BALDOR®

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BC254/BC254-FSR Regen DC Motor Speed Control

NEMA 4X, IP65

6/15 **Installation & Operating Manual** MN730

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Important:
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Introduction

Introduction

Thank you for purchasing the BC254/BC254-FSR. Baldor is committed to providing total customer satisfaction by producing quality products that are easy to install and operate. The control is manufactured with surface mount components incorporating advanced circuitry and technology.

The BC254/BC254-FSR is a Full-Wave Regenerative Drive in a NEMA-4X/IP65 washdown and watertight enclosure. It is designed to operate 90 and 180 Volt Permanent Magnet and Shunt Wound DC motors in a bidirectional mode. It provides 4-quadrant operation, which allows forward and reverse torque in both speed directions. This allows the control to maintain constant speed with overhauling loads and provides rapid instant reversing and controlled braking. Because of its excellent performance, the control can replace servo drives in many applications.

The BC254/BC254-FSR has a Regeneration Overspeed Protection Circuit, which prevents failure of the power bridge in extreme overhauling conditions. Motor overload protection (I^2t) will shut down the control if the motor is overloaded for a predetermined amount of time. The exclusive Auto-Inhibit circuit allows safe, smooth starting during rapid cycling of the AC line.

SAFETY NOTICE

A Warning statement indicates a potentially hazardous situation which, if not avoided, could result in injury or death.

A Caution statement indicates a potentially hazardous situation which, if not avoided, could result in damage to property.

A Note indicates additional information that is not critical to the installation or operation.

WARNING: This equipment may contain voltages as high as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

WARNING: Electrical shock can cause serious or fatal injury. Be sure that all power is disconnected and there is no voltage present from this equipment or equipment to which it is or will be connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation and start-up procedures.

WARNING: Electrical shock can cause serious or fatal injury. Verify there is no voltage phase-to-phase or phase-to-neutral at the motor leads before connecting motor to this control. Motor may have high voltage present even when disconnected from this control.

WARNING: Do not use motor overload relays with an automatic reset feature. These are dangerous since the process may injure someone if a sudden or unexpected automatic restart occurs. If manual reset relays are not available, disable the automatic restart feature using external control wiring.

WARNING: This unit has an automatic restart feature that will start the motor whenever input power is applied and a RUN (FWD or REV) command is issued. If an automatic restart of the motor could cause injury to personnel, the automatic restart feature should be disabled.

WARNING: Using a jumper to eliminate the start/stop function will cause the motor to run at the Main Speed Potentiometer setting when the AC line is applied.

WARNING: If possible, do not adjust trim pots with the main power applied. Electrical shock can cause serious or fatal injury. If adjustments are made with the main power applied, an insulated adjustment tool must be used to prevent shock hazard and safety glasses must be worn.

WARNING: Do not use this drive in an explosive environment. An explosion can cause serious or fatal injury. This drive is not explosion proof.

WARNING: When the Enable jumper is installed, the drive and motor will start and run when AC power is applied, when power is restored after a momentary power loss, or after an overload or TCL fault is reset. The user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

WARNING: Do not use start/stop, inhibit or enable functions as a safety disconnect. Use only an AC line disconnect for that purpose. Failure to observe this warning could result in severe bodily injury or loss of life.

SAFETY NOTICE Continued

Caution: Disconnect motor leads (A1 and A2) from control before you perform a Dielectric Withstand test on the motor. Failure to disconnect motor from the control will result in extensive damage to the control. The control is tested at the factory for high voltage / leakage resistance as part of Underwriter Laboratory requirements.

Caution: Do not connect AC power to the Motor terminals A1 and A2. Connecting AC power to these terminals may damage the control.

Caution: Baldor recommends not to use Grounded Leg Delta transformer power leads that may create ground loops. Instead, we recommend using a four wire Wye.

Caution: Suitable for use on a circuit capable of delivering not more than 5,000 RMS symmetrical short circuit amperes listed here at rated voltage.

Caution: Adjusting the current limit above 150% of the motor nameplate rating can cause overheating and demagnetization of the PM motor.

Caution: Do not leave the motor in a locked rotor condition for more than a few seconds since motor damage may occur.

Caution: Shunt wound motors may be damaged if field windings remain energized for an extended period of time without armature rotation.

Receiving

Each control is thoroughly tested at the factory and carefully packaged for shipment. When you receive your control, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your control.
2. Verify that the part number you received is the same as the part number listed on your purchase order.
3. Do not unpack until ready for use.

Table 1-1 Electrical Ratings

AC Line (VAC ±10%, 50/60 Hz, 1PH)	Max AC Current (Amps AC)	Nominal Output (VDC)	Max Output Current (Amps DC)	Maximum Power HP (kW)
115	15	0 – ±90	11	1 (0.75)
208/230	15	0 – ±180	11	2 (1.5)
208/230	15	0 – ±90(1)	11	1 (0.75)

Table 1-2 Performance Specifications

Parameter	Specification	Factory Setting
AC Input Voltage (VAC, ±10%, 50/60 Hz)	115 and 208/230	230
Armature Voltage Range at 115 Volts AC Line (VDC)	0 – ±90	—
Armature Voltage Range at 208/230 Volts AC Line (VDC)	0 – ±901, 0 – ±180	0 – ±180
Field Voltage at 115 Volts AC Line (VDC)	100/50	—
Field Voltage at 208/230 Volts AC Line (VDC)	200/100	—
Signal Following Input (Non- Isolated(2) Range (VDC)	0 – ±10, 0 – ±15	0 – ±15
Signal Following Linearity (% Base Speed)	1	—
Line Regulation (% Base Speed)	±0.5	—
Armature Feedback Load Regulation (% Base Speed)	±1	—
Tachometer Feedback Load Regulation (% Set Speed)	±1	—
Maximum Load Capacity (% for 2 Minutes)	150	—
Current Ranges (Amps DC)	1.7, 2.5, 5, 7.5, 10	10
Speed Range (Ratio)	50:1	—
Operating Temperature Range (°C / °F)	0 – 40 / 32 – 104	—
Offset Trimpot (OFFSET) Range (% Base Speed)	0 – ±10	0
Reverse Acceleration Trimpot (RACC) Range (Seconds)	0.2 – 15	1
Forward Acceleration Trimpot (FACC) Range (Seconds)	0.2 – 15	1
Maximum Speed Trimpot (MAX) Range (% Base Speed)	70 – 110	100

WARNING: Do not use this drive in an explosive environment. An explosion can cause serious or fatal injury. This drive is not explosion proof.

Mounting

Mount the BC254/BC254-FSR in a vertical position (connection terminals in down or up position) on a flat surface free of moisture, metal chips, or corrosive atmosphere. Mount the control in such a manner that there is unrestricted air flow through the heat sink cooling fins.

Note: If drive is mounted in other than a vertical position, decrease maximum allowable ambient temperature by 10°C.

Enclosure - When mounting the BC254/BC254-FSR in an enclosure, the enclosure should be large enough to allow proper heat dissipation so that the ambient temperature does not exceed 40°C (104°F). See Figure 2-1 for mounting hole locations.

Front Cover - The BC254/BC254-FSR case is designed with a hinge so that when the front cover is open, all wiring stays intact. To open the cover, the four cover screws must be loosened so they are no longer engaged in the case bottom.

Note: Front cover screws are captive. After mounting and wiring, close the front cover, making sure all wires are contained within the enclosure and the gasket is in place around the cover lip. Tighten all four cover screws so that the gasket is slightly compressed. Do not overtighten.

Figure 2-1 Mounting Dimensions

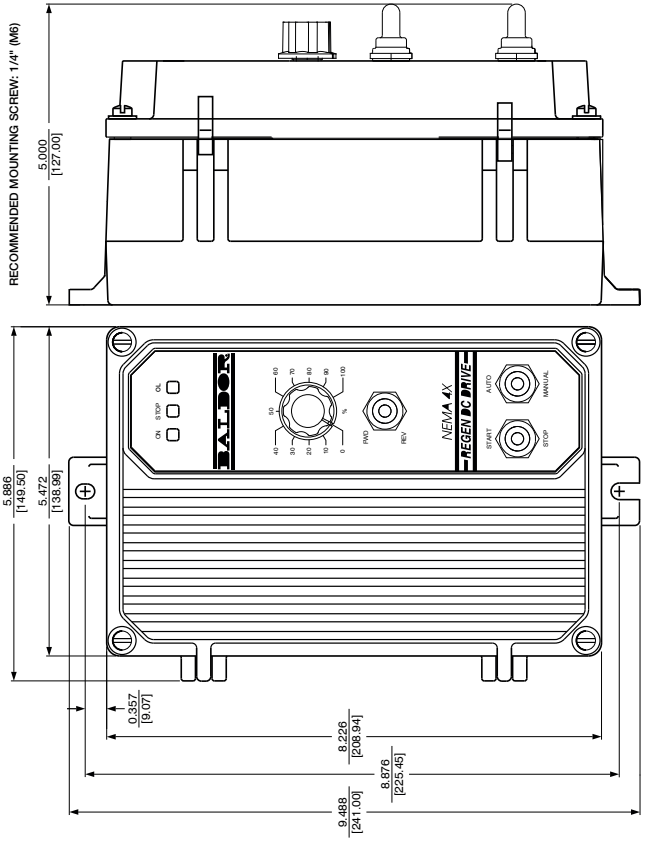
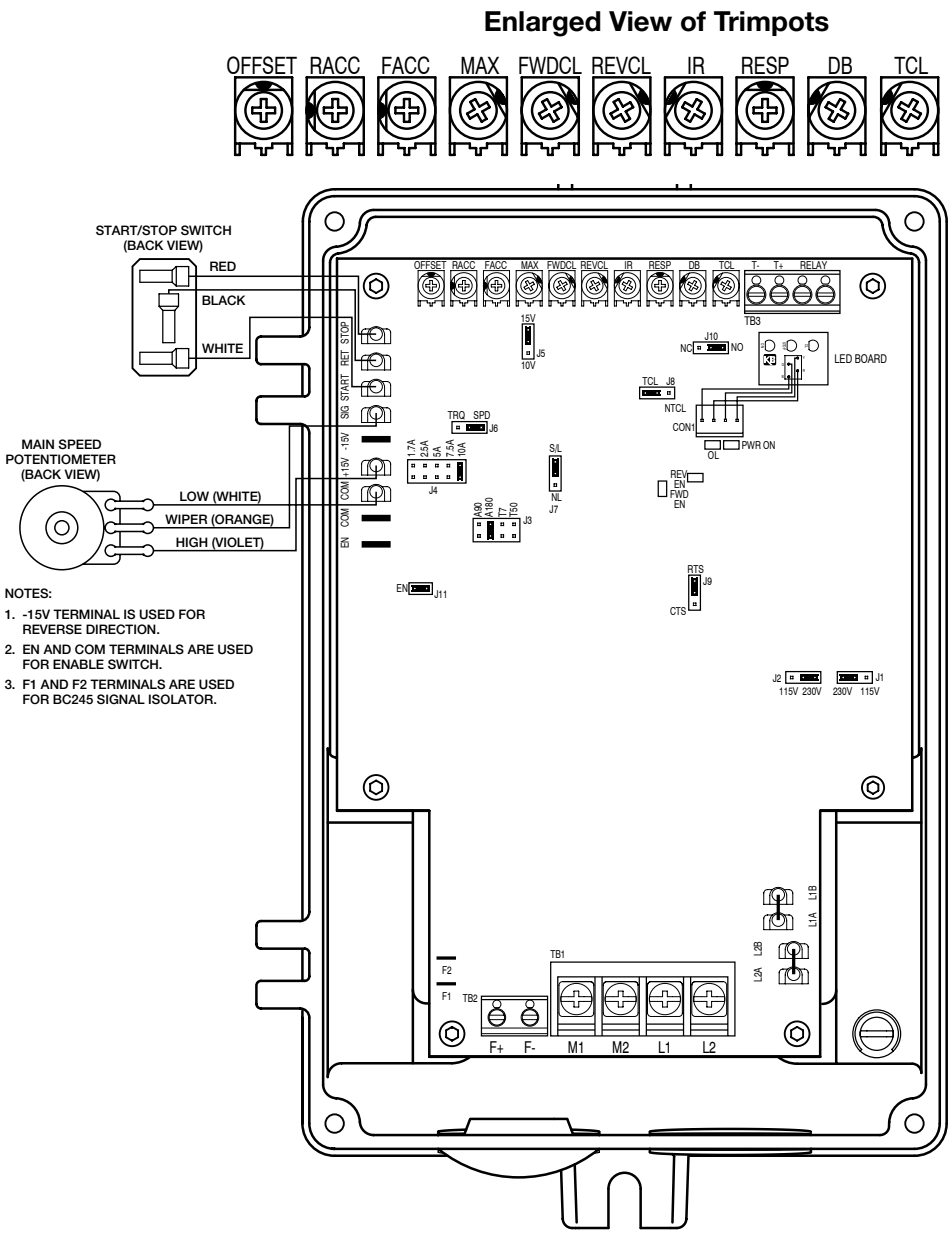


Figure 2-2 Control Board Component Location



Electrical Connections

To avoid erratic operation, do not bundle the AC line and motor wires with signal or control wiring. Do not bundle motor wires from multiple controls in the same conduit. Use shielded cables on all signal wiring over 12 (30 cm). The shield should be earth grounded on the control side only. Wire the control in accordance with the National Electrical Code requirements and other local codes that may apply.

The BC254/BC254-FSR does not contain AC line fuses. Most electrical codes require that each ungrounded conductor contain circuit protection. Install a 20 Amp fuse (Littelfuse 326, BUSS ABC or equivalent) or a circuit breaker in series with each ungrounded conductor. Check all electrical codes that apply to the application.

AC LINE

Connect the AC input to L1 & L2 of TB1, Figure 2-2. A separate AC line switch or contactor must be wired as a disconnect so that each ungrounded conductor is opened. An accessory Power On/Off Switch BC259 may be used in lieu of, or in addition to, the Start/Stop switch. The switch can be wired for single pole or double pole operation, as required.

To maintain the watertight integrity of the control, be sure to use suitable watertight connectors and wiring which are appropriate for the application. Two 7/8 (22.2mm) knockout holes are provided for standard 1/2 knockout connectors (not supplied) for wiring. A watertight plug is provided if only one knockout is required.

A separate AC line switch or contactor must be connected as a disconnect switch so that contacts open each ungrounded conductor. See Table 2-1.

Table 2-1 Terminal Block Wiring Information

Terminal Block	Designation	Connections	Wire Gauge (AWG-Cu)		Tightening Torque lb-in (Nm)
			Minimum	Maximum	
TB1	AC Input	L1 and L2	22	12	12 (1.4)
TB1	Motor Armature	M1 and M2	22	12	12 (1.4)
TB2	Motor Field (Shunt Wound Motors Only)	F1 and F2	24	14	3.5 (0.4)
TB3	Tachometer	T+ and T-	24	14	3.5 (0.4)
TB3	Run Relay	Relay	24	14	3.5 (0.4)

Ground Connection

Earth ground the control chassis using the green ground screw that is provided on the inside of the control to the right side of Terminal Block TB1, as shown in Figure 2-2.

Motor Armature Connection

Connect the motor armature positive lead (+) to Terminal M1 and negative lead (-) to Terminal M2, as shown in Figure 2-2. For step-down operation (230 Volt AC line input with 90 Volt DC SCR rated motors) set Jumper J3 to the 90V position. However, in stepdown operation the motor may have reduced brush life - consult motor manufacturer.

Note: If the motor runs in the opposite direction than is desired, disconnect power and reverse the motor leads.

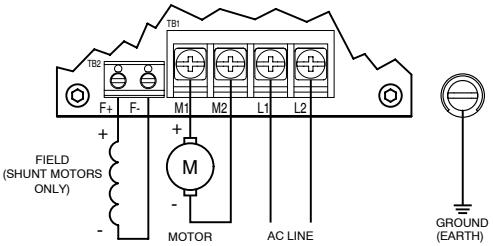
Note: Do not connect motor armature leads to F+ and F- terminals of Terminal Block TB2 or to F1 and F2 quick-connect terminals. Do not use F1 and F2 quick-connect terminals for any purpose other than to power the optional Signal Isolator BC245.

Full Voltage Field Connection (Shunt Wound Motors Only)

Wire the motor field leads to F+ and F- terminals of Terminal Block TB2, as shown in Figure 2-3 and as described in Table 2-2.

Note: Do not connect motor armature leads to F1 and F2 quickconnect terminals. Do not use F+ and F- terminals of Terminal Block TB2 for any purpose other than to power the field of a shunt wound motor.

Figure 2-3 Full Voltage Field Connection (Shunt Wound MotorsOnly)



Half Voltage Field Connection (Shunt Wound Motors Only)

Wire the motor field leads to F+ terminal of Terminal Block TB2 and L1 terminal of Terminal Block TB1, as shown in Figure 2-4 and as described in Table 2-2.

Figure 2-4 Half Voltage Field Connection (Shunt Wound Motors Only)

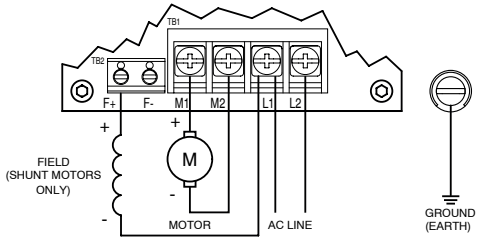


Table 2-2 Field Connection (Shunt Wound Motors Only)

AC Line (VAC)	Armature Voltage (VDC)	Field Voltage (VDC)	Field Connections
115	0 – ±90	100	F+ and F-
115	0 – ±90	50	F+ and L1
208/230	0 – ±180	200	F+ and F-
208/230	0 – ±180	100	F+ and L1
208/230	0 – ±90*	100	F+ and L1

Remote Main Speed Potentiometer

A Main Speed Potentiometer is mounted on the front cover for unidirectional forward operation of the motor as shown in Figure 2-2.

The Speed Potentiometer can be disconnected and a remote potentiometer (5k) can be used.

1. **Disconnect Main Speed Potentiometer**. Remove the white, orange and violet potentiometer leads from P1, P2 and P3 terminals.
   The leads may be taped and left inside the control. The potentiometer assembly may be removed if a watertight seal is used to cover the hole in the front cover.
2. **Forward Direction Main Speed Remote Connection**. Connect the potentiometer leads to +15V, COM, & SIG as shown in Figure 2-5.
3. **Reverse Direction Main Speed Remote Connection**. Connect the potentiometer leads to -15V,

COM, & SIG as shown in Figure 2-6.

4. **Bidirectional Operation**. Provides forward and reverse operation using the Main Speed Potentiometer. Connect the Main Speed Potentiometer to +15V, -15V, SIG as shown in Figure 2-7. Zero motor speed will now be located at 50% rotation. Rotating the Main Speed Potentiometer clockwise will increase motor speed in the forward direction. Rotating the Main Speed Potentiometer counterclockwise will increase motor speed in the reverse direction.

Note: If the motor runs in the opposite direction than is desired, disconnect power and either reverse the high side and low side of the Main Speed Potentiometer wires or reverse the motor leads to M1 and M2 terminals of Terminal Block TB1.

Figure 2-5 Unidirectional Forward Main Speed Potentiometer Connection

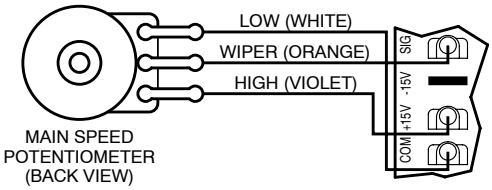


Figure 2-6 Unidirectional Reverse Main Speed Potentiometer Connection

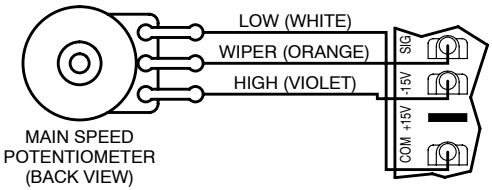
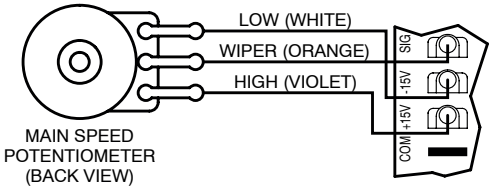


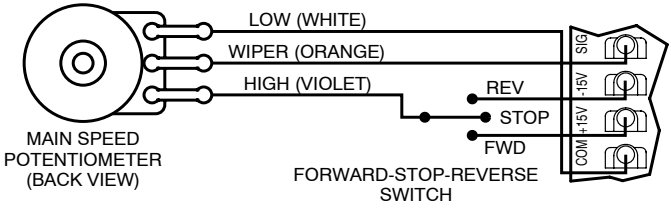
Figure 2-7 Bidirectional Main Speed Potentiometer Connection



5. **Bidirectional Operation with Reversing Contacts**.

Connect the Main Speed Potentiometer and switch (type ON-OFF-ON, SPDT switch with center off position) to +15V, -15V, SIG, COM terminals as shown in Figure 2-8.
CW rotation of the Main Speed Potentiometer will increase motor speed. The direction is selected by the switch. CCW rotation of the Main Speed Potentiometer will decrease motor speed.

Figure 2-8 Bidirectional Main Speed Potentiometer Connection with Reversing Contacts

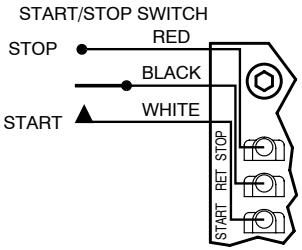


Remote Start/Stop Switch Connection

A Start/Stop Switch is mounted on the front cover. This switch can be disconnected and a remote Start/Stop Switch (type (ON)-OFF-ON, SPDT)may be used.

1. Remove the white, black, and red wires from START, RET and STOP terminals. The leads may be taped and left in the control. The switch assembly may be removed if a watertight seal is used to cover the hole in the front cover.
2. Connect the remote Start/Stop Switch wires to START (momentary), RET (common) and STOP (constant) terminals, as shown in Figure 2-9.
   To start the motor, after applying power, momentarily set the Start/Stop Switch to START position. The motor will run at the set speed of the Main Speed Potentiometer.
   To stop the motor, set the Start/Stop Switch to the STOP position.

Figure 2-9 Remote Start/Stop Switch Connection



Note: To eliminate the Start/Stop function, connect START and RET terminals with the jumper that is provided, as shown in Figure 4-9.

Warning: Eliminating the Start/Stop function using a jumper will cause the drive and motor to start and run when AC power is applied, when power is restored after a momentary power loss, or after an overload or TCL fault is reset. The user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

Figure 2-10 Start/Stop Function Eliminated (Jumper Installed)

Run Relay Connection

Normally open (NO) or normally closed (NC) relay output contacts are available at Terminal Block TB3. The contacts change state in START mode. The contacts return to their original state in STOP Mode, when the AC line is disconnected or times out in Timed Current Limit due to a motor overload. The Run Relay contacts are rated 1 Amp at 30 Volts DC and 0.5 Amp at 125 Volts AC.

NO or NO run relay output contacts can be selected depending on the position of Jumper J10. The control is factory set with Jumper J10 set to the NO position. If normally closed run relay contacts are required in the STOP Mode, set Jumper J10 to the NC position. See Table 2-3. If normally open is selected (Jumper J10 set to the NO position), the run relay output contacts open when the control is in the STOP Mode and close when the control is started.

If normally closed is selected (Jumper J10 set to the NC position), the run relay output contacts will close when the control is in the STOP Mode and open when the control is started.

Note: If relay output contacts are not required for your application, Jumper J10 may be set to any position.

Table 2-3 Run Relay Output Contacts

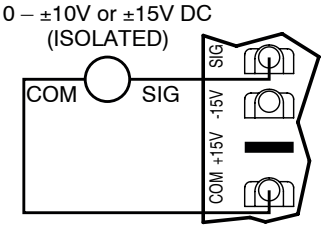
Mode	J10 Position	Run Relay Contacts
Run	NO	Closed
	NC	Open
Stop	NO	Open
	NC	Closed
TCL	NO	Open
	NC	Closed

Voltage Following Connection

An isolated 0 - 10 Volt DC or 0 - 15 Volt DC analog signal voltage can also be used to control motor speed. See Figure 2-11.

Note: If an isolated signal voltage is not available, install the optional Signal Isolator BC245. Connect the isolated signal voltage to SIG (signal) and COM (-) terminals. Adjustment of the MIN trimpot may be necessary to achieve a 0 Volt DC output with a 0 Volt DC input.

Figure 2-11 Voltage Following Connection

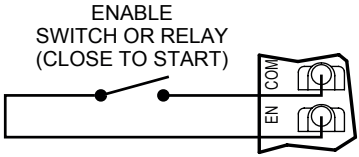


Warning: When the Enable jumper is installed, the drive and motor will start and run when AC power is applied, when power is restored after a momentary power loss, or after an overload or TCL fault is reset. The user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

Enable Circuit Connection

The control can also be started and stopped with an Enable Circuit (close to start). See Figure 2-12. The Enable function is established by wiring a switch in series with the EN and COM terminals. When the Enable switch is closed, the control will accelerate to the Main Speed Potentiometer setting. When the Enable Switch is opened, the control will either Regenerate-to-Stop or Coast-to-Stop, depending on the setting of Jumper J9. Jumper J11 must be removed for the Enable Circuit to operate.

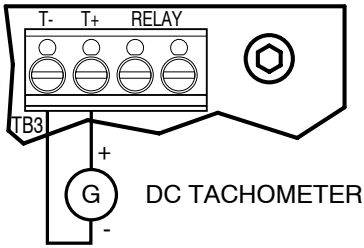
Figure 2-12 Enable Circuit Connection



DC Tachometer Connection
Wire the tachometer to T+ and T- terminals of Terminal Block TB3, as shown in Figure 4-12. Jumper J3 must be set to the 7V position for 7 Volt per 1000 RPM tachometer or to the 50V position for 50 Volt per 1000 RPM tachometer. The tachometer polarity must match the polarity of the motor armature voltage. If the tachometer polarity is reversed, the motor will accelerate to full speed and the Main Speed Potentiometer will not control speed. Tachometer feedback can greatly improve speed regulation and dynamic response.

Note: When using a tachometer, the IR trimpot should be set fully counterclockwise.

Figure 2-13 DC Tachometer Connection



The tachometer input is designed for 7 Volt or 50 Volt per 1000 RPM tachometer used with 1800 RPM motors.

For a tachometer other than 7 Volt or 50 Volt per 1000 RPM or for motors other than 1800 RPM, an external 1/2 Watt resistor (RT) must be installed in series with the tachometer.
Jumper J3 must be set to the 7V position.

The value of RT in Ω can be calculated using the following formula:

RT = [(4.37 X VT X S) - 55000]
VT = Tach voltage in volts/1000 RPM
S = Base Speed of motor in RPM

Example:
Assume a 20 Volt per 1000 RPM tachometer with a 3600 RPM motor.

RT = (4.37 X 20 X 3600) - 55000 = 259640

Choose the closest 1/2 Watt resistor value, which is 240000 (240k) or 270000 (270k).
Readjustment of the MAX trimpot may be necessary to achieve the desired maximum output voltage.

Startup and Adjustments

Motor Type
The BC254/BC254-FSR is a full wave regenerative, bi-directional control used to operate Permanent Magnet, (PM), and Shunt Wound DC motors. Do not use the control in applications where specified ratings would be exceeded.

Torque Requirements
When replacing an AC induction motor with a DC motor and speed control, consideration must be given to the maximum torque requirements. The full load torque rating of the DC motor must be equal to, or greater than, that of the AC motor.

Set Jumpers
The BC254/BC254-FSR has selectable jumpers which must be set before the control can be used. See Figure 2-2 for location of jumpers.

J1, J2 - Input AC Line Voltage

Jumpers J1 and J2 are both factory set to the 230V position for 208/230 Volt AC line input. For 115 Volt AC line input, set both Jumpers J1 and J2 to the 115V position. Figure 2-14.

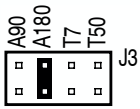
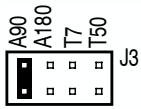
Figure 2-14 AC Line Voltage Select

Control Set for 208/230 Volt AC Line Input (Factory Setting)		Control Set for 115 Volt AC Line Input	
J2 Set for 208/230 Volt AC Line	J1 Set for 208/230 Volt AC Line	J2 Set for 115 Volt AC Line	J1 Set for 115 Volt AC Line
			

J3 - Motor Voltage Selection

Jumper J3 is factory set to the A180 position for 180 Volt motors. For 90 Volt motors, set Jumper J3 to the A90 position. Figure 2-15.

Figure 2-15 Motor Voltage Selection

J3 Set for 180 Volt Motor (Factory Setting)	J3 Set for 90 Volt Motor
	

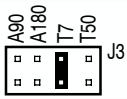
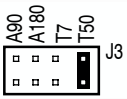
Note: If Jumper J3 is set to the T7 or T50 position, a tachometer must be wired to Terminal Block TB3. If a tachometer is not used, Jumper J3 must be in either the A180 or A90 position. If jumper J3 is in the T7 or T50 position, and a tachometer is not used, the motor will accelerate to full speed and the Main Speed Potentiometer will not control speed.

J3 - DC Tachometer Voltage Selection

J3 is factory set to the A180 position for 180 Volt motors. When connecting a tachometer to TB3, set Jumper J3 to the corresponding voltage of the tachometer being used. Figure 2-16.

Note: If using a tachometer other than 7V or 50V per 1000 RPM.

Figure 2-16 DC Tachometer Voltage Selection

J3 Set for 7V per 1000 RPM Tachometer	J3 Set for 50V per 1000 RPM Tachometer
	

J4 - Motor Current Selection

Jumper J4 is factory set to the 10A position for 10 Amp motors. For lower current motors, set Jumper J2 to the corresponding current of the motor being used. See Figure 2-17 and Table 2-4.

Figure 2-17 Motor Current Selection

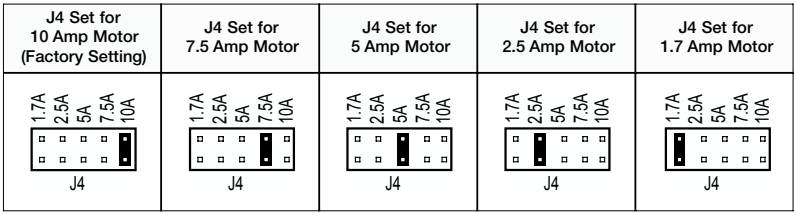


Table 2-4 Setting Motor Current

J4 Setting (Amps DC)	SCR Rated Motor Horsepower – HP (kW)	
	90 VDC Motors	180 VDC Motors
1.7	1/6, (0.1)	1/3 (0.25)
2.5	1/4, (0.18)	1/2 (0.37)
5.0	1/2, (0.37)	1 (0.75)
7.5	3/4, (0.5)	11⁄2 (1)
10	1, (0.75)	2 (1.5)

J5 - Analog Input Signal Voltage Selection
Jumper J5 is factory set to the 15V position for use with a potentiometer to control motor speed. To control motor speed using a 0 - ±10 Volt DC isolated analog signal voltage set Jumper J5 to the 10V position. To control motor speed using a 0 - ±15 Volt DC isolated analog signal voltage, set Jumper J5 to the 15V position. See Figure 2-2.

Note: Connect the isolated signal voltage to SIG (signal) and COM (-) terminals. If an isolated analog signal voltage is not available, install the optional Signal Isolator BC245.

J6 - Control Mode Selection
Jumper J6 is factory set to the SPD position for Speed Control Mode. For Torque Control Mode, set Jumper J6 to the TRQ position. See Figure 2-2.

J7 - Torque Control Mode Selection
Jumper J7 is factory set to the S/L position for Speed Mode and Linear Torque Mode. For Non-Linear Torque Mode, set Jumper J7 to the NL position. See Figure 2-2.

J8 - Current Limit Mode Selection
Jumper J8 is factory set to the TCL position for Timed Current Limit operation. For Non-Timed Current Limit operation, set Jumper J8 to the NTCL position. See Figure 2-2.

TCL (Timed Current Limit)
When Jumper J8 is set to the TCL position, the control will go into Stop Mode after it is in overload for a predetermined amount of time (set by the TCL trimpot).

Resetting the Control after TCL
To reset the control after it has gone into TCL, set the Start/Stop Switch to the STOP position and then momentarily to the START position or disconnect and reconnect the AC line. If the Start/Stop Switch is jumpered (START and RET terminals connected), the control must be restarted by disconnecting and reconnecting the AC line. If the Power On/Off Switch is installed, set it to the OFF position and then back to the ON position.

NTCL (Non-Timed Current Limit)
When Jumper J8 is set to the NTCL position, the control will not go into Stop Mode after it is in overload. The TCL trimpot will have no affect when Jumper J8 is in the NTCL position.

J9 - Stop Mode Selection
Jumper J9 is factory set to the RTS position, for Regenerate-to-Stop Mode. For Coast-to-Stop Mode, set Jumper J9 to the CTS position. See Figure 2-2.

J10 - Run Relay Output Mode Selection
Jumper J10 is factory set to the NO position for normally open relay output contacts at TB3. For normally closed relay output contacts, set Jumper J10 to the NC position. See Figure 2-2.

J11 - Enable
Jumper J11 is factory installed to enable the control. If installing the Enable Circuit, remove Jumper J11. See Figure 2-2.

Startup

After the control has been mounted properly and electrical connections have been completed and jumpers are correctly set, start the control as follows:

1. Verify the speed adjust potentiometer is set fully counterclockwise.
2. Apply AC power.
3. Observe the Power ON LED indicator is illuminated. If not on, refer to troubleshooting.
4. Verify correct direction of motor rotation.
   Start the control. The motor shaft should begin to rotate as the potentiometer knob is turned clockwise, or the analog speed reference signal is increased.
   Verify the motor shaft is rotating in the desired 'forward' direction.
   If the direction of rotation is incorrect, stop the control and disconnect AC power.
   Switch the motor lead connections at the A+ and A- terminals.
   If a tachometer is connected, the leads may also need to be switched for correct signal polarity.
   If the CL LED is on, refer to troubleshooting.

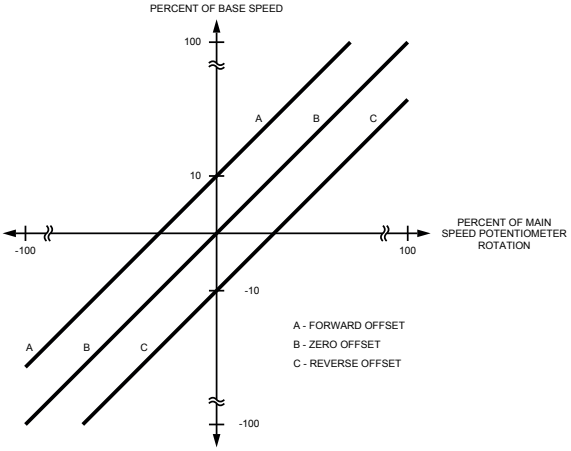
WARNING: If possible, do not adjust trim pots with the main power applied. Electrical shock can cause serious or fatal injury. If adjustments are made with the main power applied, an insulated adjustment tool must be used to prevent shock hazard and safety glasses must be worn.

Trimpot Adjustments

The BC254/BC254-FSR contains trimpots, which are factory set for most applications. Figure 2-2 illustrates the location of the trimpots and their approximate calibrated positions. Some applications may require readjustment of the trimpots to tailor the control for a specific requirement. Readjust trimpots as needed.

Offset (OFFSET)
Sets the amount of bias in the forward or reverse direction. The OFFSET trimpot is factory set for approximately zero offset, which means that neither the forward nor reverse direction is favored. To offset the control in the forward direction, rotate the OFFSET trimpot clockwise. To offset the control in the reverse direction, rotate the OFFSET trimpot counterclockwise. See Figure 2-18.

Figure 2-18 Offset Trimpot Adjustment



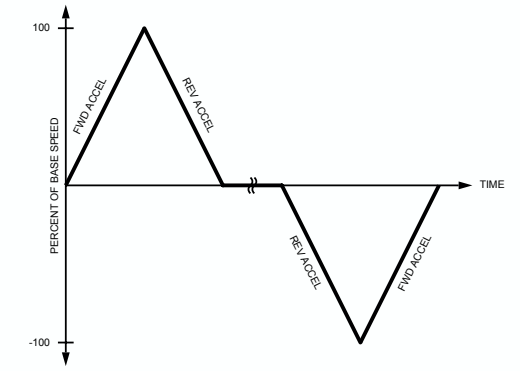
Forward Acceleration (FACC) and Reverse Acceleration (RACC)
Sets the amount of time it takes the control voltage to reach full output. The FACC and RACC trimpots are factory set to 1 second. See Figure 2-2 and 2-19.

The FACC trimpot sets the amount of time it takes the control voltage to reach full output in the forward direction. It also sets the amount of time it takes the control voltage, in the reverse direction, to reach zero output (FACC also sets the reverse deceleration time). To increase the forward acceleration time, rotate the FACC trimpot clockwise.

To decrease the forward acceleration time, rotate the FACC trimpot counterclockwise. The RACC trimpot sets the amount of time it takes the control voltage to reach full output in the reverse direction. It also sets the amount of time it takes the control voltage, in the forward direction, to reach zero output (RACC also sets the forward deceleration time). To increase the reverse acceleration time, rotate the RACC trimpot clockwise.

To decrease the reverse acceleration time, rotate the RACC trimpot counterclockwise.

Figure 2-19 FACC and RACC Trimpot Adjustment



Maximum Speed (MAX)

Sets maximum speed of the motor. The MAX trimpot is factory set for 100% of base motor speed. For a higher maximum speed setting, rotate the MAX trimpot clockwise. For a lower maximum speed setting, rotate the MAX trimpot counterclockwise. See Figure 2-2.

To Calibrate the MAX Trimpot:

1. Adjust the MAX trimpot to the desired position and set the Main Speed Potentiometer for full output voltage.
2. Monitor the armature voltage and readjust the MAX trimpot to the desired voltage.

Forward Current Limit (FWDCL) and Reverse Current Limit (REVCL)

Sets the current limit (overload), which limits the maximum current to the motor. The FWDCL and REVCL trimpots are factory set for 150% of J4 range setting. See Figure 2-2.

The FACC trimpot sets the current limit in the forward direction. To increase the forward current limit, rotate the FWDCL trimpot clockwise. To decrease the forward current limit, rotate the FWDCL trimpot counterclockwise.

The RACC trimpot sets the current limit in the reverse direction. To increase the reverse current limit, rotate the REVCL trimpot clockwise. To decrease the reverse current limit, rotate the REVCL trimpot counterclockwise.

Caution: Adjusting the FWDCL or REVCL above 150% of motor rating can cause overheating and demagnetization of some PM motors. Consult the motor manufacturer. Do not leave the motor in a locked condition for more than a few seconds since armature damage may occur.

To Calibrate the FWDCL or REVCL Trimpot:

1. Disconnect the AC power. Wire in a DC ammeter in series with either motor armature lead. Lock motor shaft. Be sure that Jumper J4 is set to the corresponding motor current position. Set Jumper J8 to the NTCL position.
2. Set the FWDCL trimpot (if in the forward direction) or the REVCL trimpot (if in the reverse direction) fully counterclockwise.
3. Apply power. Adjust the FWDCL trimpot (if in the forward direction) or the REVCL trimpot (if in the reverse direction) until the desired current limit (CL) setting is reached.

Caution: Do not leave the motor shaft locked for more than 2 - 3 seconds or motor damage may result.

IR Compensation (IR)

Sets the amount of compensating voltage required to keep the motor speed constant under changing loads. The IR trimpot is factory set for 10 Volts (at 180 Volts DC output) and 5 Volts (at 90 Volts DC output). To increase compensating voltage, rotate the IR trimpot clockwise. To reduce compensating voltage, rotate the IR trimpot counterclockwise. See Figure 2-2.

Note: If the IR compensation is too high, unstable (oscillatory) operation will result. If the control is used with a DC tachometer, the IR trimpot should be set fully counterclockwise.

To Calibrate the IR Trimpot:

1. Run the motor at approximately 30 - 50% of rated speed at no load and measure the actual speed.
2. Load the motor to the rated current. Adjust the IR trimpot so that the loaded speed is the same as the unloaded speed measured in step 1.

Response (RESP)

Sets the relative response of the control. The RESP trimpot is factory set to 50% rotation. For faster response, rotate the RESP trimpot clockwise. For slower response, rotate the RESP trimpot counterclockwise. See Figure 2-2.

Note: If response is made too rapid, unstable, oscillatory operation may result.

Deadband (DB)
Sets the amount of Main Speed Potentiometer rotation required to initiate control voltage output. The Deadband trimpot is factory set to 0.5% of base speed. For more deadband, rotate he DB trimpot clockwise. For less deadband, rotate the DB trimpot counterclockwise. See Figure 2-2.

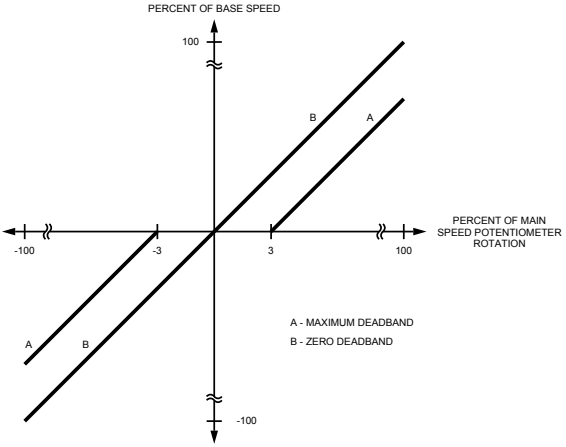
The DB trimpot also determines the amount of delay that will occur before regeneration begins. (Regeneration occurs when the applied load torque is in the same direction as the motor rotation.)

To Calibrate the DB Trimpot:

1. Set the Main Speed Potentiometer to the zero speed position.
2. Set the DB trimpot fully counterclockwise.
3. Adjust the DB trimpot until motor hum is eliminated.

Note: If the DB trimpot is set too low (counterclockwise position), the motor may oscillate between forward and reverse directions. Adjust the DB trimpot clockwise until the instability disappears. (Oscillation may also occur due to the setting of the RESP trimpot.

Figure 2-20 DB Trimpot Adjustment



Timed Current Limit (TCL)
Sets the time for the control to shut down after being in current limit (provides electronic motor burnout protection). The TCL trimpot is factory set for 5 seconds. To increase the TCL setting, rotate the TCL trimpot clockwise. To decrease the TCL setting, rotate the TCL trimpot counterclockwise. If the control remains in CL for a predetermined amount of time (set by the TCL trimpot and if Jumper J8 is in the TCL position), the control will shut down.

To reset the control after it has gone into TCL , momentarily set the Start/Stop switch to the START position or disconnect and reconnect the AC line. If the Start Switch is jumpered (START and RET terminals connected) the control must be restarted by disconnecting and reconnecting the AC line. If the Power On/Off Switch is installed, set it to the OFF position and then back to the ON position.

To Calibrate the TCL Trimpot:

1. Run the motor at approximately 30 -50% of rated speed at no load.
2. With Jumper J8 set to the TCL position, set the TCL trimpot to the desired position and lock the motor shaft.
3. Monitor the time it takes for the control to shut down.
4. If the TCL time is not as desired, reset the control and repeat steps 1 - 3.

Non-Timed Current Limit (NTCL)
When jumper J3 is set to the NTCL position and an overload condition exists, the control will remain in current limit and will not shut down.

Operation

After the BC254/BC254-FSR has been properly setup (jumpers set to desired positions and wiring completed), the startup procedure can begin. If AC power has been properly brought to the control, the ON and STOP LEDs will be illuminated. Before starting, be sure that the Main Speed Potentiometer is set to the zero speed position. The STOP LED should no longer illuminate. The motor should begin to run as the Main Speed Potentiometer is rotated.

Note: If the motor runs in the incorrect direction, it will be necessary to disconnect the AC line, reverse the motor leads and repeat the startup procedure.

Table 2-5 Control Operation

Quadrant	Type of Operation	Motor Rotation Direction	Motor Torque Direction	Load Torque Direction
I	Motoring	CW	CW	CCW
II	Regeneration	CCW	CW	CCW
III	Motoring	CCW	CCW	CW
IV	Regeneration	CW	CCW	CW

Linear Torque Mode

In Linear Torque mode (Jumper J7 set to the S/L position), speed and torque vary linearly as a function of Main Speed Potentiometer rotation or input signal. See Figure 2-21.

Figure 2-21 Linear Torque Mode

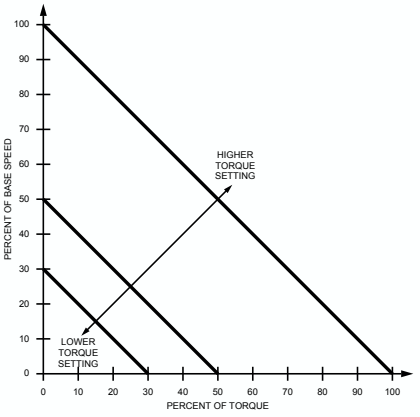
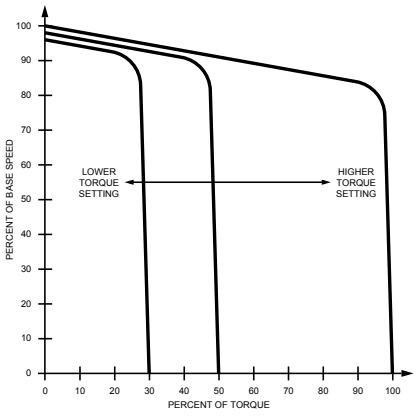


Figure 2-22 Non-Linear Torque Mode



Non-Linear Torque Mode

In Non-Linear Torque mode (Jumper J7 set to the NL position), the torque is varied by the Main Speed Potentiometer or input signal, and remains constant throughout the motor's entire speed range. See Figure 2-22.

Troubleshooting

The control has LEDs to display the control's operational status.

A. **Power On**
This lamp indicates AC power is applied to the control.

B. **STOP (STOP)**
The STOP LED will illuminate yellow when the Start/Stop switch is set to the STOP position. When the AC line is applied, this LED will also be illuminated until the Start/Stop switch is momentarily set to the START/STOP position.

C. **OVERLOAD (OL)**

The OL LED will illuminate red when the control goes into current limit, indicating that the current limit set point has been reached (set by the CL trimpot and the position of jumper J4). This LED will remain illuminated if the control times out in TCL (Jumper J8 set to the TCL position).

The control can be reset by either setting the Start/Stop Switch to the STOP position and then momentarily to the START position or by disconnecting and reconnecting the AC line. If the overload condition still exists when the control is restarted or AC line reapplied, the OL LED will illuminate again. If the OL LED remains illuminated during normal control operation, a fault condition may exist. Possible causes for this condition are as follows:

1. Motor is overloaded. Check motor current. If the motor is a shunt wound type, the field may be open or not receiving proper voltage.
2. Motor may be defective. Check motor for shorts or grounds.
3. CL may be set too low. Check position of CL trimpot and setting of jumper J4.

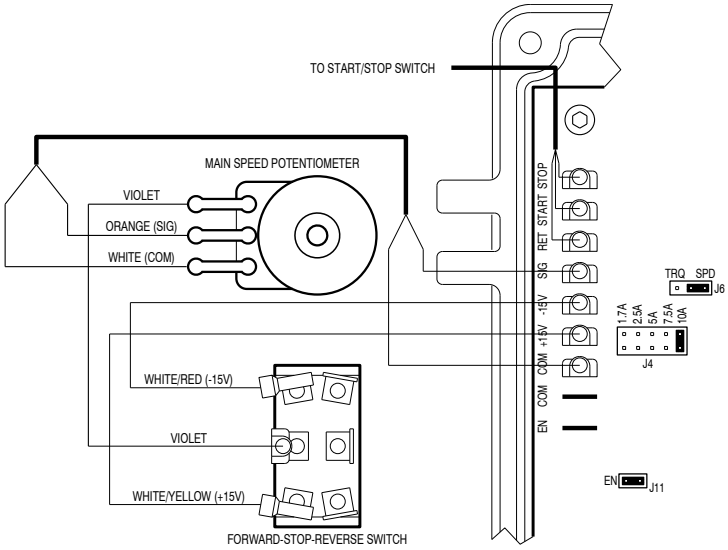
Optional Forward-Stop-Reverse Switch (Catalog No. BC253)

The optional Forward-Stop-Reverse Switch (Catalog No. BC253)* is used to stop and reverse the motor direction. The switch assembly is to be installed in the mounting hole provided on the control. See the installation instruction MN1368 provided with the Forward-Stop-Reverse Switch Kit for detailed information on mounting and connections.

Figure A-1 shows the connections of the Forward-Stop-Reverse Switch to the control board terminals and main speed pot.

*Note: The BC253 is factory installed on the BC254-FSR model.

Figure A-1 Optional Forward-Stop-Reverse Switch Connections



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