



## 1. Description

### 1.1. Project

|                 |                                  |
|-----------------|----------------------------------|
| Project Name    | F439_CPP_7_Segment_with_ATF16V8B |
| Board Name      | NUCLEO-F439ZI                    |
| Generated with: | STM32CubeMX 6.14.1               |
| Date            | 11/05/2025                       |

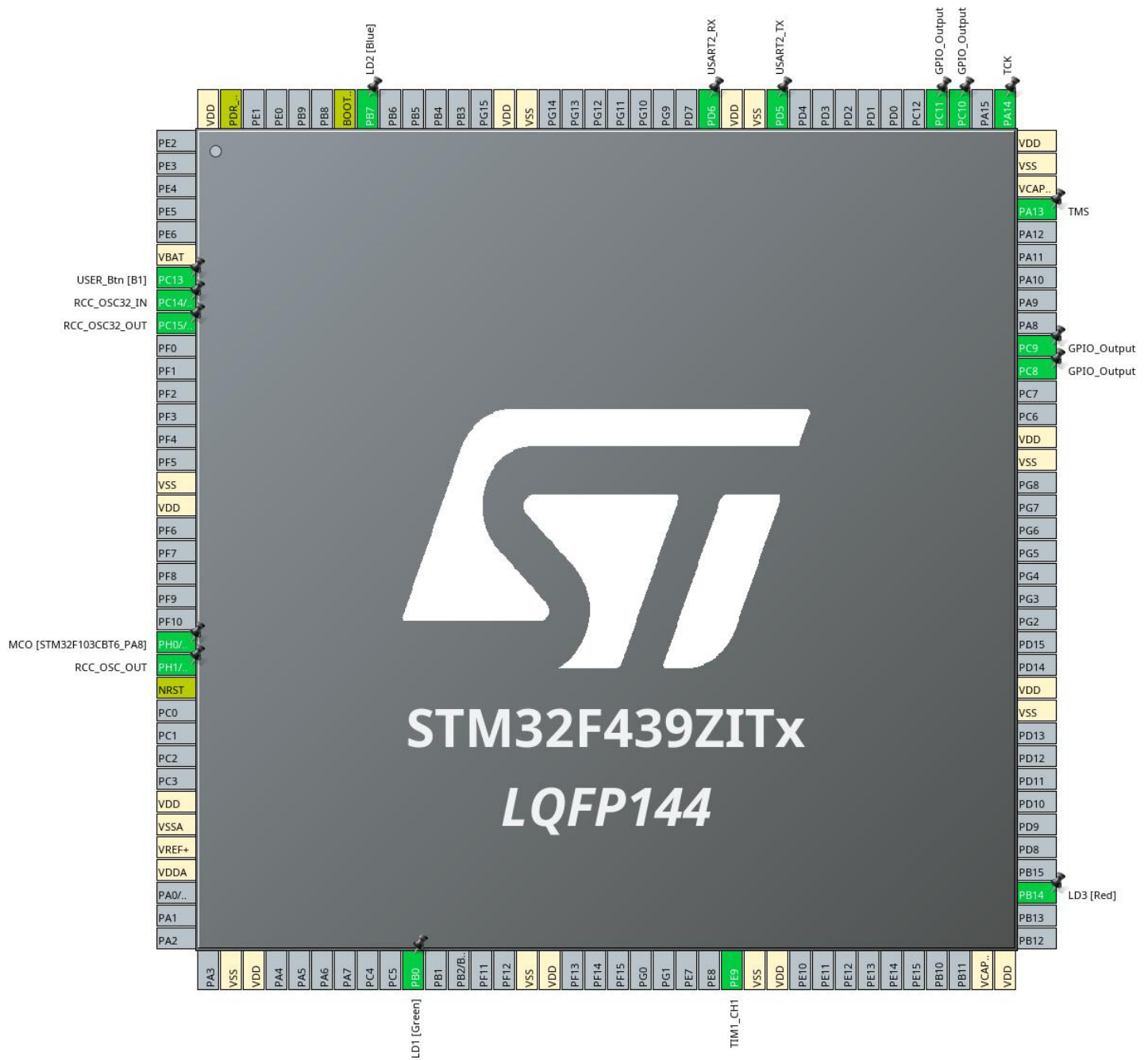
### 1.2. MCU

|                |               |
|----------------|---------------|
| MCU Series     | STM32F4       |
| MCU Line       | STM32F429/439 |
| MCU name       | STM32F439ZITx |
| MCU Package    | LQFP144       |
| MCU Pin number | 144           |

### 1.3. Core(s) information

|         |               |
|---------|---------------|
| Core(s) | Arm Cortex-M4 |
|---------|---------------|

## 2. Pinout Configuration



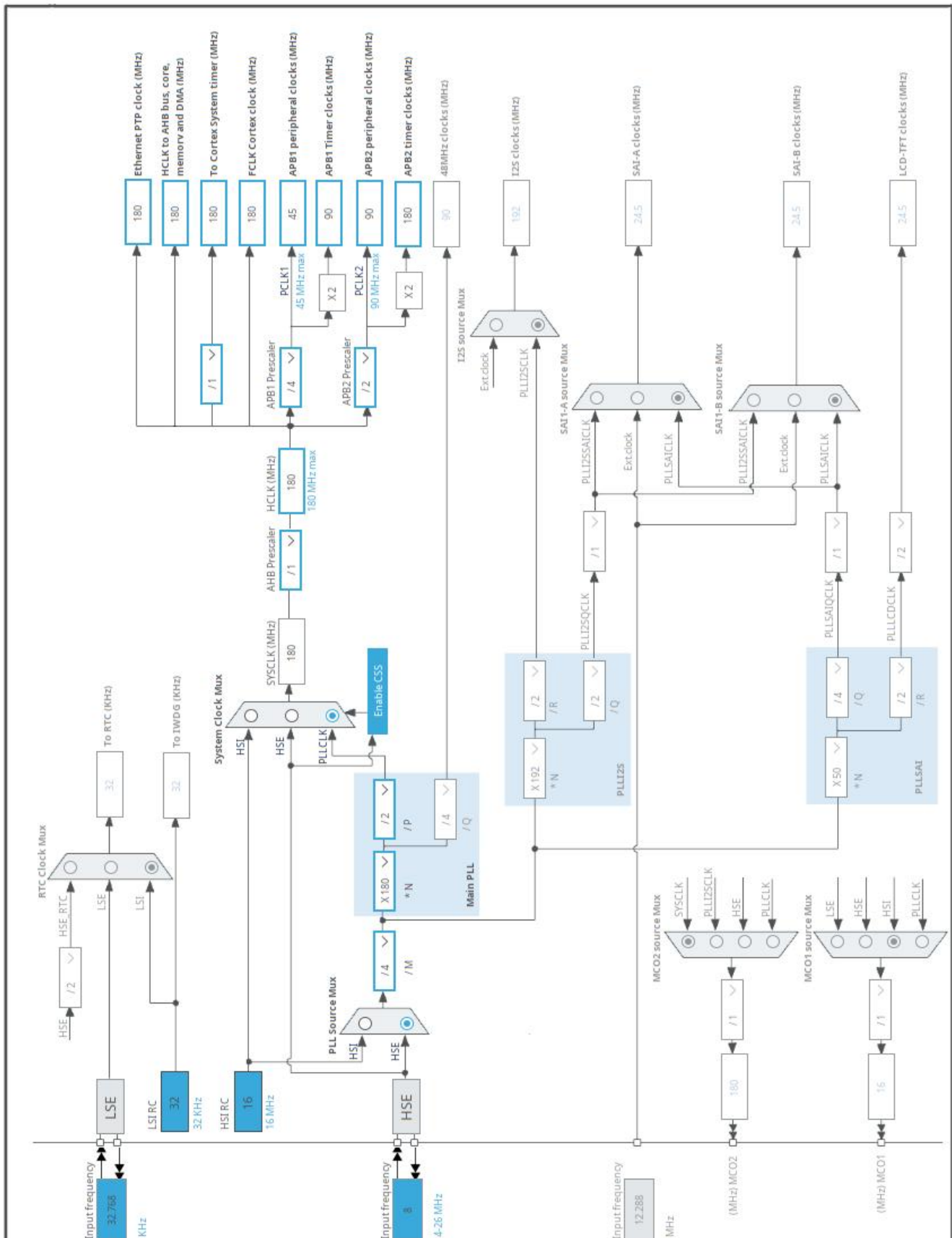
### 3. Pins Configuration

| Pin Number<br>LQFP144 | Pin Name<br>(function after<br>reset) | Pin Type | Alternate<br>Function(s) | Label                      |
|-----------------------|---------------------------------------|----------|--------------------------|----------------------------|
| 6                     | VBAT                                  | Power    |                          |                            |
| 7                     | PC13                                  | I/O      | GPIO_EXTI13              | USER_Btn [B1]              |
| 8                     | PC14/OSC32_IN                         | I/O      | RCC_OSC32_IN             |                            |
| 9                     | PC15/OSC32_OUT                        | I/O      | RCC_OSC32_OUT            |                            |
| 16                    | VSS                                   | Power    |                          |                            |
| 17                    | VDD                                   | Power    |                          |                            |
| 23                    | PH0/OSC_IN                            | I/O      | RCC_OSC_IN               | MCO<br>[STM32F103CBT6_PA8] |
| 24                    | PH1/OSC_OUT                           | I/O      | RCC_OSC_OUT              |                            |
| 25                    | NRST                                  | Reset    |                          |                            |
| 30                    | VDD                                   | Power    |                          |                            |
| 31                    | VSSA                                  | Power    |                          |                            |
| 32                    | VREF+                                 | Power    |                          |                            |
| 33                    | VDDA                                  | Power    |                          |                            |
| 38                    | VSS                                   | Power    |                          |                            |
| 39                    | VDD                                   | Power    |                          |                            |
| 46                    | PB0 *                                 | I/O      | GPIO_Output              | LD1 [Green]                |
| 51                    | VSS                                   | Power    |                          |                            |
| 52                    | VDD                                   | Power    |                          |                            |
| 60                    | PE9                                   | I/O      | TIM1_CH1                 |                            |
| 61                    | VSS                                   | Power    |                          |                            |
| 62                    | VDD                                   | Power    |                          |                            |
| 71                    | VCAP_1                                | Power    |                          |                            |
| 72                    | VDD                                   | Power    |                          |                            |
| 75                    | PB14 *                                | I/O      | GPIO_Output              | LD3 [Red]                  |
| 83                    | VSS                                   | Power    |                          |                            |
| 84                    | VDD                                   | Power    |                          |                            |
| 94                    | VSS                                   | Power    |                          |                            |
| 95                    | VDD                                   | Power    |                          |                            |
| 98                    | PC8 *                                 | I/O      | GPIO_Output              |                            |
| 99                    | PC9 *                                 | I/O      | GPIO_Output              |                            |
| 105                   | PA13                                  | I/O      | SYS_JTMS-SWDIO           | TMS                        |
| 106                   | VCAP_2                                | Power    |                          |                            |
| 107                   | VSS                                   | Power    |                          |                            |
| 108                   | VDD                                   | Power    |                          |                            |
| 109                   | PA14                                  | I/O      | SYS_JTCK-SWCLK           | TCK                        |

| Pin Number<br>LQFP144 | Pin Name<br>(function after<br>reset) | Pin Type | Alternate<br>Function(s) | Label      |
|-----------------------|---------------------------------------|----------|--------------------------|------------|
| 111                   | PC10 *                                | I/O      | GPIO_Output              |            |
| 112                   | PC11 *                                | I/O      | GPIO_Output              |            |
| 119                   | PD5                                   | I/O      | USART2_TX                |            |
| 120                   | VSS                                   | Power    |                          |            |
| 121                   | VDD                                   | Power    |                          |            |
| 122                   | PD6                                   | I/O      | USART2_RX                |            |
| 130                   | VSS                                   | Power    |                          |            |
| 131                   | VDD                                   | Power    |                          |            |
| 137                   | PB7 *                                 | I/O      | GPIO_Output              | LD2 [Blue] |
| 138                   | BOOT0                                 | Boot     |                          |            |
| 143                   | PDR_ON                                | Reset    |                          |            |
| 144                   | VDD                                   | Power    |                          |            |

\* The pin is affected with an I/O function

## 4. Clock Tree Configuration



## 1. Power Consumption Calculator report

### 1.1. Microcontroller Selection

|           |               |
|-----------|---------------|
| Series    | STM32F4       |
| Line      | STM32F429/439 |
| MCU       | STM32F439ZITx |
| Datasheet | DS9484 Rev10  |

### 1.2. Parameter Selection

|             |     |
|-------------|-----|
| Temperature | 25  |
| Vdd         | 3.3 |

### 1.3. Battery Selection

|                   |                 |
|-------------------|-----------------|
| Battery           | Li-SOCL2(A3400) |
| Capacity          | 3400.0 mAh      |
| Self Discharge    | 0.08 %/month    |
| Nominal Voltage   | 3.6 V           |
| Max Cont Current  | 100.0 mA        |
| Max Pulse Current | 200.0 mA        |
| Cells in series   | 1               |
| Cells in parallel | 1               |

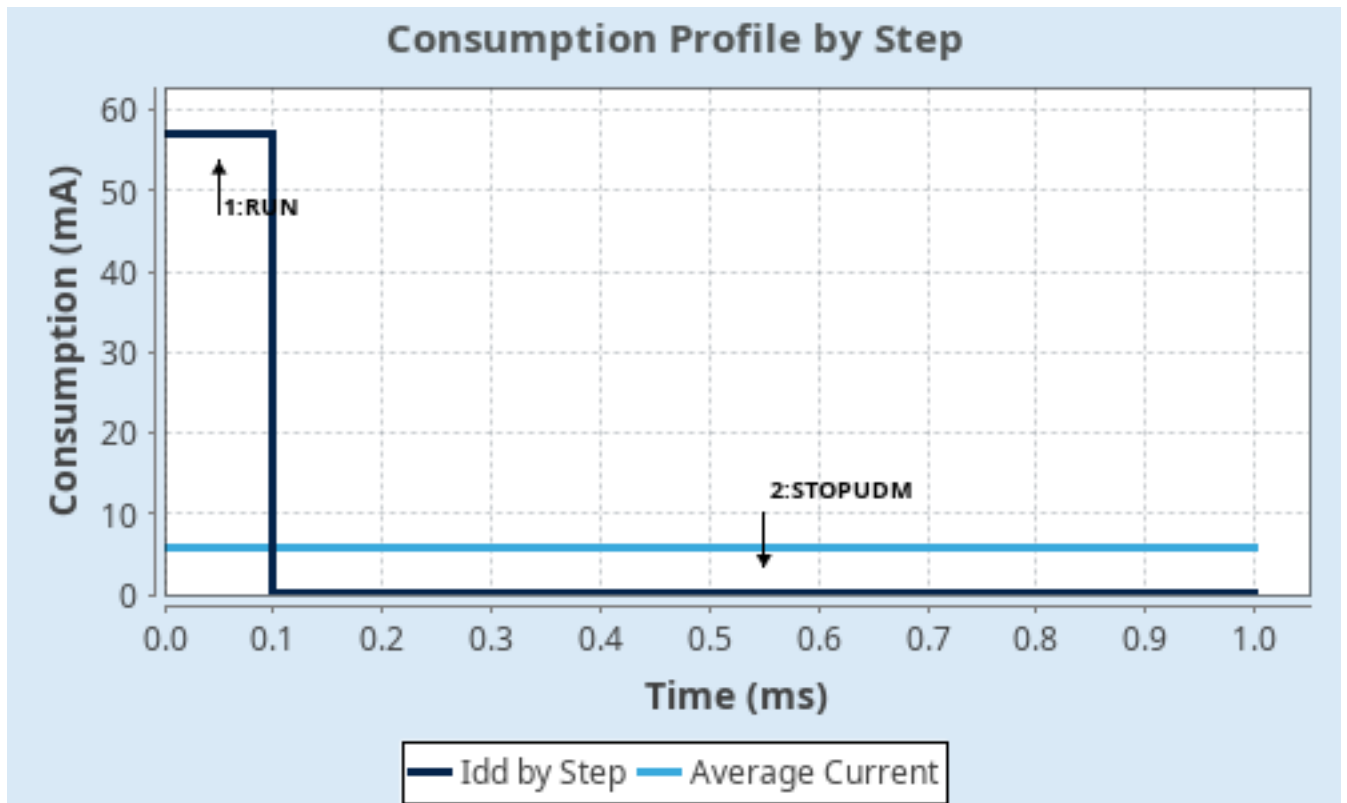
#### 1.4. Sequence

|                               |             |                           |
|-------------------------------|-------------|---------------------------|
| <b>Step</b>                   | Step1       | Step2                     |
| <b>Mode</b>                   | RUN         | STOP_UDM (Under Drive)    |
| <b>Vdd</b>                    | 3.3         | 3.3                       |
| <b>Voltage Source</b>         | Battery     | Battery                   |
| <b>Range</b>                  | Scale1-High | No Scale                  |
| <b>Fetch Type</b>             | FLASH       | n/a                       |
| <b>CPU Frequency</b>          | 180 MHz     | 0 Hz                      |
| <b>Clock Configuration</b>    | HSE PLL     | Regulator_LP Flash-PwrDwn |
| <b>Clock Source Frequency</b> | 4 MHz       | 0 Hz                      |
| <b>Peripherals</b>            |             |                           |
| <b>Additional Cons.</b>       | 0 mA        | 0 mA                      |
| <b>Average Current</b>        | 57 mA       | 100 $\mu$ A               |
| <b>Duration</b>               | 0.1 ms      | 0.9 ms                    |
| <b>DMIPS</b>                  | 225.0       | 0.0                       |
| <b>Ta Max</b>                 | 97.48       | 104.99                    |
| <b>Category</b>               | In DS Table | In DS Table               |

#### 1.5. Results

|               |                   |                 |             |
|---------------|-------------------|-----------------|-------------|
| Sequence Time | 1 ms              | Average Current | 5.79 mA     |
| Battery Life  | 24 days, 10 hours | Average DMIPS   | 225.0 DMIPS |

#### 1.6. Chart



## 2. Software Project

### 2.1. Project Settings

| Name                              | Value                                                   |
|-----------------------------------|---------------------------------------------------------|
| Project Name                      | F439_CPP_7_Segment_with_ATF16V8B                        |
| Project Folder                    | /home/johng/workbench6/F439_CPP_7_Segment_with_ATF16V8B |
| Toolchain / IDE                   | STM32CubeIDE                                            |
| Firmware Package Name and Version | STM32Cube FW_F4 V1.28.2                                 |
| Application Structure             | Advanced                                                |
| Generate Under Root               | Yes                                                     |
| Do not generate the main()        | No                                                      |
| Minimum Heap Size                 | 0x200                                                   |
| Minimum Stack Size                | 0x400                                                   |

### 2.2. Code Generation Settings

| Name                                                            | Value                                 |
|-----------------------------------------------------------------|---------------------------------------|
| STM32Cube MCU packages and embedded software                    | Copy only the necessary library files |
| Generate peripheral initialization as a pair of '.c/.h' files   | No                                    |
| Backup previously generated files when re-generating            | No                                    |
| Keep User Code when re-generating                               | Yes                                   |
| Delete previously generated files when not re-generated         | Yes                                   |
| Set all free pins as analog (to optimize the power consumption) | No                                    |
| Enable Full Assert                                              | Yes                                   |

### 2.3. Advanced Settings - Generated Function Calls

| Rank | Function Name       | Peripheral Instance Name |
|------|---------------------|--------------------------|
| 1    | SystemClock_Config  | RCC                      |
| 2    | MX_GPIO_Init        | GPIO                     |
| 3    | MX_USART2_UART_Init | USART2                   |
| 4    | MX_TIM1_Init        | TIM1                     |

## 3. Peripherals and Middlewares Configuration

### 3.1. RCC

**High Speed Clock (HSE): Crystal/Ceramic Resonator**

**Low Speed Clock (LSE) : Crystal/Ceramic Resonator**

#### 3.1.1. Parameter Settings:

##### **System Parameters:**

|                   |                    |
|-------------------|--------------------|
| VDD voltage (V)   | 3.3                |
| Instruction Cache | Enabled            |
| Prefetch Buffer   | Enabled            |
| Data Cache        | Enabled            |
| Flash Latency(WS) | 5 WS (6 CPU cycle) |

##### **RCC Parameters:**

|                                |          |
|--------------------------------|----------|
| HSI Calibration Value          | 16       |
| TIM Prescaler Selection        | Disabled |
| HSE Startup Timeout Value (ms) | 100      |
| LSE Startup Timeout Value (ms) | 5000     |

##### **Power Parameters:**

|                               |                                 |
|-------------------------------|---------------------------------|
| Power Regulator Voltage Scale | Power Regulator Voltage Scale 1 |
| Power Over Drive              | Enabled                         |

### 3.2. SYS

**Debug: Serial Wire**

**Timebase Source: SysTick**

### 3.3. TIM1

**Clock Source : Internal Clock**

**Channel1: Output Compare CH1**

#### 3.3.1. Parameter Settings:

##### **Counter Settings:**

|                                                       |             |
|-------------------------------------------------------|-------------|
| Prescaler (PSC - 16 bits value)                       | 0           |
| Counter Mode                                          | Up          |
| Counter Period (AutoReload Register - 16 bits value ) | <b>3 *</b>  |
| Internal Clock Division (CKD)                         | No Division |
| Repetition Counter (RCR - 8 bits value)               | 0           |
| auto-reload preload                                   | Disable     |

#### Trigger Output (TRGO) Parameters:

|                             |                                            |
|-----------------------------|--------------------------------------------|
| Master/Slave Mode (MSM bit) | Disable (Trigger input effect not delayed) |
| Trigger Event Selection     | Reset (UG bit from TIMx_EGR)               |

#### Break And Dead Time management - BRK Configuration:

|              |         |
|--------------|---------|
| BRK State    | Disable |
| BRK Polarity | High    |

#### Break And Dead Time management - Output Configuration:

|                                          |         |
|------------------------------------------|---------|
| Automatic Output State                   | Disable |
| Off State Selection for Run Mode (OSSR)  | Disable |
| Off State Selection for Idle Mode (OSSI) | Disable |
| Lock Configuration                       | Off     |

#### Output Compare Channel 1:

|                        |                   |
|------------------------|-------------------|
| Mode                   | Toggle on match * |
| Pulse (16 bits value)  | 3 *               |
| Output compare preload | Disable           |
| CH Polarity            | High              |
| CH Idle State          | Reset             |

### 3.4. USART2

#### Mode: Asynchronous

##### 3.4.1. Parameter Settings:

#### Basic Parameters:

|             |                           |
|-------------|---------------------------|
| Baud Rate   | 19200 *                   |
| Word Length | 8 Bits (including Parity) |
| Parity      | None                      |
| Stop Bits   | 1                         |

#### Advanced Parameters:

|                |                      |
|----------------|----------------------|
| Data Direction | Receive and Transmit |
| Over Sampling  | 16 Samples           |

\* User modified value

## 4. System Configuration

### 4.1. GPIO configuration

| IP     | Pin            | Signal         | GPIO mode                                                  | GPIO pull/up pull down      | Max Speed          | User Label                 |
|--------|----------------|----------------|------------------------------------------------------------|-----------------------------|--------------------|----------------------------|
| RCC    | PC14/OSC32_IN  | RCC_OSC32_IN   | n/a                                                        | n/a                         | n/a                |                            |
|        | PC15/OSC32_OUT | RCC_OSC32_OUT  | n/a                                                        | n/a                         | n/a                |                            |
|        | PH0/OSC_IN     | RCC_OSC_IN     | n/a                                                        | n/a                         | n/a                | MCO<br>[STM32F103CBT6_PA8] |
|        | PH1/OSC_OUT    | RCC_OSC_OUT    | n/a                                                        | n/a                         | n/a                |                            |
| SYS    | PA13           | SYS_JTMS-SWDIO | n/a                                                        | n/a                         | n/a                | TMS                        |
|        | PA14           | SYS_JTCK-SWCLK | n/a                                                        | n/a                         | n/a                | TCK                        |
| TIM1   | PE9            | TIM1_CH1       | Alternate Function Push Pull                               | <b>Pull-up *</b>            | <b>Very High *</b> |                            |
| USART2 | PD5            | USART2_TX      | Alternate Function Push Pull                               | No pull-up and no pull-down | <b>Very High *</b> |                            |
|        | PD6            | USART2_RX      | Alternate Function Push Pull                               | No pull-up and no pull-down | <b>Very High *</b> |                            |
| GPIO   | PC13           | GPIO_EXTI13    | External Interrupt Mode with Rising edge trigger detection | No pull-up and no pull-down | n/a                | USER_Btn [B1]              |
|        | PB0            | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                | LD1 [Green]                |
|        | PB14           | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                | LD3 [Red]                  |
|        | PC8            | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                |                            |
|        | PC9            | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                |                            |
|        | PC10           | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                |                            |
|        | PC11           | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                |                            |
|        | PB7            | GPIO_Output    | Output Push Pull                                           | No pull-up and no pull-down | Low                | LD2 [Blue]                 |

### 4.2. DMA configuration

nothing configured in DMA service

## 4.3. NVIC configuration

### 4.3.1. NVIC

| Interrupt Table                                                    | Enable | Preenmption Priority | SubPriority |
|--------------------------------------------------------------------|--------|----------------------|-------------|
| Non maskable interrupt                                             | true   | 0                    | 0           |
| Hard fault interrupt                                               | true   | 0                    | 0           |
| Memory management fault                                            | true   | 0                    | 0           |
| Pre-fetch fault, memory access fault                               | true   | 0                    | 0           |
| Undefined instruction or illegal state                             | true   | 0                    | 0           |
| System service call via SWI instruction                            | true   | 0                    | 0           |
| Debug monitor                                                      | true   | 0                    | 0           |
| Pendable request for system service                                | true   | 0                    | 0           |
| System tick timer                                                  | true   | 0                    | 0           |
| TIM1 capture compare interrupt                                     | true   | 0                    | 0           |
| PVD interrupt through EXTI line 16                                 | unused |                      |             |
| Flash global interrupt                                             | unused |                      |             |
| RCC global interrupt                                               | unused |                      |             |
| TIM1 break interrupt and TIM9 global interrupt                     | unused |                      |             |
| TIM1 update interrupt and TIM10 global interrupt                   | unused |                      |             |
| TIM1 trigger and commutation interrupts and TIM11 global interrupt | unused |                      |             |
| USART2 global interrupt                                            | unused |                      |             |
| EXTI line[15:10] interrupts                                        | unused |                      |             |
| FPU global interrupt                                               | unused |                      |             |

### 4.3.2. NVIC Code generation

| Enabled interrupt Table                 | Select for init sequence ordering | Generate IRQ handler | Call HAL handler |
|-----------------------------------------|-----------------------------------|----------------------|------------------|
| Non maskable interrupt                  | false                             | true                 | false            |
| Hard fault interrupt                    | false                             | true                 | false            |
| Memory management fault                 | false                             | true                 | false            |
| Pre-fetch fault, memory access fault    | false                             | true                 | false            |
| Undefined instruction or illegal state  | false                             | true                 | false            |
| System service call via SWI instruction | false                             | true                 | false            |
| Debug monitor                           | false                             | true                 | false            |
| Pendable request for system service     | false                             | true                 | false            |
| System tick timer                       | false                             | true                 | true             |
| TIM1 capture compare interrupt          | false                             | true                 | true             |

**\* User modified value**

## 5. System Views

### 5.1. Category view

#### 5.1.1. Current

Middleware

| System Core | Analog | Timers | Connectivity | Multimedia | Security | Computing |
|-------------|--------|--------|--------------|------------|----------|-----------|
| DMA         |        | TIM1 ✓ | USART2 ✓     |            |          |           |
| GPIO ✓      |        |        |              |            |          |           |
| NVIC ✓      |        |        |              |            |          |           |
| RCC ✓       |        |        |              |            |          |           |
| SYS ✓       |        |        |              |            |          |           |

## 6. Docs & Resources

| Type                    | Link                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BSDL files              | <a href="https://www.st.com/resource/en/bsdl_model/stm32f427-437_429-439_bsd1.zip">https://www.st.com/resource/en/bsdl_model/stm32f427-437_429-439_bsd1.zip</a>                                                                                                                                                                         |
| IBIS models             | <a href="https://www.st.com/resource/en/ibis_model/stm32f427-437_429-439_ibis.zip">https://www.st.com/resource/en/ibis_model/stm32f427-437_429-439_ibis.zip</a>                                                                                                                                                                         |
| System View Description | <a href="https://www.st.com/resource/en/svd/stm32f4-svd.zip">https://www.st.com/resource/en/svd/stm32f4-svd.zip</a>                                                                                                                                                                                                                     |
| Presentations           | <a href="https://www.st.com/resource/en/product_presentation/stm32-stm8_embedded_software_solutions.pdf">https://www.st.com/resource/en/product_presentation/stm32-stm8_embedded_software_solutions.pdf</a>                                                                                                                             |
| Presentations           | <a href="https://www.st.com/resource/en/product_presentation/stm32_eval_tools_portfolio.pdf">https://www.st.com/resource/en/product_presentation/stm32_eval_tools_portfolio.pdf</a>                                                                                                                                                     |
| Presentations           | <a href="https://www.st.com/resource/en/product_presentation/stm32_stm8_functional-safety-packages.pdf">https://www.st.com/resource/en/product_presentation/stm32_stm8_functional-safety-packages.pdf</a>                                                                                                                               |
| Presentations           | <a href="https://www.st.com/resource/en/product_presentation/stm32-stm8_software_development_tools.pdf">https://www.st.com/resource/en/product_presentation/stm32-stm8_software_development_tools.pdf</a>                                                                                                                               |
| Presentations           | <a href="https://www.st.com/resource/en/product_presentation/microcontrollers-stm32-family-overview.pdf">https://www.st.com/resource/en/product_presentation/microcontrollers-stm32-family-overview.pdf</a>                                                                                                                             |
| Brochures               | <a href="https://www.st.com/resource/en/brochure/products-and-solutions-for-plcs-and-smart-i-os.pdf">https://www.st.com/resource/en/brochure/products-and-solutions-for-plcs-and-smart-i-os.pdf</a>                                                                                                                                     |
| Flyers                  | <a href="https://www.st.com/resource/en/flyer/flstm32nucleo.pdf">https://www.st.com/resource/en/flyer/flstm32nucleo.pdf</a>                                                                                                                                                                                                             |
| Flyers                  | <a href="https://www.st.com/resource/en/flyer/flstm32trust.pdf">https://www.st.com/resource/en/flyer/flstm32trust.pdf</a>                                                                                                                                                                                                               |
| Flyers                  | <a href="https://www.st.com/resource/en/flyer/flstm32gui.pdf">https://www.st.com/resource/en/flyer/flstm32gui.pdf</a>                                                                                                                                                                                                                   |
| Product Certifications  | <a href="https://www.st.com/resource/en/certification_document/stm32_authentication_can.pdf">https://www.st.com/resource/en/certification_document/stm32_authentication_can.pdf</a>                                                                                                                                                     |
| Security Bulletin       | <a href="https://www.st.com/resource/en/technical_note/tn1489-security-bulletin-tn1489stpsirt-physical-attacks-on-stm32-and-stm32cube-firmware-stmicroelectronics.pdf">https://www.st.com/resource/en/technical_note/tn1489-security-bulletin-tn1489stpsirt-physical-attacks-on-stm32-and-stm32cube-firmware-stmicroelectronics.pdf</a> |
| Application Notes       | <a href="https://www.st.com/resource/en/application_note/an1709-emc-design-guide-for-stm8-stm32-and-legacy-mcus-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an1709-emc-design-guide-for-stm8-stm32-and-legacy-mcus-stmicroelectronics.pdf</a>                                                               |
| Application Notes       | <a href="https://www.st.com/resource/en/application_note/an2606-stm32-">https://www.st.com/resource/en/application_note/an2606-stm32-</a>                                                                                                                                                                                               |

microcontroller-system-memory-boot-mode-stmicroelectronics.pdf

Application Notes [https://www.st.com/resource/en/application\\_note/an2945-stm8s-and-stm32-mcus-a-consistent-832bit-product-line-for-painless-migration-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an2945-stm8s-and-stm32-mcus-a-consistent-832bit-product-line-for-painless-migration-stmicroelectronics.pdf)

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| for related Tools<br>& Software                      | <a href="#">cmake-in-stm32cubeide-stmicroelectronics.pdf</a>                                                                                                                                                                                                                                                                                                  |
| Application Notes<br>for related Tools<br>& Software | <a href="https://www.st.com/resource/en/application_note/an5054-how-to-perform-secure-programming-using-stm32cubeprogrammer-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an5054-how-to-perform-secure-programming-using-stm32cubeprogrammer-stmicroelectronics.pdf</a>                                                             |
| Application Notes<br>for related Tools<br>& Software | <a href="https://www.st.com/resource/en/application_note/an6179-how-to-integrate-the-stl-firmware-into-a-time-critical-user-application-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an6179-how-to-integrate-the-stl-firmware-into-a-time-critical-user-application-stmicroelectronics.pdf</a>                                     |
| Application Notes<br>for related Tools<br>& Software | <a href="https://www.st.com/resource/en/application_note/an6127-getting-started-with-stm32h7rx7sx-mcus-in-stm32cubeide-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an6127-getting-started-with-stm32h7rx7sx-mcus-in-stm32cubeide-stmicroelectronics.pdf</a>                                                                       |
| Errata Sheets                                        | <a href="https://www.st.com/resource/en/errata_sheet/es0206-stm32f427437-and-stm32f429439-device-errata-stmicroelectronics.pdf">https://www.st.com/resource/en/errata_sheet/es0206-stm32f427437-and-stm32f429439-device-errata-stmicroelectronics.pdf</a>                                                                                                     |
| Datasheet                                            | <a href="https://www.st.com/resource/en/datasheet/dm00077036.pdf">https://www.st.com/resource/en/datasheet/dm00077036.pdf</a>                                                                                                                                                                                                                                 |
| Programming<br>Manuals                               | <a href="https://www.st.com/resource/en/programming_manual/pm0214-stm32-cortexm4-mcus-and-mpus-programming-manual-stmicroelectronics.pdf">https://www.st.com/resource/en/programming_manual/pm0214-stm32-cortexm4-mcus-and-mpus-programming-manual-stmicroelectronics.pdf</a>                                                                                 |
| Reference<br>Manuals                                 | <a href="https://www.st.com/resource/en/reference_manual/rm0090-stm32f405415-stm32f407417-stm32f427437-and-stm32f429439-advanced-armbased-32bit-mcus-stmicroelectronics.pdf">https://www.st.com/resource/en/reference_manual/rm0090-stm32f405415-stm32f407417-stm32f427437-and-stm32f429439-advanced-armbased-32bit-mcus-stmicroelectronics.pdf</a>           |
| Technical Notes<br>& Articles                        | <a href="https://www.st.com/resource/en/technical_note/tn0516-overview-of-the-stm32f0xf100xxf103xx-and-stm32f2xxf30xf4xx-mcus-pmsm-singledual-foc-sdk-v40-stmicroelectronics.pdf">https://www.st.com/resource/en/technical_note/tn0516-overview-of-the-stm32f0xf100xxf103xx-and-stm32f2xxf30xf4xx-mcus-pmsm-singledual-foc-sdk-v40-stmicroelectronics.pdf</a> |
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| User Manuals                  | <a href="https://www.st.com/resource/en/user_manual/um3461-stm32f4-series-ulcsaiec-607301603351-selftest-library-user-guide-stmicroelectronics.pdf">https://www.st.com/resource/en/user_manual/um3461-stm32f4-series-ulcsaiec-607301603351-selftest-library-user-guide-stmicroelectronics.pdf</a>                                                             |