1. Description

1.1. Project

Project Name	MicromouseFirmware
Board Name	custom
Generated with:	STM32CubeMX 6.9.1
Date	08/30/2023

1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F405/415
MCU name	STM32F405RGTx
MCU Package	LQFP64
MCU Pin number	64

1.3. Core(s) information

Core(s)	Arm Cortex-M4

2. Pinout Configuration
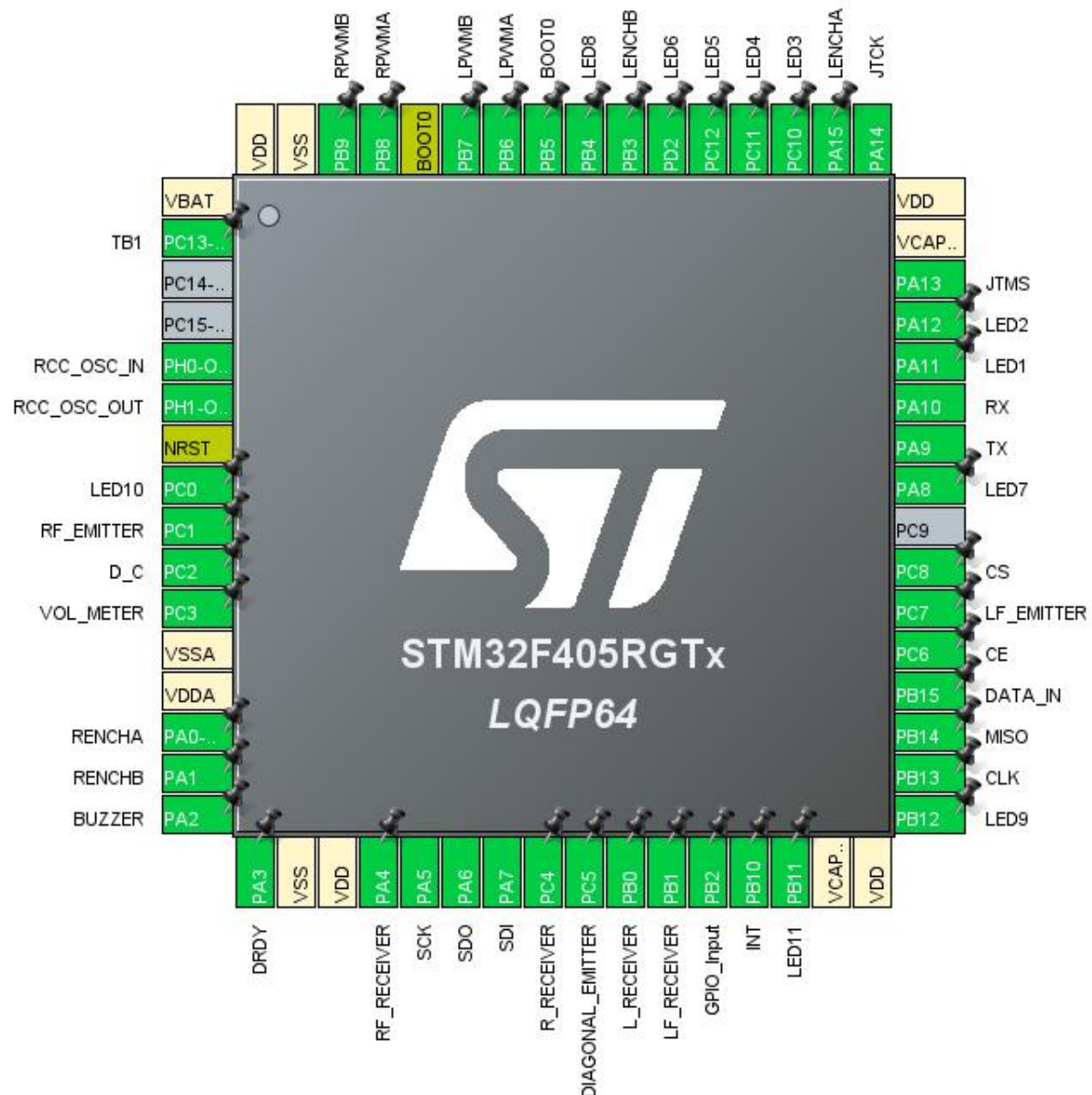
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
2	PC13-ANTI_TAMP *	I/O	GPIO_Input	TB1
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_Output	LED10
9	PC1 *	I/O	GPIO_Output	RF_EMITTER
10	PC2 *	I/O	GPIO_Output	D_C
11	PC3	I/O	ADC1_IN13	VOL_METER
12	VSSA	Power		
13	VDDA	Power		
14	PA0-WKUP *	I/O	GPIO_Input	RENCHA
15	PA1 *	I/O	GPIO_Input	RENCHB
16	PA2	I/O	TIM2_CH3	BUZZER
17	PA3 *	I/O	GPIO_Input	DRDY
18	VSS	Power		
19	VDD	Power		
20	PA4	I/O	ADC1_IN4	RF_RECEIVER
21	PA5	I/O	SPI1_SCK	SCK
22	PA6	I/O	SPI1_MISO	SDO
23	PA7	I/O	SPI1_MOSI	SDI
24	PC4	I/O	ADC1_IN14	R_RECEIVER
25	PC5 *	I/O	GPIO_Output	DIAGONAL_EMITTER
26	PB0	I/O	ADC1_IN8	L_RECEIVER
27	PB1	I/O	ADC1_IN9	LF_RECEIVER
28	PB2 *	I/O	GPIO_Input	
29	PB10 *	I/O	GPIO_Input	INT
30	PB11 *	I/O	GPIO_Output	LED11
31	VCAP_1	Power		
32	VDD	Power		
33	PB12 *	I/O	GPIO_Output	LED9
34	PB13	I/O	SPI2_SCK	CLK
35	PB14 *	I/O	GPIO_Input	MISO
36	PB15	I/O	SPI2_MOSI	DATA_IN
37	PC6 *	I/O	GPIO_Output	CE
38	PC7 *	I/O	GPIO_Output	LF_EMITTER

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
39	PC8 *	I/O	GPIO_Output	CS
41	PA8 *	I/O	GPIO_Output	LED7
42	PA9	I/O	USART1_TX	TX
43	PA10	I/O	USART1_RX	RX
44	PA11 *	I/O	GPIO_Output	LED1
45	PA12 *	I/O	GPIO_Output	LED2
46	PA13	I/O	SYS_JTMS-SWDIO	JTMS
47	VCAP_2	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	JTCK
50	PA15 *	I/O	GPIO_Input	LENCHA
51	PC10 *	I/O	GPIO_Output	LED3
52	PC11 *	I/O	GPIO_Output	LED4
53	PC12 *	I/O	GPIO_Output	LED5
54	PD2 *	I/O	GPIO_Output	LED6
55	PB3 *	I/O	GPIO_Input	LENCHB
56	PB4 *	I/O	GPIO_Output	LED8
57	PB5 *	I/O	GPIO_Input	BOOT0
58	PB6	I/O	TIM4_CH1	LPWMA
59	PB7	I/O	TIM4_CH2	LPWMB
60	BOOT0	Boot		
61	PB8	I/O	TIM4_CH3	RPWMA
62	PB9	I/O	TIM4_CH4	RPWMB
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	MicromouseFirmware
Project Folder	D:\OneDrive - University of Moratuwa\Volume
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_F4 V1.27.1
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_SPI1_Init	SPI1
4	MX_TIM4_Init	TIM4
5	MX_ADC1_Init	ADC1
6	MX_SPI2_Init	SPI2
7	MX_TIM2_Init	TIM2
8	MX_USART1_UART_Init	USART1

1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32F4
Line	STM32F405/415
MCU	STM32F405RGTx
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
Ta Max	98.02	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

Consumption Profile by Step
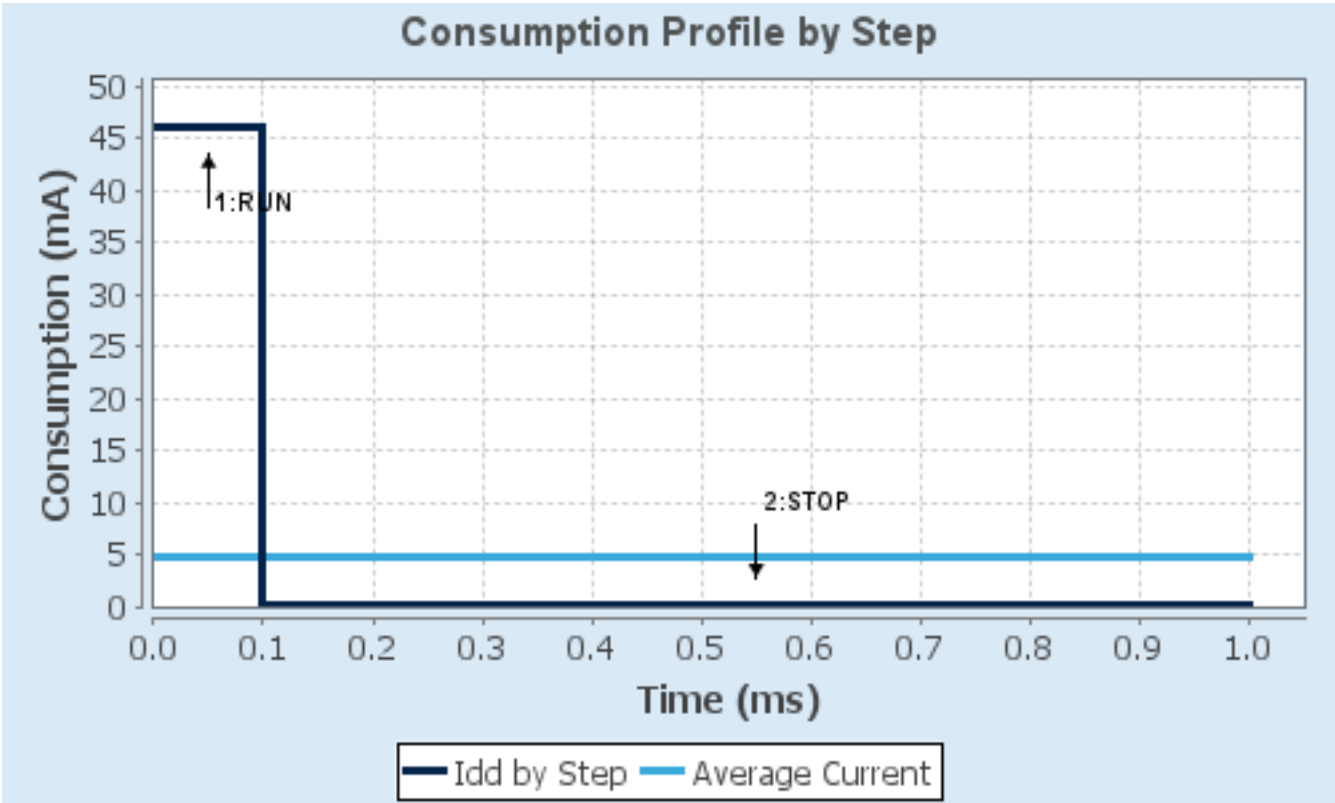
2. Peripherals and Middlewares Configuration

2.1. ADC1

mode: IN4

mode: IN8

mode: IN9

mode: IN13

mode: IN14

2.1.1. 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
Rank	1
Channel	Channel 4
Sampling Time	3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions	0

WatchDog:

Enable Analog WatchDog Mode	false

2.2. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

2.2.1. 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
HSE Startup Timout Value (ms)	100
LSE Startup Timout Value (ms)	5000

Power Parameters:

Power Regulator Voltage Scale	Power Regulator Voltage Scale 1

2.3. SPI1
Mode: Full-Duplex Master
2.3.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	2
Baud Rate	**8.0 MBits/s ***
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

2.4. SPI2
Mode: Half-Duplex Master
2.4.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	2
Baud Rate	**8.0 MBits/s ***
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

2.5. SYS
Debug: Serial Wire
Timebase Source: SysTick

2.6. TIM2
Channel3: PWM Generation CH3
2.6.1. 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 3:

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

2.7. TIM4
mode: Clock Source
Channel1: PWM Generation CH1

Channel2: PWM Generation CH2
Channel3: PWM Generation CH3
Channel4: PWM Generation CH4

2.7.1. 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
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 (16 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

PWM Generation Channel 2:

Mode	PWM mode 1
Pulse (16 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

PWM Generation Channel 3:

Mode	PWM mode 1
Pulse (16 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

PWM Generation Channel 4:

Mode	PWM mode 1
Pulse (16 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

2.8. USART1
Mode: Asynchronous
2.8.1. 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

3. System Configuration

3.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
ADC1	PC3	ADC1_IN13	Analog mode	No pull-up and no pull-down	n/a	VOL_METER
	PA4	ADC1_IN4	Analog mode	No pull-up and no pull-down	n/a	RF_RECEIVER
	PC4	ADC1_IN14	Analog mode	No pull-up and no pull-down	n/a	R_RECEIVER
	PB0	ADC1_IN8	Analog mode	No pull-up and no pull-down	n/a	L_RECEIVER
	PB1	ADC1_IN9	Analog mode	No pull-up and no pull-down	n/a	LF_RECEIVER
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	
SPI1	PA5	SPI1_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SCK
	PA6	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SDO
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SDI
SPI2	PB13	SPI2_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	CLK
	PB15	SPI2_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	DATA_IN
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	JTMS
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	JTCK
TIM2	PA2	TIM2_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	BUZZER
TIM4	PB6	TIM4_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	LPWMA
	PB7	TIM4_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	LPWMB
	PB8	TIM4_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	RPWMA
	PB9	TIM4_CH4	Alternate Function Push Pull	No pull-up and no pull-down	Low	RPWMB
USART1	PA9	USART1_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	TX
	PA10	USART1_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	RX
GPIO	PC13-ANTI_TAMP	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	TB1
	PC0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED10
	PC1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	RF_EMITTER

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
	PC2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	D_C
	PA0-WKUP	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	RENCHA
	PA1	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	RENCHB
	PA3	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	DRDY
	PC5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	DIAGONAL_EMITTER
	PB2	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	
	PB10	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	INT
	PB11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED11
	PB12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED9
	PB14	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	MISO
	PC6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	CE
	PC7	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LF_EMITTER
	PC8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	CS
	PA8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED7
	PA11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED1
	PA12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED2
	PA15	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	LENCHA
	PC10	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED3
	PC11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED4
	PC12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED5
	PD2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED6
	PB3	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	LENCHB
	PB4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED8
	PB5	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	BOOT0

3.2. DMA configuration

nothing configured in DMA service

3.3. NVIC configuration

3.3.1. 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 global interrupts	unused		
TIM2 global interrupt	unused		
TIM4 global interrupt	unused		
SPI1 global interrupt	unused		
SPI2 global interrupt	unused		
USART1 global 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
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

* User modified value

4. System Views

4.1. Category view

4.1.1. Current

Middleware

System Core	Analog	Timers	Connectivity	Multimedia	Security	Computing
DMA	ADC1 ✓	TIM2 ✓	SPI1 ✓			
GPIO ✓		TIM4 ✓	SPI2 ✓			
NVIC ✓			USART1 ✓			
RCC ✓						
SYS ✓						

5. Docs & Resources

Type   Link