

STM32 CubeMX

1. Description

1.1. Project

Project Name	Frontbox_SW
Board Name	custom
Generated with:	STM32CubeMX 6.10.0
Date	04/23/2024

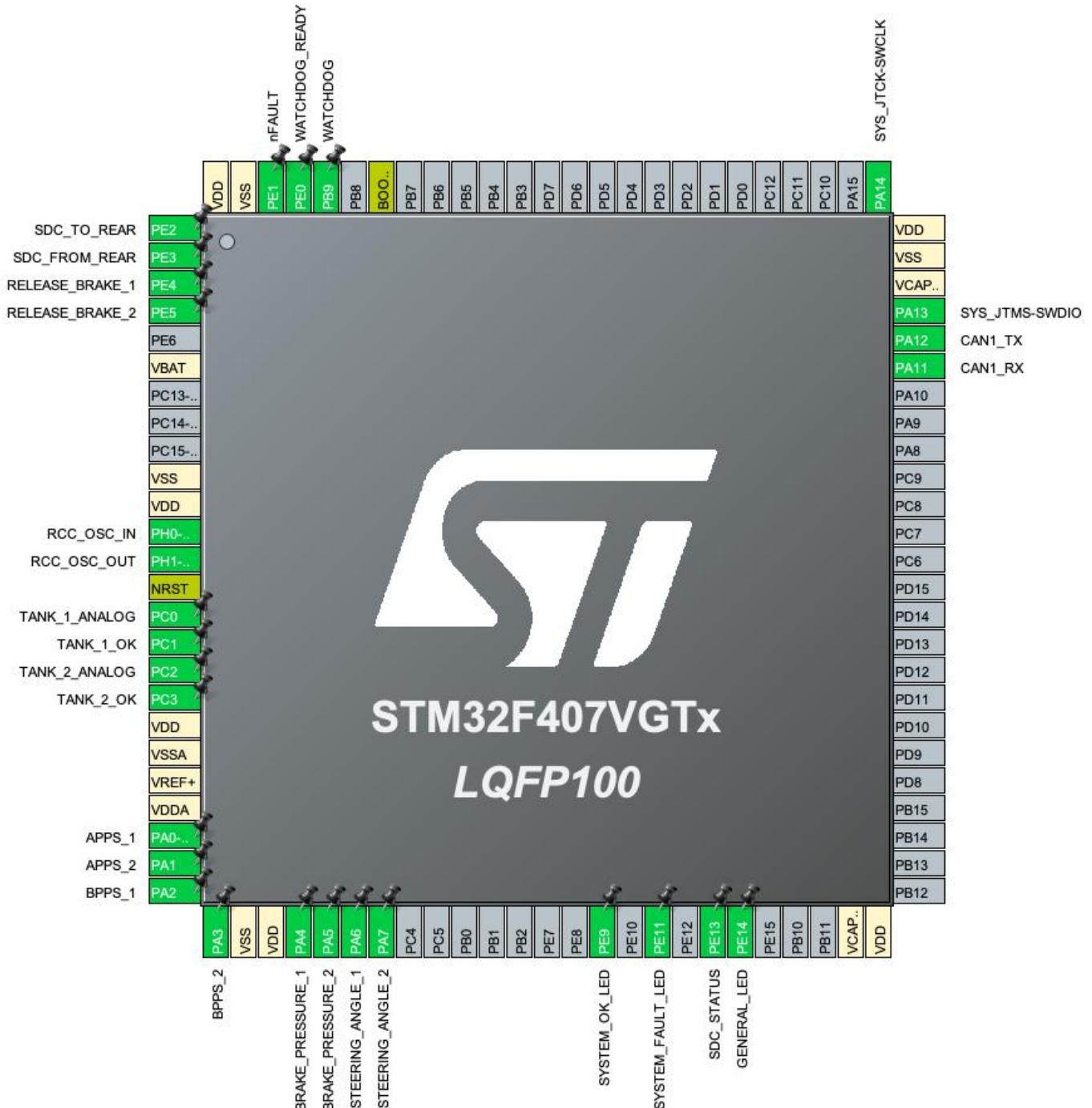
1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F407/417
MCU name	STM32F407VGTx
MCU Package	LQFP100
MCU Pin number	100

1.3. Core(s) information

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



3. Pins Configuration

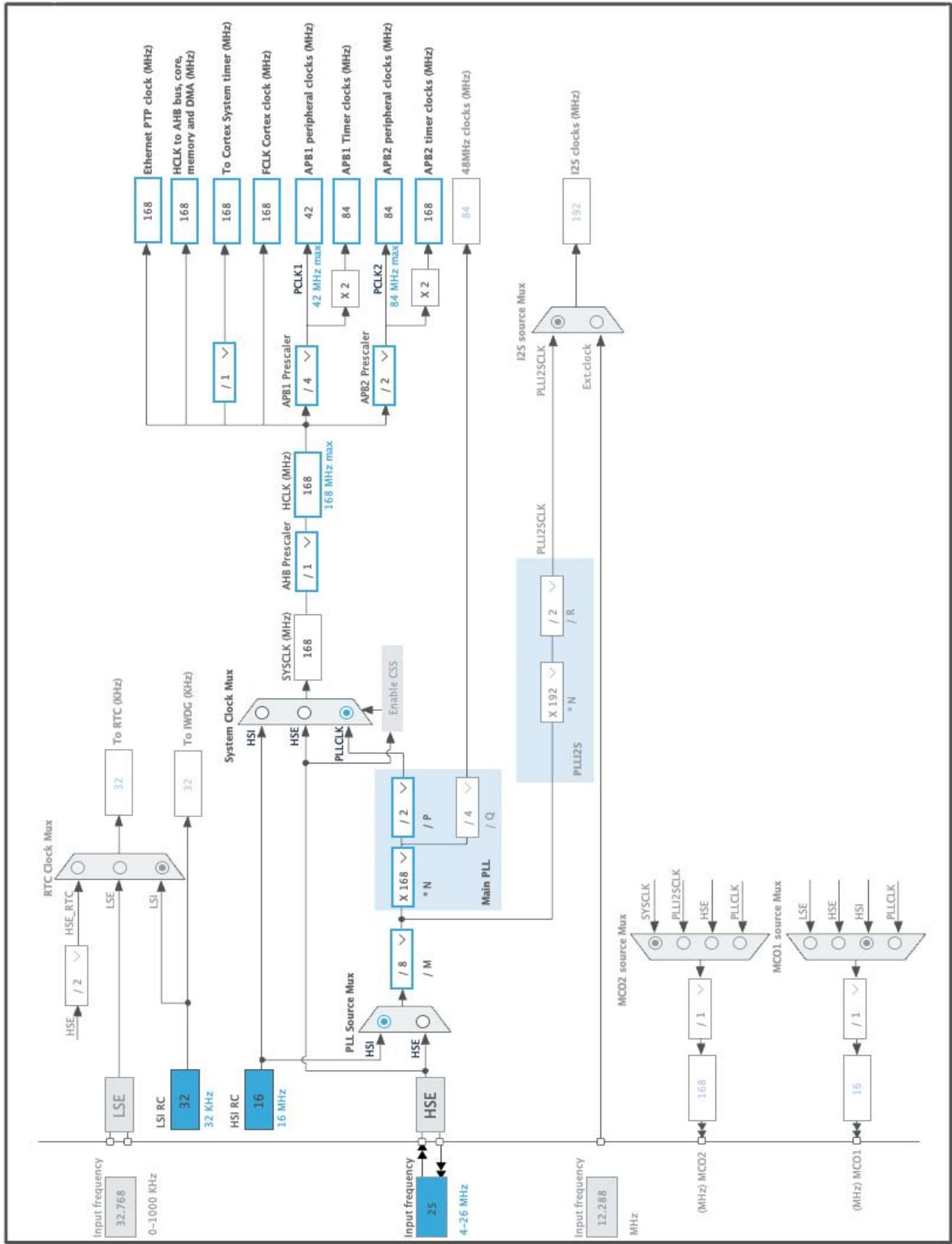
Pin Number LQFP100	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	PE2 *	I/O	GPIO_Input	SDC_TO_REAR
2	PE3 *	I/O	GPIO_Input	SDC_FROM_REAR
3	PE4 *	I/O	GPIO_Output	RELEASE_BRAKE_1
4	PE5 *	I/O	GPIO_Output	RELEASE_BRAKE_2
6	VBAT	Power		
10	VSS	Power		
11	VDD	Power		
12	PH0-OSC_IN	I/O	RCC_OSC_IN	
13	PH1-OSC_OUT	I/O	RCC_OSC_OUT	
14	NRST	Reset		
15	PC0	I/O	ADC2_IN10	TANK_1_ANALOG
16	PC1 *	I/O	GPIO_Input	TANK_1_OK
17	PC2	I/O	ADC2_IN12	TANK_2_ANALOG
18	PC3 *	I/O	GPIO_Input	TANK_2_OK
19	VDD	Power		
20	VSSA	Power		
21	VREF+	Power		
22	VDDA	Power		
23	PA0-WKUP	I/O	ADC1_IN0	APPS_1
24	PA1	I/O	ADC1_IN1	APPS_2
25	PA2	I/O	ADC1_IN2	BPPS_1
26	PA3	I/O	ADC1_IN3	BPPS_2
27	VSS	Power		
28	VDD	Power		
29	PA4	I/O	ADC2_IN4	BRAKE_PRESSURE_1
30	PA5	I/O	ADC2_IN5	BRAKE_PRESSURE_2
31	PA6	I/O	ADC1_IN6	STEERING_ANGLE_1
32	PA7	I/O	ADC1_IN7	STEERING_ANGLE_2
40	PE9 *	I/O	GPIO_Output	SYSTEM_OK_LED
42	PE11 *	I/O	GPIO_Output	SYSTEM_FAULT_LED
44	PE13 *	I/O	GPIO_Output	SDC_STATUS
45	PE14 *	I/O	GPIO_Output	GENERAL_LED
49	VCAP_1	Power		
50	VDD	Power		
70	PA11	I/O	CAN1_RX	
71	PA12	I/O	CAN1_TX	

Frontbox_SW Project
Configuration Report

Pin Number LQFP100	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
72	PA13	I/O	SYS_JTMS-SWDIO	
73	VCAP_2	Power		
74	VSS	Power		
75	VDD	Power		
76	PA14	I/O	SYS_JTCK-SWCLK	
94	BOOT0	Boot		
96	PB9 *	I/O	GPIO_Output	WATCHDOG
97	PE0 *	I/O	GPIO_Input	WATCHDOG_READY
98	PE1 *	I/O	GPIO_Output	nFAULT
99	VSS	Power		
100	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	Frontbox_SW
Project Folder	/Users/philiplind/Documents/GitHub/Frontbox-SW
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_F4 V1.28.0
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	SystemClock_Config	RCC
2	MX_GPIO_Init	GPIO
3	MX_DMA_Init	DMA
4	MX_ADC1_Init	ADC1
5	MX_ADC2_Init	ADC2
6	MX_CAN1_Init	CAN1
7	MX_TIM7_Init	TIM7
8	MX_TIM2_Init	TIM2
9	MX_TIM8_Init	TIM8

Frontbox_SW Project
Configuration Report

1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32F4
Line	STM32F407/417
MCU	STM32F407VGTx
Datasheet	DS8626_Rev8

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

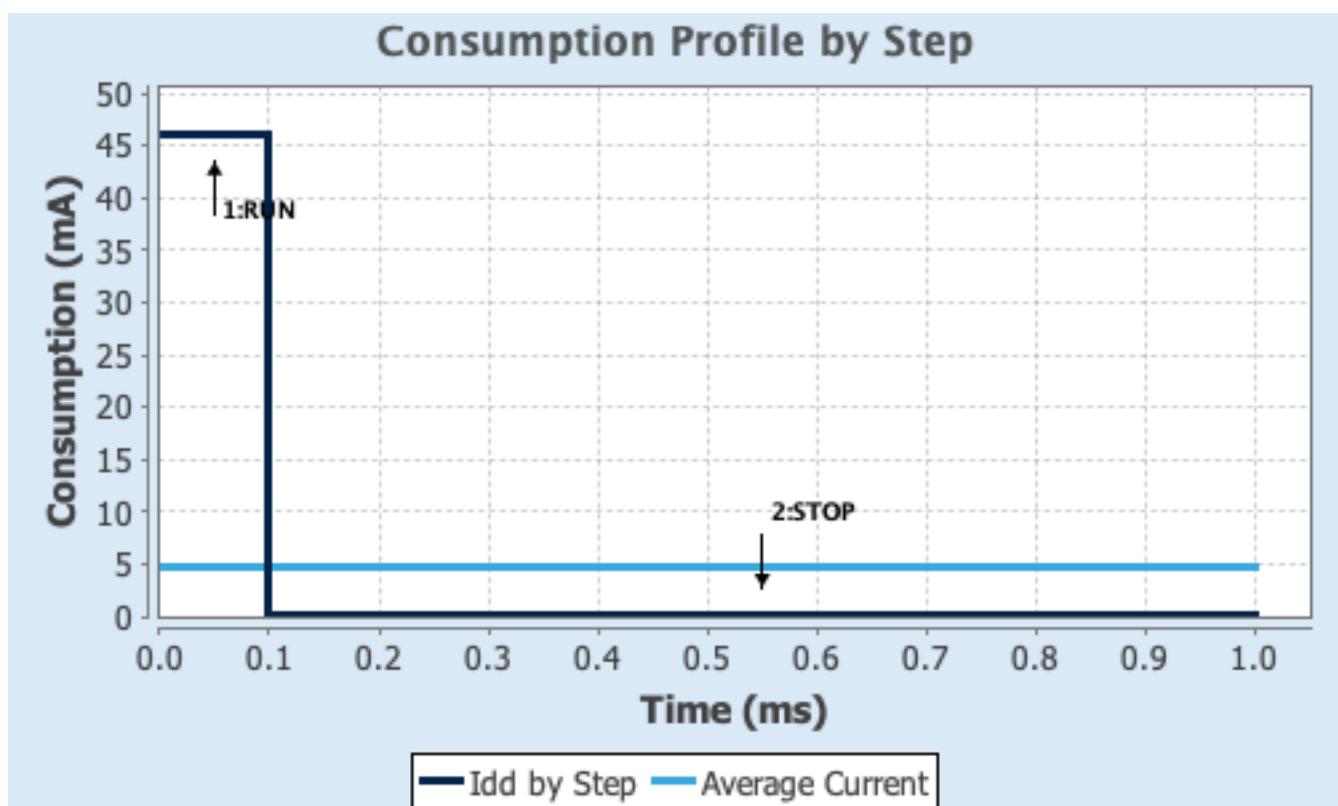
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP
Vdd	3.3	3.3
Voltage Source	Battery	Battery
Range	Scale1-High	No Scale
Fetch Type	FLASH	n/a
CPU Frequency	168 MHz	0 Hz
Clock Configuration	HSE PLL	Regulator LP Flash-PwrDwn
Clock Source Frequency	4 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	46 mA	280 µA
Duration	0.1 ms	0.9 ms
DMIPS	210.0	0.0
T_a Max	98.47	104.96
Category	In DS Table	In DS Table

1.5. Results

Sequence Time	1 ms	Average Current	4.85 mA
Battery Life	29 days, 4 hours	Average DMIPS	210.0 DMIPS

1.6. Chart



2. Peripherals and Middlewares Configuration

2.1. ADC1

mode: IN0

mode: IN1

mode: IN2

mode: IN3

mode: IN6

mode: IN7

2.1.1. 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 Enabled

Continuous Conversion Mode Disabled

Discontinuous Conversion Mode Disabled

DMA Continuous Requests Disabled

End Of Conversion Selection **EOC flag at the end of all conversions ***

ADC-Regular_ConversionMode:

Number Of Conversion **6 ***

External Trigger Conversion Source **Timer 2 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 6 ***

Sampling Time 3 Cycles

Rank **6 ***

Channel **Channel 7 ***

Sampling Time 3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions 0

WatchDog:

Enable Analog WatchDog Mode false

2.2. ADC2

mode: IN4

mode: IN5

mode: IN10

mode: IN12

2.2.1. 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 Enabled

Continuous Conversion Mode Disabled

Discontinuous Conversion Mode Disabled

DMA Continuous Requests Disabled

End Of Conversion Selection **EOC flag at the end of all conversions ***

ADC-Regular_ConversionMode:

Number Of Conversion **4 ***

External Trigger Conversion Source **Timer 8 Trigger Out event ***

External Trigger Conversion Edge Trigger detection on the rising edge

Rank 1

Channel **Channel 10 ***

Sampling Time 3 Cycles

Rank **2 ***

Channel Channel 4

Sampling Time 3 Cycles

<u>Rank</u>	3 *
Channel	Channel 10 *
Sampling Time	3 Cycles
<u>Rank</u>	4 *
Channel	Channel 12 *
Sampling Time	3 Cycles
ADC_Injected_ConversionMode:	
Number Of Conversions	0
WatchDog:	
Enable Analog WatchDog Mode	false

2.3. CAN1

mode: Activated

2.3.1. Parameter Settings:

Bit Timings Parameters:

Prescaler (for Time Quantum)	3 *
Time Quantum	71.42857142857143 *
Time Quanta in Bit Segment 1	11 Times *
Time Quanta in Bit Segment 2	2 Times *
Time for one Bit	1000
Baud Rate	1000000 *
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
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2.4. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

2.4.1. 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
HSE Startup Timeout Value (ms)	100
LSE Startup Timeout Value (ms)	5000

Power Parameters:

Power Regulator Voltage Scale	Power Regulator Voltage Scale 1
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2.5. SYS

Debug: Serial Wire

Timebase Source: TIM6

2.6. TIM2

Clock Source : Internal Clock

2.6.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	839 *
Counter Mode	Up
Counter Period (AutoReload Register - 32 bits value)	99999 *
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 *

2.7. TIM7

mode: Activated

2.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	49999 *
auto-reload preload	Disable

Trigger Output (TRGO) Parameters:

Trigger Event Selection	Reset (UG bit from TIMx_EGR)
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2.8. TIM8

Clock Source : Internal Clock

2.8.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	8399 *
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	10000-1 *
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	Update Event *

2.9. FREERTOS

Interface: CMSIS_V2

2.9.1. Config parameters:

API:

FreeRTOS API	CMSIS v2
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Versions:

FreeRTOS version	10.3.1
CMSIS-RTOS version	2.00

MPU/FPU:

ENABLE_MPU	Disabled
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ENABLE_FPU Disabled

Kernel settings:

USE_PREEMPTION Enabled

CPU_CLOCK_HZ SystemCoreClock

TICK_RATE_HZ 1000

MAX_PRIORITIES 56

MINIMAL_STACK_SIZE **256 ***

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_TRACEFacility 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 512

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

2.9.2. 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
pcTaskGetName	Disabled
uxTaskGetStackHighWaterMark	Enabled
xTaskGetCurrentTaskHandle	Enabled
eTaskGetState	Enabled
xEventGroupSetBitFromISR	Disabled
xTimerPendFunctionCall	Enabled
xTaskAbortDelay	Disabled
xTaskGetHandle	Disabled
uxTaskGetStackHighWaterMark2	Disabled

2.9.3. Advanced settings:

Newlib settings (see parameter description first):

USE_NEWLIB_REENTRANT Disabled

Project settings (see parameter description first):

Use FW pack heap file Enabled

* User modified value

3. System Configuration

3.1. 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	APPS_1
	PA1	ADC1_IN1	Analog mode	No pull-up and no pull-down	n/a	APPS_2
	PA2	ADC1_IN2	Analog mode	No pull-up and no pull-down	n/a	BPPS_1
	PA3	ADC1_IN3	Analog mode	No pull-up and no pull-down	n/a	BPPS_2
	PA6	ADC1_IN6	Analog mode	No pull-up and no pull-down	n/a	STEERING_ANGLE_1
	PA7	ADC1_IN7	Analog mode	No pull-up and no pull-down	n/a	STEERING_ANGLE_2
ADC2	PC0	ADC2_IN10	Analog mode	No pull-up and no pull-down	n/a	TANK_1_ANALOG
	PC2	ADC2_IN12	Analog mode	No pull-up and no pull-down	n/a	TANK_2_ANALOG
	PA4	ADC2_IN4	Analog mode	No pull-up and no pull-down	n/a	BRAKE_PRESSURE_1
	PA5	ADC2_IN5	Analog mode	No pull-up and no pull-down	n/a	BRAKE_PRESSURE_2
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	
GPIO	PE2	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	SDC_TO_REAR
	PE3	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	SDC_FROM_REAR
	PE4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	RELEASE_BRAKE_1
	PE5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	RELEASE_BRAKE_2
	PC1	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	TANK_1_OK
	PC3	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	TANK_2_OK
	PE9	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	SYSTEM_OK_LED
	PE11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	SYSTEM_FAULT_LED
	PE13	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	SDC_STATUS
	PE14	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	GENERAL_LED
	PB9	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	WATCHDOG
	PE0	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	WATCHDOG_READY
	PE1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	nFAULT

3.2. DMA configuration

DMA request	Stream	Direction	Priority
ADC1	DMA2_Stream0	Peripheral To Memory	Low
ADC2	DMA2_Stream2	Peripheral To Memory	Low

ADC1: DMA2_Stream0 DMA request Settings:

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

ADC2: DMA2_Stream2 DMA request Settings:

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

3.3. NVIC configuration

3.3.1. NVIC

Interrupt Table	Enable	Preenemption 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
TIM6 global interrupt, DAC1 and DAC2 underrun error interrupts	true	15	0
TIM7 global interrupt	true	5	0
DMA2 stream0 global interrupt	true	5	0
DMA2 stream2 global interrupt	true	5	0
PVD interrupt through EXTI line 16		unused	
Flash global interrupt		unused	
RCC global interrupt		unused	
ADC1, ADC2 and ADC3 global interrupts		unused	
CAN1 TX interrupts		unused	
CAN1 RX0 interrupts		unused	
CAN1 RX1 interrupt		unused	
CAN1 SCE interrupt		unused	
TIM2 global interrupt		unused	
TIM8 break interrupt and TIM12 global interrupt		unused	
TIM8 update interrupt and TIM13 global interrupt		unused	
TIM8 trigger and commutation interrupts and TIM14 global interrupt		unused	
TIM8 capture compare interrupt		unused	
FPU global interrupt		unused	

3.3.2. 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

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
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
TIM6 global interrupt, DAC1 and DAC2 underrun error interrupts	false	true	true
TIM7 global interrupt	false	true	true
DMA2 stream0 global interrupt	false	true	true
DMA2 stream2 global interrupt	false	true	true

* User modified value

4. System Views

4.1. Category view

4.1.1. Current



5. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f405-415_407-417_bsdl.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32f405-415_407-417_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
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/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/an1181-electrostatic-discharge-sensitivity-measurement-stmicroelectronics.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/an2867-oscillator-design-guide-for-stm8afals-stm32-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/an3371-using-the-hardware-realtime-clock-rtc-in-stm32-f0-f2-f3-f4-and-l1-series-of-mcus-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/an4013-stm32-crossseries-timer-overview-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/an4073-how-to-improve-adc-accuracy-when-using-stm32f2xx-and-stm32f4xx-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4076-two-or-three-shunt-resistor-based-current-sensing-circuit-design-in-3phase-inverters-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/an4229-how-to-implement-a-vocoder-solution-using-stm32-microcontrollers-stmicroelectronics.pdf

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