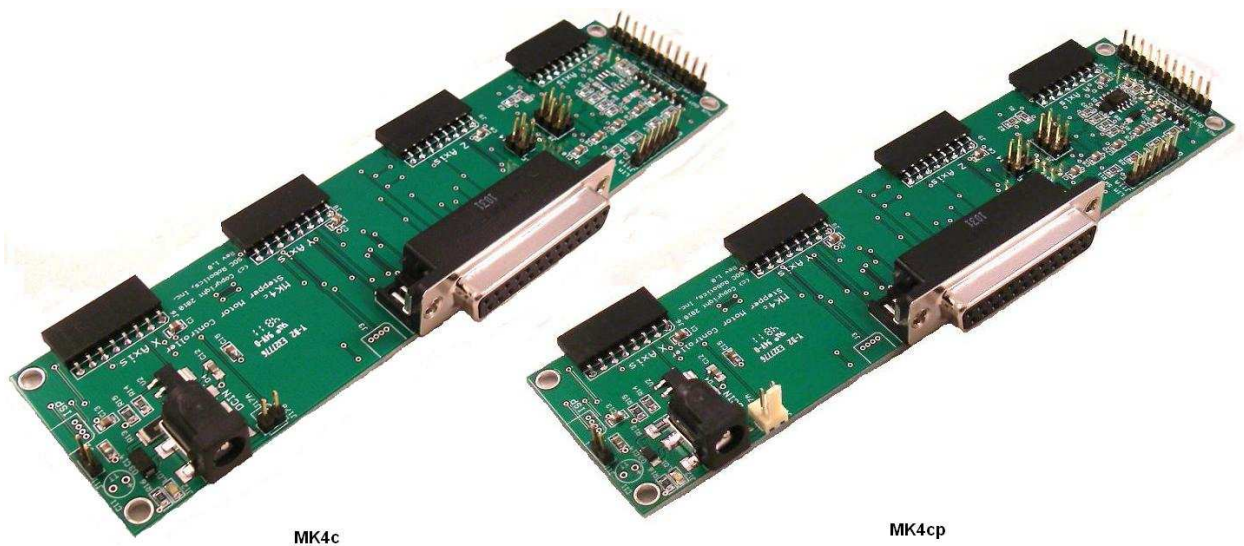


MK4c 4-Axis Controller

Technical Reference Manual

PCB Rev 1.0



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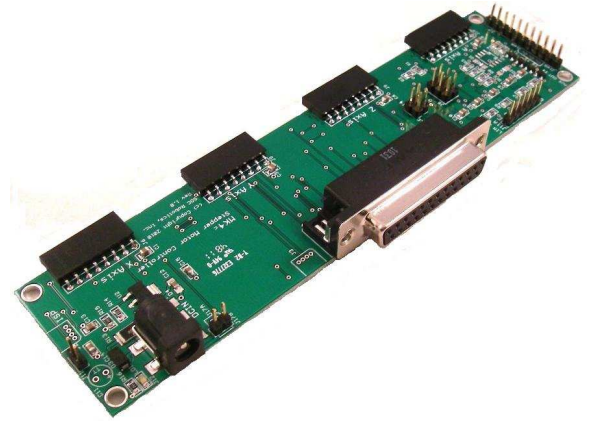
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1.0 Introduction

Features:

- 4-Axis Stepper motor break out board
- Standard female DB25 parallel port interface
- Two configurations MK4c and MK4cp
- Five limit switch inputs
- Four auxiliary outputs with open collector and digital out
- MK4cp has 2 Ch high current 3A Power Mosfet outputs
- Green LED indicates power status
- Input logic power protection and reverse polarity protection
- Transient Voltage Suppression Diodes on Motor Signals
- Optional ISP programming port and I2C port
- 18-30VDC @ 40ma Power input for logic
- Same form factor as MK4 (5.4x2.2in)



Hardware

The MK4c and MK4cp are 4-axis parallel port stepper motor control adapters with 5 limit switch inputs, 4 auxiliary outputs, 4 stepper motor drive ports, optional ISP programming port and optional I2C interface port.

The MK4c/MK4cp has a jumper selected routing feature that allows Auxiliary outputs OUT3 and OUT4 to be used to control MM160 TB6560 driver chips Reset and Enable inputs. This allows the desktop to set the MM160 to a known initial state and to enable or disable motor power.

The MK4c/MK4cp consumes about 40ma in active state.

The MK4c and MK4cp are compatible with Mach3 and EMC.

Configurations

The MK4 is available in two different configurations: MK4c and MK4cp. The difference between the two is the auxiliary output port configuration. The MK4c has four open collector outputs and the MK4cp has two open collector and two high power 3A 30V Power Mosfet outputs.

The MK4c is best for controlling high power peripherals such as pumps, spindle, etc., that require 24V and 1-2A of driver current. The technical section describes how to connect the open collector and Power Mosfet outputs.

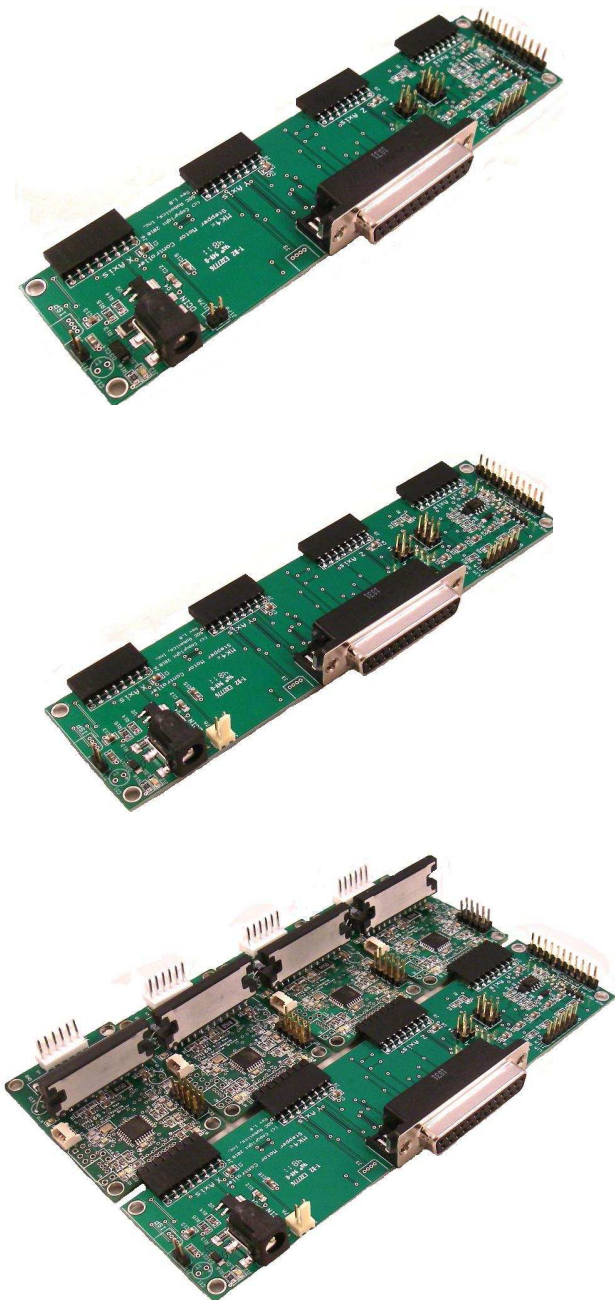
NOTE: The silkscreen incorrectly shows limit switch positions and GND incorrectly. Do not follow the silkscreen. The GND is on the other end of the header and each limit switch is shifted down by one.

CAUTION: The Reset/Enable jumpers are not installed. If these jumpers are installed and stepper motor power is used to power the MK4c make sure that the state of both of these lines is low when power is applied or the TB6560's maybe turned on before power has stabilized causing a potential malfunction.

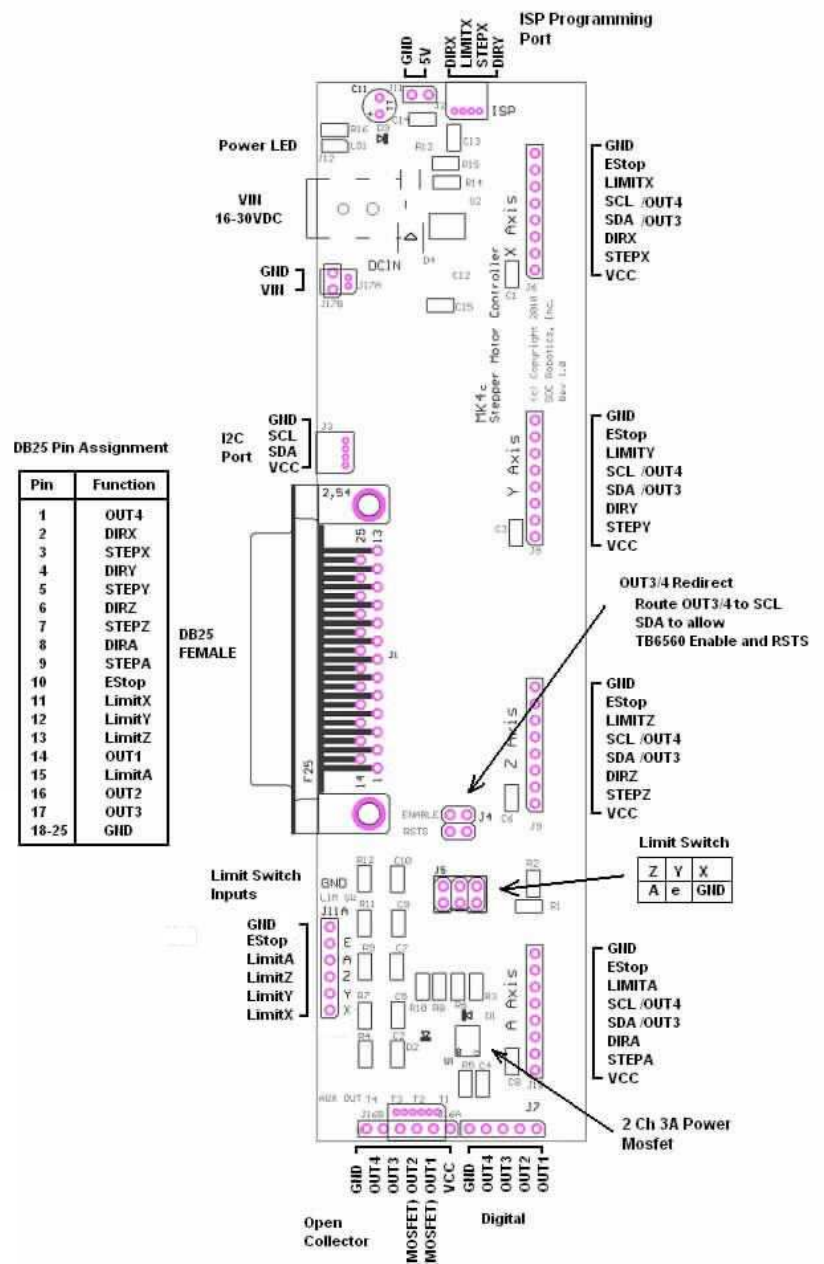
MMK4c MK4cp Detailed Description

1.1 Introduction

The MK4c is a 4-Axis breakout board that accepts the MM120, MM130, MM133, MM160, MM165 or MM220 stepper motor drivers. The MK4 connects step and direction inputs from the PC parallel port to each of the four stepper axis connectors. The correct step and direction signals for each axis must be assigned to the correct parallel port pin. For example, DIRX is assigned to pin 2, STEPX is assigned to pin 3, etc. The step signal is an active going high pulse. The circuit schematic shows the mapping between Step/Direction/Limit/Out signals on the DB25 and the four axis ports, limit switch inputs and auxiliary outputs.



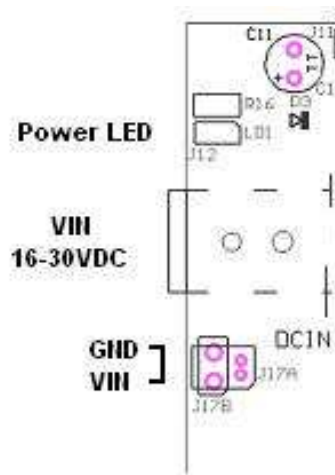
MK4c Connector Pin Assignments



1.2 Input Power

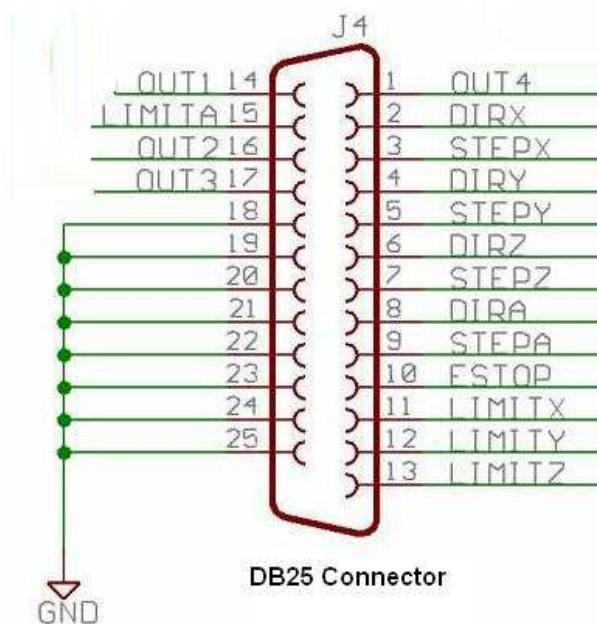
MK4c/MK4cp require 16-30VDC for logic power. A special protection circuit allows stepper motor power (24-30V) to be used as the board logic power. A separate wall power adapter is not required. Note that unlike the MK4 the MK4c/MK4cp will not operate from a 9VDC logic supply. Logic power must be at least 16V for correct operation.

A two pin header is provided on the board along side the barrel connector.



1.3 Parallel Port

MK4c DB25 default pin assignment is shown in the diagram below. Attached drivers such as the MM120, MM130, MM160 and MM220 typically expect the step input to be a raising edge. The Direction signal should be set and held before raising the step input.

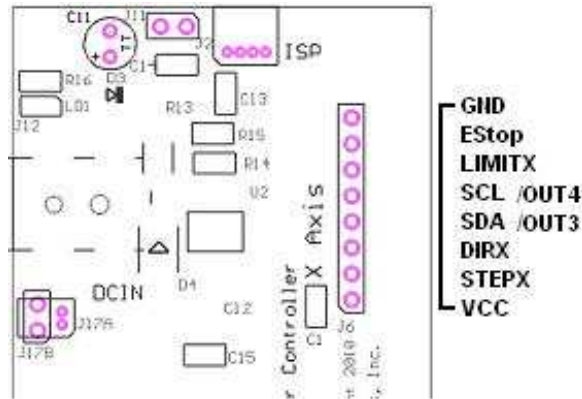


DB25 Pin Assignment

Pin	Function
1	OUT4
2	DIRX
3	STEPX
4	DIRY
5	STEPLY
6	DIRZ
7	STEPZ
8	DIRA
9	STEPA
10	EStop
11	LimitX
12	LimitY
13	LimitZ
14	OUT1
15	LimitA
16	OUT2
17	OUT3
18-25	GND

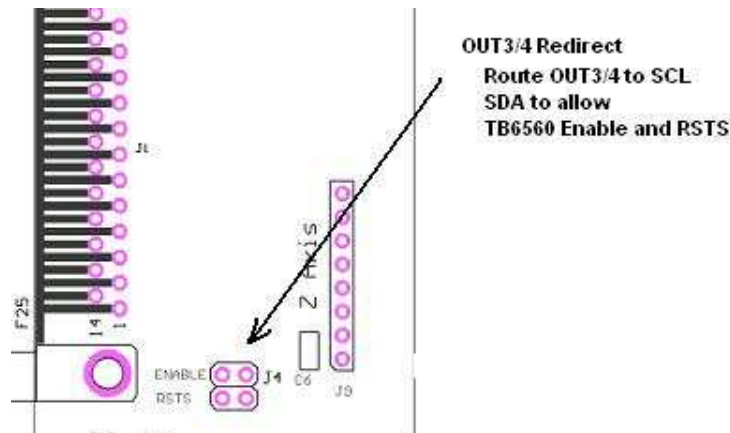
1.4 Stepper Driver Ports

There are four stepper motor driver ports label X, Y, Z and A. This ports accept several different driver modules such as the MM120, MM130, MM160, MM165 and MM220. Different drivers can be mix on one MK4c/MK4cp. Each stepper motor drive port pin assignment is as follows:



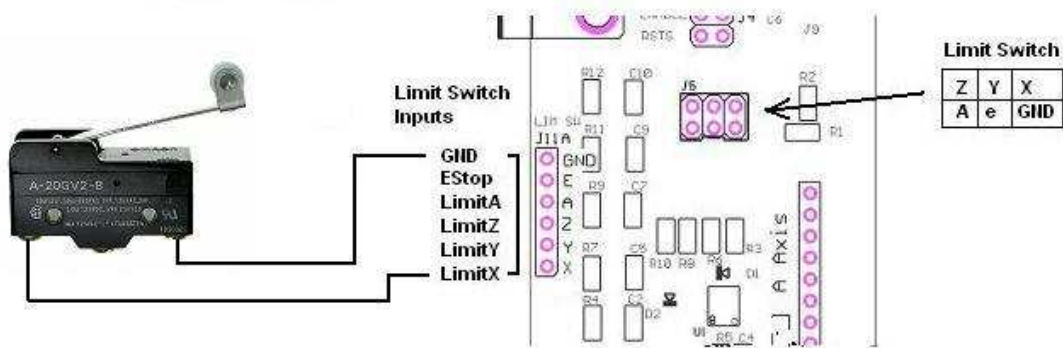
1.5 TB6560 Reset and Enable Header

A four pin header allows OUT3 and OUT4 to be routed to the Stepper driver ports SCL and SDA when shorting jumpers are installed. With suitable 0R resistors installed on the MM160 driver SCL and SDA are routed to TB6560 Reset and Enable inputs. This allows host software to reset the state machine in each TB6560 to a known starting state and to disable or enable coil output drive MOSFETs. The Reset/Enable header is located close to the limit switch input area as shown below.



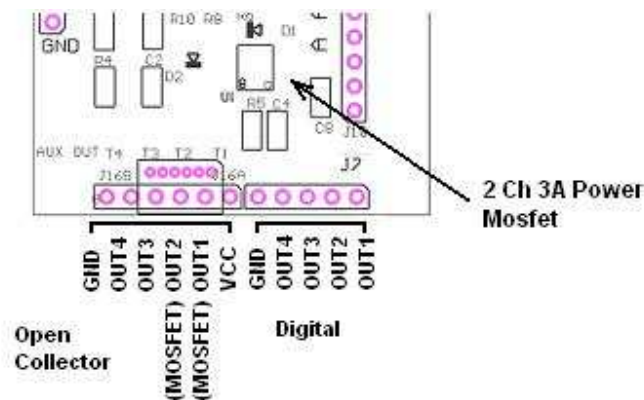
1.6 Limit Switch Inputs

Limit switch inputs for the X, Y, Z and A axis are connected to the DB25 pins 11, 12, 13 and 15 respectively. The eStop switch input is connected to DB25 connector pin 10. The eStop and limit switch inputs are pulled high by a 10K ohm resistor and filtered by a 10uF capacitor to ground to reduce false triggers due to noise. When an external limit switch contact closes it pulls the limit switch input low the state of which is reflected on the DB25. eStop operates similarly to the limit switch input – closing the eStop with switch contacts pulls the eStop input low. Note that limit switches can be normally open or normally closed – the limit switch input will reflect the state accordingly – a normally open limit switch will indicate a high condition when not closed. Limit switch inputs are routed to two different functionally equivalent headers as shown below:

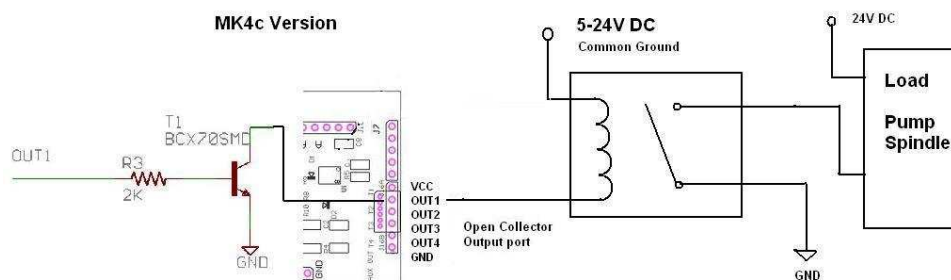


1.7 Open Collector Outputs

Auxiliary outputs OUT1, OUT2, OUT3 and OUT4 are connected to DB25 connector pins 14, 16, 17 and 1. Each OUT line drives an NPN transistor in an open collector configuration. A high level on an OUT line causes the transistor to conduct. The collector of the transistor is connected to the auxiliary output header. The transistor can be used to turn on a relay by attaching one side of the relay to the collector and the other side to +5, +12 or +24 volts. Each transistor is capable of driving about 100ma. There are four drive transistors on the MK4c and two on the MK4cp.



The open collector outputs can be connected as shown in the diagram below.

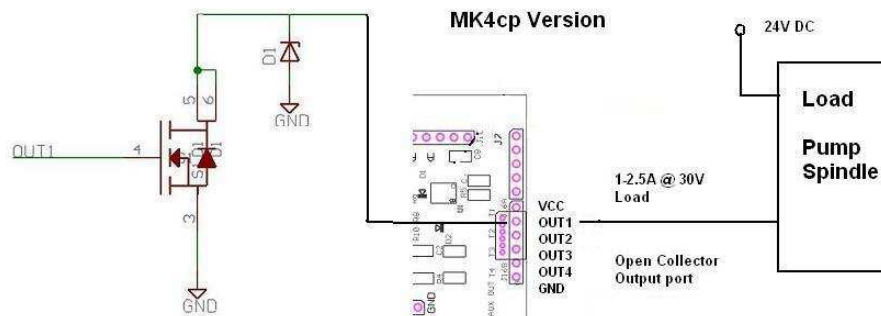


1.8 Digital Outputs

Auxiliary outputs OUT1, OUT2, OUT3 and OUT4 are connected to DB25 connector pins 14, 16, 17 and 1. Each OUT signal is directly connected to Auxiliary Digital output J17. A high output is 5V and a low output is 0V. The digital output port can be used to control external digital logic or very low current draw solid state relays.

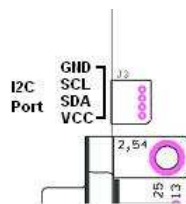
1.9 High Power MOSFET Outputs

The MK4cp has two 3A 30V Power Mosfet outputs – these outputs can be used to drive high current peripherals such as spindles, pumps etc that require 24V 1-2A. No additional relay is required. The output of the Power Mosfet is connected as shown in the diagram below.



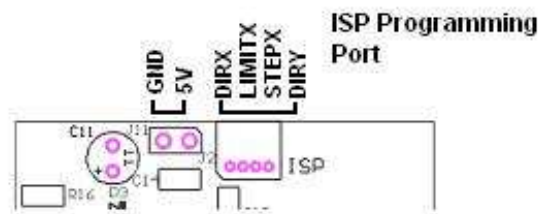
1.10 I2C Port

A small white four pin Molex connector beside the DB25 connector is the I2C communications port the signals of which are routed to the four stepper motor axis connectors. An external I2C communications Master such as the USB10 can talk to the MK4c/MK4cp and send commands to smart stepper motor drivers such as the MM120, MM130, MM165 and MM220. This is an optional component and is not installed by default.



1.11 ISP Programming Port

A small white four pin Molex connector located near the DC Power connector is the ISP programming port. This connector is used with suitable programming software and a short four wire cable to re-Flash (re-program) any attached motor controller. This is an optional component and is not installed by default.



3.0 Electrical and Mechanical Description

3.1 Electrical Specifications

Electrical

Input power: 16-30VDC @ 40ma noise protection plus reverse polarity protection

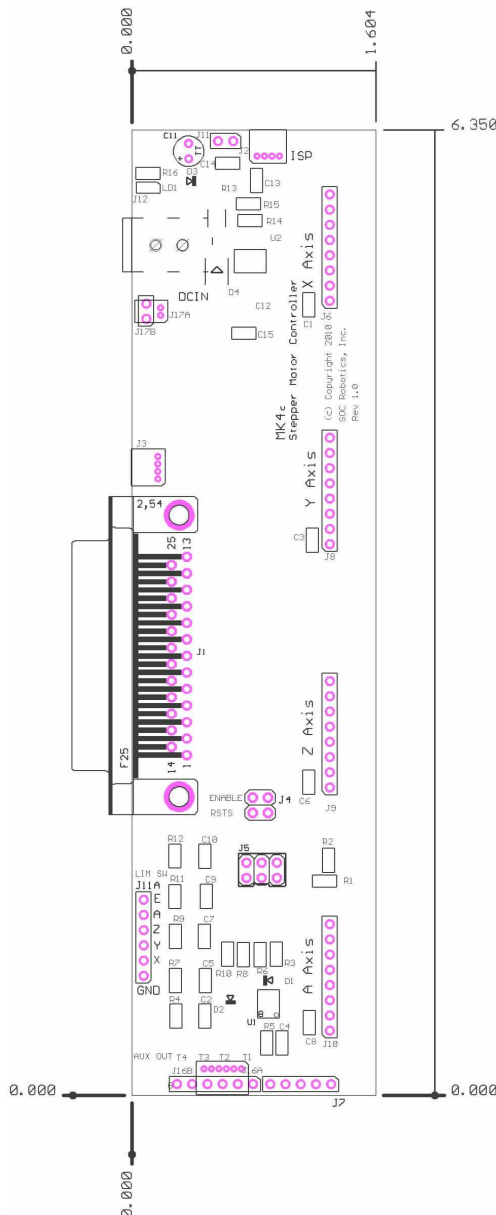
Mechanical

Dimensions: 1.65x6.35 in

Weight: 40 grams

3.2 Mechanical Dimensions

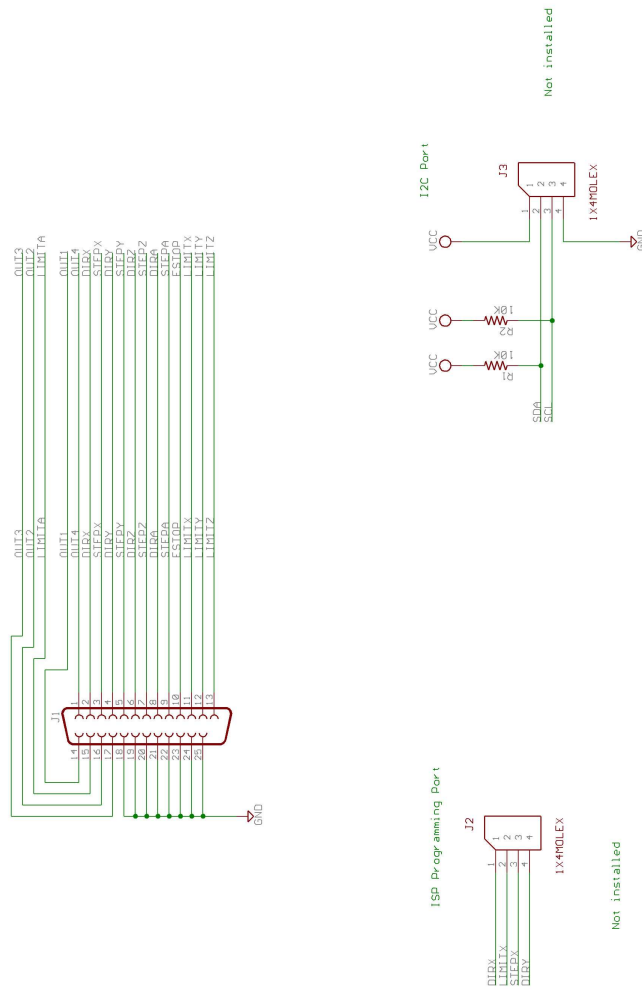
Board dimensions are stated in inches.



MK4c Circuit Schematics

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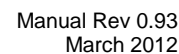
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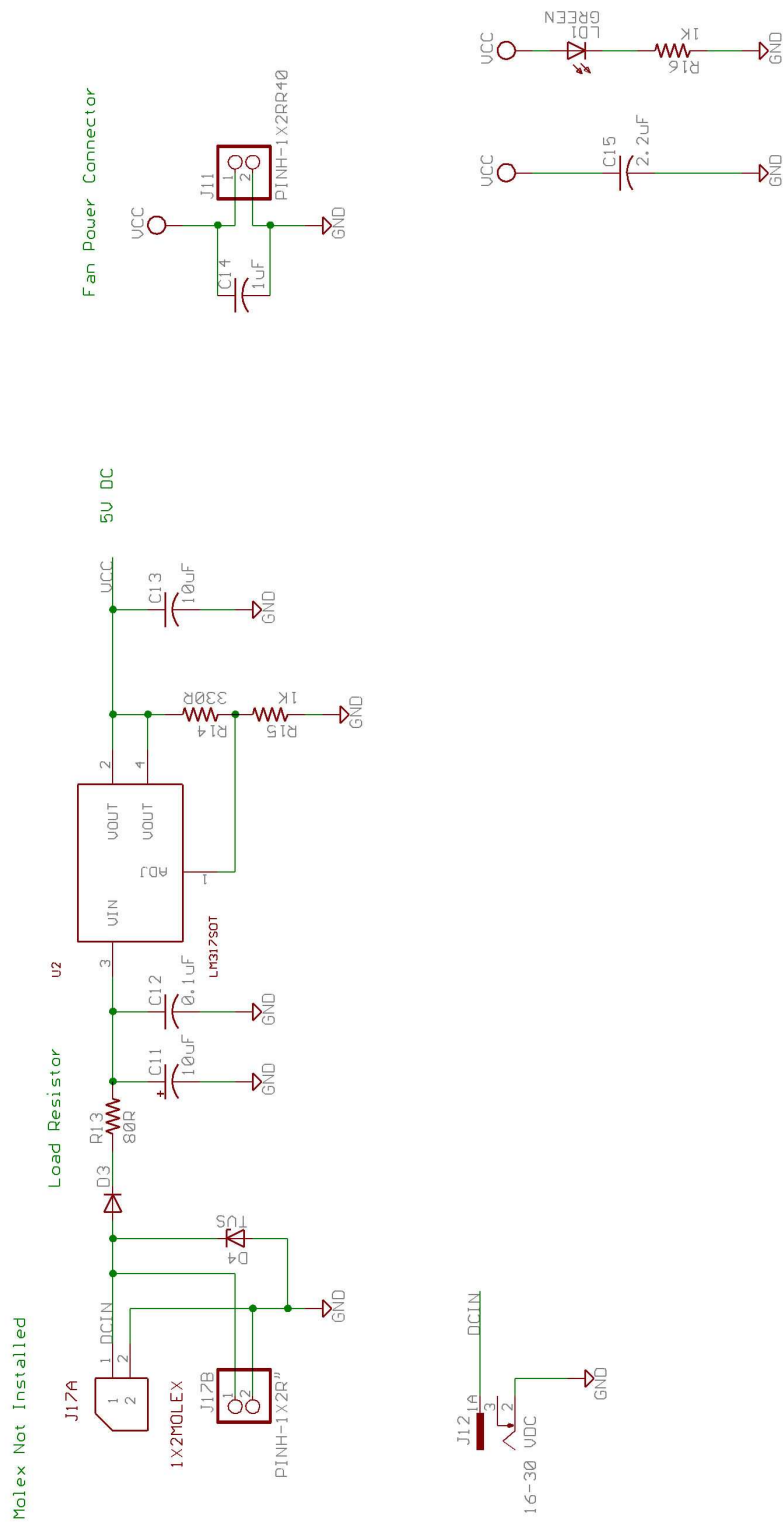
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