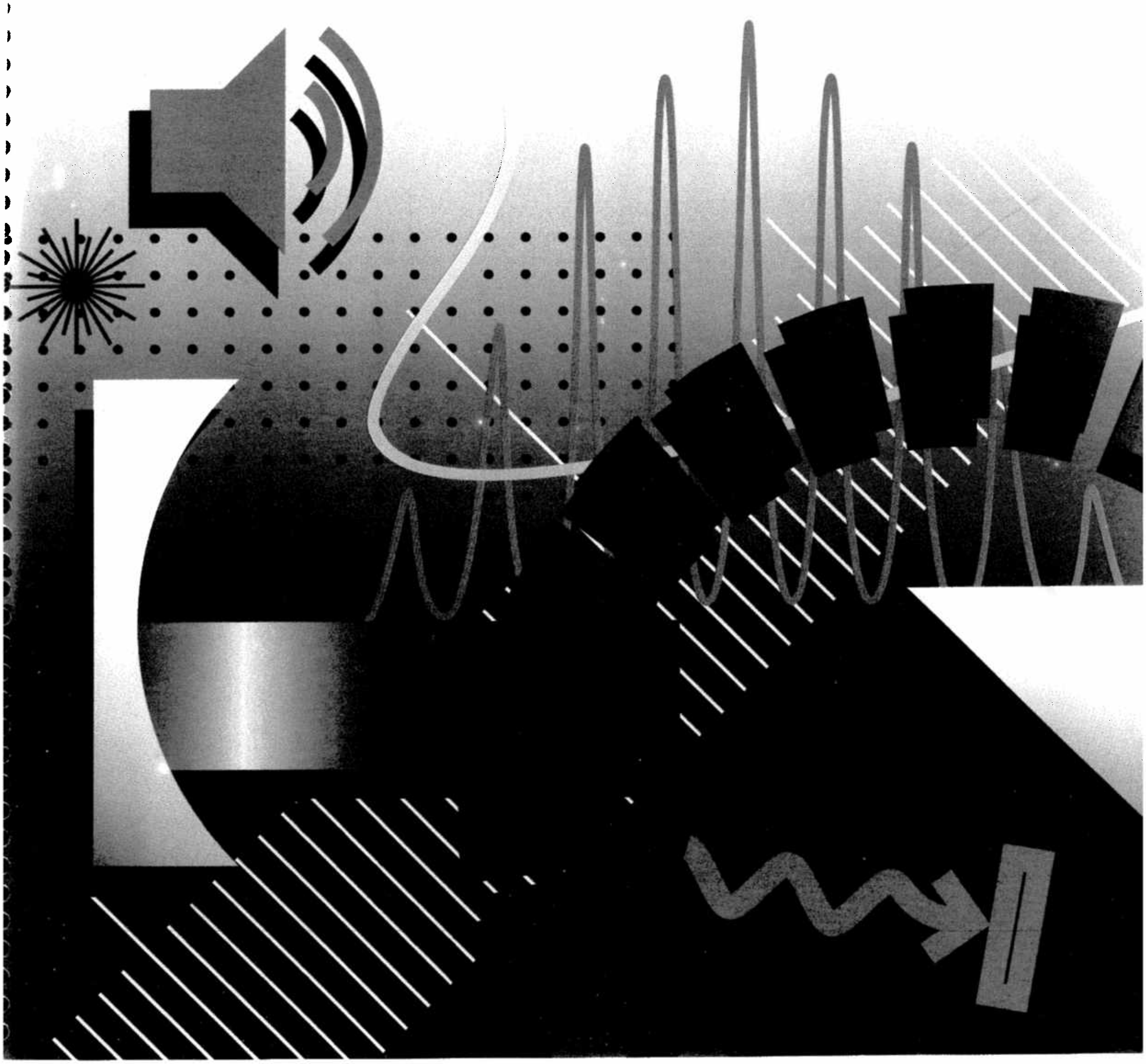
Newport

860A Series, 860SC, 860SC-C, 860J Operating and Service Manual



Warranty

The 860A family of Motorizers and Controllers is guaranteed by Newport Corporation to be free of manufacturing defects for a period of 12 months after delivery. Of course, any modification or system failure due to abuse cannot be covered under this warranty. Please contact the factory to receive a Return Material Authorization number before returning any hardware.

Caution

The warranty does not cover special gear ratio 860A motorizers that have been abused. High speed and low speed motorizers will be abused if the output shaft is driven into either limit of travel at greater than 50% of the maximum velocity.

See the instruction manual for 860A Motorizers and RSX/RSA Motorized Stages for specific warranties on these devices.

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P/N 12788-01, Rev. A
IN-02872 (10-92)

Table of Contents

Section 1.0
Introduction

860A Motorizers come in 0.5", 1", 2" and 4" travels. A single 860SC Controller can operate up to 4 Motorizers, one at a time. A single 860J Joystick Controller can operate 2 Motorizers simultaneously.

860A Series Product Line

860SC	Speed controller
860J	Joystick controller
860P	Power supply
860I	Interconnect cables
860A-05	Motorizer: 1/2" travel
860A-05MM	Mirror-mount motorizer: 1/2" travel
860A-1	Motorizer: 1" travel
860A-2	Motorizer: 2" travel
860A-4	Motorizer: 4" travel
860A-1HS	High speed motorizer: 1" travel
860A-2HS	High speed mororizer: 2" travel
860-C2	4-Axis controller (Separate manual)
861	Inexpensive hand-held controller (Separate manual)
860-MC3	3-Axis controller

Section 2.0
Linear Motorizer

860A Motorizers can be used wherever heavy or light loads must be pushed with a minimum of acoustic and mechanical noise when position information is not required. Their small size allows fitting into cramped spaces as is usually necessary when using gimbaled mirror mounts.

1. Pointing mirrors.
2. Positioning off-axis parabolic mirrors.
3. Actuating rotary table with prism.
4. Positioning translation stages.

The nose button of the 860A Motorizer does not connect or join with the load it is pushing; it merely presses against the surface of the load. For the load to follow the retracting leadscrew, there must be an external return force such as a spring.

Features

1. Small body size
   860A-05 = 1"×3.0"
   860A-1 = 1"×3.6"
   860A-2 = 1"×4.7"
   860A-4 = 1"×6.8"
2. Large load-carrying capacity
   Up to 30 lbs. of vertical lift.
3. Large speed range
4. Built-in limits
5. Engraved spindle position indicators in metric and English units.
6. Rotating spindle suppresses starting friction.
7. Vacuum compatibility option.

Construction and Performance

1. Ultra-quiet, smooth operation
2. Low-inertia DC motor with gearhead with all-steel gears
3. Black-anodized grained aluminum body
4. Phosphor-bronze nosepiece with standard 3/8-40 mounting thread.
5. Precision stainless-steel leadscrew with carbide ball tip.
6. Designed for long life (>50,000 cycles with 20 lb. load)

Specifications

+/−12volts, 120mA max current

2.1 860A Series Motorizer Load/Speed Chart

Model	Jog Mode					Slew Mode				Load	
	Resolution			Velocity		1616 or 1516 Motor		1624 Motor			
(Gear head)	Spc L-S µM	Std µM	Spc H S µM	Min µM/sec	Max µM/sec	Min µM/sec	Max µM/sec	Min µM/sec	Max µM/sec	-16 lbs.	-24 lbs.
-6.3	—	—	10	21	84	—	—	1.1	10	—	4
-11.8	—	—	5.7	11	44	—	—	.59	5.9	—	9
-22	—	—	3.1	6.0	24	—	—	.32	3.2	—	15
-41	—	—	1.6	3.2	12	—	—	.16	1.6	—	28
-76	—	—	.90	1.7	6.8	—	—	.11	1.1	—	48
-141	—	—	.48	.95	3.8	—	—	.05	.53	—	89
-262	—	**.07**	—	**.51**	**2.0**	**.040**	**.40**	—	—	**37**	—
-485	.02	—	—	.28	1.1	.024	.24	—	—	69	—
-900	.01	—	—	.15	.60	.011	.11	—	—	100*	—
-1670	.005	—	—	.080	.32	.0063	.06	—	—	100*	—
-3101	.003	—	—	.043	.17	.0034	.034	—	—	100*	—
-5752	.001	—	—	.023	.092	.0018	.016	—	—	100*	—
-10683	.0007	—	—	.013	.052	.0010	.008	—	—	100*	—

Note: All values nominal

* = Load carrying capacity limited to 100 lbs. to protect the gearhead.
µM = Micrometer, µin = Microinch
L-S = Low Speed Options
H-S = High Speed Options

2.2 Motor Size and Gearhead Ratio Options

Three different sizes of motors are available with the 860A Series Motorizers: the 1616, the 1516 and the 1624. The 1624 is the most powerful of the three, and causes a higher velocity and can handle a heavier load.

There are thirteen different gearhead ratios available, ranging from 6:3:1 to 10683:1. The 262:1 gearhead ratio is standard while other ratios are available at an additional charge. The complete list of gearhead ratio options is as follows:

Nominal	Actual	
6.3:1	6.3968254	Custom only; 1624
11.8:1	11.8641975	Custom only; 1624
22:1	22.0335093	Catalog items for 1 & 2 inch; Special order for other travels; 1624
41:1	40.8655693	Custom only; 1624
76:1	75.8932002	Custom only; 1624
141:1	140.759183	Custom only; 1624
262:1	261.409912	**Standard; 1616**
485:1	484.837188	Custom only; 1516 or 1616
900:1	900.41 1920	Custom only; 1516
1670:1	1669.99476	Special order; 1516
3101:1	3101.41884	Custom only; 1516
5752:1	5752.20417	Custom only; 1516
10683:1	10682.66483	Custom only; 1516

When choosing a gearhead ratio for the 860A Series Motorizer, three considerations come into play: speed, load capacity and resolution. The higher gearhead ratios have lower speeds, higher load capacities and higher resolution. The lower gearhead ratios have higher speeds, lower load capacities and lower resolution. For more exact information, see Section 2.1 for the load/speed chart.

2.3 Motorizers with High-Ratio Gearheads

Motorizers with gearhead ratios greater than 1670:1 and smaller than 141:1 necessitate special handling by the user. These gearheads generate unusually high thrusts, or high velocities that may damage the gearhead/ motor if the motorizers are allowed to run into their limits of travel at speeds greater than 50% of full scale. Our method of limit indication is to sense that the motor is producing high thrust but at a velocity lower than commanded. This indicates operation outside of the designed velocity servo window. Both limits have a rubber cushion to absorb the mechanical shock and momentum. However, for these non-standard gearhead ratios, the motor's momentum will be extremely high when moving at full speed and the cushions are not sufficient.

To help protect the high gear ratio gearhead/motor (LOW SPEED), the normal velocity servo electronics have been modified to limit the current into the motor to approximately 60% of its normal possible value. This limitation serves to prohibit the Motorizers from simultaneously exerting maximum thrust and maximum velocity (maximum momentum). This current limit attempts to protect the gearhead from damage if it runs into the limit of travel at maximum speed.

Extensive tests have not been made on the high gearhead-ratio units to determine their mechanical lifetimes. Caution should be used when operating near the limits with high gearhead ratio units as their gearheads can be easily damaged when run into a limit at maximum speed.

The low gear ratio (HIGH SPEED) motorizer may lock its output shaft if a high velocity was used to drive the shaft into its travel limits. Under these conditions the controller sensing circuit may not have enough time to recognize that the velocity/thrust window has been exceeded.

Therefore, we can only offer a limited warranty on Motorizers with the below gearhead ratios. See the warranty at the beginning of the manual for details.

Gearhead Ratio	Nominal Thrust(lbs)
6.3:1	4
11.8:1	9
22:1	15
41:1	28
76:1	48
3101:1	285
5752:1	529
10683:1	882

Caution

When operating near limits of travel, do not move at velocities greater than 50% of full-scale. Motorizers equipped with special gearhead ratios will not be guaranteed against drive-train failures.

Section 3.0
Getting Started

3.1 Unpacking

Each 860A Motorizer is contained within its protective foam shipping container. The 860I-10 cables are housed under the foam tray holding the Motorizers. Please save the shipping container in case the unit must be returned to the factory for service.

3.2 Mechanical Specifications

860SC Speed Controller
Maximum case dimensions (height × width × length): 3.9" × 6.1" × 8.7"
Maximum weight: 0.9 lbs. (SC) / 1.0 lbs. (SC-C)
Case material: polystyrene
Standard temperature range: 14°C to 31°C

860J Joystick Controller
Maximum case dimensions (height × width × length): 3.9" × 6.1" × 8.7"
Maximum weight: 0.9 lbs.
Case material: high impact ABS
Standard temperature range: 14°C to 31°C

860P Power Supply
Maximum case dimensions (height × width × length): 2.2" × 2.8" × 3.4"
Maximum weight: 1.4 lbs.
Case material: Cycolac KJB ABS
Maximum working temperature: 35°C

860A-025 Motorizer
Overall length: 3.27"
Body diameter: 1.0"
Weight: 0.25 lbs.
Body material: aluminum
Standard temperature range: 14°C to 31°C

860A-05 Motorizer
Overall length: 3.77"
Body diameter: 1.0"
Weight: 0.25 lbs.
Body material: aluminum
Standard temperature range: 14°C to 31°C

860A-05MM Motorizer
Overall length: 4.9"
Body diameter: 1.0"
Weight: 0.30 lbs.
Body material: aluminum
Standard temperature range: 14°C to 31°C

860A-1 and 860A-1-HS Motorizer

Overall length: 4.58"
Body diameter: 1.0"
Weight: 0.30 lbs.
Body material: aluminum
Standard temperature range: 14°C to 31°C

860A-2 and 860A-2-HS Motorizer

Overall length: 5.4"
Body diameter: 1.0"
Weight: 0.35 lbs.
Body material: aluminum
Standard temperature range: 14°C to 31°C

860A-4 Motorizer

Overall length: 7.83"
Body diameter: 1.0"
Weight: 0.50 lbs.
Body material: aluminum
Standard temperature range: 14°C to 31°C

The above specifications are for standard models only. All measurements are approximate. Overall lengths are for entire Motorizer length with leadscrew fully retracted. For more exact Motorizer dimensions, see Appendix H.

3.3 Electrical Specifications

±0–12 Volts DC, 120mA max. current

3.4 Motorizer Mounting

Although Motorizers can be used in many applications, their primary function is to replace micrometers in mechanical mounts and stages. There are basically four ways to mount a Motorizer in a mechanical device:

1. Unscrew the retaining nut and insert the motorizer into the mount. Either use a spanner wrench to tighten the nut or gently rotate the Motorizer body while holding the nut stationary with the fingers or a small screwdriver to tighten the assembly.
2. The Motorizer is mounted another way when the mount has a setscrew. The retaining nut is not used. Just insert the Motorizer and tighten the setscrew.

Caution

Some clamp-type mounts can damage the threads of motorizers or even cause the leadscrew to bind. Use of a protective sleeve is recommended; avoid overtightening in any case. A threadchaser may be used carefully to restore damaged threads

3. When neither of the above two mounting methods can be used, the customer's own ingenuity comes into play. It might be necessary to partially dissassemble the device in which the Motorizer is being used. When access to the retaining nut is reached, simply follow method #1 above.
4. For panel mounting in panels up to 1/2" thick, drill a 3/8" hole. Insert Motorizer and tighten retaining nut.

3.5 Cable Interconnection

To 860SC Speed Controller & 860SC-C Speed Controller with Computer Interface

Back panel nomenclature:

1 is for Motorizer #l
2 is for Motorizer #2
3 is for Motorizer #3
4 is for Motorizer #4

Each Motorizer connection is very easy to make. Simply plug either end of the Interconnect Cable into the desired Speed Controller socket, and plug the other end into the Motorizer. The Power Supply socket (located just under the Speed Controller's Motorizer sockets) fits the cable from the 860P Power Supply just one way, so no mistakes are possible.

To 860J Joystick

Rear panel nomenclature:

X is for X-Axis Motorizer
Y is for Y-Axis Motorizer

Simply plug the Interconnect Cable for each axis into the appropriate socket. The socket for the 860P Power Supply is specially shaped so that no incorrect connection can be made.

Section 4.0
Controller Operation

4.1 Introduction

In this and subsequent sections, references to 860A Series motorizers also apply to RSX/RSA Series Motorized rotation stages and earlier 860 series motorizers.

The 860A motorizer's motion may be controlled either from the 860SC Speed Controller, or the 860J Joystick Controller.

Since each Controller contains the motorizer servos, the Controllers must be ordered correspondingly to the motor size (-1616 or -1624) of the motorizer(s). A Controller built for a motor size other than the size being used will not run that motorizer without modification.

The 860SC Speed Controller will control 1 of 4 axes at a time, while the 860J Joystick Controller can control two axes simultaneously.

The Controllers with Computer Interface allow the operator to control the Motorizers from a computer. The advantages are in more precise velocity control and greater freedom for the operator by using computer programming to run the Motorizers.

4.2 860SC Speed Controller

Features

1. Full velocity servo

    Velocity independent of loads up to 30 lbs. (standard motorizer)

    Dynamic braking

    Rapid response

2. Select one of four motorizers
3. Forward/Reverse Direction control
4. Limit circuitry and indicators
5. Speed Control with 10:1 range
6. Jog control for small steps

4.2.1 Power

The POWER switch activates the Speed Controller and turns on the Power-on indicator light. Power is received from the 860P Power Supply in the form of ±15VDC @ 300 mA.

4.2.2 Velocity control (slew mode)

The Motorizer Selection Switch selects one of the four motorizers to be controlled.

The Velocity Slide Knob sets the speed in a 10:1 range. For the standard 860A-262-1616 motorizers, the speed can be set from .040 mm/sec to .40 mm/sec (.094 inches/min to .94 inches/min).

When operating motorizers in SLEW mode, the velocity servo is fully functional. In contrast, the velocity servo is not fully functional in the JOG mode. The 860SC uses one velocity servo for all four Motorizers. So you cannot run motorizers with different type motors off the same Speed Controller, as you can with the 860J Joystick Controller.

The FORWARD/REVERSE switch initiates motorizer movement in a forward or reverse direction. FORWARD moves leadscrew out from the motorizer and REVERSE moves leadscrew back into the motorizer.

Normally, the velocity servo electronics need no adjustment. However, due to component aging or rough handling, occasional re-adjustment may be necessary. Symptoms include rough or hesitant motion or poor velocity regulation. After verifying that the motorizer leadscrew is clean, refer to Appendix B for servo-adjustment procedures.

4.2.3 Jog

The JOG moves the motorizer in small "kicks". It moves the motorizer FORWARD or REVERSE. The speed of the JOG is dependent on the setting of the velocity slide knob. Speed (with standard 262:1 gearhead) ranges from .6 to 2.5 micrometers per second. The JOG speed is not independent of the load as the velocity servo does not apply to JOG movements.

A single JOG switch actuation will produce a single kick. But holding the switch in the FORWARD or REVERSE position will produce kicks at the rate of 5 per second and thus cause a pseudo-continuous, extremely slow motion. Various settings of the Velocity slide knob will vary the slow speed rather than high-precision large scale motions.

4.2.4 Limits

The limit lights indicate end-of-travel or motor stall. The top light is for the FORWARD limit and the bottom light is for the REVERSE limit.

The motor stall occurs when the Motorizer is loaded beyond its operating range.

When any limit is reached, the 860SC's internal circuitry automatically provides a small kick in the opposite direction to prevent mechanical binding.

Note:

Please heed the warning given in section 2.3 when operating motorizers with non-standard gear boxes near limits

4.2.5 Setting Up

Step	Action
1	Plug in Power Supply cable to Controller Box
2	Be sure Power On switch is thrown in the lower position
3	Insert Power Supply into wall-socket.
4	Install 1 to 4 Interconnect Cables
5	Plug in 1 to 4 Motorizers
6	Turn on Power (indicator will display) System is ready for operation.

4.3 860SC-C Speed Controller with Computer Interface

The 860SC-C works just like the 860SC when working independently of the computer.

The following internal signals can be useful for external or computer controllers:

1. Command velocity
2. FORWARD/REVERSE Direction Control
3. External RUN/STOP
4. FORWARD/REVERSE limits
5. System GROUND
6. Motorizer selection

Virtually anything can be done via computer control that can be done by an operator except JOGGING. However, the external source can be made to produce a pseudo-JOG.

See Section 7.0 for additional information on the 860SC-C.

4.4 860J Joystick Controller

4.4.1 Introduction

In contrast to the 860SC that controls 1 of 4 Motorizers, the 860J Joystick Controller permits simultaneous motion of two 860A Motorizers. Its important internal functions include the following:

1. Two complete velocity servos.
2. Two independent limit sensing circuits with limit sensitivity adjustment.
3. Fast automatic "kick" off limit to assure limit clearing.
4. Fast and slow JOG for both axes.

External functions and interconnects include the following:

1. Power ON/OFF with indicator light.
2. 2-Axis Joystick
3. Fast/Slow JOG Switch
4. Power Jack
5. X & Y Axis Jacks
6. Limit Indicator Lights

Because the 860J has two independent velocity servos, it is possible to simultaneously control 2 Motorizers of different motor sizes (-1616 and -1624). However, each axis jack will be keyed only to the motor size for which its servo is adjusted.

4.4.2 Operation

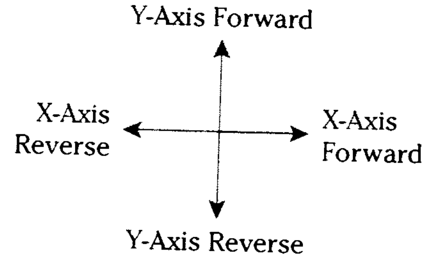
The 860J Joystick is powered the same as the 860SC (see above).

The Fast/Slow Switch sets the basic speed for motorizer movement. For the standard 262:1 gearhead, the velocity can be set from 9 to 370 µm/sec in the FAST mode, while the Slow mode has a speed range of 0.51 to 2.0 µm/sec.

The angle of the joystick varies the basic velocity set by the Fast/Slow switch. The greater the angle from the center, the greater the speed. The Joystick initiates motorizer movement.

The Slow mode basically acts like a continuous JOG (See Section 3.2.3). In the Slow mode, a regular stream of electronic pulses is sent through the servo to the motorizer, moving the motorizer in slow, regular movement.

Because the servo cannot accommodate such short pulses, the Slow mode's velocity is not independent of the load. The limits will not set or clear while in the Slow mode.



The Joystick's limit lights indicate ends-of-travel or motor stalls. Upon reaching the limit, the internal circuitry will automatically "kick" the Motorizer in the opposite direction of the limit. How far is a function of the Motorizer's gearhead ratio.

Top light = Forward Y-Axis limit
Bottom light = Reverse Y-Axis limit
Right light = Forward X-Axis limit
Left light = Reverse X-Axis limit

The joystick's limit sensitivity is adjustable. See Appendix C.

Set-up

Step	Operation
1	Plug-in Power Supply to AC socket
2	Install power cord to 860J
3	Plug-in 860I-10 Interconnect Cables between 860A Motorizers and 860J

4.5 Things to Consider about the 860J

1. SLOW cannot SET or CLEAR limits.
2. Both axes are either FAST or SLOW; they cannot be mixed.
3. Both motorizers are normally of the same motor type (-1616 or -1624). However, sometimes they are by the user's choice. Unless the original factory order specifies mixed motor types, they cannot operate with the 860J. But with an original specification, motor types can be mixed but cannot be switched between axes on the 860J itself. This is because different type motors have different coil resistances. Since the motor coil is an integral part of the velocity servo, the servo won't accommodate other sizes.
4. Please be aware that operation near the limits may produce a sudden small but rapid movement away from the limit. May we suggest that if you desire to operate near a limit, that you first deliberately run into the limit at a **slow** velocity and then back off to the desired position.

Section 5.0
Mechanical

5.1 Introduction

860A motorizers are ruggedly constructed for long life. A thick body wall protects from external damage. A precision lapped, electro-polished leadscrew coupled with a high precision DC motor assures quiet, smooth operation.

5.2 Construction

All motorizers have a similar basic design:

1. 1" O.D. Aluminum, body
2. Phosphor-bronze nosepiece with direct connection to gearhead shaft.
3. Stainless-steel 40 TPI leadscrew with direct connection to gearhead shaft.
4. Dual opposing slots on body prevent gearhead/motor rotation through a dual-tabbed connection to gearhead. But motor "floats" mechanically to accomodate slight eccentricities.
5. Electrical connection through phone-jack mounted in endcap.

See Section 3.2 and Appendix H for more mechanical specifications of Motorizers and Controllers.

5.3 Typical Performance

For the standard motorizer (with 262:1 gearhead and 1616 motor):

	Speed Setting	Actual Speed µm/sec	Estimated Resolution µm
Jog mode	1-10	0.5-2	0.02-.2
Slew mode	1-10	40-400	3.2-32

Maximum vertical load: 30-35 lbs. within servo window

See the Load/Speed Chart in Section 2.1 for more information.

Sideloads

The motorizers have been designed and tested to operate with sideloads up to 5 lbs. when the leadscrew is clean. However, as dust and dirt accumulates on the leadscrew threads, the intolerance to sideloads rapidly worsens.

5.4 Vacuum Compatibility

The high vacuum model of the 860A motorizer comes with the following features:

1. No covers on keyway slots.
2. Unanodized aluminum body without labels.
3. Teflon-coated 24-inch stripped and tinned cable for attachment to customer's vacuum feedthru.
4. Unanodized metal end cap.
5. Special lubricant with vapor pressure of 10^{-9} Torr at 39°C.
6. Vented motor/gearhead cavities.

The above features replace the following features in the standard 860A Motorizer:

1. Molded plastic covers for keyway slots.
2. Plastic-coated internal wiring.
3. Plastic end cap.
4. Standard lubricant with vapor pressure of 10^{-6} Torr at 25°C.
5. No vented motor/gearhead cavities
6. Cable with polyethelene coating and PVC sheath.

5.5 Care and Cleaning

Since the leadscrew can accumulate particles, the motorizer's performance may degrade with time and use. To maximize performance and life expectancy, with each motorizer, we have supplied a bottle of lubricant. Proper care will improve the motorizer's performance and life expectancy.

To clean and lubricate the leadscrew:

1. Move the leadscrew to its far FORWARD position.
2. With a small brush or towel, gently wash the exposed threads in alcohol, acetone, or trichloroethlyene.
3. Retract leadscrew to midrange.
4. Advance leadscrew to extreme out position again.
5. Clean again.
6. Lubricate with 1 or 2 drops of Triflow lubricant – one drop in the leadscrew center, another drop at the reverse end.

Section 6.0
Electronic

6.1 Introduction

The 860SC Controller is a self-contained servo-controller for one out of four Motorizers. Even though a single Motorizer is actuated at a time, the drive motors of the remaining three are shunted to ground for a pseudo-dynamic braking even though they are not being actively servo-controlled.

6.2 Theory of Operation

6.2.1 Servo

The velocity servo (U.S. Patent No. 4,467,250) is a bridge-balance type of control circuit. In detail, the motor's coil is one impedance in a four-impedance bridge. At rest, the bridge is balanced. Since the coil's effective resistance is a function of the motor's velocity, a convenient error signal can be generated by the bridge imbalance.

The bridge is driven by a power amplifier operating open-loop. The non-inverting input is the Command Velocity in the range of +10 to −10 VDC. The inverting input is the amplified error signal from the bridge. Initially, when the motor is at rest, the error is zero. A finite Command Velocity will cause the power amplifier to kick on fully since it is operating as a comparator. As the motor approaches the commanded velocity, the error signal rises to match the command velocity and the power driver's output approaches zero. However, as the motor subsequently begins to slow down, the amplifier's output again rises to increase the velocity. Thus the servo regulates the motor's velocity within a load window approaching 40 lbs.

The bridge balance is adjusted at the factory to produce a "critically balanced" response to a pulse. However, you may wish to modify the balance for reasons of your own. If so, please refer to Appendix B for instructions.

6.2.2 Limits

The limit or stall is detected by the ANDing of two conditions. If both the following conditions are true, then the limit is asserted:

Condition #1: The voltage driving the motor is greater than a given threshold for a predetermined period of time.

Condition #2: The motor's velocity is less than a set threshold for a predetermined period of time.

By sensing the polarity of the drive voltage, the polarity of the limit can be sensed—FORWARD or REVERSE.

In addition, considering Condition 2, if the motor is moving fast, then the threshold should also be higher so keep the ratio of slow down constant. Therefore, a portion of the command velocity is made to modify the velocity threshold. Now, the velocity threshold rises to match a fraction of the motor's velocity. A limit will trigger when the motor slows down to approximately 40% of its command velocity.

6.2.3 Coming off the Limits

Since a limit is defined as a mechanical constriction of the 860A Motorizer, this constriction is often difficult to release. It is not unlike tightening a nut on a bolt—you must use at least the same force to loosen the nut as you used to tighten it.

Whenever the Motorizer reaches a limit, it automatically comes off the limit with short 15 volt kick in the reverse direction.

6.2.4 860P Power Supply

The 860P Power Supply conveniently plugs into any 3-pronged electric socket. It comes with its own interconnect cable to the Controller. The 860P may be ordered to convert 120 VAC or 220 VAC. It supplies the controller with ±15 VDC, 60 Hz at 300 mA.

Section 7.0

860SC-C Speed Controller with Computer Interface

7.1 Introduction

The 860SC-C Speed Controller with Computer Interface permits your computer or other digital controller to operate the Speed Controller for the 860A Motorizer series. When using the Interface, you can select the Motorizer number (1 of 4), start and stop the motion, and control the velocity. In addition, you receive information about the limits-of-travel indicators. Normally interfaced through a parallel port and a DAC, the Computer Interface can be conveniently driven through BASIC or other high level languages. When position feedback is derived from another source, this unit can become a low-cost full-position control unit.

Programming examples in this section are for Microsoft™ Basic running on a Vector 5 CPM microcomputer.

7.2 Interfacing to Your Computer

The normal interconnect is through a computer's parallel port. Although the bulk of 860SC operates internally at 15 volts, it also generates an internal 5 volts for TTL-communications through the 860SC-C. You do not have to provide an external 5 volts. However, you may have to provide a signal pull-down termination at the end of the cable as it enters the parallel port for the two limit indicators on Pins #9 & 10. The resistor pull-down can be any value between 10K and 100K. The 860SC-C comes with a 6-ft. interconnect cable and we recommend that this length not be exceeded without adding some form of line-drivers and line-receivers.

The pin numbers, cable colors, and signal descriptions are found in Section 5.6.

7.3 Theory of Operation of the Interface

7.3.1 Description of Operational Modes

The 860SC-C Computer Interface can be operated in one of four modes:

Mode 1: Manual control of velocity (no DAC)

1. Velocity set by slide knob on front panel
2. Direction controlled by computer
3. Limit indicators input to computer

   Mode 1 is used when the controlling computer either does not have a DAC or you can operate the Motorizer at a fixed velocity.

Mode 2: Computer control of velocity

1. Velocity set by DAC in computer
2. Velocity attenuated by slide knob on front panel
3. Direction controlled by computer
4. Limit indicator input to computer

Mode 2 is used when the controlling computer has a q10 volt DAC and you wish to remotely vary the Motorizer's velocity.

Mode 3: Computer selection of motor number

1. Motor # selected by computer
2. Can operate whether in Mode 1 (manual velocity) or Mode 2 (Computer Velocity)

   Mode 3 is used when you have more than 1 Motorizer and want computer selection of which Motorizer is moving.

Mode 4: Pure manual control

Mode 4 decouples the computer from control even though it is still attached to the Interface.

All interconnect logic signals are TTL-compatible and are described in Section 5.6.

7.3.2 Mode 1 — Manual Control

When using Mode 1 control, the front panel's velocity control knob is active and the direction control is remotely controlled by the computer. By contrast, the velocity control slide knob is only an attenuator in Mode 2 — it attenuates the DAC output. In addition, the limit indicators are brought out to the computer. The 860SC-C's internal circuitry stops the motorizer at the limit-of-travel and only the indication of a limit is brought to the computer. It is not necessary to clear the limits by any other action than moving the motorizer in the opposite direction, even just a small distance.

Please note: if your computer forces the parallel port to all ones on power up, then the 860SC-C will be in an undetermined state and possibly run the Motorizers uncontrollably. To prevent this problem, we suggest leaving the power off on the 860SC-C until the computer's controlling program has actually taken control of the 860SC-C and shut off all Motorizers.

The following is a step-by-step procedure to be implemented either in software or front panel settings for operating in Mode 1:

Step	Action
1	Configure the parallel port.
2	Set Velocity control slide-knob to desired speed. This fixed speed will be used for both forward and reverse motions.
3	Initiate motion by setting the internal Direction Flip-Flop to desired direction.

Example:

```
OUT 9,4     ;neutral direction and forced stop
OUT 9,5     ;reverse direction
OUT 9,6     ;forward direction
OUT 9,7     ;undefined and not permitted
```

The control signals RFOR(not) and RREV(not) are active HIGH and must be level. Even though just a pulse sets the direction flip-flop, the control signals must replicate the latching action of the front-panel direction switch. If only a pulse is used, other circuitry in the 860SC-C will force a STOP condition when both direction signals are low.

4 Limit indication can be examined by polling the parallel port.

Example:

```
IF INP(10)<>2 THEN 1545
```

The logic level is a 1 to indicate a limit.

7.3.3 Mode 2 — Computer Control

When using mode 2 control, the front panel's velocity control knob is only active as an attenuator of the DAC's command velocity signal. A setting of "10" is approximately a 10% attenuation of the DAC's output and a setting of "1" is approximately a 91% attenuation. In addition, the direction control is remoted to the computer. The 860SC-C's internal circuitry stops the motorizer at the limit-of-travel and only the indication of a limit is brought to the computer. It is not necessary to clear the limits by any other action than moving the motorizer in the opposite direction.

Step Action

1 Set direction switch to desired direction. Although this does not initiate any movement in itself, it enables the limit sensors for that direction and permits motion.

Example: `OUT 9,5`

2 Set DAC output at desired level.

±10 volts will drive full-forward.

−10 volts will drive full-reverse.

0 volts is stop.

Example:

```
REVERSE=&H50        'Some REVERSE motion
OUT &H10,REVERSE    'Output to DAC
```

3 Bringing both direction control lines high will stop the motion independent of the DAC output.

Bringing the DAC output to zero volts will also stop the movement.

Example:

```
OUT 9,4          brings direction control lines high
OUT &H10, &H80      zeros the DAC output.
    &H00 => full REVERSE
    &HFF => full FORWARD
```

External position information can be used to provide a closed-loop position servo as long as the above procedure of first setting direction followed by a velocity command voltage in that direction.

PSEUDO-JOG: Since the computer is unable to work the JOG, a pseudo-JOG may be used. To produce a pseudo-JOG we suggest a 1.5 volt pulse for 5 milliseconds.

7.3.4 Mode 3 — Computer Selection of Motorizer

Library of output commands

Motor #1

Mode 1

```
OUT 9,&H0  = STOP all motion (PURE MANUAL CONTROL)
OUT 9,&H1  = Manual control (Velocity/Motor), REVERSE
             motion
OUT 9,&H2  = Manual control (Velocity/Motor), FORWARD
             motion
OUT 9,&H3  = Undefined and not permitted
```

Mode 2

```
OUT 9,&H4  = STOP all motion
OUT 9,&H5  = Manual control Motor, Computer control
             Velocity, REVERSE motion
OUT 9,&H6  = Manual control Motor, Computer control
             Velocity, FORWARD motion
OUT 9,&H7  = Undefined and not permitted
 :    :          :       :   :      :
 :    :          :       :   :      :
OUT 9,&H17 = Undefined and not permitted
```

Mode 3

Motor #1

```
OUT 9,&H20 = STOP ALL MOTION
OUT 9,&H21 = Motor #1, Manual Velocity, REVERSE
OUT 9,&H22 = Motor #1, Manual Velocity, FORWARD
OUT 9,&H24 = STOP ALL MOTION
OUT 9,&H25 = Motor #1, Computer Velocity, REVERSE
OUT 9,&H26 = Motor #1, Computer Velocity, FORWARD
OUT 9,&H27 = Undefined and not permitted
```

Motor #2

```
OUT 9,&H28 = STOP ALL MOTION
OUT 9,&H29 = Motor #2, Manual Velocity, REVERSE
OUT 9,&H2A = Motor #2, Manual Velocity, FORWARD
OUT 9,&H2B = Undefined and not permitted

OUT 9,&H2C = STOP ALL MOTION
OUT 9,&H2D = Motor #2, Computer Velocity, REVERSE
OUT 9,&H2E = Motor #2, Computer Velocity, FORWARD
OUT 9,&H2F = Undefined and not permitted
```

Motor #3

```
OUT 9,&H20$enT
OUT 9,&H30 = STOP ALL MOTION
OUT 9,&H31 = Motor #3, Manual Velocity, REVERSE
OUT 9,&H32 = Motor #3, Manual Velocity, FORWARD
OUT 9,&H33 = Undefined and not permitted

OUT 9,&H34= STOP ALL MOTION
OUT 9,&H35= Motor #3, Computer Velocity, REVERSE
OUT 9,&H36= Motor #3, Computer Velocity, FORWARD
OUT 9,&H37= Undefined and not permitted
```

Motor #4

```
OUT 9,&H38 = STOP ALL MOTION
OUT 9,&H39 = Motor #4, Manual Velocity, REVERSE
OUT 9,&H3A = Motor #4, Manual Velocity, FORWARD
OUT 9,&H3B = Undefined and not permitted

OUT 9,&H3C = STOP ALL MOTION
OUT 9,&H3D = Motor #4, Computer Velocity, REVERSE
OUT 9,&H3E = Motor #4, Computer Velocity, FORWARD
OUT 9,&H3F = Undefined and not permitted
```

Library of Input Data

```
X = INP(10)
X = 0  No limits
X = 1  FORWARD limit
X = 2  REVERSE limit
```

7.3.5 Mode 4 — Pure Manual Control

By issuing an OUT 9,0, the Interface is placed in a STOP, NO MOTOR SELECTION, NO COMPUTER CONTROL OF VELOCITY and thereby permits pure manual motion. If the Interface is not connected as depicted in the examples shown in this manual, the following signals must be set as shown:

Signal	Condition	Connector Pin
RFOR (not)	LOW	6
RREV (not)	LOW	7
SELECT1	LOW	5
SELECT2	LOW	2
SELECT3	LOW	3
SELECT4	LOW	4

7.4 Other Control Signals

A RUN signal (Output Connector Pin #8) is provided to be optionally connected to a switch closure. This can be used as an emergency stop or limit switch installed somewhere in the equipment. When not connected, a pull-up resistor internal to the 860SC-C assures a RUN condition. When grounded to pins 8 or 12 through a switch closure, the 860SC-C is placed in a STOP condition.

7.5 Operation Suggestions

7.5.1 Switching Direction

When switching directions, FORWARD to REVERSE or REVERSE to FORWARD, you must first switch to OFF, wait for a delay time, (see below) and then switch to the final direction. To switch direction at computer speeds always causes a false limit-of-travel condition. Because the limits are sensed electronically as a combination of 1) Motorizer trying to move at commanded speed and 2) Motorizer not moving at commanded speed within a certain tolerance, the limit condition is created on quick reversals. Here the Motorizer is trying to move rapidly in the new direction but the actual speed crosses through zero as it switches from one direction to another. At this point, the limit is falsely indicated.

To prevent this false condition, use the following procedure:

ACTION: Moving into REVERSE limit, then moving FORWARD.

```
1000   OUT 9,1                                    'Move REVERSE
1100   'Doing some calculation
1200   OUT 9,0: FOR I=0 to 30:I=I:NEXT I  'Stop and delay
1300   OUT 9,2                                    'Move FORWARD
```

Without line 1200, a limit will falsely occur.

7.5.2 Automatic Clearing of the Limit

To assure clearing the limits-of-travel from jamming, the 860SC-C provides a high-power kick to the motor. This kick occurs immediately upon hitting the limit. It is important that no motion control commands are given during the automatic clearing of the limit. To do so may cause a false limit. The following BASIC code shows one method of waiting until the automatic limit clear is complete.

```
1500   OUT 9,1                                    'Move REVERSE
1510   IF INP(10)<2 THEN 1510                     'Poll for limit
1520   OUT 9,0: FOR I=0 to 450:I=I:NEXT I 'Stop and wait
1530   OUT 9,2                                    'Move FORWARD
```

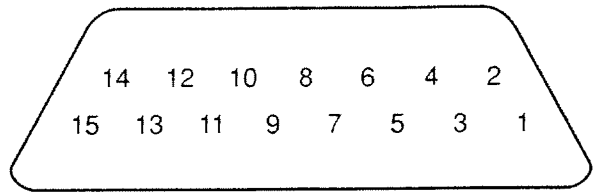
7.6 Signal Specification

Output Conn. Pin #	Signal Name	Signal Description		Range		
1	EXCMVL	External Command Velocity	Analog	+10 VDC=max. forward −10 VDC=max. reverse		
2	SELECT2	Motor Selection	MOTOR#	SELECT2	SELECT3	#
		Bit 0	1	0	0	0
3	SELECT3	Motor Selection	2	1	0	1
		Bit 1	3	0	1	2
4	SELECT4	Motor Select	4	1	1	3
		0=Manual switch 1=Computer select				
5	SELECT1	Computer/Manual	TTL	0=Manual Velocity 1=Computer Velocity		
6	RFOR	Remote Forward	TTL	High level forces direction F/F to FORWARD		
7	RREV	Remote Reverse	TTL	High level forces direction F/F to REVERSE		
8	RUN	Run/Stop	Switch Closure	Ground = STOP (Has pull-up, so "open" means RUN)		
9	REVLMT	Reverse Limit	TTL	High = at limit		
10	FORLMT	Forward Limit	TTL	High = at limit		
11	GRD	Ground				
12	NC	Not Connected				
13	NC	Not Connected				
14	NC	Not Connected				
15	NC	Not Connected				

7.7 Output Connector Pin Numbering

When viewing the output connector pins on the enclosure from the front, Pin 1 is on the lower right side when the widest row is on the bottom. Pin numbers run from right to left alternating from bottom to top.

Diagram: 15 PIN "D" CONNECTOR



Appendix A
Sample Controlling Program for 860SC-C

Language: Microsoft's Version-5 Basic Running on Vector 5 Computer

```
10      '860 Computer Interface Driver
60      'Internal select from the computer
110     '
160     '08/23/83 JTT
210     '
260     '    Mode 1--Manual control of velocity
310     '         1. Velocity set by slide knob on front panel
360     '         2. Direction controlled by computer
410     '         3. Limit indicators input to computer
460
510     '    Mode 2--Computer control of velocity
560     '         1. Velocity set by DAC in computer
610     '         2. Velocity attenuated by slide knob on front panel
660     '         3. Direction controlled by computer
710     '         4. Limit indicators input to computer
760
810     '    Mode 3--Computer selection of motor number
860     '         1. Motor # selected by computer
910     '         2. Can operate either in MODE 1 (Manual Velocity)
960                 or MODE 2 (Computer Velocity)
1010    '
1020    '    Mode 4--Pure Manual Control
1030    '
1060    '
1110    '    CONTROL BIT MAP
1160    '           Bit  5  Motor Select  0 = Manual Select,
                                          1 = Computer Select
1210    '                2  Select Velocity Control Source, 0 = Manual,
                                                            1 = Computer
1260    '                1  FORWARD motion control
1310    '                0  REVERSE motion control
1360    '
1410    '    TYPICAL HARDWARE INTERCONNECT for VECTOR-GRAPHIC VIP
1460    '    OUTPUT = Port "B" (Port
1510    ' (Output Connector)  Pin #) (8255)   (Name)
1560    '         6            26     PB0    RREV (not)  (Remote reverse)
1610    '         7            25     PB1    RFOR (not)  (Remote forward)
1660    '         5            28     PB2    SELECT1
1710    '                                    0 = Manually-set velocity
1760    '                                    1 = Computer-set velocity
1810    '         2            27     PB3    SELECT2 (not) -- MOTOR
                                                 SELECTION BIT #0
1860    '         3            30     PB4    SELECT3 (not) -- MOTOR
                                                 SELECTION BIT #1
```

```
1910  '
1960  '                                 #     SELECT2  SELECT3   MOTOR#
2010  '                                 0        0        0         1
2060  '                                 1        0        1         2
2110  '                                 2        1        0         3
2160  '                                 3        1        1         4
2210  '
2260  '       4          29      PB5    SELECT4
2310  '                                 0 = Manual switch
                                            selection of motor #
2360  '                                 1 = Computer selection of
                                            motor #
2410  '      11           2      GND    GROUND
2460  '
2500  '
      ____________________________________________________________
2510  '    INPUT = Port "C"
2560  '      10           5      PC0    FORLMT 1=Limit
2610  '       3           6      PC1    REVLMT 0=No Limit
2660  '       1                  DAC Input (+10 to -10 VDC)
2710  '       8                  RUN (1=Run, 0=Stop)
2760  '
      ____________________________________________________________
2810  'LIBRARY OF OUTPUT COMMANDS
2860  '   OUT 9,&H3  = Undefined and not permitted
2910  '   OUT 9,&H1  = Manual control (Velocity/Motor), REVERSE
                       motion
2960  '   OUT 9,&H2  = Manual control (Velocity/Motor), FORWARD
                       motion
3010  '   OUT 9,&H0  = STOP all motion (PURE MANUAL CONTROL)
3060  '   OUT 9,&H7  = Undefined and not permitted
3110  '   OUT 9,&H5  = Manual control Motor, Computer control
                       Velocity, REVERSE motion
3160  '   OUT 9,&H6  = Manual control Motor, Computer control
                       Velocity, FORWARD motion
3210  '   OUT 9,&H4  = STOP all motion
3260  '   OUT 9,&H7  = Undefined and not permitted
3310  '        :             :     :   :     :
3360  '   OUT 9,&H17 = Undefined and not permitted
3410  '   OUT 9,&H21 = Motor #1, Manual Velocity, REVERSE
3460  '   OUT 9,&H22 = Motor #1, Manual Velocity, FORWARD
3510  '   OUT 9,&H20 = STOP ALL MOTION
3560  '   OUT 9,&H27 = Undefined and not permitted
3610  '   OUT 9,&H25 = Motor #1, Computer Velocity, REVERSE
3660  '   OUT 9,&H26 = Motor #1, Computer Velocity, FORWARD
3710  '   OUT 9,&H24 = STOP ALL MOTION
3760  '   OUT 9,&H2B = Undefined and not permitted
3810  '   OUT 9,&H29 = Motor #2, Manual Velocity, REVERSE
3860  '   OUT 9,&H2A = Motor #2, Manual Velocity, FORWARD
3910  '   OUT 9,&H28 = STOP ALL MOTION
3960  '   OUT 9,&H2F = Undefined and not permitted
4010  '   OUT 9,&H2D = Motor #2, Computer Velocity, REVERSE
4060  '   OUT 9,&H2E = Motor #2, Computer Velocity, FORWARD
4110  '   OUT 9,&H2C = STOP ALL MOTION
4160  '   OUT 9,&H33 = Undefined and not permitted
4210  '   OUT 9,&H31 = Motor #3, Manual Velocity, REVERSE
4260  '   OUT 9,&H32 = Motor #3, Manual Velocity, FORWARD
4310  '   OUT 9,&H30 = STOP ALL MOTION
```

```
4360  '    OUT 9,&H37 = Undefined and not permitted
4410  '    OUT 9,&H35 = Motor #3, Computer Velocity, REVERSE
4460  '    OUT 9,&H36 = Motor #3, Computer Velocity, FORWARD
4510  '    OUT 9,&H34 = STOP ALL MOTION
4560  '    OUT 9,&H3B = Undefined and not permitted
4610  '    OUT 9,&H39 = Motor #4, Manual Velocity, REVERSE
4660  '    OUT 9,&H3A = Motor #4, Manual Velocity, FORWARD
4710  '    OUT 9,&H38 = STOP ALL MOTION
4760  '    OUT 9,&H3F = Undefined and not permitted
4810  '    OUT 9,&H3D = Motor #4, Computer Velocity, REVERSE
4860  '    OUT 9,&H3E = Motor #4, Computer Velocity FORWARD
4910  '    OUT 9,&H3C = STOP ALL MOTION
4960  '
5010  '       LIBRARY OF INPUT DATA X      =      INP(10)
5060  '                            X    =    0   No limits
5110  '                            X    =    1   FORWARD limit
5160  '                            X    =    2   REVERSE limit
5210  ' ________________________________________________________
5260  '
5310  ' MENU
5360  '
5410  COSUB 17860 'INITIALIZE MOTIONS
5460  MOTOR% = &H20:MOTOR.% = 1 'PRESET ALL MOTOR DESIGNATIONS
      TO MOTOR #1
5510  PRINT CHR$(4)AT(10,34)"PREMENU INITIALIZATION";
5560  PRINT AT(12,10)"Does your controller come off limits
      automatically or";
5610  PRINT AT(13,10)"on a direction reversal?";
5660  PRINT AT(17,10)"2 = Automatically" AT(16,10) "1 = On direction
      reversal"
5710  PRINT CHR$(20)AT(23,0)"Enter Selection--CHR$(20)" ";:CMX = 1:
      GOSUB 16760
5760  IF CIN$="1" THEN 5910 'Autoclear LIMIT on direction reversal
5810  IF CIN$="2" THEN 5960 'Autoclear LIMIT on occurence
5860  PRINT AT(22.0)"Selection Error--Try Again!"AT(23,0)CHR$(17):
      GOTO 5710
5910  MODEFLAG=1:GOTO 6010 'AUTOCLEAR LIMIT ON OPPOSITE MOTION MODEL
5960  MODEFLAG=2 'AUTOCLEAR LIMIT ON OCCURENCE MODEL
6010  GOSUB 17860:PRINT CHR$(4)AT(10,34)"M E N U for"AT(11.21)"860
      COMPUTER INTERFACE DRIVER EXAMPLE";
6060  PRINT CHR$(20)AT(0.36)"MOTOR #"MOTOR.% CHR$(20);
6110  PRINT AT(13,10)STRING$(60."*");
6160  PRINT AT(15,20)"1 = MODE 1 (Operator-controlled Velocity)
6210  PRINT AT(16,20)"2 = MODE 2 (Computer-controlled Velocity)
6260  PRINT AT(17,20)"3 = MODE 3 (Computer-selection of Motor#)
6310  PRINT AT(18,20)"4 = MODE 4 (Return to CP/M)
6360  PRINT AT(19,20)"5 = MODE 5 (Pure Manual Operation)
6410  PRINT CHR$(20)AT(23,0)Enter Selection--CHR$(20) ;
6460  CMX = 1:GOSUB 16760
6510  IF CIN$="1" THEN 7160 'Mode #1
6560  IF CIN$="2" THEN 12510 'Mode #2
6610  IF CIN$="3" THEN 15110 'Mode #3 -- Motor Selection
6660  IF CIN$="4" THEN 18660 'Return to CP/M
6710  IF CIN$="5" THEN 6810
6760  PRINT AT(22,0)"Selection Error--Try Again!"AT(23,0)CHR$(17);:
      GOTO 6460
6810  OUT 9,0 'Manual selected
```

```
6860  PRINT CHR$(4)AT(10,25CHR$(20)"MANUAL OPERATION PERMITTED
      NOW"CHR$(20);
6910  PRINT AT(23,0)"Depress any key to return to menu...";
6960  A$=INKEY$:IF LEN(A$)= THEN 6960
7010  GOTO 6010 'RETURN TO MAIN MENU
7060  ' ____________________________________________________________
7110  '
7160  ' MODE 1
7210  '
7260  PRINT CHR$(4)AT(5,28)"MODE 1 OPERATION EXAMPLE"AT(7,10)
      STRING$(60,"*");
7310  PRINT CHR$(20)AT(0,36)"MOTOR #"MOTOR.% CHR$(20);
7360  GOSUB 17860 'INITIALIZE EVERYTHING
7410  PRINT AT(9,25)"1 = Test REVERSE limit"
7460  PRINT AT(10,25)"2 = Test FORWARD limit"
7510  PRINT AT(11,25)"3 = JOG and SLEW motions"
7560  PRINT AT(12,25)"4 = Return to Menu"
7610  PRINT CHR$(20)AT(23,0)"Enter Selection--"CHR$(20)" ";
7660  CMX=1:GOSUB 16760 'Input a single character with cursor
      blinking
7710  IF CIN$="1" THEN 8010 'TEST REVERSE LIMIT
7760  IF CIN$="2" THEN 9710 'TEST FORWARD LIMIT
7810  IF CIN$="3" THEN 11260 'SELECTED MOTIONS
7860  IF CIN$="4" THEN 6010 'return to menu
7910  PRINT AT(22,0)"Selection Error--Try Again!"AT(23,0)CHR$(17);:
      GOTO 7560
7960  '
8010  ' TEST REVERSE LIMIT
8060  '
8110  PRINT CHR$(4)CHR$(20)AT(5,29)"REVERSE LIMIT
TESTING"CHR$(20)AT(7,10)STRING$(60,"*")AT(23,79);
8160  PRINT CHR$(20)AT(0,36)"MOTOR #"MOTOR.% CHR$(20);
8210  PRINT AT(9,23)"Any key depression returns to Menu"
8260  IF MODEFLAG=1 THEN PRINT AT(10,23)"Place select switch in
      MANUAL";
8310  '
8360  ' Test for existing limits
8410  '
8460  IF (INP(10) AND 3)<>0 THEN 9210 ELSE 8560 '0=>NO LIMITS
8510  '
8560  'NO EXISTING LIMITS
8610  '
8660  COUNT = 0 'CYCLE COUNTER
8710  OUT 9,1+MOTOR% 'MOVE REVERSE INTO LIMIT
8760  A$=INKEY$:IF LEN(A$)<>0 THEN 6010
8810  IF (INP(10) AND 3)<>2 THEN 8760
8860  IF MODEFLAG=1 THEN 9410 ELSE 8910 'FOR STANDARD LIMIT CLEAR
      GOTO1810 OTHERWISE USE CODE BELOW
8910  OUT 9.MOTOR%:GOSUB 17810 'DELAY TO CLEAR LIMIT
8960  OUT 9,2+MOTOR% 'MOVE FORWARD TO CLEAR REVERSE LIMIT
9010  OUT 9,MOTOR% 'STOP ALL MOTION
9060  COUNT=COUNT+1
9110  PRINT AT(15,35) COUNT " CYCLES" AT(23,79);
9160  A$=INKEY$:IF LEN(A$) <>0 THEN 6010
9210  GOTO 8710
9260  '
```

```
9310  'WITH STANDARD, ORIGINAL LIMIT CLEAR WITH OPPOSITE MOTION
9360  '
9410  OUT 9,MOTOR%:GOSUB 17810:OUT 9,2+MOTOR%:GOSUB 17810:
      OUT9,MOTOR%:GOSUB 17810 'STOP/FORWARD WITH DELAY/STOP
9460  COUNT=COUNT+1
9510  PRINT AT(15,35) COUNT " CYCLESAT(23,79);
9560  A$=INKEY$:IF LEN(A$) <>0 THEN 6010
9610  GOTO 8710
9660  '
9710  ' TEST FORWARD LIMIT
9760  '
9810  PRINT CHR$(4)CHR$(20)AT(5,29)FORWARD LIMIT
      TESTING"CHR$(20)AT(7,10)STRINGS$(60,"*")AT(23,79);
9860  PRINT CHR$(20)AT(0,36)"MOTOR #"MOTOR.% CHR$(20);
9910  PRINT AT(9,23)"Any key depression returns to Menu";
9960  IF MODEFLAG=1 THEN PRINT AT(10,23)"Place select switch in
      MANUAL";
10010 '
10060 ' Test for existing limits
10110 '
10160 IF (INP(10) AND 3)<>0 THEN 10860 ELSE 10260 '0=>NO LIMITS
10210 '
10260 'NO EXISTING LIMITS
10310 '
10360 COUNT = 0 'CYCLE COUNTER
10410 OUT 9,2+MOTOR% 'MOVE FORWARD INTO LIMIT
10460 A$=INKEY$:IF LEN(A$) <>0 THEN 6010
10510 IF (INP(10) AND 3)<>1 THEN 10460
10560 IF MODEFLAG=1 THEN 10910 ELSE 10610 'FOR STANDARD LIMIT CLEAR
      GOTO 2231 OTHERWISE USE CODE BELOW
10610 OUT 9,MOTOR%:GOSUB 17810 'DELAY TO CLEAR LIMIT
      (Otherwise, a false limit may be set)
10660 OUT 9,1+MOTOR% 'MOVE REVERSE TO CLEAR FORWARD LIMIT
10710 OUT 9,MOTOR% 'STOP ALL MOTION
10760 COUNT=COUNT+1
10810 PRINT AT(15,35) COUNT " CYCLES" AT(23,79);
10860 GOTO 10410
10910 OUT 9,MOTOR%:GOSUB 17810:OUT 9,1+MOTOR%:GOSUB 17810:
      OUT 9,MOTOR%:GOSUB 17810
10960 COUNT=COUNT+1
11010 PRINT AT(15,35) COUNT " CYCLES" AT(23,79);
11060 A$=INKEY$:IF LEN(A$) <>0 THEN 6010
11110 GOTO 10410
11160 
11210 '
11260 'ARBITRARY MOTIONS
11310 'DEPRESSING UP ARROW MOVES MOTORIZER FORWARD
11360 'DEPRESSING DOWN ARROW MOVES MOTORIZER REVERSE
11410 '
11460 FWDFLG=1:REVFLG=1 'PRESET TO ACTIVE
11510 PRINT CHR$(4)CHR$(20)AT(10,26) "MOVEMENT FROM THE
      ARROW KEYS"CHR$(20)AT(12,10)STRINGS$(60,"*")AT(23,79);
11560 PRINT CHR$(20)AT(0,36)"MOTOR #"MOTOR.% CHR$(20);
11610 PRINT AT(15,10)"UP ARROW      => FORWARD"AT(16,10)"DOWN
      ARROW      => REVERSE" AT(23,79);
11660 PRINT AT(15,37)(DEPRESS DESIRED ARROW KEY)"AT(16,37)"X
      returns to menu";
```

```
11710 OUT 9,MOTOR% 'STOP ALL MOTIONS
11760 PRINT AT(23,0)CHR$(17)"ALL MOTIONS INACTIVE      ";
11810 GOSUB 18610:A$=INKEY$:IF LEN(A$) <>0 THEN 11710 ELSE 11910
11860 IF REVFLG=1 OR FWDFLG=1 THEN 11810 ELSE 11710 'IF RUNNING,
      DON'T STOP
11910 IF ASC(A$)=21 OR ASC(A$)=126 THEN 12160 ELSE 11960
11960 IF ASC(A$)=18 OR ASC(A$)=2 THEN 12260 ELSE 12010
12010 IF A OR A THEN 12060 ELSE 12110
12060 OUT 9,MOTOR%:PRINT CHR$(4):GOTO 6010'STOP EVERYTHING
12110 GOTO 11810
12160 IF REVFLG=1 THEN 12360
12210 OUT 9,2+MOTOR%:PRINT AT(23,0)"MOVEMENT ACTIVE
FORWARD";:FWDFLG=1:GOTO 11810
12260 IF FWDFLG=1 THEN 12410
12310 OUT 9,1+MOTOR%:PRINT AT(23,0)"MOVEMENT ACTIVE REVERSE";:
      REVFLG=1:GOTO 11810
12360 OUT 9,MOTOR%:REVFLG=0:GOSUB 17810:GOTO 12210
12410 OUT 9,MOTOR%:FWDFLG=0:GOSUB 17810:GOTO 12310
12460 '
12510 ' MOTIONS USING COMPUTER-GENERATED COMMAND VELOCITY
12560 '
12610 GOSUB 15810 'CHECK AND HANDLE LIMITS
12660 PRINT CHR$(4)CHR$(20)AT(10,20)"EXAMPLE OF
      COMPUTER-CONTROLLED VELOCITY"CHR$(20);
12710 PRINT CHR$(20)AT(0,36)"MOTOR #"MOTOR.% CHR$(20);
12760 PRINT AT(12,10)STRING$(60,"*");
12860 PRINT AT(16,10)"ENTER FORWARD VELOCITY IN % OF FULL SCALE...";:
12910 CMX÷3:GOSUB 16760
12960 FORWARD=VAL(CIN$)*400/100
13010 IF FORWARD>400 OR FORWARD<40 THEN PRINT AT(16,10)CHR$(17)
      ELSE 13110
13060 GOTO 12860
13110 PRINT AT(17,10)"ENTER REVERSE VELOCITY IN % OF FULL SCALE...";:
13160 CMX=3:GOSUB 16760
13210 REVERSE=VAL(CIN$)*400/100
13260 IF REVERSE>400 OR REVERSE<50 THEN PRINT AT(17,10)CHR$(17)
      ELSE 13410
13310 GOTO 13110
13360 'PRINT AT(17,10)"FORWARD="FORWARD"REVERSE="REVERSE
13410 FORWARD=STP+(FORWARD/3.15)
13460 REVERSE=STP-(REVERSE/3.15)
13510 'PRINT AT(18,10)"FORWARD="FORWARD"REVERSE="REVERSE
13560 COUNT=0
13610 '
13660 'MOTIONS
13710 ' MOVE REVERSE FIRST
13760 '
13810 PRINT AT(19,22)"DEPRESS X TO STOP AND RETURN TO MENU";
13860 OUT 9,5+MOTOR% 'SET TO COMPUTER AND SET TO REVERSE
13910 PRINT CHR$(20)AT(23,0)"REVERSE"CHR$(20)AT(23,79);:OUT &H10,
      REVERSE
13960 '
14010 'LOOK FOR LIMIT
14060 '
14110 A$=INKEY$:IF A$="X" OR A$="x" THEN 6010
14160 IF (INP(10) AND 3)=2 THEN 14210 ELSE 14110
14210 OUT &H10,STP:OUT 9,MOTOR%:GOSUB 17810
```

```
14255 '
14260 ' MOVE FORWARD SECOND
14310 '
14410 OUT 9,6+MOTOR% 'SET TO COMPUTER AND SET TO FORWARD
14460 PRINT CHR$(20)AT(23,0)"FORWARD"CHR$(20)AT(23,79);:
      OUT &H10,FORWARD
14510 '
14560 'LOOK FOR LIMIT
14610 '
14660 A$=INKEY$:IF A$="X" OR A$="x" THEN 6010
14710 IF (INP(10) AND 3)=1 THEN 14760 ELSE 14660
14760 OUT &H10,STP:OUT 9,MOTOR%:GOSUB 17810
14810 COUNT=COUNT+1
14860 PRINT AT(20,0)COUNT "CYCLES";
14910 A$=INKEY$:IF LEN(A$) <>0 THEN 13660
14960 GOTO 13660
15010 ================================================================
15060 '
15110 ' MOTOR SELECTION BY COMPUTER
15160 PRINT CHR$(4)AT(10,31)CHR$(20)"SELECT MOTOR
NUMBER"CHR$(20)AT(12,5)STRING$(70,"*");
15210 PRINT AT(14,20)"ENTER MOTOR NUMBER..";:CMX=1:GOSUB 16760;
15260 IF CIN$="1" THEN 15510
15310 IF CIN$="2" THEN 15560
15360 IF CIN$="3" THEN 15610
15410 IF CIN$="4" THEN 15660
15460 PRINT AT(22,0)"Selection Error--Try Again!"AT(23,0)CHR$(17):
      GOSUB 17810:GOTO 15160
15510 MOTOR%=&H20:MOTOR.%=1:GOTO 6010
15560 MOTOR%=&H28:MOTOR.%=2:GOTO 6010
15610 MOTOR%=&H30:MOTOR.%=3:GOTO 6010
15660 MOTOR%=&H38:MOTOR.%=4:GOTO 6010
15710 ================================================================
15760 '
15810 ' HANDLE LIMITS SUBROUTINE
15860 '
15910 OUT 9,MOTOR% ' STOP ALL FRONT PANEL CONTROLLED MOTIONS
15960 IF (INP(10) AND 3)=0 THEN RETURN 'NO LIMITS, RETURN TO CALLER
16010 IF (INP(10) AND 3)=1 THEN 16160 'IF FORWARD LIMIT, THEN
      SET SWITCH TO REVERSE
16060 IF (INP(10) AND 3)=2 THEN 16210 'IF REVERSE LIMIT, THEN SET
      SWITCH TO FORWARD
16110 OUT 9,MOTOR%:PRINT CHR$(20)AT(23,0)"LIMIT ERROR--
      HARDWARE FAULT!"CHR$(20);:RETURN
16160 OUT &H10,70:OUT 9,5+MOTOR%:OUT &H10,STP:OUT 9,MOTOR%:RETURN
      'SET SMALL REVERSE COMMAND VELOCITY,
      SET DIRECTION SWITCH TO REVERSE, STOP MOTOR, RETURN
16210 OUT &H10,90:OUT 9,6+MOTOR%:OUT &H10,STP:OUT 9,MOTOR%:
      RETURN 'SET SMALL FORWARD COMMAND VELOCITY, SET DIRECTION
      SWITCH TO FORWARD, STOP MOTOR, RETURN
```

```
16260 '
16310 ' CURSOR BLINKER SUBROUTINE
16360 '
16410 EVEN=0
16460 FOR BI=1 TO 50:A$=INKEY$:IF LEN(A$) <>0 THEN 16610
16510 NEXT BI
16560 PRINT CHR$(4);:EVEN=EVEN XOR 1:GOTO 16460
16610 IF EVEN THEN PRINT CHR$(14);
16660 RETURN
16710 '
16760 'INPUT SUBROUTINE TYPE #1--TO BE USED WHERE THE CURSOR IS NOW
16810 '
16860 ILIN=ATL:ICOL=ATC
16910 '
16960 ' INPUT SUBROUTINE TYPE #2--FOR CALCULATED NEW CURSOR POSITION
17010 '
17060 CIN$=""
17110 FOR I=1 TO CMX
17160 GOSUB 16310
17210 ASCA%=ASC(A$)
17260 IF ASCA%=18 OR ASCA%=23 OR ASCA%=26 OR ASCA%=27 THEN 17160
17310 IF ASCA%=24 OR ASCA%=127 THEN PRINT
      AT(ILIN,ICOL)STRING$(CMX,32)AT(ILIN,ICOL);:GOTO 17060
17360 IF ASCA%<>8 THEN 17560
17410 IF LEN(CIN$)=0 THEN 17160
17460 PRINT A$;:CIN$=LEFT$(CIN$,LEN(CIN$)- 1)
17510 I=I-1:GOTO 17160
17560 IF ASCA%=13 THEN RETURN
17610 PRINT A$;
17660 CIN$=CIN$+A$
17710 NEXT I
17760 RETURN
17810 FOR I=0 TO 450:I=I:NEXT I:RETURN 'SHORT DELAY
17860 STP=&H80:OUT &H10,STP:OUT &H8,&H89:OUT 9,MOTOR%::
      RETURN 'STOP EVERYTHING
17910 '
17960 'OUT 11,&H89 'Initialize Parallel Port
18010 '              PORT A = OUTPUT, PORT B = OUTPUT, PORT C = INPUT
18060 '                        (8)                (9)                (A)
18110 'OUT 9, MOTOR%'Stop all motions
18160      'OUT 9,3 = Undefined and not permitted
18210      'OUT 9,1 = Set direction control to REVERSE
18260      'OUT 9,2 = Set direction control to FORWARD
18310      'OUT 9,0 = Stop all motions
18360      'OUT 9,7 = Undefined and not permitted
18410      'OUT 9,5 = Computer in control, Direction =< REVERSE
18460      'OUT 9,6 = Computer in control, Direction =< FORWARD
18510      'OUT 9,4 = Computer in control, ALL STOP
18560 '
18610 FOR I=0 TO 30:I=I:NEXT I:RETURN 'SHORTER DELAY
18660 PRINT CHR$(4)CHR$(20)AT(12,32)"RETURNING TO CP/M"CHR$(20);:
      SYSTEM'Clear screen and return to CP/M
```

Appendix B

Adjusting the 860SC speed controller velocity servo

Normally, the Velocity Servo needs no adjustment. However, due to component aging or shipment vibration, both the bridge balance and power driver zero might need readjustment. Symptoms include rough or hesitant operation or poor velocity regulation. Note, however, that a dirty leadscrew or over tightened mounting can cause these same symptoms. The following is a description of how to adjust the servo. Please refer to Appendix F for schematics and component placement diagrams.

1. Bridge Balance

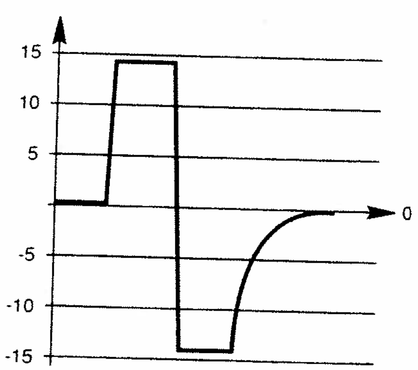
The motor coil/servo bridge is balanced by adjusting R15 by the following procedure:

Step	Action
1	Connect a scope to TP6. TP2 is ground. Vertical scale: 5 volts per division. Horizontal scale: 5 milliseconds per division. NORM trigger with positive slope.
2	Issue a FORWARD JOG repetitively.
3	Adjust R15 until response to JOG pulse is "critically damped." That is, the servo's final response to the driving pulse going away is to return to ground with no overshoot nor ringing.
4	Under damped response is when the negative servo response doesn't make it to maximum negative voltage.

2. Servo Zero

The Servo Bridge zero is set by adjusting R19 by the following procedure:

Step	Action
1	Connect scope to TP6. Vertical scale: 10 mV per division.
2	No JOG. No DIRECTION. Set scope ground to center of screen.
3	Adjust R19 until noise pattern is centered on scope ground.



CORRECT WAVEFORM

IMPORTANT:

The Bridge Balance and Servo Zero are interrelated. To align the total servo, a reiterative process must be used.

Appendix C

Joystick Adjustments

Internal Adjustments

The 860J has 6 internal adjustments that may be accessed by the user. Please refer to Appendix G, drawing No. 1148.

Function	Component	Value	Location
1. X-Axis Servo Balance	R5	200	Left rear near power amp
2. X-Axis Servo Zero	R2	20 K	Left rear near connector
3. X-Axis Limit Sensitivity	R6	1 M	Left side near rear
4. Y-Axis Servo Balance	R17	200	Right side near power amp
5. Y-Axis Servo Zero	R15	20 K	Right rear near connector
6. Y-Axis Limit Sensitivity	R23	1 M	Right side near rear

In addition, the 860J has 7 test points for aiding in making these adjustments.

1. X-Axis MOTORHIGH (After Current Limit)	TP1	
2. X-Axis MOTORHIGH (Before Current Limit)	TP2	Left side edge
3. X-Axis Limit Sensitivity	TP3	
4. Y-Axis MOTORHIGH (After Current Limit)	TP4	
5. Y-Axis MOTORHIGH (Before Current Limit)	TP5	Right side edge
6. Y-Axis Limit Sensitivity	TP6	
7. Ground		

Servo Balance

The servo balance is adjusted similarly to the description found in Appendix B for the 860SC. In detail, set the speed control switch to SLOW and attach the scope to TP2 and use TP7 for GROUND. With a motorizer attached to the X-Axis, move the JOYSTICK control rod to full forward. This will produce the characteristic servo response to a series of pulses—a rapid full-scale positive swing for <10 mS followed by a rapid full-scale negative swing for <5mS followed by a gradual return to GROUND with only a slight hint of overshoot or ringing. Adjust R2 until the desired shape is achieved.

Repeat the procedure for Y-Axis with TP5, TP7, and R17.

Zero Adjust

Be sure no motorizer is currently in a limit and the JOYSTICK control rod is freely centered. With the scope or digital voltmeter connected as described above, adjust R5 and R15 for X and Y respectively until the resultant signal is centered on zero with 50mV.

Limit Sensitivity

Maximum voltage on TP7 produces maximum sensitivity. Minimum voltage produces minimum sensitivity and may not trip the limit at all. You may adjust R46 until you have the sensitivity you desire for the load you are pushing. It has already been set at the factory for average conditions and should operate well without any adjustment.

Appendix D

860SC JOG Performance

(and other useful information)

Introduction

The JOG function of the 860SC is for refining position with smaller motions than can be achieved with the slewing controls. While the 860SC normally in slew mode controls the Motorizer via a tight velocity servo, in contrast, the 860SC JOG function does not really exhibit servo capability. This means the amount of JOG is sensitive to how much load is on the Motorizer.

The JOG is produced by a pulse or train of pulses fed into the 860SC's velocity servo. The JOG cannot produce uniform, repeatable motion because the 860 Motorizer does not have internal position information. However, if the motor/servo responds uniformly to each JOG pulse then the Motorizer JOG motion can approach uniformity. Certain factors influence the actual JOG distance: the primary factor being the load on the Motorizer, followed by temperature and motor commutator position at time of the JOG pulse.

The JOG's purpose is simply to provide a means of finer movement than can be provided by the 860SC's non-JOG slewing-type controls. It is a small "kick" or a series of small "kicks" to the control system to allow the user to refine the position but not produce precision movement.

The amplitude of each pulse is attenuated by the position of the velocity control slide-pot. While a chain of JOG pulses can simulate a slow, relatively short width, 2.8 to 7µS, the built-in velocity servo cannot function properly to produce a reliably constant distance per pulse. And as a result, the Motorizer may not travel at a constant velocity in response to a train of pulses—especially if there are small variations in the load due to "stiction." However, the velocity variation for a constant load and continuous JOG has been measured to be constant well within ±10%.

As stated above, the amount of motion is a function of the effective Motorizer load. Under a heavy load, say 20 to 30 lbs., the motor's time constant plays a role in restricting the ability of the motor to achieve commanded speed during the short pulse.

Incremental Motion

While the minimum JOG capability is 0.02µm, certain conditions must be met. We have used the following method to estimate the JOG performance:

> View a precision resolution target photoplate with a microscope at 400X. By knowing the JOG pulse rate and counting time, we can determine the number of pulses necessary to move a known distance—and thus the distance per pulse.

For example:

Special Low Speed JOG
Standard Pulse Rate
Special Reduced Pulse Width
Standard Pulse Amplitude

Pulse rate	=	8.0 pulses/second (125 mS period)
Pulse width	=	2.8 mS (R53 = 33K)
Pulse amplitude	=	.38 volts @ 1 speed unit
Dimension measured	=	57 µm
Average time for motion	=	254.8 seconds
Axial load on motorizer	=	3 lbs. ±1 lb.
860SC Velocity control setting	=	1 unit
Distance per pulse	=	(57)/((254.8)(8.0)) = 0.028 µm
Rate	=	.228 µm/second
Measured motion at 1 setting	=	0.03 µm per pulse

By increasing the load above 3 or 4 lbs., the movement per JOG pulse can be reduced.

Summary

	Special Low-Speed	Standard	Special High-Speed
Minimum JOG distance per pulse	0.3 µm	0.7 µm	.27 µm

Theory of Operation

The center-off, spring-return, front panel JOG switch routes one of two pulse streams into the velocity servo through the velocity control slide-pot—one stream for forward motion, the other for reverse. The pulse streams have a typical frequency of 6 to 8 pps allowing a single manual switch actuation to produce a single pulse. Because the 860SC is controlled by a velocity servo, the distance moved in response to each pulse is related to the pulse amplitude and pulse width, or in other words the pulse area.

While the width of each pulse is fixed in any 860SC, it can be tailored to fit a given customer's need. Similarly, the initial pulse amplitude is fixed by internal components but can be also tailored to fit an environment. In use, the velocity control slide-pot attenuates the pulse height.

Pulse Width Modification

Components Involved = R53, R54
56K 2.7M

By changing R53, the pulse width will be changed porportionally. For example, a reduction to 33K will halve the pulse width.

Initial Pulse Amplitude

Components Involved = R59
33K

By shorting out R59, the amplitude approaches 12.5 volts at a velocity control slide-pot setting of 10. When R59=33K, a setting of 10 produces 3.8 volts. Values should not exceed 100K or else the motor will fail to start.

The built-in velocity servo responds to a command velocity voltage signal. When a velocity signal is applied to the servo, it drives the motor at maximum acceleration from a dead stop until it reaches commanded speed. As the motor approaches commanded speed, the servo reduces the motor drive power until a match is made between commanded speed and actual speed. Thereafter, the motor's speed is regulated by the servo to accommodate changes in load as long as the load accommodation is not beyond the servo's capability.

However, the motor has a finite time constant of approximately 35 mS—that is, it takes 35 mS for the motor to reach 62% of its maximum speed after receiving a full-speed command. Any commanded velocity signal lasting less than 35 mS may not allow the motor to achieve commanded speed unless the commanded speed is quite low.

The net result of this is the following: At a velocity control slide-pot setting of "1", the short JOG pulses of 2.8 to 7 mS have a relatively low amplitude so the motor appears to reach commanded velocity within the pulse time. However, as the slide-pot setting is elevated, the commanded velocity rises to a point where the motor cannot reach commanded velocity with the pulse time. Thus while it is accelerated to commanded velocity, the motor is abruptly halted at the end of each pulse. Raising the command velocity signal or pulse amplitude has no effect since the motor can't accelerate any faster.

In practice, this means that a slide-pot setting of 4 or 5 produces the maximum Motorizer distance in response to a JOG pulse. Any setting above that will produce little or no increase in distance and speed.

Notes:

1. A heavy load (20–30 lbs.) may not even allow the JOG to produce any motion or else it may produce erratic motions. Even smaller loads have been known to produce erratic motion. By erratic motion we mean not taking a physical step for each pulse.
2. Velocity Control slide-pots may be non-linear at the low end with a 2 setting only being 50% greater than the 1 setting instead of 100% greater.
3. If your particular unit travels too far or too fast for the 1 setting, add more axial load to reduce the travel and speed, or change R59 to a higher value. Be cautioned that the motor needs a certain amount of input energy just to start moving. You cannot make R59 greater than 100K.
4. If you require extremely fine JOG motion, consider ordering Motorizers with higher gearhead ratios. Alternate ratios are available starting 2 times higher and at factors of 2 for 6 ratios higher than the standard. See the Load/Speed Chart in Section 2.1.

6. All motorizers appear to exhibit a "reversal error." This error is visible when you change direction. It is not backlash, but a continuation in the same direction moved before the reversal. We have typically measured it to be 1 to 5 µm. For example, if you're moving forwards and stop and then attempt to move backwards, the motorizer may continue to move forward the 1–5 µm and then move backward.

7. The motorizer's backlash is typically 5 to 10 µm. Backlash is defined as the effective distance traveled during a motion reversal when the leadscrew does not rotate. Backlash is caused by all the tolerances in the mechanical drive train.
8. If you're trying to use the motorizer for regular but extremely small movements but don't want the higher gearing, the motorizer can be controlled directly from a digital source with a ±10 volt DAC. By bypassing the 860SC Controller and driving the Motorizer directly, you can tailor the pulse height and width to satisfy your particular needs. When using the 860SC-C, you can route the DAC's output through the computer connector and drive the Motorizer with the velocity servo. But, because of the motor's fixed time constant, the best method to produce regular but slow JOG motion is with pulse-width modulation.

Other Typical Examples:

Standard Jog
Standard pulse rate
Standard pulse width
Standard pulse amplitude

PULSE RATE	= 7.3 pulses/second (138 µS period)
PULSE WIDTH	= 5.5 µS (R53 = 56K) STANDARD
PULSE AMPLITUDE	= .38 volts @ speed setting 1
(R59 = 33K)	
DIMENSION MEASURED	= 57 µM
AVERAGE TIME FOR MOTION	= 112.8 seconds
AXIAL LOAD ON MOTORIZER	= 3 lbs. = /-1 lb.
860SC VELOCITY CONTROL SETTING	= 1 unit

Distance per pulse = (57)/((112.8)(7.3)) = 0.070 µM
Rate = .51 µM/second

Special High-Speed Jog
Standard pulse rate
Standard pulse width
Special high-voltage pulse amplitude

PULSE RATE	= 6.8 pulses/second (148 µS period)
PULSE WIDTH	= 6.0 µs (R53 = 56K)
PULSE AMPLITUDE	= 1.25 volts @ speed setting 1
(R59 = 0)	
DIMENSION MEASURED	= 57 µM
AVERAGE TIME FOR MOTION	= 32.4 seconds
AXIAL LOAD ON MOTORIZER	= 3 lbs. =/- 1 lbs.
860SC VELOCITY CONTROL SETTING	= 1 unit

Distance per pulse = (57)/((32.4)(6.8)) = 0.26 µM
Rate = 1.8 µM/second

Typical Slewing Measurements
Velocity Setting = 1: 32 µM/sec
Velocity Setting = 10: 320 µM/sec

Please feel free to contact the factory for additional information.

Appendix E
Troubleshooting

860A Troubleshooting

Actuator stuck at foreword limit:

Disconnect power from actuator. To remove from limit, turn the spindle by hand. Reconnect power then run actuator.

If the actuator still senses a limit clean the spindle with a dry rag then lubricate with 3-in-1 oil.

Actuator stuck in reverse limit:

Connect a power supply, set to 15 volts 500 mA, to 860I-10 cable. Connect power supply negative lead to the center pin of the 860I-10 cable. If this does not eliminate the limit condition, return actuator to factory for repair.

860SC Troubleshooting

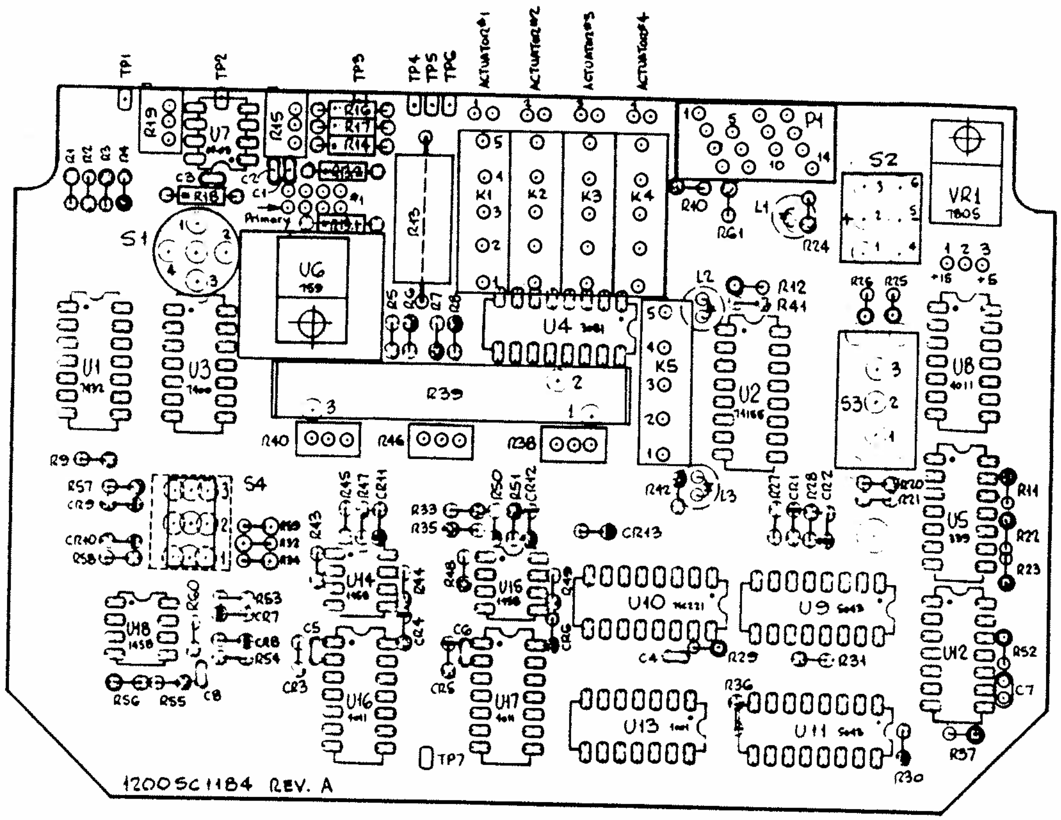
Please refer to Appendix F for Component Placement Diagrams and Schematics.

Symptom	Possible Repair
Motor vibrates	If you're near or at a limit, the motor vibration is simply caused by the velocity servo attempting to overcome the infinite resistance of the internal stop. If you're not near a limit but pushing a heavy load, 30 to 40 lbs., the vibration is again caused by the velocity servo attempting to fight against the back motion caused by the heavy load. Nothing can be done to remove this effect. If you're not near a limit and unloaded, the bridge may be out of balance, or the leadscrew may be dirty, or the motorizer is clamped too tightly in your component's mounting clamp. See adjustment procedure in Appendix B.
Limit Light won't indicate	NAND U16 or U17 defective. Replace.
High voltage kick to clear limit not functional	DUAL ONE-SHOT U10 defective. Replace.
Motor runs in one direction only	NAND U8 defective. Replace. + or – voltage missing

Appendix F

860SC & 860SC-C Speed Controller Schematics

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
		REV "A"	12/12/84	



NOTES:

1. Upright Resistor/Diode Shading Indicates Body Line indicates cathode
2. Relay Pinout 5 4 3 2 1
3. When R13, R13.1, R13.2 omitted, use insulated #24 wire indicated by dashed line. (Not R13.2)
4. TP1 = Velocity Servo Feedback
   TP2 = Analog Ground
   TP3 = Primary Amp. Output
   TP4 = Command Velocity
   TP5 = Motor High #1
   TP6 = Motor High #2
   TP7 = Limit Sensitivity Level
5. Offset R16, R17, R14 to clear TP3.
6. Place TP2 & TP3 on solder side.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

NEXT ASSY	USED ON
APPLICATION	

CONTRACT NO.

APPROVALS		DATE
DRAWN	11/16/84	JTT
CHECKED		

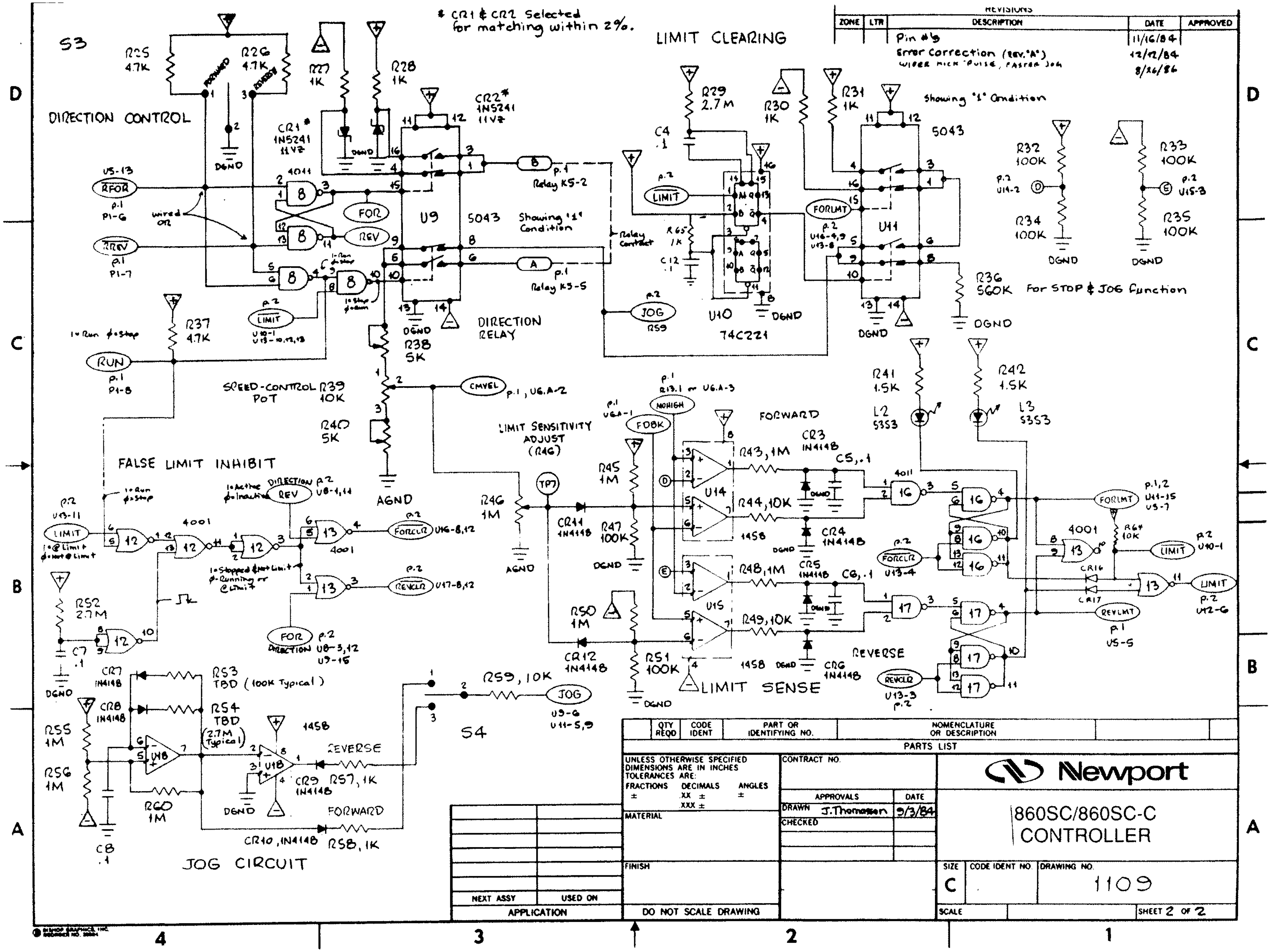
Newport

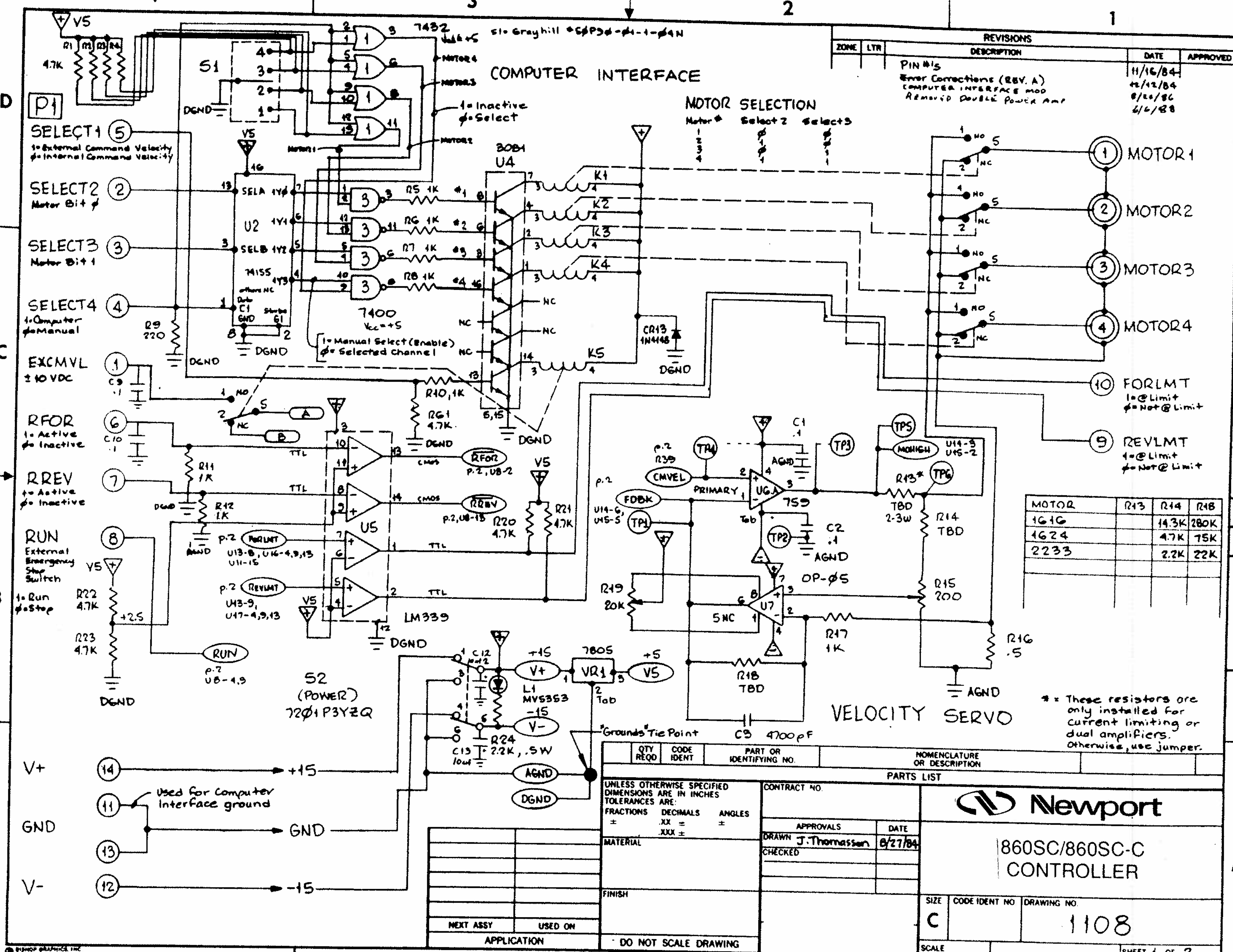
COMPONENT PLACEMENT
860SC/860SC-C CONTROLLER
PCB# 860SC1184 REV

SIZE	CODE IDENT NO	DRAWING NO.
C		1176

SCALE 2X SHEET 1 OF 1

BISHOP GRAPHICS INC. REORDER NO. 20904


* CR1 & CR2 Selected for matching within 2%.
LIMIT CLEARING
DIRECTION CONTROL
DIRECTION RELAY
SPEED-CONTROL POT
FALSE LIMIT INHIBIT
LIMIT SENSITIVITY ADJUST (R46)
FORWARD
REVERSE
LIMIT SENSE
JOG CIRCUIT
For STOP & JOG function
Showing "1" Condition
REVISIONS
Pin #'s
Error Correction (Rev."A")
11/16/84
12/12/84
8/26/86
PARTS LIST
Newport
860SC/860SC-C
CONTROLLER
DRAWN J.Thomassen 5/3/84
SIZE C
DRAWING NO. 1109
SHEET 2 OF 2
DO NOT SCALE DRAWING
APPLICATION



*= These resistors are only installed for current limiting or dual amplifiers. Otherwise, use jumper.

MOTOR	R13	R14	R18
1616		14.3K	280K
1624		4.7K	75K
2233		2.2K	22K

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
		PIN #'s		
		Error Corrections (REV. A)	11/16/84	
		COMPUTER INTERFACE MOD	12/12/84	
		Remove Double Power Amp	8/22/86	
			6/6/88	

PARTS LIST

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS | DATE
DRAWN J. Thomassen 8/27/84
CHECKED

Newport

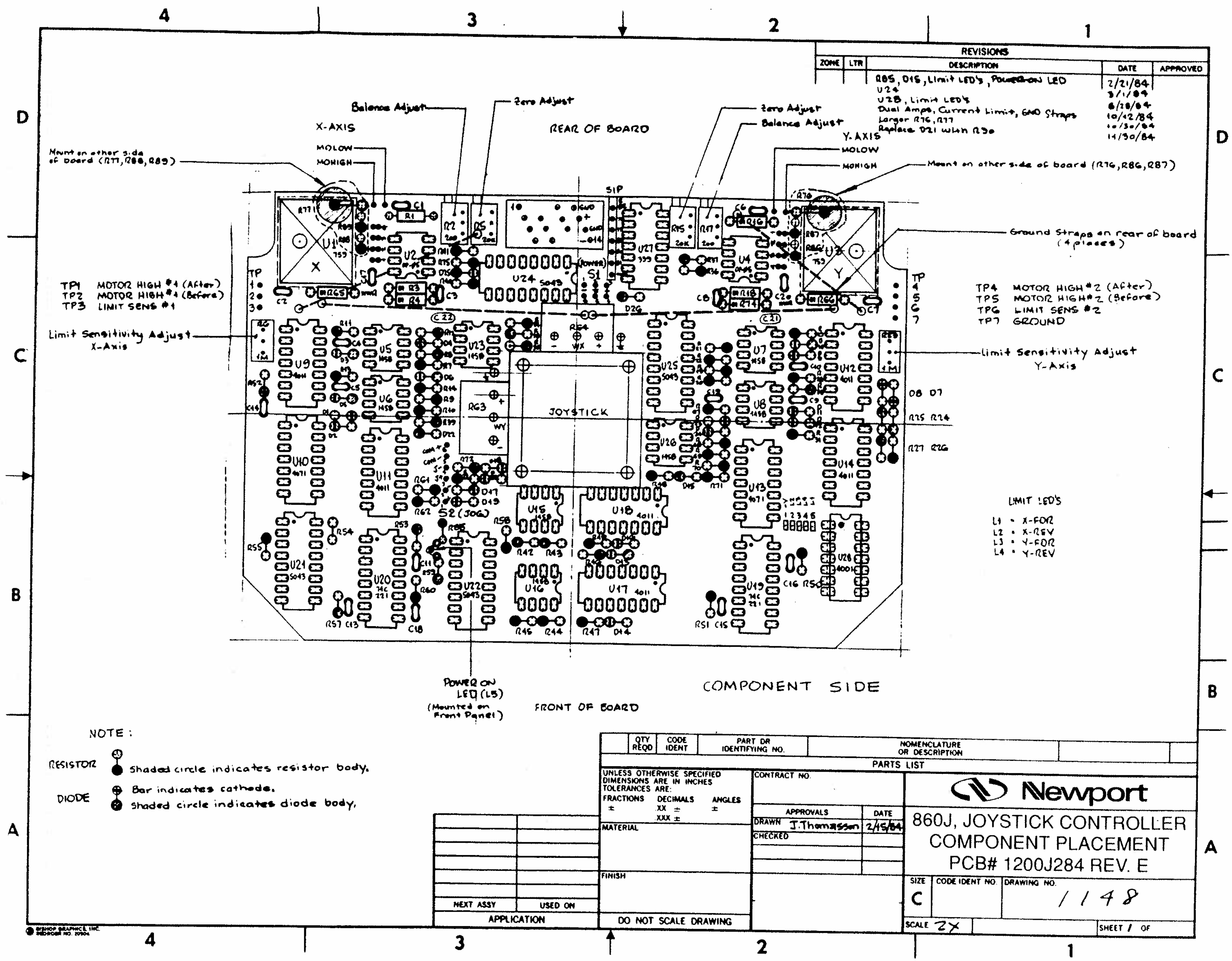
860SC/860SC-C CONTROLLER

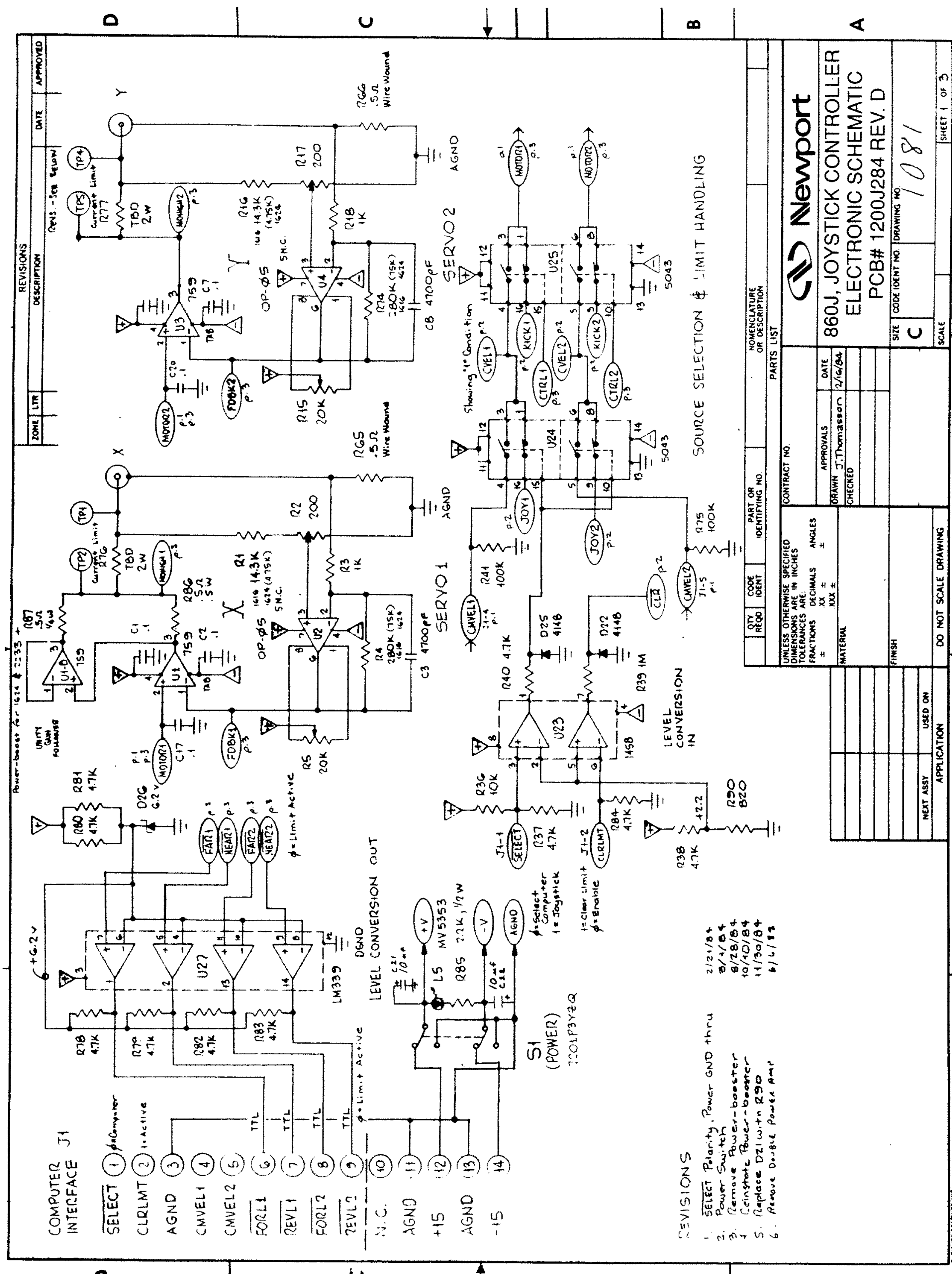
SIZE C | CODE IDENT NO | DRAWING NO. 1108

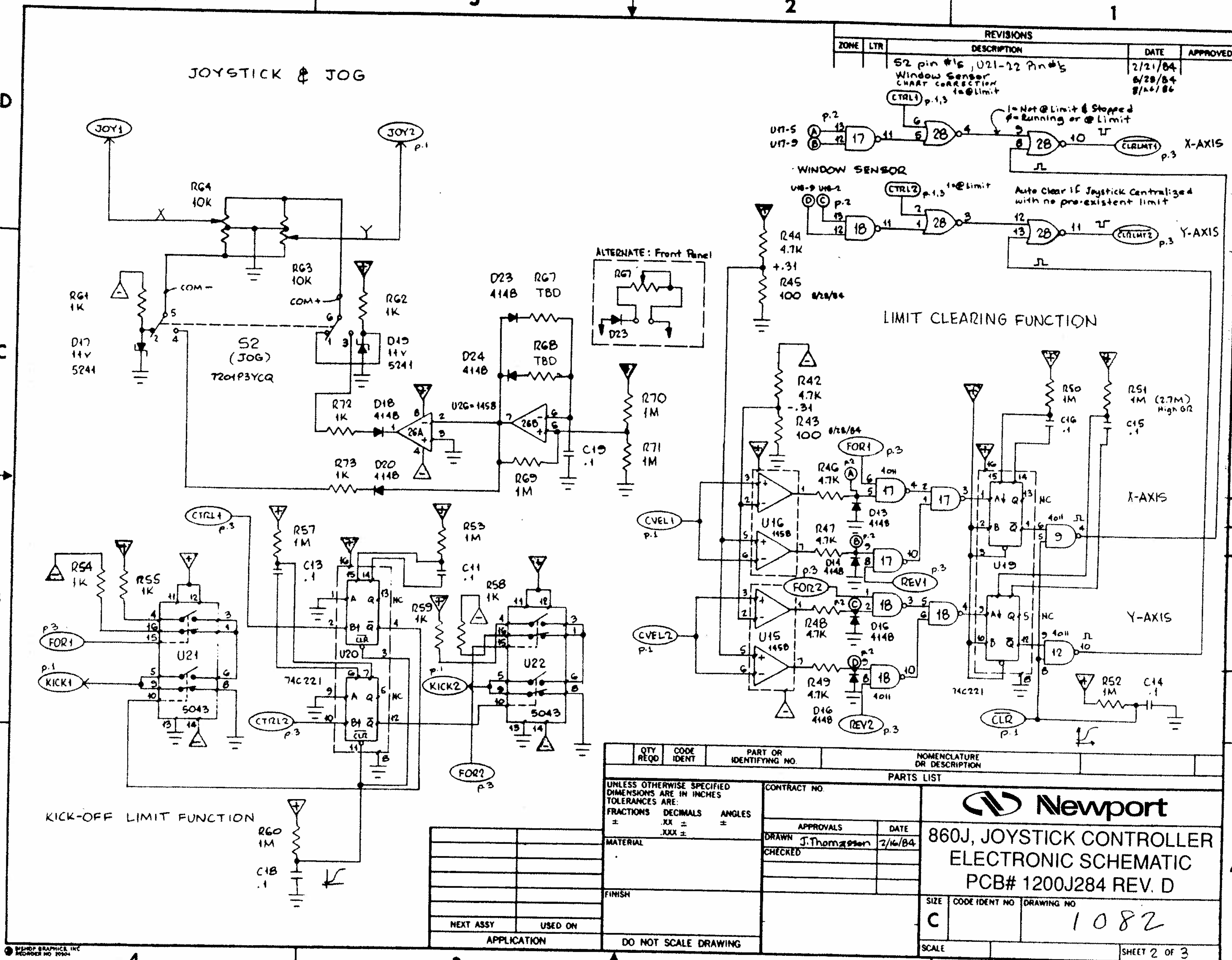
SCALE | SHEET 1 OF 2

Appendix G

860J Joystick Controller Schematics

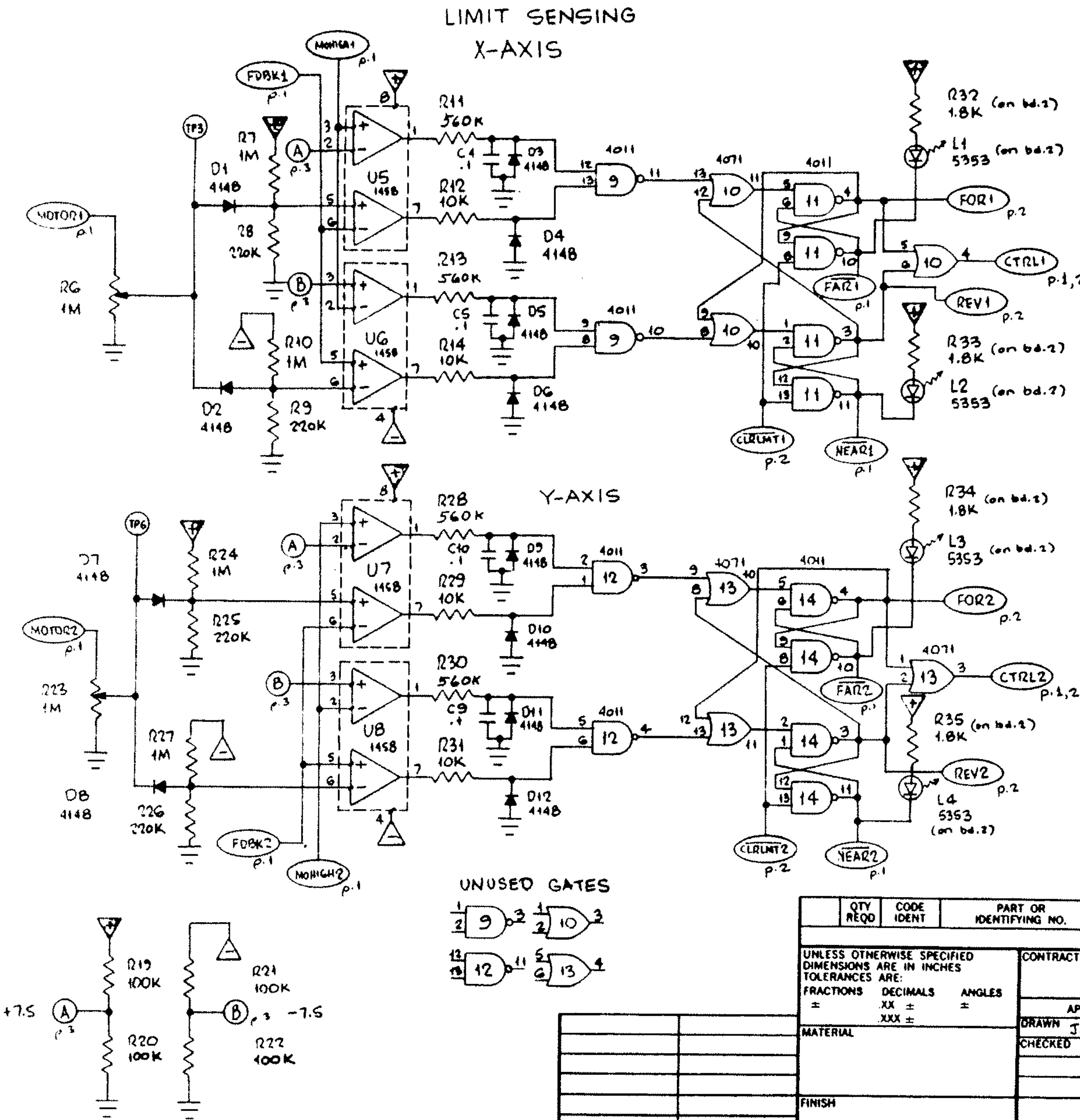

REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
R85, D15, Limit LED's, Power-on LED | 2/21/84
U24 | 3/1/84
U28, Limit LED's | 6/18/84
Dual Amps, Current Limit, GND Straps | 10/12/84
Larger R76, R77 | 10/30/84
Replace D21 with R30 | 11/30/84
Balance Adjust
Zero Adjust
X-AXIS
MOLOW
MOHIGH
Mount on other side of board (R77, R88, R89)
REAR OF BOARD
Y-AXIS
Mount on other side of board (R76, R86, R87)
Ground Straps on rear of board (4 places)
TP1 MOTOR HIGH #1 (After)
TP2 MOTOR HIGH #1 (Before)
TP3 LIMIT SENS #1
TP4 MOTOR HIGH #2 (After)
TP5 MOTOR HIGH #2 (Before)
TP6 LIMIT SENS #2
TP7 GROUND
Limit Sensitivity Adjust X-Axis
Limit Sensitivity Adjust Y-Axis
JOYSTICK
LIMIT LED'S
L1 - X-FOR
L2 - X-REV
L3 - Y-FOR
L4 - Y-REV
Power ON LED (L5) (Mounted on Front Panel)
FRONT OF BOARD
COMPONENT SIDE
NOTE:
RESISTOR Shaded circle indicates resistor body.
DIODE Bar indicates cathode. Shaded circle indicates diode body.
QTY REQD | CODE IDENT | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ± DECIMALS XX ± XXX ± ANGLES ±
MATERIAL
FINISH
CONTRACT NO.
APPROVALS DATE
DRAWN J.Thomassen 2/15/84
CHECKED
NEXT ASSY USED ON
APPLICATION
DO NOT SCALE DRAWING
Newport
860J, JOYSTICK CONTROLLER
COMPONENT PLACEMENT
PCB# 1200J284 REV. E
SIZE C CODE IDENT NO. DRAWING NO. 1148
SCALE 2X SHEET 1 OF


Newport
860J, JOYSTICK CONTROLLER
ELECTRONIC SCHEMATIC
PCB# 1200J284 REV. D
SHEET 1 OF 3
DRAWN J.Thomasson 2/16/84
DO NOT SCALE DRAWING
REVISIONS
SERVO 1
SERVO 2
SOURCE SELECTION & LIMIT HANDLING
LEVEL CONVERSION OUT
LEVEL CONVERSION IN
COMPUTER INTERFACE J1
SELECT
CLRLMT
AGND
CMVEL1
CMVEL2
FORL1
REVL1
FORL2
REVL2
N.C.
AGND
+15
AGND
-15
S1 (POWER)
X
Y
AGND
DGND
LM339
U27
U23
U24
U25
5043
1458



JOYSTICK & JOG
LIMIT CLEARING FUNCTION
KICK-OFF LIMIT FUNCTION
WINDOW SENSOR
X-AXIS
Y-AXIS
ALTERNATE: Front Panel
S2 (JOG) T201P3YCQ
Auto Clear if Joystick Centralized with no pre-existent limit
1=Not @ Limit & Stopped
0=Running or @ Limit
REVISIONS
S2 pin #'s, U21-22 Pin#'s
Window Sensor
CHART CORRECTION
2/21/84
6/28/84
8/26/86
Newport
860J, JOYSTICK CONTROLLER
ELECTRONIC SCHEMATIC
PCB# 1200J284 REV. D
DRAWN J. Thomassen 2/16/84
SIZE C
DRAWING NO 1082
SHEET 2 OF 3
DO NOT SCALE DRAWING
PARTS LIST

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
		Shaded Power Symbols, LED's on bd.2	2/21/84	
		R80, R82	3/1/84	
		R11, R13, R28, R30 CHANGED TO 560K	3/3/87	



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

NEXT ASSY | USED ON

APPLICATION

CONTRACT NO.

APPROVALS		DATE
DRAWN	J.Thomasser	2/16/84
CHECKED		

Newport

860J, JOYSTICK CONTROLLER
ELECTRONIC SCHEMATIC
PCB# 1200J284 REV. D

SIZE C | CODE IDENT NO. | DRAWING NO: 1083

SCALE | SHEET 3 OF 3

Service Form

Newport Corporation
U.S.A. Office: 714/863-3144
FAX: 714/253-1800

Name ______________________________

Company ______________________________

Address ______________________________

Country ______________________________

P.O. Number ______________________________

RETURN AUTHORIZATION # ______________

(Please obtain prior to return of item)

Date ______________________________

Phone Number ______________________________

FAX Number ______________________________

Item(s) Being Returned:

Model # ______________________ Serial # ______________________

Description: ______________________________

Reason for return of goods (please list any specific problems) ______________________________

____

Please complete the below, as appropriate.

List all control settings and describe problem: ______________________________

____

____

______________________________ (Attach additional sheets as necessary).

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Describe signal source. If source is a laser, describe output mode, peak power, pulse width, repetition rate and energy density.

Where is the measurement being performed?

(factory, controlled laboratory, out-of-doors, etc.) ______________________________

What power line voltage is used? ______________ Variation? ______________

Frequency? ______________ Ambient Temperature? ______________

Variation? ______________ °F. Rel. Humidity? ______________ Other? ______________

Any additional information. (If special modifications have been made by the user, please describe below).

____

____

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