HY-DIV268N-5A Stepper Driver

These are my engineering notes when evaluating the HY-DIV268N-5A stepper driver. The performance of the driver was not what was expected. Therefore I did some reverse engineering and modifications to see if I could rectify the situation. The bottom line is that this stepper driver is a bit of junk. But with some persistency and work it is possible to make it work correctly.

The HY-DIV268N-5A can be seen in figure 1. The driver is based on the TB6600HG IC from Toshiba. See reference 1. The device can be purchased from eBay and Amazon among other sources.

TB6600HG. I did measure the on pin 8 of the 6N137 opto coupler for the step circuit (the lower one in figure 1, right).

The power supply line for the opto coupler look like picture in figure 2. This is more or less a disaster. This was measured without any connection to the optocouplers, just the motors and the supply was connected. I tested a number of different 24 Volts power supply's but the problem persisted.

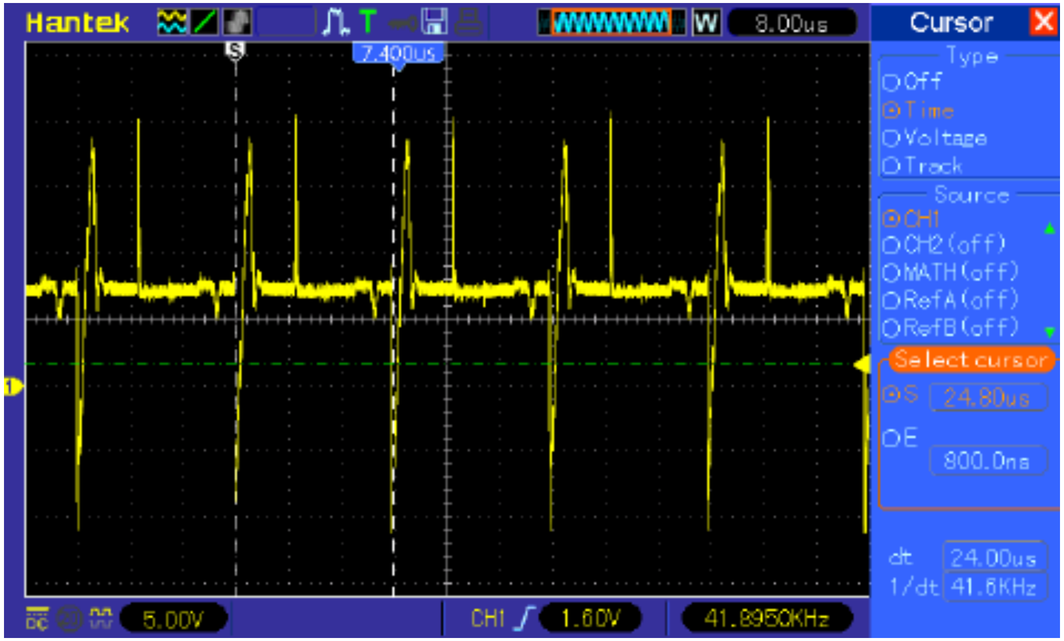


Figure 2, voltage spikes on 5 volt power supply

All the time I used a 24 Volt external power supply for the device with sufficient current capacity.

The yellow trace is the 5 volt power supply and the blue line is the output from the “Step” opto coupler collector output. This is clearly much better but far from perfect.

The next thing I suspected was that there was ripple on the Vref signal. A check with the oscilloscope gave the picture as in figure 4.

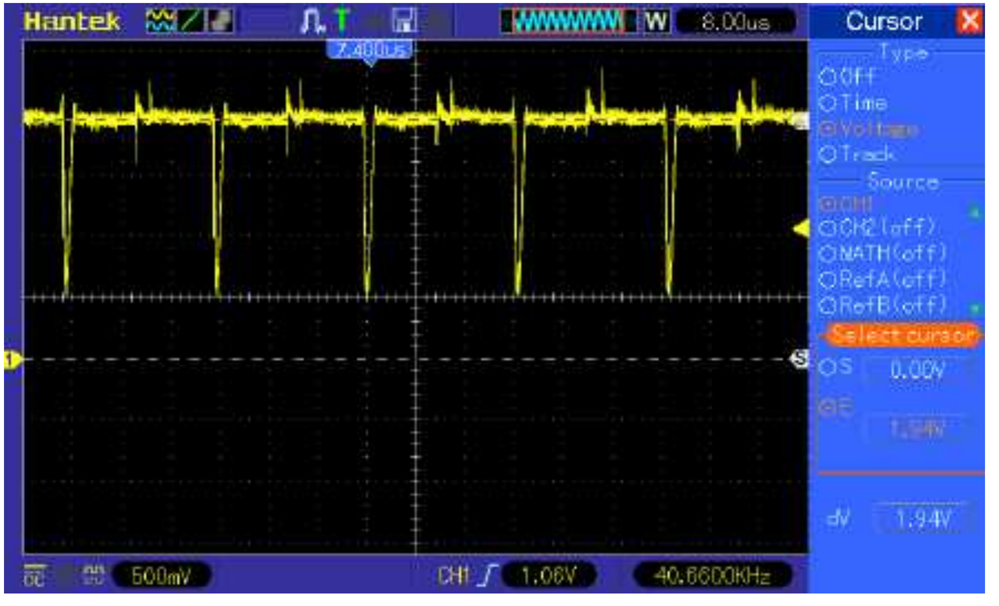


Figure 4, Vref pin signal

The voltage level, 1.94 volt is according to the datasheet for TB6600HG (0.3V ≤ Vref ≤ 1.95V). But the spikes shouldn’t be there. The Vref circuit looks like this, see figure 5:

After this and checking the Vref voltage again with the oscilloscope I got the waveform as in figure 6. This is clearly an improvement.

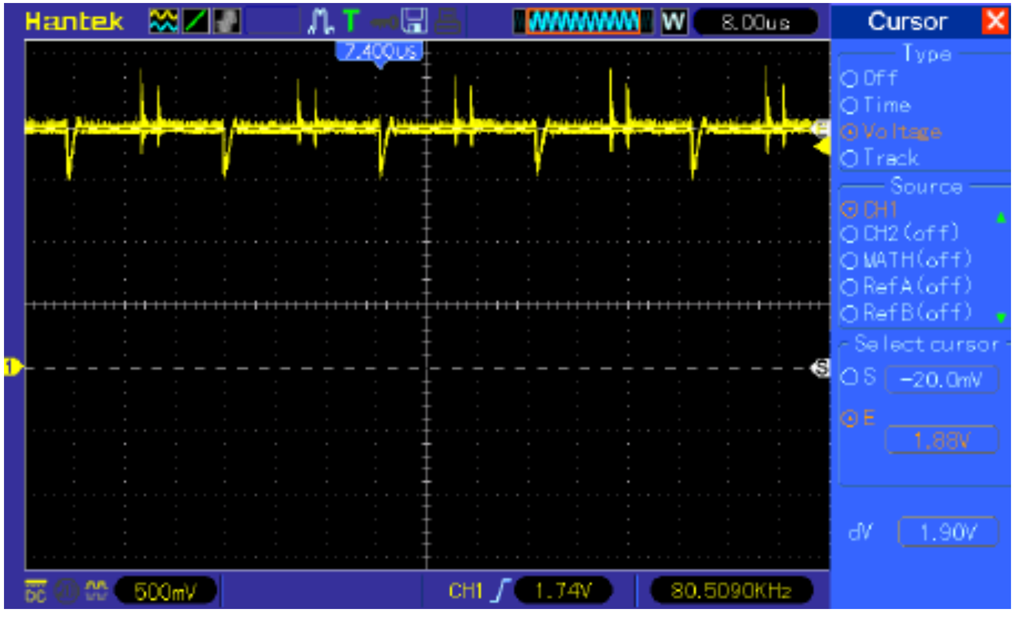


Figure 6, Vref after adding C5 and C6

I had the suspicion that the Vref have a limit current capability. Therefore I moved the supply of the LED2 to the 24 volt supply with an additional resistor of 8.1 K (R32). I also removed D1 from to be in series with the 24 volt supply line to be connected with the anode to ground and cathode to the +24 volt supply line. I also added 0.1 uF ceramic capacitors to the 24 volt line (C20, C21, C22) see figure 7.

Current Switch Settings

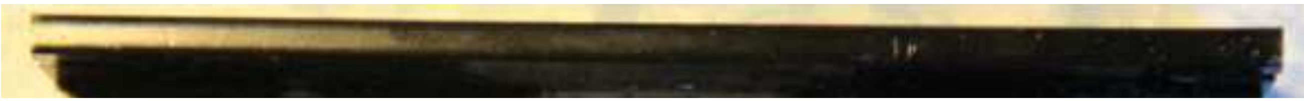
Switch settings label are wrong on the protection cover. The correct settings for S4/S5/S6 (step size) are as in figure 8. This manufacturing error is remarkable.

S6	**S5**	**S4**	
On	On	On	Standby
On	On	Off	1/1
On	Off	On	1/2A
On	Off	Off	1/2B
Off	On	On	1/4
Off	On	Off	1/8
Off	Off	On	1/16
Off	Off	Off	Standby

Figure 8, S4/S5/S6 settings

Changes made (modifications)

Below is a summation of the changes that I made to the circuit. See the schematics in appendix. The schematics shall reflect the changes I made. I have tried to keep the same identifications for resistor, capacitors etc. as in the schematics that can be found on the net, see appendix (links).



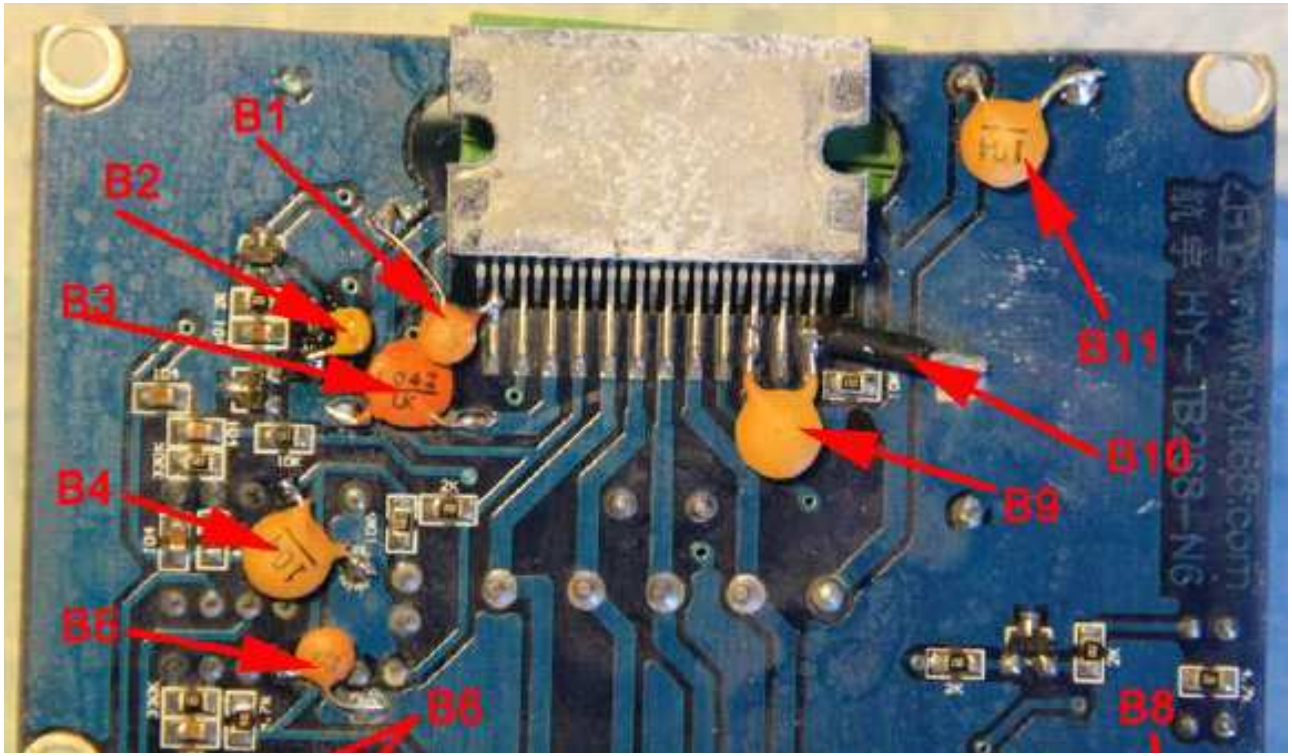
T3. Added decoupling capacitor to +24V, C20

T4. Changed R23 to 15K

T5. Changed D1 to be between ground and +24 Volt and placed a jumper between J3/1 and trace to Vcc-A and Vcc-B.

T6. Ground test point for measurements

T7. Test points for 6N137



Summarize of changes:

1. Changed D1 to be not in series with power +24 Volts. Instead D1 is connected with cathode to +24 V and anode to ground.
2. Added C20, C21, C22 to +24 volt supply
3. Added C23, C24, C25, C26 to Vreg supply
4. Changed R3, R4, R5 to 330 ohm (was 51 ohms!), Important!!
5. Modified Vref circuit to be according to datasheet. R23 = 15K, R25 = 2.2K, R26=1.5K and R27=1K
6. Changed LED1 (Step indicator) to be supplied by 24 Volt. Added R26=12K
7. Changed LED2 (Power) to be supplied by 24 Volt, added R31
8. I didn't do this but changing R7 and R8 to 2.2 K is a good idea to increase noise immunity.
9. Ground all system devices (motion controller, power supplies, driver etc.) in a star fashion (common point).

Test of modification

I did some measurements before and after the modifications. The test setup for the Y-axis is shown in figure 9. The stepper motor moves the Y-Axis sleigh between the A and B position. At the start the Y-axis is set to the A position, see figure 10. The indicator clock is set to zero at this position. A G code macro program is executed. The macro program moves the sleigh to the B position and waits there for one second. Thereafter the sleigh is moved back to position A. When it has stopped at position A the macro program sends a signal to the PIC32MX microcomputer to obtain the value of the

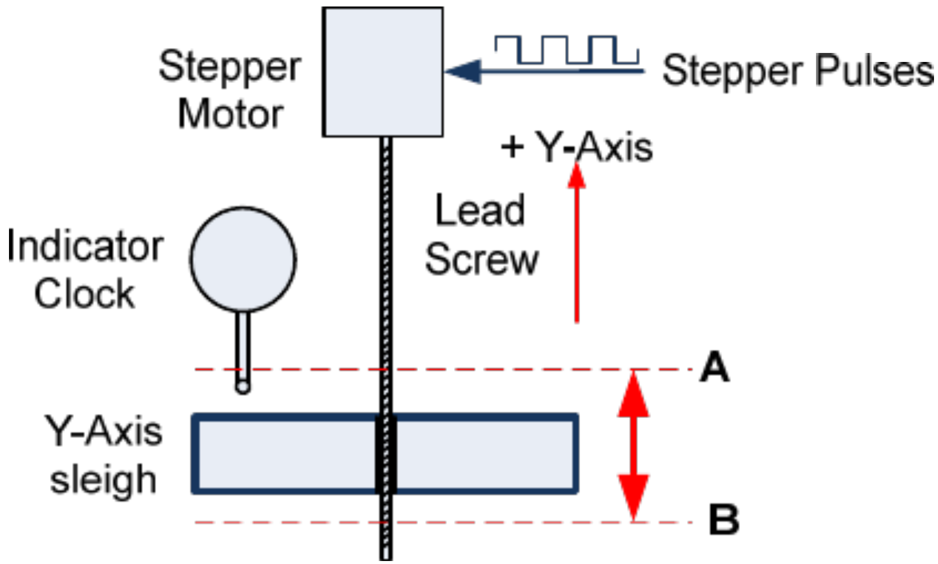


Figure 10, Y-axis test movements

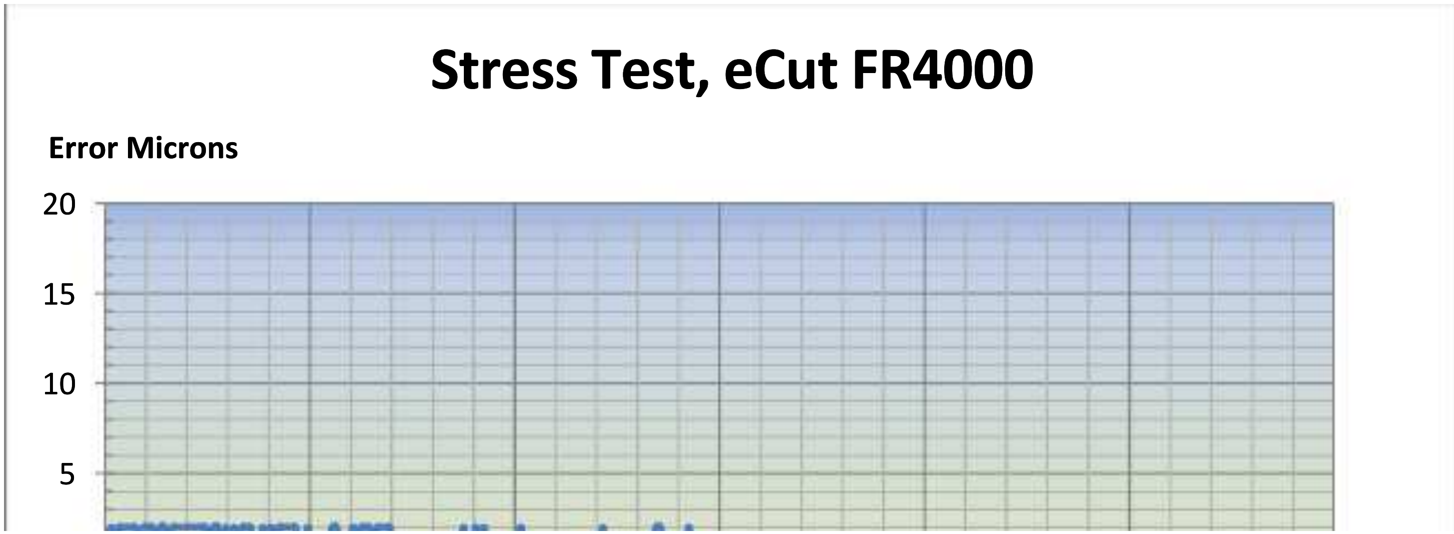
Two tests were done. One test was done before modifications and one after the modifications. The result can be seen in figure 11.

The ripple in the graph for the modification is maximum 4 microns (4E-6 meters). The setup is very sensitive to temperature, vibrations etc. So in reality the result after the modifications is almost a straight line, which is to say nearly prefect. The feedrate was as I remember 750 mm/minute during the test.

4000 mm/min with an acceleration of 110 mm/s2, this without any significant errors. I'm impressed by this. See figure 12.

Note that the stepper pulses are about 10 uS in this case (with feedrate 4000 mm/min). So we have a frequency of about 100 KHz. The eCut motion controller is specified up to 200 KHz. However the TB6600HG IC, the brain in the stepper driver has a minimum pulse length of about 5 uS. SO we are approaching the specification limits.

The ripple of +/- 2 micron around the zero line is probably due to measurement errors induced by the sensor, temperature, vibration in the room when I am moving around etc. Remember 1 micron is a very short distance. You have to have one million microns to get one meter.



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Bo Gärdmark

Appendix

Good Links:

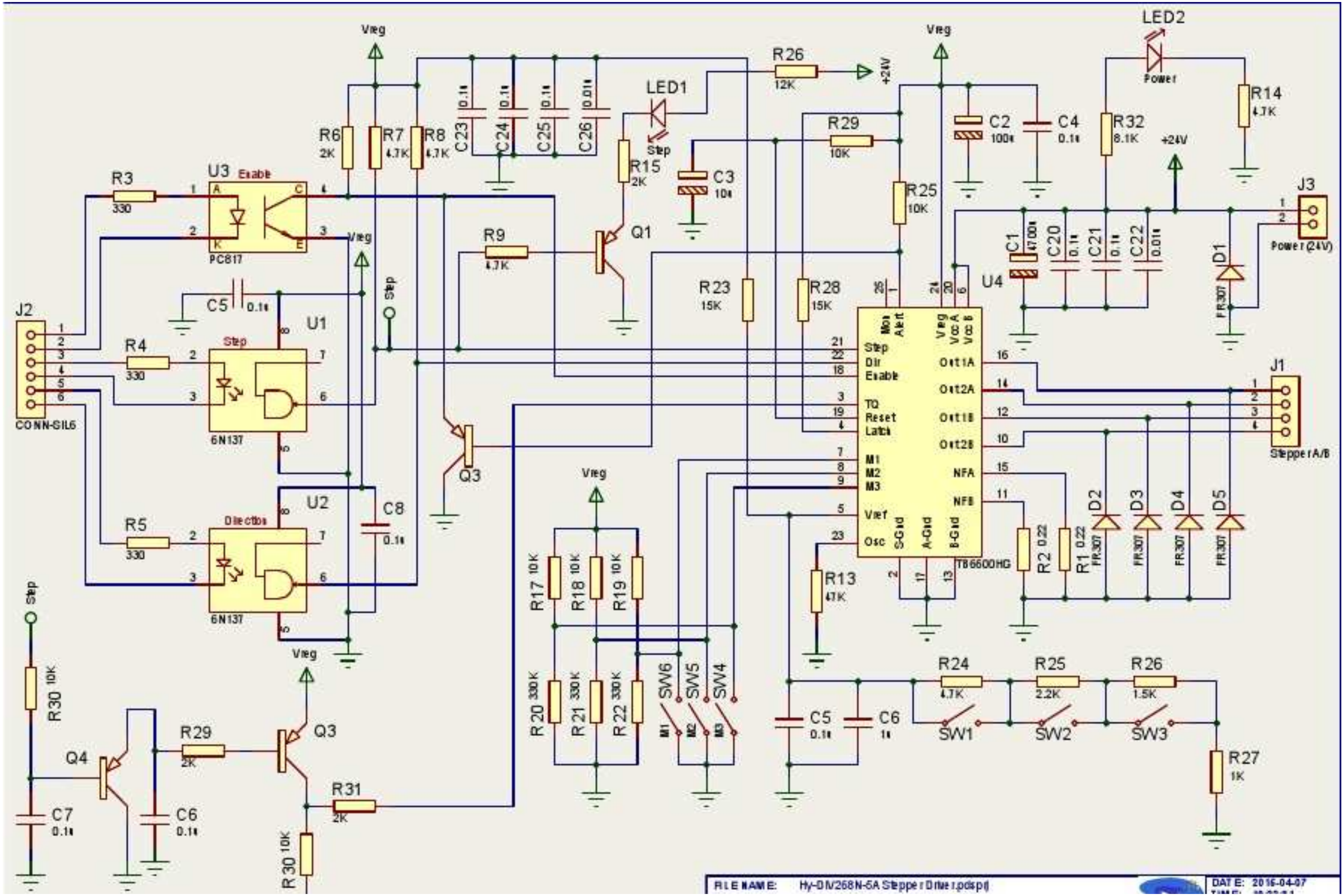
TB6600HG datasheet:
http://download.siliconexpert.com/pdfs/2012/7/3/0/23/22/201/tos_/manual/tb6600hg_summary_en_20120119.pdf

Thread: Haoyu TB6600:
http://www.cnc-arena.com/en/forum/haoyu-tb6600--187150.html

Thread: TB6600 drive from EBAY, this is a very good discussion about the TB6600. I'm thankful for the input I got from reading this thread.
http://www.cnczone.com/forums/stepper-motors-drives/186930-tb6600-drive-ebay-15.html

Schematics Haoyu TB6600:
http://www.cnczone.com/forums/attachment.php?attachmentid=190090&d=1372455055

LeadShine, good Stepper Drivers:
http://www.leadshine.com/productdetail.aspx?type=products&category=stepper-products&producttype=stepper-drives&series=DM&model=DM556



Vreg
+24V
LED1
LED2
Power
Step
Enable
Direction
U1
U2
U3
U4
PC817
6N137
TB6600HG
J1
J2
J3
CONN-SIL6
Stepper A/B
Power (24V)
Q1
Q3
Q4
R1 0.22
R2 0.22
R3 330
R4 330
R5 330
R6 2K
R7 4.7K
R8 4.7K
R9 4.7K
R13 47K
R14 4.7K
R15 2K
R17 10K
R18 10K
R19 10K
R20 330K
R21 330K
R22 330K
R23 15K
R24 4.7K
R25 10K
R25 2.2K
R26 12K
R26 1.5K
R27 1K
R28 15K
R29 10K
R29 2K
R30 10K
R31 2K
R32 8.1K
C1 4700u
C2 100u
C3 10u
C4 0.1u
C5 0.1u
C6 1u
C6 0.1u
C7 0.1u
C8 0.1u
C20 0.1u
C21 0.1u
C22 0.01u
C23 0.1u
C24 0.1u
C25 0.1u
C26 0.01u
D1
D2
D3
D4
D5
FR307
SW1
SW2
SW3
SW4
SW5
SW6
M1
M2
M3
Mo
Alert
Step
Dir
Enable
TQ
Reset
Latch
Vref
Osc
S-Gnd
A-Gnd
B-Gnd
Vreg
Vcc A
Vcc B
Out1A
Out2A
Out1B
Out2B
NFA
NFB
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