FMX SERIES
FIBER-OPTIC MULTIPLEXERS
INSTRUCTION MANUAL

IM-FMX
Revision K
3/01/16

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1. INTRODUCTION

The FMX Series Multiplexer is designed to simultaneously switch the input (source) and output (detector) signals between 2 to 16 accessory channels (depending on the model of multiplexer purchased). Two basic mechanical configurations of the FMX-Series multiplexer are available – with maximum capacities of 10 and 16 channels, respectively. Typically, the 10 channel configuration is used on all models with 10 channels or less; and the 16 channel configuration is used for models equipped with 11-16 channels.

The FMX system is designed for continuous operation with virtually no maintenance requirements. Users in the field can easily add channels to the unit's capacity, and lens assemblies are easily serviceable in the field. A properly installed unit can be expected to provide accurate and repeatable optical switching over a long service life.
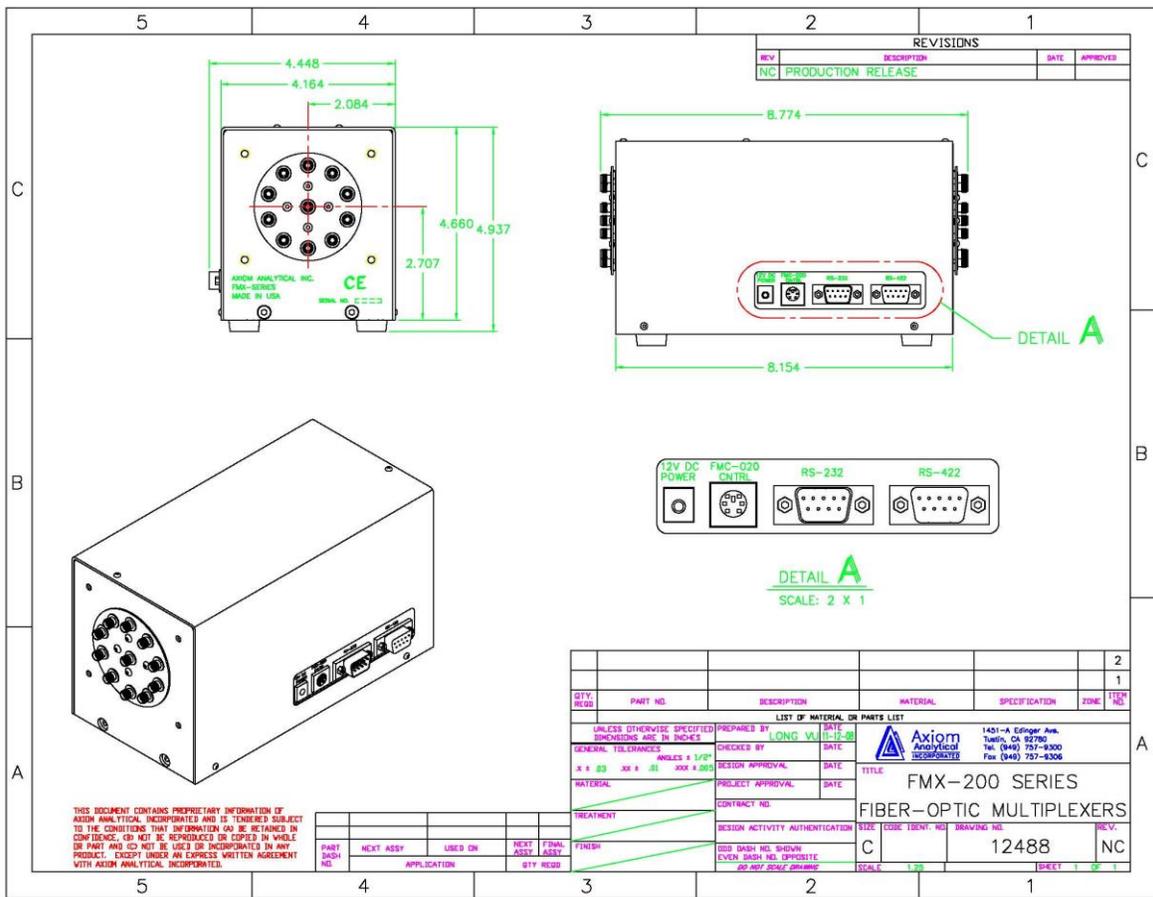

Figure 1: FMX Series dimensions and interconnections.

1.1 SYSTEM FEATURES AND DESCRIPTION

Electrical Requirements

The multiplexer unit requires a power supply source providing 12VDC, 1.2 AMPS. Typically, this is provided by the auxiliary power supply which is included in the standard multiplexer package. The auxiliary power supply runs off a 110/230VAC, 50/60 Hz source. Alternatively, a 12VDC, 1.2 amp power source can be hardwired directly to the circuit board inside the multiplexer unit. Contact the factory for details.

Optical Specifications

Fiber Connection:	SMA 905
Recommended Cable:	Low hydroxyl fused silica, 600 micron minimum core diameter
Spectral Range:	800nm – 2500nm
Transmission (at 1300nm):	>40% with 600 micron core fiber, (comparing each channel of the FMX to a pair of fiber optic cables coupled with an SMA-SMA fiber coupler)

Switch Rate

Between adjacent channels:	1 second
Between any two channels:	2 seconds

Switching Methods

There are two methods of controlling the FMX multiplexer available:
1. Remotely via computer using either OPTO-22 hardware and commands
2. A custom ASCII protocol.

OPTO-22 Commands – The FMX multiplexer can be randomly controlled from a computer using a subset of the OPTO-22 instruction protocol. Please refer to section 2.2 of this manual for detailed instructions. Also refer to section 2.3 for the correct jumper settings required for the OPTO-22 operations.

Custom ASCII Protocol – The system can also be controlled via a custom ASCII command set described in section 2.1 of this manual.

2 COMPUTER CONTROL

This chapter describes a system to drive the 4 phase unipolar stepping motor used in the FMX Series optical multiplexer. FMX units are available in two configurations, with a maximum of 10 or 16 channels, respectively. The motor has 200 steps per revolution, or 1.8 degrees per step. Therefore, the motor makes 20 steps between each channel in a 10 channel system, and 12 ½ steps between each channel in a 16 position setup.

Inputs to the system are made via a choice of serial ports following either the custom ASCII protocol described in section 2.1 or a subset of the OPTO-22 instruction protocol described in section 2.2. The serial ports are hardware configurable in RS-232, RS-422 and RS-485 modes. A port for communications with the FMC-020 hand controller is also provided which uses a custom 2 line hardware protocols.

To connect the multiplexer to RS-232 port, use a standard straight thru 9-pin serial cable.

For RS-422/RS-485 setting:

- Hellma Axiom multiplexer accepts ONLY 2-wire configuration.

- Pin out configuration to 9-pin DB connector for multiplexer

    - Pin 4 to TDB(-)
    - Pin 5 to TDB(+)
    - Pin 3 to GND

2.1 CUSTOM ASCII PROTOCOL

NOTE:

> **The custom protocol described in this section cannot be used with OPTO-22. The controller has a jumper to recognize either OPTO-22 OR this command set, but cannot recognize both.**

Each command is preceded by the ASCII "A" (10101010) character, and is terminated by a carriage return. If auto baud is included in the software, the "A" character bit pattern will serve to synchronize the receiver. Auto baud is not a requirement at this time. The FMX unit operates in an echoplex fashion, where each character received is sent back, or echoed, to the host.

Command Set

COMMAND	DEFINITION

COMMAND   **DEFINITION**

ARST   Reset the system. Bring the MUX disc to the home position.

AINC   Increment to the next higher MUX position. If this command is
                        followed by a number, then it will increment by that many positions.
                        The maximum allowable number is 15 Decimal. Numbers higher
                        than 15 are interpreted as 15.

ADEC   Decrement to the next lower MUX position.

AMOVNN   Move to the absolute position as described by "NN". The range of
                        Acceptable values for "NN" is either 1-10 or 1-16, Decimal.

ASTAT   Returns position information to the host.

AUPXX   Step the motor in INC direction for the number of steps described
                        by the HEX number "XX". The range of acceptable values for "XX"
                        is 00-FF HEX, or 0 - 255 Decimal.

ADNXX   Step the motor in DEC direction for the number of steps described
                        by the HEX number "XX". The range of acceptable values for
                        "XX" is 00-FF HEX, or 0-255 Decimal.

Communications for this custom protocol is standard ASCII. A serial word consists of the following:

    1   start bit
    8   data bits
    0   parity bits
    1   stop bit

Error Handling

If the system is lost or can't interpret an incoming command, a NAK is sent to the host.

2.2 OPTO-22 SUBSET PROTOCOL

Only two commands, **DIGITAL J** and **DIGITAL M,** are required to drive the FMX Multiplexer. Two additional information commands, **SETUP j** and **ANALOG OUTPUT V** are also supported. This section provides a sample of each command with a detailed description of each component including acceptable values. A description of response codes returned by the multiplexer is also provided.

2.21 Digital J

This output moves the multiplexer to a chosen position or resets the system with a software reset. Note: a software reset results in the system being set to position 1.
EXAMPLE: The following communication moves the multiplexer to position 10.

Instruction	Response
> DDJ00103Bcr	Acr

INSTRUCTION CONTENT:

>   = Start of instruction character

DD   = Digital Device address

J   = Function Code

0010 = Position Field

Valid range for 10 position multiplexer 0000 – 0010
Valid range for 16 position multiplexer 0000 – 0016

NOTE: These are decimal values. Hex values and 0000 will cause a reset.

3B   = Checksum (computed per OPTO-22 Standard)

cr   = Carriage Return

RESPONSE CONTENT

A   = Acknowledgement

cr   = Carriage Return

2.22 Digital M

The Digital M command reads the actual portion of multiplexer. Note: For this command only, lower case characters are also recognized.

EXAMPLE:

Instruction	Acknowledgement
> DDMB1cr	A1603C3cr

INSTRUCTION CONTENT:

>   = Start of instruction character

DD   = Digital Address

M   = Function Code

B1   = Checksum

cr   = Carriage return

RESPONSE CONTENT:

A   = Acknowledgment

16   = Size of Multiplexer (16 = 16 channel, 10 = 10 channel)

03   = Present position of multiplexer

C3   = Checksum

cr   = Carriage return

2.23 Setup j

This instruction identifies the device as an Hellma Axiom product. It is not essential to the operation of the multiplexer. The Hellma Axiom name is the response to this instruction.

EXAMPLE:

Instruction	Response
> 00jECcr	AXIOM7Ecr

INSTRUCTION CONTENT:

>   = Start of instruction character

00   = Digital Device Address

j   = Function Code (get type)

EC   = Checksum

cr　　　= Carriage Return

RESPONSE CONTENT:

AXIOM　　= Acknowledgement containing name of multiplexer

7E　　　= Checksum

cr　　　= Carriage Return

Analog Output V

This instruction receives the software version of the controller. It is not essential to the operation of the multiplexer. This instruction is also an exception to the OPTO-22 protocol in that the V is normally used for an analog output command to specify waveforms. Since the address of this controller does not handle any waveforms, the character is being used for this purpose.

EXAMPLE:

Instruction　　　**Response**

> 00VB6cr　　　A11/15/96D6 cr

INSTRUCTION CONTENT:

>　　= Start of instruction character

00　　= Digital Device Address

V　　= Function Code

B6　　= Checksum

cr　　= Carriage Return

RESPONSE CONTENT:

A　　= Acknowledgement character

11/15/96 = Software Version. The version date is stored in the format MM/DD/YY where MM = month, DD = Date, YY = last two digits of the year

D6　　= Checksum

cr　　　= Carriage Return

2.24 Error Codes

The following are descriptions of two error codes you may encounter.

　　　N00　　= Response to an invalid instruction

　　　N01　　= Response to a checksum error

2.3 HARDWARE CONFIGURATION

2.31　Jumper Settings

Jumper settings on the FMX circuit board control how the multiplexer operates and interfaces with other control devices.　Proper jumper settings are essential.　Factory settings are:　RS-232 communications enabled (jumper on W2), custom ASCII protocol enabled (jumper on W7) and a serial port speed of 9600 BAUD (jumpers on W3 and W4).　To determine the current status of jumper settings, and to modify the settings, you must first remove the multiplexer cover. Remove the screws, and spread the lower edges of the cover wide enough to clear the port sockets as you lift it up and off. The first two jumper positions, W1 and W2, are located near the center of the circuit board, while the remaining jumpers, W3-W12, are located in a row along the side of the board
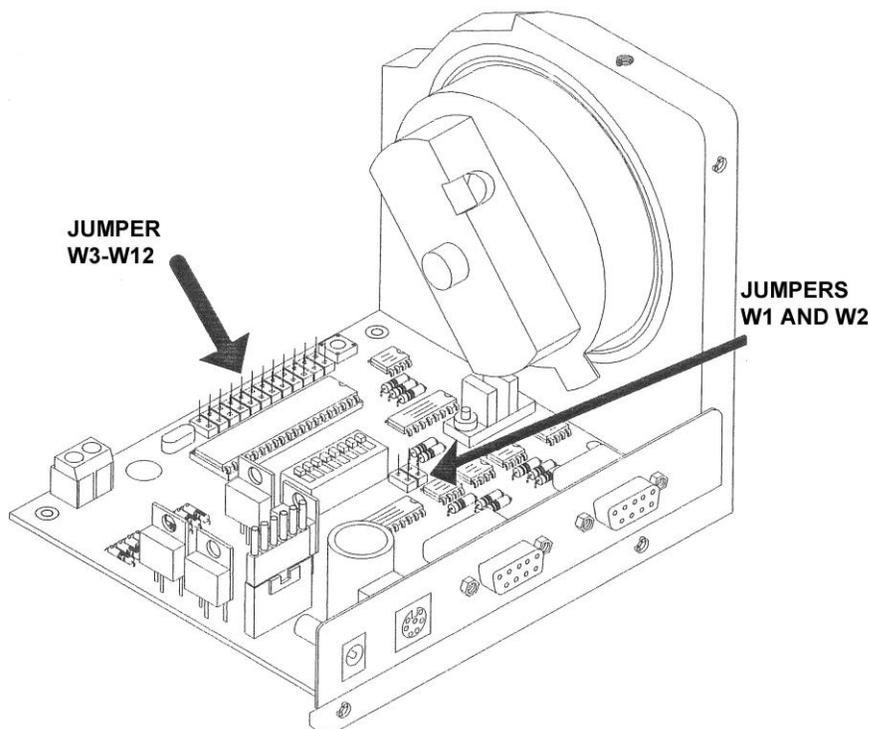
(please refer to Figure 2).　A table listing all possible jumper settings follows.

Figure 2: PCB Jumper Locations

Jumper   **Function**

W1   Enables RS-422 and RS-485. (Do not use this jumper with W2)

W2   Enables RS-232 (Do not use this jumper with W1)

W3, W4, W5   These jumpers set the baud rate for the serial port.   The table below lists the switch Combinations and their meanings. "1" means a jumper is installed at this position.

Baud Rate	W5	W4	W3
19.2 KB 0	0	0	
19.2 KB 0	0	1	
19.2 KB 0	1	0	
9600 KB	0	1	1
4800 KB	1	0	0
2400 KB	1	0	1
1200 KB	1	1	0

Jumper		
W6	1 = 16 position configuration	0 = 10 position configuration
W7	1 = custom ASCII protocol	0 = OPTO-22 command set
W8	1 = test continuously	0 = normal operation
W9	*not used as present*	
W10	1 = RS-485 mode	0 = RS-232 or RS-422

For RS-485 mode use a standard cable and plug into the RS-422 port.

|		
W11	1 = multi-drop in RS-422	0 = daisy chain
W12	*not used as present*	

2.32   Address Switches

The switch block S1 is located near the center of the printed circuit board to specify the device address under the OPTO-22 protocol.   The address range is 00-FF, hexadecimal.   Switch 1 on S1 corresponds to address bit 0, and switch 8 on S1 corresponds to address bit 7. The ON position is indicated by a "0" on the switch block.

3. MAINTENANCE

FMX fiber optic multiplexers are designed for continuous, long-term operation in most environments. The multiplexers are extremely low maintenance devices, with no periodic servicing or maintenance protocol. In the absence of any mechanical or electrical failure, the most frequent field service activity is adding channels to increase sampling capability.

Two areas of failure are possible: an electrical malfunction resulting in the failure of the controller printed circuit board, or the mechanical failure of the coupling between the stepper motor and the retro prism on either side of the motor. In either event, Hellma Axiom offers fast turnaround factory service. This is highly recommended for most users. Therefore, this chapter only describes the procedure for adding channels to your multiplexer.
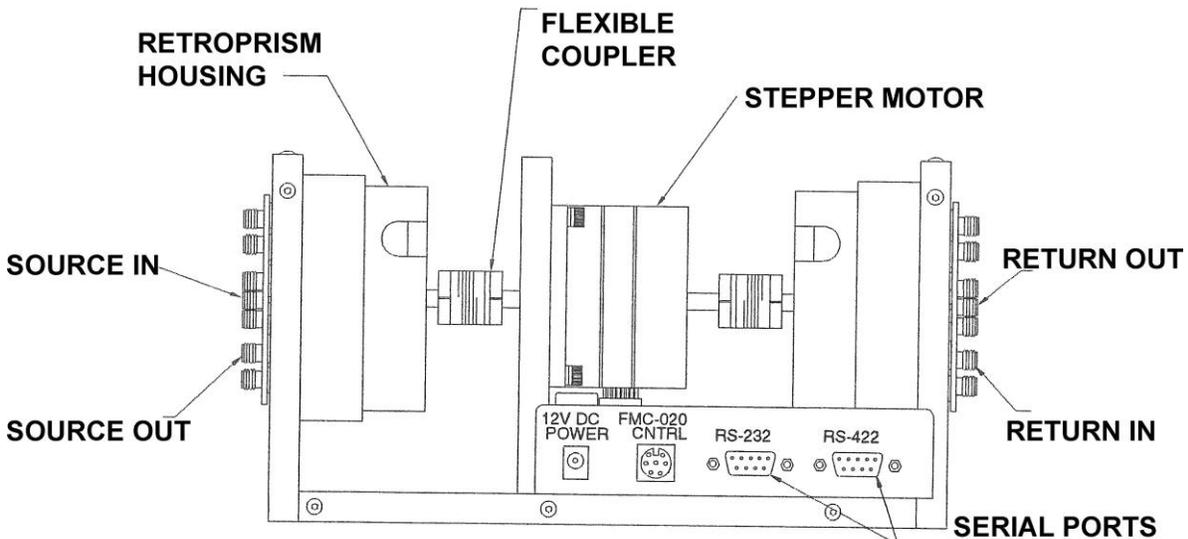
3.1 ADDING CHANNELS

Adding channels to an FMX multiplexer that has less than all of its available channels filled (10 or 16 depending on the model) is a relatively simple operation. Only one tool is required – a hex driver to remove the SMA retainers on either end of the unit. Of course, on double-sided systems, channels are added by installing SMA lens assemblies in pairs – one for the input and one for the output. Single-sided units need only one SMA lens assembly for each channel added.

STEP 1: **Shut off the power.**
Disconnect the FMX unit from the power supply to avoid any risk of shock or damage. Disconnect the fiber cables leading into and out of the unit.
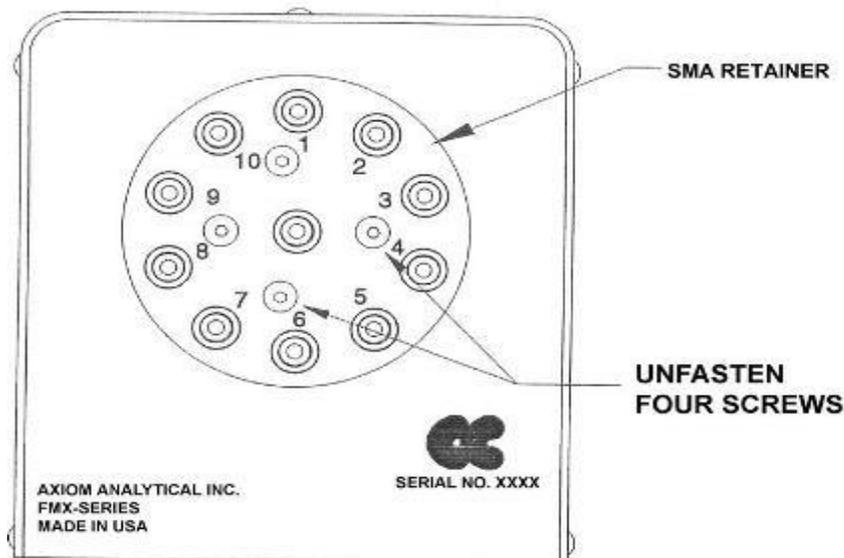
Figure 4: FMX End View, Adding Channels

STEP 2: **Remove the SMA retainer.**

Work on one side of the multiplexer at a time to simplify the task. The order doesn't matter; pick either the output or input end, install the desired number of SMA lens assemblies, then reassemble that end before beginning work on the other side. Begin by unscrewing the four #6 button head cap screws on the round SMA retainer plate. Work with the FMX on a flat surface to prevent parts from falling out indiscriminately once you remove the retainer.

Note which side of the plate faces outward as you remove the retainer from the unit. Channel markings appear on both sides of the retainer. However, one side counts upward in a clockwise direction while the other side does so counter-clockwise. If you replace the retainer with the inside out, the channel numbers will be reversed (and they won't agree with the channel designations in the software or on the local controller display). No problem, just flip the retainer over and refasten.

STEP 3: **Add one or more SMA lens assemblies.**

Lenses are permanently mounted in the SMA assemblies at the factory, so they are ready for immediate installation once you receive them. You simply insert each lens assembly, add a washer, and replace the retainer.

Be careful handling the lens assemblies. Don't touch the lens surfaces with your fingers – dirt and oils from your hands can impair optical performance and will have to be cleaned off. Also, do not let the lenses

come in contact with hard or rough surfaces – scratches will also degrade performance and can't be fixed with a quick wipe of lens tissue!

FMX channels are filled starting from the number 1 position upward in the factory. Continue this progression as you add channels. Start from the lowest numbered empty position and fill each adjacent position as you go. Unused sockets are capped, so remove the lowest numbered cap and set it aside. Take the first lens assembly and insert it into the empty socket. Note that the socket and outer shoulder of each lens assembly are "D" shaped – rather than completely round; each has a flat side to prevent any movement once the retainer is fastened in place.

With the lens assembly fully inserted into its socket, place a thin Teflon gasket onto the exposed shoulder. This provides a cushion and ensures a snug fit when the retainer is fastened.

STEP 4:   **Replace the SMA retainer.**

Check that all the lens assemblies are fully inserted in their sockets (even the ones you didn't add). Replace the round SMA retainer with the correct side facing out. Since the screw holes will only line up in one orientation, the only chance for error is if the retainer is flipped to the wrong side. Fasten all four screws securely.

STEP 5:   **Repeat the previous steps on the opposite side.**

Add channels to the opposite side as you did in Steps 2-4. When you've checked that the SMA retainer on each side is fastened securely, reconnect the power supply, plug in your fiber cables and you're ready to go.