
STM32
CubeMX

1. Description

1.1. Project

Project Name	RSM
Board Name	custom
Generated with:	STM32CubeMX 6.12.0
Date	01/31/2025

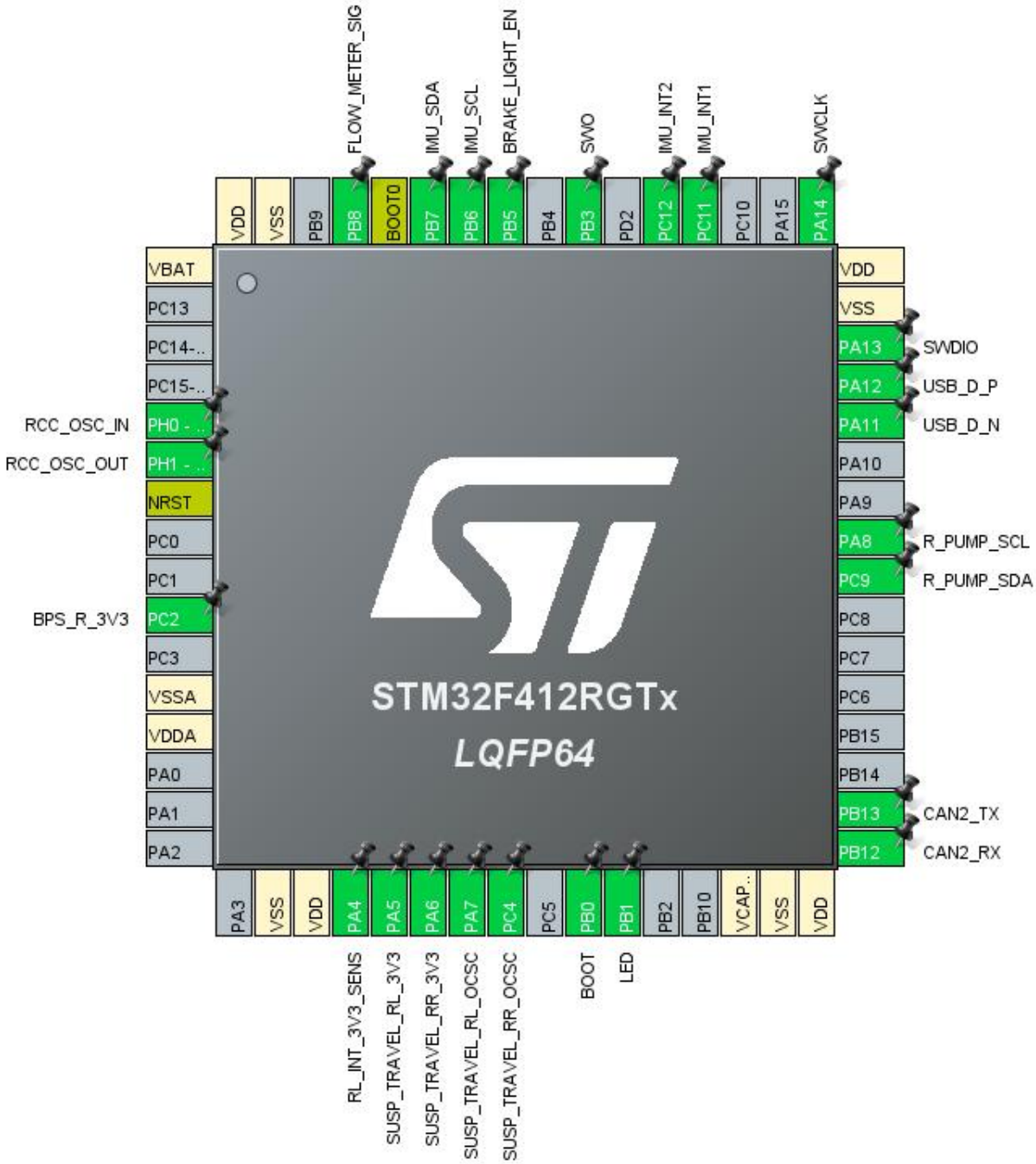
1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F412
MCU name	STM32F412RGTx
MCU Package	LQFP64
MCU Pin number	64

1.3. Core(s) information

Core(s)	Arm Cortex-M4

2. Pinout Configuration



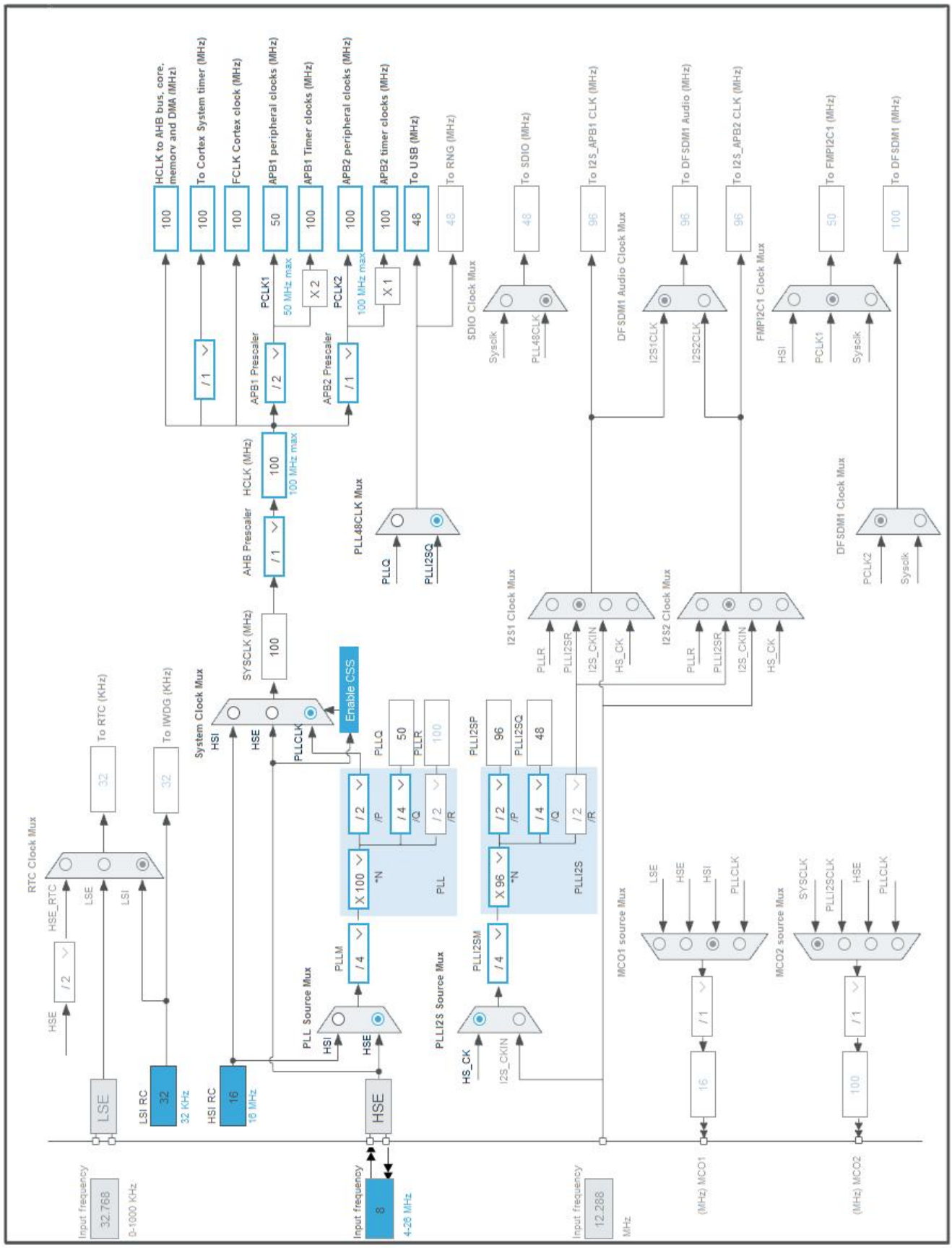
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
5	PH0 - OSC_IN	I/O	RCC_OSC_IN	
6	PH1 - OSC_OUT	I/O	RCC_OSC_OUT	
7	NRST	Reset		
10	PC2	I/O	ADC1_IN12	BPS_R_3V3
12	VSSA	Power		
13	VDDA	Power		
18	VSS	Power		
19	VDD	Power		
20	PA4 *	I/O	GPIO_Input	RL_INT_3V3_SENS
21	PA5	I/O	ADC1_IN5	SUSP_TRAVEL_RL_3V3
22	PA6	I/O	ADC1_IN6	SUSP_TRAVEL_RR_3V3
23	PA7	I/O	ADC1_IN7	SUSP_TRAVEL_RL_OCSC
24	PC4	I/O	ADC1_IN14	SUSP_TRAVEL_RR_OCSC
26	PB0 *	I/O	GPIO_Output	BOOT
27	PB1 *	I/O	GPIO_Output	LED
30	VCAP_1	Power		
31	VSS	Power		
32	VDD	Power		
33	PB12	I/O	CAN2_RX	
34	PB13	I/O	CAN2_TX	
40	PC9	I/O	I2C3_SDA	R_PUMP_SDA
41	PA8	I/O	I2C3_SCL	R_PUMP_SCL
44	PA11	I/O	USB_OTG_FS_DM	USB_D_N
45	PA12	I/O	USB_OTG_FS_DP	USB_D_P
46	PA13	I/O	SYS_JTMS-SWDIO	SWDIO
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	SWCLK
52	PC11 *	I/O	GPIO_Output	IMU_INT1
53	PC12 *	I/O	GPIO_Output	IMU_INT2
55	PB3	I/O	SYS_JTDO-SWO	SWO
57	PB5 *	I/O	GPIO_Output	BRAKE_LIGHT_EN
58	PB6	I/O	I2C1_SCL	IMU_SCL
59	PB7	I/O	I2C1_SDA	IMU_SDA
60	BOOT0	Boot		

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
61	PB8	I/O	TIM4_CH3	FLOW_METER_SIG
63	VSS	Power		
64	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	STM32F412
MCU	STM32F412RGTx
Datasheet	DS11139_Rev5

1.2. Parameter Selection

Temperature	25
Vdd	1.7

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

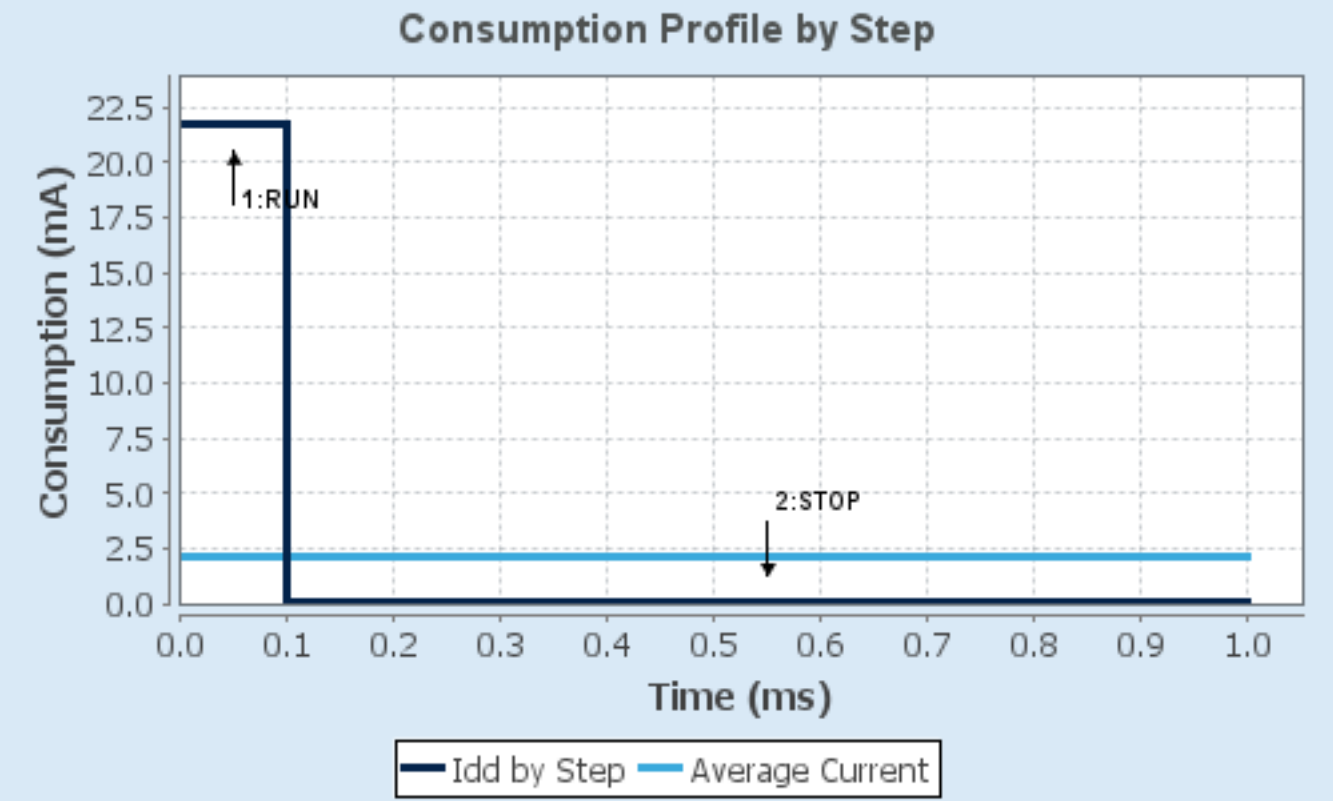
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP
Vdd	1.7	1.7
Voltage Source	Battery	Battery
Range	Scale1-High	No Scale
Fetch Type	FLASH	n/a
CPU Frequency	100 MHz	0 Hz
Clock Configuration	HSE PLL	Regulator_LPLV Flash-PwrDwn
Clock Source Frequency	4 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	21.7 mA	18.5 µA
Duration	0.1 ms	0.9 ms
DMIPS	125.0	0.0
Ta Max	103.27	105
Category	In DS Table	In DS Table

1.5. Results

Sequence Time	1 ms	Average Current	2.19 mA
Battery Life	2 months, 3 days, 20 hours	Average DMIPS	125.0 DMIPS

1.6. Chart


Consumption Profile by Step
Consumption (mA)
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1:RUN
2:STOP
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Time (ms)
Idd by Step
Average Current

2. Software Project

2.1. Project Settings

Name	Value
Project Name	RSM
Project Folder	C:\Users\jessi\Documents\School\fsae\Consolidated-
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_F4 V1.28.1
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	No

2.3. Advanced Settings - Generated Function Calls

Rank	Function Name	Peripheral Instance Name
1	SystemClock_Config	RCC
2	MX_GPIO_Init	GPIO
3	MX_ADC1_Init	ADC1
4	MX_CAN2_Init	CAN2
5	MX_I2C1_Init	I2C1
6	MX_I2C3_Init	I2C3
7	MX_TIM4_Init	TIM4
8	MX_USB_DEVICE_Init	USB_DEVICE

3. Peripherals and Middlewares Configuration

3.1. ADC1

mode: IN5

mode: IN6

mode: IN7

mode: IN12

mode: IN14

3.1.1. 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 14 ***
Sampling Time	3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions	0

WatchDog:

Enable Analog WatchDog Mode	false

3.2. CAN2

mode: Activated

3.2.1. Parameter Settings:

Bit Timings Parameters:

Prescaler (for Time Quantum)	16
Time Quantum	**320.0 ***
Time Quanta in Bit Segment 1	1 Time
Time Quanta in Bit Segment 2	1 Time
Time for one Bit	**960 ***
Baud Rate	**1041666 ***
ReSynchronization Jump Width	1 Time

Basic Parameters:

Time Triggered Communication Mode	Disable
Automatic Bus-Off Management	Disable
Automatic Wake-Up Mode	Disable
Automatic Retransmission	Disable
Receive Fifo Locked Mode	Disable
Transmit Fifo Priority	Disable

Advanced Parameters:

Operating Mode	Normal

3.3. I2C1

I2C: I2C

3.3.1. Parameter Settings:

Master Features:

I2C Speed Mode	Standard Mode
I2C Clock Speed (Hz)	100000

Slave Features:

Clock No Stretch Mode	Disabled
Primary Address Length selection	7-bit
Dual Address Acknowledged	Disabled
Primary slave address	0
General Call address detection	Disabled

3.4. I2C3

I2C: I2C

3.4.1. Parameter Settings:

Master Features:

I2C Speed Mode	Standard Mode

I2C Clock Speed (Hz)	100000

Slave Features:

Clock No Stretch Mode	Disabled
Primary Address Length selection	7-bit
Dual Address Acknowledged	Disabled
Primary slave address	0
General Call address detection	Disabled

3.5. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

3.5.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Enabled
Data Cache	Enabled
Flash Latency(WS)	3 WS (4 CPU cycle)

RCC Parameters:

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

Power Parameters:

Power Regulator Voltage Scale	Power Regulator Voltage Scale 1

3.6. SYS

Debug: Trace Asynchronous Sw

Timebase Source: SysTick

3.7. TIM4

Channel3: PWM Generation CH3

3.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up

Counter Period (AutoReload Register - 16 bits value)	65535
Internal Clock Division (CKD)	No Division
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)

PWM Generation Channel 3:

Mode	PWM mode 1
Pulse (16 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

3.8. USB_OTG_FS

Mode: Device_Only

3.8.1. Parameter Settings:

Speed	Full Speed 12MBit/s
Low power	Disabled
Battery charging	Disabled
Link Power Management	Disabled
VBUS sensing	Disabled
Signal start of frame	Disabled

3.9. FREERTOS

Interface: CMSIS_V2

3.9.1. Config parameters:

API:

FreeRTOS API	CMSIS v2

Versions:

FreeRTOS version	10.3.1
CMSIS-RTOS version	2.00

MPU/FPU:

ENABLE_MPU	Disabled
ENABLE_FPU	Disabled

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	15360
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

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

3.9.2. 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

3.9.3. Advanced settings:

Newlib settings (see parameter description first):

USE_NEWLIB_REENTRANT	Disabled

Project settings (see parameter description first):

Use FW pack heap file	Enabled

3.10. USB_DEVICE

Class For FS IP: Communication Device Class (Virtual Port Com)

3.10.1. Parameter Settings:

Basic Parameters:

USBD_MAX_NUM_INTERFACES (Maximum number of supported interfaces)	1
USBD_MAX_NUM_CONFIGURATION (Maximum number of supported configuration)	1
USBD_MAX_STR_DESC_SIZ (Maximum size for the string descriptors)	512
USBD_SELF_POWERED (Enabled self power)	Enabled
USBD_DEBUG_LEVEL (USBD Debug Level)	0: No debug message
USBD_LPM_ENABLED (Link Power Management)	1: Link Power Management supported

Class Parameters:

USB CDC Rx Buffer Size	2048
USB CDC Tx Buffer Size	2048

3.10.2. Device Descriptor:

Device Descriptor:

VID (Vendor IDentifier)	1155
LANGID_STRING (Language Identifier)	English(United States)
MANUFACTURER_STRING (Manufacturer Identifier)	STMicroelectronics

Device Descriptor FS:

PID (Product IDentifier)	22336
PRODUCT_STRING (Product Identifier)	STM32 Virtual ComPort
CONFIGURATION_STRING (Configuration Identifier)	CDC Config
INTERFACE_STRING (Interface Identifier)	CDC Interface

*** User modified value**

4. System Configuration

4.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
ADC1	PC2	ADC1_IN12	Analog mode	No pull-up and no pull-down	n/a	BPS_R_3V3
	PA5	ADC1_IN5	Analog mode	No pull-up and no pull-down	n/a	SUSP_TRAVEL_RL_3V3
	PA6	ADC1_IN6	Analog mode	No pull-up and no pull-down	n/a	SUSP_TRAVEL_RR_3V3
	PA7	ADC1_IN7	Analog mode	No pull-up and no pull-down	n/a	SUSP_TRAVEL_RL_OCSC
	PC4	ADC1_IN14	Analog mode	No pull-up and no pull-down	n/a	SUSP_TRAVEL_RR_OCSC
CAN2	PB12	CAN2_RX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PB13	CAN2_TX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
I2C1	PB6	I2C1_SCL	Alternate Function Open Drain	No pull-up and no pull-down	**Very High ***	IMU_SCL
	PB7	I2C1_SDA	Alternate Function Open Drain	No pull-up and no pull-down	**Very High ***	IMU_SDA
I2C3	PC9	I2C3_SDA	Alternate Function Open Drain	No pull-up and no pull-down	**Very High ***	R_PUMP_SDA
	PA8	I2C3_SCL	Alternate Function Open Drain	No pull-up and no pull-down	**Very High ***	R_PUMP_SCL
RCC	PH0 - OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	
	PH1 - OSC_OUT	RCC_OSC_OUT	n/a	n/a	n/a	
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	SWDIO
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	SWCLK
	PB3	SYS_JTDO-SWO	n/a	n/a	n/a	SWO
TIM4	PB8	TIM4_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	FLOW_METER_SIG
USB_OTG_FS	PA11	USB_OTG_FS_DM	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	USB_D_N
	PA12	USB_OTG_FS_DP	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	USB_D_P
GPIO	PA4	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	RL_INT_3V3_SENS
	PB0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	BOOT

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
	PB1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED
	PC11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	IMU_INT1
	PC12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	IMU_INT2
	PB5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	BRAKE_LIGHT_EN

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	15	0
System tick timer	true	15	0
USB On The Go FS global interrupt	true	5	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1 global interrupt	unused		
TIM4 global interrupt	unused		
I2C1 event interrupt	unused		
I2C1 error interrupt	unused		
CAN2 TX interrupts	unused		
CAN2 RX0 interrupts	unused		
CAN2 RX1 interrupt	unused		
CAN2 SCE interrupt	unused		
I2C3 event interrupt	unused		
I2C3 error interrupt	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	false	false
Debug monitor	false	true	false
Pendable request for system service	false	false	false
System tick timer	false	true	true

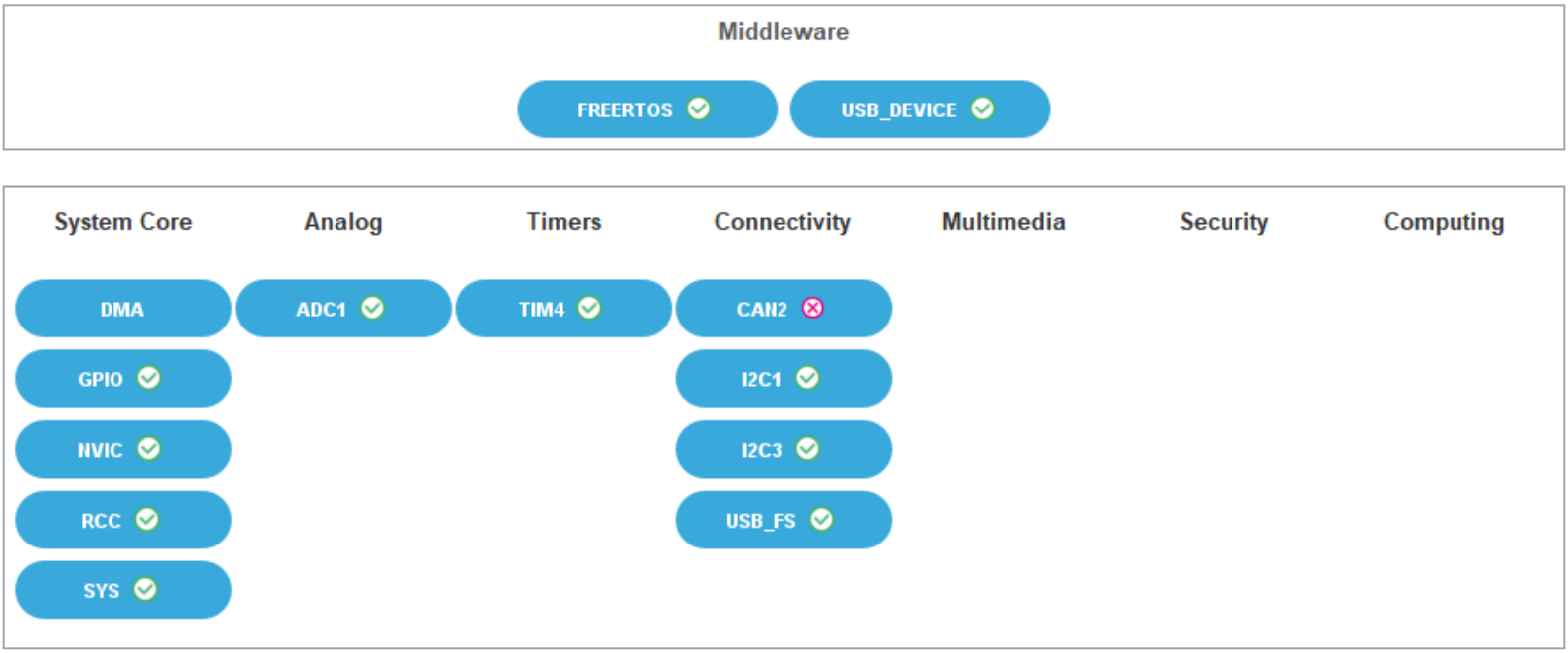
Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
USB On The Go FS global interrupt	false	true	true

*** User modified value**

5. System Views

5.1. Category view

5.1.1. Current



6. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f412_bsdl.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32f412_ibis.zip
System View Description	https://www.st.com/resource/en/svd/stm32f4-svd.zip
Presentations	https://www.st.com/resource/en/product_presentation/stm32-stm8_embedded_software_solutions.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32_eval-tools_portfolio.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32_stm8_functional-safety-packages.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32-stm8_software_development_tools.pdf
Presentations	https://www.st.com/resource/en/product_presentation/microcontrollers-stm32-family-overview.pdf
Presentations	https://www.st.com/resource/en/product_presentation/microcontrollers-stm32h7rs-lines-overview.pdf
Brochures	https://www.st.com/resource/en/brochure/products-and-solutions-for-plcs-and-smart-i-os.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32f4x1.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32nucleo.pdf
Flyers	https://www.st.com/resource/en/flyer/flstmcsuite.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32trust.pdf
Product Certifications	https://www.st.com/resource/en/certification_document/stm32_authentication_can.pdf
Application Notes	https://www.st.com/resource/en/application_note/an1709-emc-design-guide-for-stm8-stm32-and-legacy-mcus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an2606-stm32-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
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
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
Application Notes	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
Application Notes	https://www.st.com/resource/en/application_note/an3155-usart-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3156-usb-dfu-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3364-migration-and-compatibility-guidelines-for-stm32-microcontroller-applications-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3997-audio-playback-and-recording-using-the-stm32f4discovery-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3998-pdm-audio-software-decoding-on-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4031-using-the-stm32f2-stm32f4-and-stm32f7-series-dma-controller-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4221-i2c-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4286-spi-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4488-getting-started-with-stm32f4xxxx-mcu-hardware-development-stmicroelectronics.pdf

Application Notes	https://www.st.com/resource/en/application_note/an4566-extending-the-dac-performance-of-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4655-virtually-increasing-the-number-of-serial-communication-peripherals-in-stm32-applications-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4739-stm32cube-firmware-examples-for-stm32f4-series-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4750-handling-of-soft-errors-in-stm32-applications-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4776-generalpurpose-timer-cookbook-for-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4803-highspeed-si-simulations-using-ibis-and-boardlevel-simulations-using-hyperlynx-si-on-stm32-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4850-stm32-mcus-spreadspectrum-clock-generation-principles-properties-and-implementation-stmicroelectronics.pdf
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