
Simba

Simba Documentation

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Simba is an Embedded Programming Platform. It aims to make embedded programming easy and portable.

Project homepage: <https://github.com/erimoq/simba>

Transmit CAN frames between a Nano32 and an Arduino Due. More videos are available on the [Videos](#) page.

1.1 Installation

There are three build systems available; *PlatformIO*, *Arduino IDE* and *Simba build system*. The *Simba build system* has more features than to the other two. It supports executing test suites, generating code coverage, profiling and more. Still, if you are familiar with *Arduino IDE* or *PlatformIO*, use that instead since it will be less troublesome.

1.1.1 PlatformIO

Install *Simba* in [PlatformIO](#).

1.1.2 Arduino IDE

Install *Simba* in the [Arduino IDE 1.6.10](#) as a third party board using the Boards Manager.

1. Open *File* -> *Preferences*.
2. Add these URL:s to *Additional Boards Manager URLs* (click on the icon to the right of the text field) and press *OK*.

```
https://raw.githubusercontent.com/eerimoq/simba-releases/master/arduino/avr/  
↪package_simba_avr_index.json  
https://raw.githubusercontent.com/eerimoq/simba-releases/master/arduino/sam/  
↪package_simba_sam_index.json  
https://raw.githubusercontent.com/eerimoq/simba-releases/master/arduino/esp/  
↪package_simba_esp_index.json  
https://raw.githubusercontent.com/eerimoq/simba-releases/master/arduino/esp32/  
↪package_simba_esp32_index.json
```

3. Open *Tools* -> *Board: ...* -> *Boards Manager...* and type *simba* in the search box.
4. Click on *Simba by Erik Moqvist version x.y.z* and click *Install* and press *Close*.
5. Open *Tools* -> *Board: ...* -> *Boards Manager...* and select one of the Simba boards in the list.
6. Open *File* -> *Examples* -> *Simba* -> *hello_world*.
7. Verify and upload the sketch to your device.
8. Done!

1.1.3 Simba build system

The *Simba* development environment can be installed on *Windows (Cygwin)* and *Linux (Ubuntu 14)*. Just follow the steps below and you'll be up and running in no time. =)

Windows (Cygwin)

Download [Cygwin](#) and select the following packages for installation:

NOTE: ESP8266 is not supported in *Cygwin* because there is no toolchain available.

```
- gcc-core           (Devel -> gcc-core)
- make              (Devel -> make)
- python            (Python -> python)
- python-setuptools (Python -> python-setuptools)
- git               (Devel -> git)
- doxygen           (Devel -> doxygen)
```

Start *Cygwin* and execute the one-liner below to install *Simba*.

```
$ mkdir simba && \
  cd simba && \
  easy_install-2.7 pip && \
  pip install pyserial xpect readchar sphinx breathe && \
  git clone https://github.com/eerimoq/avr-toolchain-windows && \
  git clone https://github.com/eerimoq/arm-toolchain-windows && \
  git clone https://github.com/eerimoq/simba
```

Linux (Ubuntu 14)

Execute the one-liner below to install *Simba*.

```
$ mkdir simba && \
  cd simba && \
  sudo apt install ckermit valgrind cppcheck cloc python python-pip doxygen git lcov & \
  sudo apt install avrdude gcc-avr binutils-avr gdb-avr avr-libc && \
  sudo apt install bossa-cli gcc-arm-none-eabi && \
  sudo apt install make unrar autoconf automake libtool gcc g++ gperf \
    flex bison texinfo gawk ncurses-dev libexpat-dev \
    python-serial sed libtool-bin pmccabe && \
  sudo pip install pyserial xpect readchar sphinx breathe sphinx_rtd_theme && \
```

```
(git clone --recursive https://github.com/pfalcon/esp-open-sdk && \
  cd esp-open-sdk && \
  make) && \
  wget https://github.com/eerimoq/simba-releases/raw/master/arduino/esp32/tools/
→xtensa-esp32-elf-linux$(getconf LONG_BIT)-1.22.0-59.tar.gz && \
  tar xf xtensa-esp32-elf-linux$(getconf LONG_BIT)-1.22.0-59.tar.gz && \
  rm xtensa-esp32-elf-linux$(getconf LONG_BIT)-1.22.0-59.tar.gz && \
  git clone --recursive https://github.com/eerimoq/simba
```

Post-install

Let's build and run the hello world application to verify that the installation was successful.

```
$ cd simba && \
  source setup.sh && \
  cd examples/hello_world && \
  make -s run
```

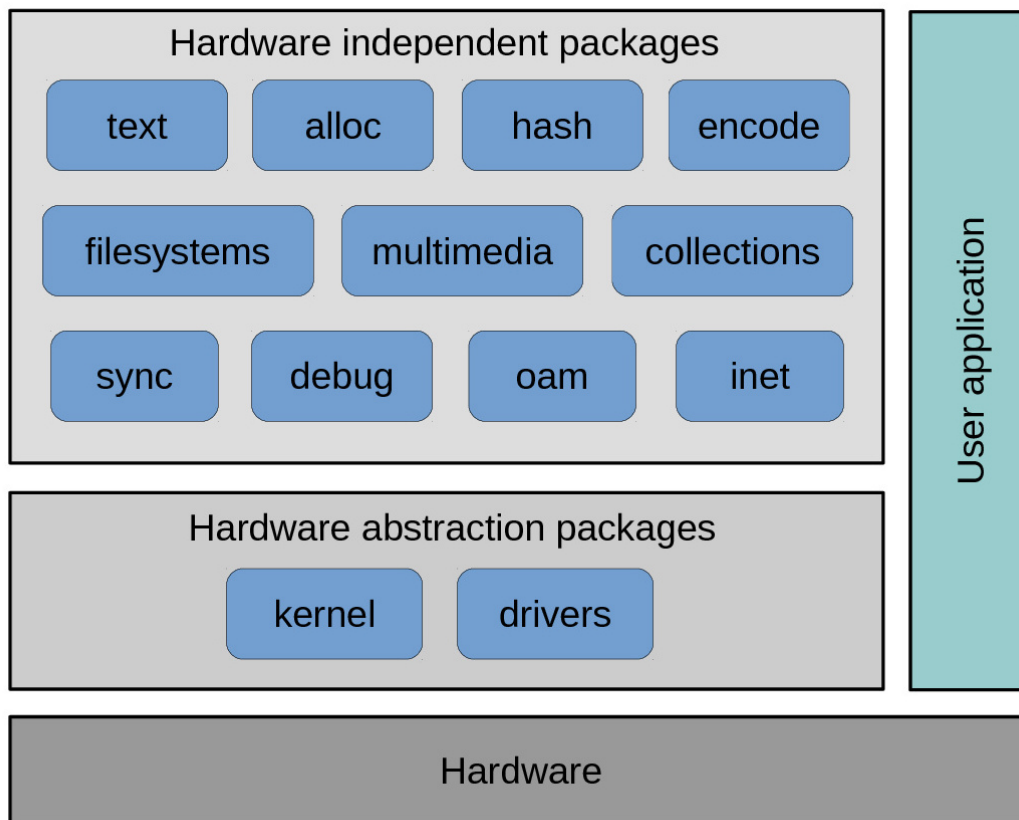
1.2 User Guide

This guide is intended for users of the Simba Embedded Programming Platform and the *Simba build system*. Parts of the guide is applicable to other build systems as well, in particular the configuration section.

The Simba installation guide can be found on the [Installation](#) page.

1.2.1 Software architecture

Below is a picture of all packages and their relation to the hardware. At the bottom is the hardware. On top of the hardware is the kernel and drivers packages, which exports a hardware independent interface that other packages and the user application can use. The user application on the right can use any package, and in rare cases directly access the hardware registers.



Contents:

Environment setup

The first step is always to setup the *Simba* environment. It's a simple matter of sourcing a setup-script in the simba root folder.

```
$ cd simba/simba
$ source setup.sh
```

Hello World application

Let's start with the *Simba* “Hello World” application. It exemplifies what an application is and how to build and run it. It consists of two files; `main.c` and `Makefile`.

main.c

`main.c` defines the application entry function `main()`.

```
#include "simba.h"

int main()
{
    /* Start the system. */
}
```

```

sys_start();

std_printf(FSTR("Hello world!\n"));
}

```

Makefile

Makefile contains build configuration of the application.

```

NAME = hello_world
BOARD ?= linux

RUN_END_PATTERN = "Hello world!"
RUN_END_PATTERN_SUCCESS = "Hello world!"

SIMBA_ROOT = ../..
include $(SIMBA_ROOT)/make/app.mk

```

Build and run

Compile, link and run it by typing the commands below in a shell:

```

$ cd examples/hello_world
$ make -s run
<build system output>
Hello world!
$

```

Cross-compile, link and then run on an Arduino Due:

```

$ cd examples/hello_world
$ make -s BOARD=arduino_due run
<build system output>
Hello world!
$

```

Applications, packages and modules

Simba has three software components; the application, the package and the module.

Application

An application is an executable consisting of zero or more packages.

An application file tree can either be created manually or by using the tool *simba*.

```

myapp
- main.c
- Makefile

```

Development workflow

Build and run often! More to be added, hopefully.

Package

A package is a container of modules.

A package file tree can either be created manually or by using the tool *simba*.

A package file tree **must** be organized as seen below. This is required by the build framework and *Simba* tools.

See the inline comments for details about the files and folders contents.

```
mypkg
- mypkg
|   - doc                      # package documentation
|   - __init__.py
|   - src                      # package source code
|       - mypkg
|           - module1.c
|           - module1.h
|       - mypkg.h              # package header file
|       - mypkg.mk             # package makefile
|   - tst                      # package test code
|       - module1
|           - main.c
|           - Makefile
- setup.py
```

Development workflow

The package development workflow is fairly straight forward. Suppose we want to add a new module to the file tree above. Create `src/mypkg/module2.h` and `src/mypkg/module2.c`, then include `mypkg/module2.h` in `src/mypkg.h` and add `mypkg/module2.c` to the list of source files in `src/mypkg.mk`. Create a test suite for the module. It consists of the two files `tst/module2/main.c` and `tst/module2/Makefile`.

It's often convenient to use an existing modules' files as skeleton for the new module.

After adding the module `module2` the file tree looks like this.

```
mypkg
- mypkg
|   - doc
|   - __init__.py
|   - src
|       - mypkg
|           - module1.c
|           - module1.h
|           - module2.c
|           - module2.h
|       - mypkg.h
|       - mypkg.mk
|   - tst
|       - module1
|           - main.c
```

```
|         | - Makefile
|         - module2
|         - main.c
|         - Makefile
- setup.py
```

Now, build and run the test suite to make sure the empty module implementation compiles and can be executed.

```
$ cd tst/module2
$ make -s run
```

Often the module development is started by implementing the module header file and at the same time write test cases. Test cases are not only useful to make sure the implementation works, but also to see how the module is intended to be used. The module interface becomes cleaner and easier to use if you actually start to use it yourself by writing test cases! All users of your module will benefit from this!

So, now we have an interface and a test suite. It's time to start the implementation of the module. Usually you write some code, then run the test suite, then fix the code, then run the tests again, then you realize the interface is bad, change it, change the implementation, change the test, change, change... and so it goes on until you are satisfied with the module.

Try to update the comments and documentation during the development process so you don't have to do it all in the end. It's actually quite useful for yourself to have comments. You know, you forget how to use your module too!

The documentation generation framework uses doxygen, breathe and sphinx. That means, all comments in the source code should be written for doxygen. Breathe takes the doxygen output as input and creates input for sphinx. Sphinx then generates the html documentation.

Just run make in the doc folder to generate the html documentation.

```
$ cd doc
$ make
$ firefox _build/html/index.html    # open the docs in firefox
```

Namespaces

All exported symbols in a package must have the prefix `<package>_<module>_`. This is needed to avoid namespace clashes between modules with the same name in different packages.

There cannot be two packages with the same name, for the namespace reason. All packages must have unique names! There is one exception though, the three *Simba* packages; kernel, drivers and slib. Those packages do *not* have the package name as prefix on exported symbols.

```
int mypackage_module1_foo(void);
int mypackage_module2_bar(void);
```

Module

A module is normally a header and a source file.

Configuration

Standard Library

The *Library Reference* is configured at compile time using defines named `CONFIG_*`. The default configuration includes most functionality, as most application wants that. If an application has special requirements, for example memory constraints, it has to be configured to remove unnecessary functionality.

Search order

Highest priority first.

Simba build system

1. Command line as `CDEFS_EXTRA="<configuration variable>=<value>".`
2. A file named `config.h` in the application root folder.
3. The default configuration file, `src/config_default.h`.

PlatformIO

1. The variable `build_flags` in `platformio.ini` as `build_flags = -D<configuration variable>=<value>.`
2. A file named `config.h` in the application source folder `src`.
3. The default configuration file, `src/config_default.h`.

Arduino IDE

1. A file (also called a *tab*) named `config.h` in the sketch.
2. The default configuration file, `src/config_default.h`.

Variables

All configuration variables are listed below. Their default values are defined in `src/config_default.h`.

Defines

`CONFIG_SYS_CONFIG_STRING`

`CONFIG_SYS_SIMBA_MAIN_STACK_MAX`

Main thread stack size for ports with a fixed size main thread stack.

`CONFIG_ASSERT`

Assertions are used to check various conditions during the application execution. A typical usage is to validate function input arguments.

`CONFIG_DEBUG`

Include more debug information.

CONFIG_FS_CMD_DS18B20_LIST

Debug file system command to list all DS18B20 sensors on the bus.

CONFIG_FS_CMD_ESP_WIFI_STATUS

Debug file system command to print the Espressif WiFi status.

CONFIG_FS_CMD_FS_APPEND

Debug file system command to append to a file.

CONFIG_FS_CMD_FS_COUNTERS_LIST

Debug file system command to list all counters.

CONFIG_FS_CMD_FS_COUNTERS_RESET

Debug file system command to set all counters to zero.

CONFIG_FS_CMD_FS_FILESYSTEMS_LIST

Debug file system command to list all registered file systems.

CONFIG_FS_CMD_FS_LIST

Debug file system command to list all registered file systems.

CONFIG_FS_CMD_FS_FORMAT

Debug file system command to format a file system.

CONFIG_FS_CMD_FS_PARAMETERS_LIST

Debug file system command to list all parameters.

CONFIG_FS_CMD_FS_READ

Debug file system command to read from a file.

CONFIG_FS_CMD_FS_REMOVE

Debug file system command to remove a file.

CONFIG_FS_CMD_FS_WRITE

Debug file system command to write to a file.

CONFIG_FS_CMD_I2C_READ

Debug file system command to read from a i2c bus.

CONFIG_FS_CMD_I2C_WRITE

Debug file system command to write to a i2c bus.

CONFIG_FS_CMD_LOG_LIST

Debug file system command to list all log objects.

CONFIG_FS_CMD_LOG_PRINT

Debug file system command to create a log entry and print it. Mainly used for debugging.

CONFIG_FS_CMD_LOG_SET_LOG_MASK

Debug file system command to set the log mask of a log object.

CONFIG_FS_CMD_NETWORK_INTERFACE_LIST

Debug file system command to list all network interfaces.

CONFIG_FS_CMD_PIN_READ

Debug file system command to read the current value of a pin.

CONFIG_FS_CMD_PIN_SET_MODE

Debug file system command to set the mode of a pin.

CONFIG_FS_CMD_PIN_WRITE

Debug file system command to write a value to a pin.

CONFIG_FS_CMD_PING_PING

Debug file system command to ping a host.

CONFIG_FS_CMD_SERVICE_LIST

Debug file system command to list all services.

CONFIG_FS_CMD_SERVICE_START

Debug file system command to start a service.

CONFIG_FS_CMD_SERVICE_STOP

Debug file system command to stop a services.

CONFIG_FS_CMD_SETTINGS_LIST

Debug file system command to list all settings.

CONFIG_FS_CMD_SETTINGS_READ

Debug file system command to read the value of a setting.

CONFIG_FS_CMD_SETTINGS_RESET

Debug file system command to reset the settings to their original values.

CONFIG_FS_CMD_SETTINGS_WRITE

Debug file system command to write a value to a setting.

CONFIG_FS_CMD_SYS_CONFIG

Debug file system command to print the system configuration.

CONFIG_FS_CMD_SYS_INFO

Debug file system command to print the system information.

CONFIG_FS_CMD_SYS_UPTIME

Debug file system command to print the system uptime.

CONFIG_FS_CMD_SYS_REBOOT

Debug file system command to reboot the system uptime.

CONFIG_FS_CMD_THRD_LIST

Debug file system command to list threads' information.

CONFIG_FS_CMD_THRD_SET_LOG_MASK

Debug file system command to set the log mask of a thread.

CONFIG_FS_CMD_USB_DEVICE_LIST

Debug file system command to list all USB devices.

CONFIG_FS_CMD_USB_HOST_LIST

Debug file system command to list all USB devices connected to the USB host.

CONFIG_FS_PATH_MAX

The maximum length of an absolute path in the file system.

CONFIG_MONITOR_THREAD

Start the monitor thread to gather statistics of the scheduler.

CONFIG_PREEMPTIVE_SCHEDULER

Use a preemptive scheduler.

CONFIG_PROFILE_STACK

Profile the stack usage in runtime. It's a cheap operation and is recommended to have enabled.

CONFIG_SETTINGS_AREA_SIZE

Size of the settings area. This size *MUST* have the same size as the settings generated by the settings.py script.

CONFIG_SHELL_COMMAND_MAX

Maximum number of characters in a shell command.

CONFIG_SHELL_HISTORY_SIZE

Size of the shell history buffer.

CONFIG_SHELL_MINIMAL

Minimal shell functionality to minimize the code size of the shell module.

CONFIG_SHELL_PROMPT

The shell prompt string.

CONFIG_SOCKET_RAW

Raw socket support.

CONFIG_SPIFFS

SPIFFS is a flash file system applicable for boards that has a reasonably big modifiable flash.

CONFIG_START_CONSOLE

Start the console device (UART/USB CDC) on system startup.

CONFIG_START_CONSOLE_DEVICE_INDEX

Console device index.

CONFIG_START_CONSOLE_UART_BAUDRATE

Console UART baudrate.

CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE

Console USB CDC control interface number.

CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN

Console USB CDC input endpoint.

CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT

Console USB CDC output endpoint.

CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNECTION

Wait for the host to connect after starting the console.

CONFIG_START_FILESYSTEM

Configure a default file system.

CONFIG_START_FILESYSTEM_ADDRESS

Configure a default file system start address.

CONFIG_START_FILESYSTEM_SIZE

Configure a default file system size.

CONFIG_START_NETWORK

Setup the ip stack and connect to all configured networks.

CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT

WiFi connect timeout is seconds.

CONFIG_START_NETWORK_INTERFACE_WIFI_SSID

SSID of the WiFi to connect to.

CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD

Password of the WiFi to connect to.

CONFIG_START_SHELL

Start a shell thread communication over the console channels.

CONFIG_START_SHELL_PRIO

Shell thread priority.

CONFIG_START_SHELL_STACK_SIZE

Shell thread stack size in words.

CONFIG_STD_OUTPUT_BUFFER_MAX

Maximum number of bytes in the print output buffer.

CONFIG_SYSTEM_TICK_FREQUENCY

System tick frequency in Hertz.

CONFIG_THRD_CPU_USAGE

Calculate thread CPU usage.

CONFIG_THRD_ENV

Each thread has a list of environment variables associated with it. A typical example of an environment variable is “CWD” - Current Working Directory.

CONFIG_THRD_IDLE_STACK_SIZE

Stack size of the idle thread.

CONFIG_THRD_SCHEDULED

Count the number of times each thread has been scheduled.

CONFIG_THRD_TERMINATE

Threads are allowed to terminate.

CONFIG_USB_DEVICE_VID

USB device vendor id.

CONFIG_USB_DEVICE_PID

USB device product id.

lwIP

Use `config.h` to fully configure lwIP and all of its modules. You do not need to define every option that lwIP provides; if you do not define an option, a default value will be used. Therefore, your `config.h` provides a way to override much of the behavior of lwIP.

By default *Simba* overrides a few of the variables in `src/inet/lwipopts.h`.

Module support (Code size)

Enabling and disabling modules

You can tune your code size by only compiling the features you really need. The following is a list of what gets compiled in “out of the box” with lwIP.

Default inclusions:

- ARP (`LWIP_ARP`)
- IP and fragmentation (`IP_FRAG`) and reassembly (`IP_REASSEMBLY`)
- Raw IP PCB support (`LWIP_RAW`)
- UDP (`LWIP_UDP`) and UDP-Lite (`LWIP_UDPLITE`)
- TCP (`LWIP_TCP`) – this is a big one!

- Statistics (LWIP_STATS)

Default exclusions:

- DHCP (LWIP_DHCP)
- AUTOIP (LWIP_AUTOIP)
- SNMP (LWIP_SNMP)
- IGMP (LWIP_IGMP)
- PPP (PPP_SUPPORT)

If you would like to change this, then you just need to set the options listed below. For example, if you would like to disable UDP and enable DHCP, the following `config.h` file would do it:

```
/* Disable UDP */
#define LWIP_UDP 0

/* Enable DHCP */
#define LWIP_DHCP 1
```

Memory management (RAM usage)

Memory pools

In an embedded environment, memory pools make for fast and efficient memory allocation. lwIP provides a flexible way to manage memory pool sizes and organization.

lwIP reserves a fixed-size static chunk of memory in the data segment, which is subdivided into the various pools that lwIP uses for the various data structures. For example, there is a pool just for struct `tcp_pcb`'s, and another pool just for struct `udp_pcb`'s. Each pool can be configured to hold a fixed number of data structures; this number can be changed in the `config.h` file by changing the various `MEMP_NUM_*` values. For example, `MEMP_NUM_TCP_PCB` and `MEMP_NUM_UDP_PCB` control the maximum number of `tcp_pcb` and `udp_pcb` structures that can be active in the system at any given time.

It is also possible to create custom memory pools in addition to the standard ones provided by lwIP.

Dynamic allocation: `mem_malloc`

lwIP uses a custom function `mem_malloc` for all dynamic allocation; therefore, it is easy to change how lwIP uses its RAM. There are three possibilities provided out-of-the-box:

1. (default) lwIP's custom heap-based `mem_malloc`. By default, lwIP uses a statically-allocated chunk of memory like a heap for all memory operations. Use `MEM_SIZE` to change the size of the lwIP heap.
2. C standard library `malloc` and `free`. If you wish to have lwIP use the standard library functions provided by your compiler/architecture, then define the option `MEM_LIBC_MALLOC`.
3. Memory pools. lwIP can also emulate dynamic allocation using custom memory pools (see that chapter for more information). This involves the options `MEM_USE_POOLS` and `MEMP_USE_CUSTOM_POOLS` and a new custom file `lwippools.h`.

Understanding/changing memory usage

lwIP uses memory for:

- code (depending on your system, may use ROM instead of RAM)
- statically allocated variables (some initialized, some not initialized)
- task stack
- dynamically allocated memory
 - heap
 - memp pools

Unless you use a C library heap implementation (by defining `MEM_LIBC_MALLOC` to 1), dynamically allocated memory must be statically allocated somewhere. This means you reserve a specific amount of memory for the heap or the memp pools from which the code dynamically allocates memory at runtime.

The size of this heap and memp pools can be adjusted to save RAM:

There are 3 types of pbufs:

- REF/ROM, RAM and POOL. `PBUF_POOL_SIZE * PBUF_POOL_BUFSIZE` only refers to type POOL.
- RAM pbufs are allocated in the memory defined by `MEM_SIZE` (this memory is not used much aside from RAM pbufs) - this is the *heap* and it is allocated as `mem_memory`.
- REF/ROM pbufs as well as pcbs and some other stuff is allocated from dedicated pools per structure type. The amount of structures is defined by the various `MEMP_NUM_` defines. Together, this memory is allocated as `mem_memory` and it *includes* the pbuf POOL.

However, if you define `MEMP_MEM_MALLOC` to 1 in your `config.h`, *every* piece of dynamically allocated memory will come from the heap (the size of which is defined by `MEM_SIZE`). If you then even define `MEM_LIBC_MALLOC` to 1, too, lwIP doesn't need extra memory for dynamically allocated memory but only uses the C library heap instead. However, you then have to make sure that this heap is big enough to run your application.

To tweak the various `MEMP_NUM_` defines, define `LWIP_STATS=1` and `LWIP_STATS_DISPLAY=1` and call `stats_display()` to see how many entries of each pool are used (or have a look at the global variable `lwip_stats` instead).

Fine-tuning even more

To see the options that you can set, open [3pp/lwip-1.4.1/src/include/lwip/opt.h](#). This file is fully commented and explains how many of the options are used.

Build system

The *Simba* build system is based on *GNU Make*.

Targets

Name	Description
all	Compile and link the application.
clean	Remove all generated files and folders.
new	clean + all
upload	all + Upload the application to the device.
console	Open a serial console on /dev/arduino with baudrate BAUDRATE.
run	all + upload + Wait for application output.
run-debugger	Run the application in the debugger, break at main.
report	Print the test report from a previous run.
test	run + report
release	Compile with NASSERT=yes and NDEBUG=yes.
size	Print application size information.
help	Show the help.

Variables

There are plenty of make variables used to control the build process. Below is a list of the most frequently used variables. The advanced user may read the make files in [make](#).

Name	Description
SIMBA_ROOT	Path to the <i>Simba</i> root folder.
BOARD	The BOARD variable selects which board to build for. It can be assigned to one of the boards listed here . For example, the command to build for <i>Arduino Due</i> is <code>make BOARD=arduino_due</code> .
BAUDRATE	Serial port baudrate used by console and run targets.
VERSION	The application version string. Usually on the form <major>.<minor>.<revision>.
SETTINGS_INI	Path to the settings file.
INC	Include paths.
SRC	Source files (.c, .asm, .rs).
CFLAGS_EXTRA	Extra flags passed to the compiler.
LD_FLAGS_EXTRA	Extra flags passed to the linker.
NASSERT	Build the application without assertions.

simba

The program *simba* is used to manage *Simba* packages and applications.

The main purpose of *simba* is to distribute software in the *Simba* community, just like *pip* for Python.

How to create an application skeleton

The code block below shows how to create a new application using *simba*. After the application has been created, it is built and executed.

```
$ mkdir myapp
$ cd myapp
```

```
$ simba application init
Application name [foo]: <Enter>
Author [erik]: <Enter>
Version [0.3.0]: <Enter>
$ tree .
.
- main.c
- Makefile
$ make -s run
```

How to create a package

The code block below shows how to create a new package using *simba*. After the package has been created, the generated test suite is built and executed.

```
$ mkdir mypkg
$ cd mypkg
$ simba package init
Package name [foo]: <Enter>
Author [erik]: <Enter>
Version [0.3.0]: <Enter>
$ tree
.
- mypkg
|   - doc
|   |   - about.rst
|   |   - api-reference.rst
|   |   - conf.py
|   |   - doxygen.cfg
|   |   - index.rst
|   |   - Makefile
|   |   - mypkg
|   |   |   - hello.rst
|   |   - requirements.txt
|   |   - sphinx.mk
|   - __init__.py
|   - src
|   |   - mypkg
|   |   |   - hello.c
|   |   |   - hello.h
|   |   - mypkg.h
|   |   - mypkg.mk
|   - tst
|       - hello
|           - main.c
|           - Makefile
- setup.py
$ cd mypkg/tst/hello
$ make -s test
```

In the output from `tree` below, two files may catch your eyes; `setup.py` and `__init__.py`. Those are Python files and are often seen in Python packages. They are present in a *Simba* package because *Simba* uses the Python tool *pip* to release and install packages. The idea is that everyone that implements a useful package should release it and make it available for other users to install, just as Python!

How to release a package

This is how to release a package. Two files are created, one with the suffix `tar.gz` and one with the suffix `.whl`. The `.whl`-file is input to the installation command, described in the next section.

```
$ cd ../../..
$ simba package release
$ tree dist
dist
- mypkg-0.1-py2.py3-none-any.whl
- mypkg-0.1.tar.gz
```

How to install a package

This is how to install a package in `${SIMBA_ROOT}/dist-packages`.

```
$ simba package install dist/mypkg-0.1-py2.py3-none-any.whl
```

1.3 Developer Guide

This guide is intended for developers of the Simba Embedded Programming Platform. Users are advised to read the *User Guide* instead.

Contents:

1.3.1 Boards and mcus

A board is the top level configuration entity in the build framework. It contains information about the MCU and the pin mapping.

In turn, the MCU contains information about available devices and clock frequencies in the microcontroller.

See `src/boards/` and `src/mcus` for available configurations.

Only one MCU per board is supported. If there are two MCU:s on one physical board, two board configurations have to be created, one for each MCU.

The porting guide *Porting* shows how to port *Simba* to a new board.

1.3.2 Threads and channels

A thread is the basic execution entity. A scheduler controls the execution of threads.

A simple thread that waits to be resumed by another thread.

```
#include "simba.h"

void *my_thread_main(void *arg_p)
{
    UNUSED(arg_p);

    while (1) {
        thrd_suspend(NULL);
    }
}
```

```
    std_printf(FSTR("Thread resumed.\r\n"));
}

return (NULL);
}
```

Threads usually communicates over channels. There are two kinds of channels; queue and event. Both implementing the same abstract channel interface (see [src/kernel/chan.h](#)). This abstraction makes channel very powerful as a synchronization primitive. They can be seen as limited functionality file descriptors in linux.

The most common channel is the queue. It can be either synchronous or semi-asynchronous. In the synchronous version the writing thread will block until all written data has been read by the reader. In the semi-asynchronous version the writer writes to a buffer within the queue, and only blocks all data does not fit in the buffer. The buffer size is selected by the application.

1.3.3 File tree

```
simba                - this directory
- 3pp                - third party products
- bin                - executables and scripts
- doc                - documentation source
- environment        - environment setup
- examples           - example applications
- LICENSE            - license
- make               - build and run files
- README.rst         - readme
- setup.sh           - setup script
- src                - source code directory
|   - alloc           - alloc package
|   - boards          - board configurations
|   - collections     - collections package
|   - debug           - debug package
|   - drivers         - drivers package
|   - encode          - encode package
|   - filesystems     - filesystems package
|   - hash            - hash package
|   - inet            - inet package
|   - kernel          - kernel package
|   - mcus            - mcu configurations
|   - multimedia     - multimedia package
|   - oam             - oam package
|   - sync            - sync package
|   - text            - text package
|   - simba.h         - includes all package headers
|   - simba.mk        - build system configuration
- tst                - test suites
|   - alloc           - alloc package test suite
|   - collections     - collections package test suite
|   - debug           - debug package test suite
|   - drivers         - drivers package test suite
|   - encode          - encode package test suite
|   - filesystems     - filesystems package test suite
|   - hash            - hash package test suite
|   - inet            - inet package test suite
|   - kernel          - kernel package test suite
|   - multimedia     - multimedia package test suite
```

```

| - oam           - oam package test suite
| - sync         - sync package test suite
| - text         - text package test suite
- VERSION.txt    - `Simba` version

```

1.3.4 Testing

To ensure high code quality each module is tested extensively by many test suites. The test suites are executed both on native Linux and on many of the supported boards. See *Test suites* for a list of all test suites that are executed before each release.

The native Linux test suites are executed automatically on each commit.

Test result: <https://travis-ci.org/erimoq/simba>

Code coverage: <https://codecov.io/gh/erimoq/simba>

Hardware setup

Below is a picture of all supported boards connected to a USB hub. The USB hub is connected to a linux PC (not in the picture) that executes test suites on all boards.

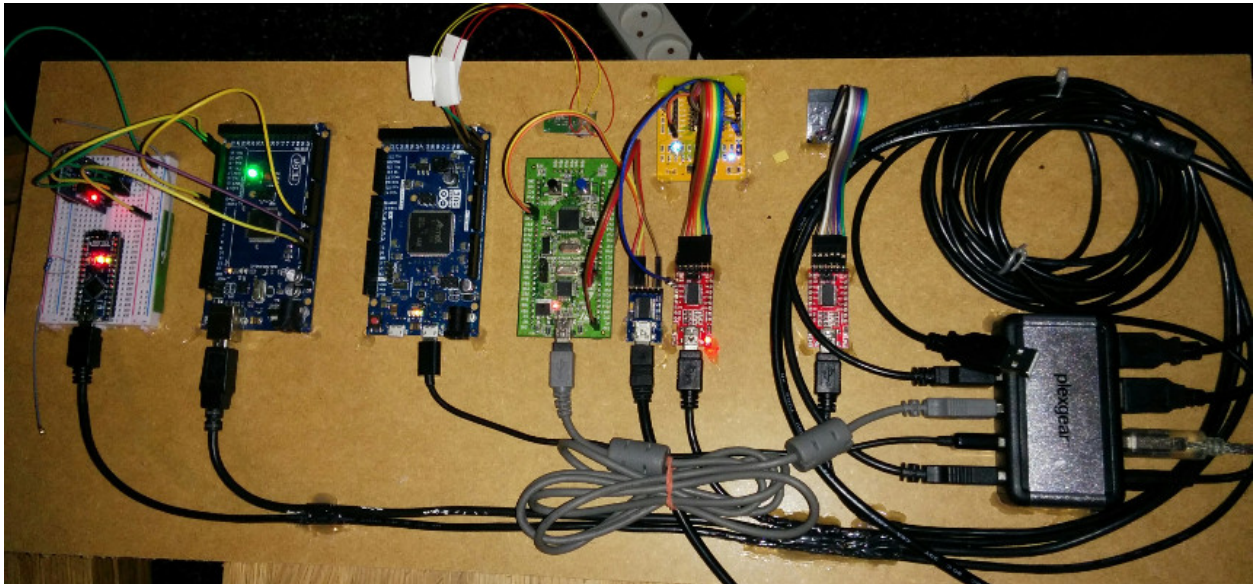


Fig. 1.1: The boards are (from left to right): *Arduino Nano*, *Arduino Mega*, *Arduino Due*, *STM32VLDISCOVERY*, *ESP-12E Development Board* and *ESP-01*

A short description of the setup:

- The DS3231 device (on the breadboard to the left) is connected over i2c to the *Arduino Mega*.
- CAN0 is connected to CAN1 on the *Arduino Due*. The CAN driver is tested by sending frames between the two CAN devices.
- The UART of the *STM32VLDISCOVERY* board is connected to a serial to USB adaptor. DTR on the adaptor is used to reset the board.

- The *ESP-12E Development Board* also has a serial to USB adaptor connected. RTS is used to set the board in flashing mode (GPIO0) and DTR is used to reset the board (REST).

Test suites

Below is a list of all test suites that are executed before every release. They are listed per board.

Arduino Due

- kernel/sys
- kernel/thrd
- kernel/time
- kernel/timer
- sync/bus
- sync/event
- sync/queue
- sync/rwlock
- sync/sem
- collections/binary_tree
- collections/bits
- collections/fifo
- collections/hash_map
- alloc/circular_heap
- alloc/heap
- text/configfile
- text/std
- text/re
- debug/log
- oam/settings
- oam/shell
- filesystems/fs
- filesystems/spiffs
- encode/base64
- encode/json
- hash/crc
- hash/sha1
- inet/http_server
- inet/http_websocket_client

- `inet/http_websocket_server`
- `inet/inet`
- `inet/mqtt_client`
- `inet/ping`
- `drivers/chipid`
- `drivers/can`
- `drivers/flash`
- `drivers/pin`

Arduino Mega

- `kernel/sys`
- `kernel/thrd`
- `kernel/time`
- `kernel/timer`
- `sync/bus`
- `sync/event`
- `sync/queue`
- `sync/rwlock`
- `sync/sem`
- `collections/binary_tree`
- `collections/bits`
- `collections/fifo`
- `collections/hash_map`
- `alloc/circular_heap`
- `alloc/heap`
- `text/configfile`
- `text/std`
- `text/re`
- `debug/log`
- `oam/settings`
- `oam/shell`
- `filesystems/fat16`
- `filesystems/fs`
- `encode/base64`
- `hash/crc`
- `hash/sha1`

- `inet/http_websocket_client`
- `inet/http_websocket_server`
- `inet/inet`
- `inet/mqtt_client`
- `inet/ping`
- `drivers/adc`
- `drivers/analog_input_pin`
- `drivers/ds3231`
- `drivers/sd`
- `drivers/pin`

Arduino Nano

- `drivers/ds18b20`
- `drivers/analog_output_pin`
- `drivers/exti`
- `drivers/owi`

Arduino Pro Micro

- `kernel/sys`
- `kernel/thrd`
- `kernel/timer`

Arduino Uno

Cygwin

ESP-01

- `kernel/sys`
- `kernel/thrd`
- `kernel/timer`

ESP-12E Development Board

- `kernel/sys`
- `kernel/thrd`
- `kernel/timer`
- `sync/bus`
- `sync/event`

- `sync/queue`
- `sync/rwlock`
- `sync/sem`
- `collections/binary_tree`
- `collections/bits`
- `collections/fifo`
- `collections/hash_map`
- `alloc/circular_heap`
- `text/std`
- `text/re`
- `debug/log`
- `oam/shell`
- `encode/base64`
- `encode/json`
- `hash/crc`
- `hash/sha1`
- `inet/http_websocket_client`
- `inet/http_websocket_server`
- `inet/inet`
- `inet/mqtt_client`
- `inet/network_interface/wifi_esp`
- `inet/ping`
- `drivers/pin`
- `filesystems/fs`
- `filesystems/spiffs`

Linux

- `kernel/sys`
- `kernel/thrd`
- `kernel/time`
- `kernel/timer`
- `sync/bus`
- `sync/chan`
- `sync/event`
- `sync/queue`
- `sync/rwlock`

- sync/sem
- collections/binary_tree
- collections/bits
- collections/fifo
- collections/hash_map
- alloc/circular_heap
- alloc/heap
- text/configfile
- text/std
- text/re
- debug/log
- oam/service
- oam/settings
- oam/shell
- filesystems/fat16
- filesystems/fs
- filesystems/spiffs
- encode/base64
- encode/json
- hash/crc
- hash/sha1
- inet/http_server
- inet/http_websocket_client
- inet/http_websocket_server
- inet/inet
- inet/mqtt_client
- inet/ping
- multimedia/midi

Nano32

- kernel/sys
- kernel/thrd
- kernel/timer
- sync/bus
- sync/event
- sync/queue

- `sync/rwlock`
- `sync/sem`
- `collections/binary_tree`
- `collections/bits`
- `collections/fifo`
- `collections/hash_map`
- `alloc/circular_heap`
- `text/std`
- `text/re`
- `debug/log`
- `oam/shell`
- `encode/base64`
- `encode/json`
- `hash/crc`
- `hash/sha1`
- `inet/http_websocket_client`
- `inet/http_websocket_server`
- `inet/inet`
- `inet/network_interface/wifi_esp`
- `inet/ping`
- `filesystems/fs`
- `filesystems/spiffs`

NodeMCU

Particle IO Photon

- `kernel/sys`
- `kernel/thrd`
- `kernel/time`
- `kernel/timer`
- `sync/bus`
- `sync/event`
- `sync/queue`
- `sync/rwlock`
- `sync/sem`
- `collections/binary_tree`
- `collections/bits`

- collections/fifo
- collections/hash_map
- alloc/circular_heap
- text/std
- text/re
- debug/log
- oam/shell
- encode/base64
- encode/json
- hash/crc
- hash/sha1
- inet/http_websocket_client
- inet/http_websocket_server
- inet/inet
- inet/mqtt_client
- inet/ping

STM32F3DISCOVERY

STM32VLDISCOVERY

- kernel/sys
- kernel/thrd
- kernel/timer
- sync/bus
- sync/event
- sync/queue
- sync/rwlock
- sync/sem
- collections/binary_tree
- collections/bits
- collections/fifo
- collections/hash_map
- alloc/circular_heap
- text/std
- text/re
- debug/log
- oam/shell

- `encode/base64`
- `encode/json`
- `hash/crc`
- `hash/sha1`
- `inet/http_websocket_client`
- `inet/http_websocket_server`
- `inet/inet`
- `inet/mqtt_client`
- `inet/ping`
- `drivers/pin`

1.3.5 Releasing

Follow these steps to create a new release:

1. Write the new version in `VERSION.txt`. The version should have the format `<major>.<minor>.<revision>`.

Increment `<major>` for non-backwards compatible changes.

Increment `<minor>` for new features.

Increment `<revision>` for bug fixes.

2. Write the new version in `package.json`. This file is used by *PlatformIO 3* to find the current *Simba* release.
3. Run the test suites and generate the documentation and other files.

```
make -s -j8 test-all-boards
make -s -j8 release-test
```

4. Commit the generated files and tag the commit with `<major>.<minor>.<revision>`.
5. Generate files for Arduino and PlatformIO releases. The generated archives and Arduino manifests are copied to the release repository.

```
make -s release
```

6. Add, commit and push the Simba Arduino releases in the release repository.

```
(cd ../simba-releases && \
git add arduino/**/*.zip platformio/*.zip && \
git commit && \
git push origin master)
```

7. Start a http server used to download package manifests in the Arduino IDE.

```
(cd make/arduino && python -m SimpleHTTPServer)
```

8. Start the Arduino IDE and add these URL:s in Preferences.

```
http://localhost:8000/avr/package_simba_avr_index.json
http://localhost:8000/esp/package_simba_esp_index.json
http://localhost:8000/esp32/package_simba_esp32_index.json
http://localhost:8000/sam/package_simba_sam_index.json
```

9. Install all four packages and run the blink example for each one of them.
10. Commit and push.
11. Add, commit and push the Simba Arduino package manifests in the release repository.

```
(cd ../simba-releases && \
git add arduino/**/*.json && \
git commit && \
git push origin master)
```

12. Done.

1.3.6 Porting

Often the board you want to use in your project is not yet supported by *Simba*. If you are lucky, *Simba* is already ported to the MCU on your board. Just create a folder with you board name in [src/boards/](#) and populate it with the `board.h`, `board.c` and `board.mk`. If *Simba* is not ported to your MCU, the kernel and drivers has to be ported.

Kernel

Porting the kernel is a matter of configuring the system tick timer and implement a few locking primitives. If you are familiar with your CPU, the port can be implemented quickly.

A kernel port is roughly 300 lines of code.

Kernel ports are implemented in [src/kernel/ports](#).

Drivers

The required work to port the drivers depends of which drivers you are intrested in. The more drivers you have to port, the longer time it takes, obviously.

A drivers port is roughly 100 lines of code per driver.

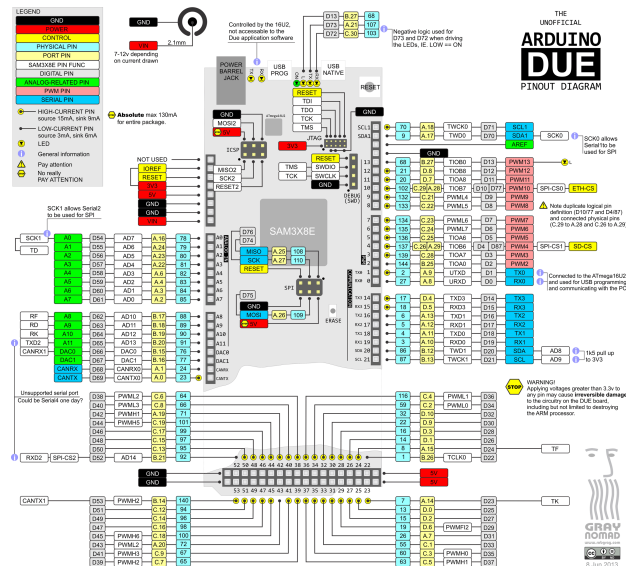
Drivers ports are implemented in [src/drivers/ports](#).

1.4 Boards

The boards supported by *Simba*.

1.4.1 Arduino Due

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- *File system.*
- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc* — *Analog to digital conversion*
- *analog_input_pin* — *Analog input pin*
- *can* — *Controller Area Network*
- *chipid* — *Chip identity*
- *dac* — *Digital to analog conversion*
- *ds18b20* — *One-wire temperature sensor*
- *exti* — *External interrupts*
- *flash* — *Flash memory*
- *i2c_soft* — *Software I2C*
- *mcp2515* — *CAN BUS chipset*
- *owi* — *One-Wire Interface*

- *pin* — Digital pins
- *sd* — Secure Digital memory
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter
- *usb* — Universal Serial Bus
- *usb_host* — Universal Serial Bus - Host

Library Reference

Read more about board specific functionality in the *Arduino Due* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	21540	5464
default-configuration	94568	11034

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1

Continued on next page

Table 1.1 – continued from previous page

Name	Value
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0x000e0000
CONFIG_START_FILESYSTEM_SIZE	32768
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	1536
CONFIG_STD_OUTPUT_BUFFER_MAX	16

Continued on next page

Table 1.1 – continued from previous page

Name	Value
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	384
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

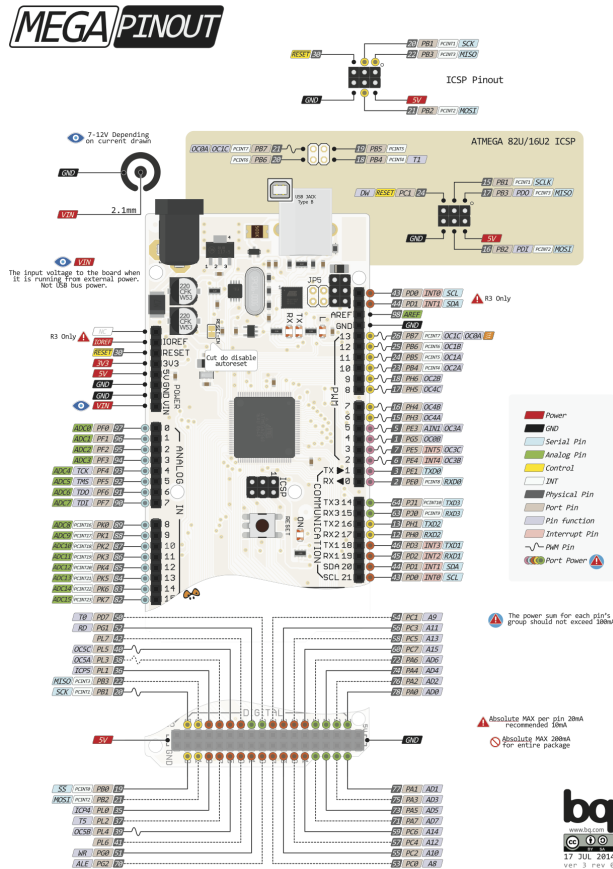
<https://www.arduino.cc/en/Main/ArduinoBoardDue>

Mcu

sam3x8e

1.4.2 Arduino Mega

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc* — Analog to digital conversion
- *analog_input_pin* — Analog input pin
- *analog_output_pin* — Analog output pin
- *ds18b20* — One-wire temperature sensor
- *ds3231* — RTC clock

- *exti* — External interrupts
- *i2c* — I2C
- *i2c_soft* — Software I2C
- *mcp2515* — CAN BUS chipset
- *nrf24l01* — Wireless communication
- *owi* — One-Wire Interface
- *pin* — Digital pins
- *pwm* — Pulse width modulation
- *sd* — Secure Digital memory
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter
- *uart_soft* — Bitbang UART
- *watchdog* — Hardware watchdog

Library Reference

Read more about board specific functionality in the *Arduino Mega* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The [minimal-configuration](#) application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The [default-configuration](#) application is built with the default configuration, including a lot more functionality. See the list of [Default system features](#) above for a summary.

Application	Flash	RAM
minimal-configuration	13674	1053
default-configuration	58156	3737

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1

Continued on next page

Table 1.2 – continued from previous page

Name	Value
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	0

Continued on next page

Table 1.2 – continued from previous page

Name	Value
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	156
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

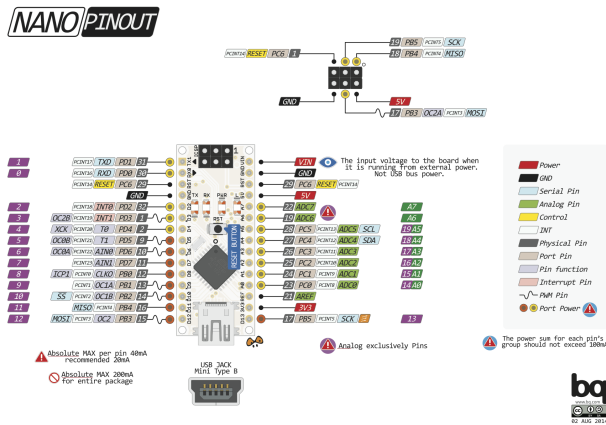
<https://www.arduino.cc/en/Main/ArduinoBoardMega>

Mcu

atmega2560

1.4.3 Arduino Nano

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*

Drivers

Supported drivers for this board.

- *adc — Analog to digital conversion*
- *analog_input_pin — Analog input pin*
- *analog_output_pin — Analog output pin*
- *ds18b20 — One-wire temperature sensor*
- *ds3231 — RTC clock*
- *exti — External interrupts*
- *i2c — I2C*
- *i2c_soft — Software I2C*
- *mcp2515 — CAN BUS chipset*
- *nrf24l01 — Wireless communication*
- *owi — One-Wire Interface*
- *pin — Digital pins*
- *pwm — Pulse width modulation*
- *sd — Secure Digital memory*
- *spi — Serial Peripheral Interface*
- *uart — Universal Asynchronous Receiver/Transmitter*
- *uart_soft — Bitbang UART*
- *watchdog — Hardware watchdog*

Library Reference

Read more about board specific functionality in the [Arduino Nano](#) module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The [minimal-configuration](#) application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The [default-configuration](#) application is built with the default configuration, including a lot more functionality. See the list of [Default system features](#) above for a summary.

Application	Flash	RAM
minimal-configuration	5604	755
default-configuration	10998	868

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	0
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	0
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	0
CONFIG_FS_CMD_FS_COUNTERS_LIST	0
CONFIG_FS_CMD_FS_COUNTERS_RESET	0
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	0
CONFIG_FS_CMD_FS_FORMAT	0
CONFIG_FS_CMD_FS_LIST	0
CONFIG_FS_CMD_FS_PARAMETERS_LIST	0
CONFIG_FS_CMD_FS_READ	0
CONFIG_FS_CMD_FS_REMOVE	0
CONFIG_FS_CMD_FS_WRITE	0
CONFIG_FS_CMD_I2C_READ	0
CONFIG_FS_CMD_I2C_WRITE	0
CONFIG_FS_CMD_LOG_LIST	0
CONFIG_FS_CMD_LOG_PRINT	0
CONFIG_FS_CMD_LOG_SET_LOG_MASK	0
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	0
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	0
CONFIG_FS_CMD_PIN_SET_MODE	0
CONFIG_FS_CMD_PIN_WRITE	0
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	0
CONFIG_FS_CMD_SETTINGS_READ	0
CONFIG_FS_CMD_SETTINGS_RESET	0
CONFIG_FS_CMD_SETTINGS_WRITE	0
CONFIG_FS_CMD_SYS_CONFIG	0
CONFIG_FS_CMD_SYS_INFO	0
CONFIG_FS_CMD_SYS_REBOOT	0
CONFIG_FS_CMD_SYS_UPTIME	0
CONFIG_FS_CMD_THRD_LIST	0
CONFIG_FS_CMD_THRD_SET_LOG_MASK	0
CONFIG_FS_CMD_USB_DEVICE_LIST	0
CONFIG_FS_CMD_USB_HOST_LIST	0
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
Continued on next page	

Table 1.3 – continued from previous page

Name	Value
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	1
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	0
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	0
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	0
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	0
CONFIG_THRD_IDLE_STACK_SIZE	156
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

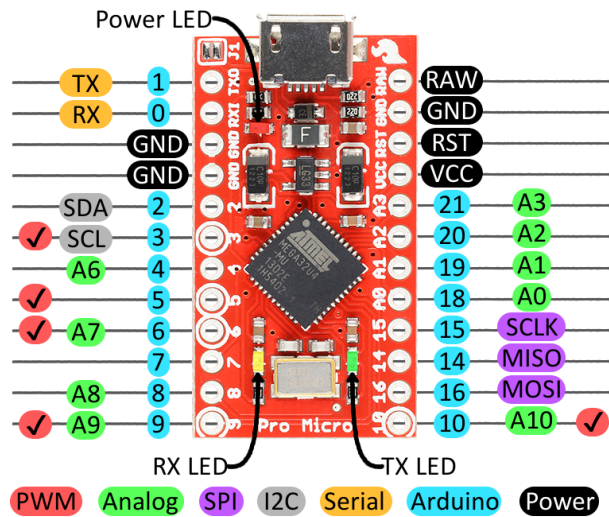
<https://www.arduino.cc/en/Main/ArduinoBoardNano>

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atmega328p

1.4.4 Arduino Pro Micro

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*

Drivers

Supported drivers for this board.

- *adc* — Analog to digital conversion
- *analog_input_pin* — Analog input pin
- *analog_output_pin* — Analog output pin
- *ds18b20* — One-wire temperature sensor
- *ds3231* — RTC clock
- *exti* — External interrupts
- *i2c* — I2C
- *i2c_soft* — Software I2C
- *mcp2515* — CAN BUS chipset
- *nrf24l01* — Wireless communication
- *owi* — One-Wire Interface
- *pin* — Digital pins
- *pwm* — Pulse width modulation
- *sd* — Secure Digital memory

- *spi* — *Serial Peripheral Interface*
- *uart* — *Universal Asynchronous Receiver/Transmitter*
- *uart_soft* — *Bitbang UART*
- *usb* — *Universal Serial Bus*
- *usb_device* — *Universal Serial Bus - Device*
- *watchdog* — *Hardware watchdog*

Library Reference

Read more about board specific functionality in the *Arduino Pro Micro* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	6562	837
default-configuration	10078	993

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	0
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	0
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	0
CONFIG_FS_CMD_FS_COUNTERS_LIST	0
CONFIG_FS_CMD_FS_COUNTERS_RESET	0
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	0
CONFIG_FS_CMD_FS_FORMAT	0
CONFIG_FS_CMD_FS_LIST	0
CONFIG_FS_CMD_FS_PARAMETERS_LIST	0
CONFIG_FS_CMD_FS_READ	0
CONFIG_FS_CMD_FS_REMOVE	0
CONFIG_FS_CMD_FS_WRITE	0
CONFIG_FS_CMD_I2C_READ	0
CONFIG_FS_CMD_I2C_WRITE	0
CONFIG_FS_CMD_LOG_LIST	0
CONFIG_FS_CMD_LOG_PRINT	0

Continued on next page

Table 1.4 – continued from previous page

Name	Value
CONFIG_FS_CMD_LOG_SET_LOG_MASK	0
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	0
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	0
CONFIG_FS_CMD_PIN_SET_MODE	0
CONFIG_FS_CMD_PIN_WRITE	0
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	0
CONFIG_FS_CMD_SETTINGS_READ	0
CONFIG_FS_CMD_SETTINGS_RESET	0
CONFIG_FS_CMD_SETTINGS_WRITE	0
CONFIG_FS_CMD_SYS_CONFIG	0
CONFIG_FS_CMD_SYS_INFO	0
CONFIG_FS_CMD_SYS_REBOOT	0
CONFIG_FS_CMD_SYS_UPTIME	0
CONFIG_FS_CMD_THRD_LIST	0
CONFIG_FS_CMD_THRD_SET_LOG_MASK	0
CONFIG_FS_CMD_USB_DEVICE_LIST	0
CONFIG_FS_CMD_USB_HOST_LIST	0
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	1
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_USB_CDC
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNCTION	1
CONFIG_START_FILESYSTEM	0
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	0
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768

Continued on next page

Table 1.4 – continued from previous page

Name	Value
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	0
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	0
CONFIG_THRD_IDLE_STACK_SIZE	156
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

<https://www.sparkfun.com/products/12640>

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atmega32u4

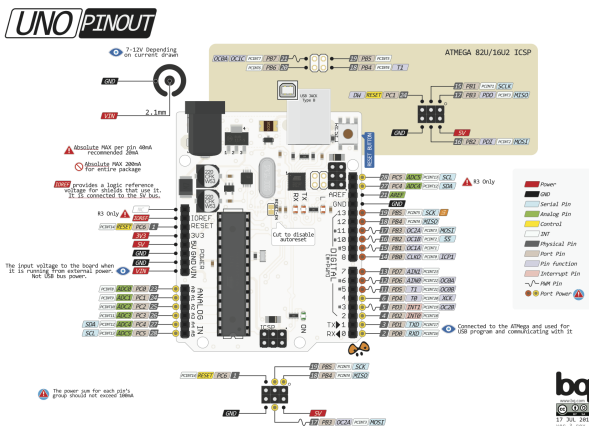
Enter the bootloader

Recover a bricked board by entering the bootloader.

1. Power up the board.
2. Connect RST to GND for a second to enter the bootloader and stay in it for 8 seconds.

1.4.5 Arduino Uno

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*

Drivers

Supported drivers for this board.

- *adc — Analog to digital conversion*
- *analog_input_pin — Analog input pin*
- *analog_output_pin — Analog output pin*
- *ds18b20 — One-wire temperature sensor*
- *ds3231 — RTC clock*
- *exti — External interrupts*
- *i2c — I2C*
- *i2c_soft — Software I2C*
- *mcp2515 — CAN BUS chipset*
- *nrf24l01 — Wireless communication*
- *owi — One-Wire Interface*
- *pin — Digital pins*
- *pwm — Pulse width modulation*
- *sd — Secure Digital memory*
- *spi — Serial Peripheral Interface*
- *uart — Universal Asynchronous Receiver/Transmitter*
- *uart_soft — Bitbang UART*
- *watchdog — Hardware watchdog*

Library Reference

Read more about board specific functionality in the [Arduino Uno](#) module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The [minimal-configuration](#) application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The [default-configuration](#) application is built with the default configuration, including a lot more functionality. See the list of [Default system features](#) above for a summary.

Application	Flash	RAM
minimal-configuration	5604	755
default-configuration	10998	868

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	0
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	0
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	0
CONFIG_FS_CMD_FS_COUNTERS_LIST	0
CONFIG_FS_CMD_FS_COUNTERS_RESET	0
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	0
CONFIG_FS_CMD_FS_FORMAT	0
CONFIG_FS_CMD_FS_LIST	0
CONFIG_FS_CMD_FS_PARAMETERS_LIST	0
CONFIG_FS_CMD_FS_READ	0
CONFIG_FS_CMD_FS_REMOVE	0
CONFIG_FS_CMD_FS_WRITE	0
CONFIG_FS_CMD_I2C_READ	0
CONFIG_FS_CMD_I2C_WRITE	0
CONFIG_FS_CMD_LOG_LIST	0
CONFIG_FS_CMD_LOG_PRINT	0
CONFIG_FS_CMD_LOG_SET_LOG_MASK	0
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	0
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	0
CONFIG_FS_CMD_PIN_SET_MODE	0
CONFIG_FS_CMD_PIN_WRITE	0
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	0
CONFIG_FS_CMD_SETTINGS_READ	0
CONFIG_FS_CMD_SETTINGS_RESET	0
CONFIG_FS_CMD_SETTINGS_WRITE	0
CONFIG_FS_CMD_SYS_CONFIG	0
CONFIG_FS_CMD_SYS_INFO	0
CONFIG_FS_CMD_SYS_REBOOT	0
CONFIG_FS_CMD_SYS_UPTIME	0
CONFIG_FS_CMD_THRD_LIST	0
CONFIG_FS_CMD_THRD_SET_LOG_MASK	0
CONFIG_FS_CMD_USB_DEVICE_LIST	0
CONFIG_FS_CMD_USB_HOST_LIST	0
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
Continued on next page	

Table 1.5 – continued from previous page

Name	Value
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	1
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	0
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	0
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	0
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	0
CONFIG_THRD_IDLE_STACK_SIZE	156
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

<https://www.arduino.cc/en/Main/ArduinoBoardUno>

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atmega328p

1.4.6 Cygwin

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- *File system.*
- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc — Analog to digital conversion*
- *analog_input_pin — Analog input pin*
- *analog_output_pin — Analog output pin*
- *can — Controller Area Network*
- *dac — Digital to analog conversion*
- *ds18b20 — One-wire temperature sensor*
- *exti — External interrupts*
- *flash — Flash memory*
- *i2c_soft — Software I2C*
- *owi — One-Wire Interface*

- *pin* — Digital pins
- *pwm* — Pulse width modulation
- *sd* — Secure Digital memory
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter

Library Reference

Read more about board specific functionality in the *Cygwin* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	313303	121312
default-configuration	404151	212608

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
Continued on next page	

Table 1.6 – continued from previous page

Name	Value
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100

Continued on next page

Table 1.6 – continued from previous page

Name	Value
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	1024
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

[Homepage](#)

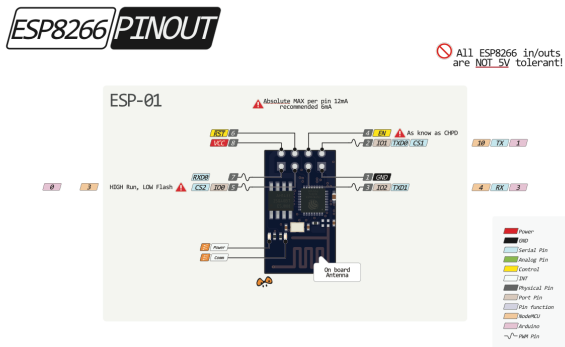
<http://www.cygwin.com>

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linux

1.4.7 ESP-01

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- File system.
- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc* — Analog to digital conversion
- *analog_input_pin* — Analog input pin
- *esp_wifi* — Espressif WiFi
- *exti* — External interrupts
- *flash* — Flash memory
- *i2c_soft* — Software I2C
- *pin* — Digital pins
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter
- *uart_soft* — Bitbang UART

Library Reference

Read more about board specific functionality in the [ESP-01](#) module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The [minimal-configuration](#) application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The [default-configuration](#) application is built with the default configuration, including a lot more functionality. See the list of [Default system features](#) above for a summary.

Application	Flash	RAM
minimal-configuration	269288	35732
default-configuration	306728	55176

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	1
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1

Continued on next page

Table 1.7 – continued from previous page

Name	Value
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	76800
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNECTION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0x0006b000

Continued on next page

Table 1.7 – continued from previous page

Name	Value
CONFIG_START_FILESYSTEM_SIZE	0x10000
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	1536
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	768
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

<http://espressif.com>

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Flashing

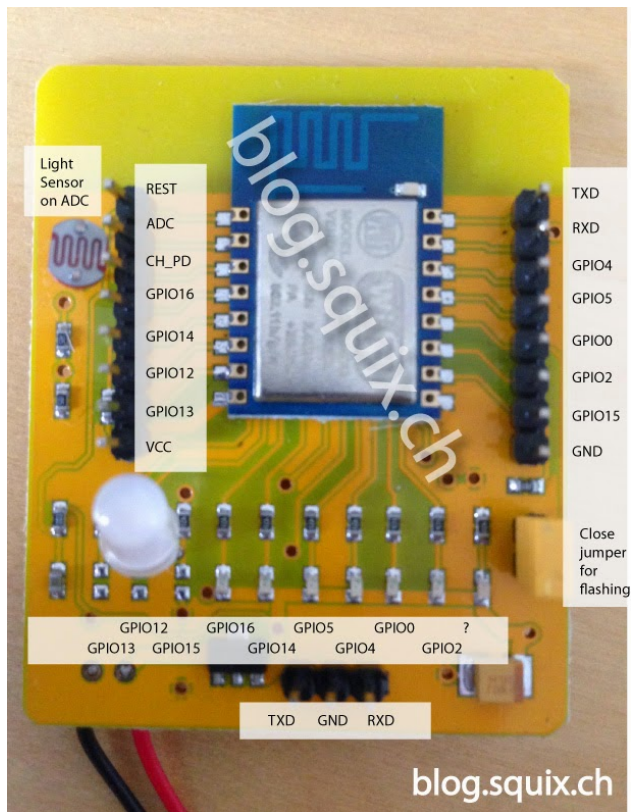
1. Connect VCC to 3.3 V and GND to ground.
2. Connect GPIO0 to GND.
3. Connect EN/CHPH to 3.3 V.
4. Turn on the power.
5. Upload the software to Flash using esptool.

Boot from flash

1. Connect VCC to 3.3 V and GND to ground.
2. Connect GPIO0 to 3.3 V.
3. Connect EN/CHPH to 3.3 V.
4. Turn on the power.

1.4.8 ESP-12E Development Board

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- File system.
- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc* — Analog to digital conversion
- *analog_input_pin* — Analog input pin
- *esp_wifi* — Espressif WiFi
- *exti* — External interrupts
- *flash* — Flash memory
- *i2c_soft* — Software I2C

- *pin* — Digital pins
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter
- *uart_soft* — Bitbang UART

Library Reference

Read more about board specific functionality in the *ESP-12E Development Board* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	269288	35732
default-configuration	306728	55204

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	1
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
Continued on next page	

Table 1.8 – continued from previous page

Name	Value
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	76800
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0x00300000
CONFIG_START_FILESYSTEM_SIZE	0xFB000
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	1536
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1

Continued on next page

Table 1.8 – continued from previous page

Name	Value
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	768
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

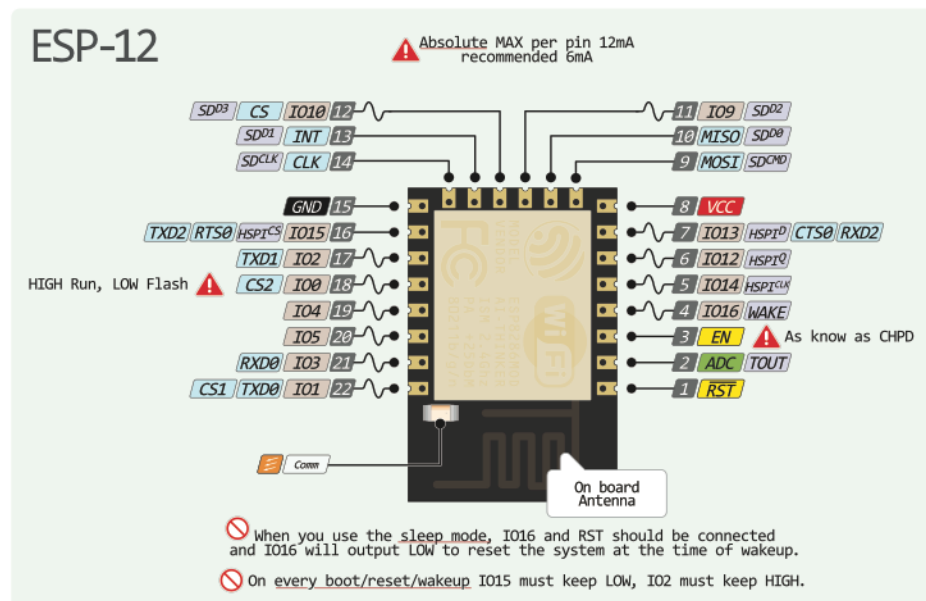
Homepage

<http://espressif.com>

Mcu

esp8266

ESP-12 pinout



Flashing

1. Connect 3.3 V to VCC and ground to GND.
2. Attach the flash jumper (to the right in the picture).
3. Turn on the power.
4. Upload the software to Flash using esptool.
5. The application starts automatically when the download is completed.

Hardware

- 3.3 V power supply and logical level voltage.
- Boot message at 76800 baud on a virgin board. Blue, red and RGB LEDs turned on.
- 4 MB Flash.

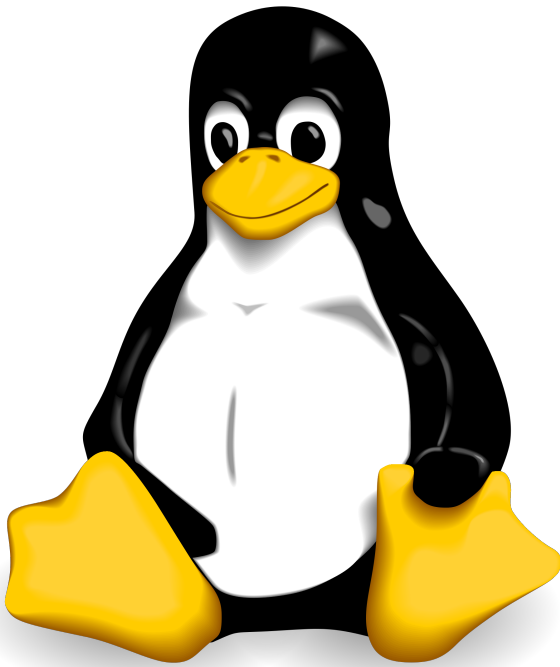
How to determine the Flash size:

```
$ python esptool.py --port /dev/ttyUSB0 flash_id
Connecting...
head: 0 ;total: 0
erase size : 0
Manufacturer: e0
Device: 4016
```

Device 4016 gives a Flash of size $2^{(16 - 1)} / 8 = 4096 \text{ kB} = 4 \text{ MB}$.

1.4.9 Linux

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- File system.

- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc* — Analog to digital conversion
- *analog_input_pin* — Analog input pin
- *analog_output_pin* — Analog output pin
- *can* — Controller Area Network
- *dac* — Digital to analog conversion
- *ds18b20* — One-wire temperature sensor
- *exti* — External interrupts
- *flash* — Flash memory
- *i2c_soft* — Software I2C
- *owi* — One-Wire Interface
- *pin* — Digital pins
- *pwm* — Pulse width modulation
- *sd* — Secure Digital memory
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter

Library Reference

Read more about board specific functionality in the [Linux](#) module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The [minimal-configuration](#) application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The [default-configuration](#) application is built with the default configuration, including a lot more functionality. See the list of [Default system features](#) above for a summary.

Application	Flash	RAM
minimal-configuration	313239	121312
default-configuration	404087	212608

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1

Continued on next page

Table 1.9 – continued from previous page

Name	Value
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	1024
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

<http://www.kernel.org>

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linux

- The `default-configuration` application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	179049	38060
default-configuration	210097	59792

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1

Continued on next page

Table 1.10 – continued from previous page

Name	Value
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	115200
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0x00300000
CONFIG_START_FILESYSTEM_SIZE	32768
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	4096
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	1024
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE VID	0x2341

Homepage

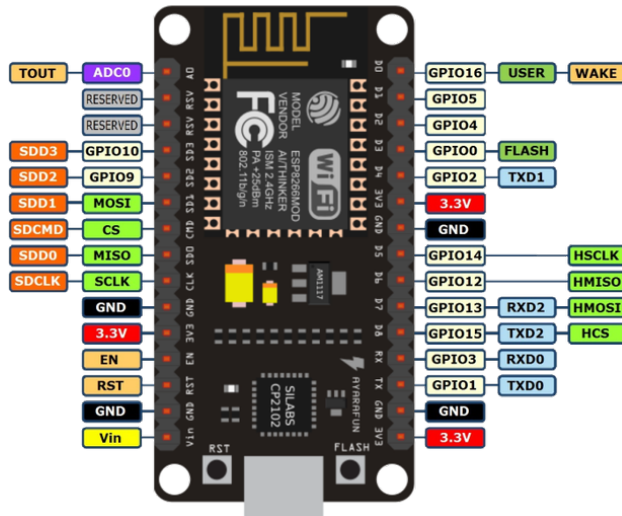
<http://esp32.de>

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esp32

1.4.11 NodeMCU

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- File system.
- *Debug shell.*

Drivers

Supported drivers for this board.

- *adc* — Analog to digital conversion
- *analog_input_pin* — Analog input pin
- *esp_wifi* — Espressif WiFi
- *exti* — External interrupts
- *flash* — Flash memory
- *i2c_soft* — Software I2C
- *pin* — Digital pins
- *spi* — Serial Peripheral Interface
- *uart* — Universal Asynchronous Receiver/Transmitter
- *uart_soft* — Bitbang UART

Library Reference

Read more about board specific functionality in the NodeMCU module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The [minimal-configuration](#) application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The [default-configuration](#) application is built with the default configuration, including a lot more functionality. See the list of [Default system features](#) above for a summary.

Application	Flash	RAM
minimal-configuration	269288	35732
default-configuration	306728	55188

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	1
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1

Continued on next page

Table 1.11 – continued from previous page

Name	Value
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	0
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	1
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	76800
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	1
CONFIG_START_FILESYSTEM_ADDRESS	0x00300000
CONFIG_START_FILESYSTEM_SIZE	0xFB000
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	1536
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	768
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

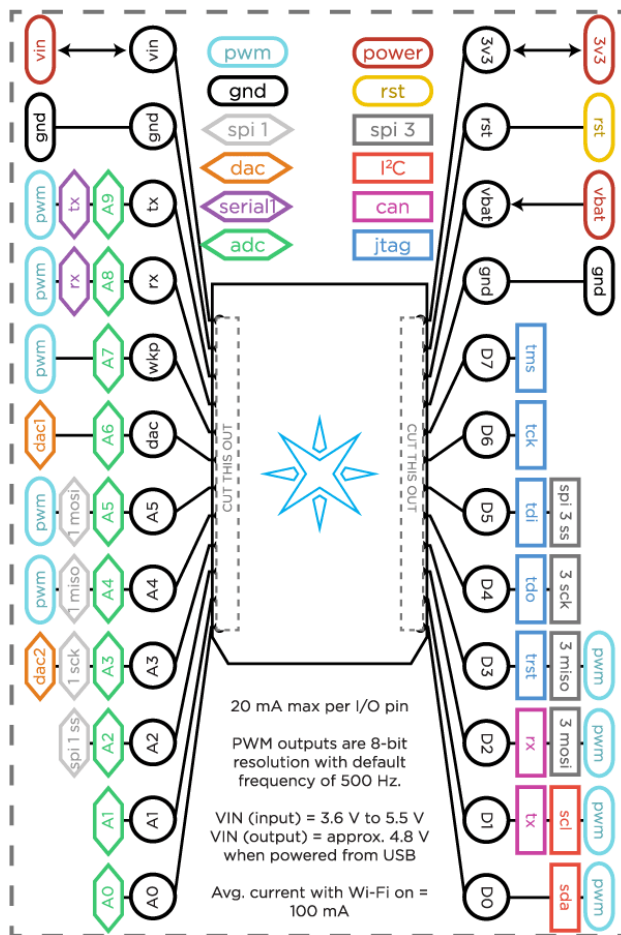
<http://www.nodemcu.com>

Mcu

esp8266

1.4.12 Particle IO Photon

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- *Debug shell.*

Drivers

Supported drivers for this board.

- *bcm43362* — *BCM43362*
- *flash* — *Flash memory*
- *i2c_soft* — *Software I2C*
- *pin* — *Digital pins*
- *sdio* — *Secure Digital Input Output*
- *uart* — *Universal Asynchronous Receiver/Transmitter*

Library Reference

Read more about board specific functionality in the *Particle IO Photon* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	16604	3376
default-configuration	60268	6746

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
Continued on next page	

Table 1.12 – continued from previous page

Name	Value
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNETION	1
CONFIG_START_FILESYSTEM	0
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword

Continued on next page

Table 1.12 – continued from previous page

Name	Value
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	384
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

<https://docs.particle.io/datasheets/photon-datasheet/>

Mcu

stm32f205rg

Detailed pinout

Right side pins

USB	Pin	Exposed Functions				STM32 Pin	PØ Pin #	PØ Pin Name	
P H O T O N	3V3	3V3							
	RST	RST					E8	26	MICRO_RST_N
	VBAT	VBAT					A9	28	VBAT
	GND	GND							
	D7	JTAG_TMS					PA13	44	MICRO_JTAG_TMS
	D6	JTAG_TCK					PA14	40	MICRO_JTAG_TCK
	D5	JTAG_TDI	SPI3_SS			I2S3_WS	PA15	43	MICRO_JTAG_TDI
	D4	JTAG_TDO	SPI3_SCK			I2S3_SCK	PB3	41	MICRO_JTAG_TDO
	D3	JTAG_TRST	SPI3_MISO		TIM3_CH1		PB4	42	MICRO_JTAG_TRSTN
	D2		SPI3_MOSI	CAN2_RX	TIM3_CH2	I2S3_SD	PB5	3	MICRO_GPIO_5
	D1	SCL		CAN2_TX	TIM4_CH1		PB6	5	MICRO_GPIO_3
	D0	SDA			TIM4_CH2		PB7	4	MICRO_GPIO_4

Left side pins

Pin	USB	Exposed Functions				STM32 Pin	PØ Pin #	PØ Pin Name
VIN	P H O T O N	VIN						
GND		GND						
TX			USART1_TX	TIM1_CH2		PA9	39	MICRO_UART_TX
RX			USART1_RX	TIM1_CH3		PA10	38	MICRO_UART_RX
WKP		ADC0		TIM5_CH1		PA0	27	MICRO_WKUP
DAC		ADC4			DAC1	PA4	22	MICRO_SPI_SSN
A5		ADC7	SPI1_MOSI		TIM3_CH2	PA7	23	MICRO_SPI_MOSI
A4		ADC6	SPI1_MISO		TIM3_CH1	PA6	25	MICRO_SPI_MISO
A3		ADC5	SPI1_SCK			PA5	24	MICRO_SPI_SCK
A2		ADC12	SPI1_SS			PC2	2	MICRO_GPIO_6
A1		ADC13				PC3	1	MICRO_GPIO_7
A0		ADC15				PC5	54	MICRO_GPIO_8

User I/O

	User I/O	Photon Pin #	Exposed Functions			STM32 Pin	PØ Pin #	PØ Pin Name
P H O T O N	RGB LED - RED	27		TIM2_CH2		PA1	8	MICRO_GPIO_0
	RGB LED - GREEN	28		TIM2_CH3		PA2	7	MICRO_GPIO_1
	RGB LED - BLUE	29		TIM2_CH4		PA3	6	MICRO_GPIO_2
	Setup Button	26		TIM3_CH2	I2S3_MCK	PC7	53	MICRO_GPIO_9
	Reset Button	23				E8	26	MICRO_RST_N
	USB Data+	31				PB15	51	MICRO_USB_HS_DP
	USB Data-	30				PB14	52	MICRO_USB_HS_DM
	SMPS Enable	25						
	Peripheral Key	ADC	SPI	PWM/Servo/Tone				
		JTAG	SPI1	I2S	DAC			
		I2C/Wire	Serial1	CAN				

Prerequisites

Install the dfu-utility.

```
git clone git://git.code.sf.net/p/dfu-util/dfu-util
cd dfu-util
sudo apt-get build-dep dfu-util
./autogen.sh
./configure
make
sudo make install
cd ..

# Give users access to the device.
sudo cp simba/environment/udev/49-photon.rules /etc/udev/rules.d
```

Flashing

The Photon must enter DFU mode before software can be uploaded to it. It's recommended to use the manual method to verify that software can be successfully uploaded to the board, and then start using the automatic method to reduce the manual work for each software upload.

Automatic (recommended)

- Connect DTR on the serial adapter to the RST pin on the Photon.
- Connect RTS on the serial adapter to the SETUP pad on the bottom side of the Photon. This requires soldering a cable to the SETUP pad.

Upload the software with `make BOARD=photon upload`.

Manual

To enter DFU Mode:

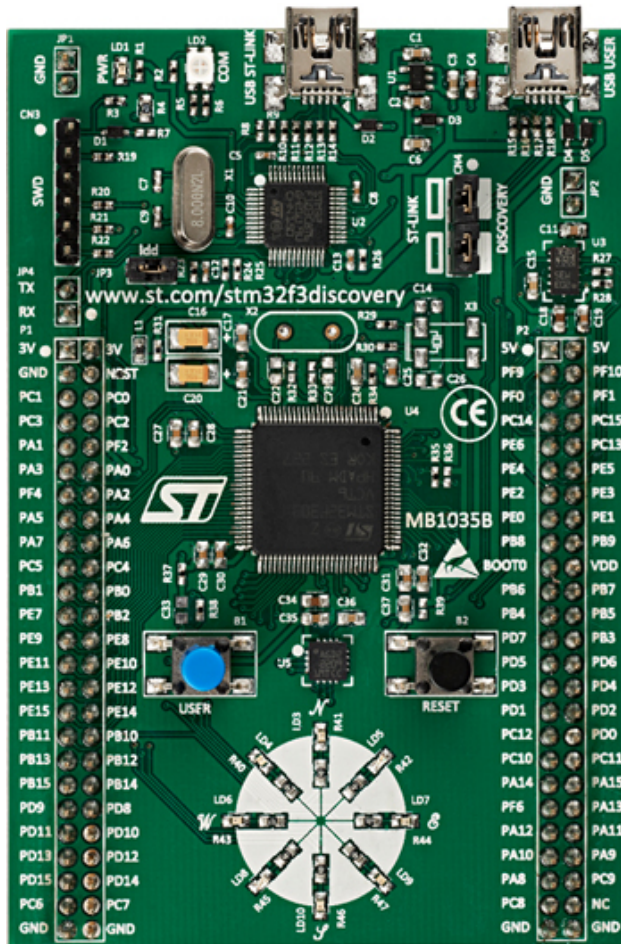
1. Hold down the RESET and SETUP buttons.
2. Release only the RESET button, while holding down the SETUP button.
3. Wait for the LED to start flashing yellow (it will flash magenta first).
4. Release the SETUP button.

NOTE: Do **not** connect DTR and/or RTS using manual upload. They must only be connected using the automatic method.

Upload the software with `make BOARD=photon upload`.

1.4.13 STM32F3DISCOVERY

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- *Debug shell.*

Drivers

Supported drivers for this board.

- *flash* — *Flash memory*
- *i2c_soft* — *Software I2C*
- *pin* — *Digital pins*
- *uart* — *Universal Asynchronous Receiver/Transmitter*

Library Reference

Read more about board specific functionality in the *STM32F3DISCOVERY* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	16344	2896
default-configuration	58988	6254

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1

Continued on next page

Table 1.13 – continued from previous page

Name	Value
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNENTION	1
CONFIG_START_FILESYSTEM	0
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	384
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037

Continued on next page

Table 1.13 – continued from previous page

Name	Value
CONFIG_USB_DEVICE_VID	0x2341

Homepage

http://www.st.com/content/st_com/en/products/evaluation-tools/product-evaluation-tools/mcu-eval-tools/stm32-mcu-eval-tools/stm32-mcu-discovery-kits/stm32f3discovery.html

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stm32f303vc

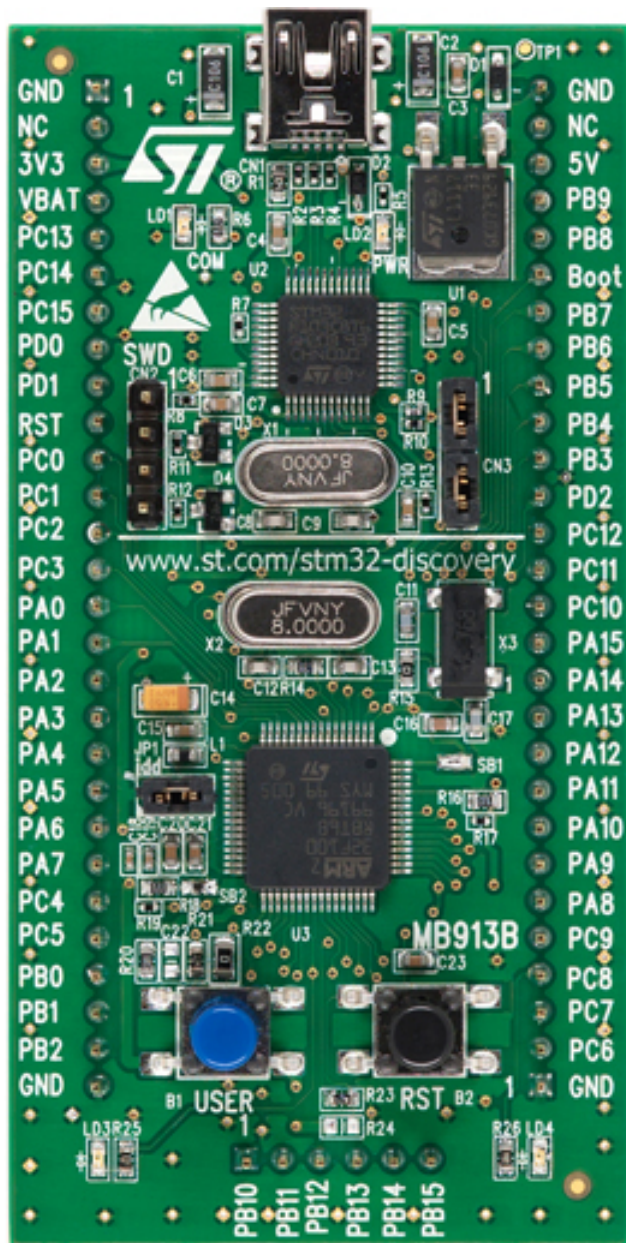
Pin functions

These are the default pin functions in Simba.

Function	Pin
UART0 TX	PA9
UART0 RX	PA10
UART1 TX	PA2
UART1 RX	PA3
UART2 TX	PB10
UART2 RX	PB11
SPI0 SCK	PA5
SPI0 MISO	PA6
SPI0 MOSI	PA7
SPI1 SCK	PA13
SPI1 MISO	PA14
SPI1 MOSI	PA15
SPI2 SCK	PC10
SPI2 MISO	PC11
SPI2 MOSI	PC12
I2C0 SCL	PB8
I2C0 SDA	PB9
I2C1 SCL	PF0
I2C1 SDA	PF1
CAN TX	PD1
CAN RX	PD0

1.4.14 STM32VLDISCOVERY

Pinout



Default system features

The default configuration includes those major features. They are all initialized by `sys_start()` at the startup of the application.

- *Console.*
- *Debug shell.*

Drivers

Supported drivers for this board.

- *flash* — *Flash memory*
- *i2c_soft* — *Software I2C*
- *pin* — *Digital pins*
- *uart* — *Universal Asynchronous Receiver/Transmitter*

Library Reference

Read more about board specific functionality in the *STM32VLDISCOVERY* module documentation in the Library Reference.

Memory usage

Below is the memory usage of two applications:

- The *minimal-configuration* application is configured to only include the bare minimum of functionality for the low level kernel to run. That is, the thread scheduler and system tick.
- The *default-configuration* application is built with the default configuration, including a lot more functionality. See the list of *Default system features* above for a summary.

Application	Flash	RAM
minimal-configuration	17036	3052
default-configuration	59808	6290

Default configuration

Default Standard Library configuration.

Name	Value
CONFIG_ASSERT	1
CONFIG_DEBUG	1
CONFIG_FS_CMD_DS18B20_LIST	1
CONFIG_FS_CMD_ESP_WIFI_STATUS	0
CONFIG_FS_CMD_FS_APPEND	1
CONFIG_FS_CMD_FS_COUNTERS_LIST	1
CONFIG_FS_CMD_FS_COUNTERS_RESET	1
CONFIG_FS_CMD_FS_FILESYSTEMS_LIST	1
CONFIG_FS_CMD_FS_FORMAT	1
CONFIG_FS_CMD_FS_LIST	1
CONFIG_FS_CMD_FS_PARAMETERS_LIST	1
CONFIG_FS_CMD_FS_READ	1
CONFIG_FS_CMD_FS_REMOVE	1
CONFIG_FS_CMD_FS_WRITE	1
CONFIG_FS_CMD_I2C_READ	1
CONFIG_FS_CMD_I2C_WRITE	1
CONFIG_FS_CMD_LOG_LIST	1
Continued on next page	

Table 1.14 – continued from previous page

Name	Value
CONFIG_FS_CMD_LOG_PRINT	1
CONFIG_FS_CMD_LOG_SET_LOG_MASK	1
CONFIG_FS_CMD_NETWORK_INTERFACE_LIST	1
CONFIG_FS_CMD_PING_PING	1
CONFIG_FS_CMD_PIN_READ	1
CONFIG_FS_CMD_PIN_SET_MODE	1
CONFIG_FS_CMD_PIN_WRITE	1
CONFIG_FS_CMD_SERVICE_LIST	1
CONFIG_FS_CMD_SERVICE_START	1
CONFIG_FS_CMD_SERVICE_STOP	1
CONFIG_FS_CMD_SETTINGS_LIST	1
CONFIG_FS_CMD_SETTINGS_READ	1
CONFIG_FS_CMD_SETTINGS_RESET	1
CONFIG_FS_CMD_SETTINGS_WRITE	1
CONFIG_FS_CMD_SYS_CONFIG	1
CONFIG_FS_CMD_SYS_INFO	1
CONFIG_FS_CMD_SYS_REBOOT	1
CONFIG_FS_CMD_SYS_UPTIME	1
CONFIG_FS_CMD_THRD_LIST	1
CONFIG_FS_CMD_THRD_SET_LOG_MASK	1
CONFIG_FS_CMD_USB_DEVICE_LIST	1
CONFIG_FS_CMD_USB_HOST_LIST	1
CONFIG_FS_PATH_MAX	64
CONFIG_MONITOR_THREAD	1
CONFIG_PREEMPTIVE_SCHEDULER	0
CONFIG_PROFILE_STACK	1
CONFIG_SETTINGS_AREA_SIZE	256
CONFIG_SHELL_COMMAND_MAX	64
CONFIG_SHELL_HISTORY_SIZE	768
CONFIG_SHELL_MINIMAL	0
CONFIG_SHELL_PROMPT	“\$ “
CONFIG_SOCKET_RAW	1
CONFIG_SPIFFS	0
CONFIG_START_CONSOLE	CONFIG_START_CONSOLE_UART
CONFIG_START_CONSOLE_DEVICE_INDEX	0
CONFIG_START_CONSOLE_UART_BAUDRATE	38400
CONFIG_START_CONSOLE_USB_CDC_CONTROL_INTERFACE	0
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_IN	2
CONFIG_START_CONSOLE_USB_CDC_ENDPOINT_OUT	3
CONFIG_START_CONSOLE_USB_CDC_WAIT_FOR_CONNCTION	1
CONFIG_START_FILESYSTEM	0
CONFIG_START_FILESYSTEM_ADDRESS	0
CONFIG_START_FILESYSTEM_SIZE	65536
CONFIG_START_NETWORK	0
CONFIG_START_NETWORK_INTERFACE_WIFI_CONNECT_TIMEOUT	30
CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD	MyWiFiPassword
CONFIG_START_NETWORK_INTERFACE_WIFI_SSID	MyWiFiSSID
CONFIG_START_SHELL	1
CONFIG_START_SHELL_PRIO	30

Continued on next page

Table 1.14 – continued from previous page

Name	Value
CONFIG_START_SHELL_STACK_SIZE	768
CONFIG_STD_OUTPUT_BUFFER_MAX	16
CONFIG_SYSTEM_TICK_FREQUENCY	100
CONFIG_SYS_CONFIG_STRING	1
CONFIG_SYS_SIMBA_MAIN_STACK_MAX	4096
CONFIG_THRD_CPU_USAGE	1
CONFIG_THRD_ENV	1
CONFIG_THRD_IDLE_STACK_SIZE	384
CONFIG_THRD_SCHEDULED	1
CONFIG_THRD_TERMINATE	1
CONFIG_USB_DEVICE_PID	0x8037
CONFIG_USB_DEVICE_VID	0x2341

Homepage

http://www.st.com/content/st_com/en/products/evaluation-tools/product-evaluation-tools/mcu-eval-tools/stm32-mcu-eval-tools/stm32-mcu-discovery-kits/stm32vldiscovery.html?sc=internet/evalboard/product/250863.jsp

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stm32f100rb

st-link

```

sudo apt install libusb-1.0-0-dev
git clone https://github.com/eerimoq/stlink
./autogen.sh
./configure
make
sudo cp etc/udev/rules.d/49* /etc/udev/rules.d
udevadm control --reload-rules
udevadm trigger

modprobe -r usb-storage && modprobe usb-storage quirks=483:3744:i

st-util -l
arm-none-eabi-gdb app.out
$ target extended-remote localhost:4242

```

Plug in the board in the PC.

Pin functions

These are the default pin functions in Simba.

Function	Pin
UART0 TX	PA9
UART0 RX	PA10
UART1 TX	PA2
UART1 RX	PA3
UART2 TX	PC10
UART2 RX	PC11
SPI0 SCK	PA5
SPI0 MISO	PA6
SPI0 MOSI	PA7
I2C0 SCL	PB8
I2C0 SDA	PB9

1.5 Examples

Below is a list of simple examples that are useful to understand the basics of *Simba*.

There are a lot more [examples](#) and [unit tests](#) on Github that shows how to use most of the *Simba* modules.

1.5.1 Analog Read

About

Read the value of an analog pin periodically once every second and print the read value to standard output.

Source code

```
/**
 * @section License
 *
 * The MIT License (MIT)
 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
 * Permission is hereby granted, free of charge, to any person
 * obtaining a copy of this software and associated documentation
 * files (the "Software"), to deal in the Software without
 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
 *
 * The above copyright notice and this permission notice shall be
 * included in all copies or substantial portions of the Software.
 *
 * THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
 * EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
 * MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
 * NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS
 * BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
 * ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
 * CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
```

```

* SOFTWARE.
*
* This file is part of the Simba project.
*/

#include "simba.h"

int main()
{
    int value;
    struct analog_input_pin_t pin;

    sys_start();
    analog_input_pin_module_init();

    /* Initialize the analog input pin. */
    analog_input_pin_init(&pin, &pin_a0_dev);

    while (1) {
        /* Read the analog pin value and print it. */
        value = analog_input_pin_read(&pin);
        std_printf(FSTR("value = %d\r\n"), value);

        /* Wait 100 ms. */
        thrd_sleep_ms(100);
    }

    return (0);
}

```

The source code can also be found on Github in the [examples/analog_read](#) folder.

Build and run

Build and run the application.

```

$ cd examples/analog_read
$ make -s BOARD=<board> run
value = 234
value = 249
value = 230

```

1.5.2 Analog Write

About

Write analog values to an analog output pin to form a sawtooth wave. Connect a LED to the analog output pin and watch the brightness of the LED change.

Source code

```

/**
 * @section License

```

```
*
* The MIT License (MIT)
*
* Copyright (c) 2014-2016, Erik Moqvist
*
* Permission is hereby granted, free of charge, to any person
* obtaining a copy of this software and associated documentation
* files (the "Software"), to deal in the Software without
* restriction, including without limitation the rights to use, copy,
* modify, merge, publish, distribute, sublicense, and/or sell copies
* of the Software, and to permit persons to whom the Software is
* furnished to do so, subject to the following conditions:
*
* The above copyright notice and this permission notice shall be
* included in all copies or substantial portions of the Software.
*
* THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
* EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
* MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
* NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS
* BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
* ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
* CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
* SOFTWARE.
*
* This file is part of the Simba project.
*/

#include "simba.h"

int main()
{
    int value;
    struct analog_output_pin_t pin;

    sys_start();
    analog_output_pin_module_init();

    /* Initialize the analog output pin. */
    analog_output_pin_init(&pin, &pin_d10_dev);

    value = 0;

    while (1) {
        /* Write a sawtooth wave to the analog output pin. */
        analog_output_pin_write(&pin, value);
        value += 5;
        value %= 1024;

        /* Wait ten milliseconds. */
        thrd_sleep_ms(10);
    }

    return (0);
}
```

The source code can also be found on Github in the [examples/analog_write](#) folder.

Build and run

Build and upload the application.

```
$ cd examples/analog_write
$ make -s BOARD=<board> upload
```

1.5.3 Blink

About

Turn a LED on and off periodically once a second. This example illustrates how to use digital pins and sleep a thread.

Source code

```

/**
 * @section License
 *
 * The MIT License (MIT)
 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
 * Permission is hereby granted, free of charge, to any person
 * obtaining a copy of this software and associated documentation
 * files (the "Software"), to deal in the Software without
 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
 *
 * The above copyright notice and this permission notice shall be
 * included in all copies or substantial portions of the Software.
 *
 * THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
 * EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
 * MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
 * NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS
 * BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
 * ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
 * CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
 * SOFTWARE.
 *
 * This file is part of the Simba project.
 */

#include "simba.h"

int main()
{
    struct pin_driver_t led;

    /* Start the system. */
    sys_start();

    /* Initialize the LED pin as output and set its value to 1. */

```

```
pin_init(&led, &pin_led_dev, PIN_OUTPUT);
pin_write(&led, 1);

while (1) {
    /* Wait half a second. */
    thrd_sleep_ms(500);

    /* Toggle the LED on/off. */
    pin_toggle(&led);
}

return (0);
}
```

The source code can also be found on Github in the [examples/blink](#) folder.

Build and run

Build and upload the application.

```
$ cd examples/blink
$ make -s BOARD=<board> upload
```

1.5.4 DS18B20

About

Read and print the temperature measured with one or more DS18B20 sensors.

Source code

```
/**
 * @section License
 *
 * The MIT License (MIT)
 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
 * Permission is hereby granted, free of charge, to any person
 * obtaining a copy of this software and associated documentation
 * files (the "Software"), to deal in the Software without
 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
 *
 * The above copyright notice and this permission notice shall be
 * included in all copies or substantial portions of the Software.
 *
 * THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
 * EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
 * MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
 * NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS
```

```

* BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
* ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
* CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
* SOFTWARE.
*
* This file is part of the Simba project.
*/

#include "simba.h"

int main()
{
    struct owi_driver_t owi;
    struct ds18b20_driver_t ds;
    struct owi_device_t devices[4];
    char temperature[16], *temperature_p;
    int number_of_sensors;
    int i;

    /* Initialization. */
    sys_start();
    ds18b20_module_init();
    owi_init(&owi, &pin_d7_dev, devices, membersof(devices));
    ds18b20_init(&ds, &owi);
    time_busy_wait_us(50000);

    /* Search for devices on the OWI bus. */
    number_of_sensors = owi_search(&owi);
    std_printf(FSTR("Number of sensors: %d\r\n"), number_of_sensors);

    while (1) {
        /* Take a new temperature sample. */
        ds18b20_convert(&ds);

        for (i = 0; i < owi.len; i++) {
            if (devices[i].id[0] != DS18B20_FAMILY_CODE) {
                continue;
            }

            temperature_p = ds18b20_get_temperature_str(&ds,
                                                         devices[i].id,
                                                         temperature);

            std_printf(FSTR("Device id: %02x %02x %02x %02x %02x %02x %02x %02x,"
                           " Temperature: %s\r\n"),
                      (unsigned int)devices[i].id[0],
                      (unsigned int)devices[i].id[1],
                      (unsigned int)devices[i].id[2],
                      (unsigned int)devices[i].id[3],
                      (unsigned int)devices[i].id[4],
                      (unsigned int)devices[i].id[5],
                      (unsigned int)devices[i].id[6],
                      (unsigned int)devices[i].id[7],
                      temperature_p);
        }
    }

    return (0);
}

```

```
}
```

The source code can also be found on Github in the [examples/ds18b20](#) folder.

Build and run

Build and run the application.

```
$ cd examples/ds18b20
$ make -s BOARD=<board> run
Number of sensors: 2
Device id: 28 9c 1d 5d 05 00 00 32, Temperature: 22.6250
Device id: 28 95 32 5d 05 00 00 33, Temperature: 22.6875
```

1.5.5 Filesystem

About

Create the file `counter.txt` and write 0 to it. Everytime the application is restarted the counter is incremented by one.

Source code

```
/**
 * @section License
 *
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 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
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 * obtaining a copy of this software and associated documentation
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 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
 *
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 *
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 * EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
 * MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
 * NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS
 * BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
 * ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
 * CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
 * SOFTWARE.
 *
 * This file is part of the Simba project.
 */
```

```

#include "simba.h"

#if !defined(BOARD_ARDUINO_DUE) && !defined(ARCH_ESP) && !defined(ARCH_ESP32)
#   error "This example can only be built for Arduino Due, ESP and ESP32."
#endif

/**
 * Increment the counter in 'counter.txt'.
 */
static int increment_counter(void)
{
    char buf[32];
    struct fs_file_t file;
    long counter;
    size_t size;

    std_printf(FSTR("Incrementing the counter in 'counter.txt'.\r\n"));

    if (fs_open(&file, "counter.txt", FS_RDWR) != 0) {
        /* Create the file if missing. */
        if (fs_open(&file,
                    "counter.txt",
                    FS_CREAT | FS_TRUNC | FS_RDWR) != 0) {
            return (-1);
        }

        if (fs_write(&file, "0", 2) != 2) {
            return (-2);
        }

        if (fs_seek(&file, 0, FS_SEEK_SET) != 0) {
            return (-3);
        }
    }

    if (fs_read(&file, buf, 16) <= 0) {
        return (-4);
    }

    if (std_strtol(buf, &counter) == NULL) {
        return (-5);
    }

    /* Increment the counter. */
    counter++;
    std_sprintf(buf, FSTR("%lu"), counter);
    size = strlen(buf) + 1;

    if (fs_seek(&file, 0, FS_SEEK_SET) != 0) {
        return (-6);
    }

    if (fs_write(&file, buf, size) != size) {
        return (-7);
    }

    if (fs_close(&file) != 0) {
        return (-8);
    }
}

```

```
    }

    std_printf(FSTR("Counter incremented to %lu\r\n"), counter);

    return (0);
}

int main()
{
    int res;

    sys_start();
    std_printf(sys_get_info());

    /* Increment the counter. */
    res = increment_counter();

    if (res != 0) {
        std_printf(FSTR("Failed to increment the counter with error %d.\r\n"),
                    res);
    }

    /* The shell thread is started in sys_start() so just suspend this
       thread. */
    thrd_suspend(NULL);

    return (0);
}
```

The source code can also be found on Github in the [examples/filesystem](#) folder.

Build and run

Build and run the application.

```
$ cd examples/filesystem
$ make -s BOARD=arduino_due upload
```

The output in the terminal emulator:

```
Incrementing the counter in 'counter.txt'.
Counter incremented to 1.
<manually reset the board>
Incrementing the counter in 'counter.txt'.
Counter incremented to 2.
<manually reset the board>
Incrementing the counter in 'counter.txt'.
Counter incremented to 3.
```

1.5.6 Hello World

About

This application prints “Hello world!” to standard output.

Source code

```

/**
 * @section License
 *
 * The MIT License (MIT)
 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
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 * obtaining a copy of this software and associated documentation
 * files (the "Software"), to deal in the Software without
 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
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 *
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 * BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
 * ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
 * CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
 * SOFTWARE.
 *
 * This file is part of the Simba project.
 */

#include "simba.h"

int main()
{
    /* Start the system. */
    sys_start();

    std_printf(FSTR("Hello world!\r\n"));

    return (0);
}

```

The source code can also be found on Github in the [examples/hello_world](#) folder.

Build and run

Build and run the application.

```

$ cd examples/hello_world
$ make -s BOARD=<board> run
...
Hello world!
$

```

1.5.7 HTTP Client

About

Conenct to a remote host perform a HTTP GET action to fetch the root page ‘/’ from the remote host.

Define `CONFIG_START_NETWORK_INTERFACE_WIFI_SSID` and `CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD` in `config.h` to the SSID and password of your WiFi, otherwise the board will fail to connect to the WiFi network. Alternatively, the defines can be given as defines on the make command line as seen in the example below.

Source code

```
/**
 * @section License
 *
 * The MIT License (MIT)
 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
 * Permission is hereby granted, free of charge, to any person
 * obtaining a copy of this software and associated documentation
 * files (the "Software"), to deal in the Software without
 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
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 * BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
 * ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
 * CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
 * SOFTWARE.
 *
 * This file is part of the Simba project.
 */

#include "simba.h"

/* The ip address of the host to connect to. */
#define REMOTE_HOST_IP 216.58.211.142

int main()
{
    struct socket_t socket;
    char http_request[] =
        "GET / HTTP/1.1\r\n"
        "Host: " STRINGIFY(REMOTE_HOST_IP) "\r\n"
        "\r\n";
    char http_response[64];
    char remote_host_ip[] = STRINGIFY(REMOTE_HOST_IP);
    struct inet_addr_t remote_host_address;
```

```

/* Start the system. Brings up the configured network interfaces
   and starts the TCP/IP-stack. */
sys_start();

/* Open the tcp socket. */
socket_open_tcp(&socket);

std_printf(FSTR("Connecting to '%s'.\r\n"), remote_host_ip);

if (inet_aton(remote_host_ip, &remote_host_address.ip) != 0) {
    std_printf(FSTR("Bad ip address '%s'.\r\n"), remote_host_ip);
    return (-1);
}

remote_host_address.port = 80;

if (socket_connect(&socket, &remote_host_address) != 0) {
    std_printf(FSTR("Failed to connect to '%s'.\r\n"), remote_host_ip);
    return (-1);
}

/* Send the HTTP request... */
if (socket_write(&socket,
                http_request,
                strlen(http_request)) != strlen(http_request)) {
    std_printf(FSTR("Failed to send the HTTP request.\r\n"));
    return (-1);
}

/* ...and receive the first 64 bytes of the response. */
if (socket_read(&socket,
                http_response,
                sizeof(http_response)) != sizeof(http_response)) {
    std_printf(FSTR("Failed to receive the response.\r\n"));
}

std_printf(FSTR("First 64 bytes of the response:\r\n"
                "%s"),
            http_response);

/* Close the socket. */
socket_close(&socket);

return (0);
}

```

The source code can also be found on Github in the [examples/http_client](#) folder.

Build and run

Build and run the application. It must be built for ESP12E or ESP01 since those are the only boards with a network connection (WiFi).

```

$ cd examples/http_client
$ make -s BOARD=esp12e CDEFS_EXTRA="CONFIG_START_NETWORK_INTERFACE_WIFI_SSID=Qvist_
↪CONFIG_START_NETWORK_INTERFACE_WIFI_PASSWORD=FooBar" run

```

```
...
Connecting to WiFi with SSID 'Qvist'.
Connected to WiFi with SSID 'Qvist'. Got IP address '192.168.1.103'.
Connecting to '216.58.211.142'.
First 64 bytes of the response:
HTTP/1.1 301 Moved Permanently
Location: http://www.google.com/GET / HTTP/1.1
Host: 216.58.211.142
...
$
```

1.5.8 Ping

About

Ping a remote host periodically once every second.

Source code

```
/**
 * @section License
 *
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 *
 * Copyright (c) 2014-2016, Erik Moqvist
 *
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 * obtaining a copy of this software and associated documentation
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 * restriction, including without limitation the rights to use, copy,
 * modify, merge, publish, distribute, sublicense, and/or sell copies
 * of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
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 * ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
 * CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
 * SOFTWARE.
 *
 * This file is part of the Simba project.
 */

#include "simba.h"

/* The ip address of the host to ping. */
#define REMOTE_HOST_IP 216.58.211.142
```

```

int main()
{
    int res, attempt;
    char remote_host_ip[] = STRINGIFY(REMOTE_HOST_IP);
    struct inet_ip_addr_t remote_host_ip_address;
    struct time_t round_trip_time, timeout;

    sys_start();

    if (inet_aton(remote_host_ip, &remote_host_ip_address) != 0) {
        std_printf(FSTR("Bad ip address '%s'.\r\n"), remote_host_ip);
        return (-1);
    }

    timeout.seconds = 3;
    timeout.nanoseconds = 0;
    attempt = 1;

    /* Ping the remote host once every second. */
    while (1) {
        res = ping_host_by_ip_address(&remote_host_ip_address,
                                     &timeout,
                                     &round_trip_time);

        if (res == 0) {
            std_printf(FSTR("Successfully pinged '%s' (%d).\r\n"),
                      remote_host_ip,
                      attempt);
        } else {
            std_printf(FSTR("Failed to ping '%s' (%d).\r\n"),
                      remote_host_ip,
                      attempt);
        }

        attempt++;
        thrd_sleep(1);
    }

    return (0);
}

```

The source code can also be found on Github in the [examples/ping](#) folder.

Build and run

Build and run the application.

```

$ cd examples/ping
$ make -s BOARD=<board> run
Successfully pinged '192.168.1.100' in 20 ms (#1).
Successfully pinged '192.168.1.100' in 20 ms (#2).
Successfully pinged '192.168.1.100' in 20 ms (#3).

```

1.5.9 Queue

About

Use a queue to communicate between two threads.

Source code

```
/**
 * @section License
 *
 * The MIT License (MIT)
 *
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 * modify, merge, publish, distribute, sublicense, and/or sell copies
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 * SOFTWARE.
 *
 * This file is part of the Simba project.
 */

#include "simba.h"

static struct queue_t queue;

static THRD_STACK(writer_stack, 256);

static void *writer_main(void *arg_p)
{
    int value;

    /* Write to the queue. */
    value = 1;
    queue_write(&queue, &value, sizeof(value));

    return (NULL);
}

int main()
{

```

```

int value;

sys_start();
queue_init(&queue, NULL, 0);
thrd_spawn(writer_main, NULL, 0, writer_stack, sizeof(writer_stack));

/* Read from the queue. */
queue_read(&queue, &value, sizeof(value));

std_printf(FSTR("read value = %d\r\n"), value);

return (0);
}

```

The source code can also be found on Github in the [examples/queue](#) folder.

Build and run

Build and upload the application.

```

$ cd examples/queue
$ make -s BOARD=<board> run
read value = 1

```

1.5.10 Shell

About

Use the serial port to monitor and control the application.

Source code

```

/**
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 *
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```

```
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* ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
* CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
* SOFTWARE.
*
* This file is part of the Simba project.
*/

#include "simba.h"

/* Hello world command. */
static struct fs_command_t cmd_hello_world;

static struct shell_t shell;

/**
 * The shell command callback for "/hello_world".
 */
static int cmd_hello_world_cb(int argc,
                              const char *argv[],
                              void *out_p,
                              void *in_p,
                              void *arg_p,
                              void *call_arg_p)
{
    /* Write "Hello World!" to the output channel. */
    std_fprintf(out_p, FSTR("Hello World!\r\n"));

    return (0);
}

int main()
{
    /* Start the system. */
    sys_start();

    std_printf(sys_get_info());

#ifdef (__DRIVERS_I2C_H__)
    i2c_module_init();
#endif

    pin_module_init();

    /* Register the hello world command. */
    fs_command_init(&cmd_hello_world,
                   FSTR("/hello_world"),
                   cmd_hello_world_cb,
                   NULL);
    fs_command_register(&cmd_hello_world);

    /* Start the shell. */
    shell_init(&shell,
              sys_get_stdin(),
              sys_get_stdout(),
              NULL,
              NULL,
```

```

        NULL,
        NULL);
    shell_main(&shell);

    return (0);
}

```

The source code can also be found on Github in the [examples/shell](#) folder.

Build and run

Build and run the application.

```

$ cd examples/shell
$ make -s BOARD=<board> upload

```

Communicate with the board using a serial terminal emulator, for example *TeraTerm*.

Type `hello_world` in the terminal emulator and press Enter. `Hello World!` is printed.

Press Tab to print a list of all registered commands and try them if you want to.

```

$ hello_world
Hello World!
$ <tab>
drivers/
filesystems/
hello_world
help
history
kernel/
logout
oam/
$ kernel/thrd/list

```

NAME	STATE	PRI	CPU	MAX-STACK-USAGE	LOGMASK
shell	current	0	0%	358/ 5575	0x0f
idle	ready	127	0%	57/ 156	0x0f

```

$

```

1.5.11 Timer

About

Start a periodic timer that writes an event to the main thread. The main thread reads the event and prints “timeout” to the standard output.

Source code

```

/**
 * @section License
 *
 * The MIT License (MIT)
 *
 * Copyright (c) 2014-2016, Erik Moqvist

```

```
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* modify, merge, publish, distribute, sublicense, and/or sell copies
* of the Software, and to permit persons to whom the Software is
* furnished to do so, subject to the following conditions:
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* BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN
* ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
* CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
* SOFTWARE.
*
* This file is part of the Simba project.
*/

#include "simba.h"

#define TIMEOUT_EVENT    0x1

static struct event_t event;
static struct timer_t timer;

static void timer_cb(void *arg_p)
{
    uint32_t mask;

    mask = TIMEOUT_EVENT;
    event_write_isr(&event, &mask, sizeof(mask));
}

int main()
{
    uint32_t mask;
    struct time_t timeout;

    sys_start();
    event_init(&event);

    /* Initialize and start a periodic timer. */
    timeout.seconds = 1;
    timeout.nanoseconds = 0;
    timer_init(&timer, &timeout, timer_cb, NULL, TIMER_PERIODIC);
    timer_start(&timer);

    while (1) {
        mask = TIMEOUT_EVENT;
        event_read(&event, &mask, sizeof(mask));

        std_printf(FSTR("timeout\\r\\n"));
    }
}
```

```
    }  
  
    return (0);  
}
```

The source code can also be found on Github in the [examples/timer](#) folder.

Build and run

Build and upload the application.

```
$ cd examples/timer  
$ make -s BOARD=<board> run  
timeout  
timeout  
timeout
```

1.6 Library Reference

Simba's standard library is very extensive, offering a wide range of facilities as indicated by the long table of contents listed below. The library contains modules used by many developers in their everyday programming.

Besides the generated documentation, the source code of the interfaces and their implementations are available on [Github](#).

1.6.1 kernel

The kernel package is the heart in *Simba*. It implements the thread scheduler.

The kernel package on [Github](#).

errno — Error numbers

Source code: [src/kernel/errno.h](#)

Defines

EPERM

ENOENT

No such file or directory.

ESRCH

No such process.

EINTR

Interrupted system call.

EIO

I/O error.

ENXIO

No such device or address.

E2BIG

Argument list too long.

ENOEXEC

Exec format error.

EBADF

Bad file number.

ECHILD

No child processes.

EAGAIN

Try again.

ENOMEM

Out of memory.

EACCES

Permission denied.

EFAULT

Bad address.

ENOTBLK

Block device required.

EBUSY

Device or resource busy.

EEXIST

File exists.

EXDEV

Cross-device link.

ENODEV

No such device.

ENOTDIR

Not a directory.

EISDIR

Is a directory.

EINVAL

Invalid argument.

ENFILE

File table overflow.

EMFILE

Too many open files.

ENOTTY

Not a typewriter.

ETXTBSY

Text file busy.

EFBIG

File too large.

ENOSPC

No space left on device.

ESPIPE

Illegal seek.

EROFS

Read-only file system.

EMLINK

Too many links.

EPIPE

Broken pipe.

EDOM

Math argument out of domain of func.

ERANGE

Math result not representable.

EDEADLK

Resource deadlock would occur.

ENAMETOOLONG

File name too long.

ENOLCK

No record locks available.

ENOSYS

Function not implemented.

ENOTEMPTY

Directory not empty.

ELOOP

Too many symbolic links encountered.

EWouldBlock

Operation would block.

ENOMSG

No message of desired type.

EIDRM

Identifier removed.

ECHRNG

Channel number out of range.

EL2NSYNC

Level 2 not synchronized.

EL3HLT

Level 3 halted.

EL3RST

Level 3 reset.

ELNRNG

Link number out of range.

EUNATCH

Protocol driver not attached.

ENOC SI

No CSI structure available.

EL2HLT

Level 2 halted.

EBADE

Invalid exchange.

EBADR

Invalid request descriptor.

EXFULL

Exchange full.

ENOANO

No anode.

EBADRQC

Invalid request code.

EBADSLT

Invalid slot.

EDEADLOCK

EBFONT

Bad font file format.

ENOSTR

Device not a stream.

ENODATA

No data available.

ETIME

Timer expired.

ENOSR

Out of streams resources.

ENONET

Machine is not on the network.

ENOPKG

Package not installed.

EREMOTE

Object is remote.

ENOLINK

Link has been severed.

EADV

Advertise error.

ESRMNT

Srmount error.

ECOMM

Communication error on send.

EPROTO

Protocol error.

EMULTIHOP

Multihop attempted.

EDOTDOT

RFS specific error.

EBADMSG

Not a data message.

EOVERFLOW

Value too large for defined data type.

ENOTUNIQ

Name not unique on network.

EBADFD

File descriptor in bad state.

EREMCHG

Remote address changed.

ELIBACC

Can not access a needed shared library.

ELIBBAD

Accessing a corrupted shared library.

ELIBSCN

.lib section in a.out corrupted.

ELIBMAX

Attempting to link in too many shared libraries.

ELIBEXEC

Cannot exec a shared library directly.

EILSEQ

Illegal byte sequence.

ERESTART

Interrupted system call should be restarted.

ESTRPIPE

Streams pipe error.

EUSERS

Too many users.

ENOTSOCK

Socket operation on non-socket.

EDESTADDRREQ

Destination address required.

EMSGSIZE

Message too long.

EPROTOTYPE

Protocol wrong type for socket.

ENOPROTOOPT

Protocol not available.

EPROTONOSUPBOARD

Protocol not supported.

ESOCKTNOSUPBOARD

Socket type not supported.

EOPNOTSUPP

Operation not supported on transport endpoint.

EPFNOSUPBOARD

Protocol family not supported.

EAFNOSUPBOARD

Address family not supported by protocol.

EADDRINUSE

Address already in use.

EADDRNOTAVAIL

Cannot assign requested address.

ENETDOWN

Network is down.

ENETUNREACH

Network is unreachable.

ENETRESET

Network dropped connection because of reset.

ECONNABORTED

Software caused connection abort.

ECONNRESET

Connection reset by peer.

ENOBUFS

No buffer space available.

EISCONN

Transport endpoint is already connected.

ENOTCONN

Transport endpoint is not connected.

ESHUTDOWN

Cannot send after transport endpoint shutdown.

ETOOMANYREFS

Too many references: cannot splice.

ETIMEDOUT

Connection timed out.

ECONNREFUSED

Connection refused.

EHOSTDOWN

Host is down.

EHOSTUNREACH

No route to host.

EALREADY

Operation already in progress.

EINPROGRESS

Operation now in progress.

ESTALE

Stale NFS file handle.

EUCLEAN

Structure needs cleaning.

ENOTNAM

Not a XENIX named type file.

ENAVAIL

No XENIX sems available.

EISNAM

Is a named type file.

EREMOTEIO

Remote I/O error.

EDQUOT

Quota exceeded.

ENOMEDIUM

No medium found.

EMEDIUMTYPE

Wrong medium type.

ECANCELED

Operation Canceled.

ENOKEY

Required key not available.

EKEYEXPIRED

Key has expired.

EKEYREVOKED

Key has been revoked.

EKEYREJECTED

Key was rejected by service.

ESTACK

Stack corrupt.

EBTASSERT

Test assertion.

sys — System

System level functionality and definitions.

Source code: `src/kernel/sys.h`, `src/kernel/sys.c`

Test code: `tst/kernel/sys/main.c`

Test coverage: `src/kernel/sys.c`

Defines

VERSION_STR

SYS_TICK_MAX

Typedefs

typedef

Functions

static *sys_tick_t* **t2st** (**struct** *time_t* **time_p*)

Conversion from the time struct to system ticks.

static void **st2t** (*sys_tick_t* *tick*, **struct** *time_t* **time_p*)

Conversion from system ticks to the time struct.

int **sys_module_init** (void)

Initialize the sys module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **sys_start** (void)

Start the system and convert this context to the main thread.

This function initializes a bunch of enabled features in the simba platform. Many low level features (scheduling, timers, ...) are always enabled, but higher level features are only enabled if configured.

This function **must** be the first function call in `main()`.

Return zero(0) or negative error code.

void **sys_stop** (int *error*)

Stop the system.

Return Never returns.

void **sys_reboot** (void)

Reboot the system. Sets all registers to their known, default values and restarts the application. Also known as a soft reset.

Return Never returns.

void **sys_set_on_fatal_callback** (void (**callback*)) int error

Set the on-fatal-callback function to given callback.

The on-fatal-callback is called when a fatal error occurs. The default on-fatal-callback is `sys_stop()`.

Return void

Parameters

- *callback*: Callback called when a fatal error occurs.

void **sys_set_stdin** (void **chan_p*)

Set the standard input channel.

Return void.

Parameters

- *chan_p*: New standard input channel.

void ***sys_get_stdin** (void)

Get the standard input channel.

Return Standard input channel or NULL.

void **sys_set_stdout** (void **chan_p*)

Set the standard output channel.

Return void.

Parameters

- *chan_p*: New standard output channel.

void ***sys_get_stdout** (void)

Get the standard output channel.

Return Standard output channel or NULL.

void **sys_lock** (void)

Take the system lock. Turns off interrupts.

Return void.

void **sys_unlock** (void)

Release the system lock. Turn on interrupts.

Return void.

void **sys_lock_isr** (void)

Take the system lock from isr. In many ports this has no effect.

Return void.

void **sys_unlock_isr** (void)

Release the system lock from isr. In many ports this function has no effect.

Return void.

`far_string_t sys_get_info (void)`

Get a pointer to the application information buffer.

The buffer contains various information about the application; for example the application name and the build date.

Return The pointer to the application information buffer.

`far_string_t sys_get_config (void)`

Get a pointer to the application configuration buffer.

The buffer contains a string of all configuration variables and their values.

Return The pointer to the application configuration buffer.

`float sys_interrupt_cpu_usage_get (void)`

Get the current interrupt cpu usage counter.

Return cpu usage, 0-100.

`void sys_interrupt_cpu_usage_reset (void)`

Reset the interrupt cpu usage counter.

Variables

`struct sys_t sys`

struct Public Members

`sys_tick_t sys_t::tick`

`void (*sys_t::on_fatal_callback) (int error)`

`void *sys_t::stdin_p`

`void *sys_t::stdout_p`

`uint32_t sys_t::start`

`uint32_t sys_t::time`

`struct sys_t::@65 sys_t::interrupt`

thrd — Threads

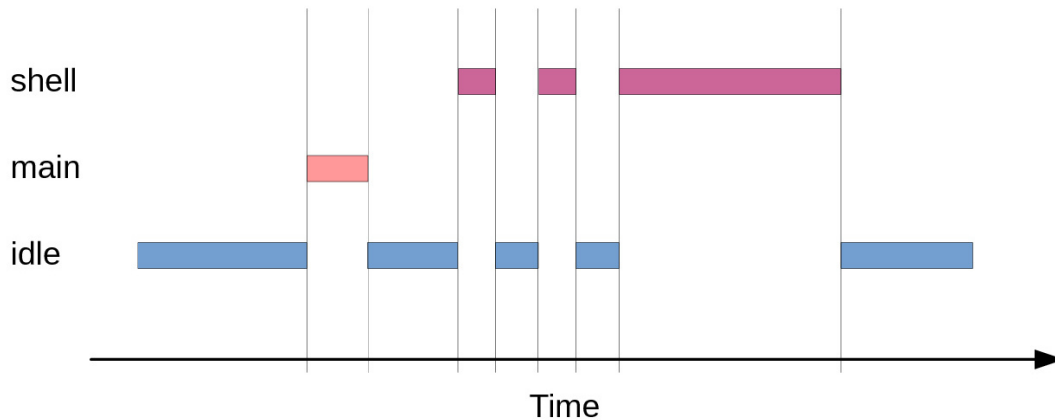
A thread is the basic execution entity in the OS. A pre-emptive or cooperative scheduler controls the execution of threads.

Scheduler

The single core scheduler is configured as cooperative or preemptive at compile time. The cooperative scheduler is implemented for all boards, but the preemptive scheduler is only implemented for a few boards.

There are two threads that are always present; the main thread and the idle thread. The main thread is the root thread in the system, created in the `main()` function by calling `sys_start()`. The idle thread is running when no other thread is ready to run. It simply waits for an interrupt to occur and then reschedules to run other ready threads.

The diagram below is an example of how three threads; `shell`, `main` and `idle` are scheduled over time.



As it is a single core scheduler only one thread is running at a time. In the beginning the system is idle and the `idle` thread is running. After a while the `main` and `shell` threads have some work to do, and since they have higher priority than the `idle` thread they are scheduled. At the end the `idle` thread is running again.

Debug file system commands

Four debug file system commands are available, all located in the directory `kernel/thrd/`.

Command	Description
<code>list</code>	Print a list of all threads.
<code>set_log_mask <thread name> <mask></code>	Set the log mask of thread <code><thread name></code> to <code>mask</code> .
<code>monitor/set_period_ms <ms></code>	Set the monitor thread sampling period to <code><ms></code> milliseconds.
<code>monitor/set_print <state></code>	Enable(1)/disable(0) monitor statistics to be printed periodically.

Example output from the shell:

```
$ kernel/thrd/list
```

NAME	STATE	PRIO	CPU	SCHEDULED	LOGMASK
main	current	0	0%	1	0x0f
	ready	127	0%	0	0x0f
	ready	-80	0%	0	0x0f

Source code: [src/kernel/thrd.h](#), [src/kernel/thrd.c](#)

Test code: [tst/kernel/thrd/main.c](#)

Test coverage: [src/kernel/thrd.c](#)

Defines

THRD_STACK (name, size)

THRD_CONTEXT_STORE_ISR

Push all callee-save registers not part of the context struct. The preemptive scheduler requires this macro before the `thrd_yield_isr()` function is called from interrupt context.

THRD_CONTEXT_LOAD_ISR

Pop all callee-save registers not part of the context struct. The preemptive scheduler requires this macro after the `thrd_yield_isr()` function is called from interrupt context.

THRD_RESCHEDULE_ISR

Reschedule from isr. Used by preemptive systems to interrupt low priority threads in favour of high priority threads.

Functions

int **thrd_module_init** (void)

Initialize the thread module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code

struct *thrd_t* ***thrd_spawn** (void *(*main)) void *

, void *arg_p, int prio, void *stack_p, size_t stack_size Spawn a thread with given main (entry) function and argument. The thread is initialized and added to the ready queue in the scheduler for execution when prioritized.

Return Thread id, or NULL on error.

Parameters

- **main**: Thread main (entry) function. This function normally contains an infinite loop waiting for events to occur.
- **arg_p**: Main function argument. Passed as `arg_p` to the main function.
- **prio**: Thread scheduling priority. [-127..127], where -127 is the highest priority and 127 is the lowest.
- **stack_p**: Stack pointer. The pointer to a stack created with the macro `THRD_STACK()`.
- **stack_size**: The stack size in number of bytes.

int **thrd_suspend** (struct *time_t* *timeout_p)

Suspend current thread and wait to be resumed or a timeout occurs (if given).

Return zero(0), -ETIMEOUT on timeout or other negative error code.

Parameters

- **timeout_p**: Time to wait to be resumed before a timeout occurs and the function returns.

int **thrd_resume** (struct *thrd_t* *thrd_p, int err)

Resume given thread. If resumed thread is not yet suspended it will not be suspended on next suspend call to `thrd_suspend()` or `thrd_suspend_isr()`.

Return zero(0) or negative error code.

Parameters

- `thrd_p`: Thread id to resume.
- `err`: Error code to be returned by `thrd_suspend()` or `thrd_suspend_isr()`.

int **thrd_yield** (void)

Put the currently executing thread on the ready list and reschedule.

This function is often called periodically from low priority work heavy threads to give higher priority threads the chance to execute.

Return zero(0) or negative error code.

int **thrd_join** (struct *thrd_t* **thrd_p*)

Wait for given thread to terminate.

Return zero(0) or negative error code.

Parameters

- `thrd_p`: Thread to wait for.

int **thrd_sleep** (float *seconds*)

Pauses the current thread for given number of seconds.

Return zero(0) or negative error code.

Parameters

- `seconds`: Seconds to sleep.

int **thrd_sleep_ms** (int *ms*)

Pauses the current thread for given number of milliseconds.

Return zero(0) or negative error code.

Parameters

- `ms`: Milliseconds to sleep.

int **thrd_sleep_us** (long *us*)

Pauses the current thread for given number of microseconds.

Return zero(0) or negative error code.

Parameters

- `us`: Microseconds to sleep.

struct *thrd_t* ***thrd_self** (void)

Get current thread's id.

Return Thread id.

int **thrd_set_name** (const char **name_p*)

Set the name of the current thread.

Return zero(0) or negative error code.

Parameters

- `name_p`: New thread name.

const char *`thrd_get_name` (void)
Get the name of the current thread.

Return Current thread name.

struct *thrd_t* *`thrd_get_by_name` (const char **name_p*)
Get the pointer to given thread.

Return Thraed pointer or NULL if the thread was not found.

int **thrd_set_log_mask** (struct *thrd_t* **thrd_p*, int *mask*)
Set the log mask of given thread.

Return Old log mask.

Parameters

- `thrd_p`: Thread to set the log mask of.
- `mask`: Log mask. See the log module for available levels.

int **thrd_get_log_mask** (void)
Get the log mask of the current thread.

Return Log mask of current thread.

int **thrd_set_prio** (struct *thrd_t* **thrd_p*, int *prio*)
Set the priority of given thread.

Return zero(0) or negative error code.

Parameters

- `thrd_p`: Thread to set the priority for.
- `prio`: Priority.

int **thrd_get_prio** (void)
Get the priority of the current thread.

Return Priority of current thread.

int **thrd_init_global_env** (struct *thrd_environment_variable_t* **variables_p*, int *length*)
Initialize the global environment variables storage. These variables are shared among all threads.

Return zero(0) or negative error code.

Parameters

- `variables_p`: Variables array.
- `length`: Length of the variables array.

int **thrd_set_global_env** (const char **name_p*, const char **value_p*)

Set the value of given environment variable. The pointers to given name and value are stored in the current global environment array.

Return zero(0) or negative error code.

Parameters

- *name_p*: Name of the environment variable to set.
- *value_p*: Value of the environment variable. Set to NULL to remove the variable.

const char ***thrd_get_global_env** (const char **name_p*)

Get the value of given environment variable in the global environment array.

Return Value of given environment variable or NULL if it is not found.

Parameters

- *name_p*: Name of the environment variable to get.

int **thrd_init_env** (struct *thrd_environment_variable_t* **variables_p*, int *length*)

Initialize the current threads' environment variables storage.

Return zero(0) or negative error code.

Parameters

- *variables_p*: Variables are to be used by this thread.
- *length*: Length of the variables array.

int **thrd_set_env** (const char **name_p*, const char **value_p*)

Set the value of given environment variable. The pointers to given name and value are stored in the current threads' environment array.

Return zero(0) or negative error code.

Parameters

- *name_p*: Name of the environment variable to set.
- *value_p*: Value of the environment variable. Set to NULL to remove the variable.

const char ***thrd_get_env** (const char **name_p*)

Get the value of given environment variable. If given variable is not found in the current threads' environment array, the global environment array is searched.

Return Value of given environment variable or NULL if it is not found.

Parameters

- *name_p*: Name of the environment variable to get.

int **thrd_suspend_isr** (struct *time_t* **timeout_p*)

Suspend current thread with the system lock taken (see `sys_lock()`) and wait to be resumed or a timeout occurs (if given).

Return zero(0), -ETIMEDOUT on timeout or other negative error code.

Parameters

- `timeout_p`: Time to wait to be resumed before a timeout occurs and the function returns.

int **thrd_resume_isr** (struct *thrd_t* **thrd_p*, int *err*)

Resume given thread from isr or with the system lock taken (see `sys_lock()`). If resumed thread is not yet suspended it will not be suspended on next suspend call to `thrd_suspend()` or `thrd_suspend_isr()`.

Return zero(0) or negative error code.

Parameters

- `thrd_p`: Thread id to resume.
- `err`: Error code to be returned by `thrd_suspend()` or `thrd_suspend_isr()`.

int **thrd_yield_isr** (void)

Yield current thread from isr (preemptive scheduler only) or with the system lock taken.

Return zero(0) or negative error code.

struct *#include <thrd.h>* A thread environment variable. **Public Members**

const char **thrd_environment_variable_t::name_p*

const char **thrd_environment_variable_t::value_p*

struct **Public Members**

struct *thrd_environment_variable_t* **thrd_environment_t::variables_p*

size_t *thrd_environment_t::number_of_variables*

size_t *thrd_environment_t::max_number_of_variables*

struct **Public Members**

struct *thrd_t* **thrd_t::prev_p*

struct *thrd_t* **thrd_t::next_p*

struct *thrd_t::@66* *thrd_t::scheduler*

struct *thrd_port_t* *thrd_t::port*

int *thrd_t::prio*

int *thrd_t::state*

int *thrd_t::err*

int *thrd_t::log_mask*

struct *timer_t* **thrd_t::timer_p*

const char **thrd_t::name_p*

struct *thrd_t::@67* *thrd_t::statistics*

time — System time

Source code: [src/kernel/time.h](#), [src/kernel/time.c](#)

Test code: [tst/kernel/time/main.c](#)

Test coverage: [src/kernel/time.c](#)

Functions

int **time_get** (struct *time_t* *now_p)

Get current time in seconds and nanoseconds. The resolution of the time is implementation specific and may vary a lot between different architectures.

Return zero(0) or negative error code.

Parameters

- now_p: Read current time.

int **time_set** (struct *time_t* *new_p)

Set current time in seconds and nanoseconds.

Return zero(0) or negative error code.

Parameters

- new_p: New current time.

int **time_diff** (struct *time_t* *diff_p, struct *time_t* *left_p, struct *time_t* *right_p)

Subtract given times.

Return zero(0) or negative error code.

Parameters

- diff_p: The result of the subtrancing left_p from right_p.
- left_p: The operand to subtract from.
- right_p: The operand to subtract.

void **time_busy_wait_us** (long *useconds*)

Busy wait for given number of microseconds.

NOTE: The maximum allowed time to sleep is target specific.

Return void

Parameters

- useconds: Microseconds to sleep.

int **time_unix_time_to_date** (struct *date_t* *date_p, struct *time_t* *time_p)

Convert given unix time to a date.

Return zero(0) or negative error code.

Parameters

- `date_p`: Converted time.
- `time_p`: Unix time to convert.

struct *#include <time.h>***Public Members**`int32_t time_t::seconds`

Number of seconds.

`int32_t time_t::nanoseconds`

Number of nanoseconds.

struct *#include <time.h>* A date in year, month, date, day, hour, minute and seconds. **Public Members**`int date_t::second`

Second [0..59].

`int date_t::minute`

Minute [0..59].

`int date_t::hour`

Hour [0..23].

`int date_t::day`

Weekday [1..7], where 1 is Monday and 7 is Sunday.

`int date_t::date`

Day in month [1..31]

`int date_t::month`

Month [1..12] where 1 is January and 12 is December.

`int date_t::year`

Year [1970..].

timer — Timers

Timers are started with a timeout, and when the time is up the timer expires and the timer callback function is called from interrupt context.

The timeout resolution is the system tick period. Timeouts are always rounded up to the closest system tick. That is, a timer can never expire early, but may expire slightly late.

An application requiring timers with higher precision than the system tick must use the hardware timers.

Source code: [src/kernel/timer.h](#), [src/kernel/timer.c](#)

Test code: [tst/kernel/timer/main.c](#)

Test coverage: [src/kernel/timer.c](#)

Defines

TIMER_PERIODIC

Typedefs

typedef Time callback prototype.

Functions

int **timer_module_init** (void)

Initialize the timer module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **timer_init** (struct *timer_t* *self_p, struct *time_t* *timeout_p, *timer_callback_t* callback, void *arg_p, int flags)

Initialize given timer object with given timeout and expiry callback. The timer resolution directly depends on the system tick frequency and is rounded up to the closest possible value. This applies to both single shot and periodic timers.

Return zero(0) or negative error code.

Parameters

- self_p: Timer object to initialize with given parameters.
- timeout_p: The timer timeout value.
- callback: Function called when the timer expires. Called from interrupt context.
- arg_p: Function callback argument. Passed to the callback when the timer expires.
- flags: Set **TIMER_PERIODIC** for periodic timer.

int **timer_start** (struct *timer_t* *self_p)

Start given initialized timer object.

Return zero(0) or negative error code.

Parameters

- self_p: Timer object to start.

int **timer_start_isr** (struct *timer_t* *self_p)

See **timer_start** () for a description.

This function may only be called from an isr or with the system lock taken (see **sys_lock** ()).

int **timer_stop** (struct *timer_t* *self_p)

Stop given timer object. This has no effect on a timer that already expired or was never started. The return code is 0 if the timer was stopped and -1 otherwise.

Return zero(0) if the timer was stopped and -1 if the timer has already expired or was never started.

Parameters

- `self_p`: Timer object to stop.

`int timer_stop_isr (struct timer_t *self_p)`
See `timer_stop()` for description.

This function may only be called from an isr or with the system lock taken (see `sys_lock()`).

struct Public Members

```
struct timer_t *timer_t::next_p  
  
sys_tick_t timer_t::delta  
  
sys_tick_t timer_t::timeout  
  
int timer_t::flags  
  
timer_callback_t timer_t::callback  
  
void *timer_t::arg_p
```

types — Common types

Source code: [src/kernel/types.h](#)

Defines

UNUSED (*v*)

STRINGIFY (*x*)

Create a string of an identifier using the pre-processor.

STRINGIFY2 (*x*)

Used internally by `STRINGIFY()`.

TOKENPASTE (*x*, *y*)

Concatenate two tokens.

TOKENPASTE2 (*x*, *y*)

Used internally by `TOKENPASTE()`.

UNIQUE (*x*)

Create a unique token.

membersof (*a*)

Get the number of elements in an array.

As an example, the code below outputs number of members in `foo = 10`.

```
int foo[10];  
  
std_printf(FSTR("number of members in foo = %d\\r\\n"),  
          membersof(foo));
```

container_of (*ptr*, *type*, *member*)

DIV_CEIL (n, d)

Integer division that rounds the result up.

MIN (a, b)

Get the minimum value of the two.

MAX (a, b)

Get the maximum value of the two.

PRINT_FILE_LINE

Debug print of file and line.

STD_PRINTF_DEBUG (...)

_ASSERTFMT (fmt, ...)

ASSERTN (cond, n, ...)

Assert given condition and call the system on fatal callback with given value n on error.

ASSERT (cond, ...)

Assert given condition and call the system on fatal callback with value 1 on error.

BIT (pos)

BITFIELD_SET (name, value)

BITFIELD_GET (name, value)

Typedefs

typedef

typedef

typedef

typedef

typedef

typedef

1.6.2 drivers

The drivers package on [Github](#).

Modules:

adc — Analog to digital conversion

Source code: [src/drivers/adc.h](#), [src/drivers/adc.c](#)

Test code: [tst/drivers/adc/main.c](#)

Defines

ADC_REFERENCE_VCC

Functions

int **adc_module_init** (void)

Initialize the ADC driver module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **adc_init** (struct adc_driver_t *self_p, struct adc_device_t *dev_p, struct pin_device_t *pin_dev_p, int reference, long sampling_rate)

Initialize given driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: ADC device to use.
- pin_dev_p: Pin device to use.
- reference: Voltage reference. Only ADC_REFERENCE_VCC is supported.
- sampling_rate: Sampling rate in Hz. The lowest allowed value is one and the highest value depends on the architecture. The sampling rate is not used in single sample conversions, ie. calls to `adc_async_convert()` and `adc_convert()` with length one; or calls to `adc_convert_isr()`.

int **adc_async_convert** (struct adc_driver_t *self_p, uint16_t *samples_p, size_t length)

Start an asynchronous conversion of analog signal to digital samples. Call `adc_async_wait()` to wait for the conversion to complete.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.
- samples_p: Converted samples.
- length: Length of samples array.

int **adc_async_wait** (struct adc_driver_t *self_p)

Wait for an asynchronous conversion to complete.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.

int **adc_convert** (struct adc_driver_t *self_p, uint16_t *samples_p, size_t length)

Start a synchronous conversion of an analog signal to digital samples. This is equivalent to `adc_async_convert() + adc_async_wait()`, but in a single function call.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `samples_p`: Converted samples.
- `length`: Length of samples array.

int **adc_convert_isr** (struct *adc_driver_t* **self_p*, uint16_t **sample_p*)

Start a synchronous conversion of analog signal to digital samples from isr or with the system lock taken. This function will poll the ADC hardware until the sample has been converted.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `sample_p`: Converted sample.

Variables

struct *adc_device_t* **adc_device**[ADC_DEVICE_MAX]

`analog_input_pin` — Analog input pin

Source code: `src/drivers/analog_input_pin.h`, `src/drivers/analog_input_pin.c`

Test code: `tst/drivers/analog_input_pin/main.c`

Functions

int **analog_input_pin_module_init** (void)

Initialize the analog input pin module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **analog_input_pin_init** (struct *analog_input_pin_t* **self_p*, struct *pin_device_t* **dev_p*)

Initialize given driver object with given device and mode.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `dev_p`: Device to use.

int **analog_input_pin_read** (struct *analog_input_pin_t* **self_p*)

Read the current value of given pin.

Return Analog pin value, otherwise negative error code.

Parameters

- `self_p`: Driver object.

int **analog_input_pin_read_isr** (struct *analog_input_pin_t* **self_p*)

Read the current value of given pin from an isr or with the system lock taken.

Return Analog pin value, otherwise negative error code.

Parameters

- `self_p`: Driver object.

struct #include <analog_input_pin.h>**Public Members**

struct adc_driver_t analog_input_pin_t : :adc

analog_output_pin — Analog output pin

Source code: `src/drivers/analog_output_pin.h`, `src/drivers/analog_output_pin.c`

Test code: `tst/drivers/analog_output_pin/main.c`

Functions

int **analog_output_pin_module_init** (void)

Initialize the analog output pin module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **analog_output_pin_init** (struct *analog_output_pin_t* **self_p*, struct pin_device_t **dev_p*)

Initialize given driver object with given device and mode.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `dev_p`: Device to use.

int **analog_output_pin_write** (struct *analog_output_pin_t* **self_p*, int *value*)

Write given value to the analog pin.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `value`: The value to write to the pin. A number in the range 0 to 1023, where 0 is lowest output and 1023 is highest output.

int **analog_output_pin_read** (struct *analog_output_pin_t* *self_p)

Read the value that is currently written to given analog output pin.

Return Value in the range 0 to 1023, or negative error code.

Parameters

- self_p: Driver object.

struct #include <analog_output_pin.h>**Public Members**

struct pwm_driver_t analog_output_pin_t : :pwm

bcm43362 — BCM43362

BCM43362 is a WiFi module by Boadcom.

Homepage: <https://www.broadcom.com/products/wireless-connectivity/wireless-lan/bcm43362>

Source code: [src/drivers/bcm43362.h](#), [src/drivers/bcm43362.c](#)

Test code: [tst/drivers/bcm43362/main.c](#)

Functions

int **bcm43362_module_init** (void)

Initialize the BCM43362 module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **bcm43362_init** (struct *bcm43362_driver_t* *self_p, struct sdio_device_t *sdio_dev_p)

Initialize driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- sdio_dev_p: SDIO device to use.

int **bcm43362_start** (struct *bcm43362_driver_t* *self_p)

Starts the BCM43362 device using given driver object.

After a successful start of the device the application may call `bcm43362_connect ()` to connect to an AP.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **bcm43362_stop** (struct *bcm43362_driver_t* *self_p)

Stops the BCM43362 device referenced by given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **bcm43362_connect** (struct *bcm43362_driver_t* *self_p, const char *ssid_p, const char *password_p)

Connect to an WiFi Access Point (AP) with given SSID and password.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- ssid_p: SSID of the WiFi AP to connect to.
- password_p: Password.

int **bcm43362_disconnect** (struct *bcm43362_driver_t* *self_p)

Disconnect from any connected WiFi AP.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

ssize_t **bcm43362_read** (struct *bcm43362_driver_t* *self_p, struct pbuf *pbuf_p, size_t size)

Read a packet from the BCM43362 device.

Return Number of read bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- pbuf_p: Buffer to read into.
- size: Number of bytes to receive.

ssize_t **bcm43362_write** (struct *bcm43362_driver_t* *self_p, struct pbuf *pbuf_p, size_t size)

Write given packet to the BCM43362 device to transmit it on the network.

This function is normally called by a network interface to send a frame on the network.

Return Number of written bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- pbuf_p: Buffer to write.
- size: Number of bytes to write.

struct *#include <bcm43362.h>***Public Members**

struct sdio_driver_t bcm43362_driver_t::sdio

can — Controller Area Network

A Controller Area Network (CAN bus) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other in applications without a host computer. It is a message-based protocol, designed originally for multiplex electrical wiring within automobiles, but is also used in many other contexts.

Below is a short example of how to use this module. The error handling is left out for readability.

```
struct can_frame_t can_rx_buf[8];
struct can_frame_t frame;

/* Initialize and start the CAN controller. */
can_init(&can,
        &can_device[0],
        CAN_SPEED_500KBPS,
        can_rx_buf,
        sizeof(can_rx_buf)) == 0);
can_start(&can);

/* Read a frame from the bus. */
can_read(&can, &frame, sizeof(frame));

/* Stop the CAN controller. */
can_stop(&can);
```

Source code: [src/drivers/can.h](#), [src/drivers/can.c](#)

Test code: [tst/drivers/can/main.c](#)

Defines

CAN_SPEED_1000KBPS

CAN_SPEED_500KBPS

CAN_SPEED_250KBPS

Functions

int **can_init** (**struct** can_driver_t *self_p, **struct** can_device_t *dev_p, uint32_t speed, void *rxbuf_p, size_t size)

Initialize given driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.
- dev_p: CAN device to use.
- speed: Can bus speed. One of the defines with the prefix CAN_SPEED_.
- rxbuf_p: CAN frame reception buffer.
- size: Size of the reception buffer in bytes.

int **can_start** (**struct** can_driver_t *self_p)

Starts the CAN device using configuration in given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **can_stop** (**struct** can_driver_t *self_p)

Stops the CAN device referenced by given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

ssize_t **can_read** (**struct** can_driver_t *self_p, **struct** can_frame_t *frame_p, size_t size)

Read one or more CAN frames from the CAN bus. Blocks until the frame(s) are received.

Return Number of bytes read or negative error code.

Parameters

- self_p: Initialized driver object.
- frame_p: Array of read frames.
- size: Size of frames buffer in bytes. Must be a multiple of sizeof(struct can_frame_t).

ssize_t **can_write** (**struct** can_driver_t *self_p, **const struct** can_frame_t *frame_p, size_t size)

Write one or more CAN frames to the CAN bus. Blocks until the frame(s) have been transmitted.

Return Number of bytes written or negative error code.

Parameters

- self_p: Initialized driver object.
- frame_p: Array of frames to write.
- size: Size of frames buffer in bytes. Must be a multiple of sizeof(struct can_frame_t).

Variables

struct can_device_t **can_device**[CAN_DEVICE_MAX]

struct **Public Members**

uint32_t can_frame_t::id

int can_frame_t::extended_frame

int can_frame_t::size

int can_frame_t::rtr

uint32_t can_frame_t::timestamp

uint8_t can_frame_t::u8[8]

```
uint32_t can_frame_t::u32[2]
union can_frame_t::@0  can_frame_t::data
```

chipid — Chip identity

Source code: [src/drivers/chipid.h](#), [src/drivers/chipid.c](#)

Test code: [tst/drivers/chipid/main.c](#)

Functions

int **chipid_read** (struct chipid_t *id_p)

dac — Digital to analog conversion

Source code: [src/drivers/dac.h](#), [src/drivers/dac.c](#)

Test code: [tst/drivers/dac/main.c](#)

Functions

int **dac_module_init** (void)

Initialize DAC driver module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **dac_init** (struct dac_driver_t *self_p, struct dac_device_t *dev_p, struct pin_device_t *pin0_dev_p, struct pin_device_t *pin1_dev_p, int sampling_rate)

Initialize given driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: Device to use.
- pin0_dev_p: Pin used for mono or first stereo channel.
- pin1_dev_p: Second stereo pin.
- sampling_rate: Sampling rate in Hz.

int **dac_async_convert** (struct dac_driver_t *self_p, uint32_t *samples_p, size_t length)

Start an asynchronous conversion of samples to an analog signal.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `samples`: Samples to convert to an analog signal.
- `length`: Length of samples array.

int **`dac_async_wait`** (**`struct`** `dac_driver_t` *`self_p`)
Wait for ongoing asynchronous conversion to finish.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.

int **`dac_convert`** (**`struct`** `dac_driver_t` *`self_p`, `uint32_t` *`samples_p`, `size_t` `length`)
Start synchronous conversion of samples to an analog signal.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `samples`: Converted samples.
- `length`: Length of samples array.

Variables

`struct` `dac_device_t` **`dac_device`**[DAC_DEVICE_MAX]

ds18b20 — One-wire temperature sensor

Source code: `src/drivers/ds18b20.h`, `src/drivers/ds18b20.c`

Test code: `tst/drivers/ds18b20/main.c`

Defines

DS18B20_FAMILY_CODE

Functions

int **`ds18b20_module_init`** (void)
Initialize the DS18B20 driver module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **`ds18b20_init`** (**`struct`** `ds18b20_driver_t` *`self_p`, **`struct`** `owi_driver_t` *`owi_p`)
Initialize given driver object. The driver object will communicate with all DS18B20 devices on given OWI bus.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `owi_p`: One-Wire (OWI) driver.

int **ds18b20_convert** (**struct** *ds18b20_driver_t* **self_p*)
Start temperature conversion on all sensors.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.

int **ds18b20_get_temperature** (**struct** *ds18b20_driver_t* **self_p*, **const** uint8_t **id_p*, int **temp_p*)
Get the temperature for given device identity.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `id_p`: Device identity.
- `temp_p`: Measured temperature in Q4.4 to Q8.4 depending on resolution.

char ***ds18b20_get_temperature_str** (**struct** *ds18b20_driver_t* **self_p*, **const** uint8_t **id_p*, char **temp_p*)
Get temperature for given device identity formatted as a string.

Return `temp_p` on success, NULL otherwise.

Parameters

- `self_p`: Driver object to be initialized.
- `id_p`: Device identity.
- `temp_p`: Measured formatted temperature.

struct Public Members

struct *owi_driver_t* *ds18b20_driver_t::**owi_p**

struct *ds18b20_driver_t* *ds18b20_driver_t::**next_p**

ds3231 — RTC clock

Source code: [src/drivers/ds3231.h](#), [src/drivers/ds3231.c](#)

Test code: [tst/drivers/ds3231/main.c](#)

Functions

int **ds3231_init** (struct *ds3231_driver_t* *self_p, struct i2c_driver_t *i2c_p)
Initialize given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- i2c_p: I2C driver to use.

int **ds3231_set_date** (struct *ds3231_driver_t* *self_p, struct *date_t* *date_p)
Set date in the DS3231 device.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.
- date_p: Date to set in the device.

int **ds3231_get_date** (struct *ds3231_driver_t* *self_p, struct *date_t* *date_p)
Get date from the DS3231 device.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.
- date_p: Date read from the device.

struct *#include <ds3231.h>***Public Members**

struct i2c_driver_t *ds3231_driver_t::i2c_p

esp_wifi — Espressif WiFi

This module is a wrapper for the Espressif WiFi interface.

Configure the WiFi as a Station and an Access Point at the same time. The application tries to connect to a Wifi with SSID *ssid* and will accept connections to the SSID *Simba*.

```
esp_wifi_set_op_mode(esp_wifi_op_mode_station_softap_t);  
esp_wifi_softap_init("Simba", NULL);  
esp_wifi_station_init("ssid", "password", NULL);
```

Configure the WiFi as an Access Point. The application will accept connections to the SSID *Simba*.

```
esp_wifi_set_op_mode(esp_wifi_op_mode_softap_t);  
esp_wifi_softap_init("Simba", NULL);
```

Configure the WiFi as a Station. The application tries to connect to a Wifi with SSID *ssid*.

```
esp_wifi_set_op_mode(esp_wifi_op_mode_station_t);  
esp_wifi_station_init("ssid", "password", NULL);
```

Submodules:

esp_wifi_softap — Espressif WiFi SoftAP

This module is a wrapper for the Espressif WiFi SoftAP interface.

Source code: `src/drivers/esp_wifi/softap.h`, `src/drivers/esp_wifi/softap.c`

Test code: `tst/drivers/esp_wifi/softap/main.c`

Functions

int **esp_wifi_softap_init** (const char *ssid_p, const char *password_p)

Initialize the WiFi SoftAP interface.

Return zero(0) or negative error code.

Parameters

- ssid_p: SSID of the SoftAP.
- password_p: Password of SoftAP.

int **esp_wifi_softap_set_ip_info** (const struct *inet_if_ip_info_t* *info_p)

Set the ip address, netmask and gateway of the WiFi SoftAP.

Return zero(0) or negative error code.

int **esp_wifi_softap_get_ip_info** (struct *inet_if_ip_info_t* *info_p)

Get the SoftAP ip address, netmask and gateway.

Return zero(0) or negative error code.

Parameters

- info_p: Read ip information.

int **esp_wifi_softap_get_number_of_connected_stations** (void)

Get the number of stations connected to the SoftAP.

Return Number of conencted stations.

int **esp_wifi_softap_get_station_info** (struct *esp_wifi_softap_station_info_t* *info_p, int length)

Get the information of stations connected to the SoftAP, including MAC and IP addresses.

Return Number of valid station information entries or negative error code.

Parameters

- info_p: An array to write the station information to.

- `length`: Length of the info array.

int **esp_wifi_softap_dhcp_server_start** (void)
 Enable the SoftAP DHCP server.

Return zero(0) or negative error code.

int **esp_wifi_softap_dhcp_server_stop** (void)
 Disable the SoftAP DHCP server. The DHCP server is enabled by default.

Return zero(0) or negative error code.

enum *esp_wifi_dhcp_status_t* **esp_wifi_softap_dhcp_server_status** (void)
 Get the SoftAP DHCP server status.

Return DHCP server status.

struct *#include <softap.h>* **Public Members**

uint8_t esp_wifi_softap_station_info_t::bssid[6]

struct *inet_ip_addr_t* esp_wifi_softap_station_info_t::ip_address

esp_wifi_station — Espressif WiFi Station

This module is a wrapper for the Espressif WiFi station interface.

Source code: [src/drivers/esp_wifi/station.h](#), [src/drivers/esp_wifi/station.c](#)

Test code: [tst/drivers/esp_wifi/station/main.c](#)

Enums

enum type **esp_wifi_station_status_t**

Values:

= 0

Functions

int **esp_wifi_station_init** (const char *ssid_p, const char *password_p, const struct *inet_if_ip_info_t* *info_p)

Initialize the WiFi station.

Return zero(0) or negative error code.

Parameters

- ssid_p: WiFi SSID to connect to.
- password_p: WiFi password.
- info_p: Static ip configuration or NULL to use DHCP.

int **esp_wifi_station_connect** (void)

Connect the WiFi station to the Access Point (AP).

Return zero(0) or negative error code.

int **esp_wifi_station_disconnect** (void)

Disconnect the WiFi station from the AP.

Return zero(0) or negative error code.

int **esp_wifi_station_set_ip_info** (const struct *inet_if_ip_info_t* *info_p)

Set the ip address, netmask and gateway of the WiFi station.

Return zero(0) or negative error code.

int **esp_wifi_station_get_ip_info** (struct *inet_if_ip_info_t* *info_p)

Get the station ip address, netmask and gateway.

Return zero(0) or negative error code.

int **esp_wifi_station_set_reconnect_policy** (int policy)

Set whether the station will reconnect to the AP after disconnection. It will do so by default.

Return zero(0) or negative error code.

Parameters

- policy: If it's true, it will enable reconnection; if it's false, it will disable reconnection.

int **esp_wifi_station_get_reconnect_policy** (void)

Check whether the station will reconnect to the AP after disconnection.

Return true(1) or false(0).

enum *esp_wifi_station_status_t* **esp_wifi_station_get_connect_status** (void)

Get the connection status of the WiFi station.

Return The connection status.

int **esp_wifi_station_dhcp_client_start** (void)

Enable the station DHCP client.

Return zero(0) or negative error code.

int **esp_wifi_station_dhcp_client_stop** (void)
Disable the station DHCP client.

Return zero(0) or negative error code.

enum *esp_wifi_dhcp_status_t* **esp_wifi_station_dhcp_client_status** (void)
Get the station DHCP client status.

Return Station DHCP client status.

Source code: [src/drivers/esp_wifi.h](#), [src/drivers/esp_wifi.c](#)

Test code: [tst/drivers/esp_wifi/main.c](#)

Enums

enum type **esp_wifi_op_mode_t**
Values:
= 0

enum type **esp_wifi_phy_mode_t**
Physical WiFi mode.
Values:
= 1

enum type **esp_wifi_dhcp_status_t**
DHCP status.
Values:
= 0

Functions

int **esp_wifi_module_init** (void)
Initialize the Espressif WiFi module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **esp_wifi_set_op_mode** (enum *esp_wifi_op_mode_t* mode)

Set the WiFi operating mode to None, Station, SoftAP or Station + SoftAP. The default mode is SoftAP.

Return zero(0) or negative error code.

Parameters

- mode: Operating mode to set.

enum *esp_wifi_op_mode_t* **esp_wifi_get_op_mode** (void)

Get the current WiFi operating mode. The operating mode can be None, Station, SoftAP, or Station + SoftAP.

Return Current operating mode.

int **esp_wifi_set_phy_mode** (enum *esp_wifi_phy_mode_t* mode)

Set the WiFi physical mode (802.11b/g/n).

The SoftAP only supports b/g.

Return zero(0) or negative error code.

Parameters

- mode: Physical mode.

enum *esp_wifi_phy_mode_t* **esp_wifi_get_phy_mode** (void)

Get the physical mode (802.11b/g/n).

Return WiFi physical mode.

void **esp_wifi_print** (void *chout_p)

Print information about the WiFi.

exti — External interrupts

Source code: [src/drivers/exti.h](#), [src/drivers/exti.c](#)

Test code: [tst/drivers/exti/main.c](#)

Defines

EXTI_TRIGGER_BOTH_EDGES

Trigger an interrupt on both rising and falling edges.

EXTI_TRIGGER_FALLING_EDGE

Trigger an interrupt on falling edges.

EXTI_TRIGGER_RISING_EDGE

Trigger an interrupt on both rising edges.

Functions

int **exti_module_init** (void)

Initialize the external interrupt (EXTI) module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **exti_init** (struct exti_driver_t *self_p, struct exti_device_t *dev_p, int trigger, void (*on_interrupt) void *arg_p, void *arg_p) Initialize given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: Device to use.
- trigger: One of EXTI_TRIGGER_BOTH_EDGES, EXTI_TRIGGER_FALLING_EDGE or EXTI_TRIGGER_RISING_EDGE.
- on_interrupt: Function callback called when an interrupt occurs.
- arg_p: Function callback argument.

int **exti_start** (struct exti_driver_t *self_p)

Starts the EXTI device using given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.

int **exti_stop** (struct exti_driver_t *self_p)

Stops the EXTI device referenced by given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.

int **exti_clear** (struct exti_driver_t *self_p)

Clear the interrupt flag.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.

Variables

struct exti_device_t **exti_device**[EXTI_DEVICE_MAX]

flash — Flash memory

Source code: `src/drivers/flash.h`, `src/drivers/flash.c`

Test code: `tst/drivers/flash/main.c`

Functions

int **flash_module_init** (void)

Initialize the flash module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **flash_init** (struct flash_driver_t *self_p, struct flash_device_t *dev_p)

Initialize given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.
- dev_p: Device to use.

ssize_t **flash_read** (struct flash_driver_t *self_p, void *dst_p, uintptr_t src, size_t size)

Read data from given flash memory.

Return Number of read bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- dst_p: Buffer to read into.
- src: Address in flash memory to read from.
- size: Number of bytes to receive.

ssize_t **flash_write** (struct flash_driver_t *self_p, uintptr_t dst, const void *src_p, size_t size)

Write data to given flash memory. Only erased parts of the memory can be written to.

Return Number of written bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- dst: Address in flash memory to write to.
- src_p: Buffer to write.
- size: Number of bytes to write.

int **flash_erase** (struct flash_driver_t *self_p, uintptr_t addr, size_t size)

Erase all sectors part of given memory range.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `dst`: Address in flash memory to erase from.
- `size`: Number of bytes to erase.

Variables

```
struct flash_device_t flash_device[FLASH_DEVICE_MAX]
```

i2c — I2C

I2C is a data transfer bus. Normally one master and one or more slaves are connected to the bus. The master addresses one slave at a time to transfer data between the devices.

The master is normally fairly easy to implement since it controls the bus clock and no race conditions can occur. The slave, on the other hand, can be implemented in various ways depending on the application requirements. In this implementation the slave will always send an acknowledgement when addressed by the master, and lock the bus by pulling SCL low until it is ready for the transmission.

Source code: [src/drivers/i2c.h](#), [src/drivers/i2c.c](#)

Test code: [tst/drivers/i2c/master/main.c](#)

Defines

`I2C_BAUDRATE_3_2MBPS`

`I2C_BAUDRATE_1MBPS`

`I2C_BAUDRATE_400KBPS`

`I2C_BAUDRATE_100KBPS`

Functions

`int i2c_module_init()`

Initialize the i2c module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

`int i2c_init(struct i2c_driver_t *self_p, struct i2c_device_t *dev_p, int baudrate, int address)`

Initialize given driver object. The same driver object is used for both master and slave modes. Use `i2c_start()` to start the device as a master, and `i2c_slave_start()` to start it as a slave.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to initialize.
- `dev_p`: I2C device to use.
- `baudrates`: Bus baudrate when in master mode. Unused in slave mode.
- `address`: Slave address when in slave mode. Unused in master mode.

int `i2c_start` (`struct i2c_driver_t *self_p`)

Start given driver object in master mode. Enables data reception and transmission, but does not start any transmission. Use `i2c_read()` and `i2c_write()` to exchange data with the peer.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to initialize.

int `i2c_stop` (`struct i2c_driver_t *self_p`)

Stop given driver object. Disables data reception and transmission in master mode.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to initialize.

ssize_t `i2c_read` (`struct i2c_driver_t *self_p`, int `address`, void `*buf_p`, size_t `size`)

Read given number of bytes into given buffer from given slave.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: Driver object.
- `address`: Slave address to read from.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read.

ssize_t `i2c_write` (`struct i2c_driver_t *self_p`, int `address`, const void `*buf_p`, size_t `size`)

Write given number of bytes from given buffer to given slave.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Driver object.
- `address`: Slave address to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

int `i2c_scan` (`struct i2c_driver_t *self_p`, int `address`)

Scan the i2c bus for a slave with given address.

Return true(1) if a slave responded to given address, otherwise false(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `address`: Address of the slave to scan for.

int **i2c_slave_start** (struct i2c_driver_t **self_p*)

Start given driver object in slave mode. Enables data reception and transmission, but does not start any transmission. Data transfers are started by calling the `i2c_slave_read()` and `i2c_slave_write()`.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to initialize.

int **i2c_slave_stop** (struct i2c_driver_t **self_p*)

Stop given driver object. Disables data reception and transmission in slave mode.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to initialize.

ssize_t **i2c_slave_read** (struct i2c_driver_t **self_p*, void **buf_p*, size_t *size*)

Read into given buffer from the next master that addresses this slave.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: Driver object.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read.

ssize_t **i2c_slave_write** (struct i2c_driver_t **self_p*, const void **buf_p*, size_t *size*)

Write given buffer to the next master that addresses this slave.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Driver object.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

Variables

struct i2c_device_t **i2c_device**[I2C_DEVICE_MAX]

i2c_soft — Software I2C

Source code: [src/drivers/i2c_soft.h](#), [src/drivers/i2c_soft.c](#)

Test code: [tst/drivers/i2c/master_soft/main.c](#)

Functions

int **i2c_soft_module_init** (void)

Initialize the i2c soft module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **i2c_soft_init** (**struct** *i2c_soft_driver_t* *self_p, **struct** pin_device_t *scl_dev_p, **struct** pin_device_t *sda_dev_p, long baudrate, long max_clock_stretching_us, long clock_stretching_sleep_us)

Initialize given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.
- scl_dev_p: The I2C clock pin (SCL).
- sda_dev_p: The I2C data pin (SDA).
- baudrate: Bus baudrate.
- max_clock_stretching_us: Maximum number of microseconds to wait for the clock stretching to end.
- clock_stretching_sleep_us: SCL poll interval in number of microseconds waiting for clock stretching to end.

int **i2c_soft_start** (**struct** *i2c_soft_driver_t* *self_p)

Start given driver object. Enables data reception and transmission, but does not start any transmission. Data transfers are started by calling the `i2c_soft_read()` and `i2c_soft_write()`.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.

int **i2c_soft_stop** (**struct** *i2c_soft_driver_t* *self_p)

Stop given driver object. Disables data reception and transmission.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.

`ssize_t i2c_soft_read(struct i2c_soft_driver_t *self_p, int address, void *buf_p, size_t size)`

Read given number of bytes into given buffer from given slave.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: Driver object.
- `address`: Slave address to read from.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read.

`ssize_t i2c_soft_write(struct i2c_soft_driver_t *self_p, int address, const void *buf_p, size_t size)`

Write given number of bytes from given buffer to given slave.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Driver object.
- `address`: Slave address to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

`int i2c_soft_scan(struct i2c_soft_driver_t *self_p, int address)`

Scan the i2c bus for a slave with given address.

Return true(1) if a slave responded to given address, otherwise false(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `address`: Address of the slave to scan for.

`struct #include <i2c_soft.h>`**Public Members**

`struct pin_device_t *i2c_soft_driver_t::scl_p`

`struct pin_device_t *i2c_soft_driver_t::sda_p`

`long i2c_soft_driver_t::baudrate`

`long i2c_soft_driver_t::baudrate_us`

`long i2c_soft_driver_t::max_clock_stretching_us`

`long i2c_soft_driver_t::clock_stretching_sleep_us`

mcp2515 — CAN BUS chipset

Source code: [src/drivers/mcp2515.h](#), [src/drivers/mcp2515.c](#)

Test code: [tst/drivers/mcp2515/main.c](#)

Defines

MCP2515_SPEED_1000KBPS

MCP2515_SPEED_500KBPS

MCP2515_MODE_NORMAL

MCP2515_MODE_LOOPBACK

Functions

int **mcp2515_init** (struct *mcp2515_driver_t* *self_p, struct spi_device_t *spi_p, struct pin_device_t *cs_p, struct exti_device_t *exti_p, void *chin_p, int mode, int speed)
Initialize given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.
- spi_p: SPI driver to use.
- cs_p: SPI chip select pin.
- exti_p: External interrupt tp use.
- chin_p: Frames received from the hardware are written to this channel.
- mode: Device mode.
- speed: CAN bus speed in kbps.

int **mcp2515_start** (struct *mcp2515_driver_t* *self_p)
Starts the CAN device using given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **mcp2515_stop** (struct *mcp2515_driver_t* *self_p)
Stops the CAN device referenced by driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

ssize_t **mcp2515_read** (struct *mcp2515_driver_t* *self_p, struct *mcp2515_frame_t* *frame_p)
Read a CAN frame.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- frame_p: Read frame.

`ssize_t mcp2515_write (struct mcp2515_driver_t *self_p, const struct mcp2515_frame_t *frame_p)`
Write a CAN frame.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `frame_p`: Frame to write.

struct Public Members

`uint32_t mcp2515_frame_t::id`

`int mcp2515_frame_t::size`

`int mcp2515_frame_t::rtr`

`uint32_t mcp2515_frame_t::timestamp`

`uint8_t mcp2515_frame_t::data[8]`

struct Public Functions

`mcp2515_driver_t::THRD_STACK(stack, 1024)`

Public Members

`struct spi_driver_t mcp2515_driver_t::spi`

`struct exti_driver_t mcp2515_driver_t::exti`

`int mcp2515_driver_t::mode`

`int mcp2515_driver_t::speed`

`struct chan_t mcp2515_driver_t::chout`

`struct chan_t *mcp2515_driver_t::chin_p`

`struct sem_t mcp2515_driver_t::isr_sem`

`struct sem_t mcp2515_driver_t::tx_sem`

nrf24101 — Wireless communication

Source code: [src/drivers/nrf24101.h](#), [src/drivers/nrf24101.c](#)

Functions

int **nrf24l01_module_init** (void)

Initialize NRF24L01 module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **nrf24l01_init** (struct *nrf24l01_driver_t* *self_p, struct spi_device_t *spi_p, struct pin_device_t *cs_p, struct pin_device_t *ce_p, struct exti_device_t *exti_p, uint32_t address)

Initialize given driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- spi_p: SPI device.
- cs_p: Chip select pin device.
- ce_p: CE pin device.
- exti_p: External interrupt flagdevice.
- address: 4 MSB:s of RX pipes. LSB is set to 0 through 5 for the 6 pipes.

int **nrf24l01_start** (struct *nrf24l01_driver_t* *self_p)

Starts the NRF24L01 device using given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **nrf24l01_stop** (struct *nrf24l01_driver_t* *self_p)

Stops the NRF24L01 device referenced by driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

ssize_t **nrf24l01_read** (struct *nrf24l01_driver_t* *self_p, void *buf_p, size_t size)

Read data from the NRF24L01 device.

Return Number of received bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to read into.
- size: Number of bytes to read (must be 32).

```
ssize_t nrf24l01_write(struct nrf24l01_driver_t *self_p, uint32_t address, uint8_t pipe, const void  
                      *buf_p, size_t size)
```

Write data to the NRF24L01 device.

Return number of sent bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `address`: 4 MSB:s of TX address.
- `pipe`: LSB of TX address.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write (must be 32).

```
struct #include <nrf24l01.h>Public Members
```

```
struct spi_driver_t nrf24l01_driver_t::spi  
struct exti_driver_t nrf24l01_driver_t::exti  
struct pin_driver_t nrf24l01_driver_t::ce  
struct queue_t nrf24l01_driver_t::irqchan  
struct queue_t nrf24l01_driver_t::chin  
struct thrd_t *nrf24l01_driver_t::thrd_p  
uint32_t nrf24l01_driver_t::address  
char nrf24l01_driver_t::irqbuf[8]  
char nrf24l01_driver_t::chinbuf[32]  
char nrf24l01_driver_t::stack[256]
```

owi — One-Wire Interface

Source code: [src/drivers/owi.h](#), [src/drivers/owi.c](#)

Test code: [tst/drivers/owi/main.c](#)

Defines

```
OWI_SEARCH_ROM  
OWI_READ_ROM  
OWI_MATCH_ROM  
OWI_SKIP_ROM  
OWI_ALARM_SEARCH
```

Functions

int **owi_init** (struct *owi_driver_t* *self_p, struct pin_device_t *dev_p, struct *owi_device_t* *devices_p, size_t nmemb)
Initialize driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: Pin device to use.
- devices_p: Storage for devices found when searching.
- nmemb: Number of members in devices.

int **owi_reset** (struct *owi_driver_t* *self_p)
Send reset on one wire bus.

Return true(1) if one or more devices are connected to the bus, false(0) if no devices were found, otherwise negative error code.

Parameters

- self_p: Driver object.

int **owi_search** (struct *owi_driver_t* *self_p)
Search for devices on given one wire bus. The device id of all found devices are stored in the devices array passed to owi_init().

Return Number of devices found or negative error code.

Parameters

- self_p: Driver object.

ssize_t **owi_read** (struct *owi_driver_t* *self_p, void *buf_p, size_t size)
Read into buffer from one wire bus.

Return Number of bits read or negative error code.

Parameters

- self_p: Driver object.
- buf_p: Buffer to read into.
- size: Number of bits to read.

ssize_t **owi_write** (struct *owi_driver_t* *self_p, const void *buf_p, size_t size)
Write buffer to given one wire bus.

Return Number of bits written or negative error code.

Parameters

- self_p: Driver object.
- buf_p: Buffer to write.

- `size`: Number of bits to write.

struct Public Members

```
uint8_t owi_device_t::id[8]  
struct Public Members
```

```
struct pin_driver_t owi_driver_t::pin  
struct owi_device_t *owi_driver_t::devices_p  
  
size_t owi_driver_t::nmemb  
  
size_t owi_driver_t::len
```

pin — Digital pins**Debug file system commands**

Three debug file system commands are available, all located in the directory `drivers/pin/`. These commands directly access the pin device registers, without using the pin driver object.

Command	Description
<code>set_mode <pin> <mode></code>	Set the mode of the pin <code><pin></code> to <code><mode></code> , where <code><mode></code> is one of output and input.
<code>read <pin></code>	Read current input or output value of the pin <code><pin></code> . high or low is printed.
<code>write <pin> <value></code>	Write the value <code><value></code> to pin <code><pin></code> , where <code><value></code> is one of high and low.

Example output from the shell:

```
$ drivers/pin/set_mode d2 output  
$ drivers/pin/read d2  
low  
$ drivers/pin/write d2 high  
$ drivers/pin/read d2  
high  
$ drivers/pin/set_mode d3 input  
$ drivers/pin/read d3  
low
```

Source code: [src/drivers/pin.h](#), [src/drivers/pin.c](#)

Test code: [tst/drivers/pin/main.c](#)

Defines

PIN_OUTPUT

PIN_INPUT

Configure the pin as an input pin.

Functions

int **pin_module_init** (void)

Initialize the pin module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **pin_init** (struct pin_driver_t *self_p, struct pin_device_t *dev_p, int mode)

Initialize given driver object with given device and mode.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: Device to use.
- mode: Pin mode. One of PIN_INPUT or PIN_OUTPUT.

int **pin_write** (struct pin_driver_t *self_p, int value)

Write given value to given pin.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.
- value: 1 for high and 0 for low output.

int **pin_read** (struct pin_driver_t *self_p)

Read the current value of given pin.

Return 1 for high and 0 for low input, otherwise negative error code.

Parameters

- self_p: Driver object.

int **pin_toggle** (struct pin_driver_t *self_p)

Toggle the pin output value (high/low).

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.

int **pin_set_mode** (struct pin_driver_t *self_p, int mode)

Set the pin mode of given pin.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object.
- mode: New pin mode.

static int **pin_device_set_mode** (**const struct** pin_device_t *dev_p, int mode)
Pin device mode to set. One of PIN_INPUT or PIN_OUTPUT.

Return zero(0) or negative error code.

Parameters

- self_p: Pin device.
- mode: New pin mode.

static int **pin_device_read** (**const struct** pin_device_t *dev_p)
Read the value of given pin device.

Return 1 for high and 0 for low input, otherwise negative error code.

Parameters

- self_p: Pin device.

static int **pin_device_write_high** (**const struct** pin_device_t *dev_p)
Write high to given pin device.

Return zero(0) or negative error code.

Parameters

- self_p: Pin device.

static int **pin_device_write_low** (**const struct** pin_device_t *dev_p)
Write low to given pin device.

Return zero(0) or negative error code.

Parameters

- self_p: Pin device.

Variables

struct pin_device_t **pin_device**[PIN_DEVICE_MAX]

pwm — Pulse width modulation

Source code: [src/drivers/pwm.h](#), [src/drivers/pwm.c](#)

Functions

int **pwm_init** (**struct** pwm_driver_t *self_p, **struct** pwm_device_t *dev_p)
Initialize driver object.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `dev_p`: Device to use.

int **pwm_set_duty** (**struct** pwm_driver_t **self_p*, uint8_t *value*)
Set the duty cycle.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object.
- `value`: Value to set [0..255].

int **pwm_get_duty** (**struct** pwm_driver_t **self_p*)
Get current duty cycle.

Return Value in the range [0..255], or negative error code.

Parameters

- `self_p`: Driver object.

struct pwm_device_t ***pwm_pin_to_device** (**struct** pin_device_t **pin_p*)
Get the PWM device for given pin.

Return PWM device, or NULL on error.

Parameters

- `pin_p`: The pin device to get the pwm device for.

Variables

struct pwm_device_t **pwm_device**[PWM_DEVICE_MAX]

sd — Secure Digital memory

Source code: [src/drivers/sd.h](#), [src/drivers/sd.c](#)

Test code: [tst/drivers/sd/main.c](#)

Defines

SD_ERR_NORESPONSE_WAIT_FOR_DATA_START_BLOCK

SD_ERR_GO_IDLE_STATE

SD_ERR_CRC_ON_OFF

SD_ERR_SEND_IF_COND

SD_ERR_CHECK_PATTERN

SD_ERR_SD_SEND_OP_COND

`SD_ERR_READ_OCR`
`SD_ERR_READ_COMMAND`
`SD_ERR_READ_DATA_START_BLOCK`
`SD_ERR_READ_WRONG_DATA_CRC`
`SD_ERR_WRITE_BLOCK`
`SD_ERR_WRITE_BLOCK_TOKEN_DATA_RES_ACCEPTED`
`SD_ERR_WRITE_BLOCK_WAIT_NOT_BUSY`
`SD_ERR_WRITE_BLOCK_SEND_STATUS`
`SD_BLOCK_SIZE`
`SD_CCC` (`csd_p`)
`SD_C_SIZE` (`csd_p`)
`SD_C_SIZE_MULT` (`csd_p`)
`SD_SECTOR_SIZE` (`csd_p`)
`SD_WRITE_BL_LEN` (`csd_p`)
`SD_CSD_STRUCTURE_V1`
`SD_CSD_STRUCTURE_V2`

Functions

int **sd_init** (**struct** *sd_driver_t* **self_p*, **struct** spi_driver_t **spi_p*)
Initialize given driver object.

Return zero(0) or negative error code.

Parameters

- *self_p*: Driver object to initialize.

int **sd_start** (**struct** *sd_driver_t* **self_p*)
Start given SD card driver. This resets the SD card and performs the initialization sequence.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized driver object.

int **sd_stop** (**struct** *sd_driver_t* **self_p*)
Stop given SD card driver.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized driver object.

ssize_t **sd_read_cid**(struct *sd_driver_t* *self_p, struct *sd_cid_t* *cid_p)

Read card CID register. The CID contains card identification information such as Manufacturer ID, Product name, Product serial number and Manufacturing date.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- cid: pointer to cid data store.

ssize_t **sd_read_csd**(struct *sd_driver_t* *self_p, union *sd_csd_t* *csd_p)

Read card CSD register. The CSD contains that provides information regarding access to the card's contents.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- csd: pointer to csd data store.

ssize_t **sd_read_block**(struct *sd_driver_t* *self_p, void *dst_p, uint32_t src_block)

Read given block from SD card.

Return Number of read bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to read into.
- src_block: Block to read from.

ssize_t **sd_write_block**(struct *sd_driver_t* *self_p, uint32_t dst_block, const void *src_p)

Write data to the SD card.

Return Number of written bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- dst_block: Block to write to.
- src_p: Buffer to write.

Variables

struct *sd_csd_v2_t* **PACKED**

struct **Public Members**

uint8_t sd_cid_t::mid

char sd_cid_t::oid[2]

char sd_cid_t::pnm[5]

uint8_t sd_cid_t::prv

uint32_t sd_cid_t::psn

uint16_t sd_cid_t::mdt

uint8_t sd_cid_t::crc

struct Public Members

uint8_t sd_csd_v1_t::reserved1

uint8_t sd_csd_v1_t::csd_structure

uint8_t sd_csd_v1_t::taac

uint8_t sd_csd_v1_t::nsac

uint8_t sd_csd_v1_t::tran_speed

uint8_t sd_csd_v1_t::ccc_high

uint8_t sd_csd_v1_t::read_bl_len

uint8_t sd_csd_v1_t::ccc_low

uint8_t sd_csd_v1_t::c_size_high

uint8_t sd_csd_v1_t::reserved2

uint8_t sd_csd_v1_t::dsr_imp

uint8_t sd_csd_v1_t::read_blk_misalign

uint8_t sd_csd_v1_t::write_blk_misalign

uint8_t sd_csd_v1_t::read_bl_partial

uint8_t sd_csd_v1_t::c_size_mid

uint8_t sd_csd_v1_t::vdd_r_curr_max

uint8_t sd_csd_v1_t::vdd_r_curr_min

uint8_t sd_csd_v1_t::c_size_low

uint8_t sd_csd_v1_t::c_size_mult_high

uint8_t sd_csd_v1_t::vdd_w_curr_max

uint8_t sd_csd_v1_t::vdd_w_curr_min

uint8_t sd_csd_v1_t::sector_size_high

uint8_t sd_csd_v1_t::erase_blk_en

uint8_t sd_csd_v1_t::c_size_mult_low

uint8_t sd_csd_v1_t::wp_grp_size

uint8_t sd_csd_v1_t::sector_size_low

```

uint8_t sd_csd_v1_t::write_bl_len_high
uint8_t sd_csd_v1_t::r2w_factor
uint8_t sd_csd_v1_t::reserved3
uint8_t sd_csd_v1_t::wp_grp_enable
uint8_t sd_csd_v1_t::reserved4
uint8_t sd_csd_v1_t::write_bl_partial
uint8_t sd_csd_v1_t::write_bl_len_low
uint8_t sd_csd_v1_t::reserved5
uint8_t sd_csd_v1_t::file_format
uint8_t sd_csd_v1_t::tmp_write_protect
uint8_t sd_csd_v1_t::perm_write_protect
uint8_t sd_csd_v1_t::copy
uint8_t sd_csd_v1_t::file_format_grp
uint8_t sd_csd_v1_t::crc
struct Public Members

```

```

uint8_t sd_csd_v2_t::reserved1
uint8_t sd_csd_v2_t::csd_structure
uint8_t sd_csd_v2_t::taac
uint8_t sd_csd_v2_t::nsac
uint8_t sd_csd_v2_t::tran_speed
uint8_t sd_csd_v2_t::ccc_high
uint8_t sd_csd_v2_t::read_bl_len
uint8_t sd_csd_v2_t::ccc_low
uint8_t sd_csd_v2_t::reserved2
uint8_t sd_csd_v2_t::dsr_imp
uint8_t sd_csd_v2_t::read_blk_misalign
uint8_t sd_csd_v2_t::write_blk_misalign
uint8_t sd_csd_v2_t::read_bl_partial
uint8_t sd_csd_v2_t::c_size_high
uint8_t sd_csd_v2_t::reserved3
uint8_t sd_csd_v2_t::c_size_mid

```

```
uint8_t sd_csd_v2_t::c_size_low
uint8_t sd_csd_v2_t::sector_size_high
uint8_t sd_csd_v2_t::erase_blk_en
uint8_t sd_csd_v2_t::reserved4
uint8_t sd_csd_v2_t::wp_grp_size
uint8_t sd_csd_v2_t::sector_size_low
uint8_t sd_csd_v2_t::write_bl_len_high
uint8_t sd_csd_v2_t::r2w_factor
uint8_t sd_csd_v2_t::reserved5
uint8_t sd_csd_v2_t::wp_grp_enable
uint8_t sd_csd_v2_t::reserved6
uint8_t sd_csd_v2_t::write_bl_partial
uint8_t sd_csd_v2_t::write_bl_len_low
uint8_t sd_csd_v2_t::reserved7
uint8_t sd_csd_v2_t::file_format
uint8_t sd_csd_v2_t::tmp_write_protect
uint8_t sd_csd_v2_t::perm_write_protect
uint8_t sd_csd_v2_t::copy
uint8_t sd_csd_v2_t::file_format_grp
uint8_t sd_csd_v2_t::crc
union Public Members
```

```
struct sd_csd_v1_t sd_csd_t::v1
```

```
struct sd_csd_v2_t sd_csd_t::v2
```

```
struct Public Members
```

```
struct spi_driver_t *sd_driver_t::spi_p
```

```
int sd_driver_t::type
```

sdio — Secure Digital Input Output

Source code: [src/drivers/sdio.h](#), [src/drivers/sdio.c](#)

Defines

`SDIO_IO_RW_EXTENDED_BLOCK_MODE_BYTE`
`SDIO_IO_RW_EXTENDED_BLOCK_MODE_BLOCK`
`SDIO_IO_RW_EXTENDED_OP_CODE_FIXED_ADDRESS`
`SDIO_IO_RW_EXTENDED_OP_CODE_INCREMENTING_ADDRESS`

Functions

int **sdio_module_init** (void)

Initialize the SDIO module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **sdio_init** (struct sdio_driver_t *self_p, struct sdio_device_t *dev_p)

Initialize driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: Device to use.

int **sdio_start** (struct sdio_driver_t *self_p)

Starts the SDIO device using given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **sdio_stop** (struct sdio_driver_t *self_p)

Stops the SDIO device referenced by driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **sdio_send_relative_addr** (struct sdio_driver_t *self_p)

Send the send relative address command (CMD3) to the device and optionally wait for the response.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **sdio_io_send_op_cond** (struct sdio_driver_t *self_p)

Send the io send operation condition command (CMD5) to the device and optionally wait for the response.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **sdio_select_deselect_card** (struct sdio_driver_t *self_p)

Send the select/deselect card command (CMD7) to the device and optionally wait for the response.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **sdio_io_read_direct** (struct sdio_driver_t *self_p, void *dst_p)

Execute the input output read write direct command (CMD52) as a read operation with given parameters.

Return Number of bytes read or negative error code.

Parameters

- self_p: Initialized driver object.
- dst_p: Destination buffer.

int **sdio_io_write_direct** (struct sdio_driver_t *self_p, const void *src_p)

Execute the input output read write direct command (CMD52) as a write operation with given parameters.

Return Number of bytes written or negative error code.

Parameters

- self_p: Initialized driver object.
- src_p: Source buffer.

ssize_t **sdio_io_read_extended** (struct sdio_driver_t *self_p, int function_number, int block_mode, int op_code, void *dst_p, uint32_t src_address, size_t size)

Execute the input output read write extended command (CMD53) as a read operation with given parameters.

Return Number of bytes read or negative error code.

Parameters

- self_p: Initialized driver object.
- function_number: Function number.
- block_mode: Block or byte mode.
- op_code: Operation code.
- dst_p: Destination buffer.
- src_address: Source address.

- `size`: Number of bytes to read.

`ssize_t sdio_io_write_extended(struct sdio_driver_t *self_p, int function_number, int block_mode, int op_code, uint32_t dst_address, const void *src_p, size_t size)`

Execute the input output read write extended command (CMD53) as a write operation with given parameters.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `function_number`: Function number.
- `block_mode`: Block or byte mode.
- `op_code`: Operation code.
- `dst_address`: Destination address.
- `src_p`: Source buffer.
- `size`: Number of bytes to write.

Variables

`struct sdio_device_t sdio_device[SDIO_DEVICE_MAX]`

struct Public Members

```
uint8_t sdio_io_rw_extended_t::rw_flag
uint8_t sdio_io_rw_extended_t::function_number
uint8_t sdio_io_rw_extended_t::block_mode
uint8_t sdio_io_rw_extended_t::op_code
uint8_t sdio_io_rw_extended_t::register_address_16_15
uint8_t sdio_io_rw_extended_t::register_address_14_7
uint8_t sdio_io_rw_extended_t::register_address_6_0
uint8_t sdio_io_rw_extended_t::byte_block_count_8
uint8_t sdio_io_rw_extended_t::byte_block_count_7_0
```

spi — Serial Peripheral Interface

Source code: [src/drivers/spi.h](#), [src/drivers/spi.c](#)

Defines

SPI_MODE_SLAVE
SPI_MODE_MASTER
SPI_SPEED_8MBPS
SPI_SPEED_4MBPS
SPI_SPEED_2MBPS
SPI_SPEED_1MBPS
SPI_SPEED_500KBPS
SPI_SPEED_250KBPS
SPI_SPEED_125KBPS

Functions

int **spi_module_init** (void)

Initialize SPI module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **spi_init** (struct spi_driver_t *self_p, struct spi_device_t *dev_p, struct pin_device_t *ss_pin_p, int mode, int speed, int polarity, int phase)
Initialize driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to initialize.
- dev_p: Device to use.
- ss_pin_p: Slave select pin device.
- mode: Master or slave mode.
- speed: Speed in kbps.
- polarity: Set to 0 or 1.
- phase: Set to 0 or 1.

int **spi_start** (struct spi_driver_t *self_p)

Start given SPI driver. Configures the SPI hardware.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **spi_stop** (struct spi_driver_t *self_p)

Stop given SPI driver. Deconfigures the SPI hardware if given driver currently owns the bus.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

int **spi_take_bus** (**struct** spi_driver_t **self_p*)

In multi master application the driver must take ownership of the SPI bus before performing data transfers. Will re-configure the SPI hardware if configured by another driver.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

int **spi_give_bus** (**struct** spi_driver_t **self_p*)

In multi master application the driver must give ownership of the SPI bus to let other masters take it.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

int **spi_select** (**struct** spi_driver_t **self_p*)

Select the slave by asserting the slave select pin.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

int **spi_deselect** (**struct** spi_driver_t **self_p*)

Deselect the slave by de-asserting the slave select pin.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

ssize_t **spi_transfer** (**struct** spi_driver_t **self_p*, void **rxbuf_p*, **const** void **txbuf_p*, size_t *size*)

Simultaneous read/write operation over the SPI bus.

Return Number of transferred bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `rxbuf_p`: Buffer to read into.
- `txbuf_p`: Buffer to write.
- `size`: Number of bytes to transfer.

ssize_t **spi_read** (**struct** spi_driver_t **self_p*, void **buf_p*, size_t *size*)

Read data from the SPI bus.

Return Number of read bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to receive.

`ssize_t spi_write (struct spi_driver_t *self_p, const void *buf_p, size_t size)`
Write data to the SPI bus.

Return Number of written bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

`ssize_t spi_get (struct spi_driver_t *self_p, uint8_t *data_p)`
Get one byte of data from the SPI bus.

Return Number of read bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `data_p`: Read data.

`ssize_t spi_put (struct spi_driver_t *self_p, uint8_t data)`
Put one byte of data to the SPI bus.

Return Number of written bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `data`: data to write.

Variables

`struct spi_device_t spi_device[SPI_DEVICE_MAX]`

uart — Universal Asynchronous Receiver/Transmitter

Source code: [src/drivers/uart.h](#), [src/drivers/uart.c](#)

Test code: [tst/drivers/uart/main.c](#)

Defines

uart_read(self_p, buf_p, size)

Read data from the UART.

Return Number of received bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to read into.
- size: Number of bytes to receive.

uart_write(self_p, buf_p, size)

Write data to the UART.

Return Number of written bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to write.
- size: Number of bytes to write.

Typedefs

typedef

Functions

int uart_module_init(void)

Initialize UART module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int uart_init(**struct** uart_driver_t *self_p, **struct** uart_device_t *dev_p, long baudrate, void *rxbuf_p, size_t size)

Initialize driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- dev_p: Device to use.
- baudrate: Baudrate.
- rxbuf_p: Reception buffer.
- size: Reception buffer size.

int **uart_set_rx_filter_cb** (struct uart_driver_t *self_p, *uart_rx_filter_cb_t* rx_filter_cb)
Set the reception filter callback function.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- rx_filter_cb: Callback to set.

int **uart_start** (struct uart_driver_t *self_p)
Starts the UART device using given driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **uart_stop** (struct uart_driver_t *self_p)
Stops the UART device referenced by driver object.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

Variables

struct uart_device_t **uart_device**[UART_DEVICE_MAX]

uart_soft — Bitbang UART

Source code: [src/drivers/uart_soft.h](#), [src/drivers/uart_soft.c](#)

Defines

uart_soft_read (self_p, buf_p, size)
Read data from the UART.

Return Number of received bytes or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to read into.
- size: Number of bytes to receive.

uart_soft_write (self_p, buf_p, size)
Write data to the UART.

Return number of sent bytes or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

Functions

```
int uart_soft_init (struct uart_soft_driver_t *self_p, struct pin_device_t *tx_dev_p, struct pin_device_t
                    *rx_dev_p, struct exti_device_t *rx_exti_dev_p, int baudrate, void *rxbuf_p, size_t
                    size)
```

Initialize driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `tx_dev_p`: TX pin device.
- `rx_dev_p`: RX pin device.
- `rx_exti_dev_p`: RX pin external interrupt device.
- `baudrate`: Baudrate.
- `rxbuf_p`: Reception buffer.
- `size`: Reception buffer size.

struct `#include <uart_soft.h>` **Public Members**

```
struct pin_driver_t uart_soft_driver_t::tx_pin
struct pin_driver_t uart_soft_driver_t::rx_pin
struct exti_driver_t uart_soft_driver_t::rx_exti
struct chan_t uart_soft_driver_t::chout
struct queue_t uart_soft_driver_t::chin
int uart_soft_driver_t::sample_time
int uart_soft_driver_t::baudrate
```

usb — Universal Serial Bus

Source code: [src/drivers/usb.h](#), [src/drivers/usb.c](#)

Defines

REQUEST_TYPE_DATA_MASK
REQUEST_TYPE_DATA_DIRECTION_HOST_TO_DEVICE
REQUEST_TYPE_DATA_DIRECTION_DEVICE_TO_HOST
REQUEST_TYPE_TYPE_MASK
REQUEST_TYPE_TYPE_STANDARD
REQUEST_TYPE_TYPE_CLASS
REQUEST_TYPE_TYPE_VENDOR
REQUEST_TYPE_RECIPIENT_MASK
REQUEST_TYPE_RECIPIENT_DEVICE
REQUEST_TYPE_RECIPIENT_INTERFACE
REQUEST_TYPE_RECIPIENT_ENDPOINT
REQUEST_TYPE_RECIPIENT_OTHER
REQUEST_GET_STATUS
REQUEST_SET_ADDRESS
REQUEST_GET_DESCRIPTOR
REQUEST_SET_CONFIGURATION
DESCRIPTOR_TYPE_DEVICE
DESCRIPTOR_TYPE_CONFIGURATION
DESCRIPTOR_TYPE_STRING
DESCRIPTOR_TYPE_INTERFACE
DESCRIPTOR_TYPE_ENDPOINT
DESCRIPTOR_TYPE_INTERFACE_ASSOCIATION
DESCRIPTOR_TYPE_RPIPE
DESCRIPTOR_TYPE_CDC
USB_CLASS_USE_INTERFACE
USB_CLASS_AUDIO
USB_CLASS_CDC_CONTROL
USB_CLASS_HID
USB_CLASS_PHYSICAL
USB_CLASS_IMAGE
USB_CLASS_PRINTER
USB_CLASS_MASS_STORAGE
USB_CLASS_HUB
USB_CLASS_CDC_DATA
USB_CLASS_SMART_CARD

USB_CLASS_CONTENT_SECURITY
USB_CLASS_VIDEO
USB_CLASS_PERSONAL_HEALTHCARE
USB_CLASS_AUDIO_VIDEO_DEVICES
USB_CLASS_BILLBOARD_DEVICE_CLASS
USB_CLASS_DIAGNOSTIC_DEVICE
USB_CLASS_WIRELESS_CONTROLLER
USB_CLASS_MISCELLANEOUS
USB_CLASS_APPLICATION_SPECIFIC
USB_CLASS_VENDOR_SPECIFIC
ENDPOINT_ENDPOINT_ADDRESS_DIRECTION (address)
ENDPOINT_ENDPOINT_ADDRESS_NUMBER (address)
ENDPOINT_ATTRIBUTES_USAGE_TYPE (attributes)
ENDPOINT_ATTRIBUTES_SYNCHRONISATION_TYPE (attributes)
ENDPOINT_ATTRIBUTES_TRANSFER_TYPE (attributes)
ENDPOINT_ATTRIBUTES_TRANSFER_TYPE_CONTROL
ENDPOINT_ATTRIBUTES_TRANSFER_TYPE_ISOCHRONOUS
ENDPOINT_ATTRIBUTES_TRANSFER_TYPE_BULK
ENDPOINT_ATTRIBUTES_TRANSFER_TYPE_INTERRUPT
CONFIGURATION_ATTRIBUTES_BUS_POWERED
USB_CDC_LINE_CODING
USB_CDC_CONTROL_LINE_STATE
USB_CDC_SEND_BREAK
USB_MESSAGE_TYPE_ADD
USB_MESSAGE_TYPE_REMOVE

Functions

int **usb_format_descriptors** (void **out_p*, uint8_t **buf_p*, size_t *size*)

Format the descriptors and write them to given channel.

Return zero(0) or negative error code.

Parameters

- *out_p*: Output channel.
- *buf_p*: Pointer to the descriptors to format.
- *size*: Number of bytes in the descriptors buffer.

```
struct usb_descriptor_configuration_t *usb_desc_get_configuration (uint8_t *desc_p, size_t size,  
                                                                    int configuration)
```

Get the configuration descriptor for given configuration index.

Return Configuration or NULL on failure.

Parameters

- *buf_p*: Pointer to the descriptors.
- *size*: Number of bytes in the descriptors buffer.
- *configuration*: Configuration to find.

```
struct usb_descriptor_interface_t *usb_desc_get_interface (uint8_t *desc_p, size_t size, int configu-  
                                                                    ration, int interface)
```

Get the interface descriptor for given configuration and interface index.

Return Interface or NULL on failure.

Parameters

- *buf_p*: Pointer to the descriptors.
- *size*: Number of bytes in the descriptors buffer.
- *configuration*: Configuration to find.
- *interface*: Interface to find.

```
struct usb_descriptor_endpoint_t *usb_desc_get_endpoint (uint8_t *desc_p, size_t size, int configura-  
                                                                    tion, int interface, int endpoint)
```

Get the endpoint descriptor for given configuration, interface and endpoint index.

Return Endpoint or NULL on failure.

Parameters

- *buf_p*: Pointer to the descriptors.
- *size*: Number of bytes in the descriptors buffer.
- *configuration*: Configuration to find.
- *interface*: Interface to find.
- *endpoint*: Endpoint to find.

```
int usb_desc_get_class (uint8_t *buf_p, size_t size, int configuration, int interface)
```

Get the interface class.

Return

Parameters

- *buf_p*: Pointer to the descriptors.
- *size*: Number of bytes in the descriptors buffer.
- *configuration*: Configuration to find.
- *interface*: Interface to find.

Variables

```

struct usb_device_t usb_device[USB_DEVICE_MAX]
    struct Public Members

    uint8_t usb_setup_t::request_type

    uint8_t usb_setup_t::request

    uint16_t usb_setup_t::feature_selector

    uint16_t usb_setup_t::zero_interface_endpoint

    struct usb_setup_t::@17::@18  usb_setup_t::clear_feature

    uint16_t usb_setup_t::zero0

    uint16_t usb_setup_t::zero1

    struct usb_setup_t::@17::@19  usb_setup_t::get_configuration

    uint8_t usb_setup_t::descriptor_index

    uint8_t usb_setup_t::descriptor_type

    uint16_t usb_setup_t::language_id

    struct usb_setup_t::@17::@20  usb_setup_t::get_descriptor

    uint16_t usb_setup_t::device_address

    uint16_t usb_setup_t::zero

    struct usb_setup_t::@17::@21  usb_setup_t::set_address

    uint16_t usb_setup_t::configuration_value

    struct usb_setup_t::@17::@22  usb_setup_t::set_configuration

    uint16_t usb_setup_t::value

    uint16_t usb_setup_t::index

    struct usb_setup_t::@17::@23  usb_setup_t::base

    union usb_setup_t::@17  usb_setup_t::u

    uint16_t usb_setup_t::length
    struct Public Members

    uint8_t usb_descriptor_header_t::length

    uint8_t usb_descriptor_header_t::descriptor_type
    struct Public Members

    uint8_t usb_descriptor_device_t::length

    uint8_t usb_descriptor_device_t::descriptor_type

    uint16_t usb_descriptor_device_t::bcd_usb

```

```
uint8_t usb_descriptor_device_t::device_class
uint8_t usb_descriptor_device_t::device_subclass
uint8_t usb_descriptor_device_t::device_protocol
uint8_t usb_descriptor_device_t::max_packet_size_0
uint16_t usb_descriptor_device_t::id_vendor
uint16_t usb_descriptor_device_t::id_product
uint16_t usb_descriptor_device_t::bcd_device
uint8_t usb_descriptor_device_t::manufacturer
uint8_t usb_descriptor_device_t::product
uint8_t usb_descriptor_device_t::serial_number
uint8_t usb_descriptor_device_t::num_configurations
struct Public Members
```

```
uint8_t usb_descriptor_configuration_t::length
uint8_t usb_descriptor_configuration_t::descriptor_type
uint16_t usb_descriptor_configuration_t::total_length
uint8_t usb_descriptor_configuration_t::num_interfaces
uint8_t usb_descriptor_configuration_t::configuration_value
uint8_t usb_descriptor_configuration_t::configuration
uint8_t usb_descriptor_configuration_t::configuration_attributes
uint8_t usb_descriptor_configuration_t::max_power
struct Public Members
```

```
uint8_t usb_descriptor_interface_t::length
uint8_t usb_descriptor_interface_t::descriptor_type
uint8_t usb_descriptor_interface_t::interface_number
uint8_t usb_descriptor_interface_t::alternate_setting
uint8_t usb_descriptor_interface_t::num_endpoints
uint8_t usb_descriptor_interface_t::interface_class
uint8_t usb_descriptor_interface_t::interface_subclass
uint8_t usb_descriptor_interface_t::interface_protocol
uint8_t usb_descriptor_interface_t::interface
```

struct Public Members

```
uint8_t usb_descriptor_endpoint_t::length
uint8_t usb_descriptor_endpoint_t::descriptor_type
uint8_t usb_descriptor_endpoint_t::endpoint_address
uint8_t usb_descriptor_endpoint_t::attributes
uint16_t usb_descriptor_endpoint_t::max_packet_size
uint8_t usb_descriptor_endpoint_t::interval
```

struct Public Members

```
uint8_t usb_descriptor_string_t::length
uint8_t usb_descriptor_string_t::descriptor_type
uint8_t usb_descriptor_string_t::string[256]
```

struct Public Members

```
uint8_t usb_descriptor_interface_association_t::length
uint8_t usb_descriptor_interface_association_t::descriptor_type
uint8_t usb_descriptor_interface_association_t::first_interface
uint8_t usb_descriptor_interface_association_t::interface_count
uint8_t usb_descriptor_interface_association_t::function_class
uint8_t usb_descriptor_interface_association_t::function_subclass
uint8_t usb_descriptor_interface_association_t::function_protocol
uint8_t usb_descriptor_interface_association_t::function
```

struct Public Members

```
uint8_t usb_descriptor_cdc_header_t::length
uint8_t usb_descriptor_cdc_header_t::descriptor_type
uint8_t usb_descriptor_cdc_header_t::sub_type
uint16_t usb_descriptor_cdc_header_t::bcd
```

struct Public Members

```
uint8_t usb_descriptor_cdc_acm_t::length
uint8_t usb_descriptor_cdc_acm_t::descriptor_type
uint8_t usb_descriptor_cdc_acm_t::sub_type
uint8_t usb_descriptor_cdc_acm_t::capabilities
```

struct Public Members

```
uint8_t usb_descriptor_cdc_union_t::length
uint8_t usb_descriptor_cdc_union_t::descriptor_type
uint8_t usb_descriptor_cdc_union_t::sub_type
uint8_t usb_descriptor_cdc_union_t::master_interface
uint8_t usb_descriptor_cdc_union_t::slave_interface
struct Public Members
```

```
uint8_t usb_descriptor_cdc_call_management_t::length
uint8_t usb_descriptor_cdc_call_management_t::descriptor_type
uint8_t usb_descriptor_cdc_call_management_t::sub_type
uint8_t usb_descriptor_cdc_call_management_t::capabilities
uint8_t usb_descriptor_cdc_call_management_t::data_interface
union Public Members
```

```
struct usb_descriptor_header_t usb_descriptor_t::header
struct usb_descriptor_device_t usb_descriptor_t::device
struct usb_descriptor_configuration_t usb_descriptor_t::configuration
struct usb_descriptor_interface_t usb_descriptor_t::interface
struct usb_descriptor_endpoint_t usb_descriptor_t::endpoint
struct usb_descriptor_string_t usb_descriptor_t::string
struct Public Members
```

```
uint32_t usb_cdc_line_info_t::dte_rate
uint8_t usb_cdc_line_info_t::char_format
uint8_t usb_cdc_line_info_t::parity_type
uint8_t usb_cdc_line_info_t::data_bits
struct Public Members
```

```
int usb_message_header_t::type
struct Public Members
```

```
struct usb_message_header_t usb_message_add_t::header
int usb_message_add_t::device
union Public Members
```

```
struct usb_message_header_t usb_message_t::header
```

```
struct usb_message_add_t usb_message_t : : add
```

usb_device — Universal Serial Bus - Device

A USB device is powered and enumerated by a USB host.

The implementation of this module aims to be simple, but yet flexible. It's possible to change the USB configuration descriptors at runtime by stopping the current driver, initialize a new driver and start the new driver. For simple devices only a single configuration is normally needed.

Using the USB device module is fairly easy. First write the USB descriptors, then initialize the class drivers, then initialize the USB device driver and then start it.

See the test code below for an example usage.

Class driver modules:

usb_device_class_cdc — CDC ACM (serial port over USB)

USB CDC (Communications Device Class) ACM (Abstract Control Model) is a vendor-independent publicly documented protocol that can be used for emulating serial ports over USB.

More information on [Wikipedia](#).

Source code: [src/drivers/usb/device/class/cdc.h](#), [src/drivers/usb/device/class/cdc.c](#)

Test code: [tst/drivers/usb_device/main.c](#)

Defines

usb_device_class_cdc_read(self_p, buf_p, size)

Read data from the CDC driver.

Return Number of bytes read or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to read into.
- size: Number of bytes to read.

usb_device_class_cdc_write(self_p, buf_p, size)

Write data to the CDC driver.

Return Number of bytes written or negative error code.

Parameters

- self_p: Initialized driver object.
- buf_p: Buffer to write.
- size: Number of bytes to write.

Functions

int **usb_device_class_cdc_module_init** (void)

Initialize the CDC module.

Return zero(0) or negative error code.

int **usb_device_class_cdc_init** (struct *usb_device_class_cdc_driver_t* *self_p, int control_interface,
int endpoint_in, int endpoint_out, void *rxbuf_p, size_t size)

Initialize driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- rxbuf_p: Reception buffer.
- size: Reception buffer size.

int **usb_device_class_cdc_input_isr** (struct *usb_device_class_cdc_driver_t* *self_p)

Called by the USB device driver periodically to let the CDC driver read received data from the hardware.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.

int **usb_device_class_cdc_is_connected** (struct *usb_device_class_cdc_driver_t* *self_p)

Check if the CDC is connected to the remote endpoint.

Return true(1) if connected, false(0) if disconnected, otherwise negative error code.

Parameters

- self_p: Initialized driver object.

struct *#include <cdc.h>* **Public Members**

struct usb_device_driver_base_t usb_device_class_cdc_driver_t::base

struct usb_device_driver_t *usb_device_class_cdc_driver_t::drv_p

int usb_device_class_cdc_driver_t::control_interface

int usb_device_class_cdc_driver_t::endpoint_in

int usb_device_class_cdc_driver_t::endpoint_out

int usb_device_class_cdc_driver_t::line_state

struct *usb_cdc_line_info_t* usb_device_class_cdc_driver_t::line_info

struct *chan_t* usb_device_class_cdc_driver_t::chout

struct *queue_t* usb_device_class_cdc_driver_t::chin

Source code: `src/drivers/usb_device.h`, `src/drivers/usb_device.c`

Test code: `tst/drivers/usb_device/main.c`

Functions

`int usb_device_module_init (void)`

`int usb_device_init(struct usb_device_driver_t * self_p, struct usb_device_t * dev_p, s`
Initialize the USB device driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- `self_p`: Driver object to be initialized.
- `dev_p`: USB device to use.
- `drivers_pp`: An array of initialized drivers.
- `drivers_max`: Length of the drivers array.
- `descriptors_pp`: A NULL terminated array of USB descriptors.

`int usb_device_start (struct usb_device_driver_t *self_p)`
Start the USB device device using given driver object.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

`int usb_device_stop (struct usb_device_driver_t *self_p)`
Stop the USB device device referenced by driver object.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.

`ssize_t usb_device_write (struct usb_device_driver_t *self_p, int endpoint, const void *buf_p, size_t`
size
Write data to given endpoint.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `endpoint`: Endpoint to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

`ssize_t usb_device_read_isr (struct usb_device_driver_t *self_p, int endpoint, void *buf_p, size_t size)`
Read data from given endpoint from an isr or with the system lock taken.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `endpoint`: Endpoint to read data from.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read.

`ssize_t usb_device_write_isr (struct usb_device_driver_t *self_p, int endpoint, const void *buf_p, size_t size)`
Write data to given endpoint from an isr or with the system lock taken.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `endpoint`: Endpoint to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

usb_host — Universal Serial Bus - Host

A USB host powers the bus and enumerates connected USB devices.

Class driver modules:

usb_host_class_hid — Human Interface Device (HID)

In computing, the USB human interface device class (USB HID class) is a part of the USB specification for computer peripherals: it specifies a device class (a type of computer hardware) for human interface devices such as keyboards, mice, game controllers and alphanumeric display devices.

More information on [Wikipedia](#).

Source code: [src/drivers/usb/host/class/hid.h](#), [src/drivers/usb/host/class/hid.c](#)

Defines

```

USB_CLASS_HID_SUBCLASS_NONE
USB_CLASS_HID_SUBCLASS_BOOT_INTERFACE
USB_CLASS_HID_PROTOCOL_NONE
USB_CLASS_HID_PROTOCOL_KEYBOARD
USB_CLASS_HID_PROTOCOL_MOUSE

```

Functions

int **usb_host_class_hid_init** (struct *usb_host_class_hid_driver_t* *self_p, struct usb_host_driver_t *usb_p, struct *usb_host_class_hid_device_t* *devices_p, size_t length)
 Initialize driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- self_p: Driver object to be initialized.
- usb_p: USB driver to use.
- devices_p: Array of devices. One entry in this array is allocated for each HID device that is connected to the host.
- length: Length of the devices array.

int **usb_host_class_hid_start** (struct *usb_host_class_hid_driver_t* *self_p)
 Starts the HID driver.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object to start.

int **usb_host_class_hid_stop** (struct *usb_host_class_hid_driver_t* *self_p)
 Stops the HID driver.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized to stop.

struct Public Members

```

uint8_t usb_host_class_hid_device_t::buf[1]
struct Public Members

```

```

struct usb_host_driver_t *usb_host_class_hid_driver_t::usb_p

```

```

struct usb_host_class_hid_device_t *usb_host_class_hid_driver_t::devices_p

```

```

size_t usb_host_class_hid_driver_t::length

```

```
size_t usb_host_class_hid_driver_t::size
struct usb_host_class_hid_driver_t::@15  usb_host_class_hid_driver_t::report
struct usb_host_device_driver_t usb_host_class_hid_driver_t::device_driver
```

usb_host_class_mass_storage — Mass Storage

The USB mass storage device class (also known as USB MSC or UMS) is a set of computing communications protocols defined by the USB Implementers Forum that makes a USB device accessible to a host computing device and enables file transfers between the host and the USB device. To a host, the USB device acts as an external hard drive; the protocol set interfaces with a number of storage devices.

More information on [Wikipedia](#).

Source code: [src/drivers/usb/host/class/mass_storage.h](#), [src/drivers/usb/host/class/mass_storage.c](#)

Functions

```
int usb_host_class_mass_storage_init (struct          usb_host_class_mass_storage_driver_t
                                     *self_p, struct  usb_host_driver_t *usb_p, struct
                                     usb_host_class_mass_storage_device_t      *devices_p,
                                     size_t length)
int usb_host_class_mass_storage_start (struct usb_host_class_mass_storage_driver_t *self_p)
int usb_host_class_mass_storage_stop (struct usb_host_class_mass_storage_driver_t *self_p)
ssize_t usb_host_class_mass_storage_device_read (struct usb_host_device_t *device_p, void
                                                *buf_p, size_t address, size_t size)
```

struct *#include <mass_storage.h>* **Public Members**

```
uint8_t usb_host_class_mass_storage_device_t::buf[1]
struct Public Members
```

```
struct usb_host_driver_t *usb_host_class_mass_storage_driver_t::usb_p
struct usb_host_class_mass_storage_device_t *usb_host_class_mass_storage_driver_t::devices_p
size_t usb_host_class_mass_storage_driver_t::length
size_t usb_host_class_mass_storage_driver_t::size
struct usb_host_class_mass_storage_driver_t::@16  usb_host_class_mass_storage_driver_t
struct usb_host_device_driver_t usb_host_class_mass_storage_driver_t::device_driver
```

Source code: [src/drivers/usb_host.h](#), [src/drivers/usb_host.c](#)

Defines

```

USB_HOST_DEVICE_STATE_NONE
USB_HOST_DEVICE_STATE_ATTACHED
USB_PIPE_TYPE_CONTROL
USB_PIPE_TYPE_INTERRUPT
USB_PIPE_TYPE_ISOCHRONOUS
USB_PIPE_TYPE_BULK

```

Functions

int **usb_host_module_init** (void)

Initialize the USB host module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **usb_host_init** (**struct** usb_host_driver_t **self_p*, **struct** usb_device_t **dev_p*, **struct** *usb_host_device_t* **devices_p*, size_t *length*)

Initialize the USB host driver object from given configuration.

Return zero(0) or negative error code.

Parameters

- *self_p*: Driver object to be initialized.
- *dev_p*: USB device to use.
- *devices_p*: An array of devices. One entry in this array is allocated for each USB device that is connected to the host.
- *length*: Length of the devices array.

int **usb_host_start** (**struct** usb_host_driver_t **self_p*)

Start the USB host device using given driver object.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized driver object.

int **usb_host_stop** (**struct** usb_host_driver_t **self_p*)

Stop the USB host device referenced by driver object.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized driver object.

```
int usb_host_driver_add (struct usb_host_driver_t *self_p, struct usb_host_device_driver_t *driver_p,  
                        void *arg_p)
```

Add given class/vendor driver to the USB host driver.

When a USB device is plugged in, its class and vendor information is read by the host. Those values are used to find the device driver for this particular device. If there is no driver, the device cannot be configured and will not work.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- driver_p: USB device driver to add.

```
int usb_host_driver_remove (struct usb_host_driver_t *self_p, struct usb_host_device_driver_t  
                           *driver_p)
```

Remove given class/vendor driver from the USB host driver.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- driver_p: USB device driver to remove.

```
struct usb_host_device_t *usb_host_device_open (struct usb_host_driver_t *self_p, int device)
```

Open given device in given driver. Open a device before reading and writing data to it with `usb_host_device_read()` or `usb_host_device_write()`.

Return Opened device or NULL on failure.

Parameters

- self_p: Initialized driver.
- device: Device to open.

```
int usb_host_device_close (struct usb_host_driver_t *self_p, int device)
```

Close given device in given driver.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver.
- device: Device to close.

```
ssize_t usb_host_device_read (struct usb_host_device_t *device_p, int endpoint, void *buf_p, size_t  
                             size)
```

Read data from given endpoint for given device.

Return Number of bytes read or negative error code.

Parameters

- device_p: Device to read from.
- endpoint: Endpoint to read data from.

- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read.

`ssize_t usb_host_device_write (struct usb_host_device_t *device_p, int endpoint, const void *buf_p, size_t size)`
Write data to given endpoint for given device.

Return Number of bytes written or negative error code.

Parameters

- `device_p`: Device to write to.
- `endpoint`: Endpoint to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

`ssize_t usb_host_device_control_transfer (struct usb_host_device_t *device_p, struct usb_setup_t *setup_p, void *buf_p, size_t size)`

Perform a control transfer on endpoint zero(0).

A control transfer can have up to three stages. First the setup stage, then an optional data stage, and at last a status stage.

Return Number of bytes read/written or negative error code.

Parameters

- `device_p`: Device to write to.
- `setup_p`: Setup packet to write.
- `buf_p`: Buffer to read/write. May be NULL if no data shall be transferred.
- `size`: Number of bytes to read/write.

`int usb_host_device_set_configuration (struct usb_host_device_t *device_p, uint8_t configuration)`

Set configuration for given device.

Return zero(0) or negative error code.

Parameters

- `device_p`: Device to use.
- `configuration`: Configuration to set.

struct `#include <usb_host.h>` An USB device as seen by the host. **Public Members**

`int usb_host_device_t::id`

`int usb_host_device_t::state`

`int usb_host_device_t::address`

`int usb_host_device_t::vid`

`int usb_host_device_t::pid`

```
char *usb_host_device_t::description_p
size_t usb_host_device_t::max_packet_size
uint8_t usb_host_device_t::configuration
struct usb_descriptor_device_t *usb_host_device_t::dev_p
struct usb_descriptor_configuration_t *usb_host_device_t::conf_p
struct usb_host_device_t::@24::@26  usb_host_device_t::descriptor
struct usb_host_device_t::@24  usb_host_device_t::current
struct usb_host_driver_t *usb_host_device_t::self_p
struct usb_pipe_t *usb_host_device_t::pipes[32]
size_t usb_host_device_t::size
uint8_t usb_host_device_t::buf[128]
struct usb_host_device_t::@25  usb_host_device_t::descriptors
struct #include <usb_host.h> Used to find a device driver. Public Members

int (*usb_host_device_driver_t::supports)(struct usb_host_device_t *)
int (*usb_host_device_driver_t::enumerate)(struct usb_host_device_t *)
struct usb_host_device_driver_t *usb_host_device_driver_t::next_p
```

watchdog — Hardware watchdog

Source code: [src/drivers/watchdog.h](#), [src/drivers/watchdog.c](#)

Functions

int **watchdog_module_init** (void)

int **watchdog_start_ms** (int *timeout*)

Start the watchdog with given timeout. Use `watchdog_kick()` to periodically restart the timer.

Return zero(0) or negative error code.

Parameters

- `timeout`: Watchdog timeout in milliseconds.

int **watchdog_stop** (void)

Stop the watchdog.

Return zero(0) or negative error code.

int **watchdog_kick** (void)

Kick the watchdog. Restarts the watchdog timer with its original timeout given to `watchdog_start_ms()`. The board will be reset if this function is not called before the watchdog timer expires.

Return zero(0) or negative error code.

1.6.3 sync

Thread synchronization refers to the idea that multiple threads are to join up or handshake at a certain point, in order to reach an agreement or commit to a certain sequence of action.

The sync package on [Github](#).

bus — Message bus

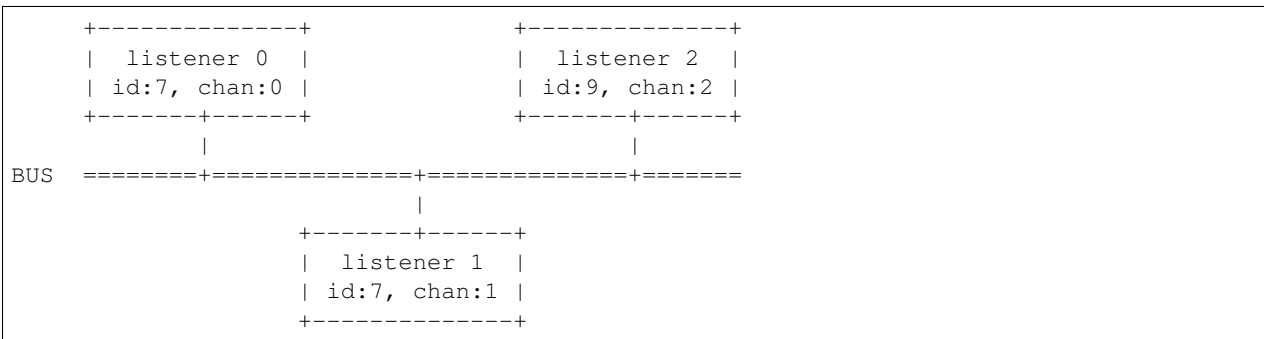
A message bus provides a software-bus abstraction that gathers all the communications between a group of threads over a single shared virtual channel. Messages are transferred on the bus from a sender to one or more attached listeners. The concept is analogous to the bus concept found in computer hardware architecture.

Example

In this example there is a bus with three listeners attached; listener 0 , 1 and 2 . Listener 0 and 1 are attached to the bus listening for message id 7 , and listener 2 for message id 9 .

Any thread can write a message to the bus by calling `bus_write()`. If a message with id 7 is written to the bus, both listener 0 and 1 will receive the message. Listener 2 will receive messages with id 9.

Messages are read from the listener channel by the thread that owns the listener.



Source code: [src/sync/bus.h](#), [src/sync/bus.c](#)

Test code: `tst/sync/bus/main.c`

Test coverage: [src/sync/bus.c](#)

Functions

```
int bus_module_init(void)
```

Initialize the bus module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code

int **bus_init** (**struct** *bus_t* **self_p*)

Initialize given bus.

Return zero(0) or negative error code.

Parameters

- *self_p*: Bus to initialize.

int **bus_listener_init** (**struct** *bus_listener_t* **self_p*, int *id*, void **chan_p*)

Initialize given listener to receive messages with given id, after the listener is attached to the bus. A listener can only receive messages of a single id, though, the same channel may be used in multiple listeners with different ids (if the channel supports it).

Return zero(0) or negative error code.

Parameters

- *self_p*: Listener to initialize.
- *id*: Message id to receive.
- *chan_p*: Channel to receive messages on.

int **bus_attach** (**struct** *bus_t* **self_p*, **struct** *bus_listener_t* **listener_p*)

Attach given listener to given bus. Messages written to the bus will be written to all listeners initialized with the written message id.

Return zero(0) or negative error code.

Parameters

- *self_p*: Bus to attach the listener to.
- *listener_p*: Listener to attach to the bus.

int **bus_detach** (**struct** *bus_t* **self_p*, **struct** *bus_listener_t* **listener_p*)

Detach given listener from given bus. A detached listener will not receive any messages from the bus.

Return zero(0) or negative error code.

Parameters

- *self_p*: Bus to detach listener from.
- *listener_p*: Listener to detach from the bus.

int **bus_write** (**struct** *bus_t* **self_p*, int *id*, **const** void **buf_p*, size_t *size*)

Write given message to given bus. All attached listeners to given bus will receive the message.

Return Number of listeners that received the message, or negative error code.

Parameters

- *self_p*: Bus to write the message to.
- *id*: Message identity.
- *buf_p*: Buffer to write to the bus. All listeners with given message id will receive this data.
- *size*: Number of bytes to write.

```
struct #include <bus.h>Public Members
```

```
struct rwlock_t bus_t::rwlock
```

```
struct binary_tree_t bus_t::listeners
struct Public Members
```

```
struct binary_tree_node_t bus_listener_t::base
```

```
int bus_listener_t::id
```

```
void *bus_listener_t::chan_p
```

```
struct bus_listener_t *bus_listener_t::next_p
```

chan — Abstract channel communication

Threads often communicate over channels. The producer thread or isr writes data to a channel and the consumer reads it. There may be multiple producers writing to a single channel, but only one consumer is allowed.

In the first example, thread 0 and thread 1 communicate over a channel. thread 0 writes data to the channel and thread 1 reads the written data.

```
+-----+
| thread 0 | channel 0 | thread 1 |
|           +-----+           |
| producer |           | consumer |
+-----+               +-----+
```

In the second example, isr 0 and thread 2 communicate over a channel. isr 0 writes data to the channel and thread 2 reads the written data.

```
+-----+
| isr 0   | channel 1 | thread 2 |
|           +-----+           |
| producer |           | consumer |
+-----+               +-----+
```

Source code: [src/sync/chan.h](#), [src/sync/chan.c](#)

Test coverage: [src/sync/chan.c](#)

Typedefs

typedef

typedef Channel write function callback type. Number of written bytes or negative error code.

Parameters • *self_p*: Channel to write to.

- *buf_p*: Buffer to write.
- *size*: Number of bytes to write.

typedef Channel write filter function callback type.true(1) if the buffer shall be written to the channel, otherwise false(0).

Parameters

- `self_p`: Channel to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes in buffer.

typedef Channel size function callback type.Number of bytes available.

Parameters

- `self_p`: Channel to get the size of.

Functions

int **chan_module_init** (void)

Initialize the channel module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **chan_init** (struct *chan_t* *`self_p`, *chan_read_fn_t* `read`, *chan_write_fn_t* `write`, *chan_size_fn_t* `size`)

Initialize given channel with given callbacks. A channel must be initialized before it can be used.

Return zero(0) or negative error code.

Parameters

- `self_p`: Channel to initialize.
- `read`: Read function callback. This function must implement the channel read functionality, and will be called when the user reads data from the channel.
- `write`: Write function callback. This function must implement the channel write functionality, and will be called when the user writes data to the channel.
- `size`: Size function callback. This function must return the size of the channel. It should return zero(0) if there is no data available in the channel, and otherwise a positive integer.

int **chan_set_write_isr_cb** (struct *chan_t* *`self_p`, *chan_write_fn_t* `write_isr_cb`)

Set the write isr function callback.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `filter`: Write isr function to set.

int **chan_set_write_filter_cb** (struct *chan_t* *`self_p`, *chan_write_filter_fn_t* `write_filter_cb`)

Set the write filter callback function. The write filter function is called when data is written to the channel, and its return value determines is the data shall be written to the underlying channel implementation, or discarded.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized driver object.
- `write_filter_cb`: filter Write filter function to set.

```
int chan_set_write_filter_isr_cb (struct chan_t *self_p, chan_write_filter_fn_t
                                write_filter_isr_cb)
```

Set the write isr filter callback function. The write filter function is called when data is written to the channel, and its return value determines if the data shall be written to the underlying channel implementation, or discarded.

Return zero(0) or negative error code.

Parameters

- self_p: Initialized driver object.
- write_filter_isr_cb: filter Write filter function to set.

```
ssize_t chan_read (void *self_p, void *buf_p, size_t size)
```

Read data from given channel. The behaviour of this function depends on the channel implementation. Often, the calling thread will be blocked until all data has been read or an error occurs.

Return Number of read bytes or negative error code.

Parameters

- self_p: Channel to read from.
- buf_p: Buffer to read into.
- size: Number of bytes to read.

```
ssize_t chan_write (void *self_p, const void *buf_p, size_t size)
```

Write data to given channel. The behaviour of this function depends on the channel implementation. Some channel implementations blocks until the receiver has read the data, and some returns immediately.

Return Number of written bytes or negative error code.

Parameters

- self_p: Channel to write to.
- buf_p: Buffer to write.
- size: Number of bytes to write.

```
size_t chan_size (void *self_p)
```

Get the number of bytes available to read from given channel.

Return Number of bytes available.

Parameters

- self_p: Channel to get the size of.

```
ssize_t chan_write_isr (void *self_p, const void *buf_p, size_t size)
```

Write data to given channel from interrupt context or with the system lock taken. The behaviour of this function depends on the channel implementation. Some channel implementations blocks until the receiver has read the data, and some returns immediately.

Return Number of written bytes or negative error code.

Parameters

- self_p: Channel to write to.
- buf_p: Buffer to write.

- `size`: Number of bytes to write.

int **chan_is_polled_isr** (struct *chan_t* **self_p*)

Check if a channel is polled. May only be called from isr or with the system lock taken (see `sys_lock()`).

Return true(1) or false(0).

Parameters

- `self_p`: Channel to check.

int **chan_list_init** (struct *chan_list_t* **list_p*, void **workspace_p*, size_t *size*)

Initialize an empty list of channels. A list is used to wait for data on multiple channel at the same time. When there is data on at least one channel, the poll function returns and the application can read from the channel with data.

Return zero(0) or negative error code.

Parameters

- `list_p`: List to initialize.
- `workspace_p`: Workspace for internal use.
- `size`: Size of the workspace in bytes.

int **chan_list_destroy** (struct *chan_list_t* **list_p*)

Destroy an initialized list of channels.

Return zero(0) or negative error code.

Parameters

- `list_p`: List to destroy.

int **chan_list_add** (struct *chan_list_t* **list_p*, void **chan_p*)

Add given channel to list of channels.

Return zero(0) or negative error code.

Parameters

- `list_p`: List of channels.
- `chan_p`: Channel to add.

int **chan_list_remove** (struct *chan_list_t* **list_p*, void **chan_p*)

Remove given channel from list of channels.

Return zero(0) or negative error code.

Parameters

- `list_p`: List of channels.
- `chan_p`: Channel to remove.

void ***chan_list_poll** (struct *chan_list_t* **list_p*, struct *time_t* **timeout_p*)

Poll given list of channels for events. Blocks until at least one of the channels in the list has data ready to be read or an timeout occurs.

Return Channel with data or NULL on timeout.

Parameters

- `list_p`: List of channels to poll.
- `timeout_p`: Time to wait for data on any channel before a timeout occurs. Set to NULL to wait forever.

void ***chan_poll** (void **chan_p*, struct *time_t* **timeout_p*)

Poll given channel for events. Blocks until the channel has data ready to be read or an timeout occurs.

Return The channel or NULL on timeout.

Parameters

- `chan_p`: Channel to poll.
- `timeout_p`: Time to wait for data on the channel before a timeout occurs. Set to NULL to wait forever.

void ***chan_null** (void)

Get a reference to the null channel. This channel will ignore all written data but return that it was successfully written.

Return The null channel.

ssize_t **chan_read_null** (void **self_p*, void **buf_p*, size_t *size*)

Null channel read function callback. Pass to `chan_init()` if no read function callback is needed for the channel.

Return Always returns -1.

ssize_t **chan_write_null** (void **self_p*, const void **buf_p*, size_t *size*)

Null channel write function callback. Pass to `chan_init()` if no write function callback is needed for the channel.

Return Always returns `size`.

size_t **chan_size_null** (void **self_p*)

Null channel size function callback. Pass to `chan_init()` if no size function callback is needed for the channel.

Return Always returns zero(0).

struct Public Members

struct *chan_t* **`chan_list_t::chans_pp`

size_t `chan_list_t::max`

size_t `chan_list_t::len`

int `chan_list_t::flags`

struct `#include <chan.h>` Channel datastructure. **Public Members**

chan_read_fn_t `chan_t::read`

```
chan_write_fn_t chan_t::write
chan_size_fn_t chan_t::size
chan_write_filter_fn_t chan_t::write_filter_cb
chan_write_fn_t chan_t::write_isr
chan_write_filter_fn_t chan_t::write_filter_isr_cb

struct thrd_t *chan_t::writer_p
struct thrd_t *chan_t::reader_p

struct chan_list_t *chan_t::list_p
```

event — Event channel

An event channel consists of a 32 bits bitmap, where each bit corresponds to an event state. If the bit is set, the event is active. Since an event only has two states, active and inactive, signalling the same event multiple times will just result in the event to be active. There is no internal counter of how “active” an event is, it’s simply active or inactive.

Source code: [src/sync/event.h](#), [src/sync/event.c](#)

Test code: [tst/sync/event/main.c](#)

Test coverage: [src/sync/event.c](#)

Functions

int **event_init** (struct [event_t](#) *self_p)

Initialize given event channel.

Return zero(0) or negative error code

Parameters

- self_p: Event channel to initialize.

ssize_t **event_read** (struct [event_t](#) *self_p, void *buf_p, size_t size)

Wait for an event to occur in given event mask. This function blocks until at least one of the events in the event mask has been set. When the function returns, given event mask has been overwritten with the events that actually occurred.

Return sizeof(mask) or negative error code.

Parameters

- self_p: Event channel object.
- buf_p: The mask of events to wait for. When the function returns the mask contains the events that have occurred.
- size: Size to read (always sizeof(mask)).

`ssize_t event_write (struct event_t *self_p, const void *buf_p, size_t size)`

Write given event(s) to given event channel.

Return sizeof(mask) or negative error code.

Parameters

- `self_p`: Event channel object.
- `buf_p`: The mask of events to write.
- `size`: Must always be sizeof(mask).

`ssize_t event_write_isr (struct event_t *self_p, const void *buf_p, size_t size)`

Write given events to the event channel from isr or with the system lock taken (see `sys_lock()`).

Return sizeof(mask) or negative error code.

Parameters

- `self_p`: Event channel object.
- `buf_p`: The mask of events to write.
- `size`: Must always be sizeof(mask).

`ssize_t event_size (struct event_t *self_p)`

Checks if there are events active on the event channel.

Return one(1) is at least one event is active, otherwise zero(0).

Parameters

- `self_p`: Event channel object.

`struct #include <event.h>` **Public Members**

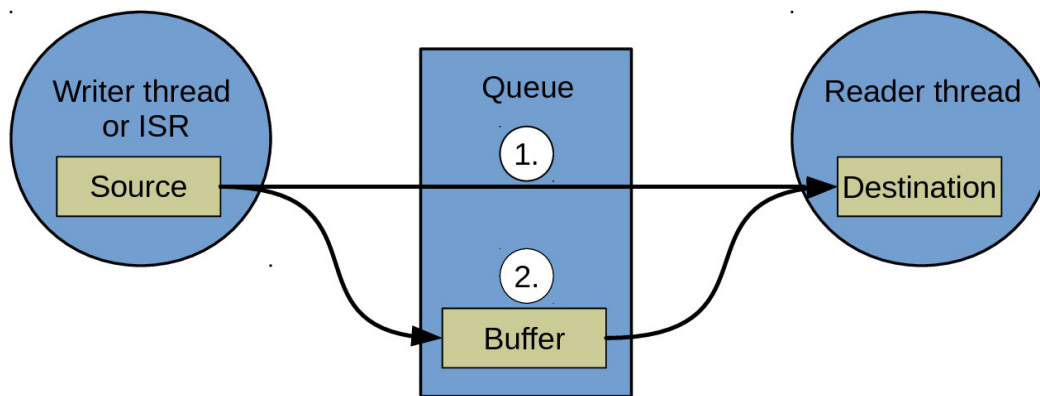
`struct chan_t event_t::base`

`uint32_t event_t::mask`

queue — Queue channel

The most common channel is the queue. It can be either synchronous or semi-asynchronous. In the synchronous version the writing thread will block until all written data has been read by the reader. In the semi-asynchronous version the writer writes to a buffer within the queue, and only blocks all data does not fit in the buffer. The buffer size is selected by the application when initializing the queue.

The diagram below shows how two threads communicates using a queue. The writer thread writes from its source buffer to the queue. The reader thread reads from the queue to its destination buffer.



The data is either copied directly from the source to the destination buffer (1. in the figure), or via the internal queue buffer (2. in the figure).

1. The reader thread is waiting for data. The writer writes from its source buffer directly to the readers' destination buffer.
2. The reader thread is *not* waiting for data. The writer writes from its source buffer into the queue buffer. Later, the reader reads data from the queue buffer to its destination buffer.

Source code: [src/sync/queue.h](#), [src/sync/queue.c](#)

Test code: [tst/sync/queue/main.c](#)

Test coverage: [src/sync/queue.c](#)

Example code: [examples/queue/main.c](#)

Defines

QUEUE_INIT_DECL (*_name*, *_buf*, *_size*)

Enums

enum type queue_state_t

Values:

- = 0 Queue initialized state.
- Queue running state.
- Queue stopped state.

Functions

int queue_init (**struct queue_t** **self_p*, void **buf_p*, size_t *size*)

Initialize given queue.

Return zero(0) or negative error code

Parameters

- `self_p`: Queue to initialize.
- `buf_p`: Buffer.
- `size`: Size of buffer.

int **queue_start** (struct *queue_t* **self_p*)

Start given queue. It is not required to start a queue unless it has been stopped.

Return zero(0) or negative error code.

Parameters

- `self_p`: Queue to start.

int **queue_stop** (struct *queue_t* **self_p*)

Stop given queue. Any ongoing read and write operations will return with the currently read/written number of bytes. Any read and write operations on a stopped queue will return zero(0).

Return true(1) if a thread was resumed, false(0) if no thread was resumed, or negative error code.

Parameters

- `self_p`: Queue to stop.

int **queue_stop_isr** (struct *queue_t* **self_p*)

Same as `queue_stop()` but from isr or with the system lock taken (see `sys_lock()`).

ssize_t **queue_read** (struct *queue_t* **self_p*, void **buf_p*, size_t *size*)

Read from given queue. Blocks until *size* bytes has been read.

Return Number of read bytes or negative error code.

Parameters

- `self_p`: Queue to read from.
- `buf_p`: Buffer to read to.
- `size`: Size to read.

ssize_t **queue_write** (struct *queue_t* **self_p*, const void **buf_p*, size_t *size*)

Write bytes to given queue. Blocks until *size* bytes has been written.

Return Number of written bytes or negative error code.

Parameters

- `self_p`: Queue to write to.
- `buf_p`: Buffer to write from.
- `size`: Number of bytes to write.

ssize_t **queue_write_isr** (struct *queue_t* **self_p*, const void **buf_p*, size_t *size*)

Write bytes to given queue from isr or with the system lock taken (see `sys_lock()`). May write less than *size* bytes.

Return Number of written bytes or negative error code.

Parameters

- `self_p`: Queue to write to.
- `buf_p`: Buffer to write from.
- `size`: Number of bytes to write.

`ssize_t queue_size (struct queue_t *self_p)`

Get the number of bytes currently stored in the queue. May return less bytes than number of bytes stored in the channel.

Return Number of bytes in queue.

Parameters

- `self_p`: Queue.

`ssize_t queue_unused_size (struct queue_t *self_p)`

Get the number of unused bytes in the queue.

Return Number of bytes unused in the queue.

Parameters

- `self_p`: Queue.

`ssize_t queue_unused_size_isr (struct queue_t *self_p)`

Get the number of unused bytes in the queue from isr or with the system lock taken (see `sys_lock()`).

Return Number of bytes unused in the queue.

Parameters

- `self_p`: Queue.

struct Public Members

`char *queue_buffer_t::begin_p`

`char *queue_buffer_t::read_p`

`char *queue_buffer_t::write_p`

`char *queue_buffer_t::end_p`

`size_t queue_buffer_t::size`

struct Public Members

`struct chan_t queue_t::base`

`struct queue_buffer_t queue_t::buffer`

`queue_state_t queue_t::state`

`char *queue_t::buf_p`

`size_t queue_t::size`

`size_t queue_t::left`

rwlock — Reader-writer lock

An RW lock allows concurrent access for read-only operations, while write operations require exclusive access. This means that multiple threads can read the data in parallel but an exclusive lock is needed for writing or modifying data. When a writer is writing the data, all other writers or readers will be blocked until the writer is finished writing. A common use might be to control access to a data structure in memory that cannot be updated atomically and is invalid (and should not be read by another thread) until the update is complete.

Source code: [src/sync/rwlock.h](#), [src/sync/rwlock.c](#)

Test code: [tst/sync/rwlock/main.c](#)

Test coverage: [src/sync/rwlock.c](#)

Functions

int **rwlock_module_init** (void)

Initialize the reader-writer lock module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code

int **rwlock_init** (struct *rwlock_t* *self_p)

Initialize given reader-writer lock object.

Return zero(0) or negative error code.

Parameters

- self_p: Reader-writer lock to initialize.

int **rwlock_reader_take** (struct *rwlock_t* *self_p)

Take given reader-writer lock. Multiple threads can have the reader lock at the same time.

Return zero(0) or negative error code.

Parameters

- self_p: Reader-writer lock to take.

int **rwlock_reader_give** (struct *rwlock_t* *self_p)

Give given reader-writer lock.

Return zero(0) or negative error code.

Parameters

- self_p: Reader-writer lock give.

int **rwlock_reader_give_isr** (struct *rwlock_t* *self_p)

Give given reader-writer lock from isr or with the system lock taken.

Return zero(0) or negative error code.

Parameters

- `self_p`: Reader-writer lock to give.

int **rwlock_writer_take** (struct *rwlock_t* **self_p*)

Take given reader-writer lock as a writer. Only one thread can have the lock at a time, including both readers and writers.

Return zero(0) or negative error code.

Parameters

- `self_p`: Reader-writer lock to take.

int **rwlock_writer_give** (struct *rwlock_t* **self_p*)

Give given reader-writer lock.

Return zero(0) or negative error code.

Parameters

- `self_p`: Reader-writer lock to give.

int **rwlock_writer_give_isr** (struct *rwlock_t* **self_p*)

Give given reader-writer lock from isr or with the system lock taken.

Return zero(0) or negative error code.

Parameters

- `self_p`: Reader-writer lock to give.

struct *#include <rwlock.h>***Public Members**

int *rwlock_t::number_of_readers*

int *rwlock_t::number_of_writers*

volatile struct *rwlock_elem_t* **rwlock_t::readers_p*

volatile struct *rwlock_elem_t* **rwlock_t::writers_p*

sem — Counting semaphores

The semaphore is a synchronization primitive used to protect a shared resource. A semaphore counts the number of resources taken, and suspends threads when the maximum number of resources are taken. When a resource becomes available, a suspended thread is resumed.

A semaphore initialized with *count_max* one(1) is called a binary semaphore. A binary semaphore can only be taken by one thread at a time and can be used to signal that an event has occurred. That is, *sem_give()* may be called multiple times and the semaphore resource count will remain at zero(0) until *sem_take()* is called.

Source code: [src/sync/sem.h](#), [src/sync/sem.c](#)

Test code: [tst/sync/sem/main.c](#)

Test coverage: [src/sync/sem.c](#)

Defines

SEM_INIT_DECL (name, _count, _count_max)

Functions

int **sem_module_init** (void)

Initialize the semaphore module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code

int **sem_init** (struct *sem_t* *self_p, int count, int count_max)

Initialize given semaphore object. Maximum count is the number of resources that can be taken at any given moment.

Return zero(0) or negative error code.

Parameters

- self_p: Semaphore to initialize.
- count: Initial taken resource count. Set the initial count to the same value as count_max to initialize the semaphore with all resources taken.
- count_max: Maximum number of resources that can be taken at any given moment.

int **sem_take** (struct *sem_t* *self_p, struct *time_t* *timeout_p)

Take given semaphore. If the semaphore count is zero the calling thread will be suspended until count is incremented by `sem_give()`.

Return zero(0) or negative error code.

Parameters

- self_p: Semaphore to get.
- timeout_p: Timeout.

int **sem_give** (struct *sem_t* *self_p, int count)

Give given count to given semaphore. Any suspended thread waiting for this semaphore, in `sem_take()`, is resumed. This continues until the semaphore count becomes zero or there are no threads in the suspended list.

Giving a count greater than the currently taken count is allowed and results in all resources available. This is especially useful for binary semaphores where `sem_give()` is often called more often than `sem_take()`.

Return zero(0) or negative error code.

Parameters

- self_p: Semaphore to give count to.
- count: Count to give.

```
int sem_give_isr (struct sem_t *self_p, int count)
```

Give given count to given semaphore from isr or with the system lock taken.

Return zero(0) or negative error code.

Parameters

- self_p: Semaphore to give count to.
- count: Count to give.

struct Public Members

```
int sem_t : : count
```

Number of used resources.

```
int sem_t : : count_max
```

Maximum number of resources.

```
struct sem_elem_t *sem_t : : head_p
```

Wait list.

1.6.4 filesystems

File systems and file system like frameworks.

The filesystems package on [Github](#).

fat16 — FAT16 filesystem

File Allocation Table (FAT) is a computer file system architecture and a family of industry-standard file systems utilizing it. The FAT file system is a legacy file system which is simple and robust. It offers good performance even in light-weight implementations, but cannot deliver the same performance, reliability and scalability as some modern file systems. It is, however, supported for compatibility reasons by nearly all currently developed operating systems for personal computers and many mobile devices and embedded systems, and thus is a well-suited format for data exchange between computers and devices of almost any type and age from 1981 up to the present.

Example

Here is the pseudo-code for mounting a file system, performing file operations and unmounting the file system.

All function arguments are omitted in this example.

```
/* Mount the file system. This is normally done once when the
   application starts. */
fat16_init();
fat16_mount();

/* Perform file operations. */
fat16_file_open();
fat16_file_read();
fat16_file_close();

fat16_file_open();
fat16_file_write();
```

```
fat16_file_close();

/* Unmount the file system when it is no long needed. Normally when
   the application stops. */
fat16_unmount();
```

Source code: `src/filesystems/fat16.h`, `src/filesystems/fat16.c`

Test code: `tst/filesystems/fat16/main.c`

Test coverage: `src/filesystems/fat16.c`

Example code: `examples/fat16/main.c`

Defines

FAT16_SEEK_SET

FAT16_SEEK_CUR

The offset is relative to the current position indicator.

FAT16_SEEK_END

The offset is relative to the end of the file.

FAT16_EOF

End of file indicator.

O_READ

Open for reading.

O_RDONLY

Same as O_READ.

O_WRITE

Open for write.

O_WRONLY

Same as O_WRITE.

O_RDWR

Open for reading and writing.

O_APPEND

The file position indicator shall be set to the end of the file prior to each write.

O_SYNC

Synchronous writes.

O_CREAT

Create the file if non-existent.

O_EXCL

If O_CREAT and O_EXCL are set, file open shall fail if the file exists.

O_TRUNC

Truncate the file to zero length.

DIR_ATTR_READ_ONLY

File is read-only.

DIR_ATTR_HIDDEN

File should hidden in directory listings.

DIR_ATTR_SYSTEM

Entry is for a system file.

DIR_ATTR_VOLUME_ID

Directory entry contains the volume label.

DIR_ATTR_DIRECTORY

Entry is for a directory.

DIR_ATTR_ARCHIVE

Old DOS archive bit for backup support.

Typedefs

typedef Block read function callback.

typedef Block write function callback.

typedef A FAT entry.

Functions

int **fat16_init** (**struct** *fat16_t* **self_p*, *fat16_read_t* *read*, *fat16_write_t* *write*, void **arg_p*, unsigned int *partition*)
Initialize a FAT16 volume.

Return zero(0) or negative error code.

Parameters

- *self_p*: FAT16 object to initialize.
- *read*: Callback function used to read blocks of data.
- *write*: Callback function used to write blocks of data.
- *arg_p*: Argument passed as the first arguemtn to *read()* and *write()*.
- *partition*: Partition to be used. Legal values for a partition are 1-4 to use the corresponding partition on a device formatted with a MBR, Master Boot Record, or zero if the device is formatted as a super floppy with the FAT boot sector in block zero.

int **fat16_mount** (**struct** *fat16_t* **self_p*)
Mount given FAT16 volume.

Return zero(0) or negative error code.

Parameters

- *self_p*: FAT16 object.

int **fat16_unmount** (**struct** *fat16_t* **self_p*)
Unmount given FAT16 volume.

Return zero(0) or negative error code.

Parameters

- `self_p`: FAT16 object.

int **fat16_format** (**struct** *fat16_t* **self_p*)
 Create an empty FAT16 file system on the device.

Parameters

- `self_p`: FAT16 object.

int **fat16_print** (**struct** *fat16_t* **self_p*, void **chan_p*)
 Print volume information to given channel.

Return zero(0) or negative error code.

Parameters

- `self_p`: FAT16 object.
- `chan_p`: Output channel.

int **fat16_file_open** (**struct** *fat16_t* **self_p*, **struct** *fat16_file_t* **file_p*, **const** char **path_p*, int *oflag*)
 Open a file by file path and mode flags.

Return zero(0) or negative error code.

Parameters

- `self_p`: FAT16 object.
- `file_p`: File object to be initialized.
- `path_p`: A valid 8.3 DOS name for a file path.
- `oflag`: mode of file open (create, read, write, etc).

int **fat16_file_close** (**struct** *fat16_file_t* **file_p*)
 Close a file and force cached data and directory information to be written to the media.

Return zero(0) or negative error code.

Parameters

- `file_p`: File object.

ssize_t **fat16_file_read** (**struct** *fat16_file_t* **file_p*, void **buf_p*, size_t *size*)
 Read data to given buffer with given size from the file.

Return Number of bytes read or EOF(-1).

Parameters

- `file_p`: File object.
- `buf_p`: Buffer to read into.
- `size`: number of bytes to read.

ssize_t **fat16_file_write** (**struct** *fat16_file_t* **file_p*, **const** void **buf_p*, size_t *size*)
 Write data from buffer with given size to the file.

Return Number of bytes written or EOF(-1).

Parameters

- `file_p`: File object.
- `buf_p`: Buffer to write.
- `size`: number of bytes to write.

int **fat16_file_seek** (**struct fat16_file_t** **file_p*, int *pos*, int *whence*)
Sets the file's read/write position relative to mode.

Return zero(0) or negative error code.

Parameters

- `file_p`: File object.
- `pos`: New position in bytes from given mode.
- `whence`: Absolute, relative or from end.

ssize_t **fat16_file_tell** (**struct fat16_file_t** **file_p*)
Return current position in the file.

Return Current position or negative error code.

Parameters

- `file_p`: File object.

int **fat16_file_truncate** (**struct fat16_file_t** **file_p*, size_t *size*)
Truncate given file to a size of precisely `size` bytes.

If the file previously was larger than this size, the extra data is lost. If the file previously was shorter, it is extended, and the extended part reads as null bytes ('\0').

Return zero(0) or negative error code.

Parameters

- `file_p`: File object.
- `size`: New size of the file in bytes.

ssize_t **fat16_file_size** (**struct fat16_file_t** **file_p*)
Return number of bytes in the file.

Return File size in bytes or negative error code.

Parameters

- `file_p`: File object.

int **fat16_file_sync** (**struct fat16_file_t** **file_p*)
Causes all modified data and directory fields to be written to the storage device.

Return zero(0) or negative error code.

Parameters

- `file_p`: File object.

int **fat16_dir_open** (struct *fat16_t* *self_p, struct *fat16_dir_t* *dir_p, const char *path_p, int oflag)
 Open a directory by directory path and mode flags.

Return zero(0) or negative error code.

Parameters

- self_p: FAT16 object.
- dir_p: Directory object to be initialized.
- path_p: A valid 8.3 DOS name for a directory path.
- oflag: mode of the directory to open (create, read, etc).

int **fat16_dir_close** (struct *fat16_dir_t* *dir_p)
 Close given directory.

Return zero(0) or negative error code.

Parameters

- dir_p: Directory object.

int **fat16_dir_read** (struct *fat16_dir_t* *dir_p, struct *fat16_dir_entry_t* *entry_p)
 Read the next file or directory within the opened directory.

Return true(1) if an entry was read or false(0) if no entry could be read, otherwise negative error code.

Parameters

- dir_p: Directory object.
- entry_p: Read entry.

int **fat16_stat** (struct *fat16_t* *self_p, const char *path_p, struct *fat16_stat_t* *stat_p)
 Gets file status by path.

Return zero(0) or negative error code.

Parameters

- self_p: The file system struct.
- path_p: The path of the file to stat.
- stat_p: The stat struct to populate.

Variables

struct *dir_t* **PACKED**

union #include <fat16.h> FAT Time Format. A FAT directory entry time stamp is a 16-bit field that has a granularity of 2 seconds. Here is the format (bit 0 is the LSB of the 16-bit word, bit 15 is the MSB of the 16-bit word). Bits 0-4: 2-second count, valid value range 0-29 inclusive (0-58 seconds). Bits 5-10: Minutes, valid value range 0-59 inclusive. Bits 11-15: Hours, valid value range 0-23 inclusive. The valid time range is from Midnight 00:00:00 to 23:59:58. **Public Members**

uint16_t fat16_time_t::as_uint16

uint16_t fat16_time_t::seconds

`uint16_t fat16_time_t::minutes`

`uint16_t fat16_time_t::hours`

struct fat16_time_t::@27 fat16_time_t::bits

union *#include <fat16.h>* FAT date representation support Date Format. A FAT directory entry date stamp is a 16-bit field that is basically a date relative to the MS-DOS epoch of 01/01/1980. Here is the format (bit 0 is the LSB of the 16-bit word, bit 15 is the MSB of the 16-bit word): Bits 0-4: Day of month, valid value range 1-31 inclusive. Bits 5-8: Month of year, 1 = January, valid value range 1-12 inclusive. Bits 9-15: Count of years from 1980, valid value range 0-127 inclusive (1980-2107). **Public Members**

`uint16_t fat16_date_t::as_uint16`

`uint16_t fat16_date_t::day`

`uint16_t fat16_date_t::month`

`uint16_t fat16_date_t::year`

struct fat16_date_t::@28 fat16_date_t::bits

struct *#include <fat16.h>* MBR partition table entry. A partition table entry for a MBR formatted storage device. The MBR partition table has four entries. **Public Members**

`uint8_t part_t::boot`

Boot Indicator. Indicates whether the volume is the active partition. Legal values include: 0x00. Do not use for booting. 0x80 Active partition.

`uint8_t part_t::begin_head`

Head part of Cylinder-head-sector address of the first block in the partition. Legal values are 0-255. Only used in old PC BIOS.

`unsigned part_t::begin_sector`

Sector part of Cylinder-head-sector address of the first block in the partition. Legal values are 1-63. Only used in old PC BIOS.

`unsigned part_t::begin_cylinder_high`

High bits cylinder for first block in partition.

`uint8_t part_t::begin_cylinder_low`

Combine beginCylinderLow with beginCylinderHigh. Legal values are 0-1023. Only used in old PC BIOS.

`uint8_t part_t::type`

Partition type. See defines that begin with PART_TYPE_ for some Microsoft partition types.

`uint8_t part_t::end_head`

head part of cylinder-head-sector address of the last sector in the partition. Legal values are 0-255. Only used in old PC BIOS.

`unsigned part_t::end_sector`

Sector part of cylinder-head-sector address of the last sector in the partition. Legal values are 1-63. Only used in old PC BIOS.

`unsigned part_t::end_cylinder_high`

High bits of end cylinder

`uint8_t part_t::end_cylinder_low`

Combine endCylinderLow with endCylinderHigh. Legal values are 0-1023. Only used in old PC BIOS.

`uint32_t part_t::first_sector`

Logical block address of the first block in the partition.

`uint32_t part_t::total_sectors`

Length of the partition, in blocks.

struct *#include <fat16.h>* BIOS parameter block; The BIOS parameter block describes the physical layout of a FAT volume. **Public Members**

`uint16_t bpb_t::bytes_per_sector`

Count of bytes per sector. This value may take on only the following values: 512, 1024, 2048 or 4096

`uint8_t bpb_t::sectors_per_cluster`

Number of sectors per allocation unit. This value must be a power of 2 that is greater than 0. The legal values are 1, 2, 4, 8, 16, 32, 64, and 128.

`uint16_t bpb_t::reserved_sector_count`

Number of sectors before the first FAT. This value must not be zero.

`uint8_t bpb_t::fat_count`

The count of FAT data structures on the volume. This field should always contain the value 2 for any FAT volume of any type.

`uint16_t bpb_t::root_dir_entry_count`

For FAT12 and FAT16 volumes, this field contains the count of 32-byte directory entries in the root directory. For FAT32 volumes, this field must be set to 0. For FAT12 and FAT16 volumes, this value should always specify a count that when multiplied by 32 results in a multiple of bytesPerSector. FAT16 volumes should use the value 512.

`uint16_t bpb_t::total_sectors_small`

This field is the old 16-bit total count of sectors on the volume. This count includes the count of all sectors in all four regions of the volume. This field can be 0; if it is 0, then totalSectors32 must be non-zero. For FAT32 volumes, this field must be 0. For FAT12 and FAT16 volumes, this field contains the sector count, and totalSectors32 is 0 if the total sector count fits (is less than 0x10000).

`uint8_t bpb_t::media_type`

This dates back to the old MS-DOS 1.x media determination and is no longer usually used for anything. 0xf8 is the standard value for fixed (non-removable) media. For removable media, 0xf0 is frequently used. Legal values are 0xf0 or 0xf8-0xff.

`uint16_t bpb_t::sectors_per_fat`

Count of sectors occupied by one FAT on FAT12/FAT16 volumes. On FAT32 volumes this field must be 0, and sectorsPerFat32 contains the FAT size count.

`uint16_t bpb_t::sectors_per_track`

Sectors per track for interrupt 0x13. Not used otherwise.

`uint16_t bpb_t::head_count`

Number of heads for interrupt 0x13. Not used otherwise.

`uint32_t bpb_t::hidddden_sectors`

Count of hidden sectors preceding the partition that contains this FAT volume. This field is generally only relevant for media visible on interrupt 0x13.

`uint32_t bpb_t::total_sectors_large`

This field is the new 32-bit total count of sectors on the volume. This count includes the count of all sectors in all four regions of the volume. This field can be 0; if it is 0, then totalSectors16 must be non-zero.

struct *#include <fat16.h>* Boot sector for a FAT16 or FAT32 volume. **Public Members**

uint8_t fbs_t::**jmp_to_boot_code**[3]

X86 jmp to boot program

char fbs_t::**oem_name**[8]

Informational only - don't depend on it

struct *bpb_t* fbs_t::**bpb**

BIOS Parameter Block

uint8_t fbs_t::**drive_number**

For int0x13 use value 0x80 for hard drive

uint8_t fbs_t::**reserved1**

Used by Windows NT - should be zero for FAT

uint8_t fbs_t::**boot_signature**

0x29 if next three fields are valid

uint32_t fbs_t::**volume_serial_number**

Usually generated by combining date and time

char fbs_t::**volume_label**[11]

Should match volume label in root dir

char fbs_t::**file_system_type**[8]

Informational only - don't depend on it

uint8_t fbs_t::**boot_code**[448]

X86 boot code

uint16_t fbs_t::**boot_sector_sig**

Must be 0x55AA

struct *#include <fat16.h>* Master Boot Record. The first block of a storage device that is formatted with a MBR. **Public Members**

uint8_t mbr_t::**codeArea**[440]

Code Area for master boot program.

uint32_t mbr_t::**diskSignature**

Optional WindowsNT disk signature. May contain more boot code.

uint16_t mbr_t::**usuallyZero**

Usually zero but may be more boot code.

struct *part_t* mbr_t::**part**[4]

Partition tables.

uint16_t mbr_t::**mbr_sig**

First MBR signature byte. Must be 0x55

struct *#include <fat16.h>* FAT short directory entry. Short means short 8.3 name, not the entry size. **Public Members**

uint8_t dir_t::**name**[11]

Short 8.3 name. The first eight bytes contain the file name with blank fill. The last three bytes contain the file extension with blank fill.

`uint8_t dir_t::attributes`

Entry attributes. The upper two bits of the attribute byte are reserved and should always be set to 0 when a file is created and never modified or looked at after that. See defines that begin with `DIR_ATT_`.

`uint8_t dir_t::reserved1`

Reserved for use by Windows NT. Set value to 0 when a file is created and never modify or look at it after that.

`uint8_t dir_t::creation_time_tenths`

The granularity of the seconds part of `creationTime` is 2 seconds so this field is a count of tenths of a second and its valid value range is 0-199 inclusive. (WHG note - seems to be hundredths)

`uint16_t dir_t::creation_time`

Time file was created.

`uint16_t dir_t::creation_date`

Date file was created.

`uint16_t dir_t::last_access_date`

Last access date. Note that there is no last access time, only a date. This is the date of last read or write. In the case of a write, this should be set to the same date as `lastWriteDate`.

`uint16_t dir_t::first_cluster_high`

High word of this entry's first cluster number (always 0 for a FAT12 or FAT16 volume).

`uint16_t dir_t::last_write_time`

Time of last write. File creation is considered a write.

`uint16_t dir_t::last_write_date`

Date of last write. File creation is considered a write.

`uint16_t dir_t::first_cluster_low`

Low word of this entry's first cluster number.

`uint32_t dir_t::file_size`

32-bit unsigned holding this file's size in bytes.

union Public Members

`uint8_t fat16_cache16_t::data[512]`

fat_t `fat16_cache16_t::fat[256]`

struct *dir_t* `fat16_cache16_t::dir[16]`

struct *mbr_t* `fat16_cache16_t::mbr`

struct *fbs_t* `fat16_cache16_t::fbs`

struct Public Members

`uint32_t fat16_cache_t::block_number`

`uint8_t fat16_cache_t::dirty`

`uint32_t fat16_cache_t::mirror_block`

union *fat16_cache16_t* `fat16_cache_t::buffer`

struct Public Members

```
fat16_read_t fat16_t::read
fat16_write_t fat16_t::write
void *fat16_t::arg_p
unsigned int fat16_t::partition
uint8_t fat16_t::fat_count
uint8_t fat16_t::blocks_per_cluster
uint16_t fat16_t::root_dir_entry_count
fat_t fat16_t::blocks_per_fat
fat_t fat16_t::cluster_count
uint32_t fat16_t::volume_start_block
uint32_t fat16_t::fat_start_block
uint32_t fat16_t::root_dir_start_block
uint32_t fat16_t::data_start_block

struct fat16_cache_t fat16_t::cache
struct Public Members
```

```
struct fat16_t *fat16_file_t::fat16_p
uint8_t fat16_file_t::flags
int16_t fat16_file_t::dir_entry_block
int16_t fat16_file_t::dir_entry_index
fat_t fat16_file_t::first_cluster
size_t fat16_file_t::file_size
fat_t fat16_file_t::cur_cluster
size_t fat16_file_t::cur_position
struct Public Members
```

```
int16_t fat16_dir_t::root_index

struct fat16_file_t fat16_dir_t::file
struct Public Members
```

```
char fat16_dir_entry_t::name[256]
int fat16_dir_entry_t::is_dir
size_t fat16_dir_entry_t::size
```

```
struct date_t fat16_dir_entry_t::latest_mod_date
struct Public Members
```

```
size_t fat16_stat_t::size
```

```
int fat16_stat_t::is_dir
```

fs — Debug file system

The debug file system is not really a file system, but rather a file system like tree of commands, counters, parameters, and “real” file systems.

- A command is a file path mapped to a function callback. The callback is invoked when its path is passed to the `fs_call()` function. Commands are registered into the debug file system by a call to `fs_command_register()`.
- A counter is a file path mapped to a 64 bit value. The value can be incremented and read by the application. Counters are registered into the debug file system by a call to `fs_counter_register()`.
- A parameter is file path mapped to a value stored in ram that can be easily read and modified by the user from a shell. Parameters are registered into the debug file system by a call to `fs_parameter_register()`.
- A “real” file system is a file path, or mount point, mapped to a file system instance. The debug file system has a file access interface. The purpose of this interface is to have a common file access interface, independent of the underlying file systems interface. File systems are registered into the debug file system by a call to `fs_filesystem_register()`.

Debug file system commands

The debug file system module itself registers seven commands, all located in the directory `filesystems/fs/`.

Command	Description
<code>filesystems/list</code>	Print a list of all registered file systems.
<code>list [<folder>]</code>	Print a list of all files and folders in given folder.
<code>read <file></code>	Read from given file.
<code>write <file> <data></code>	Create and write to a file. Overwrites existing files.
<code>append <file> <data></code>	Append data to an existing file.
<code>counters/list</code>	Print a list of all registered counters.
<code>counters/reset</code>	Rest all counters to zero.
<code>parameters/list</code>	Print a list of all registered parameters.

Example output from the shell:

```
$ filesystems/fs/filesystems/list
MOUNT-POINT          MEDIUM  TYPE      AVAILABLE  SIZE  USAGE
/tmp                  ram      fat16      54K        64K   14%
/home/erik            sd       fat16      1.9G       2G    5%
/etc                  flash    spiffs     124K       128K   3%
$ filesystems/fs/write tmp/foo.txt "Hello "
$ filesystems/fs/append tmp/foo.txt world!
$ filesystems/fs/read tmp/foo.txt
Hello world!
$ filesystems/fs/list tmp
xxxx-xx-xx xx-xx      12 foo.txt
$ filesystems/fs/counters/list
NAME                                     VALUE
```

/your/counter	0000000000000034
/my/counter	0000000000000002
\$ filesystems/fs/counters/reset	
\$ filesystems/fs/counters/list	
NAME	VALUE
/your/counter	0000000000000000
/my/counter	0000000000000000
\$ filesystems/fs/parameters/list	
NAME	VALUE
/foo/bar	-2

Source code: [src/filesystems/fs.h](#), [src/filesystems/fs.c](#)

Test code: [tst/filesystems/fs/main.c](#)

Test coverage: [src/filesystems/fs.c](#)

Defines

FS_SEEK_SET

FS_SEEK_CUR

The offset is relative to the current position indicator.

FS_SEEK_END

The offset is relative to the end of the file.

FS_READ

Open for reading.

FS_WRITE

Open for write.

FS_RDWR

Open for reading and writing.

FS_APPEND

The file position indicator shall be set to the end of the file prior to each write.

FS_SYNC

Synchronous writes.

FS_CREAT

Create the file if non-existent.

FS_EXCL

If FS_CREAT and FS_EXCL are set, file open shall fail if the file exists.

FS_TRUNC

Truncate the file to zero length.

FS_TYPE_FILE

FS_TYPE_DIR

FS_TYPE_HARD_LINK

FS_TYPE_SOFT_LINK

Typedefs

typedef Command callback prototype.zero(0) or negative error code.

Parameters • `argc`: Number of arguments in argv.

- `argv`: An array of arguments.
- `out_p`: Output channel.
- `in_p`: Input channel.
- `arg_p`: Argument passed to the init function of given command.
- `call_arg_p`: Argument passed to the `fs_call` function.

typedef Parameter setter callback prototype.zero(0) or negative error code.

Parameters • `value_p`: Buffer the new value should be written to.

- `src_p`: Value to set as a string.

typedef Parameter printer callback prototype.zero(0) or negative error code.

Parameters • `chout_p`: Channel to write the formatted value to.

- `value_p`: Value to format and print to the output channel.

Enums

enum type `fs_type_t`

Values:

= 0

Functions

int `fs_module_init` (void)

Initialize the file system module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int `fs_call` (char **command_p*, void **chin_p*, void **chout_p*, void **arg_p*)

Call given file system command with given input and output channels. Quote an argument if it contains spaces, otherwise it is parsed as multiple arguments. Any quotation mark in an argument string must be escaped with a backslash (\), otherwise it is interpreted as a string quotation mask.

Return zero(0) or negative error code.

Parameters

- `command_p`: Command string to call. The command string will be modified by this function, so don't use it after this function returns.
- `chin_p`: Input channel.
- `chout_p`: Output channel.
- `arg_p`: User argument passed to the command callback function as `call_arg_p`.

int **fs_open** (struct *fs_file_t* **self_p*, const char **path_p*, int *flags*)

Open a file by file path and mode flags. File operations are permitted after the file has been opened.

The path can be either absolute or relative. It's an absolute path if it starts with a forward slash /, and relative otherwise. Relative paths are relative to the current working directory, given by the thread environment variable CWD.

Return zero(0) or negative error code.

Parameters

- *self_p*: File object to be initialized.
- *path_p*: Path of the file to open. The path can be absolute or relative.
- *flags*: Mode of file open. A combination of FS_READ, FS_RDONLY, FS_WRITE, FS_WRONLY, FS_RDWR, FS_APPEND, FS_SYNC, FS_CREAT, FS_EXCL and FS_TRUNC.

int **fs_close** (struct *fs_file_t* **self_p*)

Close given file. No file operations are permitted on a closed file.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized file object.

ssize_t **fs_read** (struct *fs_file_t* **self_p*, void **dst_p*, size_t *size*)

Read from given file into given buffer.

Return Number of bytes read or negative error code.

Parameters

- *self_p*: Initialized file object.
- *dst_p*: Buffer to read data into.
- *size*: Number of bytes to read.

ssize_t **fs_read_line** (struct *fs_file_t* **self_p*, void **dst_p*, size_t *size*)

Read one line from given file into given buffer. The function reads one character at a time from given file until the destination buffer is full, a newline \n is found or end of file is reached.

Return If a line was found the number of bytes read not including the null-termination is returned. If the destination buffer becomes full before a newline character, the destination buffer size is returned. Otherwise a negative error code is returned.

Parameters

- *self_p*: Initialized file object.
- *dst_p*: Buffer to read data into. Should fit the whole line and null-termination.
- *size*: Size of the destination buffer.

ssize_t **fs_write** (struct *fs_file_t* **self_p*, const void **src_p*, size_t *size*)

Write from given buffer into given file.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Initialized file object.
- `dst_p`: Buffer to write.
- `size`: Number of bytes to write.

int **fs_seek** (**struct fs_file_t** **self_p*, int *offset*, int *whence*)

Sets the file's read/write position relative to whence.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized file object.
- `offset`: New position in bytes from given whence.
- `whence`: Absolute (FS_SEEK_SET), relative (FS_SEEK_CUR) or from end (FS_SEEK_END).

ssize_t **fs_tell** (**struct fs_file_t** **self_p*)

Return current position in the file.

Return Current position or negative error code.

Parameters

- `self_p`: Initialized file object.

int **fs_dir_open** (**struct fs_dir_t** **dir_p*, const char **path_p*, int *oflag*)

Open a directory by directory path and mode flags.

Return zero(0) or negative error code.

Parameters

- `dir_p`: Directory object to be initialized.
- `path_p`: A valid path name for a directory path.
- `oflag`: mode of the directory to open (create, read, etc).

int **fs_dir_close** (**struct fs_dir_t** **dir_p*)

Close given directory.

Return zero(0) or negative error code.

Parameters

- `dir_p`: Directory object.

int **fs_dir_read** (**struct fs_dir_t** **dir_p*, **struct fs_dir_entry_t** **entry_p*)

Read the next file or directory within the opened directory.

Return true(1) if an entry was read or false(0) if no entry could be read, otherwise negative error code.

Parameters

- `dir_p`: Directory object.
- `entry_p`: Read entry.

int **fs_remove** (const char **path_p*)

Remove file by given path.

Return zero(0) or negative error code.

Parameters

- *path_p*: The path of the file to remove.

int **fs_stat** (const char **path_p*, struct *fs_stat_t* **stat_p*)

Gets file status by path.

Return zero(0) or negative error code.

Parameters

- *path_p*: The path of the file to stat.
- *stat_p*: The stat struct to populate.

int **fs_mkdir** (const char **path_p*)

Create a directory with given path.

Return zero(0) or negative error code.

Parameters

- *path_p*: The path of the directory to create.

int **fs_format** (const char **path_p*)

Format file system at given path.

Return zero(0) or negative error code.

Parameters

- *path_p*: The path to the root of the file system to format. All data in the file system will be deleted.

int **fs_ls** (const char **path_p*, const char **filter_p*, void **chout_p*)

List files and folders in given path. Optionally with given filter. The list is written to the output channel.

Return zero(0) or negative error code.

Parameters

- *path_p*: Directory to list.
- *filter_p*: Filter out files and folders.
- *chout_p*: Output chan.

int **fs_list** (const char **path_p*, const char **filter_p*, void **chout_p*)

List files (callbacks) and directories in given path. Optionally with given filter. The list is written to the output channel.

Return zero(0) or negative error code.

Parameters

- *path_p*: Directory to list.
- *filter_p*: Filter out files and folders.

- `chout_p`: Output chan.

int **fs_auto_complete** (char **path_p*)
Auto-complete given path.

Return ≥ 1 if completion happened. Number of autocompleted characters added to the path. 0 if no completion happend, or negative error code.

Parameters

- `path_p`: Absolute or relative path to auto-complete.

void **fs_split** (char **buf_p*, char ***path_pp*, char ***cmd_pp*)
Split buffer into path and command inplace.

Return zero(0) or negative error code.

Parameters

- `buf_p`: Buffer to split.
- `path_pp`: Path or NULL if no path was found.
- `cmd_pp`: Command or empty string.

void **fs_merge** (char **path_p*, char **cmd_p*)
Merge path and command previously split using `fs_split()`.

Return zero(0) or negative error code.

Parameters

- `path_p`: Path from spilt.
- `cmd_p`: Command from split.

int **fs_filesystem_init_fat16** (struct *fs_filesystem_t* **self_p*, const char **name_p*, struct *fat16_t* **fat16_p*)
Initialize given FAT16 file system.

Return zero(0) or negative error code.

Parameters

- `self_p`: File system to initialize.
- `name_p`: Path to register.
- `fat16_p`: File system pointer.

int **fs_filesystem_init_spiffs** (struct *fs_filesystem_t* **self_p*, const char **name_p*, struct *spiffs_t* **spiffs_p*, struct *fs_filesystem_spiffs_config_t* **config_p*)
Initialize given SPIFFS file system.

Return zero(0) or negative error code.

Parameters

- `self_p`: File system to initialize.
- `name_p`: Path to register.
- `spiffs_p`: File system pointer.

- `config_p`: File system configuration.

int `fs_filesystem_register` (**struct `fs_filesystem_t`** *`self_p`)

Register given file system. Use the functions `fs_open()`, `fs_read()`, `fs_write()`, `fs_close()`, `fs_seek()`, `fs_tell()` and `fs_read_line()` to access files in a registered file system.

Return zero(0) or negative error code.

Parameters

- `self_p`: File system to register.

int `fs_filesystem_deregister` (**struct `fs_filesystem_t`** *`self_p`)

Deregister given file system.

Return zero(0) or negative error code.

Parameters

- `self_p`: File system to deregister.

int `fs_command_init` (**struct `fs_command_t`** * `self_p`, **const FAR char *** `path_p`, **fs_callback_t**

Initialize given command.

Return zero(0) or negative error code.

Parameters

- `self_p`: Command to initialize.
- `path_p`: Path to register.
- `callback`: Command callback function.
- `arg_p`: Callback argument.

int `fs_command_register` (**struct `fs_command_t`** *`command_p`)

Register given command. Registered commands are called by the function `fs_call()`.

Return zero(0) or negative error code.

Parameters

- `command_p`: Command to register.

int `fs_command_deregister` (**struct `fs_command_t`** *`command_p`)

Deregister given command.

Return zero(0) or negative error code.

Parameters

- `command_p`: Command to deregister.

int `fs_counter_init` (**struct `fs_counter_t`** * `self_p`, **const FAR char *** `path_p`, **uint64_t** `value`)

Initialize given counter.

Return zero(0) or negative error code.

Parameters

- `self_p`: Counter to initialize.

- `path_p`: Path to register.
- `value`: Initial value of the counter.

int **fs_counter_increment** (struct *fs_counter_t* **self_p*, uint64_t *value*)
Increment given counter.

Return zero(0) or negative error code.

Parameters

- `self_p`: Command to initialize.
- `value`: Increment value.

int **fs_counter_register** (struct *fs_counter_t* **counter_p*)
Register given counter.

Return zero(0) or negative error code.

Parameters

- `counter_p`: Counter to register.

int **fs_counter_deregister** (struct *fs_counter_t* **counter_p*)
Deregister given counter.

Return zero(0) or negative error code.

Parameters

- `counter_p`: Counter to deregister.

int **fs_parameter_init** (struct *fs_parameter_t* * *self_p*, const FAR char * *path_p*, fs_parameter_t (**set_cb*)(fs_parameter_t *, const FAR char *, void *), fs_parameter_t (**print_cb*)(fs_parameter_t *, const FAR char *, void *))
Initialize given parameter.

Return zero(0) or negative error code.

Parameters

- `self_p`: Parameter to initialize.
- `path_p`: Path to register.
- `set_cb`: Callback function set set the parameter value.
- `print_cb`: Callback function set print the parameter value.
- `value_p`: Value storage area.

int **fs_parameter_register** (struct *fs_parameter_t* **parameter_p*)
Register given parameter.

Return zero(0) or negative error code.

Parameters

- `parameter_p`: Parameter to register.

int **fs_parameter_deregister** (struct *fs_parameter_t* **parameter_p*)
Deregister given parameter.

Return zero(0) or negative error code.

Parameters

- `parameter_p`: Parameter to deregister.

int **fs_parameter_int_set** (void **value_p*, const char **src_p*)

Integer parameter setter function callback

Return zero(0) or negative error code.

Parameters

- `value_p`: Buffer the new value should be written to.
- `src_p`: Value to set as a string.

int **fs_parameter_int_print** (void **chout_p*, void **value_p*)

Integer parameter printer function callback

Return zero(0) or negative error code.

Parameters

- `chout_p`: Channel to write the formatted value to.
- `value_p`: Value to format and print to the output channel.

struct *#include <fs.h>* A SPIFFS file system. **Public Members**

struct *spiffs_config_t* *fs_filesystem_spiffs_config_t::config_p

uint8_t *fs_filesystem_spiffs_config_t::workspace_p

uint8_t *fs_filesystem_spiffs_config_t::buf_p

size_t fs_filesystem_spiffs_config_t::size

struct fs_filesystem_spiffs_config_t::@29 fs_filesystem_spiffs_config_t::fdworkspace

struct fs_filesystem_spiffs_config_t::@30 fs_filesystem_spiffs_config_t::cache

struct *#include <fs.h>* A FAT16 file system. **Public Members**

struct *fat16_t* *fs_filesystem_fat16_t::fat16_p

struct **Public Members**

const char *fs_filesystem_t::name_p

fs_type_t fs_filesystem_t::type

struct *fat16_t* *fs_filesystem_t::fat16_p

struct *spiffs_t* *fs_filesystem_t::spiffs_p

union fs_filesystem_t::@31 fs_filesystem_t::fs

struct *fs_filesystem_spiffs_config_t* *fs_filesystem_t::spiffs_p

union fs_filesystem_t::@32 fs_filesystem_t::config

struct *fs_filesystem_t* *fs_filesystem_t::next_p

struct Public Members

```
struct fs_filesystem_t *fs_file_t::filesystem_p
```

```
struct fat16_file_t fs_file_t::fat16
```

```
spiffs_file_t fs_file_t::spiffs
```

```
union fs_file_t::@33  fs_file_t::u
struct #include <fs.h> Path stats. Public Members
```

```
uint32_t fs_stat_t::size
```

```
spiffs_obj_type_t fs_stat_t::type
```

struct Public Members

```
const FAR char* fs_command_t::path_p
```

```
fs_callback_t fs_command_t::callback
```

```
void *fs_command_t::arg_p
```

```
struct fs_command_t *fs_command_t::next_p
```

struct Public Members

```
struct fs_command_t fs_counter_t::command
```

```
long long unsigned int fs_counter_t::value
```

```
struct fs_counter_t *fs_counter_t::next_p
```

struct Public Members

```
struct fs_command_t fs_parameter_t::command
```

```
fs_parameter_set_callback_t fs_parameter_t::set_cb
```

```
fs_parameter_print_callback_t fs_parameter_t::print_cb
```

```
void *fs_parameter_t::value_p
```

```
struct fs_parameter_t *fs_parameter_t::next_p
```

struct Public Members

```
struct fs_filesystem_t *fs_dir_t::filesystem_p
```

```
struct fat16_dir_t fs_dir_t::fat16
```

```
struct spiffs_dir_t fs_dir_t::spiffs
```

```
union fs_dir_t::@34  fs_dir_t::u
struct Public Members
```

```
char fs_dir_entry_t::name[256]
```

```
int fs_dir_entry_t::type
```

```
size_t fs_dir_entry_t::size  
  
struct date_t fs_dir_entry_t::latest_mod_date
```

spiffs — SPI Flash File System

The source code of this module is based on <https://github.com/pellepl/spiffs>.

About

Spiffs is a file system intended for SPI NOR flash devices on embedded targets.

Spiffs is designed with following characteristics in mind:

- Small (embedded) targets, sparse RAM without heap.
- Only big areas of data (blocks) can be erased.
- An erase will reset all bits in block to ones.
- Writing pulls one to zeroes.
- Zeroes can only be pulled to ones by erase.
- Wear leveling.

Source code: [src/filesystems/spiffs.h](#), [src/filesystems/spiffs.c](#)

Test code: [tst/filesystems/spiffs/main.c](#)

Defines

```
SPIFFS_OK  
SPIFFS_ERR_NOT_MOUNTED  
SPIFFS_ERR_FULL  
SPIFFS_ERR_NOT_FOUND  
SPIFFS_ERR_END_OF_OBJECT  
SPIFFS_ERR_DELETED  
SPIFFS_ERR_NOT_FINALIZED  
SPIFFS_ERR_NOT_INDEX  
SPIFFS_ERR_OUT_OF_FILE_DESCS  
SPIFFS_ERR_FILE_CLOSED  
SPIFFS_ERR_FILE_DELETED  
SPIFFS_ERR_BAD_DESCRIPTOR  
SPIFFS_ERR_IS_INDEX  
SPIFFS_ERR_IS_FREE
```

SPIFFS_ERR_INDEX_SPAN_MISMATCH
SPIFFS_ERR_DATA_SPAN_MISMATCH
SPIFFS_ERR_INDEX_REF_FREE
SPIFFS_ERR_INDEX_REF_LU
SPIFFS_ERR_INDEX_REF_INVALID
SPIFFS_ERR_INDEX_FREE
SPIFFS_ERR_INDEX_LU
SPIFFS_ERR_INDEX_INVALID
SPIFFS_ERR_NOT_WRITABLE
SPIFFS_ERR_NOT_READABLE
SPIFFS_ERR_CONFLICTING_NAME
SPIFFS_ERR_NOT_CONFIGURED
SPIFFS_ERR_NOT_A_FS
SPIFFS_ERR_MOUNTED
SPIFFS_ERR_ERASE_FAIL
SPIFFS_ERR_MAGIC_NOT_POSSIBLE
SPIFFS_ERR_NO_DELETED_BLOCKS
SPIFFS_ERR_FILE_EXISTS
SPIFFS_ERR_NOT_A_FILE
SPIFFS_ERR_RO_NOT_IMPL
SPIFFS_ERR_RO_ABORTED_OPERATION
SPIFFS_ERR_PROBE_TOO_FEW_BLOCKS
SPIFFS_ERR_PROBE_NOT_A_FS
SPIFFS_ERR_NAME_TOO_LONG
SPIFFS_ERR_INTERNAL
SPIFFS_ERR_TEST
SPIFFS_DBG (...)
SPIFFS_GC_DBG (...)
SPIFFS_CACHE_DBG (...)
SPIFFS_CHECK_DBG (...)
SPIFFS_APPEND
Any write to the filehandle is appended to end of the file.
SPIFFS_O_APPEND
SPIFFS_TRUNC
If the opened file exists, it will be truncated to zero length before opened.
SPIFFS_O_TRUNC

SPIFFS_CREAT

If the opened file does not exist, it will be created before opened.

SPIFFS_O_CREAT

SPIFFS_RDONLY

The opened file may only be read.

SPIFFS_O_RDONLY

SPIFFS_WRONLY

The opened file may only be written.

SPIFFS_O_WRONLY

SPIFFS_RDWR

The opened file may be both read and written.

SPIFFS_O_RDWR

SPIFFS_DIRECT

Any writes to the filehandle will never be cached but flushed directly.

SPIFFS_O_DIRECT

SPIFFS_EXCL

If SPIFFS_O_CREAT and SPIFFS_O_EXCL are set, SPIFFS_open() shall fail if the file exists.

SPIFFS_O_EXCL

SPIFFS_SEEK_SET

SPIFFS_SEEK_CUR

SPIFFS_SEEK_END

SPIFFS_TYPE_FILE

SPIFFS_TYPE_DIR

SPIFFS_TYPE_HARD_LINK

SPIFFS_TYPE_SOFT_LINK

SPIFFS_LOCK (fs)

SPIFFS_UNLOCK (fs)

Typedefs

typedef SpiFFs file descriptor index type. must be signed.

typedef SpiFFs file descriptor flags.

typedef SpiFFs file mode.

typedef Object type.

typedef Spi read call function type.

typedef Spi write call function type.

typedef Spi erase call function type.

typedef File system check callback function.

typedef File system listener callback function.

typedef

typedef

typedef

typedef

```
typedef
typedef
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typedef
```

Enums

enum type spiffs_check_type_t

File system check callback report operation.

Values:

= 0

enum type spiffs_check_report_t

File system check callback report type.

Values:

= 0

enum type spiffs_fileop_type_t

File system listener callback operation.

Values:

= 0The file has been created.

The file has been updated or moved to another page.

The file has been deleted.

Functions

int32_t spiffs_mount (**struct** *spiffs_t* *self_p, **struct** *spiffs_config_t* *config_p, uint8_t *work_p, uint8_t *fd_space_p, uint32_t fd_space_size, void *cache_p, uint32_t cache_size, *spiffs_check_callback_t* check_cb)

Initializes the file system dynamic parameters and mounts the filesystem. If SPIFFS_USE_MAGIC is enabled the mounting may fail with SPIFFS_ERR_NOT_A_FS if the flash does not contain a recognizable file system. In this case, SPIFFS_format must be called prior to remounting.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `config_p`: The physical and logical configuration of the file system.
- `work_p`: A memory work buffer comprising $2 * \text{config} \rightarrow \text{log_page_size}$ bytes used throughout all file system operations
- `fd_space_p`: Memory for file descriptors.
- `fd_space_size`: Memory size of file descriptors.
- `cache_p`: Memory for cache, may be NULL.
- `cache_size`: Memory size of cache.
- `check_cb`: Callback function for reporting during consistency checks.

void **spiffs_unmount** (**struct** *spiffs_t* **self_p*)

Unmounts the file system. All file handles will be flushed of any cached writes and closed.

Return void.

Parameters

- `self_p`: The file system struct.

int32_t **spiffs_creat** (**struct** *spiffs_t* **self_p*, **const** char **path_p*, *spiffs_mode_t* *mode*)

Creates a new file.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `path_p`: The path of the new file.
- `mode`: Ignored, for posix compliance.

spiffs_file_t **spiffs_open** (**struct** *spiffs_t* **self_p*, **const** char **path_p*, *spiffs_flags_t* *flags*, *spiffs_mode_t* *mode*)

Opens/creates a file.

Parameters

- `self_p`: The file system struct.
- `path_p`: The path of the new file.
- `flags`: The flags for the open command, can be combinations of SPIFFS_O_APPEND, SPIFFS_O_TRUNC, SPIFFS_O_CREAT, SPIFFS_O_RDONLY, SPIFFS_O_WRONLY, SPIFFS_O_RDWR, SPIFFS_O_DIRECT, SPIFFS_O_EXCL.
- `mode`: Ignored, for posix compliance.

spiffs_file_t **spiffs_open_by_dirent** (**struct** *spiffs_t* **self_p*, **struct** *spiffs_dirent_t* **ent_p*, *spiffs_flags_t* *flags*, *spiffs_mode_t* *mode*)

Opens a file by given dir entry.

Optimization purposes, when traversing a file system with SPIFFS_readdir a normal SPIFFS_open would need to traverse the filesystem again to find the file, whilst SPIFFS_open_by_dirent already knows where the file resides.

Parameters

- `self_p`: The file system struct.
- `e_p`: The dir entry to the file.
- `flags`: The flags for the open command, can be combinations of SPIFFS_APPEND, SPIFFS_TRUNC, SPIFFS_CREAT, SPIFFS_RD_ONLY, SPIFFS_WR_ONLY, SPIFFS_RDWR, SPIFFS_DIRECT. SPIFFS_CREAT will have no effect in this case.
- `mode`: Ignored, for posix compliance.

spiffs_file_t **spiffs_open_by_page** (*struct spiffs_t* **self_p*, *spiffs_page_ix_t* *page_ix*, *spiffs_flags_t* *flags*, *spiffs_mode_t* *mode*)

Opens a file by given page index.

Optimization purposes, opens a file by directly pointing to the page index in the spi flash. If the page index does not point to a file header SPIFFS_ERR_NOT_A_FILE is returned.

Parameters

- `self_p`: The file system struct.
- `page_ix`: The page index.
- `flags`: The flags for the open command, can be combinations of SPIFFS_APPEND, SPIFFS_TRUNC, SPIFFS_CREAT, SPIFFS_RD_ONLY, SPIFFS_WR_ONLY, SPIFFS_RDWR, SPIFFS_DIRECT. SPIFFS_CREAT will have no effect in this case.
- `mode`: Ignored, for posix compliance.

int32_t **spiffs_read** (*struct spiffs_t* **self_p*, *spiffs_file_t* *fh*, *void* **buf_p*, *int32_t* *len*)

Reads from given filehandle.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle.
- `buf_p`: Where to put read data.
- `len`: How much to read.

int32_t **spiffs_write** (*struct spiffs_t* **self_p*, *spiffs_file_t* *fh*, *void* **buf_p*, *int32_t* *len*)

Writes to given filehandle.

Return Number of bytes written, or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle.
- `buf_p`: The data to write.
- `len`: How much to write.

`int32_t spiffs_lseek (struct spiffs_t *self_p, spiffs_file_t fh, int32_t offs, int whence)`

Moves the read/write file offset. Resulting offset is returned or negative if error.

`lseek(fs, fd, 0, SPIFFS_SEEK_CUR)` will thus return current offset.

If `SPIFFS_SEEK_CUR`, the file offset shall be set to its current location plus offset.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle.
- `offs`: How much/where to move the offset.
- `whence`: If `SPIFFS_SEEK_SET`, the file offset shall be set to offset bytes.

If `SPIFFS_SEEK_END`, the file offset shall be set to the size of the file plus offse, which should be negative.

Return zero(0) or negative error code.

`int32_t spiffs_remove (struct spiffs_t *self_p, const char *path_p)`

Removes a file by path.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `path_p`: The path of the file to remove.

`int32_t spiffs_fremove (struct spiffs_t *self_p, spiffs_file_t fh)`

Removes a file by filehandle.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle of the file to remove.

`int32_t spiffs_stat (struct spiffs_t *self_p, const char *path_p, struct spiffs_stat_t *stat_p)`

Gets file status by path.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `path_p`: The path of the file to stat.
- `stat_p`: The stat struct to populate.

`int32_t spiffs_fstat (struct spiffs_t *self_p, spiffs_file_t fh, struct spiffs_stat_t *stat_p)`

Gets file status by filehandle.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.

- `fh`: The filehandle of the file to stat.
- `stat_p`: The stat struct to populate.

`int32_t spiffs_fflush (struct spiffs_t *self_p, spiffs_file_t fh)`

Flushes all pending write operations from cache for given file.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle of the file to flush.

`int32_t spiffs_close (struct spiffs_t *self_p, spiffs_file_t fh)`

Closes a filehandle. If there are pending write operations, these are finalized before closing.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle of the file to close.

`int32_t spiffs_rename (struct spiffs_t *self_p, const char *old_path_p, const char *new_path_p)`

Renames a file.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `old_path_p`: Path of file to rename.
- `new_path_p`: New path of file.

`int32_t spiffs_errno (struct spiffs_t *self_p)`

Returns last error of last file operation.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.

`void spiffs_clearerr (struct spiffs_t *self_p)`

Clears last error.

Return void.

Parameters

- `self_p`: The file system struct.

`struct spiffs_dir_t *spiffs_opendir (struct spiffs_t *self_p, const char *name_p, struct spiffs_dir_t *dir_p)`

Opens a directory stream corresponding to the given name. The stream is positioned at the first entry in the directory. On hydrogen builds the name argument is ignored as hydrogen builds always correspond to a flat file structure - no directories.

Parameters

- `self_p`: The file system struct.
- `name_p`: The name of the directory.
- `dir_p`: Pointer the directory stream to be populated.

`int32_t spiffs_closedir (struct spiffs_dir_t *dir_p)`

Closes a directory stream

Return zero(0) or negative error code.

Parameters

- `dir_p`: The directory stream to close.

`struct spiffs_dirent_t *spiffs_readdir (struct spiffs_dir_t *dir_p, struct spiffs_dirent_t *ent_p)`

Reads a directory into given `spifs_dirent` struct.

Return NULL if error or end of stream, else given `dirent` is returned.

Parameters

- `dir_p`: Pointer to the directory stream.
- `ent_p`: The `dirent` struct to be populated.

`int32_t spiffs_check (struct spiffs_t *self_p)`

Runs a consistency check on given filesystem.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.

`int32_t spiffs_info (struct spiffs_t *self_p, uint32_t *total_p, uint32_t *used_p)`

Returns number of total bytes available and number of used bytes. This is an estimation, and depends on if there are many files with little data or few files with much data.

NB: If used number of bytes exceeds total bytes, a `SPIFFS_check` should run. This indicates a power loss in midst of things. In worst case (repeated powerlosses in mending or gc) you might have to delete some files.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `total_p`: Total number of bytes in filesystem.
- `used_p`: Used number of bytes in filesystem.

`int32_t spiffs_format (struct spiffs_t *self_p)`

Formats the entire file system. All data will be lost. The filesystem must not be mounted when calling this.

NB: formatting is awkward. Due to backwards compatibility, `SPIFFS_mount` MUST be called prior to formatting in order to configure the filesystem. If `SPIFFS_mount` succeeds, `SPIFFS_unmount` must be called before calling `SPIFFS_format`. If `SPIFFS_mount` fails, `SPIFFS_format` can be called directly without calling `SPIFFS_unmount` first.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.

uint8_t **spiffs_mounted** (struct *spiffs_t* **self_p*)

Returns nonzero if spiffs is mounted, or zero if unmounted.

Parameters

- `self_p`: The file system struct.

int32_t **spiffs_gc_quick** (struct *spiffs_t* **self_p*, uint16_t *max_free_pages*)

Tries to find a block where most or all pages are deleted, and erase that block if found. Does not care for wear levelling. Will not move pages around.

If parameter `max_free_pages` are set to 0, only blocks with only deleted pages will be selected.

NB: the garbage collector is automatically called when spiffs needs free pages. The reason for this function is to give possibility to do background tidying when user knows the system is idle.

Use with care.

Setting `max_free_pages` to anything larger than zero will eventually wear flash more as a block containing free pages can be erased.

Will set `err_no` to `SPIFFS_OK` if a block was found and erased, `SPIFFS_ERR_NO_DELETED_BLOCK` if no matching block was found, or other error.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `max_free_pages`: maximum number allowed free pages in block.

int32_t **spiffs_gc** (struct *spiffs_t* **self_p*, uint32_t *size*)

Will try to make room for given amount of bytes in the filesystem by moving pages and erasing blocks. If it is physically impossible, `err_no` will be set to `SPIFFS_ERR_FULL`. If there already is this amount (or more) of free space, `SPIFFS_gc` will silently return. It is recommended to call `SPIFFS_info` before invoking this method in order to determine what amount of bytes to give.

NB: the garbage collector is automatically called when spiffs needs free pages. The reason for this function is to give possibility to do background tidying when user knows the system is idle.

Use with care.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `size`: Amount of bytes that should be freed.

int32_t **spiffs_eof** (struct *spiffs_t* **self_p*, *spiffs_file_t* *fh*)

Check if EOF reached.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle of the file to check.

`int32_t spiffs_tell (struct spiffs_t *self_p, spiffs_file_t fh)`

Get position in file.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `fh`: The filehandle of the file to check.

`int32_t spiffs_set_file_callback_func (struct spiffs_t *self_p, spiffs_file_callback_t cb_func)`

Registers a callback function that keeps track on operations on file headers. Do note, that this callback is called from within internal spiffs mechanisms. Any operations on the actual file system being callbacked from in this callback will mess things up for sure - do not do this. This can be used to track where files are and move around during garbage collection, which in turn can be used to build location tables in ram. Used in conjunction with SPIFFS_open_by_page this may improve performance when opening a lot of files. Must be invoked after mount.

Return zero(0) or negative error code.

Parameters

- `self_p`: The file system struct.
- `cb_func`: The callback on file operations.

struct `#include <spiffs.h>` Spiffs spi configuration struct. **Public Members**

`spiffs_read_cb_t spiffs_config_t::hal_read_f`

Physical read function.

`spiffs_write_cb_t spiffs_config_t::hal_write_f`

Physical write function.

`spiffs_erase_cb_t spiffs_config_t::hal_erase_f`

Physical erase function.

`uint32_t spiffs_config_t::phys_size`

Physical size of the spi flash.

`uint32_t spiffs_config_t::phys_addr`

Physical offset in spi flash used for spiffs, must be on block boundary.

`uint32_t spiffs_config_t::phys_erase_block`

Physical size when erasing a block.

`uint32_t spiffs_config_t::log_block_size`

Logical size of a block, must be on physical block size boundary and must never be less than a physical block.

`uint32_t spiffs_config_t::log_page_size`

Logical size of a page, must be at least `log_block_size /`

1.

struct Public Members**struct *spiffs_config_t* spiffs_t::cfg**

File system configuration.

uint32_t spiffs_t::block_count

Number of logical blocks.

spiffs_block_ix_t spiffs_t::free_cursor_block_ix

Cursor for free blocks, block index.

int spiffs_t::free_cursor_obj_lu_entry

Cursor for free blocks, entry index.

spiffs_block_ix_t spiffs_t::cursor_block_ix

Cursor when searching, block index.

int spiffs_t::cursor_obj_lu_entry

Cursor when searching, entry index.

uint8_t *spiffs_t::lu_work

Primary work buffer, size of a logical page.

uint8_t *spiffs_t::work

Secondary work buffer, size of a logical page.

uint8_t *spiffs_t::fd_space

File descriptor memory area.

uint32_t spiffs_t::fd_count

Available file descriptors.

int32_t spiffs_t::err_code

Last error.

uint32_t spiffs_t::free_blocks

Current number of free blocks.

uint32_t spiffs_t::stats_p_allocated

Current number of busy pages.

uint32_t spiffs_t::stats_p_deleted

Current number of deleted pages.

uint8_t spiffs_t::cleaning

Flag indicating that garbage collector is cleaning.

spiffs_obj_id_t spiffs_t::max_erase_count

Max erase count amongst all blocks.

***spiffs_check_callback_t* spiffs_t::check_cb_f**

Check callback function.

***spiffs_file_callback_t* spiffs_t::file_cb_f**

File callback function.

```
uint8_t spiffs_t::mounted
    Mounted flag.

void *spiffs_t::user_data
    User data.

uint32_t spiffs_t::config_magic
    Config magic.
struct #include <spiffs.h> Spiffs file status struct. Public Members

spiffs_obj_id_t spiffs_stat_t::obj_id

uint32_t spiffs_stat_t::size

spiffs_obj_type_t spiffs_stat_t::type

spiffs_page_ix_t spiffs_stat_t::pix

uint8_t spiffs_stat_t::name[SPIFFS_OBJ_NAME_LEN]
struct Public Members

spiffs_obj_id_t spiffs_dirent_t::obj_id

uint8_t spiffs_dirent_t::name[SPIFFS_OBJ_NAME_LEN]

spiffs_obj_type_t spiffs_dirent_t::type

uint32_t spiffs_dirent_t::size

spiffs_page_ix_t spiffs_dirent_t::pix
struct Public Members

struct spiffs_t *spiffs_dir_t::fs

spiffs_block_ix_t spiffs_dir_t::block

int spiffs_dir_t::entry
```

1.6.5 inet

The inet package on [Github](#).

Modules:

http_server — HTTP server

Source code: [src/inet/http_server.h](#), [src/inet/http_server.c](#)

Test code: [tst/inet/http_server/main.c](#)

Test coverage: [src/inet/http_server.c](#)

Typedefs

typedef

Enums

enum type http_server_request_action_t

Values:

= 0

= 1

enum type http_server_content_type_t

Content type.

Values:

= 0

= 1

enum type http_server_response_code_t

Response codes.

Values:

= 200

= 401

= 404

enum type http_server_connection_state_t

Connection state.

Values:

= 0

Functions

int http_server_init (**struct** *http_server_t* *self_p, **struct** *http_server_listener_t* *listener_p, **struct** *http_server_connection_t* *connections_p, **const** char *root_path_p, **const** **struct** *http_server_route_t* *routes_p, *http_server_route_callback_t* on_no_route)

Initialize given http server with given root path and maximum number of clients.

Return zero(0) or negative error code.

Parameters

- self_p: Http server to initialize.
- listener_p: Listener.
- connections_p: A NULL terminated list of connections.
- root_path_p: Working directory for the connection threads.
- routes_p: An array of routes.
- on_no_route: Callback called for all requests without a matching route in route_p.

```
int http_server_start (struct http_server_t *self_p)
```

Start given HTTP server.

Spawn the threads and start listening for connections.

Return zero(0) or negative error code.

Parameters

- self_p: Http server.

```
int http_server_stop (struct http_server_t *self_p)
```

Stop given HTTP server.

Closes the listener and all open connections, and then kills the threads.

Return zero(0) or negative error code.

Parameters

- self_p: Http server.

```
int http_server_response_write (struct http_server_connection_t *connection_p, struct  
                                http_server_request_t *request_p, struct http_server_response_t  
                                *response_p)
```

Write given HTTP response to given connected client. This function should only be called from the route callbacks to respond to given request.

Return zero(0) or negative error code.

Parameters

- connection_p: Current connection.
- request_p: Current request.
- response_p: Current response. If buf_p in the response to NULL this function will only write the HTTP header, including the size, to the socket. After this function returns write the payload by calling `socket_write()`.

struct `#include <http_server.h>` HTTP request. **Public Members**

```
http_server_request_action_t http_server_request_t::action
```

```
char http_server_request_t::path[64]
```

```
int http_server_request_t::present
```

```
char http_server_request_t::value[64]
```

```
struct http_server_request_t::@36::@37 http_server_request_t::sec_websocket_key
```

```
struct http_server_request_t::@36::@38 http_server_request_t::content_type
```

```
long http_server_request_t::value
```

```
struct http_server_request_t::@36::@39 http_server_request_t::content_length
```

```
struct http_server_request_t::@36::@40 http_server_request_t::authorization
```

```
struct http_server_request_t::@36 http_server_request_t::headers
```

struct *#include <http_server.h>* HTTP response. **Public Members**

int http_server_response_t::type

http_server_response_code_t http_server_response_t::code

const char *http_server_response_t::buf_p

size_t http_server_response_t::size

struct http_server_response_t::@41 http_server_response_t::content

struct **Public Members**

const char *http_server_listener_t::address_p

int http_server_listener_t::port

const char *http_server_listener_t::name_p

void *http_server_listener_t::buf_p

size_t http_server_listener_t::size

struct http_server_listener_t::@42::@43 http_server_listener_t::stack

struct *thrd_t* *http_server_listener_t::id_p

struct http_server_listener_t::@42 http_server_listener_t::thrd

struct *socket_t* http_server_listener_t::socket

struct **Public Members**

http_server_connection_state_t http_server_connection_t::state

const char *http_server_connection_t::name_p

void *http_server_connection_t::buf_p

size_t http_server_connection_t::size

struct http_server_connection_t::@44::@45 http_server_connection_t::stack

struct *thrd_t* *http_server_connection_t::id_p

struct http_server_connection_t::@44 http_server_connection_t::thrd

struct *http_server_t* *http_server_connection_t::self_p

struct *socket_t* http_server_connection_t::socket

struct *event_t* http_server_connection_t::events

struct *#include <http_server.h>* Call given callback for given path. **Public Members**

const char *http_server_route_t::path_p

http_server_route_callback_t http_server_route_t::callback

struct **Public Members**

const char *http_server_t::root_path_p

```
const struct http_server_route_t *http_server_t::routes_p  
http_server_route_callback_t http_server_t::on_no_route  
struct http_server_listener_t *http_server_t::listener_p  
struct http_server_connection_t *http_server_t::connections_p  
struct event_t http_server_t::events
```

http_websocket_client — HTTP websocket client

Source code: `src/inet/http_websocket_client.h`, `src/inet/http_websocket_client.c`

Test code: `tst/inet/http_websocket_client/main.c`

Test coverage: `src/inet/http_websocket_client.c`

Functions

```
int http_websocket_client_init (struct http_websocket_client_t *self_p, const char *server_p, int  
                                port, const char *path_p)
```

Initialize given http.

Return zero(0) or negative error code.

Parameters

- `self_p`: Http to initialize.
- `server_p`: Server hostname to connect to.
- `port`: Port to connect to.
- `path_p`: Path.

```
int http_websocket_client_connect (struct http_websocket_client_t *self_p)
```

Connect given http to the server.

Return zero(0) or negative error code.

Parameters

- `self_p`: Http to connect.

```
int http_websocket_client_disconnect (struct http_websocket_client_t *self_p)
```

Disconnect given http from the server.

Return zero(0) or negative error code.

Parameters

- `self_p`: Http to connect.

```
ssize_t http_websocket_client_read (struct http_websocket_client_t *self_p, void *buf_p, size_t  
                                    size)
```

Read from given http.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: Http to read from.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read..

```
ssize_t http_websocket_client_write (struct http_websocket_client_t *self_p, int type, const void
                                     *buf_p, uint32_t size)
```

Write given data to given http.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Http to write to.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

struct `#include <http_websocket_client.h>`**Public Members**

```
struct socket_t http_websocket_client_t::socket
const char *http_websocket_client_t::host_p
int http_websocket_client_t::port
struct http_websocket_client_t::@46 http_websocket_client_t::server
size_t http_websocket_client_t::left
struct http_websocket_client_t::@47 http_websocket_client_t::frame
const char *http_websocket_client_t::path_p
```

http_websocket_server — HTTP websocket server

Source code: `src/inet/http_websocket_server.h`, `src/inet/http_websocket_server.c`

Test code: `tst/inet/http_websocket_server/main.c`

Test coverage: `src/inet/http_websocket_server.c`

Functions

```
int http_websocket_server_init (struct http_websocket_server_t *self_p, struct socket_t *socket_p)
```

Initialize given websocket server. The server uses the http module interface to communicate with the client.

Return zero(0) or negative error code.

Parameters

- `self_p`: Http to initialize.

- `socket_p`: Connected socket.

int **http_websocket_server_handshake** (struct *http_websocket_server_t* *self_p, struct *http_server_request_t* *request_p)

Read the handshake request from the client and send the handshake response.

Return zero(0) or negative error code.

Parameters

- `self_p`: Websocket server.
- `request_p`: Read handshake request.

ssize_t **http_websocket_server_read** (struct *http_websocket_server_t* *self_p, int *type_p, void *buf_p, size_t size)

Read a message from given websocket.

Return Number of bytes read or negative error code.

Parameters

- `self_p`: Websocket to read from.
- `type_p`: Read message type.
- `buf_p`: Buffer to read into.
- `size`: Number of bytes to read. Longer messages will be truncated and the leftover data dropped.

ssize_t **http_websocket_server_write** (struct *http_websocket_server_t* *self_p, int type, const void *buf_p, uint32_t size)

Write given message to given websocket.

Return Number of bytes written or negative error code.

Parameters

- `self_p`: Websocket to write to.
- `type`: One of `HTTP_TYPE_TEXT` and `HTTP_TYPE_BINARY`.
- `buf_p`: Buffer to write.
- `size`: Number of bytes to write.

struct *#include <http_websocket_server.h>* **Public Members**

struct *socket_t* *http_websocket_server_t::socket_p

inet — Internet utilities

Source code: [src/inet/inet.h](#), [src/inet/inet.c](#)

Test code: [tst/inet/inet/inet.c](#)

Test coverage: [src/inet/inet.c](#)

Functions

int **inet_module_init** (void)

Initialize the inet module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **inet_aton** (const char *src_p, struct *inet_ip_addr_t* *dst_p)

Convert the Internet host address src_p from the IPv4 numbers-and-dots notation into binary form (in network byte order) and stores it in the structure that dst_p points to.

The address supplied in src_p can have one of the following forms:

- a.b.c.d Each of the four numeric parts specifies a byte of the address; the bytes are assigned in left-to-right order to produce the binary address.

Return zero(0) or negative error code.

Parameters

- src_p: Address a.b.c.d to convert into a number.
- dst_p: Converted address.

char ***inet_ntoa** (const struct *inet_ip_addr_t* *src_p, char *dst_p)

Convert the Internet host src_p from the IPv4 binary form (in network byte order) to numbers-and-dots notation and stores it in the structure that dst_p points to.

Return Converted address pointer or NULL on failure.

Parameters

- src_p: Address to convert into a string.
- dst_p: Converted address as a string.

uint16_t **inet_checksum** (void *buf_p, size_t size)

Calculate the internet checksum of given buffer.

Return Calculated checksum.

Parameters

- buf_p: Buffer to calculate the checksum of.
- size: Size of the buffer.

struct *#include <inet.h>* **Public Members**

uint32_t *inet_ip_addr_t*::**number**

IPv4 address.

struct **Public Members**

struct *inet_ip_addr_t* *inet_addr_t*::**ip**

IPv4 address.

```
uint16_t inet_addr_t::port
```

Port.

struct *#include <inet.h>* Interface IP information. **Public Members**

```
struct inet_ip_addr_t inet_if_ip_info_t::address
```

```
struct inet_ip_addr_t inet_if_ip_info_t::netmask
```

```
struct inet_ip_addr_t inet_if_ip_info_t::gateway
```

mqtt_client — MQTT client

Source code: `src/inet/mqtt_client.h`, `src/inet/mqtt_client.c`

Test code: `tst/inet/mqtt_client/main.c`

Test coverage: `src/inet/mqtt_client.c`

Typedefs

typedef Prototype of the on-publish callback function. Number of bytes read from the input channel.

Parameters • `client_p`: The client.

- `topic_p`: The received topic.
- `chin_p`: The channel to read the value from.
- `size`: Number of bytes of the value to read from `chin_p`.

typedef Prototype of the on-error callback function. zero(0) or negative error code.

Parameters • `client_p`: The client.

- `error`: The number of error that occurred.

Enums

enum type `mqtt_client_state_t`

Values:

enum type `mqtt_qos_t`

Quality of Service.

Values:

= 0

= 1

= 2

Functions

int **mqtt_client_init** (struct *mqtt_client_t* *self_p, const char *name_p, struct *log_object_t* *log_object_p, void *chout_p, void *chin_p, *mqtt_on_publish_t* on_publish, *mqtt_on_error_t* on_error)

Initialize given MQTT client.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.
- name_p: Name of the thread.
- log_object_p: Log object.
- chout_p: Output channel for client to server packets.
- chin_p: Input channel for server to client packets.
- on_publish: On-publish callback function. Called when the server publishes a message.
- on_error: On-error callback function. Called when an error occurs.

void ***mqtt_client_main** (void *arg_p)
MQTT client thread.

Return Never returns.

Parameters

- arg_p: MQTT client.

int **mqtt_client_connect** (struct *mqtt_client_t* *self_p)
Establish a connection to the server.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.

int **mqtt_client_disconnect** (struct *mqtt_client_t* *self_p)
Disconnect from the server.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.

int **mqtt_client_ping** (struct *mqtt_client_t* *self_p)
Send a ping request to the server (broker) and wait for the ping response.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.

```
int mqtt_client_publish(struct mqtt_client_t *self_p, struct mqtt_application_message_t *message_p)
```

Publish given topic.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.
- topic_p: Topic.
- payload_p: Payload to publish. May be NULL.
- payload_size: Number of bytes in the payload.

```
int mqtt_client_subscribe(struct mqtt_client_t *self_p, struct mqtt_application_message_t *message_p)
```

Subscribe to given message.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.
- message_p: The message to subscribe to. The payload part of the message is not used. The topic may use wildcards, given that the server supports it.

```
int mqtt_client_unsubscribe(struct mqtt_client_t *self_p, struct mqtt_application_message_t *message_p)
```

Unsubscribe from given message.

Return zero(0) or negative error code.

Parameters

- self_p: MQTT client.
- message_p: The message to unsubscribe from. Only the topic in the message is used.

struct #include <mqtt_client.h> MQTT client. **Public Members**

```
const char *mqtt_client_t::name_p
```

```
struct log_object_t *mqtt_client_t::log_object_p
```

```
int mqtt_client_t::state
```

```
int mqtt_client_t::type
```

```
void *mqtt_client_t::data_p
```

```
struct mqtt_client_t::@48 mqtt_client_t::message
```

```
void *mqtt_client_t::out_p
```

```
void *mqtt_client_t::in_p
```

```
struct mqtt_client_t::@49 mqtt_client_t::transport
```

```
struct queue_t mqtt_client_t::out
```

```

struct queue_t mqtt_client_t::in
struct mqtt_client_t::@50  mqtt_client_t::control
mqtt_on_publish_t mqtt_client_t::on_publish
mqtt_on_error_t mqtt_client_t::on_error
struct #include <mqtt_client.h> MQTT application message. Public Members

const char *mqtt_application_message_t::buf_p
size_t mqtt_application_message_t::size
struct mqtt_application_message_t::@51  mqtt_application_message_t::topic
const void *mqtt_application_message_t::buf_p
struct mqtt_application_message_t::@52  mqtt_application_message_t::payload
mqtt_qos_t mqtt_application_message_t::qos

```

network_interface — Network interface

The network interface module has a list of all network interfaces and their states.

Network interface modules:

network_interface_slip — Serial Link Internet Protocol

Serial Line Internet Protocol (SLIP) is a link layer internet protocol used to transfer TCP/IP packets over a point-to-point serial line.

It is documented in RFC 1055.

Source code: [src/inet/network_interface/slipo.h](#)

Example code: [examples/inet/slipo/main.c](#)

Defines

NETWORK_INTERFACE_SLIP_FRAME_SIZE_MAX

Enums

enum type network_interface_slip_state_t

Values:

= 0

Functions

int **network_interface_slip_module_init** (void)

Initialize the slip module.

Return zero(0) or negative error code.

int **network_interface_slip_init** (struct *network_interface_slip_t* *self_p, struct *inet_ip_addr_t* *ipaddr_p, struct *inet_ip_addr_t* *netmask_p, struct *inet_ip_addr_t* *gateway_p, void *chout_p)

Initialize given slip network interface with given configuration and output channel.

Return zero(0) or negative error code.

Parameters

- self_p: Slip to initialize.
- ipaddr_p: Network interface IP address.
- netmask_p: Network interface netmask.
- gateway_p: Network interface gateway.
- chout_p: Output channel.

int **network_interface_slip_input** (struct *network_interface_slip_t* *self_p, uint8_t data)

Input a byte into the SLIP IP stack. Normally a user thread reads one byte at a time from the UART and calls this functions with the read byte as argument.

Return Number of bytes written to the input frame or negative error code.

Parameters

- self_p: Slip to initialize.
- data: Byte to input into the stack.

struct Public Members

network_interface_slip_state_t network_interface_slip_t::state

struct pbuf *network_interface_slip_t::pbuf_p

uint8_t *network_interface_slip_t::buf_p

size_t network_interface_slip_t::size

struct network_interface_slip_t::@54 network_interface_slip_t::frame

void *network_interface_slip_t::chout_p

struct *network_interface_t* network_interface_slip_t::network_interface

network_interface_wifi — WiFi network interface

WiFi network interface driver modules:

network_interface_driver_esp — ESP WiFi network interface driver

Source code: `src/inet/network_interface/driver/esp.h`, `src/inet/network_interface/driver/esp.c`

Test code: `tst/inet/network_interface/wifi_esp/main.c`

Variables

struct *network_interface_wifi_driver_t* **network_interface_wifi_driver_esp_station**

struct *network_interface_wifi_driver_t* **network_interface_wifi_driver_esp_softap**
Espressif WiFi SoftAP driver callbacks. To be used as driver in the wifi network interface.

Source code: `src/inet/network_interface/wifi.h`, `src/inet/network_interface/wifi.c`

Test code: `tst/inet/network_interface/wifi_esp/main.c`

Functions

int **network_interface_wifi_module_init** (void)

Initialize the WiFi network interface module.

Return zero(0) or negative error code.

int **network_interface_wifi_init** (**struct** *network_interface_wifi_t* **self_p*, **const** char **name_p*,
 struct *network_interface_wifi_driver_t* **driver_p*, void **arg_p*,
 const char **ssid_p*, **const** char **password_p*)

Initialize given WiFi network interface with given configuration.

Return zero(0) or negative error code.

Parameters

- *self_p*: The WiFi network interface to initialize.
- *name_p*: Name to assign the to interface.
- *driver_p*: Driver virtualization callbacks to use.
- *arg_p*: Argument passed to the driver callbacks.
- *ssid_p*: Access Point SSID.
- *password_p*: Access Point password.

int **network_interface_wifi_start** (**struct** *network_interface_wifi_t* **self_p*)

Start given WiFi network interface.

Return zero(0) or negative error code.

Parameters

- `self_p`: WiFi network interface to start.

int **network_interface_wifi_stop** (struct *network_interface_wifi_t* **self_p*)
Stop given WiFi network interface.

Return zero(0) or negative error code.

Parameters

- `self_p`: WiFi network interface to stop.

int **network_interface_wifi_is_up** (struct *network_interface_wifi_t* **self_p*)
Get the connection status of given network interface.

Return true(1) if the network interface is up, false(0) if it is down, and otherwise negative error code.

Parameters

- `self_p`: Network interface to get the connection status of.

int **network_interface_wifi_set_ip_info** (struct *network_interface_wifi_t* **self_p*, const struct *inet_if_ip_info_t* **info_p*)
Set the ip address, netmask and gateway of given network interface.

Return zero(0) if the interface has valid IP information, otherwise negative error code.

Parameters

- `self_p`: Network interface.
- `info_p`: Interface IP information to set.

int **network_interface_wifi_get_ip_info** (struct *network_interface_wifi_t* **self_p*, struct *inet_if_ip_info_t* **info_p*)
Get the ip address, netmask and gateway of given network interface.

Return zero(0) if the interface has valid IP information, otherwise negative error code.

Parameters

- `self_p`: Network interface.
- `info_p`: Interface IP information. Only valid if this function returns zero(0).

struct *#include <wifi.h>* **Public Members**

struct *network_interface_t* network_interface_wifi_t::network_interface

struct *network_interface_wifi_driver_t* *network_interface_wifi_t::driver_p

void *network_interface_wifi_t::arg_p

const char *network_interface_wifi_t::ssid_p

const char *network_interface_wifi_t::password_p

const struct *inet_if_ip_info_t* *network_interface_wifi_t::info_p

struct *#include <wifi.h>* Driver virtualization callbacks. See the `driver/` subfolder for available drivers.

Public Members

```
int (*network_interface_wifi_driver_t::init)(void *arg_p)

int (*network_interface_wifi_driver_t::start)(void *arg_p, const char *ssid_p,
                                              const char *password_p, const struct
                                              inet_if_ip_info_t *info_p)

int (*network_interface_wifi_driver_t::stop)(void *arg_p)

int (*network_interface_wifi_driver_t::is_up)(void *arg_p)

int (*network_interface_wifi_driver_t::set_ip_info)(void *arg_p, const struct
                                                    inet_if_ip_info_t *info_p)

int (*network_interface_wifi_driver_t::get_ip_info)(void *arg_p, struct
                                                    inet_if_ip_info_t *info_p)
```

Debug file system commands

One debug file system command is available, located in the directory `inet/network_interface/`.

Command	Description
<code>list</code>	Print a list of all registered network interfaces.

Example output from the shell:

\$ <code>inet/network_interface/list</code>					
NAME	STATE	ADDRESS	TX BYTES	RX BYTES	
<code>esp-wlan-ap</code>	<code>up</code>	<code>192.168.4.1</code>	<code>-</code>	<code>-</code>	
<code>esp-wlan-sta</code>	<code>up</code>	<code>192.168.0.5</code>	<code>-</code>	<code>-</code>	

Source code: [src/inet/network_interface.h](#), [src/inet/network_interface.c](#)

Test coverage: [src/inet/network_interface.c](#)

Typedefs

```
typedef
typedef
typedef
typedef
typedef
```

Functions

int **network_interface_module_init** (void)

Initialize the network interface module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **network_interface_add** (struct *network_interface_t* *netif_p)

Add given network interface to the global list of network interfaces. Call `network_interface_start()` to enable the interface.

Return zero(0) or negative error code.

Parameters

- `netif_p`: Network interface to register.

int **network_interface_start** (struct *network_interface_t* *netif_p)

Start given network interface. Enables the interface in the IP stack to allow packets to be sent and received. If the interface is a WiFi station interface it will try initiate the connection to its configured access point. Use `network_interface_is_up()` to check if the interface is connected to its access point.

Return zero(0) or negative error code.

Parameters

- `netif_p`: Network interface to start.

int **network_interface_stop** (struct *network_interface_t* *netif_p)

Stop given network interface. Disconnects from any WiFi access points and disables the interface in the IP stack. No packets can be sent or received on this interface after this function is called.

Return zero(0) or negative error code.

Parameters

- `netif_p`: Network interface to stop.

int **network_interface_is_up** (struct *network_interface_t* *netif_p)

Get the connection status of given network interface. Packets can only be sent and received when the interface is up.

Return true(1) if the network interface is up, false(0) if it is down, and otherwise negative error code.

Parameters

- `netif_p`: Network interface to get the connection status of.

struct *network_interface_t* ***network_interface_get_by_name** (const char *name_p)

Search the global list of network interfaces for an interface with given name and return it.

Return Found network interface or NULL if it was not found.

Parameters

- `name_p`: Name of the network interface to find.

int **network_interface_set_ip_info** (struct *network_interface_t* *netif_p, const struct *inet_if_ip_info_t* *info_p)

Set the IP information of given network interface.

Return zero(0) or negative error code.

Parameters

- `netif_p`: Network interface to get the IP information of.
- `info_p`: IP information to set.

```
int network_interface_get_ip_info(struct network_interface_t *netif_p, struct inet_if_ip_info_t
                                *info_p)
```

Get the IP information of given network interface.

Return zero(0) or negative error code.

Parameters

- `netif_p`: Network interface to get the IP information of.
- `info_p`: Read IP information.

struct Public Members

```
const char *network_interface_t::name_p
struct inet_if_ip_info_t network_interface_t::info
network_interface_start_t network_interface_t::start
network_interface_stop_t network_interface_t::stop
network_interface_is_up_t network_interface_t::is_up
network_interface_set_ip_info_t network_interface_t::set_ip_info
network_interface_get_ip_info_t network_interface_t::get_ip_info
void *network_interface_t::netif_p
struct network_interface_t *network_interface_t::next_p
```

ping — Ping

Debug file system commands

One debug file system command is available, located in the directory `inet/ping/`.

Command	Description
<code>ping <remote host></code>	Ping a remote host by given ip address.

Example output from the shell:

```
$ inet/ping/ping 192.168.1.100
Successfully pinged '192.168.1.100' in 10 ms.
$
```

Source code: `src/inet/ping.h`, `src/inet/ping.c`

Test code: `tst/inet/ping/main.c`

Test coverage: `src/inet/ping.c`

Functions

int **ping_module_init** (void)

int **ping_host_by_ip_address** (struct *inet_ip_addr_t* *address_p, struct *time_t* *timeout_p, struct *time_t* *round_trip_time_p)

Ping host by given ip address. Send an echo request packet to given host and wait for the echo reply packet. No extra payload data is transmitted, only the ICMP header.

Return zero(0) or negative error code.

Parameters

- address_p: IP address of the host to ping.
- timeout_p: Number of seconds to wait for the echo reply packet.
- round_trip_time_p: The time it took from sending the echo request packet to receiving the echo reply packet. Only valid if this functions returns zero(0).

socket — Internet communication

Sockets are used to communicate over IP networks. TCP and UDP are the most common transport protocols.

No more than one thread may read from a socket at any given moment. The same applies when writing to a socket. The reader and writer may be different threads, though. The behaviour is undefined if more threads use the same socket simultaneously. The application will likely crash. Add a semaphore to protect the socket if more threads need access to a socket.

Below is a TCP client example that connects to a server and sends data.

```
uint8_t buf[16];
struct socket_t tcp;
struct inet_addr_t local_addr, remote_addr;

/* Set the local and remote addresses. */
inet_aton("192.168.1.103", &local_addr.ip);
local_addr.port = 6000;
inet_aton("192.168.1.106", &remote_addr.ip);
remote_addr.port = 5000;

/* Initialize the socket and connect to the server. */
socket_open_tcp(&tcp);
socket_bind(&tcp, &local_addr);
socket_connect(&tcp, &remote_addr);

/* Send the data. */
memset(buf, 0, sizeof(buf));
socket_write(&tcp, buf, sizeof(buf));

/* Close the connection. */
socket_close(&tcp);
```

And below is the same scenario for UDP.

```
uint8_t buf[16];
struct socket_t udp;
struct socket_addr_t local_addr, remote_addr;
```

```

/* Set the local and remote addresses. */
inet_aton("192.168.1.103", &local_addr.ip);
local_addr.port = 6000;
inet_aton("192.168.1.106", &remote_addr.ip);
remote_addr.port = 5000;

/* Initialize the socket and connect to the server. */
socket_open_udp(&udp);
socket_bind(&udp, &local_addr);
socket_connect(&udp, &remote_addr);

/* Send the data. */
memset(buf, 0, sizeof(buf));
socket_send(&udp, buf, sizeof(buf));

/* Close the connection. */
socket_close(&udp);

```

Source code: [src/inet/socket.h](#), [src/inet/socket.c](#)

Defines

SOCKET_DOMAIN_INET

SOCKET_TYPE_STREAM

TCP socket type.

SOCKET_TYPE_DGRAM

UDP socket type.

SOCKET_TYPE_RAW

RAW socket type.

SOCKET_PROTO_ICMP

Functions

int **socket_module_init** (void)

Initialize the socket module. This function will start the lwIP TCP/IP stack. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **socket_open_tcp** (struct *socket_t* *self_p)

Initialize given TCP socket.

Return zero(0) or negative error code.

Parameters

- self_p: Socket to initialize.

int **socket_open_udp** (struct *socket_t* *self_p)
Initialize given UDP socket.

Return zero(0) or negative error code.

Parameters

- self_p: Socket to initialize.

int **socket_open_raw** (struct *socket_t* *self_p)
Initialize given RAW socket.

Return zero(0) or negative error code.

Parameters

- self_p: Socket to initialize.

int **socket_open** (struct *socket_t* *self_p, int domain, int type, int protocol)
Initialize given socket.

Return zero(0) or negative error code.

Parameters

- self_p: Socket to initialize.
- domain: Socket domain.
- type: Socket type.
- protocol: Socket protocol.

int **socket_close** (struct *socket_t* *self_p)
Close given socket. No data transfers are allowed on after the socket has been closed.

Return zero(0) or negative error code.

Parameters

- self_p: Socket to close.

int **socket_bind** (struct *socket_t* *self_p, const struct *inet_addr_t* *local_addr_p)
Bind given local address to given socket.

Return zero(0) or negative error code.

Parameters

- self_p: Socket.
- local_addr_p: Local address.

int **socket_listen** (struct *socket_t* *self_p, int backlog)
Listen for connections from remote clients. Only applicable for TCP sockets.

Return zero(0) or negative error code.

Parameters

- self_p: Socket to listen on.

- backlog: Unused.

int **socket_connect** (struct *socket_t* *self_p, const struct *inet_addr_t* *remote_addr_p)

Connect to given remote address. Connecting a UDP socket sets the default remote address for outgoing datagrams. For TCP a three-way handshake with the remote peer is initiated.

Return zero(0) or negative error code.

Parameters

- self_p: Socket.
- remote_addr_p: Remote address.

int **socket_connect_by_hostname** (struct *socket_t* *self_p, const char *hostname_p, uint16_t port)

Connect to the remote device with given hostname.

In computer networking, a hostname (archaically nodename) is a label that is assigned to a device connected to a computer network and that is used to identify the device in various forms of electronic communication, such as the World Wide Web.

Return zero(0) or negative error code.

Parameters

- self_p: Socket.
- hostname_p: The hostname of the remote device to connect to.
- port: Remote device port to connect to.

int **socket_accept** (struct *socket_t* *self_p, struct *socket_t* *accepted_p, struct *inet_addr_t* *remote_addr_p)

Accept a client connect attempt. Only applicable for TCP sockets that are listening for connections.

Return zero(0) or negative error code.

Parameters

- self_p: TCP socket.
- accepted_p: New client socket of the accepted client.
- remote_addr_p: Address of the client.

ssize_t **socket_sendto** (struct *socket_t* *self_p, const void *buf_p, size_t size, int flags, const struct *inet_addr_t* *remote_addr_p)

Write data to given socket. Only used by UDP sockets.

Return Number of sent bytes or negative error code.

Parameters

- self_p: Socket to send data on.
- buf_p: Buffer to send.
- size: Size of buffer to send.
- flags: Unused.
- remote_addr_p: Remote address to send the data to.

`ssize_t socket_recvfrom (struct socket_t *self_p, void *buf_p, size_t size, int flags, struct inet_addr_t *remote_addr_p)`

Read data from given socket. Only used by UDP sockets.

Return Number of received bytes or negative error code.

Parameters

- self_p: Socket to receive data on.
- buf_p: Buffer to read into.
- size: Size of buffer to read.
- flags: Unused.
- remote_addr_p: Remote address to receive data from.

`ssize_t socket_write (struct socket_t *self_p, const void *buf_p, size_t size)`

Write data to given TCP or UDP socket. For UDP sockets, `socket_connect ()` must have been called prior to calling this function.

Return Number of written bytes or negative error code.

Parameters

- self_p: Socket.
- buf_p: Buffer to send.
- size: Numer of bytes to send.

`ssize_t socket_read (struct socket_t *self_p, void *buf_p, size_t size)`

Read data from given socket.

Return Number of read bytes or negative error code.

Parameters

- self_p: Socket.
- buf_p: Buffer to read into.
- size: Number of bytes to read.

`ssize_t socket_size (struct socket_t *self_p)`

Get the number of input bytes currently stored in the socket. May return less bytes than number of bytes stored in the channel.

Return Number of input bytes in the socket.

Parameters

- self_p: Socket.

struct Public Members

`struct chan_t socket_t::base`

`int socket_t::type`

`ssize_t socket_t::left`

```
struct socket_t::@55::@57::@59  socket_t::common
struct pbuf *socket_t::pbuf_p
struct inet_addr_t socket_t::remote_addr
int socket_t::closed
struct socket_t::@55::@57::@60  socket_t::recvfrom
struct tcp_pcb *socket_t::pcb_p
struct socket_t::@55::@57::@61  socket_t::accept
union socket_t::@55::@57  socket_t::u
int socket_t::state
void *socket_t::args_p
struct thrd_t *socket_t::thrd_p
struct socket_t::@55::@58  socket_t::cb
struct socket_t::@55  socket_t::input
struct socket_t::@56::@62  socket_t::cb
struct socket_t::@56  socket_t::output
void *socket_t::pcb_p
```

1.6.6 oam

Operations and maintenance of an application is essential to configure, debug and monitor its operation.

The oam package on [Github](#).

console — System console

The system console is the default communication channel to an application. The console input and output channels are often terminated by a shell to enable the user to control and debug the application.

Configure the console by changing the *configuration variables* called `CONFIG_START_CONSOLE*`.

Source code: [src/oam/console.h](#), [src/oam/console.c](#)

Test coverage: [src/oam/console.c](#)

Functions

int **console_module_init** (void)

int **console_init** (void)

Initialize the console.

Return zero(0) or negative error code.

int **console_start** (void)

Start the console.

Return zero(0) or negative error code.

int **console_stop** (void)

Stop the console.

Return zero(0) or negative error code.

int **console_set_input_channel** (void *chan_p)

Set the pointer to the input channel.

Return zero(0) or negative error code.

void ***console_get_input_channel** (void)

Get the pointer to the input channel.

Return Input channel or NULL.

void ***console_set_output_channel** (void *chan_p)

Set the pointer to the output channel.

Return zero(0) or negative error code.

void ***console_get_output_channel** (void)

Get the pointer to the output channel.

Return Output channel or NULL.

service — Services

A service is as a background task. A service is either running or stopped.

Debug file system commands

Three debug file system commands is available, all located in the directory `oam/service/`.

Command	Description
<code>list</code>	List all registered services.
<code>start <service></code>	Start given service.
<code>stop <service></code>	Stop given service.

Example output from the shell:

```

$ oam/service/list
NAME                STATUS
http_server         running
ftp_server           stopped
network_manager     running
$ oam/service/start ftp_server
$ oam/service/stop http_server
$ oam/service/list
NAME                STATE
http_server         stopped
ftp_server           running
network_manager     running

```

Source code: [src/oam/service.h](#), [src/oam/service.c](#)

Test code: [tst/oam/service/main.c](#)

Test coverage: [src/oam/service.c](#)

Defines

SERVICE_CONTROL_EVENT_START

SERVICE_CONTROL_EVENT_STOP

Service stop event.

Typedefs

typedef

Enums

enum type service_status_t

Values:

= 0

= 1

Functions

int **service_module_init** (void)

Initialize the service module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **service_init** (struct *service_t* *self_p, const char *name_p, *service_get_status_cb_t* status_cb)

Initialize a service with given name and status callback.

Return zero(0) or negative error code.

Parameters

- `self_p`: Service to initialize.
- `name_p`: Name of the service.
- `status_callback`: Callback function returning the service status.

int **service_start** (struct *service_t* **self_p*)
Start given service.

The event `SERVICE_CONTROL_EVENT_START` will be written to the control channel of given service and it's up to the service to act on this event. All services should act on all control events.

Return zero(0) or negative error code.

Parameters

- `self_p`: Service to start.

int **service_stop** (struct *service_t* **self_p*)
Stop given service.

The event `SERVICE_CONTROL_EVENT_STOP` will be written to the control channel of given service and it's up to the service to act on this event. All services should act on all control events.

Return zero(0) or negative error code.

Parameters

- `self_p`: Service to stop.

int **service_register** (struct *service_t* **service_p*)
Register given service to the global list of services.

Return zero(0) or negative error code.

Parameters

- `service_p`: Service to register.

int **service_deregister** (struct *service_t* **service_p*)
Deregister given service from the global list of services.

Return zero(0) or negative error code.

Parameters

- `service_p`: Service to deregister.

struct `#include <service.h>` A service with name and control event channel. **Public Members**

`const char` **service_t::name_p*

`struct event_t` *service_t::control*

service_get_status_cb_t *service_t::status_cb*

`struct service_t` **service_t::next_p*

settings — Persistent application settings

Settings are stored in a non-volatile memory (NVM). In other words, settings are perserved after a board reset or power cycle.

Application settings are defined in an ini-file that is used to generate the c source code. A setting has a type, a size, an address and a default value, all defined in the ini-file.

Supported types are:

- `int8_t` An 8 bits signed integer.
- `int16_t` A 16 bits signed integer.
- `int32_t` A 32 bits signed integer.
- `string` An ASCII string.

The size is the number of bytes of the value. For the standard integer types the size must be the value returned by `sizeof()`. For strings it is the length of the string, including null termination.

The address for each setting is defined by the user, starting at address 0 and increasing from there.

The build system variable `SETTINGS_INI` contains the path to the ini-file used by the build system. Set this variable to the path of yours application ini-file and run `make settings-generate` to generate four files; `settings.h`, `settings.c`, `settings.little-endian.bin` and `settings.big-endian.bin`.

Also add this to the Makefile: `SRC += settings.c` and include `settings.h` in the source files that accesses the settings.

Debug file system commands

Four debug file system commands are available, all located in the directory `oam/settings/`.

Command	Description
<code>list</code>	Print a list of the current settings.
<code>reset</code>	Overwrite the current settings values with their default values (the values defined in the ini-file values).
<code>read <name></code>	Read the value of setting <code><name></code> .
<code>write <name></code> <code><value></code>	Write <code><value></code> to setting <code><name></code> .

Example output from the shell:

```
$ oam/settings/list
NAME          TYPE      SIZE  VALUE
version       int8_t     1     1
value_1       int16_t    2    24567
value_2       int32_t    4     -57
value_3       string    16    foobar
$ oam/settings/read value_1
24567
$ oam/settings/write value_1 -5
$ oam/settings/read value_1
-5
$ oam/settings/reset
$ oam/settings/list
NAME          TYPE      SIZE  VALUE
version       int8_t     1     1
value_1       int16_t    2    24567
```

value_2	int32_t	4	-57
value_3	string	16	foobar

Example

In this example the ini-file has one setting defined, `foo`. The type is `int8_t`, the address is `0x00`, the size is 1 and the default value is `-4`.

```
[types]
foo = int8_t

[addresses]
foo = 0x00

[sizes]
foo = 1

[values]
foo = -4
```

The settings can be read and written with the functions `settings_read()` and `settings_write()`. Give the generated defines `SETTING_FOO_ADDR` and `SETTING_FOO_SIZE` as arguments to those functions.

```
int my_read_write_foo()
{
    int8_t foo;

    /* Read the foo setting. */
    if (settings_read(&foo,
                     SETTING_FOO_ADDR,
                     SETTING_FOO_SIZE) != 0) {
        return (-1);
    }

    foo -= 1;

    /* Write the foo setting. */
    if (settings_write(SETTING_FOO_ADDR,
                      &foo,
                      SETTING_FOO_SIZE) != 0) {
        return (-1);
    }

    return (0);
}
```

Source code: `src/oam/settings.h`, `src/oam/settings.c`

Test code: `tst/oam/settings/main.c`

Test coverage: `src/oam/settings.c`

Defines

SETTINGS_AREA_CRC_OFFSET

Enums

enum type setting_type_t

Settings types. Each setting must have be one of these types.

Values:

= 0

Functions

int settings_module_init (void)

Initialize the settings module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

ssize_t settings_read (void **dst_p*, size_t *src*, size_t *size*)

Read the value of given setting by address.

Return Number of words read or negative error code.

Parameters

- *dst_p*: The read value.
- *src*: Setting source address.
- *size*: Number of words to read.

ssize_t settings_write (size_t *dst*, const void **src_p*, size_t *size*)

Write given value to given setting by address.

Return Number of words written or negative error code.

Parameters

- *dst*: Destination setting address.
- *src_p*: Value to write.
- *size*: Number of bytes to write.

ssize_t settings_read_by_name (const char **name_p*, void **dst_p*, size_t *size*)

Read the value of given setting by name.

Return Number of words read or negative error code.

Parameters

- `name_p`: Setting name.
- `dst_p`: The read value.
- `size`: Size of the destination buffer.

`ssize_t settings_write_by_name(const char *name_p, const void *src_p, size_t size)`

Write given value to given setting by name.

Return Number of words read or negative error code.

Parameters

- `name_p`: Setting name.
- `src_p`: Value to write.
- `size`: Number of bytes to write.

`int settings_reset(void)`

Overwrite all settings with their default values.

Return zero(0) or negative error code.

struct Public Members

`FAR const char* setting_t::name_p`

`setting_type_t setting_t::type`

`uint32_t setting_t::address`

`size_t setting_t::size`

shell — Debug shell

The shell is a command line interface where the user can execute various commands to control, debug and monitor its

```
username: erik
password: *****
$
$ kernel/thrd/list
      NAME      PARENT    STATE  PRI0   CPU   LOGMASK
      main      current    0      0%    0x3f
      idle      main      ready  127   0%    0x3f
      monitor   main      ready  -80   0%    0x3f
$ history
1: kernel/thrd/list
2: history
$ logout
```

application. The shell module has a few configuration variables that can be used to tailor the shell to the application requirements. Most noticeably is the configuration variable `CONFIG_SHELL_MINIMAL`. If set to 0 all the shell functionality is built; including tab completion, cursor movement, line editing and command history. If set to 1 only the minimal functionality is built; only including tab completion and line editing at the end of the line.

See [Configuration](#) for a list of all configuration variables.

Source code: [src/oam/shell.h](#), [src/oam/shell.c](#)

Test code: [tst/oam/shell/main.c](#)

Test coverage: [src/oam/shell.c](#)

Example code: [examples/shell/main.c](#)

Functions

int **shell_module_init** (void)

Initialize the shell module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **shell_init** (struct *shell_t* *self_p, void *chin_p, void *chout_p, void *arg_p, const char *name_p, const char *username_p, const char *password_p)

Initialize a shell with given parameters.

Parameters

- chin_p: The shell input channel. The shell waits for commands on this channel.
- chout_p: The shell output channel. The shell writes responses on this channel.
- arg_p: User supplied argument passed to all commands.
- name_p: The shell thread name.
- username_p: Shell login username, or NULL if no username is required to use the shell.
- password_p: Shell login password. This field is unused if username_p is NULL.

void ***shell_main** (void *arg_p)

The shell main function that listens for commands on the input channel and send response on the output channel. All received commands are passed to the debug file system function `fs_call()` for execution.

Here is an example of using the shell to list and execute debug file system commands.

```
$ <tab>
drivers/
kernel/
$ kernel/ <tab>
fs/
sys/
thrd/
$ kernel/thrd/list
      NAME      STATE  PRIO   CPU  LOGMASK
      main      current    0    0%    0x0f
      idle       ready  127    0%    0x0f
      monitor    ready   -80    0%    0x0f
$
```

Return Never returns.

Parameters

- arg_p: Pointer to the shell arguemnt struct `struct shell_args_t`. See the struct definition for a description of it's content.

struct *#include <shell.h>***Public Members**

struct *shell_history_elem_t* *shell_history_elem_t::next_p

struct *shell_history_elem_t* *shell_history_elem_t::prev_p

char shell_history_elem_t::buf[1]

struct Public Members

char shell_line_t::buf[CONFIG_SHELL_COMMAND_MAX]

int shell_line_t::length

int shell_line_t::cursor

struct Public Members

void *shell_t::chin_p

void *shell_t::chout_p

void *shell_t::arg_p

const char *shell_t::name_p

const char *shell_t::username_p

const char *shell_t::password_p

struct *shell_line_t* shell_t::line

struct *shell_line_t* shell_t::prev_line

int shell_t::carriage_return_received

int shell_t::newline_received

int shell_t::authorized

struct *shell_history_elem_t* *shell_t::head_p

struct *shell_history_elem_t* *shell_t::tail_p

struct *shell_history_elem_t* *shell_t::current_p

struct *shell_line_t* shell_t::pattern

struct *shell_line_t* shell_t::match

int shell_t::line_valid

struct *circular_heap_t* shell_t::heap

uint8_t shell_t::buf[CONFIG_SHELL_HISTORY_SIZE]

struct shell_t::@87::@88 shell_t::heap

struct shell_t::@87 shell_t::history

1.6.7 debug

The debug package on [Github](#).

harness — Test harness

In software testing, a test harness or automated test framework is a collection of software and test data configured to test a program unit by running it under varying conditions and monitoring its behavior and outputs. It has two main parts: the test execution engine and the test script repository.

This module implements the test execution engine.

The test scripts are part of the build system.

Example test suite

Below is an example of a test suite using the harness. It has three test cases; `test_passed`, `test_failed` and `test_skipped`.

The test macro `BTASSERT(condition)` should be used to validate conditions.

```
#include "simba.h"

static int test_passed(struct harness_t *harness_p)
{
    /* Return zero(0) when a test case passes. */
    return (0);
}

static int test_failed(struct harness_t *harness_p)
{
    /* Return a negative integer when a test case fails. BTASSERT
       will return -1 when the condition is false. */
    BTASSERT(0);

    return (0);
}

static int test_skipped(struct harness_t *harness_p)
{
    /* Return a positive integer when a test case is skipped. */
    return (1);
}

int main()
{
    /* Test harness and NULL terminated list of test cases.*/
    struct harness_t harness;
    struct harness_testcase_t harness_testcases[] = {
        { test_passed, "test_passed" },
        { test_failed, "test_failed" },
        { test_skipped, "test_skipped" },
        { NULL, NULL }
    };

    sys_start();
}
```

```
harness_init(&harness);
harness_run(&harness, harness_testcases);

return (0);
}
```

The output from the test suite is:

```
app:    test_suite-7.0.0 built 2016-07-25 17:38 CEST by erik.
board:  Linux
mcu:    Linux

enter: test_passed
exit: test_passed: PASSED

enter: test_failed
exit: test_failed: FAILED

enter: test_skipped
exit: test_skipped: SKIPPED

      NAME      STATE  PRIO   CPU  LOGMASK
      main      current    0    0%    0x0f
                   ready   127    0%    0x0f
harness report: total(3), passed(1), failed(1), skipped(1)
```

There are plenty of test suites in the [tst](#) folder on Github.

Source code: [src/debug/harness.h](#), [src/debug/harness.c](#)

Defines

BTASSERTN (cond, res, ...)

BTASSERT (cond, ...)

Assert given condition in a testcase. Print an error message and return -1 on error.

Typedefs

typedef The testcase function callback. zero(0) if the testcase passed, a negative error code if the testcase failed, and a positive value if the testcase was skipped.

Parameters • `//debug/harness:simbastructharness_t` library-referenced `debugharness:simbastructharness_t` `harness_t` :
The harness object

Functions

int **harness_init** (struct *harness_t* *self_p)

Initialize given test harness.

Return zero(0) or negative error code.

Parameters

- `self_p`: Test harness to initialize.

int **harness_run** (struct *harness_t* *`self_p`, struct *harness_testcase_t* *`testcases_p`)
 Run given testcases in given test harness.

Return zero(0) or negative error code.

Parameters

- `self_p`: Test harness.
- `testcases_p`: An array of testcases to run. The last element in the array must have `callback` and `name_p` set to NULL.

struct Public Members

harness_testcase_cb_t `harness_testcase_t::callback`

const char *`harness_testcase_t::name_p`

struct Public Members

struct `uart_driver_t` `harness_t::uart`

log — Logging

The logging module consists of log objects and log handlers. A log object filters log entries and a log handler writes log entries to an output channel.

A log object called “log” and a log handler writing to standard output are created during the log module initialization. The log handler can be replaced by calling `log_set_default_handler_output_channel()`.

Normally one log object is created for each subsystem in an application. This gives the user the power to control which parts of the system to debug and/or monitor at runtime.

Sometimes it’s useful to write log entries to multiple channels. This is possible by creating and adding another log handler to the log module.

Log levels

There are five log levels defined; fatal, error, warning, info and debug. The log levels are defined as `LOG_<upper case level>` in the log module header file.

Log entry format

A log entry consists of a timestamp, log level, thread name, log object name and the message. The timestamp is the log entry creation time and the log level is one of fatal, error, warning, info and debug. The thread name is the name of the thread that created the log entry and the log object name is the name of the log object the entry was printed on. The message is a user defined string.

```
<timestamp>:<log level>:<thread name>:<log object name>: <message>
```

Debug file system commands

Three debug file system commands are available, all located in the directory `debug/log/`.

Command	Description
<code>list</code>	Print a list of all log objects.
<code>print <string></code>	Print a log entry using the default log object and log level <code>LOG_INFO</code> . This command has no use except to test that the log module works.
<code>set_log_mask <object> <mask></code>	Set the log mask to <code><mask></code> for log object <code><object></code> .

Example output from the shell:

```
$ debug/log/list
  OBJECT NAME  MASK
    default  0x0f
$ debug/log/print "Hello World!"
$ debug/log/set_log_mask default 0x1f
$ debug/log/list
  OBJECT NAME  MASK
    default  0x1f
$ debug/log/print "Hello World!!!"
56:info:main:default: Hello World!!!
```

Example

Here are a few example outputs using three log objects; *foo*, *bar* and the default log object *default*. All logs are from the main thread as can be seen in the third field in the entries.

```
23:info:main:foo: A foo info message.
24:info:main:bar: A bar info message.
37:debug:main:bar: A bar debug message.
56:error:main:default: A main error message.
```

Source code: [src/debug/log.h](#), [src/debug/log.c](#)

Test code: [tst/debug/log/main.c](#)

Test coverage: [src/debug/log.c](#)

Defines

LOG_FATAL

LOG_ERROR

A handable error conditions.

LOG_WARNING

A warning.

LOG_INFO

Generic (useful) information about system operation.

LOG_DEBUG

Developer debugging messages.

LOG_MASK (level)

Create a log mask with given level set.

LOG_UPTO (level)

Set all levels up to and including given level.

LOG_ALL

Set all levels.

LOG_NONE

Clear all levels.

Functions

int **log_module_init** (void)

Initialize the logging module. This function must be called before calling any other function in this module.

The module will only be initialized once even if this function is called multiple times.

Return zero(0) or negative error code.

int **log_object_init** (struct *log_object_t* *self_p, const char *name_p, char mask)

Initialize given log object with given name and mask.

Return zero(0) or negative error code.

Parameters

- self_p: Log object to initialize.
- name_p: Log object name.
- mask: Log object mask.

int **log_object_set_log_mask** (struct *log_object_t* *self_p, char mask)

Set given log mask for given log object.

Return zero(0) or negative error code.

Parameters

- self_p: Log object.
- mask: Log object mask.

char **log_object_get_log_mask** (struct *log_object_t* *self_p)

Get the log mask of given log object.

Return Log mask.

Parameters

- self_p: Log object.

int **log_object_is_enabled_for** (struct *log_object_t* *self_p, int level)

Check if given log level is enabled in given log object.

Return true(1) if given log level is enabled, false(0) if given log level is disabled, otherwise negative error code.

Parameters

- `self_p`: Log object, or NULL to check the level in the thread log mask.
- `level`: Log level to check.

int **log_object_print** (struct *log_object_t* *`self_p`, int `level`, const char *`fmt_p`, ...)

Check if given log level is set in the log object mask. If so, format a log entry and write it to all log handlers.

`self_p` may be NULL, and in that case the current thread's log mask is used instead of the log object mask.

Return zero(0) or negative error code.

Parameters

- `self_p`: Log object, or NULL to use the thread's log mask.
- `level`: Log level.
- `fmt_p`: Log format string.
- `...`: Variable argument list.

int **log_handler_init** (struct *log_handler_t* *`self_p`, void *`chout_p`)

Initialize given log handler with given output channel.

Return zero(0) or negative error code.

Parameters

- `self_p`: Log handler to initialize.
- `chout_p`: Output handler.

int **log_add_handler** (struct *log_handler_t* *`handler_p`)

Add given log handler to the list of handlers. Log entries will be written to all log handlers in the list.

Return zero(0) or negative error code.

Parameters

- `handler_p`: Log handler to add.

int **log_remove_handler** (struct *log_handler_t* *`handler_p`)

Remove given log handler from the list of log handlers.

Return zero(0) or negative error code.

Parameters

- `handler_p`: Log handler to remove.

int **log_add_object** (struct *log_object_t* *`object_p`)

Add given log object to the list of log objects. There are file system commands to list all log objects in the list and also modify their log mask.

Return zero(0) or negative error code.

Parameters

- `object_p`: Log object to add.

int **log_remove_object** (struct *log_object_t* *object_p)
 Remove given log object from the list of log objects.

Return zero(0) or negative error code.

Parameters

- object_p: Object to remove.

int **log_set_default_handler_output_channel** (void *chout_p)
 Set the output channel of the default log handler.

Return zero(0) or negative error code.

Parameters

- chout_p: Channel to set as the default output channel. May be NULL if no output should be written.

struct Public Members

void *log_handler_t::chout_p

struct *log_handler_t* *log_handler_t::next_p

struct Public Members

const char *log_object_t::name_p

char log_object_t::mask

struct *log_object_t* *log_object_t::next_p

1.6.8 collections

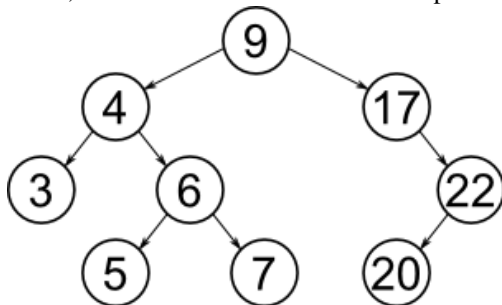
In computer science, a data structure is a particular way of organizing data in a computer so that it can be used efficiently.

The collections package on [Github](#).

binary_tree — Binary tree

A binary search tree consists of nodes, where each node has zero, one or two siblings. The left sibling has a lower value and the right sibling has a higher value than the parent.

Insert, delete and search operations all have the time complexity of $O(\log n)$.



Source code: [src/collections/binary_tree.h](#), [src/collections/binary_tree.c](#)

Test code: [tst/collections/binary_tree/main.c](#)

Test coverage: [src/collections/binary_tree.c](#)

Functions

int **binary_tree_init** (**struct** *binary_tree_t* *self_p)

Initialize given binary tree.

Return zero(0) or negative error code.

Parameters

- self_p: Binary tree.

int **binary_tree_insert** (**struct** *binary_tree_t* *self_p, **struct** *binary_tree_node_t* *node_p)

Insert given node into given binary tree.

There can not be two or more nodes in the tree with the same key. This function returns -1 if a node with the same key is already in the binary tree.

Return zero(0) on success, -1 if a node with the same key is already in the binary tree, otherwise negative error code.

Parameters

- self_p: Binary tree to insert the node into.
- node_p: Node to insert.

int **binary_tree_delete** (**struct** *binary_tree_t* *self_p, int key)

Delete given node from given binary tree.

Return zero(0) on success, -1 if the node was not found, otherwise negative error code.

Parameters

- self_p: Binary tree to delete the node from.
- key: Key of the node to delete.

struct *binary_tree_node_t* ***binary_tree_search** (**struct** *binary_tree_t* *self_p, int key)

Search the binary tree for the node with given key.

Return Pointer to found node or NULL if a node with given key was not found in the tree.

Parameters

- self_p: Binary tree to search in.
- key: Key of the binary tree node to search for.

void **binary_tree_print** (**struct** *binary_tree_t* *self_p)

Print given binary tree.

Parameters

- `self_p`: Binary tree to print.

struct `#include <binary_tree.h>`**Public Members**

`int` `binary_tree_node_t::key`

`int` `binary_tree_node_t::height`

struct `binary_tree_node_t` `*binary_tree_node_t::left_p`

struct `binary_tree_node_t` `*binary_tree_node_t::right_p`

struct **Public Members**

struct `binary_tree_node_t` `*binary_tree_t::root_p`

bits — Bitwise operations

Source code: `src/collections/bits.h`

Test code: `tst/collections/bits/main.c`

Functions

static `uint32_t` **bits_insert_32** (`uint32_t` *dst*, `int` *position*, `int` *size*, `uint32_t` *src*)

fifo — First In First Out queuing

Source code: `src/collections/fifo.h`

Test code: `tst/collections/fifo/main.c`

Defines

FIFO_DEFINE_TEMPLATE (`type`)

Define the fifo structure and functions for a given type.

```
FIFO_DEFINE_TEMPLATE(int);

int foo()
{
    struct fifo_int_t fifo;
    int buf[4];
    int value;

    fifo_init_int(&fifo, buf, membersof(buf));

    // Put a value into the fifo.
    value = 10;
    fifo_put_int(&fifo, &value);
}
```

```
// Get the value from the fifo.
fifo_get_int(&fifo, &value);

// Prints 'value = 10'.
std_printf(FSTR("value=  %d\r\n", value));
}
```

Parameters

- type: Type of the elements in the defined fifo.

Functions

static int `fifo_init` (`struct fifo_t` *self_p, int max)
Initialize given fifo.

Return zero(0) or negative error code.

Parameters

- self_p: Fifo to initialize.
- max: Maximum number of elements in the fifo.

static int `fifo_put` (`struct fifo_t` *self_p)
Put an element in the fifo.

Return Added element index in fifo, or -1 if there are no free positions.

Parameters

- self_p: Initialized fifo.

static int `fifo_get` (`struct fifo_t` *self_p)
Get the next element from the fifo.

Return The fetched element index in fifo , or -1 if the fifo is empty.

Parameters

- self_p: Initialized fifo.

struct `#include <fifo.h>`**Public Members**

`int fifo_t::rdpos`

`int fifo_t::wrpos`

`void *fifo_t::buf_p`

`int fifo_t::max`

hash_map — Hash map

Source code: `src/collections/hash_map.h`, `src/collections/hash_map.c`

Test code: `tst/collections/hash_map/main.c`

Test coverage: `src/collections/hash_map.c`

Typedefs

typedef

Functions

int hash_map_init (**struct** *hash_map_t* **self_p*, **struct** *hash_map_bucket_t* **buckets_p*, **size_t** *buckets_max*, **struct** *hash_map_entry_t* **entries_p*, **size_t** *entries_max*, *hash_function_t* *hash*)
Initialize hash map with given parameters.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized hash map.
- *buckets_p*: Array of buckets.
- *buckets_max*: Number of entries in *buckets_p*.
- *entries_p*: Array of empty entries.
- *entries_max*: Number of entries in *entries_p*.
- *hash*: Hash function.

int hash_map_add (**struct** *hash_map_t* **self_p*, **long** *key*, **void** **value_p*)
Add given key-value pair into hash map. Overwrites old value if the key is already present in map.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized hash map.
- *key*: Key to hash.
- *value_p*: Value to insert for key.

int hash_map_remove (**struct** *hash_map_t* **self_p*, **long** *key*)
Remove given key from hash map.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized hash map.
- *key*: Key to hash.

`void *hash_map_get (struct hash_map_t *self_p, long key)`
Get value for given key.

Return Value for key or NULL if key was not found in the map.

Parameters

- `self_p`: Initialized hash map.
- `key`: Key to hash.

struct Public Members

`struct hash_map_entry_t *hash_map_entry_t::next_p`

`long hash_map_entry_t::key`

`void *hash_map_entry_t::value_p`

struct Public Members

`struct hash_map_entry_t *hash_map_bucket_t::list_p`

struct Public Members

`struct hash_map_bucket_t *hash_map_t::buckets_p`

`size_t hash_map_t::buckets_max`

`struct hash_map_entry_t *hash_map_t::entries_p`

`hash_function_t hash_map_t::hash`

list — Abstract lists

Source code: <src/collections/list.h>

Defines

LIST_SL_INIT (`list_p`)

Initialize given singly linked list object.

Parameters

- `list_p`: List object to initialize.

LIST_SL_INIT_STRUCT

LIST_SL_PEEK_HEAD (`list_p`, `element_pp`)

Peek at the first element in the list.

Parameters

- `list_p`: List object.
- `element_pp`: First element of the list.

LIST_SL_ADD_HEAD (list_p, element_p)

Add given element to the beginning of given list.

Parameters

- list_p: List object.
- element_p: Element to add.

LIST_SL_ADD_TAIL (list_p, element_p)

Add given element to the end of given list.

Parameters

- list_p: List object.
- element_p: Element to add.

LIST_SL_REMOVE_HEAD (list_p, element_pp)

Get the first element of given list and then remove it from given list.

Parameters

- list_p: List object.
- element_pp: First element of the list.

LIST_SL_ITERATOR_INIT (iterator_p, list_p)

Initialize given iterator object.

Parameters

- iterator_p: Iterator to initialize.
- list_p: List object to iterate over.

LIST_SL_ITERATOR_NEXT (iterator_p, element_pp)

Get the next element from given iterator object.

Parameters

- iterator_p: Iterator object.
- element_pp: Next element of the list.

LIST_SL_REMOVE_ELEM (list_p, iterator_p, element_p, iterator_element_p, previous_element_p)

Remove given element from given list.

Parameters

- list_p: List object.
- iterator_p: Used internally.
- element_p: Used internally.
- iterator_element_p: Used internally.
- previous_element_p: Used internally.

```
struct #include <list.h>Public Members
```

```
void *list_next_t::next_p
struct Public Members
```

```
void *list_singly_linked_t::head_p
```

```
void *list_singly_linked_t::tail_p
struct Public Members
```

```
void *list_sl_iterator_t::next_p
```

1.6.9 alloc

Memory management is the act of managing computer memory. The essential requirement of memory management is to provide ways to dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed.

The alloc package on [Github](#).

circular_heap — Circular heap

The circular heap is a dynamic memory allocator allocating buffers in a circular buffer. This puts a restriction on the user to free allocated buffers in the same order as they were allocated. This allocator is useful if you know the allocation order and need a low memory overhead on each allocated buffer and no memory fragmentation.

Below is an example of the internal state of a circular heap when buffers are allocated and freed.

1. After initialization *begin*, *alloc* and *free* have the same value. All memory is available for allocation.

```
begin
alloc
free                                     end
|-----|
```

2. Allocating a buffer increments *alloc*.

```
begin
free                                     alloc                                     end
|=====|-----|
```

3. Allocating another buffer increments *alloc* once again.

```
begin
free                                     alloc                                     end
|=====|-----|
```

4. Freeing the first buffer increments *free* to the position of the first *alloc*.

```
begin                                     free                                     alloc                                     end
|-----|=====|-----|
```

5. Allocating a buffer that is bigger than the available space between *alloc* and *end* results in a buffer starting at *begin*. The memory between the old *alloc* and *end* will be unused.

begin	alloc	free	end
=====	-----	=====	oooooooooooo

6. Freeing the second buffer increments *free* to the position of the second *alloc*.

begin	alloc	free	end
=====	-----	oooooooooooo	

7. Freeing the third buffer sets *free* to *alloc*. All memory is available for allocation once again.

begin	alloc	free	end
-----	-----	-----	

8. Done!

Source code: [src/alloc/circular_heap.h](#), [src/alloc/circular_heap.c](#)

Test code: [tst/alloc/circular_heap/main.c](#)

Test coverage: [src/alloc/circular_heap.c](#)

Functions

int **circular_heap_init** (struct *circular_heap_t* *self_p, void *buf_p, size_t size)
Initialize given circular_heap.

Return zero(0) or negative error code.

Parameters

- self_p: Circular heap to initialize.
- buf_p: Memory buffer.
- size: Size of the memory buffer.

void ***circular_heap_alloc** (struct *circular_heap_t* *self_p, size_t size)
Allocate a buffer of given size from given circular heap.

Return Pointer to allocated buffer, or NULL on failure.

Parameters

- self_p: Circular heap to allocate from.
- size: Number of bytes to allocate.

int **circular_heap_free** (struct *circular_heap_t* *self_p, void *buf_p)
Free the oldest allocated buffer.

Return zero(0) or negative error code.

Parameters

- self_p: Circular heap to free to.

- `buf_p`: Buffer to free. Must be the oldest allocated buffer.

struct `#include <circular_heap.h>` **Public Members**

`void *circular_heap_t::begin_p`

`void *circular_heap_t::end_p`

`void *circular_heap_t::alloc_p`

`void *circular_heap_t::free_p`

heap — Heap

Source code: [src/alloc/heap.h](#), [src/alloc/heap.c](#)

Test code: [tst/alloc/heap/main.c](#)

Test coverage: [src/alloc/heap.c](#)

Defines

HEAP_FIXED_SIZES_MAX

Functions

`int heap_init (struct heap\_t *self_p, void *buf_p, size_t size, size_t sizes[HEAP_FIXED_SIZES_MAX])`
Initialize given heap.

Return zero(0) or negative error code.

Parameters

- `self_p`: Heap to initialize.
- `buf_p`: Heap memory buffer.
- `size`: Size of the heap memory buffer.

`void *heap_alloc (struct heap\_t *self_p, size_t size)`
Allocate a buffer of given size from given heap.

Return Pointer to allocated buffer, or NULL on failure.

Parameters

- `self_p`: Heap to allocate from.
- `size`: Number of bytes to allocate.

`int heap_free (struct heap\_t *self_p, void *buf_p)`
Decrement the share count by once and free the buffer if the count becomes zero(0).

Return Share count after the free, or negative error code.

Parameters

- `self_p`: Heap of given buffer.
- `buf_p`: Memory buffer to free.

int **heap_share** (struct *heap_t* **self_p*, const void **buf_p*, int *count*)

Share given buffer *count* times.

Return zero(0) or negative error code.

Parameters

- `self_p`: Heap of given buffer.
- `buf_p`: Buffer to share.
- `count`: Share count.

struct Public Members

void *heap_fixed_t::**free_p**

size_t heap_fixed_t::**size**

struct Public Members

void *heap_dynamic_t::**free_p**

struct Public Members

void *heap_t::**buf_p**

size_t heap_t::**size**

void *heap_t::**next_p**

struct *heap_fixed_t* heap_t::**fixed**[HEAP_FIXED_SIZES_MAX]

struct *heap_dynamic_t* heap_t::**dynamic**

1.6.10 text

Text parsing, editing and colorization.

The text package on [Github](#).

color — ANSI colors

Source code: [src/text/color.h](#)

Defines

COLOR_RESET
COLOR_BOLD_ON
COLOR_ITALICS_ON
COLOR_UNDERLINE_ON
COLOR_INVERSE_ON
COLOR_STRIKETHROUGH_ON
COLOR_BOLD_OFF
COLOR_ITALICS_OFF
COLOR_UNDERLINE_OFF
COLOR_INVERSE_OFF
COLOR_STRIKETHROUGH_OFF
COLOR_FOREGROUND_BLACK
COLOR_FOREGROUND_RED
COLOR_FOREGROUND_GREEN
COLOR_FOREGROUND_YELLOW
COLOR_FOREGROUND_BLUE
COLOR_FOREGROUND_MAGENTA
COLOR_FOREGROUND_CYAN
COLOR_FOREGROUND_WHITE
COLOR_FOREGROUND_DEFAULT
COLOR_BACKGROUND_BLACK
COLOR_BACKGROUND_RED
COLOR_BACKGROUND_GREEN
COLOR_BACKGROUND_YELLOW
COLOR_BACKGROUND_BLUE
COLOR_BACKGROUND_MAGENTA
COLOR_BACKGROUND_CYAN
COLOR_BACKGROUND_WHITE
COLOR_BACKGROUND_DEFAULT
COLOR (...)

configfile — Configuration file (INI-file)

The INI file format is an informal standard for configuration files for some platforms or software. INI files are simple text files with a basic structure composed of sections, properties, and values.

More information on [Wikipedia](#).

File format description

- Line terminators: `\n`, `\r\n` or `\n\r`.
- Opening bracket (`[`) at the beginning of a line indicates a section. The section name is all characters until a closing bracket (`]`).
- A property line starts with its name, then a colon (`:`) or equal sign (`=`), and then the value.
- Semicolon (`;`) or number sign (`#`) at the beginning of a line indicate a comment.

Example file

```
; last modified 1 April 2001 by John Doe
[owner]
name = John Doe
organization = Acme Widgets Inc.

[database]
; use IP address in case network name resolution is not working
server = 192.0.2.62
port = 143
file = "payroll.dat"
```

Source code: [src/text/configfile.h](#), [src/text/configfile.c](#)

Test code: [tst/text/configfile/main.c](#)

Test coverage: [src/text/configfile.c](#)

Functions

int **configfile_init** (**struct** *configfile_t* **self_p*, **char** **buf_p*, **size_t** *size*)
Initialize given configuration file object.

Return zero(0) or negative error code.

Parameters

- *self_p*: Object to initialize.
- *buf_p*: Configuration file contents as a NULL terminated string.
- *size*: Size of the configuration file contents.

int **configfile_set** (**struct** *configfile_t* **self_p*, **const** **char** **section_p*, **const** **char** **property_p*, **const** **char** **value_p*)
Set the value of given property in given section.

Return zero(0) or negative error code.

Parameters

- *self_p*: Initialized parser.

- `section_p`: Section to set the property from.
- `property_p`: Property to set the value for.
- `value_p`: NULL terminated value to set.

char ***configfile_get** (struct *configfile_t* **self_p*, const char **section_p*, const char **property_p*, char **value_p*, int *length*)

Get the value of given property in given section.

Return Value pointer or NULL on failure.

Parameters

- `self_p`: Initialized parser.
- `section_p`: Section to get the property from.
- `property_p`: Property to get the value for.
- `value_p`: Value of given property in given section.
- `size`: Size of the value buffer.

int **configfile_get_long** (struct *configfile_t* **self_p*, const char **section_p*, const char **property_p*, long **value_p*)

Get the value of given property in given section, converted to an integer.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized parser.
- `section_p`: Section to get the property from.
- `property_p`: Property to get the value for.
- `value_p`: Value of given property in given section.

int **configfile_get_float** (struct *configfile_t* **self_p*, const char **section_p*, const char **property_p*, float **value_p*)

Get the value of given property in given section, converted to a float.

Return zero(0) or negative error code.

Parameters

- `self_p`: Initialized parser.
- `section_p`: Section to get the property from.
- `property_p`: Property to get the value for.
- `value_p`: Value of given property in given section.

struct #include <configfile.h>**Public Members**

char *configfile_t::buf_p

size_t configfile_t::size

re — Regular expressions

Source code: `src/text/re.h`, `src/text/re.c`

Test code: `tst/text/re/main.c`

Test coverage: `src/text/re.c`

Defines

RE_IGNORECASE

RE_DOTALL

Make the `'.'` special character match any character at all, including a newline; without this flag, `'.'` will match anything except a newline.

RE_MULTILINE

When specified, the pattern character `'^'` matches at the beginning of the string and at the beginning of each line (immediately following each newline); and the pattern character `'$'` matches at the end of the string and at the end of each line (immediately preceding each newline). By default, `^` matches only at the beginning of the string, and `$` only at the end of the string and immediately before the newline (if any) at the end of the string.

Functions

`char *re_compile (char *compiled_p, const char *pattern_p, char flags, size_t size)`
Compile given pattern.

Pattern syntax:

- `'.'` - Any character.
- `'^'` - Beginning of the string (**not yet supported**).
- `'$'` - End of the string (**not yet supported**).
- `'?'` - Zero or one repetitions (greedy).
- `'*'` - Zero or more repetitions (greedy).
- `'+'` - One or more repetitions (greedy).
- `'??'` - Zero or one repetitions (non-greedy).
- `'*?'` - Zero or more repetitions (non-greedy).
- `'?+'` - One or more repetitions (non-greedy).
- `{m}` - Exactly `m` repetitions.
- `\\` - Escape character.
- `[]` - Set of characters.
- `'|'` - Alternatives (**not yet supported**).
- `'( ... )'` - Groups (**not yet supported**).
- `\\d` - Decimal digits `[0-9]`.
- `\\w` - Alphanumerical characters `[a-zA-Z0-9_]`.

- `\\s` - Whitespace characters [`\t\r\n\f\v`].

Return Compiled patten, or NULL if the compilation failed.

Parameters

- `compiled_p`: Compiled regular expression pattern.
- `pattern_p`: Regular expression pattern.
- `flags`: A combination of the flags `RE_IGNORECASE`, `RE_DOTALL` and `RE_MULTILINE` (`RE_MULTILINE` is **not yet supported**).
- `size`: Size of the compiled buffer.

`ssize_t re_match(const char *compiled_p, const char *buf_p, size_t size, struct re_group_t *groups_p, size_t *number_of_groups_p)`
Apply given regular expression to the beginning of given string.

Return Number of matched bytes or negative error code.

Parameters

- `compiled_p`: Compiled regular expression pattern. Compile a pattern with `re_compile()`.
- `buf_p`: Buffer to apply the compiled pattern to.
- `size`: Number of bytes in the buffer.
- `groups_p`: Read groups or NULL.
- `number_of_groups_p`: Number of read groups or NULL.

struct Public Members

```
const char *re_group_t::buf_p
ssize_t re_group_t::size
```

std — Standard functions

Source code: [src/text/std.h](#), [src/text/std.c](#)

Test code: [tst/text/std/main.c](#)

Test coverage: [src/text/std.c](#)

Functions

`int std_module_init(void)`

`ssize_t std_sprintf(char * dst_p, FAR const char * fmt_p, ...)`

Format and write data to destination buffer. The buffer must be big enough to fit the formatted string. The output is null terminated.

A format specifier has this format:

`%[flags][width][length]specifier`

where

- flags: 0 or -
- width: 0..127
- length: 1 for long or nothing
- specifier: c, s, d, i, u, x or f

Return Length of the string written to the destination buffer, not including the null termination, or negative error code.

Parameters

- `dst_p`: Destination buffer. The formatted string is written to this buffer.
- `fmt_p`: Format string.
- `...`: Variable arguments list.

`ssize_t std_snprintf(char * dst_p, size_t size, FAR const char * fmt_p, ...)`

Format and write data to given buffer. The output is null terminated.

Return Length of the string written to the destination buffer, not including the null termination, or negative error code.

Parameters

- `dst_p`: Destination buffer. The formatted string is written to this buffer.
- `size`: Size of the destination buffer.
- `fmt_p`: Format string.
- `...`: Variable arguments list.

`ssize_t std_vsprintf(char * dst_p, FAR const char * fmt_p, va_list * ap_p)`

Format and write data to given buffer. The output is null terminated.

Return Length of the string written to the destination buffer, not including the null termination, or negative error code.

Parameters

- `dst_p`: Destination buffer. The formatted string is written to this buffer.
- `fmt_p`: Format string.
- `ap_p`: Variable arguments list.

`ssize_t std_vsnprintf(char * dst_p, size_t size, FAR const char * fmt_p, va_list * ap_p)`

Format and write data to given buffer. The output is null terminated.

Return Length of the string written to the destination buffer, not including the null termination, or negative error code.

Parameters

- `dst_p`: Destination buffer. The formatted string is written to this buffer.
- `size`: Size of the destination buffer.
- `fmt_p`: Format string.
- `ap_p`: Variable arguments list.

ssize_t std_printf (far_string_t *fmt_p*, ...)

Format and print data to standard output. The output is not null terminated.

See `std_sprintf()` for the the format string specification.

Return Number of characters written to standard output, or negative error code.

Parameters

- *fmt_p*: Format string.
- ...: Variable argumnts list.

ssize_t std_vprintf(FAR const char * *fmt_p*, va_list * *ap_p*)

Format and print data to standard output. The output is not null terminated.

See `std_sprintf()` for the the format string specification.

Return Number of characters written to standard output, or negative error code.

Parameters

- *fmt_p*: Format string.
- *ap_p*: Variable argumnts list.

ssize_t std_fprintf(void * *chan_p*, FAR const char * *fmt_p*, ...)

Format and print data to channel. The output is not null terminated.

See `std_sprintf()` for the the format string specification.

Return Number of characters written to given channel, or negative error code.

Parameters

- *chan_p*: Output channel.
- *fmt_p*: Format string.
- ...: Variable argumnts list.

ssize_t std_vfprintf(void * *chan_p*, FAR const char * *fmt_p*, va_list * *ap_p*)

Format and print data to channel. The output is not null terminated.

See `std_sprintf()` for the the format string specification.

Return Number of characters written to given channel, or negative error code.

Parameters

- *chan_p*: Output channel.
- *fmt_p*: Format string.
- ...: Variable argumnts list.

const char *std_strtol (const char **str_p*, long **value_p*)

Convert string to integer.

Return Pointer to the next byte or NULL on failure.

Parameters

- *str_p*: Integer string.
- *value_p*: Integer value.

int std_strcpy(char * dst_p, FAR const char * src_p)

Copy string from far memory to memory.

Return String length or negative error code.

Parameters

- dst_p: Normal memory string.
- src_p: Far memory string.

int std_strcmp(const char * str_p, FAR const char * fstr_p)

Compare a string with a far string.

Return zero(0) if match, otherwise the difference of the mismatched characters

Parameters

- str_p: Normal memory string.
- fstr_p: Far memory string.

int std_strcmp_f(FAR const char * fstr0_p, FAR const char * fstr1_p)

Compare two far strings.

Return zero(0) if match, otherwise the difference of the mismatched characters.

Parameters

- fstr0_p: Far memory string.
- fstr1_p: Far memory string.

int std_strncmp(FAR const char * fstr_p, const char * str_p, size_t size)

Compare at most size bytes of one far string and one string.

Return zero(0) if match, otherwise the difference of the mismatched characters.

Parameters

- fstr_p: Far memory string.
- str_p: String.
- size: Compare at most size number of bytes.

int std_strncmp_f(FAR const char * fstr0_p, FAR const char * fstr1_p, size_t size)

Compare at most size bytes of two far strings.

Return zero(0) if match, otherwise the difference of the mismatched characters.

Parameters

- fstr0_p: Far memory string.
- fstr1_p: Far memory string.
- size: Compare at most size number of bytes.

int std_strlen(FAR const char * fstr_p)

Get the length in bytes of given far string, not including null termination.

Return String length in number of bytes (not including the null termination).

Parameters

- `fstr_p`: Far memory string.

char ***std_strip** (char **str_p*, const char **strip_p*)

Strip leading and trailing characters from a string. The characters to strip are given by `strip_p`.

Return Pointer to the stripped string.

Parameters

- `str_p`: String to strip characters from.
- `strip_p`: Characters to strip or NULL for whitespace characters. Must be null-terminated.

1.6.11 encode

In computing, a character encoding is used to represent a repertoire of characters by some kind of an encoding system. The encode package on [Github](#).

base64 — Base64 encoding and decoding.

Source code: [src/encode/base64.h](#), [src/encode/base64.c](#)

Test code: [tst/encode/base64/main.c](#)

Test coverage: [src/encode/base64.c](#)

Functions

int **base64_encode** (char **dst_p*, const void **src_p*, size_t *size*)

int **base64_decode** (void **dst_p*, const char **src_p*, size_t *size*)

Decode given base64 encoded buffer. The decoded data will be ~25% smaller than the destination data. Choose the destination buffer size accordingly.

Return zero(0) or negative error code.

Parameters

- `dst_p`: Output data.
- `src_p`: Encoded input data.
- `size`: Number of bytes in the encoded input data.

json — JSON encoding and decoding

Source code: [src/encode/json.h](#), [src/encode/json.c](#)

Test code: [tst/encode/json/main.c](#)

Test coverage: [src/encode/json.c](#)

Enums

enum type json_type_t

Values:

- = 0 Undefined type.
- = 1 Object, { }.
- = 2 Array, [].
- = 3 String, \"...\".
- = 4 Other primitive: number, boolean (true/false) or null.

enum type json_err_t

Values:

- = -1 Not enough tokens were provided.
- = -2 Invalid character inside JSON string.
- = -3 The string is not a full JSON packet, more bytes expected.

Functions

int json_init (struct json_t *self_p, struct json_tok_t *tokens_p, int num_tokens)

Initialize given JSON object. The JSON object must be initialized before it can be used to parse and dump JSON data.

Return zero(0) or negative error code.

Parameters

- self_p: JSON object to initialize.
- tokens_p: Array of tokens. The tokens are either filled by the parsing function `json_parse()`, or already filled by the user when calling this function. The latter can be used to dump the tokens as a string by calling `json_dump()` or `json_dumps()`.
- num_tokens: Number of tokens in the array.

int json_parse (struct json_t *self_p, const char *js_p, size_t len)

Parse given JSON data string into an array of tokens, each describing a single JSON object.

Return Number of decoded tokens or negative error code.

Parameters

- self_p: JSON object.
- js_p: JSON string to parse.
- len: JSON string length in bytes.

ssize_t json_dumps (struct json_t *self_p, struct json_tok_t *tokens_p, char *js_p)

Format and write given JSON tokens into a string.

Return Dumped string length (not including termination) or negative error code.

Parameters

- self_p: JSON object.
- tokens_p: Root token to dump. Set to NULL to dump the whole object.

- `js_p`: Dumped null terminated JSON string.

`ssize_t json_dump (struct json_t *self_p, struct json_tok_t *tokens_p, void *out_p)`
Format and write given JSON tokens to given channel.

Return Dumped string length (not including termination) or negative error code.

Parameters

- `self_p`: JSON object.
- `tokens_p`: Root token to dump. Set to NULL to dump the whole object.
- `out_p`: Channel to dump the null terminated JSON string to.

`struct json_tok_t *json_root (struct json_t *self_p)`
Get the root token.

Return The root token or NULL on failure.

Parameters

- `self_p`: JSON object.

`struct json_tok_t *json_object_get (struct json_t *self_p, const char *key_p, struct json_tok_t *object_p)`
Get the value the string token with given key.

Return Token or NULL on error.

Parameters

- `self_p`: JSON object.
- `key_p`: Key of the value to get.
- `object_p`: The object to get the value from.

`struct json_tok_t *json_object_get_primitive (struct json_t *self_p, const char *key_p, struct json_tok_t *object_p)`
Get the value of the primitive token with given key.

Return Token or NULL on error.

Parameters

- `self_p`: JSON object.
- `key_p`: Key of the value to get.
- `object_p`: The object to get the value from.

`struct json_tok_t *json_array_get (struct json_t *self_p, int index, struct json_tok_t *array_p)`
Get the token of given array index.

Return Token or NULL on error.

Parameters

- `self_p`: JSON object.
- `index`: Index to get.

- `array_p`: The array to get the element from.

void **json_token_object** (**struct** *json_tok_t* **token_p*, int *num_keys*)
Initialize a JSON object token.

Parameters

- `token_p`: Initialized token.
- `num_keys`: Number of keys in the object.

void **json_token_array** (**struct** *json_tok_t* **token_p*, int *num_elements*)
Initialize a JSON array token.

Parameters

- `token_p`: Initialized token.
- `num_elements`: Number of array elements.

void **json_token_true** (**struct** *json_tok_t* **token_p*)
Initialize a JSON boolean true token.

Parameters

- `token_p`: Initialized token.

void **json_token_false** (**struct** *json_tok_t* **token_p*)
Initialize a JSON boolean false token.

Parameters

- `token_p`: Initialized token.

void **json_token_null** (**struct** *json_tok_t* **token_p*)
Initialize a JSON null token.

Parameters

- `token_p`: Initialized token.

void **json_token_number** (**struct** *json_tok_t* **token_p*, **const** char **buf_p*, **size_t** *size*)
Initialize a JSON number (integer/float) token.

Parameters

- `token_p`: Initialized token.
- `buf_p`: Number as a string.
- `size`: String length.

void **json_token_string** (**struct** *json_tok_t* **token_p*, **const** char **buf_p*, **size_t** *size*)
Initialize a JSON string token.

Parameters

- `token_p`: Initialized token.
- `buf_p`: String.

- `size`: String length.

struct Public Members

json_type_t `json_tok_t::type`

`const char*` `json_tok_t::buf_p`

`size_t` `json_tok_t::size`

`int` `json_tok_t::num_tokens`

struct Public Members

`unsigned int` `json_t::pos`

Offset in the JSON string.

`unsigned int` `json_t::toknext`

Next token to allocate.

`int` `json_t::toksuper`

Superior token node, e.g parent object or array.

struct *json_tok_t* `*json_t::tokens_p`

Array of tokens.

`int` `json_t::num_tokens`

Number of tokens in the tokens array.

1.6.12 hash

A hash function is any function that can be used to map data of arbitrary size to data of fixed size.

The hash package on [Github](#).

crc — Cyclic Redundancy Checks

Source code: [src/hash/crc.h](#), [src/hash/crc.c](#)

Test code: [tst/hash/crc/main.c](#)

Test coverage: [src/hash/crc.c](#)

Functions

`uint32_t` **crc_32** (`uint32_t` *crc*, **const** `void*` *buf_p*, `size_t` *size*)

`uint16_t` **crc_ccitt** (`uint16_t` *crc*, **const** `void*` *buf_p*, `size_t` *size*)

Calculate a 16 bits crc using the CCITT algorithm (polynomial $x^{16}+x^{12}+x^5+x^1$).

Return Calculated crc.

Parameters

- `crc`: Initial crc. Should be 0xffff for CCITT.

- `buf_p`: Buffer to calculate crc of.
- `size`: Size of the buffer.

`uint16_t crc_xmodem (uint16_t crc, const void *buf_p, size_t size)`

Calculate a 16 bits crc using the XModem algorithm (polynomial $x^{16}+x^{12}+x^5+x^1$).

Return Calculated crc.

Parameters

- `crc`: Initial crc. Should be 0x0000 for XModem.
- `buf_p`: Buffer to calculate crc of.
- `size`: Size of the buffer.

`uint8_t crc_7 (const void *buf_p, size_t size)`

Calculate a 8 bits crc using the CRC-7 algorithm (polynomial x^7+x^3+1).

Return Calculated crc.

Parameters

- `buf_p`: Buffer to calculate crc of.
- `size`: Size of the buffer.

sha1 — SHA1

Source code: [src/hash/sha1.h](#), [src/hash/sha1.c](#)

Test code: [tst/hash/main.c](#)

Test coverage: [src/hash/sha1.c](#)

Functions

`int sha1_init (struct sha1_t *self_p)`

Initialize given SHA1 object.

Return zero(0) or negative error code.

Parameters

- `self_p`: SHA1 object.

`int sha1_update (struct sha1_t *self_p, void *buf_p, size_t size)`

Update the sha object with the given buffer. Repeated calls are equivalent to a single call with the concatenation of all the arguments.

Return zero(0) or negative error code.

Parameters

- `self_p`: SHA1 object.
- `buf_p`: Buffer to update the sha object with.

- `size`: Size of the buffer.

int **sha1_digest** (struct *sha1_t* **self_p*, uint8_t **hash_p*)

Return the digest of the strings passed to the `sha1_update()` method so far. This is a 20-byte value which may contain non-ASCII characters, including null bytes.

Return zero(0) or negative error code.

Parameters

- `self_p`: SHA1 object.
- `hash_p`: Hash sum.

struct *#include <sha1.h>* **Public Members**

uint8_t sha1_t::buf[64]

uint32_t sha1_t::size

struct sha1_t::@35 sha1_t::block

uint32_t sha1_t::h[5]

uint64_t sha1_t::size

1.6.13 multimedia

The multimedia package on [Github](#).

midi — Musical Instrument Digital Interface

Source code: [src/multimedia/midi.h](#), [src/multimedia/midi.c](#)

Test code: [tst/multimedia/midi/main.c](#)

Test coverage: [src/multimedia/midi.c](#)

Defines

MIDI_BAUDRATE

MIDI_NOTE_OFF

MIDI_NOTE_ON

MIDI_POLYPHONIC_KEY_PRESSURE

MIDI_CONTROL_CHANGE

MIDI_PROGRAM_CHANGE

MIDI_CHANNEL_PRESSURE

MIDI_PITCH_BEND_CHANGE

MIDI_SET_INTRUMENT

MIDI_PERC
MIDI_NOTE_MAX
MIDI_NOTE_A0
MIDI_NOTE_B0
MIDI_NOTE_C1
MIDI_NOTE_D1
MIDI_NOTE_E1
MIDI_NOTE_F1
MIDI_NOTE_G1
MIDI_NOTE_A1
MIDI_NOTE_B1
MIDI_NOTE_C2
MIDI_NOTE_D2
MIDI_NOTE_E2
MIDI_NOTE_F2
MIDI_NOTE_G2
MIDI_NOTE_A2
MIDI_NOTE_B2
MIDI_NOTE_C3
MIDI_NOTE_D3
MIDI_NOTE_E3
MIDI_NOTE_F3
MIDI_NOTE_G3
MIDI_NOTE_A3
MIDI_NOTE_B3
MIDI_NOTE_C4
MIDI_NOTE_D4
MIDI_NOTE_E4
MIDI_NOTE_F4
MIDI_NOTE_G4
MIDI_NOTE_A4
MIDI_NOTE_B4
MIDI_NOTE_C5
MIDI_NOTE_D5
MIDI_NOTE_E5
MIDI_NOTE_F5

MIDI_NOTE_G5
MIDI_NOTE_A5
MIDI_NOTE_B5
MIDI_NOTE_C6
MIDI_NOTE_D6
MIDI_NOTE_E6
MIDI_NOTE_F6
MIDI_NOTE_G6
MIDI_NOTE_A6
MIDI_NOTE_B6
MIDI_NOTE_C7
MIDI_NOTE_D7
MIDI_NOTE_E7
MIDI_NOTE_F7
MIDI_NOTE_G7
MIDI_NOTE_A7
MIDI_NOTE_B7
MIDI_NOTE_C8
MIDI_PERC_ACOUSTIC_BASS_DRUM
MIDI_PERC_BASS_DRUM_1
MIDI_PERC_SIDE_STICK
MIDI_PERC_ACOUSTIC_SNARE
MIDI_PERC_HAND_CLAP
MIDI_PERC_ELECTRIC_SNARE
MIDI_PERC_LOW_FLOOR_TOM
MIDI_PERC_CLOSED_HI_HAT
MIDI_PERC_HIGH_FLOOR_TOM
MIDI_PERC_PEDAL_HI_HAT
MIDI_PERC_LOW_TOM
MIDI_PERC_OPEN_HI_HAT
MIDI_PERC_LOW_MID_TOM
MIDI_PERC_HI_MID_TOM
MIDI_PERC_CRASH_CYMBAL_1
MIDI_PERC_HIGH_TOM
MIDI_PERC_RIDE_CYMBAL_1
MIDI_PERC_CHINESE_CYMBAL

MIDI_PERC_RIDE_BELL
MIDI_PERC_TAMBOURINE
MIDI_PERC_SPLASH_CYMBAL
MIDI_PERC_COWBELL
MIDI_PERC_CRASH_CYMBAL_2
MIDI_PERC_VIBRASLAP
MIDI_PERC_RIDE_CYMBAL_2
MIDI_PERC_HI_BONGO
MIDI_PERC_LOW_BONGO
MIDI_PERC_MUTE_HI_CONGA
MIDI_PERC_OPEN_HI_CONGA
MIDI_PERC_LOW_CONGA
MIDI_PERC_HIGH_TIMBALE
MIDI_PERC_LOW_TIMBALE
MIDI_PERC_HIGH_AGOGO
MIDI_PERC_LOW_AGOGO
MIDI_PERC_CABASA
MIDI_PERC_MARACAS
MIDI_PERC_SHORT_WHISTLE
MIDI_PERC_LONG_WHISTLE
MIDI_PERC_SHORT_GUIRO
MIDI_PERC_LONG_GUIRO
MIDI_PERC_CLAVES
MIDI_PERC_HI_WOOD_BLOCK
MIDI_PERC_LOW_WOOD_BLOCK
MIDI_PERC_MUTE_CUICA
MIDI_PERC_OPEN_CUICA
MIDI_PERC_MUTE_TRIANGLE
MIDI_PERC_OPEN_TRIANGLE

Functions

float **midi_note_to_frequency** (int *note*)

Get the frequency for given note.

Return Note frequency.

Parameters

- *note*: MIDI note.

1.6.14 boards

The boards supported by *Simba*.

The boards on [Github](#).

arduino_due — Arduino Due

Source code: [src/boards/arduino_due/board.h](#), [src/boards/arduino_due/board.c](#)

Hardware reference: *Arduino Due*

Defines

```
pin_d0_dev
pin_d1_dev
pin_d2_dev
pin_d3_dev
pin_d4_dev
pin_d5_dev
pin_d6_dev
pin_d7_dev
pin_d8_dev
pin_d9_dev
pin_d10_dev
pin_d11_dev
pin_d12_dev
pin_d13_dev
pin_d14_dev
pin_d15_dev
pin_d16_dev
pin_d17_dev
pin_d18_dev
pin_d19_dev
pin_d20_dev
pin_d21_dev
pin_d22_dev
pin_d23_dev
pin_d24_dev
```

pin_d25_dev
pin_d26_dev
pin_d27_dev
pin_d28_dev
pin_d29_dev
pin_d30_dev
pin_d31_dev
pin_d32_dev
pin_d33_dev
pin_d34_dev
pin_d35_dev
pin_d36_dev
pin_d37_dev
pin_d38_dev
pin_d39_dev
pin_d40_dev
pin_d41_dev
pin_d42_dev
pin_d43_dev
pin_d44_dev
pin_d45_dev
pin_d46_dev
pin_d47_dev
pin_d48_dev
pin_d49_dev
pin_d50_dev
pin_d51_dev
pin_d52_dev
pin_d53_dev
pin_a0_dev
pin_a1_dev
pin_a2_dev
pin_a3_dev
pin_a4_dev
pin_a5_dev
pin_a6_dev

pin_a7_dev
pin_a8_dev
pin_a9_dev
pin_a10_dev
pin_a11_dev
pin_led_dev
pin_dac0_dev
pin_dac1_dev
exti_d0_dev
exti_d1_dev
exti_d2_dev
exti_d3_dev
exti_d4_dev
exti_d5_dev
exti_d6_dev
exti_d7_dev
exti_d8_dev
exti_d9_dev
exti_d10_dev
exti_d11_dev
exti_d12_dev
exti_d13_dev
exti_d14_dev
exti_d15_dev
exti_d16_dev
exti_d17_dev
exti_d18_dev
exti_d19_dev
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exti_d28_dev
exti_d29_dev
exti_d30_dev
exti_d31_dev
exti_d32_dev
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exti_d35_dev
exti_d36_dev
exti_d37_dev
exti_d38_dev
exti_d39_dev
exti_d40_dev
exti_d41_dev
exti_d42_dev
exti_d43_dev
exti_d44_dev
exti_d45_dev
exti_d46_dev
exti_d47_dev
exti_d48_dev
exti_d49_dev
exti_d50_dev
exti_d51_dev
exti_d52_dev
exti_d53_dev
exti_a0_dev
exti_a1_dev
exti_a2_dev
exti_a3_dev
exti_a4_dev
exti_a5_dev
exti_a6_dev
exti_a7_dev
exti_a8_dev
exti_a9_dev

`exti_a10_dev`
`exti_a11_dev`
`exti_led_dev`
`exti_dac0_dev`
`exti_dac1_dev`
`pwm_d2_dev`
`pwm_d3_dev`
`pwm_d5_dev`
`pwm_d6_dev`
`pwm_d7_dev`
`pwm_d8_dev`
`pwm_d9_dev`
`pwm_d10_dev`
`pwm_d11_dev`
`pwm_d12_dev`
`adc_0_dev`
`dac_0_dev`
`flash_0_dev`

Functions

int **board_pin_string_to_device_index** (const char **str_p*)

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

arduino_mega — Arduino Mega

Source code: [src/boards/arduino_mega/board.h](#), [src/boards/arduino_mega/board.c](#)

Hardware reference: *Arduino Mega*

Defines

`pin_d0_dev`
`pin_d1_dev`
`pin_d2_dev`

pin_d3_dev
pin_d4_dev
pin_d5_dev
pin_d6_dev
pin_d7_dev
pin_d8_dev
pin_d9_dev
pin_d10_dev
pin_d11_dev
pin_d12_dev
pin_d13_dev
pin_d14_dev
pin_d15_dev
pin_d16_dev
pin_d17_dev
pin_d18_dev
pin_d19_dev
pin_d20_dev
pin_d21_dev
pin_d22_dev
pin_d23_dev
pin_d24_dev
pin_d25_dev
pin_d26_dev
pin_d27_dev
pin_d28_dev
pin_d29_dev
pin_d30_dev
pin_d31_dev
pin_d32_dev
pin_d33_dev
pin_d34_dev
pin_d35_dev
pin_d36_dev
pin_d37_dev
pin_d38_dev

pin_d39_dev
pin_d40_dev
pin_d41_dev
pin_d42_dev
pin_d43_dev
pin_d44_dev
pin_d45_dev
pin_d46_dev
pin_d47_dev
pin_d48_dev
pin_d49_dev
pin_d50_dev
pin_d51_dev
pin_d52_dev
pin_d53_dev
pin_a0_dev
pin_a1_dev
pin_a2_dev
pin_a3_dev
pin_a4_dev
pin_a5_dev
pin_a6_dev
pin_a7_dev
pin_a8_dev
pin_a9_dev
pin_a10_dev
pin_a11_dev
pin_a12_dev
pin_a13_dev
pin_a14_dev
pin_a15_dev
pin_led_dev
exti_d2_dev
exti_d3_dev
exti_d18_dev
exti_d19_dev

`exti_d20_dev`
`exti_d21_dev`
`pwm_d2_dev`
`pwm_d3_dev`
`pwm_d5_dev`
`pwm_d6_dev`
`pwm_d7_dev`
`pwm_d8_dev`
`pwm_d9_dev`
`pwm_d10_dev`
`pwm_d11_dev`
`pwm_d12_dev`
`adc_0_dev`
`i2c_0_dev`

Functions

`int board_pin_string_to_device_index (const char *str_p)`
Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- `str_p`: Pin as a string.

arduino_nano — Arduino Nano

Source code: [src/boards/arduino_nano/board.h](#), [src/boards/arduino_nano/board.c](#)

Hardware reference: [Arduino Nano](#)

Defines

`pin_d2_dev`
`pin_d3_dev`
`pin_d4_dev`
`pin_d5_dev`
`pin_d6_dev`
`pin_d7_dev`
`pin_d8_dev`

pin_d9_dev
pin_d10_dev
pin_d11_dev
pin_d12_dev
pin_d13_dev
pin_a0_dev
pin_a1_dev
pin_a2_dev
pin_a3_dev
pin_a4_dev
pin_a5_dev
pin_led_dev
exti_d2_dev
exti_d3_dev
pwm_d3_dev
pwm_d9_dev
pwm_d10_dev
pwm_d11_dev
adc_0_dev
i2c_0_dev

Functions

int **board_pin_string_to_device_index** (const char *str_p)
Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- str_p: Pin as a string.

arduino_pro_micro — Arduino Pro Micro

Source code: [src/boards/arduino_pro_micro/board.h](#), [src/boards/arduino_pro_micro/board.c](#)

Hardware reference: *Arduino Pro Micro*

Defines

`pin_d2_dev`
`pin_d3_dev`
`pin_d4_dev`
`pin_d5_dev`
`pin_d6_dev`
`pin_d7_dev`
`pin_d8_dev`
`pin_d9_dev`
`pin_d10_dev`
`pin_d14_dev`
`pin_d15_dev`
`pin_d16_dev`
`pin_a0_dev`
`pin_a1_dev`
`pin_a2_dev`
`pin_a3_dev`
`pin_led_dev`
`exti_d2_dev`
`exti_d3_dev`
`pwm_d3_dev`
`pwm_d9_dev`
`pwm_d10_dev`
`pwm_d11_dev`
`adc_0_dev`
`i2c_0_dev`

Functions

`int board_pin_string_to_device_index (const char *str_p)`
Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- `str_p`: Pin as a string.

arduino_uno — Arduino Uno

Source code: `src/boards/arduino_uno/board.h`, `src/boards/arduino_uno/board.c`

Hardware reference: *Arduino Uno*

Defines

`pin_d2_dev`
`pin_d3_dev`
`pin_d4_dev`
`pin_d5_dev`
`pin_d6_dev`
`pin_d7_dev`
`pin_d8_dev`
`pin_d9_dev`
`pin_d10_dev`
`pin_d11_dev`
`pin_d12_dev`
`pin_d13_dev`
`pin_a0_dev`
`pin_a1_dev`
`pin_a2_dev`
`pin_a3_dev`
`pin_a4_dev`
`pin_a5_dev`
`pin_led_dev`
`exti_d2_dev`
`exti_d3_dev`
`pwm_d3_dev`
`pwm_d9_dev`
`pwm_d10_dev`
`pwm_d11_dev`
`adc_0_dev`
`i2c_0_dev`

Functions

int **board_pin_string_to_device_index** (const char **str_p*)

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

cygwin — Cygwin

Source code: [src/boards/cygwin/board.h](#), [src/boards/cygwin/board.c](#)

Defines

PIN_DEVICE_BASE

pin_d2_dev

pin_d3_dev

pin_d4_dev

pin_d5_dev

pin_d6_dev

pin_d7_dev

pin_d8_dev

pin_d9_dev

pin_d10_dev

pin_d11_dev

pin_d12_dev

pin_d13_dev

pin_a0_dev

pin_a1_dev

pin_a2_dev

pin_a3_dev

pin_a4_dev

pin_a5_dev

pin_a6_dev

pin_a7_dev

pin_led_dev

pwm_d3_dev

`pwm_d9_dev`
`pwm_d10_dev`
`pwm_d11_dev`
`adc_0_dev`

Functions

int **board_pin_string_to_device_index** (const char **str_p*)
Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

esp01 — ESP8266 Development Board

Source code: [src/boards/esp01/board.h](#), [src/boards/esp01/board.c](#)

Hardware reference: *ESP-01*

Defines

`pin_gpio0_dev`
`pin_gpio1_dev`
`pin_gpio2_dev`
`pin_d0_dev`
`pin_d1_dev`
`pin_d2_dev`
`pin_led_dev`
`flash_0_dev`

Functions

int **board_pin_string_to_device_index** (const char **str_p*)
Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

esp12e — ESP8266 Development Board

Source code: `src/boards/esp12e/board.h`, `src/boards/esp12e/board.c`

Hardware reference: *ESP-12E Development Board*

Defines

`pin_gpio0_dev`
`pin_gpio2_dev`
`pin_gpio4_dev`
`pin_gpio5_dev`
`pin_gpio12_dev`
`pin_gpio13_dev`
`pin_gpio14_dev`
`pin_gpio15_dev`
`pin_gpio16_dev`
`pin_d0_dev`
`pin_d2_dev`
`pin_d4_dev`
`pin_d5_dev`
`pin_d12_dev`
`pin_d13_dev`
`pin_d14_dev`
`pin_d15_dev`
`pin_d16_dev`
`pin_led_dev`
`pin_a0_dev`
`adc_0_dev`
`flash_0_dev`

Functions

`int board_pin_string_to_device_index (const char *str_p)`

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- `str_p`: Pin as a string.

linux — Linux

Source code: [src/boards/linux/board.h](#), [src/boards/linux/board.c](#)

Defines

`PIN_DEVICE_BASE`

`pin_d2_dev`

`pin_d3_dev`

`pin_d4_dev`

`pin_d5_dev`

`pin_d6_dev`

`pin_d7_dev`

`pin_d8_dev`

`pin_d9_dev`

`pin_d10_dev`

`pin_d11_dev`

`pin_d12_dev`

`pin_d13_dev`

`pin_a0_dev`

`pin_a1_dev`

`pin_a2_dev`

`pin_a3_dev`

`pin_a4_dev`

`pin_a5_dev`

`pin_a6_dev`

`pin_a7_dev`

`pin_led_dev`

`pwm_d3_dev`

`pwm_d9_dev`

`pwm_d10_dev`

`pwm_d11_dev`

`adc_0_dev`

`pin_dac0_dev`

`pin_dac1_dev`

Functions

int **board_pin_string_to_device_index** (const char **str_p*)

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

nano32 — Nano32

Source code: [src/boards/nano32/board.h](#), [src/boards/nano32/board.c](#)

Hardware reference: [Nano32](#)

Defines

`pin_gpio00_dev`

`pin_gpio01_dev`

`pin_gpio02_dev`

`pin_gpio03_dev`

`pin_gpio04_dev`

`pin_gpio05_dev`

`pin_gpio06_dev`

`pin_gpio07_dev`

`pin_gpio08_dev`

`pin_gpio09_dev`

`pin_gpio10_dev`

`pin_gpio11_dev`

`pin_gpio12_dev`

`pin_gpio13_dev`

`pin_gpio14_dev`

`pin_gpio15_dev`

`pin_gpio16_dev`

`pin_gpio17_dev`

`pin_gpio18_dev`

`pin_gpio19_dev`

`pin_gpio21_dev`

`pin_gpio22_dev`

pin_gpio23_dev
pin_gpio25_dev
pin_gpio26_dev
pin_gpio27_dev
pin_gpio32_dev
pin_gpio33_dev
pin_gpio34_dev
pin_gpio35_dev
pin_gpio36_dev
pin_gpio39_dev
pin_led_dev
pin_adc0_dev
pin_adc3_dev
pin_adc4_dev
pin_adc5_dev
pin_adc6_dev
pin_adc7_dev
pin_adc10_dev
pin_adc11_dev
pin_adc12_dev
pin_adc13_dev
pin_adc14_dev
pin_adc15_dev
pin_adc16_dev
pin_adc17_dev
pin_adc18_dev
pin_adc19_dev
pin_dac1_dev
pin_dac2_dev
i2c_dev
spi_h_dev
spi_v_dev
adc_1_dev
adc_2_dev
flash_0_dev

Functions

int **board_pin_string_to_device_index** (const char **str_p*)

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

photon — Photon

Source code: [src/boards/photon/board.h](#), [src/boards/photon/board.c](#)

Hardware reference: *Photon*

Defines

`pin_d0_dev`

`pin_d1_dev`

`pin_d2_dev`

`pin_d3_dev`

`pin_d4_dev`

`pin_d5_dev`

`pin_d6_dev`

`pin_d7_dev`

`pin_a0_dev`

`pin_a1_dev`

`pin_a2_dev`

`pin_a3_dev`

`pin_a4_dev`

`pin_a5_dev`

`pin_led_dev`

`pin_dac0_dev`

`pin_dac1_dev`

`pwm_d0_dev`

`pwm_d1_dev`

`pwm_d2_dev`

`pwm_d3_dev`

`pwm_a4_dev`

`pwm_a5_dev`
`flash_0_dev`
`sdio_0_dev`

Functions

`int board_pin_string_to_device_index (const char *str_p)`
Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- `str_p`: Pin as a string.

`stm32f3discovery` — **STM32F3DISCOVERY**

Source code: [src/boards/stm32f3discovery/board.h](#), [src/boards/stm32f3discovery/board.c](#)

Hardware reference: *STM32F3DISCOVERY*

Defines

`pin_pa0_dev`
`pin_pa1_dev`
`pin_pa2_dev`
`pin_pa3_dev`
`pin_pa4_dev`
`pin_pa5_dev`
`pin_pa6_dev`
`pin_pa7_dev`
`pin_pa8_dev`
`pin_pa9_dev`
`pin_pa10_dev`
`pin_pa11_dev`
`pin_pa12_dev`
`pin_pa13_dev`
`pin_pa14_dev`
`pin_pa15_dev`
`pin_pb0_dev`
`pin_pb1_dev`

pin_pb2_dev
pin_pb3_dev
pin_pb4_dev
pin_pb5_dev
pin_pb6_dev
pin_pb7_dev
pin_pb8_dev
pin_pb9_dev
pin_pb10_dev
pin_pb11_dev
pin_pb12_dev
pin_pb13_dev
pin_pb14_dev
pin_pb15_dev
pin_pc0_dev
pin_pc1_dev
pin_pc2_dev
pin_pc3_dev
pin_pc4_dev
pin_pc5_dev
pin_pc6_dev
pin_pc7_dev
pin_pc8_dev
pin_pc9_dev
pin_pc10_dev
pin_pc11_dev
pin_pc12_dev
pin_pc13_dev
pin_pc14_dev
pin_pc15_dev
pin_pd0_dev
pin_pd1_dev
pin_pd2_dev
pin_pd3_dev
pin_pd4_dev
pin_pd5_dev

pin_pd6_dev
pin_pd7_dev
pin_pd8_dev
pin_pd9_dev
pin_pd10_dev
pin_pd11_dev
pin_pd12_dev
pin_pd13_dev
pin_pd14_dev
pin_pd15_dev
pin_pe0_dev
pin_pe1_dev
pin_pe2_dev
pin_pe3_dev
pin_pe4_dev
pin_pe5_dev
pin_pe6_dev
pin_pe7_dev
pin_pe8_dev
pin_pe9_dev
pin_pe10_dev
pin_pe11_dev
pin_pe12_dev
pin_pe13_dev
pin_pe14_dev
pin_pe15_dev
uart_0_dev
uart_1_dev
uart_2_dev
spi_0_dev
spi_1_dev
spi_2_dev
i2c_0_dev
i2c_1_dev
can_0_dev
flash_0_dev

Functions

int **board_pin_string_to_device_index** (const char **str_p*)

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- *str_p*: Pin as a string.

stm32vldiscovery — STM32VLDISCOVERY

Source code: [src/boards/stm32vldiscovery/board.h](#), [src/boards/stm32vldiscovery/board.c](#)

Hardware reference: *STM32VLDISCOVERY*

Defines

`pin_pa0_dev`

`pin_pa1_dev`

`pin_pa2_dev`

`pin_pa3_dev`

`pin_pa4_dev`

`pin_pa5_dev`

`pin_pa6_dev`

`pin_pa7_dev`

`pin_pa8_dev`

`pin_pa9_dev`

`pin_pa10_dev`

`pin_pa11_dev`

`pin_pa12_dev`

`pin_pa13_dev`

`pin_pa14_dev`

`pin_pa15_dev`

`pin_pb0_dev`

`pin_pb1_dev`

`pin_pb2_dev`

`pin_pb3_dev`

`pin_pb4_dev`

`pin_pb5_dev`

pin_pb6_dev
pin_pb7_dev
pin_pb8_dev
pin_pb9_dev
pin_pb10_dev
pin_pb11_dev
pin_pb12_dev
pin_pb13_dev
pin_pb14_dev
pin_pb15_dev
pin_pc0_dev
pin_pc1_dev
pin_pc2_dev
pin_pc3_dev
pin_pc4_dev
pin_pc5_dev
pin_pc6_dev
pin_pc7_dev
pin_pc8_dev
pin_pc9_dev
pin_pc10_dev
pin_pc11_dev
pin_pc12_dev
pin_pc13_dev
pin_pc14_dev
pin_pc15_dev
pin_pd0_dev
pin_pd1_dev
pin_pd2_dev
pin_led_dev
pin_ld3_dev
pin_ld4_dev
uart_0_dev
uart_1_dev
uart_2_dev
spi_0_dev

`spi_1_dev`
`spi_2_dev`
`i2c_0_dev`
`i2c_1_dev`
`flash_0_dev`

Functions

`int board_pin_string_to_device_index (const char *str_p)`

Convert given pin string to the pin number.

Return Pin number of negative error code.

Parameters

- `str_p`: Pin as a string.

1.6.15 mcus

The Micro Controller Units (MCU:s) supported by *Simba*.

The MCU:s on [Github](#).

atmega2560 — ATmega2560

Source code: [src/mcus/atmega2560/mcu.h](#)

Defines

`PIN_DEVICE_MAX`
`EXTI_DEVICE_MAX`
`SPI_DEVICE_MAX`
`UART_DEVICE_MAX`
`PWM_DEVICE_MAX`
`ADC_DEVICE_MAX`
`I2C_DEVICE_MAX`

atmega328p — ATmega328p

Source code: [src/mcus/atmega328p/mcu.h](#)

Defines

PIN_DEVICE_MAX
EXTI_DEVICE_MAX
SPI_DEVICE_MAX
UART_DEVICE_MAX
PWM_DEVICE_MAX
ADC_DEVICE_MAX
I2C_DEVICE_MAX
USART0_TX_vect
USART0_RX_vect
USART0_UDRE_vect

atmega32u4 — ATmega32u4

Source code: <src/mcus/atmega32u4/mcu.h>

Defines

PIN_DEVICE_MAX
EXTI_DEVICE_MAX
SPI_DEVICE_MAX
UART_DEVICE_MAX
PWM_DEVICE_MAX
ADC_DEVICE_MAX
I2C_DEVICE_MAX
USB_DEVICE_MAX
USART0_TX_vect
USART0_RX_vect
USART0_UDRE_vect
UCSZ00
UCSZ01
UCSZ02
UPM00
UPM01
USBS0
U2X0

UPE0
DOR0
FE0
TXC0
RXCIE0
RXEN0
TXEN0
UDRE0
UDRIE0
TXCIE0

esp32 — Esp32

Hardware reference: <https://github.com/eerimoq/hardware-reference/tree/master/esp32>

Source code: [src/mcus/esp32/mcu.h](#)

Defines

PIN_DEVICE_MAX
EXTI_DEVICE_MAX
SPI_DEVICE_MAX
UART_DEVICE_MAX
ADC_DEVICE_MAX
I2C_DEVICE_MAX
FLASH_DEVICE_MAX
CAN_DEVICE_MAX

esp8266 — Esp8266

Hardware reference: <https://github.com/eerimoq/hardware-reference/tree/master/esp8266>

Source code: [src/mcus/esp8266/mcu.h](#)

Defines

`PIN_DEVICE_MAX`
`EXTI_DEVICE_MAX`
`SPI_DEVICE_MAX`
`UART_DEVICE_MAX`
`PWM_DEVICE_MAX`
`ADC_DEVICE_MAX`
`FLASH_DEVICE_MAX`

linux — Linux

Source code: [src/mcus/linux/mcu.h](#)

Defines

`PIN_DEVICE_MAX`
`EXTI_DEVICE_MAX`
`SPI_DEVICE_MAX`
`UART_DEVICE_MAX`
`CAN_DEVICE_MAX`
`PWM_DEVICE_MAX`
`ADC_DEVICE_MAX`
`FLASH_DEVICE_MAX`
`DAC_DEVICE_MAX`

sam3x8e — SAM3X8E

Source code: [src/mcus/sam/mcu.h](#)

Defines

`SAM_PA`
`SAM_PB`
`SAM_PC`
`SAM_PD`

stm32f100rb — STM32F100RB

Source code: [src/mcus/stm32f100rb/mcu.h](#)

Defines

`PIN_DEVICE_MAX`
`UART_DEVICE_MAX`
`SPI_DEVICE_MAX`
`I2C_DEVICE_MAX`
`CAN_DEVICE_MAX`
`FLASH_DEVICE_MAX`

stm32f205rg — STM32F205RG

Source code: [src/mcus/stm32f205rg/mcu.h](#)

Defines

`PIN_DEVICE_MAX`
`UART_DEVICE_MAX`
`SPI_DEVICE_MAX`
`I2C_DEVICE_MAX`
`CAN_DEVICE_MAX`
`FLASH_DEVICE_MAX`
`SDIO_DEVICE_MAX`

stm32f303vc — STM32F303VC

Source code: [src/mcus/stm32f303vc/mcu.h](#)

Defines

`PIN_DEVICE_MAX`
`UART_DEVICE_MAX`
`SPI_DEVICE_MAX`
`I2C_DEVICE_MAX`

`CAN_DEVICE_MAX`

`FLASH_DEVICE_MAX`

1.7 License

The MIT License (MIT)

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1.8 Videos

1.8.1 #6 Simba: CAN client-server test suite on Nano32 (ESP32) and Arduino Due.

Transmit CAN frames between a Nano32 and an Arduino Due.

1.8.2 #5 Simba: Room temperature (DS18B20).

Read and print the room temperature measured with a DS18B20 sensor.

1.8.3 #4 Simba: Hello world.

This application prints “Hello world!” to standard output.

1.8.4 #3 Simba: Analog read.

Read the value of an analog pin periodically once every second and print the read value to standard output.

1.8.5 #2 Simba: Blink example.

This video demonstrates the classic blink application. It’s run on a Arduino Due that has a SAM2X8E ARM MCU.

1.8.6 #1 Simba: Gource of the Simba repository.

Gource visualizes the Simba Git repository file tree over time. In this project the source, test and documentation was written simultaneously, a perfect school book example of software development.

1.9 Links

This page contains links to external websites that are related to Simba.

Feel free to add your project to the list by submitting a pull request of [this page](#) on Github.

1.9.1 Pumbaa - MicroPython on Simba

Python on microcontrollers thanks to MicroPython (and in this case Simba).

Documentation: <http://pumbaa.readthedocs.io>

Github: <https://github.com/eerimoq/pumbaa>

MicroPython: <http://www.micropython.org>

1.9.2 Wingfence

A BWF for a home made robot mower.

Github: <https://github.com/wingstar74/wingfence>

- *Threads* scheduled by a priority based cooperative or preemptive scheduler.
- Channels for inter-thread communication (*Queue*, *Event*).
- *Timers*.
- *Counting semaphores*.
- Device drivers (*SPI*, *UART*, ...)
- A simple *shell*.
- *Logging*.
- Internet protocols (*TCP*, *UDP*, *HTTP*, ...).
- *Debug file system*.
- File systems (*FAT16*, *SPIFFS*).

See the *Library Reference* for a full list of features.

CHAPTER 3

Testing

To ensure high code quality each module is tested extensively by many test suites. See [Testing](#) for details.

CHAPTER 4

Design goals

- Rapid development.
- Clean interfaces.
- Small memory footprint.
- No dynamic memory allocation.
- Portability.

CHAPTER 5

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