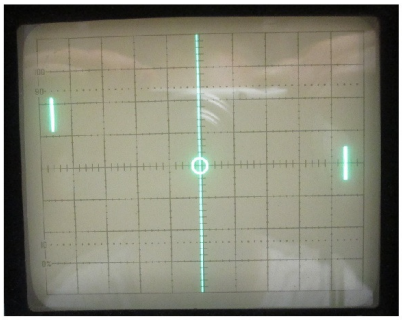
Oscilloscope Pong

For one or two players



Glen Kleinschmidt, April 2017
www.glensstuff.com

In a nutshell:

A “Pong” paddle-and-ball “computer” game that produces a high quality, clean and crisp vector display on an analogue X-Y oscilloscope. The circuity is 100% discrete and built entirely "dead bug". With the exception of a 2N2219A/2N2905A and a 2N3055/MJ2955 complementary BJT pair, the former for driving the speaker for the sound effects and the latter in the power supply circuit, the remaining bipolar junction transistors are either BC550C or BC560C. There are a bunch of 2N5484 JFETs for analogue signal switching, lots of 1N4148s and a few Zener diodes.

There are four switchable modes of play:

1) Machine against machine
2) Player 1 against machine
3) Player 2 against machine
3) Player 1 against player 2

Player one controls the paddle on the left and player 2 the paddle on the right. The hand controllers are just so called “zippy” or “jiffy” boxes each with a potentiometer and knob, though the player 1 controller sports a "serve ball" momentary push-button. A match/game starts on the pressing of this button. The position of a controllers potentiometer determines the vertical position of the respective paddle on the screen.

The moving ball automatically bounces off the vertical boundaries and the goal of each player is to keep the ball inside the court. The velocity of the ball begins at a slow and easy rate but in order to ensure a match cannot last forever, from the start of play the ball velocity linearly speeds up and will continue to do so for as long as the human player(s) can keep up with it.
If either player misses the ball the match ends with an 800mS-long 150 Hz buzz and the ball is automatically returned to the centre of the court where it remains stationary until player one presses the "serve ball" button to commence a new match.

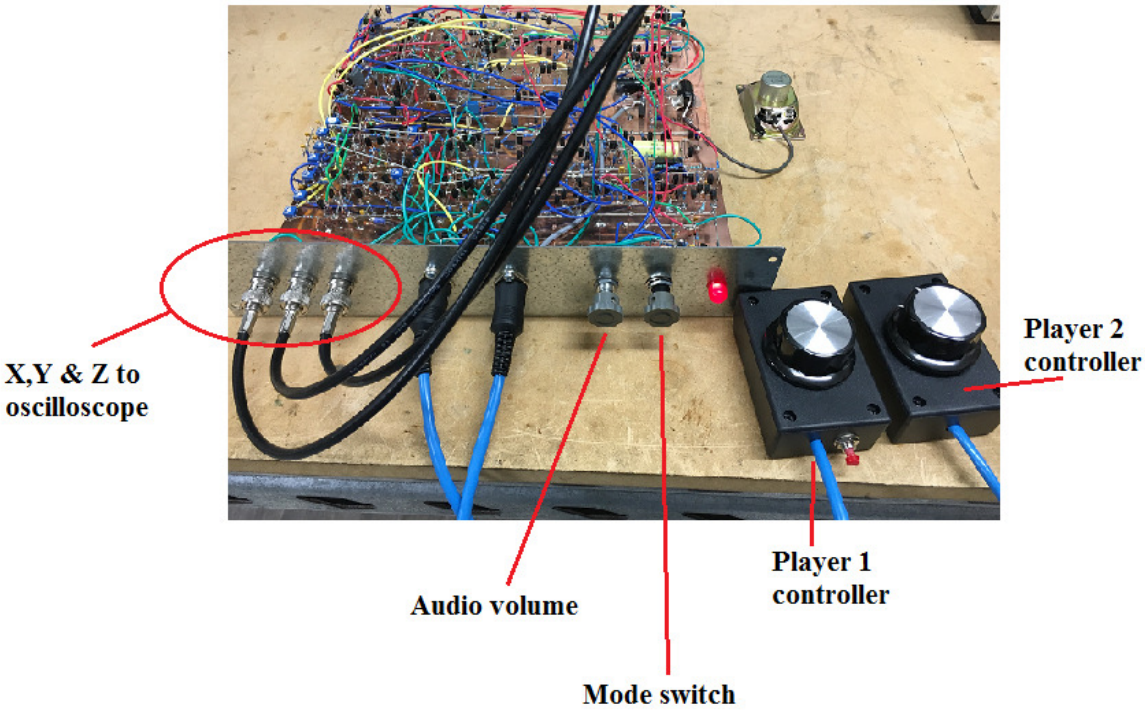
In single player mode, the machine controls the opposite paddle and is an invincible opponent. The velocity of the ball will eventually become too fast for a human player to keep up, so loosing to the machine is inevitable. The skill of the player here is gauged by how long he or she can keep a match going.

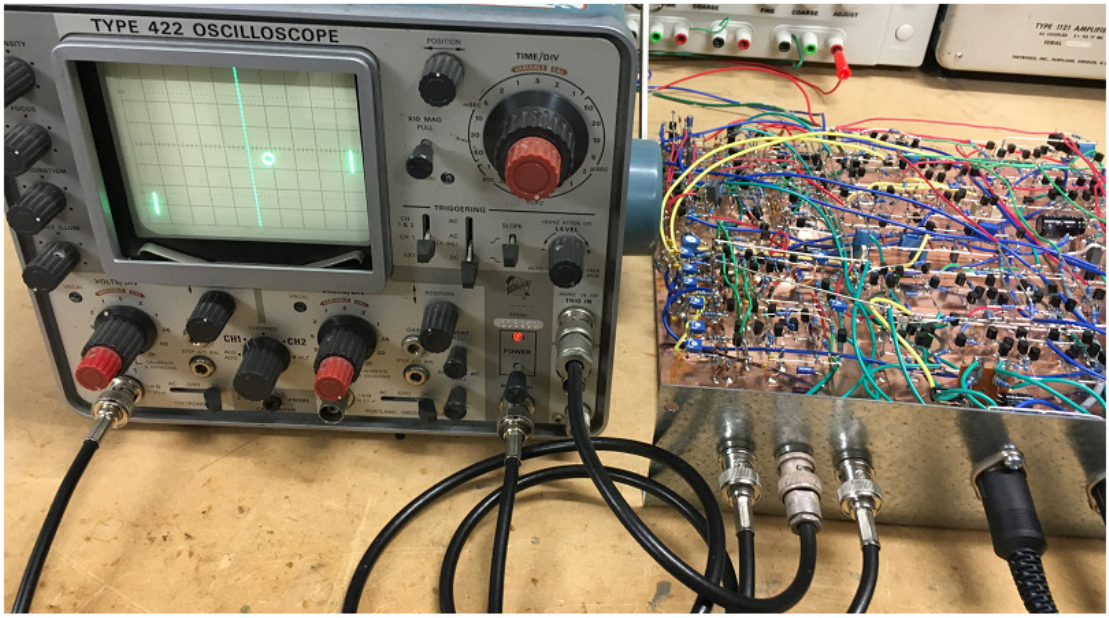
A link to a video of the machine in action:

https://www.youtube.com/watch?v=f7A5J30cqRk

Analogue oscilloscope requirements:

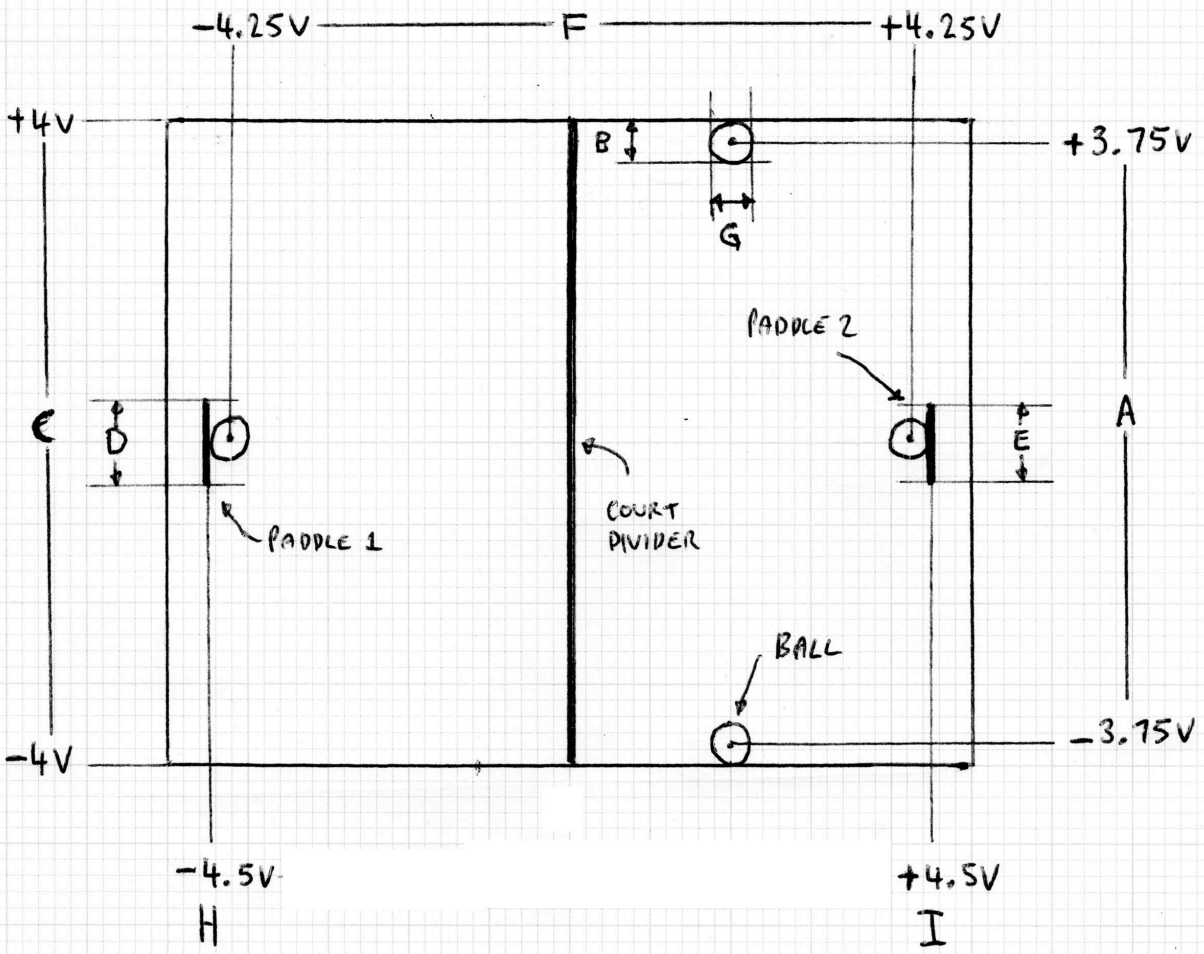
10(h) x 8(v) cm/division graticule.
1V / cm/div. Horizontal Sensitivity.
1V / cm/div. Vertical Sensitivity.
A Z-axis “blanking” or “intensity modulation” input where a positive voltage of 14V or less is sufficient for total beam cut-off.


X,Y & Z to oscilloscope
Player 2 controller
Player 1 controller
Audio volume
Mode switch


TYPE 422 OSCILLOSCOPE

HORIZONTAL AND VERTICAL DEFLECTION ADJUSTMENTS

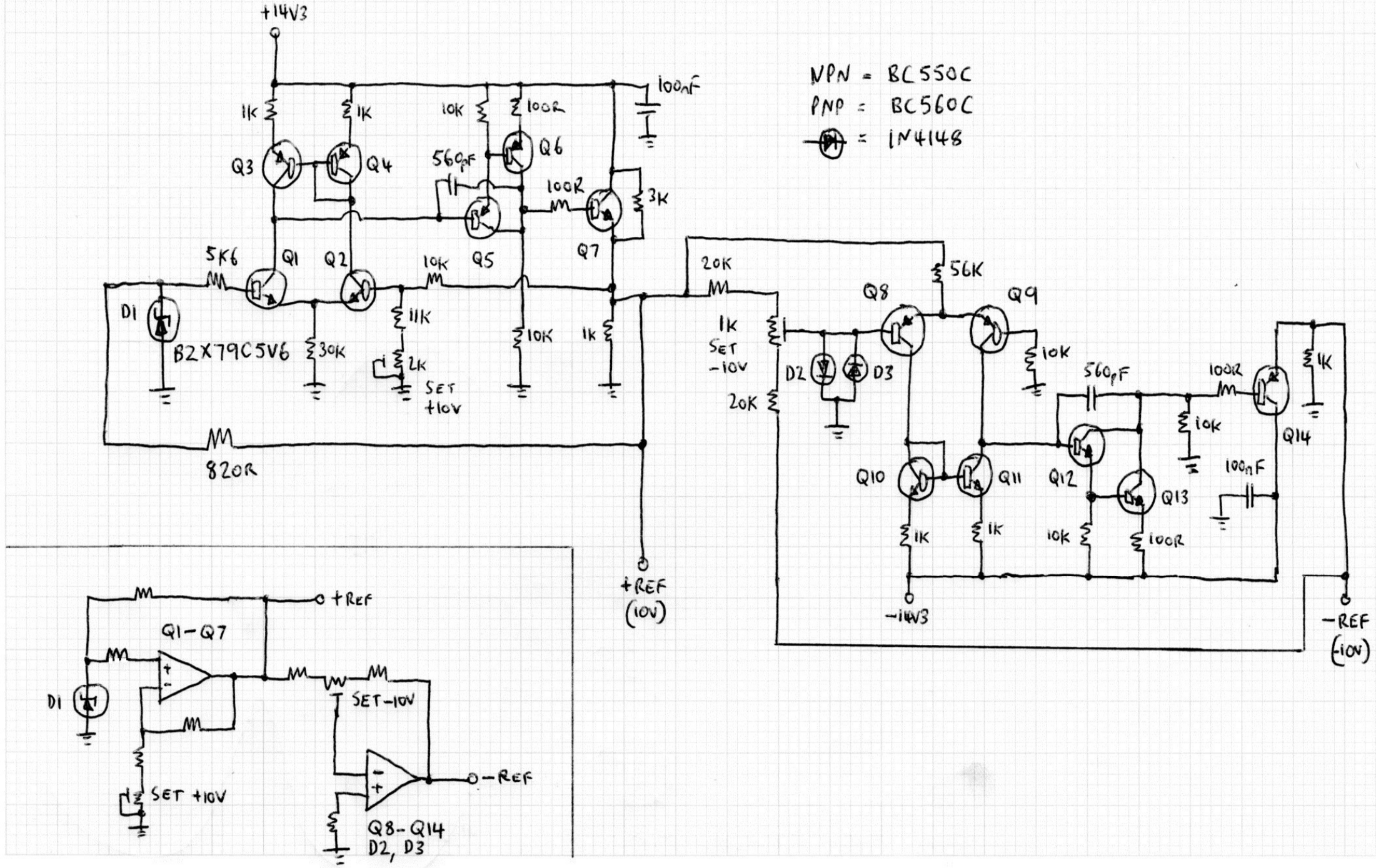
GRATICULE 10cm x 8cm
VERT. AND HORIZONTAL SENSITIVITY : 1V/cm



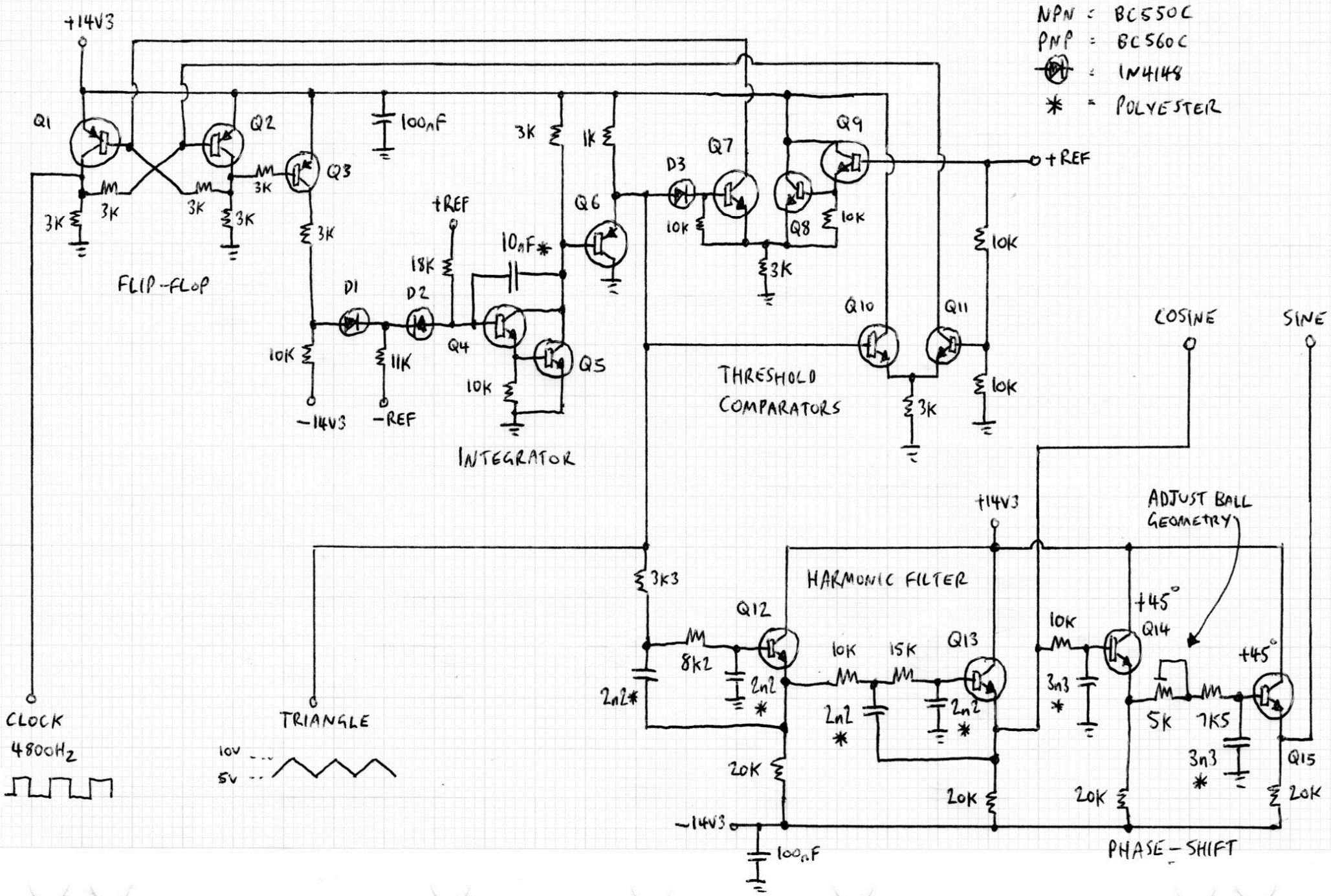
HORIZONTAL AND VERTICAL DEFLECTION CIRCUIT TRIMMER POTENTIOMETERS :

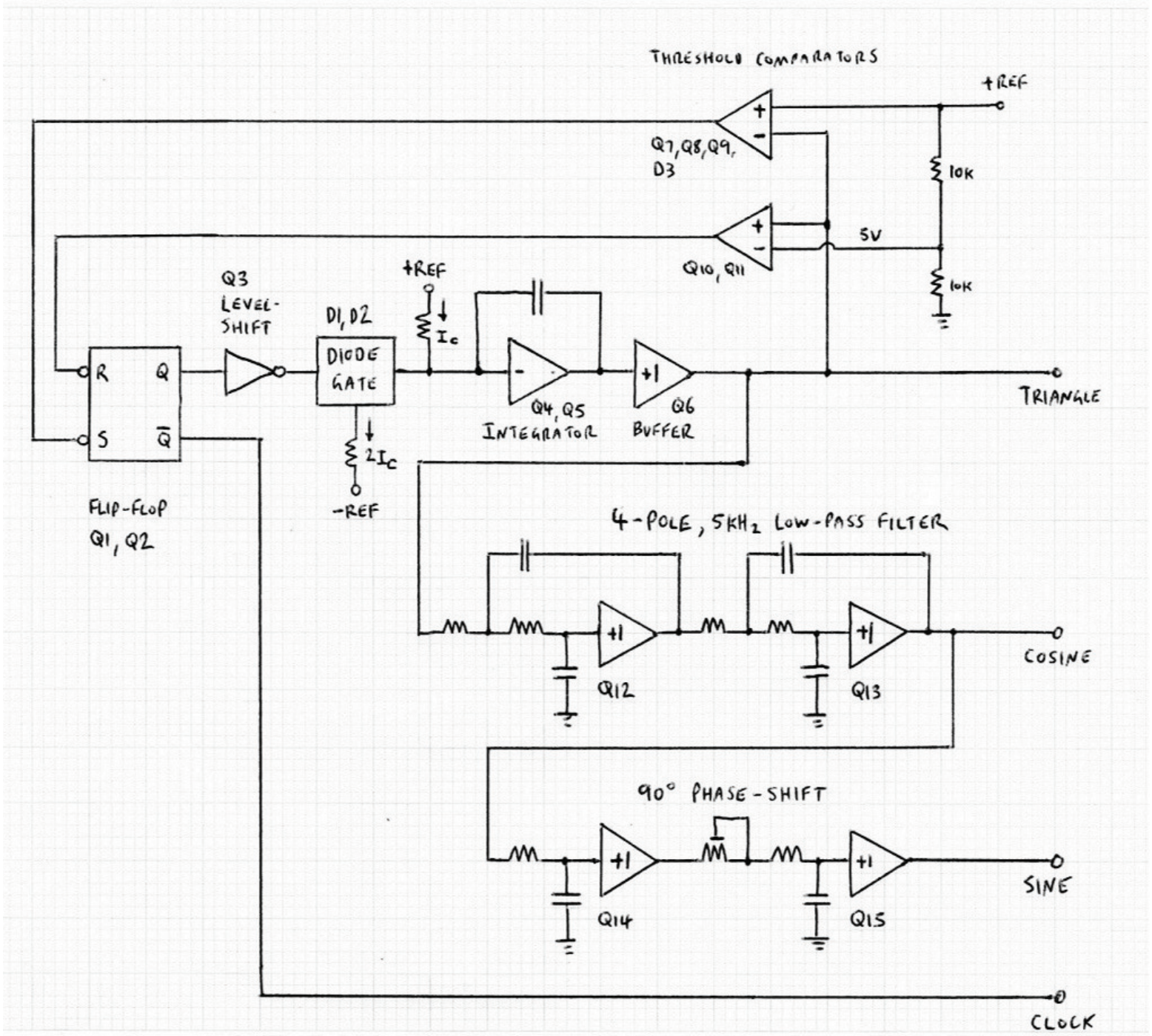
A = RV8 - CENTER BALL DEFLECTION 7.5Vpp
B = RV1 - BALL HEIGHT. 500mVpp
C = RV2 - COURT DIVIDER HEIGHT 8Vpp
D = RV3 - PADDLE 1 HEIGHT 1Vpp
E = RV4 - PADDLE 2 HEIGHT 1Vpp
F = RV9 - CENTER BALL DEFLECTION 8.5Vpp
G = RV5 - BALL WIDTH 500mVpp
H = RV6 - PADDLE 1 HORIZONTAL POSITION
I = RV7 - PADDLE 2 HORIZONTAL POSITION

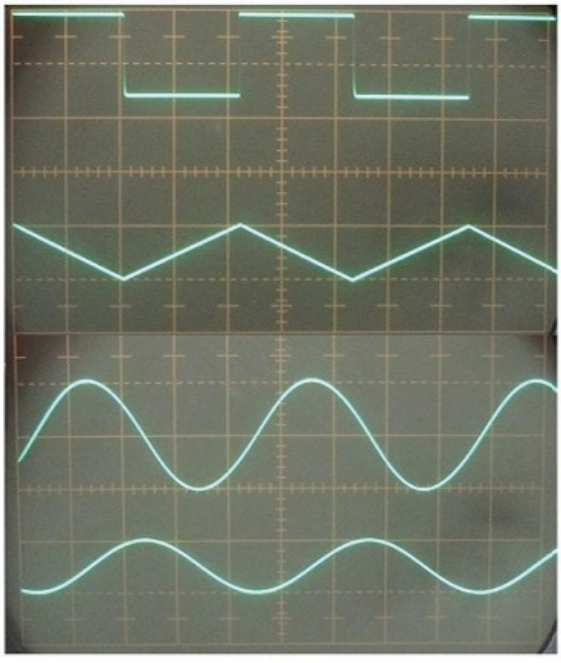
REFERENCE REGULATOR



FUNCTION GENERATOR







Clock
5V/div.

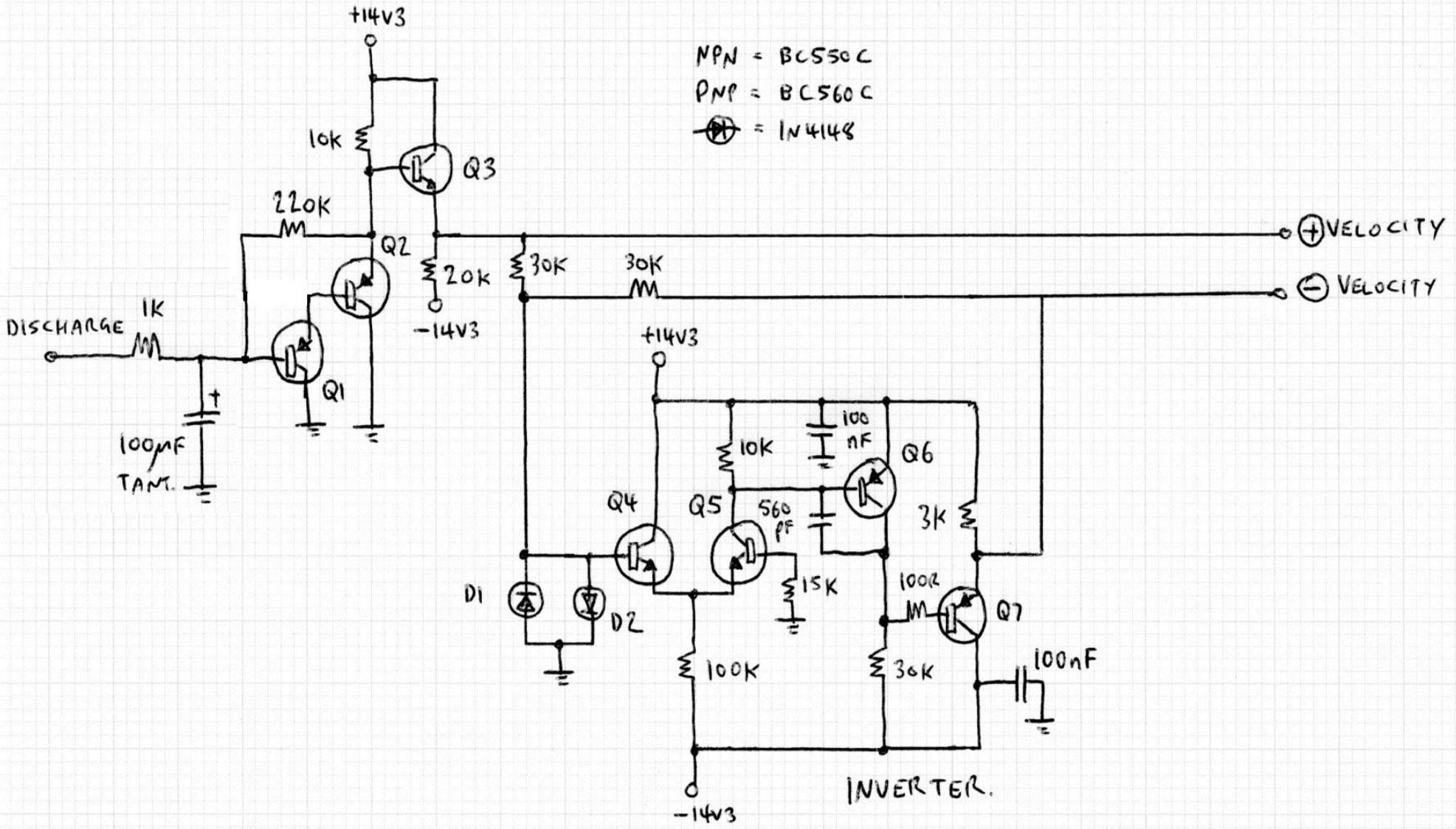
Triangle
5V/div.

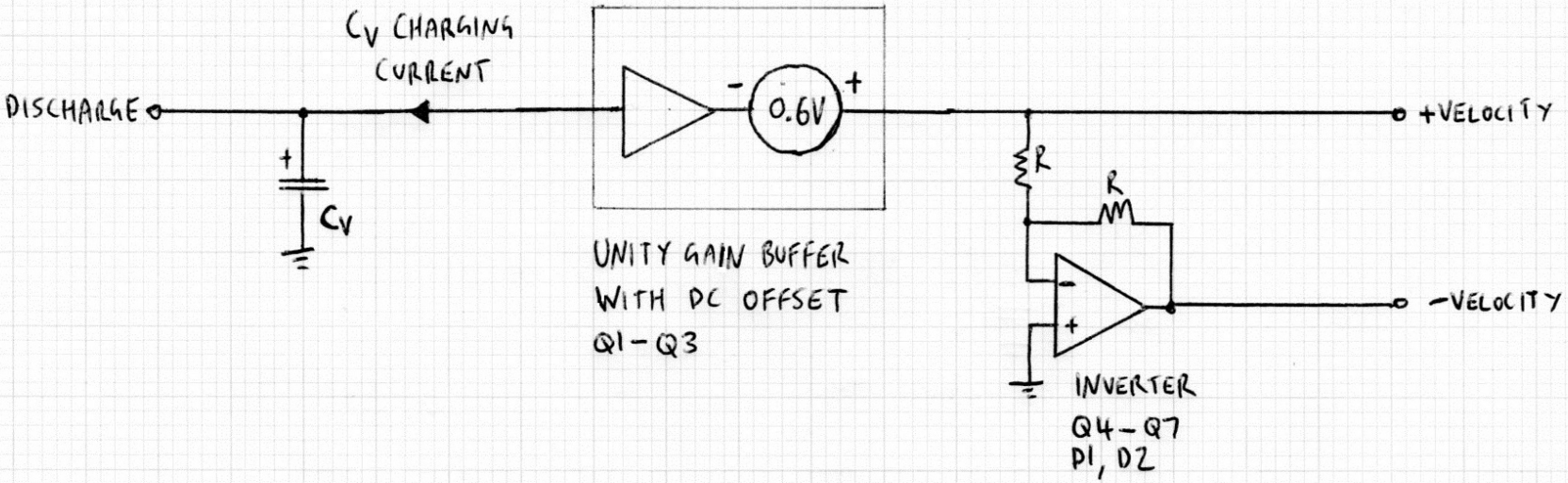
Cosine
1V/div.

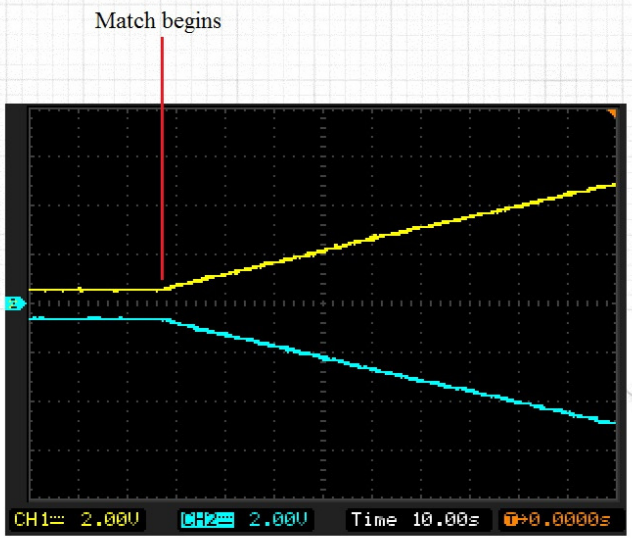
Sine
1V/div.

50uS/div.

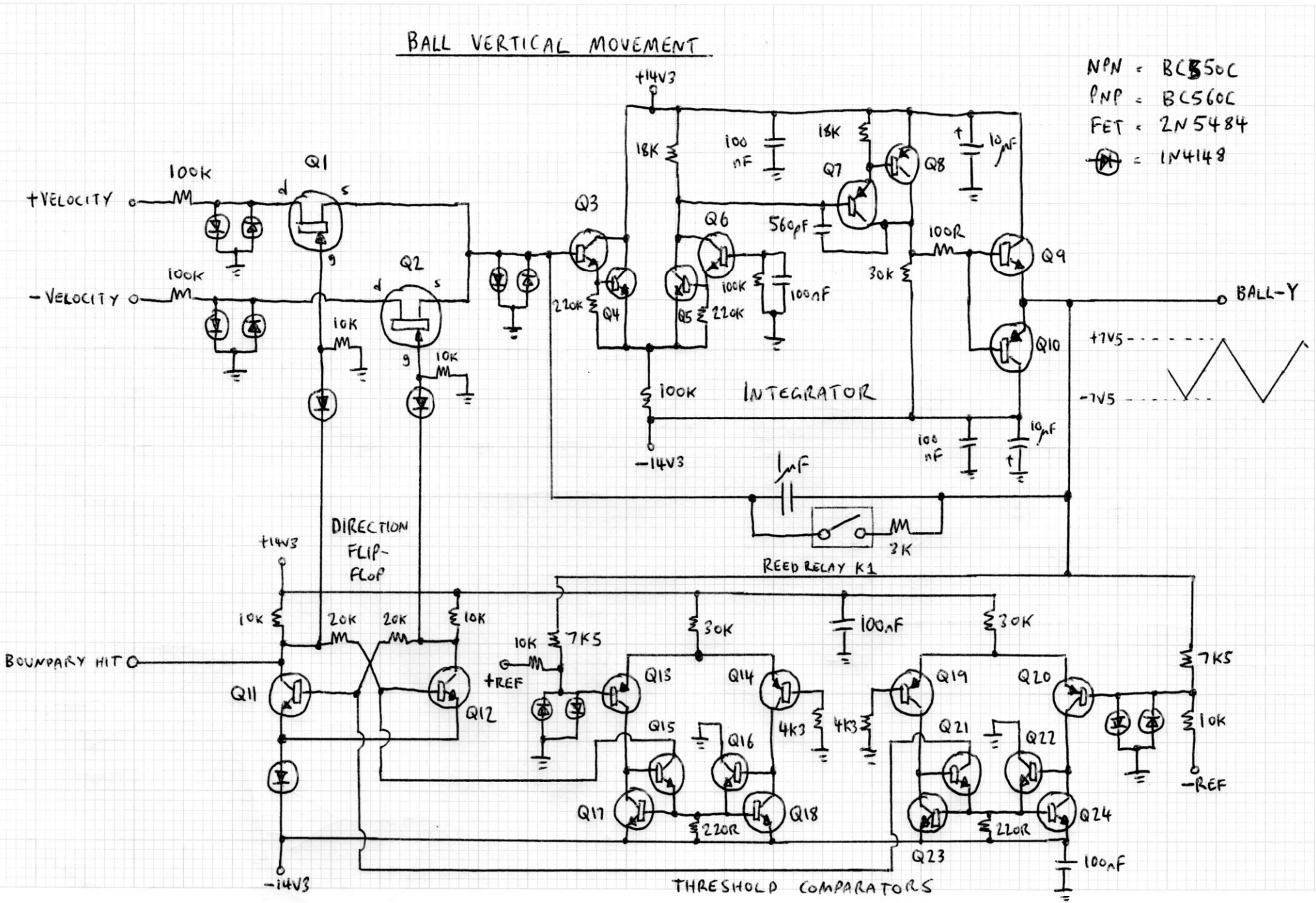
VELOCITY INTEGRATOR

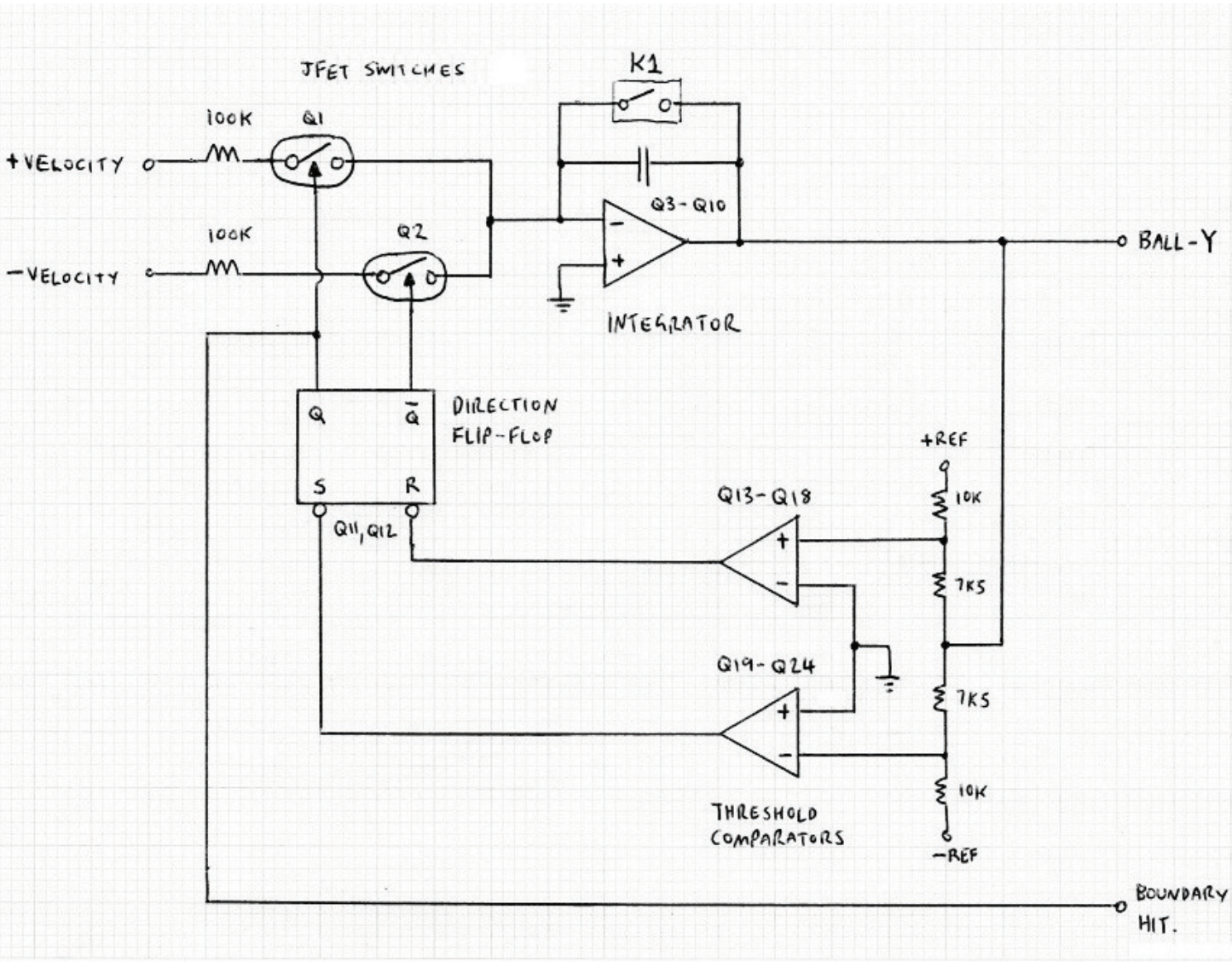


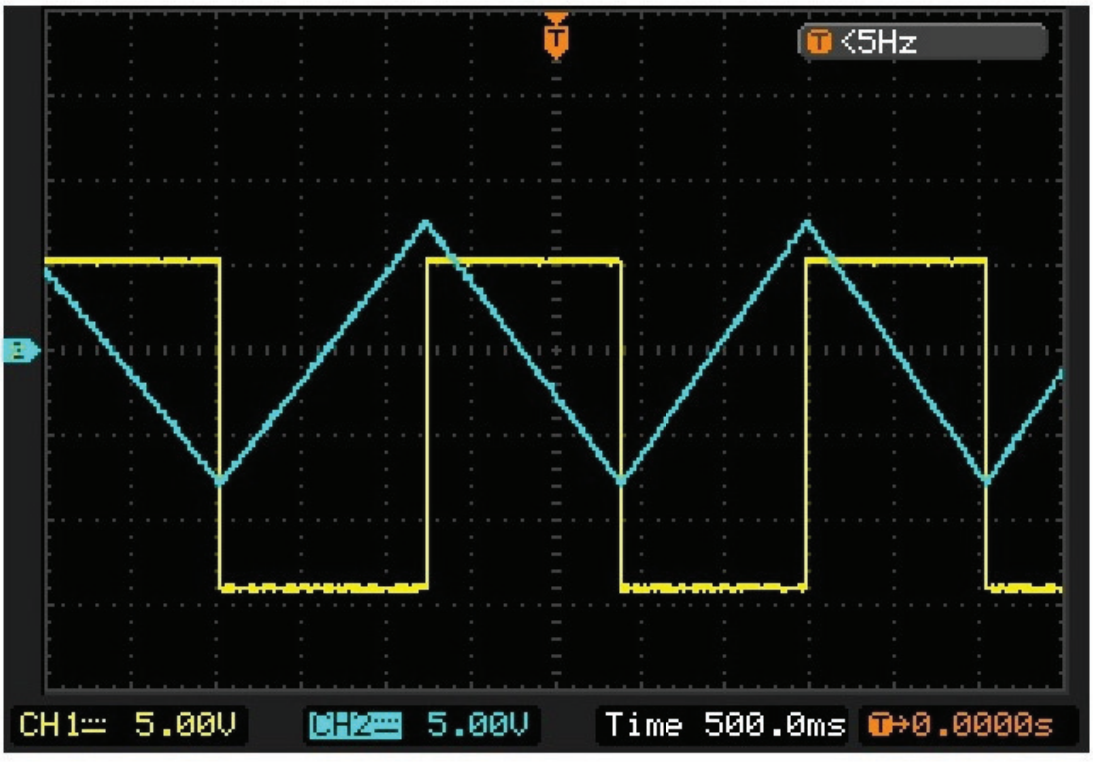




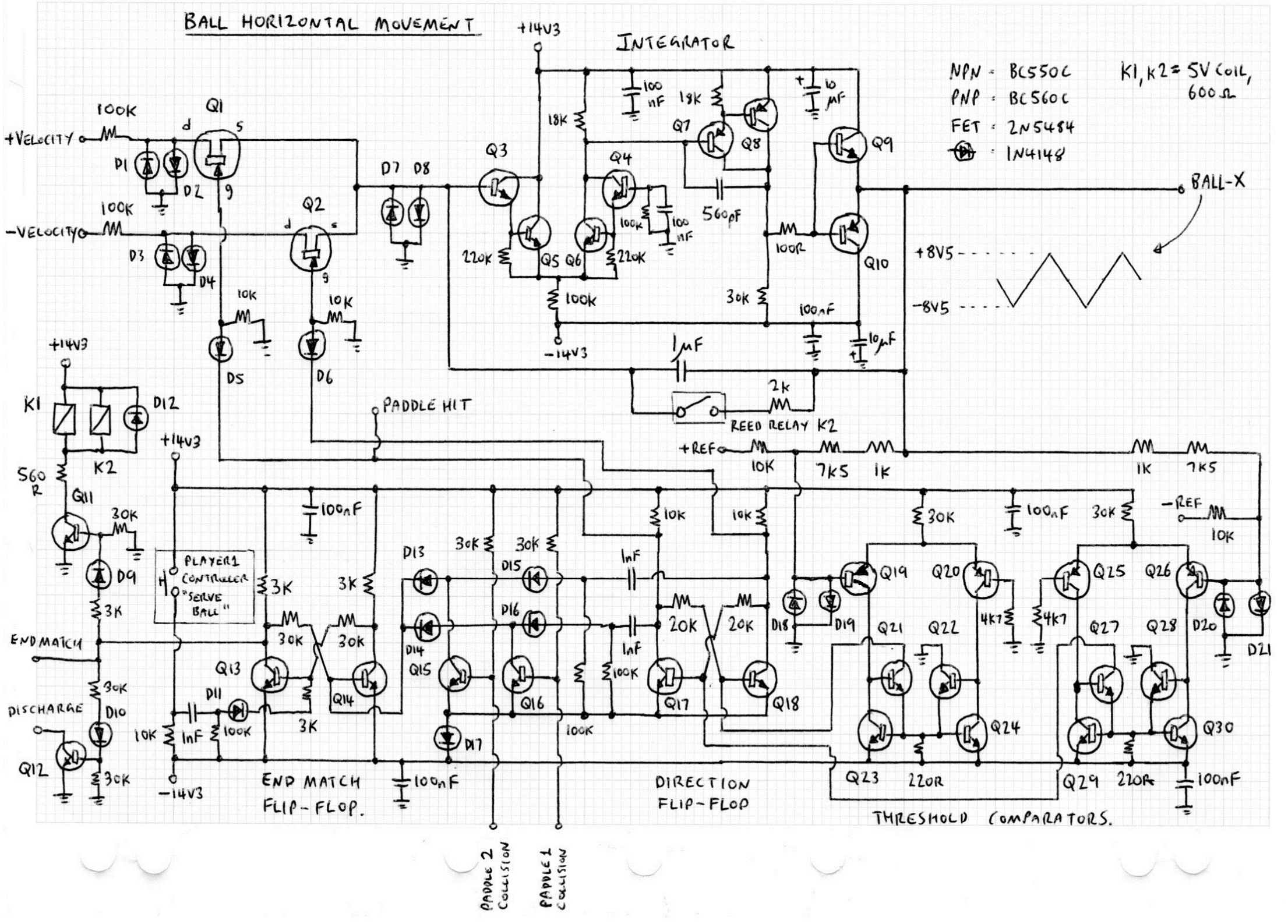
CH1 = +Velocity
CH2 = -Velocity

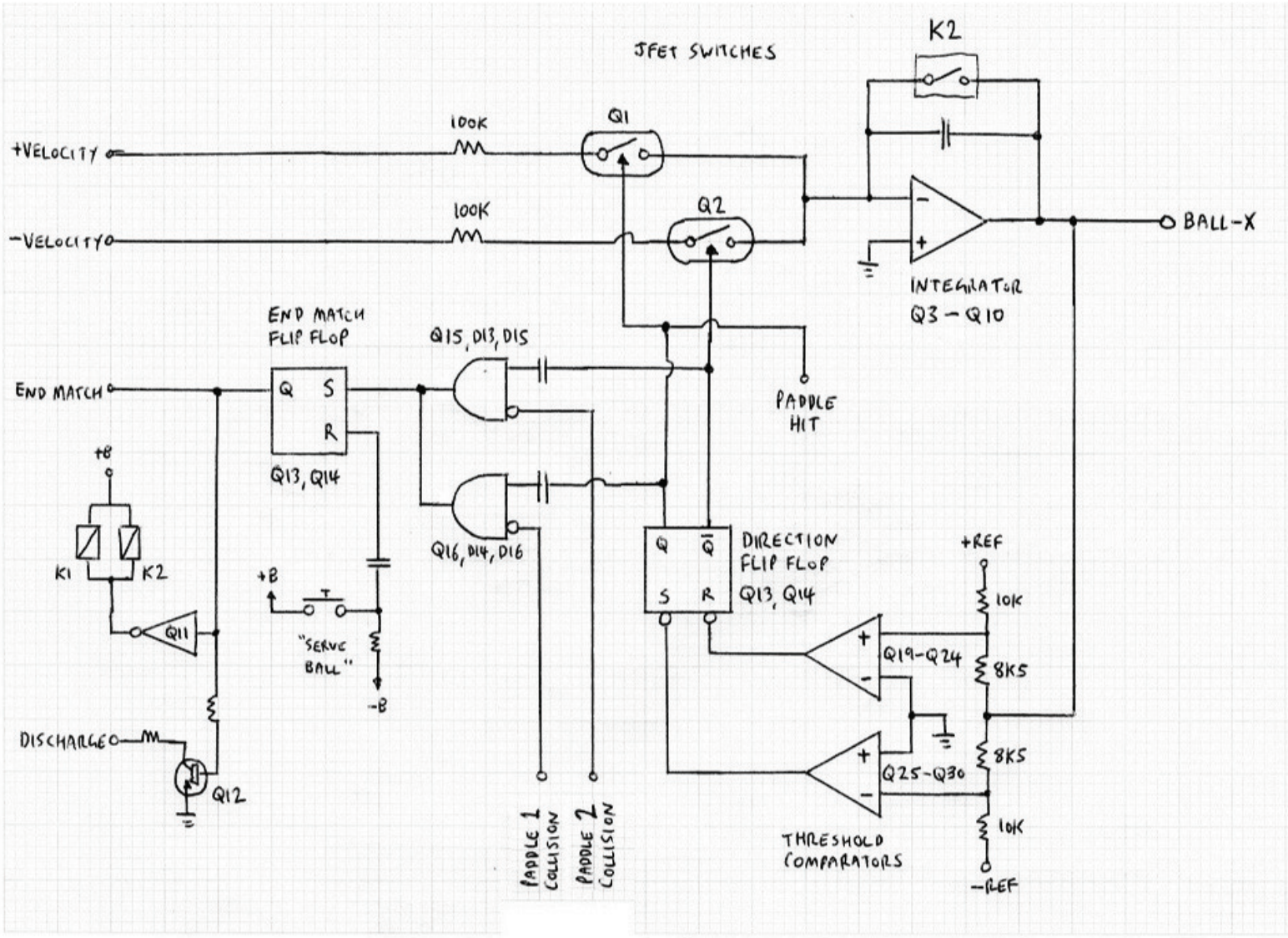

BALL VERTICAL MOVEMENT
NPN = BC550C
PNP = BC560C
FET = 2N5484
= 1N4148
+14V3
-14V3
+VELOCITY
-VELOCITY
100K
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
18K
100 nF
560pF
100R
30K
100nF
10µF
22OK
10K
INTEGRATOR
BALL-Y
+7V5
-7V5
1µF
3K
REED RELAY K1
DIRECTION FLIP-FLOP
BOUNDARY HIT
20K
7K5
+REF
-REF
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
4K3
220R
Q19
Q20
Q21
Q22
Q23
Q24
THRESHOLD COMPARATORS

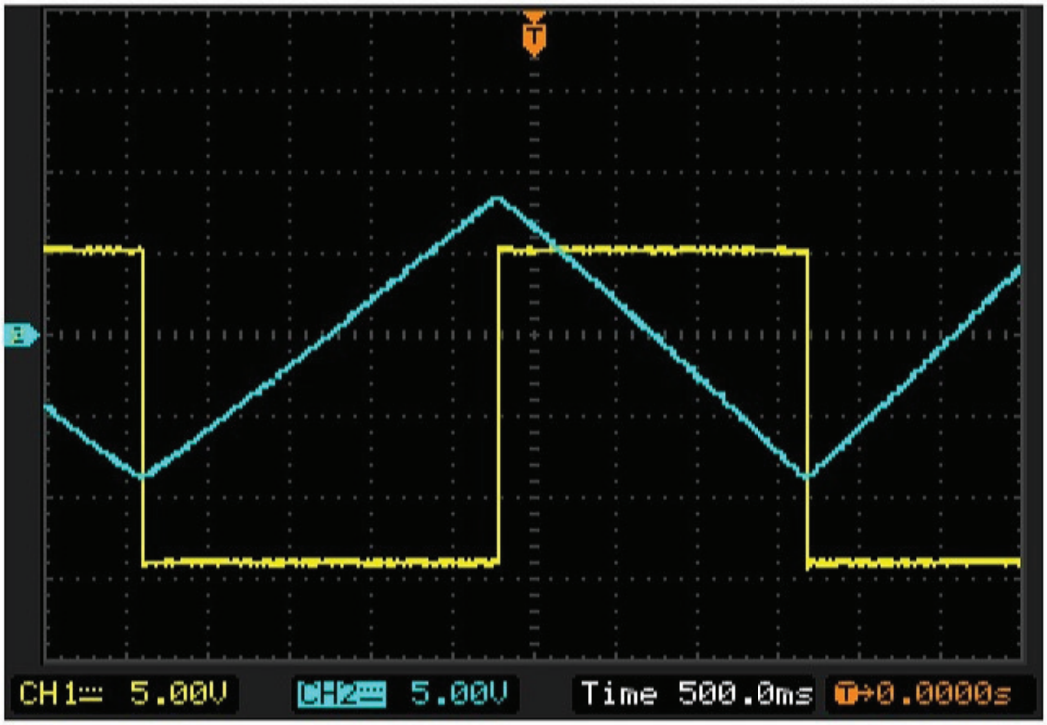




CH1 = Ball-Y
CH2 = Boundary hit

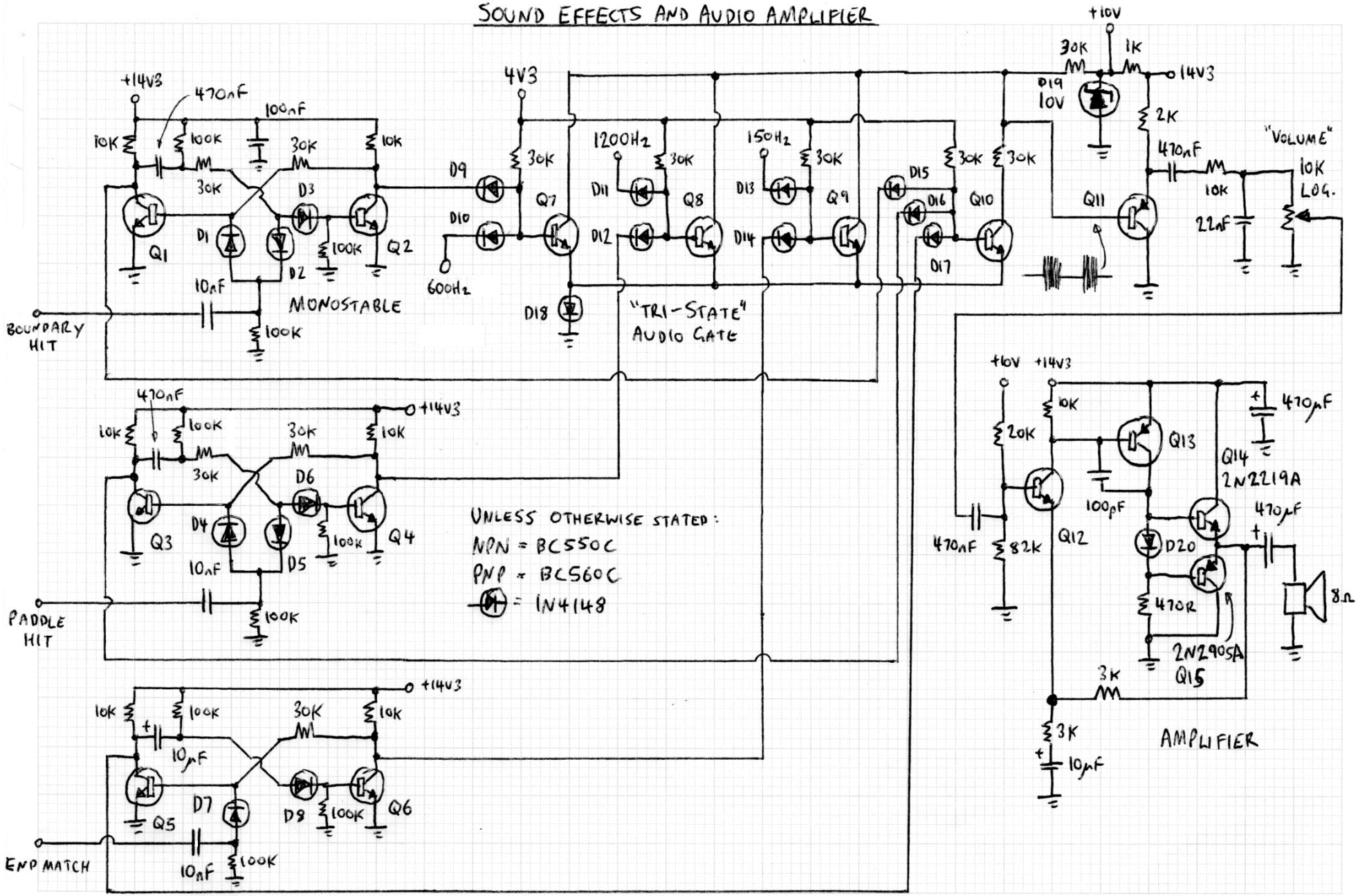

BALL HORIZONTAL MOVEMENT
INTEGRATOR
NPN = BC550C
PNP = BC560C
FET = 2N5484
D = 1N4148
K1, K2 = 5V COIL, 600Ω
+VELOCITY
-VELOCITY
100K
Q1
Q2
D1
D2
D3
D4
D5
D6
D7
D8
10K
+14V3
-14V3
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
18K
100nF
10µF
220K
100K
560pF
100R
30K
1µF
2K
REED RELAY K2
BALL-X
+8V5
-8V5
PADDLE HIT
K1
K2
D12
560R
Q11
D9
3K
END MATCH
DISCHARGE
D10
Q12
PLAYER1 CONTROLLER "SERVE BALL"
Q13
Q14
D11
1nF
D13
D14
D15
D16
D17
Q15
Q16
Q17
Q18
20K
END MATCH FLIP-FLOP.
DIRECTION FLIP-FLOP
+REF
-REF
7K5
1K
Q19
Q20
Q21
Q22
Q23
Q24
4K7
220R
D18
D19
Q25
Q26
Q27
Q28
Q29
Q30
D20
D21
THRESHOLD COMPARATORS.
PADDLE 2 COLLISION
PADDLE 1 COLLISION

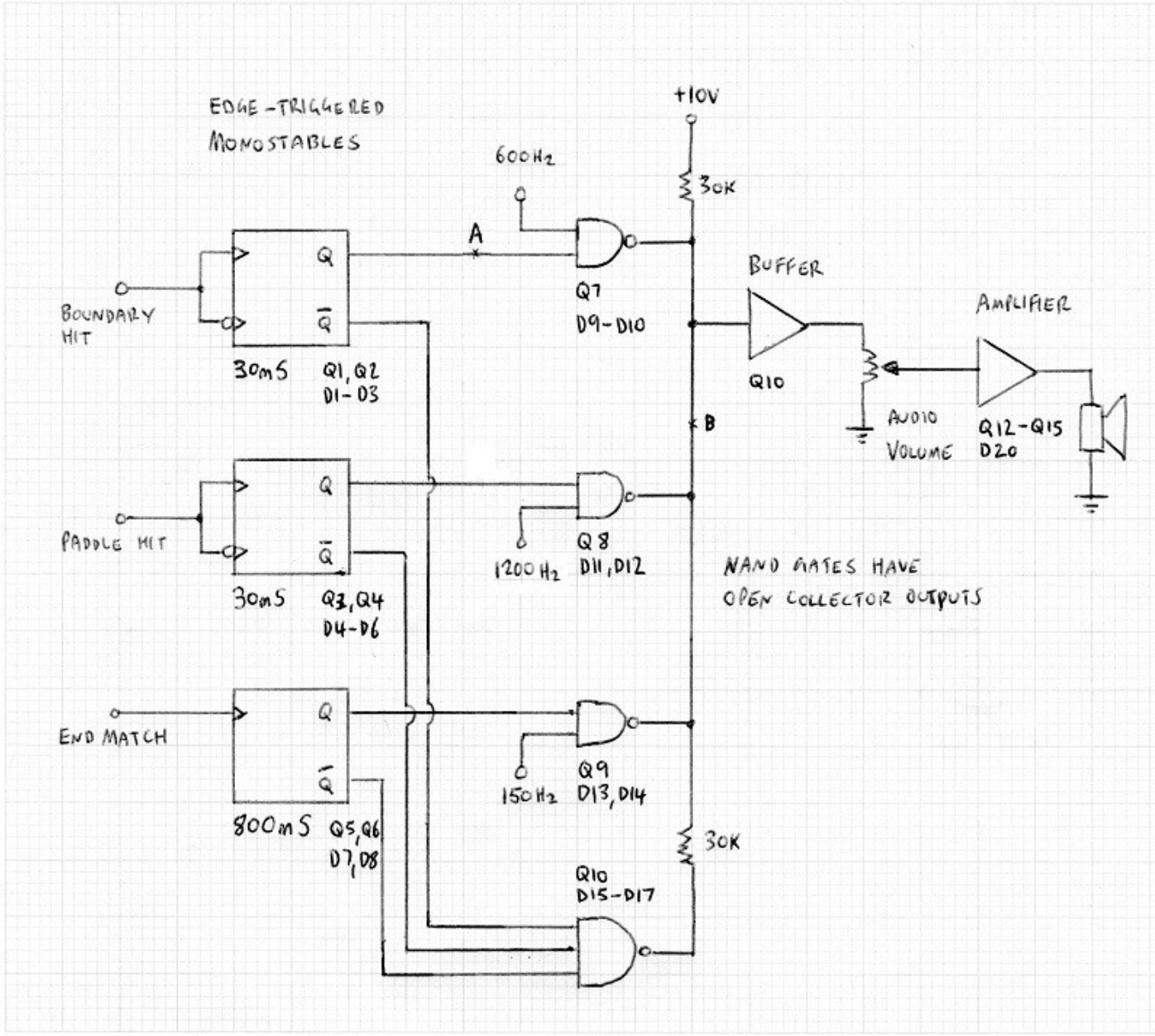




CH1 = Paddle Hit
CH2 = Ball-X

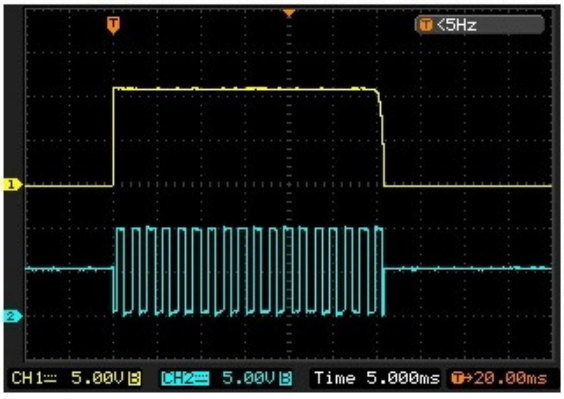
SOUND EFFECTS AND AUDIO AMPLIFIER

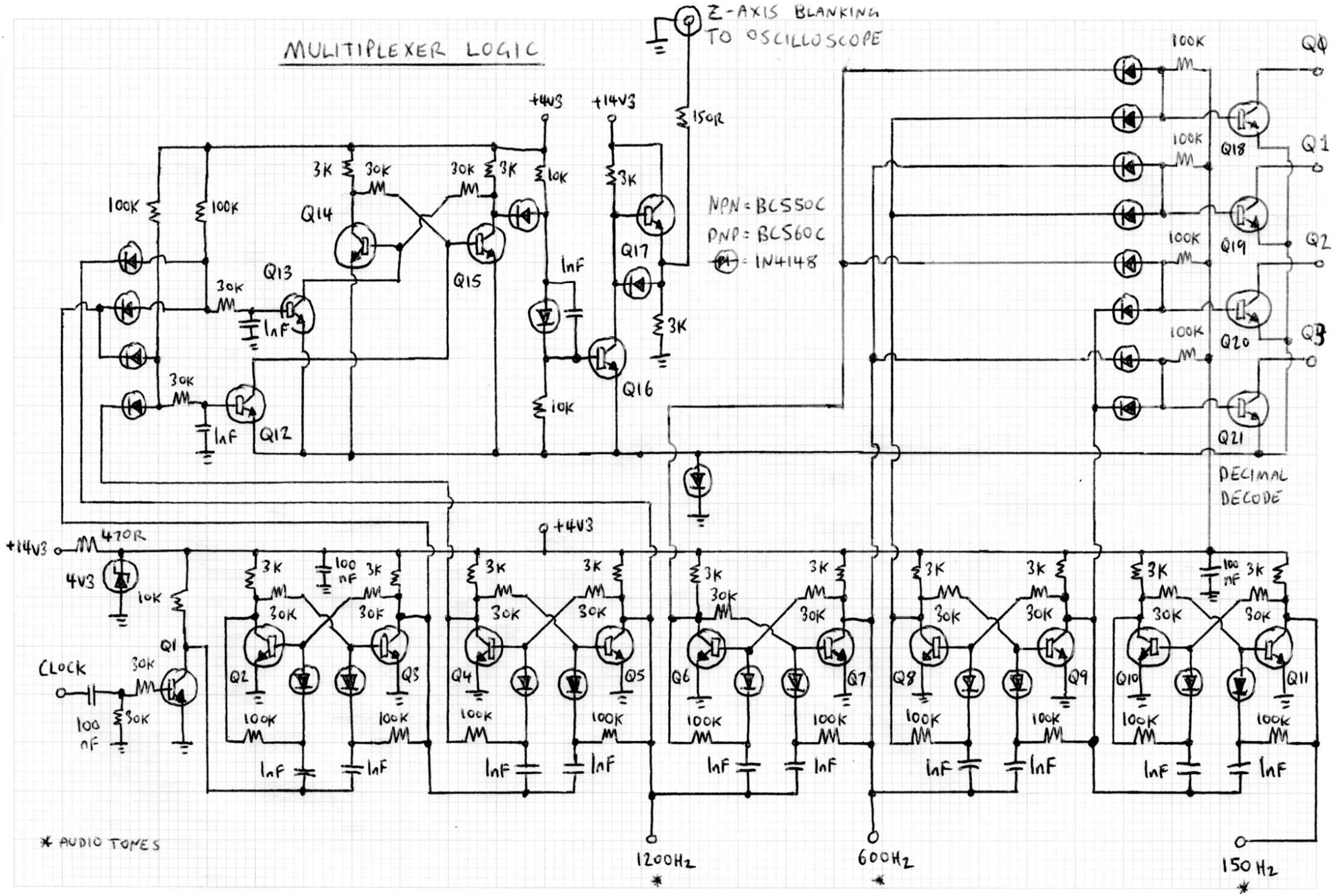


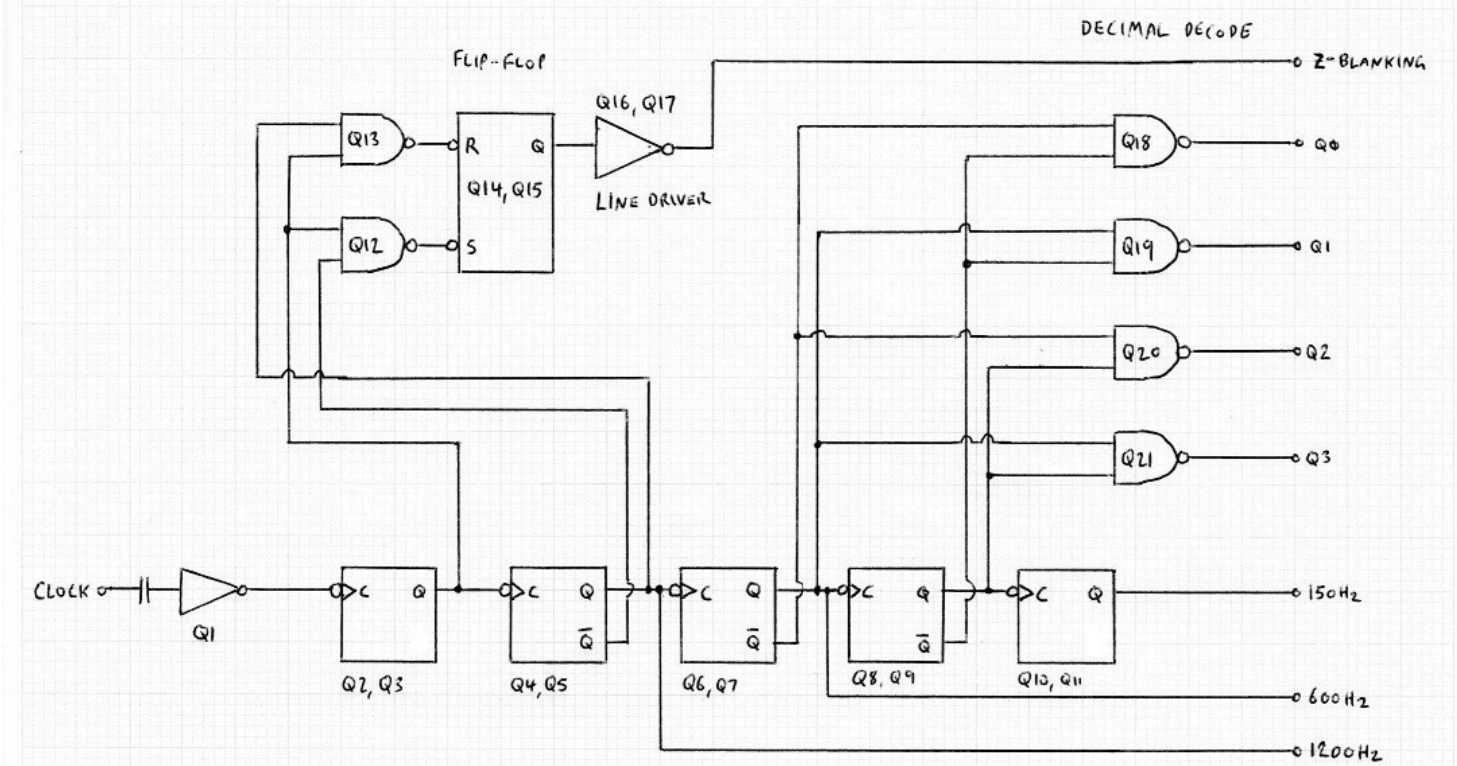

EDGE-TRIGGERED
MONOSTABLES
+10V
600Hz
30K
A
BUFFER
AMPLIFIER
Q7
D9-D10
BOUNDARY
HIT
Q
Q̄
30mS
Q1, Q2
D1-D3
Q10
B
AUDIO
VOLUME
Q12-Q15
D20
PADDLE HIT
1200Hz
Q8
D11, D12
NAND GATES HAVE
OPEN COLLECTOR OUTPUTS
30mS
Q3, Q4
D4-D6
END MATCH
150Hz
Q9
D13, D14
800mS
Q5, Q6
D7, D8
30K
Q10
D15-D17

A

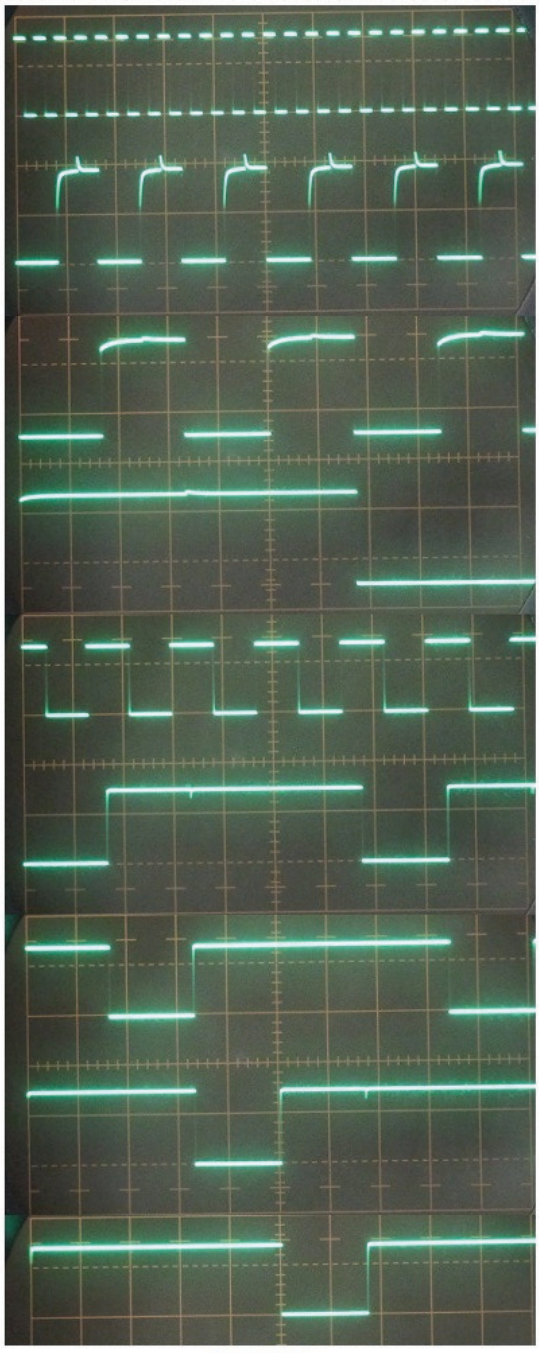
B


<5Hz
CH1 5.00V
CH2 5.00V
Time 5.000ms
20.00ms


MULITIPLEXER LOGIC
Z-AXIS BLANKING
TO OSCILLOSCOPE
150R
+4V3
+14V3
NPN = BC550C
PNP = BC560C
1N4148
100K
30K
3K
10K
1nF
Q13
Q14
Q15
Q16
Q17
Q12
Q18
Q19
Q20
Q21
Q0
Q1
Q2
Q3
DECIMAL
DECODE
470R
4V3
CLOCK
100 nF
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
* AUDIO TONES
1200Hz
600Hz
150Hz



CASCADED TOGGLE FLIP-FLOPS FORM A 5-BIT BINARY RIPPLE COUNTER.



Clock
5V/div.

1200 Hz
2V/div.

600 Hz
2V/div.

150 Hz
2V/div.

Z-Blanking
10V/div.

Q0
10V/div.

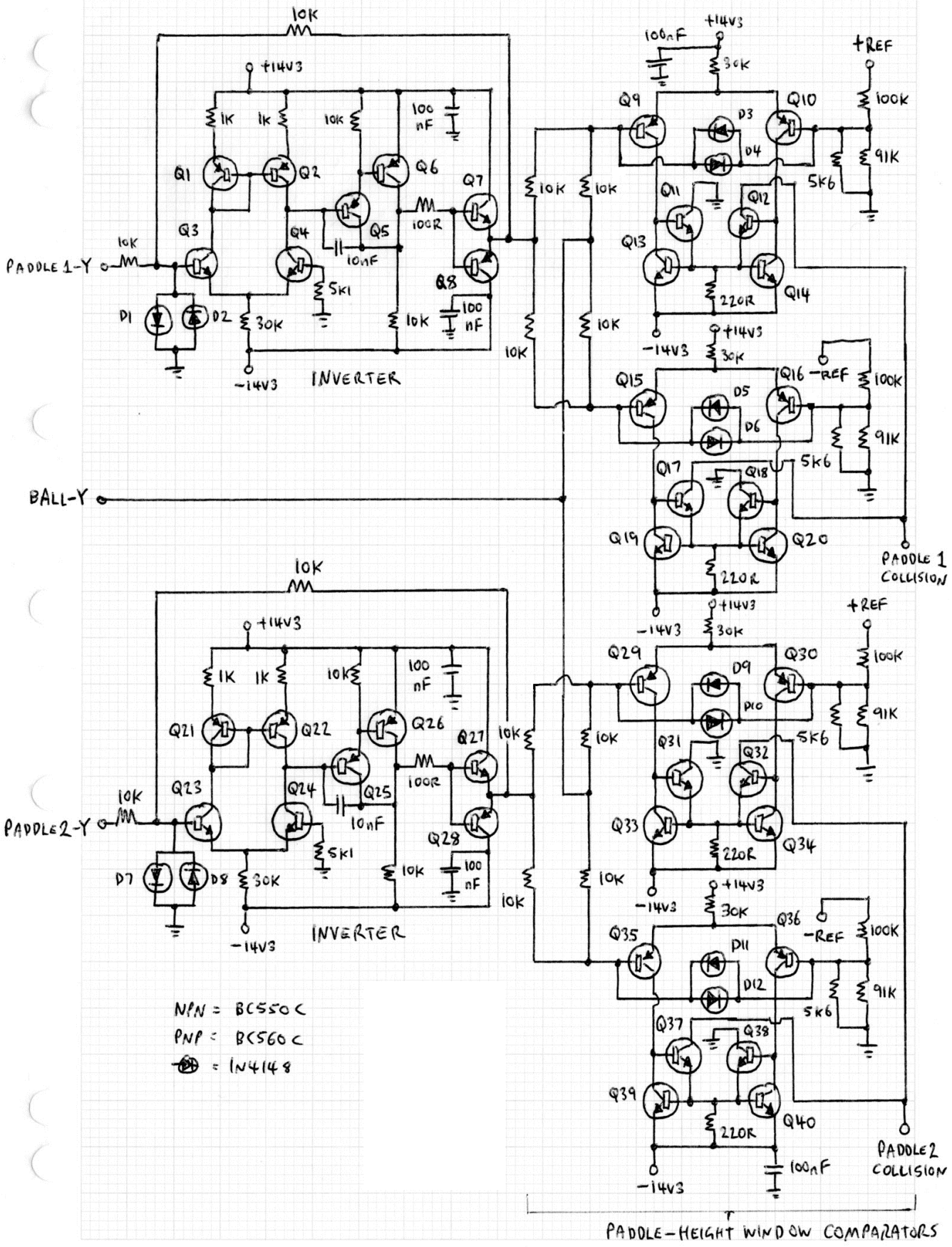
Q1
10V/div.

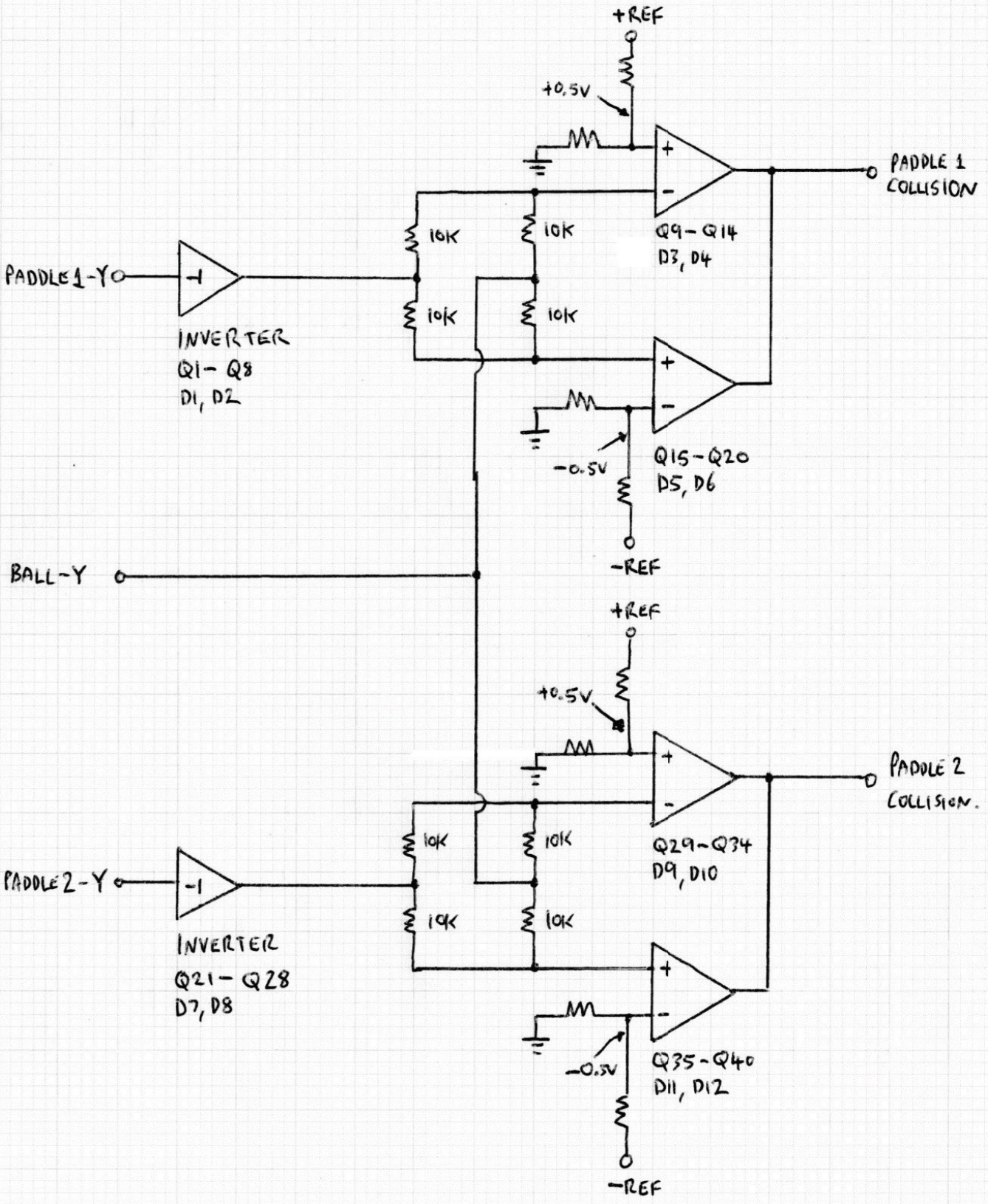
Q2
10V/div.

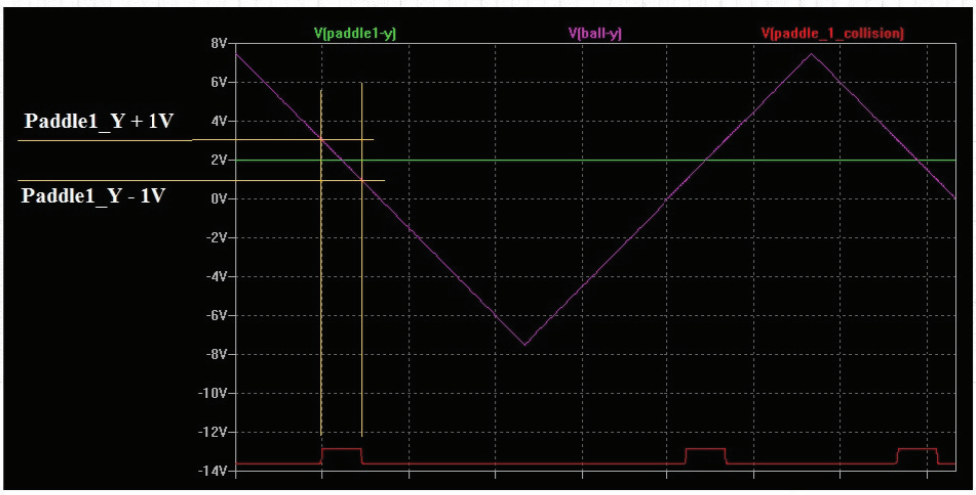
Q3
10V/div.

500uS/div.

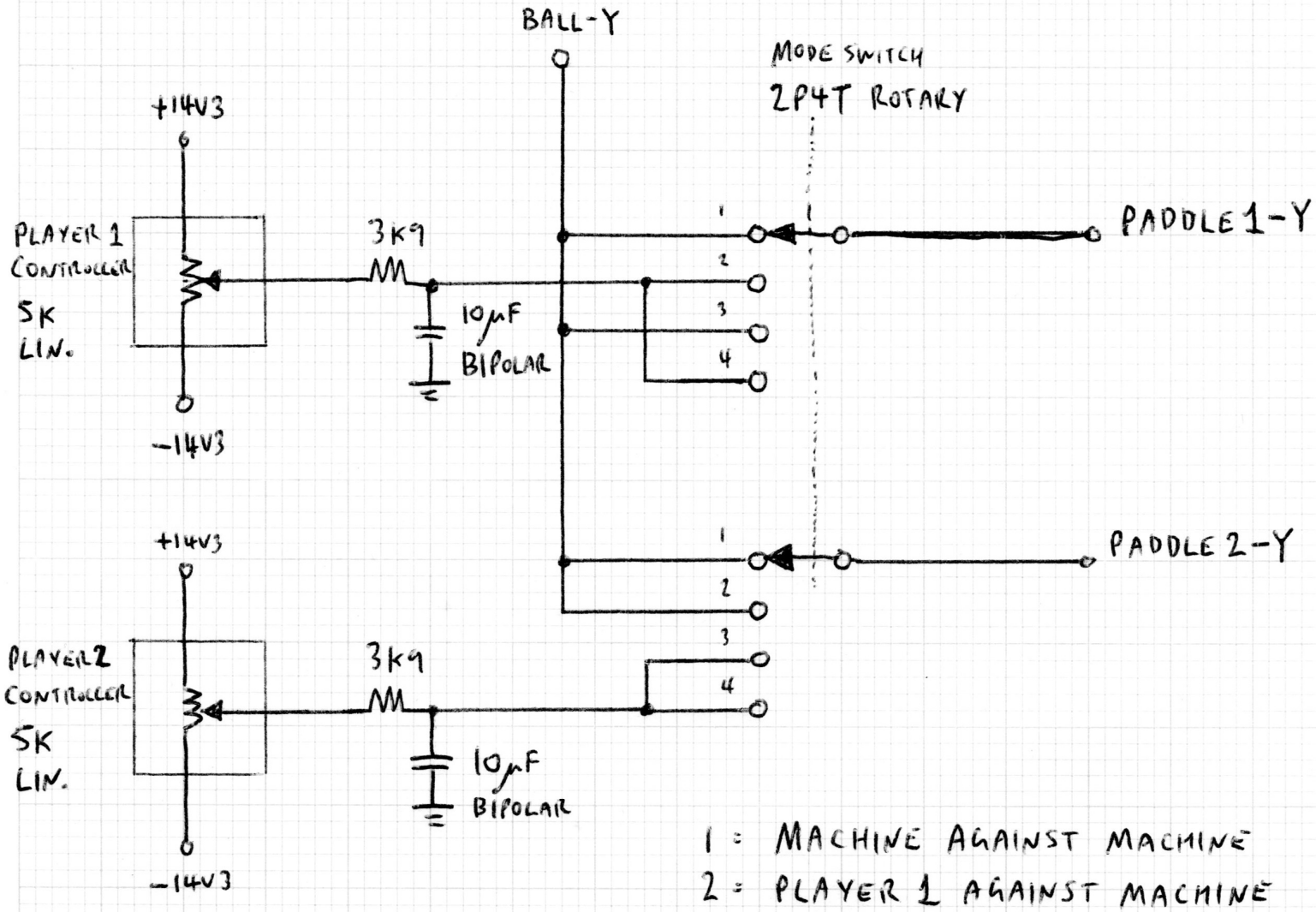
PADDLE-BALL COLLISION DETECTION




+REF
+0.5V
PADDLE 1 COLLISION
10K
10K
10K
10K
Q9 - Q14
D3, D4
PADDLE 1-Y
-1
INVERTER
Q1 - Q8
D1, D2
-0.5V
Q15 - Q20
D5, D6
-REF
BALL-Y
+REF
+0.5V
PADDLE 2 COLLISION.
10K
10K
10K
10K
Q29 - Q34
D9, D10
PADDLE 2-Y
-1
INVERTER
Q21 - Q28
D7, D8
-0.5V
Q35 - Q40
D11, D12
-REF

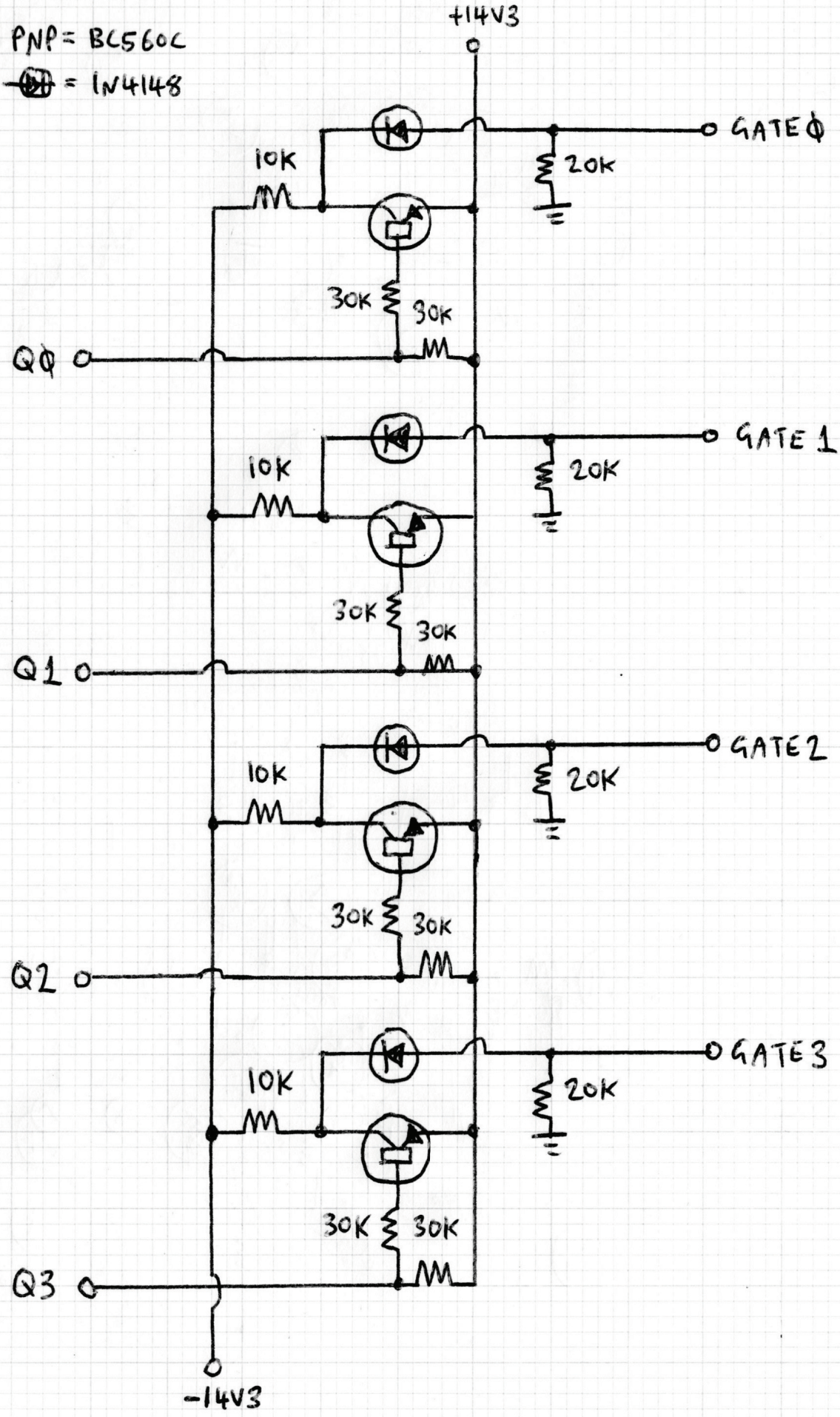

V(paddle1-y)
V(ball-y)
V(paddle_1_collision)
Paddle1_Y + 1V
Paddle1_Y - 1V
8V
6V
4V
2V
0V
-2V
-4V
-6V
-8V
-10V
-12V
-14V

MODE SWITCHING.

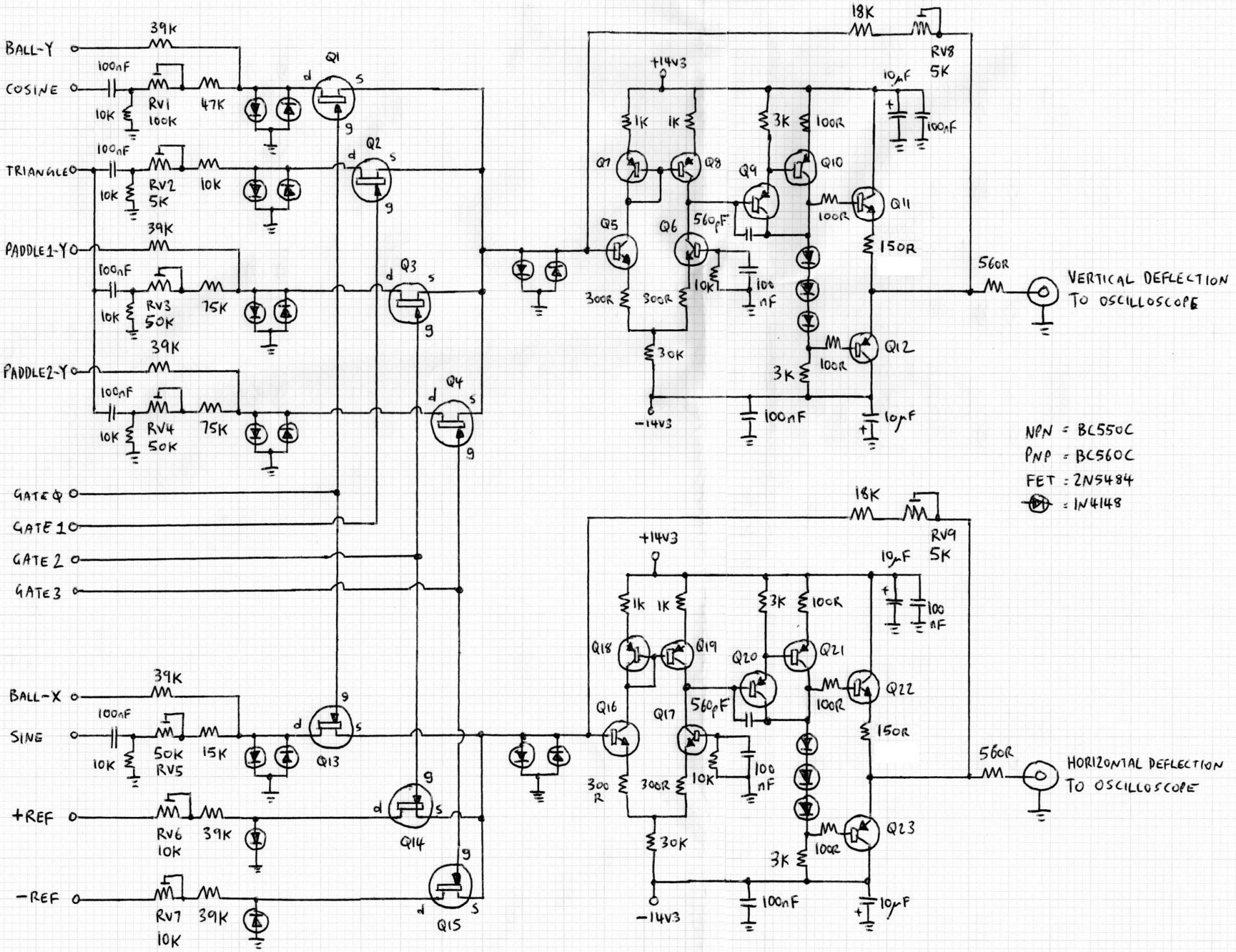


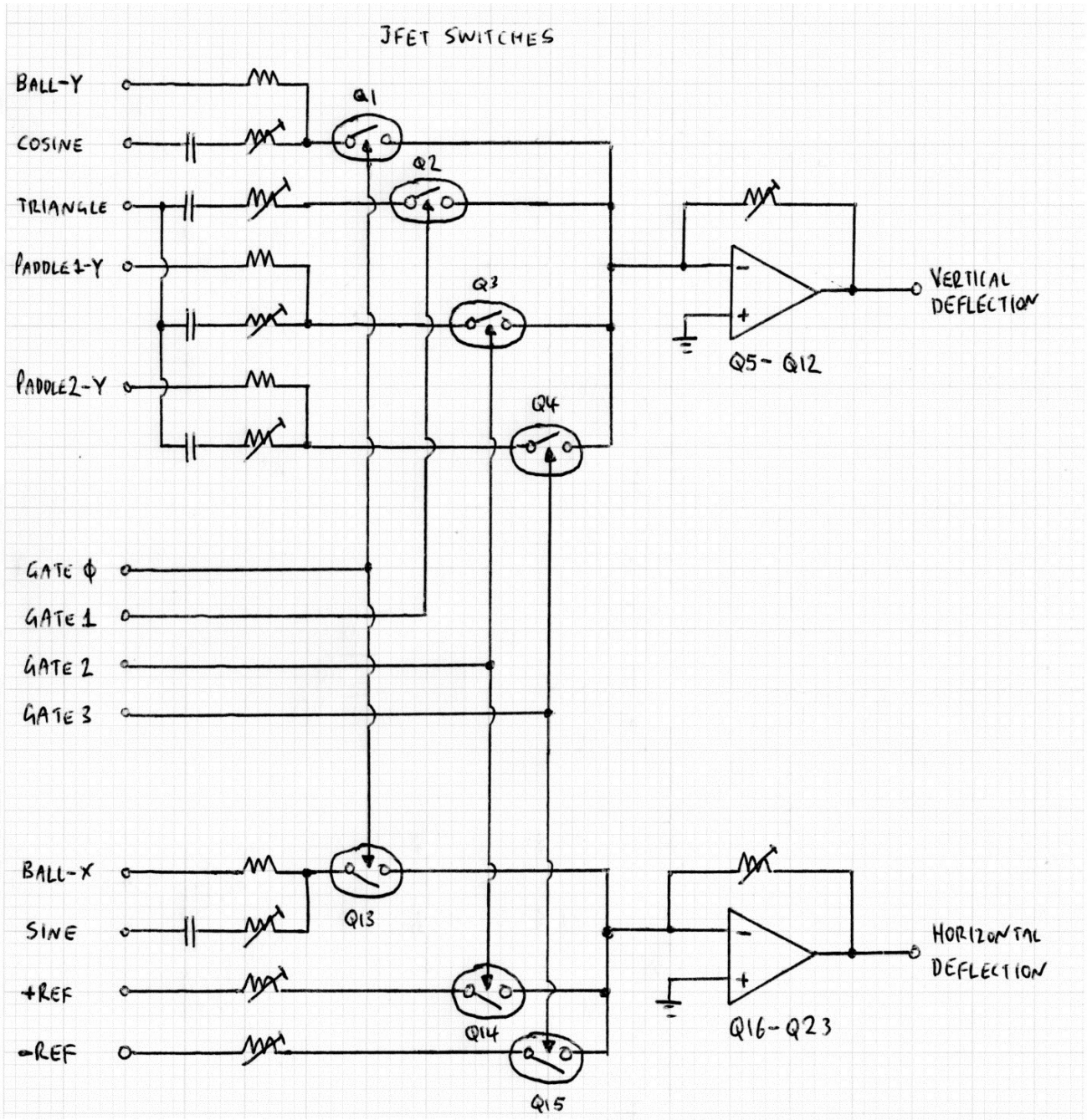
1 = MACHINE AGAINST MACHINE
2 = PLAYER 1 AGAINST MACHINE
3 = PLAYER 2 AGAINST MACHINE
4 = PLAYER 1 AGAINST PLAYER 2

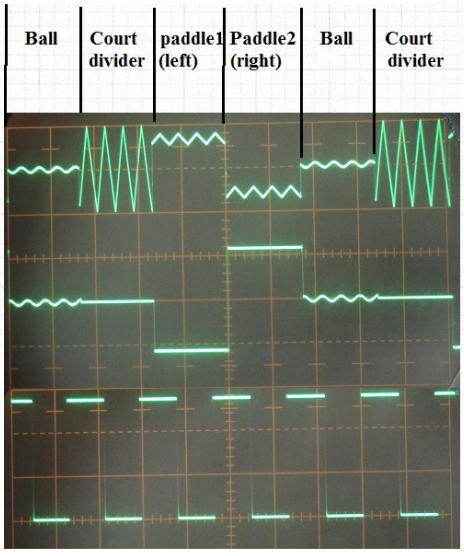
MULTIPLEXER FET GATE DRIVE



HORIZONTAL AND VERTICAL DEFLECTION







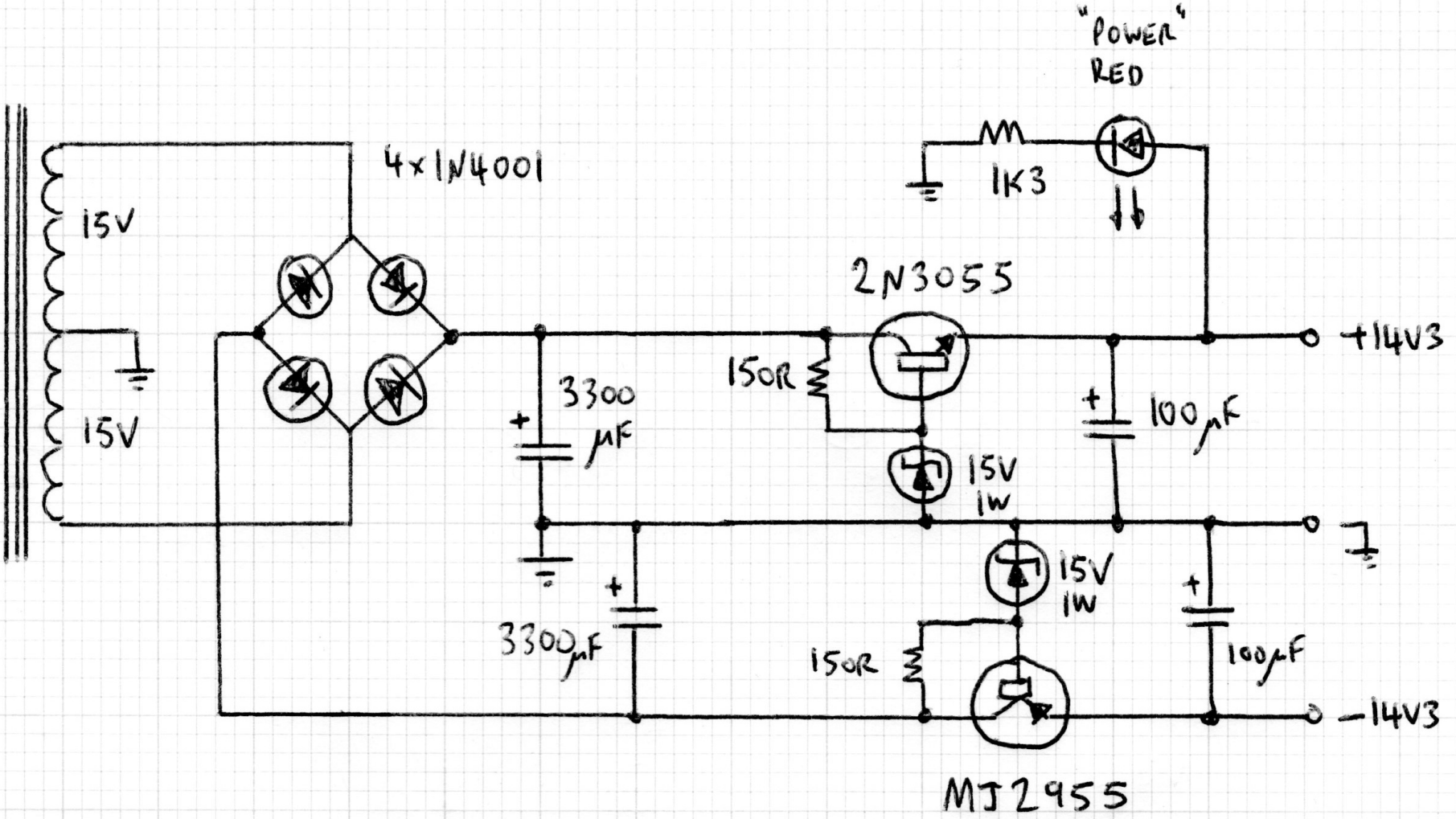
Vertical deflection 4V/div.

Hozizontal deflection 4V/div.

Z-axis blanking 5V/div. Beam cut-off when high

500uS/div.

POWER SUPPLY



The End

Happy Soldering!