WillFA11

Williams/Data East MPU based on FPGA

Hardware version v0.7

Software Version 0.89

user manual

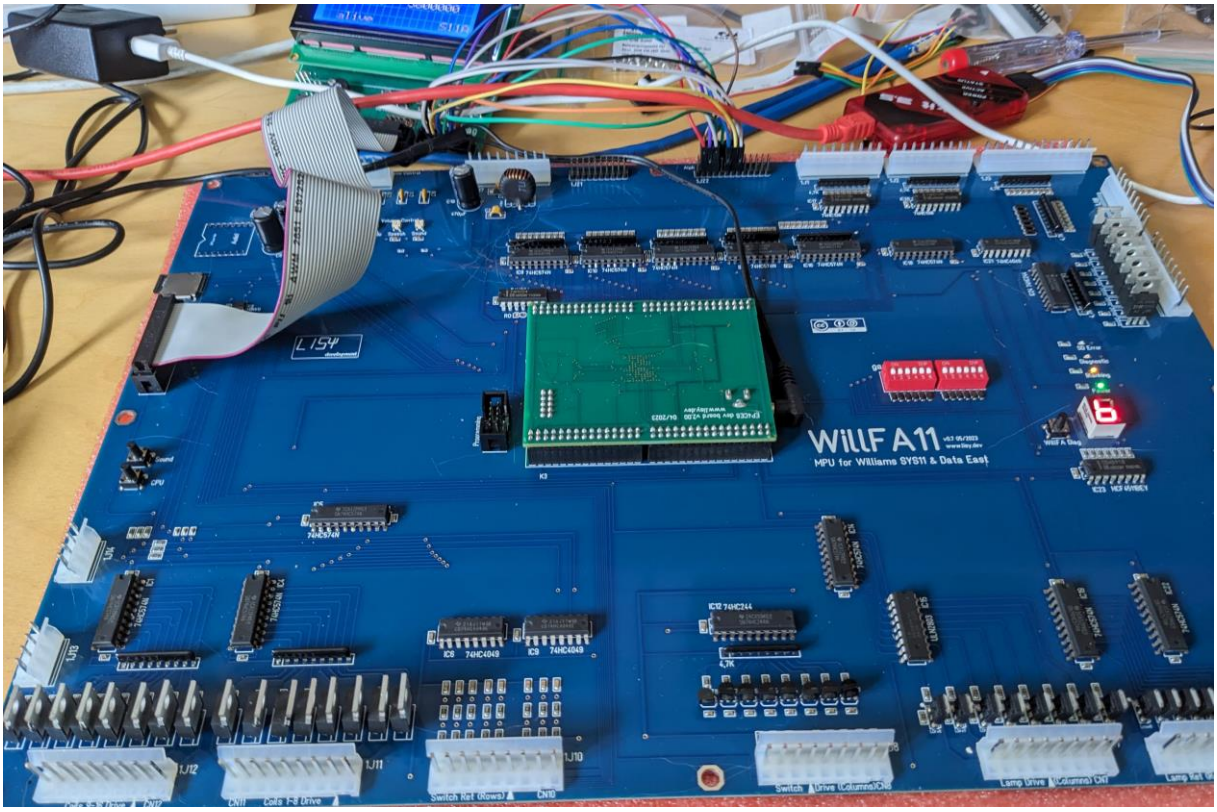
ralf@lisy.dev

v0.5 08.02.2024

Table of contents

Important remark

By using WillFA7 it is possible to damage your pinball machine. As this is a private project with NO commercial interest the author accepts no liability for any damage that may arise by using WillFA11!



1. Introduction

WillFA11 use a Cyclone IV FPGA which emulates the hardware of a Williams MPU type SYS11 up to SYS11C and Data East Version 1..3

What do you need?

- Possibility to read/write micro SD cards
- A PC with an USB port in order to be able to program the FPGA

2. Quickstart

1. Download latest versions of the SD card Image and the FPGA program from lisy.dev
2. Write the image to a SD card
3. Program the FPGA
4. Configure switch ‘game select’ according to your pinball (Appendix A)
5. Replace your original Williams MPU with WillFA11
6. On first boot with your game set option DIP1 to ON (init nvram)
    a. Switch the game ON
    b. Game will show Williams prom number, wait until ‘Diag LED’ goes off
    c. Switch the game OFF
7. Switch the Game ON
8. Enjoy

3. Installation

WillFA11 boards have the same connectors and same mounting holes as the original Williams MPUs, so replacing of the board can be done in seconds.

4. Dip Switch Settings

4.1. DIP Switch S1: game select

Here you can select what game WillFA7 should run. This depends on the roms placed on the SD card. See Appendix A for a full list and Chapter 'SD card' for an explanation of the structure of the SD card content.

4.2. DIP Switch S2: options

Default setting is all ‚OFF'

4.2.1. S2-Dip1 -> init nvram

With Dip1 to ‚ON' WillFa11 during boot will initialize the nvram ram for the selected game to zero. This is useful if you want to reset ALL ram content **and for the very first boot with your game.**

4.2.2. S2-Dip2 -> not used

Not implemented yet.

4.2.3. S2-Dip3 -> not used

Not implemented yet.

4.2.4. S2-Dip4 -> not used

Not implemented yet.

4.2.5. S2-Dip5 -> not used

Not implemented yet.

4.2.6. S2-Dip6 -> not used

Not implemented yet.

5. boot sequence

5.1. phase 1: boot message

Immediately after switching on the pinball the ‘ON’ Led will go on and you will see the following output on the display of your pinball machine

WILLFA <Gamename>

11 <SW-Version> <Gamenumber> <options>

So for example for a SYS11C ‘DINER’ (Gamenumber 27) with Software version 089 and all option DIPs to OFF, you will see:

WILLFA DINER

11 089 27 00

5.2. phase 2: SD card read

WillFA11 tries to read the SD card content, if this fails the red LED ‘SD card errror’ will go ON and ‘SD ERR’ will be shown at display 4.

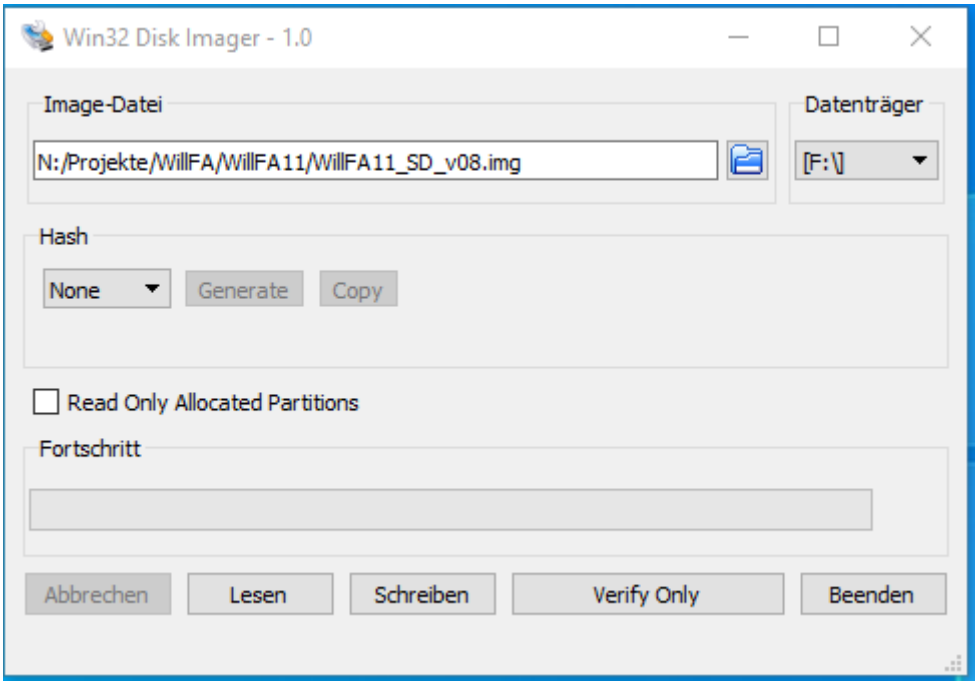
5.3. phase 3: program execution

The code indicated by the Dip switch ‘game select’ is red from the SD card and executed. If the code runs (regular display strobes are present) the ‘active’ LED will go ON.

6. Put the WillFA7 Image to the SD card

On my website you will find the latest version of the WillFA11 SD image file which have all the roms and need to be written to a SD card. I do recommend using win32diskimager.

Best to use cheap standard SD cards with 4..32 Gbyte.



After flashing you will see, independent of the original size of your SD card, a 128Mbyte drive with the rom images.

7. programming the FPGA

To program the FPGA you need the Quartus Programmer.

7.1. programmer software

It can be downloaded from the Intel Website for free. You just need to create a user account.

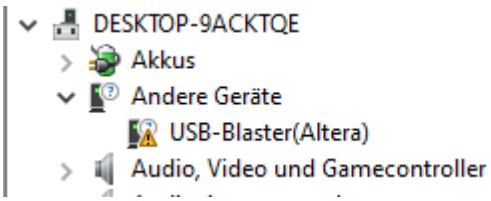
https://fpgasoftware.intel.com/13.0sp1/?edition=web

Go to Additional Software and Download **Quartus II Programmer and SignalTap II**

Note: Intel has discontinued support for Cyclone II by end of 2021 and will eventually remove version 13.0sp1 from the download section (the used FPGA for BallyFA is quite old ,and therefor cheap.) I have tested latest version (v21.4) which worked also, but I recommend to use 13.0sp1 if available.

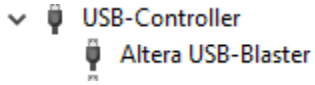
7.2. install the driver for your USB Blaster

When connecting your USB Blaster the first time it will not be recognized correctly by Windows.



You also need to install the driver for your USB Blaster. The driver comes together with the installation of the programmer and is located in the ‘driver’ subdirectory.

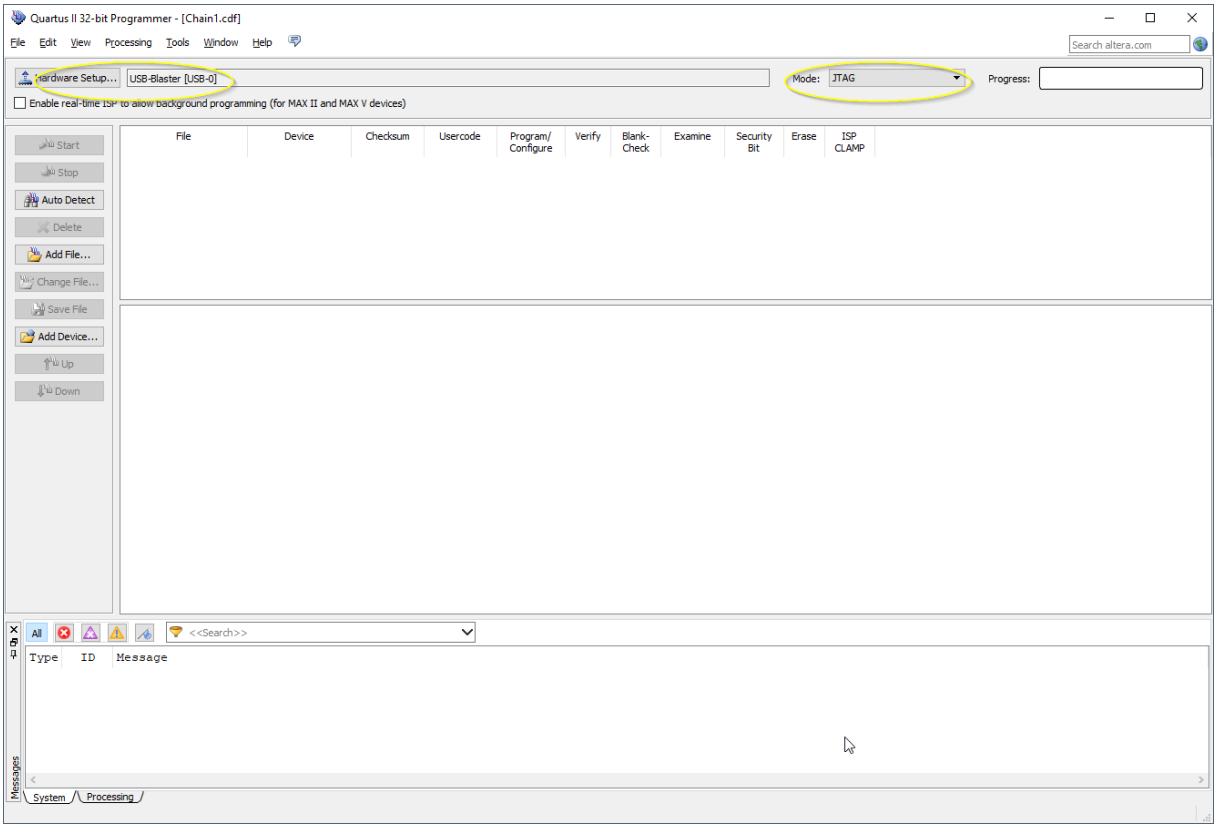
- Right click on the entry in the device manager and choose ‘update driver’ (Treiber aktualisieren)
- Choose ‘search for driver on this PC’ (auf dem Computer nach Treibersoftware suchen)
- For a default installation select ‘C:\altera\13.0sp1\qprogrammer\drivers
- Confirm installation
- Now the Altera USB Blaster should be visible und ‘USB-Controller’



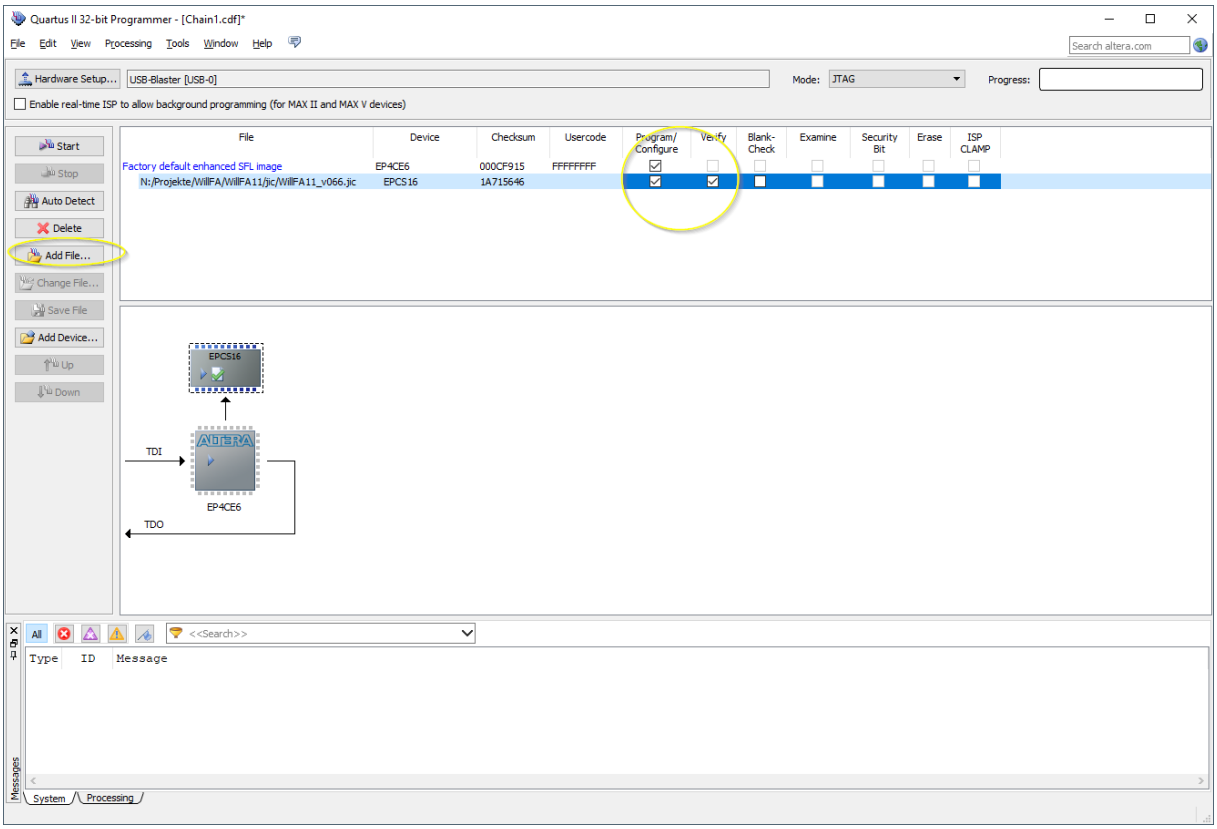
7.3. program your FPGA

1) Connect the USB Blaster to the PC

2) Start the programmer, make sure in the Hardware setup ‚USB-Blaster' is visible and set the Mode to ‚JTAG'

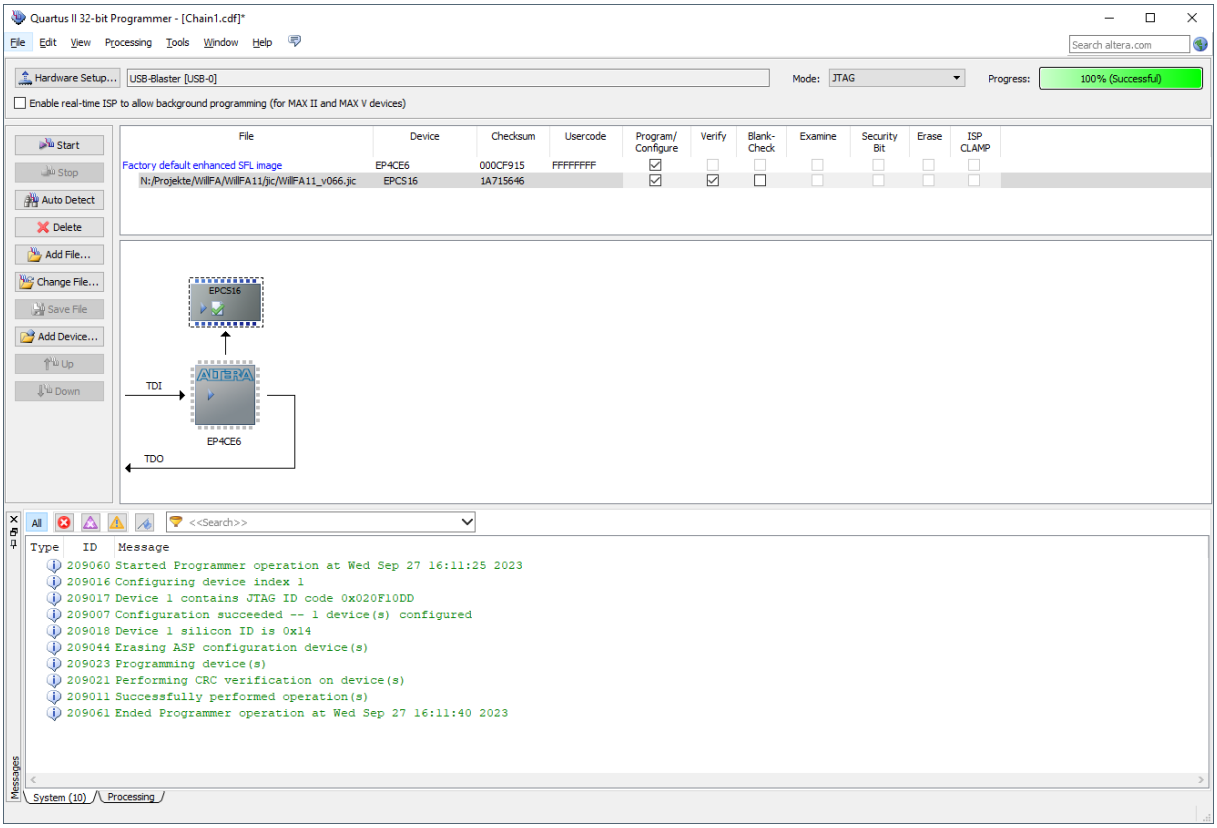


3) Select ‚Add File' and choose the right ‚jic' file for your game. Select ‚Program/Configure' and ‚Verify' options.



4) Power the FPGA with 5 Volt (middle pin ‚+', outer pin ‚-,) or power the WillFA11 board with 5Volt. Then connect the USB Blaster to the ‚Programming' connector on the WillFA11 PCB.

5) Push start, wait for progress 100%



Thats it!

8. structure of SD card

Due to limitations of the SD card read routine in the FPGA (it does read fix sector numbers instead of looking for filenames) it is necessary to use my SD-card image (128 Mbyte). You can write the image to a SD-card of your choice.

With game select all ‘0’ WillFa will try to read the first rom image at sector number 660. With my 128MB BallyFa image this is the location of the first file you write to an empty SD card.

8.1. WillFA7 image

My WillFA SD card image has almost all available roms ‘on board’. See appendix A for a gamelist

8.2. use your own roms

Data East games must be placed at selection #31 or greater!

Appendix A 'game select'

No	S1	S2	S3	S4	S5	S6	Name	Type
0	off	off	off	off	off	off	Space Shuttle	SYS9
1	on	off	off	off	off	off	Sorcerer	SYS9
2	off	on	off	off	off	off	Comet	SYS9
3	on	on	off	off	off	off	High Speed	SYS11
4	off	off	on	off	off	off	Grand Lizard	SYS11
5	on	off	on	off	off	off	Road Kings	SYS11
6	off	on	on	off	off	off	Pinbot	SYS11 A
7	on	on	on	off	off	off	Millionaire	SYS11 A
8	off	off	off	on	off	off	F-14 Tomcat	SYS11 A
9	on	off	off	on	off	off	Fire!	SYS11 A
10	off	on	off	on	off	off	Big Guns	SYS11 B
11	on	on	off	on	off	off	Space Station	SYS11 B
12	off	off	on	on	off	off	Cyclone	SYS11 B
13	on	off	on	on	off	off	Banzai Run	SYS11 B
14	off	on	on	on	off	off	Swords of Fury	SYS11 B
15	on	on	on	on	off	off	Taxi	SYS11 B
16	off	off	off	off	on	off	Jokerz!	SYS11 B
17	on	off	off	off	on	off	Earthshaker	SYS11 B
18	off	on	off	off	on	off	Black Knight 2000	SYS11 B
19	on	on	off	off	on	off	Police Force	SYS11 B
20	off	off	on	off	on	off	Elvira and the Party Monsters	SYS11 B
21	on	off	on	off	on	off	Bad Cats	SYS11 B
22	off	on	on	off	on	off	Mousin' Around!	SYS11 B
23	on	on	on	off	on	off	Whirlwind	SYS11 B
24	off	off	off	on	on	off	The Bally Game Show	SYS11 C
25	on	off	off	on	on	off	Pool Sharks	SYS11 C
26	off	on	off	on	on	off	Rollergames	SYS11 C
27	on	on	off	on	on	off	Diner	SYS11 C
28	off	off	on	on	on	off	Radical!	SYS11 C
29	on	off	on	on	on	off	Dr. Dude	SYS11 C
30	off	on	on	on	on	off	Riverboat Gambler	SYS11 C
31	on	on	on	on	on	off	Bugs Bunny's Birthday Ball	SYS11 C
32	off	off	off	off	off	on	Laser War (3/87)	Data East V1
33	on	off	off	off	off	on	Secret Service (2/88)	Data East V2
34	off	on	off	off	off	on	Torpedo Alley (8/88)	Data East V2
35	on	on	off	off	off	on	Time Machine (11/88)	Data East V2

36	off	off	on	off	off	on	Playboy 35th Anniversary (5/89)	Data East V2
37	on	off	on	off	off	on	ABC Monday Night Football (9/89)	Data East V2
38	off	on	on	off	off	on	Robocop (01/90)	Data East V2
39	on	on	on	off	off	on	Phantom of the Opera (4/90)	Data East V2
40	off	off	off	on	off	on	Back to the Future (6/90)	Data East V3
41	on	off	off	on	off	on	The Simpsons (10/90)	Data East V3
42	off	on	off	on	off	on	Checkpoint (2/91)	Data East V3
43	on	on	off	on	off	on	Teenage Mutant Ninja Turtles (6/91)	Data East V3
44	off	off	on	on	off	on	Batman (8/91)	Data East V3
45	on	off	on	on	off	on	Star Trek 25th Anniversary (9/91)	Data East V3
46	off	on	on	on	off	on	Hook (5/92)	Data East V3
47	on	on	on	on	off	on	Lethal Weapon 3 (8/92)	Data East V3
48	off	off	off	off	on	on	Star Wars (12/92)	Data East V3
49	on	off	off	off	on	on	Rocky & Bullwinkle (2/93)	Data East V3
50	off	on	off	off	on	on	Jurassic Park (6/93)	Data East V3
51	on	on	off	off	on	on	Last Action Hero (10/93)	Data East V3
52	off	off	on	off	on	on	Tales from the Crypt (12/93)	Data East V3
53	on	off	on	off	on	on	The Who's Tommy (1/94)	Data East V3
54	off	on	on	off	on	on	WWF Royal Rumble (5/94)	Data East V3
55	on	on	on	off	on	on	Guns N' Roses (7/94)	Data East V3
56	off	off	off	on	on	on	Maverick (10/94)	Data East V3
57	on	off	off	on	on	on	Mary Shelly's Frankenstein (1/95)	Data East V3
58	off	on	off	on	on	on	Baywatch (2/95)	Data East V3
59	on	on	off	on	on	on	Batman Forever (7/95)	Data East V3