USER'S MANUAL

INTELLIGENT MOTION CONTROLLER

Model: **MXA-21**

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Rev. A

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1. GENERAL DESCRIPTION

1.1. INTRODUCTION

The OMS Motion, Inc. MXA-21 is the first of the MXA family of 19" enclosure motion controllers to use high performance Ethernet or USB interfaces. The MXA-21 motion controller can manage up to 8 axes of open loop or closed loop stepper motor axes. The MXA-21 controller synchronizes all independent or coordinated motion of up to 8 axes while incorporating other critical signals such as: hard or soft limits and home signals to perform virtually any motion control task. High level functionality, such as circular and linear interpolation, multi-tasking, custom profiling, etc., allows the MXA-21 to satisfy the needs of most any motion control application. See Appendix C "Ordering Information" for specific MXA-21 family models.

The MXA-21 communicates as a "client only" device to the host computer and functions as a motion processor. It utilizes patented and proprietary technology to control the trajectory profile, acceleration, velocity, deceleration, direction and coordination of selected axes. In response to commands from the host computer, the MXA-21 will calculate the optimum velocity profile to reach the desired destination in the minimum time while conforming to the programmed acceleration and velocity parameters. In addition, the MXA-21 can provide motion control information such as axis and encoder position as well as the state of over-travel limits, home switch inputs, and done notification flags. The MXA-21 motion controllers operate as an efficient and powerful Ethernet or USB peripheral device to the PC host.

The stepper control of the MXA-21 produces a 50% duty cycle square wave step pulse at velocities of 0 to 4,194,176 pulses per second, and an acceleration of 0 to 8,000,000 pulses per second^2. The encoder feedback control can be used as feedback for the stepper axes, or strictly as position feedback of any axis. The incremental encoder input supports differential or single ended quadrature TTL signals at a rate of up to 16 MCnts/s. The absolute encoder using SSI (Synchronous Serial Interface) or BiSS interface technology also supports differential or single ended inputs at a rate up to 8MHz. Complete specifications for MXA-21 can be found in Appendix C.

The MXA-21 command set employs two or three ASCII character commands which can be combined into command strings. Using virtually any programming language, these ASCII command strings can be sent to the MXA-21 motion controller over Ethernet or USB. Refer to the "Command Reference Manual: MXA Family" for the complete command reference.

1.2. SYSTEM OVERVIEW

The MXA-21 motion controller can manage up to 8 axes of motion. The MXA-21 has an internal logic power supply that receives power (120VAC) through the connector on the back of the unit. The internal power supply is certified with CE, UL and other applicable safety standards. The main power switch is located on the back panel of the MXA-21 where the power cord attaches.

Located on the back panel of the MXA-21, individual RJ45 connectors are available for each axis control signals (+/- Step, +/- Direction, +/- Limits, Home and signal ground). Both the Step and Direction signals are differential for optimum noise immunity.

The MXA-21 also has individual 9-pin D-sub connectors for each of the encoders associated with each axis. These encoder inputs support both incremental and absolute encoder types. The control signals for these encoders are differential. Early models of the MXA-21 encoder connection pinouts require a dongle to support the pinout of the Renishaw brand of absolute encoders, but this was eliminated with newer versions (Serial Numbers 106 and greater) of the MXA-21.

Data communication is performed by sending and receiving command strings (ASCII characters) via 10/100/1000Mb Ethernet running TCP/IP or USB 2.0. More details on the functionality of the controller are included in the following chapters.

2. GETTING STARTED

2.1. INSTALLATION

For installation of the MXA-21 you will need a computer with either an Ethernet and/or USB interface.

Read through the following two sections before beginning the installation. Do not turn on the power to the MXA-21 until you have properly configured the controller for communications via the following instructions. Note that the SELECT switch at the front of the unit is used to choose the communication mode Ethernet (right) or USB (left). The MXA-21 is set for USB communication mode from the factory.

The MXA-21 is intended to be mounted into a 19" rack, though it can also be set onto a flat surface such as a bench top, which may be easy for testing and configuration.

2.2. CONFIGURING COMMUNICATION

The first requirement for setting up the communication interface is to ensure that the MXA-21 is securely and safely mounted where damage is unlikely. This includes exposure to possible static discharge, moisture, debris, etc.

CAUTION:

The MXA-21 is a static sensitive device and standard Electro Static Discharge (ESD) techniques are required when handling and installing the MXA-21. The enclosure helps in protecting the MXA-21 from ESD though the signal connections require care and protection for ESD.

To prevent motors, switches, or other devices from unexpected activation, do not connect any cables to the output connectors at this time.

2.3. USB COMMUNICATIONS

To connect the host to the MXA-21, power off the MXA-21 and set the port selector switch (SELECT) to the left (USB). Power on the MXA-21 and wait for it to enumerate on the USB bus. Windows Device Manager can be used to determine when enumeration is complete. The MXA-21 enumerates as a CDC device supporting a virtual serial port that uses Windows' standard virtual serial port driver; no special driver is necessary. Because a virtual serial port is instantiated during enumeration, no further setup of BAUD rate, start/stop bits, parity, or flow control is necessary.

After booting the MXA-21, check Windows Device Manager to determine which COM port has been assigned to the MXA-21 controller. The yellow LED on the front panel starts blinking once the controller is ready for communications to be established with the host computer.

To prevent motors, switches, or other devices from unexpected activation, do not connect any cables to the output connectors at this time.

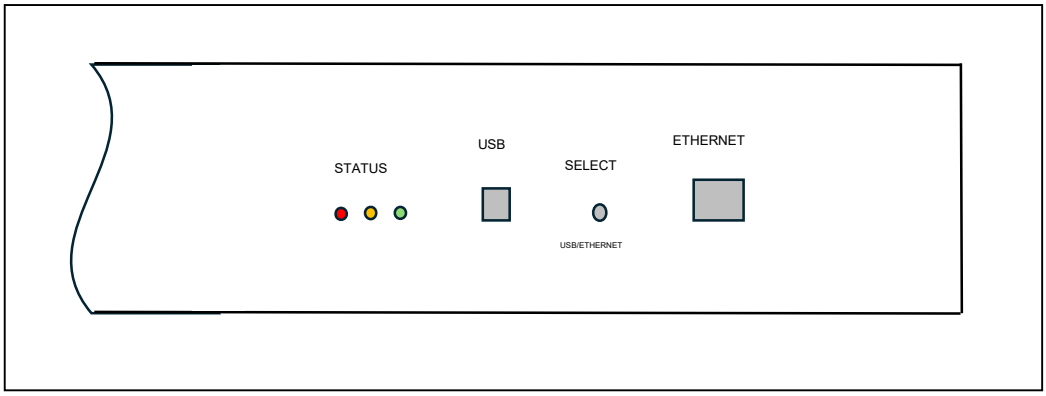

FIGURE 2-1 FRONT PANEL CONNECTORS

The MXA-21 has three status LEDs located on the front of the unit (Figure 2-1), one green, one yellow, and one red. A solid green LED indicates that the firmware has booted and the MXA is ready to communicate. If only the green LED is on, it is configured to communicate via Ethernet, if the green LED is solid and the yellow LED is blinking it is configured to communicate via USB. The red LED on solid indicates a failure with the MXA-21and may not be able to communicate. If the MXA can communicate the 'FS' command may be helpful in troubleshooting the red LED status.

2.4. ETHERNET

To configure the MXA-21 to communicate via Ethernet, power off the MXA-21, set the port selector switch (SELECT) to the right (ETHERNET). Connect the MXA-21 to the network and turn on the power. The MXA-21 will query a DHCP server for an IP address by default. Once an IP address is granted, the host can communicate with the MXA-21 using TCP and the default port of 23. While port 23 assigned to telnet is used, the MXA-21 does not support the telnet protocol. To determine the IP address of the MXA-21, either use ARP or query the DHCP server; the MAC address can be found on a label at the front of the unit, the first three octets of the MAC address are: 00-16-82.

The MXA-21 can be configured to use a static IP address instead of having one assigned dynamically. To assign a static IP address, use the #ND command to disable DHCP. To change the IP address, use the #NI command and power cycle the MXA-21. After booting, the new static IP address can be used. To change the TCP port number, use the #NP command and reboot. The #ND, #NP, and #NI commands parameters are written directly to flash memory, so they are persistent. See "Command Reference Manual: MX Family" for further details on these commands.

2.5. VERIFYING CONNECTION

To communicate with the MXA-21 via USB a host terminal emulator application (such as TeraTerm may be used). Simply select the COM port assigned by the host during USB enumeration and send the "WY" command to the MXA-21. If communication and power are configured properly, the MXA-21 will respond with an ASCII string showing its model, version, and serial number

The steps are the same to verify the Ethernet connection. Using a terminal emulator that supports sockets (such as PuTTY), select the IP address and the port and send the "WY" command. As with the USB port, if communication and power are configured properly, the MXA-21 will respond with an ASCII string showing model, version, and serial number information.

2.6. CONFIGURING FOR ENCODERS

By default the MXA-21 is configured for quadrature encoder for which the inputs are both CMOS and TTL compatible. The MXA-21 has biasing to allow single ended encoders for each axis. Single-ended encoders should be wired to the positive (+) connections of each signal. The negative (-) side of the differential signal should be left unconnected.

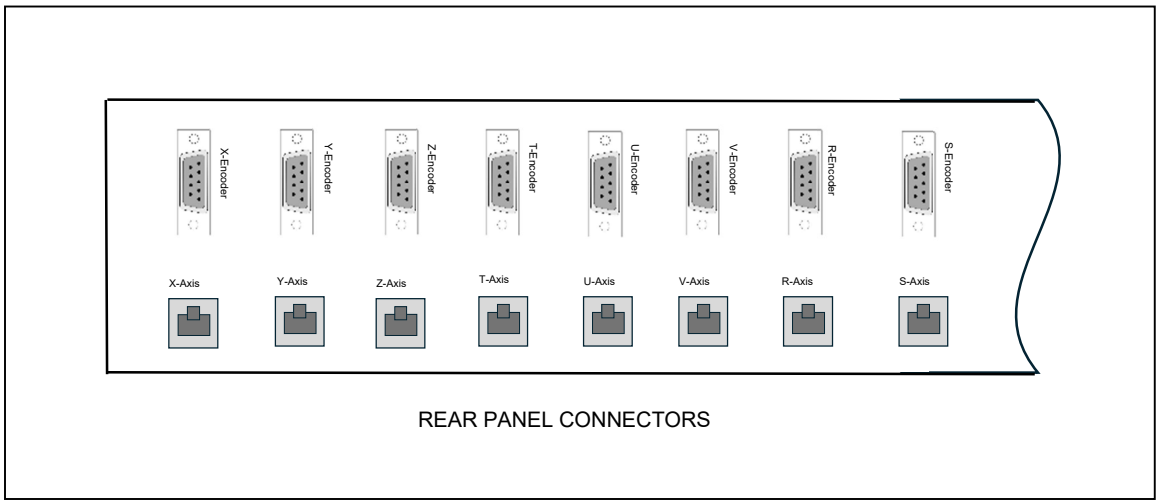

FIGURE 2-2 CONNECTOR LOCATIONS

2.7. CONNECT TO STEPPER MOTOR DRIVE

The MXA-21 control signals are located on the back panel of the enclosure and are labeled accordingly. This section will explain how to connect a stepper motor driver to the controller axis connector on the back panel.

Begin this procedure with an MXA-21 controller connected to your system (Ethernet or USB) and establish communications. This can be checked by issuing a “WY” command to the controller and verifying that the response with its model type and version levels (i.e. MXA-21 ver:1.00 S/N 0000).

Once communication has been established with the controller, shut down the system and turn off power to the controller board.

NOTE: It is not recommended to continue with the hardware connection if communication has not been established.

Connect the motor phase signals from the motor to the stepper drive output signals. Use the motor and stepper drive manufacturer’s manuals for instructions.

Connect an external power supply (which is OFF) to the stepper drive. Refer to the manufacturer’s manual for instructions. (Note that power supply requirements differ from drive to drive.) Once the motor and power supply connections are confirmed, turn on the power supply to perform a check that everything is connected correctly, before connecting the controller to the drive. Turn off the power to the motor drive before proceeding.

Axis Control (RJ-45)	
Pin	**Function**
1	Step +
2	Step -
3	Direction +
4	Positive Limit
5	Negative Limit
6	Direction -
7	Home
8	Ground

Incremental Encoder (DB9)	
Pin	**Function**
1	Index +
2	Phase A+
3	Phase B+
4	+5VDC
5	Home
6	Index -
7	Phase A-
8	Phase B-
9	Ground

Absolute Encoder (DB9)	
Pin	**Function**
1	Clock +
2	Data +
3	*NC*
4	+5VDC
5	Home
6	Clock -
7	Data -
8	*NC*
9	Ground

Connect the controller signals from the RJ45 connector on the back panel of the MXA-21 to the stepper drive according to the instructions of the stepper motor drive. Short cable lengths and shielded cables are recommended for improved signal integrity and a reduction in signal noise.

Attach the STEP outputs from the MXA-21 controller to the STEP inputs on the stepper drive. Do the same for DIR signals.

Once all wire connections have been made, power can be restored to your system. It is recommended that you bring the controller board up first (so it is in a known state and communicating), and then apply power to the stepper drive.

Refer to Figure 2-3 for an example wiring diagram of a MXA-21 connected to a stepper drive on the X-axis.

Using your communication terminal connected to the MXA-21 to send a “JG100;” command. The X-axis motor should step at a rate of 100 steps per second.

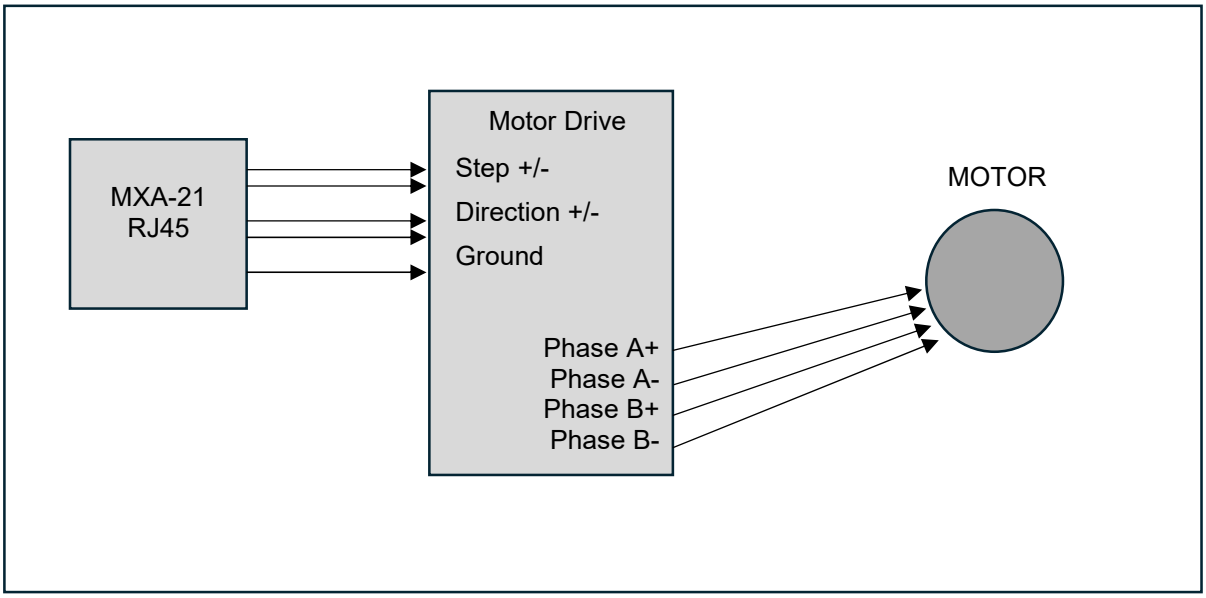

FIGURE 2-3
EXAMPLE - WIRING DIAGRAM MXA-21 TO A STEPPER DRIVER / MOTOR

2.8. SETTING THE USER DEFAULT CONFIGURATION

There are many parameters that can be defined by the user as default. These parameter values can supersede the factory default values and are stored in flash memory for power-up configuration. Most of these parameters consist of axis specific values: limit switch logic sense, encoder type, user units, velocity, acceleration, etc.

The MXA-21 comes from the factory with default values for all parameters. For instance, the default value for the axis type is open-loop stepper PSO. In a typical application, when the system is powered up, the host computer would initialize all peripherals such as the MXA-21, sending each of the axes the type, encoder type and encoder ratio. When the User Definable Default Parameter value is defined, then the configuration of the defined axes will be set accordingly. This feature can greatly simplify the software and initialization process.

Once the values for all the associated parameters are defined; i.e. axis type, encoder type, etc. the APP command is executed to place the values into flash memory. From this point forward these defined values will be used after reset or power-up. The individual parameters can be over-written any time by using the associated command; i.e. “PS”, “EC”, etc. To restore the factory defaults, execute the “RDF” command. **The RDF command does not restore communication parameters (IP address, port number, DHCP enable, and serial baud rate) to factory default.**

The following is a partial list of parameters that can be defined as part of the User Definable Power-Up Default Parameters:

Over-travel limit (soft limit or hard limit); Factory Default = Hard limit

Over-travel limit (enabled or disabled); Factory Default = Enabled

Over-travel limit polarity (active high or active low); Factory Default = active low

Software based over-travel for each axis; Factory Default = disabled

Direction Bit polarity; Factory Default = non-inverted (normal)

Acceleration value for each axis; Factory Default = 2,000,000

Trajectory profile for each axis (linear, parabolic, S-curve, custom); Factory Default = Linear

Velocity Peak; Factory Default = 200,000

Velocity Base; Factory Default = 0

User Unit values for each axis; Factory Default = Off

Encoder Ratio for each axis; Factory Default = 1:1

Encoder Slip tolerance for each axis. (Used for stepper motors); Factory Default = 0

Home Active; Factory Default = Low

Position Maintenance Dead-Band, Hold Gain, and Hold Velocity. (Used for stepper systems); Factory Default = 0,0,0

2.9. POWER SUPPLY REQUIREMENTS

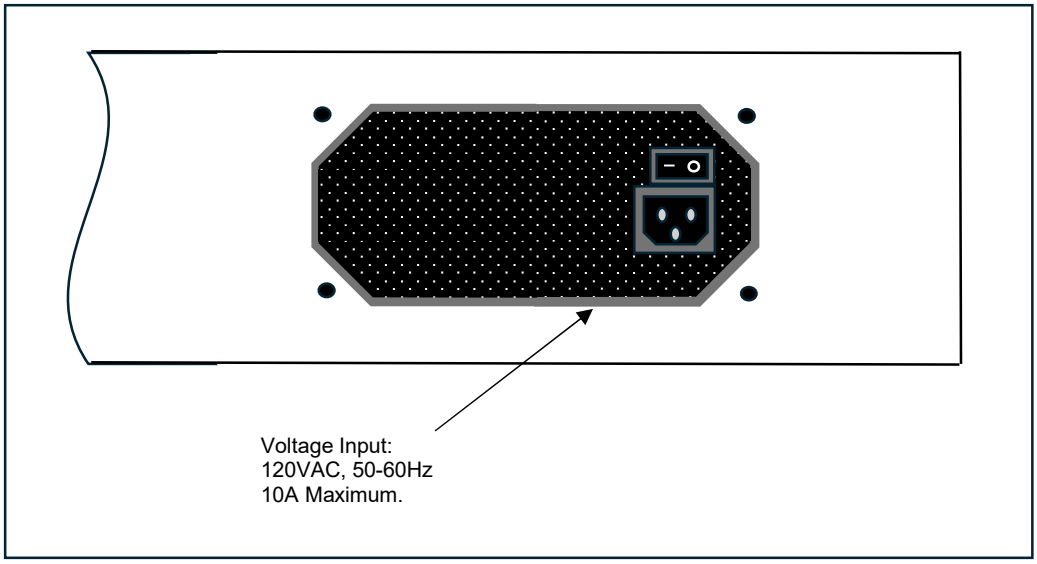

FIGURE 2-4 POWER SUPPLY REQUIREMENTS

3. COMMUNICATION INTERFACE

3.1. INTRODUCTION

The MXA-21 depends on a host computer to send the desired motion commands, which are used to produce the control signals required to perform the motion. There are two options for communicating to the MXA-21 from a host computer; Ethernet or USB. The Ethernet is connected to the MXA-21 through an RJ45 connector located on the front panel, and the USB interface is connected to a type-B USB connector located on the front panel. Located between these two connectors is the selection switch for the desired communication to use. Once the communication type selection is made the MXA-21 is power-cycled to make the selection active.

3.2. USB AND TCP/IP FLAG NOTIFICATION PROTOCOL

To permit flag notification the MXA-21 will asynchronously send text strings to notify the host when status flags are set. The flag notification string will consist of an ASCII string of the form “%<000> <SSSSSSSS>”. Where:

- The “%” character indicates that numeric data follows.
- The “000 “ code indicates that the following numeric data contains status flag information.
- The SSSSSSSS represents 8 ASCII characters that present the contents of the MXA-21 style status flag word as hexadecimal digits. Status flag information is encoded as follows:

Axis done notification flags:

- X_DONE_FLAG	0x00000001
- Y_DONE_FLAG	0x00000002
- Z_DONE_FLAG	0x00000004
- T_DONE_FLAG	0x00000008
- U_DONE_FLAG	0x00000010
- V_DONE_FLAG	0x00000020
- R_DONE_FLAG	0x00000040
- S_DONE_FLAG	0x00000080

Axis over-travel limit notification flags:

- X_LIMIT_FLAG	0x00000100
- Y_LIMIT_FLAG	0x00000200
- Z_LIMIT_FLAG	0x00000400
- T_LIMIT_FLAG	0x00000800
- U_LIMIT_FLAG	0x00001000
- V_LIMIT_FLAG	0x00002000
- R_LIMIT_FLAG	0x00004000
- S_LIMIT_FLAG	0x00008000

Axis encoder slip notification flags:

- X_SLIP_FLAG	0x00010000
- Y_SLIP_FLAG	0x00020000
- Z_SLIP_FLAG	0x00040000
- T_SLIP_FLAG	0x00080000
- U_SLIP_FLAG	0x00100000
- V_SLIP_FLAG	0x00200000
- R_SLIP_FLAG	0x00400000
- S_SLIP_FLAG	0x00800000

Command error flag:

- CMD_ERR_FLAG	0x01000000

System error flag:

-SYS_ERR_FLAG	0x80000000

3.3. REAL-TIME POSITION CAPTURE

The position capture commands control the real-time recording of axis position data and the management of the captured position data. The captured position data includes the axis home and encoder home events, and encoder position of the axis. Position data is captured when the conditions specified for the input bit are met. The capture conditions for the home switch input bits can be a rising/positive edge, falling/negative edge, or the event can be both the rising/positive and the falling/negative edge, so data is captured on any transition of the input bit. The real-time position capture feature is only available on an axis with incremental encoders. See the Command Reference Manual: MXA Family Command Manual (www.omsmotion.com) for more details on the real-time position capture feature.

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4. CONTROL SIGNAL INTERFACE

4.1. INTRODUCTION

The MXA-21 family of motion controllers is an eight axes controller to manage step motor axes and supports individual RJ45 connectors for all axes. The MXA-21 default configuration is as an open loop stepper controller supporting up to 8 axes, though the encoder inputs are all active and commands can activate the closed loop functions. The Step and Direction signals are differential for better noise immunity. The + & - Limit inputs as well as the Home input signals have a capacitive filter for better noise immunity. The Home input signal is available at both the control signal RJ45 connector as well as the encoder input 9-pin D-sub connector.

4.2. LIMIT INPUTS

To facilitate the physical system safety, TTL inputs for +/- limit conditions are provided for each axis. Limits may be activated by mechanical switches or other suitable active switches, such as a Hall Effect switch or opto-isolator that connects to ground.

If the axis travels beyond its allowable limits and trips the switch, the limit condition removes any further movement in the limit direction from the affected axis. This is considered a catastrophic situation, so the axis command queue is flushed. The LT command changes which signal state the limit switch is active for and can be configured on each axis independently. The limit behavior can be set for the axis to decelerate to a stop or to stop without deceleration when a limit condition occurs.

See Command Reference Manual: MXA Family (www.omsmotion.com): LM and LT commands.

4.3. HOME INPUTS

To facilitate positioning of an axis to a known reference position, a TTL home input is provided for each axis. For axes using an encoder, the home input can be used in conjunction with the index signal of the encoder. The logic of the encoder signals Phase A/Phase B/Index that constitutes a true home condition is programmable. Refer to Figure 4-1

Refer to “Command Reference Manual: MXA Family” (www.omsmotion.com): EH, HI, HM, HR, HT, KM, and KR commands.

4.4. MOTOR CONTROL OUTPUT

The MXA-21 is configured at the factory to control open loop stepper motors. Upon installation, axes can be configured for open loop steppers or stepper motors with encoder feedback.

Step pulse and direction outputs are active drive differential output signals which will wire directly into most drive inputs. Drives with only a single input should consider termination on the unused signal.

4.5. ENCODER FEEDBACK

Incremental encoder feedback is the default configuration and is provided for all axes. Its use is optional for stepper axes. The MXA-21 incremental encoder feedback accepts differential quadrature pulse inputs from high resolution encoders at rates up to 16 MCnts/s (after quadrature detection). The encoder monitors the actual position through the encoder pulse train. The stepper axes can monitor the error and correct and maintain the position after the move is finished.

The encoder input can also be used as an independent feedback source or, in the encoder tracking mode, to mimic an activity on the encoder input. All modes are capable of slip or stall detection and encoder tracking with electronic gearing. These options are selectable by the user through software commands.

The MXA-21 is compatible with virtually any incremental encoder which provides quadrature outputs. Times four quadrature detection is used to increase resolution. This means that an encoder rated for 1000 counts (or lines) per revolution will result in 4000 counts of quadrature encoded input for each encoder shaft revolution. Inputs are compatible with encoders that have either single ended or differential TTL outputs. The MXA-21 has differential line receivers to accommodate encoders with differential outputs. Encoders with single-ended outputs can wire the signals to the positive (+) side of the differential line receiver and leave the negative (-) side unconnected.

Absolute encoders are supported for SSI and BiSS protocols. In the absolute encoder configuration, the same connector pins are used, but in the absolute encoder pin-out, the #AE command will set the specific axis to absolute encoder mode. Reference the “Command Reference Manual: MXA Family” for all of the absolute encoder commands. More explanation is available in section 4.7 of this manual.

4.6. HOME PROCEDURES

Three logical input functionalities are provided to synchronize the physical hardware with the MXA-21 controller; i.e. put the controlled motor in the home position.

The home switch input is a TTL level input signal. If current limiting is required, it should be done externally to the controller. Contact OMS Motion, Inc. technical support for assistance.

The MXA-21 home switch input can be used to home a mechanical stage. When this functionality is used the axis position counter will be reset to a selected value. At this point the MXA-21 can either ramp the axis to a stop or stop the axis motion immediately. The control of the direction of travel, the logic active state and the response to the active switch are controlled through commands.

An alternative homing method on the MXA-21 uses the home switch and the encoder signals to home an axis. When using the Home Encoder Index (HI) mode, the homing logic is used with these input signals. The home position consists of the logical AND of the encoder index pulse, the home switch input, and a single quadrant from the encoder logic. The home switch and encoder should be positioned relative to each other in such a way that there is only a single location in the entire travel of the axis that creates a true condition for the defined home logic. The EH command can be used to create different patterns for the home logic, including the option to ignore an encoder phase signal. The default home logic expressed in Boolean terms is:

Home Encoder = (Phase A+) + (Phase B-) + (Index +) + (Home input low)This is illustrated in Figure 4-1 below.

The encoder counter (read by the RE/PE commands) must increase for positive moves, or the system will oscillate due to positive feedback. For other options, please contact OMS Technical Support.

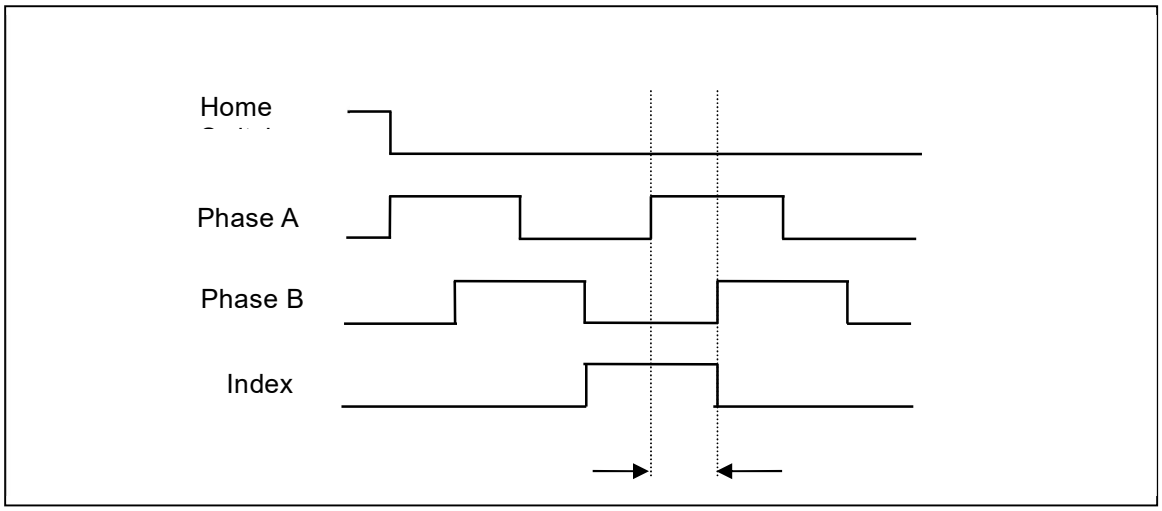

FIGURE 4-1 ENCODER HOMING STATE DETECTION

If an absolute encoder is configured to the axis, a simple synchronize command (SMEA or SEA) can sync the axis counters to the current absolute encoder value.

4.7. SERIAL ABSOLUTE ENCODERS

The MXA-family of controllers support serial absolute encoders supporting SSI and BiSS C-mode technology. The controller can support up to 60-bit resolution for serial absolute encoders. The 60-bit limit applies to the encoder data transferred excluding the BiSS CRC checksum. The supported data clock speeds are 31,250Hz, 62,500Hz, 125,000Hz, 250,000Hz, 500,000Hz, 1MHz, 2MHz, and 4MHz for SSI and BiSS and 8MHz for BiSS only.

Reference the connector pinout for absolute encoder on the 9-pin D-sub connectors on the back panel.

The absolute encoder value (RR) is mapped to the encoder position (RE, PE) with an offset. The commands SEA and SMEA allow to synchronize and offset the encoder values. The encoder position value (RE, PE) is used as feedback for the motion planning.

4.8. CONFIGURATION EXAMPLES

The following are two examples of how to configure the standard MXA for absolute encoding. The first example shows two SSI absolute encoders with one BiSS encoder. For this example, axis X uses SSI 24-bit resolution with a clock frequency of 125,000Hz and axis V uses BiSS 26-bit resolution, 2 status bits and CRC $x^6+x^1+x^0$ initialized to 0, and reads with a clock frequency of 2,000,000Hz.

Example 1 :
```
AX;
PSE;
ECA24,125000;
AV;
PSE;
ECB26,2000000,2,43,0;
```

The second example utilizes two BiSS absolute encoders. Here, axis X uses 26-bit position resolution, 2 status bits and CRC $x^6+x^1+x^0$ initialized to 0, with a frequency of 8MHz. Axis T uses 36-bit resolution, no status, no CRC and a frequency of 2MHz.

Example 2:
```
AX;
PSE;
ECB26,8000000,2,43,0;
AT;
PSE;
ECB36,2000000;          // = ECB36,2000000,0,0,0;
```

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5. SERVICE

5.1. USER SERVICE

The MXA-21 family of controllers contain no user serviceable parts. Opening the enclosure could void the warranty of the controller. The best solution for troubleshooting is to reach out to OMS Technical Support for assistance (support@omsmotion.com, 503-629-8081). Alternatively contacting OMS Customer Service can help as well (customerservice@omsmotion.com, 503-629-8081).

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6. FIRMWARE UPGRADE

OMS Motion currently recommends that Users contact Technical Support for assistance with firmware updates. See Technical Support section of this manual for instructions.

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APPENDIX A
LIMITED WARRANTY

OMS Motion (the seller) warrants that the articles furnished are free from defects in material and workmanship, and perform to applicable published OMS Motion, Inc. specifications for one year from the date of shipment. This warranty is in lieu of any other warranty express or implied. In no event will the seller be liable for incidental or consequential damages as a result of an alleged breach of the warranty. The liability of the seller hereunder shall be limited to replacing or repairing, at its option, any defective units which are returned F.O.B. to the seller's plant. Equipment or parts which have been subject to abuse, misuse, accident, alteration, neglect, or unauthorized repair are not covered by warranty. The seller shall have the right of final determination as to the existence and cause of defect. As to items repaired or replaced, the warranty shall continue in effect for the remainder of the warranty period, or for 30 days following date of shipment by the seller of the repaired or replaced parts, whichever period is longer. No liability is assumed for expendable items, such as lamps and fuses. No warranty is made with respect to custom equipment or products produced to the buyer's specifications, except as specifically stated in writing by the seller and contained in the contract.

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APPENDIX B

TECHNICAL SUPPORT

OMS Motion Inc. can be reached for technical support by any of the following methods:

1. EMail:	support@omsmotion.com
2. Web site:	www.omsmotion.com
3. Telephone:	8:00 a.m. - 5:00 p.m. Pacific Time (503) 629-8081 or (800) 707-8111
4. Facsimile:	24 Hours (503) 629-0688
5. USPS:	OMS Motion Inc. 3400 NE John Olsen Ave Suite #120 Hillsboro OR 97124

RETURN FOR REPAIRS

Call OMS Motion, Inc. Customer Service at (503) 629-8081, or (800) 707-8111, or E-Mail to sales@omsmotion.com.

Explain the problem and we may be able to solve it on the phone. If not, we will give you a Return Materials Authorization (RMA) number.

Mark the RMA number on the shipping label, packing slip, and other paperwork accompanying the return. We cannot accept returns without an RMA number.

Please be sure to enclose a packing slip with the RMA number, serial number of the equipment, reason for return, and the name and telephone number of the person we should contact if we have further questions.

Pack the equipment in an enclosure adequate for shipping fragile & static-sensitive items, such as a solid cardboard box secured with and ESD bag & packing material. Be sure to follow proper ESD procedures to protect the product from potential damage.

Ship prepaid and insured to:

OMS Motion Inc.
3400 NE John Olsen Ave.
Suite #120
Hillsboro, OR 97124

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APPENDIX C
SPECIFICATIONS

DESCRIPTION

The MXA-21 is an Ethernet/USB controller that is capable of up to 8 axes of control. Each axis can be configured as an open loop stepper or a closed loop stepper.

Every axis includes dedicated +/- over-travel limit inputs, a home input, step and direction output. The home and over-travel limit inputs are TTL level inputs. The step pulse is a TTL level, 50% duty cycle square wave that supports velocities of 0 through 4,194,176 pulses per second. Encoder feedback functionality supports quadrature encoders up to 16 MCnts/s and is used as feedback for the stepper axes, or as independent position feedback. Encoder feedback is also used to provide slip and/or stall detection.

The MXA-21 has many user-definable parameters that can customize the controller's behavior. These parameters can be conveniently stored in Flash so that the user-defined behavior will be automatically preset at each power-up.

PROGRAMMING

MXA-21 motion controllers are easily programmed with ASCII character commands through an extensive command structure. These commands are combined into character strings to create sophisticated motion profiles that feature I/O and other functionality.

All commands are sent to the controller as two or three character ASCII strings. Some of these commands expect one or more numerical operands to follow. These commands are identified with a "#" after the command. The "#" indicates a signed integer input parameter or a signed fixed-point

number of the format <##.#> when user units are enabled. User Units define distances, velocity, acceleration parameters, and may be input in inches, millimeters, revolutions, etc.
Synchronized moves may be made by entering the “AA” or “AM” command mode. This form of the command performs a context switch that allows entering commands of the format
<MR#,#,#,#,#;>
The order of axes is always X, Y, Z, T, U, V, R, and S.

Numbers are entered for each axis commanded to move. An axis may be skipped by entering the comma with no parameter. The command may be prematurely terminated with a “;”, i.e. a move requiring only the X and Y axes would use the command <MR#,#;> followed by the “GO” command. Each axis programmed to move will start together upon executing the “GO” command. The MXA-21 can be switched back to the single-axis mode by entering the desired single axis command, such as “AX”.

PROGRAMMING EXAMPLES

In a typical move requirement where it is desired to home the stage, then move to a specified position, the following demonstrates the programming for a single axis:

- Initialize the velocity and acceleration parameters to a suitable value. Perform the home operation initializing the position counter to zero. Perform a motion to an absolute position of 10,000 and set the done flag for that axis when the move is finished.

  The following would be the input to the host computer:

  ```
  AX;
  VL5000;
  AC50000;
  CL1;
  HM0;
  MA10000;
  GO;
  ID;
  ```

In a move requiring a three-axis coordinated move to a select position, the following commands could be used:

```
AM;
VL5000,5000,5000;
AC50000,50000,50000;
MT1000,2000,3000;
GO;
ID;
```

The controller would calculate the relative velocities required to perform a straight line move from the current position, to the desired absolute position, so that all axes arrive at their destinations at the same time.

SPECIFICATIONS

Velocity

0 to 4,194,176 pulses per second

Acceleration

0 to 8,000,000 pulses per second

Position range

140,737,488,355,328 pulses (+/- 70,368,744,177,664)

Accuracy

Position accuracy and repeatability ± 0 counts for point-to-point moves

Environmental

Operating temperature range: 0 to 50 C° (32° to 122°F)

Storage temperature range: -20 to 85 C° (-4° to 185°F)

Humidity: 0 to 90% (non-condensing)

Power Input requirements

120VAC, 1.5Amp, 50/60Hz
(Third-party internal power supply includes safety & EMI/EMC registrations: TUV, CE & others)

Dimensions (overall)

19” x 10.43” x 3.47” (482mm x 265mm x 88mm)

Limit switch inputs

TTL input levels. (SN75C189A)
Active low or high selectable by command input for each axis. (active low is default)

Connector

There are 8 DB9 connectors for Encoders and 8 RJ45 connectors for axis control for each axis located on the back panel of the MXA-21 unit.

Home switch inputs

TTL input levels. (SN75C189A)
Input sense (low or high true) is selectable by command input for each axis. Accurate to 1 encoder count.

Step pulse output

50% duty cycle. 5V CMOS level signal. (DS26C31TM)

Direction output

5V CMOS level signal. (DS26C31TM)

Encoder Feedback

Maximum 16 MCnts/s after 4x quadrature detection differential or single-ended signals.

60-bit Absolute (SSI or BiSS) encoder channels aliased to the position range.

Ethernet

10/100/1000Mb, TCP/IP, Standard RJ45 connector

USB 2.0

Type B connector

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FEATURES

Axes of Control
8-axes (X,Y,Z,T,U,V,R,S)

Controller I/O Capabilities
Each axis has +Limit, -Limit, Home input, and differential Step & Direction output.
Encoder input signals are differential (Phase A+ & A-, Phase B+ & B-, Index + & - for incremental encoders), (Clock + & -, Data + & - for absolute encoders). In both pinouts Home input, +5VDC and Ground are also available.

Motion Feedback
Incremental encoder input for each axis.
Quadrature Encoder Feedback up to 16 MCnts/s (quadrature) on all incremental encoder inputs.
60-bit Absolute (SSI or BiSS) encoders can replace the quadrature encoder.

Sophisticated Control Functionality
Step pulses velocity from 0 to 4,194,176 steps per second.
Point to point move distances +/- 0 steps.
Backlash compensation.
Custom, parabolic, S-Curve & Linear trajectory profiles.
Real-time encoder position capture.
S-Curve with 4-quadrant jerk parameters.

Control Signals
Standard RJ45 connectors support the axis control.
Standard DB9 connectors for Encoder feedback connection.

Communication Interfaces
Ethernet (10, 100, 1000) TCP/IP, RJ45 connector on the front panel.
USB 2.0, type B connector on the front panel.

ORDERING INFORMATION		
Model	Computer Interface	Axes
MXA-21	Ethernet / USB	8

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