



MCH Series Drives

Modbus Communications Reference Guide

About These Instructions

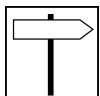
This documentation applies to the use of an MCH Series Variable Frequency Drive in a Modbus Network and should be used in conjunction with the MCH Series Installation and Operation Manual (Document MH01) that shipped with the drive. These documents should be read in their entirety as they contain important technical data and describe the installation and operation of the drive.

© 2003 Lenze AC Tech Corporation

No part of this documentation may be copied or made available to third parties without the explicit written approval of Lenze AC Tech Corporation. All information given in this documentation has been carefully selected and tested for compliance with the hardware and software described. Nevertheless, discrepancies cannot be ruled out. Lenze AC Tech does not accept any responsibility nor liability for damages that may occur. Any necessary corrections will be implemented in subsequent editions.



1	Safety Information.....	1
1.1	Warnings, Cautions and Notes	1
1.1.1	General	1
1.1.2	Application	1
1.1.3	Installation	1
1.1.4	Electrical Connection.....	2
1.1.5	Operation	2
1.2	Reference and Links	2
2	Introduction.....	3
2.1	Modbus Details.....	3
2.2	Universal Registers	4
3	Data Representation - Internal and External.....	5
3.1	Register Format	5
3.2	Data Types	5
3.3	AC Tech Drive Registers.....	5
4	MCH Drive Setup & Operation.....	6
4.1	Serial Address	6
4.2	Serial Communications Parameter	6
4.3	Control Parameter.....	6
4.4	Unlocking & Locking Controls	7
4.5	Unlocking & Locking Programming Parameters only	8
4.6	Watchdog Timer	8
4.7	Monitoring Only Operation	9
4.8	Normal Control Operation Sequence	9
4.9	Start/Stop, Speed Control and Parameter Change Operation	10



Contents

5	MCH Drive Control Registers	11
5.1	Abbreviations.....	12
5.2	Drive Control - Register #1.....	13
5.3	Drive Size - Register #21	14
5.4	Drive Status - Registers #24-29.....	14
5.4.1	Operational Status - Register #24 & 26	15
5.4.2	Actual Rotational Direction - Registers #24 & 27	15
5.4.3	Control Mode - Registers #24 & 27	16
5.4.4	Speed Command Source - Registers #24 & 28.....	16
5.4.5	Auto/Hand Status - Registers #24 & 28	16
5.4.6	Present Fault - Registers #24 & 29.....	17
5.4.7	Commanded Rotational Direction - Registers #24 & 29	17
5.5	Motor Volts - Register #30	17
5.6	Kilowatt Hours - Registers #32 & 33	18
5.7	Keypad Speed - Register #40	18
5.8	Total Run Time - Registers #36 & 37	18
5.9	PID Commands - Registers #38, 39, 41 & 43.....	18
5.10	Serial Speed Command - Register #42	18
5.11	Unlock Commands - Register #48.....	19
5.12	Unlock Parameters - Register #49	19
5.13	Register Version.....	19
6	MCH Programming Parameters	20
6.1	Format.....	20
6.2	Parameter List.....	21
7	Quick Start Instructions	26
7.1	Initial Settings.....	26
7.2	Drive Control.....	26
7.3	Basic Drive Commands.....	27
7.4	Basic Drive Status.....	28
7.5	Basic Drive Network Programming.....	28



1 Safety Information

1.1 Warnings, Cautions and Notes

1.1.1 General

Some parts of Lenze controllers (frequency inverters, servo inverters, DC controllers) can be live, moving and rotating. Some surfaces can be hot.

Non-authorized removal of the required cover, inappropriate use, and incorrect installation or operation creates the risk of severe injury to personnel or damage to equipment.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE0110 and national regulations for the prevention of accidents must be observed).

According to this basic safety information, qualified skilled personnel are persons who are familiar with the installation, assembly, commissioning, and operation of the product and who have the qualifications necessary for their occupation.

1.1.2 Application

Drive controllers are components designed for installation in electrical systems or machinery. They are not to be used as appliances. They are intended exclusively for professional and commercial purposes according to EN 61000-3-2. The documentation includes information on compliance with EN 61000-3-2.

When installing the drive controllers in machines, commissioning (i.e. the starting of operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 98/37/EC (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting drive as directed) is only allowed when there is compliance to the EMC Directive (2004/108/EC).

The drive controllers meet the requirements of the Low Voltage Directive 2006/95/EC. The harmonised standards of the series EN 50178/DIN VDE 0160 apply to the controllers.

The availability of controllers is restricted according to EN 61800-3. These products can cause radio interference in residential areas. In the case of radio interference, special measures may be necessary for drive controllers.

1.1.3 Installation

Ensure proper handling and avoid excessive mechanical stress. Do not bend any components and do not change any insulation distances during transport or handling. Do not touch any electronic components and contacts. Controllers contain electrostatically sensitive components, which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components since this might endanger your health! When installing the drive ensure optimal airflow by observing all clearance distances in the drive's user manual. Do not expose the drive to excessive: vibration, temperature, humidity, sunlight, dust, pollutants, corrosive chemicals or other hazardous environments.



Safety Information

1.1.4 Electrical Connection

When working on live drive controllers, applicable national regulations for the prevention of accidents (e.g. VBG 4) must be observed.

The electrical installation must be carried out in accordance with the appropriate regulations (e.g. cable cross-sections, fuses, PE connection). Additional information can be obtained from the regulatory documentation.

The regulatory documentation contains information about installation in compliance with EMC (shielding, grounding, filters and cables). These notes must also be observed for CE-marked controllers.

The manufacturer of the system or machine is responsible for compliance with the required limit values demanded by EMC legislation.

1.1.5 Operation

Systems including controllers must be equipped with additional monitoring and protection devices according to the corresponding standards (e.g. technical equipment, regulations for prevention of accidents, etc.). You are allowed to adapt the controller to your application as described in the documentation.



DANGER!

- After the controller has been disconnected from the supply voltage, do not touch the live components and power connection until the capacitors have discharged. Please observe the corresponding notes on the controller.
- Do not continuously cycle input power to the controller more than once every three minutes.
- Close all protective covers and doors during operation.



WARNING!

Network control permits automatic starting and stopping of the inverter drive. The system design must incorporate adequate protection to prevent personnel from accessing moving equipment while power is applied to the drive system.

Table 1: Pictographs used in these instructions

Pictograph	Signal word	Meaning	Consequences if ignored
	DANGER!	Warning of Hazardous Electrical Voltage.	Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
	WARNING!	Impending or possible danger for persons	Death or injury
	STOP!	Possible damage to equipment	Damage to drive system or its surroundings
	NOTE	Useful tip: If observed, it will make using the drive easier	

1.2 Reference and Links

MCH Series Variable Frequency Drives visit: <http://www.lenze-actech.com>

Modbus-IDA visit: <http://www.modbus-IDA.org>

2 Introduction

This document defines the specifics required for Modbus serial communication with a Lenze-AC Tech standard MCH Series drives for control, status monitoring, and programming parameters. A familiarity with normal drive capabilities and operations is assumed. If this is not the case, refer to the MCH Series Installation and Operation manual (MH01) for more information.

2.1 Modbus Details

- A. AC Tech Drives running the Modbus communication 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									Stop bit	Stop bit
Start bit	1	2	3	4	5	6	7	8		

- B. At this time the AC Tech 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. AC Tech register numbers are also numbered starting from 0. Therefore, AC Tech register numbers always correspond exactly with the address transmitted. As a result, MODBUS REGISTER NUMBERS ARE ALWAYS ONE GREATER THAN AC TECH REGISTER NUMBERS. WHENEVER THE WORDS “REGISTER #xx” APPEAR, IT SHOULD BE ASSUMED THAT THEY MEAN “AC TECH REGISTER xx” 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 AC Tech drives are:

- 03 Read Holding Registers (4X references). In general we can read only one register at a time. However, there are a few limited exceptions.

Exception One:

Register #24 (Modbus Register #25) Drive Status, can also be read as a group of 6 words.

Exception Two:

AC Tech 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.

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

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

- 04 Read Input Registers (3X references). As with function 03, we read one register at a time except where noted.

- 06 Preset Single Register (4X references). Write single register.

16 Preset Multiple Registers (4X references). Although the function is for multiple registers, we will accept only a single register to be written.

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 AC Tech 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. Web resources: <http://www.Modbus-IDA.org> and <http://www.schneider-electric.com>.

2.2 Universal Registers

Lenze-AC Tech manufactures several drive families. Currently the QC, MC, MCH, SC, TC, *smd*, *Tmd* and SMV Series drives support Modbus based communications. Since each drive family has 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 AC Tech Register locations have been made universal among AC Tech drives. While their locations are consistent, their contents may vary as defined in Table 2.

Table 2: Contents of Universal Registers

AC Tech 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 AC TECH DRIVES:			
	- 64 -- QC family	- 67 --	- 70 -- TC family	
	- 65 -- MC family	- 68 -- MCH family	- 71 -- <i>Tmd</i> family	
	- 66 -- SC family	- 69 -- <i>smd</i> family	- 72 -- SMV family	
21	Drive Size (READ ONLY). Code to identify Power (HP/KW) and Line Voltage of the drive. Family dependent. For the MCH series refer to section 5.3.			
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).			



3 Data Representation - Internal and External

3.1 Register Format

All registers are 16 bits. The data within these registers can take on the following forms:

- Individual bit commands (16 per register). Example: Register #1 (Modbus Register #2).
- Individual bit flags (16 per register). Example: Register #1.
- A chain of two 8 bit unsigned integers.
- A 16 bit unsigned integer.

This unsigned integer could represent many different types of data with various scaling rules and units, which are defined by the DATA TYPE of the register.

3.2 Data Types

Data passed in registers across the Modbus communications 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. Table 3 lists examples of the internal units used on the MCH series.

Table 3: MCH Series Internal Units

Type	Unit	Example
SPEED	0.01 Hz	60 Hz = 6000
TIME	0.1 Sec	30.0 Sec = 300

The data type "PID" requires further explanation. The internal range of any data of PID type is 0 to 32736. Many variables can 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 to the internal range (0-32736). If the feedback device measured 0 to 200 PSI, then 0 PSI is 0 internal units, and 200 PSI is 32736 internal units. To command a setpoint of 100 PSI the LOCAL PID command (Register #41) can be written with the value 16368 ($32736 \times 100 / 200$). Thus to control PID operations using real world units, the Modbus Master must have knowledge of the range of the feedback device.

3.3 AC Tech Drive Registers

Registers #0 - #50: (Modbus Reg #1 - #51) Reserved for configuration and control

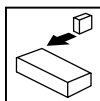
Registers #51 - #260 (Modbus Reg #52 - #261) Reserved for drive's programming mode parameters

Programming Mode Parameters are the parameters accessible from the local keypad on the drive. There is a direct correspondence between the MCH Drive Programming Mode Parameter number and the AC Tech Register number (and consequently, the Modbus register number):

$$\text{AC Tech Register \#} = (\text{MH Programming Parameter \#}) + 51$$

$$\text{Modbus Register \#} = (\text{MH Programming Parameter \#}) + 52$$

The Table 6 entries are based on MCH Drive Software # 213-070 Revision 00 (Parameter Configuration = 148). If a later revision of software were to change register definitions, drive operation could be seriously affected. Examine Register #50 (Parameter Configuration Number) for revision. The number displayed at power up on drive display also identifies it. If it is not 148, writing to any register on the drive **MUST NOT BE ATTEMPTED** unless your Controller has been setup to support the new configuration.



Drive Setup & Operation

4 MCH Drive Setup & Operation

4.1 Serial Address

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

4.2 Serial Communications Parameter

All AC Tech drives have a Serial Communications Parameter that governs the operation of the Serial Link. On MCH drives this is #57 SERIAL LINK (register #108). Table 4 lists the selections for MCH Parameter 57, SERIAL LINK.

Table 4: MCH Parameter 57 Selections

Setting	Description	Watchdog Timeout Period
00	DISABLE	
01	WITH TIMER	10 sec
02	WITHOUT TIMER	

Explanation of Terms:

- **DISABLED** serial link not operational (this is the drive's default setting)
- **WITH TIMER** serial link allows reading & writing of both control & programming parameters. Watchdog timer is enabled (refer to section 4.6, *Watchdog Timer*).
- **WITHOUT TIMER** serial link allows reading & writing of both control & programming parameters. Watchdog timer is disabled (refer to section 4.6, *Watchdog Timer*).

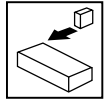
Prior to attempting to communicate with the drive, Serial Communications Parameter must be appropriately programmed.

4.3 Control Parameter

The Control Parameter on MCH drives (Programming Parameter #30 / AC Tech Register #81) determines how much control a user has over a drive via the serial link. The Control Parameter must be appropriately programmed for a particular application. Refer to the MCH Series Installation and Operation Manual (MH01) for a detailed explanation on programming the drive parameters.

Table 5: Control (Parameter 30)

Setting	Description
00	NORMAL (default)
01	NORM NO HAND
02	SERIAL SPEED
03	S SPD / NO HAND
04	SERIAL AUTO
05	S AUTO / NO HAND



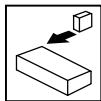
- Setting the control parameter to “NORMAL” or “NORM NO HAND” gives the user read/write access to the Program Parameters but prevents them from writing to any of the control registers.
- Setting the control parameter to “SERIAL SPEED” or “S SPD / NO HAND” maintains the user’s read/write access to the Program parameters but also gives the user write access to all control registers except for SERIAL START. In AUTO mode, the SERIAL SELECT, SERIAL SPEED and SERIAL PID control registers can be used to control the drive speed or PID setpoint. Writing a 512 (200h) to the Drive Control register sets the SERIAL SELECT flag thus commanding the drive to follow the SERIAL SPEED or SERIAL PID command register. Writing a 256 (100h) to the Drive Control register clears the SERIAL SELECT flag returning speed control to the previously selected source. The user can still write values to the SERIAL SPEED and SERIAL PID registers but they will not be used until the SERIAL SELECT flag is set again.
- Setting the control parameter to “SERIAL AUTO” or “S AUTO / NO HND” provides the user with all of the functionality of the “SERIAL SPEED” and “S SPD / NO HAND” settings with the addition of the SERIAL START command. Under these settings, when the drive is in AUTO mode, it can only be started via the serial link.

All control options are subject to the Parameter and Control Locking/Unlocking procedures.

4.4 Unlocking & Locking Controls

Registers #48 and #1 are used in Unlocking and Locking Controls.

- 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.
- 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 factory default password for MH series drives is 19.
- Once Register #48 (Unlock Controls) has been written, Controls are unlocked until the Lock Security flag (Bit 1 of Register#1) has been set or until a Watchdog Timeout occurs.
- Writing to Register #1 (Drive Control) with bit 1 set will Lock both Controls and Parameters (prevents writing to any register).
- The serial drive control can only be unlocked when the drive is not in programming mode.
- When LOCK is asserted, the drive drops out of SERIAL control and reverts back to the previous source of control.
- Even though drive might be locked, and thus parameters and control cannot be written, parameters and status can always be read. Refer to section 4.7, *Monitoring Only Operation*.



Drive Setup & Operation

4.5 Unlocking & Locking Programming Parameters only

Registers #49 and #1 are used in Unlocking and Locking Programming Parameters.

- Writing to any writeable register other than #1 can be enabled by writing the Drive's Programming Password to Register #49 (Unlock Parameters). This would be done when Drive Control (start, forward/reverse, keypad speed control, etc.) is not required.
- The Factory Default password is 19.
- Once Register #49 (Unlock Parameters) has been written, the writing of parameter registers is enabled until Bit 1 of Register #1 has been set.

4.6 Watchdog Timer

All AC Tech 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" (refer to section 5.10). If the Watchdog Timer is enabled and controls have been unlocked, the Master **MUST PERIODICALLY COMMUNICATE** with the drive or the timer will timeout. The timeout period is fixed at 10 seconds. It is recommended to communicate at least once every 5 seconds. As an example, Register #24 can be read repeatedly for this purpose.

The action of a Watchdog timeout depends on the setting of the CONTROL parameter. If the CONTROL parameter is set for:

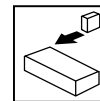
- NORMAL or NORM NO HAND: Watchdog timeout takes the drive out of SERIAL control mode and continues with normal operation.
- SERIAL SPEED or S SPD / NO HAND: Watchdog timeout takes the drive out of SERIAL control mode and follows the action of the SERIAL LOSS parameter (Parameter 56).
- SERIAL AUTO or S AUTO / NO HND: In AUTO mode, these settings force the user to START the drive through the serial link. It is fairly safe to assume that the user would intend to STOP the drive through the serial link as well. Under these circumstances, a loss of serial communications is considered somewhat more serious. Therefore, when a watchdog timeout occurs, the drive is taken out of SERIAL control mode and tripped into a FLWR/SER FAULT regardless of the setting of the SERIAL LOSS parameter.

The Watchdog Timer does not operate unless Controls have been UNLOCKED via Register #48, or Parameter writing has been unlocked via Register #49. In the case of unlocking parameters only, the watchdog timer will disable write permissions but will otherwise continue with normal operation.

Watchdog Timer Controls

- For some applications, it is inappropriate to shut down the drive because of a Watchdog Timeout. Therefore, we have provided a means of disabling the Watchdog using Programming Parameter #57 (SERIAL LINK):

Programming Parameter #57 controls both the enabling of the serial link and the Watchdog. Setting Parameter #57 to WITH TIMER enables the serial link WITH the Watchdog. Conversely, setting Parameter #57 to WITHOUT TIMER enables the serial link WITHOUT the Watchdog.



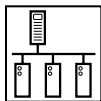
- A Watchdog failure can be recognized by reading the drive status (AC Tech Registers #24 – 29) and looking at the control mode. If it has reverted from SERIAL to LOCAL without the Modbus Master commanding it via Register #1 bit 1 (LOCK) then a watchdog failure has occurred. Serial Control can be reestablished by unlocking Register #48.
- 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.

4.7 Monitoring Only Operation

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

4.8 Normal Control Operation Sequence

1. Power up 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, etc.).
4. If the Watchdog Timer is enabled, keep it from timing out by assure 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 AUTO mode (control from the drive keypad and/or terminal strip).

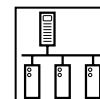


Drive Control & Communication

4.9 Start/Stop, Speed Control and Parameter Change Operation

The typical sequence for a Start/Stop, Speed Control or Parameter Change operation is listed herein.

1. Power up drive with serial enabled.
2. Unlock Controls and Parameters by writing the current programming password (default 19) to Register #48.
3. Control Drive Operation via various commands to Register #1 (Start, Stop, etc.).
4. Control Drive Speed by writing the Speed Commands to Register #40 (Keypad Speed Command) or by setting the SERIAL SELECT bit (writing 200H to Register #1) and then writing speed commands to Register #42 (Serial Speed Command).
5. Change the programming parameters (e.g., change the acceleration rate by writing new acceleration rate to register #59)
6. 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.
7. Lock Controls and Parameters when drive operations are complete by writing a 2 to Register #1 (assert bit 1 of Register 1).
8. Drive is now returned to AUTO mode (control from the drive's keypad).

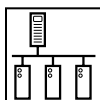


5 MCH Drive Control Registers

Table 6 describes the MCH Drive Control Registers in ascending order of AC Tech Register #. The HEX representation is given in parenthesis next to the AC Tech Register # in the left-most column.

Table 6: MCH Drive Control Registers

ACT# (HEX representation)	REGISTER NAME	R/W/RS	MESSAGE								MIN	MAX	UNITS	[NOTE] or Section
1 (01)	Drive Control	W	SA	06	00	01	DH	DL	CRC		Refer to Section 5.2			[1]
		RS	SA	06	00	01	DH	DL	CRC					
19 (13)	Drive Family	R	SA	03	00	13	00	01	CRCH	CRCL	Refer to Section 5.2			[2]
		RS	SA	03	02	00	42	CRCH	CRCL					
21 (15)	Drive Size	R	SA	03	00	15	00	01	CRCH	CRCL	Refer to Section 5.3			
		RS	SA	03	02	00	00	CRCH	CRCL					
24 (18)	Drive Status (6 register read) (reg. #24 to 29)	R	SA	03	00	18	00	06	CRCH	CRCL	Refer to Section 5.4			[3a] [3b] [3c]
		RS	SA	03	0C	D1H	D1L	D2H	D2L	D3H				
						D3L	D4H	D4L	D5H	D5L				
						D6H	D6L	CRCH	CRCL					
24 (18)	Command Speed	R	SA	03	00	18	00	01	CRCH	CRCL	0	2400	0.1 Hz	
		RS	SA	03	02	DH	DL	CRCH	CRCL					
25 (19)	Actual Speed	R	SA	03	00	19	00	01	CRCH	CRCL	0	2400	0.1 Hz	
		RS	SA	03	02	DH	DL	CRCH	CRCL					
26 (1A)	Load (DH) / Status (DL)	R	SA	03	00	1A	00	01	CRCH	CRCL	Refer to Section 5.4.1/2			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
27 (1B)	Actual Direction (DH) / Control Mode (DL)	R	SA	03	00	1B	00	01	CRCH	CRCL	Refer to Section 5.4.3/4			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
28 (1C)	Speed Source (DH) / Speed Reference (DL)	R	SA	03	00	1C	00	01	CRCH	CRCL	Refer to Section 5.4.5/6			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
29 (1D)	Fault (DH) / Commanded Direction (DL)	R	SA	03	00	1D	00	01	CRCH	CRCL	Refer to Section 5.4.7/8			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
30 (1E)	Motor Voltage	R	SA	03	00	1E	00	01	CRCH	CRCL	0	999	V	5.10
		RS	SA	03	02	DH	DL	CRCH	CRCL					
32 (20)	Kilowatt Hours Low Word	R	SA	03	00	20	00	01	CRCH	CRCL	Refer to Section 5.6			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
33 (21)	Kilowatt Hours High Word	R	SA	03	00	21	00	01	CRCH	CRCL	Refer to Section 5.6			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
36 (24)	Total Run Time Hours	R	SA	03	00	24	00	01	CRCH	CRCL	Refer to Section 5.8			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
37 (25)	Total Run Time Minutes	R	SA	03	00	25	00	01	CRCH	CRCL	Refer to Section 5.8			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
38 (26)	PID Setpoint	R	SA	03	00	26	00	01	CRCH	CRCL	Refer to Section 5.9			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
39 (27)	PID Feedback	R	SA	03	00	27	00	01	CRCH	CRCL	Refer to Section 5.9			
		RS	SA	03	02	DH	DL	CRCH	CRCL					



Drive Control & Communication

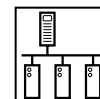
ACT# (HEX representation)	REGISTER NAME	R/W/RS	MESSAGE								MIN	MAX	UNITS	[NOTE] or Section
40 (28)	Keypad Speed Command	R	SA	03	00	28	00	01	CRCH	CRCL	0	65000	0.01 Hz	5.6
		RS	SA	03	02	DH	DL	CRCH	CRCL					
		W	SA	06	00	28	DH	DL	CRCH	CRCL				
		RS	SA	06	00	28	DH	DL	CRCH	CRCL				
41 (29)	Local PID Command	R	SA	03	00	29	00	01	CRCH	CRCL	Refer to Section 5.9			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
		W	SA	06	00	29	DH	DL	CRCH	CRCL				
		RS	SA	06	00	29	DH	DL	CRCH	CRCL				
42 (2A)	Serial Speed Command	R	SA	03	00	2A	00	01	CRCH	CRCL	0	65000	0.01 Hz	5.9
		RS	SA	03	02	DH	DL	CRCH	CRCL					
		W	SA	06	00	2A	DH	DL	CRCH	CRCL				
		RS	SA	06	00	2A	DH	DL	CRCH	CRCL				
43 (2B)	Serial PID Command	R	SA	03	00	2B	00	01	CRCH	CRCL	Refer to Section 5.9			
		RS	SA	03	02	DH	DL	CRCH	CRCL					
		W	SA	06	00	2B	DH	DL	CRCH	CRCL				
		RS	SA	06	00	2B	DH	DL	CRCH	CRCL				
48 (30)	Unlock Commands	W	SA	06	00	30	DH	DL	CRC		0	9999	None	5.10
		RS	SA	06	00	30	DH	DL	CRC					
49 (31)	Unlock Parameters	W	SA	06	00	31	DH	DL	CRC		0	9999	None	5.11
		RS	SA	06	00	31	DH	DL	CRC					
50 (32)	Register Version	R	SA	03	00	32	00	01	CRC		0	65535	None	5.12
		RS	SA	03	02	DH	DL	CRC						

5.1 Abbreviations

Table 7 lists the abbreviations used in Table 6 MCH Drive Control Registers:

Table 7: Abbreviations

Abbreviation	Description
R	Read
W	Write
RS	Response
SA	Slave Address (typically 01 through F7 hex)
CRCH	Cyclic Redundancy Check High Byte
CRCL	Cyclic Redundancy Check Low Byte
DH	Data High byte
DL	Data Low byte
ACT#	AC Tech Register # (Modbus Register numbers are 1 larger)



5.2 Drive Control - Register #1

Table 8 illustrates the Data format of Register #1, Drive Control.

Table 8: Drive Control - Register #1

	Bit	Command
Data Low Byte	0	UPDATE BUFFERS
	1	LOCK SECURITY
	2	STOP DRIVE
	3	START DRIVE
	4	UNUSED
	5	UNUSED
	6	UNUSED
	7	UNUSED
Data High Byte	8	CLEAR SERIAL SELECT FLAG
	9	SET SERIAL SELECT FLAG
	10	UNUSED
	11	UNUSED
	12	UNUSED
	13	UNUSED
	14	UNUSED
	15	UNUSED

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 update buffers bit, enables 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.



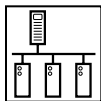
NOTE 1 - Drive Control

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



NOTE 2 - Drive Family

The QC and DL Series drives return 64 (40H)	The <i>smd</i> Series drives return 69 (45H)
The MC Series drives return 65 (41H)	The TC Series drives return 70 (46H)
The SC Series drives return 66 (42H)	The <i>Tmd</i> Series drives return 71 (47H)
The MCH Series drives return 68 (44H)	The SMV Series drives return 72 (48H)



Drive Control & Communication

5.3 Drive Size - Register #21

Table 9 lists the MCH Series drives. Register 21 will contain the value in the "Size" column. The drives are listed in ascending order by the "Size" number.

Table 9: Drive Size - Register #21

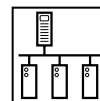
Size	HP	Voltage	Size	HP	Voltage	Size	HP	Voltage	Size	HP	Voltage
00	0.25	120	13	50	480	27	1	590	42	100	590
01	0.25	240	14	60	480	28	1.5	590	43	125	590
02	0.5	240	15	1	480	29	2	590	44	150	590
03	1	240	16	1.5	480	30	3	590	45	200	590
04	1.5	240	17	2	480	31	5	590	46	75	480
05	2	240	18	3	480	32	7.5	590	47	100	480
06	3	240	19	5	480	33	10	590	48	125	480
07	5	240	20	7.5	480	34	15	590	49	150	480
08	7.5	240	21	10	480	35	20	590	50	200	480
09	10	240	22	15	480	36	25	590	51	30	240
10	15	240	23	20	480	37	30	590	52	40	240
11	20	240	24	25	480	38	40	590	53	50	240
12	25	240	25	30	480	39	50	590	54	60	240
			26	40	480	40	60	590	55	75	240
						41	75	590	56	100	240

5.4 Drive Status - Registers #24-29

When reading parameter #24, the number of words requested 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. If 6 words are requested at parameter #24, the following will be returned:

Table 10: 6 Register read at #24

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



NOTE 3a - Command Speed (Register #24 Bytes D1H and D1L or Register #25)

- In hundredths of a Hz
- Most significant byte is first, followed by Least significant
- Example: 02 01 in hex converts to 5.13Hz in decimal.



NOTE 3b - Actual Speed (Register #24 Bytes D2H and D2L or Register #25)

- In hundredths of a Hz
- Most significant byte is first, followed by Least significant



NOTE 3c - Load (Register #24 Byte D3H or Register #26 DH)

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

5.4.1 Operational Status - Register #24 & 26

Table 11 lists the Operational Status (byte D3L)

Table 11: Operational Status - Register #26

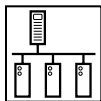
Setting	Parameter
0	FAULT LOCKOUT
1	FAULT
2	START PENDING
3	STOP
4	DC BRAKE
5	RUN AT 0Hz
6	RUN
7	ACCEL
8	DECEL
9	CURRENT LIMIT
10	DECEL OVERRIDE

5.4.2 Actual Rotational Direction - Registers #24 & 27

Table 12 lists the Actual Rotational Direction (Register #24 byte D4H or Register #27 DH).

Table 12: Actual Rotational Direction

Setting	Direction
0	FORWARD
1	REVERSE



Drive Control & Communication

5.4.3 Control Mode - Registers #24 & 27

Table 13 lists the Control Mode (Register #24 byte D4L or Register #27 DL).

Table 13: Control Mode

Setting	Control
0	OFF
1	HAND
2	AUTO
3	SERIAL

5.4.4 Speed Command Source - Registers #24 & 28

Table 14 lists the Speed Command Source (Register #24 byte D5H or Register #28 DH).

Table 14: Speed Command Source

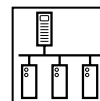
Setting	Source
0	KEYPAD
1	0 – 10VDC
2	4 – 20mA
3	PRESET 1
4	PRESET 2
5	PRESET 3
6	PRESET 4
7	MOP
8	KEYPAD SPEED
9	KEYPAD/SERIAL PID SETPOINT
10	0-10VDC PID SETPOINT
11	4-20mA PID SETPOINT
12	SERIAL SPEED
13	SERIAL PID SETPOINT
14	SLEEP

5.4.5 Auto/Hand Status - Registers #24 & 28

Table 15 lists the Auto/Hand Control (Register #24 byte D5L or Register #28 DL).

Table 15: Speed Reference Control

Setting	Control
0	HAND
1	AUTO



5.4.6 Present Fault - Registers #24 & 29

Table 16 lists the Present Fault (Register #24 byte D6H or Register #29 DH)

Table 16: Present Fault

Setting	Fault	Display
0	NO FAULT	
1	OUTPUT (TRANSISTOR) FAULT	OUTPUT
2	Reserved	
3	HIGH DC BUS VOLTAGE	HI VOLTS
4	HIGH DRIVE TEMPERATURE	HI TEMP
5	THERMAL OVERLOAD	OVERLOAD
6	Reserved	
7	LOW DC BUS VOLTAGE	LO VOLTS
8	Reserved	
9	DC BRAKE ERROR	DB ERROR
10	SERIAL/FOLLOWER LOSS	FLWR/SER
11	DYNAMIC BRAKE OVERLOAD	DB ERROR
12	POWER SAG	PWR SAG
13	CONTROL FAULT	CONTROL
14	LANGUAGE FAULT	LANGUAGE
15	EXTERNAL	EXTERNAL
16	INTERNAL 16	INTERNAL
17	POWER TRANSIENT	PWR TRAN
18	INTERNAL ERROR #18	INTERN #18
19	INTERNAL ERROR #19	INTERN #19
20	INTERNAL ERROR #20	INTERN #20
21	INTERNAL ERROR #21	INTERN #21
22	INTERNAL ERROR #22	INTERN #22
23	INTERNAL ERROR #23	INTERN #23

5.4.7 Commanded Rotational Direction - Registers #24 & 29

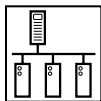
Table 17 lists the Commanded Rotational Direction (Register #24 byte D6L or Register #29 DL)

Table 17: Commanded Rotational Direction

Setting	Direction
0	FORWARD
1	REVERSE

5.5 Motor Volts - Register #30

Output Voltage to the motor expressed in 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.



Drive Control & Communication

5.6 Kilowatt Hours - Registers #32 & 33

Kilowatt hours are listed as a 32-bit value.

Register #32 - Kilowatt Hours Low Word

Register #33 - Kilowatt Hours High Word

Formula: (High Word x 65536) + Low Word = Total kWh (Kilowatt hours)

5.7 Keypad Speed - Register #40

This register enables the user to set the keypad speed to desired value.

- Range is 0 - 65000 in hundredths of a Hz
- Most significant byte is first, followed by Least significant
- CONTROL OF THE DRIVE SPEED VIA THE SERIAL LINK IS NORMALLY DONE USING THIS PARAMETER.
This register can be written only after enabling serial drive control.

5.8 Total Run Time - Registers #36 & 37

Register #36 - Total Run Time in Hours Example: A value of 20 in decimal equals 20 Hours

Register #37 - Total Run Time in Minutes Example: A value 42 in decimal equals 42 Minutes

5.9 PID Commands - Registers #38, 39, 41 & 43

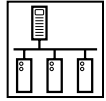
Registers #38 (PID Setpoint Command), #39 (PID Feedback Value), #41 (Local PID Setpoint Command) and #43 (Serial PID Command) are all in drive internal units with a range of 0 to 32736. The real world parameter being controlled is mapped into this internal range based on the feedback device for the parameter 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 and 110 maps to 32736. A setpoint of 30 °C for the Local PID Setpoint (Register #41) would be written with a value of 6547 (1993 hex). $(32736 * \{30 - 10\} / \{110 - 10\})$.

5.10 Serial Speed Command - Register #42

This register enables the user to set the keypad speed to desired value.

- Range is 0 - 65000 in hundredths of a Hz
- Most significant byte is first, followed by Least significant
- CONTROL OF THE DRIVE SPEED VIA THE SERIAL LINK IS NORMALLY DONE USING THIS PARAMETER.
This register can be written only after enabling serial drive control.



5.11 Unlock Commands - Register #48

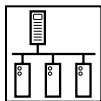
Register #48 (Unlock Commands) unlocks commands by using 0000 for the password. If the correct Programming mode password is entered then the appropriate programming parameters can also be accessed (refer to the full parameter protocol specification if access to programming parameters is required). Enabling commands also activates the drive Watchdog timer if programming parameter #15 (Serial) is set to W/TIMER (it uses a fixed 10 seconds timeout). If the drive sees no activity within the update time period and Parameter 30 is either set to SERIAL AUTO or S AUTO/NO HND, 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: Terminal TB1 must be closed in order to unlock serial control.

5.12 Unlock Parameters - Register #49

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.

5.13 Register Version

Register Version is the number to identify if current version of software has any register changes relative to previous versions: 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 (AC TECH Register #1 through #50) are quite stable.



6 MCH Programming Parameters

6.1 Format



NOTE - Attention

Parameter list presented in Section 6.2 is valid only for MCH Software 213-070 revision 00. For revisions, refer to appropriate MCH Manual (MH01).

Abbreviations:

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

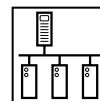
WRITING:

Message structure for writing 1 word: (all parameters)

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

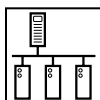
LEGEND for Parameter List

1st Column: **AC Tech Register #** MC Register # followed by Hex value in parenthesis: 51 (33H)
2nd Column: **Parameter** ¹ = Drive's programming parameter number
4th Column: **Range of Adjustment** The Modbus values are whole numbers. One decimal place is assumed. A superscript ² denotes those parameters where two decimal places are assumed.
For example, to program a value of 11.20 Hz, the user can program 11.20 into the MCH drive and the drive will display 11.20 but for Modbus communications, the user must input 1120. The two decimal places are assumed. If the user wanted a value of 112 Hz, then for Modbus communications he would have to input 11200.
5th Column: **Default Value** ² = Two decimal places assumed (hundredths)



6.2 Parameter List

AC Tech Register Number (hexadecimal representation)	Parameter ¹	Parameter Name	Range of Adjustment Modbus value (decimal value)	Factory Default
51 (33)	0	LINE VOLTS	00 - High 01 - Low 02 - Auto	02 - Auto
52 (34)	1	SPEED #1	Min. Frequency - Max. Frequency	2000 (20.00 Hz) ²
53 (35)	2	SPEED #2	Min. Frequency - Max. Frequency	2000 (20.00 Hz) ²
54 (36)	3	SPEED #3	Min. Frequency - Max. Frequency	2000 (20.00 Hz) ²
55 (37)	4	SPEED #4	Min. Frequency - Max. Frequency	2000 (20.00 Hz) ²
56 (38)	5	SKIP #1	.00 Hz - Max. Frequency	00 (.00 Hz) ²
57 (39)	6	SKIP #1	.00 Hz - Max. Frequency	00 (.00 Hz) ²
58 (3A)	7	BAND WID	0 - 1000 (.00 - 10.00 Hz)	100 (1.00 Hz) ²
59 (3B)	8	ACCEL	Refer to Note 4	300 (30.0 sec)
60 (3C)	9	DECEL	Refer to Note 5	300 (30.0 sec)
61 (3D)	10	MIN FREQ	.00 - Max Frequency	50 (.50 Hz) ²
62 (3E)	11	MAX FREQ	Min Frequency - 12000 (120.00 Hz)	6000 (60.00 Hz) ²
63 (3F)	12	DC BRAKE	Refer to Note 6	0 (.0 VDC)
64 (40)	13	DC TIME	0 - 9999 (.0 - 999.9 sec)	0 (.0 sec)
65 (41)	14	DYN BRAKE	00 - Off 01 - On	00 - Off
67 (43)	16	CURRENT	25 - 180 (25 - 180%), Refer to Note 7	180 (180%)
68 (44)	17	MOTOR OL	25 - 100 (25 - 100%)	100 (100%)
69 (45)	18	BASE	2000 - 36000 (20.00 - 360.0 Hz)	6000 (60.00 Hz) ²
70 (46)	19	FX BOOST	0 - 300 (.0 - 30.0%), Refer to Note 8	
73 (49)	22	TORQUE	00 - Contant 01 - Variable 02 - CT/NOCMP	00 - Constant
74 (4A)	23	CARRIER	00 - 2.5 kHz 01 - 6 kHz 02 - 8 kHz 03 - 10 kHz 04 - 12 kHz 05 - 14 kHz	00 - 2.5 kHz
76 (4C)	25	START	00 - Normal 01 - Power-Up 02 - Auto 1 03 - Auto 2 04 - Auto 3	00 - Normal

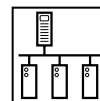


Drive Control & Communication

AC Tech Register Number (hexadecimal representation)	Parameter ¹	Parameter Name	Range of Adjustment Modbus value (decimal value)	Factory Default
77 (4D)	26	STOP	00 - Ramp 01 - Coast	00 - Coast
79 (4F)	28	SPEED SRC KEY	00 - Enabled 01 - Disabled	00 - Enabled
80 (50)	29	HAND SRC	00 - Keypad 01 - 0-10 VDC 02 - 4-20mA 03 - Preset #1 04 - Preset #2 05 - Preset #3 06 - Preset #4 07 - MOP 08 - Selected	00 - Keypad
81 (51)	30	CONTROL	00 - Normal 01 - Normal / No Hand 02 - Serial Speed 03 - Serial Speed / No Hand 04 - Serial Auto 05 - Serial Auto / No Hand	00 - Normal
82 (52)	31	UNITS	00 - Hertz 01 - RPM 02 - % Hz 03 - /SEC 04 - /MIN 05 - /HR 06 - None 07 - % 08 - PSI 09 - FPM 10 - CFM 11 - GPM 12 - IN 13 - FT 14 - /SEC 15 - /MIN 16 - /HR 17 - F 18 - C 19 - MPM	00 - Hertz
83 (53)	32	HZ MULT	10 - 65000 (.10 - 650.00)	100 (1.00) ²
84 (54)	33	UNITS DP	00 - XXXXX 01 - XXX.X 02 - XX.XX 03 - X.XXX 04 - .XXXX	00 - XXXXX
85 (55)	34	LOAD MLT	95 - 139 (95 - 139%)	100 (100%)
86 (56)	35	CONTRAST	00 - Low 01 - Medium 02 - High	02 - High
90 (5A)	39	TB5 MIN	0 - 36000 (.00 - 360.00 Hz)	0 (.00 Hz) ²
91 (5B)	40	TB5 MAX	0 - 36000 (.00 - 360.00 Hz)	0 (.00 Hz) ²
93 (5D)	42	TB10A OUT	00 - None 01 - 0 - 10 VDC 02 - 2 - 10 VDC	00 - None
94 (5E)	43	@TB10A	300 - 36000 (3.00 - 360.00 Hz)	6000 (60.00 Hz) ²

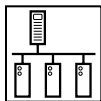
¹ = Drive's programming parameter number; ² = Two decimal places assumed (hundredths)

Drive Control & Communication



AC Tech Register Number (hexadecimal representation)	Parameter ¹	Parameter Name	Range of Adjustment Modbus value (decimal value)		Factory Default
95 (5F)	44	TB10B OUT	00 - None 01 - 0 - 10 VDC 02 - 2 - 10 VDC		00 - None
96 (60)	45	@TB10B	10 - 200 (10 - 200%)		125 (125%)
98 (62)	47	TB13A	00 - None 01 - 0 - 10 VDC 02 - 4 - 20 mA 03 - PRESET #1 04 - DEC FREQ 05 - REVERSE		00 - None
99 (63)	48	TB13B	00 - None 01 - 0 - 10 VDC 02 - 4 - 20 mA 03 - PRESET #2 04 - INC FREQ		00 - None
100 (64)	49	TB13C	00 - None 01 - 0 - 10 VDC 02 - 4 - 20 mA 03 - PRESET #3 04 - HAND 05 - REVERSE		00 - None
101 (65)	50	TB13D	00 - EXT Fault 01 - EXT /Fault 02 - EXT Clear		00 - EXT Fault
103 (67) 104 (68) 105 (69)	52 53 54	TB14OUT TB15OUT RELAY	00 - None 01 - Run 02 - Fault 03 - INV Fault 04 - Fault Lockout 05 - @ Speed 06 - Above Preset #3 07 - Current Limit 08 - AUTO/HAND SRC 09 - FLWR PRESET 10 - MIN/MAX ALARM	11 - INV MIN/MAX ALM 12 - MIN ALARM 13 - INV MIN ALARM 14 - MAX ALARM 15 - INV MAX ALARM 16 - RUN REVERSE	00 - None
106 (6A)	55	TB5B LOSS	00 - Fault 01 - Preset #3		00 - Fault
108 (6C)	57	SERIAL	00 - Disable 01 - w/ Timer 02 - w/o Timer		00 - Disable
109 (6D)	58	ADDRESS	1 - 247		30
112 (70)	61	PASSWORD	0000 - 9999		0019
114 (72)	63	SOFTWARE	(View Only)		(N/A)

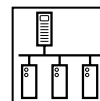
¹ = Drive's programming parameter number; ² = Two decimal places assumed (hundredths)



Drive Control & Communication

AC Tech Register Number (hexadecimal representation)	Parameter ¹	Parameter Name	Range of Adjustment Modbus value (decimal value)	Factory Default
115 (73)	64	MONITOR	00 - OFF 01 - ON	01 - ON
116 (74)	65	PROGRAM	00 - Maintain 01 - Reset 60 02 - Reset 50	01 - Reset 60
117 (75)	66	HISTORY	00 - Maintain 01 - Clear	00 - Maintain
121 (79)	70	PID MODE	00 - Off 01 - Normal 02 - Reverse	00 - Off
125 (7D)	74	PID FB	00 - TB-5A 01 - TB-5B	00 - TB-5A
126 (7E)	75	FB @ MIN	0 - 65000	0 (0.0%)
127 (7F)	76	FB @ MAX	0 - 65000	65000 (100%)
128 (80)	77	P GAIN	0 - 9999 (0.0 - 999.9%)	50 (5.0%)
129 (81)	78	I GAIN	0 - 100 (0.0 - 10.0 sec)	0 (0.0 sec)
130 (82)	79	D GAIN	0 - 100 (0.0 - 10.0 sec)	0 (0.0 sec)
131 (83)	80	PID ACC	0 - 1000 (0.0 - 100.0 sec)	300 (30.0 sec)
132 (84)	81	MIN ALRM	FB @ MIN - FB @ MAX	0.0%
133 (85)	82	MAX ALRM	FB @ MIN - FB @ MAX	0.0%
149 (95)	98	LANGUAGE		English
150 (96)	99	FAULT HISTORY	(View Only)	(N/A)

¹ = Drive's programming parameter number; ² = Two decimal places assumed (hundredths)



NOTE 4 - Acceleration Limits

Acceleration Limits	
HP	Adjustment Range
0.25 - 20	1 - 36000 (0.1 - 3600 sec)
25 - 60	3 - 36000 (0.3 - 3600 sec)
75 - 250	6 - 36000 (0.6 - 3600 sec)

NOTE 5 - Deceleration Limits

Deceleration Limits				
HP			Adjustment Range	
240/200 VAC	480/400 VAC	590/480 VAC	without dB	with dB
0.25 - 7.5	1 - 7.5		3 - 36000 (0.3 - 3600 sec)	1 - 36000 (0.1 - 3600 sec)
10 - 15	10 - 20	1 - 7.5	5 - 36000 (0.5 - 3600 sec)	1 - 36000 (0.1 - 3600 sec)
20 - 30	25 - 60	10 - 20	10 - 36000 (1.0 - 3600 sec)	2 - 36000 (0.2 - 3600 sec)
		25 - 60	20 - 36000 (2.0 - 3600 sec)	2 - 36000 (0.2 - 3600 sec)

NOTE 6 - MAX DC BRAKE VOLTAGE (Register 63)

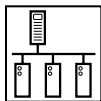
Maximum DC Brake Voltage				
Model	MH100	MH200	MH400	MH500
Voltage	240/120 Vac	240/200 Vac	480/400 Vac	590/480 Vac
MAX Brake Voltage	24 V	24 V	48 V	59 V

NOTE 7 - CURRENT (Register 67)

If LINE VOLTS, Register 51, is set to LOW (or set to Auto and the input voltage is low), the range for CURRENT is 25 - 150%.

NOTE 8 - FX BOOST (Register 70)

FX BOOST Factory Default Setting			
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%



Drive Control & Communication

7 Quick Start Instructions

Follow these Quick Start instructions to use ModBus Communications for basic network control of an MCH drive. These instructions are a reprint of Application Note AN0034, *Basic Network Control of the MCH Drive using Modbus™ Communications*. To download the MCH product manual or application note visit the AC Tech Technical Library at <http://www.lenze-actech.com>.

7.1 Initial Settings

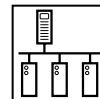
1. Set the Modbus Master to 9600 bps with 8 data bits, no parity and 2 stop bits. The MCH series drive does NOT support any other baud rates or data formats.
2. Set Parameter 58 (Serial Address) to the desired network address that the Modbus master will poll. Valid Modbus addresses are 1-247.

TIP - Avoid using address 1. Most Modbus devices ship with a default address of 1. As duplicate addressing on a Modbus network is not allowed, this can lead to conflicts when replacing and commissioning nodes. To avoid this it is recommended that you do not set the slave address to 1.

3. The MCH series drive has the provision for a watchdog timer to monitor network communications to the drive. The timer is fixed at a value of 10 seconds. If the drive is under network control (with Parameter 30 (Control) set to SERIAL AUTO or S AUTO/NO HND) and the master does not communicate with the MCH drive for longer than the 10 second timeout period, the drive will trip to FLWR/SERIAL fault. The timer can either be enabled or disabled as outlined in the next step.
4. Set Parameter 57 (Serial Communication) to either W/TIMER or W/O TIMR as desired in order for serial communication to function.

7.2 Drive Control

1. Start/Stop Control: Please be advised that while the drive is under network control the local STOP circuit is always enabled. Input TB1 needs to be asserted in order for the drive to start. If you will not be starting/stopping the drive via the terminal strip, simply jumper the TB1 input to TB2 for a basic MCH drive or jumper B3 to B4 for an MCH drive with bypass.
 - a. To Start and control the MCH drive from the network AND be able to start the drive locally in HAND mode, set Parameter 30 (Control) to SERIAL AUTO
 - b. To start and control the MCH drive exclusively from the network, set Parameter 30 (Control) to S AUTO/NO HND.
2. Use either Modbus function code 16 with a length of 1 or Modbus function code 06 to perform any writes to the drive.



Unlocking the Drive:

1. The first write necessary to the drive to perform any function (start, change speed, change a parameter, etc) needs to be an unlock command.

To only control the drive over the network you can write a value of 0 to the drive's Modbus register 40049 (AC Tech register 48).

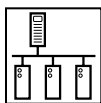
To both control the drive and alter any programming parameters then write the drive's programming password to Modbus register 40049. The default password for the MCH drive is 0019.

2. You should only need to send the unlock command once after power up. As long as the communications do not timeout you should not need to write another unlock to the drive before writing any other function.

7.3 Basic Drive Commands

The following are the basic drive commands. ONLY ONE OF THESE CAN BE DONE AT A TIME:

1. To STOP the drive using the stop method programmed in Parameter 26 (STOP), write a value of 0004hex to Modbus register 40002 (AC Tech register 1).
2. To Start the drive write a value of 0008hex to Modbus register 40002.
3. Drive direction cannot be controlled via Modbus on the MCH series drive.
4. If you want the network to control the speed of the drive, set Parameter 24 (Auto Source) to KEYPAD and write the speed to the Keypad Speed Command Register, Modbus register 40041 (AC Tech register 40). Speed is written in 0.01Hz (so 4120 would be 41.20 Hz). In this mode the drive's initial speed reference on power up will be the last speed written to the drive.



Drive Control & Communication

7.4 Basic Drive Status

AC Tech register 24 is a 6 word entity containing the drive's status information. To retrieve the entire status block (Modbus registers 24-29) send a read command to Modbus register 40025 using Modbus function code 03 with a register count of 6. The low byte of the third word in this block of data contains the operational status.

The value of that low byte of data corresponds to the following operational states:

Operational Status (byte D3L or Register #26 DL)

Value*	Operational State
0	FAULT LOCKOUT
1	FAULT
2	START PENDING
3	STOP
4	DC BRAKE
5	RUN AT 0Hz
6	RUN
7	ACCEL
8	DECEL
9	CURRENT LIMIT
10	DECEL OVERRIDE
16	SLEEP MODE

* This is the decimal equivalent value of the binary number of the bits in that byte.

7.5 Basic Drive Network Programming

The programming parameters of the MCH drive may be altered by a Modbus master. To do so simply write the desired value to the appropriate Modbus register. The translation is as follows:

$$\text{Modbus register number} = \text{MCH parameter number} + 52$$

As an example if you wanted to change the acceleration time (Parameter 8) of the MCH drive, write the time desired into Modbus register 40060. Note that time is written in 0.1 seconds (so 200 would be 20.0 sec).

Lenze AC Tech Corporation

630 Douglas Street • Uxbridge MA 01569 • USA
Sales: 800-217-9100 • Service: 508-278-9100
www.lenze-actech.com

RG-MHMOD-e6