



1. Description

1.1. Project

Project Name	self-balancing-robot
Board Name	NUCLEO-F446RE
Generated with:	STM32CubeMX 6.15.0
Date	09/10/2025

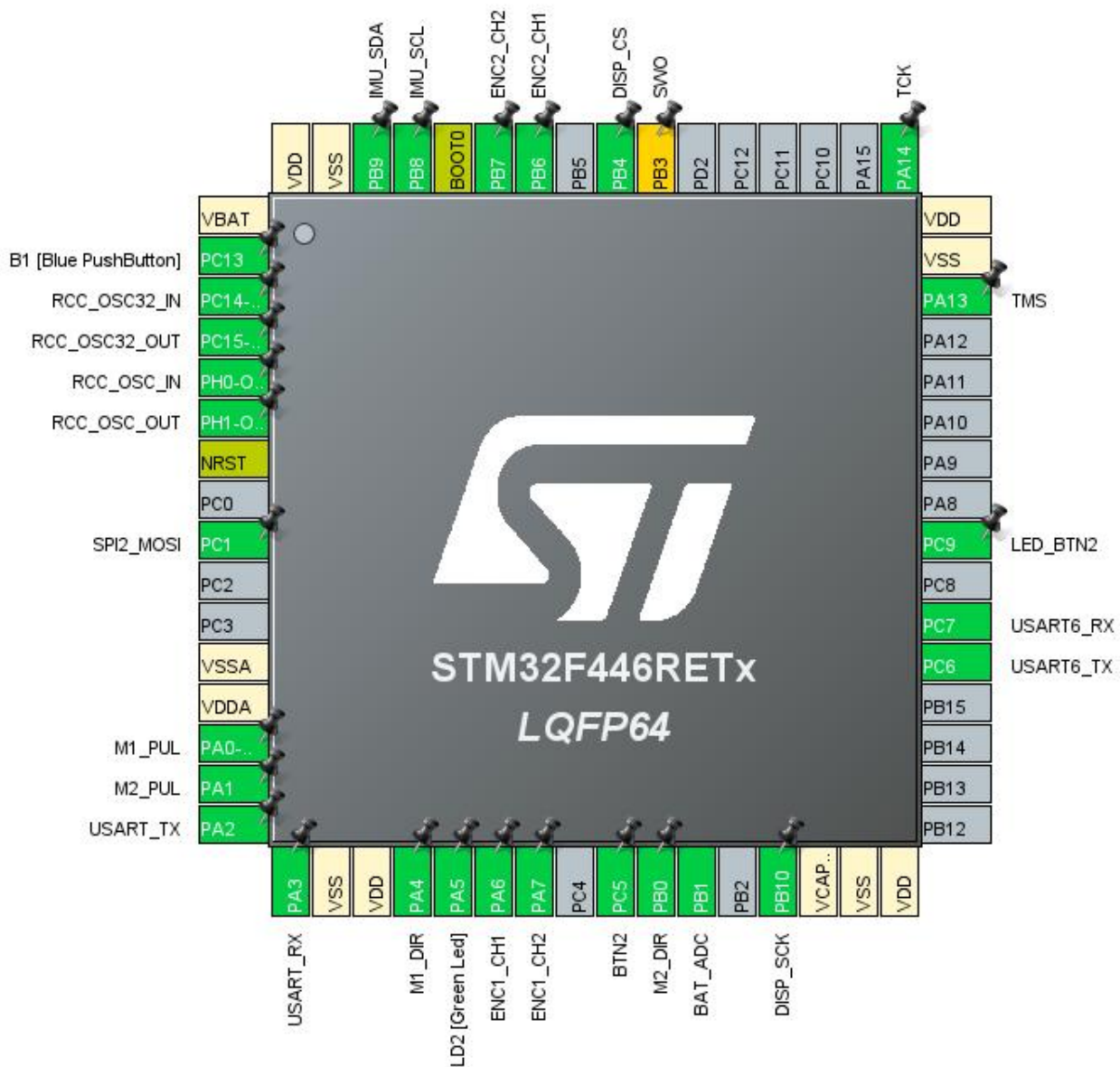
1.2. MCU

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

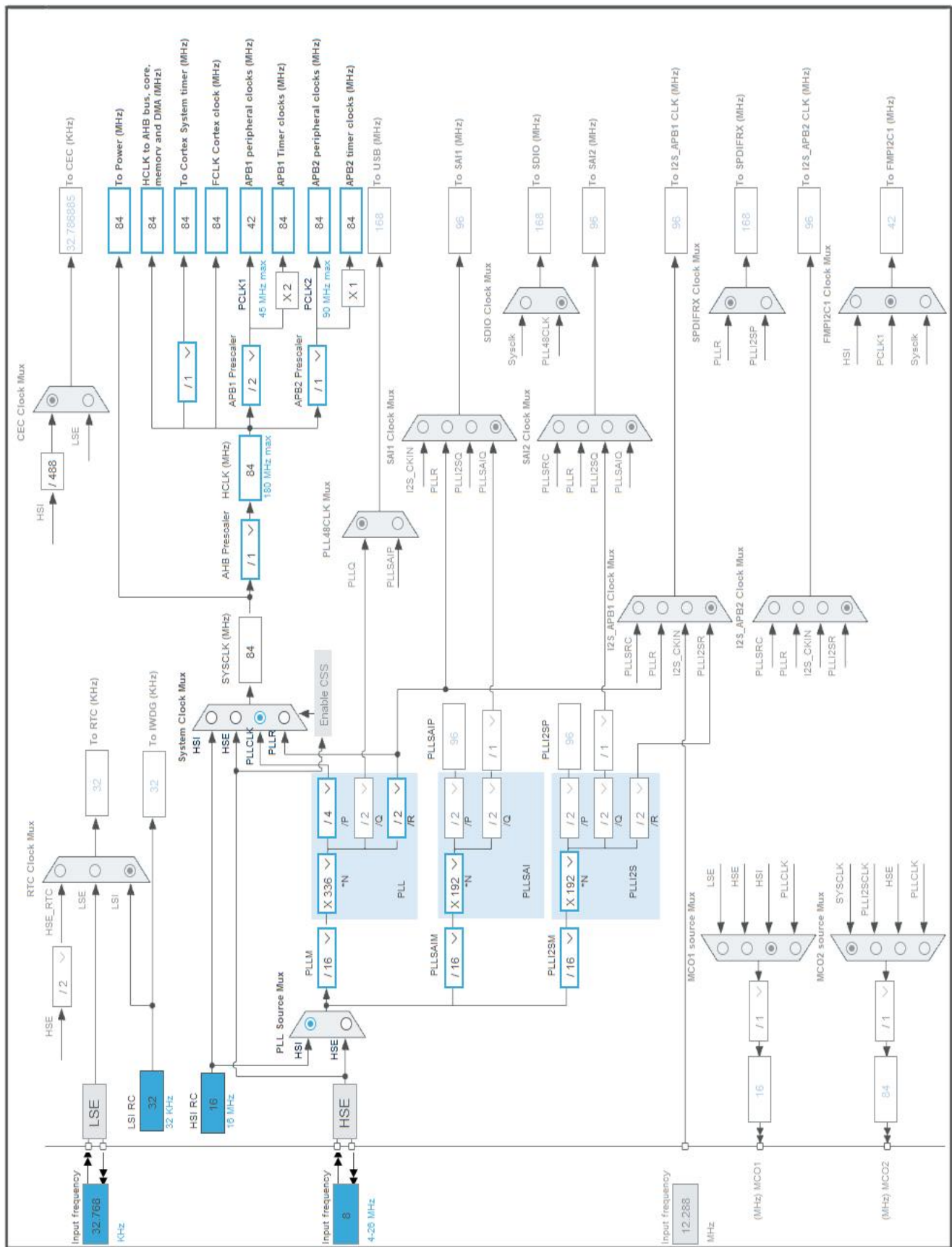
Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
2	PC13	I/O	GPIO_EXTI13	B1 [Blue PushButton]
3	PC14-OSC32_IN	I/O	RCC_OSC32_IN	
4	PC15-OSC32_OUT	I/O	RCC_OSC32_OUT	
5	PH0-OSC_IN	I/O	RCC_OSC_IN	
6	PH1-OSC_OUT	I/O	RCC_OSC_OUT	
7	NRST	Reset		
9	PC1	I/O	SPI2_MOSI	
12	VSSA	Power		
13	VDDA	Power		
14	PA0-WKUP	I/O	TIM5_CH1	M1_PUL
15	PA1	I/O	TIM2_CH2	M2_PUL
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	M1_DIR
21	PA5 *	I/O	GPIO_Output	LD2 [Green Led]
22	PA6	I/O	TIM3_CH1	ENC1_CH1
23	PA7	I/O	TIM3_CH2	ENC1_CH2
25	PC5	I/O	GPIO_EXTI5	BTN2
26	PB0 *	I/O	GPIO_Output	M2_DIR
27	PB1	I/O	ADC1_IN9	BAT_ADC
29	PB10	I/O	SPI2_SCK	DISP_SCK
30	VCAP_1	Power		
31	VSS	Power		
32	VDD	Power		
37	PC6	I/O	USART6_TX	
38	PC7	I/O	USART6_RX	
40	PC9 *	I/O	GPIO_Output	LED_BTN2
46	PA13	I/O	SYS_JTMS-SWDIO	TMS
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	TCK
55	PB3 **	I/O	SYS_JTDO-SWO	SWO
56	PB4 *	I/O	GPIO_Output	DISP_CS

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
58	PB6	I/O	TIM4_CH1	ENC2_CH1
59	PB7	I/O	TIM4_CH2	ENC2_CH2
60	BOOT0	Boot		
61	PB8	I/O	I2C1_SCL	IMU_SCL
62	PB9	I/O	I2C1_SDA	IMU_SDA
63	VSS	Power		
64	VDD	Power		

* The pin is affected with an I/O function

** The pin is affected with a peripheral function but no peripheral mode is activated

4. Clock Tree Configuration



1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32F4
Line	STM32F446
MCU	STM32F446RETx
Datasheet	DS10693_Rev6

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

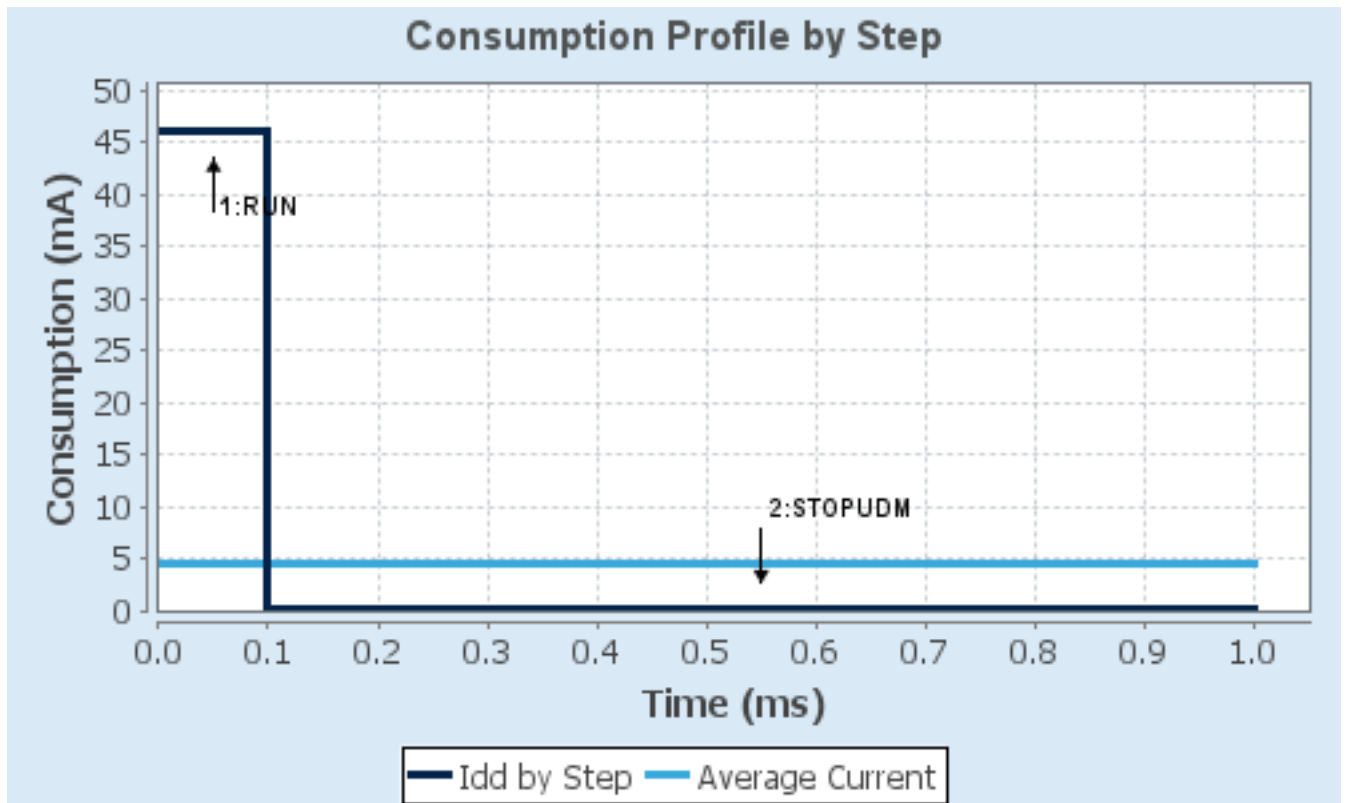
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP 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

1.5. Results

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

1.6. Chart



2. Software Project

2.1. Project Settings

Name	Value
Project Name	self-balancing-robot
Project Folder	C:\Users\Fra\git\SBRobot
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_F4 V1.28.2
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	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)	Yes
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_DMA_Init	DMA
4	MX_USART2_UART_Init	USART2
5	MX_TIM4_Init	TIM4
6	MX_TIM6_Init	TIM6
7	MX_SPI2_Init	SPI2
8	MX_TIM2_Init	TIM2
9	MX_TIM7_Init	TIM7
10	MX_TIM3_Init	TIM3
11	MX_TIM5_Init	TIM5

Rank	Function Name	Peripheral Instance Name
12	MX_ADC1_Init	ADC1
13	MX_I2C1_Init	I2C1
14	MX_TIM10_Init	TIM10
15	MX_USART6_UART_Init	USART6
16	MX_TIM1_Init	TIM1
17	MX_TIM8_Init	TIM8

3. Peripherals and Middlewares Configuration

3.1. ADC1

mode: IN9

3.1.1. Parameter Settings:

ADCs_Common_Settings:

Mode Independent mode

ADC_Settings:

Clock Prescaler	PCLK2 divided by 8 *
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 9
Sampling Time	3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions 0

WatchDog:

Enable Analog WatchDog Mode false

3.2. I2C1

I2C: I2C

3.2.1. 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

3.3. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

Low Speed Clock (LSE) : Crystal/Ceramic Resonator

3.3.1. 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

Power Parameters:

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

3.4. SPI2

Mode: Half-Duplex Master

3.4.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	2
Baud Rate	21.0 MBits/s *
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

3.5. SYS

Debug: Serial Wire

Timebase Source: SysTick

3.6. TIM1

Clock Source : Internal Clock

3.6.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	83 *
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)	Enable (Trigger delayed for master/slaves simultaneous start) *
Trigger Event Selection	Update Event *

3.7. TIM2

Channel2: PWM Generation CH2

3.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Counter Period (AutoReload Register - 32 bits value)	4294967295
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)
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Trigger Event Selection Reset (UG bit from TIMx_EGR)

PWM Generation Channel 2:

Mode	PWM mode 1
Pulse (32 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

3.8. TIM3

Channel3: Output Compare No Output

Combined Channels: Encoder Mode

3.8.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	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	Reset (UG bit from TIMx_EGR)

Output Compare No Output Channel 3:

Mode	Active Level on match *
Pulse (16 bits value)	0
Output compare preload	Disable
CH Polarity	High

Encoder:

Encoder Mode	Encoder Mode TI1 and TI2 *
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_____ Parameters for Channel 1 _____

Polarity	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter	0

_____ Parameters for Channel 2 _____

Polarity	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter	0

3.9. TIM4

Channel3: Output Compare No Output

Combined Channels: Encoder Mode

3.9.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	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	Reset (UG bit from TIMx_EGR)

Output Compare No Output Channel 3:

Mode	Active Level on match *
Pulse (16 bits value)	0
Output compare preload	Disable
CH Polarity	High

Encoder:

Encoder Mode	Encoder Mode TI1 and TI2 *
____ Parameters for Channel 1 ____	
Polarity	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter	0
____ Parameters for Channel 2 ____	
Polarity	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter	0

3.10. TIM5

Channel1: PWM Generation CH1

3.10.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Counter Period (AutoReload Register - 32 bits value)	4294967295
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 1:

Mode	PWM mode 1
Pulse (32 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

3.11. TIM6**mode: Activated****3.11.1. Parameter Settings:****Counter Settings:**

Prescaler (PSC - 16 bits value)	999 *
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	8399 *
auto-reload preload	Disable

Trigger Output (TRGO) Parameters:

Trigger Event Selection	Reset (UG bit from TIMx_EGR)
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3.12. TIM7**mode: Activated****3.12.1. Parameter Settings:****Counter Settings:**

Prescaler (PSC - 16 bits value)	99 *
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	

8399 *

auto-reload preload

Disable

Trigger Output (TRGO) Parameters:

Trigger Event Selection

Reset (UG bit from TIMx_EGR)

3.13. TIM8

Slave Mode: External Clock Mode 1

Trigger Source: ITR0

3.13.1. 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

Slave Mode Controller

ETR mode 1

Trigger Output (TRGO) Parameters:

Master/Slave Mode (MSM bit)

Disable (Trigger input effect not delayed)

Trigger Event Selection

Reset (UG bit from TIMx_EGR)

3.14. TIM10

mode: Activated

3.14.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)

19 *

Counter Mode

Up

Counter Period (AutoReload Register - 16 bits value)

8399 *

Internal Clock Division (CKD)

No Division

auto-reload preload

Disable

3.15. USART2

Mode: Asynchronous

3.15.1. 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

3.16. USART6

Mode: Asynchronous

3.16.1. Parameter Settings:

Basic Parameters:

Baud Rate	38400 *
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

Advanced Parameters:

Data Direction	Receive Only *
Over Sampling	16 Samples

* 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	PB1	ADC1_IN9	Analog mode	No pull-up and no pull-down	n/a	BAT_ADC
I2C1	PB8	I2C1_SCL	Alternate Function Open Drain	No pull-up and no pull-down	Very High *	IMU_SCL
	PB9	I2C1_SDA	Alternate Function Open Drain	No pull-up and no pull-down	Very High *	IMU_SDA
RCC	PC14-OSC32_IN	RCC_OSC32_IN	n/a	n/a	n/a	
	PC15-OSC32_OUT	RCC_OSC32_OUT	n/a	n/a	n/a	
	PH0-OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	
	PH1-OSC_OUT	RCC_OSC_OUT	n/a	n/a	n/a	
SPI2	PC1	SPI2_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
	PB10	SPI2_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	DISP_SCK
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	TMS
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	TCK
TIM2	PA1	TIM2_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	M2_PUL
TIM3	PA6	TIM3_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	ENC1_CH1
	PA7	TIM3_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	ENC1_CH2
TIM4	PB6	TIM4_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	ENC2_CH1
	PB7	TIM4_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	ENC2_CH2
TIM5	PA0-WKUP	TIM5_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	M1_PUL
USART2	PA2	USART2_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	USART_TX
	PA3	USART2_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	USART_RX
USART6	PC6	USART6_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
	PC7	USART6_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
Single Mapped Signals	PB3	SYS_JTDO-SWO	n/a	n/a	n/a	SWO
GPIO	PC13	GPIO_EXTI13	External Interrupt Mode with Falling edge trigger detection	No pull-up and no pull-down	n/a	B1 [Blue PushButton]
	PA4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	M1_DIR
	PA5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LD2 [Green Led]
	PC5	GPIO_EXTI5	External Interrupt Mode with Falling edge trigger detection	Pull-up *	n/a	BTN2
	PB0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	M2_DIR
	PC9	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_BTN2
	PB4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Very High *	DISP_CS

4.2. DMA configuration

DMA request	Stream	Direction	Priority
I2C1_RX	DMA1_Stream0	Peripheral To Memory	Low
USART6_RX	DMA2_Stream1	Peripheral To Memory	Low

I2C1_RX: DMA1_Stream0 DMA request Settings:

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

USART6_RX: DMA2_Stream1 DMA request Settings:

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

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	0	0
System tick timer	true	0	0
DMA1 stream0 global interrupt	true	0	0
EXTI line[9:5] interrupts	true	0	0
TIM1 update interrupt and TIM10 global interrupt	true	0	0
TIM3 global interrupt	true	0	0
TIM4 global interrupt	true	0	0
TIM6 global interrupt and DAC1, DAC2 underrun error interrupts	true	0	0
TIM7 global interrupt	true	0	0
DMA2 stream1 global interrupt	true	0	0
USART6 global interrupt	true	0	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1, ADC2 and ADC3 interrupts	unused		
TIM1 break interrupt and TIM9 global interrupt	unused		
TIM1 trigger and commutation interrupts and TIM11 global interrupt	unused		
TIM1 capture compare interrupt	unused		
TIM2 global interrupt	unused		
I2C1 event interrupt	unused		
I2C1 error interrupt	unused		
SPI2 global interrupt	unused		
USART2 global interrupt	unused		
EXTI line[15:10] interrupts	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		

Interrupt Table	Enable	Preenmption Priority	SubPriority
TIM8 capture compare interrupt		unused	
TIM5 global 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	true	false
Debug monitor	false	true	false
Pendable request for system service	false	true	false
System tick timer	false	true	true
DMA1 stream0 global interrupt	false	true	true
EXTI line[9:5] interrupts	false	true	true
TIM1 update interrupt and TIM10 global interrupt	false	true	true
TIM3 global interrupt	false	true	true
TIM4 global interrupt	false	true	true
TIM6 global interrupt and DAC1, DAC2 underrun error interrupts	false	true	true
TIM7 global interrupt	false	true	true
DMA2 stream1 global interrupt	false	true	true
USART6 global interrupt	false	true	true

* User modified value

5. System Views

5.1. Category view

5.1.1. Current

Middleware

System Core

Analog

Timers

Connectivity

Multimedia

Computing

DMA ✓

ADC1 ✓

TIM1 ✓

I2C1 ✓

GPIO ⚠

TIM2 ✓

SPI2 ✓

NVIC ✓

TIM3 ✓

USART2 ✓

RCC ✓

TIM4 ✓

USART6 ✓

SYS ✓

TIM5 ✓

TIM6 ✓

TIM7 ✓

TIM8 ✓

TIM10 ✓

6. 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
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/flstm32trust.pdf
Product Certifications	https://www.st.com/resource/en/certification_document/stm32_authentication_can.pdf
Security Bulletin	https://www.st.com/resource/en/technical_note/tn1489-security-bulletin-tn1489stpsirt-physical-attacks-on-stm32-and-stm32cube-firmware-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/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/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-stm32f4xxx-mcu-hardware-development-stmicroelectronics.pdf
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