

## 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](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](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

```
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](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
```

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

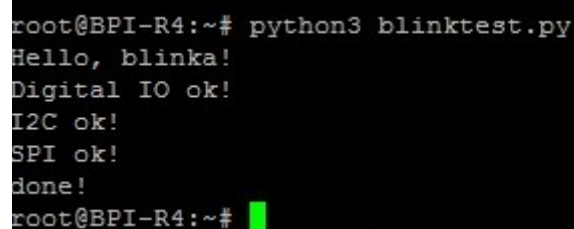
Is this a MilkV board? False

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](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)
```

## 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 ;)

A terminal window with a black background and white text. The prompt is 'root@BPI-R4:~/xpt2046-circuitpython/samples#'. The command 'python3 read.py' has been executed, resulting in a continuous output of '(0, 0)' on multiple lines.

```
root@BPI-R4:~/xpt2046-circuitpython/samples# python3 read.py
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
(0, 0)
```

## 9. References/Docs

<https://docs.circuitpython.org/projects/st7789/en/stable/examples.html>

[https://github.com/russhughes/st7789\\_mpy/tree/master](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://github.com/abhra0897/stm32f1_st7789_spi)

[https://git.datalabrotterdam.nl/customer/projects/Micropython-examples/-/tree/main/SPI%20ST7789%20Display?ref\\_type=heads](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/solinnovay/Python_ST7789)

<https://github.com/sonocotta/st7789-orangepi-python>  
[https://techatronic.com/st7789-display-pi-pico/#google\\_vignette](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://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://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://github.com/solinnovay/Python_ST7789)  
[https://raspberrypi.stackexchange.com/questions/104846/how-to-connect-st7789-lcd-to-spi-bus-1-  
as-2nd-screen](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/>