



1. Description

1.1. Project

Project Name	system-controller-program
Board Name	custom
Generated with:	STM32CubeMX 6.11.0
Date	04/13/2024

1.2. MCU

MCU Series	STM32F1
MCU Line	STM32F103
MCU name	STM32F103ZETx
MCU Package	LQFP144
MCU Pin number	144

1.3. Core(s) information

Core(s)	Arm Cortex-M3
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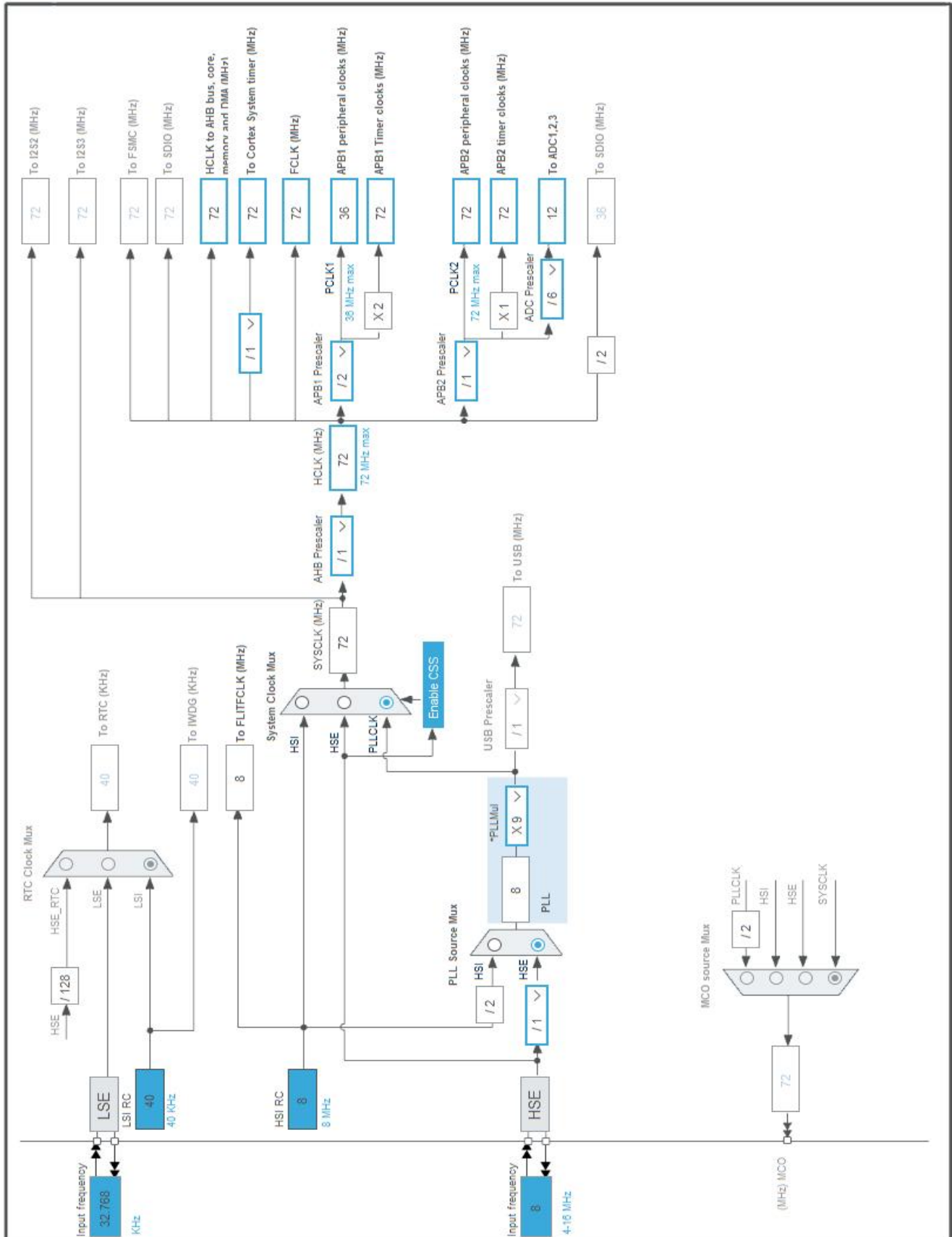
3. Pins Configuration

Pin Number LQFP144	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
6	VBAT	Power		
8	PC14-OSC32_IN	I/O	RCC_OSC32_IN	
9	PC15-OSC32_OUT	I/O	RCC_OSC32_OUT	
10	PF0 *	I/O	GPIO_Output	BKUP_STAT
11	PF1 *	I/O	GPIO_Output	MMC_STAT
12	PF2 *	I/O	GPIO_Output	WIFI_STAT_LED
13	PF3 *	I/O	GPIO_Output	FAULT
14	PF4 *	I/O	GPIO_Input	K_EB
16	VSS	Power		
17	VDD	Power		
23	OSC_IN	MonoIO	RCC_OSC_IN	
24	OSC_OUT	MonoIO	RCC_OSC_OUT	
25	NRST	Reset		
26	PC0	I/O	ADC1_IN10	VCMU_V1P
27	PC1	I/O	ADC1_IN11	VCMU_V1N
28	PC2	I/O	ADC1_IN12	VCMU_V2P
29	PC3	I/O	ADC1_IN13	VCMU_V2N
30	VSSA	Power		
31	VREF-	Power		
32	VREF+	Power		
33	VDDA	Power		
34	PA0-WKUP	I/O	ADC1_IN0	VCMU_V3P
35	PA1	I/O	ADC1_IN1	VCMU_V3N
36	PA2	I/O	ADC1_IN2	VCMU_C1N
37	PA3	I/O	ADC1_IN3	VCMU_C1P
38	VSS	Power		
39	VDD	Power		
40	PA4	I/O	ADC1_IN4	VCMU_C2P
41	PA5	I/O	ADC1_IN5	VCMU_C2N
42	PA6	I/O	ADC1_IN6	VCMU_C3P
43	PA7	I/O	ADC1_IN7	VCMU_C3N
51	VSS	Power		
52	VDD	Power		
61	VSS	Power		
62	VDD	Power		
71	VSS	Power		

Pin Number LQFP144	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
72	VDD	Power		
80	PD11 *	I/O	GPIO_Output	LCD_CS
81	PD12 *	I/O	GPIO_Output	LCD_DC
82	PD13 *	I/O	GPIO_Output	LCD_Backlight
83	VSS	Power		
84	VDD	Power		
94	VSS	Power		
95	VDD	Power		
98	PC8 *	I/O	GPIO_Output	LED0
101	PA9	I/O	USART1_TX	
102	PA10	I/O	USART1_RX	
105	PA13	I/O	SYS_JTMS-SWDIO	
106	NC	NC		
107	VSS	Power		
108	VDD	Power		
109	PA14	I/O	SYS_JTCK-SWCLK	
119	PD5	I/O	USART2_TX	
120	VSS	Power		
121	VDD	Power		
122	PD6	I/O	USART2_RX	
130	VSS	Power		
131	VDD	Power		
133	PB3	I/O	SPI1_SCK	
135	PB5	I/O	SPI1_MOSI	
138	BOOT0	Boot		
143	VSS	Power		
144	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	system-controller-program
Project Folder	D:\Senior Design Repos\system-controller
Toolchain / IDE	MDK-ARM V5.32
Firmware Package Name and Version	STM32Cube FW_F1 V1.8.5
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 only the necessary library files
Generate peripheral initialization as a pair of '.c/.h' files	Yes
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_USART1_UART_Init	USART1
6	MX_USART2_UART_Init	USART2
7	MX_SPI1_Init	SPI1

1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32F1
Line	STM32F103
MCU	STM32F103ZETx
Datasheet	DS5792_Rev12

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

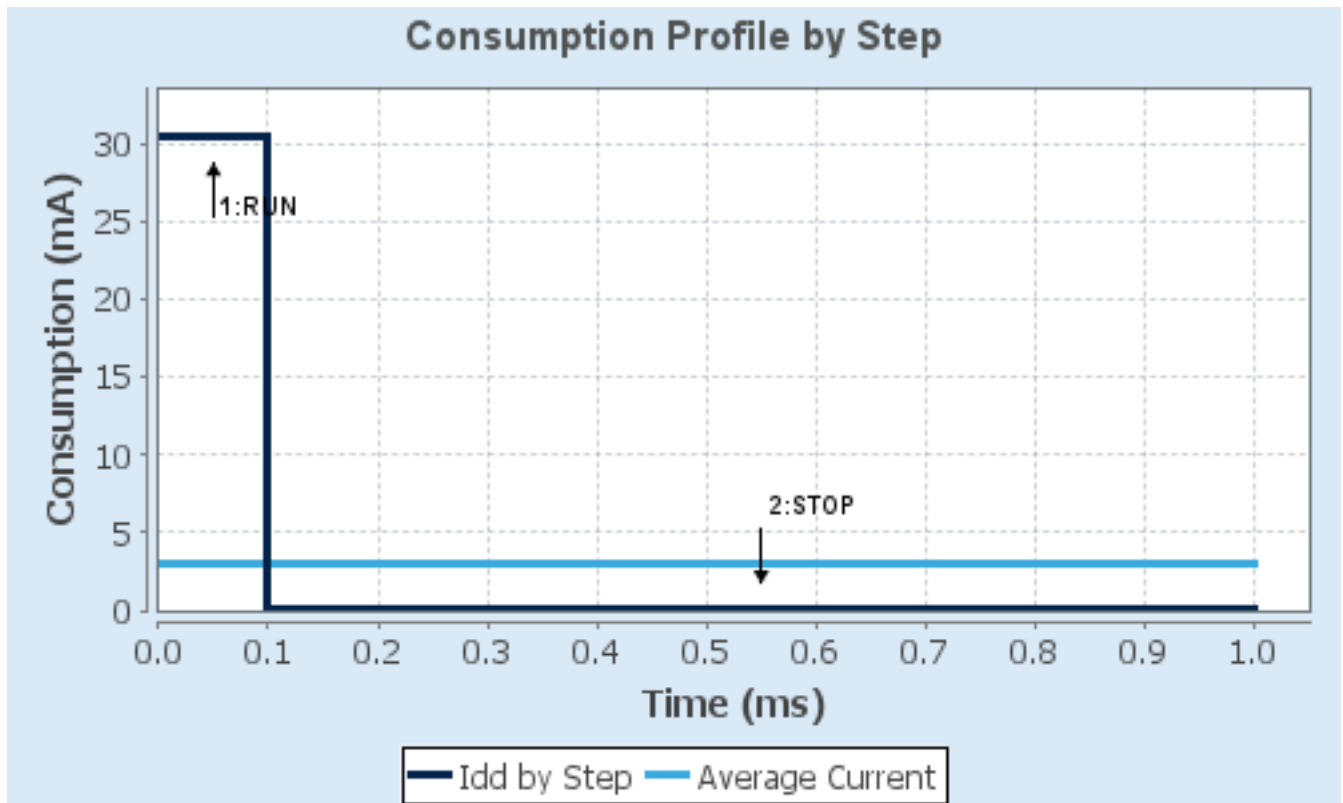
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP
Vdd	3.3	3.3
Voltage Source	Battery	Battery
Range	No Scale	No Scale
Fetch Type	FLASH	n/a
CPU Frequency	72 MHz	0 Hz
Clock Configuration	HSE PLL	Regulator LP
Clock Source Frequency	8 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	30.5 mA	25 μ A
Duration	0.1 ms	0.9 ms
DMIPS	90.0	0.0
Ta Max	101.98	105
Category	In DS Table	In DS Table

1.5. Results

Sequence Time	1 ms	Average Current	3.07 mA
Battery Life	1 month, 15 days, 15 hours	Average DMIPS	61.0 DMIPS

1.6. Chart



2. *Peripherals and Middlewares Configuration*

2.1. ADC1

mode: IN0

mode: IN1

mode: IN2

mode: IN3

mode: IN4

mode: IN5

mode: IN6

mode: IN7

mode: IN10

mode: IN11

mode: IN12

mode: IN13

mode: Temperature Sensor Channel

2.1.1. Parameter Settings:

ADCs_Common_Settings:

Mode Independent mode

ADC_Settings:

Data Alignment Right alignment

Scan Conversion Mode Disabled

Continuous Conversion Mode **Enabled ***

Discontinuous Conversion Mode Disabled

ADC_Regular_ConversionMode:

Enable Regular Conversions Enable

Number Of Conversion 1

External Trigger Conversion Source Regular Conversion launched by software

Rank 1

Channel Channel 0

Sampling Time 1.5 Cycles

ADC_Injected_ConversionMode:

Enable Injected Conversions Disable

WatchDog:

Enable Analog WatchDog Mode false

2.2. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

Low Speed Clock (LSE) : Crystal/Ceramic Resonator

2.2.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Prefetch Buffer	Enabled
Flash Latency(WS)	2 WS (3 CPU cycle)

RCC Parameters:

HSI Calibration Value	16
HSE Startup Timeout Value (ms)	100
LSE Startup Timeout Value (ms)	5000

2.3. SPI1

Mode: Half-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)	4 *
Baud Rate	18.0 MBits/s *
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

2.4. SYS

Debug: Serial Wire

Timebase Source: TIM1

2.5. USART1

Mode: Asynchronous

2.5.1. 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

2.6. USART2

Mode: Asynchronous

2.6.1. 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	PC0	ADC1_IN10	Analog mode	n/a	n/a	VCMU_V1P
	PC1	ADC1_IN11	Analog mode	n/a	n/a	VCMU_V1N
	PC2	ADC1_IN12	Analog mode	n/a	n/a	VCMU_V2P
	PC3	ADC1_IN13	Analog mode	n/a	n/a	VCMU_V2N
	PA0-WKUP	ADC1_IN0	Analog mode	n/a	n/a	VCMU_V3P
	PA1	ADC1_IN1	Analog mode	n/a	n/a	VCMU_V3N
	PA2	ADC1_IN2	Analog mode	n/a	n/a	VCMU_C1N
	PA3	ADC1_IN3	Analog mode	n/a	n/a	VCMU_C1P
	PA4	ADC1_IN4	Analog mode	n/a	n/a	VCMU_C2P
	PA5	ADC1_IN5	Analog mode	n/a	n/a	VCMU_C2N
	PA6	ADC1_IN6	Analog mode	n/a	n/a	VCMU_C3P
	PA7	ADC1_IN7	Analog mode	n/a	n/a	VCMU_C3N
RCC	PC14-OSC32_IN	RCC_OSC32_IN	n/a	n/a	n/a	
	PC15-OSC32_OUT	RCC_OSC32_OUT	n/a	n/a	n/a	
	OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	
	OSC_OUT	RCC_OSC_OUT	n/a	n/a	n/a	
SPI1	PB3	SPI1_SCK	Alternate Function Push Pull	n/a	High *	
	PB5	SPI1_MOSI	Alternate Function Push Pull	n/a	High *	
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	
USART1	PA9	USART1_TX	Alternate Function Push Pull	n/a	High *	
	PA10	USART1_RX	Input mode	No pull-up and no pull-down	n/a	
USART2	PD5	USART2_TX	Alternate Function Push Pull	n/a	High *	
	PD6	USART2_RX	Input mode	Pull-up *	n/a	
GPIO	PF0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	BKUP_STAT
	PF1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	MMC_STAT
	PF2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	WIFI_STAT_LED
	PF3	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	FAULT
	PF4	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	K_EB
	PD11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	High *	LCD_CS
	PD12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	High *	LCD_DC

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
	PD13	GPIO_Output	Output Push Pull	No pull-up and no pull-down	High *	LCD_Backlight
	PC8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LED0

3.2. DMA configuration

DMA request	Stream	Direction	Priority
USART1_RX	DMA1_Channel5	Peripheral To Memory	High *
USART1_TX	DMA1_Channel4	Memory To Peripheral	High *
USART2_RX	DMA1_Channel6	Peripheral To Memory	High *
USART2_TX	DMA1_Channel7	Memory To Peripheral	High *
ADC1	DMA1_Channel1	Peripheral To Memory	Low

USART1_RX: DMA1_Channel5 DMA request Settings:

Mode: Normal
Peripheral Increment: Disable
Memory Increment: **Enable ***
Peripheral Data Width: Byte
Memory Data Width: Byte

USART1_TX: DMA1_Channel4 DMA request Settings:

Mode: Normal
Peripheral Increment: Disable
Memory Increment: **Enable ***
Peripheral Data Width: Byte
Memory Data Width: Byte

USART2_RX: DMA1_Channel6 DMA request Settings:

Mode: Normal
Peripheral Increment: Disable
Memory Increment: **Enable ***
Peripheral Data Width: Byte
Memory Data Width: Byte

USART2_TX: DMA1_Channel7 DMA request Settings:

Mode: Normal
Peripheral Increment: Disable
Memory Increment: **Enable ***

Peripheral Data Width: Byte
Memory Data Width: Byte

ADC1: DMA1_Channel1 DMA request Settings:

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

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
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
DMA1 channel1 global interrupt	true	0	0
DMA1 channel4 global interrupt	true	0	0
DMA1 channel5 global interrupt	true	0	0
DMA1 channel6 global interrupt	true	0	0
DMA1 channel7 global interrupt	true	0	0
ADC1 and ADC2 global interrupts	true	0	0
TIM1 update interrupt	true	15	0
USART1 global interrupt	true	0	0
USART2 global interrupt	true	0	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
SPI1 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
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
DMA1 channel1 global interrupt	false	true	true
DMA1 channel4 global interrupt	false	true	true

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
DMA1 channel5 global interrupt	false	true	true
DMA1 channel6 global interrupt	false	true	true
DMA1 channel7 global interrupt	false	true	true
ADC1 and ADC2 global interrupts	false	true	true
TIM1 update interrupt	false	true	true
USART1 global interrupt	false	true	true
USART2 global interrupt	false	true	true

* User modified value

4. System Views

- 4.1. Category view
 - 4.1.1. Current

Middleware					
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System Core	Analog	Timers	Connectivity	Multimedia	Computing
DMA ✓	ADC1 ✓		SPI1 ✓		
GPIO ✓			USART1 ✓		
IIVIC ✓			USART2 ✓		
RCC ✓					
SYS ✓					

5. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f1_bsd1.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32ibis.zip
System View Description	https://www.st.com/resource/en/svd/stm32f1_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
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/flstm32nucleo.pdf
Flyers	https://www.st.com/resource/en/flyer/flstmcsuite.pdf
Flyers	https://www.st.com/resource/en/flyer/fldpstpfc11120.pdf
Product Certifications	https://www.st.com/resource/en/certification_document/1239988349.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/an1181-electrostatic-discharge-sensitivity-measurement-stmicroelectronics.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/an2586-getting-started-with-stm32f10xxx-hardware-development-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/an2784-using-the-highdensity-stm32f10xxx-fsmc-peripheral-to-drive-external-memories-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/an3095-stevalisv002v1-stevalisv002v2-3-kw-gridconnected-pv-system-based-on-the-stm32f103xx-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an3108-stlm75-firmware-library-for-the-stm32f10x-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/an3128-stm32-embedded-graphic-objectstouchscreen-library-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/an3165-digital-pfc-and-dual-foc-mc-integration-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/an3422-migration-of-microcontroller-applications-from-stm32f1-to-stm32l1-series-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an3427-migrating-a-microcontroller-application-from-stm32f1-to-stm32f2-series-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an3429-stm32-proprietary-code-protection-overview-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4013-stm32-crossseries-timer-overview-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4070-250-w-grid-connected-microinverter-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4076-two-or-three-shunt-resistor-based-current-sensing-circuit-design-in-3phase-inverters-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4088-migrating-between-stm32f1-and-stm32f0-series-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4228-migrating-from-stm32f1-series-to-stm32f3-series-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4229-how-to-implement-a-vocoder-solution-using-stm32-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4277-using-stm32-device-pwm-shutdown-features-for-motor-control-and-digital-power-conversion-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4566-extending-the-dac-performance-of-stm32-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4649-migrating-from-stm32f1-series-to-stm32l4-series--stm32l4-series-micronrollers-stmicroelectronics.pdf

- Application Notes https://www.st.com/resource/en/application_note/an4655-virtually-increasing-the-number-of-serial-communication-peripherals-in-stm32-applications-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4724-stm32cube-firmware-examples-for-stm32f1-series-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4750-handling-of-soft-errors-in-stm32-applications-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4776-generalpurpose-timer-cookbook-for-stm32-microcontrollers-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4803-highspeed-si-simulations-using-ibis-and-boardlevel-simulations-using-hyperlynx-si-on-stm32-mcus-and-mpus-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4904-migration-of-microcontroller-applications-from-stm32f1-series-to-stm32f4-access-lines-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4908-stm32-usart-automatic-baud-rate-detection-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4989-stm32-microcontroller-debug-toolbox-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an5027-interfacing-pdm-digital-microphones-using-stm32-mcus-and-mpus-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an5543-enhanced-methods-to-handle-spi-communication-on-stm32-devices-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4899-stm32-microcontroller-gpio-hardware-settings-and-lowpower-consumption-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an5612-esd-protection-of-stm32-mcus-and-mpus-stmicroelectronics.pdf
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- Application Notes https://www.st.com/resource/en/application_note/an4838-introduction-to-memory-protection-unit-management-on-stm32-mcus-stmicroelectronics.pdf
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- Application Notes https://www.st.com/resource/en/application_note/an5225-introduction-to-usb-typec-power-delivery-for-stm32-mcus-and-mpus-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an2834-how-to-optimize-the-adc-accuracy-in-the-stm32-mcus-stmicroelectronics.pdf
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