MicroMini™ Servo Amplifier

MC-4SA
User Manual

Version 1.00

Getting Started

1. Install your controller board and software according to all the relevant instructions in the Configuration and Installation chapter of its manual.

2. Connect the 68-conductor cable from the controller board in your computer and the Motor Controller Input connector in the rear of the MC-4SA amplifier.

3. Connect the motor of your stage to the properly mating connector in the rear of the MC-4SA amplifier in the column for the axis you have chosen for it. (Although connectors are provided for both 10-conductor IDC and 9-pin miniature DIN, only one motor can be connected to any one axis.)

   If you intend to use a linear encoder for positional feedback instead of the motor's self-contained encoder, connect this encoder to the "LINEAR ENC" jack having the same axis number as the motor. See also "DIP Switch Settings" below.

4. Connect the power cord to the AC Input entry.

5. Configure your controller board software as follows: Encoder lines per revolution should be 10 for a 10mm motor and 16 for a 13mm motor.

Amplifier System Overview

The MC-4SA Servo Amplifier System is a four-axis servo system specifically designed for use with National Aperture, Inc. micropositioning components and miniature brushed DC servo motors. The MC-4SA provides drive power amplification and logic control to four axes.

The MC-4SA features include:
•Built-in power supply
•Reversible motor polarity
•Encoder signal conditioning
•Linear encoder input option
•Limit switch detection
•Joystick Inputs for External Potentiometers
•Rack Mount Option

Motion Controller Compatibility
The controller board for which the MC-4SA was designed is the National Instruments 7344 controller. This controller combines the Motorola MC68331 32-bit CPU with the Analog Devices ADSP-2185 digital signal processor for real-time control and status-monitoring of each axis, freeing the host computer for other tasks specific to the application.

To construct an interface to a different controller from the 7344, see, "Motion Controller Connections."

Features:

Joystick Inputs for External Potentiometers

The analog inputs are accessible through four modular jacks on the front panel of the MC-4SA.These may be used for joystick controls or other 10 kilohm potentiometers. The excitation voltage available at each jack is the 7.5 VDC reference.

Rack Mounting

The MC-4SA can be mounted on a standard 19" relay rack by attaching 19" Rack Mount Option MC-4SA-RACKMNT-OPT.

MC-4SA Safety Features

A number of protective devices are incorporated into the design of the MC-4SA Servo Amplifier to safeguard mechanical devices from damage during programming and operation. These safeguards include:

Supply Rail Monitor

The power amplifiers in the MC-4SA are single-ended with dual rail power supply. This amplifier topology requires that both +14 volt and -14 volt supply rails be working. If either supply were to fail, the amplifier would be out of control and would operate the motor at full speed in one direction. The Supply Rail Fault Monitor provides individual power supply fault protection to each axis, positively disconnecting the motor from the amplifier within milliseconds in the event of a power supply failure.

Balance is maintained at all times between the power supply rail voltages, preventing output of power glitches to the motors, even at power-down.

Home and Limit Signals

Limit switches should be used to limit travel at either end of a linear device in order to safeguard the mechanical parts against possible damage. When either limit switch closes to ground, the controller detects this event and stops the motor. In setup of your controller, make sure that the limits are enabled and are set to Active Low configuration.

Axis Enable Switches

The Axis Enable switches are located on the front panel of the MC-4SA. These switches allow you to connect the motor command signal from the controller to the power amplifier for that axis. The switches work together with the Inhibit signal from the controller so that when the switch for an axis is latched ON and the Inhibit signal is Inactive, the switch will illuminate to indicate the axis is enabled for servo control.

DIP Switch Settings

On the rear of the MC-4SA servo amplifier are three arrays of four Dual Inline Packaged switches. They are labeled ENC SEL (Encoder Selection), HOME SEL, (Homing Selection), and REV POL (Reverse Polarity). In each array, the switches are ordered left to right for Axis 1 to Axis 4.

ENC SEL is normally open. This switch selects between the motor encoder, brought in through the MTR connector, (when open) and the linear encoder, brought in through the LINEAR ENC connector (when closed).

HOME SEL is normally open. This switch selects a Home signal from either the Index signal of the Linear encoder, (when open) or the Forward Limit Switch (when closed). If the Forward Limit switch is used as a Home signal, it is no longer sent to the controller as a Forward Limit signal. If ENC SEL is set for the motor encoder, there will be no actual Index signal to be used as Home; it will always be a High logic level .

REV POL is normally open. This switch reverses the polarity of the motor armature, so that a motor having a reversed encoder in relation to its armature may be used. If you are uncertain about this setting, disengage the motor from any mechanical system before testing.

Motor Connections

The MC-4SA provides signal-conditioning circuitry to the motors to ensure encoder signal integrity and limit switch detection in one convenient connection.

For each axis a choice of connector is provided: 10-pin IDC for motors wired with ribbon cable, and 9-pin mini-DIN for motors wired with compact round cable. Internally, the two connectors are wired to the same amplifier, encoder, and limit switch circuit, so they are not for simultaneous use on any particular axis. If you have two motors, each one wired with a different cable and plug, you must use a separate axis for each motor.

Auxiliary Motion I/O Connections

The MC-4SA provides convenient access to the special-purpose I/O provided by the controller. The MC-4SA does not require the Trigger, Breakpoint, or Analog Inputs for the amplifier to function.

Motion Controller Connections

The MC-4SA provides access to the Trigger, Breakpoint, and Analog Input signals from the 7344 controller.

Linear Encoder

The MC-4SA may be used with linear encoders of the MicroE Systems Mercury 3100 series, or with other linear encoders through the insertion of a special adapter.

Connectivity:

Motion Controller Connections
(Mating Connector, 68 pin male, Tyco Electronics P/N: 749878-7 or equivalent)

1. Axis 1 Direction
2. Digital Ground
3. Digital Ground
4. Axis 1 Home
5. Trigger 1
6. Axis 1 /Inhibit
7. Axis 2 Direction
8. Digital Ground
9. Digital Ground
10. Axis 2 Home
11. Trigger 2
12. Axis 2/Inhibit
13. Axis 3 Direction
14. Digital Ground
15. Digital Ground
16. Axis 3 Home
17. Trigger 3
18. Axis 3/Inhibit
19. Axis 4 Direction
20. Digital Ground
21. Digital Ground
22. Axis 4 Home
23. Trigger 4
24. Axis 4/Inhibit
25. Digital Ground
26. Breakpoint 1
27. Breakpoint 3
28. Digital Ground
29. Analog Output 1
30. Analog Output 3
31. Analog Output Ground
32 Analog Input 1
33. Analog Input 3
34. Analog Reference Out

35. Axis 1 Step
36. Axis 1 Encoder Phase A
37. Axis 1 Encoder Phase B
38. Axis 1 Encoder/Index
39. Axis 1 Forward Limit Switch
40. Axis 1 Reverse Limit Switch
41. Axis 2 Step
42. Axis 2 Encoder Phase A
43. Axis 2 Encoder Phase B
44. Axis 2 Encoder /Index
45. Axis 2 Forward Limit Switch
46. Axis 2 Reverse Limit Switch
47. Axis 3 Step
48. Axis 3 Encoder Phase A
49. Axis 3 Encoder Phase B
50. Axis 3 Encoder /Index
51. Axis 3 Forward Limit Switch
52. Axis 3 Reverse Limit Switch
53. Axis 4 Step
54. Axis 4 Encoder Phase A
55. Axis 4 Encoder Phase B
56. Axis 4 Encoder /Index
57. Axis 4 Forward Limit Switch
58. Axis 4 Reverse Limit Switch
59. Host +5V
60. Breakpoint 2
61. Breakpoint 4
62. Shutdown
63. Analog Output 2
64. Analog Output 4
65. Reserved
66. Analog Input 2
67. Analog Input 4
68. Analog Input Ground

Connectivity (cont.) :

Motor Connections, IDC (Mating Connector, 10 pin male, ITW / Pancon P/N 050-010-415A or equivalent)

1. Motor + Output
2. Encoder Vcc (+5V)
3. Encoder Phase A Input
4. Encoder Phase B Input
5. Encoder and Case Ground

6. Motor - Output
7. Limit Switch Ground
8. Limit Switch Vcc
9. Reverse Limit Switch
10. Forward Limit Switch

Motor Connections, Mini DIN (Mating Connector, 9 pin male, CUI Stack P/N MD-90)

1. Motor + Output
2. Vcc (+5V)
3. Encoder Phase A Input
4. Encoder Phase B Input
5. Encoder and Case Ground

6. Motor - Output
7. Limit Switch Ground
8. Forward Limit Switch
9. Reverse Limit Switch

Linear Encoder, D Sub (Mating Connector, 15 pin HD male)

1. Reserved
2. Serial Interface,Xmit
3. Serial Interface, Recv
4. Encoder A-
5. Encoder A+
6. Reserved
7. Reserved
8. Reserved

9. Encoder B-
10. Encoder B+
11. Index Window
12. Vcc (+5 VDC)
13. Ground
14. Encoder I+
15. Encoder I-

Joystick Inputs, Modular (Mating Connector, RJ-11 male)

1. Analog Reference
2. Analog Input
3. N/C

4. N/C
5. N/C
6. Analog Ground

Auxiliary Motion I/O, D Sub (Mating Connector, 25 pin male)

1. Trigger 1
2. Trigger 2
3 Trigger 3
4. Trigger 4
5. Breakpoint 1
6. Breakpoint 2
7. Breakpoint 3
8 Breakpoint4
9. Digital Ground
10. Analog Input 1
11. Analog Input 2
12. Analog Input 3
13 Analog Input 4

14. Analog Ground Out
15. N/C
16. N/C
17. N/C
18. N/C
19. N/C
20. N/C
21. N/C
22. N/C
23. N/C
24. N/C
25. N/C

Troubleshooting

The MC-4SA Servo Amplifier System was designed with the user in mind. The system connections and overall operation has been simplified to allow the complete system to be plugged in and ready to run. Still there may be occasions when the system may not operate. In this section some causes of failure to operate will be addressed.

1. MOTOR(S) WILL NOT SERVO (motor shaft does not hold to position)

    Be sure axis enable switch on MC-4SA front panel is latched on, and the switch itself is illuminated. If the switch is latched on but not illuminated check in your controller software as to whether the axis has been inhibited.

    Be sure the controller is initialized and in servo mode. Check the software you are using with your controller to be sure no status indicators show fault conditions.

    Check the fault indicator on the MC-4SA front panel. If this is illuminated it means the power supply for that axis has failed, probably due to a blown fuse. Check both fuses for that axis and replace the blown one with the proper current rating for the motor in use, then investigate possible causes of excessive current drawn by the motor.

    A 10mm motor should be protected with 600 mA fuses, while a 13mm motor should be protected with 2A to 3A fuses.

    If all fault indicators are illuminated, it may mean that the host computer is not supplying the proper +5 volt signal.

2. MOTOR IS IN SERVO MODE BUT ACCEPTS MOTION COMMANDS IN ONE DIRECTION ONLY.
    Check the limit switch status in the controlling software. If a limit switch is reported to be closed, examine the switch itself. If the switch is not being held closed by any moving parts, use an ohm meter to verify it is electrically open.

3. MOTOR VIBRATES or ENCODER READING FLUCTUATES RAPIDLY BETWEEN POSITIONS.
    Check the PID settings.
    The values found stable with the motors used by National Aperture are:
    Proportional = 600,
    Integral = 400,
    Derivative = 1000, and
    Derivative Interval = 0.

Specifications

AC power input (User-selectable):	110 / 220 VAC
Motor control input voltage:	±10 VDC across 300 K Ohms
Encoder supply voltage:	±5 VDC
Max output power (standard):	6 Watts
Output voltage range:	±12 VDC
Slew rate:	8V / µS, max.
Voltage gain (Av.)	1.2 V
Physical size (L x W x H):	15¨ x 10¨ x 3.5¨ (381mm x 254mm x 88.9mm)
Weight:	9 lbs. (4.08 Kg)