

# STM32 CubeMX

## 1. Description

### 1.1. Project

Project Name	CAMERA_OV7670_F407VE
Board Name	custom
Generated with:	STM32CubeMX 6.3.0
Date	12/10/2025

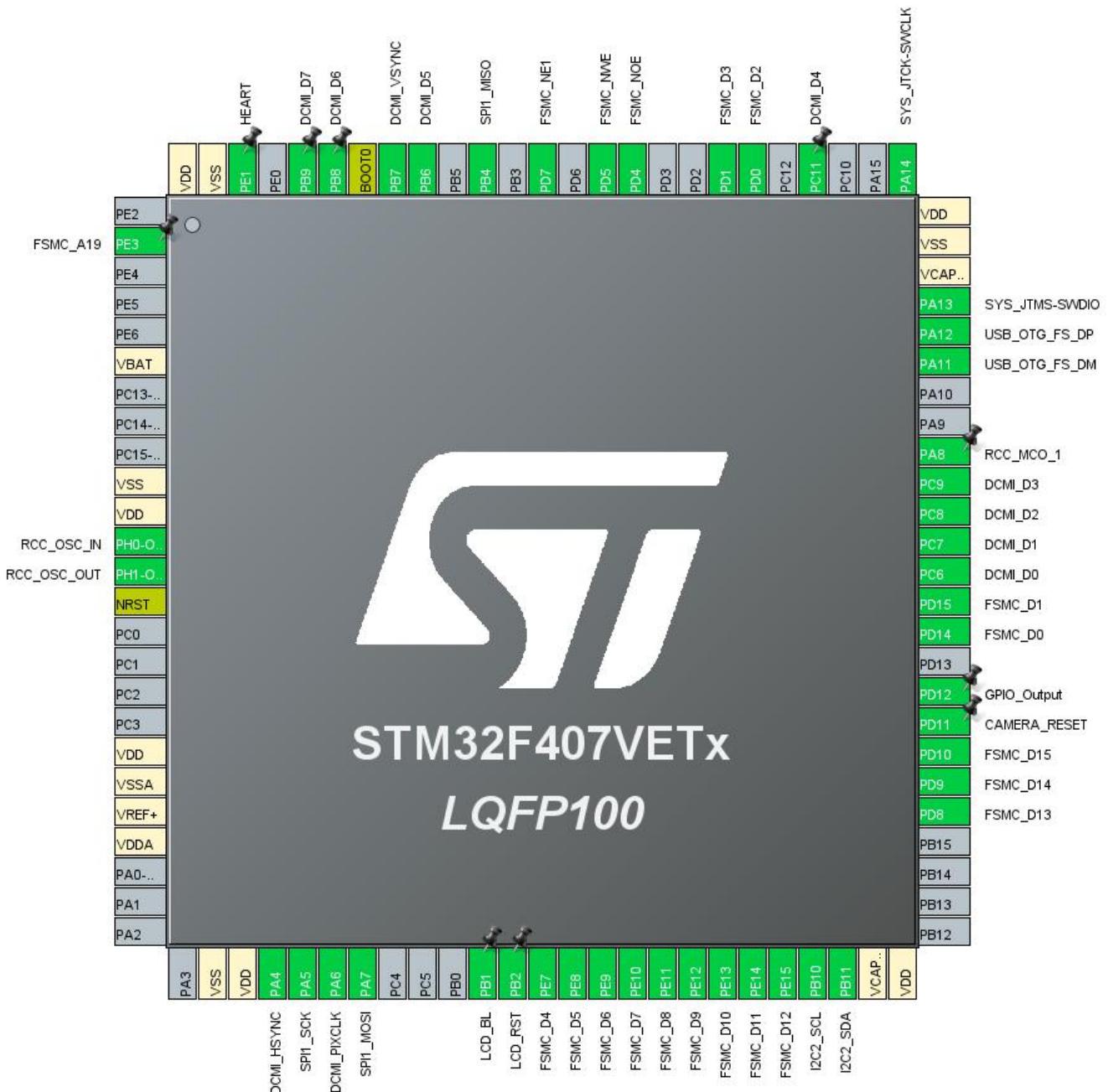
### 1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F407/417
MCU name	STM32F407VETx
MCU Package	LQFP100
MCU Pin number	100

### 1.3. Core(s) information

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



### 3. Pins Configuration

Pin Number LQFP100	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
2	PE3	I/O	FSMC_A19	
6	VBAT	Power		
10	VSS	Power		
11	VDD	Power		
12	PH0-OSC_IN	I/O	RCC_OSC_IN	
13	PH1-OSC_OUT	I/O	RCC_OSC_OUT	
14	NRST	Reset		
19	VDD	Power		
20	VSSA	Power		
21	VREF+	Power		
22	VDDA	Power		
27	VSS	Power		
28	VDD	Power		
29	PA4	I/O	DCMI_HSYNC	
30	PA5	I/O	SPI1_SCK	
31	PA6	I/O	DCMI_PIXCLK	
32	PA7	I/O	SPI1_MOSI	
36	PB1 *	I/O	GPIO_Output	LCD_BL
37	PB2 *	I/O	GPIO_Output	LCD_RST
38	PE7	I/O	FSMC_D4	
39	PE8	I/O	FSMC_D5	
40	PE9	I/O	FSMC_D6	
41	PE10	I/O	FSMC_D7	
42	PE11	I/O	FSMC_D8	
43	PE12	I/O	FSMC_D9	
44	PE13	I/O	FSMC_D10	
45	PE14	I/O	FSMC_D11	
46	PE15	I/O	FSMC_D12	
47	PB10	I/O	I2C2_SCL	
48	PB11	I/O	I2C2_SDA	
49	VCAP_1	Power		
50	VDD	Power		
55	PD8	I/O	FSMC_D13	
56	PD9	I/O	FSMC_D14	
57	PD10	I/O	FSMC_D15	
58	PD11 *	I/O	GPIO_Output	CAMERA_RESET

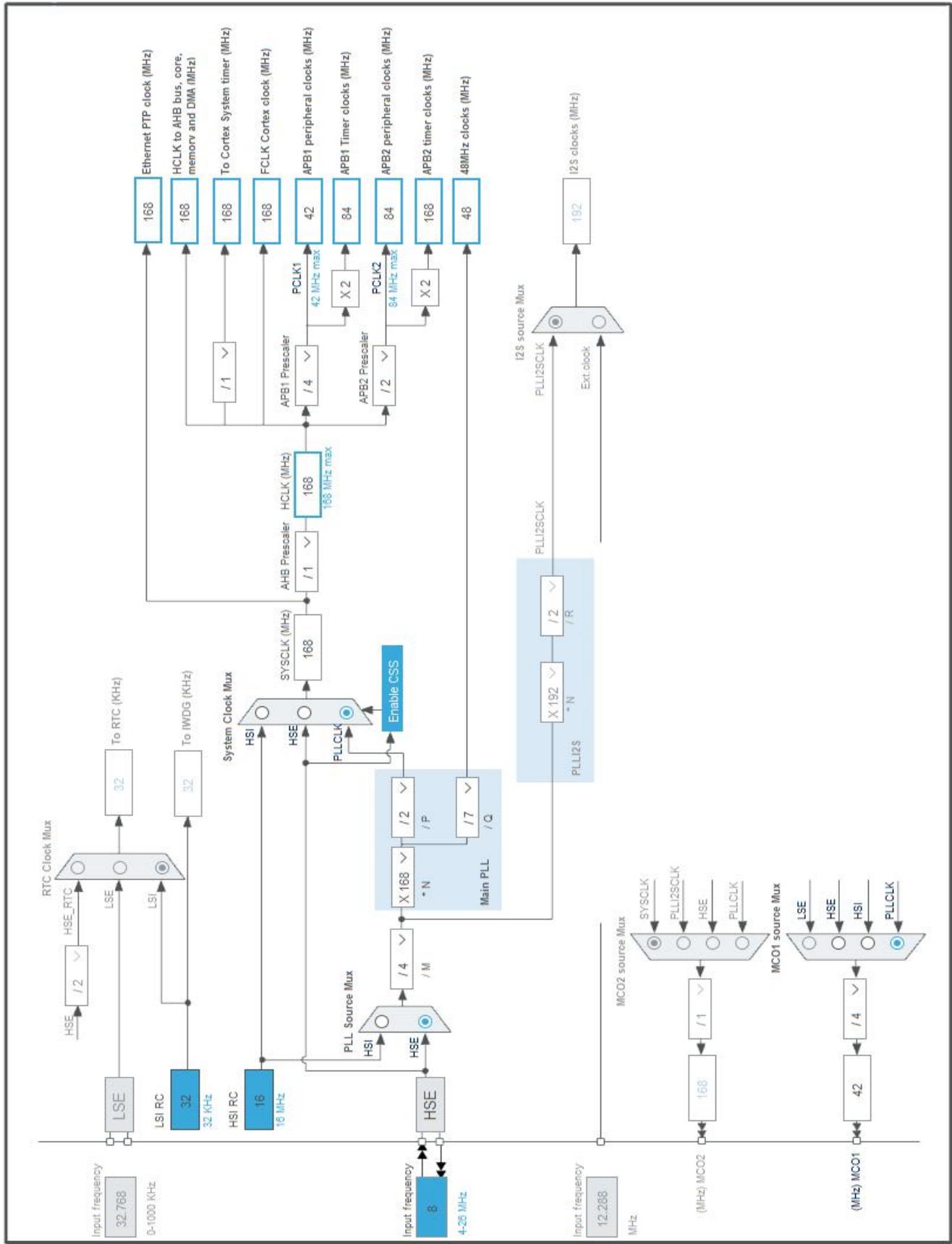
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Pin Number LQFP100	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
59	PD12 *	I/O	GPIO_Output	
61	PD14	I/O	FSMC_D0	
62	PD15	I/O	FSMC_D1	
63	PC6	I/O	DCMI_D0	
64	PC7	I/O	DCMI_D1	
65	PC8	I/O	DCMI_D2	
66	PC9	I/O	DCMI_D3	
67	PA8	I/O	RCC_MCO_1	
70	PA11	I/O	USB_OTG_FS_DM	
71	PA12	I/O	USB_OTG_FS_DP	
72	PA13	I/O	SYS_JTMS-SWDIO	
73	VCAP_2	Power		
74	VSS	Power		
75	VDD	Power		
76	PA14	I/O	SYS_JTCK-SWCLK	
79	PC11	I/O	DCMI_D4	
81	PD0	I/O	FSMC_D2	
82	PD1	I/O	FSMC_D3	
85	PD4	I/O	FSMC_NOE	
86	PD5	I/O	FSMC_NWE	
88	PD7	I/O	FSMC_NE1	
90	PB4	I/O	SPI1_MISO	
92	PB6	I/O	DCMI_D5	
93	PB7	I/O	DCMI_VSYNC	
94	BOOT0	Boot		
95	PB8	I/O	DCMI_D6	
96	PB9	I/O	DCMI_D7	
98	PE1 *	I/O	GPIO_Output	HEART
99	VSS	Power		
100	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	CAMERA_OV7670_F407VE
Project Folder	D:\HCMUT\HK251\tkl\object_classifier\PROJECTCAMERA MCU
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	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_DCMI_Init	DCMI
4	MX_USB_DEVICE_Init	USB_DEVICE
5	MX_DMA_Init	DMA
6	MX_SPI1_Init	SPI1
7	MX_FSMC_Init	FSMC
8	MX_I2C2_Init	I2C2
9	MX_TIM2_Init	TIM2
10	MX_RNG_Init	RNG



## 6. Power Consumption Calculator report

### 6.1. Microcontroller Selection

Series	STM32F4
Line	STM32F407/417
MCU	STM32F407VETx
Datasheet	DS8626_Rev8

### 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

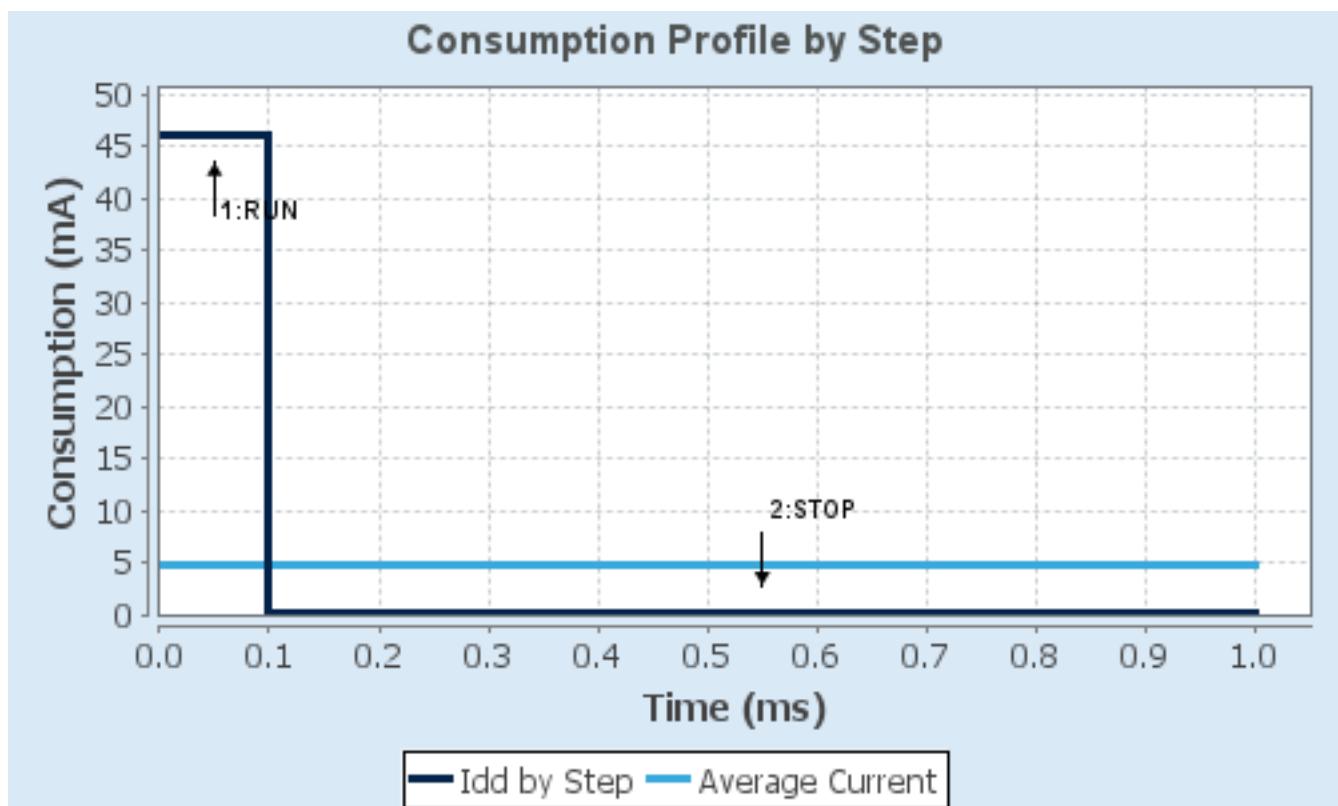
#### 6.4. Sequence

<b>Step</b>	Step1	Step2
<b>Mode</b>	RUN	STOP
<b>Vdd</b>	3.3	3.3
<b>Voltage Source</b>	Battery	Battery
<b>Range</b>	Scale1-High	No Scale
<b>Fetch Type</b>	FLASH	n/a
<b>CPU Frequency</b>	168 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	280 µA
<b>Duration</b>	0.1 ms	0.9 ms
<b>DMIPS</b>	210.0	0.0
<b>T<sub>a</sub> Max</b>	98.47	104.96
<b>Category</b>	In DS Table	In DS Table

#### 6.5. Results

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

#### 6.6. Chart



## 7. Peripherals and Middlewares Configuration

### 7.1. DCMI

#### DCMI: Slave 8 bits External Synchro

##### 7.1.1. Parameter Settings:

###### **Mode Config:**

Pixel clock polarity	<b>Active on Rising edge *</b>
Vertical synchronization polarity	<b>Active High *</b>
Horizontal synchronization polarity	Active Low
Frequency of frame capture	All frames are captured
JPEG mode	Disabled

### 7.2. FSMC

#### NOR Flash/PSRAM/SRAM/ROM/LCD 1

###### **Chip Select: set**

###### **Memory type: LCD Interface**

###### **LCD Register Select: A19**

###### **Data: 16 bits**

##### 7.2.1. NOR/PSRAM 1:

###### **NOR/PSRAM control:**

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

###### **NOR/PSRAM timing:**

Address setup time in HCLK clock cycles	<b>6 *</b>
Data setup time in HCLK clock cycles	<b>6 *</b>
Bus turn around time in HCLK clock cycles	<b>6 *</b>

### 7.3. I2C2

#### **I2C: I2C**

##### 7.3.1. 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

## 7.4. RCC

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

**mode: Master Clock Output 1**

7.4.1. 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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## 7.5. RNG

**mode: Activated**

## 7.6. SPI1

**Mode: Full-Duplex Master**

7.6.1. Parameter Settings:

**Basic Parameters:**

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

**Clock Parameters:**

Prescaler (for Baud Rate)	2
Baud Rate	<b>42.0 MBits/s *</b>
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

**Advanced Parameters:**

CRC Calculation	Disabled
NSS Signal Type	Software

## 7.7. SYS

**Debug: Serial Wire**

**Timebase Source: SysTick**

## 7.8. TIM2

**Clock Source : Internal Clock**

7.8.1. Parameter Settings:

**Counter Settings:**

Prescaler (PSC - 16 bits value)	<b>839 *</b>
Counter Mode	Up
Counter Period (AutoReload Register - 32 bits value )	<b>1999 *</b>
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)

## 7.9. USB\_OTG\_FS

**Mode: Device\_Only**

7.9.1. Parameter Settings:

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

## 7.10. USB\_DEVICE

### Class For FS IP: Communication Device Class (Virtual Port Com)

#### 7.10.1. 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:**

USB CDC Rx Buffer Size	2048
USB CDC Tx Buffer Size	2048

#### 7.10.2. 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)	22336
PRODUCT_STRING (Product Identifier)	<b>STM32 Virtual Port *</b>
CONFIGURATION_STRING (Configuration Identifier)	CDC Config
INTERFACE_STRING (Interface Identifier)	CDC Interface

\* User modified value

## 8. System Configuration

### 8.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
DCMI	PA4	DCMI_HSYNC	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PA6	DCMI_PIXCLK	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PC6	DCMI_D0	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PC7	DCMI_D1	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PC8	DCMI_D2	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PC9	DCMI_D3	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PC11	DCMI_D4	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PB6	DCMI_D5	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PB7	DCMI_VSYNC	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PB8	DCMI_D6	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
	PB9	DCMI_D7	Alternate Function Push Pull	<b>Pull-down *</b>	<b>Very High</b> *	
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	

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IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
	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	
I2C2	PB10	I2C2_SCL	Alternate Function Open Drain	<b>Pull-up *</b>	<b>Very High</b> *	
	PB11	I2C2_SDA	Alternate Function Open Drain	<b>Pull-up *</b>	<b>Very High</b> *	
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	
	PA8	RCC_MCO_1	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	
SPI1	PA5	SPI1_SCK	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	
	PB4	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	
USB_OTG_FS	PA11	USB_OTG_FS_DM	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	
	PA12	USB_OTG_FS_DP	Alternate Function Push Pull	No pull-up and no pull-down	<b>Very High</b> *	
GPIO	PB1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LCD_BL
	PB2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LCD_RST
	PD11	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	CAMERA_RESET
	PD12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	
	PE1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	HEART

## 8.2. DMA configuration

DMA request	Stream	Direction	Priority
DCMI	DMA2_Stream1	Peripheral To Memory	Low

### DCMI: DMA2\_Stream1 DMA request Settings:

Mode: Normal  
Use fifo: Disable  
Peripheral Increment: Disable  
Memory Increment: **Enable \***  
Peripheral Data Width: **Word \***  
Memory Data Width: Word

### 8.3. NVIC configuration

#### 8.3.1. NVIC

Interrupt Table	Enable	Preenemption 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 stream1 global interrupt	true	0	0
USB On The Go FS global interrupt	true	0	0
DCMI global interrupt	true	0	0
PVD interrupt through EXTI line 16		unused	
Flash global interrupt		unused	
RCC global interrupt		unused	
I2C2 event interrupt		unused	
I2C2 error interrupt		unused	
SPI1 global interrupt		unused	
HASH and RNG global interrupts		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
TIM2 global interrupt	false	true	true
DMA2 stream1 global interrupt	false	true	true
USB On The Go FS global interrupt	false	true	true

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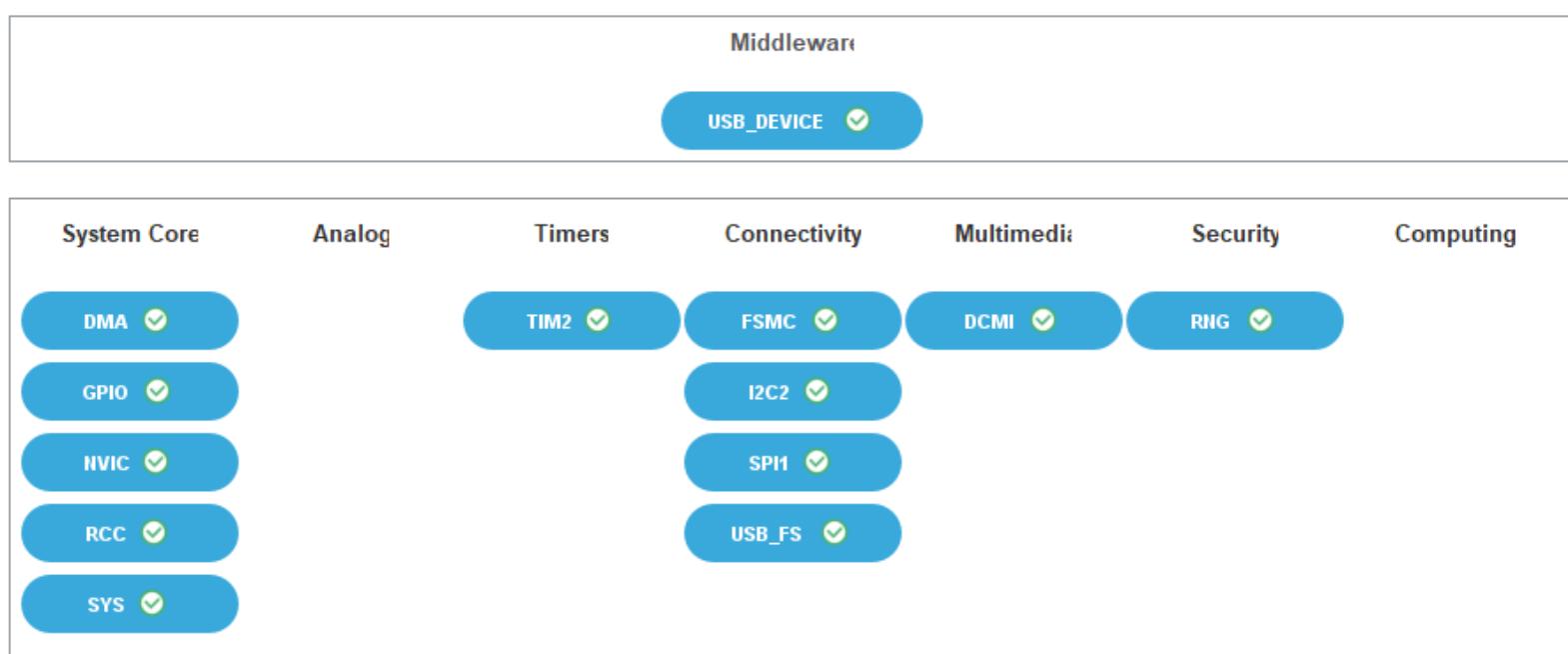
Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
DCMI global interrupt	false	true	true

\* User modified value

## 9. System Views

### 9.1. Category view

#### 9.1.1. Current



## 10. Docs & Resources

Type	Link
Datasheet	<a href="http://www.st.com/resource/en/datasheet/DM00037051.pdf">http://www.st.com/resource/en/datasheet/DM00037051.pdf</a>
Reference manual	<a href="http://www.st.com/resource/en/reference_manual/DM00031020.pdf">http://www.st.com/resource/en/reference_manual/DM00031020.pdf</a>
Programming manual	<a href="http://www.st.com/resource/en/programming_manual/DM00046982.pdf">http://www.st.com/resource/en/programming_manual/DM00046982.pdf</a>
Errata sheet	<a href="http://www.st.com/resource/en/errata_sheet/DM00037591.pdf">http://www.st.com/resource/en/errata_sheet/DM00037591.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/CD00167594.pdf">http://www.st.com/resource/en/application_note/CD00167594.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/CD00211314.pdf">http://www.st.com/resource/en/application_note/CD00211314.pdf</a>
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Application note	<a href="http://www.st.com/resource/en/application_note/DM00024853.pdf">http://www.st.com/resource/en/application_note/DM00024853.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/DM00025071.pdf">http://www.st.com/resource/en/application_note/DM00025071.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/DM00040802.pdf">http://www.st.com/resource/en/application_note/DM00040802.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/DM00040808.pdf">http://www.st.com/resource/en/application_note/DM00040808.pdf</a>
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Application note	<a href="http://www.st.com/resource/en/application_note/DM00046011.pdf">http://www.st.com/resource/en/application_note/DM00046011.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/DM00050879.pdf">http://www.st.com/resource/en/application_note/DM00050879.pdf</a>
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Application note	<a href="http://www.st.com/resource/en/application_note/DM00073853.pdf">http://www.st.com/resource/en/application_note/DM00073853.pdf</a>
Application note	<a href="http://www.st.com/resource/en/application_note/DM00080497.pdf">http://www.st.com/resource/en/application_note/DM00080497.pdf</a>
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Application note	<a href="http://www.st.com/resource/en/application_note/DM00123028.pdf">http://www.st.com/resource/en/application_note/DM00123028.pdf</a>

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