Boston Gear® Ratiopax®

DC Motor Speed Control

Installation and Operation

Doc. No. 83501

RP1, RP1R 1/6 - 1/2 HP
RP2, RP2R 3/4 - 1 HP

Boston Gear

Description

Boston Gear Ratiopax Controllers staically convert single-phase AC line power to regulated DC for adjustable-speed armature control of shunt wound and permanent magnet motors.

Enclosure

Nonventilated, dust resistant, NEMA Type 1, constructed of diecast aluminum alloy.

Operator Controls

The operator controls, integrally mounted on the front panel, include the following:
Models RP1 and RP2 - A calibrated SPEED control pot and a RUN/STOP toggle switch.
Model RP1R and RP2R - A calibrated SPEED control pot and a FORWARD/STO/REVERSE toggle switch. The reversing switch has a center position detent which provides antiplug protection.

Ratings

1. Service Factor: 1.0
2. Duty: Continuous
3. Overload Capacity: 150% for 1 minute
4. AC Line Fuse Interrupting Capacity: 5000 amperes
5. Speed Control Pot: 100K ohms, 2W

Operating Conditions

1. Line voltage Variation: +/-10% of rated
2. Line Frequency Variation: +/-2 Hertz
3. Ambient Temperature range: 0 to 40°C (32°F to 104°F)
4. Altitude (standard): 1000 meters (3300 feet) max.

Performance Characteristics

1. Controlled Speed Range: 0 to motor base speed
2. Speed Regulation (*See Table 3*) - Regulation percentages are of motor base speed under steady-state conditions.
3. Efficiency (at rated speed and rated load)
   a. Controller: 99%
   b. Controller with motor: 85%
4. Displacement Power Factor (at rated speed and rated load): 87%
5. Acceleration (nonadjustable): By current limit
6. Current Limit: 150% full-load torque (typical (nonadjustable)

Table 1. Model Types

Model	Function			HP Range	Power Output VDC		
	Regulated Power Conversion	Uni-directional Run-Stop	Reversing Run-Stop		Source (Single Phase)	Arma-ture	Field
RP1	X	X		1/6-1/2	115V	0-90	50
RP1R	X		X		50 or 60 Hz		
RP2	X	X		3/4-1	230V	0-180	100
RP2R	X		X		50 or 60 Hz		

Table 2. Ratings

Component			Ratings					
Rated Horsepower (HP)			1/6	1/4	1/3	1/2	3/4	1
Rated Kilowatts (KW)			0.124	0.187	0.249	0.373	0.560	0.746
1-Phase AC Input (Full Load)	Line Amps	115VAC Controller	3.9	5.0	6.0	8.7	---	---
		230VAC Controller	---	---	---	---	5.9	8.8
	KVA		.48	.58	.71	1.0	1.4	2.0
DC Output (Full Load)	Motor Armature Amps	90VDC	2.0	2.8	3.5	5.4	---	---
		180VDC	---	---	---	---	3.8	5.5
	Motor (1) Field Amps	50VDC	1.0	1.0	1.0	1.0	---	---
		100VDC	---	---	---	---	1.0	1.0
Full-Load Torque (lb. ft) with 1750 RPM Base Speed Motor			0.5	0.75	1.0	1.5	2.2	3.0
Minimum Transformer KVA for Voltage Matching or Isolation			0.5	0.75	0.75	1.0	1.5	2.0
Controller Physical Data	Approximate Weight		2.0 lbs. (0.9kg.)					
	Standard Dimensions		See Figure 2					

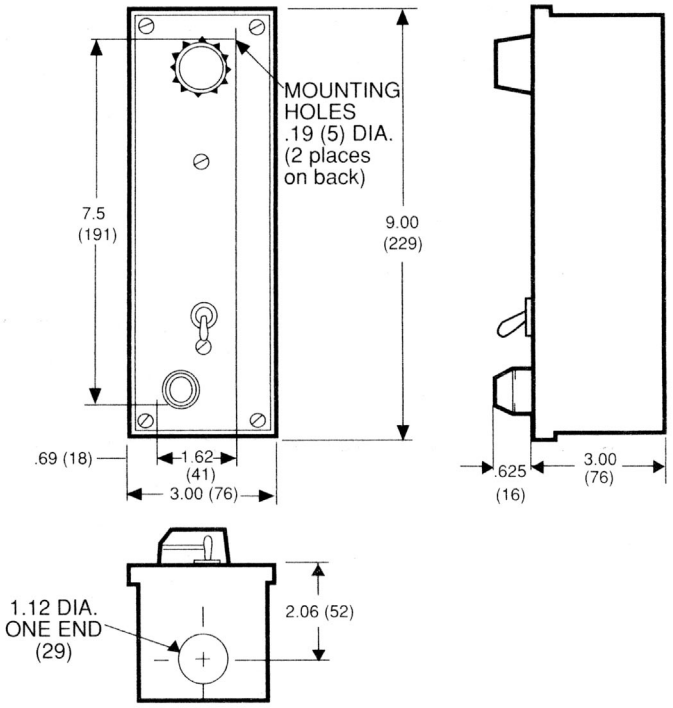
(1) Not applicable with permanent magnet motors.

Table 3. Speed Regulation Characteristics

Regulation Method	Variables				Speed Range
	Load Change 95%	Line Voltage +/-10%	Field Heating Cold/Normal	Temperature +/-10%	
Voltage Feedback with IR Compensation	2%	+/-1%	5-12%	+/-2%	50:1

Figure 1. Typical Ratiopax Controller

Figure 2. Ratiopax Dimensions



1. Report shipping damage to the carrier.
2. Unpack the controller and remove all packing material.
3. Remove the four screws on the front cover, and remove the cover from the enclosure.
4. Check components in the controller. All damaged components must be replaced.
5. Tine controller can be surface mounted, or the front cover can be removed and panel mounted using the template on the back of this instruction sheet. Never mount the controller immediately beside or above heat-generating equipment, or directly below water or steam pipes. If the controller is mounted in an enclsure, be sure the temperature in the enclosure does not exceed 55°C (131°F). Note: Never mount the operator controls remotely.
6. If the controller is subjected to vibrations, it must be shock mounted.
7. Be sure the line boltate and frequency are compatible with the controller rating.

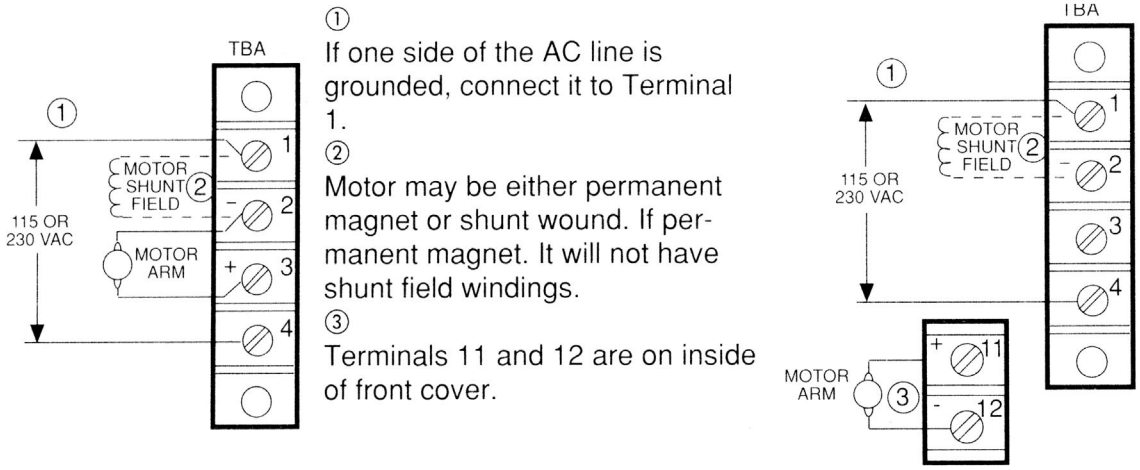
   a. SEPARATE OVERCURRENT PROTECTION IS REQUIRED BY THE NATIONAL ELECTRICAL CODE. THE USER IS RESPONSIBLE FOR CON FORMING WITH THE NATIONAL ELECTRICAL CODE AND ALL APPLICABLE LOCAL CODES WHICH GOVERN SUCH PRACTICES AS WIRING PROTECTION, GROUNDING, DISCONNECTS, AND OTHER PROTECTION

⚠CAUTION

   b. THE AVAILABLE SHORT-CIRCUIT CURRENT OF THE INPUT SUPPLY MUST BE LESS THAN 5,000 AMPERES SYMMETRICAL OR CONTROLLER DAMAGE MAY OCCUR. Short-circuit current can be limited by sizing the input supply transformer at 50 KVA or less, or by using correctly sized current limit ing fuses in the input suply to the controller. Do not size the transformer less than the minimum transformer KVA listed in Table 2.
   c. NEVER USE POWER FACTOR CORRECTION CAPACITORS ON THE INPUT LINE TO THE CONTROLLER. These capacitors can damage the solid-state components.

8. Use T & B 8225 fitting (or equal) to attach 3/4" conduit to the controller.
9. Use #14 AWG stranded wire for controller connections. Oversized or solid wire can break terminal strip barriers.
10. Connect the motor and single-phase power to the controller as shown on *Figure 3*.
11. Connect earth ground to the ground connection post inside the controller enclosure or to a front cover screw.

Figure 3. Connections



1. Recheck the wiring to the controller before applying power.

⚠CAUTION IF ONE OF THE AC SUPPLY LINES IS GROUNDED, IT MUST BE CONNECTED TO TERMINAL 1.

2. Remove the correct calibration resistor (s) from the controller circuit board with a wire cutter, as shown in *Table 4 and Figure 4*.
3. Replace the front cover on the enclosure and tighten the four screws.
4. Turn the SPEED control pot to zero on its dial.
5. Place the RUN/STOP or FORWARD/STOP/REVERSE switch (whichever is applicable) in STOP position.
6. Apply AC input power to controller.
7. Place the RUN/STOP switch in Run position or place the FORWARD/STOP/REVERSE switch in FORWARD position (whichever is applicable).
8. Turn the SPEED control pot slowly until the motor rotates.
9. If motor rotation is opposite to that desired, place the switch in STOP position, turn-off the AC input power, and interchange the motor armature leads at the motor connection box.

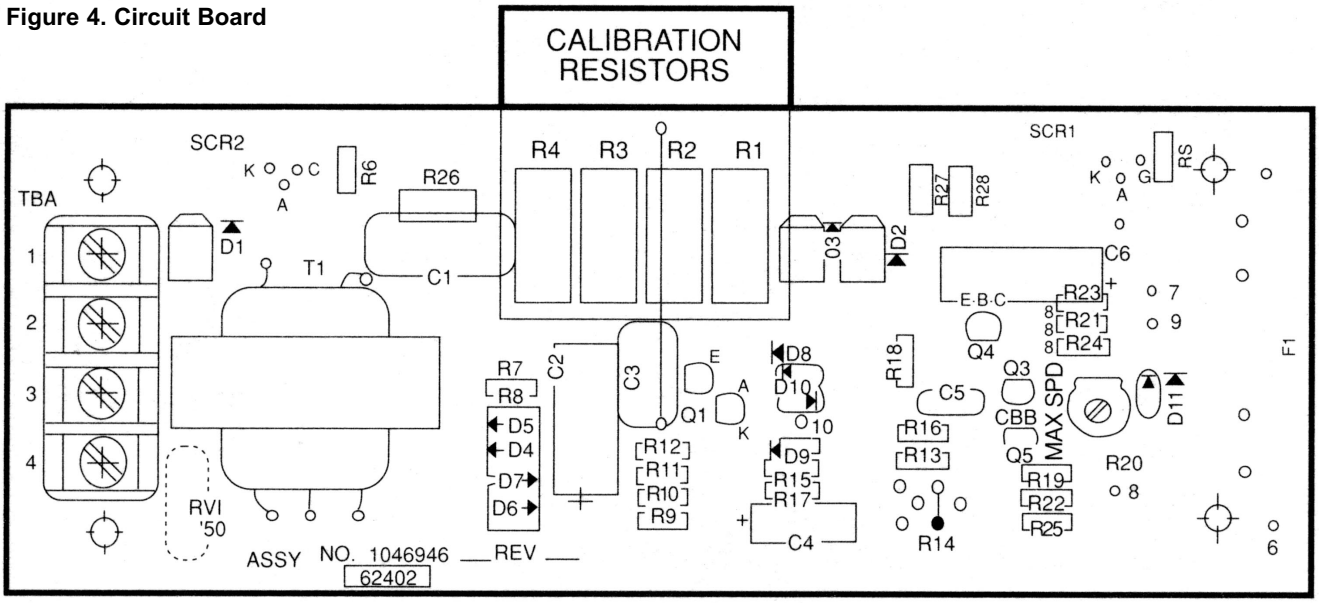
⚠CAUTION NEVER USE LINE SWITCHING TO START AND STOP THE MOTOR. Resulting transients can damage the controller.

10. Models RP1R and RP2R only: To obtain opposite motor rotation, place the FORWARD/STOP/REVERSE switch in STOP position and then in REVERSE position.
11. To obtain top speed, turn the SPEED control pot to 100 on its dial.

Table 4. Calibration Wires

Controller HP Rating		Remove Resistors
Model RP1, RP1R	Model RP2, RP2R	
1/6	---	R2, R3, R4
1/4	---	R3, R4
1/3	3/4	R4
1/2	1	None

Figure 4. Circuit Board



Note: Varistor RV1 is located on 230V circuit boards only.

Maintenance consists of keeping the controller clean and dry. Refer to maintenance instructions supplied by the motor manufacturer. If the motor doesn't rotate, check the fuse on the controller front cover. If the fuse is blown, replace it with an exact replacement.

⚠CAUTION SUBSTITUTE FUSES CAN CAUSE CONTROLLER DAMAGE.

If the replacement fuse blows, turn-off the AC input power and refer to Table 5. Most controller failures are caused by incorrect connections, overload, or the accumulation of dirt, dust, or moisture. If motor operation becomes faulty, proceed as follows:

⚠WARNING BE SURE THE AC INPUT POWER IS TURNED-OFF BEFORE WORKING ON THE CONTROLLER. HIGH VOLTAGE IN THE CONTROLLER CAN CAUSE ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

1. Check for: a. Blown fuse. b. Loose or missing terminal screws. c. Unattached wires. d. charred, darkened, or punctured components and wires.
2. If the SPEED control pot feels rough or stiff when rotated, an open or shorted pot is indicated.
3. Measure the AC input voltage to the controller on Terminals 1 and 4, and compare with controller rating.

Table 5. Troubleshooting

Indication	Possible Cause	Corrective Action
1.Controller fuse blows when AC input power is applied to the controller.	Wiring faulty, incorrect or grounded. Motor shunt field shorted or grounded Components shorted	Check all external wiring terminating in the controller. Repair or replace motor. Repair or replace controller
2.Controller fuse blows when RUN/ STOP switch is placed in RUN position	Motor armature shorted or grounded Shorted SCR SCR1 or SCR2, or circuit board	Repair or replace motor Replace circuit board or SCR
3.Contoller fuse blows while motor is running	Loose or corroded connection, or or wiring faulty, incorrect or grounded Circuit board failure	Check all terminal connections and wiring between the line, controller, and motor. Check motor armature current. If current exceeds controller rating, check for a mechanical overload or faulty motor. Also check shunt fiield current. Low shunt field current causes excessive armature current Replace circuit board.
4.Motor does not rotate	Wiring faulty, incorrect, or grounded Controller fuse blow. SPEED control pot failure RUN/STOP OR FORWARD/ STOP/REVERSE switchfailure Controller failure	Check all external wiring terminating in the controller. Replace fuse with exact replacement Replace pot Replace switch Repair or replace controller
5.Motor does not reach base speed	Low line voltage Motor overloaded MAX SPD pot R20 minadjusted Circuit board failure	Check for rated line voltage +/-10% See Indication 3. Turn R20 clockwise until top speed is reached. Replace curcuit board.
6.Unstable speed, inadequate regulation, or low torque	Wrong calibration resistor (s) removed Motor faulty Circuit board failure	See Table 4 and 5 Check motor commutator and brushes. Refer to motor manufacturer's instructions Replace circuit board

Table 6. Parts List

Part	Part Number Models RP1,RP1R	Models RP2, RP2R
Curcuit Board	60152	60155
Fuse, F1, 10A 250V	60652	60652
Fuse Holder	63804	63804
Pot, SPEED	63376	63376

Part	Part Number Models RP1, RP1R	Models RP2, RP2R
SCR, SCR1, SCR2	67492	67492
Switch FWD/ STOP/REV	63379	63379
Switch RUN/STOP	63374	63374
Transformer T	60868	60869

Boston Gear
14 Hayward Street
Quincy, MA 02171
617.328.3300
Fax: 617.479.6238
www.bostongear.com