

# Instructions for Installation and Operation

## Filtered SCR Brushless DC Motor Speed Controls

**Model 3911** 0-2500 rpm

**Model 3921**, 0-10,000 rpm



### SPECIFICATIONS

Product Type .....	ABL-3911C/ABL-3921C
Input Voltage .....	115 VAC $\pm$ 10%, 50/60 Hz (Single Phase)
Input Current .....	12 Amps rms maximum
Output Voltage .....	0 to 130 VDC
Continuous Output Current .....	3.0 Amps
Peak Output Current .....	6.0 Amps
Ambient Temperature .....	0 to 50° C
Motor HP Range: .....	Up to 3/8 HP
Speed Range: .....	Up to 30:1
Speed Regulation: .....	Less than 1% of rated (Typical)



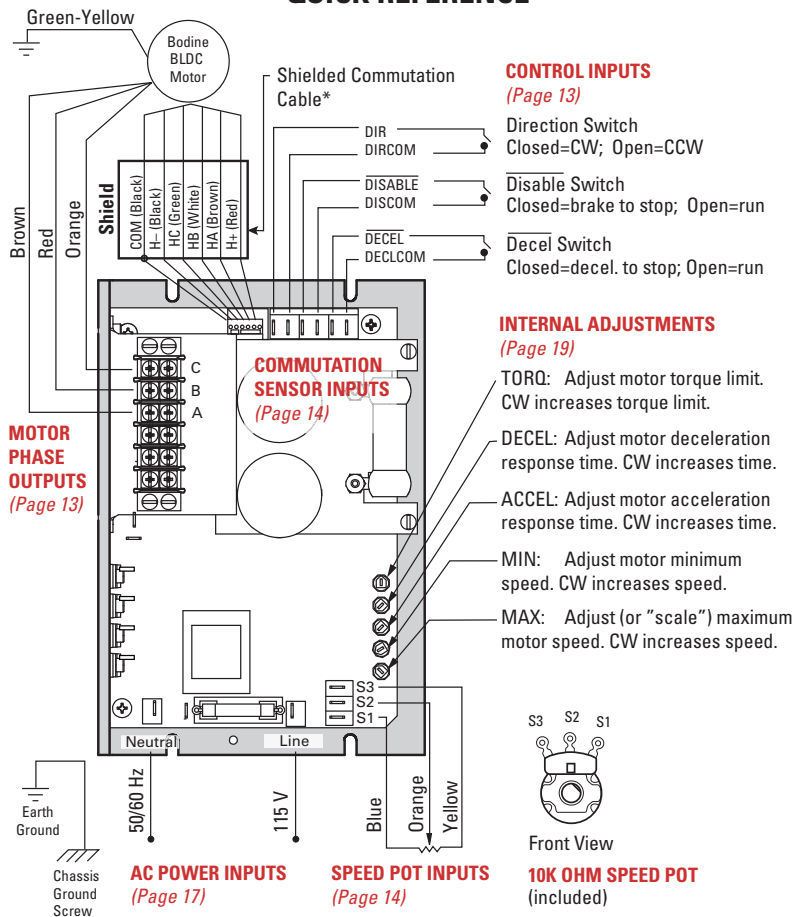
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## IMPORTANT

*Read this manual completely and carefully. Pay special attention to all warnings, cautions, and safety rules. Failure to follow the instructions could produce safety hazards which could injure personnel or damage the control, motor, or other equipment. If you have any doubts about how to connect the control or motor, refer to the detailed sections of this manual.*

## QUICK REFERENCE



**Figure 1 – Quick Reference Diagram**

\* We offer an optional 6-foot cable kit, **Model 3983**

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## GENERAL INFORMATION

### **Congratulations!**

And thank you for selecting the Bodine Type ABL Brushless DC Motor Control. Your new control will provide the same excellent performance and reliability that have been a Bodine tradition since 1905. Bodine Electric Company takes pride in the quality of its products and in satisfying its customers. Every effort has been made to provide you with a product free of defects in design, workmanship, and materials. In order for us to maintain our tradition of quality, please report any cases of unsatisfactory service or products to Bodine Electric Company promptly.

### **About This Manual**

This manual contains the basic information needed to install and operate a Bodine Model ABL-3911C and ABL-3921C Control. It is organized in a systematic, step-by-step fashion so that the system may be set up safely in the shortest possible time. It does not profess to cover all details or variations in equipment, nor to provide for every possible contingency associated with installation, operation, or maintenance – and no warranty of fitness for purpose is expressed or implied. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purpose, the matter should be referred to the Bodine Electric Company.

The issuance of this manual does not confer to the recipient any license to manufacture under any patents owned or controlled by the Bodine Electric Company.

### **Safety Standards**

Bodine products are designed and manufactured to comply to applicable safety standards and in particular to those issued by ANSI (American National Standards Institute), NEMA (National Electrical Manufacturers Association), and UL.

Type ABL controls “recognized by UL Inc.” are designated by having a UR symbol. In addition, products that are CSA certified, are identified by a CSA symbol. If you need specific information regarding the third party approval status of Bodine products, contact the nearest Bodine representative, or the home office.



## CONTROL DESCRIPTION AND FEATURES

The ABL-3911C and ABL-3921C Brushless DC Motor Controls are chassis style controls, designed to be mounted into a separate control enclosure supplied by the user. They operate from a nominal 115 VAC, 50/60 Hz. power source and provide electronic commutation and phase current switching needed to operate brushless DC motors. DIP switch selectable current limit settings allow the controls to be used with several fractional horsepower motors and gearmotors. The controls are factory pre-set for 60° commutation.

The ABL-3911C and ABL-3921C provide a 130 Volt filtered output for improved form factor, plus a built-in dynamic braking module. They allow motor speed to be manually or electronically controlled.

Motor direction of rotation, braking or disabling, and soft starts and stops can be controlled with manual switch inputs or by logic control. Since the control's signal common is not at ground potential, interface circuitry is required to isolate logic signals from the control. Trim potentiometers on the control board allow additional fine tuning of minimum and maximum speed settings, torque, acceleration and deceleration time. A built-in "Smart Reverse™" circuit prevents plug reversing by braking the motor to a stop before changing its direction. A built-in shutdown circuit disables the control during overvoltage, under-voltage, or invalid commutation sensor state conditions.

Specific Bodine motor sizes which can be used with this control are listed in the Chart in Figure 6.

### Accessory Items

- Model 3983 Connection Cable Assembly — connects standard Bodine brushless DC motors and gearmotors to ABL-3911C and ABL-3921C controls. Length: 6 foot. (see page 10).
- Model 3982 Extension Cable — extends cable between motor and control by six feet. Both ends equipped with circular connectors for easy connection between Model 3983 Cable and motor. Length: 6 ft.
- Model 3984 Isolated Interface Module (See page 16.)

Parameter	Specification
Product Type	ABL-3911C/ABL-3921C
Input Voltage	115VAC $\pm$ 10%, 50/60 Hz (Single Phase)
Input Current	12 Amps rms maximum
Output Voltage:	0 to 130 VDC
Continuous Output Current	3.0 Amps
Peak Output Current	6.0 Amps
Ambient Temperature:	0 to 50° C
Motor HP Range:	Up to 3/8 Hp
Speed Range:	Up to 30:1
Speed Regulation:	Less than 1% of rated (Typical)
Line Voltage Compensation:	Negligible speed change with changes in line voltage
Acceleration Time Range:	(Model 3911): 0.2 to 10 sec. (0 to full speed)
	(Model 3921): 0.5 to 30 sec. (0 to full speed)
Dimensions:	inches: 5.5 W x 8.0 D x 2.7 H
	cm: 14.0 W x 20.4 D x 6.9 H
Net Weight	2.5 lbs. (1.12 kg.)

\*MIN and MAX adjustments are limited to within the 0-10 VDC limits of VOUT

## IMPORTANT SAFETY PRECAUTIONS

The following safety precautions must be observed during all phases of installation, operation, service, and repair of this motor control product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the products. Bodine Electric Company assumes no liability for the customer's failure to comply with safety requirements and practices.

The use of electric motors and gearmotors, like that of all utilization of concentrated power, is potentially hazardous. The degree of hazard can be greatly reduced by proper design, selection, installation, and use, but all hazards cannot be completely eliminated. The reduction of hazards is a joint responsibility between the user, the manufacturer of the driven or driving equipment and the manufacturer of the control or motor and interface circuitry.

The user should refer to Publication No. ANSI C5.1/NEMA MG 2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators*. Available from:

National Electrical Manufacturers Association  
[www.nema.org](http://www.nema.org)

**Warnings** (such as the example below) highlight procedures which present potential danger to people. **Cautions** highlight possible danger to equipment. Both are used throughout this manual. Warnings and Cautions must always be followed.

### **WARNING**

*Dangerous voltages may be present in the electronic control and motor. These voltages could cause serious injury or death. Use extreme caution during handling, testing, and adjusting. Properly guard the electronic control and motor to prevent accidental contact by all persons.*

*The chance of explosions, fires, or electric shocks can be reduced with thermal and over-current protection, proper grounding, enclosure selection, and good maintenance. The following safety considerations are not intended to be all-inclusive. Specific references throughout this manual should also be consulted.*

### **CAUTION**

*These controls are designed to provide optimum performance when used with Bodine Electric Company motors. They should not be used with other manufacturer's motors without first contacting the Bodine Electric Company. Failure to contact Bodine in advance could cause damage to the control or the motor*

## **Inspecting the Control**

Check the items you received against your purchase order. Carefully examine the control (and any optional kits or parts) for shipping damage. Parts errors should be reported to Bodine. Shipping damage claims should be made to the freight carrier.

Before installation, review the application to confirm that the proper motor and control have been selected. This should be done after reading the documents provided with the motor and all applicable safety standards. If in doubt, contact your Bodine representative, or the home office if there is no representative in your area. Although Bodine Electric Company assists its customers in selecting motors and controls for specific applications, determination of fitness for purpose or use is solely the customer's responsibility.

## Normal Operating Conditions

Unless otherwise agreed to by Bodine, all control nameplate ratings are based on the following normal operating conditions. Consult Bodine Electric Company if variations beyond these limits are anticipated.

1. *Continuous Duty*: without frequent reversals or starts and stops.
2. *Maximum Ambient Temperature*: 50° C (122° F) for chassis controls; 40° C (104° F) for all encased controls.
3. *Voltage*: Within 10% of nameplate rating.
4. *Frequency*: Within 5% of nameplate rating.
5. *Combined Variation of Voltage and Frequency*: Within a total of 10% providing frequency variation does not exceed 5%.

## Grounding

Both electronic controls and motors must be securely mounted and adequately grounded. Failure to ground properly may cause serious injury to personnel.

## Fusing

Both the control input and output are fused. When fuses are replaced, they must always conform to the values and ratings specified on the control's nameplate or in the fuse chart located in Figure 6.

## Live Circuitry

Open-type electronics should be properly guarded or enclosed to prevent accidental human contact with live circuitry. No work should be performed on or close to the control or motor while the control is connected to the AC line. If an AC line switch is used, it should be a Double Pole Single Throw (DPST), so that both sides of the AC line are disconnected.

## Environment

Open circuit boards in ventilated enclosures may emit flame during failure. Bodine does not offer an explosion-proof line of motion control accessories for hazardous locations (e.g., environments of flammable or explosive gas, vapor, or dust). Bodine recommends using only approved explosion-proof products in hazardous locations. The National Electric Code (NEC) allows exceptions, but NEC and NEMA safety standards should be studied thoroughly before exercising this option.

Moisture increases the electrical shock hazard of electrical insulation. Therefore, open-type or unsealed controls not specifically designed for such use should be protected from contact with liquids or moisture.

## Ventilated Products

Open, ventilated products are suitable for clean, dry locations where cooling air is not restricted. Do not insert anything into a product's ventilation openings.



## Servicing

Emergency field repairs must be made only by authorized Bodine service representatives. Repairs made by persons not authorized by the Bodine Electric Company will void the warranty. Field repairs must be limited to replacing an entire printed circuit board assembly. Because of the danger of introducing safety hazards, do not install substitute parts or perform any unauthorized modifications to electronic PC boards, components or motors. To ensure continued compliance with the design specifications and safety standards, the electronic control or motor should be returned to Bodine Electric Company or an Authorized Service Center for servicing.

### WARNING

*To avoid injury because of unsuspected mechanical motion, always disconnect the power supply to the motor control before performing any service procedures on the motor, control, interface circuitry or driven equipment.*

## INSTALLATION INSTRUCTIONS

### WARNING

This control should only be installed by a qualified technician, electrician or electrical maintenance person familiar with its operation and associated hazards. The National Electrical Code (NEC), local electrical and safety codes, and when applicable, the Occupational Safety and Health Act (OSHA) should be observed to reduce hazards to personnel and property.

The user must provide a proper enclosure for chassis type controls. Circuitry is not at ground potential. Do not perform work on or near the control while it is connected to the AC line.

### CAUTION

*Only copper wire with a minimum 60° C rated insulation is recommended if Bodine cable assemblies are not used. The control terminal block will accept leads up to 14 gauge (18 gauge is the smallest recommended size).*

## Mounting the Control

Detailed mounting dimensions and CAD drawings are available online. The control should be mounted vertically so that the control panel is readable and the cabling extends from the bottom of the enclosure. This arrangement provides optimum air flow around the control.

**The control does not provide motor over temperature protection. The user is responsible for providing this protection in the equipment where this control is used (Remarque: La détection de la surchauffe du moteur n'est pas assurée par cette control).**

## Electrical Connections

Read the following instructions as well as all of the applicable safety recommendations, before making any electrical connections between the control, motor, or motion control electronics.

### WARNING

The 115 VAC power line to the control should be the very last connection made. Disconnect the power line before making any other electrical connections.

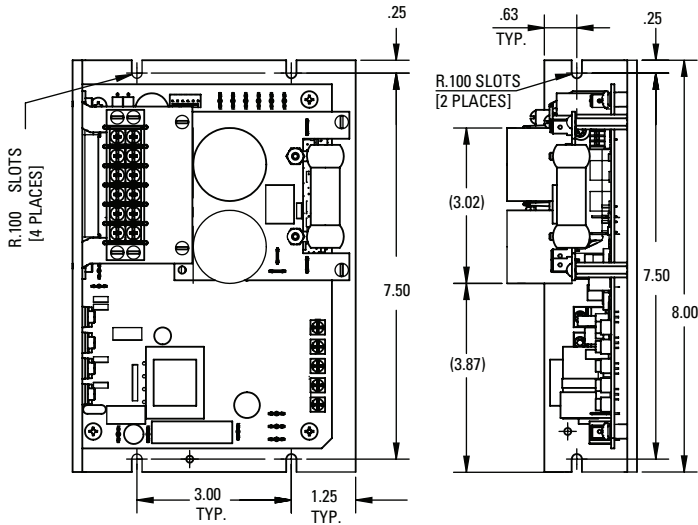


Figure 2—Heatsink preferred mounting orientation

## Cable Assembly

The Model 3983 Cable Assembly, shown in Figure 3, is designed to simplify the electrical connections to the ABL-3911C and ABL-3921C Controls. One end of the cable which connects to the motor is terminated with a circular type connector. The other end which connects to the control has a six-pin rectangular connector, three individual motor phase leads with quick disconnects, and an earth ground lead.

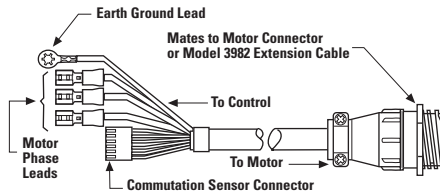


Figure 3 - Model 3983 Cable Assembly

## WARNING

The shield common is at a dangerous potential above ground and presents a voltage hazard. Contact with the shield could cause serious injury or death. If a non-Bodine cable is used or if a special cable is fabricated, care should be taken to insulate all exposed shield to avoid serious injury. The shield should only be connected to COM terminal on the Commutation Sensor Input Connector at the control. No other shield connection should be made.

## CAUTION

*Only copper wire with a minimum 60° C rated insulation is recommended if Bodine cable assemblies are not used. The control terminal block will accept leads up to 14 gauge (18 gauge is the smallest recommended size)*

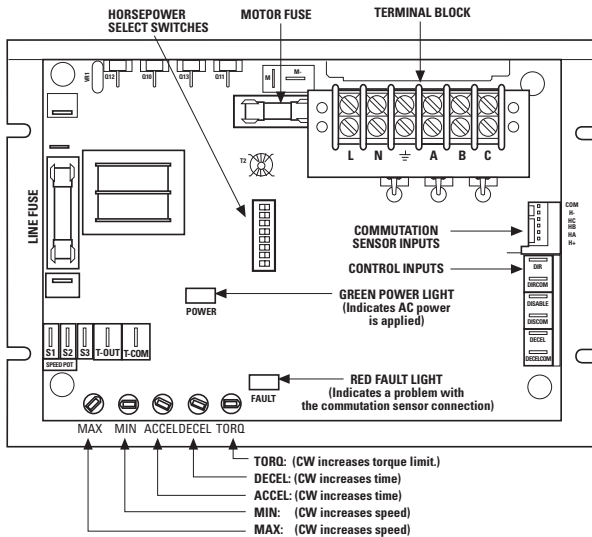


Figure 4 - Control Circuit Board Detail

### Horsepower (DIP Switch) Settings

Figure 4 shows a Horsepower Select switch on the main control board which contains eight switch levers numbered 1 through 8. The chart in Figure 6 shows the proper DIP switch settings for various Bodine motor types.

Determine the first four digits of the motor's type number from the nameplate. Find the same four digits in the chart in Figure 6 to determine the proper settings of the DIP switches. An insulated alignment tool should be used to adjust the switch settings.

## Motor Commutation Phasing (60° standard)

All standard (stock) brushless DC motors and gearmotors manufactured by Bodine Electric Company are designed for 60° commutation. **The factory setting for our BLDC speed controls is also for 60° commutation.** It is possible to configure our BLDC stock controls to operate non-Bodine BLDC motors and gearmotors with 120° commutation angle. **To change the sensor phasing output on our stock controls for 120° commutated gearmotors or motors, set DIP switch number 6 to the “Off” position.** Please note that further application details must be considered to properly match a non-Bodine BLDC motor with one of our stock BLDC controls. To avoid damage or system performance issues, please consult our Technical Support staff at 773-478-3515 or via E-mail: info@bodine-electric.com.

Typical MAX Motor Speeds with 10 K Speed Pot						
	DIP Switch 7	DIP Switch 8	CCW MAX Pot	Calibrated MAX Pot	CW MAX Pot <sup>1</sup>	T-Out Pulse Width (μS)
	ON	ON	1000	1700	2000	1200
	ON	OFF	1000	1700	2000	1200
Factory Setting	OFF	ON	1500	2500	3000	800
	OFF	OFF	1500	2500	3000	800

1. Max. Speed obtainable is dependent on motor winding (voltage, speed rating, resistance), line voltage and load conditions.

**Figure 5 – DIP Switch 7 and 8 Speed Range Settings**

Control Model No.	Bodine Motor or Gearmotor Type	Hp	Rated Speed (RPM)	DIP Switch “On” Position	Line Fuse (F1)	Motor Fuse (F2)	AC rms Input Current
ABL-3911C	22B2...	1/16	2,500	2,6,8	ABC 15	MDA 6/10	2.7
	22B3...	1/11		1,2,6,8		MDA 8/10	3.6
	22B4...	1/8		1,3,6,8		MDA 1-1/4	4.8
	34B3...	1/5		1,2,3,6,8		MDA 1-1/2	6.7
	34B4...	1/4		2,4,6,8		MDA 2	8.0
	34B6...	3/8		1,5,6,8		MDA 3	11.1
ABL-3921C	22B4...	1/5	10,000	1, 2, 3,6,8	ABC 15	MDA 1-1/2	6.7
	34B4...	1/3		1, 3, 4,6,8		MDA 2-1/2	9.5

**Figure 6 – Horsepower (DIP Switch) Settings and Fuse Selection Chart**

## Commutation Sensor Connections

The commutation sensor leads are prewired in the Model 3983 cable assembly and terminated in a six-pin connector (Figure 3). There is a corresponding “Commutation” connector on the main control board (Figure 4). Mate the polarized cable connector to the “Commutation” connector. The connectors can only mate one way.

## Motor Phase Connections

Locate the barrier terminal block mounted to the bracket above the main control board. Refer to Figure 4:

1. Cut the quick connect terminals from the brown, red, and orange motor phase leads.
2. Strip away approximately 1/4 inch of the insulation from the leads.
3. Connect the stripped leads to the barrier terminal block as follows:
  - Brown to Terminal "A BRN"
  - Red to Terminal "B RED";
  - Orange to Terminal "C ORG"

## Fuse Installation

The control input and output are fused. The line input fuse has been installed at the factory. The control output or "Motor Fuse" must be selected based on the size of the motor.

### Line Fuse

The location of line fuse (F1) is shown in Figure 4. It should always be replaced with a fuse of the same type and rating. Its rating can be determined by referring to the chart in Figure 6.

### Motor Fuse

The location of motor fuse (F2) is shown in Figure 4. The fuse rating will vary with the size of the motor used. To determine the proper fuse rating, locate the first four digits of your motor's type number on the motor nameplate. Find the same four digits in the chart in Figure 6 to determine the fuse size. The ABL-3911C and ABL-3921C are supplied with the fuses listed in Figure 6.

## Manual Control Input Connections

Motor speed, braking, direction of rotation and deceleration can be controlled manually or electronically. Refer to the following procedures for connecting control inputs.

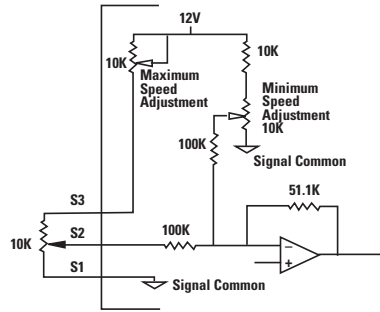
### CAUTION

*The control board signal common is not at ground potential. Any external signal or equipment connected to the control must be electrically isolated from ground (e.g., with relay contacts or optical isolation module). Non-isolated signals will damage the control and/or associated external equipment.*

### Manual Speed Control

A Manual Speed Potentiometer Kit for controlling motor speed is supplied with the Model ABL- 3911C and ABL- 3921C. The kit contains a 10K Ohm potentiometer, mounting hardware, and three 24-inch long leads terminated on one end with 1/4 inch quick connects. To connect the speed potentiometer, proceed as follows:

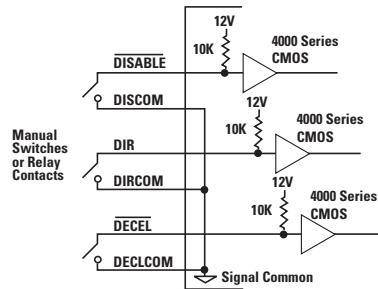
1. Solder the three leads to the potentiometer as shown in Figure 1.
2. Mount the potentiometer in the desired location.
3. Connect the speed pot to the control board terminals as follows:
  - Blue to Terminal "S1"
  - Orange to Terminal "S2"
  - Yellow to Terminal "S3"



**Figure 7 - Manual Speed Potentiometer/Interface details.**

### Manual Braking (Disable), Direction of Rotation, and Deceleration

Mechanical switches or relays can be used to switch the control inputs. Figure 8 shows a schematic representation of manual or relay switched inputs.



**Figure 8 – Manual Switch and Relay Control Inputs.**

NOTE: Shielded cable is recommended for the these connections.

The following chart lists the control functions relative to the state of the mechanical switches or relays.

Switch	Closed	Open
<u>DISABLE</u> <sup>1</sup>	Stop	Run
<u>DIR</u> <sup>2</sup>	CW <sup>4</sup>	CCW <sup>4</sup>
<u>DECEL</u> <sup>3</sup>	Decelerate	Accelerate

1. Dynamic braking will occur when the DISABLE switch is closed.
2. A "Smart Reverse Circuit" prevents plug reversing when the DIRection switch is opened or closed. The motor brakes to a stop before changing direction.
3. The DECEL switch controls soft stops. The degree of deceleration can be varied with the trim potentiometers on the control board. See Page 20.
4. The output shafts of gearmotors with odd number of stages (Bodine type designations ending with WX, E1, or E3) will rotate in the opposite direction.

## Electronic Control Input Connections

Optional Interface Boards are available from Bodine and other manufacturers. They provide electrical isolation between the input signal and the brushless DC motor control circuitry, and are recommended for motion control applications requiring electronic control of motor speed, rotational direction, deceleration, and braking.

## Electronic Speed Control

Motor speed can be controlled with a 0 to +10 VDC isolated signal with 0.1 mA current capability in lieu of the manual speed potentiometer. This speed control input should be connected to terminal S2 on the control board. The common side of the signal must also be isolated and connected to terminal S1 on the main control board.

## Logic Signal Control of Braking, Direction of Rotation, and Deceleration

Motor braking (or disable), direction of rotation and deceleration can be controlled using optically isolated logic signals from a programmable controller, personal computer, or other electronics.

### **WARNING**

*Never rely on logic circuitry as a means of disabling the motor or control. To prevent unsuspected mechanical motion and potential injury, the 115 VAC power should always be disconnected whenever logic circuits or the driven equipment are serviced.*

Exercise extreme caution when using Programmable Logic Controllers (PLCs). Although some may claim to have optically isolated output modules, their output commons may be connected to other circuitry either within or connected to the PLC. In such cases, the PLC outputs should be isolated from the control board, by a relay or by an electronic isolation module, to prevent damage to the PLC or the ABL Control.

If a Programmable Controller with a relay output module is not available, AC or DC outputs from the PLC can be used to drive separate relay coils. See PLC user's manual for application information. See Figure 8 to determine how to connect relay contacts to the ABL-3911C and ABL-3921C.

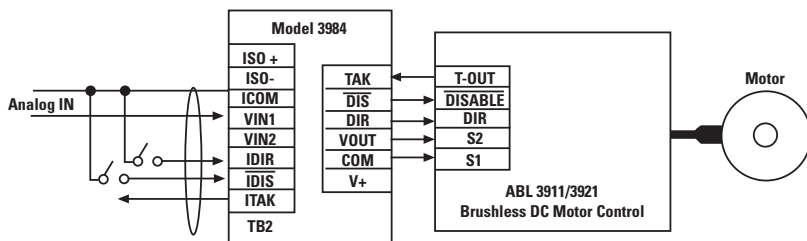


Figure 9 - Connection to Model 3984 Isolation Interface

## Signal Isolation Using a Bodine Model 3984 Interface Module

Follow the installation instructions provided with the module to isolate the input signals between the control electronics and the ABL Control. See Figure 9 for connections.

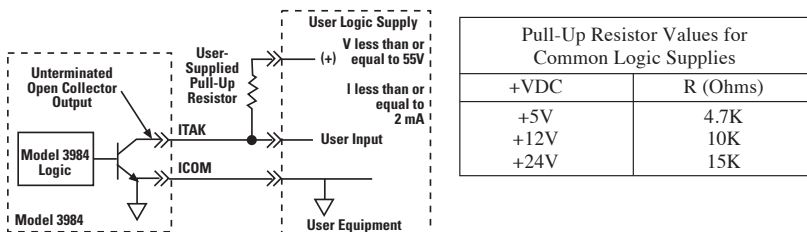


Figure 10 – Tachometer output

## Tachometer Output

When used with the Bodine ABL-3911/3921 Brushless DC Motor Controls, the Model 3984 module provides a digital tachometer output at the ITAK terminal for monitoring motor speed. The output pulse levels are low to high to low. The typical pulse width is 0.8 msec. for the ABL-3911 and 0.19 msec. for the ABL-3921. Twelve pulses correspond to one motor revolution. The ITAK output provides an unterminated open collector output. A pull-up resistor or another logic device is required for measuring the output. See Figure 10 for assistance in interfacing the ITAK output.



## AC Power Connections

Power should always be the last connection made during installation and the first item to be disconnected before servicing.

### **WARNING**

*The control and motor must be securely and adequately connected to earth ground as indicated below. Failure to ground properly may result in serious injury.*

## Power Input

Refer to Figure 4. Locate the barrier terminal block mounted to the bracket above the main control board and connect AC power to the barrier terminal block as follows:

1. Hot side of 115 VAC line to Terminal "L".
2. Neutral side of 115 VAC line to Terminal "N".
3. Cut the ring terminal off the Ground (Green/Yellow) wire of the 3983 cable. Strip the insulation 1/4" and connect the wire to the terminal labeled with the chassis ground symbol. This terminal should also be used to connect the system to earth ground.

## OPERATING INSTRUCTIONS

### WARNING

*Explosions, fires, or electric shock hazards can be reduced through thermal and over-current protection, good maintenance, proper grounding, and enclosure selection. Review safety considerations outlined in "Safety Precautions" and "Installing the Control."*

### Preliminary Checks

1. Before starting the control, check all fuses, connections, and adjustments such as horsepower DIP switch settings.
2. Proper consideration should be given to all rotating members. Before starting, be sure keys, pulleys, etc. are securely fastened. Proper guards should be provided to prevent hazards to personnel while the equipment is rotating.
3. Mechanical considerations such as proper mounting and alignment of products, and safe loads on shafts and gears should be reviewed. Do not depend upon gear friction to hold loads.
4. The motor or gearmotor should be securely mounted (because of possible reaction torque). Test the motor/gearmotor unloaded to be certain that proper connections have been made.

### Operating the Control

### WARNING

*The 115 VAC line to the driver should be switched off before starting.*

1. Turn input power OFF and set the speed potentiometer to ZERO (fully counterclockwise). If a **Disable** switch is used, close the switch. If a **Direction** switch is used set it for the desired direction of rotation. If a **Deceleration** switch is used, open the switch. See Chart in Installation Instructions, Manual Control Input Connections.
2. Connect the 115 VAC power line to the external power source. Then turn on the 115 VAC input power to the control.
3. Open the **Disable** switch, if used.
4. Turn speed potentiometer knob until motor rotates. Then adjust the potentiometer to achieve the desired speed. If you wish to reduce the torque level, refer to Internal Adjustments below.
5. If the motor does not operate, first observe if the green **POWER** light and red **FAULT** light are on (refer to Figure 4 for location). Then disconnect the AC power to the control and check all connections and fuses. If a fuse is blown and the motor is not locked (stalled) or overloaded, do not replace the fuse. The control may be damaged. Refer to Troubleshooting on page 21 and follow instructions. If the motor is overloaded, reduce the load and replace blown fuses with those of the proper type and rating as specified in Figure 6.

## Internal Adjustments/Calibration

This control was shipped with the following factory settings:

*Minimum speed:* 0 RPM

*Maximum speed:* (ABL-3911C): 2,500 RPM; (ABL-3921C): 10,000 RPM

*Acceleration:* (ABL-3911C): 2 seconds; (ABL-3921C): 5 seconds

*Deceleration:* (ABL-3911C): 2 seconds; (ABL-3921C): 5 seconds

*Torque:* 200% of rated (based on proper DIP switch settings)

*Commutation:* 60°

Refer to Figure 4 for the trim potentiometer locations and approximate initial settings. If you need to readjust the control for your specific applications, proceed as follows:

### WARNING

*Use a nonmetallic or insulated adjustment tool (such as a television alignment tool) for internal adjustments. Circuit components are not at ground potential and accidental short circuiting and shock hazard may occur with conducting tools. Adjustment should be made only by qualified service personnel.*

#### *Minimum and Maximum Speed*

The MIN and MAX trim potentiometers have been factory calibrated. The lowest MIN trim potentiometer setting (fully counterclockwise) corresponds to 0 RPM and the highest MIN setting (fully clockwise) corresponds to approximately 30% of rated speed.

The lowest MAX trim potentiometer setting (fully counterclockwise) corresponds to 60% of rated speed and the highest MAX trim potentiometer setting (fully clockwise) corresponds to approximately 120% of rated speed. Refer to Figure 4 for trim potentiometer location and settings. Adjustment of the MIN and MAX trim potentiometers may have to be repeated several times to arrive at the desired speeds.

NOTE: Increasing the MIN potentiometer setting will increase the maximum speed beyond nameplate speed. The MAX trim potentiometer will need to be readjusted.

#### *Torque (Current) Limiting Adjustment*

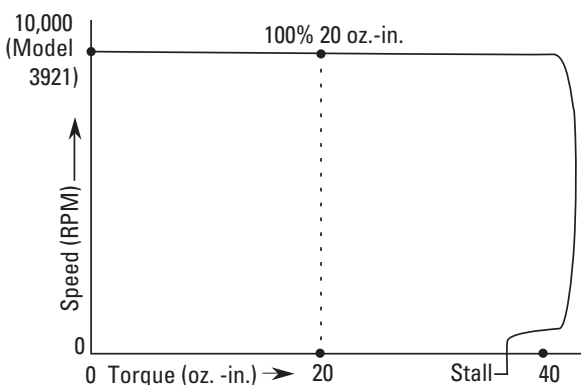
The TORQ trim potentiometer (Figure 4) has been calibrated to limit current to 200 to 250% of the motor's rated current, assuming the DIP switches are set properly. The motor's torque output can be reduced to zero or stall torque. Turn the TORQ trim potentiometer counterclockwise to decrease the torque and clockwise to increase the torque.

### *Acceleration Adjustment*

Adjusting the ACCEL trim potentiometer (See Figure 4) counterclockwise decreases the motor's acceleration time down to a minimum of approximately 0.2 seconds (ABL-3911C) or 0.5 seconds (ABL-3921C). A clockwise adjustment increases the rate up to a maximum of approximately 10 seconds (ABL-3911C) or 30 seconds (ABL-3921C).

### *Deceleration Adjustment*

Adjusting the DECEL trim potentiometer (See Figure 4) counterclockwise decreases the motor's deceleration time down to a minimum of approximately 0.2 seconds (ABL-3911C) or 0.5 seconds (ABL-3921C). A clockwise adjustment increases the rate up to a maximum of approximately 10 seconds (ABL-3911C) or 30 seconds (ABL-3921C).



**Figure 11 – Speed/Torque Curve showing decreased torque limit at lower speeds**

## WARNING

*Disconnect the control from the power source before working on the control, motor, or driven equipment.*

## TROUBLESHOOTING

Your control should not require maintenance under normal conditions. If you encounter a problem, read all applicable instruction literature provided with this control and accessories, and double-check the wiring. The charts on the following pages also provide assistance in troubleshooting those problems which usually occur during normal installation and operation.

*If the problem persists, contact your source of purchase and describe the problem in detail. Include all the nameplate data. Do not disassemble the product unless authorized by Bodine Electric Company. Performing repairs not authorized by Bodine Electric Company or removing screws will void the Warranty.*

ABNORMALITY	CHECK POINT	COUNTERMEASURE
CONTROL BLOWS LINE FUSE	Control or motor connected to or shorted to earth ground	Check for shorts and repair control and/or motor as required.
	Shorted phase leads wiring incorrect	Correct wiring.
	Damaged control Components	Contact Bodine Electric Company for assistance.
MOTOR WILL NOT START AND POWER LIGHT IS OFF	Open line fuse	Replace fuse. Refer to Figure 6 for proper value.
	Open line switch	Close the line switch.
MOTOR WILL NOT START AND POWER LIGHT IS ON	Motor overloaded	Correct load or choose larger motor.
	TORQ trim pot is out of adjustment	Visually check setting (Figure 4). Adjust TORQ trim pot, page 19.
	Incorrect commutation angle setting.	DIP 6: "On" for 60° DIP 6: "Off" for 120° Commutation
	Open motor fuse	Replace fuse. Refer to Figure 6 for proper values.
	Speed pot set to zero	Increase speed pot setting.
	Closed DISABLE switch	Open DISABLE switch and restart.
	Closed DECEL switch	Open the DECEL switch.
	Electrical noise on DISABLE and/or DECEL input	Use shielded cable.
	Damaged motor	Repair or replace motor.

ABNORMALITY	CHECK POINT	COUNTERMEASURE
MOTOR WILL NOT START AND FAULT LIGHT IS ON	Mistake in motor commutation sensor connections	Correct wiring.
	Electric noise on commutation sensor inputs	Use shielded cable.
	Damaged motor	Repair or replace motor.
MOTOR WILL NOT COME UP TO SPEED	MAX trim pot set too low	Adjust trim pot, page 19.
	Speed potentiometer set to low	Increase speed potentiometer setting
	Motor overloaded	Reexamine the load parameters.
	TORQ trim pot is out of adjustment	Visually check setting (Figure 4). Adjust TORQ trim pot, page 19.
	Wrong horsepower setting	Check DIP switch setting, page 12.
	Damaged component on the control board	Contact Bodine Electric Company for assistance.
MOTOR SPEED IS UNSTABLE OR PULSATES	Wrong horsepower setting	Check DIP switch setting, page 12.
	Motor and load not correctly aligned	Perform alignment.
	Damaged motor	Repair or replace motor.
	Speed potentiometer set too low	Increase speed potentiometer setting.
MOTOR WILL NOT MAINTAIN SPEED UNDER LOAD	Wrong horsepower setting	Check DIP switch settings, page 12.
	TORQ trim pot is out of adjustment	Visually check setting (Figure 4). Adjust TORQ trim pot, page 19.
MOTOR WILL NOT STOP WITH SPEED POT ADJUSTED AT ZERO	MIN trim potentiometer is set too high	Turn the MIN trim pots CW until motor stops.
	Open connection on speed potentiometer	Check S1, S2, S3 connections.
	Defective speed potentiometer	Replace the potentiometer.
Note: The Disable input should be used when the motor is expected to remain stopped.		
NO SPEED ADJUSTMENT	Defective speed potentiometer	Replace the potentiometer
	Open connection on speed potentiometer	Check S1, S2, S3 connections.

## **BODINE LIMITED WARRANTY**

The Bodine Electric Company warrants all products it manufactures to be free of defects in workmanship and materials when applied in accordance with nameplate specifications. Bodine motors and gearmotors purchased with and used only with appropriately applied Bodine controls are covered by this warranty for a period of 24 months from the date of purchase or 30 months from date of manufacture, whichever comes first. Bodine motors and gearmotors used with non-Bodine controls and Bodine controls used with non-Bodine motors and gearmotors are covered by a 12 month warranty period. The Bodine Electric Company will repair, replace, or refund at its option, any of its products which has been found to be defective and within the warranty period, provided that the product is shipped freight prepaid, with previous authorization, to Bodine or to a Bodine Authorized Service Center. Bodine is not responsible for removal, installation, or any other incidental expenses incurred in shipping the products to or from Bodine. This warranty is in lieu of any other expressed or implied warranty – including, but not limited to, any implied warranties of merchantability and/or fitness for a particular use. Bodine's liability under this warranty shall be limited to repair or replacement of the Bodine product and Bodine shall not be liable, under any circumstances, for any consequential, incidental or indirect damages or expenses associated with the warranted products. Proof of purchase of motor or gearmotor and matching control as a system must be provided with any claim.

**Control Type:**\_\_\_\_\_ **Serial No.**\_\_\_\_\_

**Date of Purchase:**\_\_\_\_\_ **Place of Purchase:**\_\_\_\_\_

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