

Servo Drive Board - 200V/40A

Features:

- Standard stepper input interface - STEP & DIRECTION
- 5 volts incremental encoder input – differential or TTL level
- Output for driving brushed DC PM servo motor
- Output bridge rated 200V 46A continuous.
- Peak and average current limiter
- Full PID filtering
- Optional SPI interface for host control
- Kp Ki Kd can be adjusted via trim pots or via SPI
- Multiplying Step / Encoder transition via SPI or DIP switches
- PCB size 127 x 79 x 25 mm (5.0 x 3.1 x 1.0 inch)
- Low cost



Description:

The R90H Servo Drive Board is a RT990H based motion controller. It accepts STEP and DIRECTION commands from host. The host is usually a PC running CNC software which outputs the STEP and DIRECTION commands via a parallel port. This is an upgraded high-speed version of the popular R90 driver.

The R90H board can simplify the replacement of stepper motors with DC servomotors and encoders to produce a high-end closed loop servo system.

The minimum host interface is STEP and DIRECTION and R90H will use the predefined parameters and trim-pots for setting up the PID gains. Optionally, the host can use the STEP and DIR line as CLOCK and DATA line in standard SPI fashion and setup the control parameters.

See the RT990H.pdf datasheets for detailed description of operation.

Electrical specifications:

Model:		R90H	
Supply voltage for motor:	V_M	12-200	V
Supply voltage for control circuit:	V_C	15 – 36	V
Supply Current (no encoder connected, $V_C = 24$ V):	I_C	20	mA
Maximum peak motor current for $t < 1$ ms	I_{PEAK}	180	A
Maximum continuous motor current	I_{MAX}	40	A
Default PWM frequency	f_{PWM}	19.5	kHz
Adjustable average current limit [typical]	I_{LIM}	1-40	A
Operating temperature	T	0-70	°C

Pin descriptions:

J1 – interface

Pin No	Name	Description
1	+Vc	External power supply 17 – 36 V DC
2	0V	External power supply 0V
3	STEPPER/SPI	Host interface [Pin 1 of DB25 (LPT1) for RT990H.EXE test software]
4	DIR/Din	Host interface [Pin 3 of DB25 (LPT1) for RT990H.EXE test software]
5	STEP/CLK	Host interface [Pin 2 of DB25 (LPT1) for RT990H.EXE test software]
6	ERR/Dout	Host interface [Pin 10 of DB25 (LPT1) for RT990H.EXE test software]

J2 – DB9 – Encoder connection

Pin#	Signal Name	Description
1	+ 5V	Positive supply for encoder
2	Ch – A (non inv.)	Encoder input channel A
3	Ch – A (inv.)	Encored input channel <u>A</u>
4	Ch – B (non inv.)	Encoder input channel B
5	Ch – B (inv.)	Encoder input channel <u>B</u>
6	Shield	Cable screen
9	0V / signal ground	Supply for encoder

Setup procedure:

Download the latest RT990H.exe from <http://rutex.com/>. Do a preliminary test on the bench to familiarize yourself with the drive. For this test setup, start with lower V_m and use a current limiting power supply. Note that the drive must be mounted to a large heatsink.

Pots:

1. Adjust all three pots (K_p , K_i , K_d) fully CCW. Note, that these pots are multiturn with 20 turns and no stops. Adjust I_{lim} pot fully CCW. This is a single turn pot with stop.
2. Connect motor, encoder and supplies to the R90H as per above drawing.
3. Gently increase K_p and by hand move rotor of motor. Verify that the drive corrects the error. If the motor runs away, the polarity of the motor must be swapped or channels A and B from the encoder must be swapped.

4. Increase the K_p until the system starts to oscillate. After that, increase the K_d to damp the oscillations.
5. The K_p , K_d and acceleration of the systems should be fine tuned without any K_i , with your application software. The K_i should be applied when system is nearly finished. K_i corrects the steady error. Too much of K_i causes oscillations. Always, when increasing K_i , the K_p and K_d should be increased as well.
6. Adjust the I_{lim} pot for required torque of the servo drive.

Maximum peak current.

The output MOSFET bridge is rated 46A / 200V continuous (peak current 180A for < 1 ms). R90H has built it 'cycle by cycle' current limiter. This current limiter is set to about 40 Amps. This current limiting point can be slightly lower in real application due to the fact that noise might be induced to the sensing circuitry. Make sure that no motor wires are routed above or close to the servo drive.

Maximum average current.

Changing value of I_{lim} potentiometer can set the maximum average current. This is a single turn pot and if set fully CCW the current limit is set to minimum – about 1 Ampere. Fully CW sets the average current limiting to maximum. Please note, that the current limiting point is largely dependent on the motor parameters and is also affected slightly by the V_m voltage.

Maximum idle current.

A Low inductance motor (i.e. 'pancake' type) might have a high idle current due to pulse width modulation and consequent ripple current. The high idle current can overheat the motor even in steady state. A small inductor in series with motor should be used to limit this current. The value about 1 mH is in most cases sufficient. The inductors must be rated for the anticipated motor current.

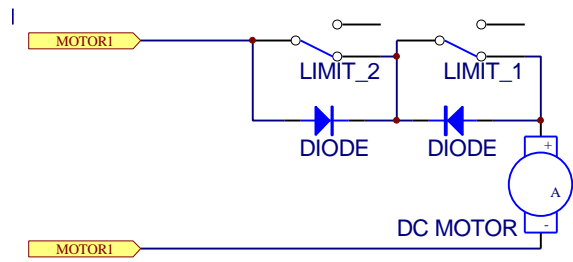
Step multiplier.

Step multiplier can be set by DIP switched. The dual DIP switch is binary coded and allows 4 different pre-sets:

DIP SW 1	DIP SW 2	Step Multiplier
Off	Off	10
On	Off	1
Off	On	4
On	On	20

Limit switches:

The limit switches for axes should be normally closed and the contact should be bridged with diode that allows driving only in the opposite direction of the limit switches. Note that these diodes and limit switches must be rated for anticipated current. If you cannot fit large enough limit switches on the machine then use high capacity interposing relays instead of limit switches driven by small limit switches on the machine.

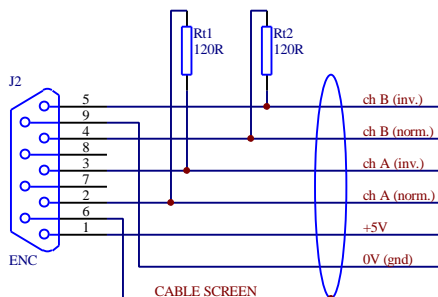


Power supplies.

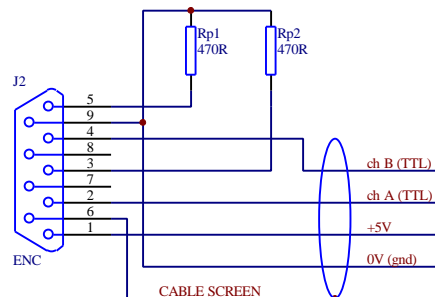
The R90H employs split power supply practice. The control supply V_c should be kept between 15 to 36 VDC at all times. The V_m should be fed via the E-STOP circuitry (relay) and must not exceed DC 200V. None of these supplies have to be very well regulated. Usually a bridge and a capacitor are sufficient. The value of at least 1000uF per 1 Ampere should be used for calculation of filtering capacitor. The V_m capacitor should be located no more than 30 cm (1ft) away from R990H driver. If single supply is desired, use only the V_m supply and connect a zener diode between V_m and V_c to drop the voltage ($V_{zener} = V_m - 20$).

Encoders.

The R90H accept signals from 5V differential or TTL encoders. The equivalent input impedance is 1 kilo-ohm. Additional termination resistors might be required across the input terminals, if long cables are used with differential encoders. The value of these termination resistors should be selected to match the cables. The impedance of twisted pair cable can be anywhere between 40 to 300 ohms – check your cable data (typically 120 ohms). The single ended TTL encoder should be connected to one input only and a pull down resistor (470 - 1000 ohms) should be connected to other input. These pull-down resistors are not required for true CMOS encoders, which can sink and source same current.

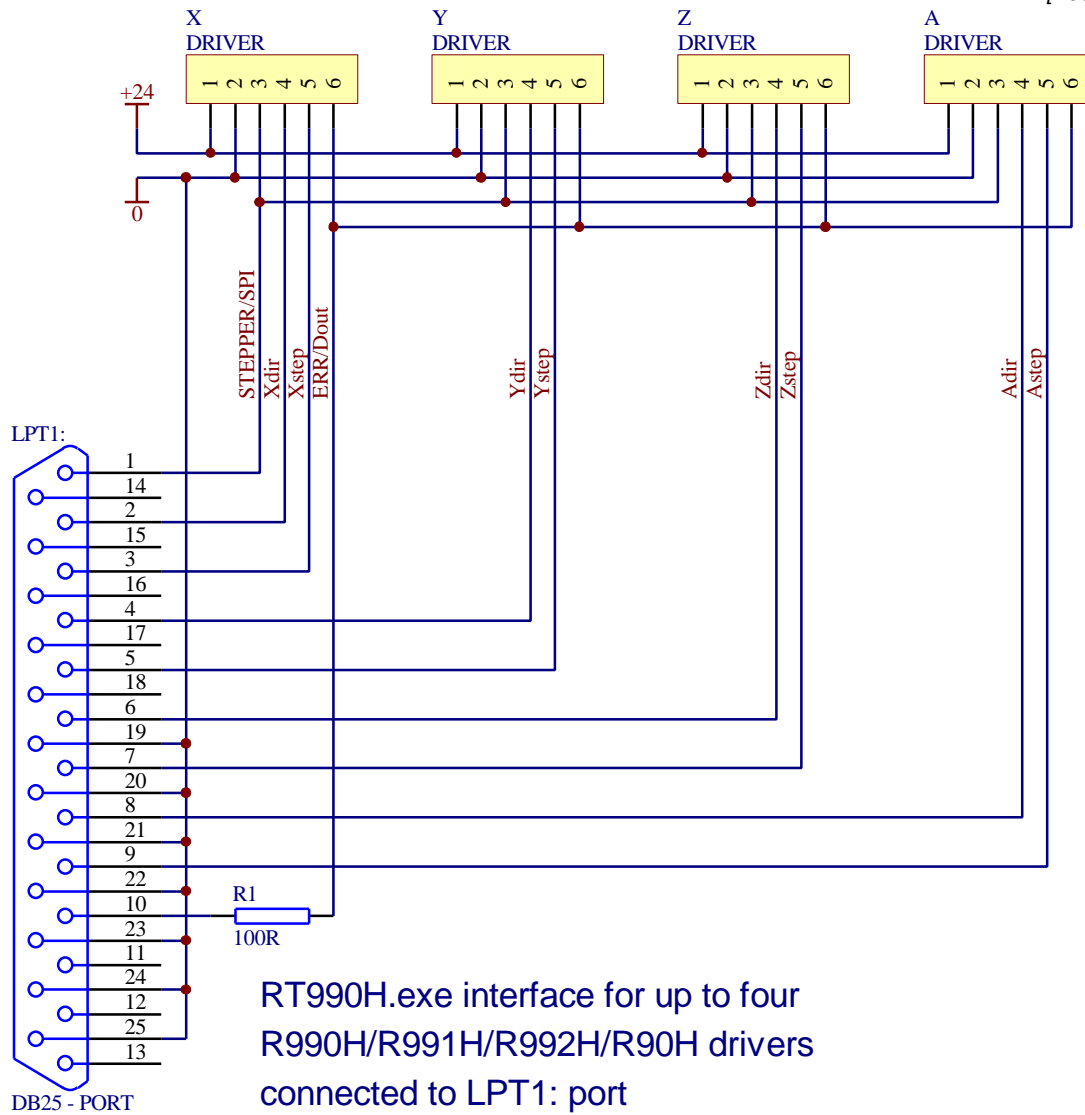


Connecting differential encoder
Rt1 and Rt2 are optional (40-300 ohms)
They might be required for long cable.



Connecting single-ended encoder
Rp1 and Rp2 are required for TTL
or Open collector encoders.

Interface for RT990H.exe test software:



RT990H.exe interface for up to four R990H/R991H/R992H/R90H drivers connected to LPT1: port