

ANAVI Infrared pHAT

Convert Your Raspberry Pi to Powerful Remote Control

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ANAVI Infrared pHAT hardware design is licensed under a Creative Commons Attribution-ShareAlike 3.0 Unported License.

The software examples are released under MIT and the rest of the software is available under GPLv3.

It is possible that the pictures in this manual differ from the latest revision of the board.

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There is no warranty for the design materials and the components used to create ANAVI Infrared pHAT. There are considered suitable only for ANAVI Infrared pHAT.

CHAPTER 1: Overview

Introduction

ANAVI Infrared pHAT is an open source hardware Raspberry Pi add-on board with IR receiver, transmitter, UART and 3 I2C slots for sensors. ANAVI Infrared pHAT was started as a hobby project by Leon Anavi in January 2017. The project allows you to convert your Raspberry Pi into powerful remote control using the open source software LIRC.

ANAVI Infrared pHAT is designed with the free and open source electronics design automation suite [KiCAD](#). No soldering is required. You can assemble ANAVI Infrared pHAT to your Raspberry Pi with your bare hands.

Anavi is fully compatible with the Raspbian GNU/Linux distribution and open source sample applications are provided. ANAVI Infrared pHAT also supports its own ANAVI IoT GNU/Linux distribution which is based on the Yocto Project and Openembedded and features open source daemon for communicating with other Internet of Things (IoT) through the lightweight machine-to-machine connectivity protocol MQTT.

Features

ANAVI Infrared pHAT Raspberry Pi HAT includes:

- IR LED
- IR photo sensor
- Slots for up to 3 plug and play I2C sensors

Supported Raspberry Pi Versions and Models

ANAVI Infrared pHAT is compatible with the following Raspberry Pi versions and models:

- [Raspberry Pi 3 Model B](#)
- [Raspberry Pi 2 Model B](#)
- [Raspberry Pi 0](#)
- [Raspberry Pi Model B+](#)
- [Raspberry Pi Model A+](#)

ANAVI Infrared pHAT is **NOT** compatible with the earlier 26-pin models of Raspberry Pi 1 Model B & A's.

Target Market

ANAVI Infrared pHAT is a Raspberry Pi HAT suitable for existing Raspberry Pi customers interested

in home automation, software development and Internet of Things. The board is appropriate for embedded programming enthusiasts, GNU/Linux gadget fans, students as well as web and/or mobile app developers. The main usage of the board is embedded software development and controlling IR devices without the urge of understanding perfectly the hardware.

Board Version

Revision 1.0 of ANAVI Infrared pHAT was used while writing this document. It is possible that it is outdated so it is always recommended to check the latest sources from the GitHub page of the board.

CHAPTER 2: Getting Started

Electrostatic Warning

ANAVI Infrared pHAT is shipped in a protective antistatic bag. The HAT as well as the Raspberry Pi must **NOT** be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

Requirements

In order to setup ANAVI Infrared pHAT the following items are required:

- Compatible Raspberry Pi
- microSD card with compatible image
- USB power supply

Additionally you may attach USB mouse, keyboard, HDMI monitor or addition peripheral devices to your Raspberry Pi. It is recommended to use 2.5A (2500mA) power supply.

Supported Peripherals

ANAVI Infrared pHAT Raspberry Pi HAT has an infrared receiver and an infrared transmitter. Up to 3 I2C sensors can be also easily attached to the pHAT.

Sensors

The officially supported sensors by ANAVI Infrared pHAT are:

- Temperature and barometric pressure (BMP180)
- Temperature and humidity (HTU21)
- Light (BH1750)

You may also attach any other I2C sensors but you will have to take care of their software

integration.

Temperature Sensor

The official temperature sensor for ANAVI Infrared pHAT is BMP180. This is I2C sensor capable of measuring both temperature and barometric pressure.

Using 4 Dupont jumper wires connect BMP180 to one of the 5 I2C slots on ANAVI Infrared pHAT as follows:

BMP180 ANAVI Infrared pHAT

VIN	3.3V
GND	GND
SCL	SCL
SDA	SDA

Humidity Sensor

The official humidity temperature for ANAVI Infrared pHAT is HTU21 (SHT21). This is I2C sensor capable of measuring both humidity and temperature.

Using 4 Dupont jumper wires connect HTU21 to one of the 5 I2C slots on ANAVI Infrared pHAT as follows:

HTU21 ANAVI Infrared pHAT

VIN	3.3V
GND	GND
SCL	SCL
SDA	SDA

Light Sensor

The official light I2C sensor for ANAVI Infrared pHAT is BH1750.

Using 4 Dupont jumper wires connect BH1750 to one of the 5 I2C slots on ANAVI Infrared pHAT as follows:

BH1750 ANAVI Infrared pHAT

VCC	3.3V
GND	GND
SCL	SCL
SDA	SDA

Assembly

You can assemble ANAVI Infrared pHAT and mount it on your Raspberry Pi with your bare hands following the steps below:

- Ensure that your Raspberry Pi is compatible with ANAVI Infrared pHAT.
- Power off your Raspberry Pi.
- Gently mount ANAVI Infrared pHAT on the 40 pin header of your Raspberry Pi.
- Add sensors to your ANAVI Infrared pHAT.
- Optionally, you may also mount two or four brass M2.5 standoffs to keep your Pi HAT snug on your Raspberry Pi while also keeping the two boards separated.
- That's all, now you are ready to go!

Powering ANAVI Infrared pHAT

ANAVI Infrared pHAT is Raspberry Pi HAT therefore it is powered through Raspberry Pi. It is recommended to use the [official Raspberry Pi Power Supply](#) or another 2.5A USB power supply from reputable retailer.

CHAPTER 3: Software

Installation

In order to work correctly, ANAVI Infrared pHAT requires an up-to-date kernel, I2C to be enabled, and a few libraries to get started. After booting microSD card with **Raspbian**, open a terminal and follow the steps below:

- Ensure your APT package list is up-to-date:

```
sudo apt-get update
```

- Install additional applications, libraries and other tools needed by ANAVI Infrared pHAT

```
sudo apt-get install -y git i2c-tools vim
```

Enable I2C

Follow the steps below to enable I2C which is required by the sensors for ANAVI Infrared pHAT

- Open a terminal or login remotely via SSH to your Raspberry Pi and type in the following command:

```
sudo raspi-config
```

- Select **Advanced Options > I2C** and enable it.
- Reboot the board.

Serial Debugging

Follow the steps below to enable serial debugging through USB to serial cable:

- Open a terminal or login remotely via SSH to your Raspberry Pi and type in the following command:

```
sudo raspi-config
```

- Select **Advanced Options > Serial** and enable it.
- Reboot the board.
- Plug the USB to serial cable and connect your Raspberry Pi to your PC. The **RX** line of the cable should go to **TX** line of **UART** on ANAVI Infrared pHAT. The **TX** line of the cable should go to the **RX** line of **UART** on ANAVI Infrared pHAT. The **GND** wire should go to the **GND** line of **UART** on ANAVI Infrared pHAT.
- Type in the following command on your computer if you are using GNU/Linux distribution to access ANAVI Infrared pHAT. Alternatively if your OS is Microsoft Windows use [putty](#).

The recommended USB to serial cable for ANAVI Infrared pHAT is [Olimex USB-Serial-Cable-F](#).

Examples

Sample applications written in Python and the C programming language are provided for ANAVI Infrared pHAT under MIT license in GitHub. All examples have been tested on **Raspbian**.

Open a terminal and execute the follow the steps by step instructions to install all dependencies and to get the source code:

- Install dependencies:

```
sudo apt-get update
sudo apt-get install -y git git-core vim python-dev python-rpi.gpio
```

- Install the GPIO interface library for Raspberry Pi called [wiringPi](#):

```
cd ~
git clone git://git.drogon.net/wiringPi
cd wiringPi
./build
```

- Download the examples for ANAVI Infrared pHAT Raspberry Pi HAT

```
cd ~
git clone https://github.com/AnaviTech/anavi-examples.git
cd anavi-examples
```

Sensors

It is mandatory to enable I2C to use any of the sensors supported by ANAVI Infrared pHAT Raspberry Pi HAT.

Temperature Sensor (BMP180)

Follow the steps below to use the BMP180 I2C temperature and barometric pressure sensor with ANAVI Infrared pHAT:

- Connect BMP180 to any of the I2C slots on ANAVI Infrared pHAT using male to female Duport jumper wire.
- Type in the following command and verify that the address of the sensor is listed:

```
sudo i2cdetect -y 1
```

- Type in the following commands to build and run the sample application that display temperature and barometric pressure:

```
cd ~/anavi-examples/flex/sensor-temperature/c/  
make  
sudo ./rabbitmax-sensor-temperature
```

- Verify that the output is similar to (the exact values depend on the atmospheric condition):

```
pi@raspberrypi:~/anavi-examples/flex/sensor-temperature/c $ sudo  
./rabbitmax-sensor-temperature  
Anavi Temperature and Barometric Pressure Sensor  
Temperature 25.0 C  
Pressure 995.49 hPa
```

Humidity Sensor (HTU21D)

Follow the steps below to use the HTU21D I2C temperature and humidity sensor with ANAVI Infrared pHAT:

- Connect HTU21D to any of the I2C slots on ANAVI Infrared pHAT using male to female Duport jumper wire.
- Type in the following command and verify that the address of the sensor is listed:

```
sudo i2cdetect -y 1
```

- Type in the following commands to build and run the sample application that display temperature and humidity:

```
cd ~/anavi-examples/flex/sensor-humidity/c/  
make
```

```
sudo ./rabbitmax-sensor-humidity
```

- Verify that the output is similar to (the exact values depend on the atmospheric condition):

```
pi@raspberrypi:~/anavi-examples/flex/sensor-humidity/c $ sudo
./rabbitmax-sensor-humidity
Anavi Humidity and Temperature Sensor
24.54C
37.78%rh
```

Light Sensor (BH1750)

Follow the steps below to use the BH1750 I2C light sensor with ANAVI Infrared pHAT:

- Connect BH1750 to any of the I2C slots on ANAVI Infrared pHAT using male to female Duport jumper wire.
- Type in the following command and verify that the address of the sensor is listed:

```
sudo i2cdetect -y 1
```

- Type in the following commands to build and run the sample application that display luminous emittance:

```
cd ~/anavi-examples/flex/sensor-light/c/
make
./rabbitmax-light-sensor
```

- Verify that the output is similar to (the exact values depend on the atmospheric condition):

```
pi@raspberrypi:~/anavi-examples/flex/sensor-light/c $ ./rabbitmax-light-sensor
Anavi Light Sensor
Light: 43 Lux
```

Infrared and LIRC

ANAVI Infrared pHAT Raspberry Pi HAT has built-in infrared receiver and transmitter. [LIRC](#) (Linux Infrared Remote Control) is popular open source application for sending and receiving data over infrared on GNU/Linux distributions. This chapter provides guidelines how to enable ANAVI Infrared pHAT infrared receiver and transmitter on **Raspbian** and to use LIRC.

Setting up LIRC

Perform the steps below to enable the infrared receiver and transmitter:

- Install LIRC


```
sudo apt-get update
sudo apt-get install -y lirc
```

- Edit `/etc/modules` and add the IR pins by adding the following line to the end of the file:

```
lirc_dev
lirc_rpi gpio_in_pin=18 gpio_out_pin=17
```

- Configure `/etc/lirc/hardware.conf` in a way to match:

```
# /etc/lirc/hardware.conf
#
# Arguments which will be used when launching lircd
LIRCD_ARGS="--uinput"

#Don't start lircmd even if there seems to be a good config file
#START_LIRCMD=false

#Don't start irexec, even if a good config file seems to exist.
#START_IREXEC=false

#Try to load appropriate kernel modules
LOAD_MODULES=true

# Run "lircd --driver=help" for a list of supported drivers.
#DRIVER="UNCONFIGURED"
DRIVER="default"
# usually /dev/lirc0 is the correct setting for systems using udev
DEVICE="/dev/lirc0"
MODULES="lirc_rpi"

# Default configuration files for your hardware if any
LIRCD_CONF=""
LIRCMD_CONF=""
```

- Edit `/boot/config.txt` and configure kernel extensions by adding the following line to the end of the file:

```
dtoverlay=lirc-rpi,gpio_in_pin=18,gpio_out_pin=17
```

- Reboot Raspberry Pi:

```
sudo shutdown -r 0
```

Using IR Receiver

Follow the steps below to verify that the IR receiver is working as expected:

- Stop LIRC systemd service:

```
sudo systemctl stop lirc
```

- Start outputting raw data from the IR receiver

```
mode2 -d /dev/lirc0
```

- Point a remote control at the IR receiver on ANAVI Infrared pHAT and press its buttons. If the IR receiver is configured successfully you will see similar output:

```
space 3662230
pulse 2428
space 594
pulse 1201
space 596
pulse 1230
space 595
pulse 1209
space 590
pulse 1204
```

Using IR LED

Follow the steps below to create LIRC configuration file and test the infrared transmitter:

- Stop LIRC systemd service

```
sudo systemctl stop lirc
```

- Type in the following command to create new LIRC control configuration file and follow the on screen instructions to scan a remote control:

```
irrecord -d /dev/lirc0 ~/lircd.conf
```

List all available names for buttons supported by LIRC:

```
irrecord --list-namespace
```

Example configuration output:

```
Now enter the names for the buttons.

Please enter the name for the next button (press <ENTER> to finish recording)
KEY_POWER

Now hold down button "KEY_POWER".
```

```
Please enter the name for the next button (press <ENTER> to finish recording)
KEY_VOLUMEUP

Now hold down button "KEY_VOLUMEUP".

Please enter the name for the next button (press <ENTER> to finish recording)
KEY_VOLUMEDOWN

Now hold down button "KEY_VOLUMEDOWN".

Please enter the name for the next button (press <ENTER> to finish recording)

Successfully written config file.
```

- Backup the original LIRC configuration file:

```
sudo mv /etc/lirc/lircd.conf /etc/lirc/lircd-backup.conf
```

- Load the new configuration file:

```
sudo mv ~/lircd.conf /etc/lirc/lircd.conf
```

- Launch LIRC systemd service again:

```
sudo systemctl start lirc
```

- List all saved keys:

```
irsend LIST /home/pi/lircd.conf ""
```

- Test the configuration file by sending recorded IR command, for example POWER (please note the exact command may vary for different LIRC configuration files, IR devices and IR remote controls):

```
irsend SEND_ONCE /home/pi/lircd.conf KEY_POWER
```

Device Tree Overlays

Device Tree (DT) in Linux is a description of the hardware in a system. The DT overlay adds a number of optional elements.

The EEPROM of ANAVI Infrared pHAT contains DT overlay with description of the peripheral devices on the HAT. After adding Anavi to your Raspberry Pi and booting it you should have some new filesystem nodes at */proc/device-tree/hat*:

```
pi@raspberrypi:~ $ ls -l /proc/device-tree/hat/
total 0
```

```
-r--r--r-- 1 root root 4 Feb 15 00:27 name
-r--r--r-- 1 root root 20 Feb 15 00:27 product
-r--r--r-- 1 root root 7 Feb 15 00:27 product_id
-r--r--r-- 1 root root 7 Feb 15 00:27 product_ver
-r--r--r-- 1 root root 37 Feb 15 00:27 uuid
-r--r--r-- 1 root root 6 Feb 15 00:27 vendor
```

The information provided in these filesystem nodes helps you to identify ANAVI Infrared pHAT vendor, version, product name, etc. For example:

```
pi@raspberrypi:~ $ cat /proc/device-tree/hat/product
ANAVI Infrared pHAT

pi@raspberrypi:~ $ cat /proc/device-tree/hat/vendor
ANAVI
```

More information about device trees, overlays and parameters are available at [the official Raspberry Pi documentation](#).

CHAPTER 4: ANAVI IoT GNU/Linux Distribution

Anavi IoT GNU/Linux distribution is still *under construction*. It is built using the **Yocto Project** and **OpenEmbedded** and features daemon that sends data from the sensors and receives messages through the lightweight machine-to-machine communication protocol **MQTT**. There is also a responsive HTML5 web interface developed with jQuery Mobile and **Node.js** API. For more details visit:

- [anaviflexd](#)
 - [meta-anavi](#)
 - [anavi-api](#)
 - [anavi-ui](#)
-

CHAPTER 5: Schematics

Pinout

The components of ANAVI Infrared pHAT utilize the following pins on Raspberry Pi:

Component Pins

I2C	3, 5
EEPROM	27, 28

Component Pins

IR LED	11
IR receiver	12
UART	1, 8, 9, 10

I2C

The sensors that can be connected to ANAVI Infrared pHAT communicate with a host microcontroller via a communications standard called I2C (Inter-Integrated-Circuit). I2C uses two wires, labelled SDA (Serial Data) and SCL (Serial Clock). To function properly, I2C requires a pullup resistor on each of those lines therefore ANAVI Infrared pHAT includes two 4.7kohm resistors labelled as R6 and R7. If for one reason or another you need to disable the I2C pullup resistors remove R6 and R7.

CHAPTER 6: Frequently Asked Questions (FAQ)

May I use ANAVI Infrared pHAT with other operating systems?

Yes, you can use ANAVI Infrared pHAT with other GNU/Linux distributions and even other operating systems but some porting efforts might be required.

May I use other I2C sensors with ANAVI Infrared pHAT?

Yes, you can use other I2C sensors with ANAVI Infrared pHAT but you should take care for their drivers and software support.

May I use non-I2C sensors with ANAVI Infrared pHAT?

No.

Is ANAVI Infrared pHAT software free and open source?

Yes, the official ANAVI Infrared pHAT software is free and open source. The examples are available under MIT license and the rest is available under GPLv3. Please contact us if you are working on a commercial product and you would like to use the software under alternative commercial license.

CHAPTER 7: Revision History

Document Revision

Date	Changes	Modified pages	Author
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Date	Changes	Modified pages	Author
15 February 2017	Initial manual release	All	Leon Anavi

ANAVI Infrared pHAT Revision

Revision Notable changes

1.0 First version

See Also

For more information please visit anavi.technology and our [GitHub repositories](#). If you have any questions or enquiries please contact us through [Facebook](#), [Twitter](#) or [email](#).
