AMERICAN CONTROL ELECTRONICS

MHS Series

USER MANUAL

MHS403-1.5
MHS403-10
MHS403-25
MHS443-10

Dear Valued Consumer:

Congratulations on your purchase of the **MHS Series** drive. This User Manual was created for you to get the most out of your new device and assist with the initial setup. Please visit www.americancontrolelectronics.com to learn more about our other drives.

Thank you for choosing **American Control Electronics®**!

Safety First!

SAFETY WARNINGS

Text in gray boxes denote important safety tips or warnings. Please read these instructions carefully before performing any of the procedures contained in this manual.

- DO NOT INSTALL, REMOVE, OR REWIRE THIS EQUIPMENT WITH POWER APPLIED. Have a qualified electrical technician install, adjust and service this equipment. Follow the National Electrical Code and all other applicable electrical and safety codes, including the provisions of the Occupational Safety and Health Act (OSHA), when installing equipment.
- Reduce the chance of an electrical fire, shock, or explosion by using proper grounding techniques, over-current protection, thermal protection, and enclosure. Follow sound maintenance procedures.

It is possible for a drive to run at full speed as a result of a component failure. AMERICAN CONTROL ELECTRONICS® (ACE) strongly recommends the installation of a master switch in the main power input to stop the drive in an emergency.

Circuit potentials are at 115 VAC or 230 VAC above earth ground. Avoid direct contact with the printed circuit board or with circuit elements to prevent the risk of serious injury or fatality. Use a non-metallic screwdriver for adjusting the calibration trim pots. Use approved personal protection equipment and insulated tools if working on this drive with power applied.

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Section 1. Specifications

Model	*Maximum Armature Current (ADC)*	*HP Range with 90 VDC Motor*	*HP Range with 180 VDC Motor*	*Enclosure*
MHS403-1.5	*1.5*	*1/20 - 1/8*	*1/10 - 1/4*	*Chassis*
MHS403-10 *MHS443-10*	*10.0*	*1/4 - 1*	*1/2 - 2*	*Chassis* *NEMA 4X*
MHS403-25	*25.0*	*1 - 2 1/2*	*2 - 5*	*Chassis*

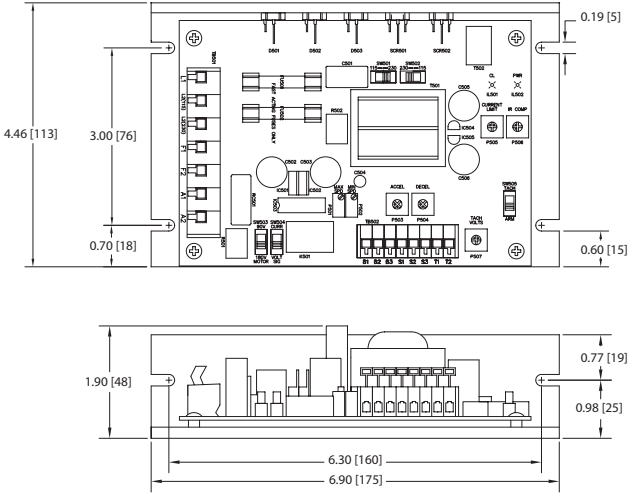
AC Line Voltage	115/230 VAC ± 10% 50/60 Hz, single phase
DC Armature Voltage	
with 115 VAC Line Voltage	0 - 90 VDC
with 230 VAC Line Voltage	0 - 180 VDC
Field Voltage	
with 115 VAC Line Voltage	50 VDC (F1 to L1); 100 VDC (F1 to F2)
with 230 VAC Line Voltage	100 VDC (F1 to L1); 200 VDC (F1 to F2)
Maximum Field Current	
MHS403-1.5, MHS403-10, and MHS443-10	1 ADC
MHS403-25	3 ADC
Acceleration Time Range (with no load)	
MHS403-1.5, MHS403-10, and MHS443-10	1 - 11 seconds
MHS403-25	0.5 - 12 seconds
Deceleration Time Range (with no load)	
MHS403-1.5, MHS403-10, and MHS443-10	coast to a stop - 11 seconds
MHS403-25	coast to a stop - 12 seconds
Analog Input Range (Signal may be isolated or non-isolated; S1 to S2)	
Voltage Signal Range	0 - 5; 0 - 10 VDC
Current Signal Range	4 - 20 mA

Input Impedance (S1 to S2)	>100K ohms
Tachogenerator Feedback Voltage Range	7-50 VDC per 1000 RPM
Form Factor	1.37 at base speed
Load Regulation	
with Armature Feedback	1% base speed or better
with Tachogenerator Feedback	0.1% base speed
Speed Range	60:1
Vibration	0.5G maximum (0 - 50 Hz) 0.1G maximum (> 50 Hz)
Safety Certifications	
All models	UL/cUL Listed Equipment, File # E132235
All models except MHS403-25	CSA Certified Component, File # LR41380
Ambient Temperature Range	
MHS403-1.5 and MHS403-10	10°C - 55°C
MHS443-10	10°C - 45°C
MHS403-25	10°C - 40°C* 10°C - 50°C **

*When mounted flat (horizontally) or in an enclosure whose volume is between 4 and 6 cubic feet.

**When mounted upright (vertically), or in an enclosure whose volume is greater than 6 cubic feet.

Section 2. Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. MHS403-1.5 and MHS403-10 Dimensions

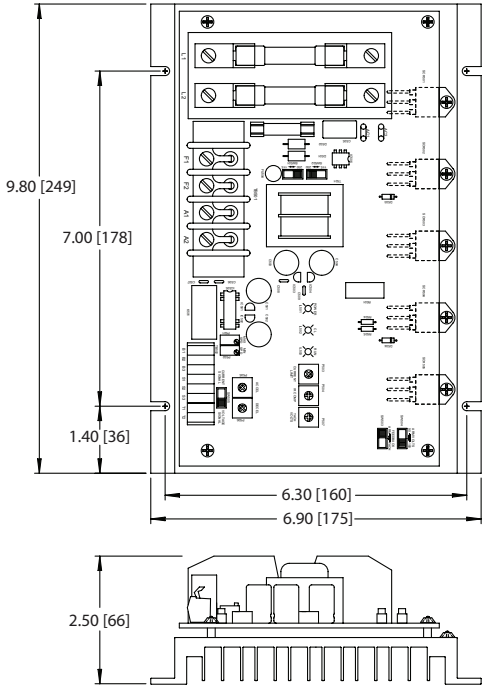


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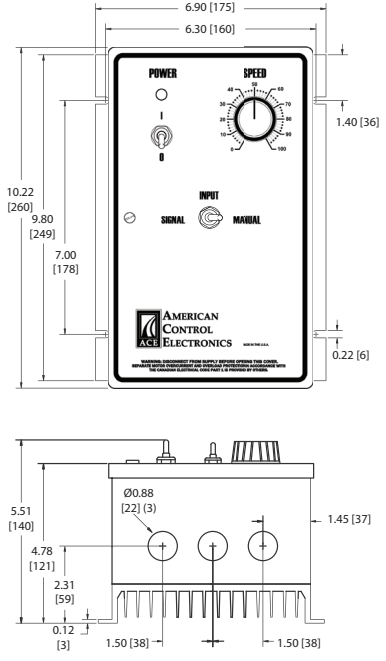
Figure 2. MHS403-25 Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 3. MHS443-10 Dimensions

Section 3. Installlation

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury. Make sure you read and understand the Safety Precautions on page i before attempting to install this product.

Chassis Drives

Mounting

- Drive components are sensitive to electrostatic discharge. Avoid direct contact with the circuit board. Hold the drive by the chassis or heat sink only.
- Protect the drive from dirt, moisture, and accidental contact.
- Provide sufficient room for access to the terminals and calibration trim pots.
- Mount the drive away from heat sources. Operate the drive within the specified ambient operating temperature range.
- Prevent loose connections by avoiding excessive vibration of the drive.
- Mount the drive with its board in either a horizontal or vertical plane. Six 0.19" (5 mm) wide slots in the chassis or four in the heat sink accept #8 pan head screws. Fasten either the large base or the narrow flange of the chassis to the subplate.
- The chassis or heat sink should be earth grounded. Use a star washer beneath the head of at least one of the mounting screws to penetrate the anodized surface and to reach bare metal.

Speed Adjust Potentiometer

> **WARNING!** Be sure that the potentiometer tabs do not make contact with the potentiometer's body. Grounding the input will cause damage to the drive.

Mount the speed adjust potentiometer through a 0.38 in. (10 mm) hole with the hardware provided (Figure 4). Install the circular insulating disk between the panel and the 10K ohm speed adjust potentiometer.

Twist the speed adjust potentiometer wires to avoid picking up unwanted electrical noise. If the speed adjust potentiometer wires are longer than 18 in. (46 cm), use shielded cable. Keep the speed adjust potentiometer wires separate from power leads (L1, L2, L2 (115), L2 (230), A1, A2, F1, F2).

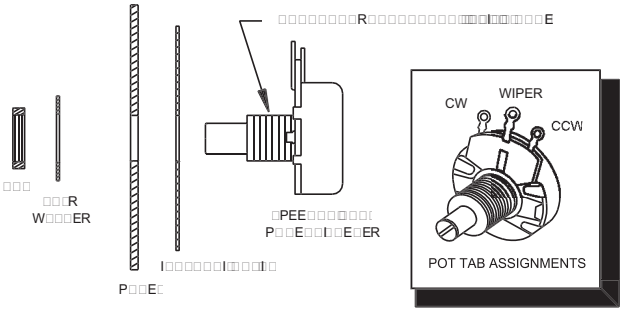


Figure 4. Speed Adjust Potentiometer

Wiring

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

Circuit potentials are at 115 or 230 VAC above ground. To prevent the risk of injury or fatality, avoid direct contact with the printed circuit board or with circuit elements.

Do not disconnect any of the motor leads from the drive unless power is removed or the drive is disabled. Opening any one motor lead while the drive is running may destroy the drive.

- Use 18 - 24 AWG wire for logic wiring. Use 14 - 16 AWG wire for AC line and motor wiring.

Shielding Guidelines

Under no circumstances should power and logic level leads be bundled together. Induced voltage can cause unpredictable behavior in any electronic device, including motor controls.

As a general rule, AMERICAN CONTROL ELECTRONICS® (ACE) recommends shielding of all conductors. If it is not practical to shield power conductors, ACE recommends shielding all logic-level leads. If shielding of all logic-level leads is not practical, the user should twist all logic leads with themselves to minimize induced noise.

It may be necessary to earth ground the shielded cable. If noise is produced by devices other than the drive, ground the shield at the drive end. If noise is generated by a device on the drive, ground the shield at the end away from the drive. Do not ground both ends of the shield.

Shielding Guidelines (continued)

If the drive continues to pick up noise after grounding the shield, it may be necessary to add AC line filtering devices, or to mount the drive in a less noisy environment.

Logic wires from other input devices, such as motion controllers and PLL velocity controllers, must be separated from power lines in the same manner as the logic I/O on this drive.

Line Fusing

All models are preinstalled with two line fuses in fuse holders FU501 and FU502.

Model MHS403-25 is preinstalled with 40 amp fuses. Model MHS403-10 is preinstalled with 15 amp fuses. Model MHS403-1.5 is preinstalled with 5 amp fuses.

Preinstalled line fuses are rated at or close to maximum horsepower. If the horsepower rating of the motor being used is less than the maximum horsepower rating of the drive, the line fuse may have to be replaced with a lower rated one. Fuses should be rated for 250 VAC or higher and approximately 150% of the maximum armature current. Refer to Table 1 on page 10 for recommended fuse values.

Table 1. Recommended Line Fuse Sizes

90 VDC Motor Horsepower	*180 VDC Motor Horsepower*	*Maximum DC Armature Current (amps)*	*AC Line Fuse Size (amps)*
1/20	*1/10*	*0.5*	*1*
1/15	*1/8*	*0.8*	*1.5*
1/8	*1/4*	*1.5*	*3*
1/6	*1/3*	*1.7*	*3*
1/4	*1/2*	*2.5*	*5*
1/3	*3/4*	*3.5*	*8*
1/2	*1*	*5.0*	*10*
3/4	*1 ½*	*7.5*	*15*
1	*2*	*10*	*15*
1 1/2	*3*	*15*	*25*
2	*4*	*20*	*40*
2 1/2	*5*	*25*	*40*

ACE offers fuse kits. See Section 10: Accessories and Replacement Parts on page 56 for fuse kit part numbers.

Connections

Do not connect this equipment with power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

ACE strongly recommends the installation of a master power switch in the voltage input line, as shown in Figure 6 (page 15) and Figure 7 (page 16). The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

Cage-Clamp Terminal Block

MHS series drives use a cage-clamp terminal block. To connect a wire to the cage-clamp terminal block (see Figure 5), use a small screwdriver to press down on the lever arm. Insert a wire stripped approximately 0.25 inches (6 mm) into the opening in front of the terminal block. Release the lever arm to clamp the wire.

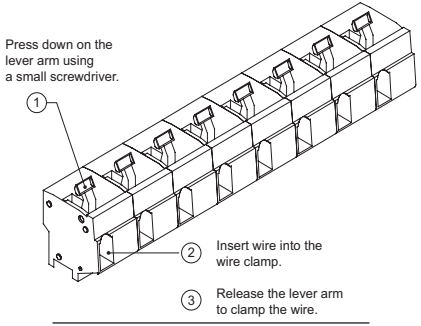


Figure 5. Cage Clamp Terminal Block

Power Input

For models MHS403-1.5 and MHS403-10, connect the AC line power leads to terminals L1 and L2 (115) if using a 115 VAC line or to terminals L1 and L2 (230) if using a 230 VAC line. For model MHS403-25, connect the AC line power leads to terminals L1 and L2. ACE recommends the use of a single-throw, double-pole master power switch. The switch should be rated at a minimum of 250 volts and 200% of motor current. Refer to Figure 6 on page 15 and Figure 7 on page 16.

Motor

ACE drives supply motor armature voltage from A1 and A2 terminals, where A1 is positive with respect to A2. If the motor does not spin in the desired direction, remove power and reverse the A1 and A2 connections.

Connect a DC motor to terminals A1 and A2 as shown in Figure 6 on page 15 and Figure 7 on page 16. Ensure that the motor voltage rating is consistent with the drive's output voltage.

Field Output Connections

The field output is for shunt wound motors only. Do not make any connections to F1 and F2 when using a permanent magnet motor.

See Table 2 for field output connections. Use 14 - 16 AWG wire to connect the field output to a field / shunt wound motor.

Table 2. Field Output Connections

Line Voltage (VAC)	*Approximate Field Voltage (VDC)*	*Connect Motor Field To*
115	*50*	*F1 and L1*
115	*100*	*F1 and F2*
230	*100*	*F1 and L1*
230	*200*	*F1 and F2*

Speed Adjust Potentiometer

Use a 10K ohm, 1/4 W potentiometer for speed control. Connect the counter-clockwise end of the potentiometer to S1, the wiper to S2, and the clockwise end to S3. If the potentiometer works inversely of the desired functionality (e.g. to increase motor speed you must turn the potentiometer counterclockwise), power off the drive and swap the S1 and S3 connections. Set SW504 to VOLT. Refer to Figure 6 on page 15 and Figure 7 on page 16.

Tachogenerator Feedback

Using tachogenerator feedback improves speed regulation from approximately 1% of motor base speed to approximately 0.1% of motor base speed. Use tachogenerators rated from 7 VDC per 1000 RPM to 50 VDC per 1000 RPM. Connect the tachogenerator to terminals T1 and T2 of terminal block TB502. The polarity is positive (+) for T1 and negative (-) for T2 when the motor is running in the forward direction. Place SW504 in the TACH position. See Figure 6 on page 15 and Figure 7 on page 16 for tachogenerator connections. The TACH trim pot must be adjusted prior to operating with tachogenerator feedback. Refer to the Calibration section for instructions on calibrating the TACH trim pot.

START/STOP Pushbuttons

Pushbutton operation of the MHS series requires a momentary normally open START pushbutton be wired to terminals B1 and B2 and a momentary normally closed STOP pushbutton wired to terminals B2 and B3. These switches must be used together and are not included with the drive. The B1, B2, and B3 terminals are on terminal block TB502.

Closing the START pushbutton powers a latching relay on the drive, meaning a run command stays present regardless of the START switch opening. Opening the STOP pushbutton will remove power from the latching relay, which removes the run command.

If the START/STOP pushbuttons are not used, wire a jumper between terminals B1 and B3 to bypass the latching circuit. The drive will then operate in a start on power-up mode. See Figure 6 on page 15 and Figure 7 on page 16 for these switch connections.

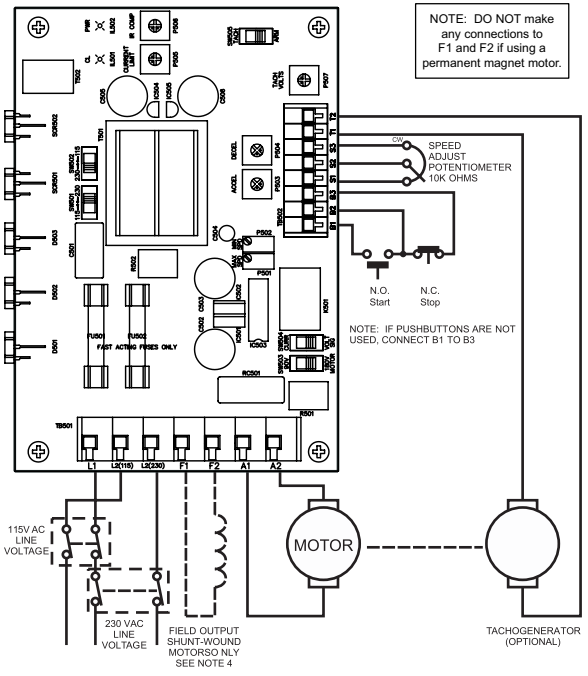


Figure 6. MHS403-1.5 and MHS403-10 Connections

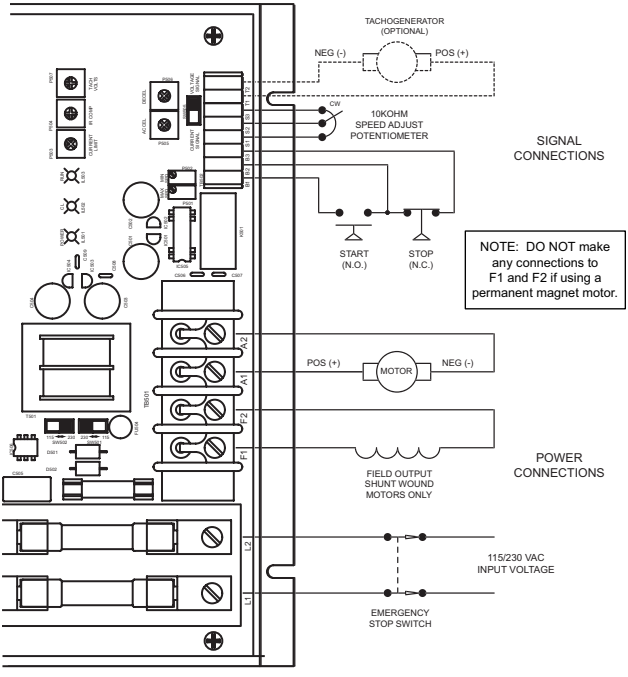


Figure 7. MHS403-25 Connections

Analog Input Signal

Instead of using a speed adjust potentiometer, the drive may be wired to follow an analog input voltage or current signal that is either isolated or non-isolated from earth ground. Connect the signal common (-) to S1. Connect the signal input (+) to S2. Refer to Figure 8.

Refer to page 24 for switch SW504 settings and Figure 10 on page 25 for location.

An analog input voltage range of 0-5 VDC, 0–10 VDC, or 4–20 mA is required to produce an armature voltage range of 0–90 VDC with 115 VAC line voltage, or 0-180 VDC with 230 VAC line voltage.

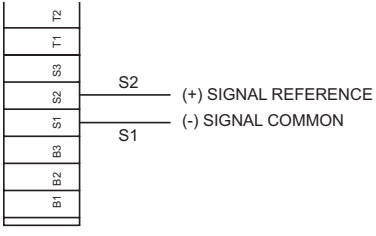


Figure 8. Analog Input Signal Connections

Cased Drives

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury. Make sure you read and understand the Safety Precautions on page i before attempting to install this product.

Mounting (NEMA 4X Enclosures)

NEMA 4X cased drives come with two 0.88 inch (22 mm) conduit knockout holes at the bottom of the case. The units may be vertically wall mounted using the four 0.19 inch (5 mm) slotted holes on the attached heat sink. For motor loads less than 5 ADC, the drive may be bench mounted horizontally or operated without mounting.

1. Install the mounting screws.
2. For access to the terminal strip, turn the slotted screw on the front cover counterclockwise until it is free from the case. The right side of the cover is hinged to the case. Pull the slotted screw to open the case.
3. Carefully remove the conduit knockouts by tapping them into the case and twisting them off with pliers.
4. Set the POWER switch to the OFF position before applying the AC line voltage.
5. Install conduit hardware through the 0.88 inch (22 mm) knockout holes. Connect external wiring to the terminal block.
6. Grasp the slotted screw and tilt the front cover back into place. Avoid pinching any wires between the front cover and the case.
7. Turn the slotted screw clockwise until tight to secure the front cover.

Wiring

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

Circuit potentials are at 115 or 230 VAC above ground. To prevent the risk of injury or fatality, avoid direct contact with the printed circuit board or with circuit elements.

Do not disconnect any of the motor leads from the drive unless power is removed or the drive is disabled. Opening any one motor lead while the drive is running may destroy the drive.

- Use 18 - 24 AWG wire for logic wiring. Use 14 - 16 AWG wire for AC line and motor wiring.

Line Fusing

Model MHS443-10 is preinstalled with 15 amp fuses.

Preinstalled line fuses are rated at or close to maximum horsepower. If the horsepower rating of the motor being used is less than the maximum horsepower rating of the drive, the line fuse may have to be replaced with a lower rated one. Fuses should be rated for 250 VAC or higher and approximately 150% of the maximum armature current. Refer to Table 1 on page 10 for recommended fuse values.

Connections

Do not connect this equipment with power appliled. Failure to heed this warning may result in fire, explosion, or serious injury.

Power Input

Connect the AC line power leads to screw terminals 1 (L1) and 2 (L2 115) if using a 115 VAC line or to screw terminals 1 (L1) and 3 (L2 230) if using a 230 VAC line. Refer to Figure 9, page 23.

Motor

ACE drives supply motor voltage from A1 and A2 terminals, where A1 is positive with respect to A2. If the motor does not spin in the desired direction, remove power and reverse the A1 and A2 connections.

Connect a DC motor to screw terminals 6 (A1) and 7 (A2) as shown in Figure 9 on page 23. Ensure that the motor voltage rating is consistent with the drive's output voltage.

Field Output Connections

The field output is for shunt wound motors only. Do not make any connections to F1 and F2 when using a permanent magnet motor.

See Table 3 for field output connections. Use 14 - 16 AWG wire to connect the field output to a shunt wound motor.

Table 3. Field Output Connections

Line Voltage (VAC)	*Approximate Field Voltage (VDC)*	*Connect Motor Field To*
115	*50*	*Terminals 4 and 1*
115	*100*	*Terminals 4 and 5*
230	*100*	*Terminals 4 and 1*
230	*200*	*Terminals 4 and 5*

Analog Input Signal

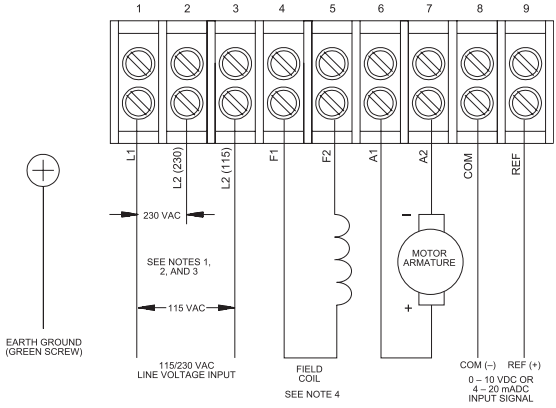
Instead of using the speed adjust potentiometer on the front cover in Manual Mode, the drive may be wired to follow an analog input voltage or current signal that is either isolated or non-isolated from earth ground in Signal Mode. Connect the signal common (-) to terminal 8. Connect the signal input (+) to terminal 9. Refer to Figure 9 on page 23 for connections. Refer to page 27 for operation.

Regardless of using an input voltage or current signal, set switch SW504 to VOLT. Refer to Figure 10 on page 26 for location. If using an input voltage signal, remove the 510 ohm resistor between terminals 8 and 9.

An analog input voltage range of 0-5, 0–10 VDC, or 4-20 mA is required to produce an armature voltage range of 0–90 VDC with 115 VAC line voltage, or 0-180 VDC with 230 VAC line voltage.

Tachogenerator Feedback

Using tachogenerator feedback improves speed regulation from approximately 1% of motor base speed to approximately 0.1% of motor base speed. Use tachogenerators rated from 7 VDC per 1000 RPM to 50 VDC per 1000 RPM. Connect the tachogenerator to terminals T1 and T2 of terminal block TB502. The polarity is positive (+) for T1 and negative (-) for T2 when the motor is running in the forward direction. Place SW504 in the TACH position. See Figure 6 on page 15 for tachogenerator connections. The TACH trim pot must be adjusted prior to operating with tachogenerator feedback. Refer to the Calibration section for instructions on calibrating the TACH trim pot.



1. L1 IS THE **HOT** TERMINAL.
2. L2/115 IS THE **NEUTRAL** TERMINAL FOR 115 VAC INPUT.
3. TYPICAL FIELD CONNECTIONS SHOWN. REFER TO TABLE 3 (PAGE 21).
4. REMOVE THE 510 OHM INTERNAL RESISTOR CONNECTED BEWEEN TERMINALS 8 AND 9 IF YOU ARE USING A 0 - 10 VDC ANALOG INPUT SIGNAL.

Figure 9. Cased Drive Connections

Section 4. Operation

Change voltage switch settings only when the drive is disconnected from AC line voltage. Make sure both switches are set to their correct position. If the switches are improperly set to a lower voltage position, the motor will not run at full voltage and may cause damage to the transformer. If the switches are improperly set to a higher voltage position, the motor will overspeed, which may cause motor damage, or result in bodily injury or loss of life.

Dangerous voltages exist on the drive when it is powered. BE ALERT. High voltages can cause serious or fatal injury. For your safety, use personal protective equipment (PPE) when operating this drive.

If the motor or drive does not perform as described, disconnect the AC line voltage immediately. Refer to the Troubleshooting section, page 51, for further assistance.

Before Applying Power

1. Verify that no foreign conductive material is present on the printed circuit board.
2. Ensure that all switches are properly set.

Select Switches

Input Voltage Select (SW501, SW502)

Set the input voltage select switches SW501 and SW502 to either 115 or 230 to match the AC line voltage. See Figure 10 on page 26.

Armature Voltage Select (SW503 / SW504 on MHS403-25)

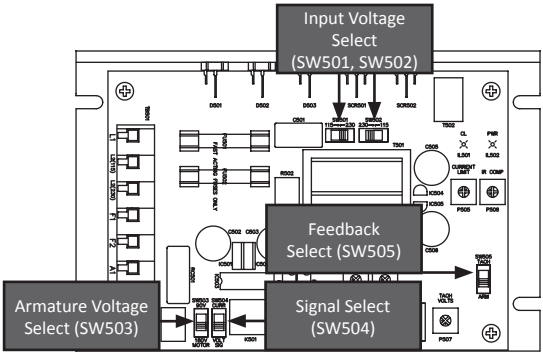
Set the armature voltage select switch SW503 to either 90V or 180V to match the maximum armature voltage. See Figure 10 on page 26.

Signal Select (SW504 / SW505 on MHS403-25)

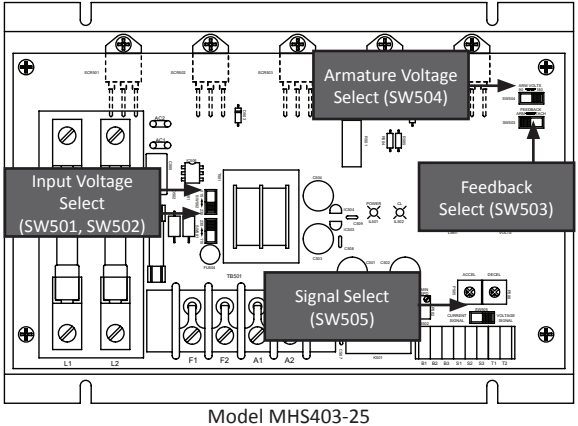
Set the signal select switch SW504 to either CURR to use a current input signal or to VOLT to use a voltage input signal or potentiometer. See Figure 10 on page 26. When using the cased model MHS443-10, the signal select switch should always be set to VOLT. If using a voltage input signal, remove the resistor between terminals 8 and 9. If using a current input signal, then the resistor must stays on terminals 8 and 9. See Figure 10 on page 26.

Feedback Select (SW505 / SW503 on MHS403-25)

Set the feedback select switch SW505 to either ARM for armature feedback or TACH for tachogenerator feedback. See Figure 10 on page 26.



Models MHS403-1.5, MHS403-10, and MHS443-10



Model MHS403-25

Figure 10. Select Switches

Enclosed Drive Operation Modes

Signal Mode

Set the SIGNAL/MANUAL selector switch on the front cover to SIGNAL if you wish to control the motor speed using either a 0 - 10 VDC signal or a 4 - 20 mA signal.

Manual Mode

Set the SIGNAL/MANUAL selector switch on the front cover to MANUAL if you wish to control the motor speed using the speed adjust potentiometer mounted on the drive cover.

Startup

MHS403-1.5, MHS403-10, and MHS403-25

1. Turn the speed adjust potentiometer full counterclockwise (CCW) or set the input voltage or current signal to minimum.
2. Apply AC line voltage.
3. Close the START pushbutton or place a jumper across terminals B1 and B3.
4. Slowly advance the speed adjust potentiometer clockwise (CW) or increase the input voltage or current signal. The motor slowly accelerates as the potentiometer is turned CW or as the input voltage or current signal is increased. Continue until the desired speed is reached.
5. Remove AC line voltage from the drive to coast the motor to a stop.

MHS443-10

1. If using MANUAL mode, turn the speed adjust potentiometer to “0” (full CW). If using SIGNAL mode, set the input voltage or current signal to minimum.
2. Set the POWER switch to the ON position.
3. If using MANUAL mode, slowly advance the speed adjust potentiometer clockwise (CW). If using SIGNAL mode, slowly increase the input voltage or current signal. The motor slowly accelerates as the potentiometer is turned CW or as the input voltage or current signal is increased. Continue until the desired speed is reached.
4. Set the POWER switch to the OFF position to coast the motor to a stop.

Starting and Stopping Methods

Dynamic braking, coasting to a stop, or decelerating to minimum speed is recommended for frequent starts and stops. Do not use any of these methods for emergency stopping. They may not stop a drive that is malfunctioning. Removing AC line power (both lines) is the only acceptable method for emergency stopping.

For this reason, ACE strongly recommends installing an emergency stop switch on both AC line inputs (see Figure 6 on page 15 and Figure 7 on page 16).

Frequent starting and stopping can produce high torque. This may cause damage to motors, especially gearmotors that are not properly sized for the application.

Automatic Restart Upon Power Restoration

All drives automatically run to set speed when power is applied and there is a short across the B1 and B3 terminals.

Line Starting and Stopping

Line starting and stopping (applying and removing AC line voltage) is recommended for infrequent starting and stopping of a drive only. When AC line voltage is applied to the drive and there is a short across the B1 and B3 terminals, the motor accelerates to the speed set by the speed adjust potentiometer or analog signal. When AC line voltage is removed, the motor coasts to a stop.

Dynamic Braking

Wait for the motor to completely stop before switching back to RUN. This will prevent high armature currents from damaging the motor or drive.

Dynamic braking may be used to rapidly stop a motor (Figure 11 on page 30). For the RUN/BRAKE switch, use a two pole, two position switch rated for at least the armature voltage rating and 150% of the armature current rating. For the dynamic brake resistor, use a 40 watt minimum, high power, wirewound resistor.

Sizing the dynamic brake resistor depends on load inertia, motor voltage, and braking time. Use a lower-value, higher-wattage dynamic brake resistor to stop a motor more rapidly. Refer to Table 4 on page 31 for recommended dynamic brake resistor sizes.

Table 4. Minimum Recommended Dynamic Brake Resistor Values

Motor Armature Voltage	*Dynamic Brake Resistor Value*
90 VDC	*15 ohms*
180 VDC	*30 ohms*

For motors rated 1/17 horsepower and lower, a brake resistor is not necessary since the armature resistance is high enough to stop the motor without demagnetization. Replace the dynamic brake with 12-gauge wire.

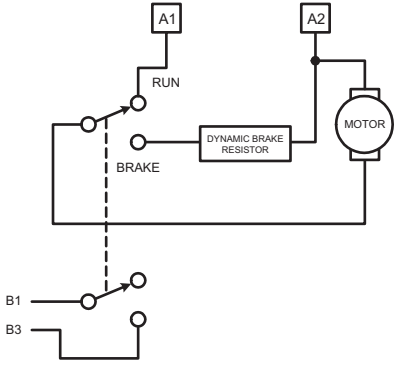


Figure 11. Dynamic Brake Wiring

Stop Pushbutton

The STOP pushbutton shown in Figure 6 on page 15 and Figure 7 on page 16 may be used to bring the motor to a stop. Opening the switch between B2 and B3 decelerates the motor from set speed to zero speed. The STOP pushbutton ignores the MIN SPD trim pot, meaning if the MIN SPD is set to something other than zero speed, the STOP pushbutton will still decelerate to zero speed. Likewise, the STOP pushbutton ignores the deceleration rate set by the DECEL trim pot. The motor will coast to a stop in the time it takes to naturally coast to a stop.

Decelerating to Minimum Speed

The switch shown in Figure 12 may be used to decelerate a motor to a minimum speed. Closing the switch between S1 and S2 decelerates the motor from set speed to a minimum speed determined by the MIN SPD trim pot setting. If the MIN SPD trim pot is set full CCW, the motor decelerates to zero speed when the switch between S1 and S2 is closed. The DECEL trim pot setting determines the rate at which the drive decelerates. By opening the switch, the motor accelerates to set speed at a rate determined by the ACCEL trim pot setting.

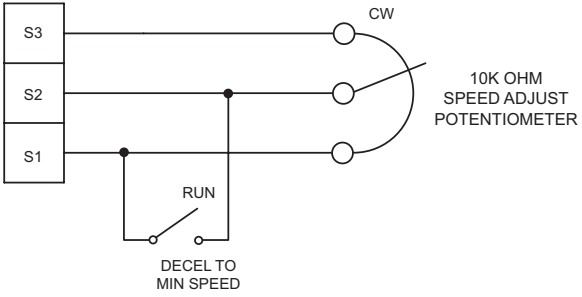


Figure 12. Run/Decelerate to Minimum Speed Switch

Section 5. Calibration

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the voltage input from the drive before adjusting the trim pots. If the trim pots must be adjusted with power applied, use insulated tools and the appropriate personal protection equipment. **BE ALERT.** High voltages can cause serious or fatal injury.

MHS series drives have user-adjustable trim pots. Each drive is factory calibrated to its maximum current rating. Readjust the calibration trim pot settings to accommodate lower current rated motors.

All adjustments increase with CW rotation, and decrease with CCW rotation. Use a non-metallic screwdriver for calibration. Each trim pot is identified on the printed circuit board.

Minimum Speed (MIN SPD)

The MIN SPD setting determines the minimum motor speed when the speed adjust potentiometer or input voltage or current signal is set for minimum speed. It is factory set for zero speed.

To calibrate the MIN SPD:

1. Set the speed adjust potentiometer or input voltage or current signal for minimum speed.
2. Adjust MIN SPD until the desired minimum speed is reached or is just at the threshold of rotation.

Maximum Speed (MAX SPD)

The MAX SPD setting determines the maximum motor speed when the speed adjust potentiometer or input voltage or current signal is set for maximum speed.

To calibrate MAX SPD:

1. Set the speed adjust potentiometer or input voltage or current signal for maximum speed.
2 . Adjust MAX SPD until the desired maximum speed is reached.

Note: Check the MIN SPD and MAX SPD adjustments after recalibrating to verify that the motor runs at the desired minimum and maximum speed.

Torque (CURRENT LIMIT)

CURRENT LIMIT should be set to 150% of motor nameplate current rating. Continuous operation beyond this rating may damage the motor. If you intend to operate beyond the rating, contact your ACE representative for assistance.

The CURRENT LIMIT setting determines the maximum torque for accelerating and driving the motor. To calibrate CURRENT LIMIT, refer to the recommended CURRENT LIMIT settings in Figure 13 on page 38 and Figure 14 on page 39 or use the following procedure:

1. With the power disconnected from the drive, connect a DC ammeter in series with the armature.
2. Set the CURRENT LIMIT trim pot to minimum (full CCW).
3. Set the speed adjust potentiometer or input voltage or current signal to maximum speed.
4. Carefully lock the motor armature. Be sure that the motor is firmly mounted.
5. Apply line power. The motor should be stopped.
6. Slowly adjust the CURRENT LIMIT trim pot CW until the armature current is 150% of motor rated armature current.
7. Turn the speed adjust potentiometer CCW or decrease the input voltage or current signal.
8. Remove line power.
9. Remove the stall from the motor.
10. Remove the ammeter in series with the motor armature if it is no longer needed.

IR Compensation (IR COMP)

The IR COMP setting determines the degree to which motor speed is held constant as the motor load changes.

Use the following procedure to recalibrate the IR COMP setting:

1. Set the IR COMP trim pot to minimum (full CCW).
2. Increase the speed adjust potentiometer or input voltage or current signal until the motor runs at midspeed without load (for example, 900 RPM for an 1800 RPM motor). A handheld tachogenerator may be used to measure motor speed.
3. Load the motor armature to its full load armature current rating. The motor should slow down.
4. While keeping the load on the motor, rotate the IR COMP trim pot until the motor runs at the speed measured in step 2. If the motor oscillates (overcompensation), the IR COMP trim pot may be set too high (CW). Turn the IR COMP trim pot CCW to stabilize the motor.
5. Unload the motor.

See Figure 13 on page 38 and Figure 14 on page 39 for recommended IR COMP settings.

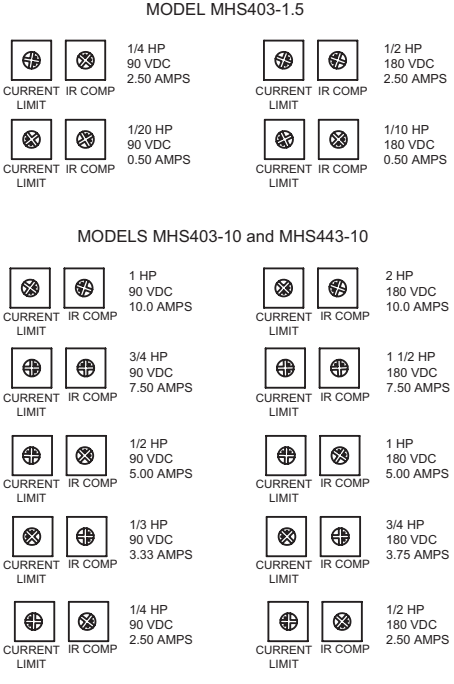


Figure 13. Recommended CURRENT LIMIT and IR COMP Settings for models MHS403-1.5, MHS403-10, and MHS443-10 (actual settings may vary with each application)

MODEL MHS403-25

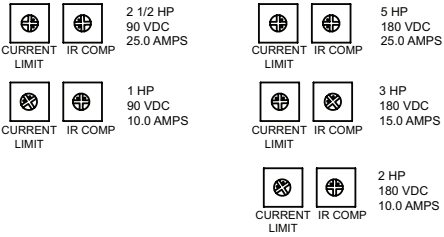


Figure 14. Recommended CURRENT LIMIT and IR COMP Settings for model MHS403-25
(actual settings may vary with each application)

Acceleration (ACCEL)

The ACCEL setting determines the time the motor takes to ramp to a higher speed. See Specifications on page 1 for approximate acceleration times. ACCEL is factory set for the shortest acceleration time (full CCW).

To set the acceleration time:

1. Set the speed adjust potentiometer or input voltage or current signal for minimum speed. The motor should run at minimum speed.
2. Set the speed adjust potentiometer or input voltage or current signal for maximum speed. Measure the time it takes the motor to go from minimum to maximum speed.
3. If the time measured in step 2 is not the desired acceleration time, turn the ACCEL trim pot CW for a longer acceleration time or CCW for a shorter acceleration time. Repeat steps 1 through 2 until the acceleration time is correct.

Deceleration (DECEL)

The DECEL setting determines the time the motor takes to ramp to a lower speed. See Specifications on page 1 for approximate deceleration times. DECEL is factory set for the shortest deceleration time (full CCW).

To set the deceleration time:

1. Set the speed adjust potentiometer or input voltage or current signal for maximum speed. The motor should run at maximum speed.
2. Set the speed adjust potentiometer or input voltage or current signal for minimum speed. Measure the time it takes the motor to go from maximum to minimum speed.
3. If the time measured in step 2 is not the desired deceleration time, turn the DECEL trim pot CW for a longer deceleration time or CCW for a shorter deceleration time. Repeat steps 1 through 2 until the deceleration time is correct.

Tachogenerator (TACH VOLTS)

Calibrate the TACH VOLTS setting only when a tachogenerator is used.

The TACH VOLTS setting, like IR COMP setting, determines the degree to which motor speed is held constant as the motor load changes. To calibrate the TACH VOLTS trim pot:

1. Connect the tachogenerator to T1 and T2. The polarity is positive (+) for T1 and negative (-) for T2 when the motor is running in the forward direction (A1 is positive in respect to A2).
2. Set the feedback select switch SW505 (SW503 on the MHS403-25) to ARM for armature feedback.
3. Set the speed adjust potentiometer or input voltage or current signal to maximum speed. Measure the armature voltage across A1 and A2 using a voltmeter.
4. Set the speed adjust potentiometer or input voltage or current signal to zero speed.
5. Set SW505 (SW503 on the MHS403-25) to TACH for tachogenerator feedback.
6. Set the IR COMP trim pot to full CCW.
7. Set the TACH VOLTS trim pot to full CW.
8. Set the speed adjust potentiometer or input voltage or current signal to maximum speed.
9. Adjust the TACH VOLTS trim pot until the armature voltage is the same value as the voltage measured in step 3.

Check that the TACH VOLTS is properly calibrated. The motor should run at the same set speed when SW505 is set to either ARM or TACH.

Section 6. Application Notes

Multiple Fixed Speeds

Replace the speed adjust potentiometer with a series of resistors with a total series resistance of 10K ohms (Figure 15). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

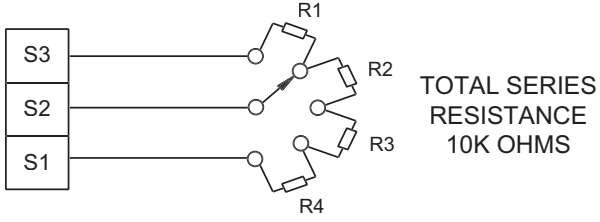


Figure 15. Multiple Fixed Speeds

Adjustable Speeds Using Potentiometers In Series

Replace the speed adjust potentiometer with a series of potentiometers with a total series resistance of 10K ohms (Figure 16). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

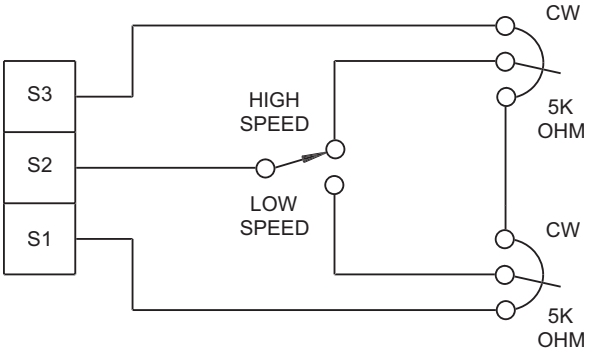


Figure 16. Adjustable Speeds using Potentiometers In Series

Independent Adjustable Speeds

Replace the speed adjust potentiometer with a single pole, multi-position switch, and two or more potentiometers in parallel, with a total parallel resistance of 10K ohms. Figure 17 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

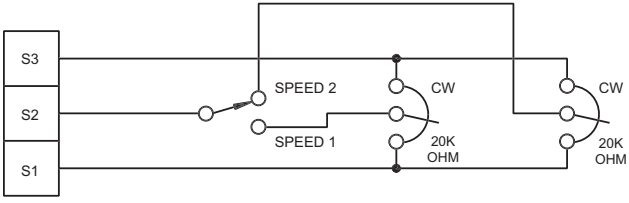


Figure 17. Independent Adjustable Speeds

RUN/JOG Switch

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 18. When the RUN/JOG switch is set to JOG, the motor decelerates to minimum speed (minimum speed is determined by the MIN SPD trim pot setting). Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

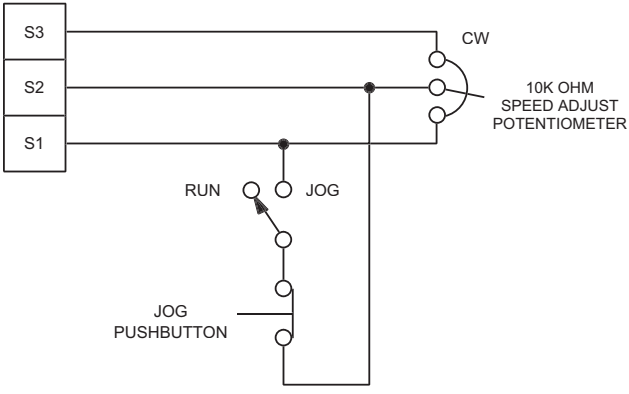


Figure 18. RUN/JOG Switch

Leader-Follower Application

In this application, use a ISO202-1 to monitor the speed of the leader motor (Figure 19). The ISO202-1 isolates the leader motor from the follower drive, and outputs a voltage proportional to the leader motor armature voltage. The follower drive uses this voltage reference to set the speed of the follower motor. An optional ratio potentiometer may be used to scale the ISO202-1 output voltage.

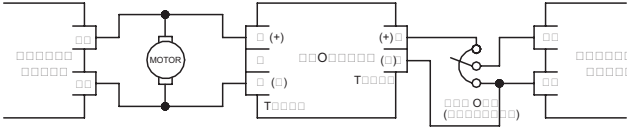


Figure 19. Leader-Follower Application

Single Speed Potentiometer Control Of Multiple Drives

Multiple drives can be controlled with a single speed adjust potentiometer because MHS series drives have built-in isolation. Connect all drive commons (S1) and wipers (S2). Connect the supply end of the speed adjust potentiometer to S3 of only one drive. See Figure 20.

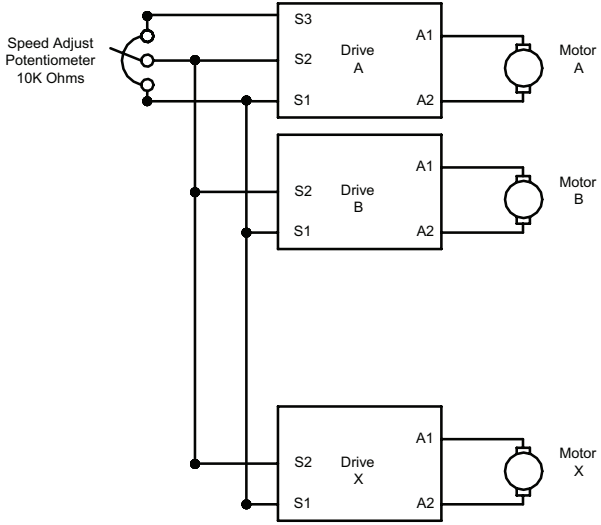


Figure 20. Single Speed Potentiometer Control of Multiple Drives

Reversing

A dynamic brake may be used when reversing the motor direction (Figure 21). Use a three pole, three position switch rated for at least the maximum DC armature voltage and maximum braking current. Wait for the motor to stop completely before switching it to either the forward or reverse direction. See the Dynamic Braking section on page 31 for recommended dynamic brake resistor sizes.

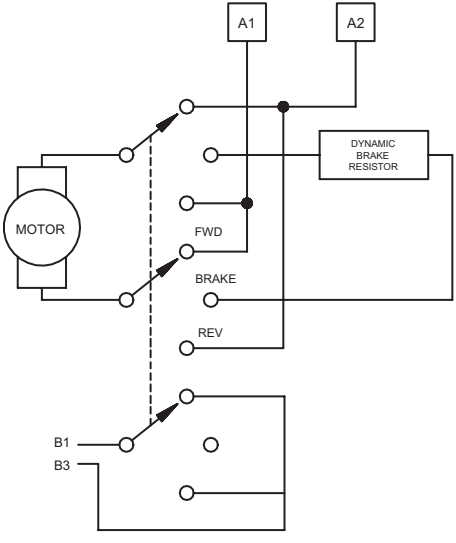


Figure 21. Reversing Circuit Wiring

Reversing with a CLD100-1 Controller

A CLD100-1 controller can be used in a reversing application. The CLD100-1 must be inhibited while braking. If the inhibit feature is not used, the CLD100-1 will continue to regulate. This will cause overshoot when the motor is reconnected to the drive. Figure 22 shows a wiring diagram of the reversing circuit using a MHS series drive and a CLD100-1.

Note: Only one feedback device (Optical Encoder or Magnetic Pickup) may be connected to a CLD100-1 at a time.

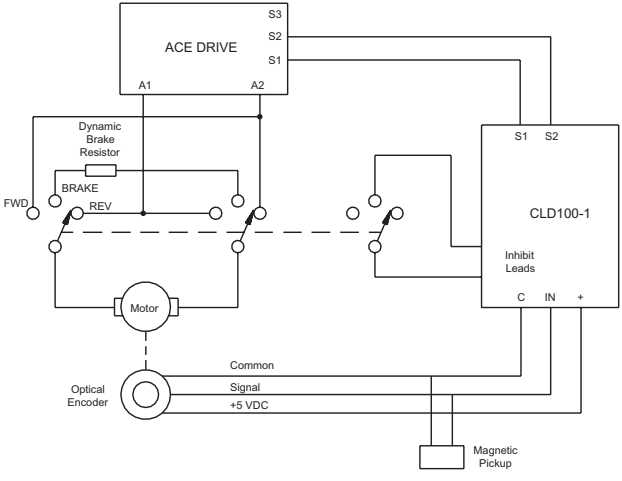


Figure 22. Reversing with a CLD100-1

Section 7. Diagnostic LEDs

MHS series drives are equipped with two or three diagnostic LEDs:

- Power (POWER or PWR): Green LED lights whenever AC line voltage is applied to the drive.
- Current Limit (CL): Red LED lights whenever the drive reaches current limit.
- Run (RUN): Green LED lights whenever a Start command is received across the B1, B2, and B3 terminals. (MHS403-25 only)

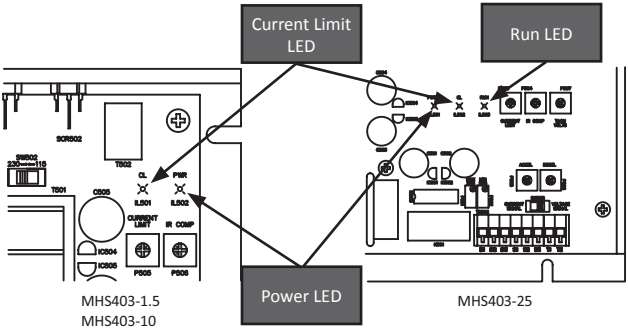


Figure 23. Diagnostic LED Locations

Section 8. Troubleshooting

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the drive while troubleshooting. High voltages can cause serious or fatal injury.

Before Troubleshooting

Perform the following steps before starting any procedure in this section:

1. Disconnect AC line voltage from the drive.
2. Check the drive closely for damaged components.
3. Check that no conductive or other foreign material has become lodged on the printed circuit board.
4. Verify that every connection is correct and in good condition.
5. Verify that there are no short circuits or grounded connections.
6. Check that the switch settings are correctly set.
7. Check that the drive's rated armature and field outputs are consistent with the motor ratings.

For additional assistance, contact your local AMERICAN CONTROL ELECTRONICS distributor, or the factory direct:

1-815-624-6915 or FAX: 1-815-624-6965

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Line fuse blows.	1. Line fuse is the wrong size.	1. Check that the line fuse is correct for the motor size.
	2. Motor cable or armature is shorted to ground.	2. Check motor cable and armature for shorts.
	3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes (i.e. reversing).	3. Add a blower to cool the drive components, decrease CURRENT LIMIT settings, resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See page 35 for information on adjusting the CURRENT LIMIT trim pot.
Line fuse does not blow, but the motor does not run.	1. Speed adjust potentiometer or input voltage or current signal is set to zero speed.	1. Increase the speed adjust potentiometer setting or input voltage or current signal.
	2. Start switch is open.	2. Close the Start switch or jumper terminals B1 and B3.
	3. S2 is shorted to S1.	3. Remove the short.
	4. Drive is in current limit.	4. Verify that the motor is not jammed. Increase CURRENT LIMIT setting if set too low. See page 35.
	5. Drive is not receiving AC line voltage.	5. Apply AC line voltage.
	6. Motor is not connected.	6. Remove power. Connect the motor to A1 and A2. Reapply power.

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Motor does not stop when the speed adjust potentiometer is full CCW.	1. MIN SPD is set too high.	1. Calibrate MIN SPD. See page 34.
Motor runs in the opposite direction	1. Motor connections to A1 and A2 are reversed.	1. Remove power. Reverse connections to A1 and A2. Reapply power.
Motor runs too fast.	1. MAX SPD is set too high.	1. Calibrate MAX SPD. See page 35.
	2. Motor field connections are loose (shunt wound motors only).	2. Check motor field connections.
Motor will not reach the desired speed.	1. MAX SPD setting is too low.	1. Increase MAX SPD setting. See page 35.
	2. IR COMP setting is too low.	2. Increase IR COMP setting. See page 37.
	3. CURRENT LIMIT setting is too low.	3. Increase CURRENT LIMIT setting. See page 36.
	4. Motor is overloaded.	4. Check motor load. Resize the motor and drive if necessary.
Motor pulsates or surges under load.	1. IR COMP is set too high.	1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes. See page 37.
	2. Motor bouncing in and out of current limit.	2. Make sure motor is not undersized for load; adjust CURRENT LIMIT trim pot CW. See page 36.

Section 9. Block Diagrams

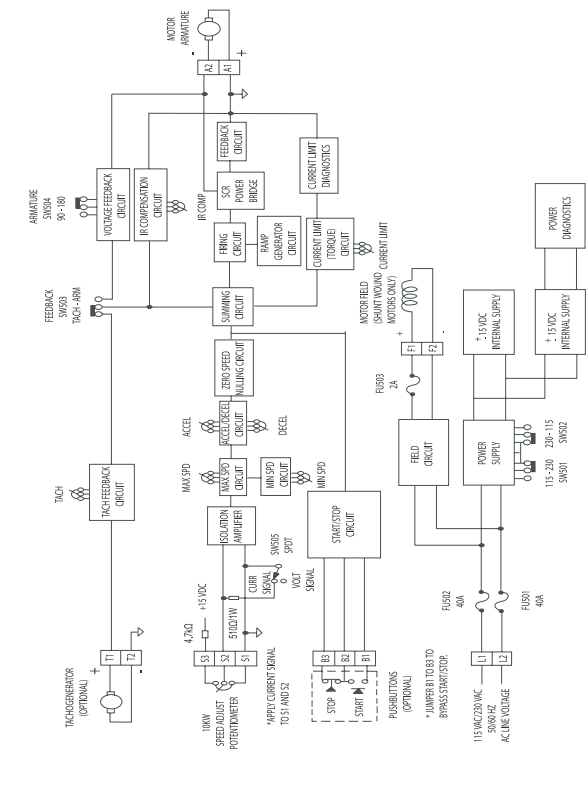


Figure 24. MHS Series Block Diagram

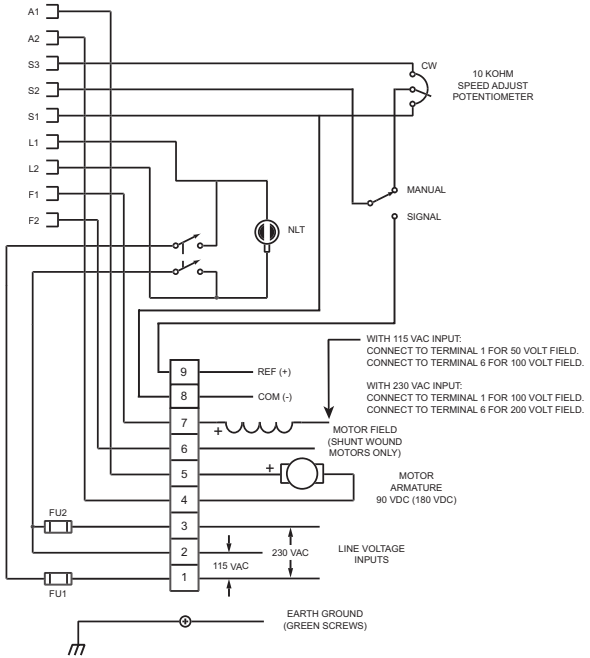


FIgure 25. MHS443-10 Terminal Block Connections

Section 10. Accessories & Replacement Parts

Displays

Closed Loop..... CLD100-1

Open Loop.....OLD100-1

Kits

Potentiometer & Connector

10K Pot, Insulating Washer.....KTP-0001

Fuse

2 1.5 Amp 250 V 3AG Fast-blow Glass Fuses.....KTF-0001

2 3 Amp 250 V 3AG Fast-blow Glass Fuses.....KTF-0002

2 5 Amp 250 V 3AG Fast-blow Glass Fuses.....KTF-0003

2 8 Amp 250 V 3AG Fast-blow Glass Fuses.....KTF-0004

2 10 Amp 250 V 3AB Normal-blow Ceramic Fuses.....KTF-0005

2 15 Amp 250 V 3AB Normal-blow Ceramic Fuses.....KTF-0006

2 20 Amp 250 V 3AB Normal-blow Ceramic Fuses.....KTF-0007

2 40 Amp 480 V Slow-blow Ceramic Fuses.....KTF-0008

Logic Cards

Current Monitoring

5 Amps.....CMC100-5

20 Amps.....CMC100-20

30 Amps.....CMC100-30

Unconditional Warranty

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This warranty applies only to standard catalog products, and does not apply to specials. Any returns of special controls will be evaluated on a case-by-case basis. The Corporation is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to and from the repair point.

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Any action against the Corporation based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment or the use thereof, must be commenced within one year after the cause of such action arises.

Notes

Notes

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