1. Description

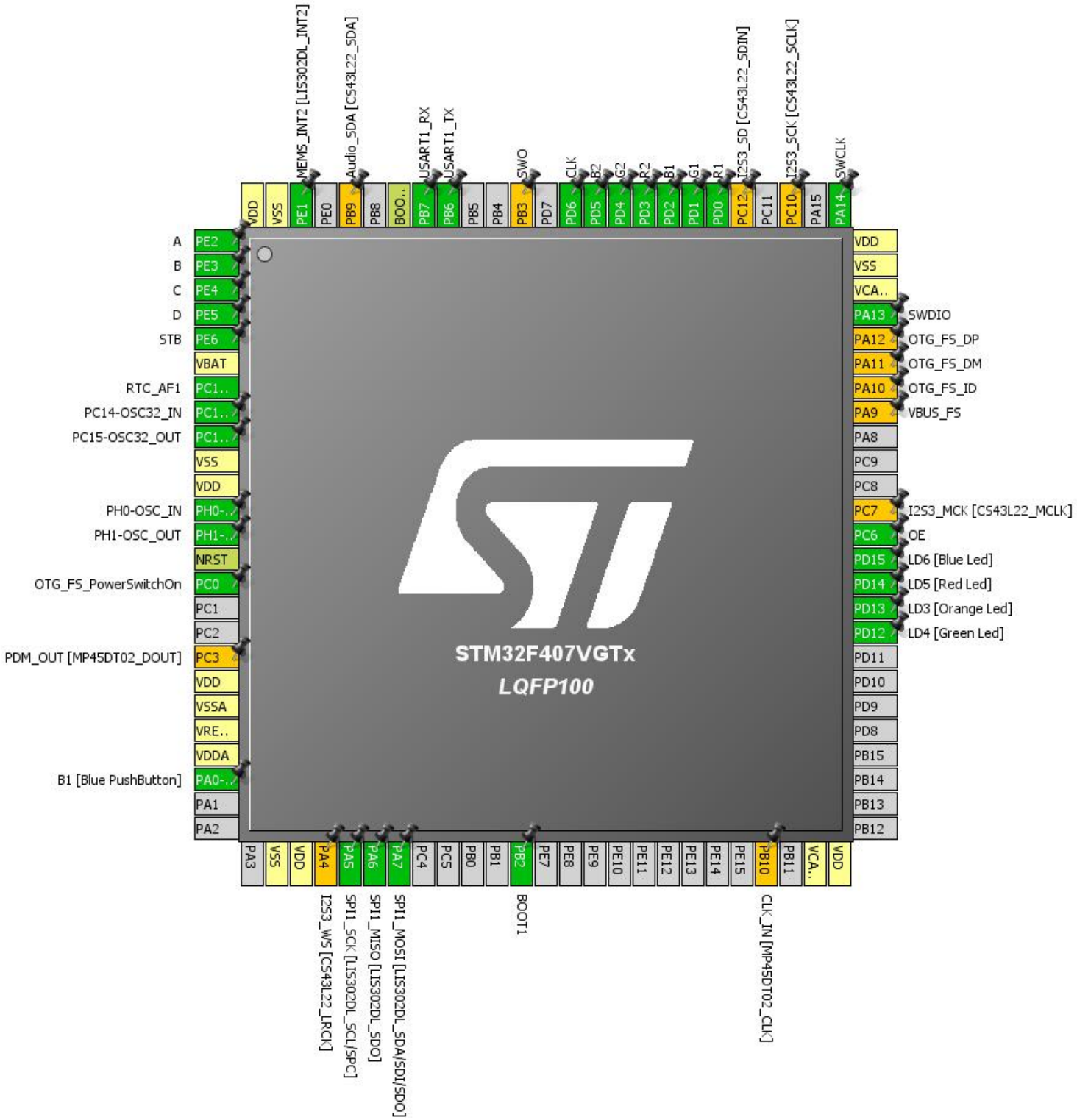
1.1. Project

Project Name	Matrix_FZS
Board Name	STM32F4DISCOVERY
Generated with:	STM32CubeMX 4.20.1
Date	04/23/2017

1.2. MCU

MCU Series	STM32F4
MCU Line	STM32F407/417
MCU name	STM32F407VGTx
MCU Package	LQFP100
MCU Pin number	100

2. Pinout Configuration



3. Pins Configuration

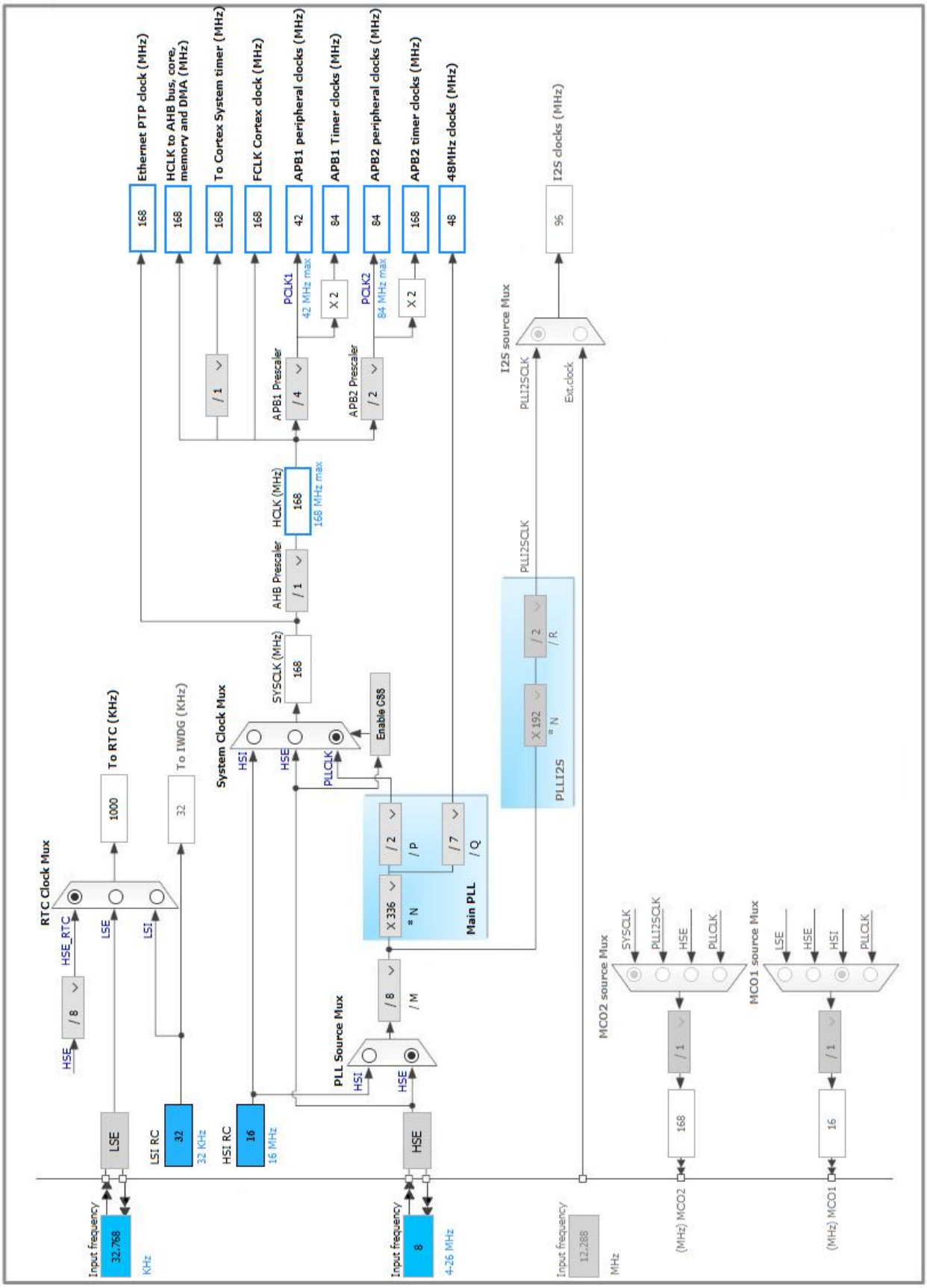
Pin Number LQFP100	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	PE2 *	I/O	GPIO_Output	A
2	PE3 *	I/O	GPIO_Output	B
3	PE4 *	I/O	GPIO_Output	C
4	PE5 *	I/O	GPIO_Output	D
5	PE6 *	I/O	GPIO_Output	STB
6	VBAT	Power		
7	PC13-ANTI_TAMP	I/O	RTC_AF1	
8	PC14-OSC32_IN	I/O	RCC_OSC32_IN	PC14-OSC32_IN
9	PC15-OSC32_OUT	I/O	RCC_OSC32_OUT	PC15-OSC32_OUT
10	VSS	Power		
11	VDD	Power		
12	PH0-OSC_IN	I/O	RCC_OSC_IN	PH0-OSC_IN
13	PH1-OSC_OUT	I/O	RCC_OSC_OUT	PH1-OSC_OUT
14	NRST	Reset		
15	PC0 *	I/O	GPIO_Output	OTG_FS_PowerSwitchOn
18	PC3 **	I/O	I2S2_SD	PDM_OUT [MP45DT02_DOUT]
19	VDD	Power		
20	VSSA	Power		
21	VREF+	Power		
22	VDDA	Power		
23	PA0-WKUP	I/O	GPIO_EXTI0	B1 [Blue PushButton]
27	VSS	Power		
28	VDD	Power		
29	PA4 **	I/O	I2S3_WS	I2S3_WS [CS43L22_LRCK]
30	PA5	I/O	SPI1_SCK	SPI1_SCK [LIS302DL_SCL/SPC]
31	PA6	I/O	SPI1_MISO	SPI1_MISO [LIS302DL_SDO]
32	PA7	I/O	SPI1_MOSI	SPI1_MOSI [LIS302DL_SDA/SDI/SDO]
37	PB2 *	I/O	GPIO_Input	BOOT1
47	PB10 **	I/O	I2S2_CK	CLK_IN [MP45DT02_CLK]
49	VCAP_1	Power		
50	VDD	Power		
59	PD12 *	I/O	GPIO_Output	LD4 [Green Led]

Pin Number LQFP100	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
60	PD13 *	I/O	GPIO_Output	LD3 [Orange Led]
61	PD14 *	I/O	GPIO_Output	LD5 [Red Led]
62	PD15 *	I/O	GPIO_Output	LD6 [Blue Led]
63	PC6 *	I/O	GPIO_Output	OE
64	PC7 **	I/O	I2S3_MCK	I2S3_MCK [CS43L22_MCLK]
68	PA9 **	I/O	USB_OTG_FS_VBUS	VBUS_FS
69	PA10 **	I/O	USB_OTG_FS_ID	OTG_FS_ID
70	PA11 **	I/O	USB_OTG_FS_DM	OTG_FS_DM
71	PA12 **	I/O	USB_OTG_FS_DP	OTG_FS_DP
72	PA13	I/O	SYS_JTMS-SWDIO	SWDIO
73	VCAP_2	Power		
74	VSS	Power		
75	VDD	Power		
76	PA14	I/O	SYS_JTCK-SWCLK	SWCLK
78	PC10 **	I/O	I2S3_CK	I2S3_SCK [CS43L22_SCLK]
80	PC12 **	I/O	I2S3_SD	I2S3_SD [CS43L22_SDIN]
81	PD0 *	I/O	GPIO_Output	R1
82	PD1 *	I/O	GPIO_Output	G1
83	PD2 *	I/O	GPIO_Output	B1
84	PD3 *	I/O	GPIO_Output	R2
85	PD4 *	I/O	GPIO_Output	G2
86	PD5 *	I/O	GPIO_Output	B2
87	PD6 *	I/O	GPIO_Output	CLK
89	PB3 **	I/O	SYS_JTDO-SWO	SWO
92	PB6	I/O	USART1_TX	
93	PB7	I/O	USART1_RX	
94	BOOT0	Boot		
96	PB9 **	I/O	I2C1_SDA	Audio_SDA [CS43L22_SDA]
98	PE1	I/O	GPIO_EXTI1	MEMS_INT2 [LIS302DL_INT2]
99	VSS	Power		
100	VDD	Power		

* The pin is affected with an I/O function

** The pin is affected with a peripheral function but no peripheral mode is activated

4. Clock Tree Configuration



5. IPs and Middleware Configuration

5.1. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator
Low Speed Clock (LSE) : Crystal/Ceramic Resonator

5.1.1. 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 Timout Value (ms)	100
LSE Startup Timout Value (ms)	5000

Power Parameters:

Power Regulatror Voltage Scale	Power Regulator Voltage Scale 1

5.2. RNG

mode: Activated

5.3. RTC

mode: Activate Clock Source
mode: Activate Calendar
Alarm A: Internal Alarm
Calibration: Calibration 512Hz

5.3.1. Parameter Settings:

General:

Hour Format	Hourformat 24
Asynchronous Predivider value	**64 ***

Synchronous Predivider value	**15625 ***

Calendar Time:

Data Format	BCD data format
Hours	**12 ***
Minutes	0
Seconds	0
Day Light Saving: value of hour adjustment	Daylightsaving None
Store Operation	Storeoperation Reset

Calendar Date:

Week Day	Monday
Month	January
Date	1
Year	**17 ***

Alarm A:

Hours	0
Minutes	0
Seconds	0
Sub Seconds	0
Alarm Mask Date Week day	Disable
Alarm Mask Hours	Disable
Alarm Mask Minutes	Disable
Alarm Mask Seconds	Disable
Alarm Sub Second Mask	All Alarm SS fields are masked.
Alarm Date Week Day Sel	Date
Alarm Date	1

Calibration:

Calibration	Signal has a regular waveform at 512Hz

5.4. SPI1

Mode: Full-Duplex Master

5.4.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	8 Bits
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	2

Baud Rate	**42.0 MBits/s ***
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSS Signal Type	Software

5.5. SYS

Debug: Serial Wire

Timebase Source: SysTick

5.6. TIM3

Clock Source : Internal Clock

Channel1: Output Compare No Output

5.6.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**1 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**42 ***
Internal Clock Division (CKD)	No Division

Trigger Output (TRGO) Parameters:

Master/Slave Mode	Disable (no sync between this TIM (Master) and its Slaves
Trigger Event Selection	Reset (UG bit from TIMx_EGR)

Output Compare No Output Channel 1:

Mode	Frozen (used for Timing base)
Pulse (16 bits value)	0
CH Polarity	High

5.7. TIM8

Clock Source : Internal Clock

Channel1: Output Compare No Output

5.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**1 ***
Counter Mode	**Down ***
Counter Period (AutoReload Register - 16 bits value)	**42 ***
Internal Clock Division (CKD)	No Division
Repetition Counter (RCR - 8 bits value)	0

Trigger Output (TRGO) Parameters:

Master/Slave Mode	Disable (no sync between this TIM (Master) and its Slaves
Trigger Event Selection	Reset (UG bit from TIMx_EGR)

Break And Dead Time management - BRK Configuration:

BRK State	Disable
BRK Polarity	High

Break And Dead Time management - Output Configuration:

Automatic Output State	Disable
Off State Selection for Run Mode (OSSR)	Disable
Off State Selection for Idle Mode (OSSI)	Disable
Lock Configuration	Off

Output Compare No Output Channel 1:

Mode	Frozen (used for Timing base)
Pulse (16 bits value)	0
CH Polarity	High
CH Idle State	Reset

5.8. USART1

Mode: Asynchronous

5.8.1. 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**

6. System Configuration

6.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
RCC	PC14-OSC32_IN	RCC_OSC32_IN	n/a	n/a	n/a	PC14-OSC32_IN
	PC15-OSC32_OUT	RCC_OSC32_OUT	n/a	n/a	n/a	PC15-OSC32_OUT
	PH0-OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	PH0-OSC_IN
	PH1-OSC_OUT	RCC_OSC_OUT	n/a	n/a	n/a	PH1-OSC_OUT
RTC	PC13-ANTI_TAMP	RTC_AF1	n/a	n/a	n/a	
SPI1	PA5	SPI1_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Low	SPI1_SCK [LIS302DL_SCL/SPC]
	PA6	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Low	SPI1_MISO [LIS302DL_SDO]
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Low	SPI1_MOSI [LIS302DL_SDA/SDI/SDO]
SYS	PA13	SYS_JTMS-SWDIO	n/a	n/a	n/a	SWDIO
	PA14	SYS_JTCK-SWCLK	n/a	n/a	n/a	SWCLK
USART1	PB6	USART1_TX	Alternate Function Push Pull	Pull-up	**Very High ***	
	PB7	USART1_RX	Alternate Function Push Pull	Pull-up	**Very High ***	
Single Mapped Signals	PC3	I2S2_SD	Alternate Function Push Pull	No pull-up and no pull-down	Low	PDM_OUT [MP45DT02_DOUT]
	PA4	I2S3_WS	Alternate Function Push Pull	No pull-up and no pull-down	Low	I2S3_WS [CS43L22_LRCK]
	PB10	I2S2_CK	Alternate Function Push Pull	No pull-up and no pull-down	Low	CLK_IN [MP45DT02_CLK]
	PC7	I2S3_MCK	Alternate Function Push Pull	No pull-up and no pull-down	Low	I2S3_MCK [CS43L22_MCLK]
	PA9	USB_OTG_FS_VBUS	Input mode	No pull-up and no pull-down	n/a	VBUS_FS
	PA10	USB_OTG_FS_ID	Alternate Function Push Pull	No pull-up and no pull-down	Low	OTG_FS_ID
	PA11	USB_OTG_FS_	Alternate Function Push Pull	No pull-up and no pull-down	Low	OTG_FS_DM

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
		DM				
	PA12	USB_OTG_FS_DP	Alternate Function Push Pull	No pull-up and no pull-down	Low	OTG_FS_DP
	PC10	I2S3_CK	Alternate Function Push Pull	No pull-up and no pull-down	Low	I2S3_SCK [CS43L22_SCLK]
	PC12	I2S3_SD	Alternate Function Push Pull	No pull-up and no pull-down	Low	I2S3_SD [CS43L22_SDIN]
	PB3	SYS_JTDO-SWO	n/a	n/a	n/a	SWO
	PB9	I2C1_SDA	Alternate Function Open Drain	Pull-up	Low	Audio_SDA [CS43L22_SDA]
GPIO	PE2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	A
	PE3	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	B
	PE4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	C
	PE5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	D
	PE6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	STB
	PC0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	OTG_FS_PowerSwitchOn
	PA0-WKUP	GPIO_EXTI0	External Interrupt Mode with Rising edge trigger detection	No pull-up and no pull-down	n/a	B1 [Blue PushButton]
	PB2	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	BOOT1
	PD12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LD4 [Green Led]
	PD13	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LD3 [Orange Led]
	PD14	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LD5 [Red Led]
	PD15	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LD6 [Blue Led]
	PC6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	OE
	PD0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	R1
	PD1	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	G1
	PD2	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High**	B1

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
					*	
	PD3	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	R2
	PD4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	G2
	PD5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	B2
	PD6	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	CLK
	PE1	GPIO_EXTI1	**External Event Mode with Rising edge trigger detection ***	No pull-up and no pull-down	**n/a**	MEMS_INT2 [LIS302DL_INT2]

6.2. DMA configuration

nothing configured in DMA service

6.3. NVIC configuration

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	0	0
EXTI line0 interrupt	true	0	0
TIM3 global interrupt	true	0	5
USART1 global interrupt	true	0	0
RTC alarms A and B interrupt through EXTI line 17	true	0	0
TIM8 capture compare interrupt	true	0	0
PVD interrupt through EXTI line 16	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
SPI1 global interrupt	unused		
TIM8 break interrupt and TIM12 global interrupt	unused		
TIM8 update interrupt and TIM13 global interrupt	unused		
TIM8 trigger and commutation interrupts and TIM14 global interrupt	unused		
HASH and RNG global interrupts	unused		
FPU global interrupt	unused		

*** User modified value**

7. Power Consumption Calculator report

7.1. Microcontroller Selection

Series	STM32F4
Line	STM32F407/417
MCU	STM32F407VGTx
Datasheet	022152_Rev7

7.2. Parameter Selection

Temperature	25
Vdd	3.3

7.3. Battery Selection

Battery	Battery_29
Capacity	100.0 mAh
Self Discharge	1.0 %/month
Nominal Voltage	3.7 V
Max Cont Current	2700.0 mA
Max Pulse Current	2700.0 mA
Cells in series	1
Cells in parallel	1

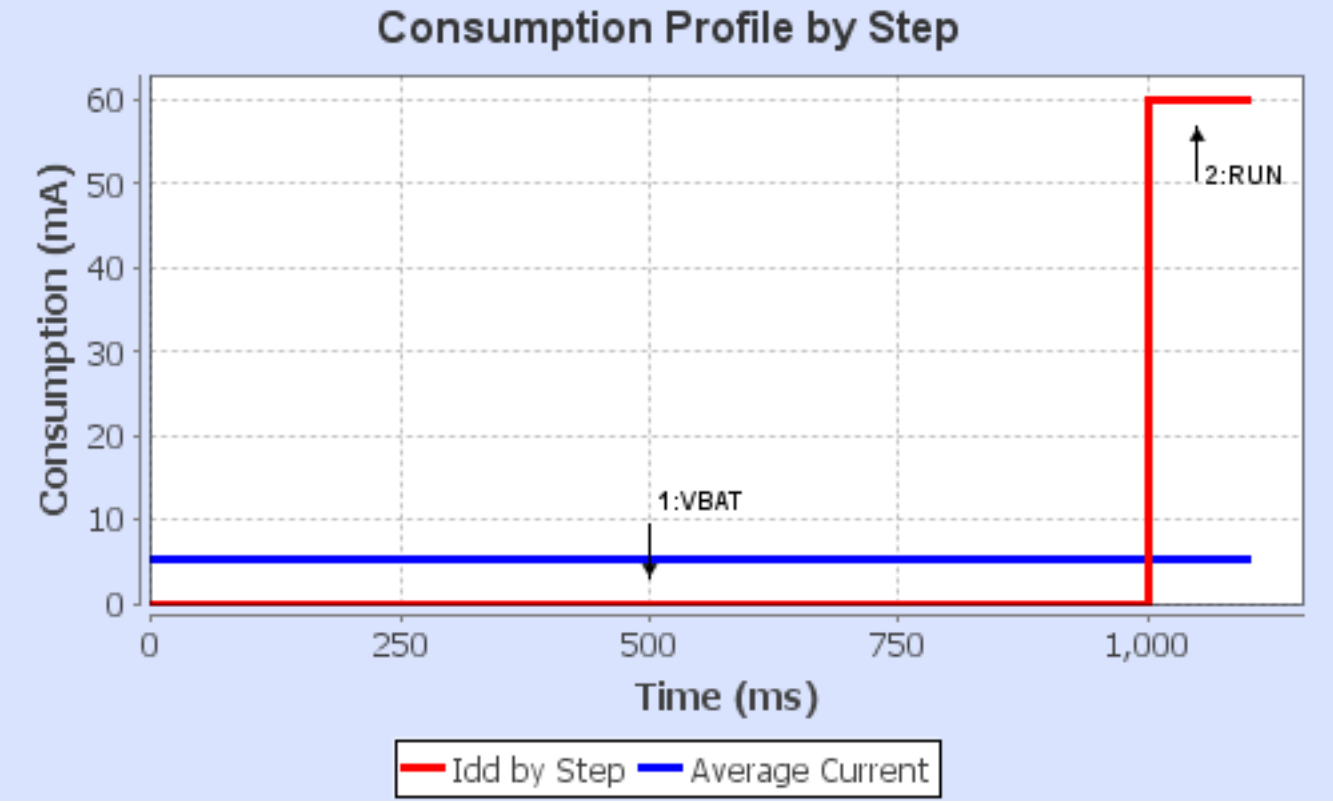
7.4. Sequence

Step	Step1	Step2
Mode	VBAT	RUN
Vdd	3.3	3.3
Voltage Source	Battery	Vbus
Range	No Scale	Scale1-High
Fetch Type	n/a	RAM/FLASH/ART
Clock Configuration	LSE SRAM RTC	HSE PLL
Clock Source Frequency	32.768 kHz	4.0 MHz
CPU Frequency	0 Hz	168.0 MHz
Peripherals		ADC1 ADC3 BusMatrix GPIOA GPIOB GPIOC GPIOD GPIOE PVD/BOR PWR RTC SYS TIM8 USART1
Additional Cons.	0 mA	10 mA
Average Current	1.68 µA	59.87 mA
Duration	1000 ms	100 ms
DMIPS	0.0	210.0
Ta Max	105	96.5
Category	In DS Table	In DS Table

7.5. RESULTS

Sequence Time	1.1 s	Average Current	5.44 mA
Battery Life	3 years, 11 months, 3 days, 19 hours	Average DMIPS	210.0 DMIPS

7.6. Chart


Consumption Profile by Step
Consumption (mA)
60
50
40
30
20
10
0
1:VBAT
2:RUN
0
250
500
750
1,000
Time (ms)
Idd by Step
Average Current

8. Software Project

8.1. Project Settings

Name	Value
Project Name	Matrix_FZS
Project Folder	C:\Users\fzs\Documents\git\MatrixF4_github
Toolchain / IDE	MDK-ARM V5
Firmware Package Name and Version	STM32Cube FW_F4 V1.13.1

8.2. Code Generation Settings

Name	Value
STM32Cube Firmware Library Package	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
Delete previously generated files when not re-generated	Yes
Set all free pins as analog (to optimize the power consumption)	No