**Pi1541-HAT Rev. 2**

**Module description**

# Description

The Pi1541 HAT is the required electrical and user interface for the Raspberry Pi (Model 3, 3+ or better) to emulate the Commodore 1541 floppy disk drive in conjunction with Steve White’s software project ([https://cbm-pi1541.firebaseapp.com/](https://cbm-pi1541.firebaseapp.com/%20%20)). This software is a cycle exact, real-time emulation of the 1541. The disk images are stored on the SD-card of the Raspberry Pi and the switches and the display (of the HAT) allow the user to navigate through his disk archive. Since Pi1541 emulates the exact hardware of the 1541, it is compatible to every speed loader, that work with the original disk drive.

This Pi1541 HAT is one of many possible variants. It holds the original I/O-driver configuration of the 1541, which is then adapted to the Raspberry Pi. The user interface consists of an OLED-display, six switches and a piezo buzzer, which resembles the sound of the working stepper motor.

Further on, it is designed to offer a good flexibility. The display can be either connected to a 4 pole receptable on the board or it can be detached and connected with a small piece of ribbon cable. The switches can also be soldered on the PCB or on a little extra PCB (Pi1541-Switch), which also holds two LEDs and is designed for a front panel mount. The two IEC-connectors can be mounted on this PCB or a separate PCB (Pi1541-IEC), which also holds a RESET switch and a barrel connector for a 5V power supply.

# Pin outs

## IEC-Bus

J1 and J2 – Lumberg 010599 06, 6p DIN receptables

|  |  |
| --- | --- |
| Pin | Signal |
| 1 | /SRQ (not used in this design) |
| 2 | GND |
| 3 | ATN |
| 4 | CLK |
| 5 | DATA |
| 6 | /RESET |

## IEC Bus (break out board)

X1 – 10p Micro Match receptible, female, vertical, through hole, e.g. MPE Garry 369-1-010

X1 can be assembled instead of J1 and J2

|  |  |
| --- | --- |
| Pin | Signal |
| 1 | /SRQ (not used in this design) |
| 2 | GND |
| 3 | ATN |
| 4 | CLK |
| 5 | DATA |
| 6 | /RESET |
| 7 | +5V |
| 8 | +5V |
| 9 | GND |
| 10 | GND |

## Display

M2 - A 0.96” OLED display (I²C) can be connected to the 4p receptable M2 (0.1” pin distance). This connector provides +3.3V supply voltage. It is important to check the pinning of the display. Some might have swapped +3.3V and GND, so inserting those displays will destroy them.

From left to right:

|  |  |
| --- | --- |
| Pin | Signal |
| 1 | VCC |
| 2 | GND |
| 3 | SCL |
| 4 | SDA |

## External Display

In case the display is desired to be mounted externally or it is bigger than the footprint (e.g. 1.3”) or it has a different pin sequence such as GND, VCC etc. it can be attached to this connector.

X2 – 4p Micro Match receptible, female, vertical, through hole, e.g. MPE Garry 369-1-004

|  |  |
| --- | --- |
| Pin | Signal |
| 1 | VCC |
| 2 | GND |
| 3 | SCL |
| 4 | SDA |

## External Switches

X3 – 8p Micro Match receptible, female, vertical, through hole, e.g. MPE Garry 369-1-008

|  |  |
| --- | --- |
| Pin | Signal |
| 1 | /SW1 |
| 2 | /SW2 |
| 3 | /SW3 |
| 4 | /SW4 |
| 5 | /SW5 |
| 6 | LED\_OUT (LD1) |
| 7 | +3V3 |
| 8 | GND |

## Raspberry Pi Connector

A 2x20 Pin receptible, assembled on the solder side of the PCB.

|  |  |  |  |
| --- | --- | --- | --- |
| Pin | GPIO | Signal | Comment |
| 1 | - | +3.3V | Supply voltage |
| 2 | - | +5V | Supply voltage |
| 3 | SDA | SDA (I²C) | I²C-Bus (display) |
| 4 | - | +5V | Supply voltage |
| 5 | SCL | SCL (I²C) | I²C-Bus (display) |
| 6 | - | GND | Ground |
| 7 | 4 | /SW4\_IN | Switch 4, active low |
| 9 | - | GND | Ground |
| 11 | 17 | /CLK\_OUT | /CLK\_(output to IEC-Bus driver) |
| 12 | 18 | /DATA\_OUT | /DATA (output to IEC-Bus driver) |
| 13 | 27 | /SW1\_IN | Switch 1, active low |
| 14 | - | GND | Ground |
| 15 | 22 | /SW2\_IN | Switch 2, active low |
| 16 | 23 | /SW3\_IN | Switch 3, active low |
| 17 | - | +3.3V | Supply voltage |
| 18 | 24 | ATN\_IN | ATN (IEC-Bus), 3.3V-level |
| 20 | - | GND | Ground |
| 22 | 25 | DATA\_IN | DATA (IEC-Bus), 3.3V-level |
| 25 | - | GND | Ground |
| 27 | ID\_SD | ID\_SD | Secondary I²C: SDA |
| 28 | IC\_SC | ID\_SC | Secondary I²C: SCL |
| 29 | 5 | /SW5\_IN | Switch 5, active low |
| 30 | - | GND | Ground |
| 33 | 13 | SND\_OUT | Sound/Piezo buzzer |
| 34 | - | GND | Ground |
| 36 | 16 | LED\_OUT | Activity LED |
| 37 | 26 | CLK\_IN | CLK (IEC-Bus), 3.3V-level |
| 38 | 20 | /RESET\_IN | /RESET (IEC-Bus), 3.3V-level |
| 39 | - | GND | Ground |

## Rotary Encoder connector

J3 – 5-pin pin header (2.54mm pitch) vertical or 90°.

|  |  |
| --- | --- |
| Pin | Signal |
| 1 | GND |
| 2 | +3V3 |
| 3 | SW (/SW1\_IN) |
| 4 | DATA (/SW3\_IN) |
| 5 | CLK (/SW2\_IN) |

# Jumpers

JP1 and JP2 are SMD jumpers (to be bridged by a 0603 resistor/0Ω). The I²C bus for the display can be selected. For a proper function, they should both be bridged between 1-2. This selects the primary I²C-bus.

# Switches

|  |  |
| --- | --- |
| Switch | Function |
| SW1 (left) | Select/Reset |
| SW2 | Move Up/Previous Disk |
| SW3 | Move Down/Next Disk |
| SW4 | Exit Folder |
| SW5 (right) | Insert Disk |

SW6 is a RESET switch for the IEC-Bus

# Configuration

The configuration of the software can be found in the root directory of the micro SD-card (options.txt). It has to be edited before powering up the Raspberry Pi for the first time.

Since there are input and output drivers, for the bidirectional IEC-Bus signals signal, the parameter has to be set in the following way:

splitIECLines = 1

There is a buzzer acting as a sound device for resembling the working stepper motor of the real drive:

SoundOnGPIO = 1

SoundOnGPIODuration = 70 // Length of buzz in micro seconds

SoundOnGPIOFreq = 900 // Frequency of buzz in Hz

The I²C-Bus for the display requires this configuration:

i2cBusMaster = 1 //SDA - pin 3 SCL - pin 5

More information about the configuration and setup can be found on the Pi1541 project website mentioned above. It is highly recommended to read the instructions there before setting up the SD card.

The (optional) rotary encoder is activated with

RotaryEncoderEnable = 1

# Revision history

## Rev. 0 → Rev. 1

* R20 added, due to the SND\_OUT being High during idle
* X1 became 10p to enable a power supply being connected on the external IEC-Board
* Added TP1 as a ground connection for measurement

## Rev. 1 → Rev. 2

* J3 for an optional rotary encoder added (supported by the Firmware/Kernel v1.21 and later)