



1. Description

1.1. Project

Project Name	VES_FLIGHT_CONTROLLER_FW
Board Name	custom
Generated with:	STM32CubeMX 6.12.1
Date	10/05/2024

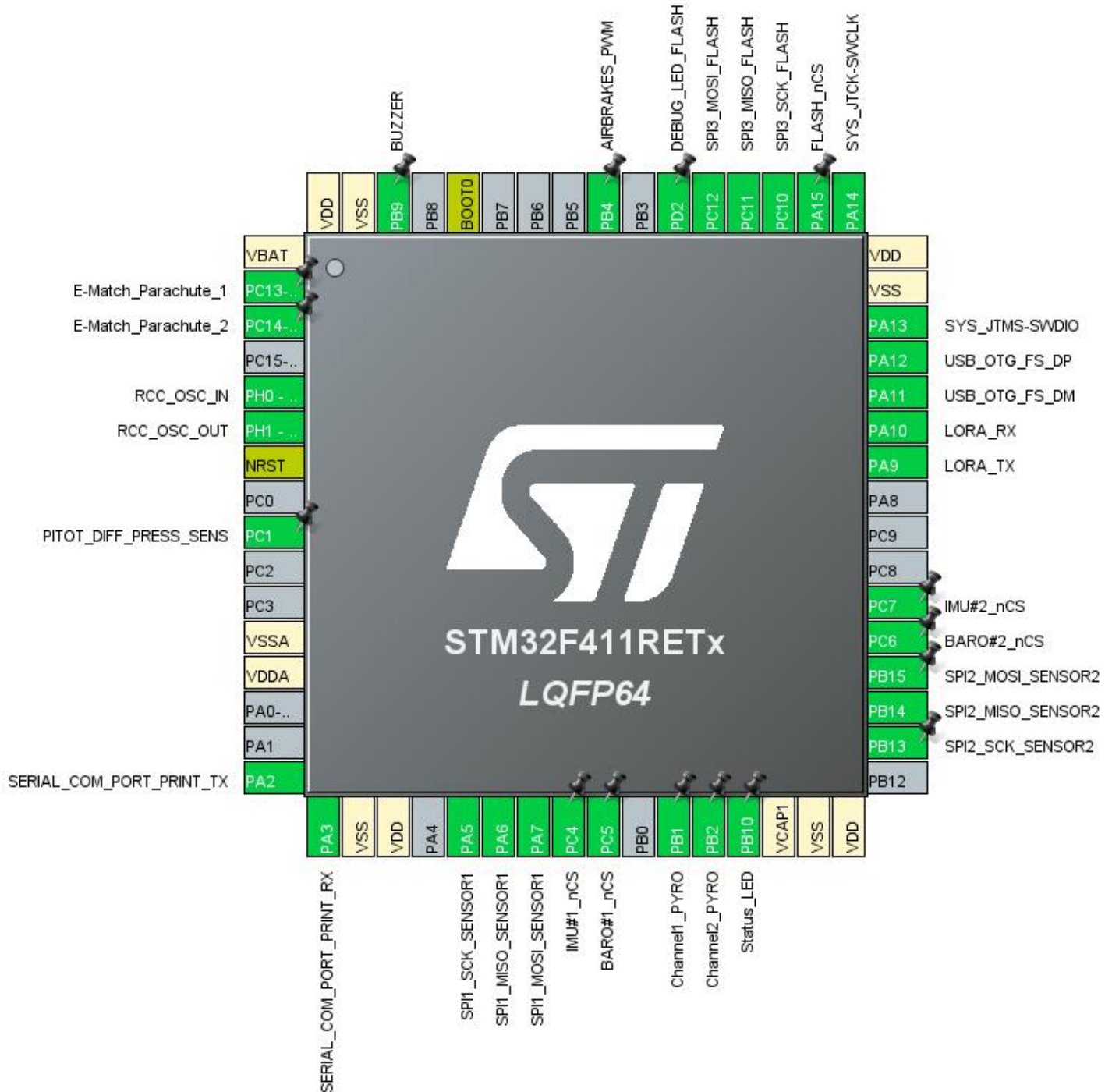
1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F411
MCU name	STM32F411RETx
MCU Package	LQFP64
MCU Pin number	64

1.3. Core(s) information

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



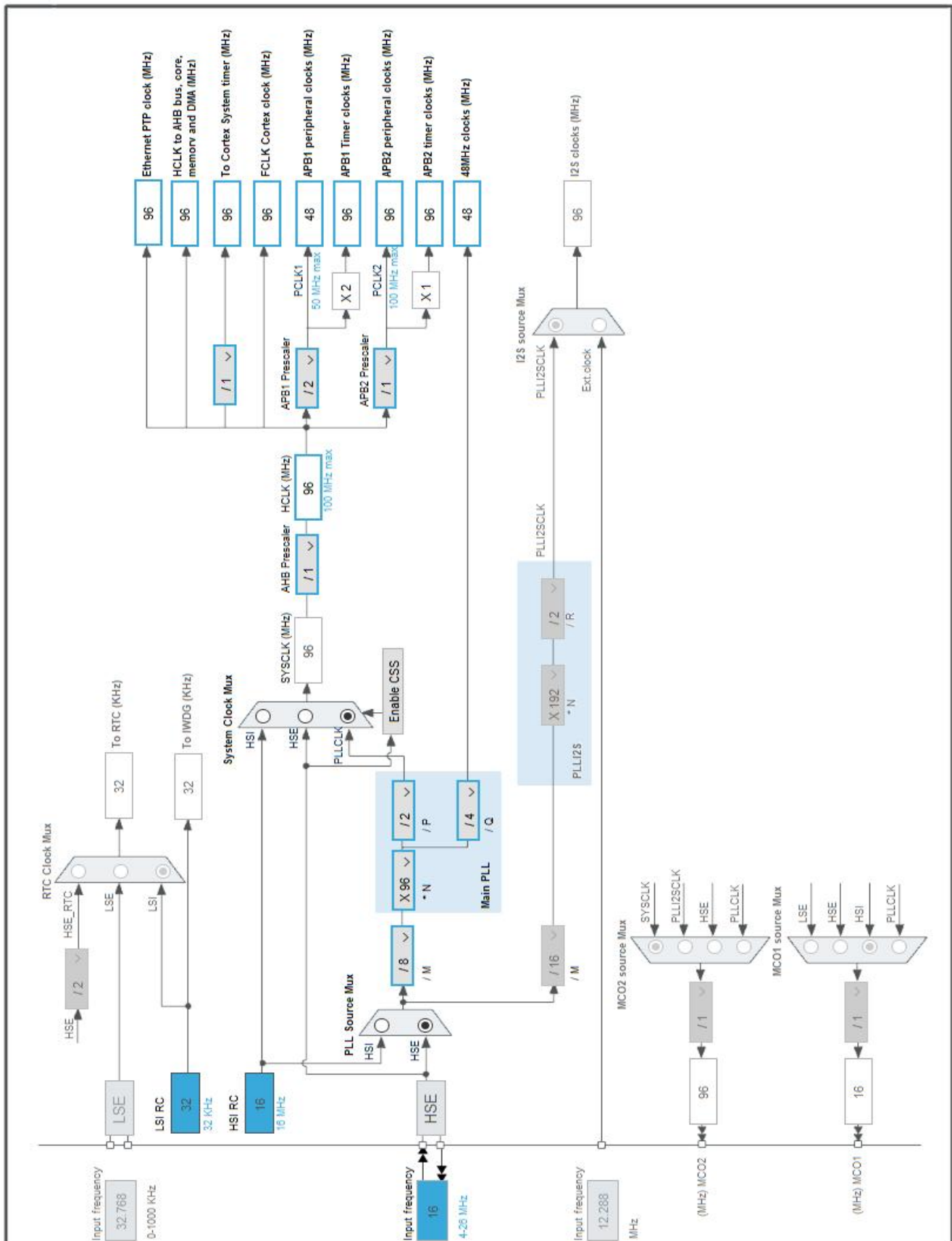
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
2	PC13-ANTI_TAMP *	I/O	GPIO_Output	E-Match_Parachute_1
3	PC14-OSC32_IN *	I/O	GPIO_Output	E-Match_Parachute_2
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	ADC1_IN11	PITOT_DIFF_PRESS_SEN S
12	VSSA	Power		
13	VDDA	Power		
16	PA2	I/O	USART2_TX	SERIAL_COM_PORT_PRIN T_TX
17	PA3	I/O	USART2_RX	SERIAL_COM_PORT_PRIN T_RX
18	VSS	Power		
19	VDD	Power		
21	PA5	I/O	SPI1_SCK	SPI1_SCK_SENSOR1
22	PA6	I/O	SPI1_MISO	SPI1_MISO_SENSOR1
23	PA7	I/O	SPI1_MOSI	SPI1_MOSI_SENSOR1
24	PC4 *	I/O	GPIO_Output	IMU#1_nCS
25	PC5 *	I/O	GPIO_Output	BARO#1_nCS
27	PB1 *	I/O	GPIO_Output	Channel1_PYRO
28	PB2 *	I/O	GPIO_Output	Channel2_PYRO
29	PB10 *	I/O	GPIO_Output	Status_LED
30	VCAP1	Power		
31	VSS	Power		
32	VDD	Power		
34	PB13	I/O	SPI2_SCK	SPI2_SCK_SENSOR2
35	PB14	I/O	SPI2_MISO	SPI2_MISO_SENSOR2
36	PB15	I/O	SPI2_MOSI	SPI2_MOSI_SENSOR2
37	PC6 *	I/O	GPIO_Output	BARO#2_nCS
38	PC7 *	I/O	GPIO_Output	IMU#2_nCS
42	PA9	I/O	USART1_TX	LORA_TX
43	PA10	I/O	USART1_RX	LORA_RX
44	PA11	I/O	USB_OTG_FS_DM	
45	PA12	I/O	USB_OTG_FS_DP	

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
46	PA13	I/O	SYS_JTMS-SWDIO	
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	
50	PA15 *	I/O	GPIO_Output	FLASH_nCS
51	PC10	I/O	SPI3_SCK	SPI3_SCK_FLASH
52	PC11	I/O	SPI3_MISO	SPI3_MISO_FLASH
53	PC12	I/O	SPI3_MOSI	SPI3_MOSI_FLASH
54	PD2 *	I/O	GPIO_Output	DEBUG_LED_FLASH
56	PB4	I/O	TIM3_CH1	AIRBRAKES_PWM
60	BOOT0	Boot		
62	PB9	I/O	TIM4_CH4	BUZZER
63	VSS	Power		
64	VDD	Power		

* The pin is affected with an I/O function

4. Clock Tree Configuration



1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32F4
Line	STM32F411
MCU	STM32F411RETx
Datasheet	DS10314_Rev6

1.2. Parameter Selection

Temperature	25
Vdd	1.7

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

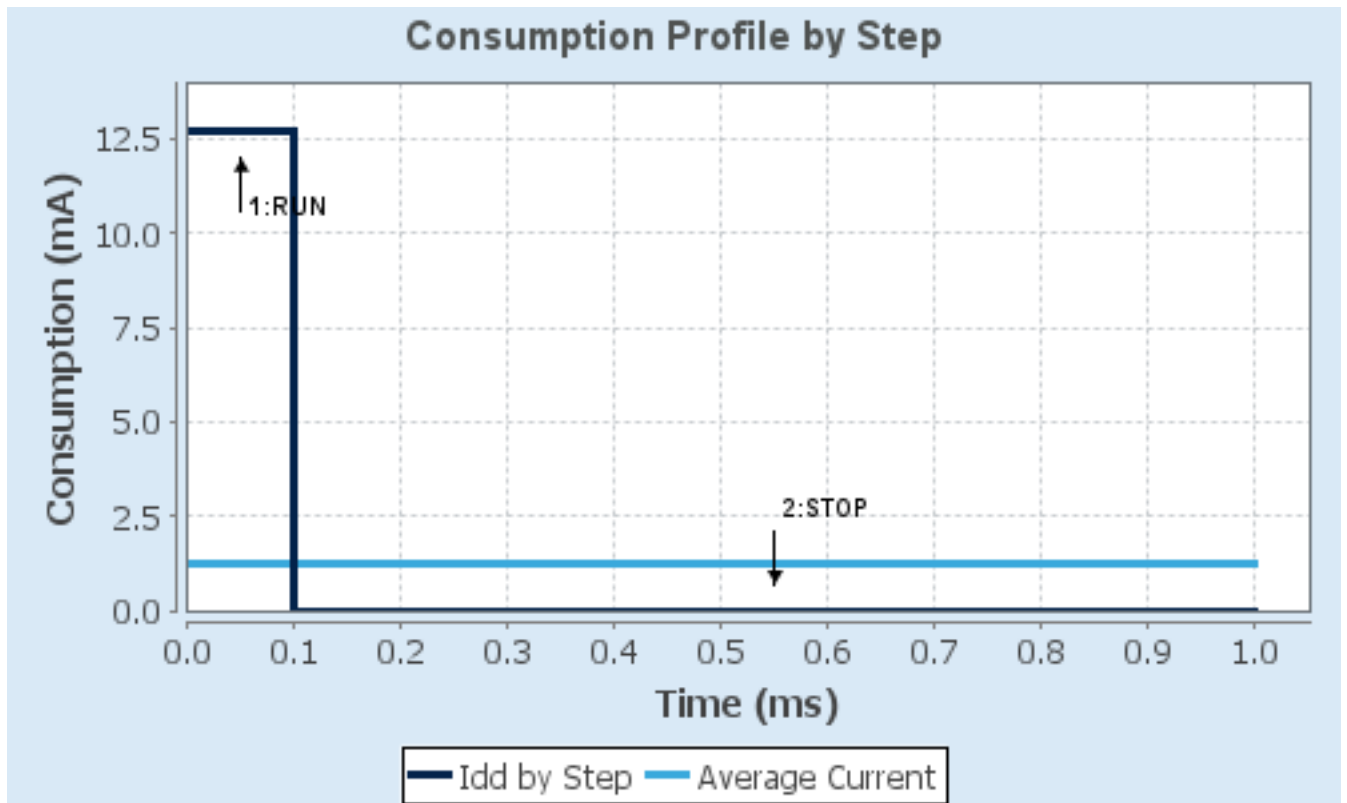
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP
Vdd	1.7	1.7
Voltage Source	Battery	Battery
Range	Scale1-High	No Scale
Fetch Type	SRAM	n/a
CPU Frequency	100 MHz	0 Hz
Clock Configuration	HSE PLL	Regulator_LPLV Flash-PwrDwn
Clock Source Frequency	4 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	12.7 mA	9 μ A
Duration	0.1 ms	0.9 ms
DMIPS	125.0	0.0
Ta Max	103.99	105
Category	In DS Table	In DS Table

1.5. Results

Sequence Time	1 ms	Average Current	1.28 mA
Battery Life	3 months, 19 days, 6 hours	Average DMIPS	125.0 DMIPS

1.6. Chart



2. Software Project

2.1. Project Settings

Name	Value
Project Name	VES_FLIGHT_CONTROLLER_FW
Project Folder	C:\Users\fabate\Documents\VES-firmware\VES_FLIGHT_CONTROLLER_FW
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	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)	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_SPI1_Init	SPI1
4	MX_SPI2_Init	SPI2
5	MX_SPI3_Init	SPI3
6	MX_TIM3_Init	TIM3
7	MX_USB_DEVICE_Init	USB_DEVICE
8	MX_USART2_UART_Init	USART2
9	MX_USART1_UART_Init	USART1
10	MX_ADC1_Init	ADC1
11	MX_TIM4_Init	TIM4

3. Peripherals and Middlewares Configuration

3.1. ADC1

mode: IN11

3.1.1. 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 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 11

Sampling Time 3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions 0

WatchDog:

Enable Analog WatchDog Mode false

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) 3 WS (4 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 1
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3.3. SPI1

Mode: Full-Duplex Master

3.3.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	16 *
Baud Rate	6.0 MBits/s *
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

3.4. SPI2

Mode: Full-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)	8 *
Baud Rate	6.0 MBits/s *

Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge
Advanced Parameters:	
CRC Calculation	Disabled
NSS Signal Type	Software

3.5. SPI3

Mode: Full-Duplex Master

3.5.1. Parameter Settings:

Basic Parameters:	
Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First
Clock Parameters:	
Prescaler (for Baud Rate)	2
Baud Rate	24.0 MBits/s *
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge
Advanced Parameters:	
CRC Calculation	Disabled
NSS Signal Type	Software

3.6. SYS

Debug: Serial Wire

Timebase Source: TIM1

3.7. TIM3

Clock Source : Internal Clock

Channel1: PWM Generation CH1

3.7.1. 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

3.8. TIM4

Channel4: PWM Generation CH4

3.8.1. Parameter Settings:

Counter Settings:	
Prescaler (PSC - 16 bits value)	0
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	0 *
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 4:	
Mode	PWM mode 1
Pulse (16 bits value)	0
Output compare preload	Enable
Fast Mode	Disable
CH Polarity	High

3.9. USART1

Mode: Asynchronous

3.9.1. 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

3.10. USART2

Mode: Asynchronous

3.10.1. Parameter Settings:

Basic Parameters:

Baud Rate	9600 *
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

Advanced Parameters:

Data Direction	Receive and Transmit
Over Sampling	16 Samples

3.11. USB_OTG_FS

Mode: Device_Only

3.11.1. Parameter Settings:

Speed	Device Full Speed 12MBit/s
Low power	Disabled
Link Power Management	Disabled
VBUS sensing	Disabled
Signal start of frame	Disabled

3.12. FREERTOS

Interface: CMSIS_V2

3.12.1. Config parameters:

API:

FreeRTOS API CMSIS v2

Versions:

FreeRTOS version 10.3.1

CMSIS-RTOS version 2.00

MPU/FPU:

ENABLE_MPU Disabled

ENABLE_FPU Disabled

Kernel settings:

USE_PREEMPTION Enabled

CPU_CLOCK_HZ SystemCoreClock

TICK_RATE_HZ 1000

MAX_PRIORITIES 56

MINIMAL_STACK_SIZE 128

MAX_TASK_NAME_LEN **25 ***

USE_16_BIT_TICKS Disabled

IDLE_SHOULD_YIELD Enabled

USE_MUTEXES Enabled

USE_RECURSIVE_MUTEXES Enabled

USE_COUNTING_SEMAPHORES Enabled

QUEUE_REGISTRY_SIZE 8

USE_APPLICATION_TASK_TAG Disabled

ENABLE_BACKWARD_COMPATIBILITY Enabled

USE_PORT_OPTIMISED_TASK_SELECTION Disabled

USE_TICKLESS_IDLE Disabled

USE_TASK_NOTIFICATIONS Enabled

RECORD_STACK_HIGH_ADDRESS Disabled

Memory management settings:

Memory Allocation Dynamic / Static

TOTAL_HEAP_SIZE 15360

Memory Management scheme heap_4

Hook function related definitions:

USE_IDLE_HOOK Disabled

USE_TICK_HOOK Disabled

USE_MALLOC_FAILED_HOOK Disabled

USE_DAEMON_TASK_STARTUP_HOOK Disabled

CHECK_FOR_STACK_OVERFLOW Disabled

Run time and task stats gathering related definitions:

GENERATE_RUN_TIME_STATS Disabled

USE_TRACE_FACILITY Enabled

USE_STATS_FORMATTING_FUNCTIONS Disabled

Co-routine related definitions:

USE_CO_ROUTINES Disabled

MAX_CO_ROUTINE_PRIORITIES 2

Software timer definitions:

USE_TIMERS Enabled

TIMER_TASK_PRIORITY 2

TIMER_QUEUE_LENGTH 10

TIMER_TASK_STACK_DEPTH 256

Interrupt nesting behaviour configuration:

LIBRARY_LOWEST_INTERRUPT_PRIORITY 15

LIBRARY_MAX_SYSCALL_INTERRUPT_PRIORITY 5

Added with 10.2.1 support:

MESSAGE_BUFFER_LENGTH_TYPE size_t

USE_POSIX_ERRNO Disabled

CMSIS-RTOS V2 flags:

USE_OS2_THREAD_SUSPEND_RESUME Enabled

USE_OS2_THREAD_ENUMERATE Enabled

USE_OS2_EVENTFLAGS_FROM_ISR Enabled

USE_OS2_THREAD_FLAGS Enabled

USE_OS2_TIMER Enabled

USE_OS2_MUTEX Enabled

3.12.2. Include parameters:

Include definitions:

vTaskPrioritySet Enabled

uxTaskPriorityGet Enabled

vTaskDelete Enabled

vTaskCleanUpResources Disabled

vTaskSuspend Enabled

vTaskDelayUntil Enabled

vTaskDelay Enabled

xTaskGetSchedulerState Enabled

xTaskResumeFromISR Enabled

xQueueGetMutexHolder Enabled

xSemaphoreGetMutexHolder Disabled

pcTaskGetTaskName Disabled

uxTaskGetStackHighWaterMark Enabled

xTaskGetCurrentTaskHandle Enabled

eTaskGetState Enabled

xEventGroupSetBitFromISR	Disabled
xTimerPendFunctionCall	Enabled
xTaskAbortDelay	Disabled
xTaskGetHandle	Disabled
uxTaskGetStackHighWaterMark2	Disabled

3.12.3. Advanced settings:

Newlib settings (see parameter description first):

USE_NEWLIB_REENTRANT **Enabled ***

Project settings (see parameter description first):

Use FW pack heap file Enabled

3.13. USB_DEVICE

Class For FS IP: Mass Storage Class

3.13.1. Parameter Settings:

Basic Parameters:

USBD_MAX_NUM_INTERFACES (Maximum number of supported interfaces)	1
USBD_MAX_NUM_CONFIGURATION (Maximum number of supported configuration)	1
USBD_MAX_STR_DESC_SIZ (Maximum size for the string descriptors)	512
USBD_SELF_POWERED (Enabled self power)	Enabled
USBD_DEBUG_LEVEL (USBD Debug Level)	0: No debug message

Class Parameters:

MSC_MEDIA_PACKET (Media I/O buffer Size)	512
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3.13.2. Device Descriptor:

Device Descriptor:

VID (Vendor Identifier)	1155
LANGID_STRING (Language Identifier)	English(United States)
MANUFACTURER_STRING (Manufacturer Identifier)	STMicroelectronics

Device Descriptor FS:

PID (Product Identifier)	22314
PRODUCT_STRING (Product Identifier)	STM32 Mass Storage
CONFIGURATION_STRING (Configuration Identifier)	MSC Config
INTERFACE_STRING (Interface Identifier)	MSC Interface

* 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	PC1	ADC1_IN11	Analog mode	No pull-up and no pull-down	n/a	PITOT_DIFF_PRESS_SENS
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 *	SPI1_SCK_SENSOR1
	PA6	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI1_MISO_SENSOR1
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI1_MOSI_SENSOR1
SPI2	PB13	SPI2_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI2_SCK_SENSOR2
	PB14	SPI2_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI2_MISO_SENSOR2
	PB15	SPI2_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI2_MOSI_SENSOR2
SPI3	PC10	SPI3_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI3_SCK_FLASH
	PC11	SPI3_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI3_MISO_FLASH
	PC12	SPI3_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SPI3_MOSI_FLASH
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	
TIM3	PB4	TIM3_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	AIRBRAKES_PWM
TIM4	PB9	TIM4_CH4	Alternate Function Push Pull	No pull-up and no pull-down	Low	BUZZER
USART1	PA9	USART1_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	LORA_TX
	PA10	USART1_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	LORA_RX
USART2	PA2	USART2_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High	SERIAL_COM_PORT_PRI

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
					*	NT_TX
	PA3	USART2_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SERIAL_COM_PORT_PRINT_RX
USB_OTG_FS	PA11	USB_OTG_FS_DM	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
	PA12	USB_OTG_FS_DP	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
GPIO	PC13-ANTI_TAMP	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	E-Match_Parachute_1
	PC14-OSC32_IN	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	E-Match_Parachute_2
	PC4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	IMU#1_nCS
	PC5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	BARO#1_nCS
	PB1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	Channel1_PYRO
	PB2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	Channel2_PYRO
	PB10	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	Status_LED
	PC6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	BARO#2_nCS
	PC7	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	IMU#2_nCS
	PA15	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	FLASH_nCS
	PD2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	DEBUG_LED_FLASH

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	15	0
System tick timer	true	15	0
TIM1 update interrupt and TIM10 global interrupt	true	15	0
USB On The Go FS global interrupt	true	5	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1 global interrupt	unused		
TIM3 global interrupt	unused		
TIM4 global interrupt	unused		
SPI1 global interrupt	unused		
SPI2 global interrupt	unused		
USART1 global interrupt	unused		
USART2 global interrupt	unused		
SPI3 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	false	false
Debug monitor	false	true	false
Pendable request for system service	false	false	false
System tick timer	false	false	true

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
TIM1 update interrupt and TIM10 global interrupt	false	true	true
USB On The Go FS global interrupt	false	true	true

* User modified value

5. System Views

5.1. Category view

5.1.1. Current

Middleware					
<div><div>FREERTOS ✓</div><div>USB_DEVICE ✓</div></div>					
System Core	Analog	Timers	Connectivity	Multimedia	Computing
DMA	ADC1 ✓	TIM3 ✓	SPI1 ✓		
GPIO ✓		TIM4 ✓	SPI2 ✓		
NVIC ✓			SPI3 ✓		
RCC ✓			USART1 ✓		
SYS ✓			USART2 ✓		
			USB_FS ✓		

6. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f411_bsdl.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32f411_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
Presentations	https://www.st.com/resource/en/product_presentation/microcontrollers-stm32h7rs-lines-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/flstm32f4x1.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32nucleo.pdf
Flyers	https://www.st.com/resource/en/flyer/flstmcsuite.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
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/an2639-soldering-

recommendations-and-package-information-for-leadfree-ecopack-mcus-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

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/an3154-can-protocol-used-in-the-stm32-bootloader-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

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