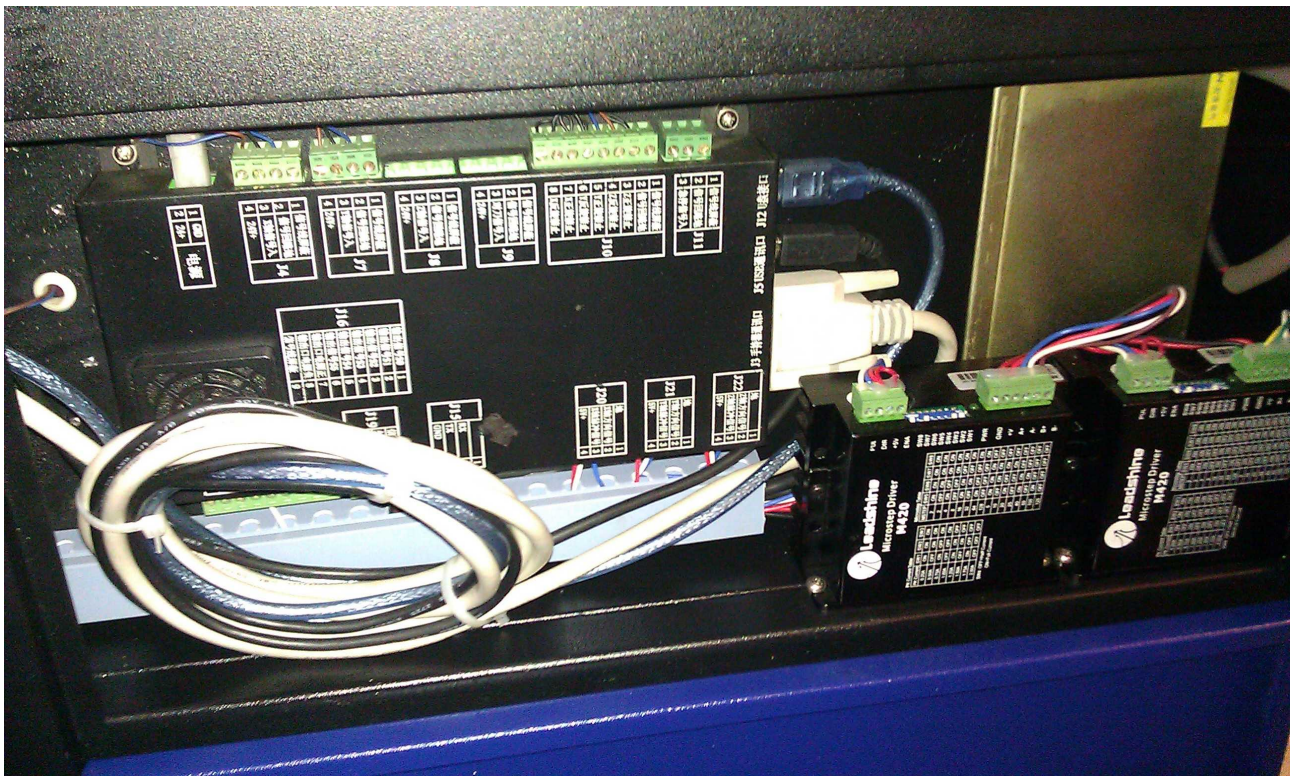
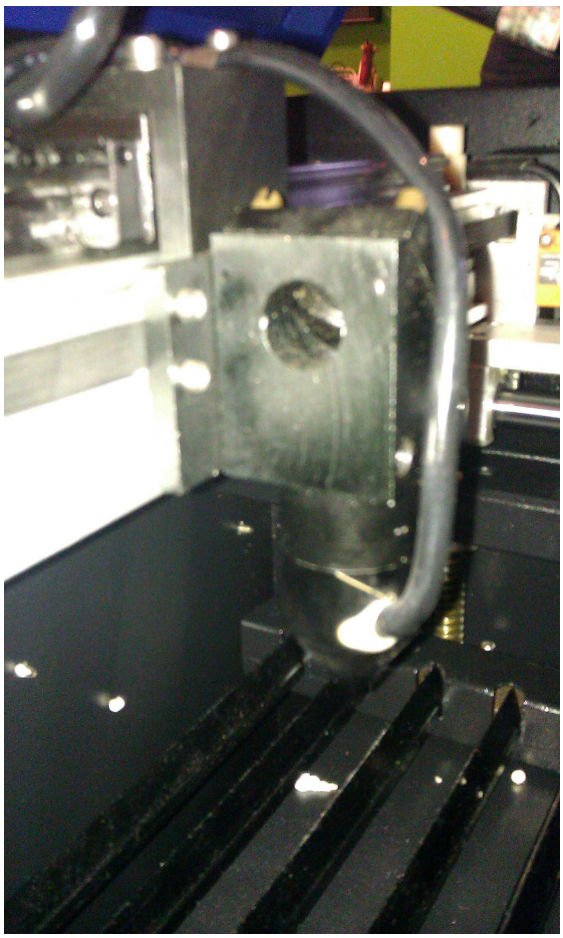
Reverse engineering the Suda Laser System @ Protospace
Peter Brier

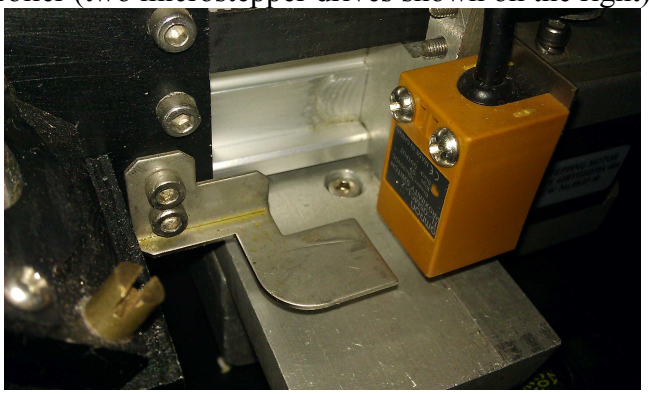
The suda laser system is a very basic CO2 laser cutter/marker. This system can be used as a proof of concept platform for the LaOS driver software and hardware.
Specs:

- CO2 glass tube laser (approx 30W?)
- 3x 45degrees beam bender (two adjusteable) 1 axis flying optics (with air purge)
- 3 axis (open loop stepper). X,Y (H-bridge) with height adjustable substrate table (Z axis).
- 36V microstepping stepper drives (2A max). Set at 32 microsteps.
- DSP controller with USB host/slave and internal flash. 3xPulse/dir output, lase routput, limit inputs, GPIO outputs, display/keyspad interface. 12..24V power supply input (5V output)
- Inductive (omron) home sensors on X and Y axis (12V)
- Microswitch limit switches on Z axis
- LCD display
- 16 key keypad (manual X,Y,Z and laser control, menu navigation)
- Integrated exhaust and purge pump. Integrated water cooler with pump.
- 4 key manual control for laser power, exhaus pump, water pump and purge pump (no signal lights)
- E-Stop button (acts as ON/OFF switch for complete equipment)
- Alarm buzzer (switches on when laser power is enabled, without switching on water cooling) does not interrupt the laser power!
- NO FEEDBACK on any sensor for the correct functioning of the exhaust or cooling system.
- NO SAFETY SWITCH ON COVER: Laser can switch on even if cover is opened. Z-axis can move and cut off fingers when substrate table is raised!
- NO Switch-off for the the motors when cover is open. Allways enabled (hard-wired) drives
- NO CE MARKING. Basically: not allowed to be sold on european market, and not allowed to be used.

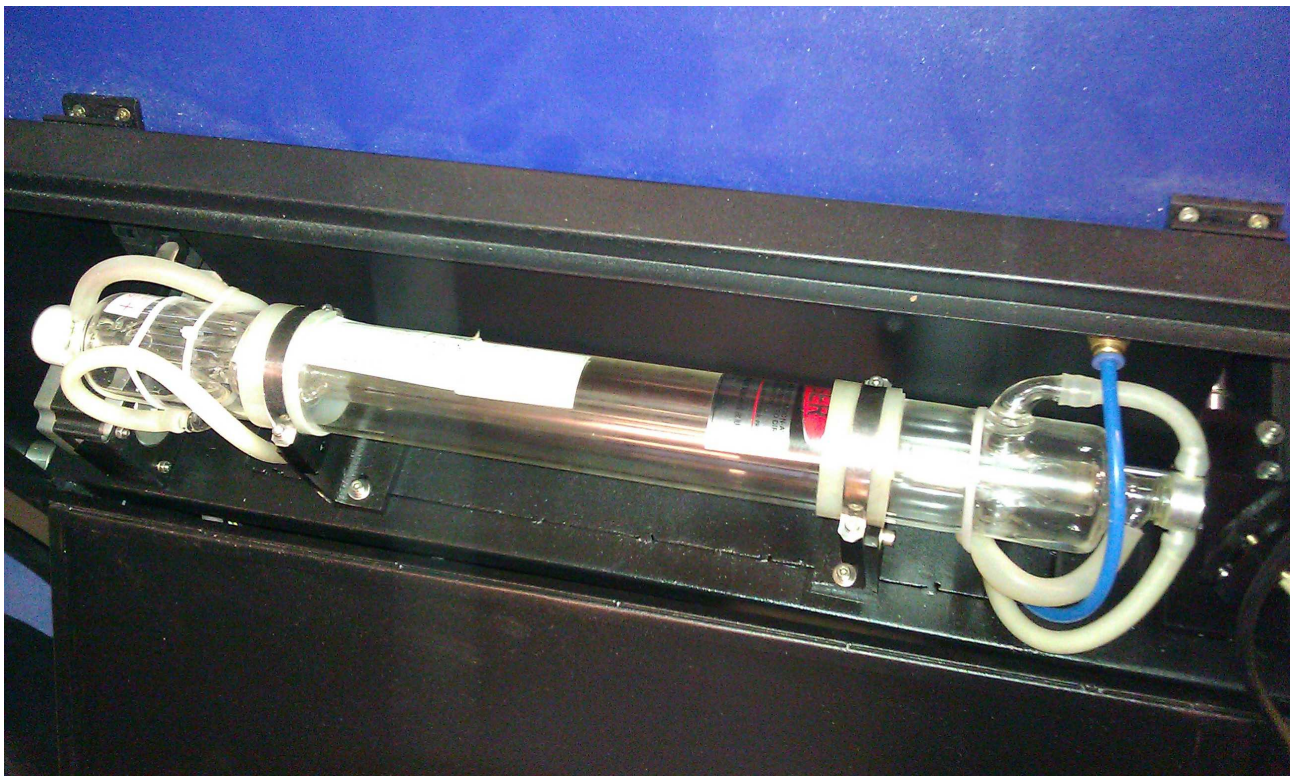


Controller cabinet with 3-axis laser/motion controller (two microstepper drives shown on the right)

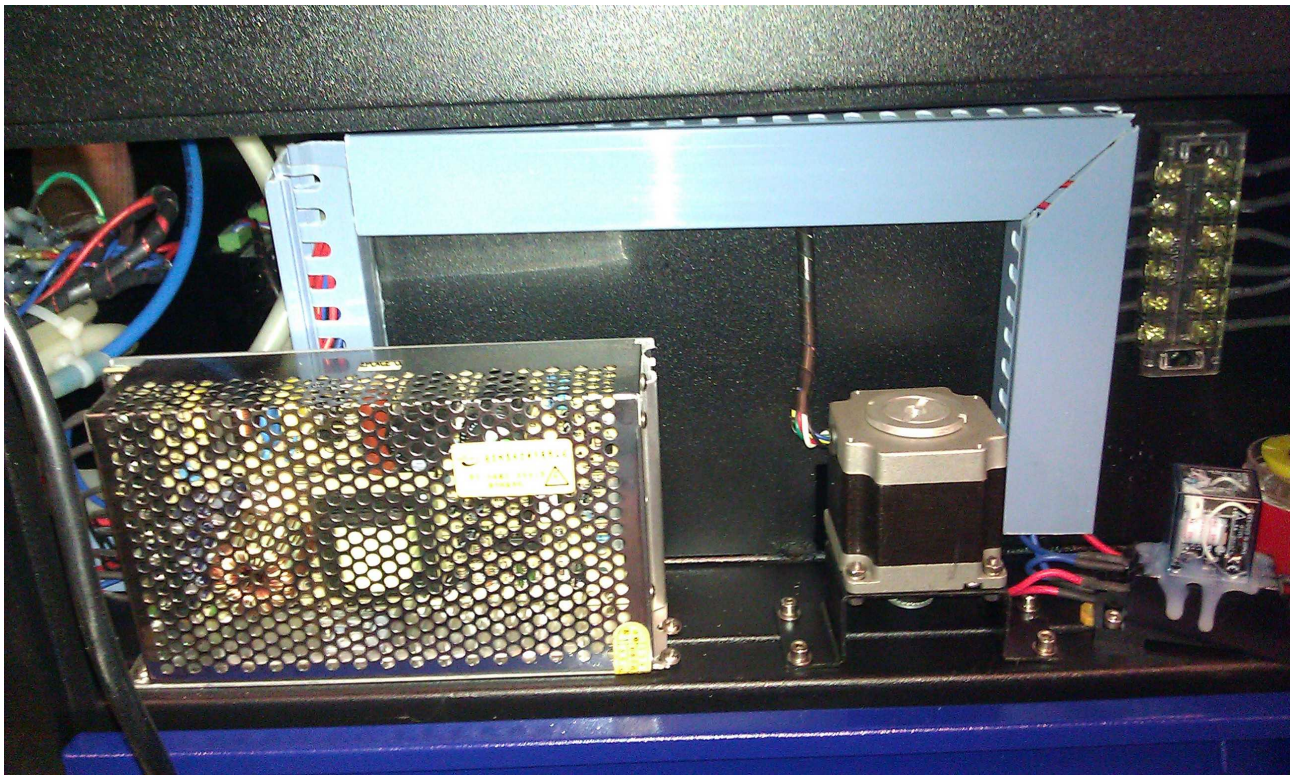




Left: Moving optics (x-axis) and home sensor (right)



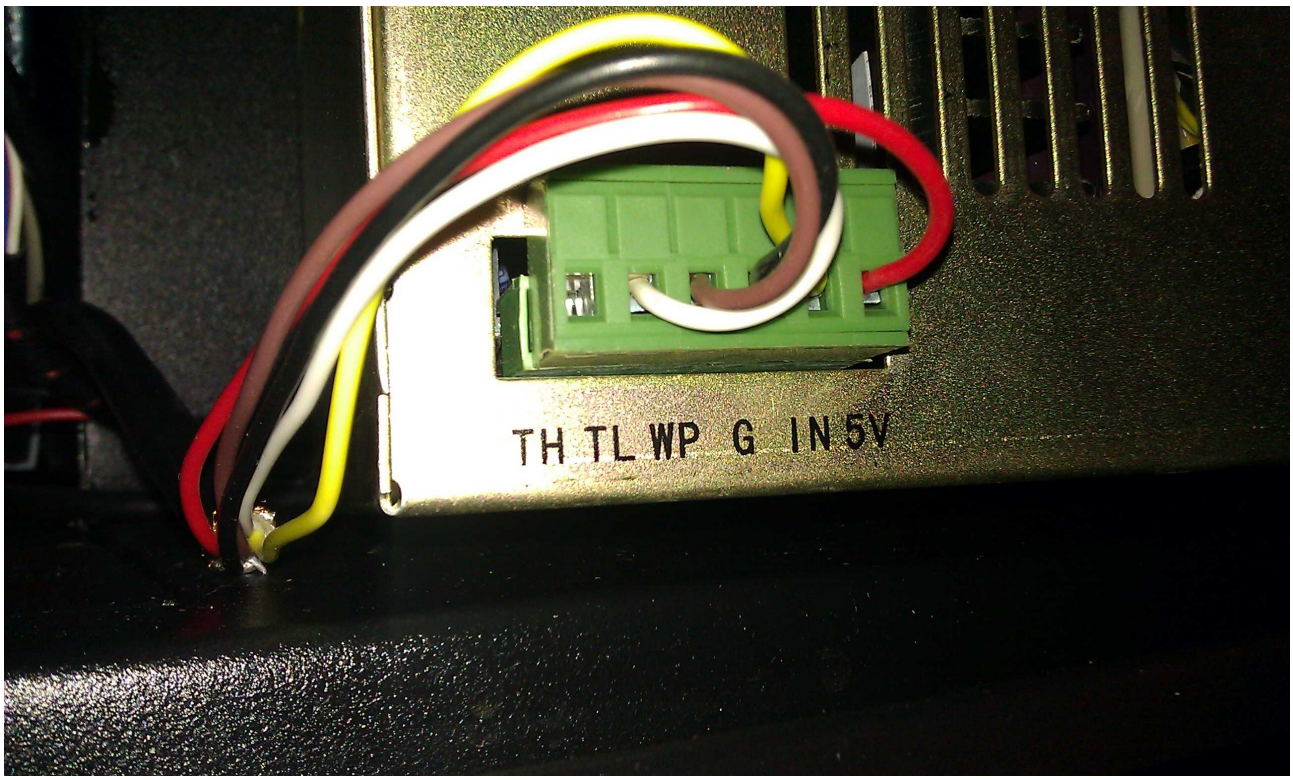
Laser tube



Left: Motor power supply (36V) Z-axis motor (middle). Relay and buzzer (right).

LCD and Control panel

E-Stop and power butons.



Laser power supply. Note: WP & G tied together on conroller side output ground. TL connected to "Switch" output of controller. IN connected to J14 (laser) connection of controller. Inputs seem to have internal pull-ups and laser is switched on when TL is tied to GND.

The laser seems to be connected in the following way:

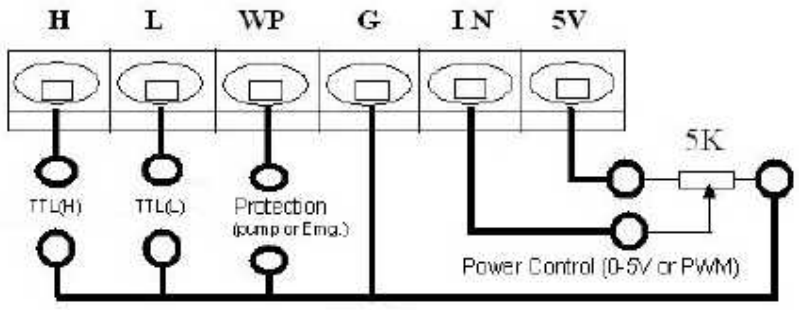
- WP (protection/interlock) always ON (tied to ground)
- Negative logic on TL to enable the laser (via switch output of controller)
- IN supplied with PWM modulated power signal
- 5V connected to the controller to supply the isolated outputs (ADUM1300)
- GND connected to the common ground of the LASER and SWITCH output of the controller

See next page for some (unconfirmed) info on the laser power supply signal.

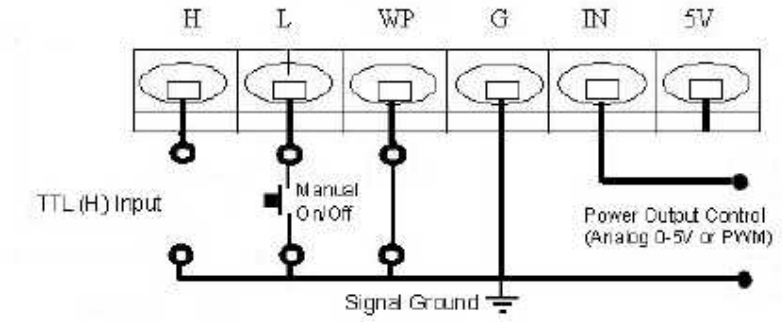
Laser power supply connections (from documentation of "similar" component):

PIN	Signal (on laser)	Notes
TH	enable/on (logic HIGH)	Apply 5V to enable laser
TL	enable/on (logic LOW)	Tie to GND to enable laser
WP	Protection	Tie to GND to enable laser
G	Ground	Signal ground for all other signals.
IN	Laser power input	0..5V or TTL PWM > 20kHz. < 1 msec response to laser power
+5V	5V output	< 20 mA

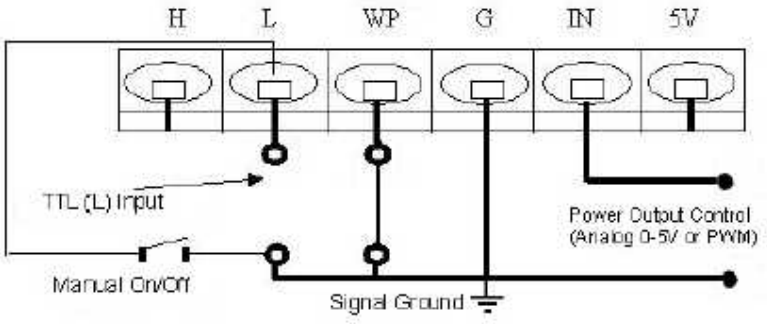
Note: it is mentioned somewhere (but not verified) that the inputs TH,TL,WP have opto-couplers inside the laser power supply.



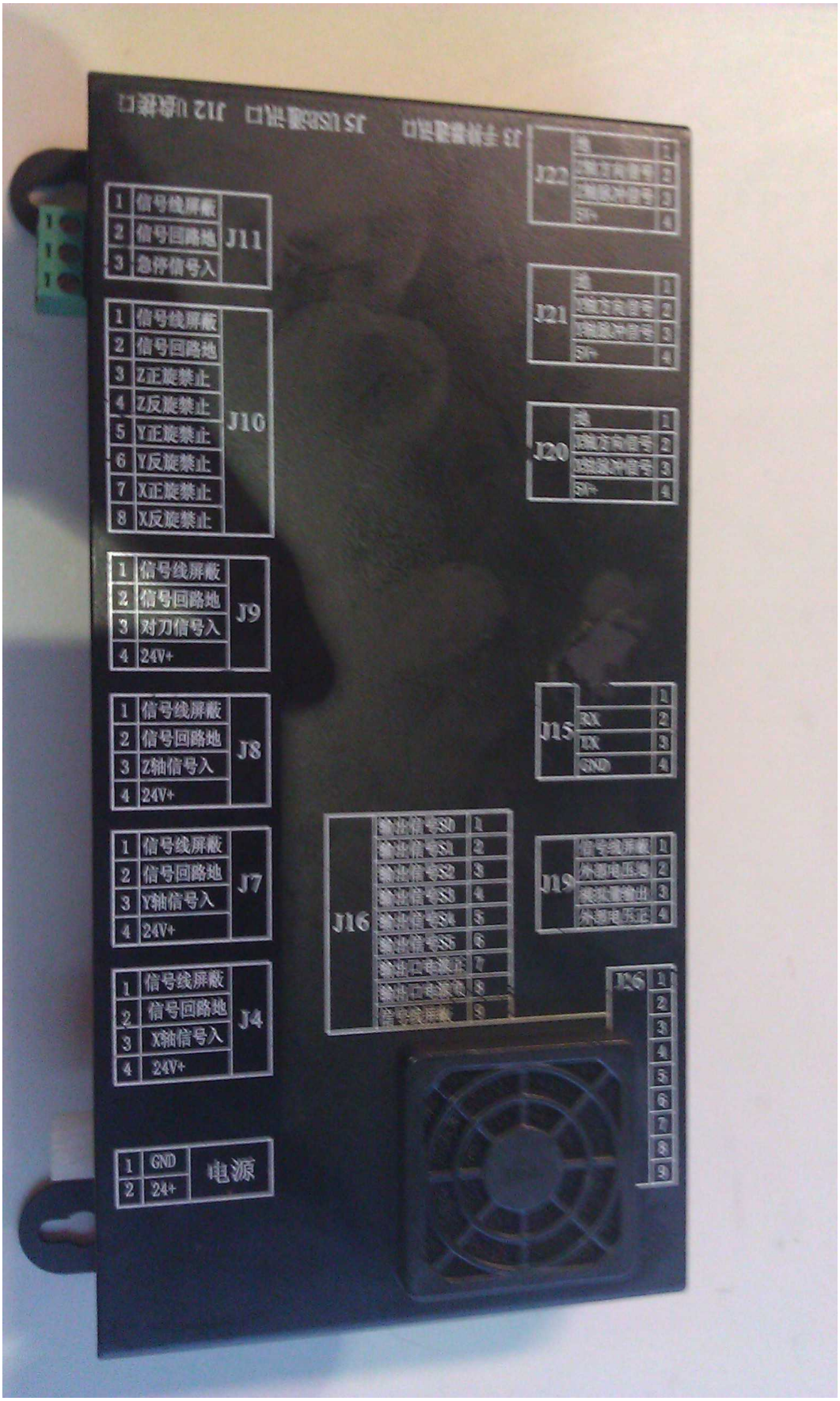
General diagram



High Level Input Control diagram



Low Level Input Control Diagram



Controller connector layout.

Stepper motor driver (M420) interface (note: from M415B stepper motor driver documentation)
Umotor = 36VDC

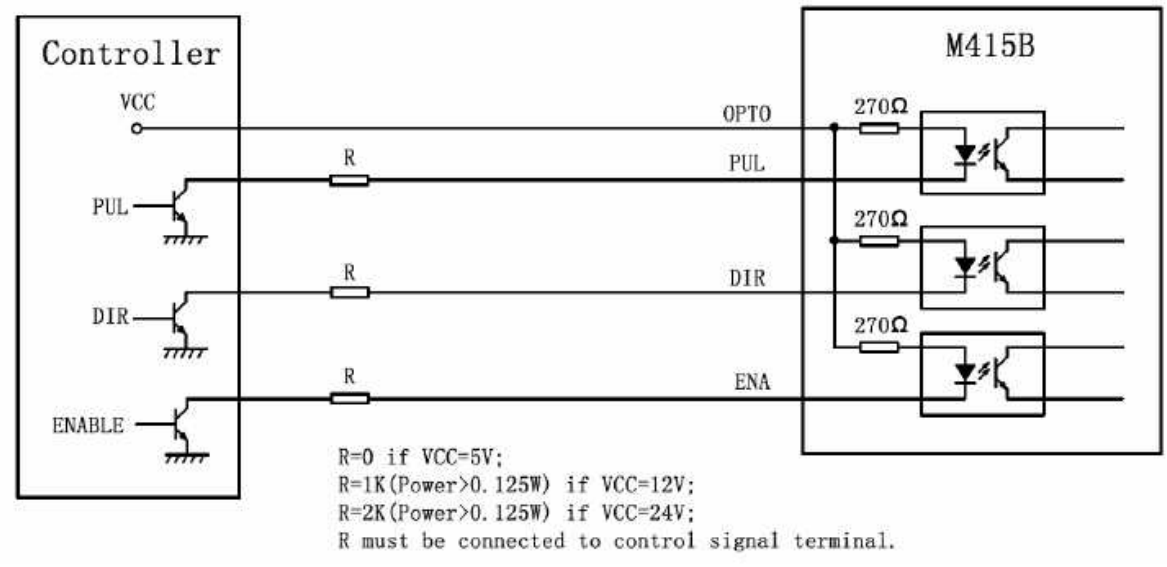
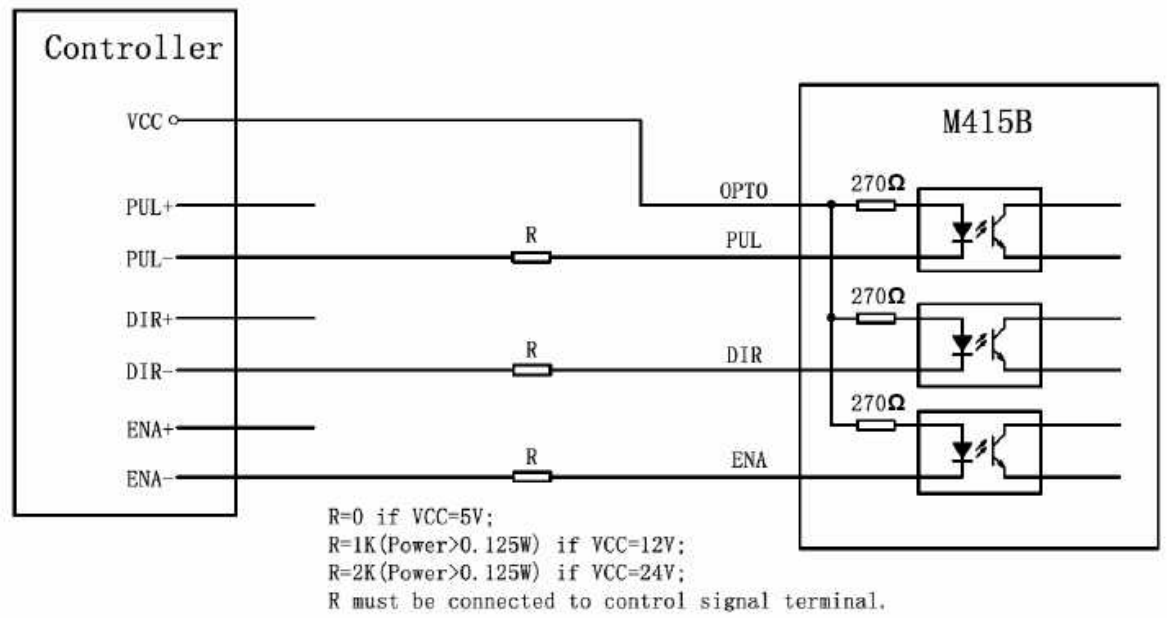


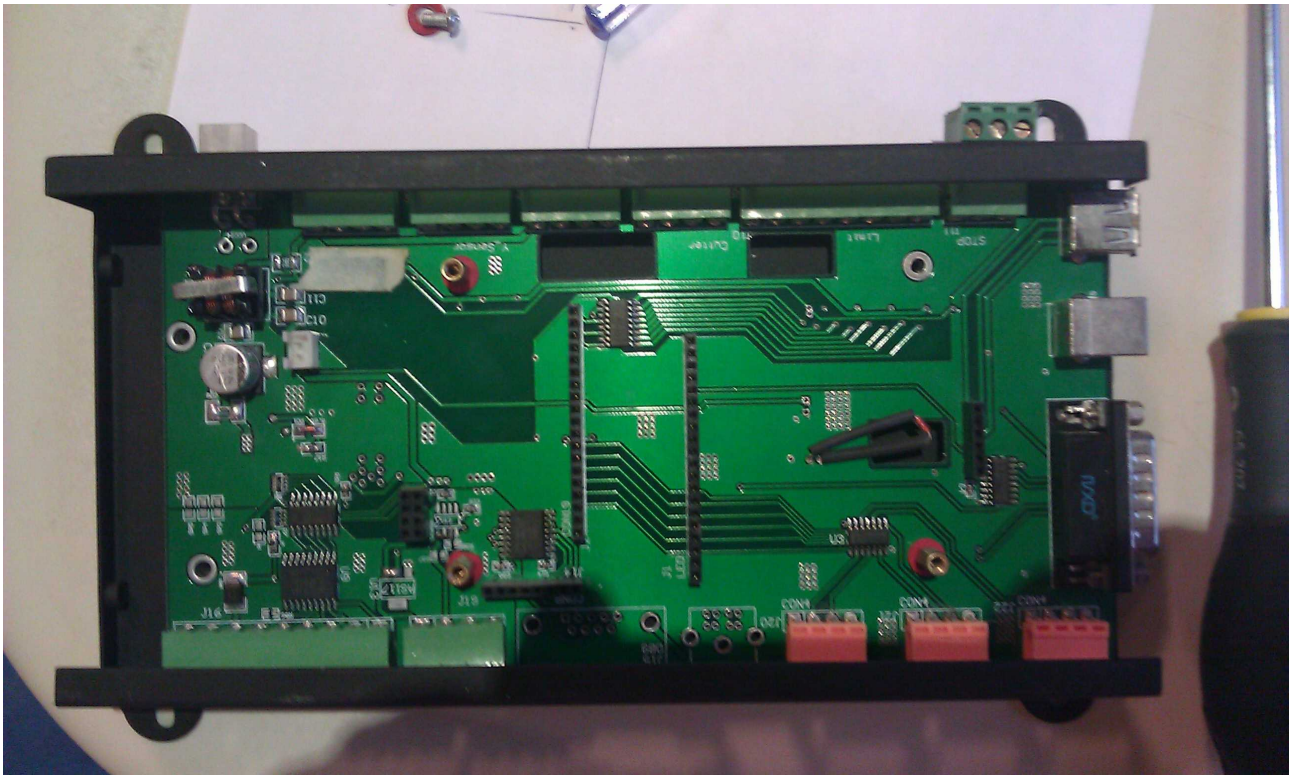
Figure 2: Connections to open-collector signal (common-anode)



Switches

	X	Y	Z	
SW1	**ON**	**OFF**	**ON**	X = 1.25 Amp Y = 1.50 Amp Z = 2.0 Amp (max)
SW2	**ON**	**ON**	**OFF**	
SW3	**OFF**	**OFF**	**OFF**	
SW4	OFF	OFF	OFF	Full current
SW5	OFF	OFF	OFF	32 microsteps/step == 6400 steps/rev
SW6	ON	ON	ON	
SW7	OFF	OFF	OFF	
SW8	ON	ON	ON	

Controller board



Base board

Electronic components:

Controller board

TI TMS 160 (320VC5416PGE)	DSP
Altera MAX II (EPM 1270T)	CLPD
Samsung 710 K9F160840B	128M x 8 bit NAND flash memory
SST39VF16F	16 Mbit / 32 Mbit / 64 Mbit (x16) Multi-Purpose Flash Plus
Cypress SL811 HST	Cypress' SL811HS is the world's first Dual Role Device (DRD) and can act as an embedded USB host or slave controller. It can communicate in both full speed and low speed USB modes. SL811HS incorporates USB Serial Interface Engine (SIE) functionality along with internal transceivers to function at Full or Low-Speed USB, and is configurable to USB host and peripheral modes. The flexible 8-bit interface allows connectivity to a variety of microcontrollers, microprocessors, and DSPs.
DS26LV31	3V ENHANCED CMOS QUAD DIFFERENTIAL LINE DRIVER
NEC PS2801	SSOP16 SMT Quad Channel 70 V 2500 Vrms Transistor Output Photocoupler
PDI 488D12	??
6Ad5 kkk lvc07	??

Base board

UNC2803L (J16 == Switch out, to laser TL signal)	OCTAL HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON ARRAYS (95V / 500mA)
NEC PS2801	SSOP16 SMT Quad Channel 70 V 2500 Vrms Transistor Output Photocoupler
ADUM1300 (J19 == laser)	Triple-Channel Digital Isolator
TI 7407	HEX BUFFER with OPEN-COLLECTOR HIGH-VOLTAGE outputs (30V / 30mA)
TI 64C6RW MC3487	Quadruple Differential Line Driver
LM2596 (power supply)	SIMPLE SWITCHER® Power Converter 150 kHz 3A Step-Down Voltage Regulator
65C757 MC3486 (to keypad/display)	Quadruple Differential Line Receiver With 3-State Outputs (RS422)

Interfaces:

J20 Y-axis
J21 X-axis
J22 Z-axis

PIN	**Signal**
1	GND
2	DIR
3	PULSE
4	+5V OUT

J14 Laser

PIN	**Signal (on laser**
1	NC
2	G + WP
3	IN
4	+5V OUT

Stepper drive M420 (opto coupler)

PIN	**Signal (on laser**
1	ENA (LOW=disable)
2	+5V (Common anode)
3	DIR
4	PULSE (LOW=pulse)