MDC300-120151 Series
120VAC, 15A Brushless Controller

User's Guide

ANAHEIM AUTOMATION

910 East Orangefair Lane, Anaheim, CA 92801 (714) 992-6990 fax: (714) 992-0471
e-mail: info@anaheimautomation.com website: www.anaheimautomation.com

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MDC300-120151 Driver Features

- Maximum Current Limit Setting from 5.0 to 15.0 Amps
- Internal/External Potentiometer or Voltage Input Speed Control
- Onboard Potentiometer Ramp Up/Down Adjustment
- 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
- Optically Isolated Inputs and Outputs
- Dual Mounting Option
- Detachable, Screw type Terminal Blocks for the logic inputs and outputs
- Covered, Screw type Barrier Strips for the power input and motor phases

General Description

The MDC300-120151 Driver is designed to drive DC brushless motors at currents of up to 15A and 170VDC. 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 or voltage input can be used to control the speed as well. The direction of the motor can be present by the direction control input or controlled by the external voltage speed input. Other inputs to the drive include a run/stop and a motor freewheel input. An onboard potentiometer sets the ramp up/down profile from standstill. 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 a 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 MDC300-120151 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.

Pin Descriptions

The inputs on the MDC300-120151 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 synced through the opto-diode. This is done simply by placing a voltage of +5 to +7 VDC across the two inputs of the opto-diode. I 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 isolated external Speed Voltage Input must be an analog voltage from 0VDC to +/-5VDC. The PG Out and Fault output on the MDC300-120151 are an opto-decoupled open collector output. When normal operation occurs, this ouytput will conduct current into the emitter. Care must be taken not to pass more than 50mA through this transistor.

Electrical Specifications

Item	Min	Typ	Max	Units
Input Voltage (Power)	85	120	135	VAC
Input Voltage (Power)	120	170	191	VDC
Phase Output Current	3.5		10.7	A (RMS)
Phase Output Current	5		15	A (Peak)
Input Voltage (Inputs)	3.5		24	VDC
Chopping Frequency	23	25	27	kHz
Operation Temperature	0		70	C

Table 1: MDC300-121051 electrical specifications

Speed Output: (TB1, Pin 1 and 2)

A signal pulse out is available 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.
8-pole motor RPM = 15 * PG OUT (in Hz)
6-pole motor RPM = 20 * PG OUT (in Hz)
4-pole motor RPM = 30 * PG OUT (in Hz)

Hall Sensor Power Output:

6.25V @ 30mA maximum. Typical current draw from hall sensors is 20mA.
All three Hall Sensors inputs are pulled up through 20K ohm resistors.

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 swith 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 CLADJ potentiometer (R3) and CLADJ dip switched (SW2, pin 2-4) must be set to optimize the driver for each application. The Closed Loop adjustments are needed for faster and slower motor operation, within the restrictions of the motor rated speed. The adjustments provide a direct duty cycle to the driver with repect to the required motor speed.

The tables shown on the next page are the Closed Loop potentiometer and dip switch settings for each motor. These adjustments will set the maximum running speed of the internal/external speed potentiometer or the 5VDC voltage set to the motors maximum running speed. Motor operation at slower speeds may also be attained. For the slower speed, the pulse width of the duty cycle can be increasedby adjusting the CLPOT toward 100% and switching ‘off’ CL3, CL2, and CL1 one after another, until the desired motor speed is achieved. The motor speed can be monitored by measuring the pulse rate of PG OUT (TB1 pin 1 and 2).

If the motor is not listed in the tables on the next page, the maximum operating speed can be set following these instructions.
Set CLPOT to 100% and follow the CL switch settings until the desired maximum speed range is achieved.

CL1	CL2	CL3	Duty Cycle Setting
On	On	On	Max
Off	On	On	
On	Off	On	
Off	Off	On	
On	On	Off	
Off	On	Off	
On	Off	Off	
Off	Off	Off	Min

Table 2: Closed Loop Compensation Settings

Once the maximum desired speed range is set via CL switches, CL Pot can be adjusted to tune the exact speed desired.

4-pole motors

Motor	CL1	CL2	CL3	CL POT	MAX SPD (RPM)	MIN SPD (RPM)
BLWR1103-15V-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

Table 3: Closed Loop Operation Motor Settings

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-160-3500	Off	On	On	10%	3500	330
BLZ482S-160V-3500	Off	On	On	10%	3500	330
BLZ242S-24V-3500	Off	On	On	10%	3500	330

Table 4: Closed Loop Operation Motor Settings

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 connection a motor for the first time, connect the hall sensor wires (5 of them) to the driver. **DO NOT CONNECT THE PHASE YET.** 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.

Terminal Block 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)
11	Speed Voltage (+)
12	Speed Voltage (-)

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	AC Hot
2	AC Neutral
3	EARTH GND (must be connected)

TB4:AC Voltage In Terminals

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

TB3: Motor Phase Terminals

Dip Switch Descriptions

SW#	Description
1	INT/EXT SPEED
2	FLT LATCH
3	RAMP
4	AUTO DIRECTION
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	SW1	SW2	SW3	SW4	SW5
Internal Speed Control (R46)	Off	---	---	---	---
External Speed Control (TB1 - Pins 11 & 12)	On	---	---	---	---
Over Current Latching	---	On	---	---	---
Over Current Cycle by Cycle	---	Off	---	---	---
Ramp Up/Down set by R140	---	---	On	---	---
Ramp Off	---	---	Off	---	---
Direction control via Direction Opto-input	---	---	---	Off	---
Direction Control via Speed Voltage polarity	---	---	---	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	SW1	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	---	---	---	---
Standard 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.

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. When the motor is stalled, this input must be toggled from low to high to resume from a latched STOP state.

Motor Direction

The motor direction feature allows the changing of the rotation of the motor. This input should not be changed while maximum speed is in progress. The direction can be controlled two different ways.

When DIREC SET switch (SW1, pin 3) in the OFF Position (default):

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.

When DIREC SET switch (SW1, pin 3) in the ON Position (default):

A 0 to +5V speed voltage signal at TB1 - pins 11 & 12 causes the motor to turn in the CW direction, whilea 0 to -5V speed voltage causes the motor to turn in the CCW direction. With SW1-position 3 in the ON position, the Direction inputs (TB1-pins 3 & 4) should be left open.

Speed Adjust Setting

There are two ways to set the speed on this drive. One is to use the on board or an external potentiometer/voltage. To use the on board potentiometer, set INT/EXT SPD switch (SW1, pin 1) to the 'off' position (default). The speed is adjusted by setting R46. To use the external 10K potentiometer set INT/EXT SPD switch to the 'on' position. If an external potentiometer is used to control the speed of the motor, connect the pot to P1.

When INT/EXT SPD switch (SW1, pin 1) in the OFF Position (default):

The onboard potentiometer is used to control the speed of the motor. The motor speed increases as the potentiometer is set from 0% - 100%.

When INT/EXT SPD switch (SW1, pin 1) in the ON Position (default):

Either an external speed analog voltage or an external potentiometer can be used to set the motor speed. For an external voltage, apply a +/- voltage on TB1 - pin 11 and the return on TB1 - pin 12. The motor speed increases as the voltage is set from 0 to +5VDC or 0 to -5VDC. A -5VDC to +5VDC voltage span cay be used to change the speed and direction of the motor (*see Motor Direction above).*

For an external potentiometer, connect the POT WIPER to TB1 - pin 11, POT (-) to TB1 - pin 12, and POT (+) to an external +/-5V supply.

Speed Output

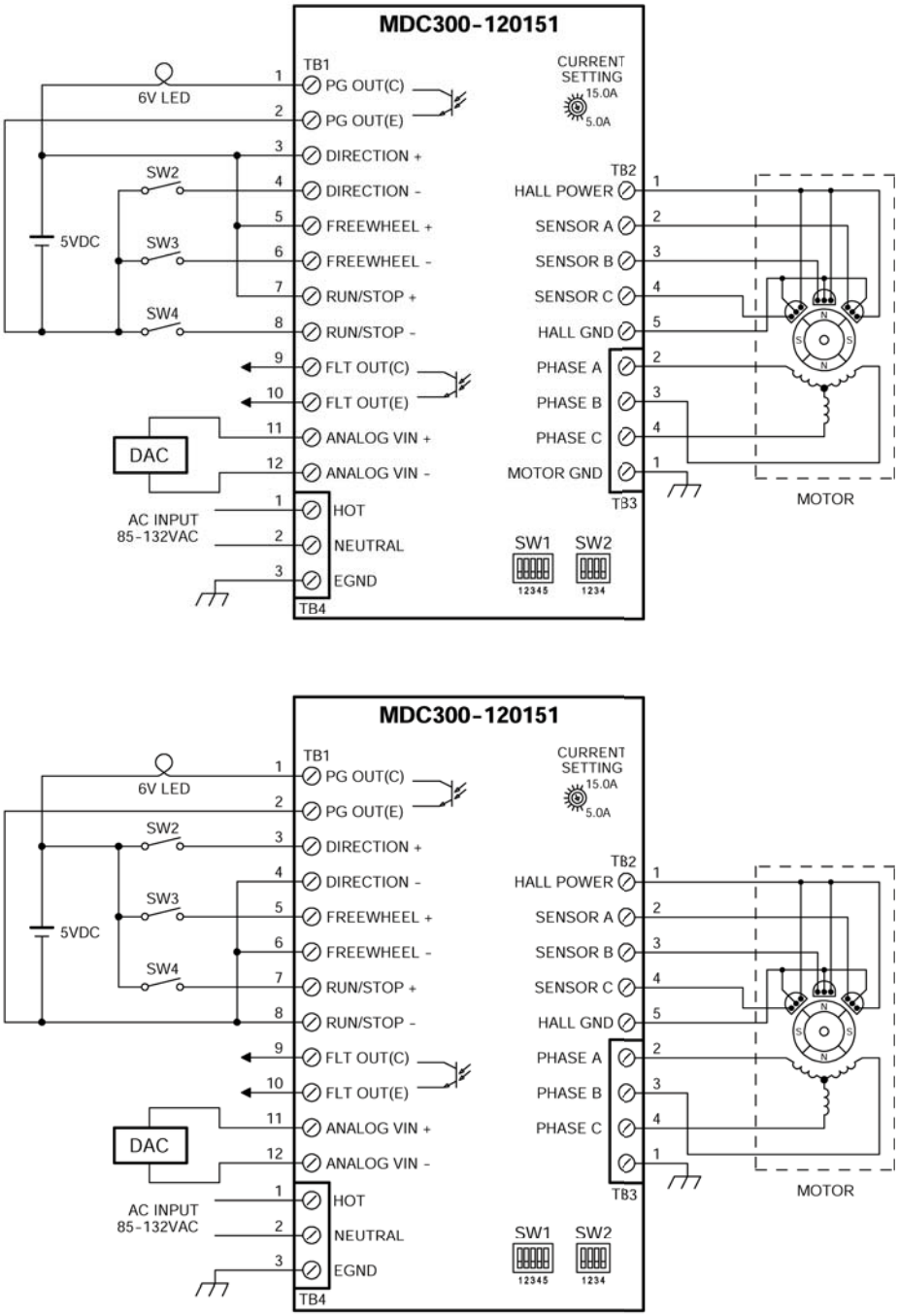
The PG OUT Terminal (TB1 - pin 1 and 2) is used to determine the speed of the motor shaft. An optode-coupled open collector output is shown at a rate of 4 pulses for 1 revolution of an 8-pole motor, 3 pulses for 1 revolution of a 6 pole motor, and 2 pulse for 1 revolution of a 4-pole motor. Care must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

# Poles	RPM
8	1500 * PG OUT (in Hz)
6	2000 * PG OUT (in Hz)
4	3000 * PG OUT (in Hz)

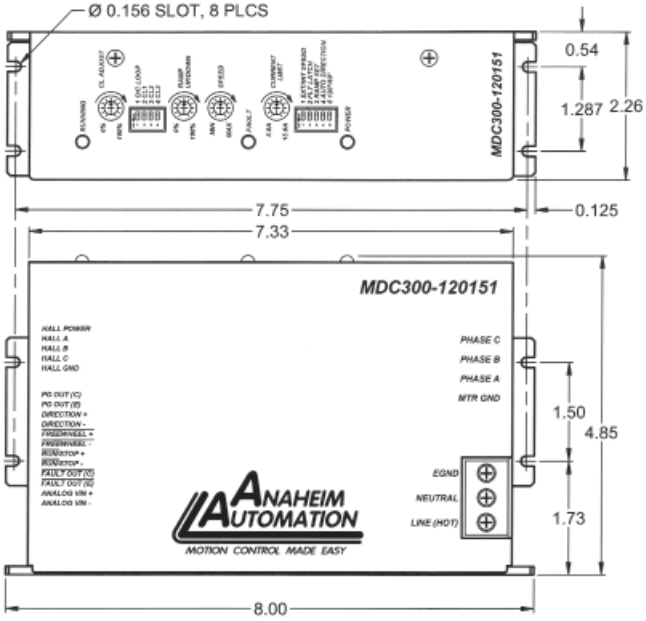
Heating Considerations

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

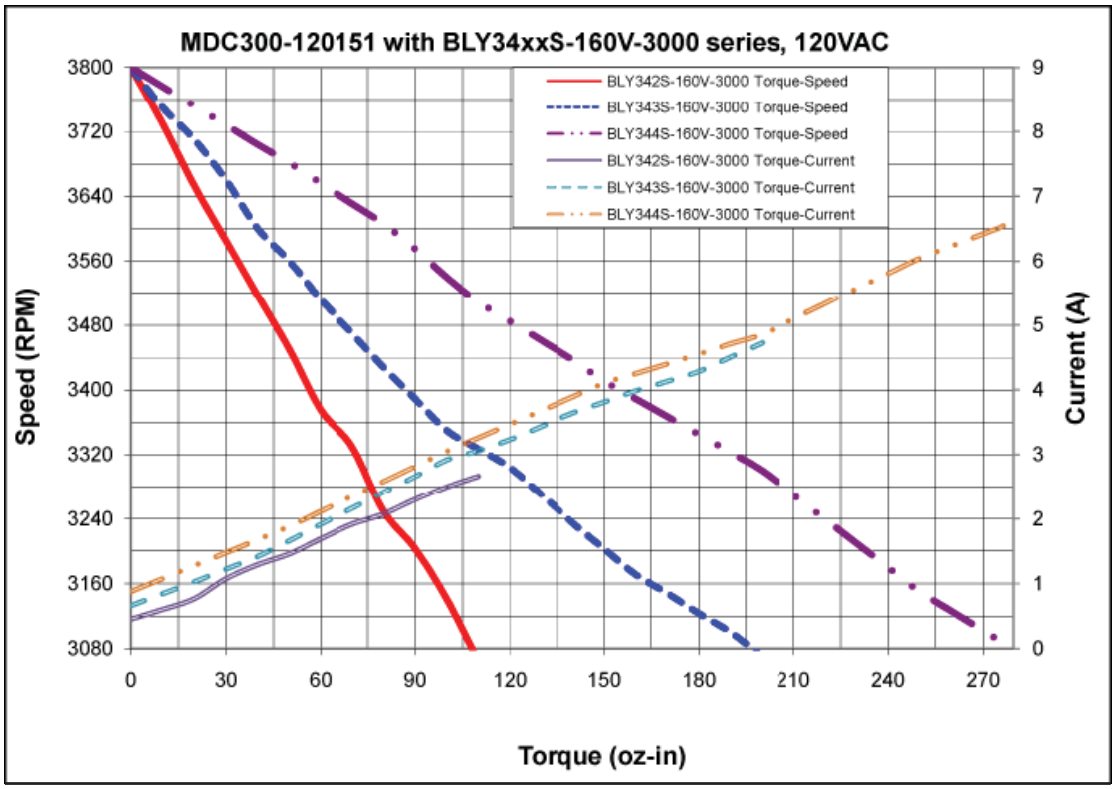
Typical Hookup Drawing

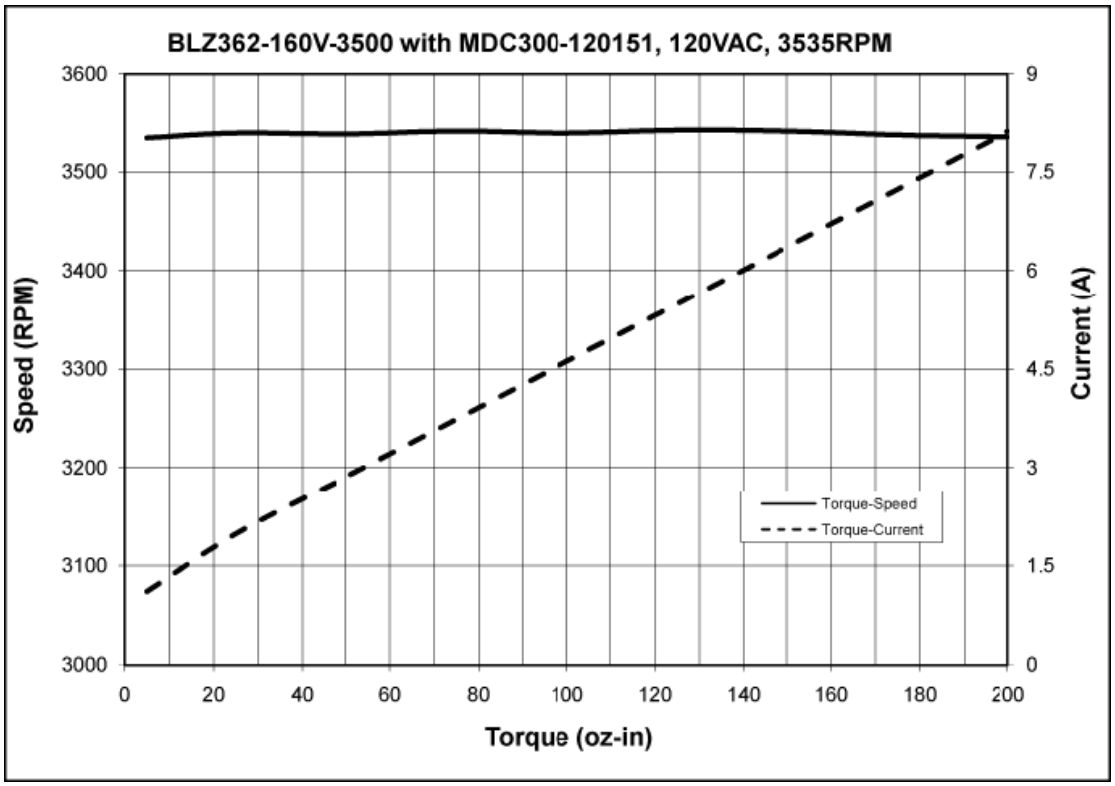


Dimensions


Ø 0.156 SLOT, 8 PLCS
0.54
1.287
2.26
MDC300-120151
7.75
7.33
0.125
MDC300-120151
HALL POWER
HALL A
HALL B
HALL C
HALL GND
PG OUT (C)
PG OUT (E)
DIRECTION +
DIRECTION -
FREERWHEEL +
FREERWHEEL -
ROTOR +
ROTOR -
FAULT OUT (C)
FAULT OUT (E)
ANALOG VIN +
ANALOG VIN -
PHASE C
PHASE B
PHASE A
MTR GND
EGND
NEUTRAL
LINE (HOT)
1.50
4.85
1.73
ANAHEIM AUTOMATION
MOTION CONTROL MADE EASY
8.00

Open Loop Torque Speed Curve





Troubleshooting

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 appropriately 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 setting is correct on SW1, pin 1 is correct.
	Verify on-board or external speed adjustment not at 0VDC or 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 70°C), or incorrect speed	Verify if Motor Halls, Power, and GND are not either disconnected or miswired.
	Verify Motor Phases are not either disconnected or miswired.
	Verify the on-board/external speed setting is correct on SW1, pin 1 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.
	Verify that nothing is connected to the Direction inputs when the Auto Dire ction mode is selected.
	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 when open-loop operation is used.
	Verify the motor is not damaged by trying another motor with the driver.

DISCLAIMER
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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.