1. Description

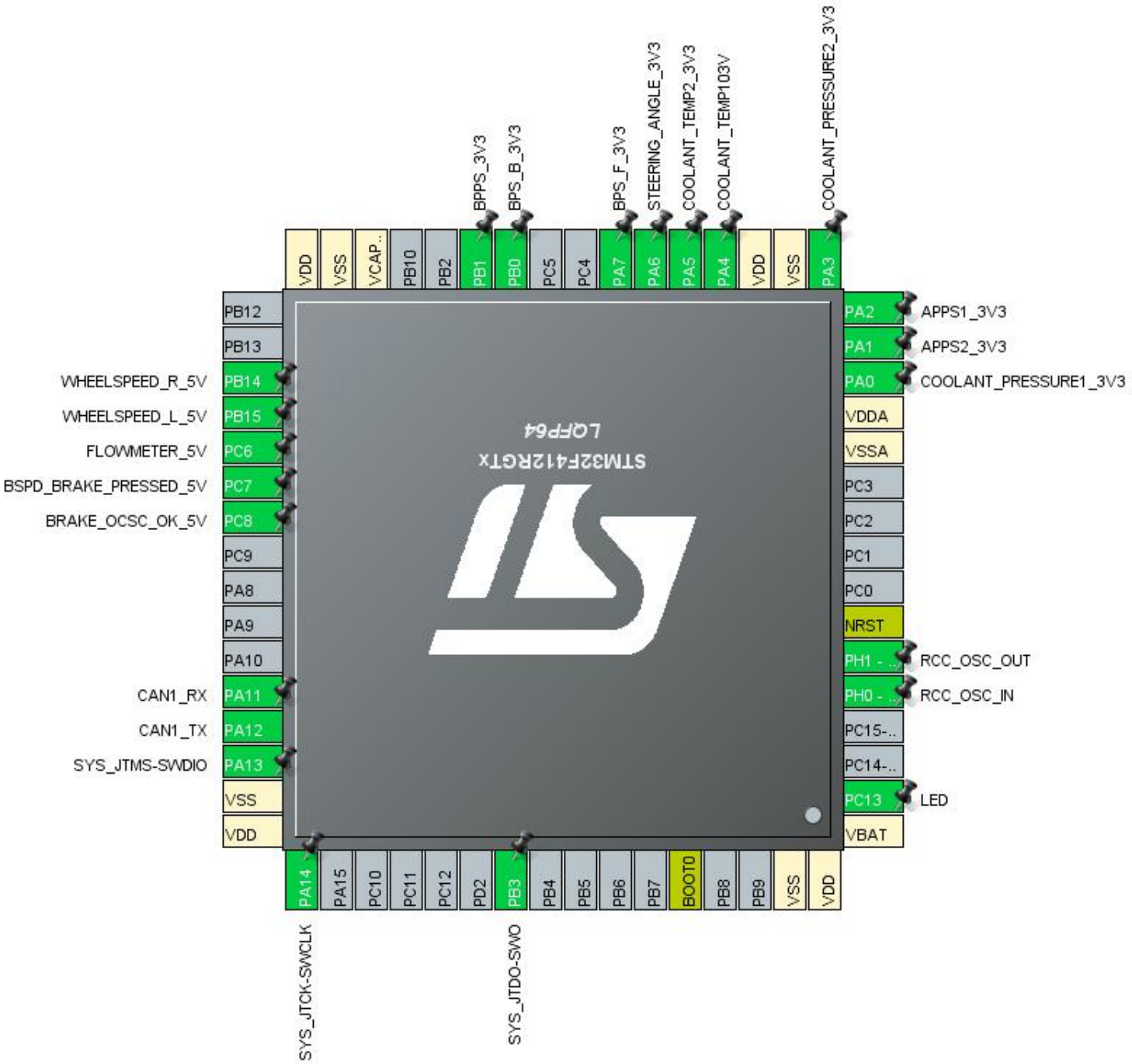
1.1. Project

Project Name	FSM
Board Name	custom
Generated with:	STM32CubeMX 5.3.0
Date	03/18/2023

1.2. MCU

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

2. Pinout Configuration



(Rotated -180°)

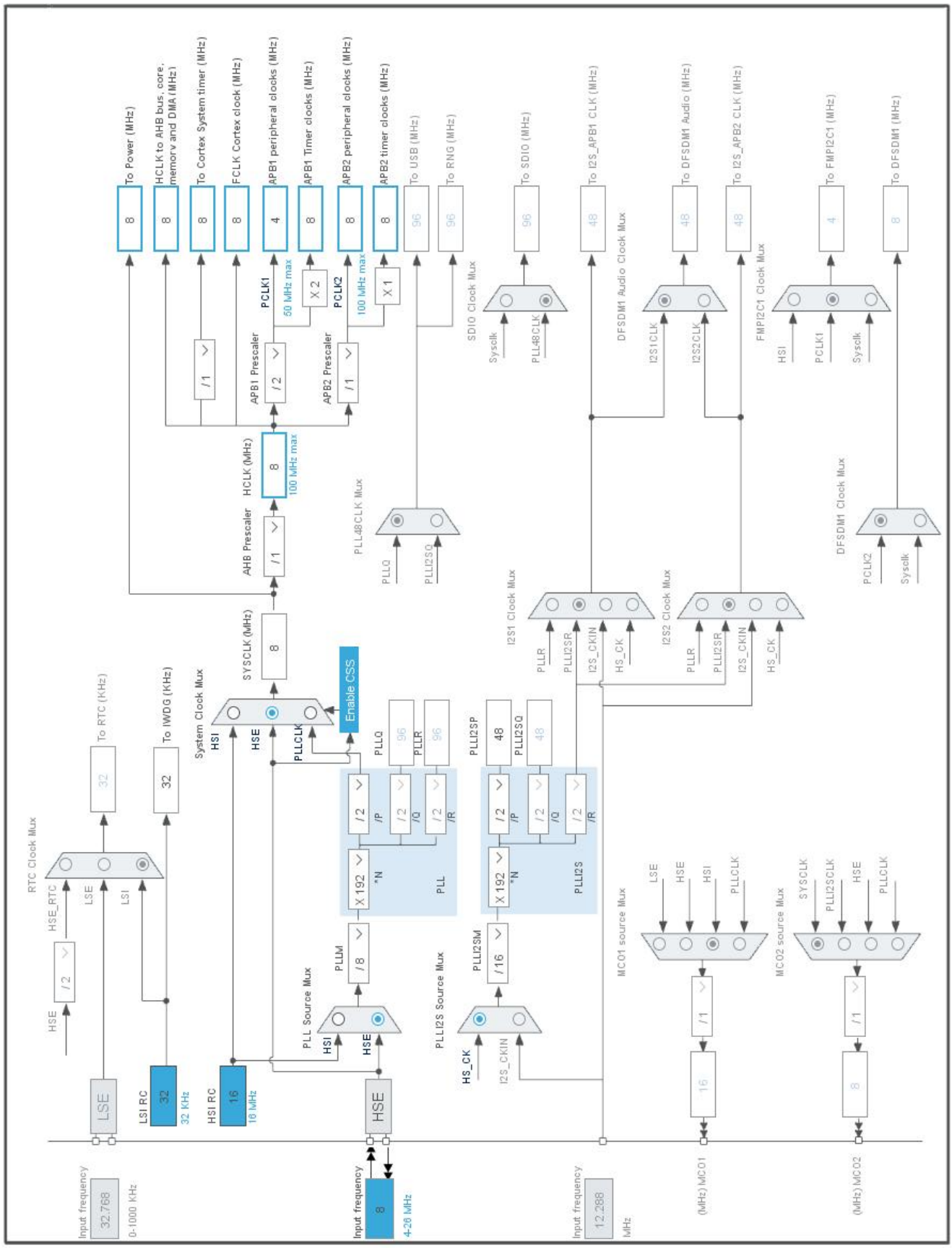
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
2	PC13 *	I/O	GPIO_Output	LED
5	PH0 - OSC_IN	I/O	RCC_OSC_IN	
6	PH1 - OSC_OUT	I/O	RCC_OSC_OUT	
7	NRST	Reset		
12	VSSA	Power		
13	VDDA	Power		
14	PA0	I/O	ADC1_IN0	COOLANT_PRESSURE1_3V3
15	PA1	I/O	ADC1_IN1	APPS2_3V3
16	PA2	I/O	ADC1_IN2	APPS1_3V3
17	PA3	I/O	ADC1_IN3	COOLANT_PRESSURE2_3V3
18	VSS	Power		
19	VDD	Power		
20	PA4	I/O	ADC1_IN4	COOLANT_TEMP103V
21	PA5	I/O	ADC1_IN5	COOLANT_TEMP2_3V3
22	PA6	I/O	ADC1_IN6	STEERING_ANGLE_3V3
23	PA7	I/O	ADC1_IN7	BPS_F_3V3
26	PB0	I/O	ADC1_IN8	BPS_B_3V3
27	PB1	I/O	ADC1_IN9	BPPS_3V3
30	VCAP_1	Power		
31	VSS	Power		
32	VDD	Power		
35	PB14	I/O	TIM12_CH1	WHEELSPEED_R_5V
36	PB15	I/O	TIM12_CH2	WHEELSPEED_L_5V
37	PC6	I/O	TIM8_CH1	FLOWMETER_5V
38	PC7 *	I/O	GPIO_Input	BSPD_BRAKE_PRESSED_5V
39	PC8 *	I/O	GPIO_Input	BRAKE_OCSC_OK_5V
44	PA11	I/O	CAN1_RX	
45	PA12	I/O	CAN1_TX	
46	PA13	I/O	SYS_JTMS-SWDIO	
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
55	PB3	I/O	SYS_JTDO-SWO	
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	FSM
Project Folder	C:\Users\jessi\Documents\School\Grade_13\fsae\Consolidated-
Toolchain / IDE	SW4STM32
Firmware Package Name and Version	STM32Cube FW_F4 V1.24.2

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
Delete previously generated files when not re-generated	Yes
Set all free pins as analog (to optimize the power consumption)	No

6. Power Consumption Calculator report

6.1. Microcontroller Selection

Series	STM32F4
Line	STM32F412
MCU	STM32F412RGTx
Datasheet	028087_Rev5

6.2. Parameter Selection

Temperature	25
Vdd	null

7. IPs and Middleware Configuration

7.1. ADC1

mode: IN0

mode: IN1

mode: IN2

mode: IN3

mode: IN4

mode: IN5

mode: IN6

mode: IN7

mode: IN8

mode: IN9

7.1.1. Parameter Settings:

ADC_Settings:

Clock Prescaler	PCLK2 divided by 2
Resolution	12 bits (15 ADC Clock cycles)
Data Alignment	Right alignment
Scan Conversion Mode	Enabled
Continuous Conversion Mode	Disabled
Discontinuous Conversion Mode	Disabled
DMA Continuous Requests	**Enabled ***
End Of Conversion Selection	EOC flag at the end of single channel conversion

ADC_Regular_ConversionMode:

Number Of Conversion	**10 ***
External Trigger Conversion Source	**Timer 3 Trigger Out event ***
External Trigger Conversion Edge	Trigger detection on the rising edge
Rank	1
Channel	Channel 0
Sampling Time	3 Cycles
Rank	**2 ***
Channel	**Channel 1 ***
Sampling Time	3 Cycles
Rank	**3 ***
Channel	**Channel 2 ***
Sampling Time	3 Cycles
Rank	**4 ***

Channel	**Channel 3 ***
Sampling Time	3 Cycles
Rank	**5 ***
Channel	**Channel 4 ***
Sampling Time	3 Cycles
Rank	**6 ***
Channel	**Channel 5 ***
Sampling Time	3 Cycles
Rank	**7 ***
Channel	**Channel 6 ***
Sampling Time	3 Cycles
Rank	**8 ***
Channel	**Channel 7 ***
Sampling Time	3 Cycles
Rank	**9 ***
Channel	**Channel 8 ***
Sampling Time	3 Cycles
Rank	**10 ***
Channel	**Channel 9 ***
Sampling Time	3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions	0

WatchDog:

Enable Analog WatchDog Mode	false

7.2. CAN1

mode: Mode

7.2.1. Parameter Settings:

Bit Timings Parameters:

Prescaler (for Time Quantum)	**1 ***
Time Quantum	**250.0 ***
Time Quanta in Bit Segment 1	**6 Times ***
Time Quanta in Bit Segment 2	1 Time
ReSynchronization Jump Width	**4 Times ***

Basic Parameters:

Time Triggered Communication Mode	Disable
Automatic Bus-Off Management	**Enable ***
Automatic Wake-Up Mode	Disable
No-Automatic Retransmission	**Enable ***
Receive Fifo Locked Mode	**Enable ***
Transmit Fifo Priority	**Enable ***

Advanced Parameters:

Operating Mode	Normal

7.3. IWDG

mode: Activated

7.3.1. Parameter Settings:

Clocking:

IWDG counter clock prescaler	4
IWDG down-counter reload value	**LSI_FREQUENCY / IWDG_PRESCALER / IWDG_RESET_FREQUENCY ***

7.4. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

7.4.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Enabled
Data Cache	Enabled
Flash Latency(WS)	0 WS (1 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 Regulatror Voltage Scale	Power Regulator Voltage Scale 1

7.5. SYS

Debug: Trace Asynchronous Sw

Timebase Source: TIM6

7.6. TIM3

Clock Source : Internal Clock

7.6.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**TIM3_PRESCALER - 1 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**(TIMx_FREQUENCY / TIM3_PRESCALER / ADC_FREQUENCY) - 1 ***
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	**Update Event ***

7.7. TIM8

Channel1: Input Capture direct mode

7.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**TIM8_PRESCALER ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**TIM8_AUTO_RELOAD_REG ***
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)

Input Capture Channel 1:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

7.8. TIM12

Channel1: Input Capture direct mode

Channel2: Input Capture direct mode

7.8.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**TIM12_PRESCALER ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**TIM12_AUTO_RELOAD_REG ***
Internal Clock Division (CKD)	No Division
auto-reload preload	Disable

Input Capture Channel 1:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

Input Capture Channel 2:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

7.9. FREERTOS

Interface: CMSIS_V1

7.9.1. Config parameters:

API:

FreeRTOS API	CMSIS v1

Versions:

FreeRTOS version	10.0.1
CMSIS-RTOS version	1.02

Kernel settings:

USE_PREEMPTION	Enabled
CPU_CLOCK_HZ	SystemCoreClock
TICK_RATE_HZ	1000
MAX_PRIORITIES	7
MINIMAL_STACK_SIZE	128
MAX_TASK_NAME_LEN	16
USE_16_BIT_TICKS	Disabled
IDLE_SHOULD_YIELD	Enabled
USE_MUTEXES	Enabled
USE_RECURSIVE_MUTEXES	Disabled
USE_COUNTING_SEMAPHORES	Disabled
QUEUE_REGISTRY_SIZE	8
USE_APPLICATION_TASK_TAG	Disabled
ENABLE_BACKWARD_COMPATIBILITY	Enabled
USE_PORT_OPTIMISED_TASK_SELECTION	Enabled
USE_TICKLESS_IDLE	Disabled
USE_TASK_NOTIFICATIONS	Enabled
RECORD_STACK_HIGH_ADDRESS	Disabled

Memory management settings:

Memory Allocation	**Static ***

Hook function related definitions:

USE_IDLE_HOOK	Disabled
USE_TICK_HOOK	**Enabled ***
USE_MALLOC_FAILED_HOOK	Disabled
USE_DAEMON_TASK_STARTUP_HOOK	Disabled
CHECK_FOR_STACK_OVERFLOW	**Option2 ***

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	Disabled

Interrupt nesting behaviour configuration:

LIBRARY_LOWEST_INTERRUPT_PRIORITY	15
LIBRARY_MAX_SYSCALL_INTERRUPT_PRIORITY	5

7.9.2. Include parameters:

Include definitions:

vTaskPrioritySet	Enabled
uxTaskPriorityGet	Enabled
vTaskDelete	Enabled
vTaskCleanUpResources	Disabled
vTaskSuspend	Enabled
vTaskDelayUntil	**Enabled ***
vTaskDelay	Enabled
xTaskGetSchedulerState	Enabled
xTaskResumeFromISR	Enabled
xQueueGetMutexHolder	Disabled
xSemaphoreGetMutexHolder	Disabled
pcTaskGetTaskName	Disabled
uxTaskGetStackHighWaterMark	Disabled
xTaskGetCurrentTaskHandle	Disabled
eTaskGetState	Disabled
xEventGroupSetBitFromISR	Disabled
xTimerPendFunctionCall	Disabled
xTaskAbortDelay	Disabled
xTaskGetHandle	Disabled

*** 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	ADC1_IN0	Analog mode	No pull-up and no pull-down	n/a	COOLANT_PRESSURE1_3V3
	PA1	ADC1_IN1	Analog mode	No pull-up and no pull-down	n/a	APPS2_3V3
	PA2	ADC1_IN2	Analog mode	No pull-up and no pull-down	n/a	APPS1_3V3
	PA3	ADC1_IN3	Analog mode	No pull-up and no pull-down	n/a	COOLANT_PRESSURE2_3V3
	PA4	ADC1_IN4	Analog mode	No pull-up and no pull-down	n/a	COOLANT_TEMP103V
	PA5	ADC1_IN5	Analog mode	No pull-up and no pull-down	n/a	COOLANT_TEMP2_3V3
	PA6	ADC1_IN6	Analog mode	No pull-up and no pull-down	n/a	STEERING_ANGLE_3V3
	PA7	ADC1_IN7	Analog mode	No pull-up and no pull-down	n/a	BPS_F_3V3
	PB0	ADC1_IN8	Analog mode	No pull-up and no pull-down	n/a	BPS_B_3V3
	PB1	ADC1_IN9	Analog mode	No pull-up and no pull-down	n/a	BPPS_3V3
CAN1	PA11	CAN1_RX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PA12	CAN1_TX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
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	
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	
	PB3	SYS_JTDO-SWO	n/a	n/a	n/a	
TIM8	PC6	TIM8_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	FLOWMETER_5V
TIM12	PB14	TIM12_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	WHEELSPEED_R_5V
	PB15	TIM12_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	WHEELSPEED_L_5V
GPIO	PC13	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED
	PC7	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	BSPD_BRAKE_PRESSED_5V
	PC8	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	BRAKE_OCSC_OK_5V

8.2. DMA configuration

DMA request	Stream	Direction	Priority
ADC1	DMA2_Stream0	Peripheral To Memory	Low

ADC1: DMA2_Stream0 DMA request Settings:

Mode:	**Circular ***
Use fifo:	Disable
Peripheral Increment:	Disable
Memory Increment:	**Enable ***
Peripheral Data Width:	Half Word
Memory Data Width:	Half Word

8.3. NVIC configuration

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
TIM3 global interrupt	true	5	0
TIM8 break interrupt and TIM12 global interrupt	true	5	0
TIM8 update interrupt and TIM13 global interrupt	true	5	0
TIM6 global interrupt	true	0	0
DMA2 stream0 global interrupt	true	5	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1 global interrupt	unused		
CAN1 TX interrupts	unused		
CAN1 RX0 interrupts	unused		
CAN1 RX1 interrupt	unused		
CAN1 SCE interrupt	unused		
TIM8 trigger and commutation interrupts and TIM14 global interrupt	unused		
TIM8 capture compare interrupt	unused		
FPU global interrupt	unused		

*** User modified value**

9. Software Pack Report