RPi Synth Kit Software Installation:

Installing OS image

There are several available options for Linux distributions to be used with Raspberry Pi for audio. For simplicity purposes, let's focus on Patchbox only (https://blokas.io/patchbox-os/), as it comes with many pre-installed components such as Pure Data and a great realtime plugin environment MODEP.

- Download the image and deploy onto SD Card. Refer the basic guide here: https://blokas.io/patchbox-os/docs/first-run-options/

The following steps could be performed locally on RPi or another PC connected over VNC remote console once network is set. For the initial update you may decide to connect to Ethernet or update software later once WiFi is set. For all steps below you'll need Internet access to install extra software. Default login/password: patch/blokaslabs

- The first boot will take some extra time after login and will guide you directly to Patchbox wizard. It won't be able to detect the audio shield right away if PCM5102a is used. It needs to be set in the configuration later. Skip the audio configuration (ESC) and choose to boot to "desktop autologin" by default. Also if you're planning to connect to a WiFi network which is not broadcasted, it's easier to do that from the desktop GUI later.

- Finally, select the Patchbox environment to NONE module. You'll need to run it again once Audio and MIDI modules are properly configured. Reboot RPi. Configure network.

- Also, optional, it might be worth running the distro update manually. Pathchbox wizard attempts that but it might be dated. To do that manually type:

```
sudo apt-get update --allow-releaseinfo-change
sudo apt-get upgrade
```

Calibrating a touchscreen

Calibrating a touchscreen is an optional procedure, but most of the time there is slight misalignment between cursor position and a point on the screen. It's better to fix it as the first step.

- Install calibration tool first

```
sudo apt-get install xinput-calibrator
```

- Calibrate a touchscreen, use a stylus or make sure you accurately point the center

`xinput_calibrator`

- Follow onscreen instructions - copy a section(right mouse click) from the output starting from **Section "InputClass"** until **EndSection** into the new file

  `sudo nano /usr/share/X11/xorg.conf/99-calibration.conf`

Configuring audio output board PCM5102s

Burr-Brown PCM5102s is a high quality audio DAC connected over the I2C interface. It needs to be configured properly. First, in hardware - the board requires some jumpers to be set. Secondly, in software an input port needs to be configured. You need to set it up only once during initial configuration.

- Open main configuration file for editing

  `sudo nano /boot/config.txt`

- Find the section
  `# Uncomment some or all of these to enable optional hardware interfaces`

- Uncomment `dtparam=i2s=on` (i.e. remove "#" before it).

- Then find the section `# Enable audio (loads snd_bcm2835)`. Comment the line `dtparam=audio=on` (i.e. add "#"). This will disable onboard poor quality audio output.

- Add new section after it
  ```
  # I2C DAC
  dtoverlay=hifiberry-dac
  ```

- Exit Cntrl-X and Save.

- Reboot.

- Make sure "HifiBerry DAC HiFi pcm5102a-hifi-0" is properly recognized by typing `aplay -l`

- Lastly, re-run patchbox wizard by executing `patchbox` command and selecting wizard. You should see the newly created audio interface. Set it with recommended settings 128 buffer, period 2 at 48kHz.

Configuring MIDI Ports

RPi Synth kit uses Raspberry Pi serial port0 for MIDI communication. With RPi4 it supports a proper baud rate required for MIDI communication speed, so no external controllers needed, other than optocoupler and several resistors. Similar to I2C DAC it needs to be configured first to set the port configuration. However, it also requires a support app that will translate serial data into the proper MIDI. Following steps also cover how to put it into autostart.

- First, disable Serial0 for console output by opening the editor

  ```
  sudo nano /boot/cmdline.txt
  ```

  and delete `console=serial0, 115200, console=tty1`
  leave everything else then save and exit

- Disable logging over serial. Run RPi configuration

  ```
  sudo raspi-config
  ```

  Select “Interface Options” -> “P6 Serial Port”. Then enable Serial port, disable login shell.

- Open main configuration file for editing

  ```
  sudo nano /boot/config.txt
  ```

- Add the section at the end

  ```
  # Serial MIDI
  enable_uart=1
  dtoverlay=pi3-miniuart-bt
  dtoverlay=midi-uart0
  ```

- Reboot

- Check UART speed, it shoult report ~48001464 if UART is set properly

  ```
  vcgencmd measure_clock uart
  ```

- List all devices and find /serial0 should be on AMA0; /serial1 should be ttyS0

  ```
  ls -lh /dev/serial*
  ```

- Install a support library

```
sudo apt-get install libasound2-dev
```

- Install and compile ttymidi utility for translating serial into MIDI

```
wget http://www.varal.org/ttymidi/ttymidi.tar.gz
tar -zxvf ttymidi.tar.gz
cd ttymidi/
nano Makefike
```

- Add `-lpthread` at the end of the "all:" command line, then compile

```
make
sudo make install
```

- Connect a MIDI input source and run ttymidi tool in verbose mode to make sure it operates properly

```
ttymidi -s /dev/ttyAMA0 -b 38400 -v
```

Play some midi notes and you should see corresponding messages on the screen. If there is no input on the screen, check hardware wiring for TRS-A vs TRS-B pinout. Exit with Cntrl-C.

- While you can add ttymidi into autostart (~/.profile configuration), it could be more convenient to start it manually in background mode while keeping a terminal window open. With that any error that might occur in serial translation will be printed.

```
ttymidi -s /dev/ttyAMA0 -b 38400 &
```

PatchBox operation and MODEP usage

Now it's time to enjoy all new hardware additions. Based on previous steps they are operational already and could be used with pre-installed applications such as Pure Data. However, it might be easier to start with MODEP module which is integrated into Patchbox OS. It’s a modular environment with GUI, that could be used as a synth environment or processing.

- Install MODEP module as it’s not yet fully loaded with Patchbox. Run `patchbox` utility again, select module, select MODEP. It will start downloading instruments and the content.

- MODEP GUI could be run locally or remotely in the Chrome browser. Just open 127.0.0.1 locally or remote IP in the browser.

- From where you can experiment, create a new setup with a simple MIDI instrument such as fluidsynth connected to aggregated midi input and routed to the output. Play a MIDI keyboard and you should hear sounds!

Other software to consider

- PD (Pure Data) is integrated into Patchbox OS. Learn it, it's worth it.
- Cockos Reaper DAW www.reaper.fm
- Extra plugins for Reaper in LV2 and VST formats from Zynthian repo. Fully RPi compatible, however not adopted by MODEP https://github.com/zynthian/zynthian-plugins
- MODEP plugin builder - full dev environment to compile more plugins. https://github.com/moddevices/mod-plugin-builder