ESP32-PICO-KIT
User Guide

Version 1.0

About This Guide

This user guide shows how to get started with the ESP32-PICO-KIT mini development board.

Release Notes

Date	Version	Release notes
2017.11	V1.0	First release.

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1. ESP-PICO-KIT Overview

1.1. ESP-PICO-KIT

ESP32-PICO-KIT is a mini development board based on the ESP32-PICO-D4 SIP module. All the IO signals and system power on ESP32-PICO-D4 are led out through two rows of 20 pads populated with standard 0.1" pitch header pins. Developers can connect the board to other circuit modules according to their needs. The development board integrates a USB-UART Bridge circuit, allowing the developers to connect the development board to a PC's USB port for downloads and debugging.

At the core of this development board is the ESP32-PICO-D4, a System-in-Package (SIP) module with complete Wi-Fi and Bluetooth functionalities. ESP32-PICO-D4 integrates several peripheral components seamlessly in one single package, that otherwise would need to be installed separately. This includes a crystal oscillator, 4 MB flash, filter capacitors and RF matching links in. This greatly reduces quantity and costs of additional components, subsequent assembly and testing cost, as well as overall product complexity.

With its ultra-small size, robust performance and low-energy consumption, ESP32-PICO-D4 is well suited for any space-limited or battery-operated applications, such as wearable electronics, medical equipment, sensors and other IoT products.

1.2. Functional Description

The following list and figure below describe key components, interfaces and controls of ESP32-PICO-KIT board.

- ESP32-PICO-D4: Standard ESP32-PICO-D4 module soldered to the ESP32-PICO-KIT board. The complete system of the ESP32 chip has been integrated into the SIP module, requiring only external filter capacitors and pull-up resistors for EN signals to function properly.
- USB-UART Bridge:
- I/O: All the pins on ESP32-PICO-D4 are broken out to the pin headers on the board. Users can program ESP32 to enable multiple functions such as PWM, ADC, DAC, I2C, I2S, SPI, etc.
- Micro USB Port: USB interface. It functions as the power supply for the board and the communication interface between PC and ESP32-PICO-KIT.
- EN Button: Reset button; pressing this button resets the system.
- BOOT Button: Holding down the Boot button and pressing the EN button initiates the firmware download mode. Then user can download firmware through the serial port.

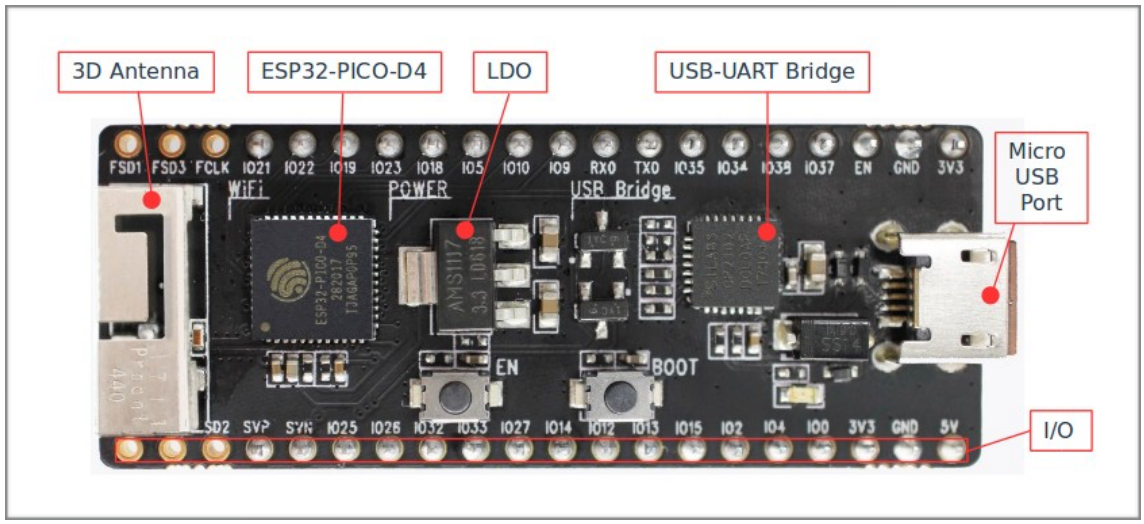


Figure 1-2. ESP32-PICO-KIT Board Layout

2. Get Started on ESP32-PICO-KIT

2.1. Preparation

To develop applications for ESP32-PICO-KIT you need:

- 1 × ESP32-PICO-KIT mini development board
- 1 × USB A / Micro USB B cable
- 1 × PC loaded with Windows, Linux or Mac OS

2.2. Standard Setup of Toolchain for Linux

The quickest way to start development with ESP32-PICO-KIT is by installing a prebuilt toolchain. Pick up your OS below and follow provided instructions.

2.2.1. Install Prerequisites

To compile with ESP-IDF you need to get the following packages:

- CentOS 7:

```
sudo yum install git wget make ncurses-devel flex bison gperf python pyserial
```

- Ubuntu and Debian:

```
sudo apt-get install git wget make libncurses-dev flex bison gperf python python-serial
```

- Arch:

```
sudo pacman -S --needed gcc git make ncurses flex bison gperf python2-pyserial
```

2.2.2. Toolchain Setup

ESP32 toolchain for Linux is available for download from Espressif website:

- for 64-bit Linux:

https://dl.espressif.com/dl/xtensa-esp32-elf-linux64-1.22.0-61-gab8375a-5.2.0.tar.gz

- for 32-bit Linux:

https://dl.espressif.com/dl/xtensa-esp32-elf-linux32-1.22.0-61-gab8375a-5.2.0.tar.gz

Download this file, then extract it in ***~/esp*** directory

```
mkdir -p ~/esp

cd ~/esp

tar -xzf ~/Downloads/xtensa-esp32-elf-linux64-1.22.0-61-gab8375a-5.2.0.tar.gz
```

The toolchain will be extracted into ***~/esp/xtensa-esp32-elf/*** directory.

To use it, you will need to update your `***PATH***` environment variable in ***~/.bash_profile*** file. To make ***xtensa-esp32-elf*** available for all terminal sessions, add the following line to your ***~/.bash_profile*** file:

```
export PATH=$PATH:$HOME/esp/xtensa-esp32-elf/bin
```

Alternatively, you may create an alias for the above command. This way you can get the toolchain only when you need it. To do this, add different line to your ***~/.bash_profile*** file:

```
alias get_esp32="export PATH=$PATH:$HOME/esp/xtensa-esp32-elf/bin"
```

Then when you need the toolchain you can type ***get_esp32*** on the command line and the toolchain will be added to your ***PATH***.

2.3. Get ESP-IDF

Once you have the toolchain (that contains programs to compile and build the application) installed, you also need ESP32 specific API / libraries. They are provided by Espressif in *ESP-IDF repository*. To get it, open terminal, navigate to the directory you want to put ESP-IDF, and clone it using `git clone` command:

```
cd ~/esp

git clone --recursive https://github.com/espressif/esp-idf.git
```

ESP-IDF will be downloaded into ***~/esp/esp-idf***.

> 📖 ***Note:***
>
> - *While cloning submodules on Windows platform, the* `git clone` *command may print some output starting* `': not a valid identifier...`. *This is a known issue but the git clone still succeeds without any problems.*
> - *Do not miss the* `--recursive` *option. If you have already cloned ESP-IDF without this option, run another command to get all the submodules:*
>
> ```
> cd ~/esp/esp-idf
>
> git submodule update --init
> ```

2.4. Set up Path to ESP-IDF

The toolchain programs access ESP-IDF using ***IDF_PATH*** environment variable. This variable should be set up on your PC, otherwise projects will not build. Setting may be done manually, each time PC is restarted. Another option is to set up it permanently by defining ***IDF_PATH*** in user profile. To do so, follow instructions specific to ***:ref:`Windows <add-idf_path-to-profile-windows>`***, ***:ref:`Linux and MacOS <add-idf_path-to-profile-linux-macos>`*** in section ***:doc:`add-idf_path-to-profile`***.

3. Start a Project with ESP32-PICO-KIT

Now you are ready to prepare your application for ESP32-PICO-KIT. To start off quickly, we will use ***:example:`get-started/hello_world`*** project from ***:idf:`examples`*** directory in IDF.

Copy ***:example:`get-started/hello_world`*** to ***~/esp*** directory:

```
cd ~/esp

cp -r $IDF_PATH/examples/get-started/hello_world .
```

You can also find a range of example projects under the ***:idf:`examples`*** directory in ESP-IDF. These example project directories can be copied in the same way as presented above, to begin your own projects.

> 📖 ***Note:***
>
> *The ESP-IDF build system does not support spaces in paths to ESP-IDF or to projects.*

4. Connect

You are almost there. To be able to proceed further, connect ESP32 board to PC, check under what serial port the board is visible and verify if serial communication works. If you are not sure how to do it, check instructions in section ***:doc:`establish-serial-connection`***. Note the port number, as it will be required in the next step.

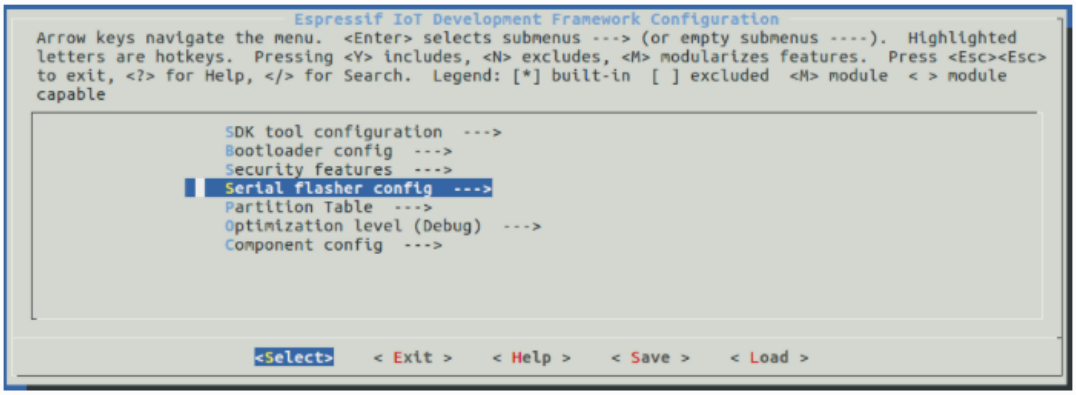
5. Configure

Being in terminal window, go to directory of ***hello_world*** application by typing `cd ~/esp/hello_world`. Then start project configuration utility ***menuconfig***:

```
cd ~/esp/hello_world

make menuconfig
```

If previous steps have been done correctly, the following menu will be displayed:



Project configuration - Home window

In the menu, navigate to ***Serial flasher config*** > ***Default serial port*** to configure the serial port, where project will be loaded to. Confirm selection by pressing enter, save configuration by selecting ***< Save >*** and then exit application by selecting ***< Exit >***.

Here are couple of tips on navigation and use of ***menuconfig***:

- Use up & down arrow keys to navigate the menu.
- Use Enter key to go into a submenu, Escape key to go out or to exit.
- Type ***?*** to see a help screen. Enter key exits the help screen.
- Use Space key, or ***Y*** and ***N*** keys to enable (Yes) and disable (No) configuration items with checkboxes "***[*]***".
- Pressing ***?*** while highlighting a configuration item displays help about that item.
- Type **/** to search the configuration items.

> 📖 ***Notes:***
>
> - *On Windows, serial ports have names like COM1. On MacOS, they start with **/dev/cu.**. On Linux, they start with **/dev/tty.** (See **:doc:`establish-serial-connection`** for full details.)*
> - *If you are Arch Linux user, navigate to **SDK tool configuration** and change the name of **Python 2 interpreter** from **python** to **python2**.*
> - *Most ESP32 development boards have a 40 MHz crystal installed. However, some boards use a 26 MHz crystal. If your board uses a 26MHz crystal, or you get garbage output from serial port after code upload, adjust the **:ref:`CONFIG_ESP32_XTAL_FREQ_SEL`** option in **menuconfig**.*

6. Build and Flash

6.1. Build and Flash

Now you can build and flash the application. Run:

```
make flash
```

This will compile the application and all the ESP-IDF components, generate bootloader, partition table, and application binaries, and flash these binaries to your ESP32 board.

```
esptool.py v2.0-beta2

Flashing binaries to serial port /dev/ttyUSB0 (app at offset 0x10000)...

esptool.py v2.0-beta2

Connecting........___

Uploading stub...

Running stub...

Stub running...

Changing baud rate to 921600

Changed.

Attaching SPI flash...

Configuring flash size...

Auto-detected Flash size: 4MB

Flash params set to 0x0220

Compressed 11616 bytes to 6695...

Wrote 11616 bytes (6695 compressed) at 0x00001000 in 0.1 seconds (effective 920.5 kbit/s)...

Hash of data verified.

Compressed 408096 bytes to 171625...

Wrote 408096 bytes (171625 compressed) at 0x00010000 in 3.9 seconds (effective 847.3 kbit/
s)...

Hash of data verified.

Compressed 3072 bytes to 82...

Wrote 3072 bytes (82 compressed) at 0x00008000 in 0.0 seconds (effective 8297.4 kbit/s)...

Hash of data verified.


Leaving...

Hard resetting...
```

If there are no issues, at the end of build process, you should see messages describing progress of loading process. Finally, the end module will be reset and “hello_world” application will start.

If you'd like to use the Eclipse IDE instead of running make, check out the ***:doc:`Eclipse guide <eclipse-setup>`***.

6.2. Monitor

To see if “hello_world” application is indeed running, type `make monitor`. This command is launching ***:doc:`IDF Monitor <idf-monitor>`*** application:

```
$ make monitor

MONITOR

--- idf_monitor on /dev/ttyUSB0 115200 ---

--- Quit: Ctrl+] | Menu: Ctrl+T | Help: Ctrl+T followed by Ctrl+H ---

ets Jun  8 2016 00:22:57


rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)

ets Jun  8 2016 00:22:57

...
```

Several lines below, after start up and diagnostic log, you should see “Hello world!” printed out by the application.

```
...

Hello world!

Restarting in 10 seconds...

I (211) cpu_start: Starting scheduler on APP CPU.

Restarting in 9 seconds...

Restarting in 8 seconds...

Restarting in 7 seconds...
```

To exit monitor use shortcut ***Ctrl+]***. To execute `make flash` and `make monitor` in one shoot type `make flash monitor`. Check section ***:doc:`IDF Monitor <idf-monitor>`*** for handy shortcuts and more details on using this application.

That's all what you need to get started with ESP32!

Now you are ready to try some other ***:idf:`examples`***, or go right to developing your own applications.

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

FCC Label Instructions

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: "Contains Transmitter Module FCC ID:2AC7Z-ESP32PICOKIT" or "Contains FCC ID:2AC7Z-ESP32PICOKIT" Any similar wording that expresses the same meaning may be used.