INSTRUCTION MANUAL

Model 308B

High-Speed Length Controller

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1.0 Introduction

The 308B system was designed to enable physiology researchers to study the transient mechanical characteristics of muscle tissue. This system is capable of generating forces of 50 mN at the end of a 1.3cm arm. The system's step response time of 250 microseconds is exceptionally fast. This transducer is a length controller only. For measuring very small forces, an external force transducer is required at the other end of the muscle tissue. Please contact Aurora Scientific Inc. for information about our 400A series of force transducers that were designed for muscle physiology research.

The heart of 308B system is a very high performance moving magnet rotary motor. The rotor of this motor is a magnet suspended on precision ball bearings. A high performance optical position detector at the rear of the motor senses length changes at the end of the lever arm. A three-meter cable connects the motor to the 308B electronics controller. The motor is protected against various overload conditions by the electronics. In addition there are mechanical stops inside the motor to prevent gross over travel.

2.0 Specifications
Model: 308B

Maximum Lever Arm Excursion:	4 millimeters
Maximum Isometric Force:	50 milliNewton
Isometric Compliance:	1 micron per 1 milliNewton maximum
Length Step Response Time:	250 microseconds maximum, 50-micron step, 1% to 99% critically damped
Length Sinusoidal Response:	DC to 3.5KHz -3db, minimum
Dither at Lever Tip:	0.2 microns peak-to-peak maximum
Length In Scale Factor:	0.20 millimeter per volt +/-10%
Length Out Scale Factor:	0.40 millimeter per volt +/-10%
Length Signal Linearity:	98% minimum
Warm Up Time:	None
Power Requirements:	120VAC ±10% standard, 50/60Hz, 35 watts maximum 100VAC, 220VAC, and 240VAC optional
Dimensions:	
Electronics Enclosure:	23cm wide x 29cm deep x 13cm high
Motor:	See 308B Head Assembly Drawing
Weight:	
Electronics:	2 kg
Motor:	50 grams

3.0 First Time Operation

The following procedure is recommended to verify that the 308B system is operating properly.

1. Attach the male end of the 3-meter cable the rear panel of the electronics box and the other end to the motor. Use the screws supplied on the electronics end of the cable to firmly secure the cable to the electronics. Ensure the locking clips fold over the cable end at the motor.

2. With the power switch located on the rear of the electronics box in the OFF (down) position, plug the instrument into an appropriate AC source using the detachable line cord.

3. Turn the front panel FORCE OFFSET control fully clockwise and then back 5 turns counter-clockwise.

4. Gently, push the lever arm back and forth. It should move freely until the mechanical stops are reached. Be careful when placing the motor on a surface that the arm does not hit anything during operation.

5. Turn the power switch ON. The POWER LED should illuminate.

6. Turn the LENGTH OFFSET control back and forth a turn or so. The arm should move in proportion to the turning of the control.

7. Input a signal into the LENGTH IN BNC connector. The arm should move in response to the input. Positive signals should cause CW rotation and vice versa for negative signals. Refer to the specifications at the front of the manual for the scale factor.

8. View the LENGTH OUT signal with an oscilloscope. The waveform should follow the input signal with ~300 microseconds of time lag.

This concludes the initial instrument checkout procedure.

4.0 General Operating Procedure

The best way to understand the operation of the 308B is to think of it as a length controller that follows the length input signal.

LENGTH IN controls the position of the tip of the lever arm such that a positive signal rotates the arm in a clockwise direction, and conversely, a negative signal counter-clockwise. The maximum length input signal is ±10V.

LENGTH OUT is a bipolar signal capable of swinging symmetrically about zero volts. The center of the mechanical range is when LENGTH OUT is at zero volts. Try to make use of the center portion of the range rather than just one side of the mechanical center. A clockwise rotation of the shaft causes LENGTH OUT to become more positive, and conversely a counter-clockwise rotation more negative. A +1 volt change in LENGTH IN will cause a +0.5 volt change in LENGTH OUT. A length change could also be accomplished by turning the LENGTH OFFSET knob. Both LENGTH IN and LENGTH OUT have a scale factor as shown in the specifications section.

4.1 Controlling the System with External Electronics

Most experiments will require that LENGTH IN be driven with external devices. The cost of computers and data acquisition circuit boards have dropped to such a level that they are the best way to control the 308B. One analog input and one analog output are all that are required to control the instrument. Analog-to-digital resolution of 12 bits (1 part in 4096) is adequate.

5.0 Calibration

***** CAUTION: Lethal voltages are exposed during this procedure. *****
Use caution whenever the top cover of the electronics box is removed.

The 308B has been calibrated at the factory before shipment. It should not need recalibrating over the life of the instrument. This procedure is written to help those customers that want to readjust their 308B for various reasons. Some of those reasons might be that they have changed the load inertia, that someone has turned some of the adjustment pots on the 6589F printed circuit board, or that someone just wants to adjust the system step response.

Please read this entire procedure before attempting any changes. It is possible to damage the motor if the procedure is not understood completely. If there are any questions, please contact Aurora Scientific Inc.

The following materials are needed:

a. Dual-trace oscilloscope
b. 3-1/2 digit DVM
c. Function generator
d. Flat-tip screwdriver (medium)
e. Flat-tip screwdriver (small)
f. Several BNC cables

1.) Ensure the power switch located on the rear panel of the electronics box is turned OFF. Attach the power cable to the back of the box and to the appropriate power.

2.) Firmly attach the cable between the electronics box and motor using the captured screws on the cable.

3.) Turn the front panel LENGTH OFFSET to the center of its range (5 turns from either stop).

Adjusting the Step Response

4.) Remove the four slot-head screws that are located inside the feet on the bottom panel. Note: Do not remove the rear-most screws that are holding on the front feet.

***** CAUTION: Lethal voltages are exposed during this procedure. *****
Use caution whenever the top cover of the box is removed.

5.) Apply a 1-volt peak-to-peak square wave @60Hz to the LENGTH IN BNC.

** Note: If it only desired to make a slight adjustment to the dynamic tuning of the system, skip down to step (10) below.

6.) On the 6589F printed circuit board situated within the electronics enclosure locate the potentiometers labeled R25, R28, and R42. Turn all of these pots CCW until either a click is heard or approximately 30 turns (some pots don't click).

7.) While holding the motor and arm such that the arm is prevented from moving an excessive amount, turn on the power switch located on the rear panel. Observe LENGTH OUT on an oscilloscope while moving the arm back and forth. LENGTH OUT should change positively with CW rotation.

8.) While holding the arm about in the center of the range, turn R25 a few turns CW. Slowly turn R28 a few turns CW. The arm should now want to sit close to the center of its range and the arm should be following the input signal somewhat. Let go of the arm now.

9.) While carefully monitoring LENGTH OUT with an oscilloscope synced to the function generator, slowly turn R28 CW until the motor response is underdamped.

10.) The three tuning pots R25, R28, and R42 should now be alternately turned in a generally CW direction until a critically damped squarewave with a step response time of ~300 microseconds is achieved. (This requires practice and an intuitive feel for what these three controls do). In general these three pots have the following effects:

a. R25 is the position differentiator potentiometer. This provides low frequency damping to the system. Turning this CW will increase damping during the beginning of the tuning process, but soon runs out of bandwidth. At that point R42 should be turned up in conjunction with R25.
b. R28 is the error amplifier potentiometer. It controls servo gain for the system. During calibration, this pot acts to increase the speed and overshoot of the system.
c. R42 is the current integrator potentiometer. It provides high frequency damping to the system. Use this pot in conjunction with R25 to dampen an underdamped waveform after R25 alone loses its effectiveness.

11.) When the servo is properly calibrated, the following points should be checked:

a. The output response should look critically damped with little overshoot or undershoot.

b. Any ringing on the position signal or on the current signal should dampen soon (<200 microseconds) after the step has been made. If the ringing persists or is constant, the servo gain is probably turned up too high.

c. It is always best to use the least amount of loop gain possible to get the job done.

d. There should be no audible ringing heard from the scanner. If there is, the loop gain is probably turned up too high. There might be a small amount of hissing heard. That is a normal condition and should be ignored. It also will go up as the servo gain is increased.

Adjusting the Fieldsize

12.) The system's step response should already have been adjusted and the system turned on. Apply a 10-volt peak-to-peak **sine** wave to LENGTH IN at 100Hz. Adjust R13 such that the tip of the lever arm moves 2mm. If any adjustments have to be made to R13, go back and check the step response again. Ensure that the system is still critically damped.

13.) Measure the voltage at U4, pin 14. It should be between +5.0VDC and +11.5VDC. If the voltage is outside of this range there is probably a scanner problem. Contact Aurora Scientific Inc.

The calibration procedure is now complete.

6.0 Warranty

The 308B Servo System is warranted to be free of defects in materials and workmanship for one year from the date of shipment. Aurora Scientific Inc. will repair or replace, at our option, any part of the 308B Series system that upon our examination is found to be defective while under warranty. Obligations under this warranty are limited to repair or replacement of the instrument. Aurora Scientific Inc. shall not be liable for any other damages of any kind, including consequential damages, personal injury, or the like. Opening the motor assembly itself will void this warranty. Damage to the system through misuse will void this warranty. Aurora Scientific Inc. pursues a policy of continual product development and improvement therefore we reserve the right to change published specifications without prior notice.

Drawings

This section consists of the following drawings:

1.)	308B Head Assembly Drawing	D02394
2.)	Preferred Mount for Model 308B	A02469
3.)	308B Assembly Drawing	D0003-2383
4.)	308B Interconnection Drawing	D0003-2384
5.)	6589F Schematic	D0006-2386