R990(preliminary)

Servo Drive Board.

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 100V 27A continues
- 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
- size 89 x 89 x 25 mm (3.5 x 2.5 x 1.0 inch)
- low cost

Description:

The R990 Servo Drive Board is a RT990A 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 parallel port.

The R990 board can simplify the replacement of the stepper motors with DC servomotors / encoder to produce a high-end closed loop servo system.

The minimum host interface is STEP and DIRECTION and R990 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 RT990A datasheet for detailed description of operation.

Electrical specifications:

Model:		R990	
Supply voltage for motor:	V_M	12-100	V
Supply voltage for control circuit:	V_C	18 - 36	V
Supply Current (no encoder connected, Vc = 24 V):	I_C	20	mA
Maximum peak motor current for t < 1 ms	I_{PEAK}	100	A
Maximum continues motor current	I_{MAX}	20	A
Default PWM frequency	f_{PWM}	9	kHz
Adjustable average current limit [typical]	I_{LIM}	2-20	A
Operating temperature	T	0-70	^{O}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 4 of DB25 (LPT1) for R90.EXE test software]
4	DIR/Din	Host interface [Pin 3 of DB25 (LPT1) for R90.EXE test software]
5	STEP/CLK	Host interface [Pin 2 of DB25 (LPT1) for R90.EXE test software]
6	ERR/Dout	Host interface [Pin 15 of DB25 (LPT1) for R90.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 A
4	Ch – B (non inv.)	Encoder input channel B
5	Ch – B (inv.)	Encoder input channel B
6	Shield	Cable screen
9	0V / signal ground	Supply for encoder
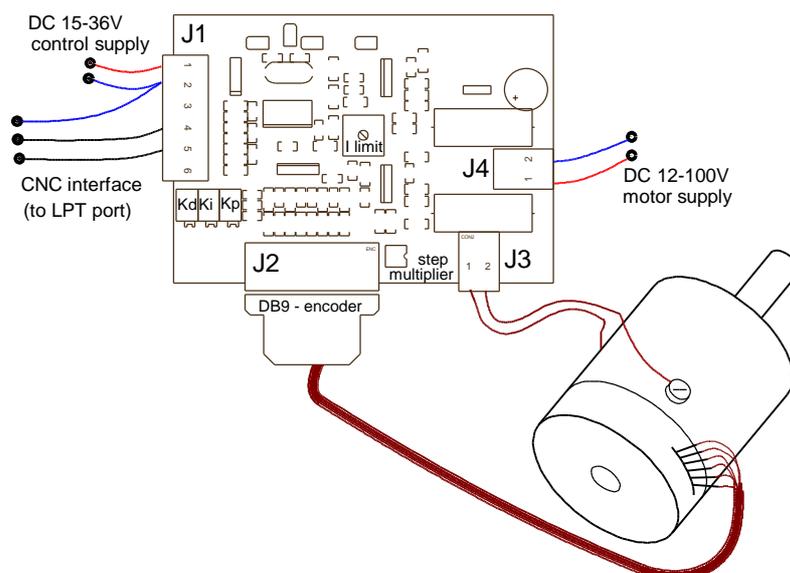
Setup procedure:

Download the latest RT990A datasheet and the R90.exe from http://rutex.com/. Do a preliminary test on the bench to familiarize yourself with the drive. Start with lower *Vm* and use current limiting power supply. Note, that drive must mount on a large heatsink while on the machine.

Pots:

1. Adjust all three pots (*Kp, Ki, Kd*) fully CCW so there is 0 volts on pins 1, 17 & 18 of RT990A. Note, that these pots are multiturn with 20 turns and no stop. Adjust *I lim* pot fully CW. This is a single turn pot with stop.

2. Connect motor, encoder and supplies to the R990 as per above drawing.

3. Gently increase *Kp* and by hand move rotor of motor. Verify that the drive corrects the error. If the motor runs away, the polarity of motor must be swapped or channel A and B from encoder must be swapped.

4. Increase the *Kp* until the system starts to oscillate. After that, increase the *Kd* to dump the oscillations.

5. The *Kp, Kd* and acceleration of the systems should be fine tuned without any *Ki*, with your application software. The *Ki* should be applied when system is nearly finished. *Ki* corrects the steady error. Too much of *Ki* causes oscillations. Always, when increasing *Ki*, the *Kd* 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 27A / 100V continues (peak current 100A for < 1 ms). R990 has built it 'cycle by cycle' current limiter. This current limiter is set to around 20 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 is 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 CW the current limit is set to minimum. Fully CCW sets the average current limiting to maximum. Please note, that current limiting point is dependent in the motor parameters as well as slightly worries with the *Vm* voltage. Following table shows the typical values.

I lim (trimpot)	R990
Fully CW	2 Amps
¼	3 Amps
½	10 Amps
¾	15 Amps
Fully CCW	Not limited

Maximum idle current.

Low inductance motor (i.e. 'pancake' type) might have high the 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 use 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 prior to power up or it can be overwritten via SPI. See the RT990A datasheets for SPI communication. The dual DIP switch is binary coded what allows 4 different pre-sets:

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

Power supplies.

The R990 employs split power supply practice. The control supply Vc should be kept between 15 to 36 VDC at all the time. The Vm should be fed via the E-STOP circuitry (relay) and must not exceed DC 100V. 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 Vm capacitor should be located no more than 30 cm (1ft) away from R990 driver. If single supply is desired, use only the Vm supply and connect zener diode between Vm and Vc to drop the voltage ($Vzener = Vm - 20$).

Encoders.

The R990 accept signal from 5V differential or TTL encoders. The equivalent input impedance is 1 kilo-ohm. An additional termination resistor might be required across input terminal, if long cable is used for differential encoders. Value of these termination resistors should be selected, to mach the cable. The impedance of twisted pare 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.
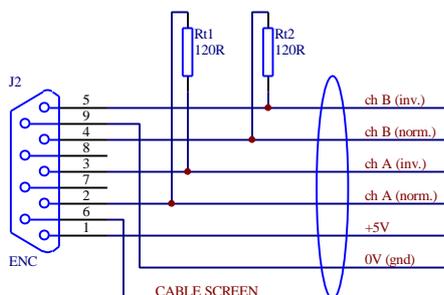
Connecting diffrential encoder
Rt1 and Rt2 are optional (40-300 ohms)
They might be required for long cable.
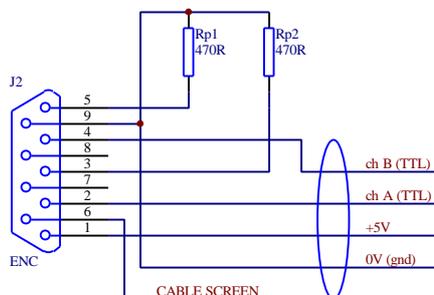
Connecting single-ended encoder
Rp1 and Rp2 are required for TTL
or Open collector encoders.