



1. Description

1.1. Project

Project Name	tlb_battery
Board Name	custom
Generated with:	STM32CubeMX 6.8.0
Date	05/23/2023

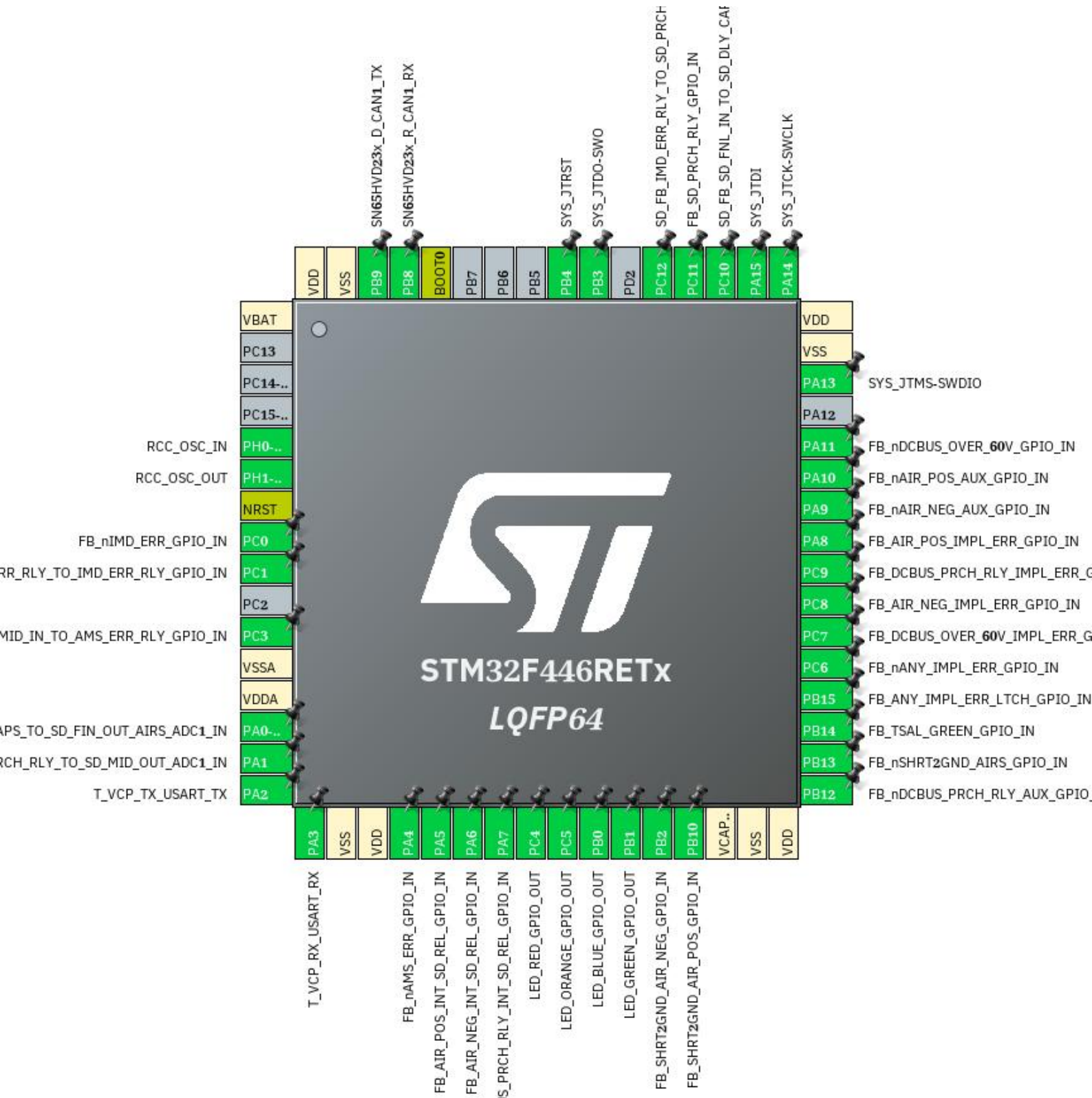
1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F446
MCU name	STM32F446RETx
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

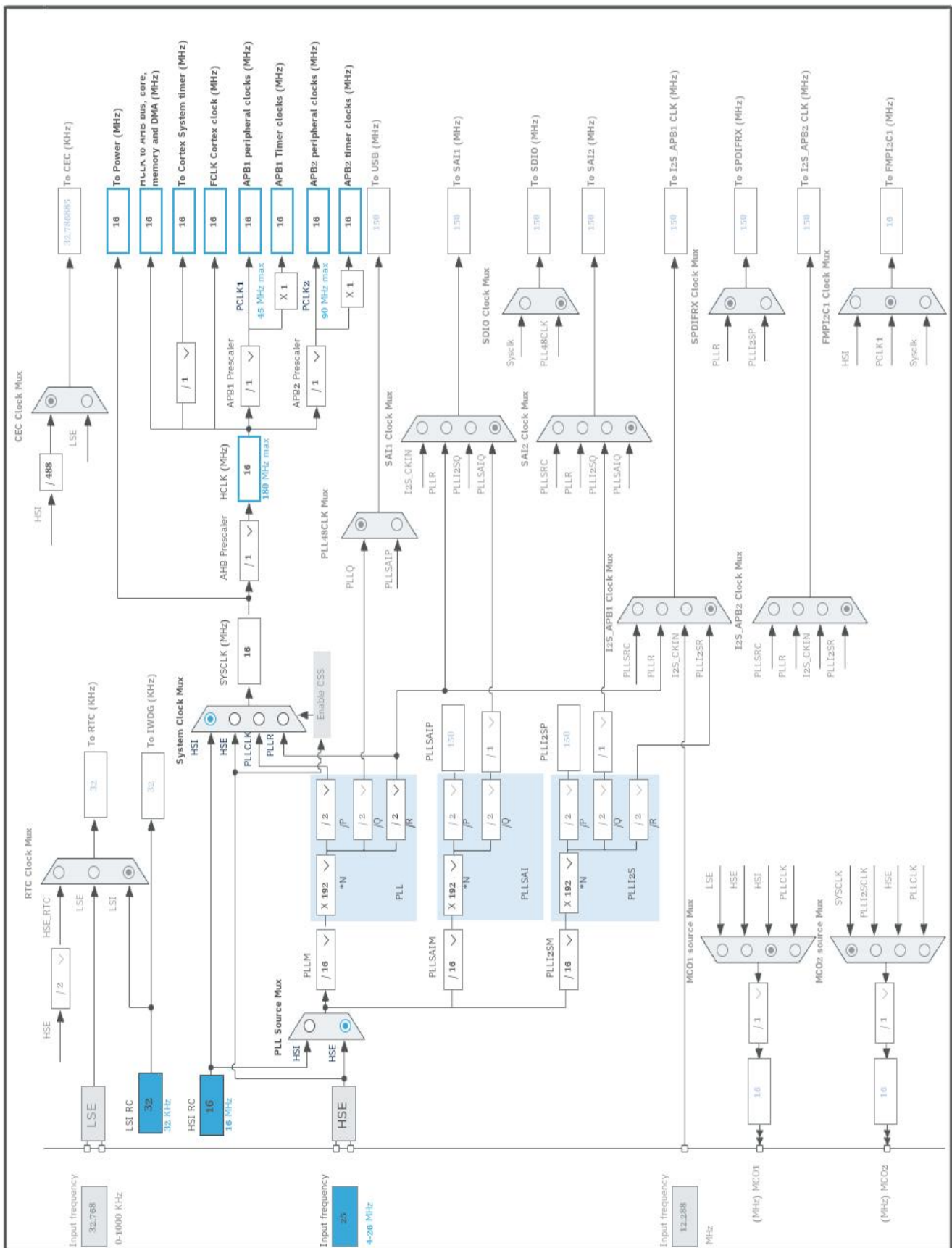
Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
5	PH0-OSC_IN	I/O	RCC_OSC_IN	
6	PH1-OSC_OUT	I/O	RCC_OSC_OUT	
7	NRST	Reset		
8	PC0 *	I/O	GPIO_Input	FB_nIMD_ERR_GPIO_IN
9	PC1 *	I/O	GPIO_Input	SD_FB_AMS_ERR_RLY_T O_IMD_ERR_RLY_GPIO_I N
11	PC3 *	I/O	GPIO_Input	SD_FB_SD_MID_IN_TO_A MS_ERR_RLY_GPIO_IN
12	VSSA	Power		
13	VDDA	Power		
14	PA0-WKUP	I/O	ADC1_IN0	SD_FB_SD_DLY_CAPS_T O_SD_FIN_OUT_AIRS_AD C1_IN
15	PA1	I/O	ADC1_IN1	SD_FB_SD_PRCH_RLY_T O_SD_MID_OUT_ADC1_IN
16	PA2	I/O	USART2_TX	T_VCP_TX_USART_TX
17	PA3	I/O	USART2_RX	T_VCP_RX_USART_RX
18	VSS	Power		
19	VDD	Power		
20	PA4 *	I/O	GPIO_Input	FB_nAMS_ERR_GPIO_IN
21	PA5 *	I/O	GPIO_Input	FB_AIR_POS_INT_SD_REL _GPIO_IN
22	PA6 *	I/O	GPIO_Input	FB_AIR_NEG_INT_SD_RE L_GPIO_IN
23	PA7 *	I/O	GPIO_Input	FB_DCBUS_PRCH_RLY_IN T_SD_REL_GPIO_IN
24	PC4 *	I/O	GPIO_Output	LED_RED_GPIO_OUT
25	PC5 *	I/O	GPIO_Output	LED_ORANGE_GPIO_OUT
26	PB0 *	I/O	GPIO_Output	LED_BLUE_GPIO_OUT
27	PB1 *	I/O	GPIO_Output	LED_GREEN_GPIO_OUT
28	PB2 *	I/O	GPIO_Input	FB_SHRT2GND_AIR_NEG _GPIO_IN
29	PB10 *	I/O	GPIO_Input	FB_SHRT2GND_AIR_POS _GPIO_IN
30	VCAP_1	Power		
31	VSS	Power		

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
32	VDD	Power		
33	PB12 *	I/O	GPIO_Input	FB_nDCBUS_PRCH_RLY_ AUX_GPIO_IN
34	PB13 *	I/O	GPIO_Input	FB_nSHRT2GND_AIRS_GP IO_IN
35	PB14 *	I/O	GPIO_Input	FB_TSAL_GREEN_GPIO_I N
36	PB15 *	I/O	GPIO_Input	FB_ANY_IMPL_ERR_LTCH _GPIO_IN
37	PC6 *	I/O	GPIO_Input	FB_nANY_IMPL_ERR_GPI O_IN
38	PC7 *	I/O	GPIO_Input	FB_DCBUS_OVER_60V_IM PL_ERR_GPIO_IN
39	PC8 *	I/O	GPIO_Input	FB_AIR_NEG_IMPL_ERR_ GPIO_IN
40	PC9 *	I/O	GPIO_Input	FB_DCBUS_PRCH_RLY_I MPL_ERR_GPIO_IN
41	PA8 *	I/O	GPIO_Input	FB_AIR_POS_IMPL_ERR_ GPIO_IN
42	PA9 *	I/O	GPIO_Input	FB_nAIR_NEG_AUX_GPIO _IN
43	PA10 *	I/O	GPIO_Input	FB_nAIR_POS_AUX_GPIO _IN
44	PA11 *	I/O	GPIO_Input	FB_nDCBUS_OVER_60V_ GPIO_IN
46	PA13	I/O	SYS_JTMS-SWDIO	
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	
50	PA15	I/O	SYS_JTDI	
51	PC10 *	I/O	GPIO_Input	SD_FB_SD_FNL_IN_TO_S D_DLY_CAPS_GPIO_IN
52	PC11 *	I/O	GPIO_Input	FB_SD_PRCH_RLY_GPIO_ IN
53	PC12 *	I/O	GPIO_Input	SD_FB_IMD_ERR_RLY_TO _SD_PRCH_RLY_GPIO_IN
55	PB3	I/O	SYS_JTDO-SWO	
56	PB4	I/O	SYS_JTRST	
60	BOOT0	Boot		
61	PB8	I/O	CAN1_RX	SN65HVD23x_R_CAN1_RX
62	PB9	I/O	CAN1_TX	SN65HVD23x_D_CAN1_TX
63	VSS	Power		

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
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	tlb_battery
Project Folder	/home/simone/Documents/10.SquadraCorse/Work/tlb_battery
Toolchain / IDE	Makefile
Firmware Package Name and Version	STM32Cube FW_F4 V1.27.1
Application Structure	Advanced
Generate Under Root	No
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 all used libraries into the project folder
Generate peripheral initialization as a pair of '.c/.h' files	Yes
Backup previously generated files when re-generating	Yes
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_ADC1_Init	ADC1
4	MX_CAN1_Init	CAN1
5	MX_TIM1_Init	TIM1
6	MX_USART2_UART_Init	USART2

6. Power Consumption Calculator report

6.1. Microcontroller Selection

Series	STM32F4
Line	STM32F446
MCU	STM32F446RETx
Datasheet	DS10693_Rev6

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

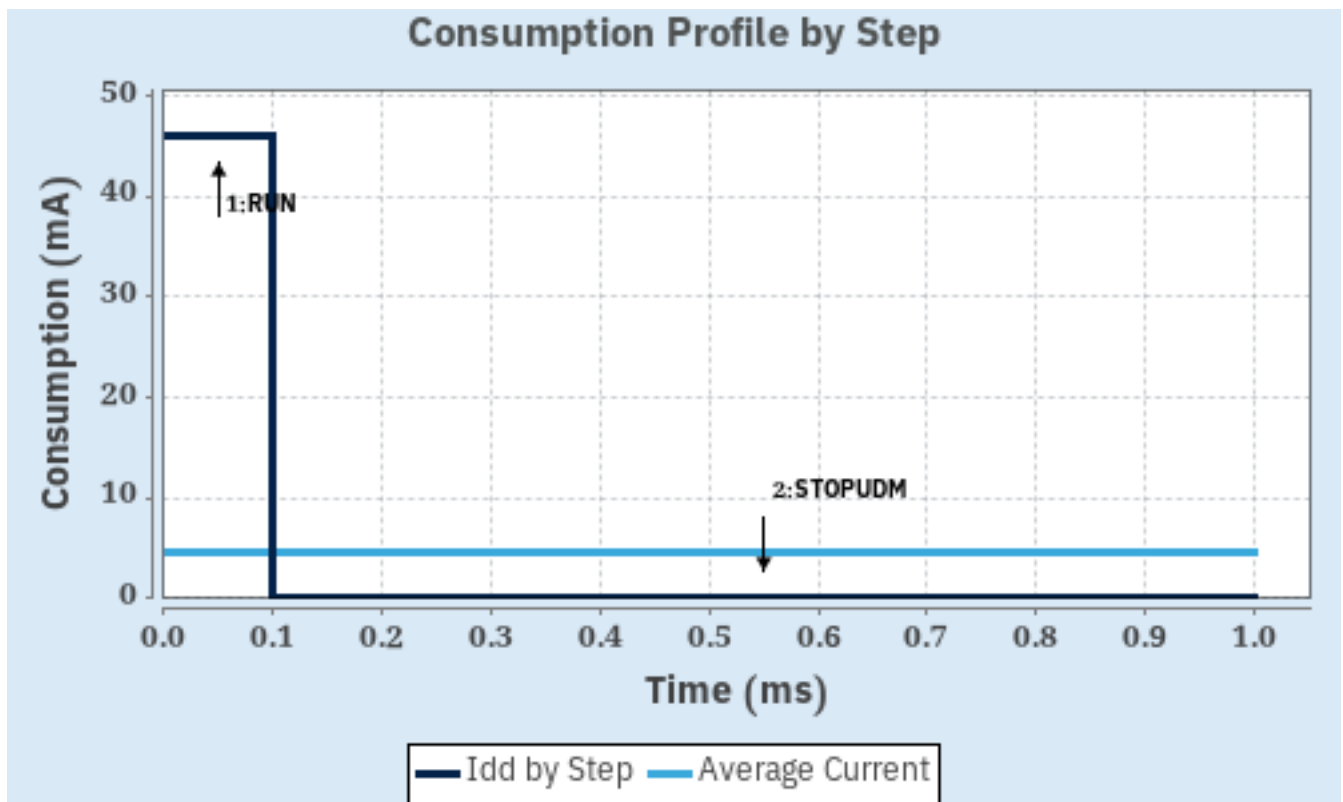
6.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP UDM (Under Drive)
Vdd	3.3	3.3
Voltage Source	Battery	Battery
Range	Scale1-High	No Scale
Fetch Type	RAM/FLASH/REGON/ART/P REFETCH	n/a
CPU Frequency	180 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	55 μ A
Duration	0.1 ms	0.9 ms
DMIPS	225.0	0.0
Ta Max	98.02	104.99
Category	In DS Table	In DS Table

6.5. Results

Sequence Time	1 ms	Average Current	4.65 mA
Battery Life	1 month	Average DMIPS	225.0 DMIPS

6.6. Chart



7. Peripherals and Middlewares Configuration

7.1. ADC1

mode: IN0

mode: IN1

7.1.1. Parameter Settings:

ADCs_Common_Settings:

Mode	Independent mode
ADC_Settings:	
Clock Prescaler	PCLK2 divided by 2
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
<u>Rank</u>	1
Channel	Channel 0
Sampling Time	3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions	0
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WatchDog:

Enable Analog WatchDog Mode	false
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7.2. CAN1

mode: Activated

7.2.1. Parameter Settings:

Bit Timings Parameters:

Prescaler (for Time Quantum)	16
Time Quantum	1000.0 *
Time Quanta in Bit Segment 1	1 Time
Time Quanta in Bit Segment 2	1 Time

Time for one Bit	3000 *
Baud Rate	333333 *
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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7.3. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

7.3.1. 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 Timeout Value (ms)	100
LSE Startup Timeout Value (ms)	5000

Power Parameters:

Power Regulator Voltage Scale	Power Regulator Voltage Scale 3
Power Over Drive	Disabled

7.4. SYS

Debug: JTAG (5 pins)

Timebase Source: SysTick

7.5. TIM1

Clock Source : Internal Clock

7.5.1. 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
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)

7.6. USART2

Mode: Asynchronous

7.6.1. 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

* 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	SD_FB_SD_DLY_CAPS_T O_SD_FIN_OUT_AIRS_A DC1_IN
	PA1	ADC1_IN1	Analog mode	No pull-up and no pull-down	n/a	SD_FB_SD_PRCH_RLY_ TO_SD_MID_OUT_ADC1 _IN
CAN1	PB8	CAN1_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SN65HVD23x_R_CAN1_R X
	PB9	CAN1_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SN65HVD23x_D_CAN1_T X
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	
	PA15	SYS_JTDI	n/a	n/a	n/a	
	PB3	SYS_JTDO- SWO	n/a	n/a	n/a	
	PB4	SYS_JTRST	n/a	n/a	n/a	
USART2	PA2	USART2_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	T_VCP_TX_USART_TX
	PA3	USART2_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	T_VCP_RX_USART_RX
GPIO	PC0	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nIMD_ERR_GPIO_IN
	PC1	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	SD_FB_AMS_ERR_RLY_ TO_IMD_ERR_RLY_GPIO _IN
	PC3	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	SD_FB_SD_MID_IN_TO_ AMS_ERR_RLY_GPIO_IN
	PA4	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nAMS_ERR_GPIO_IN
	PA5	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_AIR_POS_INT_SD_R EL_GPIO_IN
	PA6	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_AIR_NEG_INT_SD_R EL_GPIO_IN
	PA7	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_DCBUS_PRCH_RLY_I

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
						NT_SD_REL_GPIO_IN
	PC4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_RED_GPIO_OUT
	PC5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_ORANGE_GPIO_OUT
	PB0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_BLUE_GPIO_OUT
	PB1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_GREEN_GPIO_OUT
	PB2	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_SHRT2GND_AIR_NEG_GPIO_IN
	PB10	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_SHRT2GND_AIR_POS_GPIO_IN
	PB12	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nDCBUS_PRCH_RLY_AUX_GPIO_IN
	PB13	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nSHRT2GND_AIRS_GPIO_IN
	PB14	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_TSAL_GREEN_GPIO_IN
	PB15	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_ANY_IMPL_ERR_LATCH_GPIO_IN
	PC6	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nANY_IMPL_ERR_GPIO_IN
	PC7	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_DCBUS_OVER_60V_IMPL_ERR_GPIO_IN
	PC8	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_AIR_NEG_IMPL_ERR_GPIO_IN
	PC9	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_DCBUS_PRCH_RLY_IMPL_ERR_GPIO_IN
	PA8	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_AIR_POS_IMPL_ERR_GPIO_IN
	PA9	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nAIR_NEG_AUX_GPIO_IN
	PA10	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nAIR_POS_AUX_GPIO_IN
	PA11	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_nDCBUS_OVER_60V_GPIO_IN
	PC10	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	SD_FB_SD_FNL_IN_TO_SD_DLY_CAPS_GPIO_IN
	PC11	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	FB_SD_PRCH_RLY_GPIO_IN
	PC12	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	SD_FB_IMD_ERR_RLY_TO_SD_PRCH_RLY_GPIO_IN

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	0	0
System tick timer	true	15	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1, ADC2 and ADC3 interrupts	unused		
CAN1 TX interrupt	unused		
CAN1 RX0 interrupt	unused		
CAN1 RX1 interrupt	unused		
CAN1 SCE interrupt	unused		
TIM1 break interrupt and TIM9 global interrupt	unused		
TIM1 update interrupt and TIM10 global interrupt	unused		
TIM1 trigger and commutation interrupts and TIM11 global interrupt	unused		
TIM1 capture compare interrupt	unused		
USART2 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	true	false
Debug monitor	false	true	false
Pendable request for system service	false	true	false

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
System tick timer	false	true	true

* User modified value

9. System Views

9.1. Category view

9.1.1. Current

Middleware

System Core

Analog

Timers

Connectivity

Multimedia

Computing

DMA

ADC1 

TIM1 

CAN1 

GPIO 

USART2 

NVIC 

RCC 

SYS 

10. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f446_bsdl.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32f446_ibis.zip
System View Description	https://www.st.com/resource/en/svd/stm32f4_svd.zip
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f446_bsdl.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32f446_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
Training Material	https://www.st.com/resource/en/sales_guide/sg_sc2154.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/an2834-how-to-get-the-best-adc-accuracy-in-stm32-microcontrollers-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/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/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

Application Notes https://www.st.com/resource/en/application_note/an4230-stm32-microcontroller-random-number-generation-validation-using-the-nist-statistical-test-suite-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4277-using-stm32-device-pwm-shutdown-features-for-motor-control-and-digital-power-conversion-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-stm32f4xxx-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/an4640-peripherals-interconnections-on-stm32f4057xx-stm32f4157xx-stm32f42xxx-stm32f43xxx-stm32f446xx-and-stm32f469479xx-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/an4658-migration-of-applications-from-stm32f429439-lines-to-stm32f446-line-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/an4759-using-the-hardware-realtime-clock-rtc-and-the-tamper-management-unit-tamp-with-

stm32-microcontrollers-stmicroelectronics.pdf

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