HP 5004a Signature Analysis for Atari Games

Centipede

Missile Command

Millipede

Introduction

As per Peter Fyfe and Al Kossow's excellent documentation on the subject of Signature Analysis, you will have to build a NOP card. I've included instructions for this in the appendix of this document. Other documentation on the subject of Signature Analysis has been floating around the internet for years so if you don't have it, a quick search should be able to locate some of those files.

The signatures in this file pretty much follow the Atari Cat Box signature analysis found in the manuals for these games with the exception that they have been obtained using a HP 5004a signature analyser instead of the much rarer Atari Cat Box.

The documentation follows the conventions of other signature analysis files with the exception that I've used underlining to indicate an active low signal instead of a line above the word (more commonly found in schematics). It was just easier to do that.

If you find any errors in the file, let me know and I'll correct them. Hopefully this information will be of use in keeping your games running. Finally, in the words of Peter Fyfe:

"Disclaimer

If you toast yourself, your house, your dog, your family or more importantly your video

game, then it's not my fault. You use the information contained in this guide at your own

risk. Good luck. "

Cheers,

Mark AKA SpudJones

Centipede

- 6502 NOP card in CPU socket
- Jumper Watchdog Disable to ground

Address Lines

Start -ve C2-25

Stop -ve C2-25

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
C1-12	AB0	UUUU
C1-14	AB1	FFFF
C1-16	AB2	8484
C1-18	AB3	P763
C1-9	AB4	1U5P
C1-7	AB5	0356
C1-5	AB6	U759
C1-3	AB7	6F9A
B1-12	AB8	7791
B1-14	AB9	6321
B1-16	AB10	37C5
B1-5	AB11	6U28
B1-3	AB12	4FCA
C2-23	A13	4868
C2-24	A14	9UP1
C2-25	A15	

Address Decoder

Start -ve C2-25

Stop -ve C2-25

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
K3-10		486C
J3-8	ROM	486C
J2-9	ROM3	7A02
J2-10	ROM2	1C16
J2-11	ROM1	052A
J2-12	ROM0	2F56
H3-11		125F
H3-10		3P09
H3-9		F0UU
H3-7		3346
H3-6		434P

H3-5	POKEY	9H59
H3-4		26H6
H3-3	SWRD	F26U
H3-2	PF	8A8P
H3-1	RAM0	0FU2
J3-11		6791
C5-8		24HF
C4-6	EA READ	F229
C4-5	EA CONTROL	4P12
C4-4	EA ADDR	PC5U
E3-3	IN 0	AF17
K3-12		FFFU
E3-6	IN1	UHF2
E3-8	PFRAMRD	8A8P
J2-7*	PFWR3	4A01
J2-6*	PFWR2	4457
J2-5*	PFWR1	555U
J2-4*	PFWR0	560A

*ground J2, pin 1.

ROM and data lines

Start -ve D1-20 ROM0

Stop +ve D1-20 ROM0

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
D1-9	DB0	5U7F
D1-10	DB1	A748
D1-11	DB2	7F70
D1-13	DB3	AC1A
D1-14	DB4	H768
D1-15	DB5	A66H
D1-16	DB6	F0F0
D1-17	DB7	369H

Start -ve E1-20 ROM1

Stop +ve E1-20 ROM1

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
E1-9	DB0	1433
E1-10	DB1	AP6C
E1-11	DB2	101F
E1-13	DB3	P2FF
E1-14	DB4	9FCA
E1-15	DB5	H907
E1-16	DB6	6U25
E1-17	DB7	CU2C

Start -ve F/H1-20 ROM2

Stop +ve F/H1-20 ROM2

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
F/H1-9	DB0	P3C9
F/H1-10	DB1	C50C
F/H1-11	DB2	4524
F/H1-13	DB3	CF76
F/H1-14	DB4	AA7U
F/H1-15	DB5	CUPH
F/H1-16	DB6	CU44
F/H1-17	DB7	F117

Start -ve J1-20 ROM3

Stop +ve J1-20 ROM3

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
J1-9	DB0	UH88
J1-10	DB1	19AA
J1-11	DB2	9177
J1-13	DB3	F10H
J1-14	DB4	FH96
J1-15	DB5	007F
J1-16	DB6	FCPC
J1-17	DB7	1510

Horizontal Sync

Start +ve P2-11

Stop +ve P2-11

Clock +ve P2-2

PIN	SIGNAL	SIGNATURE
P2-15		0102
P2-14	6MHZ	55H1
P2-13	1H	334U
P2-12	2H	0U16
K4-11		0102
N1-6	6MHZ	ACA2

Start +ve N2-11

Stop +ve N2-11

Clock +ve P2-2

PIN	SIGNAL	SIGNATURE
N2-15		C3F2
N2-14	8H	7P25
N2-13	16H	85PA
N2-12	32H	77F7

Start +ve M2-13

Stop +ve M2-13

Clock +ve P2-2

PIN	SIGNAL	SIGNATURE
M2-15		4596
M2-14	128H	2946
N1-10		CC34
M3-8		1979
M3-5	HSYNC	P77U
M3-6	HSYNC	309C
M4-3	256H2D	P1HC
M4-15	256HD	U3UF
M4-14	256HD	P3HA
N1-4	4H	H93H
L4-3	COLOREN	U3UF
L4-2		7UFH
L8-11	HBLANK	H559
D4-8		95F9

Vertical Sync

Start +ve P3-11

Stop -ve P3-11

Clock +ve P2-2

PIN	SIGNAL	SIGNATURE
P3-15		H7P4
P3-14	1V	3F3U
P3-13	2V	UUCC
P3-12	4V	2A42

Start -ve N3-11

Stop -ve N3-11

Clock -ve P2-2

PIN	SIGNAL	SIGNATURE
N3-14	16V	239F
N3-13	32V	6U0H
N3-12	64V	U047
P4-9		F91U
P4-10		5890
P4-11		108A
P4-12		FUU7
N4-10	VBLANK	9H7H
N4-11	VBLANK	C697
N4-6	VRESET	94FP
N4-2	VSYNC	F5U6
N4-3	VSYNC	PP1F
M4-10	VBLANKD	8F15

Missile Command

- 6502 NOP card in CPU socket
- Jumper Watchdog Disable to ground

Address Lines

Start -ve C2-25

Stop -ve C2-25

Clock -ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
A/B1-12	BA0	UUUU
A/B1-14	BA1	FFFF
A/B1-16	BA2	8484
A/B1-18	BA3	P763
A/B1-9	BA4	1U5P
A/B1-7	BA5	0356
A/B1-5	BA6	U759
A/B1-3	BA7	6F9A

Start +ve C2-25

Stop -ve C2-25

Clock +ve C2-39 ϕ2

PIN	SIGNAL	SIGNATURE
F2-4		755U
F2-15		3827
F2-17		3C96
F2-8		HAP7
F2-6		1293
F2-13		HPP0
F2-11		2H70
F2-16	BA14	755U
F2-5	BA13	3827
F2-3	BA12	3C96
F2-12	BA11	HAP7
F2-14	BA10	1293
F2-7	BA9	HPP0
F2-9	BA8	2H70
N2-9	PROGSEL2	P255
K7-6		HAP7
R5-6	NI/O	H759
R5-1		H759

Address Decoder

Start -ve C2-25

Stop -ve C2-25

Clock -ve C2-39 $\phi 2$

PIN	SIGNAL	SIGNATURE
N2-6	PROGSEL 0	1ACA
R5-6	NI/O	79PA
P2-9	ROM11	8P93
P2-10	ROM10	0821
P2-11	ROM9	943F
P2-12	ROM8	3472
M5-4	IN0	FA99
M5-5	IN1	6H49
M5-6	IN2	U32F
M5-9	ROM3	2C60
M5-10	ROM2	H5HF
M5-11	ROM1	PC8F
M5-12	ROM0	0U89

Horizontal Sync

Start +ve D5-11

Stop +ve D5-11

Clock +ve D5-2

PIN	SIGNAL	SIGNATURE
D5-15		AF14
D5-14	2H	9344
E6-9	2H	3448
D5-13	4H	18CU
D5-12	8H	9P86
TP	5MHZ	62UC

Start +ve E5-11

Stop +ve E5-11

Clock +ve D5-2

PIN	SIGNAL	SIGNATURE
E5-15		53FP
E5-14	32H	57H3
E5-13	64H	HFP7
E5-12	128H	CC34
B8-9		H149
B8-5		A735

Vertical Sync

Start +ve A4-7

Stop -ve A4-7

Clock +ve P2-2

PIN	SIGNAL	SIGNATURE
A4-13		7U30
A4-3	1V	F0FA
A4-2	2V	P03H
A4-6	4V	4U34

Start -ve B4-7

Stop -ve B4-7

Clock -ve P2-2

PIN	SIGNAL	SIGNATURE
B4-13		HAPC
B4-3	16V	H833
B4-2	32V	506A
B4-6	64V	P389
A5-5	VBLANK	9H2C
E6-4	VBLANK	7AH4
E6-6	3INH	0H9H
A8-8		CF95
D7-2		69PA

Millipede

- 6502 NOP card in CPU socket
- Jumper Watchdog Disable to ground
- All voltages must be present for CPU to run (else reset kept low)

Address Lines

Start -ve 2C-25

Stop -ve 2C-25

Clock -ve 2C-39 ϕ2

PIN	SIGNAL	SIGNATURE
1D/E-16	AB0	UUUU
1D/E-12	AB1	FFFF
1D/E-14	AB2	8484
1D/E-18	AB3	P763
1D/E-9	AB4	1U5P
1D/E-7	AB5	0356
1D/E-3	AB6	U759
1D/E-5	AB7	6F9A

PIN	SIGNAL	SIGNATURE
1C/D-16	AB12	4FCA
5H-6		U5CH
5H-8		0A15
4E-2	DB7	6FUC
4E-5	DB4	88U3
4E-6	DB3	48U6
4E-7	DB2	74A1
4E-8	DB1	4UCH
4E-9	DB0	09FP

Address Decoder and More Address Lines

Start -ve 2C-25

Stop -ve 2C-25

Clock -ve 2C-39 ϕ2

PIN	SIGNAL	SIGNATURE
1D-3		7791
1D-4		4FCA
1D-5		6321
1D-7		6U28
1D-9		37C5
4F-3	ROM	H809
8F-6		47P8
7F-3	SCRAMRD	3714
3E-10	I/OS1	7879
3E-11	I/OS0	0778
3E-12	ZRAM	4U34
3E-5	OUTPUTS	AF76
3E-4	INPUTS	6913

PIN	SIGNAL	SIGNATURE
4H-9	EAROMRD	0A2C
4H-11	IN1	9724
4H-12	IN0	9FH4
3F-10		11H8
3F-11		9C4C
3F-13	AB9	6321
3F-14	AB8	779C
3F-15	AB7	6F5A

PIN	SIGNAL	SIGNATURE
1B-1	MOS	H21U
1B-2	SCRAM	3714
1B-3	I/O	3H02
1B-5	ROM1	C7HA
1B-6	ROM2	1ACA
1B-7	ROM3	147P
1B-9	ROM4	26UU
1B-13	A14	9UP1
1B-14	A13	4868

Horizontal Sync

Start +ve 6E-11

Stop +ve 6E-11

Clock +ve 6E-2

PIN	SIGNAL	SIGNATURE
6E-14	8H	7P25
6E-13	16H	85PA
6E-12	32H	77F7
6E-15		C3F2

Start +ve 6D-11

Stop +ve 6D-11

Clock +ve 6D-2

PIN	SIGNAL	SIGNATURE
6D-15		0102
6D-14	6MHZ	55H1
6D-13	1H	334U
6D-12	2H	0U16
5F-12	PLOAD	UH74
6C-2	1H	FH3F
6C-8	4H	00UP
7H-6	4HD	7U46
7H-7	4HD	8135

Vertical Sync

Start +ve 7C-11

Stop -ve 7C-11

Clock +ve 7C-2

PIN	SIGNAL	SIGNATURE
7C-15		0001
7C-14	1V	0055
7C-13	2V	0033
7C-12	4V	000U

Start -ve 7D-11

Stop -ve 7D-11

Clock -ve 7D-2

PIN	SIGNAL	SIGNATURE
7D-14	16V	91FC
7D-13	32V	3CPF
7D-12	64V	A70F
7E-9		UFP6
7E-11		AF5A
7E-12		386U
9H-8	VBLANKD	90FH
8E-2	VBLANK	UP73
8E-3	VBLANK	90FH
8E-7	VSYNC	1F37
12C-2		83C0
12C-8		2579

Appendix – NOP card

Constructing A 6502 NOP card

The NOP card can be hand made and involves hard wiring the NOP instruction

(Hex = EA) onto the data bus. This in effect keeps the processor constantly in the NOP instruction and so forces it to act as a counter. Therefore we now have constant known data to work with. You can refer to the following link for further information on NOP cards and Signature Analysis in general.

*www.coinop.org/kb_dl.aspx/KB/Test_Equipment/**SigAnalNotes.pdf***

To Make The NOP Card

You will need

40 pin DIL socket

6502 processor

Some small gauge wire

Soldering iron, pliers, wire cutters.

1. Bend out the following legs on the processor by 90 degrees

2, 4, 6, 26, 27, 28, 29, 30, 31, 32 and 33.

2. Place the processor (with bent out legs) into the DIL socket.

3. Using the small gauge wire link the following legs.

   a) 2, 4, 6, 26, 27, 28, 30 and 32.

   b) 21, 29, 31 and 33.

4. Cut a couple of lengths of wire about 2 inches long. Attach one to pin 25 (A15, the highest address line) and the other to pin 39 (clock). Strip back about half an inch of insulation on both flying wires.

Your NOP card is now complete for the 6502 processor.

To check the NOP card, remove the game processor from the PCB and replace it with your NOP card. Set the 5004 up as follows

Start -ve

Stop -ve

Clock -ve

Put both the Start and Stop onto the same point, which will be pin 25 of the NOP card.

The clock will go on pin 39 of the NOP card. The following pins on the NOP card should give the corresponding signatures

9	UUUU
10	FFFF
11	8484
12	P763
13	1U5P
14	0356
15	U759
16	6F9A
17	7791
18	6321
19	37C5
20	6U28
22	4FCA
23	4868
24	9UP1

If your signatures match then your NOP card is good.