
STM32
CubeMX

1. Description

1.1. Project

Project Name	Micromouse
Board Name	custom
Generated with:	STM32CubeMX 6.8.1
Date	04/15/2024

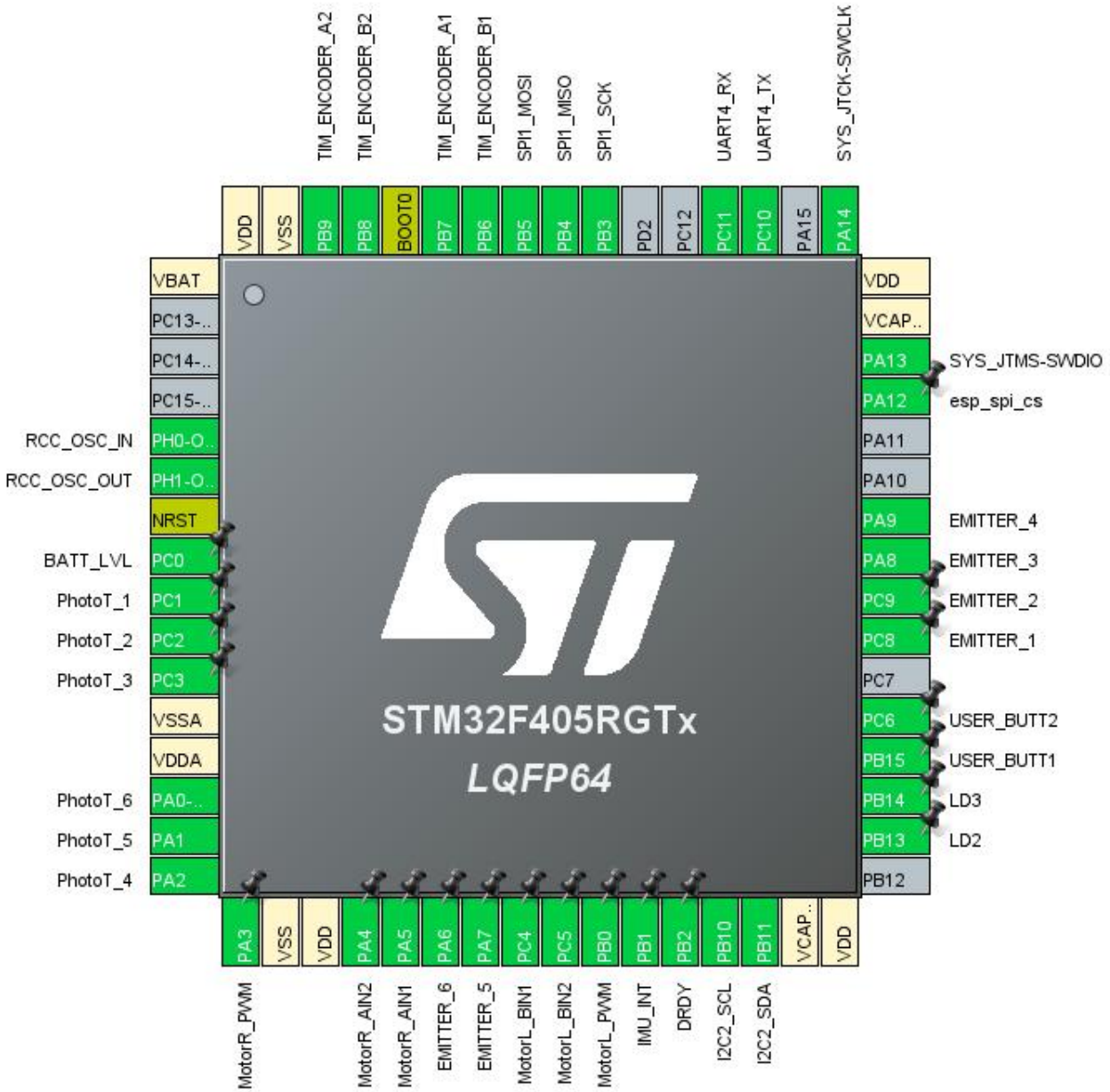
1.2. MCU

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



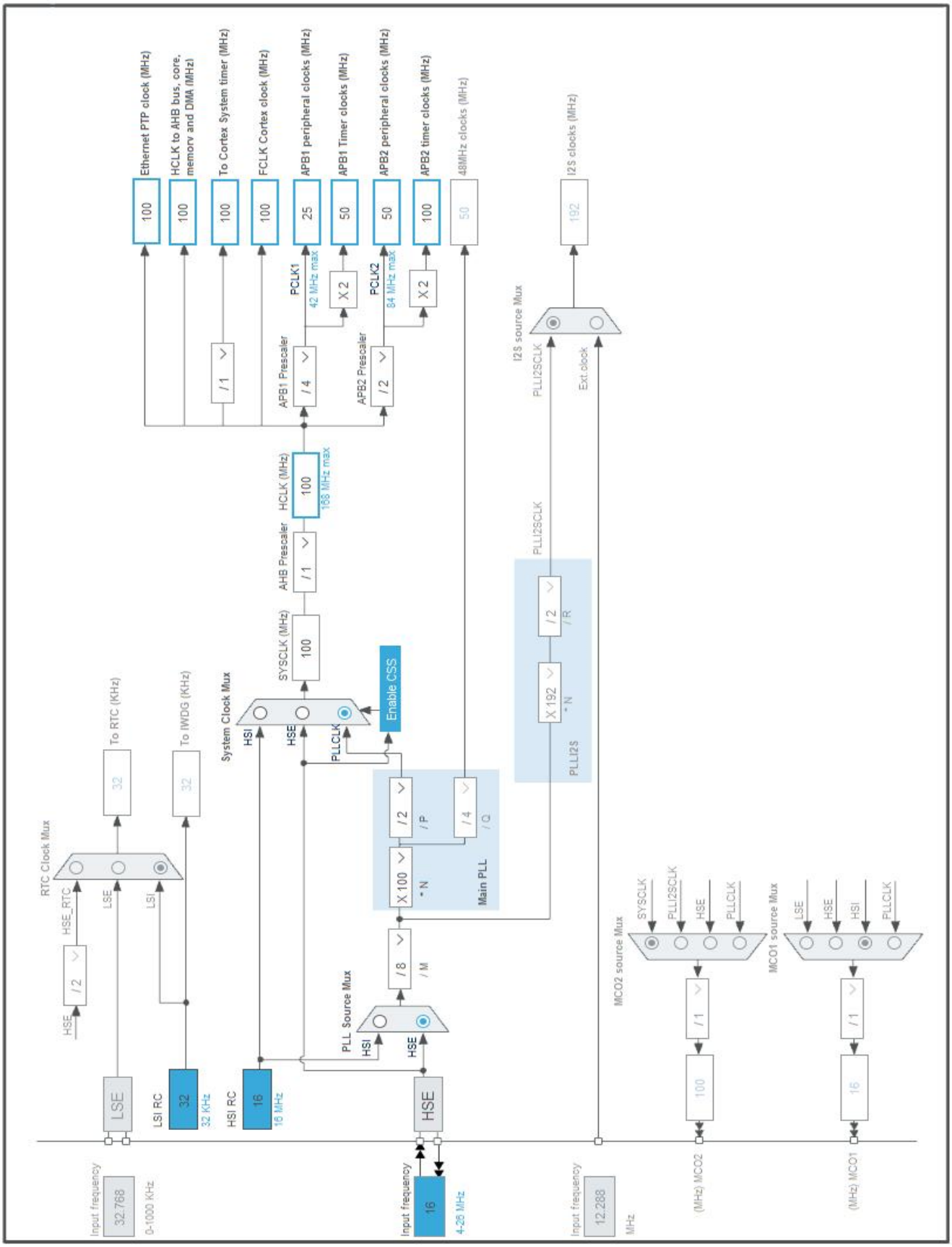
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
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	ADC3_IN10	BATT_LVL
9	PC1	I/O	ADC1_IN11	PhotoT_1
10	PC2	I/O	ADC1_IN12	PhotoT_2
11	PC3	I/O	ADC1_IN13	PhotoT_3
12	VSSA	Power		
13	VDDA	Power		
14	PA0-WKUP	I/O	ADC1_IN0	PhotoT_6
15	PA1	I/O	ADC1_IN1	PhotoT_5
16	PA2	I/O	ADC1_IN2	PhotoT_4
17	PA3	I/O	TIM9_CH2	MotorR_PWM
18	VSS	Power		
19	VDD	Power		
20	PA4 *	I/O	GPIO_Output	MotorR_AIN2
21	PA5 *	I/O	GPIO_Output	MotorR_AIN1
22	PA6	I/O	TIM3_CH1	EMITTER_6
23	PA7	I/O	TIM3_CH2	EMITTER_5
24	PC4 *	I/O	GPIO_Output	MotorL_BIN1
25	PC5 *	I/O	GPIO_Output	MotorL_BIN2
26	PB0	I/O	TIM3_CH3	MotorL_PWM
27	PB1	I/O	GPIO_EXTI1	IMU_INT
28	PB2	I/O	GPIO_EXTI2	DRDY
29	PB10	I/O	I2C2_SCL	
30	PB11	I/O	I2C2_SDA	
31	VCAP_1	Power		
32	VDD	Power		
34	PB13 *	I/O	GPIO_Output	LD2
35	PB14 *	I/O	GPIO_Output	LD3
36	PB15	I/O	GPIO_EXTI15	USER_BUTT1
37	PC6	I/O	GPIO_EXTI6	USER_BUTT2
39	PC8	I/O	TIM8_CH3	EMITTER_1
40	PC9	I/O	TIM3_CH4	EMITTER_2
41	PA8	I/O	TIM1_CH1	EMITTER_3

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
42	PA9	I/O	TIM1_CH2	EMITTER_4
45	PA12 *	I/O	GPIO_Output	esp_spi_cs
46	PA13	I/O	SYS_JTMS-SWDIO	
47	VCAP_2	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	
51	PC10	I/O	UART4_TX	
52	PC11	I/O	UART4_RX	
55	PB3	I/O	SPI1_SCK	
56	PB4	I/O	SPI1_MISO	
57	PB5	I/O	SPI1_MOSI	
58	PB6	I/O	TIM4_CH1	TIM_ENCODER_B1
59	PB7	I/O	TIM4_CH2	TIM_ENCODER_A1
60	BOOT0	Boot		
61	PB8	I/O	TIM4_CH3	TIM_ENCODER_B2
62	PB9	I/O	TIM4_CH4	TIM_ENCODER_A2
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	Micromouse
Project Folder	D:\Micromouse\Micromouse_Kicad\Micromouse_STM32CUBEMX
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_DMA_Init	DMA
4	MX_ADC1_Init	ADC1
5	MX_SPI1_Init	SPI1
6	MX_TIM1_Init	TIM1
7	MX_TIM3_Init	TIM3
8	MX_TIM4_Init	TIM4
9	MX_UART4_Init	UART4
10	MX_I2C2_Init	I2C2
11	MX_TIM8_Init	TIM8

Rank	Function Name	Peripheral Instance Name
12	MX_TIM9_Init	TIM9
13	MX_ADC3_Init	ADC3

6. Power Consumption Calculator report

6.1. Microcontroller Selection

Series	STM32F4
Line	STM32F405/415
MCU	STM32F405RGTx
Datasheet	DS8626_Rev8

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

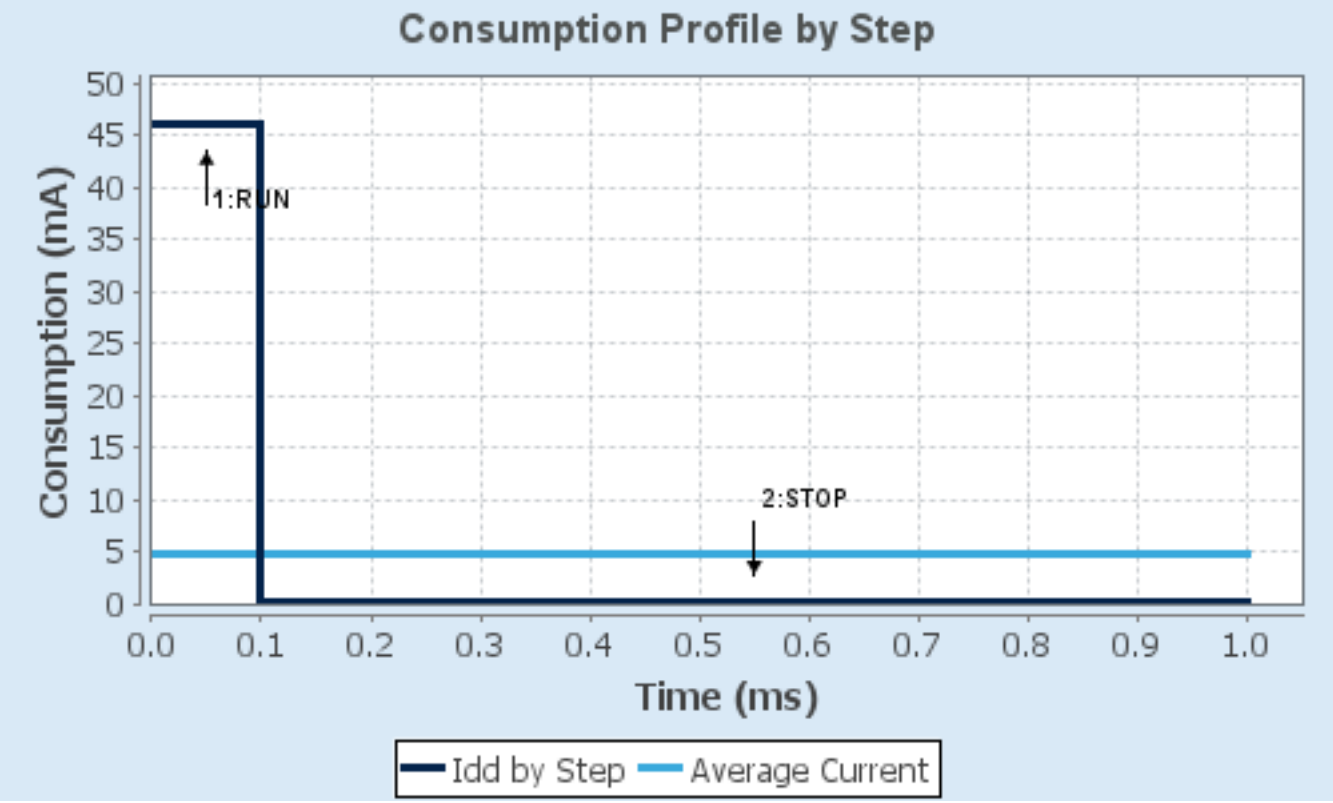
6.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP
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

6.5. Results

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

6.6. Chart


Consumption Profile by Step
Consumption (mA)
50
45
40
35
30
25
20
15
10
5
0
1:RUN
2:STOP
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Time (ms)
Idd by Step
Average Current

7. Peripherals and Middlewares Configuration

7.1. ADC1

mode: IN0

mode: IN1

mode: IN2

mode: IN11

mode: IN12

mode: IN13

7.1.1. 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	**Enabled ***
Discontinuous Conversion Mode	Disabled
DMA Continuous Requests	**Enabled ***
End Of Conversion Selection	EOC flag at the end of single channel conversion

ADC_Regular_ConversionMode:

Number Of Conversion	**6 ***
External Trigger Conversion Source	Regular Conversion launched by software
External Trigger Conversion Edge	None
Rank	1
Channel	**Channel 11 ***
Sampling Time	**480 Cycles ***
Rank	**2 ***
Channel	**Channel 12 ***
Sampling Time	**480 Cycles ***
Rank	**3 ***
Channel	**Channel 13 ***
Sampling Time	**480 Cycles ***
Rank	**4 ***
Channel	**Channel 2 ***
Sampling Time	**480 Cycles ***

Rank	**5 ***
Channel	**Channel 1 ***
Sampling Time	**480 Cycles ***
Rank	**6 ***
Channel	Channel 0
Sampling Time	**480 Cycles ***

ADC_Injected_ConversionMode:

Number Of Conversions	0

WatchDog:

Enable Analog WatchDog Mode	false

7.2. ADC3

mode: IN10

7.2.1. Parameter Settings:

ADC_Settings:

Clock Prescaler	**PCLK2 divided by 4 ***
Resolution	12 bits (15 ADC Clock cycles)
Data Alignment	Right alignment
Scan Conversion Mode	Disabled
Continuous Conversion Mode	**Enabled ***
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 10
Sampling Time	**480 Cycles ***

ADC_Injected_ConversionMode:

Number Of Conversions	0

WatchDog:

Enable Analog WatchDog Mode	false

7.3. I2C2

I2C: I2C

7.3.1. Parameter Settings:

Master Features:

I2C Speed Mode	**Fast Mode ***
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

7.4. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

7.4.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Enabled
Data Cache	Enabled
Flash Latency(WS)	3 WS (4 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

7.5. SPI1

Mode: Full-Duplex Master

7.5.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	**8 ***
Baud Rate	**6.25 MBits/s ***
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

7.6. SYS

Debug: Serial Wire

7.7. TIM1

Clock Source : Internal Clock

Channel1: PWM Generation CH1

Channel2: PWM Generation CH2

7.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**19 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**99 ***
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)

Break And Dead Time management - BRK Configuration:

BRK State	Disable
BRK Polarity	High

Break And Dead Time management - Output Configuration:

Automatic Output State	Disable
Off State Selection for Run Mode (OSSR)	Disable
Off State Selection for Idle Mode (OSSI)	Disable
Lock Configuration	Off

PWM Generation Channel 1:

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

PWM Generation Channel 2:

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

7.8. TIM3

Clock Source : Internal Clock

Channel1: PWM Generation CH1

Channel2: PWM Generation CH2

Channel3: PWM Generation CH3

Channel4: PWM Generation CH4

7.8.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**9 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**99 ***
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

7.9. TIM4

Channel1: Input Capture direct mode

Channel2: Input Capture direct mode

Channel3: Input Capture direct mode

Channel4: Input Capture direct mode

7.9.1. 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)

Input Capture Channel 1:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

Input Capture Channel 2:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

Input Capture Channel 3:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

Input Capture Channel 4:

Polarity Selection	Rising Edge
IC Selection	Direct
Prescaler Division Ratio	No division
Input Filter (4 bits value)	0

7.10. TIM8

Clock Source : Internal Clock

Channel3: PWM Generation CH3

7.10.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**19 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**99 ***
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)

Break And Dead Time management - BRK Configuration:

BRK State	Disable

BRK Polarity	High

Break And Dead Time management - Output Configuration:

Automatic Output State	Disable
Off State Selection for Run Mode (OSSR)	Disable
Off State Selection for Idle Mode (OSSI)	Disable
Lock Configuration	Off

PWM Generation Channel 3:

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

7.11. TIM9

mode: Clock Source

Channel2: PWM Generation CH2

7.11.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**19 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**99 ***
Internal Clock Division (CKD)	No Division
auto-reload preload	Disable

PWM Generation Channel 2:

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

7.12. UART4

Mode: Asynchronous

7.12.1. 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	PC1	ADC1_IN11	Analog mode	No pull-up and no pull-down	n/a	PhotoT_1
	PC2	ADC1_IN12	Analog mode	No pull-up and no pull-down	n/a	PhotoT_2
	PC3	ADC1_IN13	Analog mode	No pull-up and no pull-down	n/a	PhotoT_3
	PA0-WKUP	ADC1_IN0	Analog mode	No pull-up and no pull-down	n/a	PhotoT_6
	PA1	ADC1_IN1	Analog mode	No pull-up and no pull-down	n/a	PhotoT_5
	PA2	ADC1_IN2	Analog mode	No pull-up and no pull-down	n/a	PhotoT_4
ADC3	PC0	ADC3_IN10	Analog mode	No pull-up and no pull-down	n/a	BATT_LVL
I2C2	PB10	I2C2_SCL	Alternate Function Open Drain	No pull-up and no pull-down	**Very High ***	
	PB11	I2C2_SDA	Alternate Function Open Drain	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	
SPI1	PB3	SPI1_SCK	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PB4	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PB5	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
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	No pull-up and no pull-down	Low	EMITTER_3
	PA9	TIM1_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	EMITTER_4
TIM3	PA6	TIM3_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	EMITTER_6
	PA7	TIM3_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	EMITTER_5
	PB0	TIM3_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	MotorL_PWM
	PC9	TIM3_CH4	Alternate Function Push Pull	No pull-up and no pull-down	Low	EMITTER_2
TIM4	PB6	TIM4_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	TIM_ENCODER_B1
	PB7	TIM4_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	TIM_ENCODER_A1
	PB8	TIM4_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	TIM_ENCODER_B2
	PB9	TIM4_CH4	Alternate Function Push Pull	No pull-up and no pull-down	Low	TIM_ENCODER_A2
TIM8	PC8	TIM8_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	EMITTER_1

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
TIM9	PA3	TIM9_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	MotorR_PWM
UART4	PC10	UART4_TX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PC11	UART4_RX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
GPIO	PA4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	MotorR_AIN2
	PA5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	MotorR_AIN1
	PC4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	MotorL_BIN1
	PC5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	MotorL_BIN2
	PB1	GPIO_EXTI1	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	IMU_INT
	PB2	GPIO_EXTI2	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	DRDY
	PB13	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LD2
	PB14	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LD3
	PB15	GPIO_EXTI15	External Interrupt Mode with Rising edge trigger detection	**Pull-up ***	n/a	USER_BUTT1
	PC6	GPIO_EXTI6	External Interrupt Mode with Rising edge trigger detection	**Pull-up ***	n/a	USER_BUTT2
	PA12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	esp_spi_cs

8.2. DMA configuration

DMA request	Stream	Direction	Priority
ADC1	DMA2_Stream0	Peripheral To Memory	**High ***

ADC1: DMA2_Stream0 DMA request Settings:

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

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
DMA2 stream0 global interrupt	true	0	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
EXTI line1 interrupt	unused		
EXTI line2 interrupt	unused		
ADC1, ADC2 and ADC3 global interrupts	unused		
EXTI line[9:5] interrupts	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		
TIM3 global interrupt	unused		
TIM4 global interrupt	unused		
I2C2 event interrupt	unused		
I2C2 error interrupt	unused		
SPI1 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		
TIM8 capture compare interrupt	unused		
UART4 global interrupt	unused		
FPU global interrupt	unused		

8.3.2. NVIC Code generation

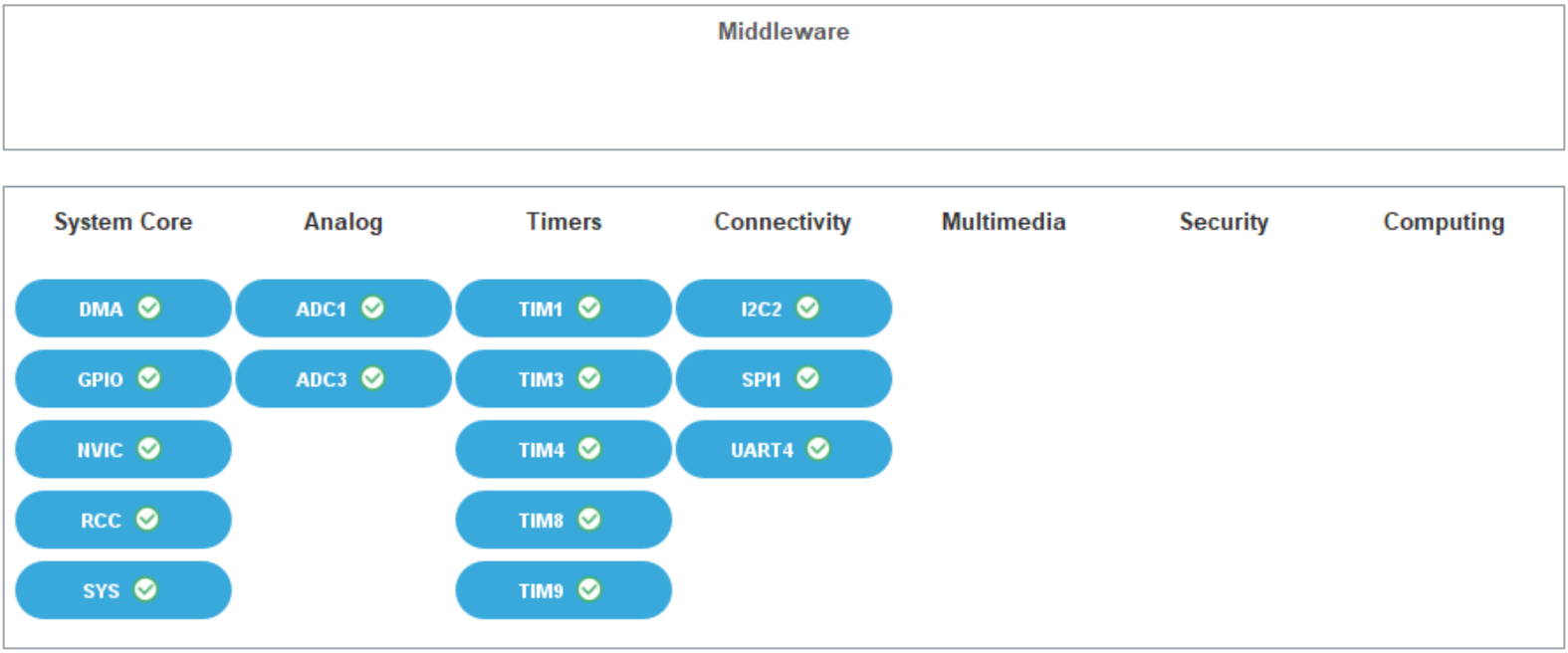
Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
Non maskable interrupt	false	true	false
Hard fault interrupt	false	true	false
Memory management fault	false	true	false
Pre-fetch fault, memory access fault	false	true	false
Undefined instruction or illegal 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
System tick timer	false	true	true
DMA2 stream0 global interrupt	false	true	true

*** User modified value**

9. System Views

9.1. Category view

9.1.1. Current



10. Docs & Resources

Type	Link