

# Boston Gear®

## Ratiotrol®

DC Motor Speed Control

P-3035-BG

*Installation and Operation*

Doc. No. 83531

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



 **Boston**  
Gear

a division of **Altra Industrial Motion**

## GENERAL INFORMATION

### Description

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

### Model Types

Table 1. Model Types

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

### Enclosure

Nonventilated, dust resistant, NEMA Type 1, constructed of die-cast aluminum alloy.

### 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

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	115 VAC Controller	3.9	5.0	6.0	8.7	-----	-----
		230 VAC Controller	-----	-----	-----	-----	5.9	8.8
	KVA		.48	.58	.71	1.0	1.4	2.0
DC Output (Full Load)	Motor Armature Amps	90 VDC	2.0	2.8	3.5	5.4	-----	-----
		180 VDC	-----	-----	-----	-----	3.8	5.5
	Motor (1) Field Amps	50 VDC	1.0	1.0	1.0	1.0	-----	-----
		100 VDC	-----	-----	-----	-----	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.

## 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/STOP/REVERSE toggle switch. The reversing switch has a center position detent which provides antiplug protection.

## 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) maximum

**Table 3. Speed Regulation Characteristics**

Regulation Method	Variables				Speed Range
	Load change	Line Voltage	Field Heating	Temperature	
Voltage Feedback with IR Compensation	95%	+/-10%	Cold/Normal	+/- 10%	20:1
	2%	+/-1%	5-12%	+/-2%	

## 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 (nonadjustable) .....150% full-load torque (typical)

## Installation and Wiring

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. The controller can be surface mounted, or the front cover can be removed and panel mounted. 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 enclosure, 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 voltage and frequency are compatible with the controller rating.
  - a. SEPARATE OVERCURRENT PROTECTION IS REQUIRED BY THE NATIONAL ELECTRICAL CODE. THE USER IS RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE AND ALL APPLICABLE LOCAL CODES WHICH GOVERN SUCH PRACTICES AS WIRING PROTECTION, GROUNDING, DISCONNECTS, AND OTHER PROTECTION.

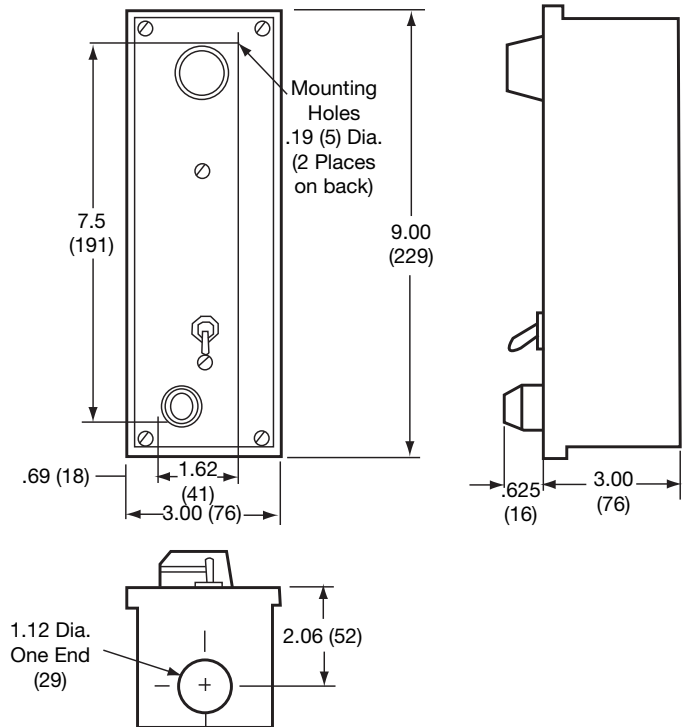
- b. THE AVAILABLE SHORT-CIRCUIT CURRENT OF THE INPUT SUPPLY MUST BE LESS THAN 5,000 AMPERES SYMMETRICAL OR CONTROLLER DAMAGE MAY OCCUR.

Short-circuit current can be limited by sizing the input supply transformer at 50 KVA or less, or by using correctly sized current limiting fuses in the input supply 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.

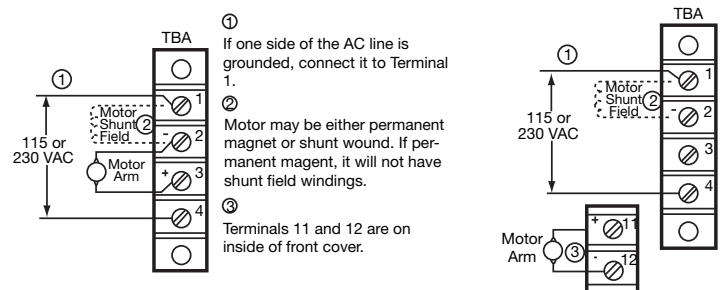
8. Use T & B 8225 fitting (or equal) to attach 3/4" conduit to the controller.
9. Use #14 AWG stranded wire for controller connections. Oversized or solid wire can break terminal strip barriers.

**Figure 2. Ratiopax Dimensions**



10. Connect the motor and single-phase power to the controller as shown in Figure 3.
11. Connect earth ground to the ground connection post inside the controller enclosure or to a front cover screw.

**Figure 3. Connections**



## Startup and Operation

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

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

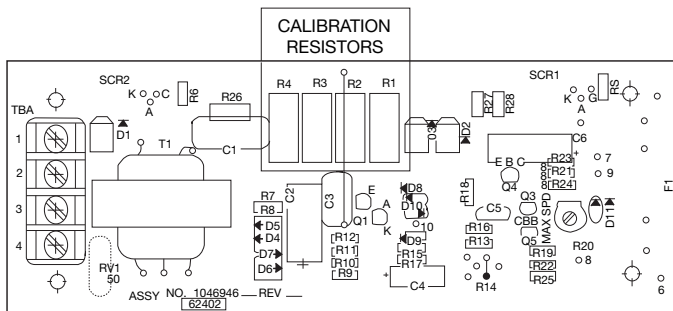
2. Remove the correct calibration resistor(s) from the controller circuit board with a wire cutter, as shown in Table 4 and Figure 4.
3. Replace the front cover on the enclosure and tighten the four screws.

Table 4. Calibration Wires

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

4. Turn the SPEED control pot to zero on its dial.
5. Place the RUN/STOP/FORWARD/STOP/REVERSE switch (whichever is applicable) in STOP position.
6. Apply AC input power to controller.

Figure 4. Circuit Board



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

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.

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.

## Maintenance

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.

### **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:

### **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**

<b>Indication</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
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. Controller fuse blows while motor is running.	Loose or corroded connection, 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 field 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 switch failure. 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 misadjusted. Circuit board failure.	Check for rated line voltage +/- 10%. See Indication 3. Turn R20 clockwise until top speed is reached. Replace circuit board.
6. Unstable speed, inadequate regulation, or low torque.	Wrong calibration resistor(s) removed. Motor faulty.    Circuit board failure.	See Tables 4 and 5.  Check motor commutator and brushes. Refer to motor manufacturer's instructions. Replace circuit board.

**Table 6. Parts List**

<b>Part</b>	<b>Part Number</b>		<b>Part</b>	<b>Part Number</b>	
	<b>Models RP1, RP1R</b>	<b>Models RP2, RP2R</b>		<b>Models RP1, RP1R</b>	<b>Models RP2, RP2R</b>
Circuit Board	60152	60155	SCR, SCR1, SCR2	67492	67492
Fuse, F1, 10A 250V	60652	60652	Switch FWD/STOP/REV	63379	63379
Fuse Holder	63804	63804	Switch RUN/STOP	63374	63374
Pot, Speed	63376	63376	Transformer T	60868	60869

# Warranty

Boston Gear warrants that products manufactured or sold by it shall be free from defects in material and workmanship. Any products which shall within two (2) years of delivery, be proved to the Company's satisfaction to have been defective at the time of delivery in these respects will be replaced or repaired by the Company at its option. Freight is the responsibility of the customer. The Company's liability under this limited warranty is limited to such replacement or repair and it shall not be held liable in any form of action for direct or consequential damages to property or person. The foregoing limited warranty is expressly made in lieu of all other warranties whatsoever, express, implied and statutory and including without limitation the implied warranties of merchantability and fitness.

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