



## 1. Description

### 1.1. Project

Project Name	Projet_Final
Board Name	NUCLEO-F410RB
Generated with:	STM32CubeMX 6.7.0
Date	02/28/2023

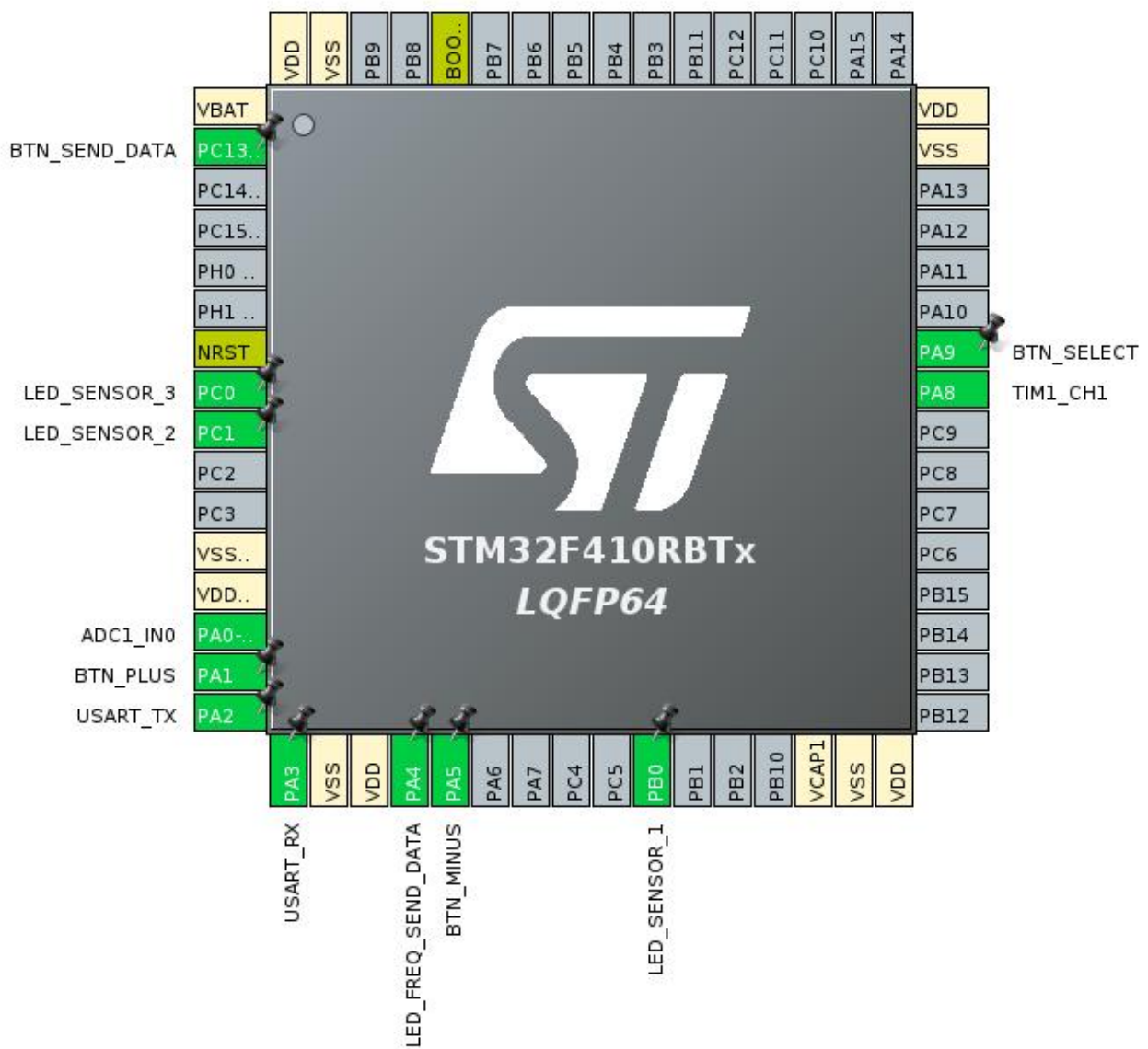
### 1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F410
MCU name	STM32F410RBTx
MCU Package	LQFP64
MCU Pin number	64

### 1.3. Core(s) information

Core(s)	Arm Cortex-M4
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## 2. Pinout Configuration

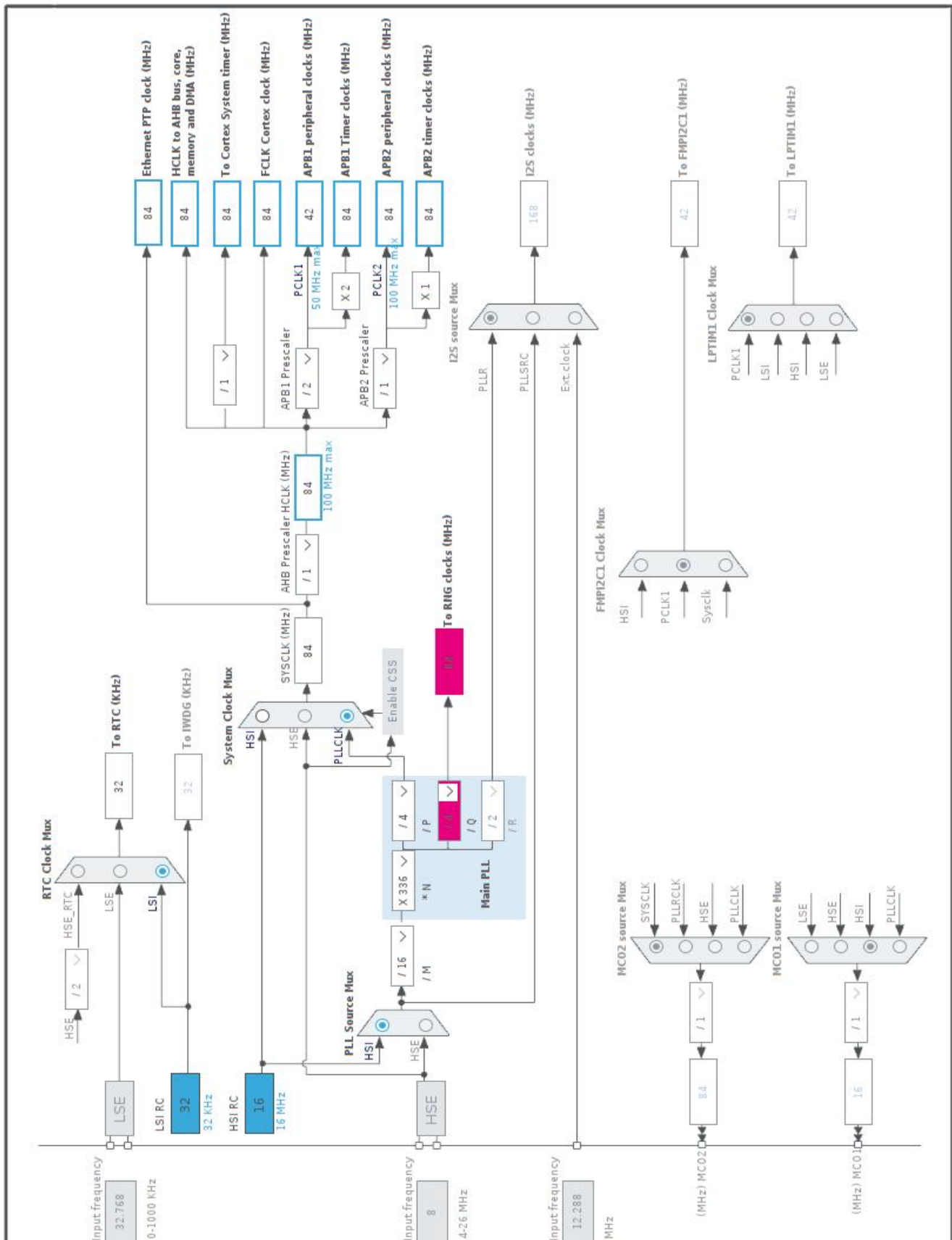


### 3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
2	PC13-ANTI_TAMP	I/O	GPIO_EXTI13	BTN_SEND_DATA
7	NRST	Reset		
8	PC0 *	I/O	GPIO_Output	LED_SENSOR_3
9	PC1 *	I/O	GPIO_Output	LED_SENSOR_2
12	VSSA/VREF-	Power		
13	VDDA/VREF+	Power		
14	PA0-WKUP	I/O	ADC1_IN0	
15	PA1	I/O	GPIO_EXTI1	BTN_PLUS
16	PA2	I/O	USART2_TX	USART_TX
17	PA3	I/O	USART2_RX	USART_RX
18	VSS	Power		
19	VDD	Power		
20	PA4 *	I/O	GPIO_Output	LED_FREQ_SEND_DATA
21	PA5	I/O	GPIO_EXTI5	BTN_MINUS
26	PB0 *	I/O	GPIO_Output	LED_SENSOR_1
30	VCAP1	Power		
31	VSS	Power		
32	VDD	Power		
41	PA8	I/O	TIM1_CH1	
42	PA9	I/O	GPIO_EXTI9	BTN_SELECT
47	VSS	Power		
48	VDD	Power		
60	BOOT0	Boot		
63	VSS	Power		
64	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	Projet_Final
Project Folder	/home/thomas/Documents/ales/s9/IMT_Embedded_System
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_F4 V1.27.1
Application Structure	Advanced
Generate Under Root	Yes
Do not generate the main()	Yes
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	Yes
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	SystemClock_Config	RCC
2	MX_GPIO_Init	GPIO
3	MX_USART2_UART_Init	USART2
4	MX_RNG_Init	RNG
5	MX_RTC_Init	RTC
6	MX_ADC1_Init	ADC1
7	MX_TIM1_Init	TIM1

## 6. Power Consumption Calculator report

### 6.1. Microcontroller Selection

Series	STM32F4
Line	STM32F410
MCU	STM32F410RBTx
Datasheet	DS11144_Rev5

### 6.2. Parameter Selection

Temperature	25
Vdd	1.7

### 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

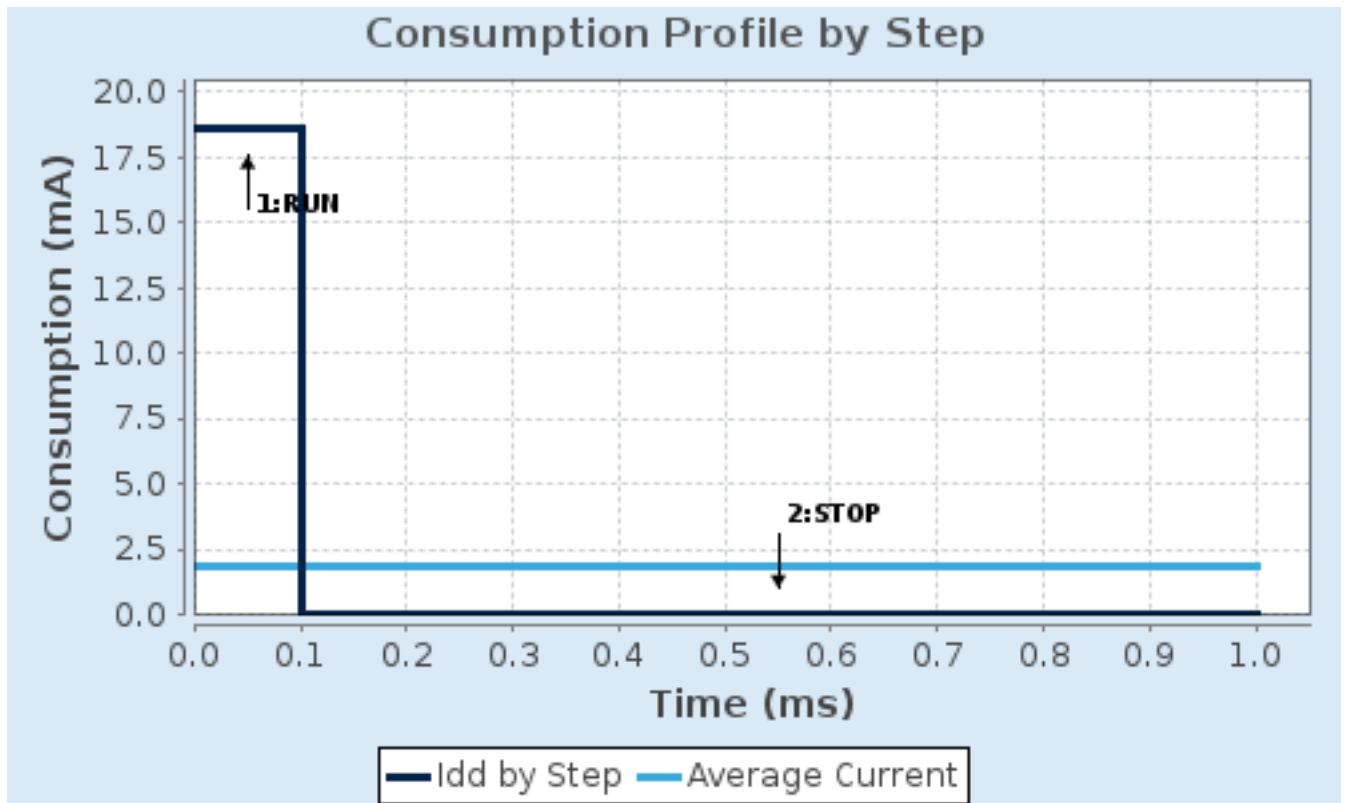
<b>Step</b>	Step1	Step2
<b>Mode</b>	RUN	STOP
<b>Vdd</b>	1.7	1.7
<b>Voltage Source</b>	Battery	Battery
<b>Range</b>	Scale1-High	No Scale
<b>Fetch Type</b>	FLASH	n/a
<b>CPU Frequency</b>	100 MHz	0 Hz
<b>Clock Configuration</b>	HSE PLL	Regulator_LPLV Flash-PwrDwn
<b>Clock Source Frequency</b>	4 MHz	0 Hz
<b>Peripherals</b>		
<b>Additional Cons.</b>	0 mA	0 mA
<b>Average Current</b>	18.6 mA	6.1 $\mu$ A
<b>Duration</b>	0.1 ms	0.9 ms
<b>DMIPS</b>	125.0	0.0
<b>Ta Max</b>	103.55	105
<b>Category</b>	In DS Table	In DS Table

#### 6.5. Results

Sequence Time	1 ms	Average Current	1.87 mA
Battery Life	2 months, 14 days, 22 hours	Average DMIPS	125.0 DMIPS

#### 6.6. Chart





## 7. Peripherals and Middlewares Configuration

### 7.1. ADC1

mode: IN0

#### 7.1.1. Parameter Settings:

##### **ADCs\_Common\_Settings:**

Mode Independent mode

##### **ADC\_Settings:**

Clock Prescaler PCLK2 divided by 4

Resolution 12 bits (15 ADC Clock cycles)

Data Alignment Right alignment

Scan Conversion Mode Disabled

Continuous Conversion Mode Disabled

Discontinuous Conversion Mode Disabled

DMA Continuous Requests Disabled

End Of Conversion Selection EOC flag at the end of single channel conversion

##### **ADC\_Regular\_ConversionMode:**

Number Of Conversion 1

External Trigger Conversion Source Regular Conversion launched by software

External Trigger Conversion Edge None

Rank 1

Channel Channel 0

Sampling Time 3 Cycles

##### **ADC\_Injected\_ConversionMode:**

Number Of Conversions 0

##### **WatchDog:**

Enable Analog WatchDog Mode false

### 7.2. RCC

#### 7.2.1. Parameter Settings:

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

VDD voltage (V) 3.3

Instruction Cache Enabled

Prefetch Buffer Enabled

Data Cache Enabled

Flash Latency(WS) 2 WS (3 CPU cycle)

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

HSI Calibration Value	16
TIM Prescaler Selection	Disabled
HSE Startup Timeout Value (ms)	100
LSE Startup Timeout Value (ms)	5000
<b>Power Parameters:</b>	
Power Regulator Voltage Scale	Power Regulator Voltage Scale 1

### 7.3. RNG

**mode: Activated**

### 7.4. RTC

**mode: Activate Clock Source**

#### 7.4.1. Parameter Settings:

##### **General:**

Hour Format	Hourformat 24
Asynchronous Predivider value	127
Synchronous Predivider value	255

### 7.5. SYS

**Timebase Source: TIM6**

### 7.6. TIM1

**Channel1: PWM Generation CH1**

#### 7.6.1. Parameter Settings:

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

Prescaler (PSC - 16 bits value)	<b>500-1 *</b>
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value )	<b>100-1 *</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

#### PWM Generation Channel 1:

Mode	PWM mode 1
Pulse (16 bits value)	<b>25 *</b>
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High
CH Idle State	Reset

## 7.7. USART2

### Mode: Asynchronous

#### 7.7.1. Parameter Settings:

##### Basic Parameters:

Baud Rate	115200
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

##### Advanced Parameters:

Data Direction	Receive and Transmit
Over Sampling	16 Samples

## 7.8. FREERTOS

### Interface: CMSIS\_V2

#### 7.8.1. Config parameters:

##### API:

FreeRTOS API	CMSIS v2
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##### Versions:

FreeRTOS version	10.3.1
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CMSIS-RTOS version	2.00
<b>MPU/FPU:</b>	
ENABLE_MPU	Disabled
ENABLE_FPU	Disabled
<b>Kernel settings:</b>	
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
<b>Memory management settings:</b>	
Memory Allocation	Dynamic / Static
TOTAL_HEAP_SIZE	15360
Memory Management scheme	heap_4
<b>Hook function related definitions:</b>	
USE_IDLE_HOOK	Disabled
USE_TICK_HOOK	Disabled
USE_MALLOC_FAILED_HOOK	Disabled
USE_DAEMON_TASK_STARTUP_HOOK	Disabled
CHECK_FOR_STACK_OVERFLOW	Disabled
<b>Run time and task stats gathering related definitions:</b>	
GENERATE_RUN_TIME_STATS	Disabled
USE_TRACE_FACILITY	Enabled
USE_STATS_FORMATTING_FUNCTIONS	Disabled
<b>Co-routine related definitions:</b>	
USE_CO_ROUTINES	Disabled
MAX_CO_ROUTINE_PRIORITIES	2
<b>Software timer definitions:</b>	
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

**Added with 10.2.1 support:**

MESSAGE_BUFFER_LENGTH_TYPE	size_t
USE_POSIX_ERRNO	Disabled

**CMSIS-RTOS V2 flags:**

USE_OS2_THREAD_SUSPEND_RESUME	Enabled
USE_OS2_THREAD_ENUMERATE	Enabled
USE_OS2_EVENTFLAGS_FROM_ISR	Enabled
USE_OS2_THREAD_FLAGS	Enabled
USE_OS2_TIMER	Enabled
USE_OS2_MUTEX	Enabled

**7.8.2. 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	Enabled
eTaskGetState	Enabled
xEventGroupSetBitFromISR	Disabled
xTimerPendFunctionCall	Enabled
xTaskAbortDelay	Disabled
xTaskGetHandle	Disabled
uxTaskGetStackHighWaterMark2	Disabled

### 7.8.3. Advanced settings:

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

USE\_NEWLIB\_REENTRANT                      Disabled

**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
ADC1	PA0-WKUP	ADC1_IN0	Analog mode	No pull-up and no pull-down	n/a	
TIM1	PA8	TIM1_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	
USART2	PA2	USART2_TX	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	USART_TX
	PA3	USART2_RX	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	USART_RX
GPIO	PC13-ANTI_TAMP	GPIO_EXTI13	<b>External Interrupt Mode with Falling edge trigger detection</b>	No pull-up and no pull-down	n/a	BTN_SEND_DATA
	PC0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_SENSOR_3
	PC1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_SENSOR_2
	PA1	GPIO_EXTI1	External Interrupt Mode with Rising edge trigger detection	<b>Pull-down</b> *	n/a	BTN_PLUS
	PA4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_FREQ_SEND_DATA
	PA5	GPIO_EXTI5	External Interrupt Mode with Rising edge trigger detection	<b>Pull-down</b> *	n/a	BTN_MINUS
	PB0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_SENSOR_1
	PA9	GPIO_EXTI9	External Interrupt Mode with Rising edge trigger detection	<b>Pull-down</b> *	n/a	BTN_SELECT

### 8.2. DMA configuration

nothing configured in DMA service



### 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
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	15	0
System tick timer	true	15	0
EXTI line1 interrupt	true	5	0
EXTI line[9:5] interrupts	true	5	0
USART2 global interrupt	true	5	0
EXTI line[15:10] interrupts	true	5	0
TIM6 global interrupt and DAC channel underrun error interrupt	true	15	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1 global interrupt	unused		
TIM1 break interrupt and TIM9 global interrupt	unused		
TIM1 update interrupt	unused		
TIM1 trigger and commutation interrupts and TIM11 global interrupt	unused		
TIM1 capture compare interrupt	unused		
RNG global interrupt	unused		
FPU 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
Pre-fetch 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

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
Pendable request for system service	false	false	false
System tick timer	false	false	true
EXTI line1 interrupt	false	true	true
EXTI line[9:5] interrupts	false	true	true
USART2 global interrupt	false	true	true
EXTI line[15:10] interrupts	false	true	true
TIM6 global interrupt and DAC channel underrun error 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

#### Multimedia

#### Security

#### Computing

DMA

ADC1 

RTC 

USART2 

RNG 

GPIO 

TIM1 

NVIC 

RCC 

SYS 

## 10. Docs & Resources

Type	Link
BSDL files	<a href="https://www.st.com/resource/en/bsdl_model/stm32f410_bsd1.zip">https://www.st.com/resource/en/bsdl_model/stm32f410_bsd1.zip</a>
IBIS models	<a href="https://www.st.com/resource/en/ibis_model/stm32f410_ibis.zip">https://www.st.com/resource/en/ibis_model/stm32f410_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>
BSDL files	<a href="https://www.st.com/resource/en/bsdl_model/stm32f410_bsd1.zip">https://www.st.com/resource/en/bsdl_model/stm32f410_bsd1.zip</a>
IBIS models	<a href="https://www.st.com/resource/en/ibis_model/stm32f410_ibis.zip">https://www.st.com/resource/en/ibis_model/stm32f410_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>
Training Material	<a href="https://www.st.com/resource/en/sales_guide/sg_sc2154.pdf">https://www.st.com/resource/en/sales_guide/sg_sc2154.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flstm32f4x1.pdf">https://www.st.com/resource/en/flyer/flstm32f4x1.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/flstmcsuite.pdf">https://www.st.com/resource/en/flyer/flstmcsuite.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flstm32trust.pdf">https://www.st.com/resource/en/flyer/flstm32trust.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>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an1181-electrostatic-discharge-sensitivity-measurement-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an1181-electrostatic-discharge-sensitivity-measurement-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/an2639-soldering-recommendations-and-package-information-for-leadfree-ecopack-mcus-and-mpus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an2639-soldering-recommendations-and-package-information-for-leadfree-ecopack-mcus-and-mpus-stmicroelectronics.pdf)
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- Application Notes [https://www.st.com/resource/en/application\\_note/an3070-managing-the-driver-enable-signal-for-rs485-and-iolink-communications-with-the-stm32s-usart-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an3070-managing-the-driver-enable-signal-for-rs485-and-iolink-communications-with-the-stm32s-usart-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an3126-audio-and-waveform-generation-using-the-dac-in-stm32-products-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an3126-audio-and-waveform-generation-using-the-dac-in-stm32-products-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an3154-can-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an3154-can-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf)
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- Application Notes [https://www.st.com/resource/en/application\\_note/an3364-migration-and-compatibility-guidelines-for-stm32-microcontroller-applications-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an3364-migration-and-compatibility-guidelines-for-stm32-microcontroller-applications-stmicroelectronics.pdf)
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- Application Notes [https://www.st.com/resource/en/application\\_note/an4013-stm32-crossseries-timer-overview-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4013-stm32-crossseries-timer-overview-stmicroelectronics.pdf)
- Application Notes [---

Page 20](https://www.st.com/resource/en/application_note/an4031-using-the-</a></p></div><div data-bbox=)

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stmicroelectronics.pdf

Application Notes [https://www.st.com/resource/en/application\\_note/an4221-i2c-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4221-i2c-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf)

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