

The background of the slide is a photograph of a mountain range. The mountains are layered, with the closest ones in the foreground and others receding into the distance. The entire scene is covered with a light blue mist or fog, giving it a soft, ethereal appearance. The sky is a pale, uniform blue.

# **Chapter 2**

# **STM32L0 Architecture**

# LAYOUT

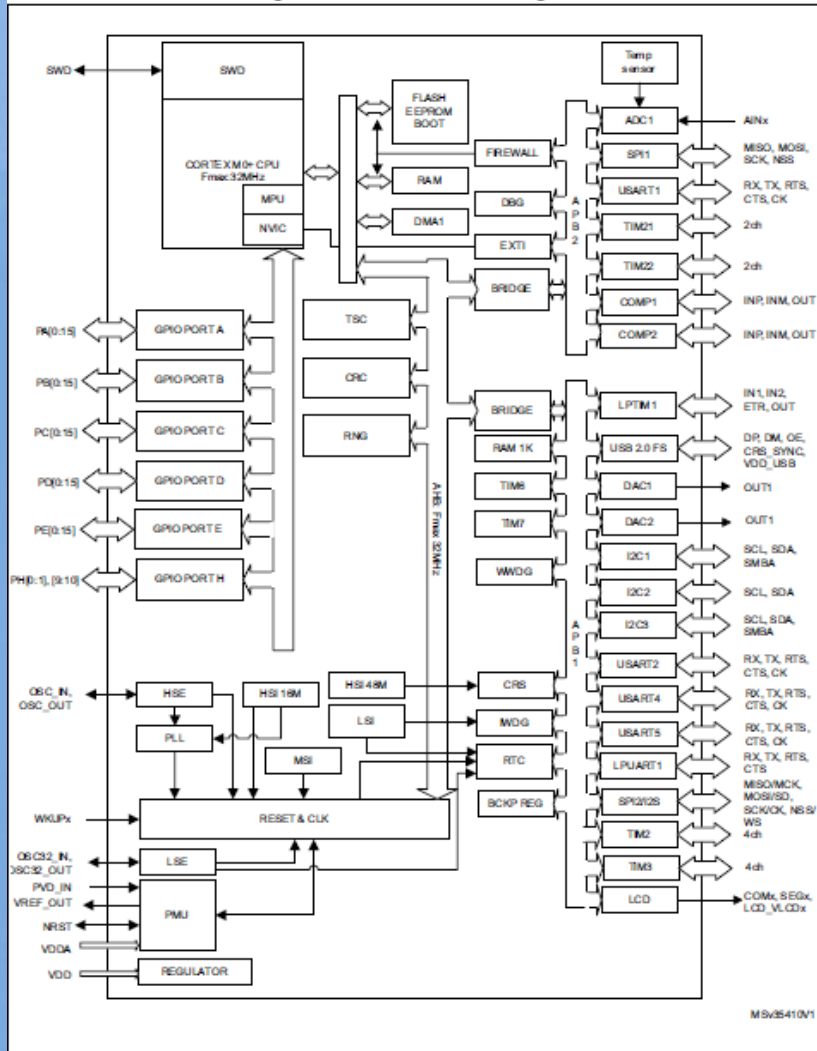
- Introduction
- The STM32L0 Microcontroller
  - Functional Block Diagram of the STM32L073RZ Microcontroller
  - Central Processing Unit
  - Memory
  - General Purpose Input and Output Ports
  - Clock and Timer Modules
  - Analog Modules
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  - Other Modules
- Assembly Language
  - The Arm Cortex M0+ Instruction Set
  - Forming a Complete Assembly Program
  - Executing the Machine Language Code in the Microcontroller
- The NUCLEO-L073RZ Board
  - General Information
  - Pin Layout
  - Powering and Programming the Board

# Introduction

- This chapter introduces the architecture of the STM32L0 microcontroller. Architecture consists of
  - hardware modules
  - software commands, (aka assembly language)
- We will see each hardware module as microcontroller unit and peripheral unit in detail in the following chapters.
- Here, we aim to show the connection between these modules.

# The STM32L0 Microcontroller

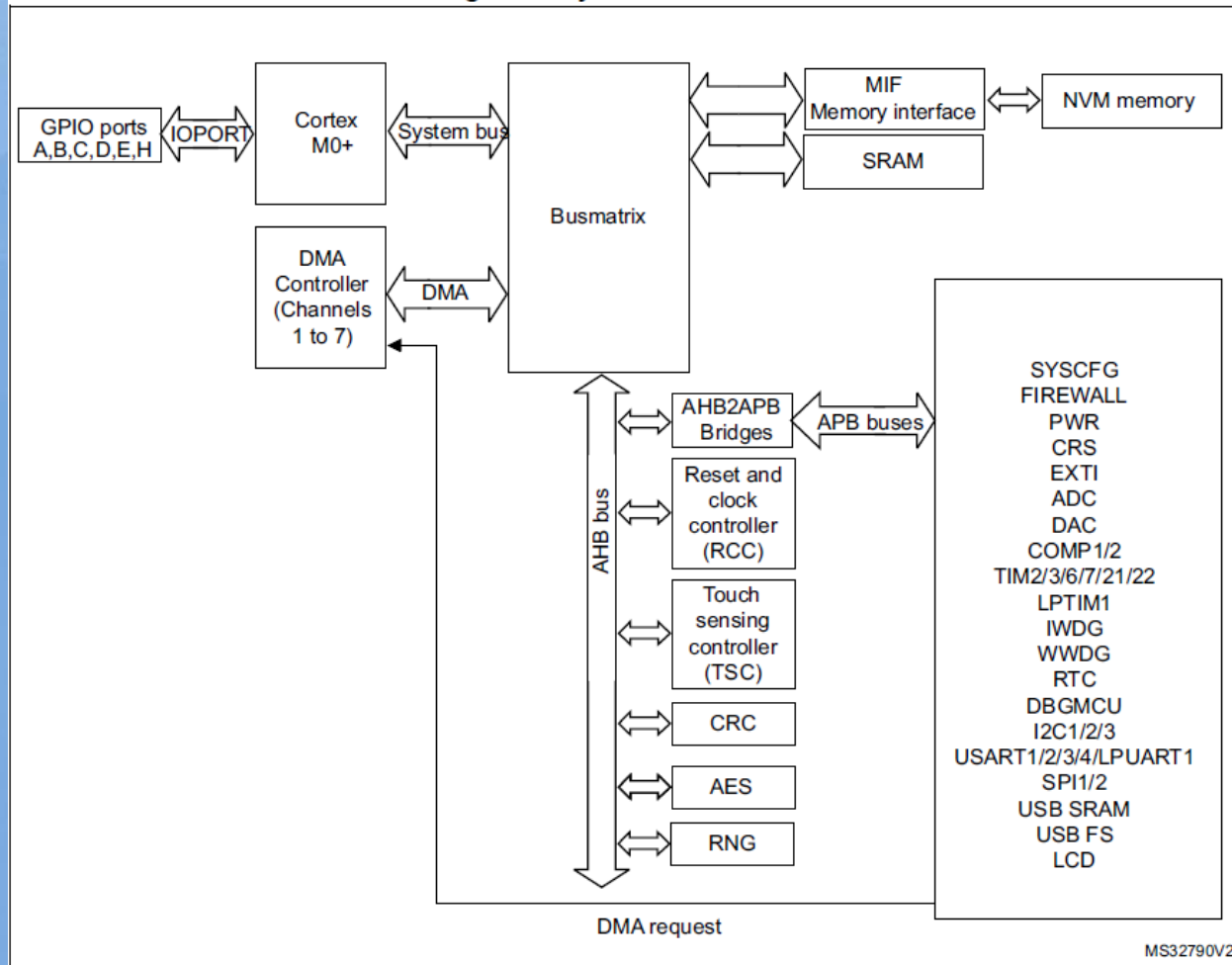
Figure 1. STM32L073xx block diagram



Functional Block Diagram of the STM32L073RZ Microcontroller

# The STM32L0 Microcontroller

Figure 1. System architecture



## System architecture

# Central Processing Unit

The STM32L0 microcontroller has

- ▣ 32 MHz CPU with ARM Cortex M0+ architecture
- ▣ ARM Cortex M0+ architecture
  - ▣ Description

# Central Processing Unit

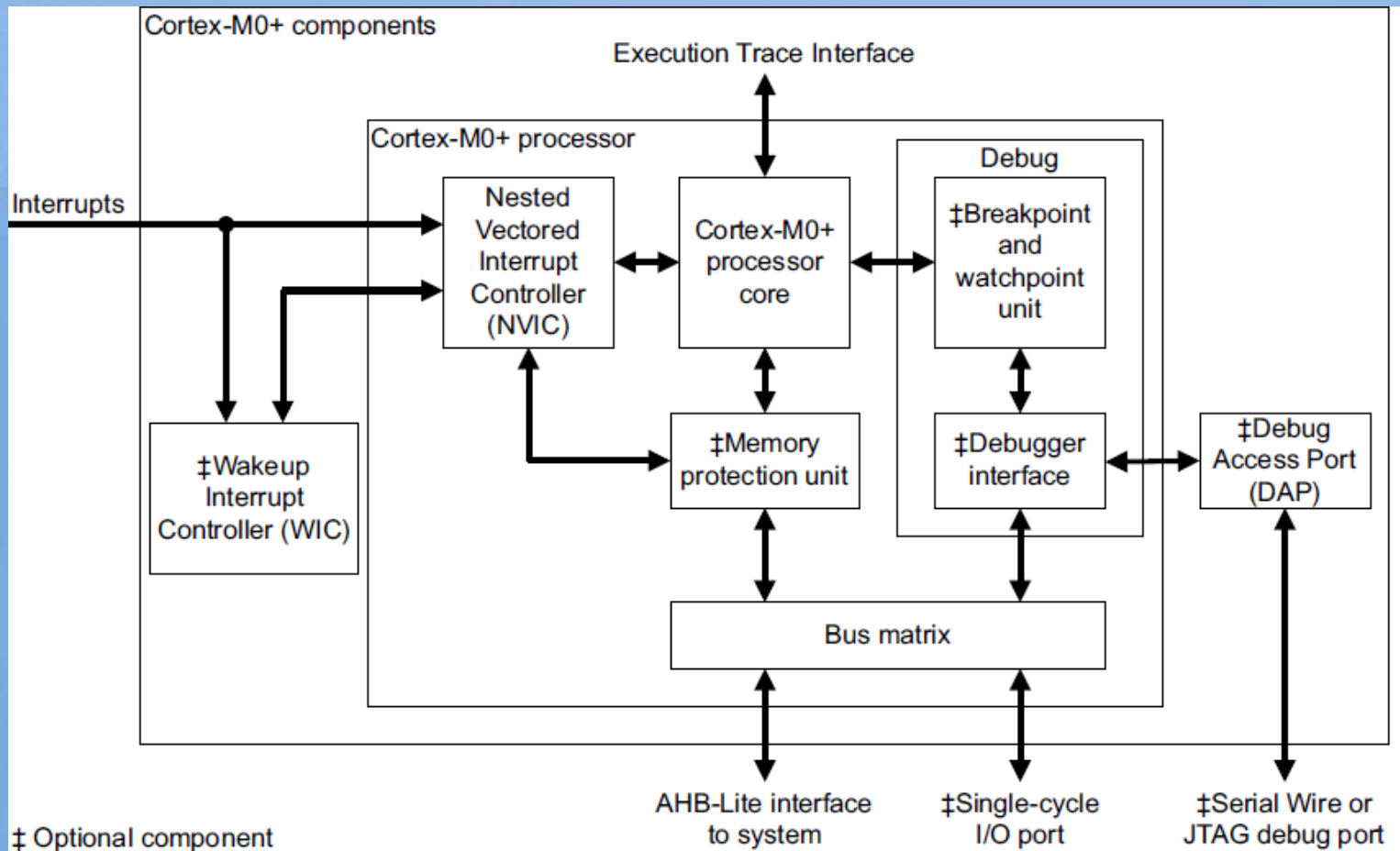


Figure 2-1 Functional block diagram

## Functional block diagram

# Memory

The STM32L0 microcontroller memory types

- ▣ RAM

- ▣ Description
  - ▣ STM32L0 RAM size

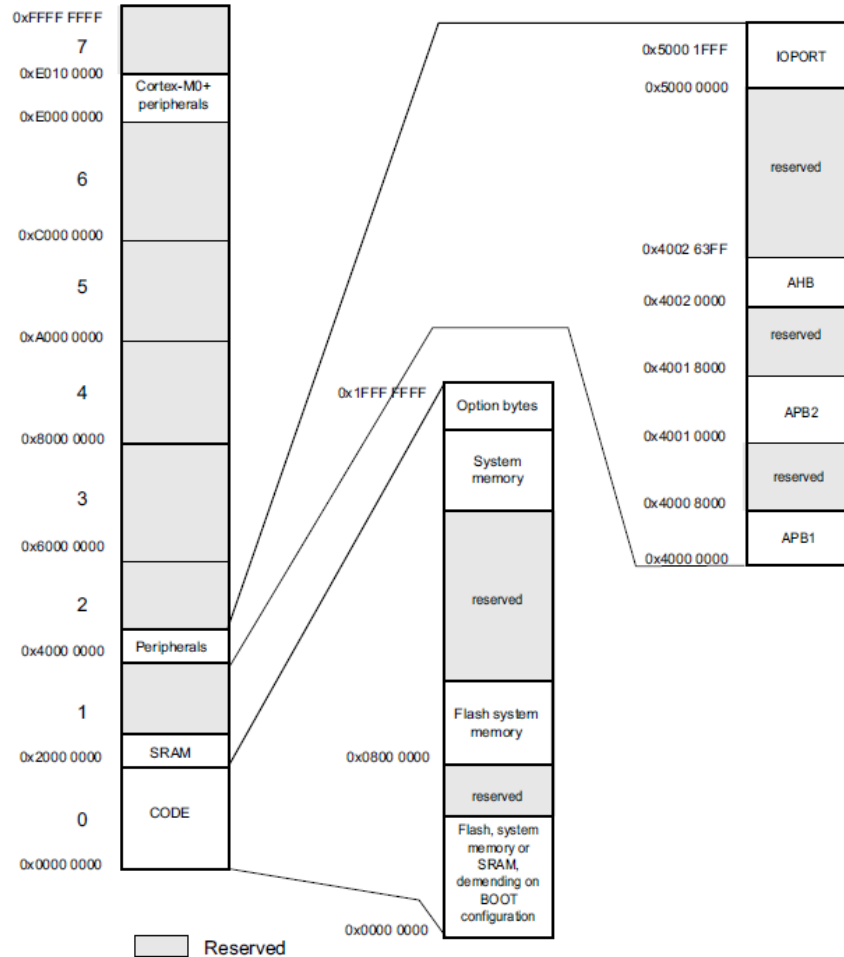
- ▣ ROM (Flash)

- ▣ Description
  - ▣ STM32L0 Flash size



# Memory

### Figure 2. Memory map



# Memory map of the STM32L0 microcontroller

MS34761V1

# Memory

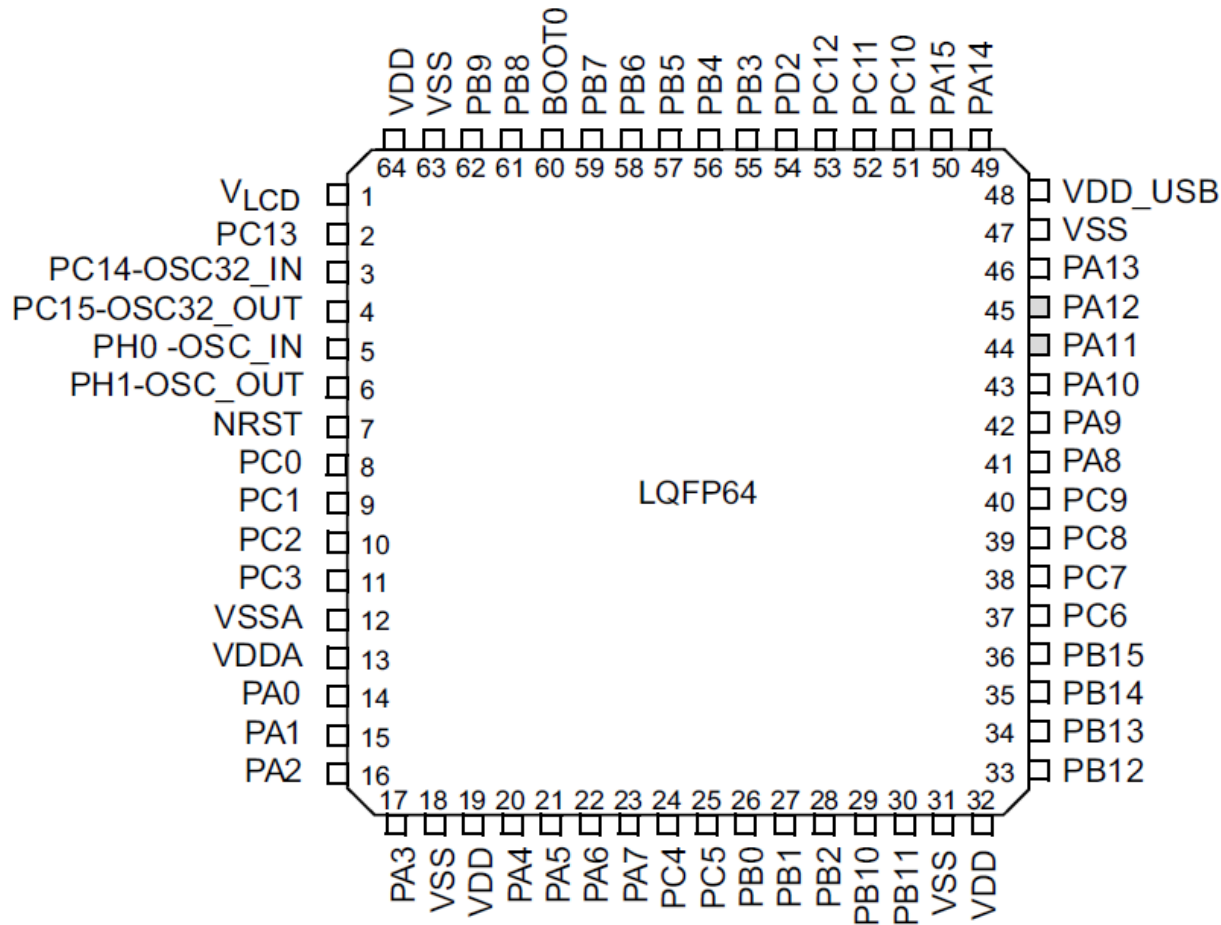
- ▣ Working Principles
  - ▣ Smallest element
- ▣ Memory Address description
  - ▣ Reaching a specific memory address
- ▣ More

# General Purpose Input and Output Ports

- Unlike desktop or laptop computers, the STM32L0 microcontroller does not have a keyboard (input) or a screen (output).
- Instead there are general purpose input and output ports (GPIO) within the microcontroller.
- Each port has up to 16 pins associated with it.
- These pins can be used to input and output data (in analog or digital form) to and from the STM32L0 microcontroller.

# General Purpose Input and Output Ports

Figure 5. STM32L073xx LQFP64 pinout



MS31485V3

The STM32L0  
microcontroller  
pin layout

# Clock and Timer Modules

- With each clock cycle (MCLK), the processor performs an action that corresponds to an instruction phase.
- Cycles Per Instruction (CPI) is the average number of clock cycles required for a processor to execute an instruction.
- Millions of instructions per second (MIPS) is a unit used to characterize a processor's performance and corresponds to the processor frequency (MCLK) divided by the average cycles per second (CPI).

# Analog Modules

- When we want to process an analog signal via the STM32L0 microcontroller, we will need an analog to digital converter (ADC).
- In the same manner, we will need a digital to analog converter (DAC) if we want to feed an analog circuit via the STM32L0 microcontroller.
- The STM32L0 microcontroller has specific modules to handle the ADC and DAC operations.

# Digital Communication Modules

- The STM32L0 microcontroller offers several methods for digital communication. Among these
  - Universal Asynchronous Receiver/Transmitter (UART)
  - Universal Synchronous Receiver/Transmitter (USART) are important.
- These may be used to establish a communication between two or more microcontrollers.
- They may also be used between the microcontroller and a peripheral.



# Other Modules

- There are also other modules under the STM32L0 microcontroller.
- We will not deal with them here.
- Please see the microcontroller user's guide for these.



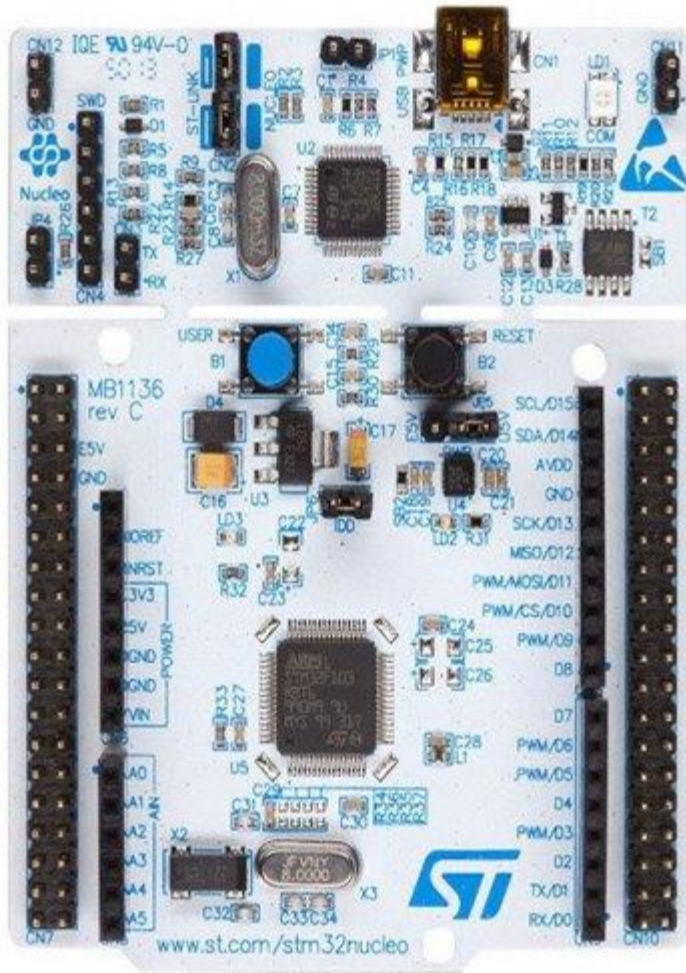
# Assembly Language

- The Arm Cortex M0+ Instruction Set
- Forming a Complete Assembly Program
- Executing the Machine Language Code in the Microcontroller

# The NUCLEO-L073RZ Board

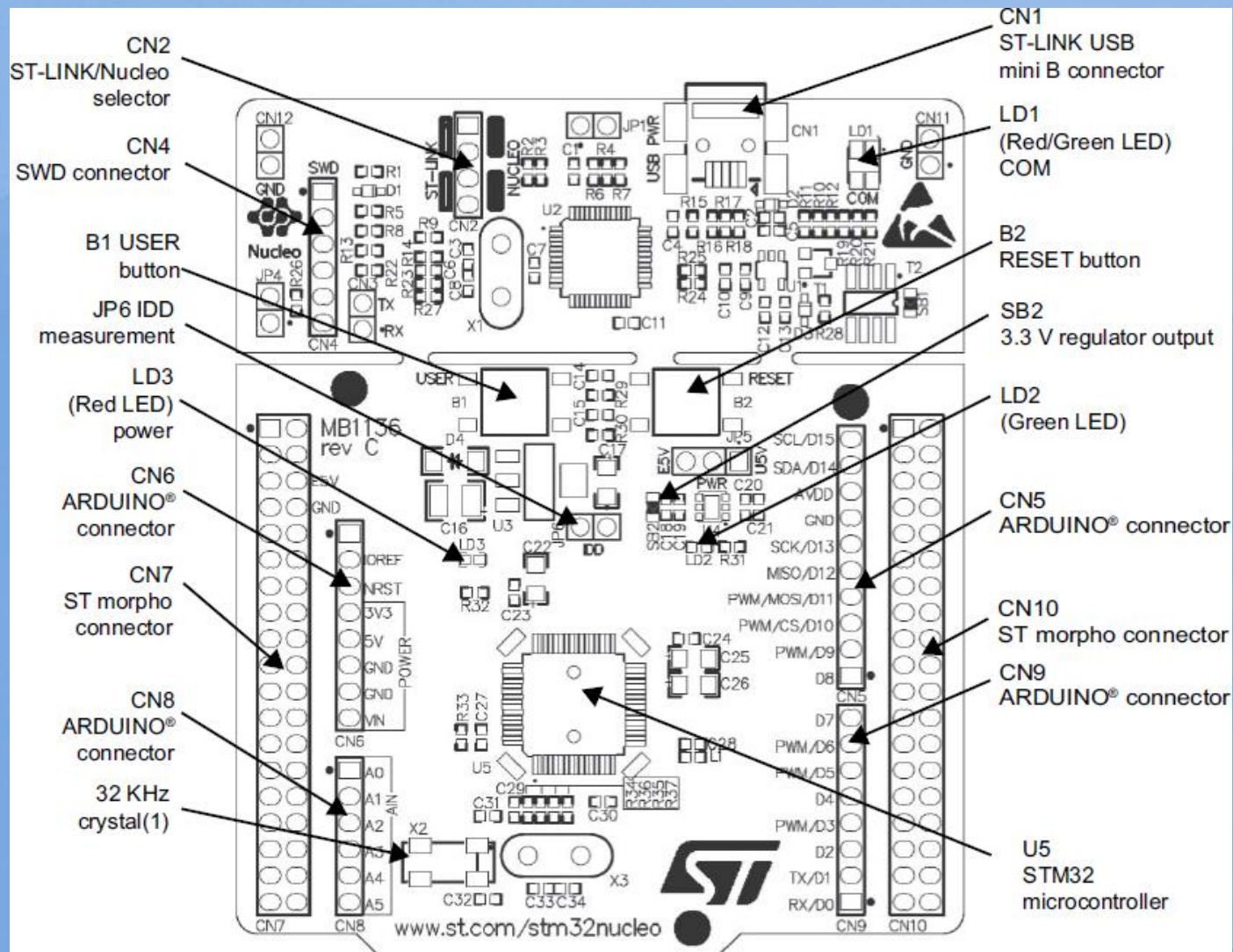
- ▣ General Information
- ▣ Pin Layout
- ▣ Powering and Programming the Board

# The NUCLEO-L073RZ Board



## General Information

# The NUCLEO-L073RZ Board



## General Information

MS34376V3



# The NUCLEO-L073RZ Board


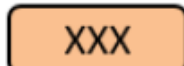





## Pin Layout

### Pins Legend

#### Labels usable in code

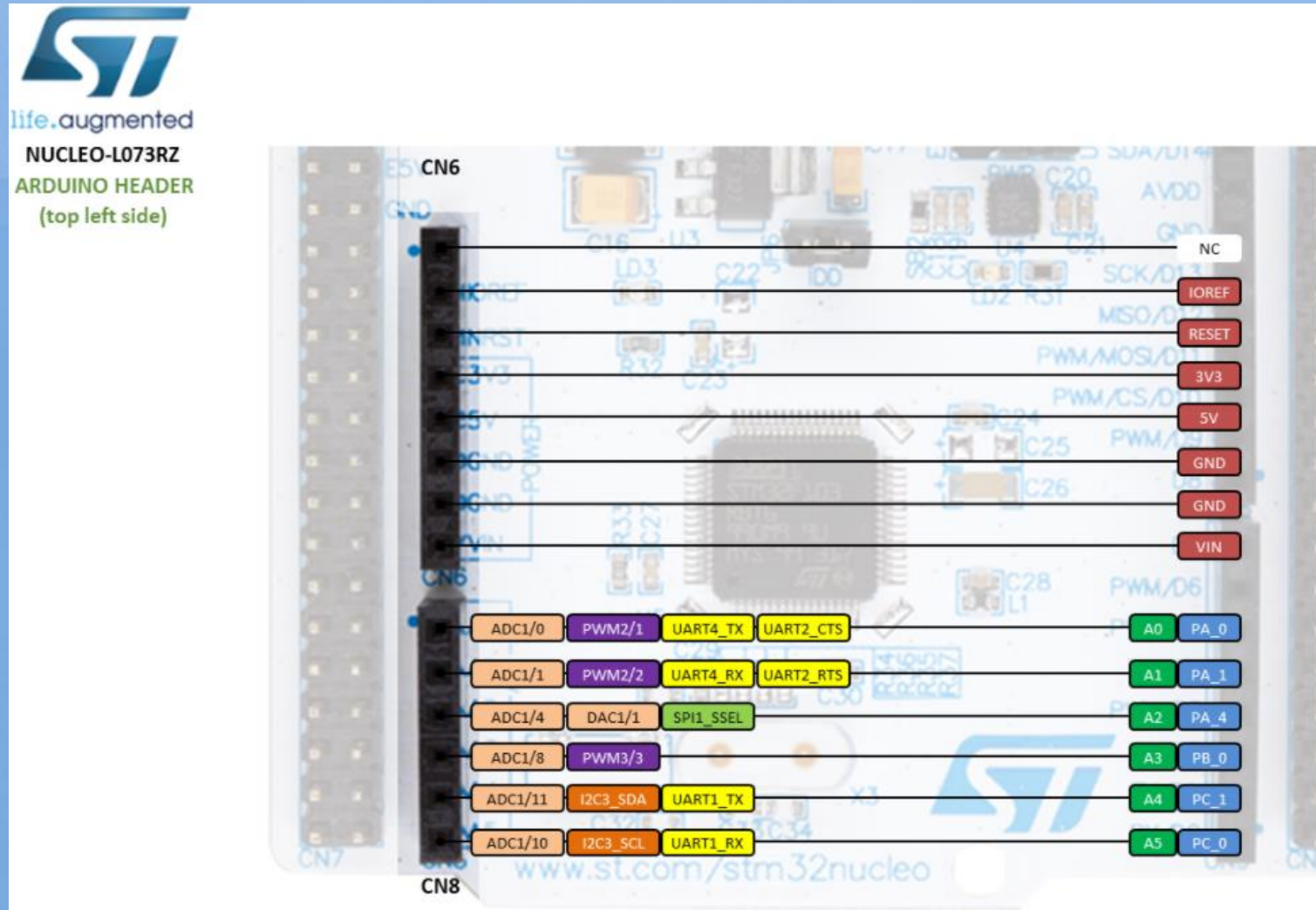
	MCU pin without conflict		Arduino connector names (A0, D1, ...)
	MCU pin connected to other components See <b>PeripheralPins.c</b> (link below) for more information		LEDs and Buttons (LED_1, USER_BUTTON, ...)

#### Labels not usable in code (for information only)

	Serial pins (USART/UART)		AnalogIn (ADC) and AnalogOut pins (DAC)
	SPI pins		CAN pins
	I2C pins		Power and control pins (3V3, GND, RESET, ...)
	PWMOut pins (TIMER n/c[N]) n = Timer number c = Channel N = Inverted channel		

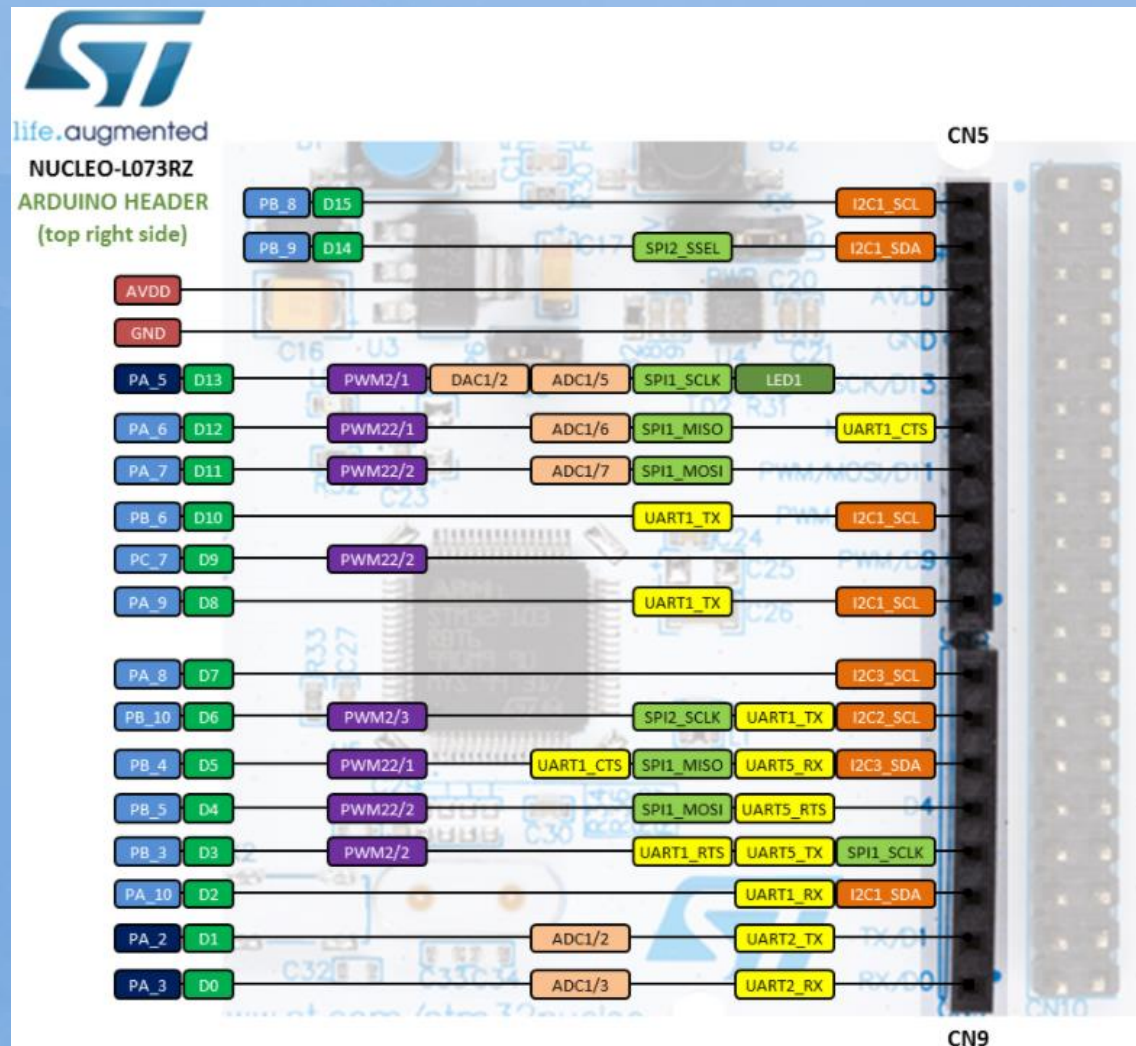
<https://os.mbed.com/platforms/ST-Nucleo-L073RZ/>

# The NUCLEO-L073RZ Board



<https://os.mbed.com/platforms/ST-Nucleo-L073RZ/>

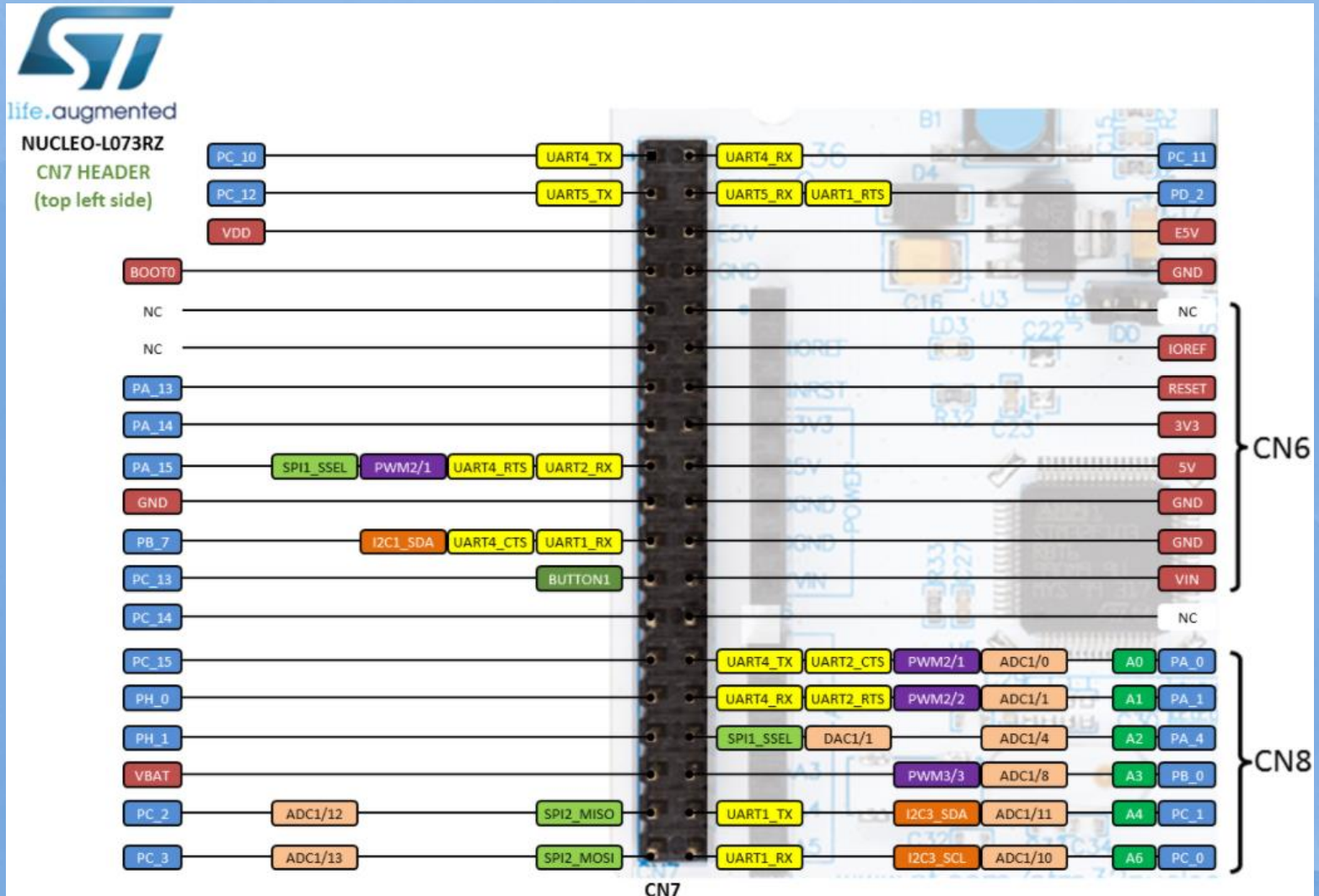
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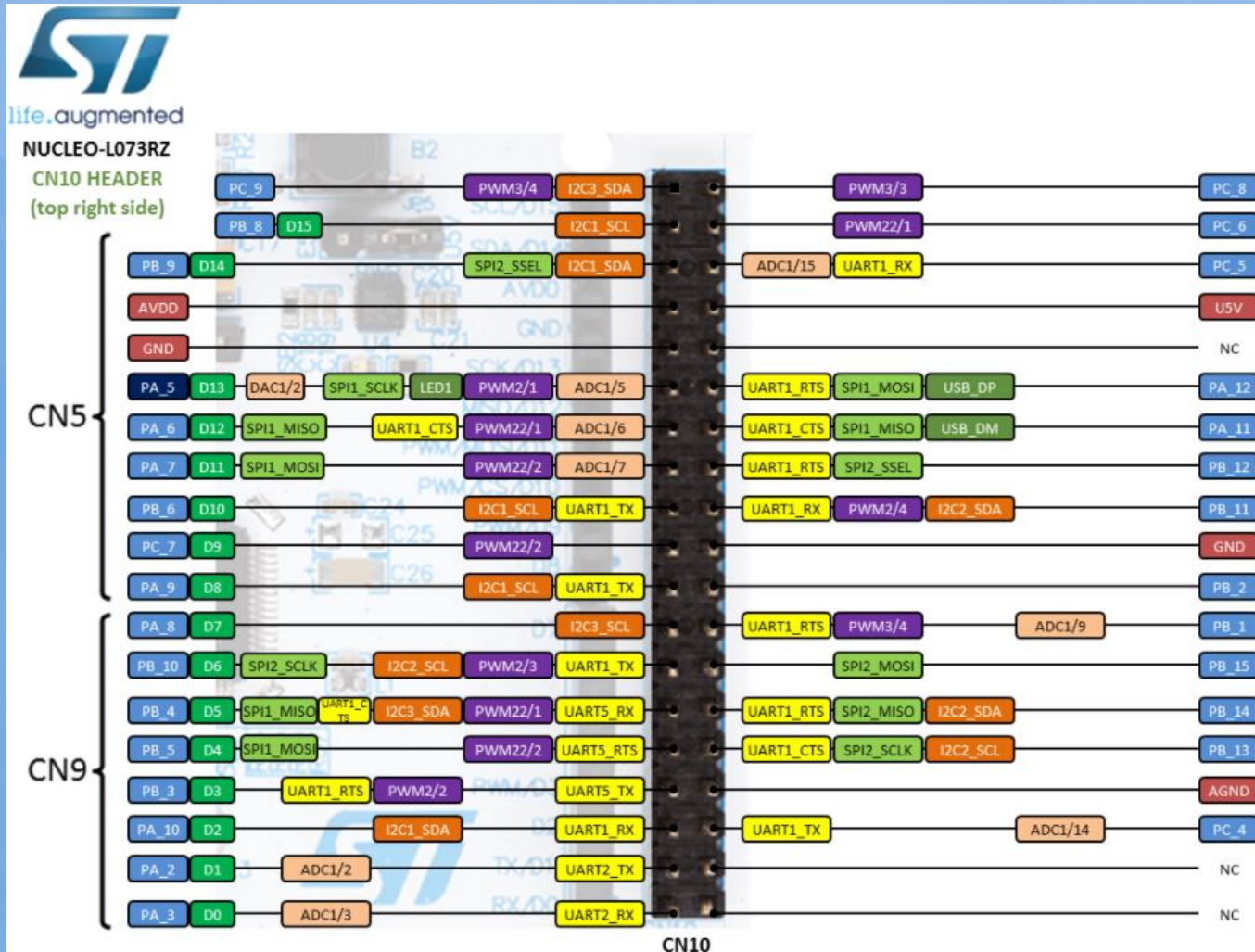
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