

# IRONHORSE™

## GSD7 SERIES DC DRIVES USER MANUAL

USER MANUAL NUMBER: IH-GSD7-USER-M



**⚡ WARNING ⚡**

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To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

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**GSD7 DC DRIVES USER MANUAL OVERVIEW**

**OVERVIEW OF THIS PUBLICATION**

The IronHorse GSD7 Series DC Drives User Manual describes the installation, configuration, and methods of operation of the GSD7 Series DC Drives.

All information contained in this manual is intended to be correct. However, information and data in this manual are subject to change without notice. AutomationDirect (ADC) makes no warranty of any kind with regard to this information or data. Further, ADC is not responsible for any omissions or errors or consequential damage caused by the user of the product. ADC reserves the right to make manufacturing changes which may not be included in this manual.

**WHO SHOULD READ THIS USER MANUAL**

This manual contains important information for those who will install, maintain, and/or operate any of the GSD7 Series DC Drives.

**TECHNICAL SUPPORT**

By Telephone: 770-844-4200 (Mon.–Fri., 9:00 a.m.–6:00 p.m. E.T.)

On the Web: [www.automationdirect.com](http://www.automationdirect.com)

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call Technical Support at 770-844-4200. We are available weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time.

We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company. Visit us at [www.automationdirect.com](http://www.automationdirect.com).

**SPECIAL SYMBOLS**




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*WHEN YOU SEE THE “NOTEPAD” ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A SPECIAL NOTE.*

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*WHEN YOU SEE THE “EXCLAMATION MARK” ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A **WARNING**. THIS INFORMATION COULD PREVENT INJURY, LOSS OF PROPERTY, OR EVEN DEATH (IN EXTREME CASES).*

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## IRONHORSE GSD7 SERIES DC DRIVES GENERAL INFORMATION

The GSD7 series reversing speed control DC drive is designed to provide rapid reversing, quick and precise stopping, or rapid cycling for a wide range of DC motor applications. The GSD7 series drives utilize zero-speed-detect and solid-state-assisted dynamic braking circuits. These circuits eliminate contact arcing and failed braking problems. The zero-speed-detect circuit also eliminates the motor problems associated with plug reversing a motor by not reapplying power to the motor until zero speed is obtained.

- Designed so that upon a power loss condition to the drive or an E-stop condition, the drive will drop into a dynamic brake condition to safely and quickly bring the motor to a stop and remain there until power is reapplied and a run condition is recognized.
- Extremely small package size that fits the industry standard footprint for both vertical and horizontal mounting patterns.
- Designed for DC Permanent Magnet and Shunt Wound motors.
- Incoming AC voltage is converted to adjustable full wave rectified DC voltage to operate the DC motor. A full wave field voltage is provided for shunt wound motors also.




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*CAREFULLY CHECK THE DC DRIVE FOR SHIPPING DAMAGE. REPORT ANY DAMAGE TO THE CARRIER IMMEDIATELY. DO NOT ATTEMPT TO OPERATE THE DRIVE IF VISIBLE DAMAGE IS EVIDENT TO EITHER THE CIRCUIT OR TO THE ELECTRONIC COMPONENTS.*

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### **STANDARD FEATURES**

- Input voltages 120/240VAC @ 50/60Hz; output 0–90/180VDC.
- Adjustable horsepower settings.
- Barrier terminal blocks.
- Full-wave bridge supply.
- 1% speed regulation with armature voltage feedback.
- Adjustable Minimum speed, Maximum speed, IR Compensation, and Current Limit.
- Line voltage compensation.
- 5k $\Omega$  speed potentiometer with leads, dial, and knob included.
- 50:1 speed range.
- Transient voltage protection.
- Inhibit circuit permits start & stop without breaking AC lines.
- Shunt field supply provided.
- On-board dynamic braking resistor.
- Automatic dynamic braking on power loss.
- Capable of plugging (reversing motor armature polarity to rapidly change motor direction while it is still running).
- Available in open-frame chassis.

**CONTROL FEATURES**

MINIMUM SPEED – Allows adjustment of the motor speed when the speed pot is set at minimum (CCW). This permits the user to eliminate “Deadband” on the main speed control, permitting zero calibration. Clockwise rotation of “MIN” trim pot increases speed.

MAX SPEED (Maximum Speed) – Allows adjustment of the motor speed when the speed pot is set at maximum (CW). This permits the user to eliminate the top end “Deadband”, which will provide full speed at maximum rotation. Rotation of the “MAX” trim pot in the clockwise direction increases the maximum motor speed.

ACCEL (Acceleration) – Allows adjustment of the motor acceleration from a minimum of 0.5 seconds to approximately 8.0 seconds. The deceleration time depends on the ACCEL setting.

IR COMP (Speed Regulation) – Allows for adjustment of the circuitry that controls the speed regulation of the motor. The circuitry controls armature speed by changing the armature voltage to compensate for increased or decreased motor loading. Clockwise rotation of the “IR COMP” trim pot will increase compensation.

CUR LIM (Current Limit) – Provides protection from excessive armature current by limiting the maximum armature current the drive can provide. This enables adjustment of the maximum torque the motor can deliver. Torque adjustment (CUR LIM) is preset at 125% of rated motor torque (current) based on horsepower. Clockwise rotation of the “CUR LIM” trim pot increases the torque (current) the drive will provide.

ONBOARD DYNAMIC BRAKE RESISTOR – For automatic dynamic braking.

POWER LOSS BRAKE – Upon an E-stop command or a power loss to the drive, the drive will drop into a dynamic brake condition to safely and quickly bring the motor to a stop and remain stopped until power is reapplied and a run condition is recognized.

## SELECTION AND SPECIFICATIONS

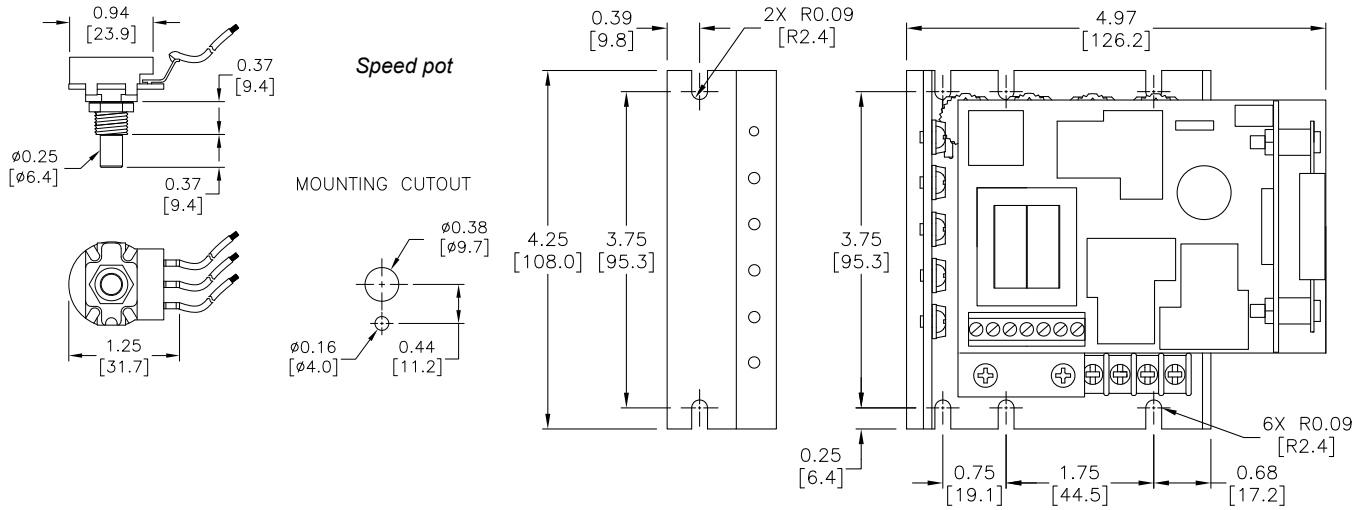
GSD7 Series DC Drives – Selection & Specifications							
Model	GSD7-120-1CR3	GSD7-120-1CR30	GSD7-120-5CR3	GSD7-120-10CR30	GSD7-240-1CR3	GSD7-240-5CR3	GSD7-240-10CR30
Package Configuration	open frame						
Power Quality Form Factor	1.4						
Input Voltage (@50/60Hz)	120 VAC ±10%				240 VAC ±10%		
Output Voltage	0–90 VDC				0–180 VDC		
Shunt Field Voltage	100 VDC (1A max)				200 VDC (1A max)		
Motor Rating (hp)	1/15 – 1/8		1/8 – 1/2	1/8 – 1	1/25 – 1/4	1/4 – 1	1/4 – 2
Output Current (continuous)	500mA–1.2A (DC)		500mA–5.5A (DC)	500mA–10A (DC)	500mA–1.2A (DC)	500mA–5.5A (DC)	500mA–10A (DC)
Current Overload Capacity	200% for 60s						
Current Limit (adjustable)	0.3–3A (DC)		1–18A (DC)		0.3–3A (DC)		1–18A (DC)
Cycling Rate (cycles/min)	3	30	3	30	3	3	30
Transient Protection	Metal Oxide Varistor (MOV)						
I.R. Compensation	adjustable						
Speed Adjustment	5kΩ 0.5W potentiometer or 0–10VDC isolated input signal						
Speed Range	50:1						
Speed Regulation	±1% of base speed						
Maximum Speed	adjustable from 60% to 110% of base speed						
Minimum Speed	linear ramp 0–30% of adjustable maximum speed						
Acceleration	0.5 seconds						
Deceleration	0.5 seconds						
Dynamic Braking	yes						
Plugging Capability **	yes						
Electrical Connections	barrier-type terminal blocks; 22–14 AWG						
External Fusing Required	Bussman ABC or Littlefuse 314 series ceramic fuses or equivalent Refer to "Installation and Wiring" section for details.						
Operating Temperature	-10 to 45 °C [14 to 113 °F]						
Thermal Protection	current limiting						
Mounting Orientation	can be mounted in any orientation						
Corrosive Gases	NOT compatible with any corrosive gases						
Weight	1.1 lb [490g]	3.3 lb [1497g]	1.1 lb [490g]	3.3 lb [1497g]	1.1 lb [490g]	1.1 lb [490g]	3.3 lb [1497g]
Agency Approvals	cUL <sub>US</sub> Listed (E333109), RoHS						
<b>Optional Accessories *</b>							
Replacement Potentiometer	GSDA-5K						
Digital Potentiometer	GSDA-DP						

\* For accessories details, please visit [www.AutomationDirect.com](http://www.AutomationDirect.com).

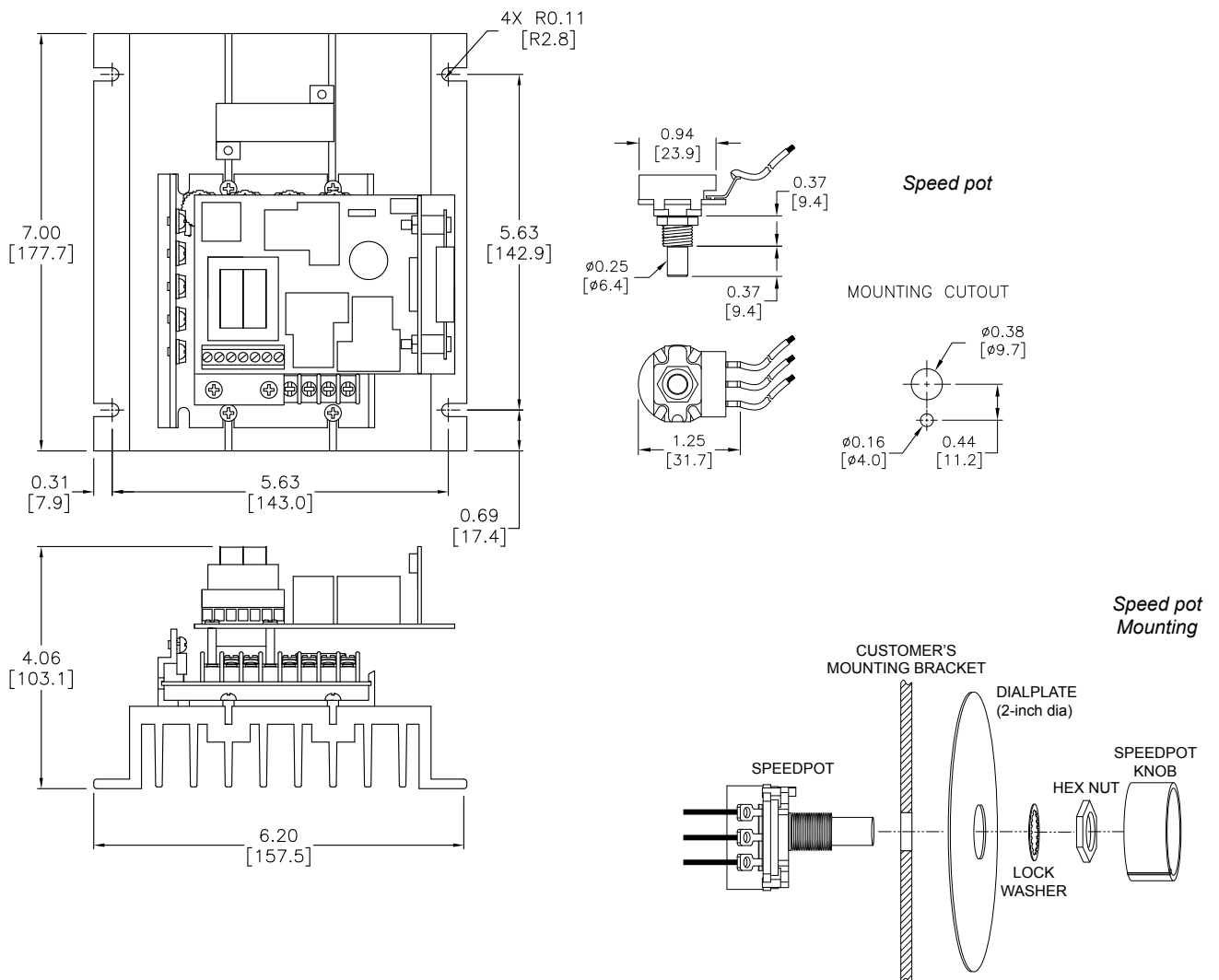
\*\* Plugging is a method of rapidly changing motor direction by reversing motor armature polarity, while the motor is still running.

# DIMENSIONS

## ***GSD7-xxx-xCR3*** (dimensions = in [mm])



## ***GSD7-xxx-xCR30*** (dimensions = in [mm])



## INSTALLATION AND WIRING



INSTALL OPEN-FRAME DRIVES IN AN ENCLOSURE WITH A VOLUME AT LEAST THREE TIMES THE VOLUME OF THE OPEN-FRAME DRIVE.



DO NOT MOUNT GSD7-xxx-xCRxx DC DRIVE WHERE AMBIENT TEMPERATURE IS OUTSIDE THE RANGE OF -10 TO 45 °C (14 TO 113 °F).



SIZE ALL WIRES THAT CARRY ARMATURE OR LINE CURRENTS AS SPECIFIED BY APPLICABLE NATIONAL, STATE, AND/OR LOCAL CODES. ALL OTHER WIRES MAY BE 18AWG OR SMALLER AS PERMITTED BY THE CODES.



SEPARATE CONTROL WIRES FROM THE ARMATURE AND AC LINES WHEN ROUTED IN CONDUIT OR WIRE TRAYS.



**CAUTION!!** TURN POWER OFF WHILE MAKING WIRING CONNECTIONS.



IMPROPER INSTALLATION OR OPERATION OF THIS DC DRIVE MAY CAUSE INJURY TO PERSONNEL OR DRIVE FAILURE. THE DRIVE MUST BE INSTALLED IN ACCORDANCE WITH LOCAL, STATE, AND NATIONAL SAFETY CODES. MAKE CERTAIN THAT THE POWER SUPPLY IS DISCONNECTED BEFORE ATTEMPTING TO SERVICE OR REMOVE ANY COMPONENTS!!! IF THE POWER DISCONNECT POINT IS OUT OF SIGHT, LOCK IT IN DISCONNECTED POSITION AND TAG IT TO PREVENT UNEXPECTED APPLICATION OF POWER. ONLY A QUALIFIED ELECTRICIAN OR SERVICE PERSONNEL SHOULD PERFORM ANY ELECTRICAL TROUBLESHOOTING OR MAINTENANCE. AT NO TIME SHOULD CIRCUIT CONTINUITY BE CHECKED BY SHORTING TERMINALS WITH A SCREWDRIVER OR OTHER METAL DEVICE.



BEFORE ATTEMPTING TO WIRE THE DC DRIVE, MAKE SURE ALL POWER IS DISCONNECTED. RECHECK CODE DESIGNATION TO ASSURE PROPER VOLTAGE IS PRESENT FOR THE DC DRIVE. CAREFULLY SELECT PROPER WIRE SIZE FOR CURRENT AND VOLTAGE DROP. LIMIT THE VOLTAGE DROP THROUGH THE WIRING TO 5% OF THE LINE VOLTAGE AT FULL LOAD



**CAUTION!!** DO NOT ATTEMPT TO PERFORM A HI-POT TEST ACROSS THE AC LINES WITH THE DC DRIVE IN THE CIRCUIT. THIS WILL RESULT IN IMMEDIATE OR LONG-TERM DAMAGE TO THE DRIVE.



- 1) ENSURE THAT THE GSD7 DRIVE CHASSIS IS PROPERLY GROUNDED.
- 2) THE INPUTS TO THE SPEED POT TERMINALS (P1-6, P1-7, P1-8) MUST NOT BE GROUNDED. SERIOUS DAMAGE MAY RESULT.

### FUSING

External customer-supplied circuit protection is required for all hot AC lines connected to the GSD7 power input terminals AC1/L and AC2/N (P4-1 & P4-2).

Recommended fuse types are Bussman ABC or LittleFuse 314 or equivalent.

(AutomationDirect sells ABC series fuses.)

Fuse Selection *		
GSD7-xxx-xxCRxx		
Motor HP	Fuse @ 120 VAC Input	Fuse @ 240 VAC Input
1/50	2A	–
1/20	2A	1A
1/8	3A	2A
1/4	4A	3A
1/3	6A	3A
1/2	8A	4A
3/4	12A	6A
1.0	15A	8A
1.5	–	12A
2.0	–	15A

\* Select fuse type Bussman ABC or Littlefuse 314 series or equivalent.



**INSTALLATION AND WIRING (CONTINUED)**

**WIRING TERMINALS**

GSD7 Wiring Terminals		
Type	Wire Range	Tightening Torque
barrier-type terminal blocks	22–14 AWG	9.0 lb·in [1.0 N·m]

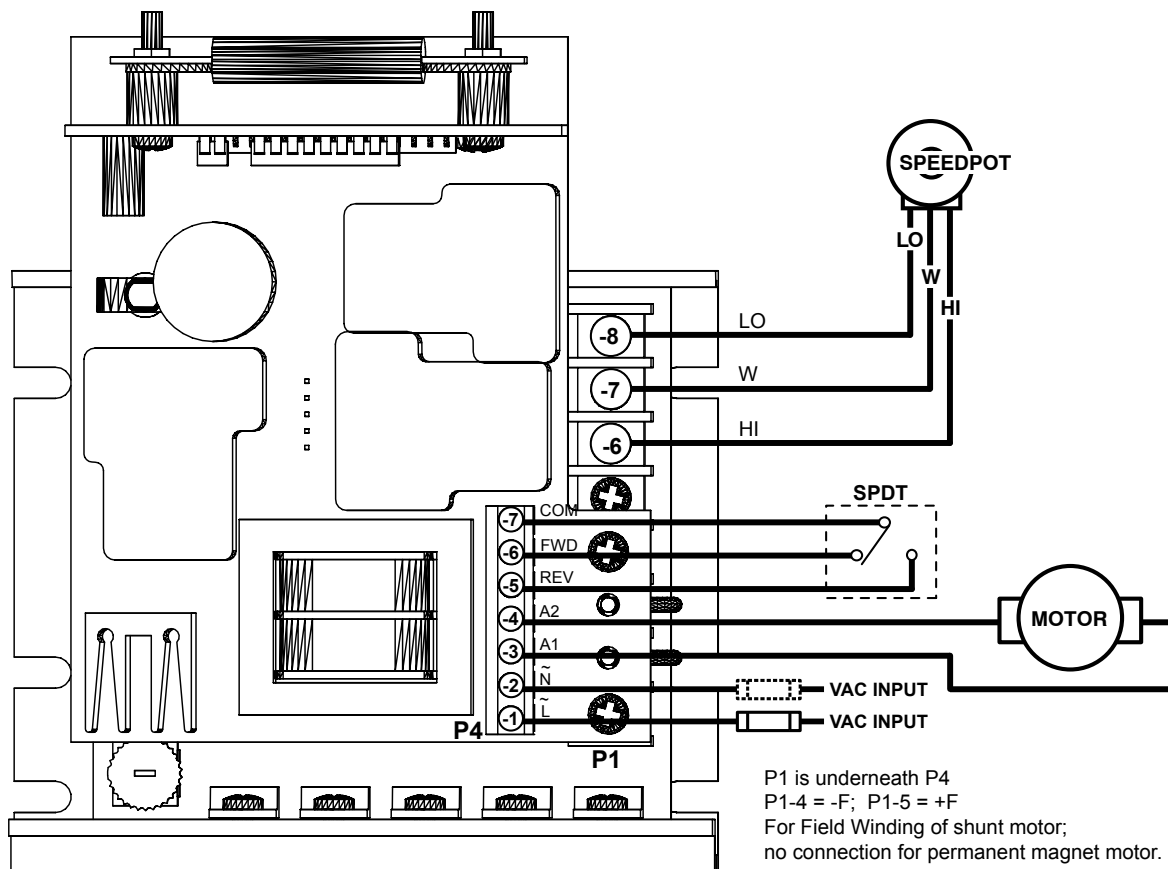
**WIRING TERMINAL FUNCTIONS**

GSD7 Series DC Drives – Terminal Strip Functions	
CAUTION: BE SURE DRIVE HOUSING IS PROPERLY GROUNDED.	
Number	Purpose
<b>P4 – Upper Terminal Block Connections</b>	
<b>P4-1</b>	(AC1 / L) – For AC systems with a grounded neutral line, connect the Hot (ungrounded) side of your AC line to this terminal. For systems with two Hot AC lines, connect either of the Hot AC lines to this terminal.
<b>P4-2</b>	(AC2 / N) – For AC systems with a grounded neutral line, connect the Neutral (grounded) side of your AC line to this terminal. For systems with two Hot AC lines, connect either of the Hot AC lines to this terminal.
<b>P4-3</b>	(A1) – For clockwise rotation of your motor in the Fwd Direction, connect the Plus (+) Armature wire of the motor to this terminal.
<b>P4-4</b>	(A2) – For counter-clockwise rotation of your motor in the Rev direction, connect the Minus (-) Armature wire of the motor to this terminal.
<b>P4-5</b>	(REV) – This is the reverse direction input terminal. When connected to the COM terminal, the drive will release its brake circuit and accelerate to its set point in the reverse direction. When the connection to the COM terminal is opened, the drive will brake to zero speed. The connection to the COM terminal can be made via a mechanical switch, a relay contact, or an ungrounded solid-state open-collector type switch. Switching requirements are 5VDC at less than 1ma.
<b>P4-6</b>	(FWD) – This is the forward direction input terminal. When connected to the COM terminal, the drive will release its brake circuit and accelerate to its set point in the forward direction. When the connection to the COM terminal is opened, the drive will brake to zero speed. The connection to the COM terminal can be made via a mechanical switch, a relay contact, or an ungrounded solid-state open-collector type switch. Switching requirements are 5VDC at less than 1ma.
<b>P4-7</b>	(COM) – This is the common terminal for the forward and reverse speed/dynamic brake commands. <u><i>This terminal should not be grounded or tied to any other terminal.</i></u>
<b>P1 – Lower Terminal Block Connections</b>	
<b>P1-4</b>	(-A/-F) – DO NOT use for Permanent Magnet Motor. This supplies -Field voltage for a SHUNT WOUND MOTOR. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure highest value is connected. <u><i>Note: When connecting to this terminal, you will need to use a fork or ring connector placed directly under the screw head.</i></u>
<b>P1-5</b>	(+F) – DO NOT use for Permanent Magnet Motor. This supplies +Field voltage for a SHUNT WOUND MOTOR. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure highest value is connected.
<b>P1-6</b>	(Speed pot Hi) – Connects to high side (white wire) of Speed pot (CW end). This is an internal +12VDC. For start-stop applications, the connection between this terminal and Speed pot HI can be opened and closed by a SPST switch. <u><b>INPUT MUST NOT BE GROUNDED!</b></u>
<b>P1-7</b>	(Speed pot Wiper) – Connects to wiper (red wire) of Speed pot (center lead). For Voltage-Follower applications, this INPUT MUST NOT BE GREATER THAN +12V MAXIMUM AND <u><b>MUST NOT BE GROUNDED!</b></u>
<b>P1-8</b>	(Speed pot Lo) – Connects to Low side (orange wire) of 5kΩ Speed pot (CCW end). This input is raised and lowered by the MIN trim pot (5kΩ). Electronic speed input (voltage follower) may be referenced to Speed pot LO if the MIN trim pot adjustments are to be active. Otherwise, inputs may be referenced to -ARM, which will bypass the MIN trim pot. <u><b>INPUT MUST NOT BE GROUNDED!</b></u>

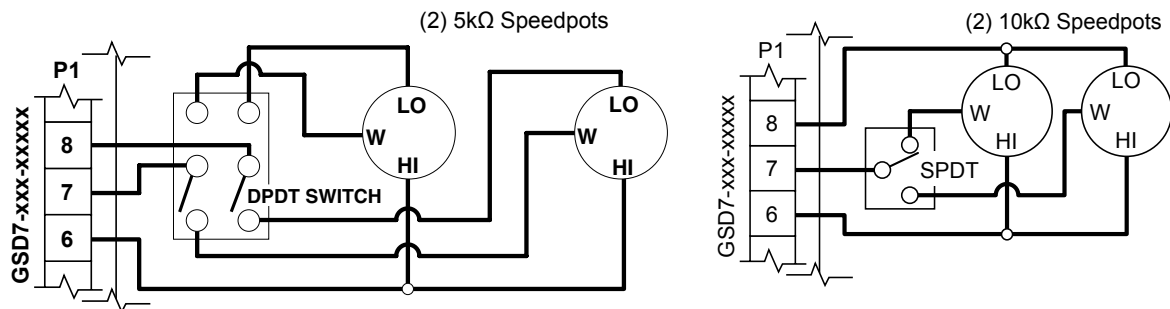
**INSTALLATION AND WIRING (CONTINUED)**

**WIRING DIAGRAMS**

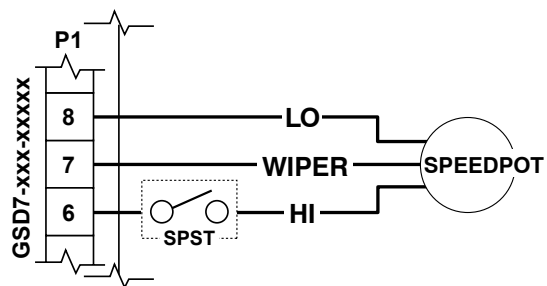
**GSD7-xxx-xxxxx BASIC WIRING DIAGRAM**



**GSD7-xxx-xxxxx Two-Speed OPERATION**



**GSD7-xxx-xxxxx INHIBIT OPERATION**



## START-UP

All power must be OFF before proceeding.

- 1) Recheck all wiring. Accidental grounds, loose or pinched wires on armature or speed pot wires may damage the DC drive when power is applied.
- 2) Check to see that the incoming power is of the correct voltage.
- 3) Turn the speed pot to zero (fully CCW).
- 4) Turn power on, close contact from COM (P4-7) to either FWD (P4-6) or REV (P4-5), and advance the speed pot while observing motor direction of rotation.  
*Power must be turned off again before step 5 can be accomplished!*
- 5) If the motor rotation is incorrect, turn power off at external disconnect, and reverse the A1 and A2 (P4-3 & P4-4) motor armature connections.
- 6) Check for satisfactory operation throughout the speed range.
- 7) *If operation is satisfactory, no readjustments are needed.*
- 8) If instability or surging is observed, or if minimum and maximum speed settings need further adjustments, then refer to the “Trim pot Adjustments” section.”
- 9) For other problems, consult the “Troubleshooting” section.

## TRIM POT ADJUSTMENTS

If the system is unstable after the previous Start-Up procedure, then adjust the trim pots as follows.

These adjustments are maintained, and periodic readjustments are not normally needed. However, readjustments could be needed if the drive is operated beyond  $\pm 10\%$  of the rated line voltage.

GSD7-xxx-xxxxx Trim pot Adjustment		
Trim pot	Function	Adjustment
<b>Max</b>	Sets maximum motor speed when speed pot is set at maximum (fully CW rotation). CW rotation of MAX trim pot increases maximum motor speed.	<ol style="list-style-type: none"> <li>1) TURN DRIVE POWER OFF!!</li> <li>2) Connect a DC Voltmeter across A1 and A2. <i>NOTE: Meter must not be grounded!!</i></li> <li>3) Set meter voltage range if needed: (90 VDC for 120 VAC; 180VDC for 240 VAC).</li> <li>4) Turn power ON. Select a direction and set Speed pot at 100%.</li> <li>5) Adjust the MAX trim pot to rated motor armature voltage as shown on meter. <i>NOTE: A tachometer or strobe may be used in lieu of a meter. Follow above steps, except adjust MAX trim pot to rated motor base speed indicated by tachometer or strobe.</i></li> </ol>
<b>Min</b>	Sets minimum motor speed when speed pot is set at zero. CW rotation will increase minimum motor speed.	<ol style="list-style-type: none"> <li>1) Select a direction and set Speed pot to zero (fully CCW).</li> <li>2) Rotate MIN trim pot CW until motor starts to rotate.</li> <li>3) Slowly rotate MIN trim pot CCW until motor stops. <i>NOTE: If motor rotation is desired, rotate MIN trim pot CW until desired MIN speed is reached</i></li> </ol>
<b>IR Comp</b>	Provides a means of improving motor speed regulation. If a slowdown due to load change is of no concern, rotate this trim pot fully CCW.	<ol style="list-style-type: none"> <li>1) Select a direction and set Speed pot at 50%.</li> <li>2) Observe motor speed at no load condition.</li> <li>3) Apply full load to motor.</li> <li>4) Turn IR COMP trim pot CW until you obtain the same motor speed as the no load condition.</li> </ol>
<b>Cur Lim</b>	Limits DC motor armature current (torque) to prevent damage to the motor or drive. The current limit is set for the rated motor current. CW rotation of this trim pot increases the armature current (or torque produced).	<ol style="list-style-type: none"> <li>1) TURN DRIVE POWER OFF!!</li> <li>2) Connect a DC ammeter between A1 on motor and A1 on the control. This is in series with the motor. <i>NOTE: Meter must not be grounded!!</i></li> <li>3) Turn power ON.</li> <li>4) Select a direction and set Speed pot at the 50% position.</li> <li>5) Apply friction braking to motor shaft until motor stalls.</li> <li>6) With motor stalled, set current at 125% of rated motor armature current by adjusting CUR LIM trim pot.</li> </ol>

## TROUBLESHOOTING

If a newly installed DC Drive will not operate, it is likely that a terminal connection is loose. Check the terminal connections and ensure that they are secure and correct. If the drive is still inoperative, refer to the Troubleshooting Table.

Troubleshooting		
<b>Problem</b>	<b>Possible Cause(s)</b>	<b>Corrective Action</b>
<b>Motor doesn't run</b>	<ol style="list-style-type: none"> <li>1) Blown fuse or circuit breaker</li> <li>2) Incorrect or no power</li> <li>3) Speed pot set at zero</li> <li>4) Worn motor brushes</li> </ol>	<ol style="list-style-type: none"> <li>1) Replace fuse or reset breaker</li> <li>2) Install proper power service</li> <li>3) Rotate Speed pot CW to start</li> <li>4) Replace motor brushes</li> </ol>
<b>Armature output voltage cannot be adjusted; output is a constant DC level</b>	<ol style="list-style-type: none"> <li>1) No motor or load connected</li> <li>2) Speed pot low connection open</li> </ol>	<ol style="list-style-type: none"> <li>1) Ensure that motor or load is connected to armature terminals</li> <li>2) Ensure that Speed pot Low wire is connected</li> </ol>
<b>Motor stalls, or runs very slowly with speed control set fully CW</b>	<ol style="list-style-type: none"> <li>1) Low voltage</li> <li>2) Overload condition</li> <li>3) Worn motor brushes</li> <li>4) Max speed set incorrectly</li> </ol>	<ol style="list-style-type: none"> <li>1) Ensure that VAC is above 100 VAC for 120V systems and above 200V for 240V systems</li> <li>2) Reduce load or increase motor size or Current Limit setting</li> <li>3) Replace brushes</li> <li>4) Consult "Trim pot Adjustments" section</li> </ol>
<b>Motor "hunts"</b>	<ol style="list-style-type: none"> <li>1) Motor current less than 150 mA</li> <li>2) Too much IR Comp</li> <li>3) Motor is in Current Limit</li> <li>4) Max trim pot set too high</li> <li>5) Motor speed is above rated speed</li> </ol>	<ol style="list-style-type: none"> <li>1) Motor current must be greater than 150 mA (DC)</li> <li>2) Consult "Trim pot Adjustments" section</li> <li>3) Consult "Trim pot Adjustments" section</li> <li>4) Consult "Trim pot Adjustments" section</li> <li>5) Reduce speed</li> </ol>
<b>Repeated fuse blowing</b>	<ol style="list-style-type: none"> <li>1) Low voltage</li> <li>2) Overload condition</li> <li>3) Worn motor brushes</li> <li>4) Defective motor bearings</li> <li>5) Defective electrical components</li> </ol>	<ol style="list-style-type: none"> <li>1) Ensure that VAC is above 100 VAC for 120V systems and above 200V for 240V systems</li> <li>2) Reduce load</li> <li>3) Replace brushes</li> <li>4) Replace bearings or motor</li> <li>5) Contact AutomationDirect "Product Returns" for replacement</li> </ol>

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Drawing Number: A-5-3905A