

GottFA80_PLuS

Gottlieb System80 MPU based on FPGA

With integrated soundboard

Software Version 5.11 / 6.11

user manual

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Important remark

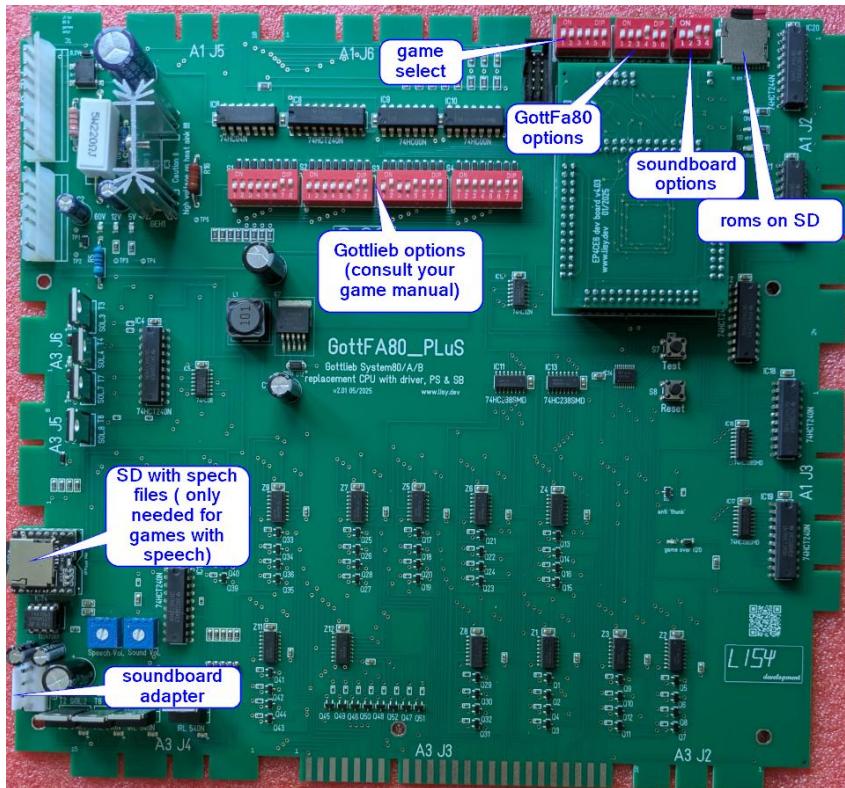
By using GottFA80_PLuS it is possible to damage your pinball machine. As this is a private project with NO commercial interest the author accepts no liability for any damage that may arise by using GottFA80_PLuS!

1. Introduction

- GottFA80_PLuS is a 100% hobby project. This makes the solution cheap, depending on where you buy your components it is possible to create your Gottlieb replacement MPU for less than 50€.

What do you need?

- Basic soldering skills
- Possibility to read/write micro SD cards
- A PC with an USB port in order to be able to program the FPGA
- Gottlieb rom images (not included due to Copyright limitation)



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. Add Gottlieb roms
4. Program the FPGA
5. Configure switch 'game select' according to your pinball
6. Replace your original System80 MPU with GottFA80
7. Switch the Game ON
8. Enjoy

For all my 'FA' boards you will find a user manual on the 'product page'. However all these boards have in common that you need to:

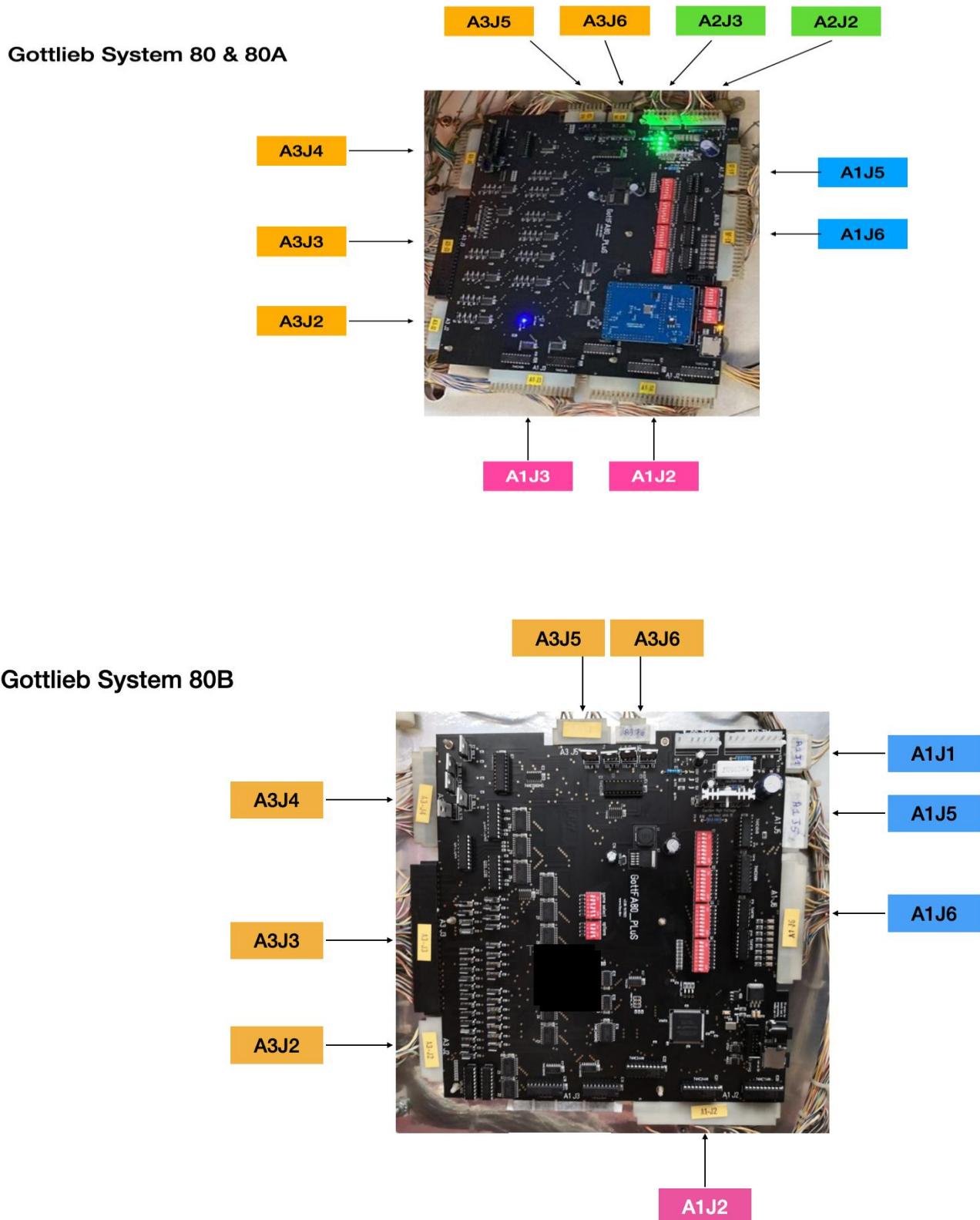
1. [select a SD card which works with my 'FA' boards](#)
2. [put the image to the SD card](#)
3. [buy or build an USB Blaster](#)
4. [program the FPGA](#)

Just follow the above links for more information.

[Information about my different DIY FPGA boards you can find here.](#)

3. Board wiring

GottFA80 comes with the same connectors as the original Gottlieb CPU, so replacing is straight forward. Note that for System80B A1J3 will be left unconnected.



4. Installation

GottFA80 boards have the same connectors and same mounting holes as the original Gottlieb System80 MPUs, so replacing of the board can be done in seconds.

5. Dip Switch Settings

5.1. S1 Dips 1...6 : game select

Here you can select what game GottFA80 should run. This depends on the roms placed on the SD card. See chapter 9 for an explanation of the structure of the SD card content.

5.2. S2

5.2.1. S2-Dip1 -> Freeplay

With set to ,ON' GottFa will enable 'Freeplay'. By 'press and hold' the credit button for more than two seconds a coin insert for the left coin chute is simulated.

5.2.2. S2-Dip2 -> init nvram

With set to ,ON' GottFa will initialize the nvram ram during boot for the selected game to zero. This is useful if you want to reset ALL ram content. (recommended for the first start of the game)

5.2.3. S2-Dip3 -> slam contact open

With set to ,ON' the slam will be simulated as 'open' (needed for late 80B games)

5.2.4. S2-Dip4 -> slam contact closed

Most System80 games need the Slam contact to be closed and will not boot in case the slam contact is open. With set to ,ON' the slam will be simulated as 'closed' independent of the real status.

5.3. S3 'soundboard options'

See chapter 'integrated soundboard'

6. integrated soundboard

GottFA80_PLuS comes with an integrated soundboard which can emulate all Gottlieb 80/80A and 'early' 80B soundboards.

6.1. S3 'soundboard options'

Soundboard options can be configured with S3 and do vary from game to game. For specific settings have a look into the appropriate Gottlieb manual. In general Dips 1&2 of the S3 dip switch bank are used for Dips1&2 of MA55 and MA490 soundboards. While dips 1..4 do correspond to dips 2..5 of MA215 and MA309 soundboards.

6.2. Test switch

By pressing the 'Test switch' the integrated soundcard will play sound #3 ('Tilt tilt tilt' via Mini Player with speech soundcard, 'oohhhh' sound with others)

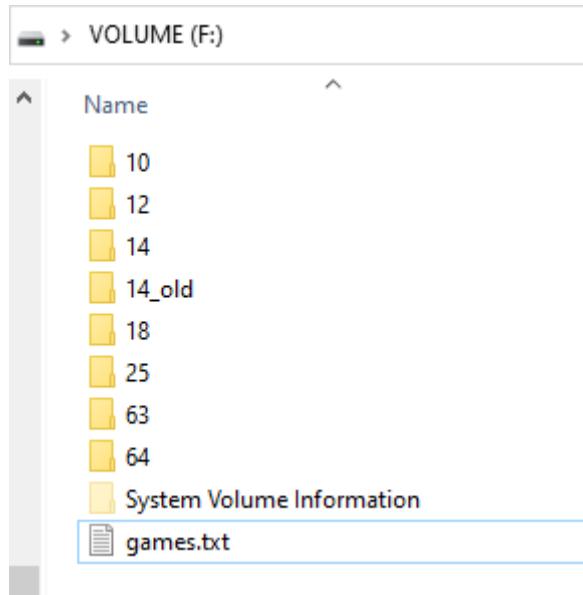
6.3. DFPlayer Mini

Gosof80 use a small device ('DFPlayer' Mini) for the speeches used by some games. The speeches are stored on a standard micro SD card in the Mini player.

You only need the DFPlayer Mini if you want to emulate a Gottlieb soundboard which is capable of producing speech (Votrax chip). Gottlieb games with speech are: Mars - Volcano - Black Hole - Devil's Dare - Rocky - Striker - Q*Bert's Quest – Caveman

6.3.1. speechfiles on the SD card

I do provide a ZIP file containing all speeches on my website. Just extract the ZIP archive and write it on a micro SD card. The structure should look like this:



Speech

10 - Mars

12 - Volcano

14 - Black Hole

18 - Devils Dare

20 - Rocky

23 - Striker

25 - Q*Bert's Quest

63 - Caveman

64 - Test (numbers as wav)

6.4. supported soundboards

6.4.1. MA55



Panthera - Spiderman - Circus -
CounterForce - StarRace -James Bond -
Time Line - Force II - Pink Panther - Eclipse

"export" versions of Volcano - Black Hole -
Devil's Dare

6.4.2. MA216



Mars - Volcano - Black Hole - Devil's Dare
- Rocky -

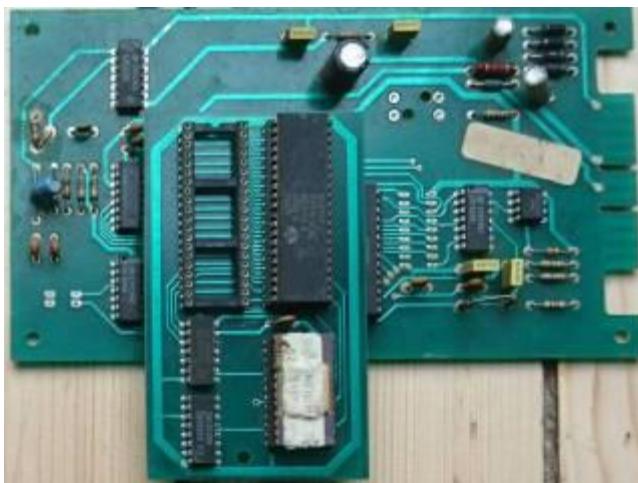
Striker - Q*Bert's Quest - Caveman

6.4.3. MA309



Haunted House - Spirit - Punk! - Krull -
Goin'Nuts - Super Orbit - Amazon Hunt -
Royal Flush Deluxe

6.4.4. MA490



7. boot sequence

7.1. phase 1: init

Immediately after switching on the pinball with GottFA80 inserted you will see the following output on the display of your pinball machine

Player 1: version of the FPGA program running

Player 2: value of selected game on S1

Player 3: lisy.dev unique identifier for FPGA based MPUs

Player 4: version of image on inserted SD card (not implemented yet)

7.2. phase 2: SD card read

GottFA80 tries to read the SD card content, if this fails the red LED 'SD card error' will go ON. On success the current version of the SD card image is shown at display 4.

7.3. phase 3: program execution

The code indicated by the Dip switch 'game select' is read from the SD card and executed. If the code runs (regular interrupts are seen) the yellow 'ON' LED will go ON.

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, any size equal or bigger than 128 Mbyte will work.

Note: 'Sandisk' SD cards can not be used with GottFA!

8.1. rom file structure for GottFA80 plus

Each rom file has a size of 16Kbyte and must have the 'game rom' within the first 4 Kbyte, the soundcard rom in the second 4 Kbyt and the 'System rom' in the last 8 Kbyte. All Gottlieb Games have a 8Kbyte system rom while the size of the game roms depends on the game. Early Gottlieb games (Panthera, Spiderman, Circus, Counterforce and Star Race) will come with a game rom of only 1Kbyte. Games as James Bond and later will come with a 2Kbyte game rom. Late System80B (Excalibur, Bad Girls, Big House, Hot Shots Bone Buster and Night Moves) come with a 4Kbyte game rom. Soundcard roms differ from the used soundcard (MA216, MA55, ...)

For each game GottFA read a 16Kbyte block from the SD card, so you need to fill the gaps depending on the game you are using.

8.2. game selection

The game selection aims to choose the proper project "image" for running the game. The "image" here means the combination of game ROM + soundcard rom + system ROM. Depending on the fact you wanna build a multi-system game SD card or not, there are two case:

- 1) Your SD card is intended to run a single pinball game. In that case, you just need to "merged" this game ROM and system ROM in a single image file (see examples below) and put it on the SD card. Because you have only a single image, the proper configuration for game select DIP switch is all switches set to '0' (OFF).
- 2) You have several game + system ROM mostly because the same SD card is used in several pinballs or you have a set of game + system roms for all the pinballs supported by this board. In that case, you also have to create several "merged" image files containing game + system ROM and to copy them on the SD card (see examples below). The copy order will determined the game selection index.

Ex, you have the game+system ROM for Black Hole, Raven and Bad Girls:

You copy on the SD card first Black Hole image, then Raven image then Bad Girls. The proper game select DIP configuration is 0 for select Black Home game, 1 for Raven game, 2 for Bad Girls and so on. To determine the All the decimal value is encoded in binary here, so:

0 -> switches 1 to 6 to 0 (OFF)

1 -> switch. 1 to 1 (ON) and 2 to 6 to 0 (OFF)

2 -> switch. 1 to 0 (OFF) and 2 to 1 (ON) and 3 to 6 to 0 (OFF)

8.3. examples

8.3.1. Black Hole (with speech)

Gottlieb Black Hole has a 2Kbyte game.rom (668-4.cpu), two systems roms 4Kbyte each (U2_80.bin & U3_80.bin) and two soundcard roms 2 Kbyte each (668-s1.snd & 668-s2.snd) To create a rom file for GottFa (GottFA80_BH.img) you can use the following command on a windows system:

```
copy /b 668-4.cpu + 2K + 668-s1.snd + 668-s2.snd + u2_80.bin + u3_80.bin GottFA80_BH.img
```

8.3.2. Q-Bert

Gottlieb Q-Bert has a 2Kbyte game.rom (677.cpu), two systems roms 4Kbyte each (U2_80a.bin & U3_80a.bin) and two soundcard roms 2 Kbyte each (677-s1.snd & 677-s2.snd) To create a rom file for GottFa (GottFA80_QB.img) you can use the following command on a windows system:

```
copy /b 677.cpu + 2K + 677-s1.snd + 677-s2.snd + u2_80a.bin + u3_80a.bin GottFA80_QB.img
```

8.3.3. Bounty Hunter

Gottlieb Bounty Hunter (System80B) has only one 8Kbyte game.rom (bountyh.cpu) and a 2Kbyte soundcard rom (694-s.snd). To create a rom file for GottFa (GottFA80_Bounty.img) you can use the following command on a windows system:

```
copy /b 2K + 2K + 694-s.snd + 2K + bountyh.cpu GottFA80_Bounty.img
```

8.3.4. Bad Girls

Gottlieb Raven (System80B) has a 4Kbyte game.rom (prom2.cpu) and a 8Kbyte system.rom (prom1.cpu). The soundcard rom is not included here as GottFA80+ do not support (yet) 80B soundcards. To create a rom file for GottFa (GottFA80_BadGirls.img) you can use the following command on a windows system:

```
copy /b prom2.cpu + 4K + prom1.cpu GottFA80_BadGirls.img
```

Appendix A example ,Gamelist'

No	game select						Game
	S1	S2	S3	S4	S5	S6	
0	off	off	off	off	off	off	Panthera
1	on	off	off	off	off	off	Spiderman
2	off	on	off	off	off	off	Circus
3	on	on	off	off	off	off	Counterforce
4	off	off	on	off	off	off	Star Race
5	on	off	on	off	off	off	James Bond Timed Play
6	off	on	on	off	off	off	James Bond 3/5-Ball
7	on	on	on	off	off	off	Time Line
8	off	off	off	on	off	off	Force II
9	on	off	off	on	off	off	Pink Panther
10	off	on	off	on	off	off	Mars - God of War Speech
11	on	on	off	on	off	off	Mars - God of War Soundonly
12	off	off	on	on	off	off	Volcano speech rev4
13	on	off	on	on	off	off	Volcano Soundonly
14	off	on	on	on	off	off	Black Hole
15	on	on	on	on	off	off	Black Hole Soundonly
16	off	off	off	off	on	off	Haunted House
17	on	off	off	off	on	off	Eclipse
18	off	on	off	off	on	off	Devils DareSpeech
19	on	on	off	off	on	off	Devils Dare Soundonly
20	off	off	on	off	on	off	Rocky
21	on	off	on	off	on	off	Spirit
22	off	on	on	off	on	off	Punk
23	on	on	on	off	on	off	Striker
24	off	off	off	on	on	off	Krull
25	on	off	off	on	on	off	Q*Bert's Quest
26	off	on	off	on	on	off	Super Orbit
27	on	on	off	on	on	off	Royal Flush Deluxe
28	off	off	on	on	on	off	Goin' Nuts
29	on	off	on	on	on	off	Amazon Hunt
30	off	on	on	on	on	off	Rack 'Em Up
31	on	on	on	on	on	off	Ready...Aim...Fire!
32	off	off	off	off	off	on	Jacks To Open
33	on	off	off	off	off	on	Touchdown
34	off	on	off	off	off	on	Alien Star
35	on	on	off	off	off	on	The Games
36	off	off	on	off	off	on	El Dorado City of Gold

37	on	off	on	off	off	on	Ice Fever
38	off	on	on	off	off	on	Caveman
39	on	on	on	off	off	on	Caveman fliprojects
40	off	off	off	on	off	on	Bounty Hunter
41	on	off	off	on	off	on	Chicago Cubs Triple Play
42	off	on	off	on	off	on	Tag Team
43	on	on	off	on	off	on	Rock
44	off	off	on	on	off	on	Raven
45	on	off	on	on	off	on	Rock Encore
46	off	on	on	on	off	on	Hollywood Heat
47	on	on	on	on	off	on	Genesis
48	off	off	off	off	on	on	Gold Wings
49	on	off	off	off	on	on	Monte Carlo
50	off	on	off	off	on	on	Spring Break
51	on	on	off	off	on	on	Arena
52	off	off	on	off	on	on	Victory
53	on	off	on	off	on	on	Diamond Lady
54	off	on	on	off	on	on	TX Sector
55	on	on	on	off	on	on	Robo War
56	off	off	off	on	on	on	Excalibur
57	on	off	off	on	on	on	Bad Girls
58	off	on	off	on	on	on	Big House
59	on	on	off	on	on	on	Hot Shots
60	off	off	on	on	on	on	Bone Busters Inc.
61	on	off	on	on	on	on	Night Moves
62	off	on	on	on	on	on	Amazon Hunt II
63	on	on	on	on	on	on	notused4