



MODA Setup Guide

author: *Emanuele Cocco*

Contents

1. Useful Things (passwords, ...)
2. Hardware Configuration
3. Software Dependencies
4. ALSA and HifiBerry File Configuration
5. ALSAMIXER Configuration for HifiBerry DAC+ ADC Pro
6. MODA Framework Installation
7. Most Used Configuration

1 Useful Things

- RaspBerry Pi 4 Model B:
 - **user:** pi
 - **password:** signet
 - **git passphrase:** linaro

2 Hardware Configuration

- **RaspBerry Pi 4 Model B** (3+, or similar should work, not tested)
- **HifiBerry DAC+ ADC Pro**
- **Hydrophone AS-1**
- **Preamplifier PA-4**
- **Arduino-like amplifier** (or whatever audio amplifier with no cutoff freq above 20kHz)
- **precise clock:** OCXO (TM2500) or atomic clock (MAC/CSAC)
- cables when necessary

2.1 Setup Procedure

1. connect the Hifiberry board on top of the Rasp HAT using the provided spacers
2. prepare two cables to connect the Hifiberry to the TX/RX devices with the following connectors:
1) RCA to be connected to RAC red for TX; 2) mini-JACK 3.5mm to be connected on microphone port for RX
3. TX amplifier: BNC connector on output of amplifier
4. precise clock: connect to PPS output port of the clock to GPIO4 and a ground reference to one GROUND GPIO (e.g. bottom right)

3 Software Dependencies

3.1 ALSA Installation

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

3.2 FFTW3 Installation (optimized FFT library)

```
sudo apt install libfftw3-dev
```

3.3 FEC (KA9Q's optimized library for Convolutional and RS coding scheme, and dotproduct)

```
git clone https://github.com/quiet/libfec.git
cd libfec/
./configure
make
sudo make install
```

3.4 PPS-Client (synchronizer for internal clock using PPS signal)

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

Abilitate the GPIO4 on the Rasp, adding this to the bottom of the configuration (uncommenting the entry or adding this to the existing entry, **under [pi4] section (!!!)**)

```
dtoverlay=pps-gpio,gpiopin=4
```

(if not already installed)

```
sudo apt install git pps-tools build-essential
```

```
git clone https://github.com/rascal/PPS-Client.git
cd PPS-Client
./configure
./create-backups
make
sudo make install
sudo reboot
```

4 ALSA and HifiBerry File Configuration

4.1 ALSA Configuration

Enter the following settings in ALSA configuration or create a new file, if not existent (last case taken into consideration)

```
sudo touch /etc/asound.conf
sudo nano /etc/asound.conf
```

File content:

```
pcm.!default {
    rate 192000
    type hw
    card 0
    device 0
}
ctl.!default {
    type hw card 0
}
```

4.2 HifiBerry Configuration

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

Comment the following line:

```
dtparam=audio=on
```

In [pi4] section, add this overlay:

```
dtoverlay=vc4-fkms-v3d
```

In [all] section, add these lines:

```
dtoverlay=hifiberry-dacplusadcpro
force_eeprom_read=0
```

and comment (if present)

```
dtoverlay=vc4-fk
```

Reboot the board.

To test if the configuration is complete, execute the command

```
aplay -l
```

And the output should be

```
**** List of PLAYBACK Hardware Devices ****
card 0: sndrpihifiberry [snd_rpi_hifiberry_dacplusadcpro], device 0:
      HiFiBerry DAC+ADC Pro HiFi multicodec-0 [HiFiBerry DAC+ADC Pro
      HiFi multicodec-0]
Subdevices: 1/1
Subdevice #0: subdevice #0
```

Check whether all the related interfaces are present (e.g. *hw*, *plughw*, ...)

```
aplay -L
```

5 ALSAMIXER configuration for HifiBerry DAC+ ADC Pro

On a terminal, type

```
alsamixer
```

F6 (to change card) and select `snd_rpi_hifiberry_dacplusadcpro`

Navigate with left/right arrow keys and change parameters with up/down arrow keys, F3 for Playback tab and F4 for Capture tab.

In Playback(F3) check that the following parameters are set:

- ADC Left: [VINL1[SE]]
- ADC Right: [VINR1[SE]]
- Analogue [db gain: 0.00, 0.00] (bar to 100)
- Analogue Playback Boost [db gain: 0.00, 0.00]

In Capture(F4) check that the following parameters are set:

- ADC [db gain: 0.00, 0.00] (bar to 9)
- Analogue Playback Boost [db gain: 0.00, 0.00]
- Max Overclock DAC: 0
- Max Overclock DSP: 0
- Max Overclock PLL: 0

6 MODA Framework Installation

To clone/pull the repositories on the RaspBerry Pis already used, deploy keys have already been set up in read-only with passphrase `linaro`.

The installation order for the different repositories is the following:

1. base-object

```
./installer.sh -p $PWD -t 1
```

2. mac

```
./installer.sh -p $PWD -b $PWD/../../base-object/ -t 1
```

3. liquid

```
./installer.sh -p $PWD -C
```

4. phy

```
./installer.sh -p $PWD -b $PWD/../../base-object -l $PWD/../../liquid  
-t 1
```

5. modem-executable

```
./installer.sh -p $PWD -b $PWD/../../base-object -l $PWD/../../liquid  
-P $PWD/../../phy -m $PWD/../../mac -t 1
```

7 Most Used Configuration

- flexframe BPSK
interpolation to 10 sps
inner FEC: convolutional (Viterbi)
outer FEC: Reed Solomon

```
./bin/test_modem -m -I cv29 -O rs -f -i 10 -p
```

- dsssframe BPSK
interpolation to 3 sps
inner FEC: convolutional (Viterbi)
outer FEC: Reed Solomon

```
./bin/test_modem -m -I cv29 -O rs -D -i 3 -p
```