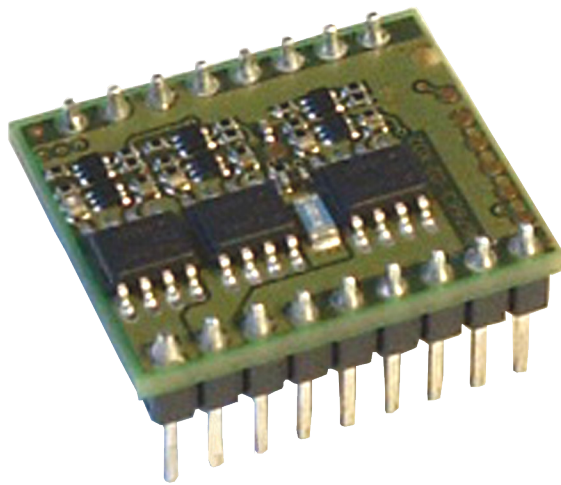


MDC010 - 024031

24V, 2A Brushless Controller

User's Guide



A N A H E I M A U T O M A T I O N

4985 E. Landon Drive Anaheim, CA 92807
e-mail: info@anaheimautomation.com

(714) 992-6990 fax: (714) 992-0471
website: www.anaheimautomation.com

MDC010-024031 Speed Controller Features

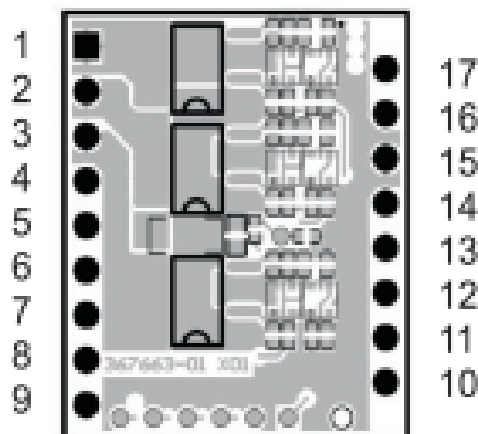
- Closed or Open Loop Speed Control
- 8 - 24VDC Voltage Range
- Max Speed at 80,000 RPM
- 3 Different Speed Ranges Selectable
- Easy Connectivity/Integration into Motherboard
- Maximum Current Limit Setting at 3 Amps Peak 2 Amps (rated)
- The Output Stage can be Enabled or Disabled
- Protective Functions: Undervoltage, overvoltage and thermal overload
- Compact Size
- 2-Mode Operation

General Description

The MDC010-024031 driver has a compact, powerful and cost-effective design. Designed as a speed controller for Brushless DC Motor products to perform complex applications with very little effort. The flexible multifunctional operation with high efficiency is a direct result of the wide supply of voltage ranging from 8-24VDC with a continuous current rating of 2A. Some of the different inputs offered with this Speed Controller include: direction of rotation presetting, enabling, current limiting, speed ranges, and operational status; also has protective features against blockage and short circuit, undervoltage/overvoltage, overcurrent, and thermal overload. The MDC010-024031 deliver a maximum speed of 80,000 RPM's to the shaft of the Brushless DC Motor. With a two connector arrays arranged in a 2.54 mm pattern, it allows easy integration and connectivity to the MDC010-EVALBOARD or the OEM-side mother board.

Pin Assignment

Pin #	Description
1	Motor Winding 1
2	Motor Winding 2
3	Motor Winding 3
4	Supply Voltage 8-24VDC
5	Ground
6	+5VDC Output Voltage
7	Hall Sensor 1
8	Hall Sensor 2
9	Hall Sensor 3



Pin #	Description
10	Status Indication Output
11	Digital Input 1
12	Digital Input 2
13	Enable Input
14	Direction Input
15	Ground
16	Set Current Limit Input
17	Set Value Speed Input

Specifications

Electrical Data

Nominal Supply Voltage +V - 8 - 24VDC
Absolute Minimum Supply Voltage +V - 8VDC
Absolute Maximum Supply Voltage +V - 28VDC
Max Output Voltage - +V
Continuous Output Current (I) - 2A
Max. Output Current (I) - 3A
Switching Frequency - 46.8kHz
Max. Speed (motor with 1 pole pair) - 80,000 RPM

Inputs

Set Value Speed - Analogue Input (0 - 5V); Resolution:1024 Steps
Enable - +2.4 - +28V (R=100kohms) or switch against V
Direction - +2.4 - +28V (R=100kohms) or switch against V
Speed Range <<DignIN1>> - +2.4 - +28V (R=15kohms at 5V) or switch against Gnd
Speed Range <<DignIN2>> - +2.4 - 28V (R=15kohms at 5V) or switch against Gnd
Set Current Limit - External Resistor (1/16 W) against Gnd
Hall Sensors - <<Hall Sensor 1>>, <<Hall Sensor>>, <<Hall Sensor>>

Output

Status Indication <<Ready>> - Digital Output Signal, 5V (R=10kohms)

Voltage Output

+5VDC Output Voltage <<V Hall>> - +5VDC, max. 35mA

Motor Connections

Motor Connections - <<Motor Winding 1>>, <<Motor Winding 2>>, <<Motor Winding 3>>

Ambient Temperature

Operation - -10 - +45°C

Storage - -40 - +85°C

Humidity Range

Non Condensating - 20-80%

Protective Functions

Current Limitation (cycle-by-cycle) - Adjustable up to Maximum 3A

Blockage - Motor Current limitation if motor shaft is blocked for longer than 1.5s

Undervoltage shutdown - Shutdown if V<6.5VDC

Overvoltage Shutdown - Shutdown if V>30VDC

Thermal Overload Protection of Power Stage - Shutdown if T>95°C

Mechanical Data

Weight - approx. 4g

Dimensions - 24.2 x 20.38 x 12.7mm (0.95 x 0.8 x 0.5in)

Terminals

Pin Header 1 - 9 poles (single row, pitch 2.54mm (0.1in))

Pin Header 2 - 8 poles (single row, pitch 2.54mm (0.1in))

Inputs

Speed Range and Mode Selection with <<DigIN1>> and <<DigIN2>>

The digital inputs <<DigIN1>> [11] and <<DigIN2>> [12] determine both, the operation mode (digital speed controller of digital speed actuator) and the speed range in speed set value mode.

DigIN1	DigIN2	1 Pole Pair	4 Pole Pair	8 Pole Pair
0	0	Open Loop Speed Control, 0 - 100% PWM depending on the <<Set Value Speed>> Input Voltage		
1	0	500-5,000 RPM	125 - 1,250 RPM	62 - 625 RPM
0	1	500 - 20,000 RPM	125 - 5,000 RPM	62 - 2,500 RPM
1	1	500 - 80,000 RPM	125 - 20,000 RPM	62 - 10,000 RPM

Please Note

If the signal level of the digital inputs DigIN1 [11] and DigIN2 [12] are changed, the new levels are adopted by a disable-enable procedure.

If the input <<Dig>> is not connected (floating) or a voltage higher than 2.4V is applied, the input is inactive.		
Logic 1	Input not connected (floating) Input voltage > 2.4V	Input Active
	If the input <<DigIN>> is set to ground potential or a voltage smaller than 0.8V is applied, the digital input is inactive.	
Logic 2	Input set to Gnd Input Voltage < 0.8V	Input Inactive
	The inputs <<DigIN1>> and <<DigIN2>> are protected against over voltage.	
	Digital Input 1	Pin Number [11] <<DigIN1>>
	Digital Input 2	Pin Number [12] <<DigIN2>>
	Input Voltage Range	0 - +5V
	Input Impedance	15kohms pull-up resistor against 5V
	Continuous Overvoltage Protection	-28 - +28V

Set Value <<Set Value Speed>>

The external analogue set value is predetermined at the <<Set Value Speed>> input [17]. The <<Set Value Speed>> input sets the rotational speed of the motor shaft.

By adjusting the signal levels on digital inputs <<DigIN1 [11]>> and <<DigIN2 [12]>> the speed range can be set in advance.

DigIN1	DigIN2	1 Pole Pair	4 Pole Pair	8 Pole Pair
0	0	Open Loop Speed Control, 0 - 100% PWM depending on the <<Set Value Speed>> Input Voltage		
1	0	500-5,000 RPM	125 - 1,250 RPM	62 - 625 RPM
0	1	500 - 20,000 RPM	125 - 5,000 RPM	62 - 2,500 RPM
1	1	500 - 80,000 RPM	125 - 20,000 RPM	62 - 10,000 RPM

Note

If the signal level of the digital inputs DigIN1 [11] and DigIN2 [12] are changed, the new levels are adopted by a disable-enable procedure.

Set Value Voltage	Description
0 - 0.1V	Operation at Minimum Speed
0.1 - 5.0V	Linear Speed Adjustment

The actual Speed value is calculated according the formula:

Known Values

Minimum Speed (see table above) n_{\min} [rpm]

Maximum Speed (see table above) n_{\max} [rpm]

Set value voltage V_{set} [V] respectively speed n [rpm]

Sought Value
Speed n [rpm]
Solution

Sought Value
Set value Voltage [V]
Solution

$$n = \left[\frac{V_{\text{set}} - 0.1[V]}{4.9[V]} \cdot (n_{\max} - n_{\min}) \right] + n_{\min} \quad V_{\text{set}} = \left(\frac{n - n_{\min}}{n_{\max} - n_{\min}} \cdot 4.9[V] \right) + 0.1[V]$$

The <<Set Value Speed>> Input is protected against overvoltage.

Sought Value Speed Input	Pin Number [17] <<Set Value Speed>>
Input Voltage Range	0 - +5V (reference to Gnd)
Resolution	1024 Steps (4.88mV)
Input Impedance	107kohms (in range 0 - +5V)
Continuous Over Voltage Protection	-28 - +28V

<<Enable>>

The <<Enable>> input enables or disables the power stage.

If a voltage higher than 2.4V is applied to the <<Enable>> input, the amplifier is activated (Enable). A speed ramp will be performed during acceleration.		
Enable	Input voltage > 2.4V	Motor Shaft Running
	If the input is not connected (floating) or ground potential is applied to the <<Enable>> input, the power stage is high impedent and the motor shaft freewheels and slows down (Disable).	
Disable	Input not connected (floating) Input set to Gnd Input Voltage < 0.8V	Power Stage Switched Off
	The <<Enable>> input is protected against overvoltage.	
	Enable	Pin Number [13] <<DigIN1>>
	Input Voltage Range	0 - +5V
	Input Impedance	100kohms (in range 0 - +5V)
	Continuous Overvoltage Protection	-28 - +28V
	Delay Time	Max. 20ms

<<Direction>>

The <<Direction>> input determines the rotational direction of the motor shaft. When the level changes, the motor shaft slows down with a ramp to standstill, and accelerates with a speed ramp in the opposite direction, until the nominal speed is reached again.

If the input is not connected (floating) or ground potential is applied to the <<Direction>> input, the motor shaft runs clockwise (CW).		
CW	Input not connected (floating) Input Set to Gnd Input voltage < 0.8V	Clockwise (CW)
	If a voltage higher than 2.4V is applied to the <<Direction>> input, the motor shaft runs clockwise (CCW).	
CCW	Input Voltage > 2.4V	Counter-Clockwise (CCW)
	The <<Direction>> input is protected against overvoltage.	
	Direction	Pin Number [14] <<Direction>>
	Input Voltage Range	0 - +5V
	Input Impedance	100kohms (in range 0 - +5V)
	Continuous Overvoltage Protection	-28 - +28V

<<Set Current Limit>>

The <<Set Current Limit>> inputs is used for setting the continuous output current limitation in the range of 0.5-3.0A

The current applied at the input <<Set Current Limit>> will stay available for an indefinite period of time.

Note: The limiting value should be below the rated motor current (max continuous current).

Set Value Voltage	Pin Number [16] <<Set current limit>>
Referenced to Ground	Pin Number [15] <<Gnd>>

To parameterize the preferred current limiting value, an external resistor (at least 62.5mW) between current limiting input <<Set Current Limit>> Pin [16] and ground <<Gnd>> Pin [15] must be added.

Current Value	Resistance Value (E12) Series
3.0A	Input Floating
2.5A	47kohms
2.0A	10kohms
1.5A	4.7kohms
1.0A	2.2kohms
0.5A	470ohms

Note: Under unfavorable circumstances the actual motor peak current can not be limited to the set current limit in all cases.

Unfavorable circumstances are given, if the current limit value is set lower than 1.5A, the supply voltage is higher than 15V and the terminal inductance is smaller than 0.3 mH at the same time.

<<Hall Sensor 1>>, <<Hall Sensor 2>>, <<Hall Sensor 3>>

Hall sensors are needed for detecting rotor position and actual speed. The Hall sensor inputs are protected against overvoltage.

Suitable for Hall Sensor IC's with Schmitt-Trigger behavior and open collector outputs.

Hall Sensor 1	Pin Number [7] <<Hall Sensor 1>>
Hall Sensor 2	Pin Number [8] <<Hall Sensor 2>>
Hall Sensor 3	Pin Number [9] <<Hall Sensor 3>>
Input Voltage Range	0-+5V
Input Impedence	10kohms pull-up resistor to 5V
Voltage Level <<Low>>	Max. 0.8V
Voltage Level <<High>>	Min. 2.4V
Continuous Over Voltage Protection	-28-+28V

Outputs

+5 VDC Output Voltage <<Vcc Hall>>

An internal auxiliary voltage of =5 VDC is provided for:

- Hall sensor supply voltage <<Vcc Hall>>
- For external set value potentiometer (recommended value: 10kohms)
- Gating the signals: <<Enable>> and <<Direction>>

The output is thermal overload protected against short circuit.

+5 VDC Output Voltage	Pin Number [6] <<V Hall>>
Referenced to Ground	Pin Number [5] <<Gnd>>
Output Voltage	+5 VDC 5%
Max. Output Current	35mA

Status Indication <<Ready>>

The <<Ready>> output can be used to report the state of operational readiness or a fault condition to a master control unit.

In normal cases (no fault) the output is switched to 5V.	
Ready (no fault)	5V
In case of a fault the output is switched to Ground.	
Fault (not ready)	0V (Gnd)

Possible reasons for a fault message:

Undervoltage	Fault message occurs in case supply +V<6.5VDC. To reset the fault condition the amplifier must be disabled and the supply voltage (V) must be higher than 6.5VDC.
Overvoltage	Fault message occurs in case supply voltage +V>30VDC. To reset the fault condition the amplifier must be disabled and the supply voltage (V) must be lower than 29VDC.
Thermal Overload	Fault message occurs in case power stage temperature exceeds>95 degrees Celcius. To reset the fault condition the amplifier must be disabled and the power stage temperature must fall below 75 degrees Celcius.
Invalid Hall Sensor Signals	The amplifier recognizes invalid conditions in the Hall sensor inputs during the power-up. To reset the fault condition the amplifier must be disabled and the hall sensors must be wired correctly.

The output <<Ready>> is protected against short circuit.

Status Indication	Pin Number [12] <<Ready>>
Output Voltage Range	0-+5V
Output Resistance	10kohms

Protective Features

Undervoltage Protection

The Power stage will be disabled in case the supply voltage +Vcc gets lower than 6.5VDC. To reset the fault condition the amplifier must be disabled and the supply voltage +Vcc must be higher than 6.5VDC.

Overvoltage Protection

The power stage will be disabled in case the supply voltage +Vcc gets higher than 30VDC. To reset the fault condition the amplifier must be disabled and the supply voltage +Vcc must be lower than 29VDC.

Thermal Overload Protection

The power stage will be disabled in case the power stage temperature exceeds higher than 95°C. To reset the fault condition the amplifier must be disabled and the power stage temperature must fall below 75°C.

Invalid Hall Sensor Protection

The power stage will be disabled in case invalid conditions in the Hall sensor inputs during the power-up occurs. To reset the fault condition the amplifier must be disabled and the Hall sensors must be disabled and the Hall sensors must be wired correctly.

Blockage Protection

If the motor shaft is blocked for longer than 1.5s, the current limit is set at 2.5A, provided the current limit was not set lower via <<Set Current Limit>> input. Definition <<Motor Shaft Blocked>>: A lower speed than 400rpm (motor with 1 pole pair) occurs for longer than 1.5s.

Note

No fault message occurs at the <<Ready>> output if blockage protection is active.

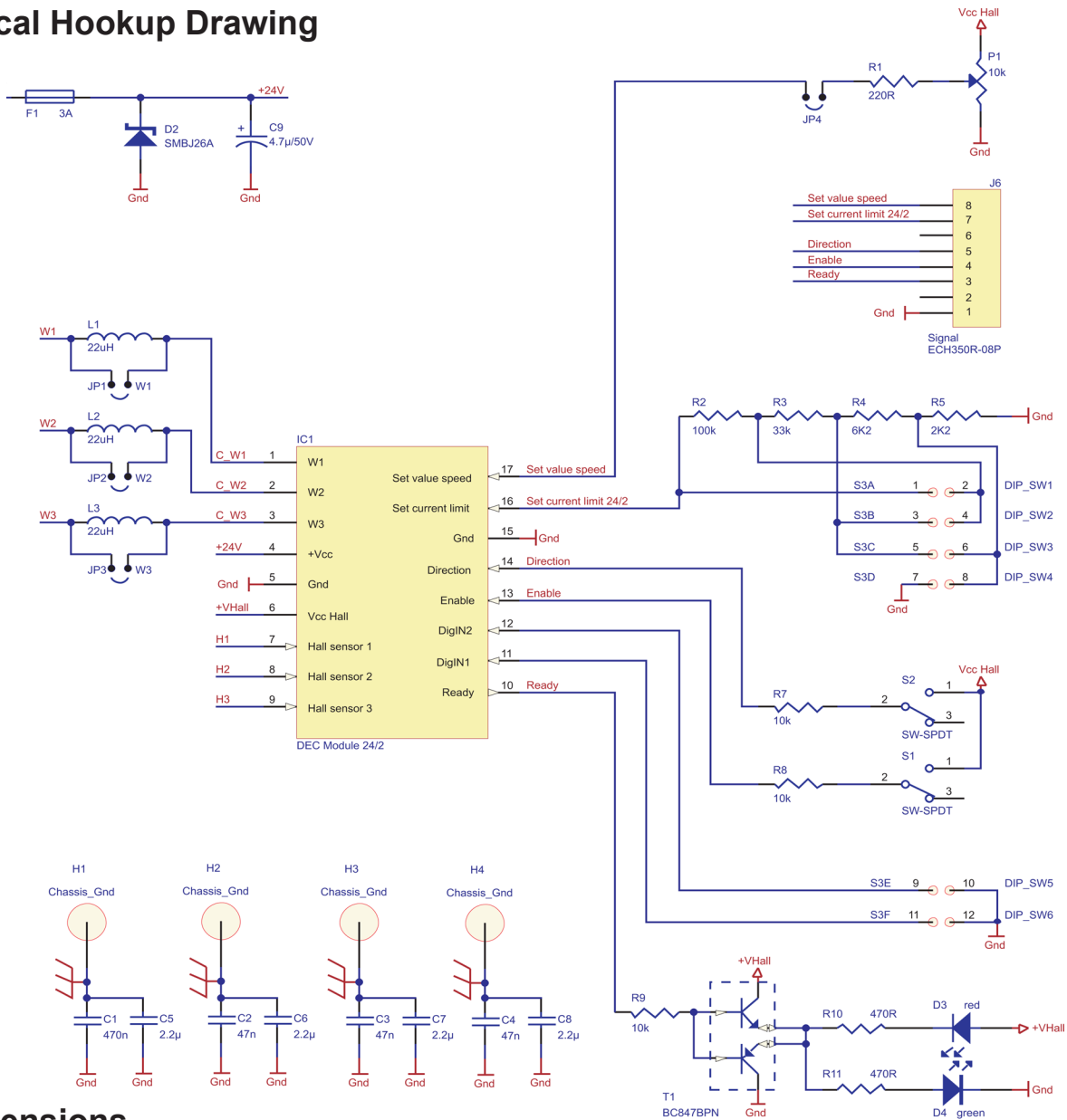
Current Limitation

The motor current will be restricted to 0.5-3.0A depending on the value applied to the input <<Set Current Limit>> by means of a cycle-to-cycle limitation.

Note

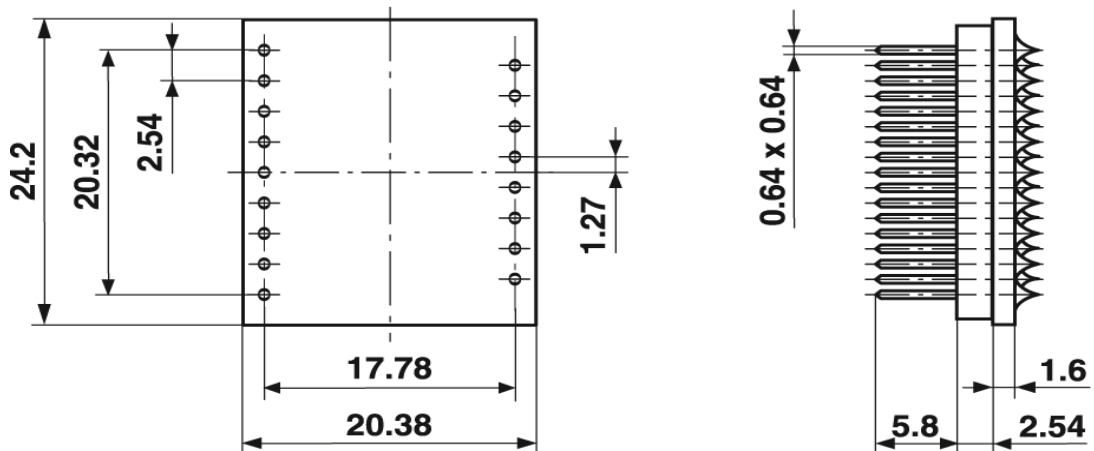
No fault message occurs at the <<Ready>> output if current limitation is active.

Typical Hookup Drawing



Dimensions

Dimensions in [mm]



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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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