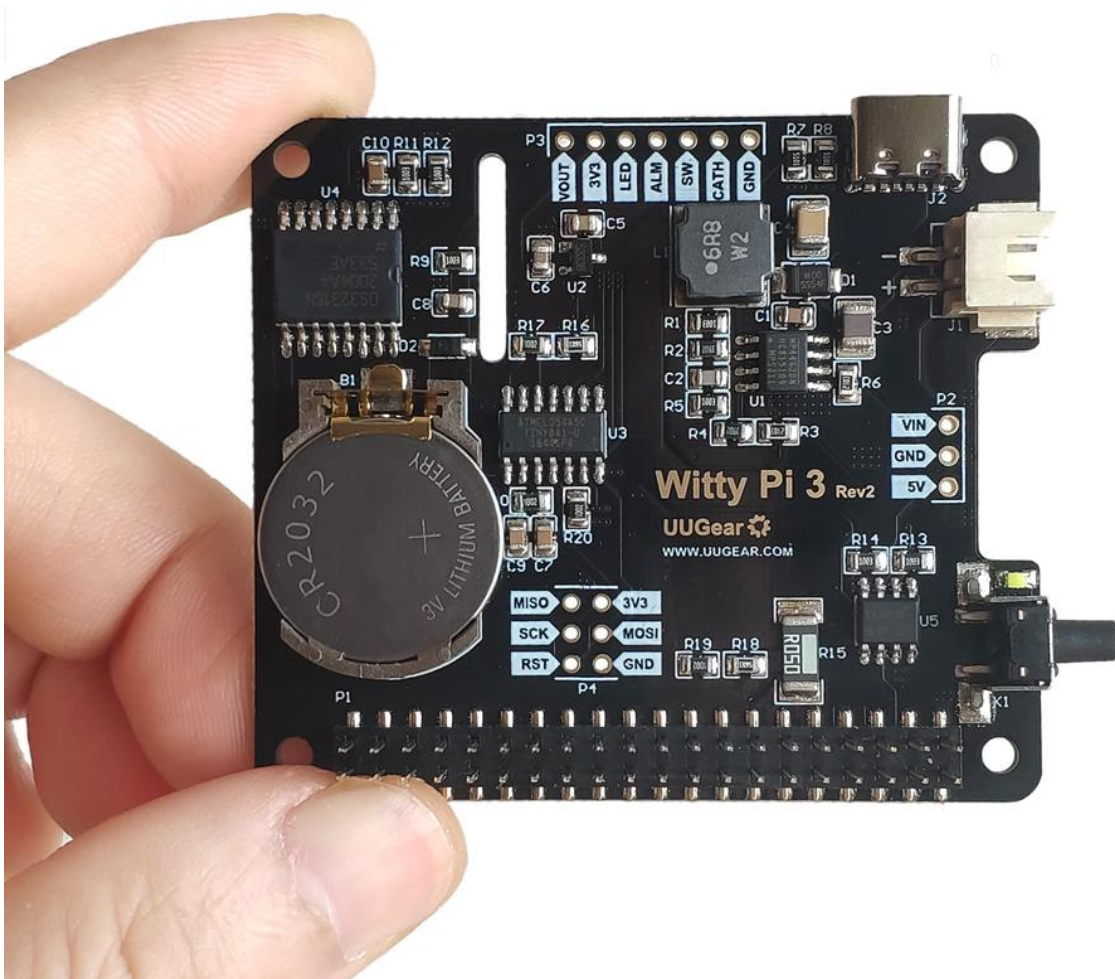


# Witty Pi3 Rev2

Realtime Clock and Power Management for Raspberry Pi

User Manual (revision 1.00)



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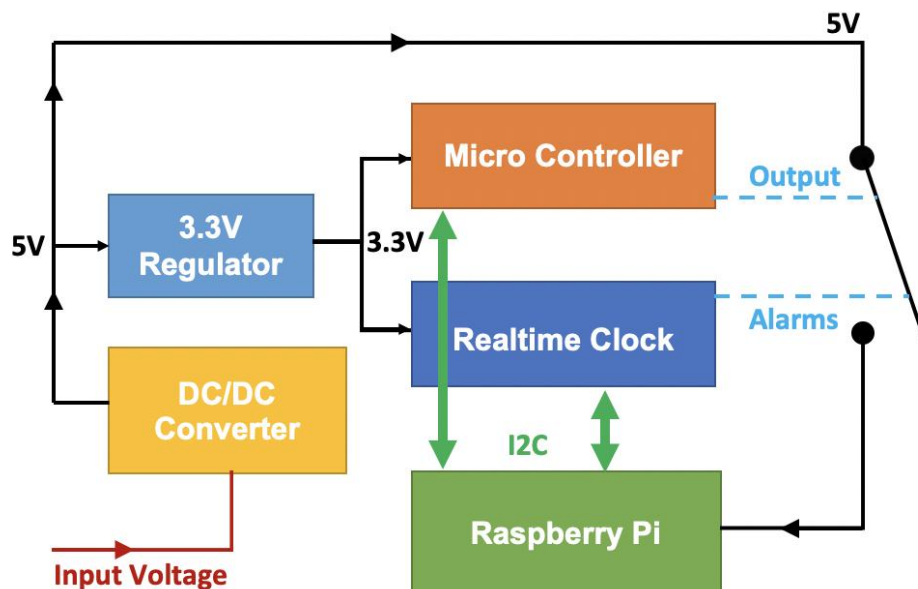
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## What is Witty Pi?

Witty Pi is a small electronic circuit board that can add realtime clock and power management to your Raspberry Pi. Witty Pi3 is the third generation of Witty Pi products, and Witty Pi 3 Rev2 is the second revision of Witty Pi 3, which supports bigger input voltage range and higher output current. Witty Pi 3 Rev2 allows you to:

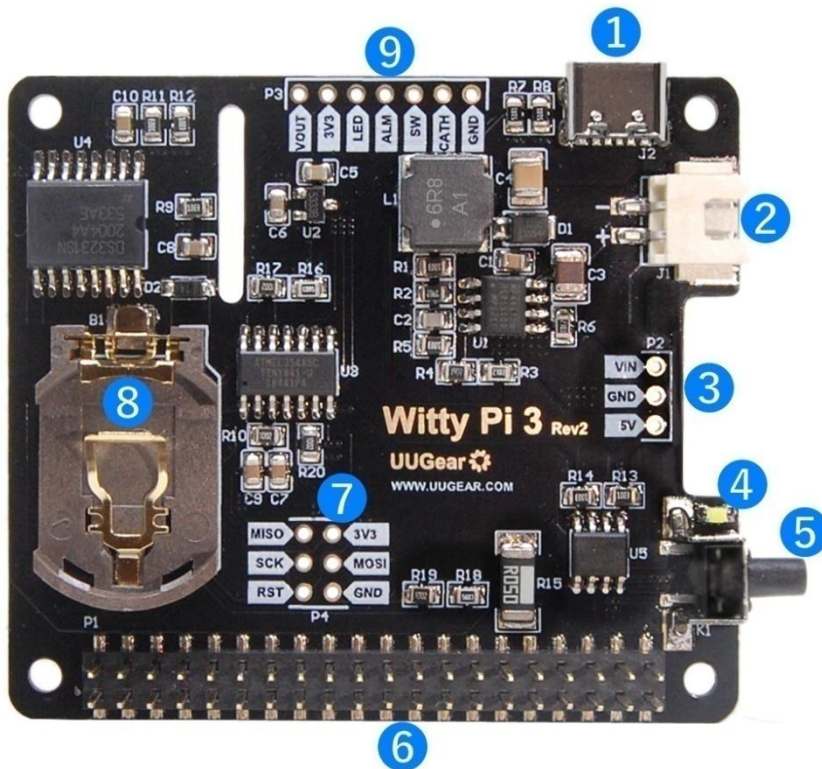
- Power your Raspberry Pi with higher voltage (up to DC 28V).
- Gracefully turn on/off Raspberry Pi with single tap on the button.
- Fully cut the power of Raspberry Pi and all its USB peripherals after the shutdown.
- Automatically synchronize time between realtime clock and Raspberry Pi.
- Monitor the temperature around your Pi (thanks to the sensor in RTC chip).
- Schedule the startup/shutdown of your Raspberry Pi.
- Write a script to define complex ON/OFF sequence.
- Shutdown Raspberry Pi when input voltage is lower than the threshold value.
- Turn on Raspberry Pi when input voltage raise over the threshold value.
- Long hold the button to force power cut (when the OS loses response).



Witty Pi 3 Rev2 supports all Raspberry Pi models that has the 40-pin GPIO header, including A+, B+, 2B, Zero, Zero W, 3B, 3B+, 3A+ and 4B.

Witty Pi 3 Rev2 uses DS3231SN as the realtime clock and ATtiny841 as the micro-controller. Thanks to the on-board DC/DC converter, Witty Pi 3 Rev 2 can accept input voltage up to 28V.

The picture below shows how is Witty Pi3 Rev2 look like:

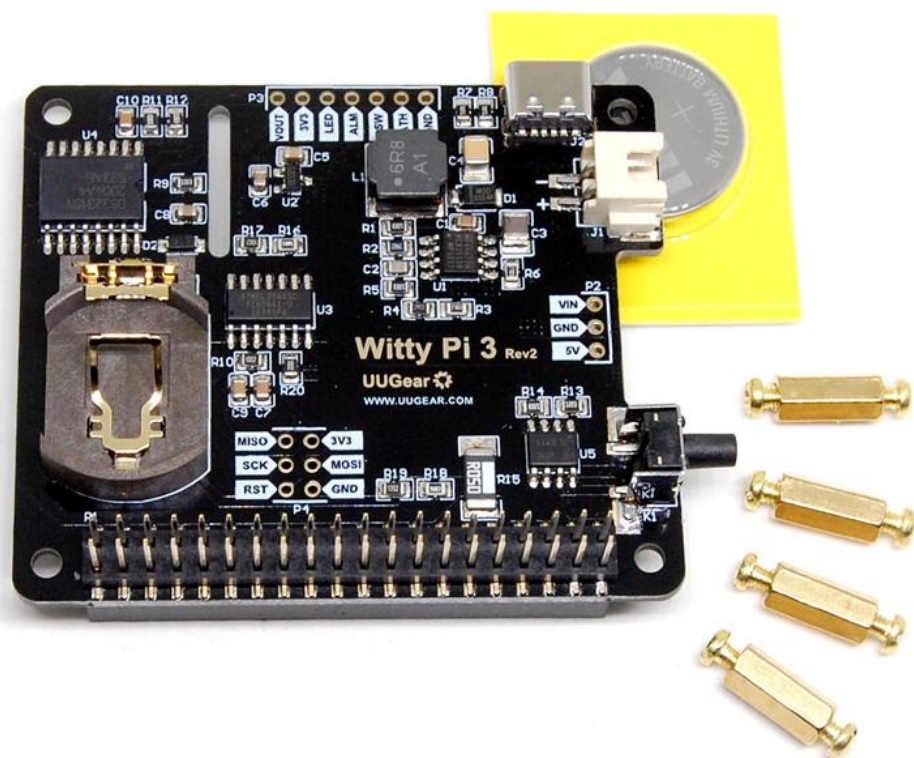


- 1) Type C USB connector as DC 5V power input
- 2) XH2.54 connector as higher voltage DC power input
- 3) Unpopulated 3-pin header/connector for VIN, GND and 5V
- 4) White LED as indicator
- 5) On/off switch
- 6) 2x20 pin stacking header (connects to Raspberry Pi)
- 7) Unpopulated 2x3 pin ICSP header for uploading firmware
- 8) Battery holder for CR2032 button cell lithium battery
- 9) Unpopulated 7-pin header for extension or integration

## What is in the Package?

Each Witty Pi 3 Rev2 package contains:

- Witty Pi 3 Rev2 board x 1
- CR2032 battery x 1
- M2.5 x 11mm copper standoff x 4
- M2.5 screws x 8



## Witty Pi 3 Rev2 Specifications

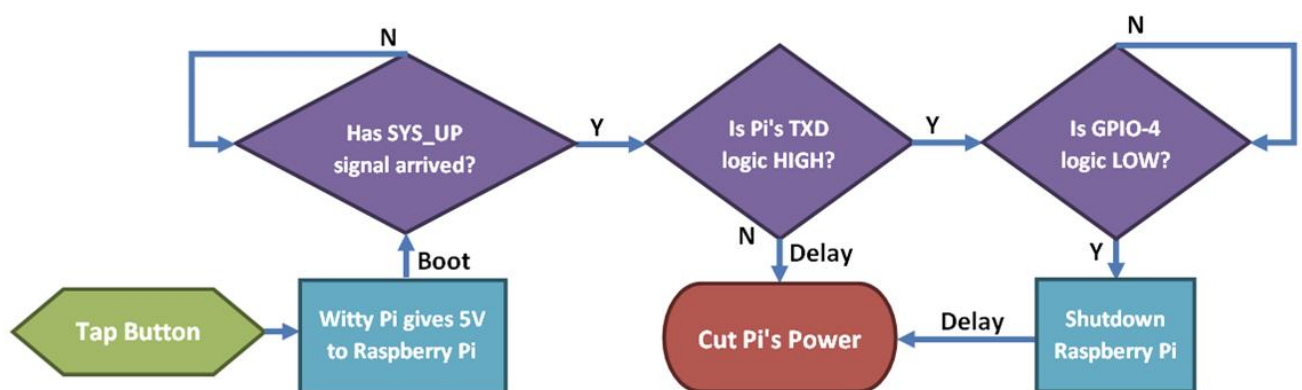
<b>Dimension:</b>	65mm x 56mm x 19mm
<b>Weight</b>	23g (net weight without battery)
<b>Micro Controller</b>	ATtiny841( <a href="#">datasheet</a> )
<b>Realtime Clock</b>	DS3231SN ( <a href="#">datasheet</a> )
<b>DC/DC Converter</b>	MP4462 ( <a href="#">datasheet</a> )
<b>Battery</b>	CR2032 (for time keeping)
<b>Power In</b>	DC 5V (via USB Type C connector) or DC6V~28V (via XH2.54 connector)
<b>Output Current</b>	Up to 3A for Raspberry Pi and its peripherals
<b>Standby Current</b>	~ 1mA
<b>Operating Temperature</b>	-30°C~80°C (-22°F~176°F)
<b>Storage Temperature</b>	-40°C~85°C (-40°F~185°F)
<b>Humidity</b>	0~80% RH, no condensing

## Try Not to Use NOOBS

There is rather big chance that Witty Pi has problem with [NOOBS](#), because NOOBS changes Raspberry Pi's booting behaviour, which is relied by Witty Pi.

In the user manual for Witty Pi 2, we suggested our customers not to use NOOBS, because NOOBS will introduce a boot menu, which will block the boot process for a few seconds. With those a few seconds' delay, Witty Pi could not see the TXD voltage raising and hence think the system has been shut down, so it will cut the power before the actual boot starts.

In the user manual for Witty Pi 3 (first revision), we did not suggest our customers to avoid NOOBS, because at the time of writing that user manual, the latest version of NOOBS works pretty well with Witty Pi 3. Because Witty Pi 3 starts to use micro-controller and it behave smarter: it will not monitor the TXD pin until the system is really up and send out the SYS\_UP signal. The diagram below shows how Witty Pi 3 turns on/off your Raspberry Pi:



However after the latest NOOBS update, it may not work with Witty Pi 3 anymore, especially when multiple operating systems are installed on your Pi via NOOBS. It seems that NOOBS makes the booting process more complex, and it will actually boot multiple times to finally have your OS running. This behaviour will confuse Witty Pi 3's firmware and cause some weird problems (cut power before finish booting, button not working after boot etc.).

So we again do not suggest our customers to use NOOBS with Witty Pi. If you just need one OS running, you don't need NOOBS: just flash the OS disk image into your SD card and it is even faster. If you really want to use NOOBS with Witty Pi 3, please set [the power cut delay after shutdown](#) to a big value (e.g. 25 seconds) to maximize the change to have them working together.



## Software Installation

It is recommended to install the software for Witty Pi3 before physically mount Witty Pi 3 on your Raspberry Pi.

**Before installing the software, please check whether you have 1-Wire interface enabled.** This is important because 1-Wire interface uses GPIO-4 by default, which will conflict with Witty Pi. If you need to use 1-Wire interface, please assign it to a different GPIO pin.

You can assign different GPIO pin to 1-Wire interface in `/boot/config.txt` file, find the “`dtoverlay=w1-gpio`” text and replace it with:

```
dtoverlay=w1-gpio,gpiopin=18
```

If you don't need 1-Wire interface for now, you can disable it:

```
#dtoverlay=w1-gpio
```

If you have 1-Wire interface enabled on GPIO-4 and installed Witty Pi's software, you may not be able to login to your Raspberry Pi because it always shuts itself down before you get the chance to login. To solve this problem, you will need to take out the micro SD card on your Raspberry Pi, and access its file system via a card reader on your PC. You need to edit the `config.txt` file (as mentioned above) in the "boot" volume to change the GPIO pin used by 1-Wire interface, or you can disable 1-Wire interface given you don't need it for now. After saving the file and put the micro SD card back to Raspberry Pi, you should be able to boot it again.

In order to install the software, you will need to have your Raspberry Pi connected to the Internet. The installation will be very simple if you run our installing script.

First step is to run this command in your home directory:

```
pi@raspberrypi~ $ wget http://www.uugear.com/repo/WittyPi3/install.sh
```

If your Raspberry Pi has internet connection, it will immediately download the script from our website, and you will then see the “`install.sh`” script in your home directory. Then you just need to run it with `sudo` as follows:

```
pi@raspberrypi~ $ sudo sh install.sh
```

Please notice that **sudo is necessary to run this script**, because it needs to write to the `/etc/init.d/` directory. This script will automatically do these tasks in sequence:

1. Enable I2C on your Raspberry Pi
2. Install `i2c-tools`, if it is not installed yet
3. Configure Bluetooth to use mini-UART (Raspberry Pi 3 only)
4. Install `wiringPi`, if it is not installed yet (Raspberry Pi 4 needs version 2.52+)
5. Install Witty Pi programs, if they are not installed yet

You can also manually install these packages and make those configurations, if you prefer to. After the installation, please remember to **reboot your Raspberry Pi**, so the Realtime clock hardware will be loaded correctly.

You will then see a new “wittypi” directory, and it contains 6runnable files... viz.:

```
pi@raspberrypi~ $ cd wittypi
pi@raspberrypi~ /wittypi $ ls
afterStartup.sh  daemon.sh  runScript.sh  schedules  utilities.sh  wittyPi.sh
beforeShutdown.sh  init.sh  schedule.log  syncTime.sh  wittyPi.log
```

Although the `daemon.sh` is executable, you should not run it manually. The installing script has registered it into `/etc/init.d` and it will run automatically after the start up.

The `syncTime.sh` script is not supposed to be manually run either; it will run automatically after the start up. It will copy the time from Raspberry Pi system to RTC if you have never set the RTC time before. If RTC has the correct time and your Raspberry Pi has the wrong time – perhaps because of the lack of Internet connection, it will copy the RTC time to your Raspberry Pi system.

The `runScript.sh` script is the one who takes charge of the schedule script running. Usually you don't need to run it manually, as it will be executed after the system is up. If there is a schedule script in use, it will schedule the next shutdown and next startup, according to the schedule script.

The `wittyPi.sh` is the software that allows you to configure your Witty Pi interactively. You can use it to copy time between Realtime clock and the system, and schedule the time for auto shutdown and/or startup. Please see the “Software Usage” chapter for more information.

The `afterStartup.sh` script will be run automatically after system is up. You can execute your own commands here if you wish them to be run after boot.

The `beforeShutdown.sh` script will be run automatically before system gets shut down by Witty Pi. You can also place your commands here. Please notice that, if the system is not shut down by Witty Pi (tapping button, schedule shutdown or auto-shutdown due to low input voltage), this script will not be executed.

Now the software has been installed and you will need to physically mount/install Witty Pi 3 Rev2 on your Raspberry Pi and **connect power supply to Witty Pi 3 Rev2 only**.

## Software Update/Uninstall

If you want to update the software to newer version, you don't have to uninstall it first. Just remove or rename your "wittypi" directory and repeat the installing process, then you are all set.

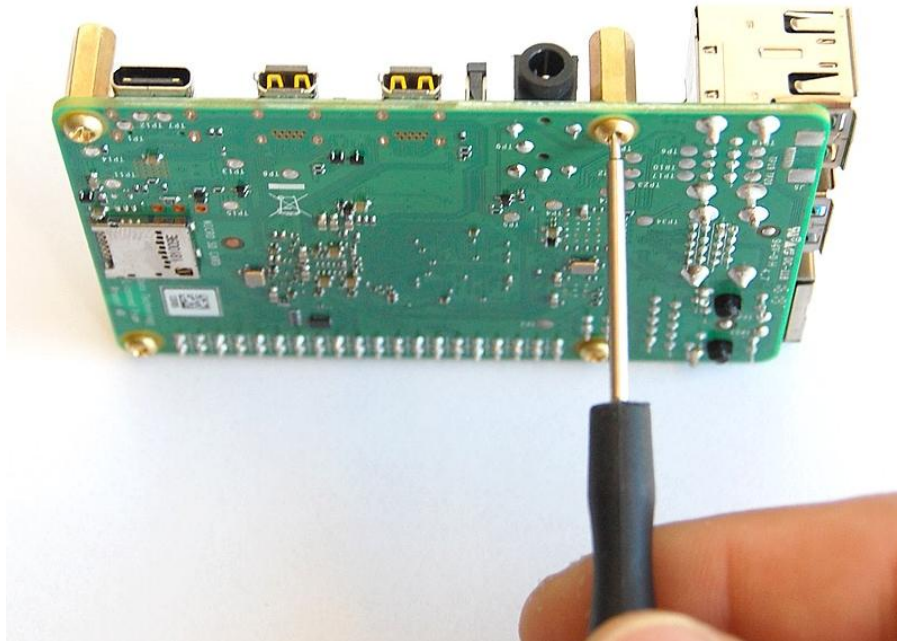
```
pi@raspberrypi~ $mv wittypi wittypi.bak
pi@raspberrypi~ $wget http://www.uugear.com/repo/WittyPi3/install.sh
pi@raspberrypi~ $sudo sh install.sh
```

If you prefer to completely remove the software, besides removing the "wittypi" directory, you should also remove the "/etc/init.d/wittypi" file. There are some dependencies (such as wiringPi, i2c-tools etc.), which may be installed during the software installation. In the majority of cases you don't have to remove them, but if you wish to do so, you can check the content of "install.sh" script and do the reverse.

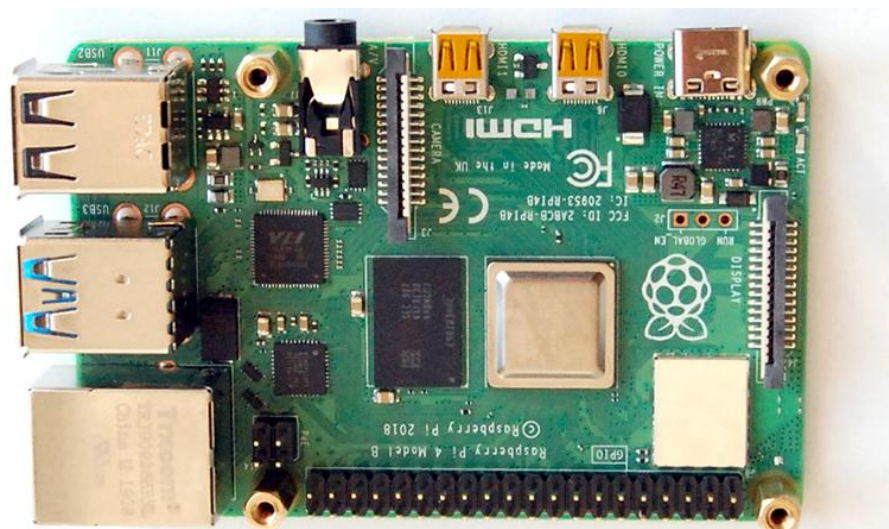
## Mounting Witty Pi3 on Raspberry Pi

You can mount Witty Pi 3 Rev2 on your Raspberry Pi's 2x20pin header, and it can work directly. However, if you wish, you can use the copper standoffs and screws in the package to firmly mount Witty Pi 3 Rev2 on your Raspberry Pi.

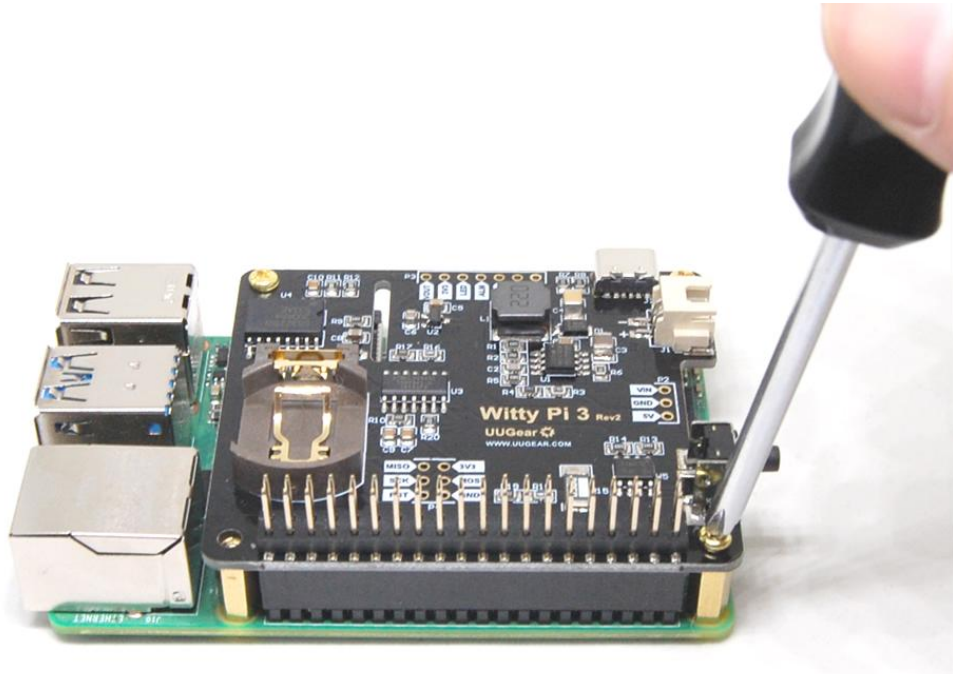
First you can mount the 3 copper standoffs on your Raspberry Pi, using the screws.



Your Raspberry Pi should look like this after mounting the 4 standoffs:



Then you can mount Witty Pi3 Rev2's stacking header on Raspberry Pi's 2x20 pin male header, and then tighten the screws.

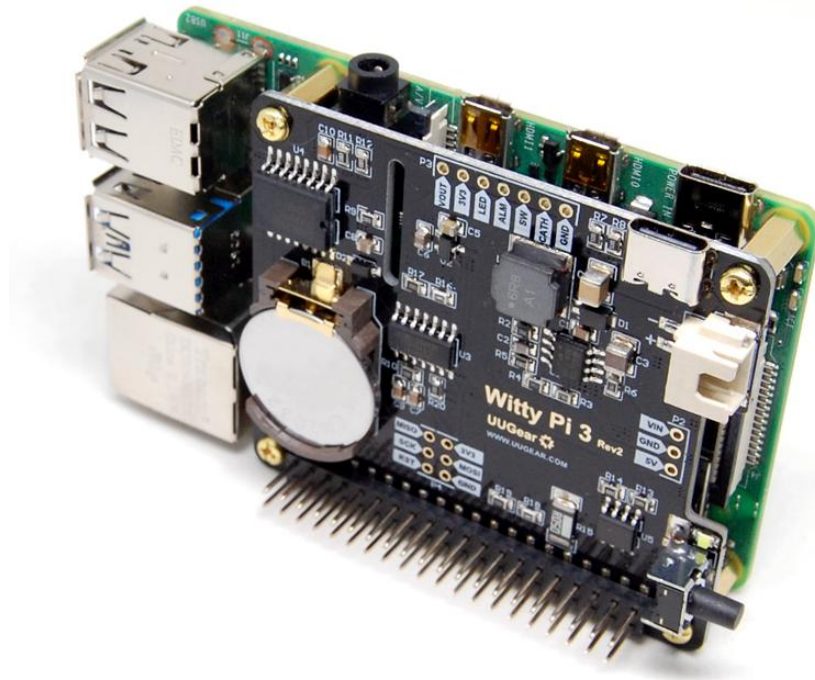


You can put the CR2032 button battery into the battery holder. With that battery Witty Pi can remember the time and preset alarms even after you cut its power. The RTC only draws about 4uA current from the battery to keep the time and alarms, so the battery can last years. If your Witty Pi always have power supply connected, you may omit this battery and Witty Pi's functionalities will not get affected.



After mounting Witty Pi 3 Rev2 on your Raspberry Pi, and connect power supply to Witty Pi 3 Rev2 (via the USB Type C connector or via the XH2.54 connector), you can see **the white LED blinks for every few seconds, which means it is standing by.**

Now your Witty Pi 3 Rev2 is ready to go.



## Software Usage

The wittyPi.sh is a bash script, and you can run it with:

```
pi@raspberrypi ~/wittypi $ ./wittyPi.sh
```

Please notice that **sudo is not necessary here** (older version of Witty Pi software needs that). The programme displays the current temperature, the system time, the RTC time, the input/output voltage and output current:

```
pi@raspberrypi ~/wittypi $ sudo ./wittyPi.sh
=====
|
|   Witty Pi - Realtime Clock + Power Management for Raspberry Pi
|
|                               < Version 3.12 >       by UUGear s.r.o.
|
=====
>>> Current temperature: 29.50°C / 85.1°F
>>> Your system time is: Mon 24 Jun 2019 14:45:09 BST
>>> Your RTC time is:      Mon 24 Jun 2019 14:45:10 BST
>>> Vin=7.92V, Vout=5.18V, Iout=0.41A
Now you can:
  1. Write system time to RTC
  2. Write RTC time to system
  3. Synchronize time
  4. Schedule next shutdown
  5. Schedule next startup
  6. Choose schedule script
  7. Set low voltage threshold
  8. Set recovery voltage threshold
  9. View/change other settings...
 10. Reset data...
 11. Exit
What do you want to do? (1~11)
```

The program gives you 11 options, and you can input the number and press ENTER to confirm.

## 1. *Write system time to RTC*

This option will copy the time from your Raspberry Pi system to the Realtime Clock on Witty Pi. This option should be used when you find the Raspberry Pi system time is correct (may be synchronized from the Internet) while the RTC time is not correct.

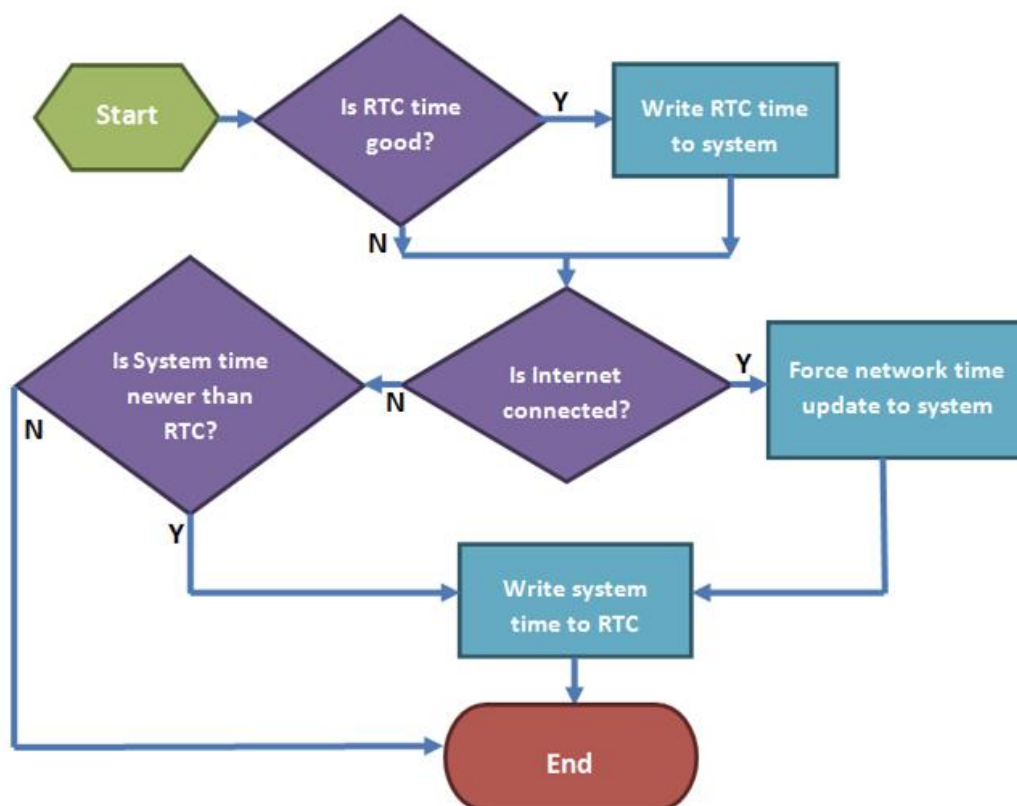
## 2. *Write RTC time to system*

This option will copy the time from the Realtime Clock on Witty Pi 3 Rev2 to your Raspberry Pi system. This option should be used when you find the RTC time is correct while the system time is not correct.

## 3. *Synchronize time*

If you choose this option, it will run the “syncTime.sh” script explicitly, which should have been executed once automatically after the system is up.

This script will detect if Internet is connected, and apply network time to both system and RTC. The flow chart below shows what this script actually do:





#### 4. *Schedule next shutdown*

This option allows you to specify when your Raspberry Pi should shutdown automatically.

Please notice the input format should be “DD HH:MM”. DD means the day in the month, HH is the hour, MM is the minute. All these should be 2 digits and 24-hour system should be used. Here you **can not specify the second**. This is due to the hardware limitation on the RTC chip, and only day, hour and minute could be specified for scheduled shutdown.

You can use “??” as **wildcard**, which gives you the possibility to make a repeatable schedule. Please see the table below:

Repeatable Shutdown Schedule			
Day (dd)	Hour (HH)	Minute (MM)	Result
??	??	??	Minutely Schedule <b>(DON'T USE IT!)</b>
??	??	Number	Hourly Schedule
??	Number	Number	Daily Schedule

Please don't use “?? ??:??” to schedule the next shutdown, or your Raspberry Pi will keep being shutdown and you hardly have a chance to change this setting (unless you remove the 3V button battery and force RTC to forget its configuration).

Due to the hardware limitation, not all patterns with wildcards are supported. The rule is: **wildcards have to show up from left to right**, and there is no number between two wildcards. So “?? ??:38” is good, while “?? 16:??” is not supported.

Here are some examples of scheduling the shutdown:

- **15 21:45** means 9:45 at night, on 15<sup>th</sup> in this month.
- **?? 23:30** means 23:30 at night everyday (daily schedule)
- **?? ??:15** means the 15<sup>th</sup> minute every hour (hourly schedule)

#### 5. *Schedule next startup*

This option allows you to specify when your Raspberry Pi should startup automatically.

Please notice the input format should be “DD HH:MM:SS”, DD means the day in the month, HH is the hour, MM is the minute and SS is the second. All these should be 2 digits and 24-hour system should be used. Different than the shutdown scheduling, you can specify the second here.

You can also use “??” as wildcard, which gives you the possibility to make a repeatable schedule. Please see the table below:

Repeatable Startup Schedule			
Day (dd)	Hour (HH)	Minute (MM)	Result
??	??	??	Minutely Schedule
??	??	Number	Hourly Schedule
??	Number	Number	Daily Schedule

According to the hardware limitation, not all patterns with wildcards are supported. The rule is: **wildcards have to show up from left to right**, and there is no number between two wildcards. So “?? ??:?:12” is good, while “?? 15:?:25” is not supported.

If you input an unsupported pattern, Witty Pi will try to revise it to the closest supported. When this happens, you will see the message accordingly on the console.

Here are some examples of scheduling the startup:

- **15 07:30:00** means 7:30 in the morning, on 15<sup>th</sup> in this month.
- **?? 23:30:00** means 23:30:00 at night everyday (daily schedule)
- **?? ??:15:00** means the 15<sup>th</sup> minute every hour (hourly schedule)
- **?? ??:?:05** means the 5<sup>th</sup> second every minute (minutely schedule)

## 6. Choose Schedule Script

What if you want to define a complex ON/OFF sequence for your Raspberry Pi? The answer is “using schedule script”.

A schedule script (.wpi file) defines a loop, with all states and their durations inside. By automatically running “runScript.sh” after booting, Witty Pi will automatically schedule the next shutdown and next startup for you, and hence a complex ON/OFF sequence could be achieved.

After you select the “Choose schedule script” option, it will list all schedule scripts in the “schedules” folder. You can choose one, and then Witty Pi will take care of the rest.

If you want to confirm what the script is doing, you can check the “schedule.log” file in the “~/wittypi” directory, when your Raspberry Pi is running.

If you want to create your own schedule script, please read the “[Making Schedule Script](#)” section.

## ***7. Set low voltage threshold***

If you are powering your Witty Pi via the XH2.54 connector, and the input voltage is lower than the low voltage threshold, Witty Pi will shut down your Raspberry Pi. Here you can specify the low voltage threshold from 2.0V to 25.0V. If you want to disable the low voltage threshold, just set it to 0, which is actually its default value.

## ***8. Set recovery voltage threshold***

If you are powering your Witty Pi via the XH2.54 connector, and the input voltage is higher than the recovery voltage threshold, Witty Pi will turn on your Raspberry Pi if it was previously shut down due to low input voltage. Here you can specify the recovery voltage threshold from 2.0V to 25.0V. If you want to disable the recovery voltage threshold, just set it to 0, which is actually its default value.

**Remarks:** the low voltage threshold and recovery voltage threshold can be set individually and their combinations will make Witty Pi work differently, please see the table below for details.

Low Voltage	Recovery Voltage	Result
Not Set	Not Set	Witty Pi doesn't care about the input voltage changing.
Set	Not Set	Witty Pi will shut down your Raspberry Pi if input voltage is too low. It will not turn on Raspberry Pi unless you tap the button, or the scheduled startup comes (given input voltage is higher than low voltage threshold).
Set	Set	Witty Pi will shut down your Raspberry Pi if input voltage is too low. Once this happens, Witty Pi will monitor the input voltage during the sleep and will turn on your Raspberry Pi when input voltage gets higher than recovery voltage threshold.
Not Set	Set	Witty Pi will wake up your Raspberry Pi when input voltage is higher than recovery voltage threshold. Please mind that if input voltage is always higher than recovery voltage threshold, you will not be able to turn off your Raspberry Pi with these settings, because it always turn on Raspberry Pi again just after shutting it down.

## 9. View/change other settings...

Choosing this option will display a sub menu and allows you to set these parameters:

- Default state when powered**  
 It is "OFF" by default, which means your Raspberry Pi will not be turned on when power supply is connected to Witty Pi, and you will need to tap the button on Witty Pi to start it. Here you can set it to 1 (ON) or 0 (OFF).
- Power cut delay after shutdown**  
 Default value is 5.0 seconds, which means Witty Pi will fully cut the power after 5 seconds since Raspberry Pi has been shut down. Here you can input a number between 0.0 to 25.0.
- Pulsing interval during sleep**  
 This parameter will decide how long Witty Pi's micro controller will wake up and drive the white LED and/or the dummy load. By default, this interval is 4 seconds. If you wish the white LED blinks slower, or the dummy load draws current less frequently, you can choose a bigger value. Here you can only pick a value from 1, 2, 4 and 8.

- **White LED duration**

This parameter will decide how long the white LED should stay on, when Witty Pi blinks it during the sleep. The default value is 100, and you can use bigger value if you wish the white LED to stay on for longer. Here you can input number from 0 to 255. If you input 0, the white LED will not blink at all.

- **Dummy load duration**

This parameter will decide how long the dummy load should draw current from the power source.

What is (pulsing) dummy load? It is a trick to keep power bank alive, when Raspberry Pi is off. If you are using power bank to power Witty Pi 3 + Raspberry Pi, after turning off Raspberry Pi and cut the power, Witty Pi 3 only draws about 1mA from the power bank, which is way too small to keep the power bank alive. If the power bank goes to sleep mode, it will not provide any power to Witty Pi 3 and hence your Raspberry Pi will not wake up when scheduled startup is due. Pulsing dummy load is such a trick, that it draws rather big current from the power bank for a short duration and it does so with a fixed interval. That way the power bank might be fooled and think the load is heavy enough, and avoid entering the sleep mode.

The default value of dummy load duration is 0, which means disabled (no dummy load at all). You can set a value between 0 and 255 here. However, **we suggest to use smallest value that could keep your power bank alive, usually 10 will do.**

- **Vin adjustment**

The voltage is measured by the 10-bit ADC in micro controller. Due to the inaccuracy of internal voltage standard and error on divider resistors, the result could have up to 5% error. You can configure this parameter to adjust the result of voltage measurement.

The default value is set to 0.20V, and you can input a value between -1.27 and 1.27 here.

- **Vout adjustment**

You can configure this parameter to adjust the result of output voltage measurement.

The default value is set to 0.20V, and you can input a value between -1.27 and 1.27 here.

- **Iout adjustment**

The output current is calculated by measuring the voltage drop on the 0.05 Ohm sampling resistor. You can configure this parameter to adjust the result of output current calculation.

The default value is set to 0.00A, and you can input a value between -1.27 and 1.27 here.

## 10. *Reset Data...*

If you want to erase some data you previously set(scheduled startup time, scheduled shutdown time, currently used schedule script, low voltage threshold, recovery voltage threshold), you can choose this option.

Once you select this option, the software will display a sub menu, which allows you to:

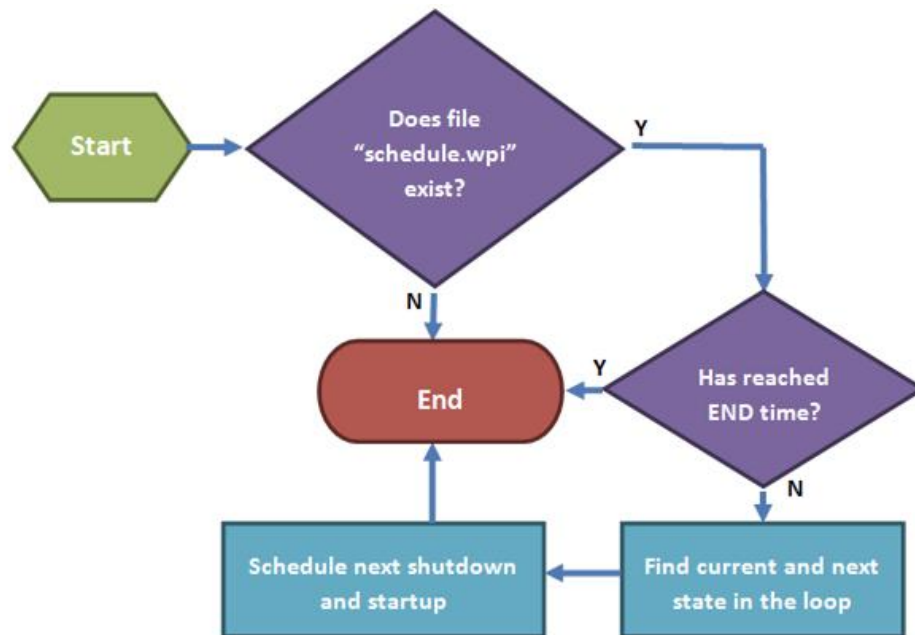
- **Clear auto startup time:**  
The auto-startup time will be erased and Witty Pi will not auto-start your Raspberry Pi.
- **Clear auto shutdown time:**  
The auto-shutdown time will be erased and Witty Pi will not auto-shutdown your Raspberry Pi.
- **Stop using schedule script:**  
The “schedule.wpi” file will be deleted.
- **Clear low voltage threshold:**  
The low voltage threshold will be unset.
- **Clear recovery voltage threshold**  
The recovery voltage threshold will be unset.
- **Perform all actions above:**  
Clear all scheduled times, remove the “schedule.wpi” file and unset the low voltage and recovery voltage thresholds.

## 11. *Exit*

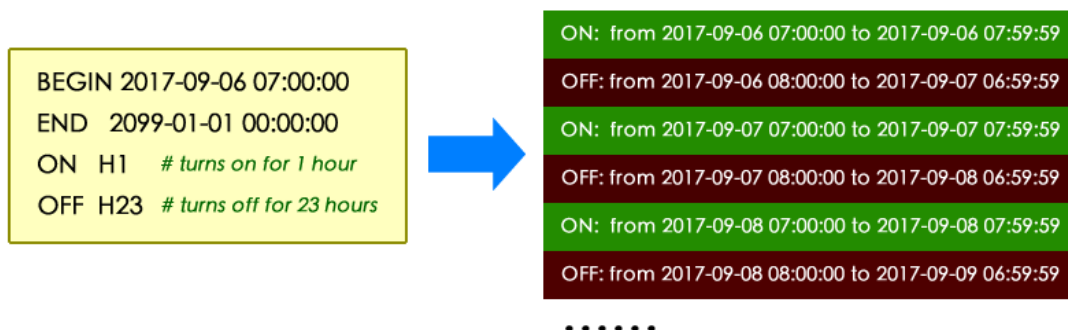
Selecting this option will exit the software and return to the console.

## How Schedule Script Works?

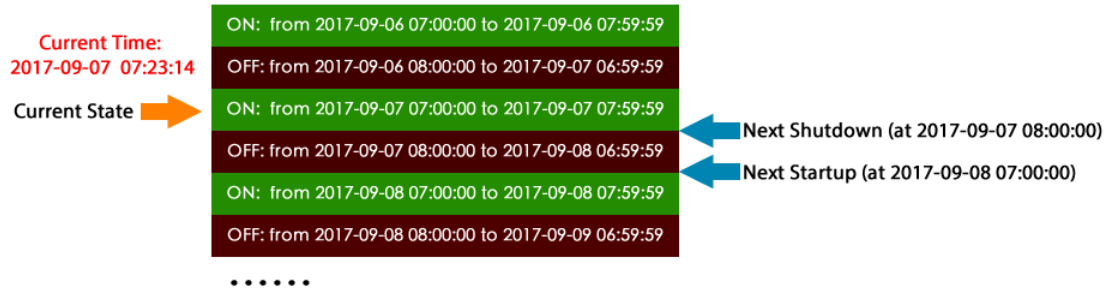
A schedule script defines a serial of ON/OFF states and specify the duration of each state. At the end of each state, there should be a scheduled shutdown (for ON state) or scheduled startup (for OFF state). All states in the schedule script will be executed in sequence and repeatedly, until the END time is reached.



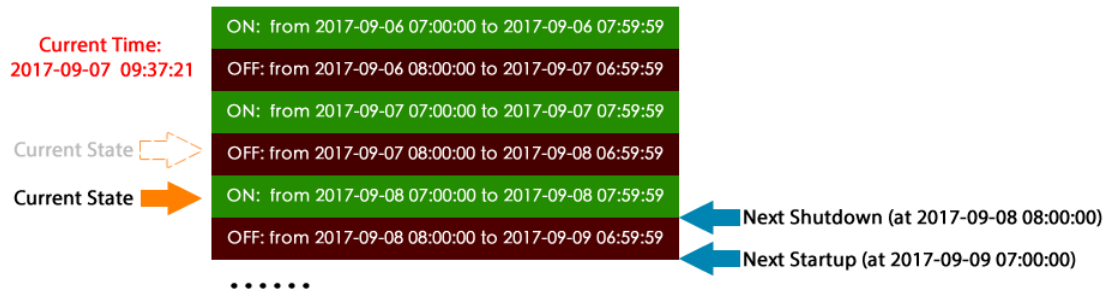
Every time your Raspberry Pi wakes up, it has a chance to run the runScript.sh file, which loads the schedule script (“schedule.wpi” file). If the current time doesn’t reach the END time defined by the schedule script, the next shutdown and next startup will be scheduled automatically. When your Raspberry Pi is wakened at scheduled startup time, it will repeat this process and schedule the next shutdown and startup. Although a schedule script only defines a few ON/OFF states, they could become many ON/OFF states in reality.



Please keep in mind that, running the same schedule script at different moment may get different result, as the “runScript.sh” will search and find the proper state according to current time.



When the “runScript.sh” is executed, if the current time is located at an “OFF” state instead, it will take the next “ON” state as the current state, as it knows Raspberry Pi is currently ON.





## Make Schedule Script

A schedule script is a text file with .Wpi file extension. You can use any text editor to create and edit it. In the major of cases, using “nano” will be very convenient.

Below is a very simple schedule script and it will keep your Raspberry Pi on for 5 minutes in every 20 minutes.

```
# Turn on Raspberry Pi for 5 minutes, in every 20 minutes
BEGIN 2015-08-01 00:00:00
END   2025-07-31 23:59:59
ON    M5    # keep ON state for 5 minutes
OFF   M15   # keep OFF state for 15 minutes
```

Like many other scripting languages, Witty Pi’s schedule script also uses “#” to make single line comment.

The first two lines define the time range for executing the script. Please make sure to use the correct time format (YYYY-mm-DD HH:MM:SS). You can use one or more white characters (space or tab) between BEGIN/END and the time string.

The rest of the script defines the states in the loop. It could be “ON” or “OFF”, and you should define at least one “ON” and one “OFF” states in the loop. The ON and OFF states are used in pair.

You should also specify the duration of each state. You can do so by putting one or more parameters after ON/OFF text, separated by space or tab. Each parameter starts with a capital letter and follows by a number, where the capital letter is the unit of time:

- D = Days (D2 means 2 days)
- H=Hours (H3 means 3 hours)
- M=Minutes (M15 means 15 minutes)
- S=Seconds (S30 means 30 seconds)

For example, if you wish to define an ON state for one and a half hours, you can write:

```
ON    H1    M30
```

When the script engine executes this line, it will schedule a shutdown at the end of the ON state.

If you wish to define an OFF state for two days, you can write:

```
OFF D2
```

When this line gets executed, a startup will be scheduled at the end of the OFF state.

Sometimes you may want to skip certain scheduling of shutdown/startup, and let your own program to do the job. This can be achieved by using the WAIT syntax. For example:

```
ON M15 WAIT
```

This will keep your Raspberry Pi ON and **no shutdown will be scheduled after 15 minutes**, because there is a WAIT at the end of the line. The parameter M15 is here only to make sure the next OFF state can be calculated correctly and next shutdown can be scheduled properly.

Once you use WAIT in the ON state, you (or your programme) are responsible for the shutdown of your Raspberry Pi. If you use WAIT in the OFF state, you will need to turn on your Raspberry Pi (manually or via external electronic switch).

After installing the software, there are some schedule scripts in the “[schedules](#)” directory, and they all have comments inside to explain themselves. You can take them as example to learn how to create the Witty Pi schedule script.

## Using Schedule Script Generator

You can use our web application to create your schedule script. Just simply open this URL in your web browser:

<http://www.uugear.com/app/wittypi-scriptgen/>

This web application allows you to visually create the schedule script, it immediately generate the final schedule script (on the right).

You can also click the “Run” button to preview how the schedule script will work. Alternatively, you can click the “Run at...” button and specify the moment to run the script.

**Witty Pi Schedule Script Generator**
Load an Example ... ▾

The script's first startup occurs at:

The script will continue running until:

<b>ON</b>	0 Days 0 Hours 30 Minutes 0 Seconds	<b>X</b>
<b>OFF</b>	0 Days 23 Hours 30 Minutes 0 Seconds	▾
<b>ON</b>	0 Days 0 Hours 30 Minutes 0 Seconds	<b>X</b>
<b>OFF</b>	0 Days 23 Hours 30 Minutes 0 Seconds	▾
<b>ON</b>	0 Days 0 Hours 30 Minutes 0 Seconds	<b>X</b>
<b>OFF</b>	0 Days 23 Hours 30 Minutes 0 Seconds	▾
Repeat for <input type="text" value="1"/> times <input type="checkbox"/> Shut down externally		
<b>ON</b>	0 Days 0 Hours 30 Minutes 0 Seconds	<b>X</b>
<b>OFF</b>	2 Days 23 Hours 30 Minutes 0 Seconds	▾

```

BEGIN 2015-08-03 08:00:00
END 2025-07-31 23:59:59
ON M30
OFF H23 M30
ON M30
OFF H23 M30
ON M30
OFF H23 M30
ON M30
OFF H23 M30
ON M30
OFF D2 H23 M30

```

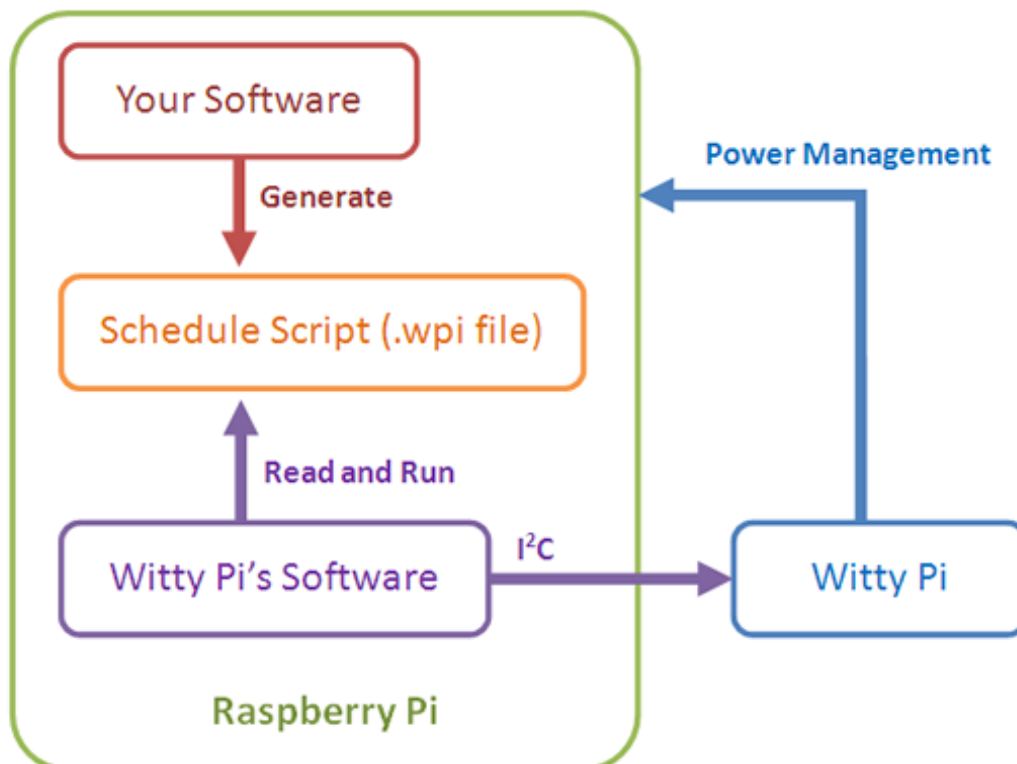
**Diagnose**

The script's cycle period is 7 days.

**Preview**

## Advanced Usage of Schedule Script

Besides choosing the schedule script from wittyPi.sh, you can also use schedule script without the help from wittyPi.sh. Just copy the schedule script file to “~/wittypi/schedule.wpi” and then run “./runScript.sh” in the “~/wittypi” directory, the script will start to work. This allows you to [use schedule script as an interface](#), to integrate other tools with Witty Pi together. For example, you can create your own tool to visually create a schedule script, or remotely generate the schedule script via a web interface.



## The Unpopulated 3-Pin Header (P2)

On the right edge of Witty Pi 3 Rev2 board, there is an unpopulated 3-pin header, and you can solder a male or female connector here.



This header is for inputting voltage to power Witty Pi. It will be useful if you neither want to input 5V via the USB Type C connector, nor input higher voltage via the XH2.54 connector.

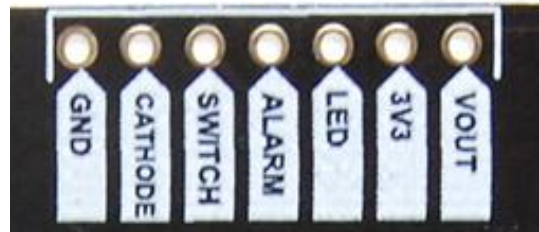
You can either input 5V between the “5V” and GND pins, or input higher voltage between the “VIN” and “GND” pins.

## The Unpopulated 7-Pin Header (P3)

On the upper edge of Witty Pi 3 Rev2 board, there is an unpopulated 7-pin header, and you can solder a male or female connector here.



(Front View)



(Back View)

This header breaks out some useful signals and is very helpful for extension and integration. The pins from left to right (at top view) are VOUT, 3V3, LED, ALARM, SWITCH, CATHODE and GND.

### VOUT

This pin is actually connected to the +5V pin on Raspberry Pi, which is the output voltage of Witty Pi 3 board. By detecting its voltage, you will know if your Raspberry Pi is in ON state.

Please mind the actual voltage applied to your Raspberry Pi is between VOUT and CATHODE. The GND in this header is for Witty Pi 3, not for Raspberry Pi.

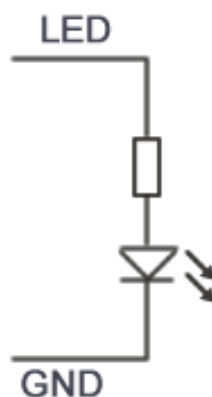
If there is another device need to get powered (by 5V) with Raspberry Pi together, you can connect it to this VOUT and CATHODE pins.

## 3V3

It is 3.3V voltage on board that powers the micro controller and the RTC.

## LED

It is connected to the anode of the white LED. You can use this pin to connect your own LED, but don't forget to put a 1K resistor in serial.



## ALM / ALARM

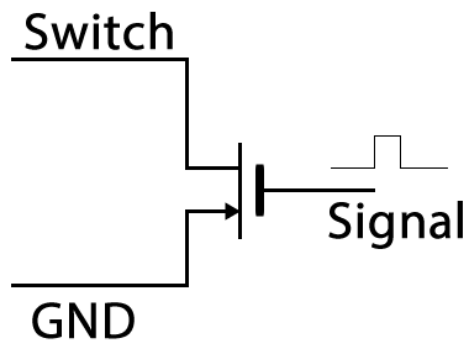
It is the interrupt signal that generated by the RTC alarm. It is in 3.3V level and has HIGH state (3.3V) by default. If any alarm occurs (scheduled startup or shutdown), it goes to LOW state (0V), and this state will be cleared once Witty Pi 3's software detects and processes it.

## SW / SWITCH

It is the signal line that connects to the switch (button) on Witty Pi 3. If you want to connect your own (2-lead) switch, just wire the two leads to Switch and GND pins.



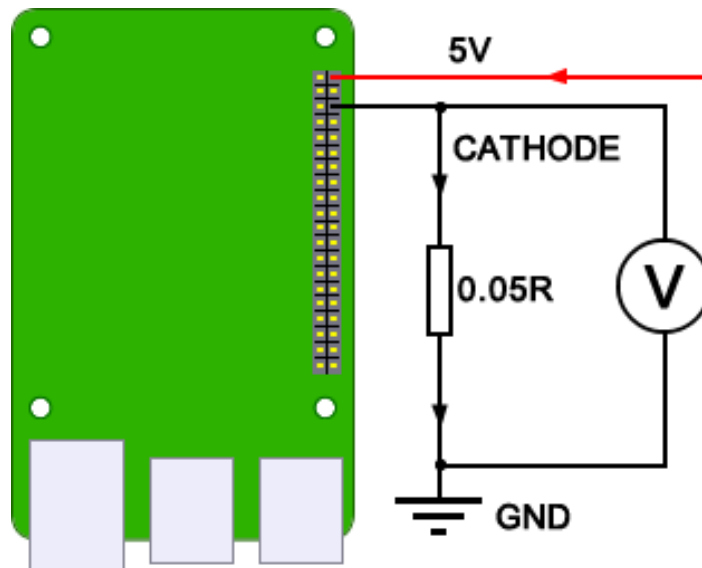
Alternatively, if you wish to trigger Witty Pi 3 with external signal, you can use a N-channel MOSFET to achieve this:



The signal should be a positive pulse, and the pulse length should be longer than 300ms. Processing a pulse will be equal to taping the switch once, so it will turn on your Raspberry Pi if your Pi is off, or turn off your Raspberry Pi if your Pi is on.

## **CATH / CATHOD**

It is the cathode for Raspberry Pi. There is a 0.05 Ohm sampling resistor between CATHOD and GND, to measure the actual output current.



If you measure the voltage between cathode and ground as  $V_k$ , you can calculate the actual current with this formula:

$$I_{out} = V_k / 0.05 = 20 * V_k$$

## GND

It is the ground of Witty Pi 3 Rev2 board, and it directly connects to the GND wire of power supply.

## External Battery for Time/Alarms Keeping

Witty Pi 3 Rev2 comes with a CR2032 battery holder, and that battery is for RTC time/alarms keeping (when power supply is not connected to Witty Pi). If you want to connect your own battery to Witty Pi for such purpose, you can make use of the two testing pads on the back. It is labelled "Vb 3V", but you can actually connect any battery with voltage from 2.3V to 5.5V.





## Witty Pi Log Files

In the directory that you install your Witty Pi software, you can find two log files: **schedule.log** and **wittyPi.log**. If you need our help for solving a problem, please kindly put the log files in email attachment too. This will help us to help you better.

The “schedule.log” file contains the history of schedule script executions. In this log file you can see how the next shutdown and startup were scheduled. If you saw unexpected schedule script behaviour, this log should be the first file to check.

The “wittyPi.log” file records the history of all Witty Pi activities. If you think your Witty Pi doesn’t behave correctly, this log file might provide more information for troubleshooting.

**The time-stamp in the log file is always the system time**, instead of the RTC time. During the booting, the first log written by Witty Pi’s software is “Witty Pi daemon (vX.XX) is started.”, but its time-stamp might not be correct as the system time has not been updated by RTC yet. You will see the correct time after the RTC time has been written to the system. For example:

```
[2020-05-09 11:10:14] Witty Pi daemon (v3.11) is started.  
.....  
[2020-05-09 11:10:16] Synchronizing time between system and Witty Pi...  
[2020-05-09 11:10:16] Writing RTC time to system...  
[2020-05-09 14:05:13] Done :-)
```

The correct time-stamp firstly appears in the line with text “Done :-)”, so you know this startup happened at 14:05.

When the booting is done, the last log written by Witty Pi software is “Pending for incoming shutdown command...”. If there is Internet connection, the NTP time will be applied to the system and RTC later.

Again, if you need our help for solving a problem, please kindly put the log files in email attachment too. In the majority of cases, they will help us a lot to help you better.

## Frequently Asked Questions (FAQ)

### *What I2C Addresses are used by Witty Pi3 Rev2?*

Raspberry Pi communicates with the RTC chip (DS3231) on Witty Pi 3 Rev2 via I<sup>2</sup>C protocol. The DS3231 chip has a fixed I<sup>2</sup>C address: **0x68**.

Also Witty Pi 3 Rev2 has a micro controller (ATtiny841), which also works as an I<sup>2</sup>C slave, and the micro controller's I<sup>2</sup>C address is **0x69**.

If you have Witty Pi 3 Rev2 connected to Raspberry Pi and run “sudo i2cdetect -y 1” in the console, you will see this:

```
pi@raspberrypi ~ $ sudo i2cdetect -y 1
   0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
10:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
20:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
30:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
40:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
50:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
60:  --  --  --  --  --  --  --  --  68 69  --  --  --  --  --
70:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
pi@raspberrypi ~ $
```

The RTC address (0x68) is fixed and you can never change it. If you want to use other I<sup>2</sup>C devices on your Raspberry Pi, please make sure they have different I<sup>2</sup>C addresses.

The micro controller can use other address than 0x69 by configuring the I<sup>2</sup>C register at position #9. However, that also need to modify the software accordingly.

### ***What I<sup>2</sup>C Registers Are Provided by Witty Pi 3 Rev2?***

The micro controller on Witty Pi 3 Rev2 works as an I<sup>2</sup>C slave and Raspberry Pi can read/write some registers via I<sup>2</sup>C interface. The software configures Witty Pi 3 Rev2 by setting the I<sup>2</sup>C register accordingly.

The table below shows the 20 registers provided by Witty Pi 3 Rev2. As you can see, some of them are read-only (cannot be changed, or can only be updated by the firmware itself):

Address	Description	Range	Default	Accessible
0	Firmware ID	--	0x23	Read-only
1	Integer part for input voltage	0~255	0	Read-only
2	Decimal part (multiple 100 times) for input voltage	0~99	0	Read-only
3	Integer part for output voltage	0~255	0	Read-only
4	Decimal part (multiple 100 times) for output voltage	0~99	0	Read-only
5	Integer part for output current	0~255	0	Read-only
6	Decimal part (multiple 100 times) for output current	0~99	0	Read-only
7	Power mode: <ul style="list-style-type: none"> <li>• Power via LDO regulator = 1</li> <li>• Input 5V via USB Type C = 0</li> </ul>	1 or 0	1	Read-only
8	A flag indicates that whether the previous shutdown was due to low voltage: <ul style="list-style-type: none"> <li>• Yes = 1</li> <li>• No = 0</li> </ul>	1 or 0	0	Read-only

9	I2C slave address: default=0x69	0x08 ~0x77	0x69	Read & Write
10	State when power connected: <ul style="list-style-type: none"> <li>• Default On = 1</li> <li>• Default Off = 0</li> </ul>	1 or 0	0	Read & Write
11	Pulse interval when Raspberry Pi is off: <ul style="list-style-type: none"> <li>• 1 second = 6</li> <li>• 2 seconds = 7</li> <li>• 4 seconds = 8</li> <li>• 8seconds = 9</li> </ul> <p>This parameter affects the white LED blinking and dummy load.</p>	6,7,8 or 9	8	Read & Write
12	Low voltage threshold (multiple 10 times, 255=disabled)	0~255	255	Read & Write
13	LED lights up duration. 0 if white LED should not blink. The bigger value, the longer time to light up the white LED	0~255	100	Read & Write
14	The delay (multiple 10) before power cut: default=50 (5 seconds)	0~255	50	Read & Write
15	Recovery voltage threshold (multiple 10 times, 255=disabled)	0~255	255	Read & Write
16	Dummy load duration. 0 if dummy load is off. The bigger value, the longer time for dummy load to draw current	0~255	0	Read & Write
17	Adjustment for measured input voltage (multiple 100 times)	-127~1 27	20	Read & Write

18	Adjustment for measured output voltage (multiple 100 times)	-127 ~127	20	Read & Write
19	Adjustment for measured output current (multiple 100 times)	-127 ~127	0	Read & Write

Below is an example to read the register at address 7, to know the current power mode (0x00 means input 5V via the USB Type C connector):

```
pi@raspberrypi ~$ i2cget -y 1 0x69 7
0x00
pi@raspberrypi ~$
```

And below is an example to write the register at address 11, to set the pulsing interval to 1 second (using value 6):

```
pi@raspberrypi ~$ i2cset -y 1 0x69 11 6
pi@raspberrypi ~$
```

**Remarks:** although the register at address 9 is writable, **changing the I2C slave address is more than writing an I<sup>2</sup>C register**. You will need to modify the software accordingly (change the I2C\_MC\_ADDRESS value in utilities.sh file), and reconnect the power supply to make it work.

## What GPIO Pins Are Used by Witty Pi3 Rev2?

The GPIO pins used by Witty Pi 3 are marked with **green** color in the table below.

GPIO (BCM)	Name	Physical		Name	GPIO (BCM)
	3.3V	<b>1</b>	<b>2</b>	5V	
<b>2</b>	SDA 1	<b>3</b>	<b>4</b>	5V	
<b>3</b>	SCL 1	<b>5</b>	<b>6</b>	GND	
<b>4</b>	GPIO 7	<b>7</b>	<b>8</b>	TXD	14
	GND	<b>9</b>	<b>10</b>	RXD	15
<b>17</b>	GPIO 0	<b>11</b>	<b>12</b>	GPIO 1	18
27	GPIO 2	<b>13</b>	<b>14</b>	GND	
22	GPIO 3	<b>15</b>	<b>16</b>	GPIO 4	23
	3.3V	<b>17</b>	<b>18</b>	GPIO 5	24
10	MOSI	<b>19</b>	<b>20</b>	GND	
9	MISO	<b>21</b>	<b>22</b>	GPIO 6	25
11	SCLK	<b>23</b>	<b>24</b>	CE0	8
	GND	<b>25</b>	<b>26</b>	CE1	7
0	SDA 0	<b>27</b>	<b>28</b>	SCL 0	1
5	GPIO 21	<b>29</b>	<b>30</b>	GND	
6	GPIO 22	<b>31</b>	<b>32</b>	GPIO 26	12
13	GPIO 23	<b>33</b>	<b>34</b>	GND	
19	GPIO 24	<b>35</b>	<b>36</b>	GPIO 27	16
26	GPIO 25	<b>37</b>	<b>38</b>	GPIO 28	20
	GND	<b>39</b>	<b>40</b>	GPIO 29	21

As you can see, Witty Pi 3 Rev2 uses **GPIO-4**, **GPIO-17**, **GPIO-2(SDA 1)** and **GPIO-3(SCL 1)**.

Witty Pi 3 Rev2 doesn't actually use the TXD pin, but it will monitor its voltage. The TXD pin is supposed to be HIGH when system is on, and should go LOW after system has been shut down. If

you connect some other devices that also use the TXD pin, please make sure they don't change this default behaviour, otherwise Witty Pi 3 Rev2 doesn't know when the system is off, and cannot fully cut the power.

GPIO-2 and GPIO-3 are for I<sup>2</sup>C communication between Raspberry Pi and the RTC chip (DS3231). I<sup>2</sup>C devices are identified by I<sup>2</sup>C address, and they can share the I<sup>2</sup>C pins as long as they have different I<sup>2</sup>C addresses.

## ***Is Witty Pi 3 Rev2 Compatible with “Other Hardware”?***

We have got a lot of emails asking question like this, with the “Other Hardware” replaced by different kinds of hardware.

Please understand that we might not have the hardware you refer, and even if we have, it is difficult for us to make tests on all these hardware with Witty Pi 3 Rev2. Fortunately, it is not that difficult to figure out the answer by yourself. Basically you just need to consider the I<sup>2</sup>C address and GPIO pins used by the “Other Hardware”.

If the “Other Hardware” uses 0x68 I<sup>2</sup>C address, it will be a confliction with Witty Pi's RTC chip and you cannot use it with Witty Pi together. If the “Other Hardware” uses 0x69 I<sup>2</sup>C address, you will need to change the I<sup>2</sup>C address used by Witty Pi's micro controller, and change the software accordingly.

If the “Other Hardware” doesn't use any GPIO pin that used by Witty Pi, and it doesn't use 0x68 or 0x69 I<sup>2</sup>C address, then it should be compatible with Witty Pi.

If you have no idea which I<sup>2</sup>C address (if applicable) or GPIO pins are used by the “Other Hardware”, please contact its developer, as they certainly know their hardware and can provide you accurate information about it.

## ***Witty Pi3 Rev2 does not boot?***

Some customers meet the situation that Witty Pi 3 Rev2 only boot Raspberry Pi for a few seconds, and then shutdown Raspberry Pi or cut the power directly.

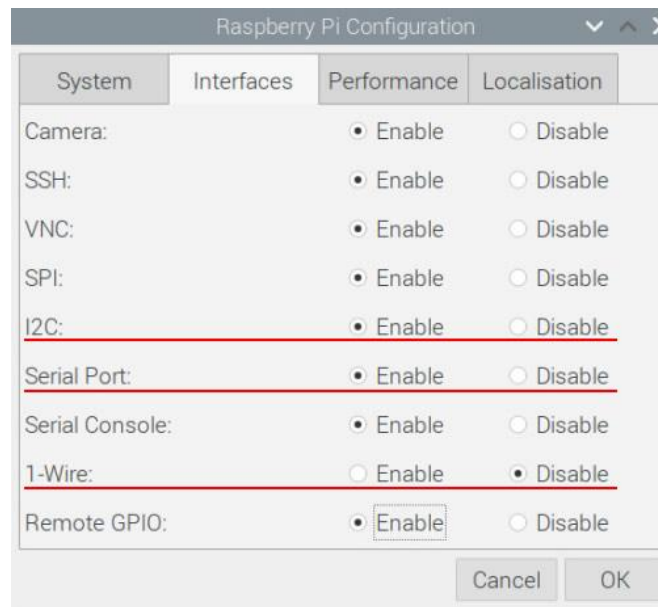
**Remarks:** you may need to disconnect Witty Pi 3 Rev2 from your Raspberry Pi, and power on Raspberry Pi only for troubleshooting.

Before making further troubleshooting, please first check these interfaces are properly configured:

- I2C interface should be enabled
- Serial Port should be enabled

- 1-Wire interface should be disabled if you don't need it, or you need to assign a GPIO pin other than GPIO-4 to it.

If your Raspbian (Raspberry Pi OS) has GUI installed, you can review/configure these interfaces via Raspberry Pi Configuration:



Also you can check all GPIO pin states with “gpio readall” command. The good GPIO states are shown below (please mind those highlighted in green). If you see something different, then it might be the culprit that causes the problem.

```
pi@raspberrypi ~/wittyPi $ gpio readall
```

BCM	wPi	Name	Mode	V	Physical	V	Mode	Name	wPi	BCM
		3.3v			1	2		5v		
2	8	SDA.1	ALT0	1	3	4		5v		
3	9	SCL.1	ALT0	1	5	6		0v		
4	7	GPIO.7	IN	1	7	8	1	ALT0	TxD	15
		0v			9	10	1	ALT0	RxD	16
17	0	GPIO.0	IN	0	11	12	0	IN	GPIO.1	1
27	2	GPIO.2	IN	0	13	14			0v	18
22	3	GPIO.3	IN	0	15	16	0	IN	GPIO.4	4
		3.3v			17	18	0	IN	GPIO.5	5
10	12	MOSI	IN	0	19	20			0v	24
9	13	MISO	IN	0	21	22	0	IN	GPIO.6	6
11	14	SCLK	IN	0	23	24	1	IN	CE0	10
		0v			25	26	1	IN	CE1	11
0	30	SDA.0	IN	1	27	28	1	IN	SCL.0	31
5	21	GPIO.21	IN	1	29	30			0v	1
6	22	GPIO.22	IN	1	31	32	0	IN	GPIO.26	26
13	23	GPIO.23	IN	0	33	34			0v	12
19	24	GPIO.24	IN	0	35	36	0	IN	GPIO.27	27
26	25	GPIO.25	IN	0	37	38	0	IN	GPIO.28	28
		0v			39	40	1	IN	GPIO.29	29



There are some possible reasons that can cause this kind of problem:

## 1. You are using NOOBS

NOOBS is not always causing this kind of problem, but the chance does exist. If you installed multiple operating systems into your Pi, the chance that NOOBS causes this problem will be rather big. If possible, please [try not to use NOOBS](#). If you already use NOOBS and still try to make it work, you may set a big [power cut delay](#) value (e.g. 25 seconds). If it doesn't help, you will need to install the OS without using NOOBS, which is actually faster.

## 2. 1-Wire interface is enabled on GPIO-4, which conflicts with Witty Pi

If you have 1-Wire interface enabled, by default it will use GPIO-4. Because Witty Pi uses GPIO-4 pin to receive shutdown command, this will bring confliction and Witty Pi will shut down your Raspberry Pi after every boot. You won't even have chance to login the system.

In order avoid this problem, 1-Wire interface should be disabled, or assigned to a different GPIO pin before installation of Witty Pi's software. If the problem already happens, you need to take out the micro SD card from Raspberry Pi and access its file system via a card reader.

You need to edit the config.txt file in the "boot" volume to change the GPIO pin used by 1-Wire interface, or you can disable 1-Wire interface if you don't need it for now. You need to find something like "dtoverlay=w1-gpio" in the file.

If you want 1-Wire to use GPIO-18, just replace "dtoverlay=w1-gpio" with:

```
dtoverlay=w1-gpio,gpiopin=18
```

If you want to disable 1-Wire interface, just comment it out:

```
#dtoverlay=w1-gpio
```

Save the file and eject your micro SD card, and put it back to your Raspberry Pi. Now your Raspberry Pi should be able to boot normally.

## 3. Software does not run automatically after Raspberry Pi system is on

After installing the software, you will have "daemon.sh", "syncTime.sh" and "runScript.sh" scripts in the directory that has software installed. These scripts should be executed automatically after the operating system is up.

If these scripts are not automatically executed for any reason, Witty Pi will cut the power of Raspberry Pi. In this case, the first place to check is the “/etc/init.d/wittypi” file, and there is possibility that it contains wrong paths to these scripts.

If you are running a special distribution of OS, make sure to check if the commands in the “/etc/init.d/wittypi” file do exist in the system, or it will fail silently. For example, Minibian doesn’t have “sudo” command.

#### **4. Witty Pi is unexpectedly woken up by shutdown alarm**

This could happen, after you scheduled a shutdown in the future, and then Witty Pi lost power connection. Raspberry Pi is off ungracefully and later the power connection is resume. If the shutdown alarm occurs when Raspberry Pi is still off, it will wake it up, which is unexpected. The software will detect this situation and shutdown your Raspberry Pi immediately.

Next time when you turn on your Raspberry Pi, it will be normal again, and you can find this message in the log, for previous shutdown:

*Seems I was unexpectedly woken up by shutdown alarm, must go back to sleep...*

Sometimes the same case can happen when you tap the button to turn on your Raspberry Pi, if the shutdown alarm occurs during the time that no power supply was connected.

You may ask, how comes the shutdown alarm could act like a startup alarm? This situation exists since Witty Pi 2. Witty Pi 2 and 3 use the same RTC chip (DS3231), which is way better than the one used in on Witty Pi (DS1337). The downside however, is the new RTC chip merges two alarm pins into one. Hence without turning on your Raspberry Pi and check the RTC registers, Witty Pi doesn’t know if the current alarm is a shutdown alarm or a startup alarm.

#### **5. Serial Port is not properly configured**

The serial port (UART0) should be enabled, and it should be on GPIO-14 and GPIO-15 (BCM naming). The TXD pin in serial port will be monitored by Witty Pi and it goes to LOW when system has been shut down. If the serial port is not properly configured, the TXD pin doesn’t have proper default state and Witty Pi may mistakenly think the system is off and then cut the power.

#### **6. GPIO-4 pin doesn’t reach a stable status in given time**

After the system is on, GPIO-4 pin should be in input mode and gets internally pulled up. However, during the startup the GPIO-4 pin could be unstable. In the [daemon.sh](#) script, the GPIO-4 listener will be started once the pin state hasn’t changed for 10 seconds. Once the GPIO-4 listener is started,

any action that pulls down GPIO-4 will be regarded as a shutdown command. So if GPIO-4 pin doesn't really get stable after the given 10 seconds, Witty Pi will take it as a shutdown command, **lights up the white LED** and then shutdown the system.

There are many factors that might cause the GPIO pin unstable, and **the most common one is the power supply**. If your power supply is not strong enough, during the booting its voltage may drop from time to time, which may also make the GPIO pin voltage drop, and trigger Witty Pi's software to shut down your Raspberry Pi.

If it is the case, you can try to delay the starting of GPIO-4 listener, and in the majority of cases it will help. You can modify the “**daemon.sh**” script, in line 94:

```
while [ $counter -lt 5 ]; do
```

Try to change the number 10 to 25. The bigger number you use, the later the GPIO-4 listener will be started.

This modification may workaround the problem. If it doesn't, it means your GPIO-4 is really pulled down (by software or hardware), and you can confirm that by measuring the voltage on GPIO-4 with a multimeter. By default, the GPIO-4 should be internally pulled up. If it gets pulled down, try to find out who does this and don't let it do this again.

**Revision History**

Revision	Date	Description
<b>1.00</b>	2021.02.01	Initial revision