



## 1. Description

### 1.1. Project

Project Name	main
Board Name	custom
Generated with:	STM32CubeMX 6.12.1
Date	11/25/2024

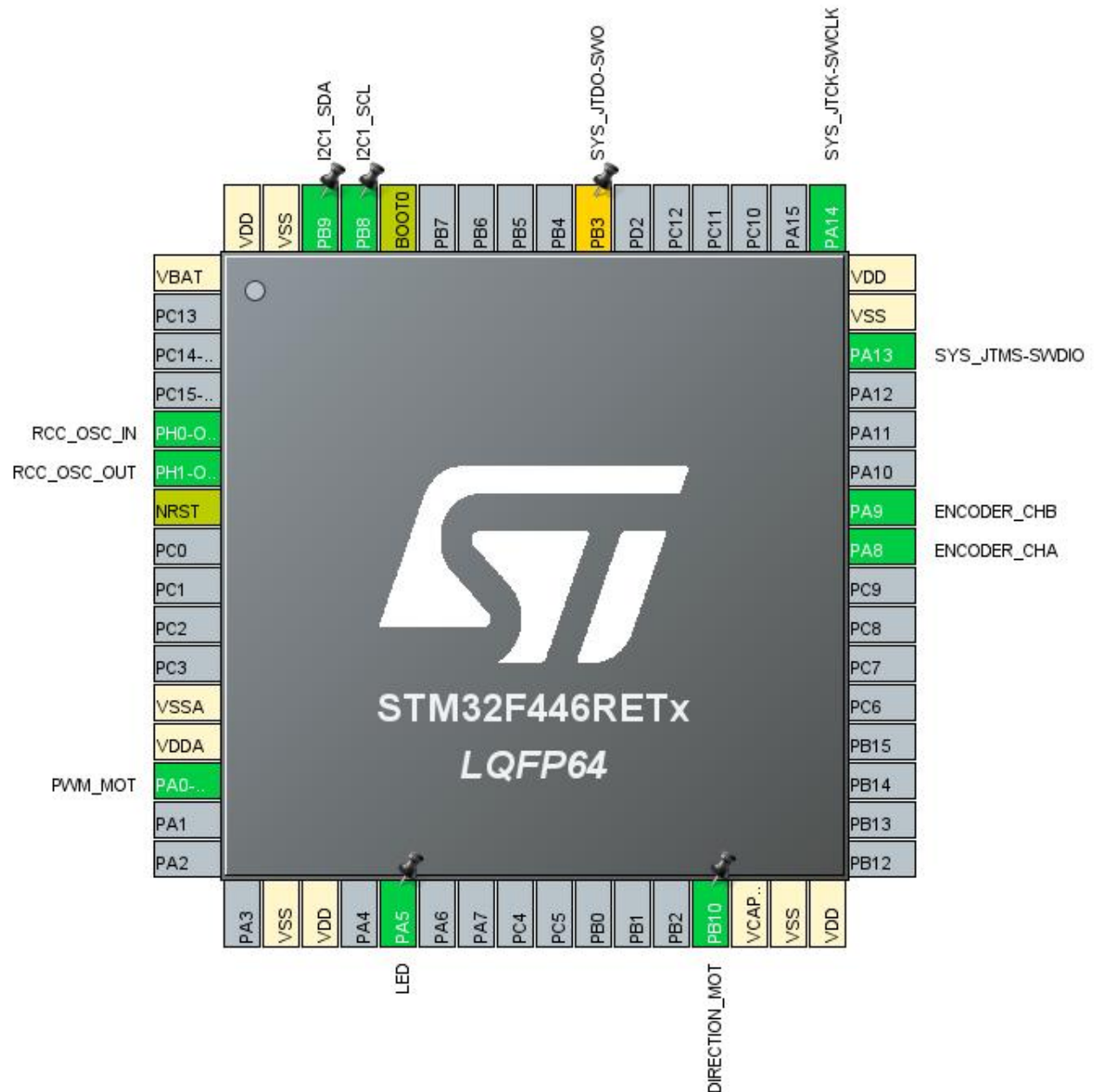
### 1.2. MCU

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



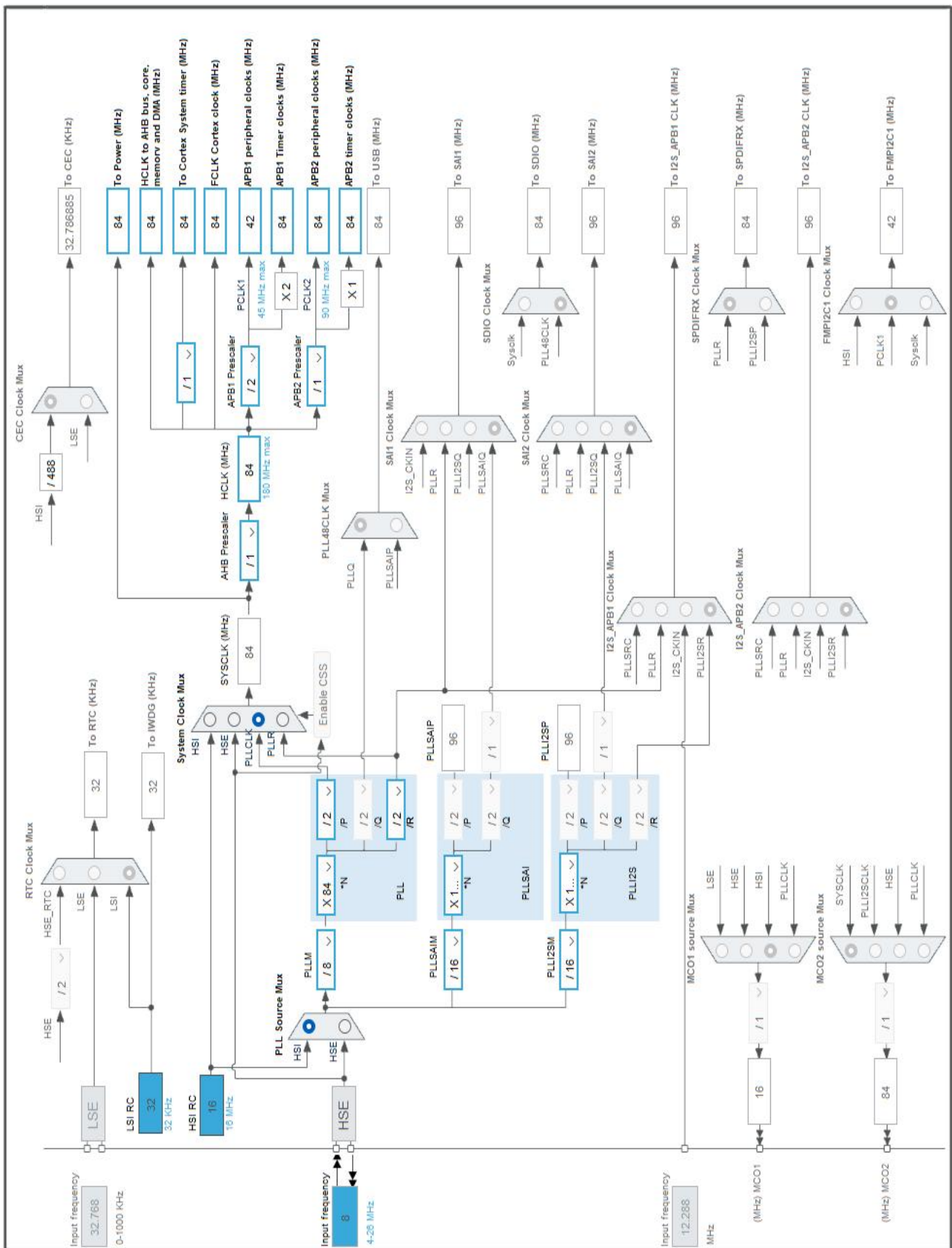
### 3. Pins Configuration

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		
12	VSSA	Power		
13	VDDA	Power		
14	PA0-WKUP	I/O	TIM5_CH1	PWM_MOT
18	VSS	Power		
19	VDD	Power		
21	PA5 *	I/O	GPIO_Output	LED
29	PB10 *	I/O	GPIO_Output	DIRECTION_MOT
30	VCAP_1	Power		
31	VSS	Power		
32	VDD	Power		
41	PA8	I/O	TIM1_CH1	ENCODER_CHA
42	PA9	I/O	TIM1_CH2	ENCODER_CHB
46	PA13	I/O	SYS_JTMS-SWDIO	
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	
55	PB3 **	I/O	SYS_JTDO-SWO	
60	BOOT0	Boot		
61	PB8	I/O	I2C1_SCL	
62	PB9	I/O	I2C1_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

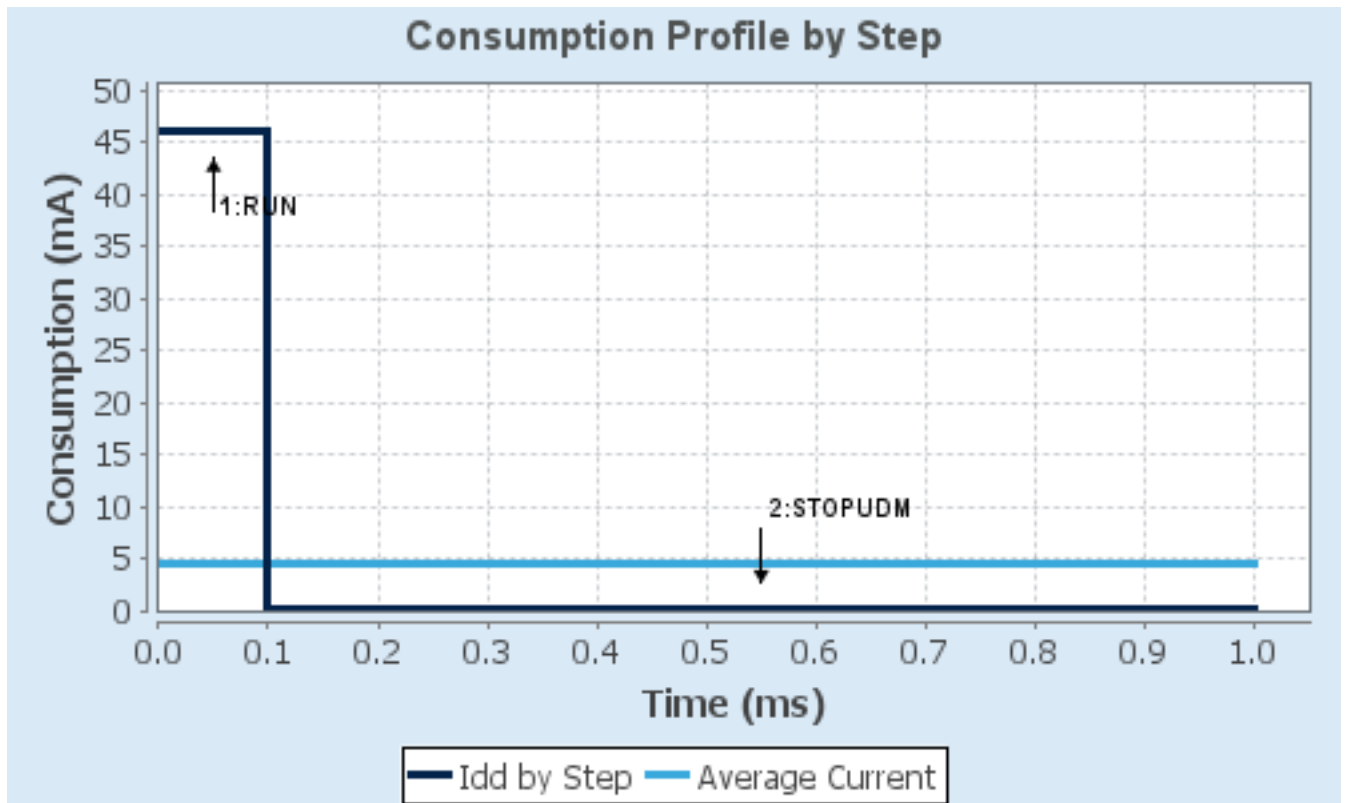
#### 1.4. Sequence

<b>Step</b>	Step1	Step2
<b>Mode</b>	RUN	STOP UDM (Under Drive)
<b>Vdd</b>	3.3	3.3
<b>Voltage Source</b>	Battery	Battery
<b>Range</b>	Scale1-High	No Scale
<b>Fetch Type</b>	RAM/FLASH/REGON/ART/P REFETCH	n/a
<b>CPU Frequency</b>	180 MHz	0 Hz
<b>Clock Configuration</b>	HSE PLL	Regulator LP Flash-PwrDwn
<b>Clock Source Frequency</b>	4 MHz	0 Hz
<b>Peripherals</b>		
<b>Additional Cons.</b>	0 mA	0 mA
<b>Average Current</b>	46 mA	55 $\mu$ A
<b>Duration</b>	0.1 ms	0.9 ms
<b>DMIPS</b>	225.0	0.0
<b>Ta Max</b>	98.02	104.99
<b>Category</b>	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	main
Project Folder	C:\Users\Francesco Stasi\OneDrive - Politecnico di
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	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)	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_TIM5_Init	TIM5
4	MX_I2C1_Init	I2C1
5	MX_TIM1_Init	TIM1
6	MX_TIM2_Init	TIM2

## 3. Peripherals and Middlewares Configuration

### 3.1. I2C1

#### I2C: I2C

##### 3.1.1. Parameter Settings:

###### Master Features:

I2C Speed Mode	<b>Fast Mode *</b>
I2C Clock Speed (Hz)	400000
Fast Mode Duty Cycle	Duty cycle Tlow/Thigh = 2

###### 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

### 3.2. RCC

#### High Speed Clock (HSE): Crystal/Ceramic Resonator

##### 3.2.1. 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

### 3.3. SYS

**Debug: Serial Wire**

**Timebase Source: SysTick**

### 3.4. TIM1

**Combined Channels: Encoder Mode**

#### 3.4.1. 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)

##### **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

### 3.5. TIM2

**Clock Source : Internal Clock**

#### 3.5.1. Parameter Settings:

##### **Counter Settings:**

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

Counter Period (AutoReload Register - 32 bits value ) **336000-1 \***

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)

### 3.6. TIM5

#### Channel1: PWM Generation CH1

##### 3.6.1. Parameter Settings:

**Counter Settings:**

Prescaler (PSC - 16 bits value) 0

Counter Mode Up

Counter Period (AutoReload Register - 32 bits value ) **4199 \***

Internal Clock Division (CKD) No Division

auto-reload preload **Enable \***

**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

**\* User modified value**

## 4. System Configuration

### 4.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
I2C1	PB8	I2C1_SCL	Alternate Function Open Drain	<b>Pull-up *</b>	<b>Very High *</b>	
	PB9	I2C1_SDA	Alternate Function Open Drain	<b>Pull-up *</b>	<b>Very High *</b>	
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	
TIM1	PA8	TIM1_CH1	Alternate Function Push Pull	<b>Pull-up *</b>	Low	ENCODER_CHA
	PA9	TIM1_CH2	Alternate Function Push Pull	<b>Pull-up *</b>	Low	ENCODER_CHB
TIM5	PA0-WKUP	TIM5_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	PWM_MOT
Single Mapped Signals	PB3	SYS_JTDO-SWO	n/a	n/a	n/a	
GPIO	PA5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED
	PB10	GPIO_Output	Output Push Pull	<b>Pull-down *</b>	Low	DIRECTION_MOT

### 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	0	0
System tick timer	true	15	0
TIM2 global interrupt	true	0	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global 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		
I2C1 event interrupt	unused		
I2C1 error 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
TIM2 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		TIM1 ✓	I2C1 ✓		
GPIO ⚠		TIM2 ✓			
NVIC ✓		TIM5 ✓			
RCC ✓					
SYS ✓					



## 6. Docs & Resources

Type	Link
BSDL files	<a href="https://www.st.com/resource/en/bsdl_model/stm32f446_bsdل.zip">https://www.st.com/resource/en/bsdl_model/stm32f446_bsdل.zip</a>
IBIS models	<a href="https://www.st.com/resource/en/ibis_model/stm32f446_ibis.zip">https://www.st.com/resource/en/ibis_model/stm32f446_ibis.zip</a>
System View Description	<a href="https://www.st.com/resource/en/svd/stm32f4-svd.zip">https://www.st.com/resource/en/svd/stm32f4-svd.zip</a>
Presentations	<a href="https://www.st.com/resource/en/product_presentation/stm32-stm8_embedded_software_solutions.pdf">https://www.st.com/resource/en/product_presentation/stm32-stm8_embedded_software_solutions.pdf</a>
Presentations	<a href="https://www.st.com/resource/en/product_presentation/stm32_eval_tools_portfolio.pdf">https://www.st.com/resource/en/product_presentation/stm32_eval_tools_portfolio.pdf</a>
Presentations	<a href="https://www.st.com/resource/en/product_presentation/stm32_stm8_functional-safety-packages.pdf">https://www.st.com/resource/en/product_presentation/stm32_stm8_functional-safety-packages.pdf</a>
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Presentations	<a href="https://www.st.com/resource/en/product_presentation/microcontrollers-stm32h7rs-lines-overview.pdf">https://www.st.com/resource/en/product_presentation/microcontrollers-stm32h7rs-lines-overview.pdf</a>
Brochures	<a href="https://www.st.com/resource/en/brochure/products-and-solutions-for-plcs-and-smart-i-os.pdf">https://www.st.com/resource/en/brochure/products-and-solutions-for-plcs-and-smart-i-os.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flstm32nucleo.pdf">https://www.st.com/resource/en/flyer/flstm32nucleo.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flstmcsuite.pdf">https://www.st.com/resource/en/flyer/flstmcsuite.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flstm32trust.pdf">https://www.st.com/resource/en/flyer/flstm32trust.pdf</a>
Product Certifications	<a href="https://www.st.com/resource/en/certification_document/stm32_authentication_can.pdf">https://www.st.com/resource/en/certification_document/stm32_authentication_can.pdf</a>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an1709-emc-design-guide-for-stm8-stm32-and-legacy-mcus-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an1709-emc-design-guide-for-stm8-stm32-and-legacy-mcus-stmicroelectronics.pdf</a>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an2606-stm32-microcontroller-system-memory-boot-mode-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an2606-stm32-microcontroller-system-memory-boot-mode-stmicroelectronics.pdf</a>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an2639-soldering-recommendations-and-package-information-for-leadfree-ecopack-mcus-">https://www.st.com/resource/en/application_note/an2639-soldering-recommendations-and-package-information-for-leadfree-ecopack-mcus-</a>

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](https://www.st.com/resource/en/application_note/an2945-stm8s-and-stm32-mcus-a-consistent-832bit-product-line-for-painless-migration-stmicroelectronics.pdf)

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Application Notes [https://www.st.com/resource/en/application\\_note/an3364-migration-and-compatibility-guidelines-for-stm32-microcontroller-applications-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an3364-migration-and-compatibility-guidelines-for-stm32-microcontroller-applications-stmicroelectronics.pdf)

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digital-microphones-using-stm32-mcus-and-mpus-stmicroelectronics.pdf

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Application Notes [https://www.st.com/resource/en/application\\_note/an4899-stm32-microcontroller-gpio-hardware-settings-and-lowpower-consumption-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4899-stm32-microcontroller-gpio-hardware-settings-and-lowpower-consumption-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an5612-esd-protection-of-stm32-mcus-and-mpus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an5612-esd-protection-of-stm32-mcus-and-mpus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an4838-introduction-to-memory-protection-unit-management-on-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4838-introduction-to-memory-protection-unit-management-on-stm32-mcus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an4879-introduction-to-usb-hardware-and-pcb-guidelines-using-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4879-introduction-to-usb-hardware-and-pcb-guidelines-using-stm32-mcus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an5225-introduction-to-usb-typec-power-delivery-for-stm32-mcus-and-mpus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an5225-introduction-to-usb-typec-power-delivery-for-stm32-mcus-and-mpus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an2834-how-to-optimize-the-adc-accuracy-in-the-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an2834-how-to-optimize-the-adc-accuracy-in-the-stm32-mcus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an5537-how-to-use-adc-oversampling-techniques-to-improve-signal-to-noise-ratio-on-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an5537-how-to-use-adc-oversampling-techniques-to-improve-signal-to-noise-ratio-on-stm32-mcus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an5036-guidelines-for-thermal-management-on-stm32-applications-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an5036-guidelines-for-thermal-management-on-stm32-applications-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an4230-introduction-to-random-number-generation-validation-using-the-nist-statistical-test-suite-for-stm32-mcus-and-mpus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4230-introduction-to-random-number-generation-validation-using-the-nist-statistical-test-suite-for-stm32-mcus-and-mpus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an2867-guidelines-for-oscillator-design-on-stm8afals-and-stm32-mcus-mpus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an2867-guidelines-for-oscillator-design-on-stm8afals-and-stm32-mcus-mpus-stmicroelectronics.pdf)

- Application Notes [https://www.st.com/resource/en/application\\_note/an4013-introduction-to-timers-for-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4013-introduction-to-timers-for-stm32-mcus-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an4277-how-to-use-pwm-shutdown-for-motor-control-and-digital-power-conversion-on-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4277-how-to-use-pwm-shutdown-for-motor-control-and-digital-power-conversion-on-stm32-mcus-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an4759-introduction-to-using-the-hardware-realtime-clock-rtc-and-the-tamper-management-unit-tamp-with-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4759-introduction-to-using-the-hardware-realtime-clock-rtc-and-the-tamper-management-unit-tamp-with-stm32-mcus-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an4908-getting-started-with-uart-automatic-baud-rater-detection-for-stm32-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4908-getting-started-with-uart-automatic-baud-rater-detection-for-stm32-mcus-stmicroelectronics.pdf)
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- Application Notes [https://www.st.com/resource/en/application\\_note/an5543-guidelines-for-enhanced-spi-communication-on-stm32-mcus-and-mpus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an5543-guidelines-for-enhanced-spi-communication-on-stm32-mcus-and-mpus-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an5992-migrating-from-stm32f446-to-stm32h523533-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an5992-migrating-from-stm32f446-to-stm32h523533-mcus-stmicroelectronics.pdf)
- Application Notes [https://www.st.com/resource/en/application\\_note/an1202\\_freertos\\_guide-for\\_related\\_Tools\\_freertos-guide-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an1202_freertos_guide-for_related_Tools_freertos-guide-stmicroelectronics.pdf)  
& Software
- Application Notes [https://www.st.com/resource/en/application\\_note/an1602\\_semihosting\\_in\\_for\\_related\\_Tools\\_truestudio-how-to-do-semihosting-in-truestudio-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an1602_semihosting_in_for_related_Tools_truestudio-how-to-do-semihosting-in-truestudio-stmicroelectronics.pdf)  
& Software
- Application Notes [https://www.st.com/resource/en/application\\_note/an1801\\_stm32cubeprog\\_for\\_related\\_Tools\\_rammer\\_in\\_truestudio-installing-stm32cubeprogrammer-in-truestudio-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an1801_stm32cubeprog_for_related_Tools_rammer_in_truestudio-installing-stm32cubeprogrammer-in-truestudio-stmicroelectronics.pdf)  
& Software
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Application Notes    [https://www.st.com/resource/en/application\\_note/an2656-stm32f10xxx-](https://www.st.com/resource/en/application_note/an2656-stm32f10xxx-lcd-glass-driver-firmware-stmicroelectronics.pdf)  
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for related Tools    modes-and-their-applications-stmicroelectronics.pdf  
& Software

Application Notes    [https://www.st.com/resource/en/application\\_note/an3174-implementing-](https://www.st.com/resource/en/application_note/an3174-implementing-receivers-for-infrared-remote-control-protocols-using-stm32f10xxx-microcontrollers-stmicroelectronics.pdf)  
for related Tools    receivers-for-infrared-remote-control-protocols-using-stm32f10xxx-  
& Software            microcontrollers-stmicroelectronics.pdf

Application Notes    [https://www.st.com/resource/en/application\\_note/an3241-qvga-tftlcd-](https://www.st.com/resource/en/application_note/an3241-qvga-tftlcd-direct-drive-using-the-stm32f10xx-fsmc-peripheral-stmicroelectronics.pdf)  
for related Tools    direct-drive-using-the-stm32f10xx-fsmc-peripheral-stmicroelectronics.pdf  
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Application Notes    [https://www.st.com/resource/en/application\\_note/an3307-guidelines-for-](https://www.st.com/resource/en/application_note/an3307-guidelines-for-obtaining-iec-60335-class-b-certification-for-any-stm32-application-stmicroelectronics.pdf)  
for related Tools    obtaining-iec-60335-class-b-certification-for-any-stm32-application-  
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for related Tools    stm32f40xstm32f41x-inapplication-programming-using-the-usart-  
& Software            stmicroelectronics.pdf

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for related Tools    emulation-in-stm32f40xstm32f41x-microcontrollers-stmicroelectronics.pdf  
& Software

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for related Tools    unit-demonstration-on-stm32-microcontrollers-stmicroelectronics.pdf  
& Software

Application Notes    [https://www.st.com/resource/en/application\\_note/an4323-getting-started-](https://www.st.com/resource/en/application_note/an4323-getting-started-with-stemwin-library-stmicroelectronics.pdf)  
for related Tools    with-stemwin-library-stmicroelectronics.pdf

& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4365-using-stm32f4-](https://www.st.com/resource/en/application_note/an4365-using-stm32f4-for-related-Tools-mcu-power-modes-with-best-dynamic-efficiency-stmicroelectronics.pdf)  
for related Tools [mcu-power-modes-with-best-dynamic-efficiency-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4365-using-stm32f4-for-related-Tools-mcu-power-modes-with-best-dynamic-efficiency-stmicroelectronics.pdf)

& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4435-guidelines-for-](https://www.st.com/resource/en/application_note/an4435-guidelines-for-obtaining-ulcsaiec-607301603351-class-b-certification-in-any-stm32-application-stmicroelectronics.pdf)  
for related Tools [obtaining-ulcsaiec-607301603351-class-b-certification-in-any-stm32-](https://www.st.com/resource/en/application_note/an4435-guidelines-for-obtaining-ulcsaiec-607301603351-class-b-certification-in-any-stm32-application-stmicroelectronics.pdf)  
& Software [application-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4435-guidelines-for-obtaining-ulcsaiec-607301603351-class-b-certification-in-any-stm32-application-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an4457-implementing-](https://www.st.com/resource/en/application_note/an4457-implementing-an-emulated-uart-on-stm32f4-microcontrollers-stmicroelectronics.pdf)  
for related Tools [an-emulated-uart-on-stm32f4-microcontrollers-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4457-implementing-an-emulated-uart-on-stm32f4-microcontrollers-stmicroelectronics.pdf)  
& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4499-stm32--](https://www.st.com/resource/en/application_note/an4499-stm32--nrf51822-bluetooth-low-energy-system-solution-stmicroelectronics.pdf)  
for related Tools [nrf51822-bluetooth-low-energy-system-solution-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4499-stm32--nrf51822-bluetooth-low-energy-system-solution-stmicroelectronics.pdf)  
& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4657-stm32-](https://www.st.com/resource/en/application_note/an4657-stm32-inapplication-programming-iap-using-the-usart-stmicroelectronics.pdf)  
for related Tools [inapplication-programming-iap-using-the-usart-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4657-stm32-inapplication-programming-iap-using-the-usart-stmicroelectronics.pdf)  
& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4666-parallel-](https://www.st.com/resource/en/application_note/an4666-parallel-synchronous-transmission-using-gpio-and-dma-stmicroelectronics.pdf)  
for related Tools [synchronous-transmission-using-gpio-and-dma-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4666-parallel-synchronous-transmission-using-gpio-and-dma-stmicroelectronics.pdf)  
& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4678-full-duplex-spi-](https://www.st.com/resource/en/application_note/an4678-full-duplex-spi-emulation-for-stm32f4-microcontrollers-stmicroelectronics.pdf)  
for related Tools [emulation-for-stm32f4-microcontrollers-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4678-full-duplex-spi-emulation-for-stm32f4-microcontrollers-stmicroelectronics.pdf)  
& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4701-proprietary-](https://www.st.com/resource/en/application_note/an4701-proprietary-code-readout-protection-on-microcontrollers-of-the-stm32f4-series-stmicroelectronics.pdf)  
for related Tools [code-readout-protection-on-microcontrollers-of-the-stm32f4-series-](https://www.st.com/resource/en/application_note/an4701-proprietary-code-readout-protection-on-microcontrollers-of-the-stm32f4-series-stmicroelectronics.pdf)  
& Software [stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4701-proprietary-code-readout-protection-on-microcontrollers-of-the-stm32f4-series-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an4739-stm32cube-](https://www.st.com/resource/en/application_note/an4739-stm32cube-firmware-examples-for-stm32f4-series-stmicroelectronics.pdf)  
for related Tools [firmware-examples-for-stm32f4-series-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4739-stm32cube-firmware-examples-for-stm32f4-series-stmicroelectronics.pdf)  
& Software

Application Notes [https://www.st.com/resource/en/application\\_note/an4758-proprietary-](https://www.st.com/resource/en/application_note/an4758-proprietary-code-readout-protection-on-stm32l4-stm32l4-stm32g4-and-stm32wb-series-mcus-stmicroelectronics.pdf)  
for related Tools [code-readout-protection-on-stm32l4-stm32l4-stm32g4-and-stm32wb-](https://www.st.com/resource/en/application_note/an4758-proprietary-code-readout-protection-on-stm32l4-stm32l4-stm32g4-and-stm32wb-series-mcus-stmicroelectronics.pdf)  
& Software [series-mcus-stmicroelectronics.pdf](https://www.st.com/resource/en/application_note/an4758-proprietary-code-readout-protection-on-stm32l4-stm32l4-stm32g4-and-stm32wb-series-mcus-stmicroelectronics.pdf)

Application Notes [https://www.st.com/resource/en/application\\_note/an4841-digital-signal-](https://www.st.com/resource/en/application_note/an4841-digital-signal-processing-for-stm32-microcontrollers-using-cmsis-stmicroelectronics.pdf)  
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Datasheet	<a href="https://www.st.com/resource/en/datasheet/dm00141306.pdf">https://www.st.com/resource/en/datasheet/dm00141306.pdf</a>
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