



1. Description

1.1. Project

Project Name	PCBot
Board Name	custom
Generated with:	STM32CubeMX 6.8.0
Date	05/26/2023

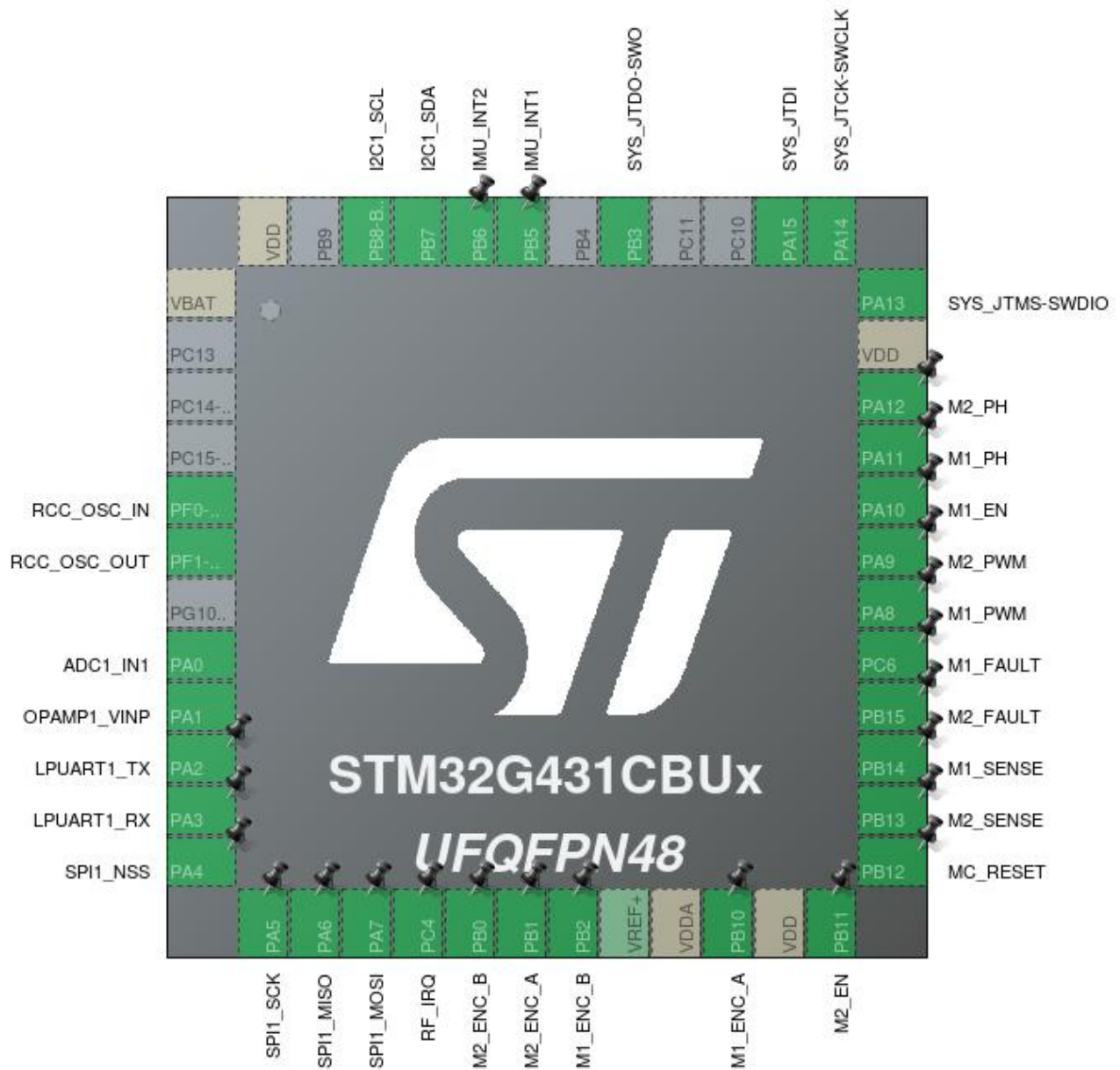
1.2. MCU

MCU Series	STM32G4
MCU Line	STM32G4x1
MCU name	STM32G431CBUx
MCU Package	UFQFPN48
MCU Pin number	48

1.3. Core(s) information

Core(s)	ARM Cortex-M4
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2. Pinout Configuration



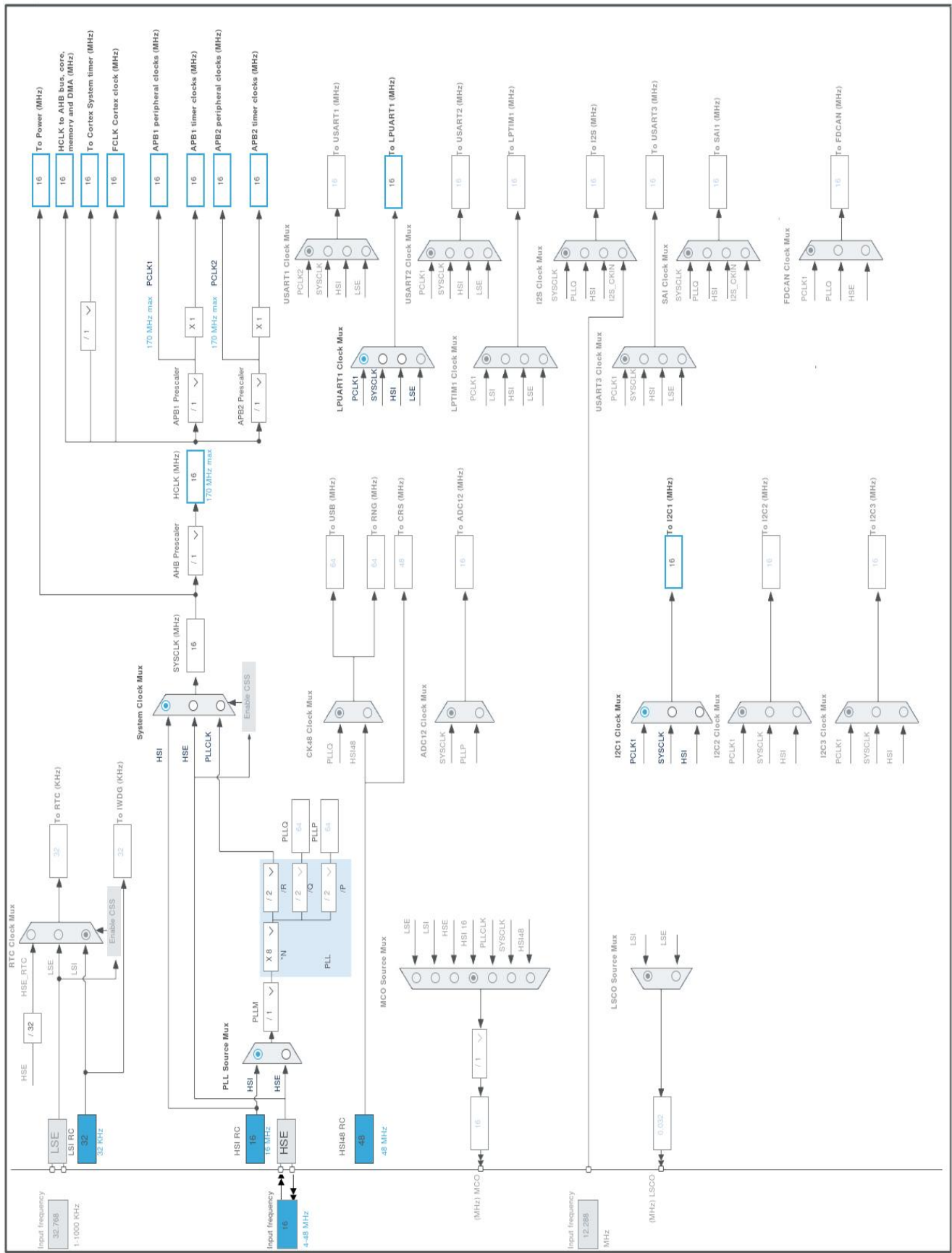
3. Pins Configuration

Pin Number UFQFPN48	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
5	PF0-OSC_IN	I/O	RCC_OSC_IN	
6	PF1-OSC_OUT	I/O	RCC_OSC_OUT	
8	PA0	I/O	ADC1_IN1	
9	PA1	I/O	OPAMP1_VINP	
10	PA2	I/O	LPUART1_TX	
11	PA3	I/O	LPUART1_RX	
12	PA4	I/O	SPI1_NSS	
13	PA5	I/O	SPI1_SCK	
14	PA6	I/O	SPI1_MISO	
15	PA7	I/O	SPI1_MOSI	
16	PC4	I/O	GPIO_EXTI4	RF_IRQ
17	PB0	I/O	GPIO_EXTI0	M2_ENC_B
18	PB1	I/O	GPIO_EXTI1	M2_ENC_A
19	PB2	I/O	GPIO_EXTI2	M1_ENC_B
21	VDDA	Power		
22	PB10	I/O	GPIO_EXTI10	M1_ENC_A
23	VDD	Power		
24	PB11 *	I/O	GPIO_Output	M2_EN
25	PB12 *	I/O	GPIO_Output	MC_RESET
26	PB13	I/O	OPAMP3_VINP	M2_SENSE
27	PB14	I/O	OPAMP2_VINP	M1_SENSE
28	PB15 *	I/O	GPIO_Input	M2_FAULT
29	PC6 *	I/O	GPIO_Input	M1_FAULT
30	PA8	I/O	TIM1_CH1	M1_PWM
31	PA9	I/O	TIM1_CH2	M2_PWM
32	PA10 *	I/O	GPIO_Output	M1_EN
33	PA11	I/O	TIM1_CH1N	M1_PH
34	PA12	I/O	TIM1_CH2N	M2_PH
35	VDD	Power		
36	PA13	I/O	SYS_JTMS-SWDIO	
37	PA14	I/O	SYS_JTCK-SWCLK	
38	PA15	I/O	SYS_JTDI	
41	PB3	I/O	SYS_JTDO-SWO	
43	PB5	I/O	GPIO_EXTI5	IMU_INT1
44	PB6	I/O	GPIO_EXTI6	IMU_INT2

Pin Number UFQFPN48	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
45	PB7	I/O	I2C1_SDA	
46	PB8-BOOT0	I/O	I2C1_SCL	
48	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	PCBot
Project Folder	/home/connor/workspace/connorrigby/PCBot/firmware/PCBot
Toolchain / IDE	Makefile
Firmware Package Name and Version	STM32Cube FW_G4 V1.5.1
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	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_ADC1_Init	ADC1
4	MX_ADC2_Init	ADC2
5	MX_I2C1_Init	I2C1
6	MX_LPUART1_UART_Init	LPUART1
7	MX_OPAMP2_Init	OPAMP2
8	MX_OPAMP3_Init	OPAMP3
9	MX_SPI1_Init	SPI1
10	MX_TIM1_Init	TIM1
11	MX_OPAMP1_Init	OPAMP1

6. Power Consumption Calculator report

6.1. Microcontroller Selection

Series	STM32G4
Line	STM32G4x1
MCU	STM32G431CBUx
Datasheet	DS12589_Rev0

6.2. Parameter Selection

Temperature	25
Vdd	3.0

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

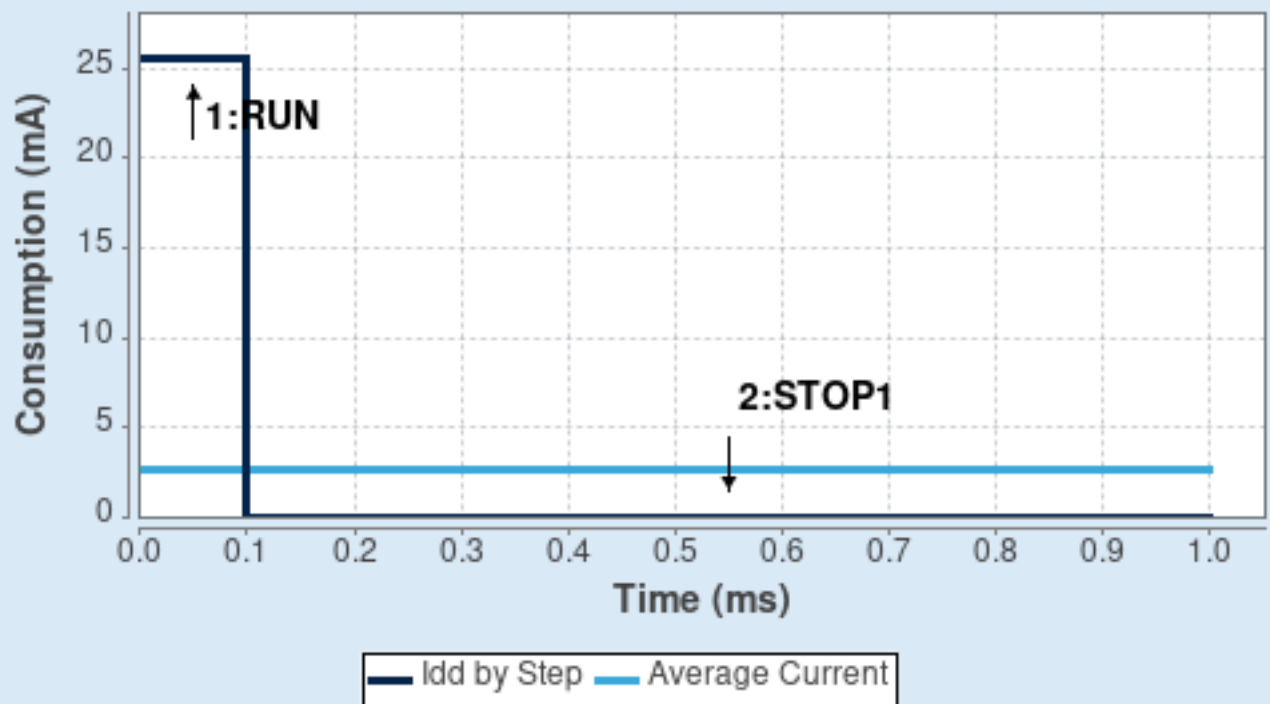
Step	Step1	Step2
Mode	RUN	STOP1
Vdd	3.0	3.0
Voltage Source	Battery	Battery
Range	Range1-Boost	NoRange
Fetch Type	FLASH/ART	NA
CPU Frequency	170 MHz	0 Hz
Clock Configuration	HSE BYP PLL	ALL CLOCKS OFF
Clock Source Frequency	4 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	25.5 mA	59 μ A
Duration	0.1 ms	0.9 ms
DMIPS	213.0	0.0
Ta Max	127.71	129.99
Category	In DS Table	In DS Table

6.5. Results

Sequence Time	1 ms	Average Current	2.6 mA
Battery Life	1 month, 23 days, 22 hours	Average DMIPS	212.5 DMIPS

6.6. Chart

Consumption Profile by Step



7. Peripherals and Middlewares Configuration

7.1. ADC1

IN1: IN1 Single-ended

7.1.1. Parameter Settings:

ADCs_Common_Settings:

Mode Independent mode

ADC_Settings:

Clock Prescaler Synchronous clock mode divided by 2

Resolution ADC 12-bit resolution

Data Alignment Right alignment

Gain Compensation 0

Scan Conversion Mode Disabled

End Of Conversion Selection End of single conversion

Low Power Auto Wait Disabled

Continuous Conversion Mode Disabled

Discontinuous Conversion Mode Disabled

DMA Continuous Requests Disabled

Overrun behaviour Overrun data preserved

ADC_Regular_ConversionMode:

Enable Regular Conversions Enable

Enable Regular Oversampling Disable

Number Of Conversion 1

External Trigger Conversion Source Regular Conversion launched by software

External Trigger Conversion Edge None

Rank 1

Channel Channel 1

Sampling Time 2.5 Cycles

Offset Number No offset

ADC_Injected_ConversionMode:

Enable Injected Conversions Disable

Analog Watchdog 1:

Enable Analog WatchDog1 Mode false

Analog Watchdog 2:

Enable Analog WatchDog2 Mode false

Analog Watchdog 3:

Enable Analog WatchDog3 Mode false

7.2. ADC2

mode: VOPAMP3 Channel

7.2.1. Parameter Settings:

ADCs_Common_Settings:

Mode Independent mode

ADC_Settings:

Clock Prescaler Synchronous clock mode divided by 2

Resolution ADC 12-bit resolution

Data Alignment Right alignment

Gain Compensation 0

Scan Conversion Mode Disabled

End Of Conversion Selection End of single conversion

Low Power Auto Wait Disabled

Continuous Conversion Mode Disabled

Discontinuous Conversion Mode Disabled

DMA Continuous Requests Disabled

Overrun behaviour Overrun data preserved

ADC_Regular_ConversionMode:

Enable Regular Conversions Enable

Enable Regular Oversampling Disable

Number Of Conversion 1

External Trigger Conversion Source Regular Conversion launched by software

External Trigger Conversion Edge None

Rank 1

Channel Channel Vopamp3

Sampling Time 2.5 Cycles

Offset Number No offset

ADC_Injected_ConversionMode:

Enable Injected Conversions Disable

Analog Watchdog 1:

Enable Analog WatchDog1 Mode false

Analog Watchdog 2:

Enable Analog WatchDog2 Mode false

Analog Watchdog 3:

Enable Analog WatchDog3 Mode false

7.3. I2C1

I2C: I2C

7.3.1. Parameter Settings:

Timing configuration:

Custom Timing	Disabled
I2C Speed Mode	Standard Mode
I2C Speed Frequency (KHz)	100
Rise Time (ns)	0
Fall Time (ns)	0
Coefficient of Digital Filter	0
Analog Filter	Enabled
Timing	0x00303D5B

Slave Features:

Clock No Stretch Mode	Disabled
General Call Address Detection	Disabled
Primary Address Length selection	7-bit
Dual Address Acknowledged	Disabled
Primary slave address	0

7.4. LPUART1

Mode: Asynchronous

7.4.1. Parameter Settings:

Basic Parameters:

Baud Rate	209700
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

Advanced Parameters:

Data Direction	Receive and Transmit
Single Sample	Disable
ClockPrescaler	1
Fifo Mode	FIFO mode disable
Txfifo Threshold	1 eighth full configuration
Rxfifo Threshold	1 eighth full configuration

Advanced Features:

TX Pin Active Level Inversion	Disable
RX Pin Active Level Inversion	Disable

Data Inversion	Disable
TX and RX pins Swapping	Disable
Overrun	Enable
DMA on RX Error	Enable
MSB First	Disable

7.5. OPAMP1

Mode: PGA Internally Connected

7.5.1. Parameter Settings:

Basic Parameters:

Power Mode	Normal
PGA Gain	2 or -1
User Trimming	Disable

7.6. OPAMP2

Mode: PGA Internally Connected

7.6.1. Parameter Settings:

Basic Parameters:

Power Mode	Normal
PGA Gain	2 or -1
User Trimming	Disable

7.7. OPAMP3

Mode: PGA Internally Connected

7.7.1. Parameter Settings:

Basic Parameters:

Power Mode	Normal
PGA Gain	2 or -1
User Trimming	Disable

7.8. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

7.8.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Disabled
Data Cache	Enabled
Flash Latency(WS)	0 WS (1 CPU cycle)

RCC Parameters:

HSI Calibration Value	64
HSE Startup Timeout Value (ms)	100
LSE Startup Timeout Value (ms)	5000

Power Parameters:

Power Regulator Voltage Scale	Power Regulator Voltage Scale 1
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Peripherals Clock Configuration:

Generate the peripherals clock configuration	TRUE
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7.9. SPI1

Mode: Full-Duplex Master

Hardware NSS Signal: Hardware NSS Output Signal

7.9.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	4 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
NSSP Mode	Enabled
NSS Signal Type	Output Hardware

7.10. SYS

Debug: JTAG (4 pins)

Timebase Source: SysTick

mode: save power of non-active UCPD - deactive Dead Battery pull-up

7.11. TIM1

Channel1: PWM Generation CH1 CH1N

Channel2: PWM Generation CH2 CH2N

7.11.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Dithering	Disable
Counter Period (AutoReload Register - 16 bits value)	65535
Internal Clock Division (CKD)	No Division
Repetition Counter (RCR - 16 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 TRGO	Reset (UG bit from TIMx_EGR)
Trigger Event Selection TRGO2	Reset (UG bit from TIMx_EGR)

Break And Dead Time management - BRK Configuration:

BRK State	Disable
BRK Polarity	High
BRK Filter (4 bits value)	0
BRK Sources Configuration	
- Digital Input	Disable
- COMP1	Disable
- COMP2	Disable
- COMP3	Disable
- COMP4	Disable

Break And Dead Time management - BRK2 Configuration:

BRK2 State	Disable
BRK2 Polarity	High
BRK2 Filter (4 bits value)	0
BRK2 Sources Configuration	
- Digital Input	Disable

- COMP1	Disable
- COMP2	Disable
- COMP3	Disable
- COMP4	Disable

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
DeadTime Preload	Disable
Dead Time	0
Asymmetrical DeadTime	Disable
Falling Dead Time	0

Clear Input:

Clear Input Source	Disable
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PWM Generation Channel 1 and 1N:

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

PWM Generation Channel 2 and 2N:

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

* 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	ADC1_IN1	Analog mode	No pull-up and no pull-down	n/a	
I2C1	PB7	I2C1_SDA	Alternate Function Open Drain	No pull-up and no pull-down	Low	
	PB8-BOOT0	I2C1_SCL	Alternate Function Open Drain	No pull-up and no pull-down	Low	
LPUART1	PA2	LPUART1_TX	Alternate Function Push Pull	No pull-up and no pull-down	Low	
	PA3	LPUART1_RX	Alternate Function Push Pull	No pull-up and no pull-down	Low	
OPAMP1	PA1	OPAMP1_VINP	Analog mode	No pull-up and no pull-down	n/a	
OPAMP2	PB14	OPAMP2_VINP	Analog mode	No pull-up and no pull-down	n/a	M1_SENSE
OPAMP3	PB13	OPAMP3_VINP	Analog mode	No pull-up and no pull-down	n/a	M2_SENSE
RCC	PF0-OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	
	PF1-OSC_OUT	RCC_OSC_OUT	n/a	n/a	n/a	
SPI1	PA4	SPI1_NSS	Alternate Function Push Pull	No pull-up and no pull-down	Low	
	PA5	SPI1_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Low	
	PA6	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Low	
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Low	
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	
TIM1	PA8	TIM1_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	M1_PWM
	PA9	TIM1_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	M2_PWM
	PA11	TIM1_CH1N	Alternate Function Push Pull	No pull-up and no pull-down	Low	M1_PH
	PA12	TIM1_CH2N	Alternate Function Push Pull	No pull-up and no pull-down	Low	M2_PH
GPIO	PC4	GPIO_EXTI4	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	RF_IRQ
	PB0	GPIO_EXTI0	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	M2_ENC_B
	PB1	GPIO_EXTI1	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	M2_ENC_A
	PB2	GPIO_EXTI2	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	M1_ENC_B
	PB10	GPIO_EXTI10	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	M1_ENC_A

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
	PB11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	M2_EN
	PB12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	MC_RESET
	PB15	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	M2_FAULT
	PC6	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	M1_FAULT
	PA10	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	M1_EN
	PB5	GPIO_EXTI5	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	IMU_INT1
	PB6	GPIO_EXTI6	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	IMU_INT2

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
Prefetch 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/PVM1/PVM2/PVM3/PVM4 interrupts through EXTI lines 16/38/39/40/41	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
EXTI line0 interrupt	unused		
EXTI line1 interrupt	unused		
EXTI line2 interrupt	unused		
EXTI line4 interrupt	unused		
ADC1 and ADC2 global interrupt	unused		
EXTI line[9:5] interrupts	unused		
TIM1 break interrupt and TIM15 global interrupt	unused		
TIM1 update interrupt and TIM16 global interrupt	unused		
TIM1 trigger and commutation interrupts and TIM17 global interrupt	unused		
TIM1 capture compare interrupt	unused		
I2C1 event interrupt / I2C1 wake-up interrupt through EXTI line 23	unused		
I2C1 error interrupt	unused		
SPI1 global interrupt	unused		
EXTI line[15:10] interrupts	unused		
FPU global interrupt	unused		
LPUART1 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

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
Memory management fault	false	true	false
Prefetch 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

9. System Views

9.1. Category view

9.1.1. Current

Middleware

System Core	Analog	Timers	Connectivity	Multimedia	Security	Computing	Utilities
DMA	ADC1 ✓	TIM1 ✓	I2C1 ✓				
GPIO ✓	ADC2 ✓		LPUART1 ✓				
NVIC ✓	OPAMP1 ✓		SPI1 ✓				
RCC ✓	OPAMP2 ✓						
SYS ✓	OPAMP3 ✓						

10. Docs & Resources

Type	Link
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