
STM32
CubeMX

# 1. Description

## 1.1. Project

| | |
|---|---|
| Project Name | 477final |
| Board Name | NUCLEO-F413ZH |
| Generated with: | STM32CubeMX 6.0.1 |
| Date | 11/23/2020 |

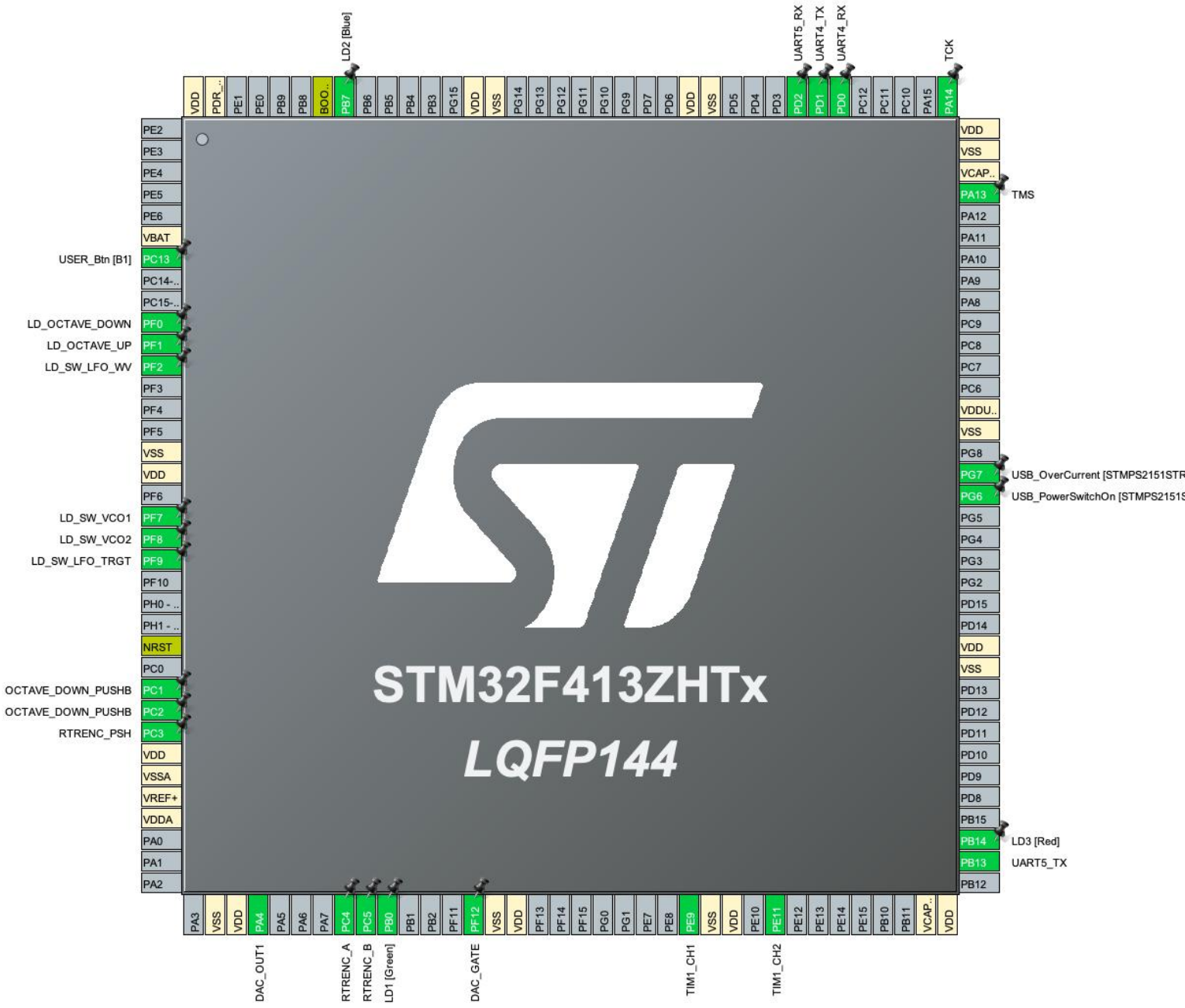
## 1.2. MCU

| | |
|---|---|
| MCU Series | STM32F4 |
| MCU Line | STM32F413/423 |
| MCU name | STM32F413ZHTx |
| MCU Package | LQFP144 |
| MCU Pin number | 144 |

## 1.3. Core(s) information

| | |
|---|---|
| Core(s) | Arm Cortex-M4 |

## 2. Pinout Configuration



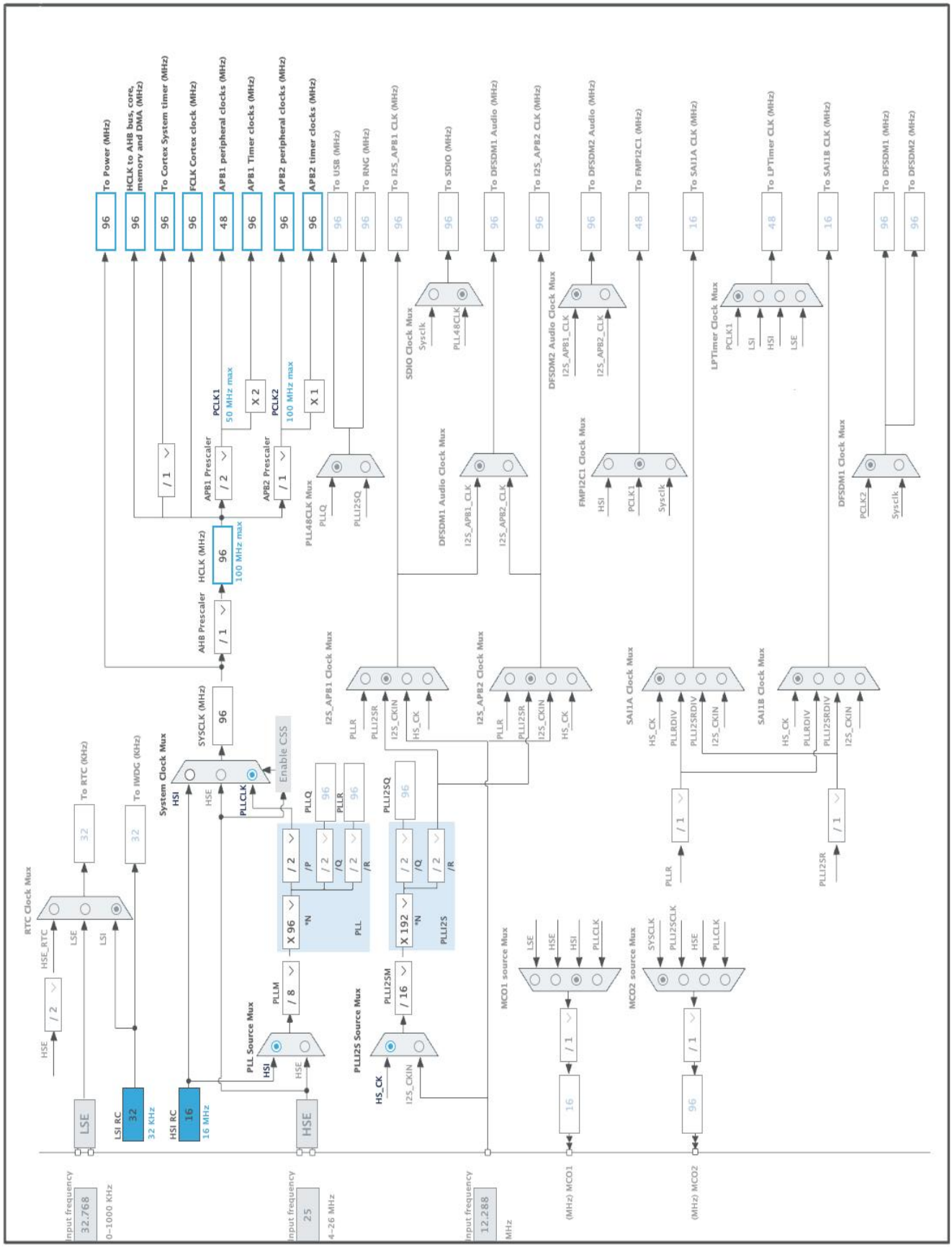
# 3. Pins Configuration

| Pin Number LQFP144 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 6 | VBAT | Power | | |
| 7 | PC13 | I/O | GPIO_EXTI13 | USER_Btn [B1] |
| 10 | PF0 * | I/O | GPIO_Output | LD_OCTAVE_DOWN |
| 11 | PF1 * | I/O | GPIO_Output | LD_OCTAVE_UP |
| 12 | PF2 * | I/O | GPIO_Output | LD_SW_LFO_WV |
| 16 | VSS | Power | | |
| 17 | VDD | Power | | |
| 19 | PF7 * | I/O | GPIO_Output | LD_SW_VCO1 |
| 20 | PF8 * | I/O | GPIO_Output | LD_SW_VCO2 |
| 21 | PF9 * | I/O | GPIO_Output | LD_SW_LFO_TRGT |
| 25 | NRST | Reset | | |
| 27 | PC1 | I/O | GPIO_EXTI1 | OCTAVE_DOWN_PUSHB |
| 28 | PC2 | I/O | GPIO_EXTI2 | OCTAVE_DOWN_PUSHB |
| 29 | PC3 | I/O | GPIO_EXTI3 | RTRENC_PSH |
| 30 | VDD | Power | | |
| 31 | VSSA | Power | | |
| 32 | VREF+ | Power | | |
| 33 | VDDA | Power | | |
| 38 | VSS | Power | | |
| 39 | VDD | Power | | |
| 40 | PA4 | I/O | DAC_OUT1 | |
| 44 | PC4 | I/O | GPIO_EXTI4 | RTRENC_A |
| 45 | PC5 | I/O | GPIO_EXTI5 | RTRENC_B |
| 46 | PB0 * | I/O | GPIO_Output | LD1 [Green] |
| 50 | PF12 * | I/O | GPIO_Output | DAC_GATE |
| 51 | VSS | Power | | |
| 52 | VDD | Power | | |
| 60 | PE9 | I/O | TIM1_CH1 | |
| 61 | VSS | Power | | |
| 62 | VDD | Power | | |
| 64 | PE11 | I/O | TIM1_CH2 | |
| 71 | VCAP_1 | Power | | |
| 72 | VDD | Power | | |
| 74 | PB13 | I/O | UART5_TX | |
| 75 | PB14 * | I/O | GPIO_Output | LD3 [Red] |
| 83 | VSS | Power | | |

| Pin Number LQFP144 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 84 | VDD | Power | | |
| 91 | PG6 * | I/O | GPIO_Output | USB_PowerSwitchOn [STMPS2151STR_EN] |
| 92 | PG7 * | I/O | GPIO_Input | USB_OverCurrent [STMPS2151STR_FAULT] |
| 94 | VSS | Power | | |
| 95 | VDDUSB | Power | | |
| 105 | PA13 | I/O | SYS_JTMS-SWDIO | TMS |
| 106 | VCAP_2 | Power | | |
| 107 | VSS | Power | | |
| 108 | VDD | Power | | |
| 109 | PA14 | I/O | SYS_JTCK-SWCLK | TCK |
| 114 | PD0 | I/O | UART4_RX | |
| 115 | PD1 | I/O | UART4_TX | |
| 116 | PD2 | I/O | UART5_RX | |
| 120 | VSS | Power | | |
| 121 | VDD | Power | | |
| 130 | VSS | Power | | |
| 131 | VDD | Power | | |
| 137 | PB7 * | I/O | GPIO_Output | LD2 [Blue] |
| 138 | BOOT0 | Boot | | |
| 143 | PDR_ON | 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 | 477final |
| Project Folder | /Users/rchoyhughes/STM32CubeIDE/workspace_1.4.0/477final |
| Toolchain / IDE | STM32CubeIDE |
| Firmware Package Name and Version | STM32Cube FW_F4 V1.25.2 |
| 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 | IP Instance Name |
|---|---|---|
| 1 | MX_GPIO_Init | GPIO |
| 2 | SystemClock_Config | RCC |
| 3 | MX_UART4_Init | UART4 |
| 4 | MX_DAC_Init | DAC |
| 5 | MX_TIM1_Init | TIM1 |
| 6 | MX_UART5_Init | UART5 |

# 6. Power Consumption Calculator report

## 6.1. Microcontroller Selection

| | |
|---|---|
| Series | STM32F4 |
| Line | STM32F413/423 |
| MCU | STM32F413ZHTx |
| Datasheet | DS11581_Rev5 |

## 6.2. Parameter Selection

| | |
|---|---|
| Temperature | 25 |
| Vdd | 1.7 |

## 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 |

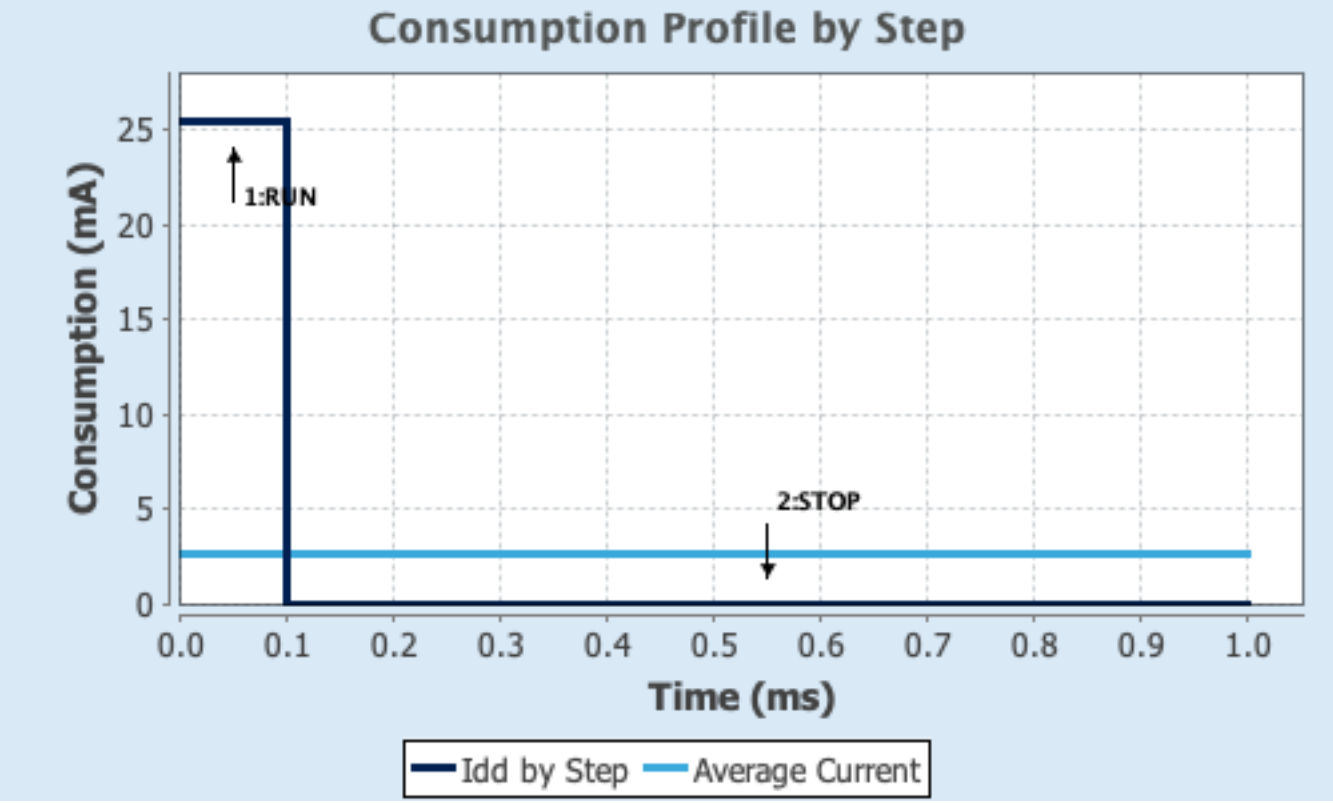
## 6.4. Sequence

| ***Step*** | Step1 | Step2 |
|---|---|---|
| ***Mode*** | RUN | STOP |
| ***Vdd*** | 1.7 | 1.7 |
| ***Voltage Source*** | Battery | Battery |
| ***Range*** | Scale1-High | No Scale |
| ***Fetch Type*** | FLASH/ART/PREFETCH | n/a |
| ***CPU Frequency*** | 100 MHz | 0 Hz |
| ***Clock Configuration*** | HSE PLL | Regulator_LPLV Flash-PwrDwn |
| ***Clock Source Frequency*** | 4 MHz | 0 Hz |
| ***Peripherals*** | | |
| ***Additional Cons.*** | 0 mA | 0 mA |
| ***Average Current*** | 25.4 mA | 15.3 µA |
| ***Duration*** | 0.1 ms | 0.9 ms |
| ***DMIPS*** | 125.0 | 0.0 |
| ***Ta Max*** | 103.49 | 105 |
| ***Category*** | In DS Table | In DS Table |

## 6.5. Results

| Sequence Time | 1 ms | Average Current | 2.55 mA |
|---|---|---|---|
| Battery Life | 1 month, 24 days, 23 hours | Average DMIPS | 125.0 DMIPS |

## 6.6. Chart


Consumption Profile by Step
Consumption (mA)
25
20
15
10
5
0
1:RUN
2:STOP
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Time (ms)
Idd by Step
Average Current

# 7. IPs and Middleware Configuration

## 7.1. DAC

**mode: OUT1 Configuration**

### 7.1.1. Parameter Settings:

**DAC Out1 Settings:**

| | |
|---|---|
| Output Buffer | Enable |
| Trigger | None |

## 7.2. GPIO

## 7.3. RCC

### 7.3.1. Parameter Settings:

**System Parameters:**

| | |
|---|---|
| VDD voltage (V) | 3.3 |
| Instruction Cache | Enabled |
| Prefetch Buffer | Enabled |
| Data Cache | Enabled |
| Flash Latency(WS) | 3 WS (4 CPU cycle) |

**RCC Parameters:**

| | |
|---|---|
| HSI Calibration Value | 16 |
| TIM Prescaler Selection | Disabled |
| HSE Startup Timout Value (ms) | 100 |
| LSE Startup Timout Value (ms) | 5000 |

**Power Parameters:**

| | |
|---|---|
| Power Regulator Voltage Scale | Power Regulator Voltage Scale 1 |

## 7.4. SYS

**Debug: Serial Wire**

**Timebase Source: SysTick**

## 7.5. TIM1

**Clock Source : Internal Clock**

## Channel1: PWM Generation CH1
## Channel2: PWM Generation CH2

### 7.5.1. Parameter Settings:

**Counter Settings:**

| | |
|---|---|
| Prescaler (PSC - 16 bits value) | 0 |
| 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) |

**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 |

**PWM Generation Channel 1:**

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

**PWM Generation Channel 2:**

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

## 7.6. UART4

### Mode: Asynchronous

7.6.1. Parameter Settings:

**Basic Parameters:**

| | |
|---|---|
| Baud Rate | **9600 *** |
| Word Length | 8 Bits (including Parity) |
| Parity | None |
| Stop Bits | 1 |

**Advanced Parameters:**

| | |
|---|---|
| Data Direction | Receive and Transmit |
| Over Sampling | 16 Samples |

## 7.7. UART5

### Mode: Asynchronous

7.7.1. Parameter Settings:

**Basic Parameters:**

| | |
|---|---|
| Baud Rate | **31250 *** |
| Word Length | 8 Bits (including Parity) |
| Parity | None |
| Stop Bits | 1 |

**Advanced Parameters:**

| | |
|---|---|
| Data Direction | **Receive Only *** |
| Over Sampling | 16 Samples |

*** User modified value**

# 8. System Configuration

## 8.1. GPIO configuration

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| DAC | PA4 | DAC_OUT1 | Analog mode | No pull-up and no pull-down | n/a | |
| SYS | PA13 | SYS_JTMS-SWDIO | n/a | n/a | n/a | TMS |
| | PA14 | SYS_JTCK-SWCLK | n/a | n/a | n/a | TCK |
| TIM1 | PE9 | TIM1_CH1 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PE11 | TIM1_CH2 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| UART4 | PD0 | UART4_RX | Alternate Function Push Pull | Pull-up | **High *** | |
| | PD1 | UART4_TX | Alternate Function Push Pull | Pull-up | **High *** | |
| UART5 | PB13 | UART5_TX | Alternate Function Push Pull | Pull-up | **High *** | |
| | PD2 | UART5_RX | Alternate Function Push Pull | Pull-up | **High *** | |
| GPIO | PC13 | GPIO_EXTI13 | External Interrupt Mode with Rising edge trigger detection | No pull-up and no pull-down | n/a | USER_Btn [B1] |
| | PF0 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD_OCTAVE_DOWN |
| | PF1 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD_OCTAVE_UP |
| | PF2 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD_SW_LFO_WV |
| | PF7 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD_SW_VCO1 |
| | PF8 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD_SW_VCO2 |
| | PF9 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD_SW_LFO_TRGT |
| | PC1 | GPIO_EXTI1 | External Interrupt Mode with Rising edge trigger detection | **Pull-up *** | n/a | OCTAVE_DOWN_PUSHB |
| | PC2 | GPIO_EXTI2 | External Interrupt Mode with Rising edge trigger detection | **Pull-up *** | n/a | OCTAVE_DOWN_PUSHB |
| | PC3 | GPIO_EXTI3 | External Interrupt Mode with Rising edge trigger detection | **Pull-up *** | n/a | RTRENC_PSH |
| | PC4 | GPIO_EXTI4 | **External Interrupt Mode with Falling edge trigger detection** | **Pull-up *** | n/a | RTRENC_A |
| | PC5 | GPIO_EXTI5 | **External Interrupt Mode with Falling edge trigger detection** | **Pull-up *** | n/a | RTRENC_B |
| | PB0 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD1 [Green] |
| | PF12 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | **Fast *** | DAC_GATE |
| | PB14 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD3 [Red] |
| | PG6 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | USB_PowerSwitchOn [STMPS2151STR_EN] |
| | | | | | | |

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| | PG7 | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | USB_OverCurrent [STMPS2151STR_FAULT] |
| | PB7 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LD2 [Blue] |

### 8.2. DMA configuration

nothing configured in DMA service

## 8.3. NVIC configuration

### 8.3.1. 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 | 0 | 0 |
| EXTI line1 interrupt | true | 0 | 0 |
| EXTI line2 interrupt | true | 0 | 0 |
| EXTI line3 interrupt | true | 0 | 0 |
| EXTI line4 interrupt | true | 0 | 0 |
| EXTI line[9:5] interrupts | true | 0 | 0 |
| UART5 global interrupt | true | 0 | 0 |
| PVD interrupt through EXTI line 16 | unused | | |
| Flash global interrupt | unused | | |
| RCC global interrupt | 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 | | |
| EXTI line[15:10] interrupts | unused | | |
| UART4 global interrupt | unused | | |
| TIM6 global interrupt, DAC1 and DAC2 underrun error 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 | true | true | false |
| Hard fault interrupt | true | true | false |
| Memory management fault | true | true | false |
| Pre-fetch fault, memory access fault | true | true | false |
| Undefined instruction or illegal state | true | true | false |

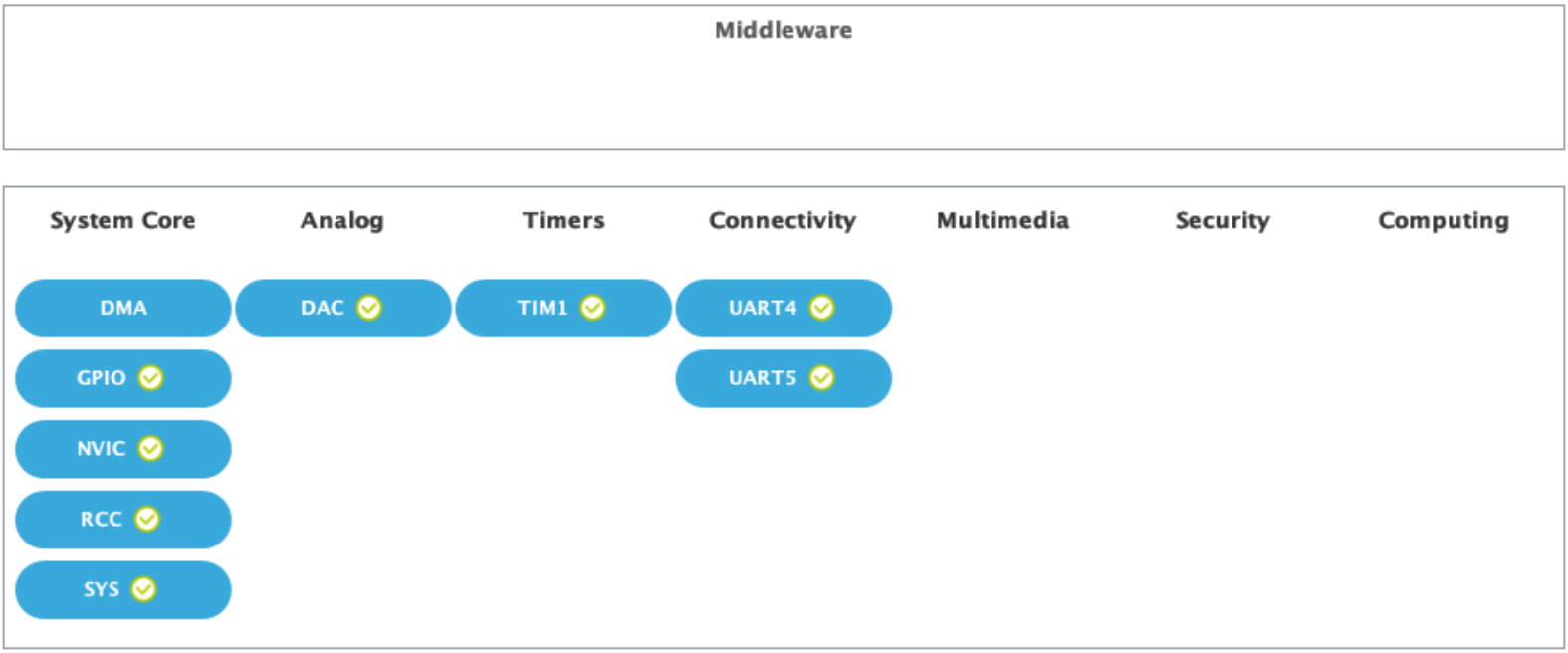
| Enabled interrupt Table | Select for init sequence ordering | Generate IRQ handler | Call HAL handler |
|---|---|---|---|
| System service call via SWI instruction | true | true | false |
| Debug monitor | true | true | false |
| Pendable request for system service | true | true | false |
| System tick timer | true | true | true |
| EXTI line1 interrupt | true | true | true |
| EXTI line2 interrupt | true | true | true |
| EXTI line3 interrupt | true | true | true |
| EXTI line4 interrupt | true | true | true |
| EXTI line[9:5] interrupts | true | true | true |
| UART5 global interrupt | true | true | true |

*** User modified value**

# 9. System Views

9.1. Category view

*9.1.1. Current*



## 10. Docs & Resources

| Type | Link |
|---|---|
| Datasheet | http://www.st.com/resource/en/datasheet/DM00282249.pdf |
| Reference manual | http://www.st.com/resource/en/reference_manual/DM00305666.pdf |
| Programming manual | http://www.st.com/resource/en/programming_manual/DM00046982.pdf |
| Errata sheet | http://www.st.com/resource/en/errata_sheet/DM00318678.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00167594.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00211314.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00249778.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00259245.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00264321.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00264342.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00264379.pdf |
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| Application note | http://www.st.com/resource/en/application_note/DM00040802.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00040808.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00042534.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00046011.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00072315.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00073742.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00073853.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00080497.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00081379.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00115714.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00129215.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00160482.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00213525.pdf |

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|---|---|
| Application note | http://www.st.com/resource/en/application_note/DM00220769.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00227538.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00257177.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00272912.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00226326.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00236305.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00281138.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00296349.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00325582.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00327191.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00343623.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00377852.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00354244.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00315319.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00380469.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00354333.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00395696.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00431633.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00493651.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00536349.pdf |