Solid-State Scope and the Dutchtronix Clock

I received the excellent Dutchtronix Scope Clock kit to try out on the tube scope (version 2). You can obtain a kit here: http://www.dutchtronix.com/ScopeClock.htm.

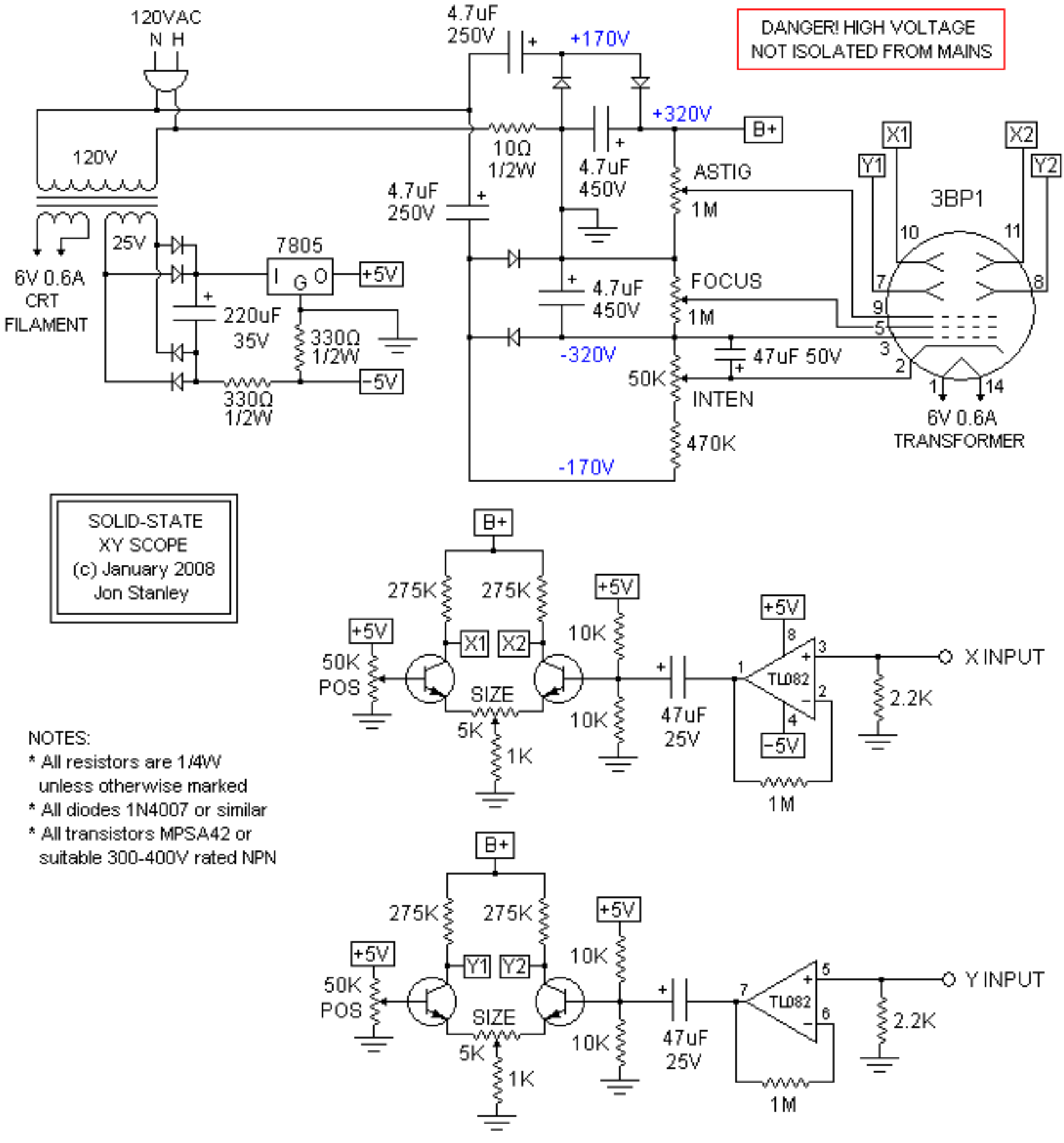
The quality of the graphics on the tube scope was rather disappointing because of the large distortion caused by the 6AU6 amplifiers. The amplifiers were constructed around the OZ2CPU scope clock. To avoid making adjustments and changes, I decided to build a whole new scope clock using simple solid-state components instead. For the sake of simplicity, below is the schematic.

The high voltage power supply is simply two voltage doublers that produce approximately +320V and -320V for a total potential of about 650V. I used a 3BP1 CRT, which works well with this voltage but the circuit should be compatable with many other 2" and 3" CRTs. I have no guarantees as I have not tested other CRTs, but if you use a different CRT that works well then let me know. Lastly, the high voltage supply is not isolated from mains so please use an isolation transformer if possible. A basic isolation transformer can be constructed using two 120V-to-12V transformers back to back with the 12V connected between the two transformers. The low voltage supply uses a transformer that provides 4-6V power to the CRT filament (rated 6V 0.6A) and 15 to 25 volts to be rectified and reduced to provide +5V and -5V for the clock and deflection amplifiers. The -5V supply is not critical and can vary up to -10V or so. The Dutchtronix clock requires regulated 5V so a 5-volt regulator such as the 7805 is strongly recommended.

When the circuit is first constructed, I would recommend leaving the Dutchtronix clock disconnected to check the voltages on the supplies. If all is well, then adjust the INTEN pot all the way towards the -320V for maximum brightness. Center the POS and SIZE pots and a dot should appear on the CRT face. Adjust FOCUS to sharpen the dot and ASTIG to make the dot as round as possible. After these steps are completed, the clock can be hooked up to the +5V supply and the outputs to the X INPUT and Y INPUT. Readjust the pots until the picture fills the CRT face and the quality is best.

The circuit was built around the Dutchtronix scope clock kit. The graphics quality is fairly good despite slight distortion and some visible retrace lines. The 2.2K resistors on the inputs of the TL082 dual op-amps help linearize the output of the DAC of the clock, but these resistors can be removed to increase input impediance. The scope works reasonably well for the full clock with the digital numeric display turned off. The menu is readable albeit not perfect. I do not recommend making centering adjustments to the scope by using the calibration screen because the clock display has slightly different DC offset that will shift the picture off-center due to the 47uF coupling capacitors. Lastly, if the picture is flipped on one or both axes then simply reverse the connections on the deflection plates. The SIZE pot will adjust the size of the picture, but it also affects the positioning so the POS pot is used to recenter the picture.

The clock innards was housed in a plexiglass cabinet that I made myself. A table saw was used to cut the striaght lines on the pieces. A heat gun was used for bending the front and rear pieces. The edges were filed and sanded down to fit, and then all the pieces were screwed together. My initial plan was to locate the CRT further in the cabinet but the magnetic field from the transformer caused the picture to "swim" so the CRT had to be located a bit further out. As a result, I added a plexiglass ring to hold the CRT in place and this adds an interesting touch to the overall appearance.


DANGER! HIGH VOLTAGE
NOT ISOLATED FROM MAINS
120VAC
N H
120V
6V 0.6A
CRT
FILAMENT
25V
7805
I G O
+5V
-5V
220uF
35V
330Ω
1/2W
330Ω
1/2W
4.7uF
250V
+170V
+320V
B+
10Ω
1/2W
4.7uF
450V
4.7uF
250V
ASTIG
1M
FOCUS
1M
4.7uF
450V
-320V
47uF 50V
50K
INTEN
470K
-170V
3BP1
X1
X2
Y1
Y2
6V 0.6A
TRANSFORMER
SOLID-STATE
XY SCOPE
(c) January 2008
Jon Stanley
B+
275K
275K
+5V
X1
X2
50K
POS
SIZE
5K
1K
10K
10K
47uF
25V
TL082
2.2K
X INPUT
1M
Y1
Y2
Y INPUT
NOTES:
* All resistors are 1/4W
unless otherwise marked
* All diodes 1N4007 or similar
* All transistors MPSA42 or
suitable 300-400V rated NPN