USER MANUAL

MC-CQ-4X
Motion Controller

Contents

Using this Manual

The MC-CQ-4X Motion Controller is a PWM motor controller designed to drive National Aperture MM series stages and other systems utilizing DC brush type motors with single ended quadrature AB encoders. The MC-CQ-4X incorporates a Faulhaber MCDC3003/3006S series motor controller and provides connectivity and packaging suitable for ease of use and rapid deployment in desk top, bench top and industrial automation applications.

This manual provides information necessary to set up and configure the MC-CQ-4X controller and is intended to be used in conjunction with the user manual for the Faulhaber MCDC3003/3006S controller. The MC-CQ-4X controller provides the connectivity required for RS-232 serial port based control of National Aperture motion equipment using a subset of the Faulhaber MCDC controller connectivity.

Since aspects of the Faulhaber MCDC3003/3006S controller connectivity and functionality are not supported in the MC-CQ-4X implementation, portions of the MCDC3003/3006S documentation will not be applicable to the MC-CQ. Supported and unsupported functionality is described in the section of this user manual entitled "Using the Faulhaber MCDC Controller Documentation".

What your MC-CQ-4X Purchase Includes

Your MC-CQ-4X Motion Controller purchase includes the following:
MC-CQ-4X Motion Controller
Null Modem Cable (9 pin female DSub to 9 pin female DSub crossover) – 1cable
      per axis ordered
15 V @ 6.67A Power Supply
Power Cord
Extension Ribbon Cable – 10 Conductor- 1cable per axis ordered
Fuses (2 each for each axis ordered)

    .25 Amp   Littlefuse 0312.250HXP
    .5 Amp   Littlefuse 0312.500HXP (for MM3 stages, 10mm motors)
    1 Amp   Littlefuse 0312001.HXP (for most MM4 stage apps.)
    2 Amp   Littlefuse 0312002.HXP
CD Including:
    National Aperture MC-CQ-4X User Manual (this manual)
    Faulhaber Motion Manager Application
    Faulhaber MCDC Motion Controller Instruction Manual

CD Including Evaluation Version of "IMS Motion Console" Motion Control Software Application

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Introduction to the MC-CQ-4X Motion Controller

The MC-CQ-4X motion controller provides closed loop control for DC brush type motors incorporating AB quadrature encoders. This PWM motion controller is designed to be controlled via an RS-232 serial interface accessed through the 9 pin male DSub connector labeled "Serial". The MC-CQ-4X includes a 10 pin motor interface, labeled "Mot/Enc/Lim", supporting motor drive, AB quadrature encoder and limit switch connectivity.   National Aperture MM series stages may be plugged directly into this connector. Power is provided at 15 volts through a threaded rear panel power jack.   The MC-CQ-4X also includes front panel power switches and user accessible fuses. This controller supports up to 4 axis of motion control.

Getting Started

Selecting and Installing the Fuse

The MC-CQ-4X can be used to drive DC motors operating at up to 30 volts and 5 amps with Faulhaber MCDC3006S controllers (and 3 amps with MCDC3003S). When used with National Aperture MM series stages, a 15 volt,6.67A supply is used, and load currents are well below the capabilities of the controller. In order to protect the stage and controller from damage in the event of certain types of mis-wiring or mis-configuration, a fuse appropriate for the stage and application must be installed.

Stage	Recommended Fuse
National Aperture MM3M and MM3MR Series Stages	
With 10mm Standard Torque Motor	.5 amp
With 10mm High Torque Motor	.5 amp
National Aperture MM4M and MM4MR Series Stages	
With 10mm Standard Torque Motor	.5 amp
With 10mm Hight Torque Motor	.5 amp
With 13mm Motor	1 amp

The fuse should be installed in the front panel fuse holder using the slotted cap included with the fuses. A screwdriver is required.

Making Hardware Connections

Serial Interface:

If you are using your motion controller(s) with a computer that does not have one available serial port for each controller, a plug-and-play USB to RS232 (serial) converter will be required. Converters providing 1, 4, 8 and more additional serial ports via a single USB connection are available. If needed and not already installed, install your USB to serial converter using the disk provided with the USB to RS232 converter. Following installation, your computer will recognize and interact with the added serial ports as if they were part of your computer whenever the USB to serial converter is plugged into a USB port.

Connecting Motion Controller(s) to Serial Port(s):

Each motion controller is provided with a null modem cable. This cable incorporates 9 pin female D-sub connectors on both ends and connects pin 2 on one end to pin 3 on the other, pin 3 on one end to pin 2 on the other and pin 5 on one end to pin 5 on the other. For each of your motion controllers, attach one end of the null modem cable to the motion controller's "Serial" connector and the other to one of your computer's native or USB plug-and-play serial ports.

Power Source:

Connect the 15 volt power supply output cable to the threaded power jack on the rear panel of the MC-CQ-4X controller. Install the AC power cord into the 15 volt power supply. Plug the AC power cord into an outlet and switch the MC-CQ-4X controller on.

> **Do not connect the stage to the controller until controller configuration has been completed.**

Configuration and Operation with Faulhaber Motion Manager Software Application

Motion Manager is a software application for configuration and basic operation of certain Faulhaber motion controllers including the MCDC controllers utilized in the National Aperture MC-CQ-4X.

Configuration and Operation with Faulhaber Motion Manager Software Application (continued)

Installing Motion Manager:

Motion Manager is provided on the CD included with your controller and may be installed with the setup utility in the Motion Manager folder. If not already installed on your computer, it should be installed now by running the SetupFaulhaberMotionManager exe file.

Establishing Communication:

Start the Motion Manager application. When the "First Steps" window appears, select "Drive at a serial RS232 interface" if it isn't already selected. There is some chance that Motion Manager will be able to automatically identify connected controllers without further user interaction. Click "OK" to allow the automated node search to start. If the process succeeds, the connected controller(s) will appear in the "Node Explorer" section on the left side of the user interface. Identified motion controllers will appear as nodes under the COM port to which they are connected. If all of your connected motion controller(s) appear in the node explorer, proceed to "Setting Baud Rate and Node Address" below.

**Configuration and Operation with Faulhaber Motion Manager
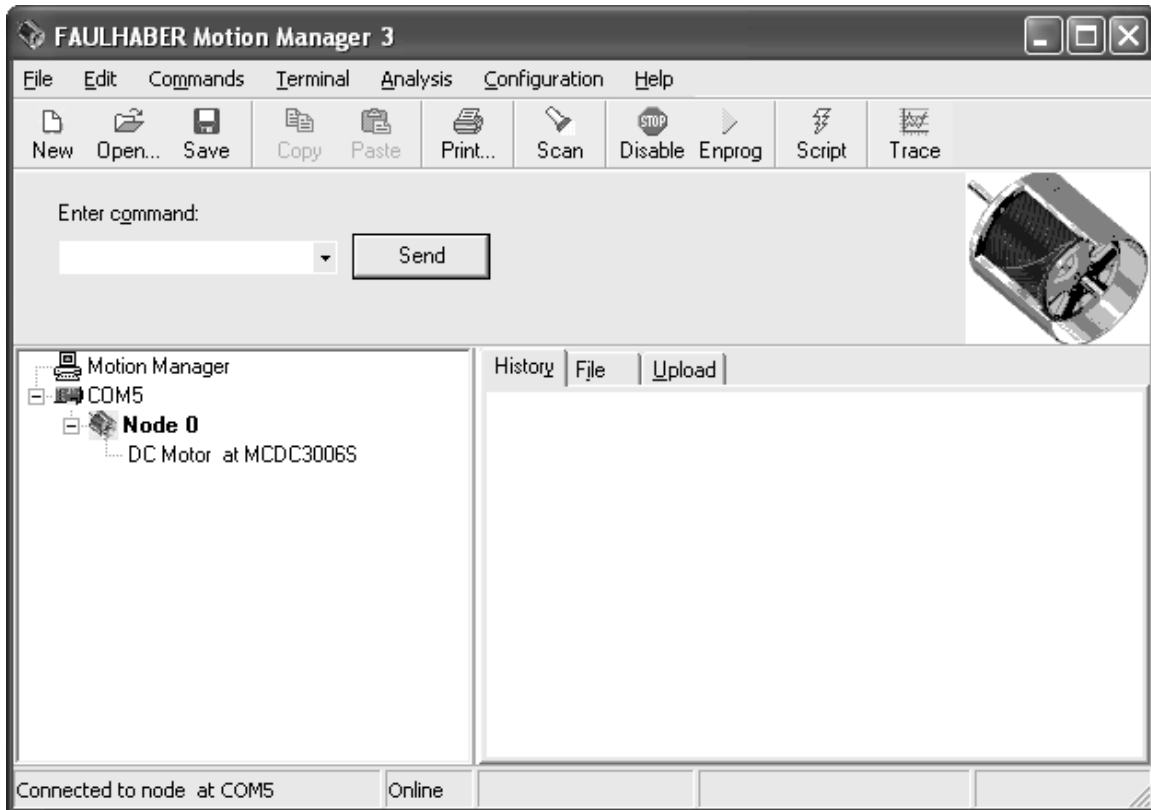Software Application (continued)**

Figure 1 – Motion Manager User Interface

If some or all of your controllers do not appear in the node explorer, an understanding of Motion Manager's node search functionality must be established.

Motion Manager scans for MCDC and certain other controllers appropriately powered and appropriately connected with a null modem cable to any of a selected set of COM ports operating at the baud rate selected for each COM port. Motion Manager may fail to establish communication with your controller(s) for the following reasons (4, 5 and 6 being the most common):

Configuration and Operation with Faulhaber Motion Manager Software Application (continued)

1. Power is not connected to the controller.
2. The controller is not switched on.
3. The controller is not connected to the computer's serial port with a null modem cable as described above.
4. The controller is connected to a computer COM port that has not been selected for use in Motion Manager.
5. The controller is configured to operate with a baud rate that is different than the baud rate selected in Motion Manager for the COM port it is connected to.
6. The computer's COM port is in use by another software application.
7. The controller needs to be restarted by switching the power off and on. (A subsequent node search is required and can be started by clicking on Motion Manager's "Scan" button.)
8. The controller's fuse is blown.
9. The computer's COM port is not functioning.

Ensure that power is applied to the controller, that it is switched on and that it is connected to a computer COM port with a null modem cable such as the one provided with the controller. Also ensure that the COM ports you are using are not already in use by another running application. Next, click on "Terminal" in the top menu bar, select "Connections…" and click on the "Connections" tab to open the "Connections" window shown in Figure 2. Be sure that the "Serial Interface" check box is checked and that the COM ports you are using are checked. (If you need assistance in determining the COM port numbers for the COM ports to which your motion controller(s) is/are connected, refer to Appendix A – "Determining COM Port Numbering".) Click on OK. A new scan will be initiated. If your controller(s) appear in the Node Explorer, proceed to "Setting Baud Rate and Node Address" below. If not, the current baud rate setting for each controller must be identified.

Configuration and Operation with Faulhaber Motion Manager Software Application (continued)
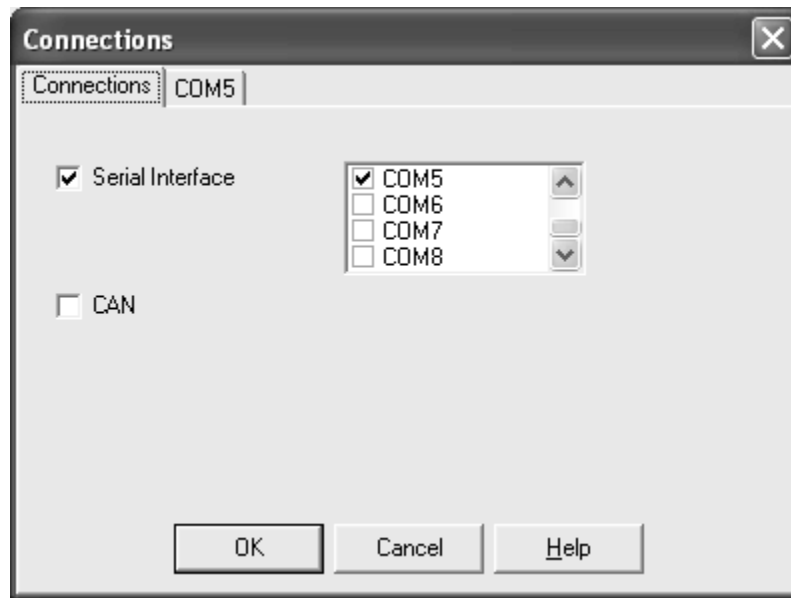

Figure 2 – Connections

The controller baud rate is stored in the controller's non-volatile memory and can only be set through the serial port. It cannot be determined for certain without establishing a serial connection with the controller unless the controller's history is known. Controllers will usually be configured for operation at 9600 or 19200 baud, but other baud rates are possible.

The baud rate may be determined by trial and error by clicking once again on "Terminal" in the top menu bar, selecting "Connections…" and clicking on the tab labeled with the COM port of interest as shown in Figure 3. For each COM port corresponding to a motion controller with an undetermined baud rate, select the next baud rate guess then click on "OK" to initiate a new scan at the selected rate(s). Repeat this process until communication with your controller(s) is established or until all baud rates have been tried. If communication with your controller was not

MC-CQ-4X   www.naimotion.com

successfully established, verify that the controller's fuse is not blown, verify that the computer's COM port is operational, cycle the power to the controller and repeat this process
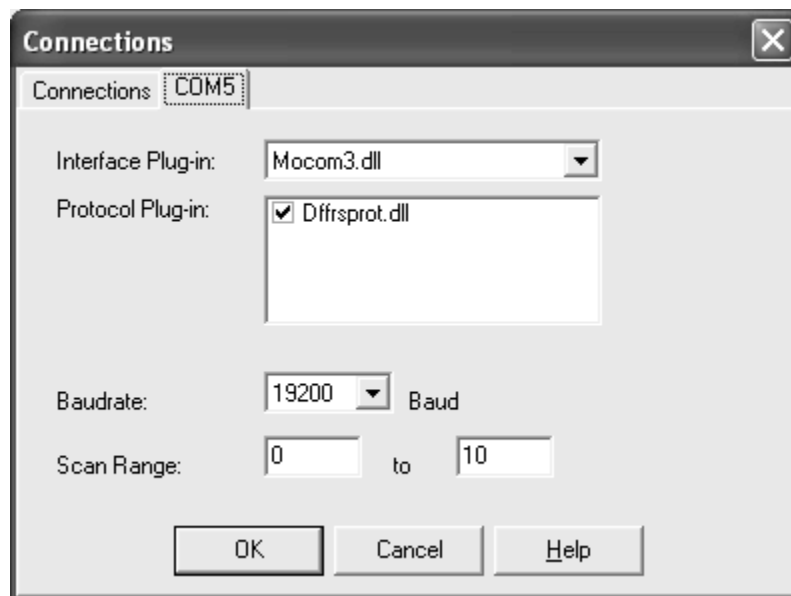

Figure 3 – Baud Rate

Setting Baud Rate and Node Address:
(Communication with the controller should now be established.

The node address may be, but need not be changed since the node search process will identify nodes with any node address regardless of the (node) scan range setting. Node addresses need not be used at all since each controller will have its own serial port. Serial commands not preceded by a node address will be processed by the motion controller, regardless of the node address that the controller has been assigned. If you would like to assign node addresses anyway, they may be changed along with the baud rate as described below. If the node address is

changed, settings between 0 and 254 are possible, but settings between 1 and 254 are recommended.

If your controller's baud rate(s) is/are not already set to 19200, it is strongly recommended that the baud rate(s) be set to this value. The controller is known to perform reliably at this baud rate, and National Aperture motion system architectures and software products are based on this rate for your motion controller. Using this baud rate also eases the process of integrating current and future National Aperture system offerings into your motion system.

To change the baud rate to 19200 after communication with your controllers has been established, for each controller, select it in the node explorer by double clicking on it, click on "Configuration" and select "Connection Parameters", opening the "Connection Settings" window shown in Figure 4. (Note that this window is different than the "Connections" window previously used.) Select the 19200 baud rate, select a node address if desired, and click on "Send". When this process completes, click on "EEPSAV" to store the baud rate setting to non-volatile memory so that the controller retains the new setting(s) when power is removed. Repeat for each controller.
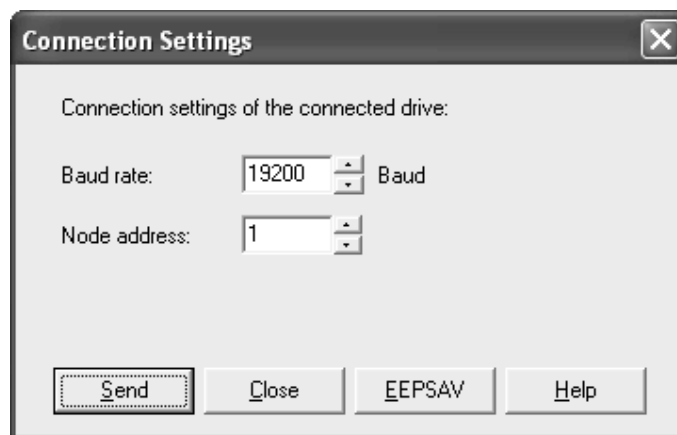
Figure 4 – Connection Settings Window

Communication with all of your controllers should now be established at 19200 baud.

Configuring the MC-CQ-4X Motion Controller

Setting Operating Parameters:

Operating parameters for each of your 4 axis controllers must now be configured. The "Drive Configuration" process must be repeated for each controller. Select the controller by double clicking on it in the "Node Explorer" window. Next, on the Motion Manger menu bar, click on "Configuration" and "Drive Functions…" On the "Basic Settings" tab page, select the settings shown in Figure 5.
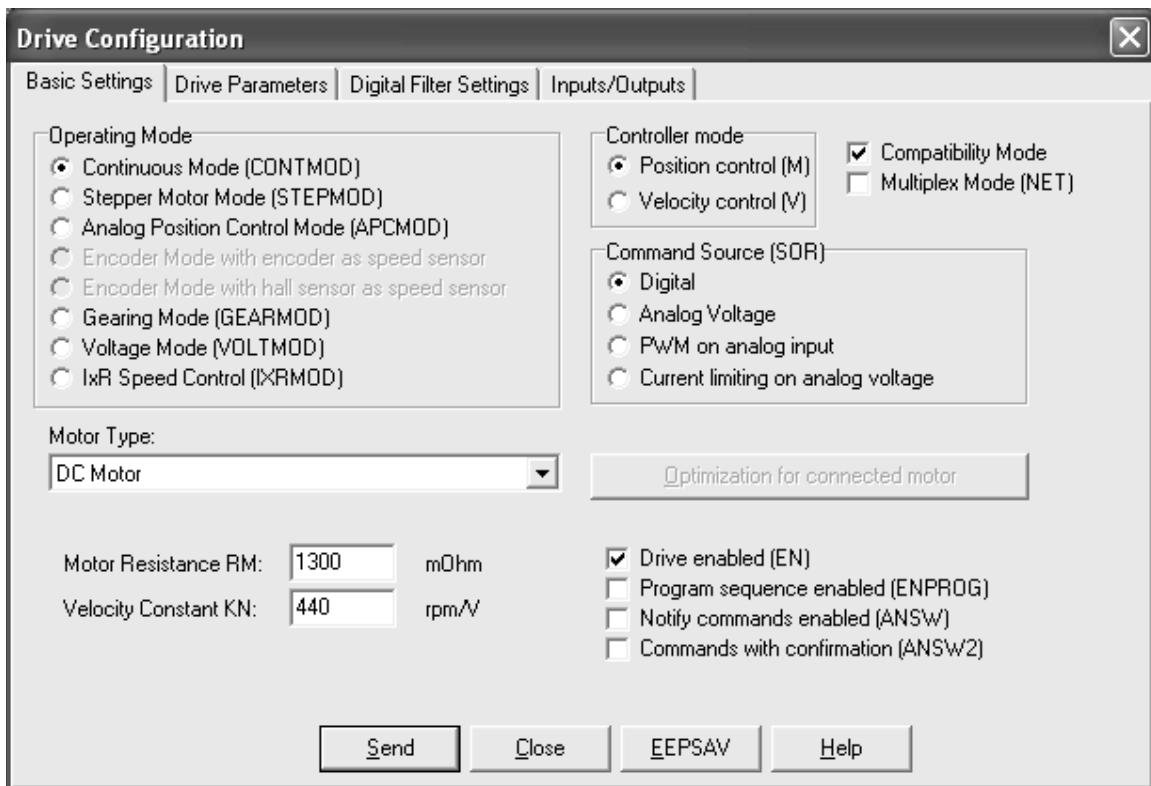

Figure 5 – Basic Settings

After these settings have been selected, click on the "Send" button to transfer the settings to the controller. It is necessary to click on the "Send" button after changes are made to settings on any tab page in the "Drive Configuration" window. You must click on "Send" to transfer

settings to the controller before selecting another tab page. Clicking on the "EEPSAV" button will save all settings to the controller's non-volatile memory so that they are retained when power is removed. It is only necessary to click on the "EEPSAV" button once before closing the "Drive Configuration" window, after changes to settings on all of the tab pages have been made.

After clicking on "Send" from the "Basic Settings" page, select the "Drive Parameters" page shown in Figure 6. Software position limits may be set by entering the desired limit values and checking the "Activate Position Limits (APL)" check box. The "Resolution of external encoder (ENCRES)" setting is critical and must be made based on the characteristics of the encoder in the associated stage's motor. The required setting for various NAI stages are provided on pages 17-20 in the section entitled "Recommended Setup Parameters for Various NAI Stages".

Figure 6 – Drive Parameters

Configuring the MC-CQ-4X Motion Controller (continued)

The remaining settings on the Drive Parameters page should be made as shown in Figure 6. Click on "Send" to transfer the settings to the controller.

Select the "Digital Filter Settings" page shown in Figure 7. The controller's feedback loop gains determine the controller's ability to accurately and responsively produce commanded motion in a stable manner. Recommended settings for the "POR", "I", "PP" and "PD" gain terms for various NAI stages are provided on pages 17-20. In some instances you may wish to fine tune the settings of these two parameters for optimal performance in your application, but this will usually not be necessary if the recommended settings are used. <u>It should be noted that when the "Compatibility Mode" check box on the Basic Settings tab page is checked, deceleration will take place at the rate defined by the AC parameter.</u> Peak and continuous current limits are also provided on pages 17-20 and should be adhered to strictly. The Acceleration parameter may be set as desired, keeping in mind that extremely abrupt acceleration can result in premature stage wear. The maximum speed parameter is used as the steady state velocity for position mode moves. It may be set as desired, but should not exceed the relevant value provided on pages 17-20. Click on "Send" to transfer the settings to the controller.

Figure 7 – Digital Filter Settings

Select the "Inputs/Outputs" page shown in Figure 8. The Homing Speed should be set to the desired value without exceeding the speed rating for the stage. The remaining settings should match those shown below to provide the necessary limit switch functionality.

When using rotary stages, you may choose to uncheck the "Hard blocking" check boxes to allow motion past the limit (homing) switch. **If you choose to do this, care must be used to recheck the "Hard blocking" check boxes when linear stages are connected. Failure to do so may result in damage to the linear stage.** After settings have been made on the "Inputs/Outputs" page, click on "Send" to transfer the settings to the controller then click on "EEPSAV" to store all of the new settings to non-volatile memory so that they are retained after power is removed. The stage should now be connected to the motion controller.

Figure 8 – Inputs/Outputs

Recommended Setup Parameters for Various NAI Stages

For NAI MM-3M stages with standard torque motors and standard 10 line, 40 count per revolution encoders:

Resolution of External Encoder (ENCRES): 40

Velocity Proportional Term (POR):	2
Velocity Integral Term (I):	70
Position Proportional Term (PP):	40
Position Derivative Term (PD):	0
Peak Current Limit (LPC):	250 mA
Continuous Current Limit (LCC):	190 mA
Acceleration (AC):	1000 revs/s^2 typical
Maximum Speed (SP):	<= 18,142 rpm or rpm for rated stage speed
Homing Speed (HOSP):	<= 18,142 rpm or rpm for rated stage speed

For NAI MM-3M stages with high torque motors and standard 10 line, 40 count per revolution encoders:

Resolution of External Encoder (ENCRES): 40

Velocity Proportional Term (POR):	2
Velocity Integral Term (I):	70
Position Proportional Term (PP):	40
Position Derivative Term (PD):	0
Peak Current Limit (LPC):	370 mA
Continuous Current Limit (LCC):	280 mA
Acceleration (AC):	1000 revs/s^2 typical
Maximum Speed (SP):	<= 18,142 rpm or rpm for rated stage speed
Homing Speed (HOSP):	<= 18,142 rpm or rpm for rated stage speed

Recommended Setup Parameters for Various NAI Stages (continued)

For NAI MM-3M stages with high torque motors and 12 line, 48 count per revolution encoders:

Resolution of External Encoder (ENCRES): 48

Velocity Proportional Term (POR): 2
Velocity Integral Term (I): 70
Position Proportional Term (PP): 40
Position Derivative Term (PD): 0
Peak Current Limit (LPC): 370 mA
Continuous Current Limit (LCC): 280 mA
Acceleration (AC): 1000 revs/s^2 typical
Maximum Speed (SP): <= 18,142 rpm or rpm for rated stage speed

Homing Speed (HOSP): <= 18,142 rpm or rpm for rated stage speed

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For NAI MM-4M stages with standard torque 10mm motors and standard 10 line, 40 count per revolution encoders:

Resolution of External Encoder (ENCRES): 40

Velocity Proportional Term (POR): 2
Velocity Integral Term (I): 70
Position Proportional Term (PP): 40
Position Derivative Term (PD): 0
Peak Current Limit (LPC): 250 mA
Continuous Current Limit (LCC): 190 mA
Acceleration (AC): 1000 revs/s^2 typical
Maximum Speed (SP): <= 18,142 rpm or rpm for rated stage speed

Homing Speed (HOSP): <= 18,142 rpm or rpm for rated stage speed

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Recommended Setup Parameters for Various NAI Stages (continued)

For NAI MM-4M stages with high torque 10mm motors and standard 10 line, 40 count per revolution encoders:

Resolution of External Encoder (ENCRES): 40

Velocity Proportional Term (POR):	2
Velocity Integral Term (I):	70
Position Proportional Term (PP):	40
Position Derivative Term (PD):	0
Peak Current Limit (LPC):	370 mA
Continuous Current Limit (LCC):	280 mA
Acceleration (AC):	1000 revs/s^2 typical
Maximum Speed (SP):	<= 18,142 rpm or rpm for rated stage speed
Homing Speed (HOSP):	<= 18,142 rpm or rpm for rated stage speed

For NAI MM-4M stages with high torque 10mm motors and 12 line, 48 count per revolution encoders:

Resolution of External Encoder (ENCRES): 48

Velocity Proportional Term (POR):	2
Velocity Integral Term (I):	70
Position Proportional Term (PP):	40
Position Derivative Term (PD):	0
Peak Current Limit (LPC):	370 mA
Continuous Current Limit (LCC):	280 mA
Acceleration (AC):	1000 revs/s^2 typical
Maximum Speed (SP):	<= 18,142 rpm or rpm for rated stage speed
Homing Speed (HOSP):	<= 18,142 rpm or rpm for rated stage speed

Recommended Setup Parameters for Various NAI Stages (continued)

For NAI MM-4M stages with 13mm motors and standard 16 line, 64 count per revolution encoders:

Resolution of External Encoder (ENCRES): 64

Velocity Proportional Term (POR):   2
Velocity Integral Term (I):   70
Position Proportional Term (PP):   40
Position Derivative Term (PD):   0
Peak Current Limit (LPC):   790 mA
Continuous Current Limit (LCC):   590 mA
Acceleration (AC):   1000 revs/s^2 typical
Maximum Speed (SP):   <= 18,250 rpm or rpm for rated stage speed

Homing Speed (HOSP):   <= 18,250 rpm or rpm for rated stage speed

Notes: 1. For early 10 mm motors (Faulhaber type 1016 series) with a capacitor across the motor connections set LPC and LCC >2000 (typical value = 5000).

Basic Motion Commands and Examples

Some commonly used commands are provided below. A complete list of commands is available in the MCDC3006 Instruction Manual and should only be utilized after reviewing the section of this document entitled "Using the Faulhaber MCDC Controller Documentation"

Command	Function	Description	Example
HO	Define Home Position	With no argument:Sets the actual position to 0 With argument:Sets actual position to given value	HO HO 12500
EN	Enable Drive	Activates the controller power stage	EN
DI	Disable Drive	Deactivates the controller power stage	DI
POS	Get Actual Position	Returns the current position	POS->500
SP	Load Max Speed	Loads a new maximum velocity Argument in rpm. Range 0-30,000 Steady state velocity for M command	SP 14000
LA	Load Absolute Position	Loads new absolute position. Argument:Encoder Counts	LA 10000
LR	Load Relative Position	Loads new relative position Argument:Encoder Counts	LR -2500
M	Move	Activates position mode and starts motion	M
AC	Load Acceleration	Load new acceleration. Argument in revs/s^2 (0-30,000)	AC 1000
V	Move at Specified Velocity	Activates velocity mode and starts motion at specified velocity in rpm	V 10000
POR	Load Velocity Proportional Term	Load controller vel. proportional gain (0-255)	POR 2
I	Load Velocity Integral Term	Load controller vel. integral gain (0-255)	I 70
PP	Load Position Proportional Term	Load controller pos. proportional gain (0-255)	PP 40
PD	Load Position Derivative Term	Load controller pos. derivative gain (0-255)	PD 0
HOSP	Load Homing Speed	Loads the homing speed in rpm Range -30,000 to 30,000	HOSP 90
GOHOSEQ	Go Homing Sequence	Executes the programmed homing sequence without regard to the current mode	GOHOSEQ
GSP	Get Max Speed	Calls up the maximum velocity parameter	GSP->14000
GAC	Get Acceleration	Calls up the acceleration	GAC->1000

Command	Function	Description	Example
GPOR	Get Proportional Term	Calls up controller proportional gain	GPOR->1
GI	Get Integral Term	Calls up controller integral gain	GI->4
GHOSP	Get Homing Speed	Calls up the homing speed	GHOSP->90
SOR	Velocity Source	Must use SOR 0, RS-232 is Velocity Source	SOR 0

Example – Commanding Motion with Text Commands

After powering up the motion system, starting motion manager and configuring the controller, the user may send motion commands to the motion controller by typing them into Motion Manager's "Enter Command" box. This is a small text box on the upper left portion of the main Motion Manager interface. Assume the user wants to enable the controller's power stage, execute the homing sequence to establish a known position, set the position following the homing sequence to 25000 counts, move to the absolution position of 0 counts, make three relative moves of 5600 counts, the first at 5,000 rpm, the second at 10,000 rpm and the third at 15,000 rpm, display the current position of 16,800 counts, return to the zero position and disable the controller power stage. These operations may be achieved by typing the following sequence of commands into the "Enter Command" box.

```
EN
GOHOSEQ
HO 25000
LA 0
M
SP 5000
LR 5600
M
SP 10000
LR 5600
M
SP 15000
LR 5600
M
POS
LA 0
M
DI
```

Further instructions for commanding and controlling motion are available in the MCDC controller Instruction Manual (which should be used in conjunction with this document) and in the Motion Manager help section.

Using the Faulhaber MCDC Controller Documentation

The NAI MC-CQ-4X motion controller incorporates a Faulhaber MCDC3006 (or 3003S) controller and has been implemented with a packaging and connectivity approach that allows for rapid and user friendly deployment in desktop, benchtop and industrial automation applications with no wiring required. The MC-CQ-4X is designed to be controlled using serial commands from a host computer and supports the MCDC3006 serial command based functionality, which is a subset of the MCDC3006's functionality. The supported MCDC3006 connectivity and operating modes are outlined in detail in this section.

Supported MCDC Controller Functionality
Connectivity:

The Faulhaber MCDC controller incorporated in the MC-CQ-4X supports connectivity to a subset of the MCDC controller's inputs and outputs as described below.

MCDC3006 Pin	MC-CQ-4X Support
TxD	Fully Supported
RxD	Fully Supported
AGND	Separate Connectivity Not Supported (tied to GND)
Fault	Supported, Dedicated to Limit Switch Functionality
AnIn	Connectivity Not Supported
+24V	Fully Supported (utilizes 15V supply)
GND	Fully Supported
Input 3	Supported, Dedicated to Limit Switch Functionality
Mot -	Fully Supported
Mot +	Fully Supported
SGND	Fully Supported
+5V	Fully Supported
Enc. Ch A	Fully Supported
Enc. Ch B	Fully Supported
Input 4	Connectivity Not Supported
Input 5	Connectivity Not Supported

Supported MCDC Controller Functionality (continued)

<u>Operating Modes:</u>

SOR0-3: The MC-CQ-4X controller supports only the RS-232 based SOR0 mode for velocity and current control. Analog and PWM means of velocity and current control associated with SOR1, SOR2 and SOR3 are not supported.

CONTMOD: Supported (MCDC3006's normal operating mode)

STEPMOD, APCMOD, VOLTMOD, IXRMOD: Not Supported

Fault Pin: **REFIN** Required (Fault Pin is dedicated to limit switch)
          DIRIN, ERROUT, DIGOUT, ENCOUT Not Supported
          DEV fault pin speed deviation Not Supported
          DCE fault pin signaled delayed current error Not Supported

Specifications

Supply Voltage	12-30 V DC, 15V DC recommended for NAI stages
PWM Switching Frequency	78.12 kHz
Efficiency	95%
Max. Continuous Motor Current	6 A with sufficient conductors for motor connection 1 A with 28 gauge ribbon cable
Max. Peak Motor Current	10 A with sufficient conductors for motor connection and sufficient power supply current 2 A with 28 gauge ribbon cable
Controller Current Consumption With no Motor, Encoder or Limit Switch Current	60 mA
5 V Outputs – Max Combined Load (from Encoder Vcc and Limit Vcc)	50 mA
Limit Switch Configuration	Switches to ground expected (controller incorporates 1k pullup resistors to 5V)
Limit Switch Logic Levels	low 0-0.5 V, high 4.0-5.0 V
Encoder Input Logic Levels	low 0-0.5 V, high 4.0-5.0 V
Encoder Input Max Frequency	400 kHz
Maximum Motor Velocity	30,000 rpm (do not exceed stage speed rating)
Baud Rate	600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Serial EEPROM Program Memory	6656 bytes
Operating Temperature	0 to 70 ºC
Storage Temperature	-25 to +85 ºC

Mating Connectors

For motor, encoder and limits:

Pin #	Name	Pin #	Name
1	Motor -	6	Motor +
2	Encoder Vcc (+5V)	7	Limit Ground
3	Encoder Ch A	8	Limit Vcc (+5V)
4	Encoder Ch B	9	Reverse Limit
5	Encoder/Case Ground	10	Forward Limit
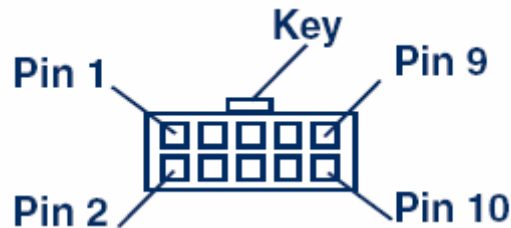
Motion Controller End of Stage or Motor Cable
(ITW Pancon 050-010-415A or equivalent)

For RS-232: (9 pin female Dsub)   For DC Power Input: (Switchcraft 760K)

(motion controller end of cable)

Pin #	Name	Pin #	Name
2	RS-232 RXD	Center Pin	V+ (15V, 1A min)
3	RS-232 TXD	Outside	Ground
5	GND		

RS-232 (Serial) Cable: (L-com CSNULL9FF-10 or equivalent)

Null modem type
9 pin female Dsub - both ends
Pin 2 to Pin 3
Pin 3 to Pin 2
Pin 5 to Pin 5

Support

For technical support, contact National Aperture at (603) 893-7393 and ask for technical support for the MC-CQ-4X motion controller.

Although the MC-CQ-4X incorporates a Faulhaber motion controller, <u>neither Faulhaber nor Micromo provide technical support for the MC-CQ-4X</u> and will refer any inquiries to National Aperture.

Appendix A – Determining COM Port Numbering

If you don't know the COM port numbers for the COM ports to which your motion controllers are connected, you may gain some insight into this question using the following approaches.

For Edgeport type USB to serial converters, you may determine the COM port number for each of the converter's numbered physical ports using the Edgeport Configuration Utility, which is installed when the converter installation setup is run. It can be started by clicking on "Start", "All Programs", "Inside Out Networks" and "Edgeport Configuration Utility". On the "General" tab, click on the "+" before the converter of interest to view the COM port assignments.

Information on all of your computer's COM ports may also be displayed using the Windows Device Manger by clicking on "Start", "Control Panel", "System", "Hardware", "Device Manager" and "Ports". The lowest numbered ports will usually correspond to your computers native COM ports. Following installation, USB to serial converters such as the Edgeport 4 will show four sequentially numbered COM ports labeled EdgePort in the Device Manager. Unless changed after installation, the Edgeport serial port with the lowest COM port number will correspond to the Edgeport DSub connector labeled "port 1". COM port and associated physical port numbers will proceed in sequence. It is recommended that you do not change COM port settings using the Windows Device Manager.

If the COM port numbers associated with the native serial ports on your computer are unknown, they may be determined by trial and error or by using serial port test freeware in combination with a loopback connector.

Appendix B – Sample Programs

. **Sequence program for stand-alone application.**
Note this is a modification to the program on page 22. The use of commands NP and HN (See also Faulhaber MCDC 3003/06S Manual) halt the sequencing of the program until a condition is satisfied. In the case of NP (Notify Position), sequence stops at the next M command, until the relevant position is reached. With the HN (Hard Notify) command, sequence stops at the GOHOSEQ command.

```
EN
HN
GOHOSEQ
HO 25000
LA 0
NP
M
SP 5000
LR 5600
NP
M
POS
SP 10000
LR 5600
NP
M
POS
SP 15000
LR 5600
NP
M
POS
LA 0
NP
M
POS
DI
```