

How to enable SPI under BananaPi BPI-R4 v3.

1. Intro

All necessary files are located in my repo: https://github.com/drozdi70/bananapi_bpi-r4

Especially [Adafruit Blinka SPI Pack.tar](#) used in point 5.

2. Image preparation.

Add in DTS file section related to enabling spi/spidev

(~/openwrt/target/linux/mediatek/files-6.6/arch/arm64/boot/dts/mediatek/mt7988a-bananapi-bpi-r4.dts):

```
&spi1 {
    #address-cells = <1>;
    #size-cells = <0>;
    pinctrl-names = "default";
    pinctrl-0 = <&spi1_pins>;
    status = "okay";

    spidev0: spidev@0 {
        compatible = "sitronix,st7789v";
        spi-max-frequency = <32000000>;
        #address-cells = <1>;
        #size-cells = <0>;
        reg = <0>;
        dc-gpios = <&pio 50 GPIO_ACTIVE_HIGH>; //GPIO50/pin 15
        reset-gpios = <&pio 53 GPIO_ACTIVE_LOW>; //pin 22 / GPIO53
        spi-cpol;
        spi-cpha;
        status = "okay";
    };
};
```

Install a patch for st7789v – 0004-spidev-lcd-6.6.patch in your directory where you compile openwrt:

```
cp 0004-spidev-lcd-6.6.patch ~/openwrt/target/linux/mediatek/patches-6.6/
```

In menuconfig → enable spi/spidev to be sure all is installed as
kmod-spi-dev spi_tools spidev_test kmod-spi-gpio

Write image to SD and start router from SD card.

Make connection to internet working from your router.

```
# apk update
```

```
# apk upgrade
```

```

root@BPI-R4:~# ls -ltr /dev/spi*
crw----- 1 root root 153, 0 Nov 23 20:27 /dev/spidev1.0
root@BPI-R4:~# lsmod | grep spi
crc_itu_t      12288 1 mmc_spi
crc7           12288 1 mmc_spi
mmc_spi       16384 0
of_mmc_spi    12288 1 mmc_spi
spi_bitbang   12288 1 spi_gpio
spi_gpio      16384 0
spidev        20480 0
root@BPI-R4:~#

```

3. SPI bus check

If nothing is connected to the bus:

```

root@BPI-R4:~# spidev_test -D /dev/spidev1.0 -v
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 kHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF F0 0D |.....@.....|
RX | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 |.....|

```

Next we short pin19 and pin21:

```

root@BPI-R4:~# spidev_test -D /dev/spidev1.0 -v
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 kHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF F0 0D |.....@.....|
RX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF F0 0D |.....@.....|
root@BPI-R4:~#

```

```

root@BPI-R4:~# spi-config -d /dev/spidev1.0 -q
/dev/spidev1.0: mode=0, lsb=0, bits=8, speed=32000000, spiready=0

```

4. ST7899 LCD screen wiring to the board

BPI-R4 GPIO pinout:

https://docs.banana-pi.org/en/BPI-R4/GettingStarted_BPI-R4#_gpio_define

SPI - 1.69inch LCD Module 240x280 pixels, ST7789V2

SPI - 1.54inch LCD module 240x240 pixels, ST7789

VCC -> 3.3V (pin 17)
GND -> GND (pin 20)
SCL -> SPI1_CLK (pin 23) GPIO31
SDA -> SPI1_MOSI (pin 19) GPIO30
RST -> pin 22 / GPIO53
DC -> pin 15 / GPIO50
CS -> pin26 / GPIO52
BL -> +VCC or not connected

SPI1_CSB (24) GPIO28 -- not connected!
SPI1_MISO (21) GPIO29 -- not connected!

How to check which GPIO line is free and can be used?

```
root@BPI-R4:~# apk add gpiod-tools
```

```
root@BPI-R4:~# gpioinfo
```

```
gpiochip0 - 84 lines:
```

line 0:	unnamed	output consumer=tx-disable
line 1:	unnamed	input consumer=tx-fault
line 2:	unnamed	input consumer=los
line 3:	unnamed	input active-low consumer=rate-select0
line 4:	unnamed	input
line 5:	unnamed	output active-low consumer=reset
line 6:	unnamed	input
line 7:	unnamed	input
line 8:	unnamed	input
line 9:	unnamed	input consumer=kernel
line 10:	unnamed	input consumer=kernel
line 11:	unnamed	input
line 12:	unnamed	input active-low consumer=cd
line 13:	unnamed	input
line 14:	unnamed	input active-low consumer=WPS
line 15:	unnamed	input consumer=kernel
line 16:	unnamed	input consumer=kernel
line 17:	unnamed	input
line 18:	unnamed	input
line 19:	unnamed	input
line 20:	unnamed	input consumer=kernel
line 21:	unnamed	input active-low consumer=rate-select0
line 22:	unnamed	input consumer=kernel

line 23:	unnamed	input consumer=kernel
line 24:	unnamed	input consumer=kernel
line 25:	unnamed	input consumer=kernel
line 26:	unnamed	input consumer=kernel
line 27:	unnamed	input consumer=kernel
line 28:	unnamed	input consumer=kernel
line 29:	unnamed	input consumer=kernel
line 30:	unnamed	input consumer=kernel
line 31:	unnamed	input consumer=kernel
line 32:	unnamed	input consumer=kernel
line 33:	unnamed	input consumer=kernel
line 34:	unnamed	input consumer=kernel
line 35:	unnamed	input consumer=kernel
line 36:	unnamed	input consumer=kernel
line 37:	unnamed	input consumer=kernel
line 38:	unnamed	input
line 39:	unnamed	input
line 40:	unnamed	input
line 41:	unnamed	input
line 42:	unnamed	input
line 43:	unnamed	input
line 44:	unnamed	input
line 45:	unnamed	input
line 46:	unnamed	input
line 47:	unnamed	input
line 48:	unnamed	input
line 49:	unnamed	input
line 50:	unnamed	input
line 51:	unnamed	input
line 52:	unnamed	input
line 53:	unnamed	input
line 54:	unnamed	input consumer=los
line 55:	unnamed	input consumer=kernel
line 56:	unnamed	input consumer=kernel
line 57:	unnamed	input consumer=kernel
line 58:	unnamed	input consumer=kernel
line 59:	unnamed	input consumer=kernel
line 60:	unnamed	input consumer=kernel
line 61:	unnamed	input consumer=kernel
line 62:	unnamed	input
line 63:	unnamed	output consumer=blue:wps
line 64:	unnamed	input consumer=kernel
line 65:	unnamed	input consumer=kernel
line 66:	unnamed	input consumer=kernel
line 67:	unnamed	input consumer=kernel
line 68:	unnamed	input
line 69:	unnamed	input consumer=tx-fault
line 70:	unnamed	output consumer=tx-disable
line 71:	unnamed	input consumer=kernel
line 72:	unnamed	input consumer=kernel
line 73:	unnamed	input
line 74:	unnamed	input consumer=kernel

line 75:	unnamed	input
line 76:	unnamed	input
line 77:	unnamed	input consumer=kernel
line 78:	unnamed	input consumer=kernel
line 79:	unnamed	output consumer=green:status
line 80:	unnamed	input consumer=kernel
line 81:	unnamed	input consumer=kernel
line 82:	unnamed	input active-low consumer=mod-def0
line 83:	unnamed	input active-low consumer=mod-def0

All lines consumer=kernel cannot be used as already reserved.
We check lines (GPIO) 50,52,53

```
root@BPI-R4:~# gpioinfo |grep -e "50:" -e "52:" -e "53:"
    line 50:      unnamed      input
    line 52:      unnamed      input
    line 53:      unnamed      input
root@BPI-R4:~#
```

We also check base number for gpiochip → in our case is 512 (needed for pin mapping).

```
root@BPI-R4:~# ls -ltr /sys/class/gpio/
--W----- 1 root root      4096 Jan 1 1970 unexport
lrwxrwxrwx 1 root root        0 Jan 1 1970 gpiochip512 -> ../../devices/platform/soc/1001f000.pinctrl/gpio/gpiochip512
--W----- 1 root root      4096 Jan 1 1970 export
root@BPI-R4:~#
```

5. SPI configuration

SPI can work programmed in different ways, I decided to use Adafruit-Blinka package and adopt it a little bit as per now our board is not supported officially there.

Please remember one fact that in the case of any possible upgrade of the package Adafruit_Blinka you need to repeat whole process as probably some files will be replaced by new ones from new release.

Adafruit-Blinka version: 8.50.0

Adafruit-platformdetect version: 3.75.0

Python 3.11

apk update

apk upgrade

apk add python3 curl git git-http

apk add python3-dev make

apk add python3-setuptools

apk add python3-pip sudo coreutils

apk add python3-pillow

apk add python3-gpiod

pip3 install Adafruit-Blinka

```
pip3 install adafruit-platformdetect
pip3 install --upgrade adafruit-python-shell click
pip3 install adafruit-circuitpython-st7789
pip install adafruit-circuitpython-display-text
pip install Adafruit-GPIO
```

Some Hocus-Pocus (based on https://github.com/Dangku/Adafruit_Python_PlatformDetect)

```
cd /usr/lib/python3.11/site-packages
mv adafruit_platformdetect adafruit_platformdetect.ORIG
copy adafruit_platformdetect.tar here and extract
tar xvf adafruit_platformdetect.tar
mv board.py board.py.ORIG
copy board.py here
copy bananapi.tar to /usr/lib/python3.11/site-packages/adafruit_blinka/board
mv bananapi bananapi.ORIG
tar xvf bananapi.tar
copy mt7988a.tar to /usr/lib/python3.11/site-packages/adafruit_blinka/microcontroller
tar xvf mt7988a.tar
in /usr/lib/python3.11/site-packages/
mv digitalio.py digitalio.py.ORIG
copy digitalio.py here
in /usr/lib/python3.11/site-packages/
mv microcontroller microcontroller.ORIG
copy microcontroller.tar here and extract
tar xvf microcontroller.tar
```

=====

```
Adafruit-Blinka version: 8.51.0
Adafruit-platformdetect version: 3.77.0
Python 3.13
```

For debian please use apt update/apt upgrade/apt install...

```
apk update
apk upgrade
apk add python3 curl git git-http
apk add python3-dev make
apk add python3-setuptools
apk add python3-pip sudo coreutils
apk add python3-pillow
apk add python3-gpiod (python3-libgpiod)
```

Use option `--break-system-packages` for Adafruit packages

```
pip3 install Adafruit-Blinka
pip3 install adafruit-platformdetect
pip3 install --upgrade adafruit-platformdetect
pip3 install --upgrade adafruit-python-shell click
pip3 install adafruit-circuitpython-st7789
```

```
pip install adafruit-circuitpython-display-text
pip install Adafruit-GPIO
```

```
cd /usr/local/lib/python3.13/dist-packages
```

```
mv adafruit_platformdetect adafruit_platformdetect.Orig
```

```
copy adafruit_platformdetect.tar here and extract
```

```
tar xvf adafruit_platformdetect.tar
```

```
!!!
```

```
cd /usr/local/lib/python3.13/dist-packages/adafruit_platformdetect
```

```
vi board.py
```

```
in line 913 please replace the line
```

```
if board_value and "Bananapi BPI-R4" in board_value:
```

```
with
```

```
if board_value and "BPI-R4" in board_value:
```

```
cd /usr/local/lib/python3.13/dist-packages/
```

```
mv board.py board.py.Orig
```

```
copy board.py here
```

```
copy bananapi.tar to /usr/local/lib/python3.13/dist-packages/adafruit_blinka/board
```

```
mv bananapi bananapi.Orig
```

```
tar xvf bananapi.tar
```

```
copy mt7988a.tar to /usr/local/lib/python3.13/dist-packages/adafruit_blinka/microcontroller
```

```
tar xvf mt7988a.tar
```

```
in /usr/local/lib/python3.13/dist-packages
```

```
mv digitalio.py digitalio.py.Orig
```

```
copy digitalio.py here
```

```
in /usr/local/lib/python3.13/dist-packages
```

```
mv microcontroller microcontroller.Orig
```

```
copy microcontroller.tar here and extract
```

```
tar xvf microcontroller.tar
```

Tests:

```
root@BPI-R4:~# python3 detect.py
```

```
Board Detection Test
```

Check that the Chip and Board IDs match your board and that this it is correctly detecting whether or not it is a Linux board.

```
Board detected:
```

```
-----
```

```
Chip id: MT7988A
```

```
Board id: BANANA_PI_BPI_R4
```

```
Linux Detection
```

Is this an embedded Linux system? True

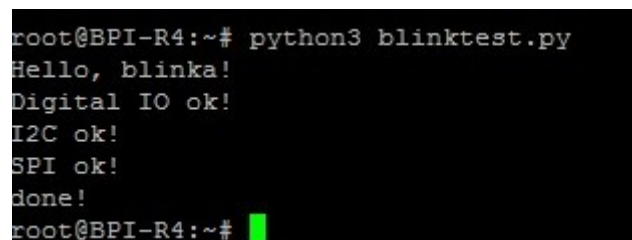
Raspberry Pi Boards

Is this a Pi 3B+? False
Is this a Pi 4B? False
Is this a 40-pin Raspberry Pi? False
Is this a Raspberry Pi Compute Module? False

Other Boards

Is this a Siemens Simatic IOT2000 Gateway? False
Is this a BananaPi board? True
Is this a 96boards board? False
Is this a BeagleBone board? False
Is this a Giant board? False
Is this a Coral Dev board? False
Is this a MaaXBoard? False
Is this a SiFive board? False
Is this a PYNQ board? False
Is this a Rock Pi board? False
Is this a NanoPi board? False
Is this a Khadas VIM3 board? False
Is this a Clockwork Pi board? False
Is this a Seeed Board? False
Is this a UDOO board? False
Is this an ASUS Tinker board? False
Is this an STM32MP1 board? False
Is this a MilkV board? False
Is this a Luckfox Pico board? False
Is this a generic Linux PC? False
Is this an OS environment variable special case? False

BananaPi board detected.



```
root@BPI-R4:~# python3 blinktest.py
Hello, blinka!
Digital IO ok!
I2C ok!
SPI ok!
done!
root@BPI-R4:~#
```

Remark:

Adafruit-Blinka package could be probably pinned / hold to the current version/state as below by running:

```
# pip3 freeze > requirements.txt
```

and revert operation:

```
# pip3 install -r requirements.txt
```


Ref. <https://builtin.com/software-engineering-perspectives/pip-freeze>

6. Examples for LCD ST7899

git clone https://github.com/adafruit/Adafruit_CircuitPython_ST7789

cd Adafruit_CircuitPython_ST7789/examples/

edit a file and adjust SPI lines parameteres as below:

```
spi = busio.SPI(board.D23, MOSI=board.D19)
tft_cs = board.D26
tft_dc = board.D15
tft_backlight = None
```

or

```
tft_dc = board.D15
tft_cs = board.D26
spi_clk = board.D23
spi_mosi = board.D19
tft_rst = board.D22
backlight = None
spi = busio.SPI(spi_clk, spi_mosi)
```

or

```
spi = board.SPI()
tft_cs = board.D26
tft_dc = board.D15
```

```
display_bus = FourWire(spi, command=tft_dc, chip_select=tft_cs, reset=board.D22)
```

or

```
spi = board.SPI()
tft_cs = None
tft_dc = board.D15
```

```
display_bus = FourWire(spi, command=tft_dc, chip_select=tft_cs)
```

The CS line of ST7899V2 attached to D24!!!

If your text is mirrored please use option polarity 0/1 in function FourWires to correctly display text!

display_bus = FourWire(spi, command=tft_dc, chip_select=tft_cs, polarity=1)

(<https://docs.circuitpython.org/en/stable/shared-bindings/fourwire/index.html>)

7. XPT2046 touchscreen wiring to the board

TFT	Board	GPIO	Pin #
-----	-----	-----	-----
T_CLK	SPI1_CLK	GPIO31	23
T_CS		GPIO52	26
T_DIN	SPI1_MOSI	GPIO30	19
T_DO	SPI1_MISO	GPIO29	21
T_IRQ		GPIO50	15
T_RST		GPIO53	22

VCC -> 5V (pin 2 or pin 4)

GND -> GND (pin 20)

Installation:

```
# pip3 install xpt2046-circuitpython
# pip3 install adafruit-circuitpython-rgb-display
```

8. Examples for touchscreen XPT2046

```
git clone https://github.com/humeman/xpt2046-circuitpython
```

```
cd xpt2046-circuitpython/sample
```

Setting proper values for GPIO lines as:

```
from board import D23, D19, D21, D26, D15
```

```
# Pin config
T_CS_PIN = D26
T_IRQ_PIN = D15
MOSI = D19
SCK = D23
MISO = D21
```

In my case touchscreen is not returning correct value ;)

[illegible]

9. References/Docs

<https://docs.circuitpython.org/projects/st7789/en/stable/examples.html>
https://github.com/russhughes/st7789_mpy/tree/master
<https://forum.banana-pi.org/t/banana-pi-bpi-r64-spi-touch-panel-test-with-openwrt/10009/2>
<https://www.coderdojotc.org/micropython/displays/graph/14-lcd-st7789V/>
<https://github.com/rm-hull/luma.examples>
<https://forum.banana-pi.org/t/bpi-r2-r3-and-ssd1306-oled-screen/11917/47>
https://github.com/abhra0897/stm32f1_st7789_spi
https://git.datalabrotterdam.nl/customer/projects/Micropython-examples/-/tree/main/SPI%20ST7789%20Display?ref_type=heads
https://github.com/solinnovay/Python_ST7789
<https://github.com/sonocotta/st7789-orangepi-python>
https://techatronic.com/st7789-display-pi-pico/#google_vignette
<https://forum.banana-pi.org/t/spi-touchscreen-ads7846-xpt2046-on-ubuntu-images-bpi-r2/4781/29>
<https://blog.embeddedexpert.io/?p=1215>
<https://github.com/pimoroni/st7789-python>
<https://techatronic.com/st7789-raspberry-pi/>
<https://github.com/pimoroni/st7789-python>
https://github.com/devbis/st7789_mpy
<https://forums.pimoroni.com/t/adafruit-st7789-1-54-python-code/14238>
<https://git.datalabrotterdam.nl/customer/projects/Micropython-examples/-/tree/main/SPI%20ST7789%20Display>
<https://github.com/russhughes/ttgo-hershey-fonts>
https://github.com/solinnovay/Python_ST7789
<https://raspberrypi.stackexchange.com/questions/104846/how-to-connect-st7789-lcd-to-spi-bus-1-as-2nd-screen>
<http://helloraspberrypi.blogspot.com/2021/02/raspberry-pi-picomicropython-st7789-spi.html>
<https://python.scitoys.com/st7789>
<https://www.programcreek.com/python/example/101401/machine.SPI>
<https://pypi.org/project/xpt2046-circuitpython/>