Keysight Hacking Platform Hardware Overview

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1   Overview

This document gives a general hardware architecture overview of the Keysight Hacking Platform (KHP), a general hardware overview of the Raspberry Pi 3 and a detailed description of how the touch-screen is connected to the Raspberry Pi 3.

2   Raspberry Pi 3 Block Diagram

At the heart of the Keysight Hacking Platform is a Raspberry Pi 3. The Raspberry Pi 3 is a general purpose embedded ARM Linux device.
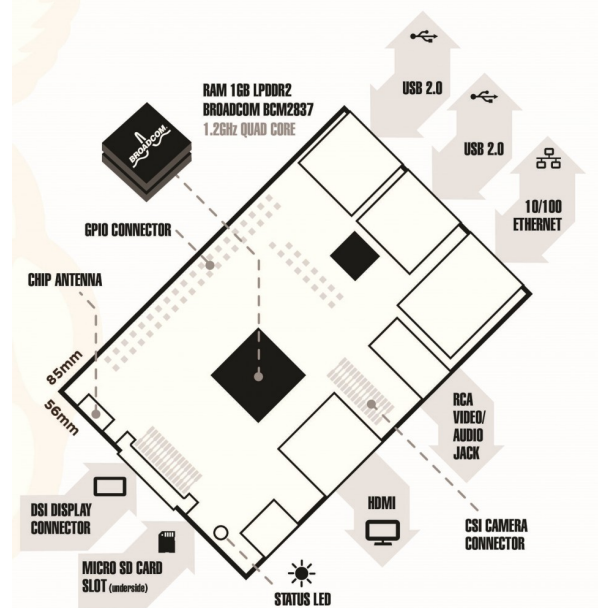
- CPU: 1.2 GHz quad-core ARM Cortex A53

- Memory: 1 GB LPDDR2-900 SDRAM

- 4 USB ports (Max current draw of 1.2A combined on all the USB ports)

- 10/100 Ethernet

- HDMI

- Bluetooth 4.0

- 802.11n Wireless LAN

- Combination RCA Video / Audio jack

- 40 Pin GPIO Connector

3   Raspberry Pi 3 Used GPIO Lines

This section explains which GPIO lines are used by the touchscreen and which GPIO lines are connected to the four push-buttons. The LCD is driven by a Serial Peripheral Interface (SPI) bus. The Raspberry Pi 3 contains three independent SPI bus drivers and in the case the screen is connected to SPI bus 0. The Raspberry Pi 3 has two I2C buses available on the GPIO header and both are used by the screen (I2C bus 0 is used by the configuration EEPROM and I2C bus 1 is used by the touchscreen). Figure 1 shows the GPIO lines used by the touchscreen and the LCD.
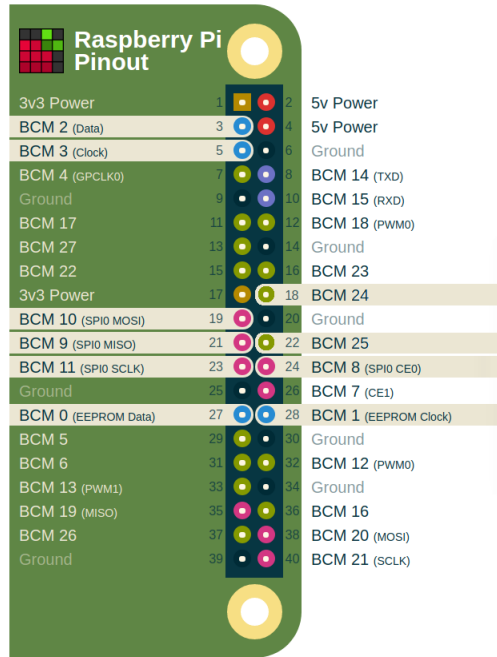
Figure 1: GPIO Lines Used by the Screen

Communication Bus	Used by
I2C Bus 0	Configuration EEPROM
I2C Bus 1	Touchscreen
SPI Bus 0	LCD
SPI Bus 1	nothing

The touch-screen also features four hardware push-buttons which are connected directly to GPIO lines as shown in the section of the touch-screen schematic shown in Figure 2.
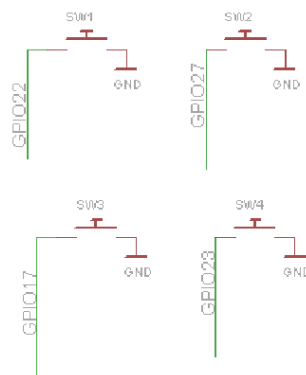

Figure 2: Screen Push-Buttons Schematic

In order to use the push-buttons, the GPIO lines connected to the push-buttons need to be configured as inputs and the internal pull-up resistors enabled (external pull-up resistors could alternatively be used). The push-buttons are connected to the GPIO lines on the Raspberry Pi 3 header as shown in Figure 3.
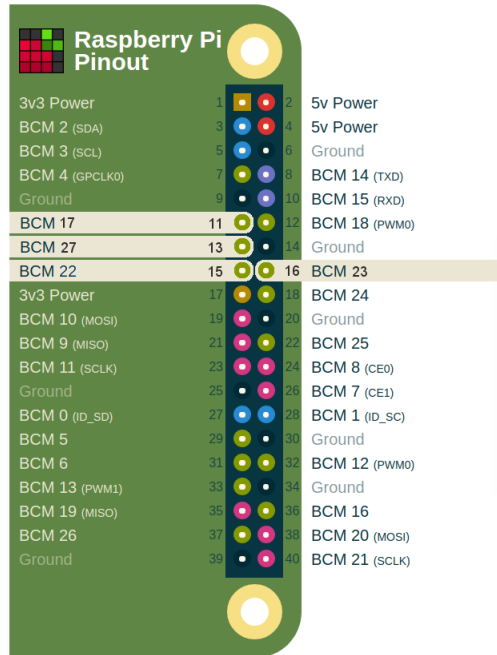
Figure 3: GPIO Lines used by Push-Buttons

It is also possible to figure out which push-button is connected to which GPIO line by looking at the silkscreen labels next to the push-buttons on the screen. Note: the numbers on the labels are the Broadcom pin numbers (BCM numbers) and not the physical pin numbers!

Figure 4: Push Button Labels

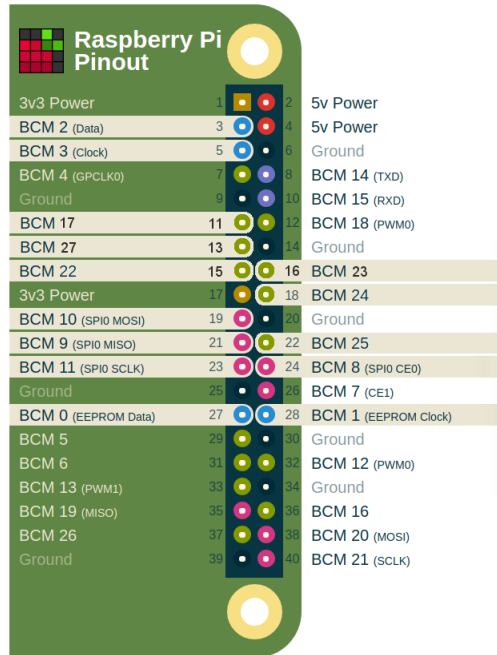In summary, Figure 5 shows all the GPIO lines in use.

Figure 5: All Used GPIO

4 Raspberry Pi 3 Available GPIO and Interfaces

After accounting for the pins used by the LCD screen, touchscreen, and hardware buttons there are 13 GPIO lines left unused (17 it you don't need to use the HW buttons). These unused GPIO lines can be used as general input pins or outputs (hence the name GPIO - General Purpose Input Output). To use the extra GPIO lines, the wiringPi library or the RPi.GPIO Python library can be used. For example Python programs that use the RPi.GPIO Python library, refer to the example programs in the GPIO_Examples folder. For API documentation for the RPi.GPIO library refer the the project's Wiki: https://sourceforge.net/p/raspberry-gpio-python/wiki/Examples/

Also, SPI bus 1 is unused and can be used to communicate with external SPI devices such as the MCP3008 ADC. For more information on how to use the MCP3008 ADC refer to the **Using_the_MCP3008_ADC** document.
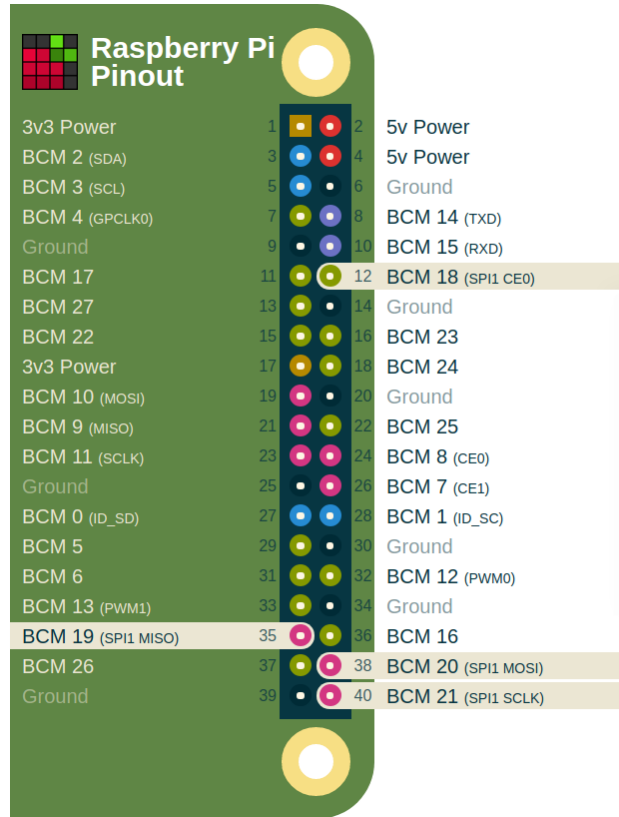
Figure 6: Raspberry Pi 3, SPI Bus 1

It should be noted that all the GPIO lines on the Raspberry Pi 3 are 3.3V lines and are **NOT** 5V tolerant!