MDC150-120151
120VAC, 15A Brushless Controller

User's Guide

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MDC150-120151 Driver Features

- Maximum Current Limit Setting from 5.0 to 15.0 Amps (peak)
- Internal or External Potentiometer Speed Control
- 2-Quadrant Operation
- Hall Sensor Feedback
- Constant Velocity Mode
- Short Circuit Protection
- Requires 85 - 135 VAC
- Speed Out
- Fault Out
- Run/Stop, Freewheel and Direction Inputs
- Selectable Ramp Up
- Optically Isolated Inputs and Outputs
- Dual Mounting Option
- Detachable, Screw type Terminal Blocks for the logic inputs, outputs and motor phases
- Covered, Screw type Barrier Strips for the power input

General Description

The MDC150-120151 driver is designed to drive DC brushless motors at currents of up to 15A (peak) and 170V. Using hall sensor feedback, a constant velocity mode can be selected. The driver is protected against over current (cycle-by-cycle or latched), hall sensor error and under voltage. When an error occurs, a fault light and output is turned on to notify the user. Included on the driver is an internal potentiometer to control the maximum phase current allowed into the motor and an internal potentiometer to control the speed of the motor. An optional external potentiometer (10K) can be used to control the speed as well. The direction of the motor can be preset by the direction control input. Other inputs to the drive include a run/stop and a motor freewheel input. When using the run/stop input, there are three ramp up profiles from standstill to select from. The freewheel input overrides all other inputs into the driver. If the motor stalls, run/stop must be toggled to have the motor run again.

Fault Protection

Over current protection can be provided by means of an over current latch function by setting the 'FLT LATCH' dip switch. If a motor current level exceeding the current limit set by the internal current limit potentiometer is produced, an over current latch is activated, shutting off the output. This driver is equipped with a FAULT LED and Fault-out output to alert the user of the following conditions. To reset the MDC150-120151 driver from a latched condition, power down, allow 30 seconds for power to dissipate, then power up.

1. Invalid Sensor Input code
2. Over Current. The driver is equipped with cycle-by-cycle current limiting or over current latch.
3. Undervoltage Lockout activation at 9.1VDC for the motor bus voltage and 4.5VDC for Hall Sensor voltage.

Speed Adjust Setting

There are two ways to set the speed on this drive. One is to use the on board potentiometer. To use the on board potentiometer, set INT/EXT SPD switch (SW1, pin 1) to the 'off 'position (default). The speed is then adjusted by setting R46. The second is to use an external 10K potentiometer. To use the external potentiometer, set the INT/EXT SPD switch to the 'on' position. If an external potentimeter is used to control the speed of the motor, connect the pot to TB5.

Specifications

Item	Min	Typ	Max	Units
Input Voltage (Power)	85	120	135	VAC
Phase Output Current	5		15	A (Peak)
Phase Output Current	2.5		7.5	A (Continuous)
Input Voltage (Inputs)	3.5		24	VDC
Chopping Frequency	23	25	27	kHz
Operation Temperature	0		70	C

Hall Sensor Power Output:
6.25V @30mA maximum. Typical current draw from hall sensors is 20mA.
All three Hall Sensor inputs are pulled up through 20K ohm resistors.
The external speed control potentiometer must be 10K ohms.

Pin Descriptions

The inputs on the MDC150-120151 are optically isolated with the anode (+) and cathode (-) both brought out to the user. With no current going through the Direction, Freewheel, and Run/Stop opto-diodes, the input is considered high. To enable the motor to Run, current must go through the Run/Stop input opto-diode. To Freewheel (remove energy from the motor) the motor, current must go through the Freewheel input opto-diode.To enable the input a minimum of 1.0 mA needs to be sourced or sinked through the opto-diode. This is done simply by placing a voltage of +5 to +24 VDC across the two inputs of the opto-diode. If sourcing current into the inputs, then all three cathodes (-) should be tied together and grounded. If sinking current, then all three anodes (+) should be tied together to the +voltage. The PG Out and Fault output on the MDC150-120151 are an opto-decoupled open collector output. When normal operation occurs, this output will conduct current into the emitter. Care must be taken not to pass more than 50mA through these transistor.

Motor Freewheel

The motor freewheel feature allows the de-energizing of the motor phases. A high (open) input causes the motor to run at the given speed, while a low at this input causes the motor to coast to a stop.

Motor Run/Stop

The motor run/stop feature allows the stopping of a motor by shorting out the bottom drives of the three phases. A low at this input allows the motor to run, while a high (open) input does not allow motor operation and if operating causes rapid deceleration.

Motor Direction

The motor direction feature allows the changing of the rotation of the motor. This input should not be changed while motion is in progress. A high (open) input causes the motor to turn in the CW direction, while a low at this input causes the motor to turn in the CCW direction.

Heating Considerations

The temperature of the heat sink should never be allowed to rise above 70 degrees Celsius. If necessary, mount the unit to an additional heat sink or air should be blown across the heat sink to maintain suitable temperatures.

Speed Output

The PG OUT terminal (TB1 - pin 1 and 2) is used to determine the speed of the motor shaft. An opto-decoupled open collector output is shown at a rate of 4 pulses for 1 revolution of an 8-pole motor, 3 pulses for 1 revolution of a 6-pole motor, and 2 pulses for 1 revolution of a 4-pole motor. Care must be taken not to pass more than 50mA through this transistor.

# Poles	RPM
8	15 * PG OUT (in Hz)
6	20 * PG OUT (in Hz)
4	30 * PG OUT (in Hz)

Terminal and Dip Switch Descriptions

Pin #	Description
1	PG OUT(collector)
2	PG OUT(emitter)
3	Direction (+)
4	Direction (-)
5	Freewheel (+)
6	Freewheel (-)
7	Run/Stop (+)
8	Run/Stop (-)
9	Fault Out (collector)
10	Fault Out (emitter)

TB1: Opto-isolated Control Inputs and Outputs

Pin #	Description
1	Hall Sensor Power
2	Hall Sensor A
3	Hall Sensor B
4	Hall Sensor C
5	Hall Sensor Reference

TB2: Motor Hall Terminals

Pin #	Description
1	Phase A
2	Phase B
3	Phase C

TB3: Motor Phase Terminals

Pin#	Description
1	VIN (85-135VAC)
2	GND
3	EARTH GND

TB4: AC Voltage In Terminals

Pin#	Description
1	Ex Pot (+)
2	Ex Pot (w)
3	Ex Pot (-)

TB5: 10K External Pot (optional)

SW #	Description
1	INT/EXT SPEED
2	FLT LATCH
3	RAMP 1
4	RAMP 2
5	60/120

SW1: Dip Switch

SW #	Description
1	O/C LOOP
2	CL1
3	CL2
4	CL3

SW2: Dip Switch

Dip Switch and Jumper Settings

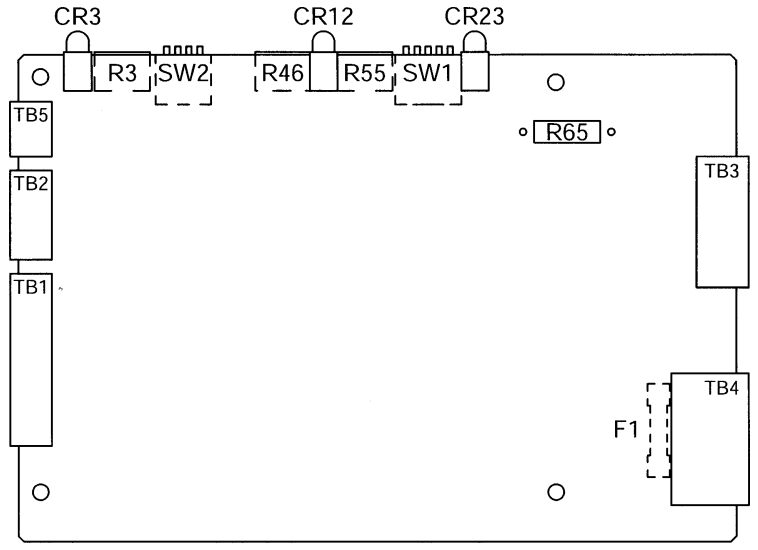
Function	SW 1	SW2	SW3	SW4	SW5
Internal Speed Control (R46)	Off	---	---	---	---
External Speed Control (TB5)	On	---	---	---	---
Over Current Latching	---	On	---	---	---
Over Current Cycle by Cycle	---	Off	---	---	---
Ramp Profile1 (4 Sec)	---	---	Off	Off	---
Ramp Profile 2 (2 Sec)	---	---	Off	On	---
Ramp Profile 3 (1 Sec)	---	---	On	Off	---
Ramp Profile 4 (500mSec)	---	---	On	On	---
60° Hall Sensor Spacing	---	---	---	---	Off
120° Hall Sensor Spacing	---	---	---	---	On
Standard Product (Ready to Ship)	Off	Off	Off	Off	On

SW1: Speed Adjustment, Over Current, and Ramp settings

Function	SW 1	SW2	SW3	SW4
Constant Speed Mode (Closed Looped)	Off	---	---	---
Voltage Controlled Speed Mode (Open Loop)	On	---	---	---
Closed Loop Compensation 1	---	---	---	---
Closed Loop Compensation 2	---	---	---	---
Closed Loop Compensation 3	---	---	---	---
Stnadard Producy (Ready to Ship_	On	Off	Off	Off

SW2: Open Loop and Closed Loop. If Closed Loop selected, Closed Loop compensation switches must be set according to motor speed desired.

Switch and Terminal Block Locations



Open Loop/ Closed Loop (Constant Velocity Mode)

The driver can either be set for Open Loop or Closed Loop operation. Open Loop operation is used for applications where the speed of the motor needs to change according to the load. Closed Loop operation is used for applications where speed regulation is needed. Under closed loop operation, the speed is regulated despite changes to the load and the power supply voltage.

To operate Open Loop, the O/C LOOP switch (SW2, pin1) must be in the 'on' position.

To operate Closed Loop, the O/C LOOP switch (SW2, pin1) must be in the 'off' position and the CL ADJ POT (R3) and CL ADJ dip switches (SW2, pin 2-4) must be set to optimize the driver for each application.

* **If using an Anaheim Automation DC Brushless motor:** the tables shown on the next page are the Closed Loop potentiometer and dip switch settings for each motor. The regulated speed of the motor is then controlled by adjusting the internal (R46) or external speed pot. The motor speed can be monitored by measuring the pulse rate of PG OUT (TB1 - pin 1 and 2).

* **If using a non-Anaheim Automation DC Brushless motor:**
  1) Set the O/C LOOP switch (SW2, pin1) in the 'off' position
  2) Set the closed loop switches CL1, CL2, and CL3 on the 'on' position.
  3) Set CL ADJ POT to 0%.
  4) Adjust the internal speed pot (R46) or external speed pot to 100% The motor at this time should be running at its maximum speed.
  5) Increase the closed loop gain by switching CL1, CL2, and CL3 incrementally one stage according to the following table until the motor speed dips below the maximum speed. Set the switches up one stage to the position before the motor dips below the maximum speed and proceed to step 6. Decreasing the gain will increase the motor speed.

CL1	CL2	CL3	CL Gain
On	On	On	Min
Off	On	On	
On	Off	On	
Off	Off	On	
On	On	Off	
Off	On	Off	
On	Off	Off	
Off	Off	Off	Max

  6) Slowly rotate CL POT toward 100% until the motor speed slightly begins to decreases. At this point, the motor closed loop adjustments are set.
     * If a slower top motor speed is desired, set CL ADJ POT to 0%. Increase the closed loop gain incrementally by setting CL1, CL2, CL3 with respect to the desired top motor speed and re-tune CL ADJ POT, as described in step 4 and step 5.

Anaheim Automation Motor Closed Loop Settings

4-pole motors

Motor	CL1	CL2	CL3	CL POT	MAX SPD (RPM)	MIN SPD (RPM)
BLWR110S-15V-8000	On	On	On	80%	8000	500
BLWR111S-24V-10000	On	On	On	50%	10050	825
BLWR112S-24V-3700	On	Off	On	100%	3735	450
BLWR231D-36V-4000	On	Off	On	65%	4010	550
BLWR232D-36V-4000	On	Off	On	65%	4010	550
BLWR233D-36V-4000	On	Off	On	65%	4010	550
BLWR234D-36V-4000	On	Off	On	65%	4010	550
BLWR235D-36V-4000	On	Off	On	65%	4010	550
BLWR232S-24V-1350	Off	Off	Off	0%	1600	200
BLWS231D-36V-4000 BLWS231S-36V-4000	On	Off	On	65%	4010	550
BLWS232D-36V-4000 BLWS232S-36V-4000	On	Off	On	65%	4010	550
BLWS233S-36V-4000	On	Off	On	65%	4010	550
BLWS234D-36V-4000 BLWS234S-36V-4000	On	Off	On	65%	4010	550
BLWS235S-36V-4000	On	Off	On	65%	4010	550

8-pole motors

Motor	CL1	CL2	CL3	CL POT	MAX SPD (RPM)	MIN SPD (RPM)
BLY171S-17V-8000	On	On	On	0%	7500	500
BLY172S-17V-9500	On	On	On	0%	9000	500
BLY171S-24V-4000	On	On	On	80%	4000	250
BLY172D-24V-4000 BLY172S-24V-4000	On	On	On	80%	4000	250
BLY173D-24V-4000	On	On	On	80%	4000	250
BLY174D-24V-4000 BLY174S-24V-4000	On	On	On	80%	4000	250
BLY341D-48V-3200 BLY341S-48V-3200	Off	On	On	40%	3200	250
BLY342D-24V-3000	Off	On	On	40%	3000	250
BLY342D-30V-3000 BLY342S-30V-3000	Off	On	On	40%	3000	250
BLY342D-48V-3200 BLY342S-48V-3200	Off	On	On	30%	3200	250
BLY343D-48V-3200 BLY343S-48V-3200	Off	On	On	30%	3200	250
BLY343S-30V-3000	Off	On	On	40%	3000	250
BLY344D-48V-3200 BLY344S-48V-3200	Off	On	On	30%	3200	250
BLZ362S-36V-3500	Off	On	On	10%	3500	330
BLZ362S-160V-3500	Off	On	On	10%	3500	330
BLZ482S-160V-3500	Off	On	On	10%	3500	330
BLZ242S-24V-3500	Off	On	On	10%	3500	330

Commutation Sequence

	Step					
	1	2	3	4	5	6
Phase A	+	Z	-	-	Z	+
Phase B	Z	+	+	Z	-	-
Phase C	-	-	Z	+	+	Z
Hall A	1	1	0	0	0	1
Hall B	0	1	1	1	0	0
Hall C	0	0	0	1	1	1

120° Hall Spacing Sequence Forward

	Step					
	1	2	3	4	5	6
Phase A	-	Z	+	+	Z	-
Phase B	Z	-	-	Z	+	+
Phase C	+	+	Z	-	-	Z
Hall A	1	1	0	0	0	1
Hall B	0	1	1	1	0	0
Hall C	0	0	0	1	1	1

120° Hall Spacing Sequence Reverse

	Step					
	1	2	3	4	5	6
Phase A	+	Z	-	-	Z	+
Phase B	Z	+	+	Z	-	-
Phase C	-	-	Z	+	+	Z
Hall A	1	1	1	0	0	0
Hall B	0	1	1	1	0	0
Hall C	0	0	1	1	1	0

60° Hall Spacing Sequence Forward

	Step					
	1	2	3	4	5	6
Phase A	-	Z	+	+	Z	-
Phase B	Z	-	-	Z	+	+
Phase C	+	+	Z	-	-	Z
Hall A	1	1	1	0	0	0
Hall B	0	1	1	1	0	0
Hall C	0	0	1	1	1	0

60° Hall Spacing Sequence Reverse

+ = Top Transistor ON, Bottom Transistor OFF, Current flows into this wire
- = Top Transistor OFF, Bottom Transistor ON, Current flows out of this wire
Z = Top Transistor OFF, Bottom Transistor OFF, No current into or out of this wire (High Impedance)

Motor Connection

Refer to the hookup diagram for typical driver applications. When connecting a motor for the first time, connect the hall sensor wires (5 of them) to the driver. **DO NOT CONNECT THE PHASES YET AND DO NOT HOOKUP ANYTHING BUT THE HALL WIRES TO THE HALL CONNECTIONS**. Turn on power and rotate the motor by hand. If the RED FAULT LED comes on, the hall phases are incorrectly wired. If the RED FAULT LED does not come on then the hall wires are connected correctly. Power the unit down and proceed to connect the motor phases. If the motor does not run or runs erratically, power down and check the speed potentiometer and make sure the phases are connected correctly. There are six different ways to connect the phase wires, and normally only two will allow the motor to rotate, but only one is correct. If the direction of the motor is changed and the no-load current of the motor is approximately the same and the motor runs smoothly in both directions then the phase wires are correct.

The wiring of the motor phases should be separated from the hall and input connections to not allow a possible source of interference.

Typical Hookup Drawing

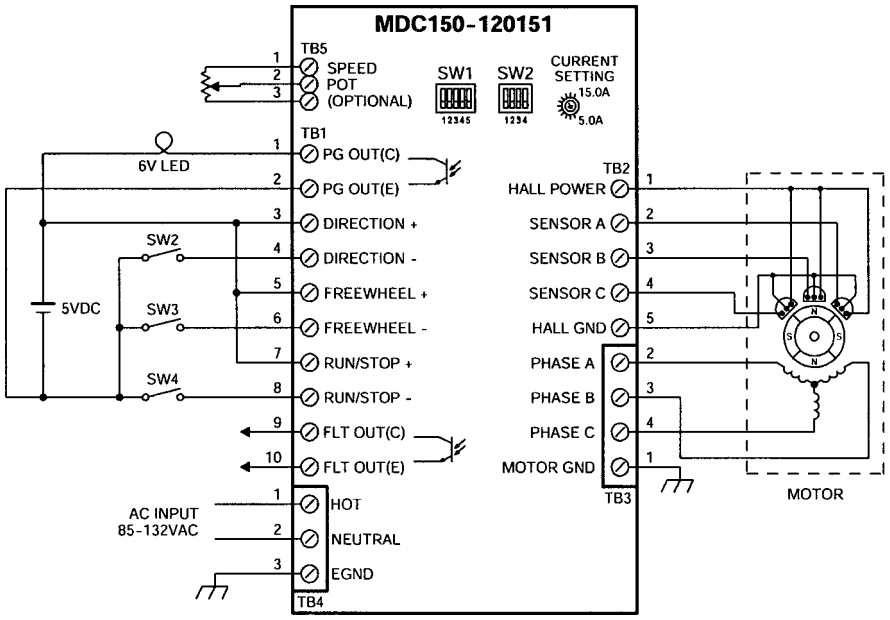


Figure 2: Hook up for current sinking inputs

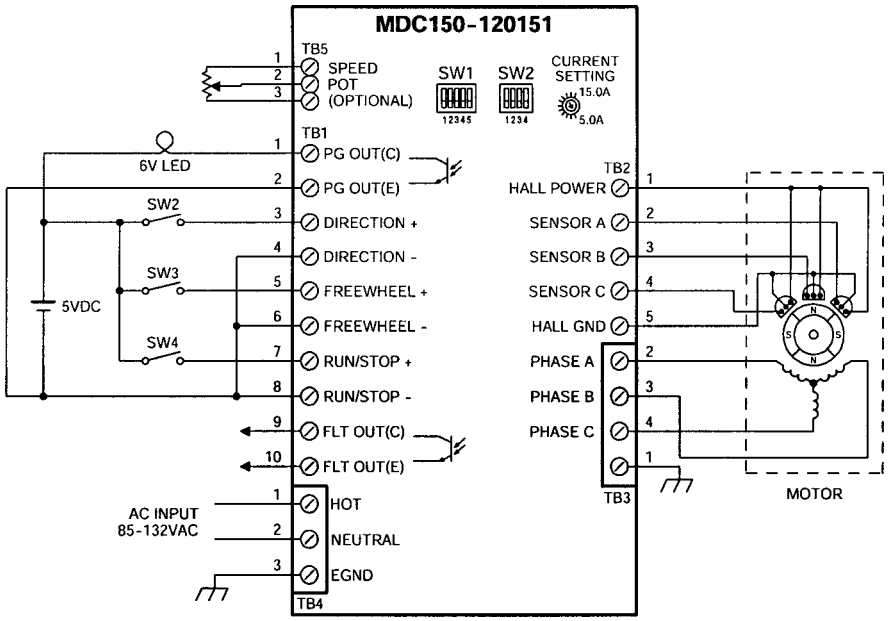
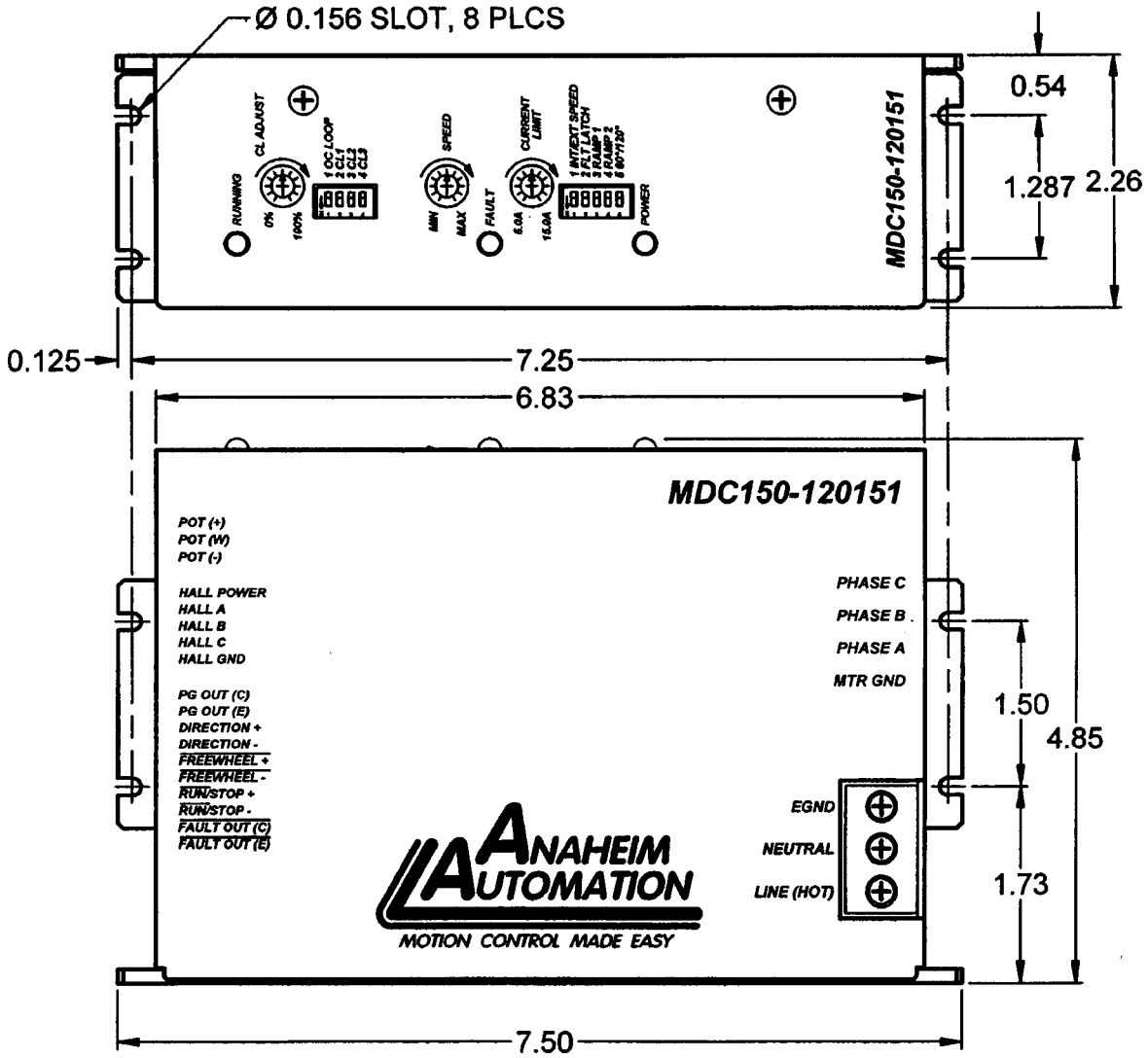


Figure 3: Hook up for current sourcing inputs

Dimensions


Ø 0.156 SLOT, 8 PLCS
0.54
1.287
2.26
0.125
7.25
6.83
MDC150-120151
POT (+)
POT (W)
POT (-)
HALL POWER
HALL A
HALL B
HALL C
HALL GND
PG OUT (C)
PG OUT (E)
DIRECTION +
DIRECTION -
FREEWHEEL +
FREEWHEEL -
RUN/STOP +
RUN/STOP -
FAULT OUT (C)
FAULT OUT (E)
PHASE C
PHASE B
PHASE A
MTR GND
EGND
NEUTRAL
LINE (HOT)
1.50
4.85
1.73
ANAHEIM AUTOMATION
MOTION CONTROL MADE EASY
7.50

Trouble Shooting

Problem	Suggested things to test
Red Fault LED on at Power Up	Verify if Motor Halls, Power, and GND are not either disconnected or miswired.
	Verify if Motor Phases are not either disconnected or miswired.
	Verify that the Hall Sensor Spacing switch (SW1 - POS. 5) is properly set for the motor used.
	If a heavy load is present at power up, verify current limit setting is set appropiately and current latch (SW2 - POS. 2) is not set to the ON position.
	Verify the Motor Hall Power is not overloaded. This occurs when other external circuitry other than the motor halls is using this voltage reference for power, i.e. motor encoder.
	Verify the Freewheel input is not sinking or sourcing any current through the opto-diode.
Motor does not run	Check if Red Fault LED is on.
	Verify if Motor Halls, Power, and GND are not either disconnected or miswired.
	Verify if Motor Phases are not either disconnected or miswired.
	Verify the Run / Stop input is sinking or sourcing current through the opto-diode.
.	Verify the on-board / external speed potentiometer settingis correct.
	Verify on-board or external speed adjustment potentiometer is not at 0%
	If a Closed-Loop operation is required, verify the Closed-Loop settings are correct for the motor used.
	If the motor stalls, the run / stop input must be toggled to resume operation
Motor runs erratic, at high temperature (above 70ºC), or incorrect speed	Verify if Motor Halls, Power, and GND are not either disconnected or miswired.
	Verify if Motor Phases are not either disconnected or miswired.
	Verify the on-board / external speed potentiometer setting is correct.
	Verify the Freewheel input is not intermittently sinking or sourcing any current through the opto-diode.
	Verify the Run / Stop input is not intermittently losing any current sinking or sourcing through the opto-diode.
	If a Closed-Loop operation is required, verify the Closed-Loop settings are correct for the motor used.
	Verify there are no large variations in the motor bus voltage by monitoring the voltage input.
	Verify the motor is not damaged by trying another motor with the driver.

DISCLAIMER
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All Anaheim Automation products are warranted against defects in workmanship, materials and construction, when used under Normal Operating Conditions and when used in accordance with specifications. This warranty shall be in effect for a period of twelve months from the date of purchase or eighteen months from the date of manufacture, whichever comes first. **Warranty provisions may be voided if products are subjected to physical modifications, damage, abuse, or misuse.**

Anaheim Automation will repair or replace at its' option, any product which has been found to be defective and is within the warranty period, provided that the item is shipped freight prepaid, with previous authorization (RMA#) to Anaheim Automation's plant in Anaheim, California.

TECHNICAL SUPPORT
If you should require technical support or if you have problems using any of the equipment covered by this manual, please read the manual completely to see if it will answer the questions you have. If you need assistance beyond what this manual can provide, contact your Local Distributor where you purchased the unit, or contact the factory direct.

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