



## 1. Description

### 1.1. Project

|                 |                   |
|-----------------|-------------------|
| Project Name    | LidarStm32f103    |
| Board Name      | custom            |
| Generated with: | STM32CubeMX 6.3.0 |
| Date            | 11/22/2021        |

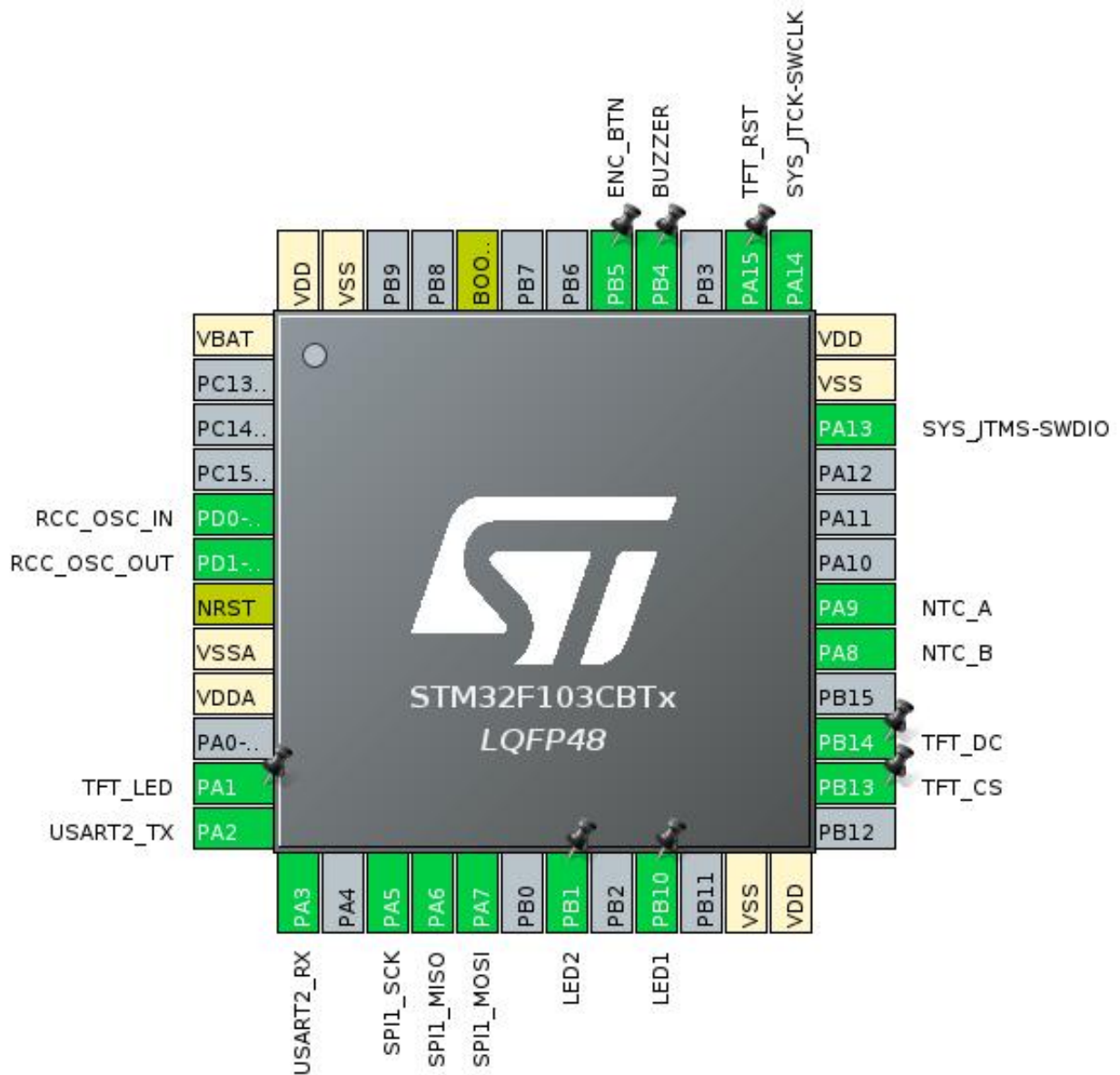
### 1.2. MCU

|                |               |
|----------------|---------------|
| MCU Series     | STM32F1       |
| MCU Line       | STM32F103     |
| MCU name       | STM32F103CBTx |
| MCU Package    | LQFP48        |
| MCU Pin number | 48            |

### 1.3. Core(s) information

|         |               |
|---------|---------------|
| Core(s) | Arm Cortex-M3 |
|---------|---------------|

## 2. Pinout Configuration

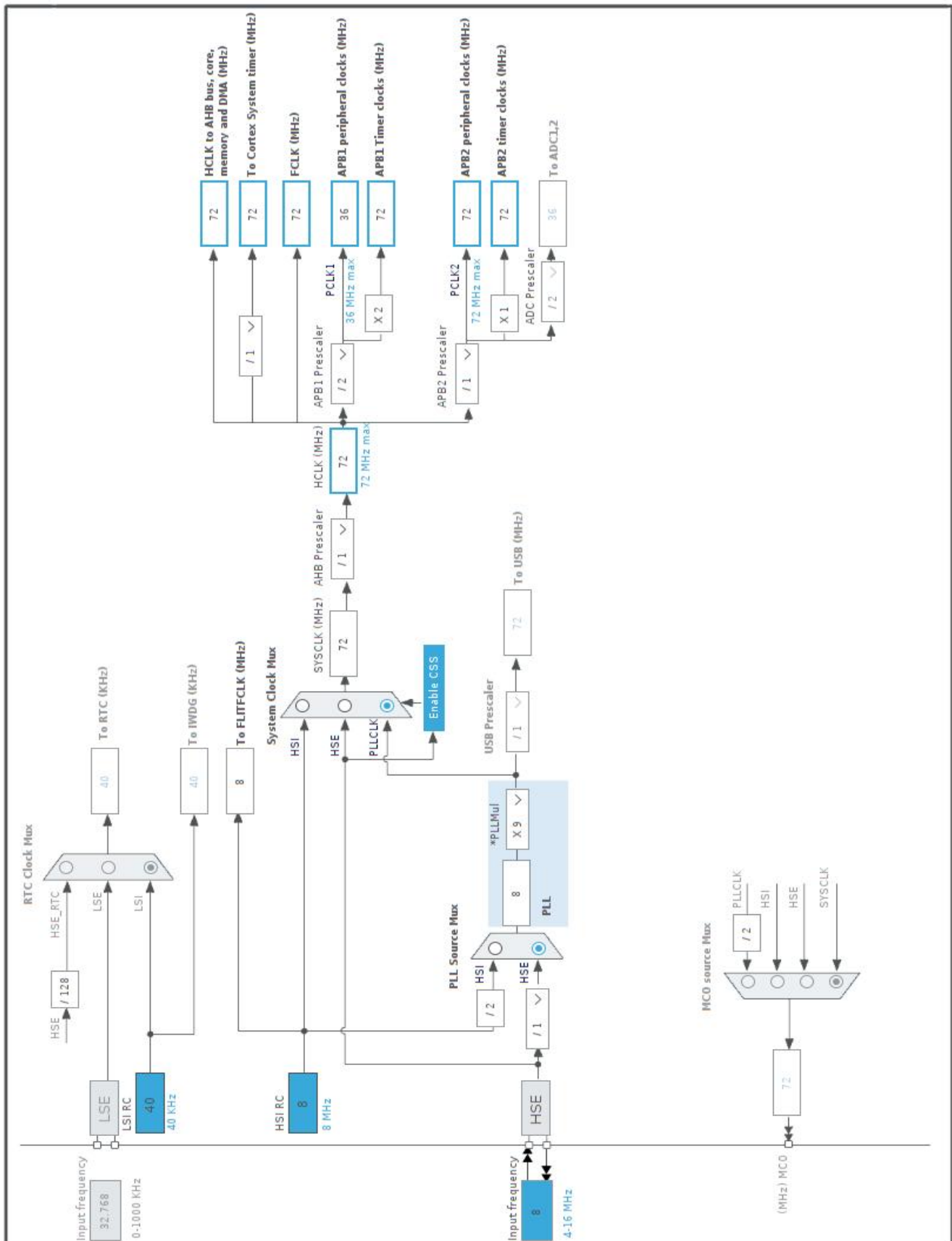


### 3. Pins Configuration

| Pin Number<br>LQFP48 | Pin Name<br>(function after<br>reset) | Pin Type | Alternate<br>Function(s) | Label   |
|----------------------|---------------------------------------|----------|--------------------------|---------|
| 1                    | VBAT                                  | Power    |                          |         |
| 5                    | PD0-OSC_IN                            | I/O      | RCC_OSC_IN               |         |
| 6                    | PD1-OSC_OUT                           | I/O      | RCC_OSC_OUT              |         |
| 7                    | NRST                                  | Reset    |                          |         |
| 8                    | VSSA                                  | Power    |                          |         |
| 9                    | VDDA                                  | Power    |                          |         |
| 11                   | PA1 *                                 | I/O      | GPIO_Output              | TFT_LED |
| 12                   | PA2                                   | I/O      | USART2_TX                |         |
| 13                   | PA3                                   | I/O      | USART2_RX                |         |
| 15                   | PA5                                   | I/O      | SPI1_SCK                 |         |
| 16                   | PA6                                   | I/O      | SPI1_MISO                |         |
| 17                   | PA7                                   | I/O      | SPI1_MOSI                |         |
| 19                   | PB1 *                                 | I/O      | GPIO_Output              | LED2    |
| 21                   | PB10 *                                | I/O      | GPIO_Output              | LED1    |
| 23                   | VSS                                   | Power    |                          |         |
| 24                   | VDD                                   | Power    |                          |         |
| 26                   | PB13 *                                | I/O      | GPIO_Output              | TFT_CS  |
| 27                   | PB14 *                                | I/O      | GPIO_Output              | TFT_DC  |
| 29                   | PA8                                   | I/O      | TIM1_CH1                 | NTC_B   |
| 30                   | PA9                                   | I/O      | TIM1_CH2                 | NTC_A   |
| 34                   | PA13                                  | I/O      | SYS_JTMS-SWDIO           |         |
| 35                   | VSS                                   | Power    |                          |         |
| 36                   | VDD                                   | Power    |                          |         |
| 37                   | PA14                                  | I/O      | SYS_JTCK-SWCLK           |         |
| 38                   | PA15 *                                | I/O      | GPIO_Output              | TFT_RST |
| 40                   | PB4 *                                 | I/O      | GPIO_Output              | BUZZER  |
| 41                   | PB5 *                                 | I/O      | GPIO_Input               | ENC_BTN |
| 44                   | BOOT0                                 | Boot     |                          |         |
| 47                   | VSS                                   | Power    |                          |         |
| 48                   | VDD                                   | Power    |                          |         |

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

## 4. Clock Tree Configuration



## 5. Software Project

### 5.1. Project Settings

| Name                              | Value   |
|-----------------------------------|---|
| Project Name                      | LidarStm32f103  |
| Project Folder                    | /home/pavel/STM32CubeIDE/workspace_1.3.0/LidarStm32f103 |
| Toolchain / IDE                   | STM32CubeIDE  |
| Firmware Package Name and Version | STM32Cube FW_F1 V1.8.4                                  |
| Application Structure             | Advanced  |
| Generate Under Root               | Yes   |
| Do not generate the main()        | No  |
| Minimum Heap Size                 | 0x200   |
| Minimum Stack Size                | 0x400   |

### 5.2. 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  | No                                    |

### 5.3. Advanced Settings - Generated Function Calls

| Rank | Function Name       | Peripheral Instance Name |
|------|---------------------|--------------------------|
| 1    | MX_GPIO_Init        | GPIO                     |
| 2    | MX_DMA_Init         | DMA                      |
| 3    | SystemClock_Config  | RCC                      |
| 4    | MX_USART2_UART_Init | USART2                   |
| 5    | MX_SPI1_Init        | SPI1                     |
| 6    | MX_TIM1_Init        | TIM1                     |

## 6. Power Consumption Calculator report

### 6.1. Microcontroller Selection

|           |               |
|-----------|---------------|
| Series    | STM32F1       |
| Line      | STM32F103     |
| MCU       | STM32F103CBTx |
| Datasheet | DS5319_Rev17  |

### 6.2. Parameter Selection

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

### 6.3. 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               |

#### 6.4. Sequence

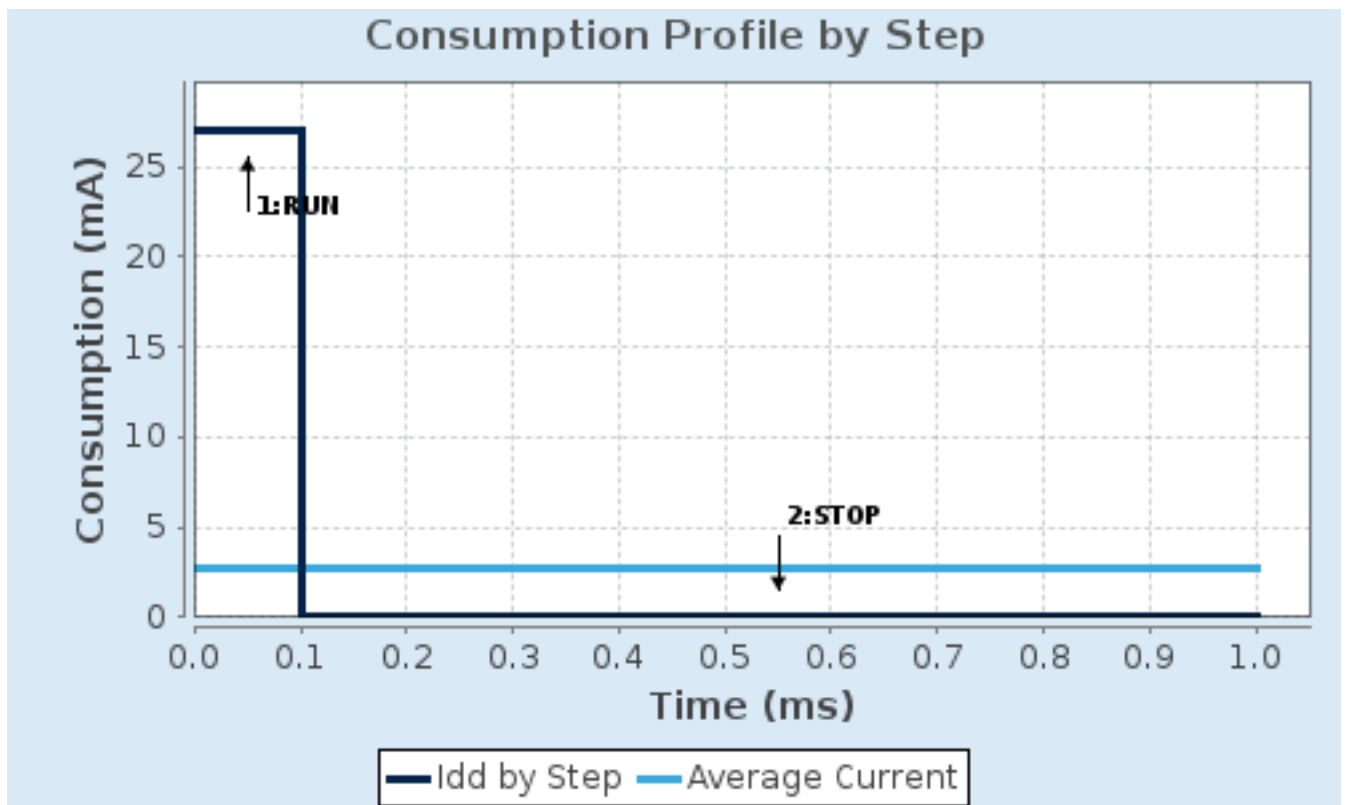
|                               |             |              |
|-------------------------------|-------------|--------------|
| <b>Step</b>                   | Step1       | Step2        |
| <b>Mode</b>                   | RUN         | STOP         |
| <b>Vdd</b>                    | 3.3         | 3.3          |
| <b>Voltage Source</b>         | Battery     | Battery      |
| <b>Range</b>                  | No Scale    | No Scale     |
| <b>Fetch Type</b>             | FLASH       | n/a          |
| <b>CPU Frequency</b>          | 72 MHz      | 0 Hz         |
| <b>Clock Configuration</b>    | HSE PLL     | Regulator LP |
| <b>Clock Source Frequency</b> | 8 MHz       | 0 Hz         |
| <b>Peripherals</b>            |             |              |
| <b>Additional Cons.</b>       | 0 mA        | 0 mA         |
| <b>Average Current</b>        | 27 mA       | 14 $\mu$ A   |
| <b>Duration</b>               | 0.1 ms      | 0.9 ms       |
| <b>DMIPS</b>                  | 90.0        | 0.0          |
| <b>Ta Max</b>                 | 100.1       | 105          |
| <b>Category</b>               | In DS Table | In DS Table  |

#### 6.5. Results

|               |                               |                 |            |
|---------------|-------------------------------|-----------------|------------|
| Sequence Time | 1 ms                          | Average Current | 2.71 mA    |
| Battery Life  | 1 month, 21 days,<br>17 hours | Average DMIPS   | 61.0 DMIPS |

#### 6.6. Chart





## 7. Peripherals and Middlewares Configuration

### 7.1. RCC

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

##### 7.1.1. Parameter Settings:

###### System Parameters:

|                   |                    |
|-------------------|--------------------|
| VDD voltage (V)   | 3.3                |
| Prefetch Buffer   | Enabled            |
| Flash Latency(WS) | 2 WS (3 CPU cycle) |

###### RCC Parameters:

|                                |      |
|--------------------------------|------|
| HSI Calibration Value          | 16   |
| HSE Startup Timeout Value (ms) | 100  |
| LSE Startup Timeout Value (ms) | 5000 |

### 7.2. SPI1

#### Mode: Full-Duplex Master

##### 7.2.1. Parameter Settings:

###### Basic Parameters:

|              |           |
|--------------|-----------|
| Frame Format | Motorola  |
| Data Size    | 8 Bits    |
| First Bit    | MSB First |

###### Clock Parameters:

|                           |                       |
|---------------------------|-----------------------|
| Prescaler (for Baud Rate) | <b>4 *</b>            |
| Baud Rate                 | <b>18.0 MBits/s *</b> |
| Clock Polarity (CPOL)     | Low                   |
| Clock Phase (CPHA)        | 1 Edge                |

###### Advanced Parameters:

|                 |          |
|-----------------|----------|
| CRC Calculation | Disabled |
| NSS Signal Type | Software |

### 7.3. SYS

#### Debug: Serial Wire

#### Timebase Source: TIM2

## 7.4. TIM1

### Combined Channels: Encoder Mode

#### 7.4.1. Parameter Settings:

##### Counter Settings:

|   |             |
|---|-------------|
| Prescaler (PSC - 16 bits value)                       | 0           |
| Counter Mode  | Up          |
| Counter Period (AutoReload Register - 16 bits value ) | <b>11 *</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)               |

##### Encoder:

|                                    |                  |
|------------------------------------|------------------|
| Encoder Mode                       | Encoder Mode T11 |
| ____ Parameters for Channel 1 ____ |                  |
| Polarity                           | Rising Edge      |
| IC Selection                       | Direct           |
| Prescaler Division Ratio           | No division      |
| Input Filter                       | <b>15 *</b>      |
| ____ Parameters for Channel 2 ____ |                  |
| Polarity                           | Rising Edge      |
| IC Selection                       | Direct           |
| Prescaler Division Ratio           | No division      |
| Input Filter                       | <b>15 *</b>      |

## 7.5. USART2

### Mode: Asynchronous

#### 7.5.1. Parameter Settings:

##### Basic Parameters:

|             |                           |
|-------------|---------------------------|
| Baud Rate   | <b>153600 *</b>           |
| Word Length | 8 Bits (including Parity) |
| Parity      | None                      |
| Stop Bits   | 1                         |

##### Advanced Parameters:

|                |                       |
|----------------|-----------------------|
| Data Direction | <b>Receive Only *</b> |
| Over Sampling  | 16 Samples            |

## 7.6. FREERTOS

### Interface: CMSIS\_V2

#### 7.6.1. Config parameters:

##### API:

|              |          |
|--------------|----------|
| FreeRTOS API | CMSIS v2 |
|--------------|----------|

##### Versions:

|                    |        |
|--------------------|--------|
| FreeRTOS version   | 10.0.1 |
| CMSIS-RTOS version | 2.00   |

##### Kernel settings:

|                                   |                 |
|-----------------------------------|-----------------|
| USE_PREEMPTION                    | Enabled         |
| CPU_CLOCK_HZ                      | SystemCoreClock |
| TICK_RATE_HZ                      | 1000            |
| MAX_PRIORITIES                    | 56              |
| MINIMAL_STACK_SIZE                | 128             |
| MAX_TASK_NAME_LEN                 | 16              |
| USE_16_BIT_TICKS                  | Disabled        |
| IDLE_SHOULD_YIELD                 | Enabled         |
| USE_MUTEXES                       | Enabled         |
| USE_RECURSIVE_MUTEXES             | Enabled         |
| USE_COUNTING_SEMAPHORES           | Enabled         |
| QUEUE_REGISTRY_SIZE               | 8               |
| USE_APPLICATION_TASK_TAG          | Disabled        |
| ENABLE_BACKWARD_COMPATIBILITY     | Enabled         |
| USE_PORT_OPTIMISED_TASK_SELECTION | Disabled        |
| USE_TICKLESS_IDLE                 | Disabled        |
| USE_TASK_NOTIFICATIONS            | Enabled         |
| RECORD_STACK_HIGH_ADDRESS         | Disabled        |

##### Memory management settings:

|                          |                  |
|--------------------------|------------------|
| Memory Allocation        | Dynamic / Static |
| TOTAL_HEAP_SIZE          | 3072             |
| Memory Management scheme | heap_4           |

##### Hook function related definitions:

|                              |          |
|------------------------------|----------|
| USE_IDLE_HOOK                | Disabled |
| USE_TICK_HOOK                | Disabled |
| USE_MALLOC_FAILED_HOOK       | Disabled |
| USE_DAEMON_TASK_STARTUP_HOOK | Disabled |

CHECK\_FOR\_STACK\_OVERFLOW Disabled

**Run time and task stats gathering related definitions:**

GENERATE\_RUN\_TIME\_STATS Disabled

USE\_TRACE\_FACILITY Enabled

USE\_STATS\_FORMATTING\_FUNCTIONS Disabled

**Co-routine related definitions:**

USE\_CO\_ROUTINES Disabled

MAX\_CO\_ROUTINE\_PRIORITIES 2

**Software timer definitions:**

USE\_TIMERS Enabled

TIMER\_TASK\_PRIORITY 2

TIMER\_QUEUE\_LENGTH 10

TIMER\_TASK\_STACK\_DEPTH 256

**Interrupt nesting behaviour configuration:**

LIBRARY\_LOWEST\_INTERRUPT\_PRIORITY 15

LIBRARY\_MAX\_SYSCALL\_INTERRUPT\_PRIORITY 5

7.6.2. Include parameters:

**Include definitions:**

vTaskPrioritySet Enabled

uxTaskPriorityGet Enabled

vTaskDelete Enabled

vTaskCleanUpResources Disabled

vTaskSuspend Enabled

vTaskDelayUntil Enabled

vTaskDelay Enabled

xTaskGetSchedulerState Enabled

xTaskResumeFromISR Enabled

xQueueGetMutexHolder Enabled

xSemaphoreGetMutexHolder Disabled

pcTaskGetTaskName Disabled

uxTaskGetStackHighWaterMark Enabled

xTaskGetCurrentTaskHandle Disabled

eTaskGetState Enabled

xEventGroupSetBitFromISR Disabled

xTimerPendFunctionCall Enabled

xTaskAbortDelay Disabled

xTaskGetHandle Disabled

### 7.6.3. Advanced settings:

#### **Newlib settings (see parameter description first):**

USE\_NEWLIB\_REENTRANT                      **Enabled \***

#### **Project settings (see parameter description first):**

Use FW pack heap file                      Enabled

**\* User modified value**

## 8. System Configuration

### 8.1. GPIO configuration

| IP     | Pin         | Signal         | GPIO mode                    | GPIO pull/up pull down      | Max Speed     | User Label |
|--------|-------------|----------------|------------------------------|-----------------------------|---------------|------------|
| RCC    | PD0-OSC_IN  | RCC_OSC_IN     | n/a                          | n/a                         | n/a           |            |
|        | PD1-OSC_OUT | RCC_OSC_OUT    | n/a                          | n/a                         | n/a           |            |
| SPI1   | PA5         | SPI1_SCK       | Alternate Function Push Pull | n/a                         | <b>High *</b> |            |
|        | PA6         | SPI1_MISO      | Input mode                   | No pull-up and no pull-down | <b>n/a</b>    |            |
|        | PA7         | SPI1_MOSI      | Alternate Function Push Pull | n/a                         | <b>High *</b> |            |
| SYS    | PA13        | SYS_JTMS-SWDIO | n/a                          | n/a                         | n/a           |            |
|        | PA14        | SYS_JTCK-SWCLK | n/a                          | n/a                         | n/a           |            |
| TIM1   | PA8         | TIM1_CH1       | Input mode                   | No pull-up and no pull-down | n/a           | NTC_B      |
|        | PA9         | TIM1_CH2       | Input mode                   | No pull-up and no pull-down | n/a           | NTC_A      |
| USART2 | PA2         | USART2_TX      | Alternate Function Push Pull | n/a                         | <b>High *</b> |            |
|        | PA3         | USART2_RX      | Input mode                   | No pull-up and no pull-down | <b>n/a</b>    |            |
| GPIO   | PA1         | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | Low           | TFT_LED    |
|        | PB1         | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | Low           | LED2       |
|        | PB10        | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | Low           | LED1       |
|        | PB13        | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | <b>High *</b> | TFT_CS     |
|        | PB14        | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | <b>High *</b> | TFT_DC     |
|        | PA15        | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | Low           | TFT_RST    |
|        | PB4         | GPIO_Output    | Output Push Pull             | No pull-up and no pull-down | Low           | BUZZER     |
|        | PB5         | GPIO_Input     | Input mode                   | No pull-up and no pull-down | n/a           | ENC_BTN    |

## 8.2. DMA configuration

| DMA request | Stream        | Direction            | Priority        |
|-------------|---------------|----------------------|-----------------|
| SPI1_TX     | DMA1_Channel3 | Memory To Peripheral | Low             |
| USART2_RX   | DMA1_Channel6 | Peripheral To Memory | <b>Medium *</b> |

### SPI1\_TX: DMA1\_Channel3 DMA request Settings:

Mode: Normal  
 Peripheral Increment: Disable  
 Memory Increment: **Enable \***  
 Peripheral Data Width: Byte  
 Memory Data Width: Byte

### USART2\_RX: DMA1\_Channel6 DMA request Settings:

Mode: Normal  
 Peripheral Increment: Disable  
 Memory Increment: **Enable \***  
 Peripheral Data Width: Byte  
 Memory Data Width: Byte



### 8.3. NVIC configuration

#### 8.3.1. 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           |
| Prefetch 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   | 15                   | 0           |
| System tick timer                       | true   | 15                   | 0           |
| DMA1 channel3 global interrupt          | true   | 5                    | 0           |
| DMA1 channel6 global interrupt          | true   | 5                    | 0           |
| TIM2 global interrupt                   | true   | 15                   | 0           |
| USART2 global interrupt                 | true   | 5                    | 0           |
| PVD interrupt through EXTI line 16      | unused |                      |             |
| Flash global interrupt                  | unused |                      |             |
| RCC global interrupt                    | unused |                      |             |
| TIM1 break interrupt                    | unused |                      |             |
| TIM1 update interrupt                   | unused |                      |             |
| TIM1 trigger and commutation interrupts | unused |                      |             |
| TIM1 capture compare interrupt          | unused |                      |             |
| SPI1 global interrupt                   | unused |                      |             |

#### 8.3.2. 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            |
| Prefetch fault, memory access fault     | false                             | true                 | false            |
| Undefined instruction or illegal state  | false                             | true                 | false            |
| System service call via SWI instruction | false                             | false                | false            |
| Debug monitor                           | false                             | true                 | false            |
| Pendable request for system service     | false                             | false                | false            |
| System tick timer                       | false                             | false                | true             |
| DMA1 channel3 global interrupt          | false                             | true                 | true             |
| DMA1 channel6 global interrupt          | false                             | true                 | true             |
| TIM2 global interrupt                   | false                             | true                 | true             |

| Enabled interrupt Table | Select for init<br>sequence ordering | Generate IRQ<br>handler | Call HAL handler |
|-------------------------|--------------------------------------|-------------------------|------------------|
| USART2 global interrupt | false                                | true                    | true             |

\* User modified value

## 9. System Views

### 9.1. Category view

#### 9.1.1. Current

| Middleware  |        |        |              |           |
|-------------|--------|--------|--------------|-----------|
| FREERTOS    |        |        |              |           |
| System Core | Analog | Timers | Connectivity | Computing |
| DMA         |        | TIM1   | SPI1         |           |
| GPIO        |        |        | USART2       |           |
| NVIC        |        |        |              |           |
| RCC         |        |        |              |           |
| SYS         |        |        |              |           |

## 10. Docs & Resources

| Type               | Link  |
|--------------------|---|
| Datasheet          | <a href="http://www.st.com/resource/en/datasheet/CD00161566.pdf">http://www.st.com/resource/en/datasheet/CD00161566.pdf</a>                   |
| Reference manual   | <a href="http://www.st.com/resource/en/reference_manual/CD00171190.pdf">http://www.st.com/resource/en/reference_manual/CD00171190.pdf</a>     |
| Programming manual | <a href="http://www.st.com/resource/en/programming_manual/CD00228163.pdf">http://www.st.com/resource/en/programming_manual/CD00228163.pdf</a> |
| Programming manual | <a href="http://www.st.com/resource/en/programming_manual/CD00283419.pdf">http://www.st.com/resource/en/programming_manual/CD00283419.pdf</a> |
| Errata sheet       | <a href="http://www.st.com/resource/en/errata_sheet/CD00190234.pdf">http://www.st.com/resource/en/errata_sheet/CD00190234.pdf</a>             |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00160362.pdf">http://www.st.com/resource/en/application_note/CD00160362.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00164185.pdf">http://www.st.com/resource/en/application_note/CD00164185.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00167594.pdf">http://www.st.com/resource/en/application_note/CD00167594.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00211314.pdf">http://www.st.com/resource/en/application_note/CD00211314.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00249778.pdf">http://www.st.com/resource/en/application_note/CD00249778.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00259245.pdf">http://www.st.com/resource/en/application_note/CD00259245.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00264321.pdf">http://www.st.com/resource/en/application_note/CD00264321.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00264342.pdf">http://www.st.com/resource/en/application_note/CD00264342.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/CD00264379.pdf">http://www.st.com/resource/en/application_note/CD00264379.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00024853.pdf">http://www.st.com/resource/en/application_note/DM00024853.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00032987.pdf">http://www.st.com/resource/en/application_note/DM00032987.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00033267.pdf">http://www.st.com/resource/en/application_note/DM00033267.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00033344.pdf">http://www.st.com/resource/en/application_note/DM00033344.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00042534.pdf">http://www.st.com/resource/en/application_note/DM00042534.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00052530.pdf">http://www.st.com/resource/en/application_note/DM00052530.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00073742.pdf">http://www.st.com/resource/en/application_note/DM00073742.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00080497.pdf">http://www.st.com/resource/en/application_note/DM00080497.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00129215.pdf">http://www.st.com/resource/en/application_note/DM00129215.pdf</a>     |
| Application note   | <a href="http://www.st.com/resource/en/application_note/DM00156964.pdf">http://www.st.com/resource/en/application_note/DM00156964.pdf</a>     |

Application note [http://www.st.com/resource/en/application\\_note/DM00160482.pdf](http://www.st.com/resource/en/application_note/DM00160482.pdf)  
Application note [http://www.st.com/resource/en/application\\_note/DM00209695.pdf](http://www.st.com/resource/en/application_note/DM00209695.pdf)  
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