Oscilloscope Pong
For one or two players

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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
4) 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.
HORIZONTAL AND VERTICAL DEFLECTION ADJUSTMENTS

GRATICULE 10cm x 8cm
VERT. AND HORIZONTAL SENSITIVITY = 4V/cm

CIRCUIT TRIMMER POTENTIOMETERS:

A = RV8 - CENTER BALL DEFLECTION 7.5Vpp
B = RV1 - BALL HEIGHT 500mVpp
C = RV2 - COURT DIVIDER HEIGHT 3Vpp
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
FUNCTION GENERATOR

NPN = BC550C
PNP = BC560C
R = 1W4148
* = POLYESTER

Q1 Q2 Q3
3k 3k 3k

Q4 Q5
18k 10k

Q6 Q7 Q8 Q9
10k 10k 3k 3k

D3 D1 D2

Q10 Q11

INTEGRATOR

100µF

Q12 Q13 Q14 Q15

HARMONIC FILTER

+14V3

CLOCK 4800Hz

+10V -5V

TRIANGLE

Phase-Shift

Cosine Sine
**Velocity Integrator**

- **NPN**: BC550C
- **PNP**: BC560C
- **Q1**: 1N4148

Diagram:

- Discharge 1K
- 100µF Tantalum
- Q1, Q2, Q3, Q4, Q5, Q6, Q7
- 10K, 22K, 30K, 100nF, 100µF
- INVERTER
- +VELOCITY
- -VELOCITY
Match begins

CH1 = +Velocity
CH2 = -Velocity
CH1 = Ball-Y
CH2 = Boundary hit
CH1 = Paddle Hit
CH2 = Ball-X
EDGE-TRIGGERED MONOSTABLES

+10V

50k

600 Hz

Boundary Hit

Paddle Hit

End Match

30 ns Q1, Q2 D1-D5

30 ns Q3, Q4 D4-D6

800 ns Q5, Q6 D7, D8

1200 Hz D10, D12

150 Hz D13, D14

300 Hz D15, D17

Q10

Audio Volume

Q12-Q15 D20

A

B

WAVES HASE OPEN COLLECTOR OUTPUTS
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.

500μS/div.
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

PNP: BC560C

\(-\) = 1N4148

\begin{circuit}
\draw
\node at (0,0) {Q0};
\draw
\node at (0,-10) {Q1};
\draw
\node at (0,-20) {Q2};
\draw
\node at (0,-30) {Q3};
\draw
\node at (0,10) {GATE \Phi};
\draw
\node at (0,-40) {GATE 1};
\draw
\node at (0,-50) {GATE 2};
\draw
\node at (0,-60) {GATE 3};
\draw
\node at (0,0) {+14V3};
\draw
\node at (0,-70) {-14V3};
\draw
\node at (0,-75) {10K};
\draw
\node at (0,-78) {10K};
\draw
\node at (0,-81) {10K};
\draw
\node at (0,-84) {10K};
\draw
\node at (0,-87) {30K};
\draw
\node at (0,-90) {30K};
\draw
\node at (0,-93) {30K};
\draw
\node at (0,-96) {30K};
\draw
\node at (0,-99) {30K};
\draw
\node at (0,-102) {30K};
\draw
\node at (0,-105) {20K};
\draw
\node at (0,-108) {20K};
\draw
\node at (0,-111) {20K};
\draw
\node at (0,-114) {20K};
\end{circuit}
POWER SUPPLY

4x1W4001

15V

3300 µF
150R

2N3055

150R

15V 1W

100 µF

15V 1W

MJ2955

+14V3

-14V3
The End

Happy Soldering!