



1. Description

1.1. Project

Project Name	Bai7_TouchScreen
Board Name	custom
Generated with:	STM32CubeMX 6.9.2
Date	12/09/2023

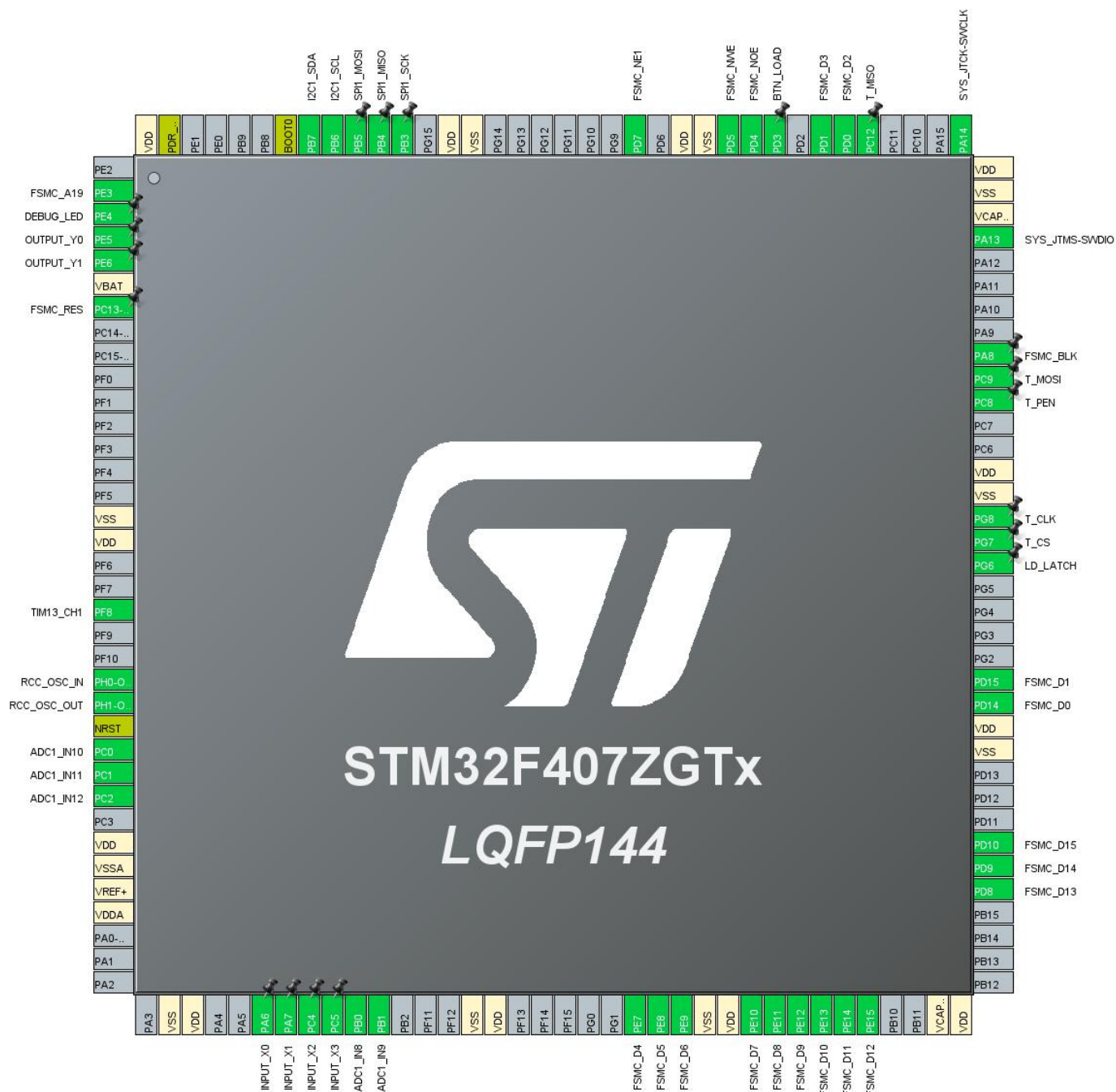
1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F407/417
MCU name	STM32F407ZGTx
MCU Package	LQFP144
MCU Pin number	144

1.3. Core(s) information

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



3. Pins Configuration

Pin Number LQFP144	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
2	PE3	I/O	FSMC_A19	
3	PE4 *	I/O	GPIO_Output	DEBUG_LED
4	PE5 *	I/O	GPIO_Output	OUTPUT_Y0
5	PE6 *	I/O	GPIO_Output	OUTPUT_Y1
6	VBAT	Power		
7	PC13-ANTI_TAMP *	I/O	GPIO_Output	FSMC_RES
16	VSS	Power		
17	VDD	Power		
20	PF8	I/O	TIM13_CH1	
23	PH0-OSC_IN	I/O	RCC_OSC_IN	
24	PH1-OSC_OUT	I/O	RCC_OSC_OUT	
25	NRST	Reset		
26	PC0	I/O	ADC1_IN10	
27	PC1	I/O	ADC1_IN11	
28	PC2	I/O	ADC1_IN12	
30	VDD	Power		
31	VSSA	Power		
32	VREF+	Power		
33	VDDA	Power		
38	VSS	Power		
39	VDD	Power		
42	PA6 *	I/O	GPIO_Input	INPUT_X0
43	PA7 *	I/O	GPIO_Input	INPUT_X1
44	PC4 *	I/O	GPIO_Input	INPUT_X2
45	PC5 *	I/O	GPIO_Input	INPUT_X3
46	PB0	I/O	ADC1_IN8	
47	PB1	I/O	ADC1_IN9	
51	VSS	Power		
52	VDD	Power		
58	PE7	I/O	FSMC_D4	
59	PE8	I/O	FSMC_D5	
60	PE9	I/O	FSMC_D6	
61	VSS	Power		
62	VDD	Power		
63	PE10	I/O	FSMC_D7	
64	PE11	I/O	FSMC_D8	

Pin Number LQFP144	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
65	PE12	I/O	FSMC_D9	
66	PE13	I/O	FSMC_D10	
67	PE14	I/O	FSMC_D11	
68	PE15	I/O	FSMC_D12	
71	VCAP_1	Power		
72	VDD	Power		
77	PD8	I/O	FSMC_D13	
78	PD9	I/O	FSMC_D14	
79	PD10	I/O	FSMC_D15	
83	VSS	Power		
84	VDD	Power		
85	PD14	I/O	FSMC_D0	
86	PD15	I/O	FSMC_D1	
91	PG6 *	I/O	GPIO_Output	LD_LATCH
92	PG7 *	I/O	GPIO_Output	T_CS
93	PG8 *	I/O	GPIO_Output	T_CLK
94	VSS	Power		
95	VDD	Power		
98	PC8 *	I/O	GPIO_Input	T_PEN
99	PC9 *	I/O	GPIO_Output	T_MOSI
100	PA8 *	I/O	GPIO_Output	FSMC_BLK
105	PA13	I/O	SYS_JTMS-SWDIO	
106	VCAP_2	Power		
107	VSS	Power		
108	VDD	Power		
109	PA14	I/O	SYS_JTCK-SWCLK	
113	PC12 *	I/O	GPIO_Input	T_MISO
114	PD0	I/O	FSMC_D2	
115	PD1	I/O	FSMC_D3	
117	PD3 *	I/O	GPIO_Output	BTN_LOAD
118	PD4	I/O	FSMC_NOE	
119	PD5	I/O	FSMC_NWE	
120	VSS	Power		
121	VDD	Power		
123	PD7	I/O	FSMC_NE1	
130	VSS	Power		
131	VDD	Power		
133	PB3	I/O	SPI1_SCK	
134	PB4	I/O	SPI1_MISO	

Pin Number LQFP144	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
135	PB5	I/O	SPI1_MOSI	
136	PB6	I/O	I2C1_SCL	
137	PB7	I/O	I2C1_SDA	
138	BOOT0	Boot		
143	PDR_ON	Reset		
144	VDD	Power		

* The pin is affected with an I/O function



5. Software Project

5.1. Project Settings

Name	Value
Project Name	Bai7_TouchScreen
Project Folder	C:\Users\Huy Nam
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_F4 V1.26.2
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	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_SPI1_Init	SPI1
5	MX_FSMC_Init	FSMC
6	MX_I2C1_Init	I2C1
7	MX_TIM13_Init	TIM13
8	MX_TIM2_Init	TIM2
9	MX_ADC1_Init	ADC1
10	MX_TIM1_Init	TIM1

1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32F4
Line	STM32F407/417
MCU	STM32F407ZGTx
Datasheet	DS8626_Rev8

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

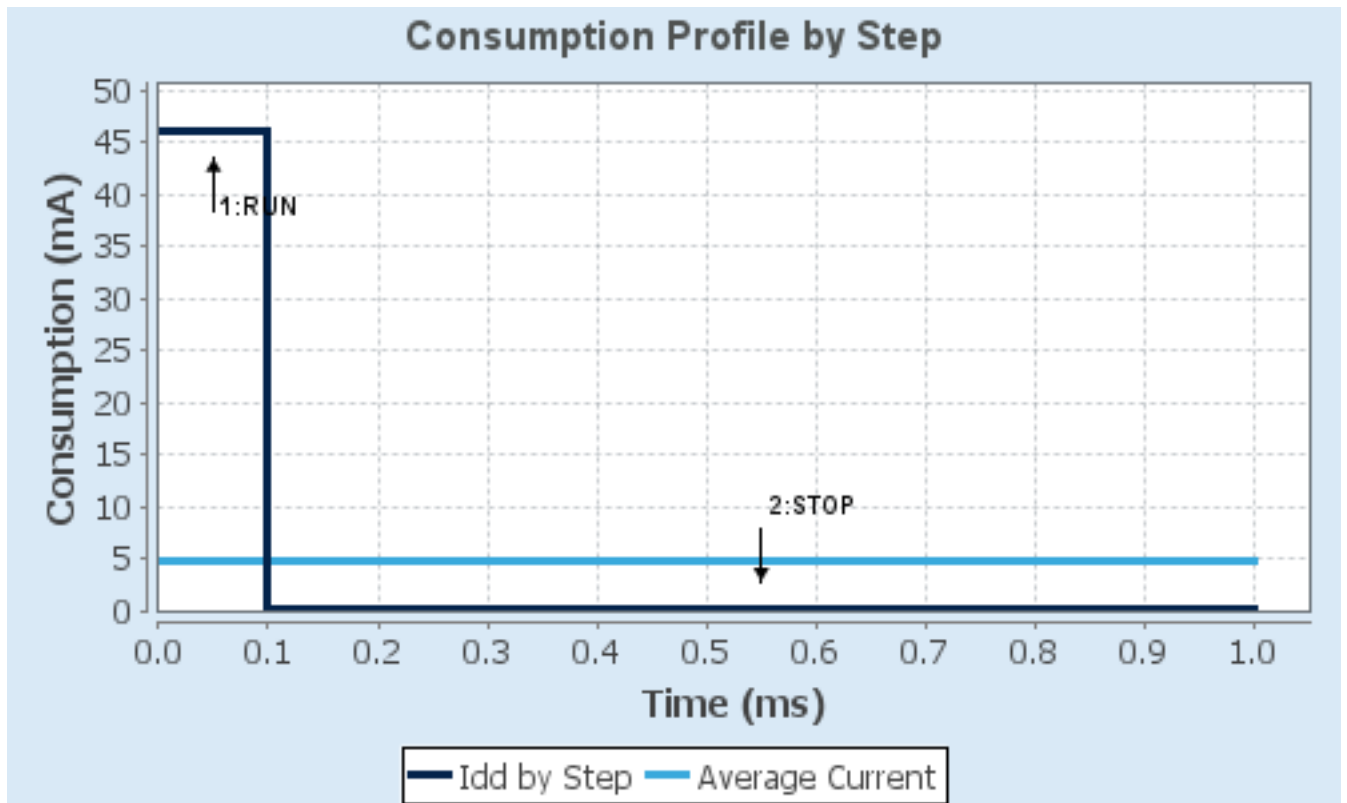
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP
Vdd	3.3	3.3
Voltage Source	Battery	Battery
Range	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 μ A
Duration	0.1 ms	0.9 ms
DMIPS	210.0	0.0
Ta Max	98.93	104.96
Category	In DS Table	In DS Table

1.5. Results

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

1.6. Chart



2. Peripherals and Middlewares Configuration

2.1. ADC1

mode: IN8

mode: IN9

mode: IN10

mode: IN11

mode: IN12

2.1.1. 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 Enabled

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 **5 ***

External Trigger Conversion Source Regular Conversion launched by software

External Trigger Conversion Edge None

Rank 1

Channel Channel 8

Sampling Time 3 Cycles

Rank **2 ***

Channel **Channel 9 ***

Sampling Time 3 Cycles

Rank **3 ***

Channel **Channel 10 ***

Sampling Time 3 Cycles

Rank **4 ***

Channel **Channel 11 ***

Sampling Time 3 Cycles

Rank **5 ***

Channel **Channel 12 ***

Sampling Time 3 Cycles

ADC_Injected_ConversionMode:

Number Of Conversions 0

WatchDog:

Enable Analog WatchDog Mode false

2.2. FSMC

NOR Flash/PSRAM/SRAM/ROM/LCD 1

Chip Select: NE1

Memory type: LCD Interface

LCD Register Select: A19

Data: 16 bits

2.2.1. NOR/PSRAM 1:

NOR/PSRAM control:

Memory type	LCD Interface
Bank	Bank 1 NOR/PSRAM 1
Write operation	Enabled
Extended mode	Enabled *

NOR/PSRAM timing:

Address setup time in HCLK clock cycles	0xf
Data setup time in HCLK clock cycles	60 *
Bus turn around time in HCLK clock cycles	0 *
Access mode	A

NOR/PSRAM timing for write accesses:

Extended address setup time	8 *
Extended data setup time	9 *
Extended bus turn around time	0 *
Extended access mode	A

2.3. I2C1

I2C: I2C

2.3.1. Parameter Settings:

Master Features:

I2C Speed Mode	Standard Mode
I2C Clock Speed (Hz)	100000

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

2.4. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

2.4.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Enabled
Data Cache	Enabled
Flash Latency(WS)	5 WS (6 CPU cycle)

RCC Parameters:

HSI Calibration Value	16
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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2.5. SPI1

Mode: Full-Duplex Master

2.5.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	2
Baud Rate	21.0 MBits/s *

Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

2.6. SYS

Debug: Serial Wire

Timebase Source: SysTick

2.7. TIM1

Clock Source : Internal Clock

2.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	84-1 *
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	65535
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)

2.8. TIM2

Clock Source : Internal Clock

2.8.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	840-1 *
Counter Mode	Up
Counter Period (AutoReload Register - 32 bits value)	100-1 *
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)

2.9. TIM13

mode: Activated

Channel1: PWM Generation CH1

2.9.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	840-1 *
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	100-1 *
Internal Clock Division (CKD)	No Division
auto-reload preload	Disable

PWM Generation Channel 1:

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

*** 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	No pull-up and no pull-down	n/a	
	PC1	ADC1_IN11	Analog mode	No pull-up and no pull-down	n/a	
	PC2	ADC1_IN12	Analog mode	No pull-up and no pull-down	n/a	
	PB0	ADC1_IN8	Analog mode	No pull-up and no pull-down	n/a	
	PB1	ADC1_IN9	Analog mode	No pull-up and no pull-down	n/a	
FSMC	PE3	FSMC_A19	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE7	FSMC_D4	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE8	FSMC_D5	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE9	FSMC_D6	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE10	FSMC_D7	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE11	FSMC_D8	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE12	FSMC_D9	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE13	FSMC_D10	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE14	FSMC_D11	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PE15	FSMC_D12	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD8	FSMC_D13	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD9	FSMC_D14	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD10	FSMC_D15	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD14	FSMC_D0	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD15	FSMC_D1	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD0	FSMC_D2	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD1	FSMC_D3	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD4	FSMC_NOE	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD5	FSMC_NWE	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
	PD7	FSMC_NE1	Alternate Function Push Pull	No pull-up and no pull-down	Very High	
I2C1	PB6	I2C1_SCL	Alternate Function Open Drain	No pull-up and no pull-down	Very High *	
	PB7	I2C1_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	

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
					*	
	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	
TIM13	PF8	TIM13_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	
GPIO	PE4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	DEBUG_LED
	PE5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	OUTPUT_Y0
	PE6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	OUTPUT_Y1
	PC13-ANTI_TAMP	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	FSMC_RES
	PA6	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	INPUT_X0
	PA7	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	INPUT_X1
	PC4	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	INPUT_X2
	PC5	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	INPUT_X3
	PG6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LD_LATCH
	PG7	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	T_CS
	PG8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	T_CLK
	PC8	GPIO_Input	Input mode	Pull-up *	n/a	T_PEN
	PC9	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	T_MOSI
	PA8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	FSMC_BLK
	PC12	GPIO_Input	Input mode	Pull-up *	n/a	T_MISO
	PD3	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	BTN_LOAD

3.2. DMA configuration

DMA request	Stream	Direction	Priority
ADC1	DMA2_Stream0	Peripheral To Memory	Low

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

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
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
TIM2 global interrupt	true	0	0
DMA2 stream0 global interrupt	true	0	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1, ADC2 and ADC3 global 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		
I2C1 event interrupt	unused		
I2C1 error interrupt	unused		
SPI1 global interrupt	unused		
TIM8 update interrupt and TIM13 global interrupt	unused		
FPU 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
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

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
Pendable request for system service	false	true	false
System tick timer	false	true	true
TIM2 global interrupt	false	true	true
DMA2 stream0 global interrupt	false	true	true

* User modified value

4. System Views

4.1. Category view

4.1.1. Current

Middleware						
System Core	Analog	Timers	Connectivity	Multimedia	Security	Computing
DMA ✓	ADC1 ✓	TIM1 ✓	FSMC ✓			
GPIO ✓		TIM2 ✓	I2C1 ✓			
NVIC ✓		TIM13 ✓	SP1 ✓			
RCC ✓						
SYS ✓						

5. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32f405-415_407-417_bsdl.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32f405-415_407-417_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
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/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/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/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/an2834-how-to-get-the-best-adc-accuracy-in-stm32-microcontrollers-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an2867-oscillator-design-guide-for-stm8afals-stm32-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/an3371-using-the-hardware-realtime-clock-rtc-in-stm32-f0-f2-f3-f4-and-l1-series-of-mcus-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an3997-audio-playback-and-recording-using-the-stm32f4discovery-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an3998-pdm-audio-software-decoding-on-stm32-microcontrollers-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4013-stm32-crossseries-timer-overview-stmicroelectronics.pdf
- Application Notes [---

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stm32f2-stm32f4-and-stm32f7-series-dma-controller-
stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4073-how-to-improve-adc-accuracy-when-using-stm32f2xx-and-stm32f4xx-microcontrollers-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/an4221-i2c-protocol-used-in-the-stm32-bootloader-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

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