# 1. Description

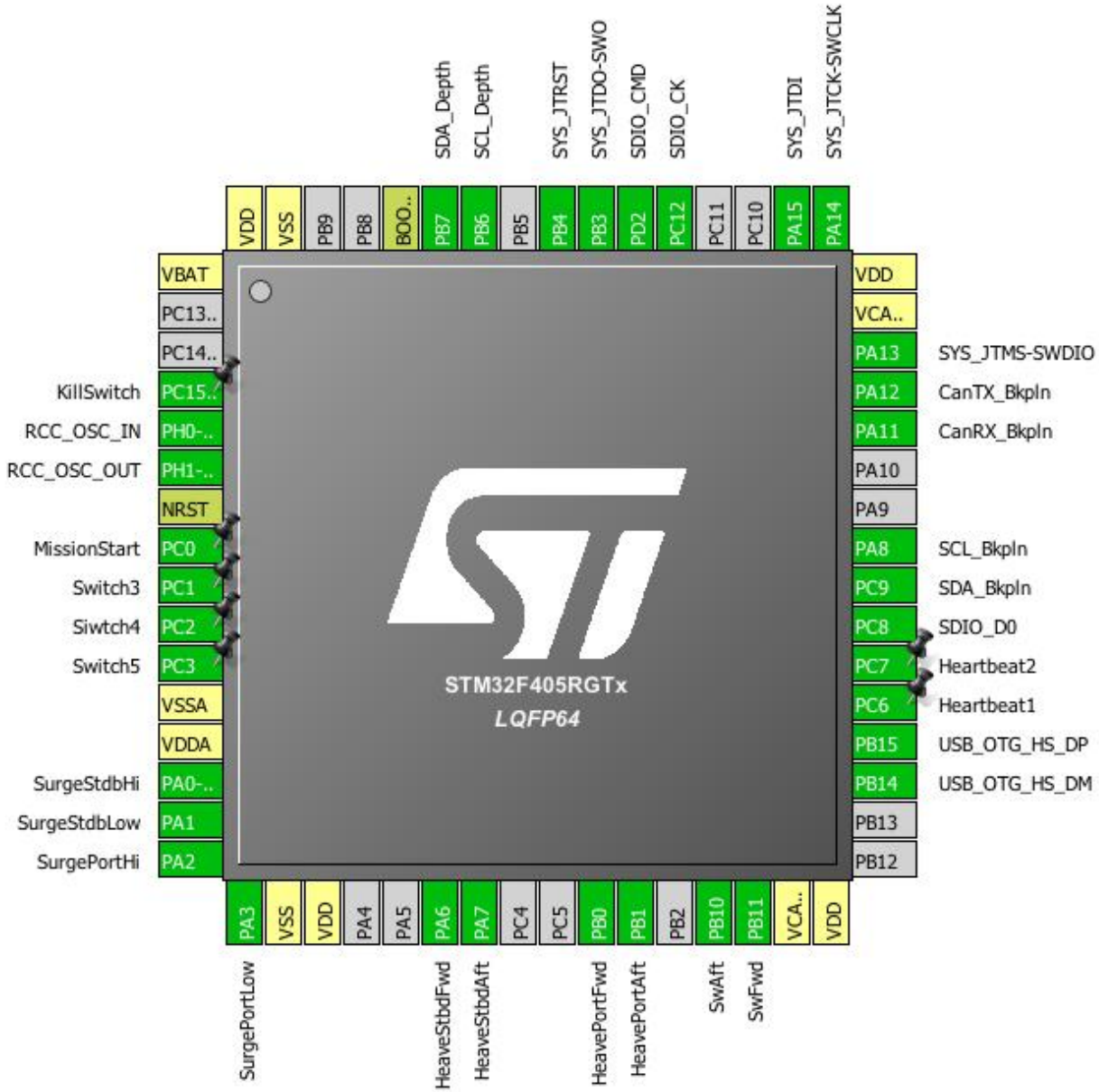
## 1.1. Project

| | |
|---|---|
| Project Name | sauron |
| Board Name | sauron |
| Generated with: | STM32CubeMX 4.22.0 |
| Date | 11/28/2017 |

## 1.2. MCU

| | |
|---|---|
| MCU Series | STM32F4 |
| MCU Line | STM32F405/415 |
| MCU name | STM32F405RGTx |
| MCU Package | LQFP64 |
| MCU Pin number | 64 |

# 2. Pinout Configuration



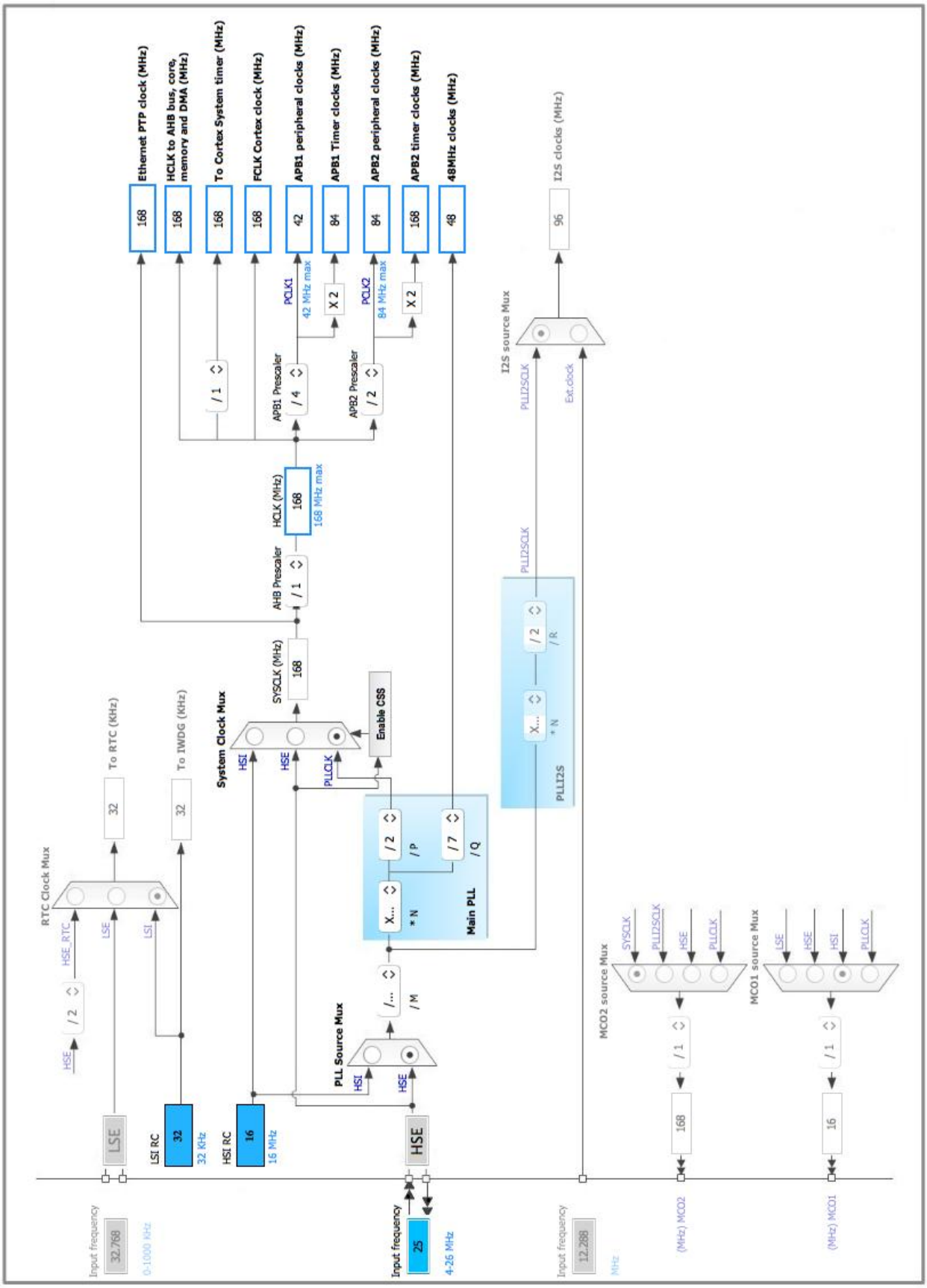
# 3. Pins Configuration

| Pin Number LQFP64 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 1 | VBAT | Power | | |
| 4 | PC15-OSC32_OUT * | I/O | GPIO_Input | KillSwitch |
| 5 | PH0-OSC_IN | I/O | RCC_OSC_IN | |
| 6 | PH1-OSC_OUT | I/O | RCC_OSC_OUT | |
| 7 | NRST | Reset | | |
| 8 | PC0 * | I/O | GPIO_Input | MissionStart |
| 9 | PC1 * | I/O | GPIO_Input | Switch3 |
| 10 | PC2 * | I/O | GPIO_Input | Siwtch4 |
| 11 | PC3 * | I/O | GPIO_Input | Switch5 |
| 12 | VSSA | Power | | |
| 13 | VDDA | Power | | |
| 14 | PA0-WKUP | I/O | TIM5_CH1 | SurgeStdbHi |
| 15 | PA1 | I/O | TIM5_CH2 | SurgeStdbLow |
| 16 | PA2 | I/O | TIM5_CH3 | SurgePortHi |
| 17 | PA3 | I/O | TIM5_CH4 | SurgePortLow |
| 18 | VSS | Power | | |
| 19 | VDD | Power | | |
| 22 | PA6 | I/O | TIM13_CH1 | HeaveStbdFwd |
| 23 | PA7 | I/O | TIM14_CH1 | HeaveStbdAft |
| 26 | PB0 | I/O | TIM3_CH3 | HeavePortFwd |
| 27 | PB1 | I/O | TIM3_CH4 | HeavePortAft |
| 29 | PB10 | I/O | TIM2_CH3 | SwAft |
| 30 | PB11 | I/O | TIM2_CH4 | SwFwd |
| 31 | VCAP_1 | Power | | |
| 32 | VDD | Power | | |
| 35 | PB14 | I/O | USB_OTG_HS_DM | |
| 36 | PB15 | I/O | USB_OTG_HS_DP | |
| 37 | PC6 * | I/O | GPIO_Output | Heartbeat1 |
| 38 | PC7 * | I/O | GPIO_Output | Heartbeat2 |
| 39 | PC8 | I/O | SDIO_D0 | |
| 40 | PC9 | I/O | I2C3_SDA | SDA_Bkpln |
| 41 | PA8 | I/O | I2C3_SCL | SCL_Bkpln |
| 44 | PA11 | I/O | CAN1_RX | CanRX_Bkpln |
| 45 | PA12 | I/O | CAN1_TX | CanTX_Bkpln |
| 46 | PA13 | I/O | SYS_JTMS-SWDIO | |
| 47 | VCAP_2 | Power | | |

| Pin Number LQFP64 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 48 | VDD | Power | | |
| 49 | PA14 | I/O | SYS_JTCK-SWCLK | |
| 50 | PA15 | I/O | SYS_JTDI | |
| 53 | PC12 | I/O | SDIO_CK | |
| 54 | PD2 | I/O | SDIO_CMD | |
| 55 | PB3 | I/O | SYS_JTDO-SWO | |
| 56 | PB4 | I/O | SYS_JTRST | |
| 58 | PB6 | I/O | I2C1_SCL | SCL_Depth |
| 59 | PB7 | I/O | I2C1_SDA | SDA_Depth |
| 60 | BOOT0 | Boot | | |
| 63 | VSS | Power | | |
| 64 | VDD | Power | | |

* The pin is affected with an I/O function

# 4. Clock Tree Configuration



# 5. IPs and Middleware Configuration

## 5.1. CAN1

**mode: Mode**

### 5.1.1. Parameter Settings:

**Bit Timings Parameters:**

| | |
|---|---|
| Prescaler (for Time Quantum) | 16 |
| Time Quantum | **380.95238095238096 *** |
| Time Quanta in Bit Segment 1 | 1 Time |
| Time Quanta in Bit Segment 2 | 1 Time |
| Time for one Bit | **1142 *** |
| ReSynchronization Jump Width | 1 Time |

**Basic Parameters:**

| | |
|---|---|
| Time Triggered Communication Mode | Disable |
| Automatic Bus-Off Management | Disable |
| Automatic Wake-Up Mode | Disable |
| No-Automatic Retransmission | Disable |
| Receive Fifo Locked Mode | Disable |
| Transmit Fifo Priority | Disable |

**Advanced Parameters:**

| | |
|---|---|
| Operating Mode | Normal |

## 5.2. I2C1

**I2C: I2C**

### 5.2.1. 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 |

## *5.3. I2C3*

### I2C: I2C

### 5.3.1. 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 |

## *5.4. RCC*

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

### 5.4.1. 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 Timout Value (ms) | 100 |
| LSE Startup Timout Value (ms) | 5000 |

**Power Parameters:**

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

## 5.5. SDIO

**Mode: SD 1 bit**

### 5.5.1. Parameter Settings:

**SDIO parameters:**

| | |
|---|---|
| SDIOCLK clock divide factor | 0 |

## 5.6. SYS

**Debug: JTAG (5 pins)**

**Timebase Source: TIM1**

## 5.7. TIM2

**Channel3: PWM Generation CH3**

**Channel4: PWM Generation CH4**

### 5.7.1. Parameter Settings:

**Counter Settings:**

| | |
|---|---|
| Prescaler (PSC - 16 bits value) | 0 |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 32 bits value ) | 0 |
| 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) |

**PWM Generation Channel 3:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (32 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

**PWM Generation Channel 4:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (32 bits value) | 0 |
| Fast Mode | Disable |

| | |
|---|---|
| CH Polarity | High |

## *5.8. TIM3*

### Channel3: PWM Generation CH3
### Channel4: PWM Generation CH4

#### 5.8.1. Parameter Settings:

**Counter Settings:**

| | |
|---|---|
| Prescaler (PSC - 16 bits value) | 0 |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value ) | 0 |
| 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) |

**PWM Generation Channel 3:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (16 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

**PWM Generation Channel 4:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (16 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

## *5.9. TIM5*

### Channel1: PWM Generation CH1
### Channel2: PWM Generation CH2
### Channel3: PWM Generation CH3
### Channel4: PWM Generation CH4

#### 5.9.1. Parameter Settings:

**Counter Settings:**

| | |
|---|---|
| Prescaler (PSC - 16 bits value) | 0 |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 32 bits value ) | 0 |
| 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) |

**PWM Generation Channel 1:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (32 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

**PWM Generation Channel 2:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (32 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

**PWM Generation Channel 3:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (32 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

**PWM Generation Channel 4:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (32 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

## *5.10. TIM13*

**mode: Activated**

**Channel1: PWM Generation CH1**

### 5.10.1. Parameter Settings:

**Counter Settings:**

| | |
|---|---|
| Prescaler (PSC - 16 bits value) | 0 |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value ) | 0 |
| Internal Clock Division (CKD) | No Division |

**PWM Generation Channel 1:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (16 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

## *5.11. TIM14*

**mode: Activated**

**Channel1: PWM Generation CH1**

### 5.11.1. Parameter Settings:

**Counter Settings:**

| | |
|---|---|
| Prescaler (PSC - 16 bits value) | 0 |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value ) | 0 |
| Internal Clock Division (CKD) | No Division |

**PWM Generation Channel 1:**

| | |
|---|---|
| Mode | PWM mode 1 |
| Pulse (16 bits value) | 0 |
| Fast Mode | Disable |
| CH Polarity | High |

## *5.12. USB_OTG_HS*

**Internal FS Phy: Device_Only**

### 5.12.1. Parameter Settings:

| | |
|---|---|
| Speed | Device Full Speed 12MBit/s |
| Endpoint 0 Max Packet size | 64 Bytes |
| Enable internal IP DMA | Disabled |
| Physical interface | Internal Phy |
| Low power | Disabled |
| Link Power Management | Disabled |
| Use dedicated end point 1 interrupt | Disabled |
| VBUS sensing | Disabled |
| Signal start of frame | Disabled |

## *5.13. FREERTOS*

**mode: Enabled**

### 5.13.1. Config parameters:

**Versions:**

| | |
|---|---|
| FreeRTOS version | 9.0.0 |
| CMSIS-RTOS version | 1.02 |

**Kernel settings:**

| | |
|---|---|
| USE_PREEMPTION | Enabled |
| CPU_CLOCK_HZ | SystemCoreClock |
| TICK_RATE_HZ | 1000 |
| MAX_PRIORITIES | 7 |
| MINIMAL_STACK_SIZE | 128 |
| MAX_TASK_NAME_LEN | 16 |
| USE_16_BIT_TICKS | Disabled |
| IDLE_SHOULD_YIELD | Enabled |
| USE_MUTEXES | Enabled |
| USE_RECURSIVE_MUTEXES | Disabled |
| USE_COUNTING_SEMAPHORES | Disabled |
| QUEUE_REGISTRY_SIZE | 8 |
| USE_APPLICATION_TASK_TAG | Disabled |
| ENABLE_BACKWARD_COMPATIBILITY | Enabled |
| USE_PORT_OPTIMISED_TASK_SELECTION | Enabled |
| USE_TICKLESS_IDLE | Disabled |
| USE_TASK_NOTIFICATIONS | Enabled |

**Memory management settings:**

| | |
|---|---|
| Memory Allocation | Dynamic |
| TOTAL_HEAP_SIZE | 15360 |
| Memory Management scheme | heap_4 |

**Hook function related definitions:**

| | |
|---|---|
| USE_IDLE_HOOK | Disabled |
| USE_TICK_HOOK | Disabled |
| USE_MALLOC_FAILED_HOOK | Disabled |
| USE_DAEMON_TASK_STARTUP_HOOK | Disabled |
| CHECK_FOR_STACK_OVERFLOW | Disabled |

**Run time and task stats gathering related definitions:**

| | |
|---|---|
| GENERATE_RUN_TIME_STATS | Disabled |

| | |
|---|---|
| USE_TRACE_FACILITY | Disabled |
| USE_STATS_FORMATTING_FUNCTIONS | Disabled |

**Co-routine related definitions:**

| | |
|---|---|
| USE_CO_ROUTINES | Disabled |
| MAX_CO_ROUTINE_PRIORITIES | 2 |

**Software timer definitions:**

| | |
|---|---|
| USE_TIMERS | Disabled |

**Interrupt nesting behaviour configuration:**

| | |
|---|---|
| LIBRARY_LOWEST_INTERRUPT_PRIORITY | 15 |
| LIBRARY_MAX_SYSCALL_INTERRUPT_PRIORITY | 5 |

## 5.13.2. Include parameters:

**Include definitions:**

| | |
|---|---|
| vTaskPrioritySet | Enabled |
| uxTaskPriorityGet | Enabled |
| vTaskDelete | Enabled |
| vTaskCleanUpResources | Disabled |
| vTaskSuspend | Enabled |
| vTaskDelayUntil | Disabled |
| vTaskDelay | Enabled |
| xTaskGetSchedulerState | Enabled |
| xTaskResumeFromISR | Enabled |
| xQueueGetMutexHolder | Disabled |
| xSemaphoreGetMutexHolder | Disabled |
| pcTaskGetTaskName | Disabled |
| uxTaskGetStackHighWaterMark | Disabled |
| xTaskGetCurrentTaskHandle | Disabled |
| eTaskGetState | Disabled |
| xEventGroupSetBitFromISR | Disabled |
| xTimerPendFunctionCall | Disabled |
| xTaskAbortDelay | Disabled |
| xTaskGetHandle | Disabled |

*** User modified value**

# 6. System Configuration

## 6.1. GPIO configuration

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| CAN1 | PA11 | CAN1_RX | Alternate Function Push Pull | No pull-up and no pull-down | **Very High *** | CanRX_Bkpln |
| | PA12 | CAN1_TX | Alternate Function Push Pull | No pull-up and no pull-down | **Very High *** | CanTX_Bkpln |
| I2C1 | PB6 | I2C1_SCL | Alternate Function Open Drain | Pull-up | **Very High *** | SCL_Depth |
| | PB7 | I2C1_SDA | Alternate Function Open Drain | Pull-up | **Very High *** | SDA_Depth |
| I2C3 | PC9 | I2C3_SDA | Alternate Function Open Drain | Pull-up | **Very High *** | SDA_Bkpln |
| | PA8 | I2C3_SCL | Alternate Function Open Drain | Pull-up | **Very High *** | SCL_Bkpln |
| 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 | |
| SDIO | PC8 | SDIO_D0 | Alternate Function Push Pull | No pull-up and no pull-down | Very High | |
| | PC12 | SDIO_CK | Alternate Function Push Pull | No pull-up and no pull-down | Very High | |
| | PD2 | SDIO_CMD | 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 | |
| | PA15 | SYS_JTDI | n/a | n/a | n/a | |
| | PB3 | SYS_JTDO-SWO | n/a | n/a | n/a | |
| | PB4 | SYS_JTRST | n/a | n/a | n/a | |
| TIM2 | PB10 | TIM2_CH3 | Alternate Function Push Pull | No pull-up and no pull-down | Low | SwAft |
| | PB11 | TIM2_CH4 | Alternate Function Push Pull | No pull-up and no pull-down | Low | SwFwd |
| TIM3 | PB0 | TIM3_CH3 | Alternate Function Push Pull | No pull-up and no pull-down | Low | HeavePortFwd |
| | PB1 | TIM3_CH4 | Alternate Function Push Pull | No pull-up and no pull-down | Low | HeavePortAft |
| TIM5 | PA0-WKUP | TIM5_CH1 | Alternate Function Push Pull | No pull-up and no pull-down | Low | SurgeStdbHi |
| | PA1 | TIM5_CH2 | Alternate Function Push Pull | No pull-up and no pull-down | Low | SurgeStdbLow |
| | PA2 | TIM5_CH3 | Alternate Function Push Pull | No pull-up and no pull-down | Low | SurgePortHi |

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| | PA3 | TIM5_CH4 | Alternate Function Push Pull | No pull-up and no pull-down | Low | SurgePortLow |
| TIM13 | PA6 | TIM13_CH1 | Alternate Function Push Pull | No pull-up and no pull-down | Low | HeaveStbdFwd |
| TIM14 | PA7 | TIM14_CH1 | Alternate Function Push Pull | No pull-up and no pull-down | Low | HeaveStbdAft |
| USB_OTG_HS | PB14 | USB_OTG_HS_DM | Alternate Function Push Pull | No pull-up and no pull-down | **Very High *** | |
| | PB15 | USB_OTG_HS_DP | Alternate Function Push Pull | No pull-up and no pull-down | **Very High *** | |
| GPIO | PC15-OSC32_OUT | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | KillSwitch |
| | PC0 | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | MissionStart |
| | PC1 | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | Switch3 |
| | PC2 | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | Siwtch4 |
| | PC3 | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | Switch5 |
| | PC6 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Heartbeat1 |
| | PC7 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Heartbeat2 |

## *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 | 15 | 0 |
| System tick timer | true | 15 | 0 |
| TIM1 update interrupt and TIM10 global interrupt | true | 0 | 0 |
| PVD interrupt through EXTI line 16 | unused | | |
| Flash global interrupt | unused | | |
| RCC global interrupt | unused | | |
| CAN1 TX interrupts | unused | | |
| CAN1 RX0 interrupts | unused | | |
| CAN1 RX1 interrupt | unused | | |
| CAN1 SCE interrupt | unused | | |
| TIM2 global interrupt | unused | | |
| TIM3 global interrupt | unused | | |
| I2C1 event interrupt | unused | | |
| I2C1 error interrupt | unused | | |
| TIM8 update interrupt and TIM13 global interrupt | unused | | |
| TIM8 trigger and commutation interrupts and TIM14 global interrupt | unused | | |
| SDIO global interrupt | unused | | |
| TIM5 global interrupt | unused | | |
| I2C3 event interrupt | unused | | |
| I2C3 error interrupt | unused | | |
| USB On The Go HS End Point 1 Out global interrupt | unused | | |
| USB On The Go HS End Point 1 In global interrupt | unused | | |
| USB On The Go HS global interrupt | unused | | |
| FPU global interrupt | unused | | |

*** User modified value**

# 7. Power Consumption Calculator report

7.1. Microcontroller Selection

| | |
|---|---|
| Series | STM32F4 |
| Line | STM32F405/415 |
| MCU | STM32F405RGTx |
| Datasheet | 022152_Rev8 |

7.2. Parameter Selection

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

# 8. Software Project

## 8.1. Project Settings

| Name | Value |
|---|---|
| Project Name | sauron |
| Project Folder | /Users/augustmason/Documents/GitHub/riptide_firmware/STM32/sauron |
| Toolchain / IDE | Makefile |
| 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 |