



## 1. Description

### 1.1. Project

Project Name	BMS_LV
Board Name	custom
Generated with:	STM32CubeMX 6.6.1
Date	12/13/2022

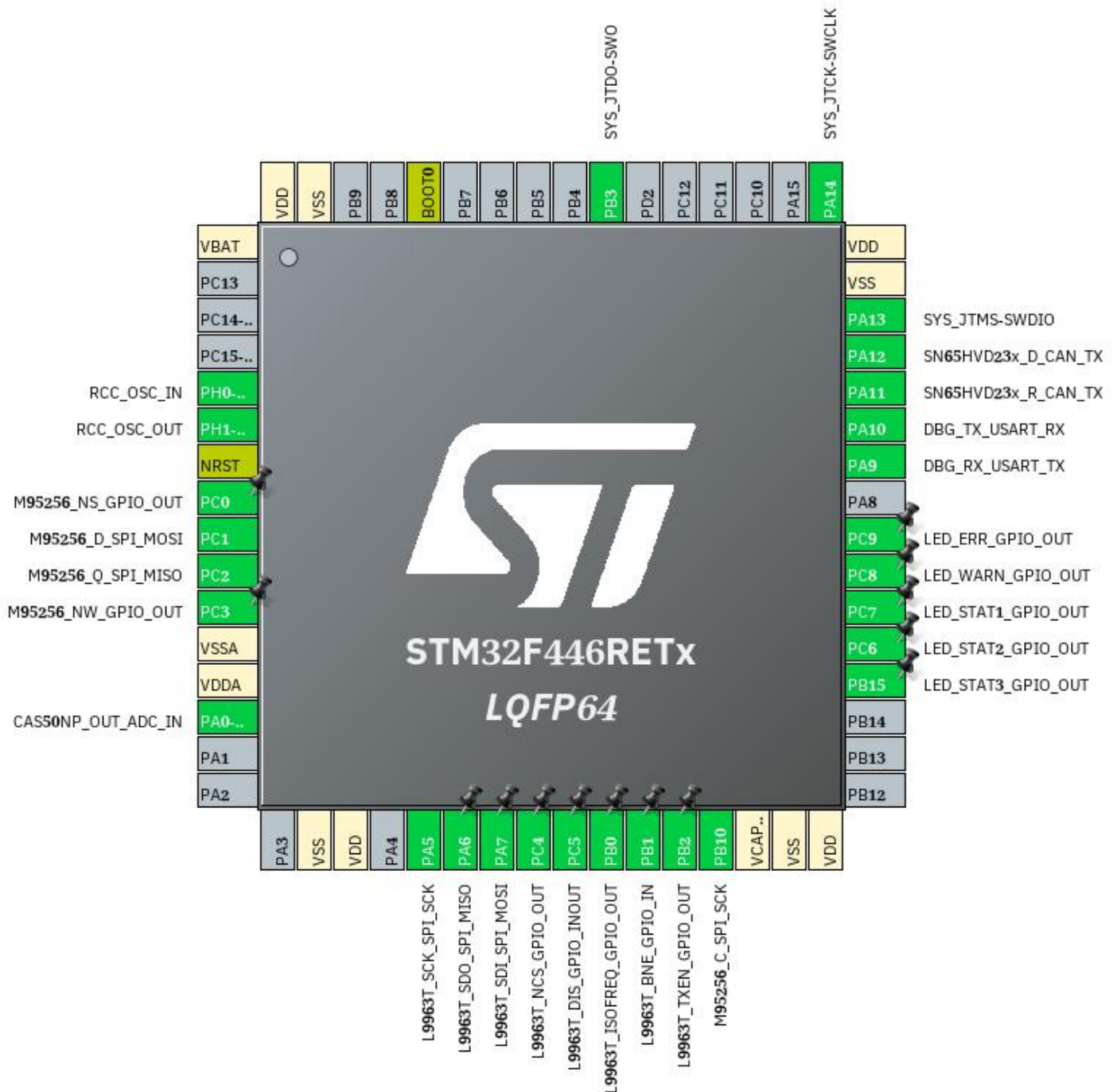
### 1.2. MCU

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



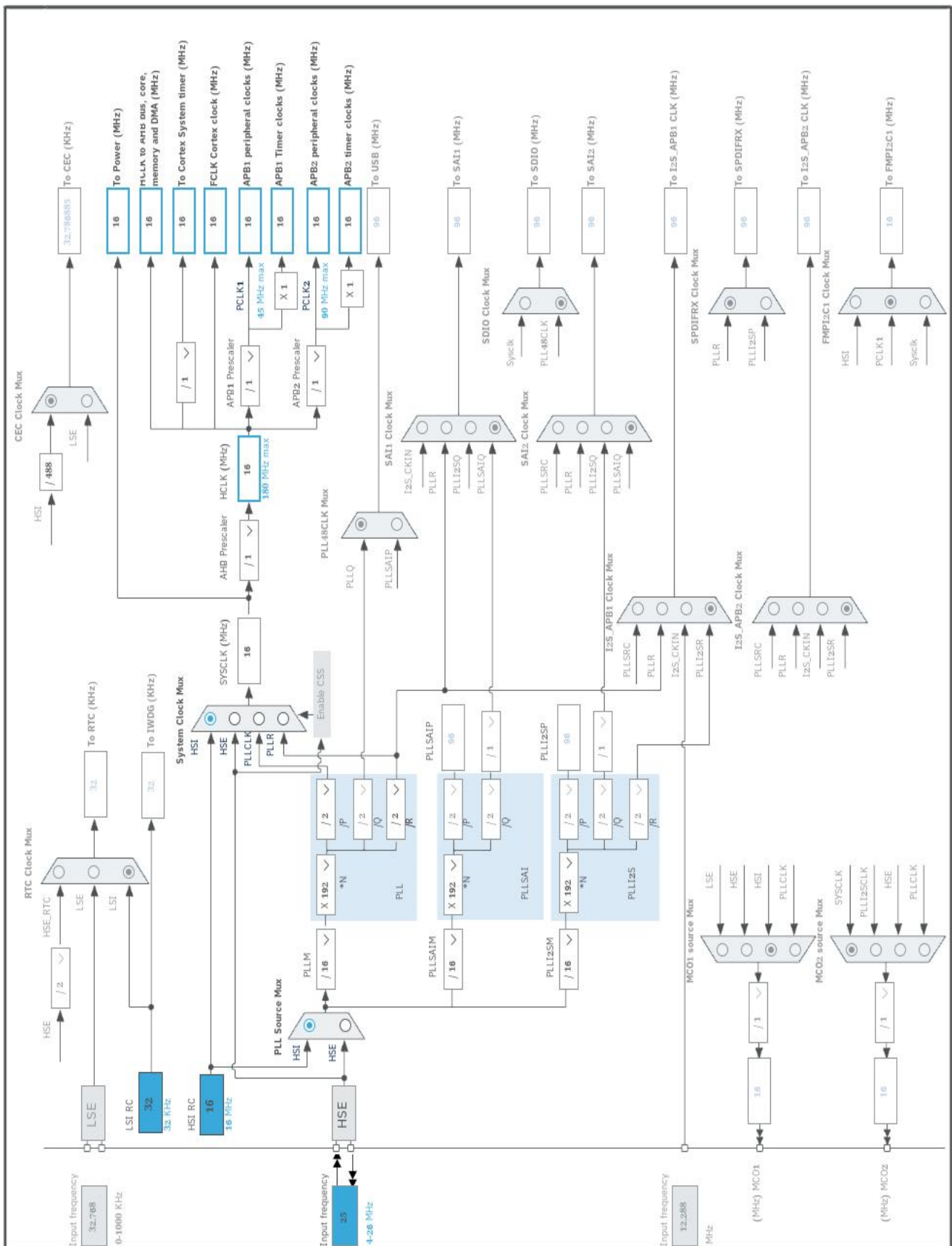
### 3. Pins Configuration

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		
8	PC0 *	I/O	GPIO_Output	M95256_NS_GPIO_OUT
9	PC1	I/O	SPI2_MOSI	M95256_D_SPI_MOSI
10	PC2	I/O	SPI2_MISO	M95256_Q_SPI_MISO
11	PC3 *	I/O	GPIO_Output	M95256_NW_GPIO_OUT
12	VSSA	Power		
13	VDDA	Power		
14	PA0-WKUP	I/O	ADC1_IN0	CAS50NP_OUT_ADC_IN
18	VSS	Power		
19	VDD	Power		
21	PA5	I/O	SPI1_SCK	L9963T_SCK_SPI_SCK
22	PA6	I/O	SPI1_MISO	L9963T_SDO_SPI_MISO
23	PA7	I/O	SPI1_MOSI	L9963T_SDI_SPI_MOSI
24	PC4 *	I/O	GPIO_Output	L9963T_NCS_GPIO_OUT
25	PC5 *	I/O	GPIO_Output	L9963T_DIS_GPIO_INOUT
26	PB0 *	I/O	GPIO_Output	L9963T_ISOFREQ_GPIO_OUT
27	PB1 *	I/O	GPIO_Input	L9963T_BNE_GPIO_IN
28	PB2 *	I/O	GPIO_Output	L9963T_TXEN_GPIO_OUT
29	PB10	I/O	SPI2_SCK	M95256_C_SPI_SCK
30	VCAP_1	Power		
31	VSS	Power		
32	VDD	Power		
36	PB15 *	I/O	GPIO_Output	LED_STAT3_GPIO_OUT
37	PC6 *	I/O	GPIO_Output	LED_STAT2_GPIO_OUT
38	PC7 *	I/O	GPIO_Output	LED_STAT1_GPIO_OUT
39	PC8 *	I/O	GPIO_Output	LED_WARN_GPIO_OUT
40	PC9 *	I/O	GPIO_Output	LED_ERR_GPIO_OUT
42	PA9	I/O	USART1_TX	DBG_RX_USART_TX
43	PA10	I/O	USART1_RX	DBG_TX_USART_RX
44	PA11	I/O	CAN1_RX	SN65HVD23x_R_CAN_TX
45	PA12	I/O	CAN1_TX	SN65HVD23x_D_CAN_TX
46	PA13	I/O	SYS_JTMS-SWDIO	

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
47	VSS	Power		
48	VDD	Power		
49	PA14	I/O	SYS_JTCK-SWCLK	
55	PB3	I/O	SYS_JTDO-SWO	
60	BOOT0	Boot		
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	BMS_LV
Project Folder	/home/simone/Documents/10.SquadraCorse/BMS_LV
Toolchain / IDE	EWARM V8.50
Firmware Package Name and Version	STM32Cube FW_F4 V1.27.1
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_CAN1_Init	CAN1
5	MX_SPI1_Init	SPI1
6	MX_SPI2_Init	SPI2
7	MX_USART1_UART_Init	USART1

## 6. Power Consumption Calculator report

### 6.1. Microcontroller Selection

Series	STM32F4
Line	STM32F446
MCU	STM32F446RETx
Datasheet	DS10693_Rev6

### 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



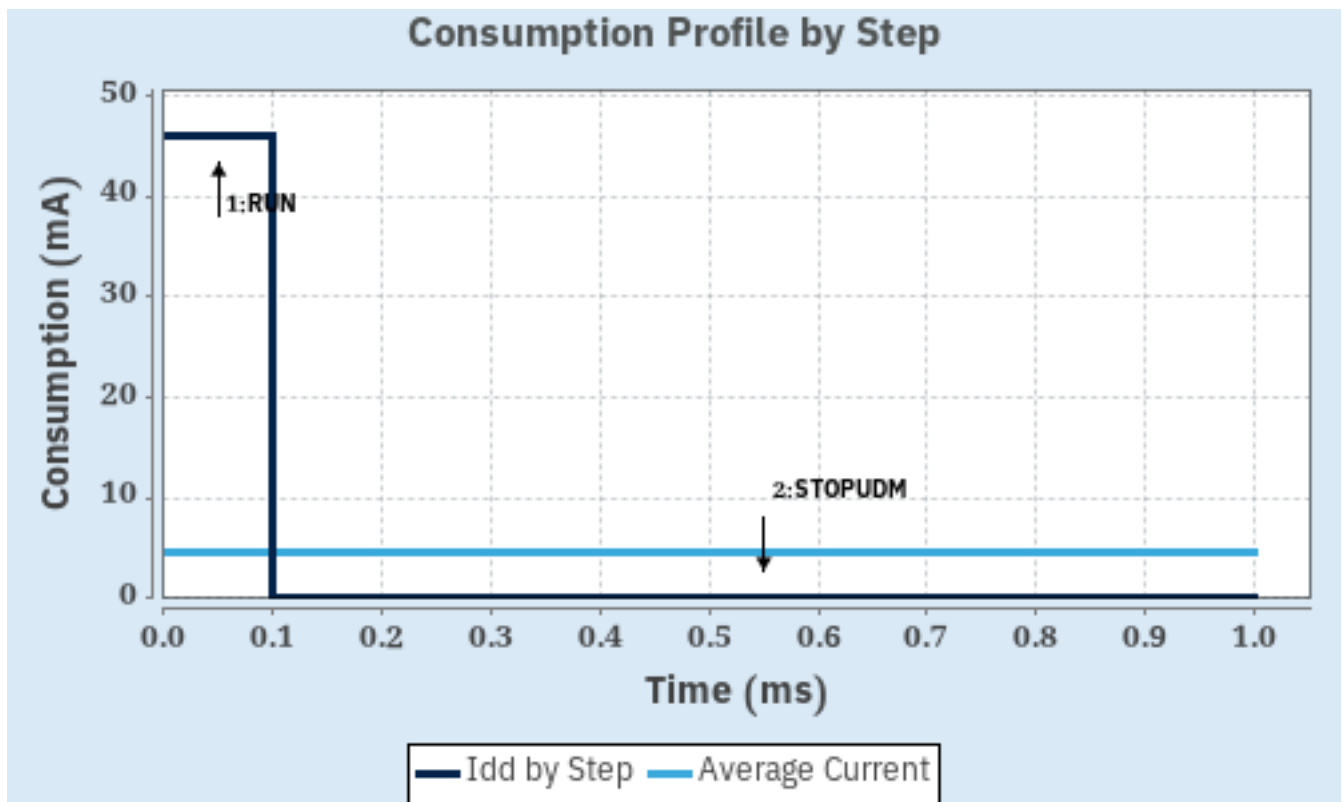
#### 6.4. Sequence

<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

#### 6.5. Results

Sequence Time	1 ms	Average Current	4.65 mA
Battery Life	1 month	Average DMIPS	225.0 DMIPS

#### 6.6. Chart



## 7. Peripherals and Middlewares Configuration

### 7.1. ADC1

**mode: IN0**

#### 7.1.1. 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 0

Sampling Time 3 Cycles

##### **ADC\_Injected\_ConversionMode:**

Number Of Conversions 0

##### **WatchDog:**

Enable Analog WatchDog Mode false

### 7.2. CAN1

**mode: Activated**

#### 7.2.1. Parameter Settings:

##### **Bit Timings Parameters:**

Prescaler (for Time Quantum) 16

Time Quantum **1000.0 \***

Time Quanta in Bit Segment 1 1 Time

Time Quanta in Bit Segment 2 1 Time

Time for one Bit **3000 \***

Baud Rate **333333 \***

ReSynchronization Jump Width 1 Time

**Basic Parameters:**

Time Triggered Communication Mode Disable

Automatic Bus-Off Management Disable

Automatic Wake-Up Mode Disable

Automatic Retransmission Disable

Receive Fifo Locked Mode Disable

Transmit Fifo Priority Disable

**Advanced Parameters:**

Operating Mode Normal

## 7.3. RCC

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

#### 7.3.1. 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  
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

## 7.4. SPI1

### Mode: Full-Duplex Master

#### 7.4.1. Parameter Settings:

**Basic Parameters:**

Frame Format Motorola

Data Size	8 Bits
First Bit	MSB First
<b>Clock Parameters:</b>	
Prescaler (for Baud Rate)	2
Baud Rate	<b>8.0 MBits/s *</b>
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge
<b>Advanced Parameters:</b>	
CRC Calculation	Disabled
NSS Signal Type	Software

## 7.5. SPI2

### Mode: Full-Duplex Master

#### 7.5.1. Parameter Settings:

<b>Basic Parameters:</b>	
Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First
<b>Clock Parameters:</b>	
Prescaler (for Baud Rate)	2
Baud Rate	<b>8.0 MBits/s *</b>
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge
<b>Advanced Parameters:</b>	
CRC Calculation	Disabled
NSS Signal Type	Software

## 7.6. SYS

### Debug: Trace Asynchronous Sw

#### Timebase Source: SysTick

## 7.7. USART1

### Mode: Asynchronous

#### 7.7.1. 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	PA0-WKUP	ADC1_IN0	Analog mode	No pull-up and no pull-down	n/a	CAS50NP_OUT_ADC_IN
CAN1	PA11	CAN1_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SN65HVD23x_R_CAN_TX
	PA12	CAN1_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	SN65HVD23x_D_CAN_TX
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 *	L9963T_SCK_SPI_SCK
	PA6	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	L9963T_SDO_SPI_MISO
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	L9963T_SDI_SPI_MOSI
SPI2	PC1	SPI2_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	M95256_D_SPI_MOSI
	PC2	SPI2_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	M95256_Q_SPI_MISO
	PB10	SPI2_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	M95256_C_SPI_SCK
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	
	PB3	SYS_JTDO-SWO	n/a	n/a	n/a	
USART1	PA9	USART1_TX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	DBG_RX_USART_TX
	PA10	USART1_RX	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	DBG_TX_USART_RX
GPIO	PC0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	M95256_NS_GPIO_OUT
	PC3	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	M95256_NW_GPIO_OUT
	PC4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	L9963T_NCS_GPIO_OUT
	PC5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	L9963T_DIS_GPIO_INOU

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
						T
	PB0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	L9963T_ISOFREQ_GPIO_OUT
	PB1	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	L9963T_BNE_GPIO_IN
	PB2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	L9963T_TXEN_GPIO_OUT
	PB15	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_STAT3_GPIO_OUT
	PC6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_STAT2_GPIO_OUT
	PC7	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_STAT1_GPIO_OUT
	PC8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_WARN_GPIO_OUT
	PC9	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED_ERR_GPIO_OUT

## 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
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 interrupts	unused		
CAN1 TX interrupt	unused		
CAN1 RX0 interrupt	unused		
CAN1 RX1 interrupt	unused		
CAN1 SCE interrupt	unused		
SPI1 global interrupt	unused		
SPI2 global interrupt	unused		
USART1 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

**\* User modified value**

## 9. System Views

### 9.1. Category view

#### 9.1.1. Current

#### Middleware

#### System Core

#### Analog

#### Timers

#### Connectivity

#### Multimedia

#### Computing

DMA

ADC1



CAN1



GPIO



SPI1



NVIC



SPI2



RCC



USART1



SYS



## 10. Docs & Resources

Type	Link
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>
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Training Material	<a href="https://www.st.com/resource/en/sales_guide/sg_sc2154.pdf">https://www.st.com/resource/en/sales_guide/sg_sc2154.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flnucleolrwan.pdf">https://www.st.com/resource/en/flyer/flnucleolrwan.pdf</a>
Flyers	<a href="https://www.st.com/resource/en/flyer/flstm32nucleo.pdf">https://www.st.com/resource/en/flyer/flstm32nucleo.pdf</a>
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Flyers	<a href="https://www.st.com/resource/en/flyer/flstm32trust.pdf">https://www.st.com/resource/en/flyer/flstm32trust.pdf</a>
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Application Notes	<a href="https://www.st.com/resource/en/application_note/an1181-electrostatic-discharge-sensitivity-measurement-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an1181-electrostatic-discharge-sensitivity-measurement-stmicroelectronics.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-and-mpus-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an2639-soldering-recommendations-and-package-information-for-leadfree-ecopack-mcus-and-mpus-stmicroelectronics.pdf</a>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an2834-how-to-get-the-best-adc-accuracy-in-stm32-microcontrollers-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an2834-how-to-get-the-best-adc-accuracy-in-stm32-microcontrollers-stmicroelectronics.pdf</a>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an2867-oscillator-design-guide-for-stm8afals-stm32-mcus-and-mpus-stmicroelectronics.pdf">https://www.st.com/resource/en/application_note/an2867-oscillator-design-guide-for-stm8afals-stm32-mcus-and-mpus-stmicroelectronics.pdf</a>
Application Notes	<a href="https://www.st.com/resource/en/application_note/an2945-stm8s-and-">https://www.st.com/resource/en/application_note/an2945-stm8s-and-</a>

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](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)

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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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statistical-test-suite-stmicroelectronics.pdf

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