down the drive because of a Watchdog Timeout. Programming Parameter #57 (Serial Communications) controls both the enabling of the serial link as well as the watchdog. Setting this to W / Timer enables the serial link as well as the watchdog. Setting this to W / O Timer enables the serial link without the watchdog.
   b) A Watchdog failure can be recognized by reading the drive status (Minarik Registers #24-29) and looking at the control mode. If it has reverted from SERIAL to LOCAL without the Modbus Master commandng it via Register #1 bit 1 (LOCK) then a watchdog failure has occurred. Serial control can be reestablished by reasserting Register #48.
   c) If the Watchdog Timer has been disabled, the Unlock Control Register #48 or Unlock Writing Register #49 must still be asserted in order to write to Register #1 (Drive Control) or to any of the programming parameters (in case of unlocking writing). However, there are no longer any constraints on how often the Master must communicate with the drive.

F. Monitoring Only Operation

1. Power up the drive in TERMINAL mode with serial enabled.
2. Simply read Minarik Register #24 (Modbus Register #25) or any other readable register.
3. No unlocking or watchdog issues apply for monitoring.

G. Normal Control Operation Sequence

1. Power up the drive with serial enabled.
2. Unlock control by writing a zero to Register #48.
3. Control drive operation via various commands to Register #1 (Start, Stop, Reverse direction, etc.).
4. If the Watchdog Timer is enabled, keep it from timing out by assuring that repeated reads of drive status (Register #24 - 6 registers) are performed at reasonable intervals (typically less than 5 seconds between reads because the Watchdog typically faults at 10 seconds).
5. Lock Control when drive operations are complete by writing a 2 to Register #1 (assert bit 1 of Register 1).
6. Drive is now returned to TERMINAL mode (control from the drive's terminal).

H. Start/Stop, Speed Control and Parameter Change Operation Typical Sequence

1. Power up the drive with serial enabled.
2. Unlock Controls and Parameters by writing the current programming password (default 19) to Register #48.
3. Put drive in MANUAL mode so that it responds to speed commands from the Keypad Speed Command register. This is done by sending 0200 hex to Register #1 (bit 9 asserted).
4. Control Drive Operation via various commands to Register #1 (Start, Stop, Reverse direction, etc.).
5. Control Drive Speed by writing the Speed Commands to Register #40 (Keypad Speed Command).
6. Change the programming parameters (e.g., change the acceleration rate by writing new acceleration rate to register #59).
7. If the Watchdog Timer is enabled, keep it from timing out by insuring that repeated reads of any of the registers are performed at reasonable intervals (typically less than 5 seconds between reads because the Watchdog typically faults at 10 seconds).
   Note: It is suggested that the drive status register (#24) be used for this function.
8. Lock Controls and Parameters when drive operations are complete by writing a 2 to Register #1 (assert bit 1 of Register 1).

Table 1 - AC300/400 Drive Control Registers

* *See Note [1]*, for an explanation of the abbreviations used below.

ACT # (Hex Representation)	REGISTER NAME	R/W/RS	MESSAGE								MIN	MAX	UNITS	NOTE
1 (01)	Drive Control	W	SA	06	00	01	DH	DL	CRC		See Notes			[2]
		RS	SA	06	00	01	DH	DL	CRC					
19 (13)	Drive Family	R	SA	03	00	13	00	01	CRC		See Notes			[3]
		RS	SA	03	02	00	42	CRC						
21 (15)	Drive Size	R	SA	03	00	15	00	01	CRC		See Notes			[4]
		RS	SA	03	02	00	00	CRC						
24 (18)	Drive Status	R	SA	03	00	18	00	06	CRC		See Notes			[5]
	(6 register read)	RS	SA	03	0C	D1H	D1L	D2H	D2L					
	(reg. #24 to 29)					D3H	D3L	D4H	D4L					
						D5H	D5L	D6H	D6L	CRC				
		RS	SA	03	02	DH	DL	CRC						
30 (1e)	Motor Voltage	R	SA	03	00	1E	00	01	CRC		0	1000	0V	[6]
		RS	SA	03	02	DH	DL	CRC						
36 (24)	Total Run time	R	SA	03	00	24	00	01	CRC		See Notes			[8]
	Hours (AC400)	RS	SA	03	02	DH	DL	CRC						
37 (25)	Total Run time	R	SA	03	00	25	00	01	CRC		See Notes			[8]
	Mins (AC400)	RS	SA	03	02	DH	DL	CRC						
38 (26)	PID Setpoint	R	SA	03	00	26	00	01	CRC		See Notes			[9]
	(AC400 Only)	RS	SA	03	02	DH	DL	CRC						
39 (27)	PID Feedback	R	SA	03	00	27	00	01	CRC		See Notes			[9]
	(AC400 Only)	RS	SA	03	02	DH	DL	CRC						
40 (28)	Keypad Speed	R	SA	03	00	28	00	01	CRC		0	65000	0.01 Hz	[7]
	Command	RS	SA	03	02	DH	DL	CRC						
		W	SA	06	00	28	DH	DL	CRC					
		RS	SA	06	00	28	DH	CDL	CRC					
41 (29)	Local PID	R	SA	03	00	29	00	01	CRC		See Notes			[9]
	Cmd (AC400)	RS	SA	03	02	DH	DL	CRC						
		W	SA	06	00	29	DH	DL	CRC					
		RS	SA	06	00	29	DH	DL	CRC					
48 (30)	Unlock	W	SA	06	00	30	DH	DL	CRC					[10]
	Commands	RS	SA	06	00	30	DH	DL	CRC		0	9999	None	
49 (31)	Unlock	W	SA	06	00	31	DH	DL	CRC					[11]
	Parameters	RS	SA	06	00	31	DH	DL	CRC		0	9999	None	
50 (32)	Register	R	SA	03	00	32	00	01	CRC					[12]
	Version	RS	SA	03	02	DH	DL	CRC			0	65535	None	

NOTES:

Note [1]: Following are the abbreviations used in table 1:

R	Read
W	Write
RS	Response
SA	Slave Address (typically 01 through F7 hex)
CRC	CRC high + CRC low (see CRC calculations section in MODBUS manual)
DH	Data High byte
DL	Data Low byte
B	Byte
ACT#	Minarik Register # (Modbus Register numbers are 1 larger)

Note [2]: Register #1 (Drive Control):

Data Low Byte	0	UPDATE BUFFERS
	1	LOCK SECURITY
	2	STOP DRIVE
	3	START DRIVE
	4	UNUSED
	5	UNUSED
	6	SET REVERSE
	7	SET FORWARD
Data High Byte	8	AUTO MODE
	9	MANUAL MODE
	10	
	11	
	12	
	13	
	14	
	15	

The appropriate bit is set to 1. For example, to stop, the drive bit two is set (send 0004H). To start the drive send 0008H. Setting the update buffers bit, enables you to start the drive using downloaded data. Locking security disables the serial drive control, the communications Watchdog Timer and prevents any further writing to control or parameter registers.

IMPORTANT: During each write to Register #1 only one bit should be set in the drive control word. Drive responds to stop bit only, if more than 1 bit is set. If stop bit is not set, but more than 1 bit is set, drive responds with exception 04.

Note [3]: Minarik Corporation's AC300/400 Series returns 65 (41H) and AC200 Series drives always returns 66 (42H).

Note [4]: Register #21 (Drive Size)

Size	HP	Voltage
00	.25	120
01	.25	240
02	.5	240
03	1	240
04	1.5	240
05	2	240
06	3	240
07	5	240
08	7.5	240
09	10	240
10	15	240
11	20	240
12	25	240
13	50	480
14	60	480
15	1	480
16	1.5	480
17	2	480
18	3	480
19	5	480
20	7.5	480
21	10	480
22	15	480
23	20	480
24	25	480
25	30	480
26	40	480
27	1	590
28	1.5	590
29	2	590
30	3	590
31	5	590
32	7.5	590
33	10	590
34	15	590
35	20	590
36	25	590
37	30	590
38	40	590
39	50	590
40	60	590
41	75	590
42	100	590
43	125	590
44	150	590
45	200	590
46	75	480
47	100	480
48	125	480
49	450	480
50	200	480
51	30	240
52	40	240
53	50	240
54	60	240
55	75	240
56	100	240

Note [5]: When reading parameter #24, the number of points must be 6.
This is an exception to the rule of being able to read only one register at a time. The drive will send back 6 registers to the master. The AC300 or AC400 drive will not respond to a read from register #25, 26, 27, 28, and 29.

6 Register read at #24:

Command Speed	D1H D1L
Actual Speed	D2H D2L
Load	D3H
Operation Status	D3L
Rotational Direction	D4H
Control Mode	D4L
Speed Command Source	D5L
Auto/Manual Status	D5H
Present Fault	D6H
Command Rotation	D6L

Command Speed (bytes D1H and D1L)
- In hundredths of a Hz.
- Most significant byte is first, followed by least significant.
- Example: 02 01 in hex converts to 5.13 Hz in decimal.

Actual Speed (bytes D2H)
- In hundredths of a Hz.
- Most significant byte is first followed by least significant.

Load (byte D3H)
- In percent of full load.
- Example: 64 (one byte in hex) → 100 (in decimal) → 100% (drive load).

Operational Status (byte D3L)

0	FAULT LOCKOUT
1	FAULT
2	START PENDING
3	STOP
4	DC BRAKE
5	RUN AT 0 Hz
6	RUN
7	ACCEL
8	DECEL
9	CURRENT LIMIT
10	DECEL OVERRIDE

Actual Rotational Direction (Register #24 byte D4H or Register #27 DH)

0	FORWARD
1	REVERSE

Control Mode (Register #24 bye D4L or Register #27 DL)

0	LOCAL	Start/Stop operation controlled from drive's keypad.
1	REMOTE	Start/Stop operation controlled from the drives terminal strip.
2	SERIAL	Start/Stop operation controlled via serial link.

Speed Command Source (Register #24 byte D5H)

0	KEYPAD
1	0 - 10 VDC
2	4 - 20 MA
3	PRESET 1
4	PRESET 2
5	PRESET 3
6	PRESET 4
7	MOP
8	Jog (AC300), Keypad Speed (AC400)
9	Keypad / Serial PID Setpoint (AC400)
10	0 - 10 VDC PID Setpoint (AC400)
11	4 - 20 MA PID Setpoint (AC400)

Auto/Manual Status (Register #24 byte D5L)

0	AUTO
1	MANUAL

Present Fault (Register #24 byte D6H of Register #29 DH)

0	NO FAULT
1	OUTPUT (TRANSISTOR) FAULT
2	Reserved
3	HIGH DC BUS VOLTAGE
4	HIGH DRIVE TEMPERATURE
5	THERMAL OVERLOAD
6	Reserved
7	LOW DC BUS VOLTAGE
8	Reserved
9	DC BRAKE ERROR
10	FOLLOWER LOSS (AC400)
11	DYNAMIC BRAKE OVERLOAD
12	POWER SAG
13	CONTROL ERROR #18
14	LANGUAGE FAULT
15	EXTERNAL FAULT
16	INTERNAL 16
17	POWER TRANSIENT
18	INTERNAL ERROR #18
19	INTERNAL ERROR #19
20	INTERNAL ERROR #20
21	INTERNAL ERROR #21
22	INTERNAL ERROR #22
23	INTERNAL ERROR #23

Note [6]: Register #30 - Motor Volts. This is the effective output voltage to the motor. It is not the same as the incoming voltage to the drive from the line.

Note [7]: Register #40 - Keypad Speed. This register is used to set the keypad speed to a desired value.
- In hundredths of a Hz.
- Most significant byte is first, followed by least significant.
- Control of the drive speed via the serial is normally done using this parameter. This register can be written only after unlocking parameters.

Note [8]: Register #36 and #37 - Total Run Time. AC400 Only.
Register #34 - Number of Hours.
Register #35 - Number of Minutes.

Note [9]: PID Units. AC400 Only.
Registers #38 (PID Setpoint Cmd), #39 (PID Feedback Value), and #41 (Local PID Setpoint Cmd) are all in drive internal units with a range of 0 to 35736. The real world parameter being controlled is mapped into this internal range based on the feedback device for the parameter being measured and controlled.

For example, if the device measures temperature in °C with a range of 10°C to +110°C, then 10°C maps to 0 in internal units. A setpoint of 30°C for the Local PID Setpoint (Register #41) would be written with a value of 7147 (1BEB hex). (35736 * {30 - 10} / {110 - 10}).

Note [10]: Register #48 (Unlock Commands) unlocks commands by using 0000 for the password. If the correct Programming mode password is entered then the appropriate programming parameters can also be accessed (see the full parameter protocol specification if access to programming parameters is required). Enabling commands also activates the drive Watchdog timer if programming parameter #57 (Serial) is to W/TIMER (it uses a fixed 10 second timeout). If the drive sees no activity within the update time period it will stop the drive. Whenever a communications session (where #48 or #49 was activated) is to be ended, register #1 bit 1 (Lock Security) must be asserted. This disables the watchdog and prevents further accesses to registers.

Note [11]: Register #49 (Unlock Parameters) unlocks Programming Parameters for writing when the proper Programming Password is entered. Whenever a parameter writing session (where #49 was activated) is to be ended, register #1 bit 1 (Lock Security) must be asserted. This disables the watchdog and prevents further write access to Parameter Registers.

Note [12]: Register Version is the number to identify if the current version of software has any register changes relative to previous version: a register has been added or deleted, a register's min/max limits have changed, a register's function has been changed, or a register's default value has been changed. Generally it is the programming parameters that are changed. Typically the Control Registers (Minarik Register #1 through #50) are quite stable.

7.0 AC300/400 Series Programming Parameters Details

SA - (1 byte) drive address (1 - 247)
RA - (1 byte) register address
CRC - (2 bytes) Cyclic Redundancy Check

READING:

Message structure for reading 1 word: (most of parameters)

Request:	SA	03	00	RA	00	01	CRC	
Response:	SA	03	02	DH	DL	CRC		

Message structure for reading 4 word: (Reg. #100 Fault history and #101 Software Version)

Request:	SA	03	00	RA	00	04	CRC	
Response:	SA	03	08	D1H	D1L	D2H	D2L	D3H
				D3L	D4H	D4L	CRC	

WRITING:

Message structure for reading 1 word: (all parameters)

Request:	SA	06	00	RA	DH	DL	CRC
Response:	SA	06	00	RA	DH	DL	CRC

PROGRAMMING PARAMETER LIST

Minarik Register Number (hexadecimal representation)	Parameter Number*	Parameter Name	Range of Adjustment (values representing selection)	Factory Default
51 (33)	0	LINE VOLTS	High (00), Low (01), Auto (02)	Auto (02)
52 (34)	1	SPEED #1	Min. Frequency - Max. Frequency	2000 (20.00 Hz)
53 (35)	2	SPEED #2	Min. Frequency - Max. Frequency	2000 (20.00 Hz)
54 (36)	3	SPEED #3	Min. Frequency - Max. Frequency	2000 (20.00 Hz)
55 (37)	4	SPEED #4	Min. Frequency - Max. Frequency	2000 (20.00 Hz)
56 (38)	5	SKIP #1	.00 Hz - Max. Frequency	00 (.00 Hz)
57 (39)	6	SKIP #2	.00 Hz - Max. Frequency	00 (.00 Hz)
58 (3A)	7	BANDWID	0 - 1000 (.00 - 10.00 Hz)	100 (1.00 Hz)
59 (3B)	8	ACCEL	see Note [1]	300 (30.0 Sec)
60 (3C)	9	DECEL	see Note [2]	300 (30.0 Sec)
61 (3D)	10	MIN FREQ	.00 Hz - Max Frequency	50 (.50 Hz)
62 (3E)	11	MAX FREQ	Min Frequency - 12000 (120.00 Hz) see Note [3]	6000 (60.00 Hz)
63 (3F)	12	DC BRAKE	see Note [4]	.0 VDC
64 (40)	13	DC TIME	0 - 9999 (.0 - 999.9 Sec)	0 (.0 Sec)
65 (41)	14	DYN BRAKE	Off (00), On (01)	Off
67 (43)	16	CURRENT	25 - 180 (25 - 180%) see Note [5]	180 (180%)
68 (44)	17	MOTOR OL	25 - 100 (25 - 100%)	100 (100%)
69 (45)	18	BASE	2000 - 36000 (20.00 - 360.0 Hz) see Note [3]	6000 (60.00 Hz)
70 (46)	19	FX BOOST	0 - 300 (.0 - 30.0%)	SEE Note [6]
71 (47)	20[1]	AC BOOST	0 - 200 (.0 - 20.0%)	0 (.0%)
72 (48)	21[1]	SLIM CMP	0 - 50 (.0 - 5.0%)	0 (.0%)
73 (49)	22	TORQUE	Constant (00), Variable (01), CT/NOCMP (02)	Constant
74 (4A)	23	CARRIER	2.5kHz (00), 6kHz (01), 8kHz (02), 10kHz (03), 12kHz (04), 14kHz (05)	2.5 KHz
76 (4C)	25[1]	START	Normal (00), Power-Up (01), Auto Re- (02), Re-Brake (03)	Normal
76 (4C)	25[3]	START	Normal (00), Power-Up (01), Auto 1 (02), Auto 2 (03) Auto 3 (04)	Normal
77 (4D)	26	STOP	Ramp (00), Coast (01)	Coast
78 (4E)	27[1]	ROTATION	Forward (00), Reverse (01), FWD & REV (02), FWD @ LOC (03)	Forward
79 (4F)	28[1]	AUTO/MAN	Auto (00), Manual (01), Both (02)	Both
79 (4F)	28[3]	AUTO/MAN	A/M LOC (00), Auto (01), Manual (02), A/M SPD (03)	A/M LOC
80 (50)	29[1]	MANUAL	Keypad (00), 0 - 10 VDC (01)	Keypad
81 (51)	30[1]	CONTROL	Local (00), Remote (01), Both (02)	Local
81 (51)	30[3]	CONTROL	Local (00), Remote (01), Serial (02), Keypad (03), TB Strip (04), Keypad (05)	Local

Minarik Register Number (hexadecimal representation)	Parameter Number*	Parameter Name	Range of Adjustment (values representing selection)	Factory Default
82 (52)	31[1]	HZ UNITS	HERTZ (00), RPM (01), %Hz (02), /SEC (03), /MIN (04), /HR (05), None (06)	Hertz
82 (52)	31[3]	UNITS	Hertz (00), RPM (01), %Hz (02), /SEC (03), /MIN (04), /HR (05), None (06), % (07), PSI (08), FPM (09), CFM (10), GPM (11), IN (12), FT (13), /SEC (14), /MIN (15), /HR (16), F (17), C (18), MPM (19)	Hertz
83 (53)	32	HZ MULT	10 - 65000 (.10 - 650.00)	100 (1.00)
84 (54)	33[1]	SPEED DP	XXXXX (00), XXX.X (01), XX.XX (02), X.XXX (03), .XXXX (04)	XXXXX
84 (54)	33[3]	UNITS DP	XXXXX (00), XXX.X (01), XX.XX (02), X.XXX (03), .XXXX (04)	XXXXX
85 (55)	34	LOAD MLT	95 - 139 (95 - 139%)	100 (100%)
86 (56)	35	CONTRAST	Low (00), Med (01), High (02)	High
90 (5A)	39	TB5 MIN	0 - 36000 (.00 - 360.00 Hz) see Note [3]	0 (.00 Hz)
91 (5B)	40	TB5 MAX	0 - 36000 (.00 - 360.00 Hz) see Note [3]	0 (.00 Hz)
93 (5D)	42	TB10A OUT	None (00), 0 - 10V (01), 2 - 10 V (02)	None
94 (5E)	43	@TB10A	300 - 36000 (3.00 - 360.00 Hz) see Note [3]	6000 (60.00 Hz)
95 (5F)	44	TB10B OUT	None (00), 0 - 10V (01), 2 - 1 V (02)	None
96 (60)	45	@TB10B	10 - 200 (10 - 200%)	125 (125%)
98 (62)	47[1]	TB13A	NONE (00), 0 - 10VDC (01), 4 - 20 MA (02), SPEED #1 (03, LOC SEL (04), DEC FREQ (05)	None
98 (62)	47[3]	TB13A	NONE (00), 0 - 10VDC (01), 4 - 20 MA (02), SPEED #1 (03, LOC SEL (04), DEC FREQ (05)	None
99 (63)	48[1]	TB13B	NONE (00), 0 - 10 VDC 901), 4 - 20 MA (02), SPEED #2 (03), INC FREQ (04), JOG FWD (05), JOG REV (06)	None
99 (63)	48[3]	TB13B	NONE (00), 0 - 10 VDC (01), 4 - 20 MA (02), SPEED #2 (03), INC FREQ (04)	None
100 (64)	49[1]	TB13C	NONE (00), 0 - 10 VDC (01), 4 - 20 MA (02), SPEED #3 (03), LOC SEL (04), RUN REV (05), STRT REV (06)	
100 (64)	49[3]	TB13C	NONE (00), 0 - 10 VDC (01), 4 - 20 MA (02), SPEED #3 (03), LOC SEL (04)	None
101 (65)	50	TB13D	EXT FAULT (00), EXT / FAULT (01), EXT CLEAR (02)	Ext Fault

Minarik Register Number (hexadecimal representation)	Parameter Number*	Parameter Name	Range of Adjustment (values representing selection)	Factory Default
103 (67)	52[1]	TB14 OUT	NONE (00), RUN (01), FAULT (02),	None
104 (68)	53[1]	TB15 OUT	/FAULT (03), LOCK (04),	
105 (69)	54[1]	RELAY	@ SPEED (05), ABOVE #3 (06), 1 LIMIT (07), AUTO/MAN (08)	
103 (67)	52[3]	TB14 OUT	NONE (00), RUN (01), FAULT (02),	None
104 (68)	53[3]	TB15 OUT	/FAULT (03), LOCK (04), @ SPEED (05),	
105 (69)	54[3]	RELAY	ABOVE #3 (06), 1 LIMIT (07) AUTO/MAN (08), FLWR PR (09), MIN/MAX (10)	
106 (6A)	55[3]	TB5B LOSS	FAULT (00), SP#4 (01)	Fault
108 (6C)	57	SERIAL	DISABLE (00), W/ TIMER (01), W/OUT TIMER (02)	Disable
109 (6D)	58[1]	ADDRESS	1 - 247	30
109 (6D)	58[3]	ADDRESS	1 - 255 (Metasys) (00),	30
			1 - 247 (Modbus) (01)	
112 (70)	61	PASSWORD	0000 - 9999	0019
114 (72)	63	SOFTWARE	(View - Only)	(N/A)
115 (73)	64	MONITOR	Off (00), On (01)	on
116 (74)	65	PROGRAM	Maintain (00), Reset 60 (01), Reset 50 (02), see Note [7]	Reset 60
117 (75)	66	HISTORY	Maintain (00), Clear (01)	Maintain
120 (78)	69[1]	LANGUAGE	see Note [?]	English
121 (79)	70[1]	Fault History	(View - Only)	(N/A)
121 (79)	70[3]	PID MODE	Off (00), Normal (01), Reverse (02)	Off
125 (7D)	74[3]	PID FB	TB-5A (00), TB-5B (01)	TB-5A
126 (7E)	75[3]	FB @ MIN	0 - 65000	0 (0.0%)
127 (7F)	76[3]	FB @ MAX	0 - 65000	65000 (100%)
129 (81)	78[3]	I GAIN	0 - 100 (0.0 - 100.0 Sec)	0 (0.0 Sec)
130 (82)	79[3]	D GAIN	0 - 100 (0.0 - 100.0 Sec)	0 (0.0 Sec)
131 (83)	80[3]	PID ACC	0 - 1000 (0.0 - 100.0 Sec)	300 (30.0 Sec)
132 (84)	81[3]	MIN ALRM	FB @ MIN - FB @ MAX	0.0%
133 (85)	82[3]	MAX ALRM	FB @ MIN - FB @ MAX	0.0%
149 (95)	98[3]	LANGUAGE	see Note [?]	English
150 (96)	99[3]	Fault History	(View - Only)	(N/A)

[1]AC300
[2]AC400

NOTES:

Note [1]:

ACCELERATION LIMITS	
Horsepower	Range of Adjustment
.025 - 20	1 - 36000 (0.1 - 3600 Sec)
25 - 60	3 - 36000 (0.3 - 3600 Sec)

Note [2]:

DECELERATION LIMITS				
Horsepower/Voltage Rating			Range of Adjustment	
240/200 VAC	480/400 VAC	590/480 VAC	Without dB	With dB
0.25 - 7.5 HP	1 - 7.5 HP	----	3 - 36000 (0.3 - 3600 Sec)	1 - 36000 (0.1 - 3600 Sec)
10 - 15 HP	10 - 20 HP	1 - 7.5 HP	5 - 36000 (0.5 - 3600 Sec)	1 - 36000 (0.1 - 3600 Sec)
20 - 30 HP	25 - 60 HP	10 - 20 HP	10 - 36000 (1.0 - 3600 Sec)	2 - 36000 (0.2 - 3600 Sec)
----	----	25 - 60 HP	20 - 36000 (2.0 - 3600 Sec)	2 - 36000 (0.2 - 3600 Sec)

Note [3]: Maximum limit is 650 Hz on units with high frequency software.

Note [4]:

MAXIMUM DC BRAKE VOLTAGE			
Model M3100 240/120 VAC	Model M3200 240/200 Va.	Model 3400 480/400 Va.	Model 3500 590/480 Va.
24 Volts	24 Volts	48 Volts	59 Volts

Note [5]: If LINE VOLTS is set to “Low” (or set to “Auto” and the input voltage is low, the range is 25 - 150%.

Note [6]:

FX BOOST FACTORY DEFAULT SETTINGS			
HP	FACTORY DEFAULT	HP	FACTORY DEFAULT
0.25 - 1	5.30%	15	2.20%
1.5 - 2	4.40%	20	2.00%
3	3.60%	25	1.80%
5	3.00%	30	1.60%
7.5	2.70%	40	1.20%
10	2.40%	50-60	0.80%

Note [7]: “RST HIGH” will appear on units set up for high frequency.

Notes

Notes

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