

## 1. Description

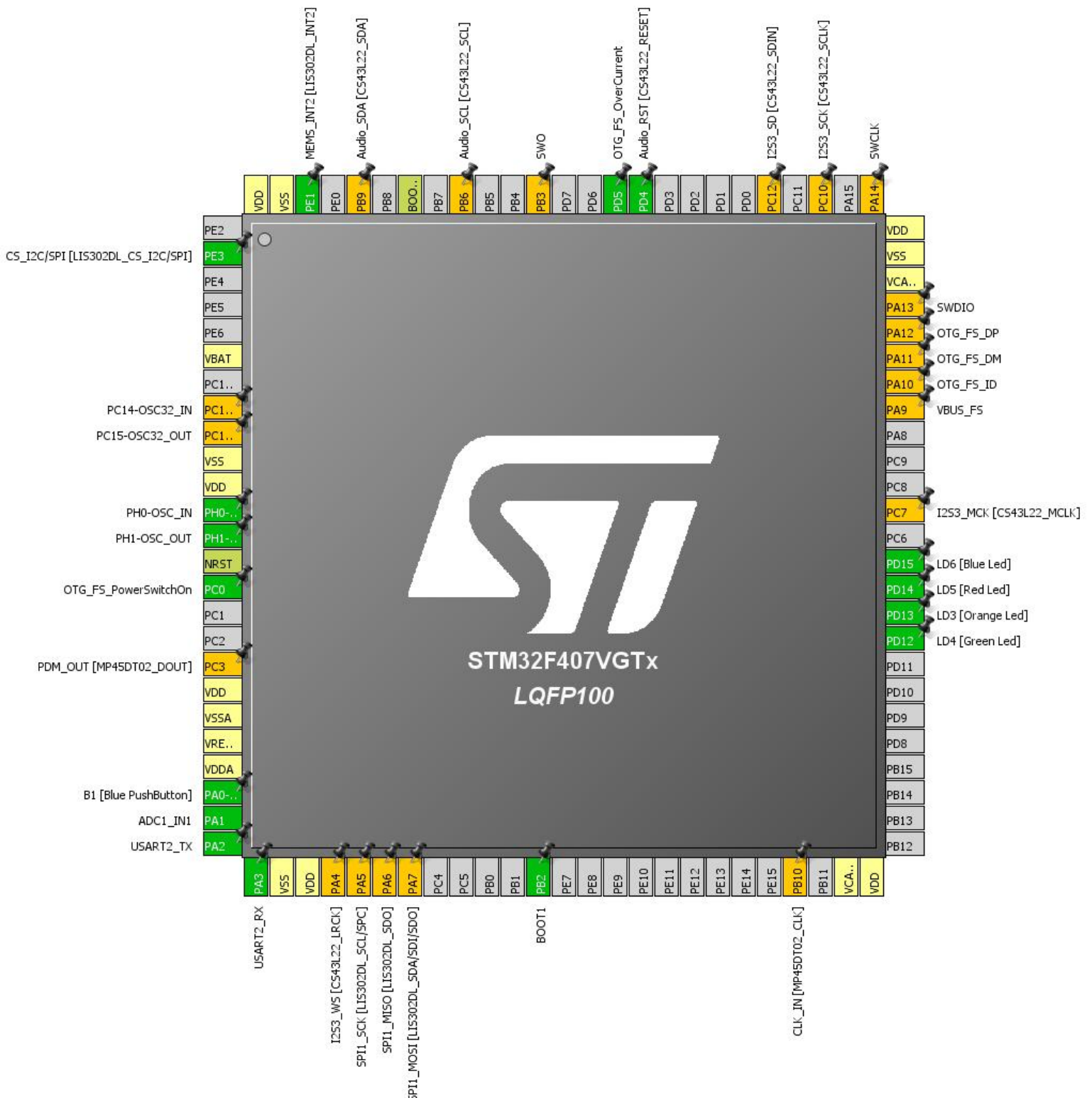
### 1.1. Project

|                 |                    |
|-----------------|--------------------|
| Project Name    | SmartCane          |
| Board Name      | STM32F4DISCOVERY   |
| Generated with: | STM32CubeMX 4.22.1 |
| Date            | 09/26/2017         |

### 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

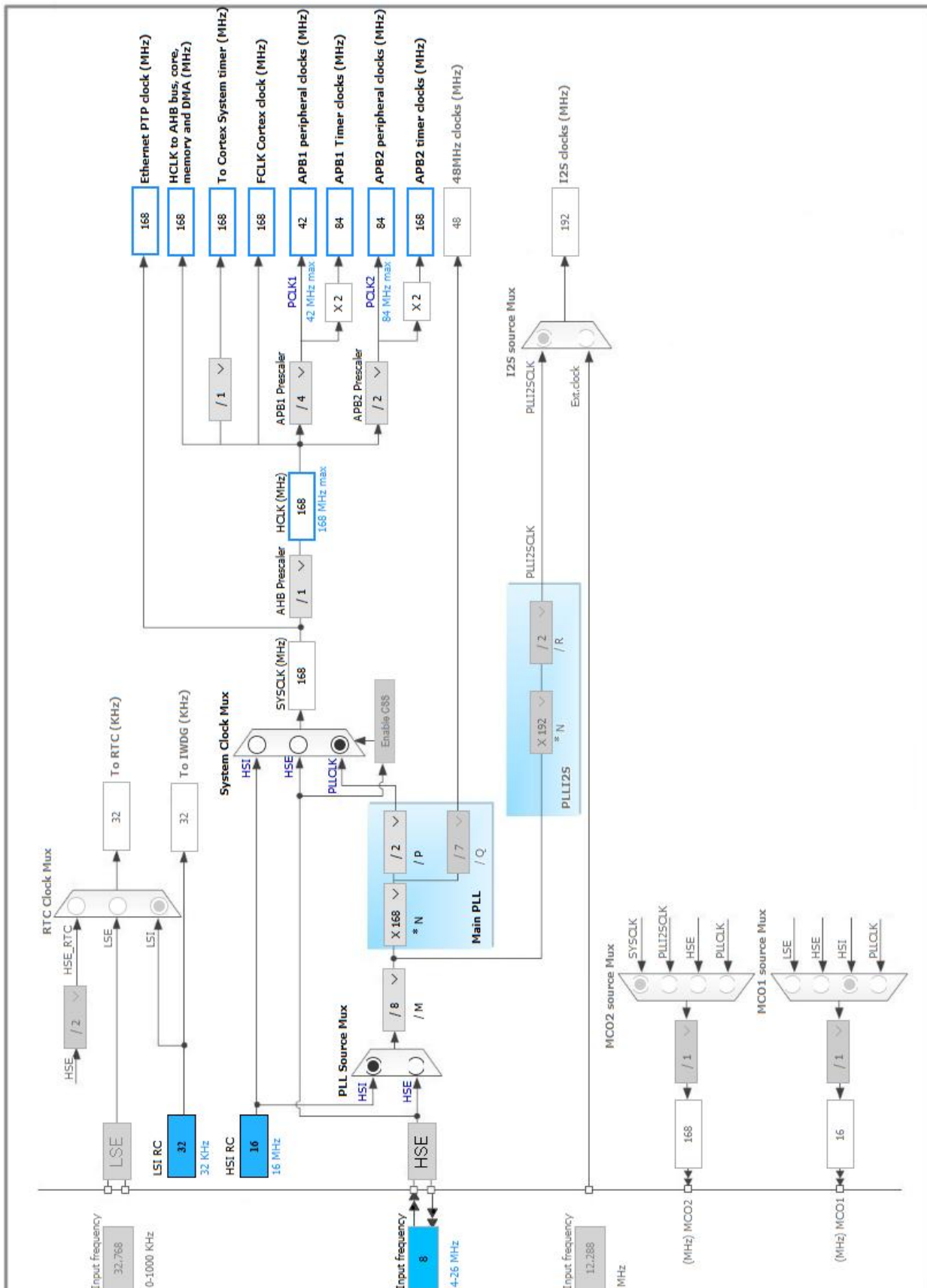
| Pin Number<br>LQFP100 | Pin Name<br>(function after<br>reset) | Pin Type | Alternate<br>Function(s) | Label                               |
|-----------------------|---------------------------------------|----------|--------------------------|-------------------------------------|
| 2                     | PE3 *                                 | I/O      | GPIO_Output              | CS_I2C/SPI<br>[LIS302DL_CS_I2C/SPI] |
| 6                     | VBAT                                  | Power    |                          |                                     |
| 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<br>[MP45DT02_DOUT]          |
| 19                    | VDD                                   | Power    |                          |                                     |
| 20                    | VSSA                                  | Power    |                          |                                     |
| 21                    | VREF+                                 | Power    |                          |                                     |
| 22                    | VDDA                                  | Power    |                          |                                     |
| 23                    | PA0-WKUP                              | I/O      | GPIO_EXTI0               | B1 [Blue PushButton]                |
| 24                    | PA1                                   | I/O      | ADC1_IN1                 |                                     |
| 25                    | PA2                                   | I/O      | USART2_TX                |                                     |
| 26                    | PA3                                   | I/O      | USART2_RX                |                                     |
| 27                    | VSS                                   | Power    |                          |                                     |
| 28                    | VDD                                   | Power    |                          |                                     |
| 29                    | PA4 **                                | I/O      | I2S3_WS                  | I2S3_WS [CS43L22_LRCK]              |
| 30                    | PA5 **                                | I/O      | SPI1_SCK                 | SPI1_SCK<br>[LIS302DL_SCL/SPC]      |
| 31                    | PA6 **                                | I/O      | SPI1_MISO                | SPI1_MISO<br>[LIS302DL_SDO]         |
| 32                    | PA7 **                                | I/O      | SPI1_MOSI                | SPI1_MOSI<br>[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]                     |
| 60                    | PD13 *                                | I/O      | GPIO_Output              | LD3 [Orange Led]                    |
| 61                    | PD14 *                                | I/O      | GPIO_Output              | LD5 [Red Led]                       |

| Pin Number<br>LQFP100 | Pin Name<br>(function after<br>reset) | Pin Type | Alternate<br>Function(s) | Label                        |
|-----------------------|---------------------------------------|----------|--------------------------|------------------------------|
| 62                    | PD15 *                                | I/O      | GPIO_Output              | LD6 [Blue Led]               |
| 64                    | PC7 **                                | I/O      | I2S3_MCK                 | I2S3_MCK<br>[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<br>[CS43L22_SCLK]   |
| 80                    | PC12 **                               | I/O      | I2S3_SD                  | I2S3_SD [CS43L22_SDIN]       |
| 85                    | PD4 *                                 | I/O      | GPIO_Output              | Audio_RST<br>[CS43L22_RESET] |
| 86                    | PD5 *                                 | I/O      | GPIO_Input               | OTG_FS_OverCurrent           |
| 89                    | PB3 **                                | I/O      | SYS_JTDO-SWO             | SWO                          |
| 92                    | PB6 **                                | I/O      | I2C1_SCL                 | Audio_SCL [CS43L22_SCL]      |
| 94                    | BOOT0                                 | Boot     |                          |                              |
| 96                    | PB9 **                                | I/O      | I2C1_SDA                 | Audio_SDA [CS43L22_SDA]      |
| 98                    | PE1                                   | I/O      | GPIO_EXTI1               | MEMS_INT2<br>[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. ADC1

mode: IN1

#### 5.1.1. Parameter Settings:

##### ADCs\_Common\_Settings:

Mode Independent mode

##### ADC\_Settings:

Clock Prescaler PCLK2 divided by 4

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 1

External Trigger Conversion Source **Timer 3 Trigger Out event \***

External Trigger Conversion Edge Trigger detection on the rising edge

Rank 1

Channel Channel 1

Sampling Time **56 Cycles \***

##### ADC\_Injected\_ConversionMode:

Number Of Conversions 0

##### WatchDog:

Enable Analog WatchDog Mode false

### 5.2. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

#### 5.2.1. 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 |
|-------------------------------|---------------------------------|

## 5.3. SYS

**Timebase Source: SysTick**

## 5.4. TIM2

**Clock Source : Internal Clock**

### 5.4.1. Parameter Settings:

**Counter Settings:**

|   |                 |
|---|-----------------|
| Prescaler (PSC - 16 bits value)                       | <b>2000-1 *</b> |
| Counter Mode  | Up              |
| Counter Period (AutoReload Register - 32 bits value ) | <b>4200-1 *</b> |
| 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)                               |

## 5.5. TIM3

**Clock Source : Internal Clock**

### 5.5.1. Parameter Settings:

**Counter Settings:**

|                                 |
|---------------------------------|
| Prescaler (PSC - 16 bits value) |
|---------------------------------|

|   |  |
|---|--|
|   | <b>10-1 *</b>  |
| Counter Mode  | Up   |
| Counter Period (AutoReload Register - 16 bits value ) | <b>8400-1 *</b>  |
| Internal Clock Division (CKD)                         | No Division  |
| <b>Trigger Output (TRGO) Parameters:</b>              |  |
| Master/Slave Mode                                     | <b>Enable (sync between this TIM (Master) and its Slaves (through TRGO)) *</b> |
| Trigger Event Selection                               | <b>Enable (CNT_EN) *</b>   |

## 5.6. USART2

**Mode: Asynchronous**

### 5.6.1. 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**



## 6. System Configuration

### 6.1. GPIO configuration

| IP                    | Pin            | Signal          | GPIO mode                    | GPIO pull/up pull down      | Max Speed   | User Label                       |
|-----------------------|----------------|-----------------|------------------------------|-----------------------------|-------------|----------------------------------|
| ADC1                  | PA1            | ADC1_IN1        | Analog mode                  | No pull-up and no pull-down | n/a         |                                  |
| RCC                   | 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                      |
| USART2                | PA2            | USART2_TX       | Alternate Function Push Pull | Pull-up                     | Very High * |                                  |
|                       | PA3            | USART2_RX       | Alternate Function Push Pull | Pull-up                     | Very High * |                                  |
| Single Mapped Signals | 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                   |
|                       | 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]           |
|                       | 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] |
|                       | 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_DM   | Alternate Function Push Pull | No pull-up and no pull-down | Low         | OTG_FS_DM                        |
|                       | PA12           | USB_OTG_FS_DP   | Alternate Function Push Pull | No pull-up and no pull-down | Low         | OTG_FS_DP                        |
|                       | PA13           | SYS_JTMS-SWDIO  | n/a                          | n/a                         | n/a         | SWDIO                            |

| IP   | Pin      | Signal         | GPIO mode   | GPIO pull/up pull down      | Max Speed | User Label                       |
|------|----------|----------------|---|-----------------------------|-----------|----------------------------------|
|      | PA14     | SYS_JTCK-SWCLK | n/a   | n/a                         | n/a       | SWCLK                            |
|      | 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                              |
|      | PB6      | I2C1_SCL       | Alternate Function Open Drain                                   | Pull-up                     | Low       | Audio_SCL [CS43L22_SCL]          |
|      | PB9      | I2C1_SDA       | Alternate Function Open Drain                                   | Pull-up                     | Low       | Audio_SDA [CS43L22_SDA]          |
| GPIO | PE3      | GPIO_Output    | Output Push Pull  | No pull-up and no pull-down | Low       | CS_I2C/SPI [LIS302DL_CS_I2C/SPI] |
|      | 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 | Low       | LD4 [Green Led]                  |
|      | PD13     | GPIO_Output    | Output Push Pull  | No pull-up and no pull-down | Low       | LD3 [Orange Led]                 |
|      | PD14     | GPIO_Output    | Output Push Pull  | No pull-up and no pull-down | Low       | LD5 [Red Led]                    |
|      | PD15     | GPIO_Output    | Output Push Pull  | No pull-up and no pull-down | Low       | LD6 [Blue Led]                   |
|      | PD4      | GPIO_Output    | Output Push Pull  | No pull-up and no pull-down | Low       | Audio_RST [CS43L22_RESET]        |
|      | PD5      | GPIO_Input     | Input mode  | No pull-up and no pull-down | n/a       | OTG_FS_OverCurrent               |
|      | PE1      | GPIO_EXTI1     | <b>External Event Mode with Rising edge trigger detection *</b> | No pull-up and no pull-down | n/a       | MEMS_INT2 [LIS302DL_INT2]        |

## 6.2. DMA configuration

| DMA request | Stream       | Direction            | Priority      |
|-------------|--------------|----------------------|---------------|
| ADC1        | DMA2_Stream0 | Peripheral To Memory | <b>High *</b> |

### ADC1: DMA2\_Stream0 DMA request Settings:

Mode: **Circular \***  
Use fifo: **Enable \***  
FIFO Threshold: Full  
Peripheral Increment: Disable  
Memory Increment: **Enable \***  
Peripheral Data Width: Half Word  
Memory Data Width: Half Word  
Peripheral Burst Size: Single  
Memory Burst Size: Single

### 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           |
| TIM2 global interrupt                   | true   | 0                    | 0           |
| USART2 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 |                      |             |
| EXTI line0 interrupt                    | unused |                      |             |
| ADC1, ADC2 and ADC3 global interrupts   | unused |                      |             |
| TIM3 global interrupt                   | 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_Rev8   |

### 7.2. Parameter Selection

|             |     |
|-------------|-----|
| Temperature | 25  |
| Vdd         | 3.3 |

## 8. Software Project

### 8.1. Project Settings

| Name                              | Value   |
|-----------------------------------|---|
| Project Name                      | SmartCane   |
| Project Folder                    | C:\Users\wonsu\Documents\STM32CubeMX Project Examples\SmartCane |
| Toolchain / IDE                   | MDK-ARM V5  |
| Firmware Package Name and Version | STM32Cube FW_F4 V1.16.0   |

### 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  |