

Introduction to IoT LAB Exercises

2024

IoT LAB - Outline

Today's lab goal:

- Introduction of lab hardware
- IDE setup

Hardware Overview

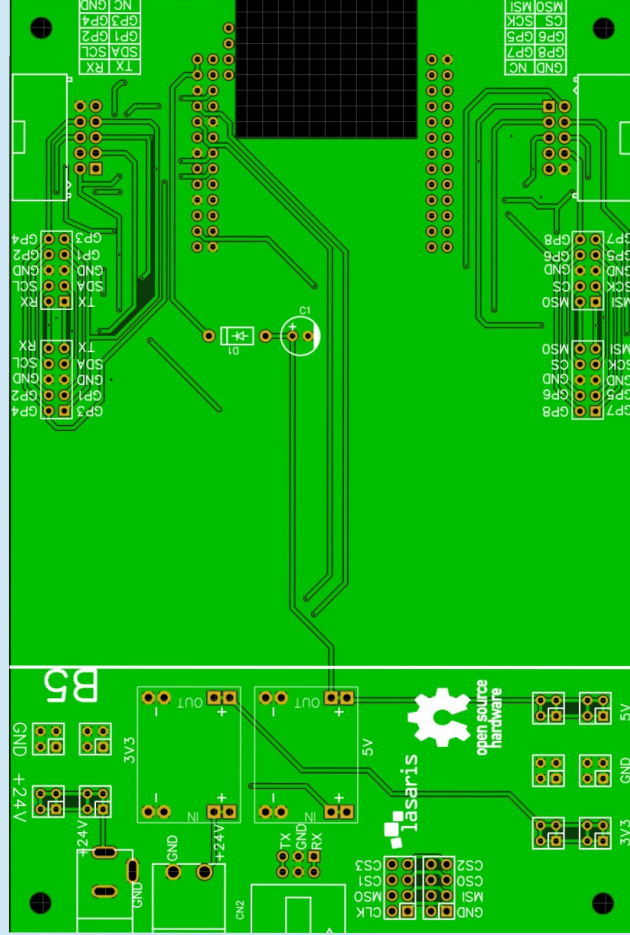
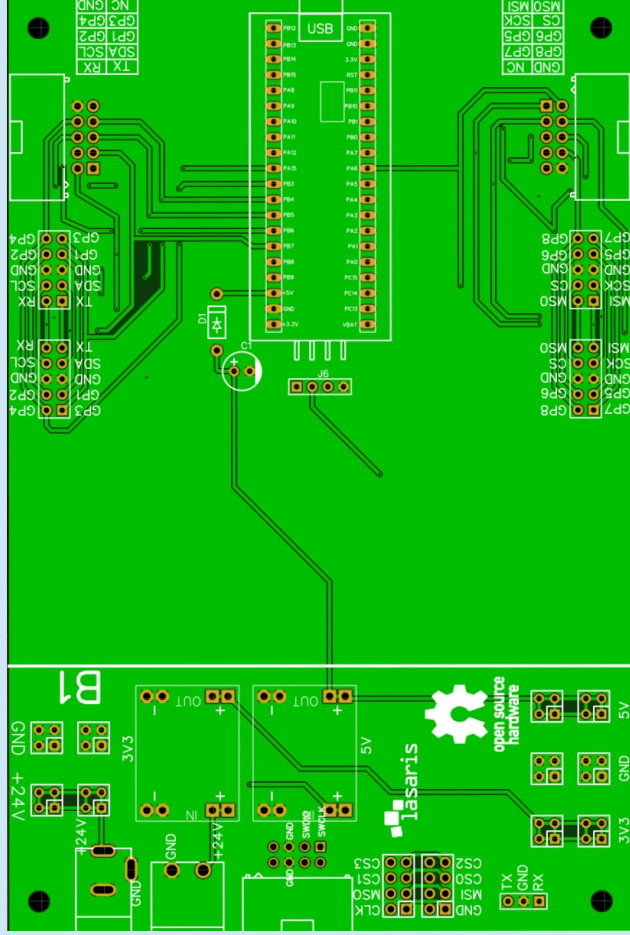
- Building blocks consisting of:
 - **Base board (green)**
 - **Communication board (red)**
 - **Application board (blue)**
 - Cryptography support (for PV285) violet
- Interconnection – cabling
- Supplemental items – uSD
- Debugging tools – logic analyzer

Hardware - MCUs



Hardware – Base boards

STM32 - BluePill



RockPi S

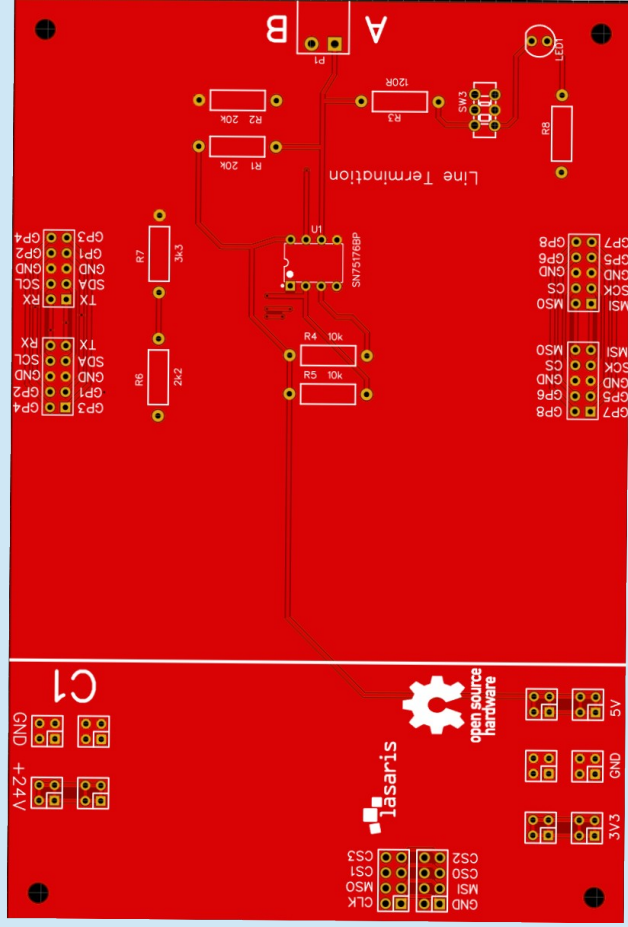
Hardware – Base boards

More base boards in testing state – available for standalone work:

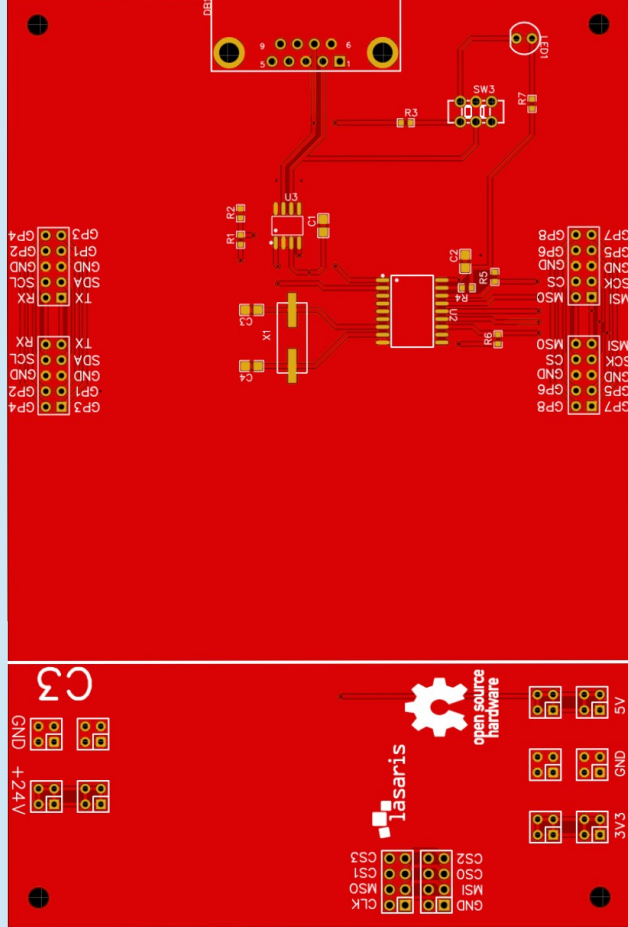
- ATmega 328
- ESP-32
- Raspberry Pico
- Universal board for 5V powered MCUs
- Universal board for 3V3 powered MCUs

Hardware - Communication

RS - 485

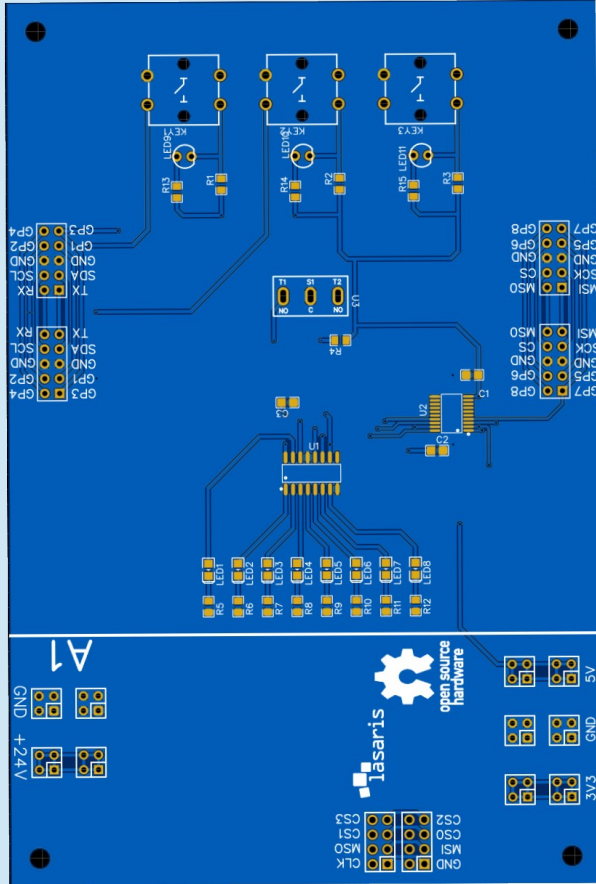


CANBUS

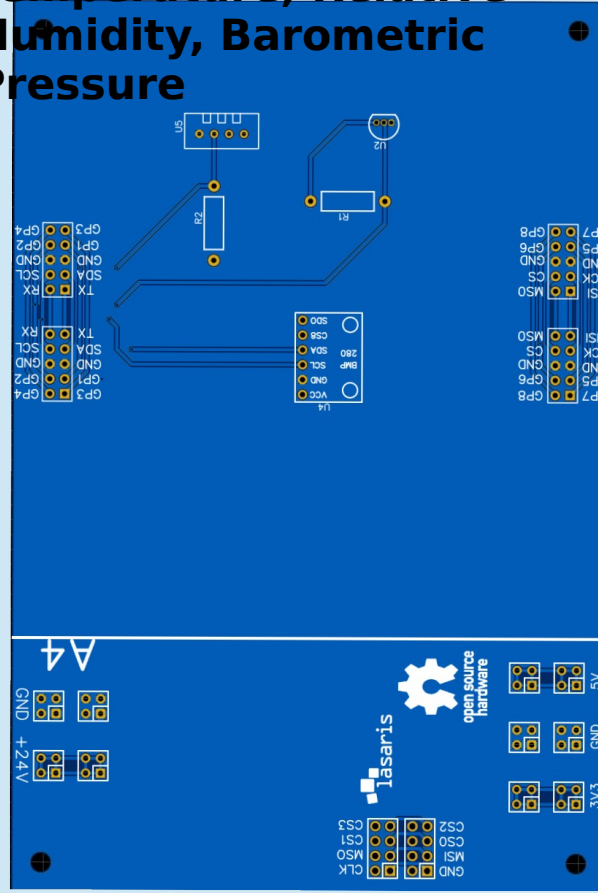


Hardware - Applications

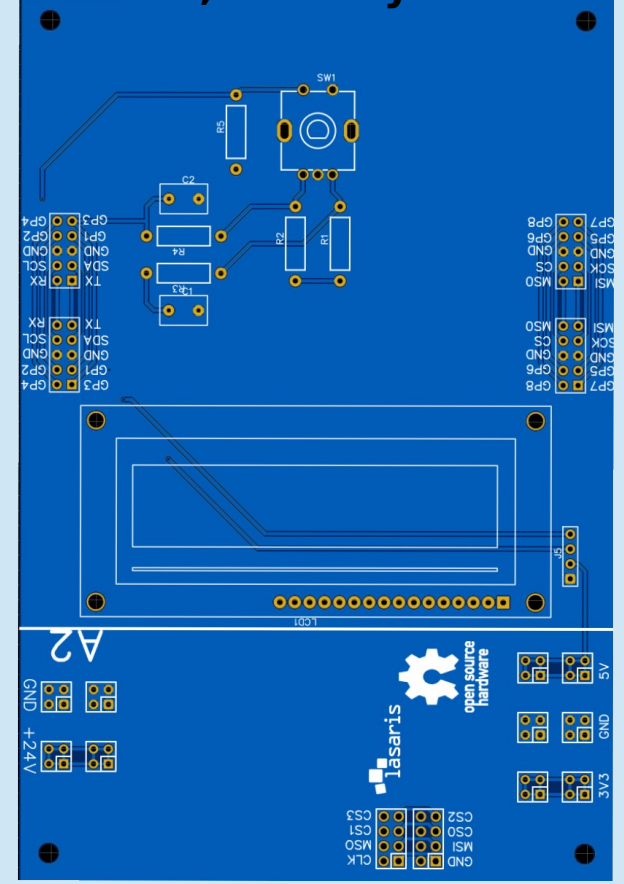
Push Buttons, Switch, LEDs



Temperature, Relative Humidity, Barometric Pressure



LCD 2x16, Rotary Encoder



IDE

- For bare-metal programming
- Lightweight – Arduino IDE
- Heavy duty – STM Cube

KYPO PC Environment setup

- Use your fi.muni account
 - <https://www.fi.muni.cz/tech/account.html.cs>
- Data should be stored in cloud
- Today's goal: configuration and test of the IDE
- Application: just blinking the LED

Private laptops

- Download and install Arduino IDE:
- <https://www.arduino.cc/en/software>
- Available for Windows, Linux, and MAC
- Currently, we use release 1.8.19
- Latest available release 2.3.3

Arduino IDE



- File → Preferences
- Additional Boards Manager URLs:
 - http://dan.drown.org/stm32duino/package_STM32duino_index.json
 - Beare, more STM32 cores available
- Tools → Board → Boards Manager
 - STM32F1xx/GD32F1xx
- Tools → Board → STM32F1 Boards (Arduino_STM32)
 - Generic STM32F103C series

Basic example

- File → Examples → 0.1 Basic → Blink
- Tools → Upload Method: → STLink
- Sketch → Verify/Compile
- Sketch → Upload

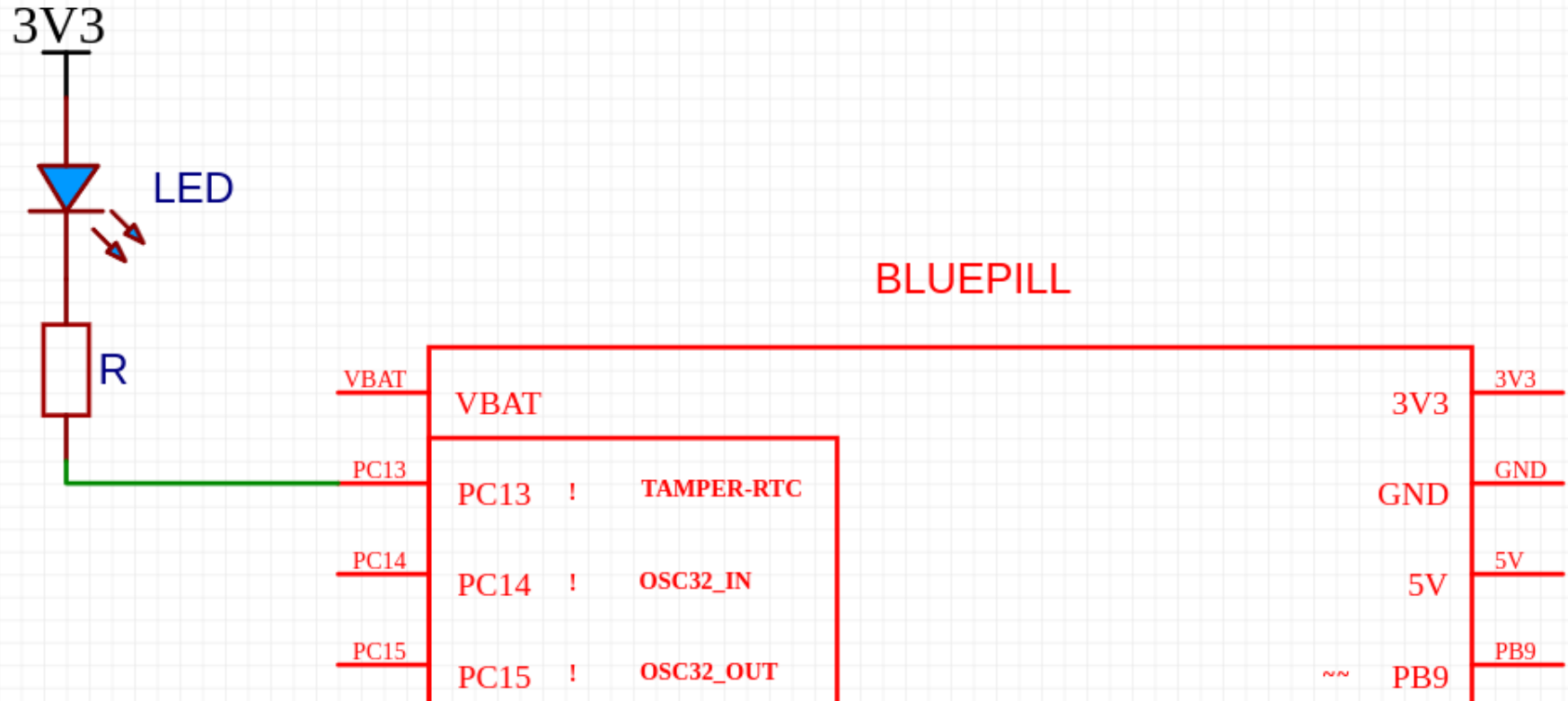
Basic example

```
void loop() {  
    digitalWrite(LED_BUILTIN, HIGH); // turn the LED on  
    delay(1000);                    // wait for 1000 ms  
    digitalWrite(LED_BUILTIN, LOW); // turn the LED off  
    delay(1000);                    // wait for 1000 ms  
}
```

Basic example

- Task: change the delay time in asymmetric way, e.g., 2000 ms HIGH state, 100 ms LOW state
- Observe the result
- Explanation?

Basic example



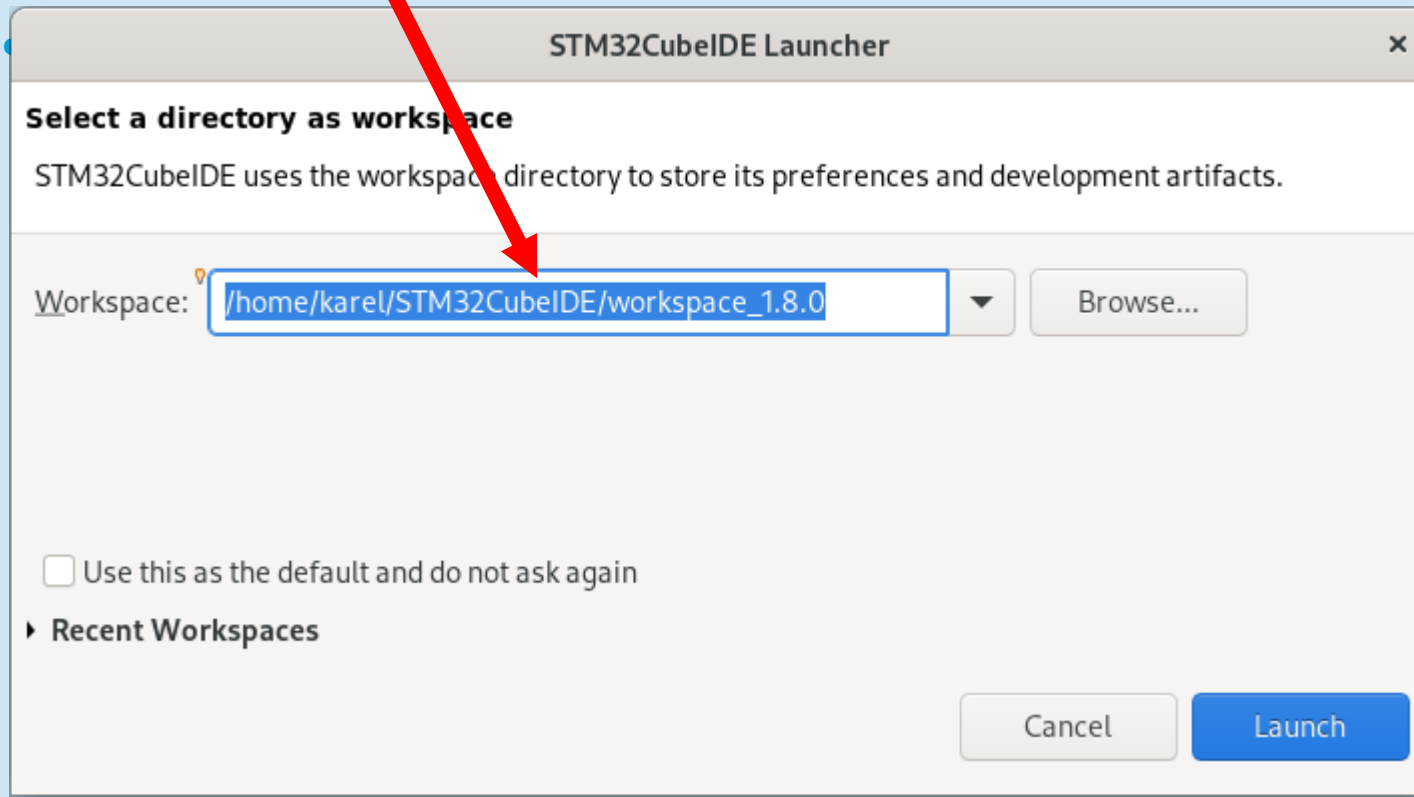
STM CUBE IDE

- Offered by STMicroelectronic
- Covers all STM32 MCUs
- C / C++
- Based on Eclipse → similarity with Simplicity Studio, MCUXpresso, Code Composer Studio, ...
- Used also for ST-Link SW upgrade
- Can help to install ST-Link drivers
- MCU specific libraries downloaded on per project basis

STM Cube on KYPO PCs



- **H:_profile\Documents\stm**



STM CUBE IDE installation

- Download from STMicroelectronic:
 - <https://www.st.com/en/development-tools/stm32cubeide.html>
 - Current release: 1.16.1
 - Older release installed on KYPO PCs
 - Registration needed (and recommended)

STM Cube – getting started

The screenshot shows the STM32CubeIDE Home page in a browser window. The window title is "LAB - STM32CubeIDE". The page has a navigation menu at the top: File, Edit, Source, Refactor, Navigate, Search, Project, Run, Window, Help. Below the menu is an "Information Center" tab and a "STM32CubeIDE Home" header. The main content area is divided into several sections:

- Start a project:** A sidebar on the left contains four buttons: "Start new STM32 project" (highlighted with a red box), "Start new project from STM32CubeMX file (.ioc)", "Import project", and "Import STM32Cube example".
- Welcome to STM32CubeIDE:** A central heading with the sub-heading "What's new".
- Featured Article:** A yellow banner for the "STM32U5 ultra-low-power MCU series with comprehensive STM32Cube ecosystem" featuring images of STM32 boards and the ST logo.
- Quick links:** Three buttons: "Access to Videos", "Read STM32CubeIDE Documentation", and "Getting Started with STM32CubeIDE".
- Support & Community:** A section on the right with social media links: Twitter, Facebook, Youtube, ST Home, ST Community, and ST Longevity Commitment.
- Standalone STM32 Tools:** A section on the right listing tools: STM32CubeMX, STM32CubeMonitor, STM32CubeMon-Pwr, STM32CubeMon-RF, STM32CubeMon-UCPD, and STM32CubeProg.
- Application Tools:** A section on the right listing tools: eDesignSuite, AlgoBuilder, and ST-MC-Suite.

STM Cube – getting started

STM32F103C8T6

Target Selection

⚠ STM32 target or STM32Cube example selection is required

MCU/MPU Selector | Board Selector | Example Selector | Cross Selector

MCU/MPU Filters

★ 📁 🔍 ↻

Part Number

Core

Check/Uncheck All

- Arm Cortex-A7 + Arm Cortex-M4
- Arm Cortex-M0
- Arm Cortex-M0+
- Arm Cortex-M3
- Arm Cortex-M4
- Arm Cortex-M4 + Arm Cortex-M0+
- Arm Cortex-M7
- Arm Cortex-M7 + Arm Cortex-M4
- Arm Cortex-M33

Series

Check/Uncheck All

- STM32F0
- STM32F1
- STM32F2
- STM32F3
- STM32F4
- STM32F7
- STM32G0
- STM32G4
- STM32H7
- STM32L0

Features | Block Diagram | Docs & Resources | Datasheet | Buy

STM32Cube

STM32U5 ultra-low-power MCU series with comprehensive STM32Cube ecosystem

ST

MCUs/MPUs List: 1912 items

Display similar items

Export

*	Part No	Reference	Marketin...	Unit Price...	Board	Package	Flash	RAM	IO	Freq.
☆	STM32F03...	STM32F03...	Active	0.722		LQFP48	32 kBytes	4 kBytes	39	48 MHz
☆	STM32F03...	STM32F03...	Active	0.874		LQFP48	64 kBytes	8 kBytes	39	48 MHz
☆	STM32F03...	STM32F03...	Active	1.331		LQFP48	256 kBytes	32 kBytes	37	48 MHz
☆	STM32F03...	STM32F03...	Active	0.513		TSSOP20	16 kBytes	4 kBytes	15	48 MHz
☆	STM32F03...	STM32F03...	Active	0.627		LQFP32	32 kBytes	4 kBytes	25	48 MHz
☆	STM32F03...	STM32F03...	Active	0.912	NUCL...STM3...	LQFP64	64 kBytes	8 kBytes	55	48 MHz
☆	STM32F03...	STM32F03...	Active	1.464		LQFP64	256 kBytes	32 kBytes	51	48 MHz
☆	STM32F03...	STM32F03...	Active	1.174		LQFP48	16 kBytes	4 kBytes	39	48 MHz
☆	STM32F03...	STM32F03...	Active	1.226		LQFP48	32 kBytes	4 kBytes	39	48 MHz
☆	STM32F03...	STM32F03...	Active	0.939		WLCSP25	32 kBytes	4 kBytes	20	48 MHz
☆	STM32F03...	STM32F03...	Active	0.861		TSSOP20	16 kBytes	4 kBytes	15	48 MHz
☆	STM32F03...	STM32F03...	Active	0.913		TSSOP20	32 kBytes	4 kBytes	15	48 MHz
☆	STM32F03...	STM32F03...	Active	0.887		UFQFPN28	16 kBytes	4 kBytes	23	48 MHz

< Back | Next > | Cancel | Finish

STM Cube – getting started

The image shows a dialog box titled "STM32 Project" with a close button (x) in the top right corner. A blue "IDE" label is positioned in the top right area. A red error icon and the text "Empty project name is not supported" are displayed at the top left. The dialog is divided into sections: "Project" and "Options".

Project

Project Name:

Use default location

Location:

Options

Targeted Language

C C++

Targeted Binary Type

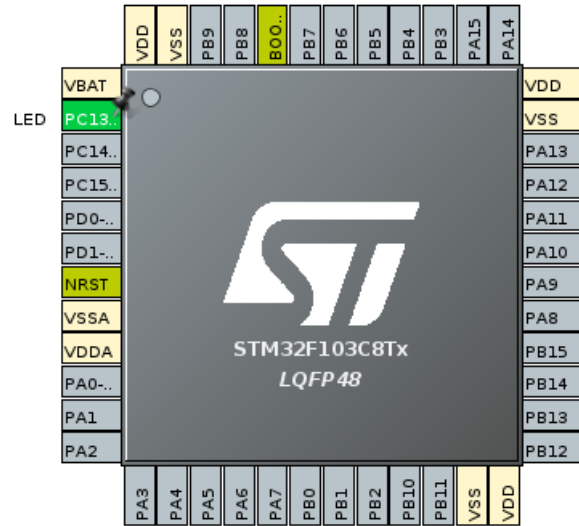
Executable Static Library

Targeted Project Type

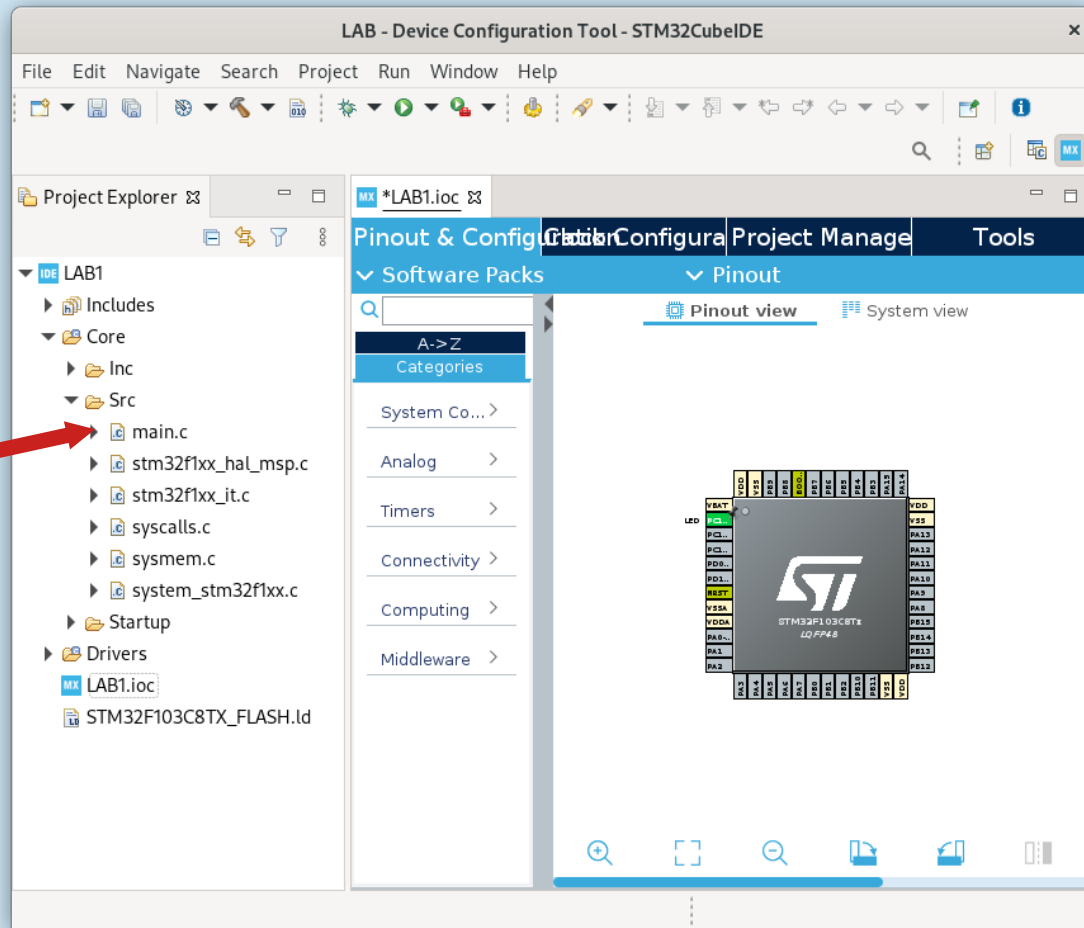
STM32Cube Empty

At the bottom, there is a help icon (question mark) and four buttons: "< Back", "Next >", "Cancel", and "Finish".

STM Cube – getting started



STM Cube – getting started



STM Cube – C programming

- Main.c

```
while (1)
```

```
{
```

```
    // LED OFF
```

```
    HAL_GPIO_WritePin(GPIOC, GPIO_PIN_13, GPIO_PIN_SET);
```

```
    HAL_Delay(100); // Dealy in ms
```

```
    // LED ON
```

```
    HAL_GPIO_WritePin(GPIOC, GPIO_PIN_13, GPIO_PIN_RESET);
```

```
    HAL_Delay(100); // Dealy in ms
```

```
}
```

**Please consider both Arduino IDE and
STM Cube**