DC Servo Drive

Low cost closed loop controller for brushed DC motors.

Safety Information

You should read this notes before installing this device.

CNC equipment can cause injuries due to the forces and momentum involved when the equipment is functioning. One may think that fingers and hands can be replaced with awesome robotic limbs, but they're very time consuming to install and operate, so you better take care of your original parts.

This device is capable of operating up to 36 VDC and 7 A. The user needs to mind power supply polarity, as the device does not posses reverse polarity protection for any of the power inputs.

Be careful when close to the device while in operation, it may get very hot.

Disconnecting the motor from this device when powered is not advised, as it could damage it.

Features

This device is designed to control brushed DC motors up to 36 V and 7 A (⅓ HP) for positioning in CNC machines such as routers, mills and 3D printers. It could also be used as the power stage of a mobile robot that requires odometry.

The device main components are:

MCU for closed loop control

An ATmega328 microcontroller operating at 20 MHz is present to read the STEP/DIR signals from the machine controller, read a quadrature encoder input and perform the calculations required for PID control of the motor position.

It also controls an indicator LED for signaling the different fault modes the device is able to detect, such as motor overcurrent and driver undervoltage.

MOSFET driver

A DRV8701 full bridge mosfet driver provides the capabilities to drive the MOSFET gates at an appropriate voltage with acceptable switching speed, while also protecting them from being damaged from heating due to insufficient gate voltage, shoot-through, etc.

The IC also provides a low side current sense amplifier that uses an external 10 mOhm power resistor to produce a voltage drop across it for the amplifier. The MCU reads the amplified voltage signal (gain is 20) easily with an 8-bit ADC.

Finally, the driver also performs a current limiting function to avoid damaging the transistors. The current level is set via two resistors in a voltage divider configuration.

MOSFETs in H bridge configuration

The device utilizes four IRFH7545 MOSFETs. This transistors have a breakdown voltage of 60 V and a RDSon of 4.3 mOhm typically (or up to about 9.5 mOhm at 150 °C Tj) with a Vgs of 10 V. In the worst case scenario, one transistor is going to dissipate approximately 0.5 W, and its temperature will rise about 50 °C above ambient, with its case ending at a scorching 100 °C assuming the ambient temperature is 50 °C. They should be able to survive that.

Device Characteristics

Parameter	Min	Typ	Max	Unit
Motor side voltage	6		36	V
Motor side current	0		7	A
Logic side Voltage	4.5		5.5	V
Logic side current consumption	20	50	100	mA
Step signal frequency	0		50	kHz
Encoder frequency (4x)	0		50	kHz
Error signal output current	0	50	100	mA
Ambient temperature for operation	0		50	°C

Installation

The device comes with two pluggable terminals installed. The one marked with the MOTOR-A and MOTOR-B labels should be connected to the two cables for powering your motor. The other terminal, marked V+ and V- should be connected to a power supply of the correct voltage, ensuring the correct polarity of the connection.

Two JST PH headers are also installed on the board. the 4 way PH header accepts the encoder signal inputs and supplies 5 V to said encoder. The 6 way PH header is used for supplying 5 V to the board's logic side, accepts the STEP, DIR and RESET signal from the machine controller and has the open drain ERROR output to inform the rest of the system of a fault condition.

The last connector present is a 3x2 0.1 in pitch male header. It is used for reprogramming the MCU present on the board.

Every microcontroller input present in the PH headers has a 330 Ohm resistor connected in series for protection against a mistake when making the connections or a misconfiguration of the pin in the case of a firmware change.

The input signals are active low.

Operation

Troubleshooting

Software Parameters

Electrical Schematic

Dimensional Drawing