

STM32 CubeMX

1. Description

1.1. Project

| | |
|-----------------|-------------------|
| Project Name | DUMRON |
| Board Name | custom |
| Generated with: | STM32CubeMX 6.0.0 |
| Date | 10/09/2020 |

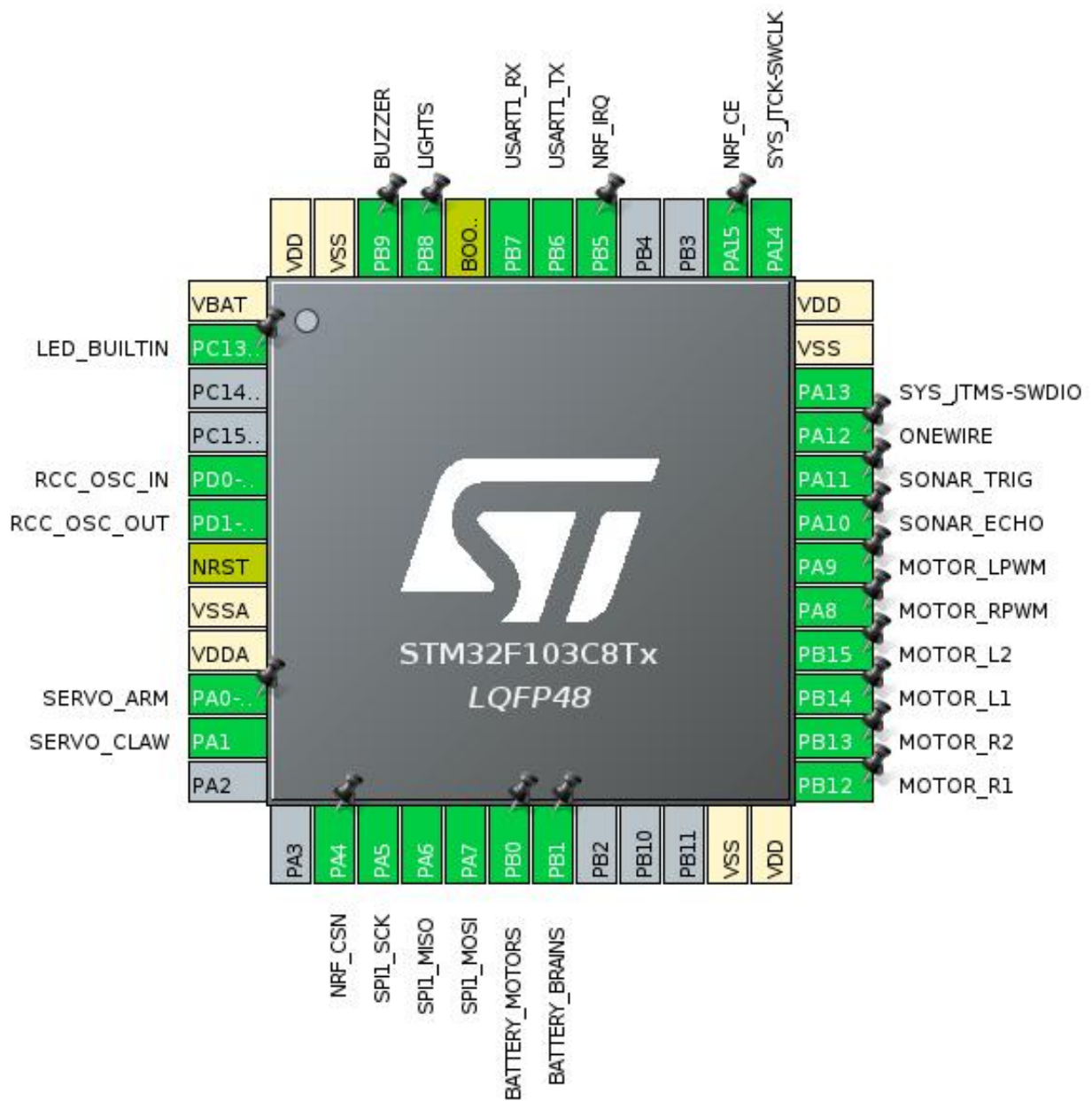
1.2. MCU

| | |
|----------------|---------------|
| MCU Series | STM32F1 |
| MCU Line | STM32F103 |
| MCU name | STM32F103C8Tx |
| MCU Package | LQFP48 |
| MCU Pin number | 48 |

1.3. Core(s) information

| | |
|---------|---------------|
| Core(s) | Arm Cortex-M3 |
|---------|---------------|

2. Pinout Configuration



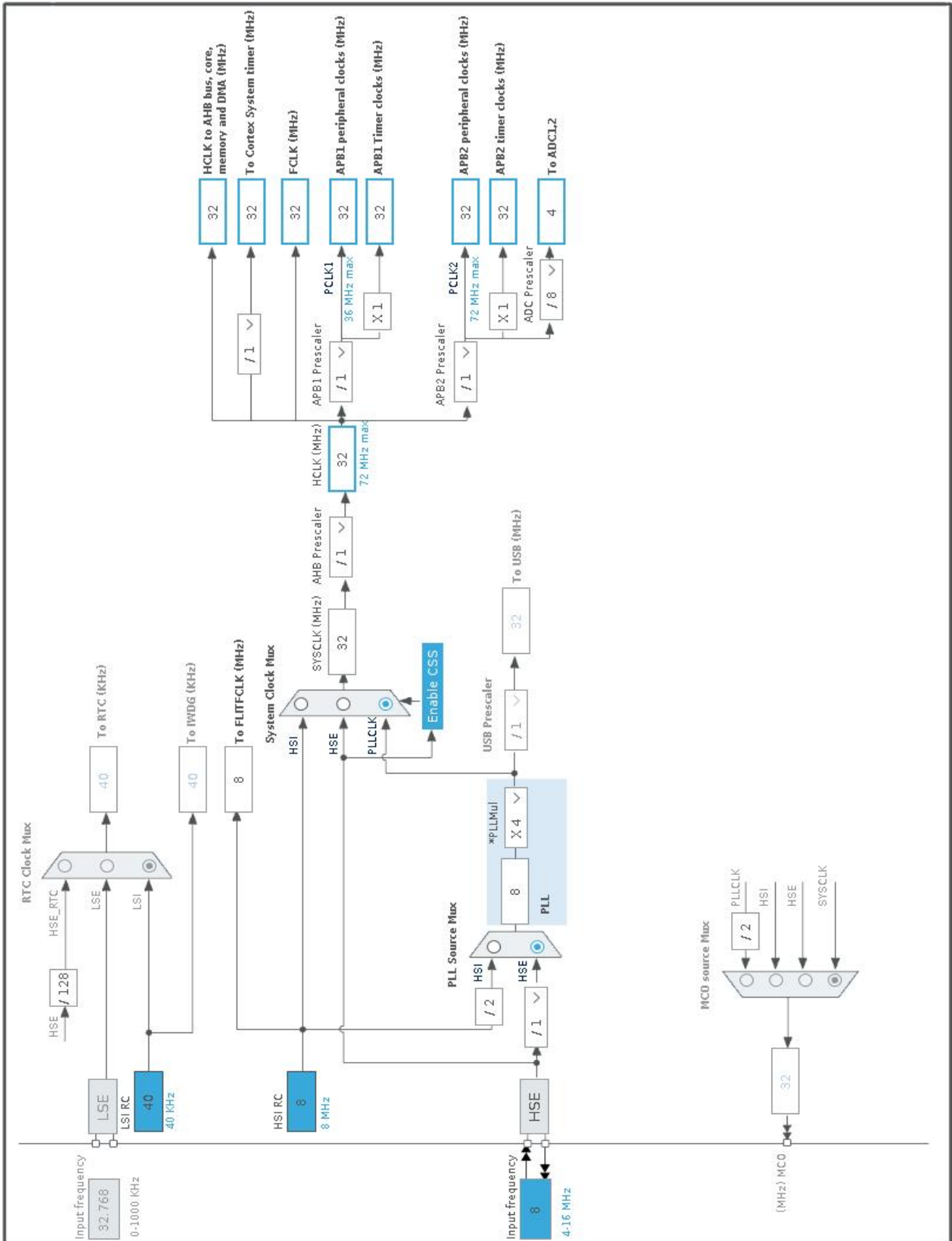
3. Pins Configuration

| Pin Number LQFP48 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|----------------------|---------------------------------------|----------|--------------------------|----------------|
| 1 | VBAT | Power | | |
| 2 | PC13-TAMPER-RTC * | I/O | GPIO_Output | LED_BUILTIN |
| 5 | PD0-OSC_IN | I/O | RCC_OSC_IN | |
| 6 | PD1-OSC_OUT | I/O | RCC_OSC_OUT | |
| 7 | NRST | Reset | | |
| 8 | VSSA | Power | | |
| 9 | VDDA | Power | | |
| 10 | PA0-WKUP | I/O | TIM2_CH1 | SERVO_ARM |
| 11 | PA1 | I/O | TIM2_CH2 | SERVO_CLAW |
| 14 | PA4 * | I/O | GPIO_Output | NRF_CSN |
| 15 | PA5 | I/O | SPI1_SCK | |
| 16 | PA6 | I/O | SPI1_MISO | |
| 17 | PA7 | I/O | SPI1_MOSI | |
| 18 | PB0 | I/O | ADC1_IN8 | BATTERY_MOTORS |
| 19 | PB1 | I/O | ADC1_IN9 | BATTERY_BRAINS |
| 23 | VSS | Power | | |
| 24 | VDD | Power | | |
| 25 | PB12 * | I/O | GPIO_Output | MOTOR_R1 |
| 26 | PB13 * | I/O | GPIO_Output | MOTOR_R2 |
| 27 | PB14 * | I/O | GPIO_Output | MOTOR_L1 |
| 28 | PB15 * | I/O | GPIO_Output | MOTOR_L2 |
| 29 | PA8 | I/O | TIM1_CH1 | MOTOR_RPWM |
| 30 | PA9 | I/O | TIM1_CH2 | MOTOR_LPWM |
| 31 | PA10 * | I/O | GPIO_Input | SONAR_ECHO |
| 32 | PA11 * | I/O | GPIO_Output | SONAR_TRIG |
| 33 | PA12 * | I/O | GPIO_Output | ONEWIRE |
| 34 | PA13 | I/O | SYS_JTMS-SWDIO | |
| 35 | VSS | Power | | |
| 36 | VDD | Power | | |
| 37 | PA14 | I/O | SYS_JTCK-SWCLK | |
| 38 | PA15 * | I/O | GPIO_Output | NRF_CE |
| 41 | PB5 | I/O | GPIO_EXTI5 | NRF_IRQ |
| 42 | PB6 | I/O | USART1_TX | |
| 43 | PB7 | I/O | USART1_RX | |
| 44 | BOOT0 | Boot | | |
| 45 | PB8 * | I/O | GPIO_Output | LIGHTS |

| Pin Number LQFP48 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|----------------------|---------------------------------------|----------|--------------------------|--------|
| 46 | PB9 * | I/O | GPIO_Output | BUZZER |
| 47 | VSS | Power | | |
| 48 | 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 | DUMRON |
| Project Folder | /home/danya/projects/DUMRON |
| Toolchain / IDE | STM32CubeIDE |
| Firmware Package Name and Version | STM32Cube FW_F1 V1.8.2 |
| 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 | Yes |
| 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 | MX_DMA_Init | DMA |
| 3 | SystemClock_Config | RCC |
| 4 | MX_ADC1_Init | ADC1 |
| 5 | MX_SPI1_Init | SPI1 |
| 6 | MX_TIM1_Init | TIM1 |
| 7 | MX_TIM2_Init | TIM2 |
| 8 | MX_USART1_UART_Init | USART1 |
| 9 | MX_TIM3_Init | TIM3 |

6. Power Consumption Calculator report

6.1. Microcontroller Selection

| | |
|-----------|---------------|
| Series | STM32F1 |
| Line | STM32F103 |
| MCU | STM32F103C8Tx |
| Datasheet | DS5319_Rev17 |

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 |

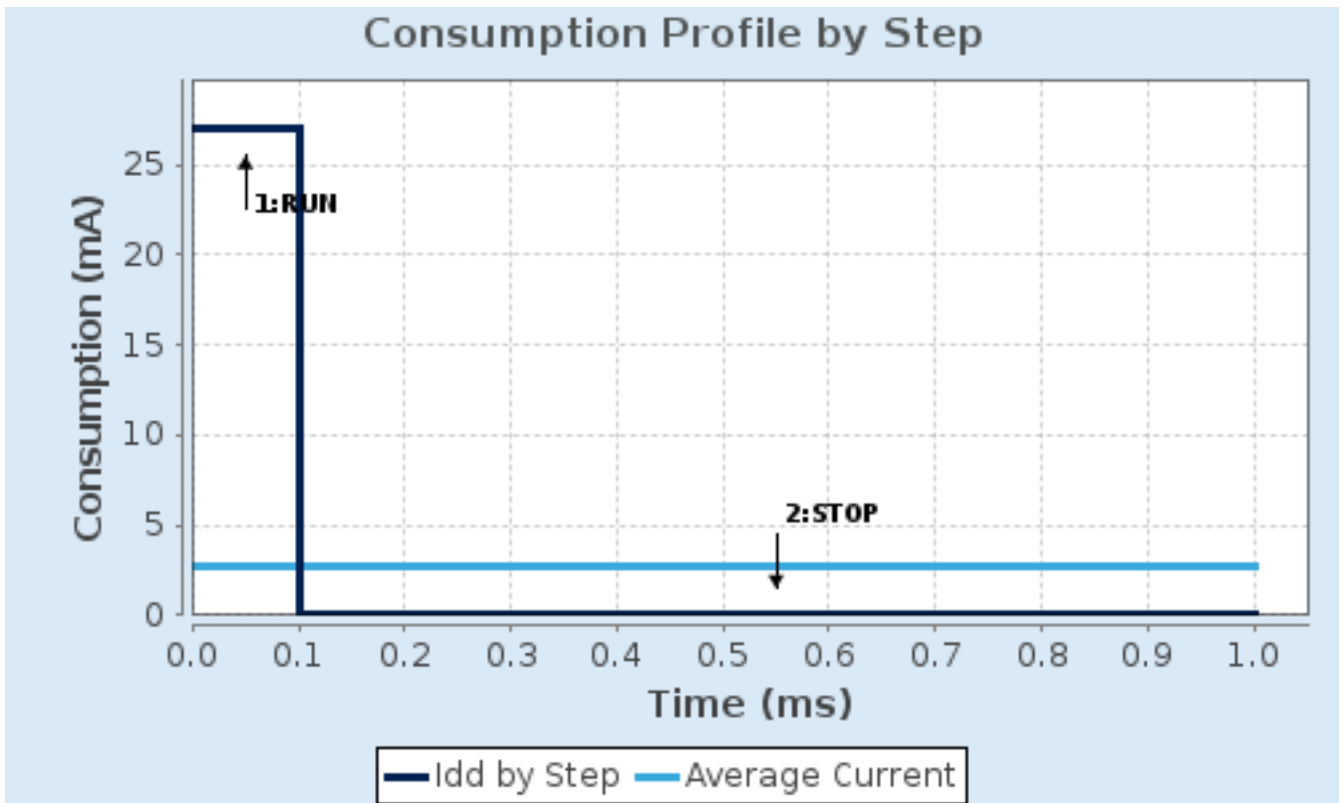
6.4. Sequence

| | | |
|-------------------------------|-------------|--------------|
| Step | Step1 | Step2 |
| Mode | RUN | STOP |
| Vdd | 3.3 | 3.3 |
| Voltage Source | Battery | Battery |
| Range | No Scale | No Scale |
| Fetch Type | FLASH | n/a |
| CPU Frequency | 72 MHz | 0 Hz |
| Clock Configuration | HSE PLL | Regulator LP |
| Clock Source Frequency | 8 MHz | 0 Hz |
| Peripherals | | |
| Additional Cons. | 0 mA | 0 mA |
| Average Current | 27 mA | 14 μ A |
| Duration | 0.1 ms | 0.9 ms |
| DMIPS | 90.0 | 0.0 |
| Ta Max | 100.1 | 105 |
| Category | In DS Table | In DS Table |

6.5. Results

| | | | |
|---------------|-------------------------------|-----------------|------------|
| Sequence Time | 1 ms | Average Current | 2.71 mA |
| Battery Life | 1 month, 21 days, 17 hours | Average DMIPS | 61.0 DMIPS |

6.6. Chart



7. IPs and Middleware Configuration

7.1. ADC1

mode: IN8

mode: IN9

7.1.1. Parameter Settings:

ADCs_Common_Settings:

Mode Independent mode

ADC_Settings:

Data Alignment Right alignment

Scan Conversion Mode Enabled

Continuous Conversion Mode Disabled

Discontinuous Conversion Mode Disabled

ADC_Regular_ConversionMode:

Enable Regular Conversions Enable

Number Of Conversion **2 ***

External Trigger Conversion Source Regular Conversion launched by software

Rank 1

Channel **Channel 9 ***

Sampling Time **55.5 Cycles ***

Rank **2 ***

Channel Channel 8

Sampling Time **55.5 Cycles ***

ADC_Injected_ConversionMode:

Enable Injected Conversions Disable

WatchDog:

Enable Analog WatchDog Mode false

7.2. GPIO

7.3. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

7.3.1. Parameter Settings:

System Parameters:

VDD voltage (V) 3.3

| | |
|-------------------|--------------------|
| Prefetch Buffer | Enabled |
| Flash Latency(WS) | 1 WS (2 CPU cycle) |

RCC Parameters:

| | |
|--------------------------------|------|
| HSI Calibration Value | 16 |
| HSE Startup Timeout Value (ms) | 100 |
| LSE Startup Timeout Value (ms) | 5000 |

7.4. SPI1

Mode: Full-Duplex Master

7.4.1. Parameter Settings:

Basic Parameters:

| | |
|--------------|-----------|
| Frame Format | Motorola |
| Data Size | 8 Bits |
| First Bit | MSB First |

Clock Parameters:

| | |
|---------------------------|------------------------|
| Prescaler (for Baud Rate) | 64 * |
| Baud Rate | 500.0 KBits/s * |
| Clock Polarity (CPOL) | Low |
| Clock Phase (CPHA) | 1 Edge |

Advanced Parameters:

| | |
|-----------------|----------|
| CRC Calculation | Disabled |
| NSS Signal Type | Software |

7.5. SYS

Debug: Serial Wire

Timebase Source: TIM4

7.6. TIM1

Clock Source : Internal Clock

Channel1: PWM Generation CH1

Channel2: PWM Generation CH2

7.6.1. Parameter Settings:

Counter Settings:

| | |
|---------------------------------|--------------|
| Prescaler (PSC - 16 bits value) | 320 * |
|---------------------------------|--------------|

| | |
|---|--------------|
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value) | 255 * |
| 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 |

7.7. TIM2

Clock Source : Internal Clock

Channel1: PWM Generation CH1

Channel2: PWM Generation CH2

7.7.1. Parameter Settings:

Counter Settings:

| | |
|---------------------------------|--------------|
| Prescaler (PSC - 16 bits value) | 255 * |
|---------------------------------|--------------|

| | |
|---|---------------|
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value) | 2499 * |
| 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) |

PWM Generation Channel 1:

| | |
|------------------------|--------------|
| Mode | PWM mode 1 |
| Pulse (16 bits value) | 272 * |
| Output compare preload | Enable |
| Fast Mode | Disable |
| CH Polarity | High |

PWM Generation Channel 2:

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

7.8. TIM3

mode: Clock Source

7.8.1. Parameter Settings:

Counter Settings:

| | |
|---|-------------------|
| Prescaler (PSC - 16 bits value) | 31 * |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value) | 0xFFFF-1 * |
| 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. USART1

Mode: Asynchronous

7.9.1. 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 |

7.10. FREERTOS

Interface: CMSIS_V2

7.10.1. Config parameters:

API:

| | |
|--------------|----------|
| FreeRTOS API | CMSIS v2 |
|--------------|----------|

Versions:

| | |
|--------------------|--------|
| FreeRTOS version | 10.0.1 |
| CMSIS-RTOS version | 2.00 |

Hook function related definitions:

| | |
|------------------------------|------------------|
| USE_IDLE_HOOK | Enabled * |
| USE_TICK_HOOK | Disabled |
| USE_MALLOC_FAILED_HOOK | Enabled * |
| USE_DAEMON_TASK_STARTUP_HOOK | Disabled |
| CHECK_FOR_STACK_OVERFLOW | Option2 * |

Run time and task stats gathering related definitions:

| | |
|--------------------------------|----------|
| GENERATE_RUN_TIME_STATS | Disabled |
| USE_TRACE_FACILITY | Enabled |
| USE_STATS_FORMATTING_FUNCTIONS | Disabled |

Co-routine related definitions:

| | |
|---------------------------|------------|
| USE_CO_ROUTINES | Disabled |
| MAX_CO_ROUTINE_PRIORITIES | 1 * |

Software timer definitions:

| | |
|------------------------|------------|
| USE_TIMERS | Enabled |
| TIMER_TASK_PRIORITY | 2 |
| TIMER_QUEUE_LENGTH | 5 * |
| TIMER_TASK_STACK_DEPTH | |

96 *

Interrupt nesting behaviour configuration:

LIBRARY_LOWEST_INTERRUPT_PRIORITY 15
LIBRARY_MAX_SYSCALL_INTERRUPT_PRIORITY 5

7.10.2. Include parameters:

Include definitions:

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

7.10.3. Advanced settings:

Newlib settings (see parameter description first):

USE_NEWLIB_REENTRANT Disabled

Project settings:

Use FW pack heap file Enabled

* User modified value

8. System Configuration

8.1. GPIO configuration

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|--------|-----------------|----------------|--|-----------------------------|-----------|----------------|
| ADC1 | PB0 | ADC1_IN8 | Analog mode | n/a | n/a | BATTERY_MOTORS |
| | PB1 | ADC1_IN9 | Analog mode | n/a | n/a | BATTERY_BRAINS |
| RCC | PD0-OSC_IN | RCC_OSC_IN | n/a | n/a | n/a | |
| | PD1-OSC_OUT | RCC_OSC_OUT | n/a | n/a | n/a | |
| SPI1 | PA5 | SPI1_SCK | Alternate Function Push Pull | n/a | High * | |
| | PA6 | SPI1_MISO | Input mode | No pull-up and no pull-down | n/a | |
| | PA7 | SPI1_MOSI | Alternate Function Push Pull | n/a | High * | |
| SYS | PA13 | SYS_JTMS-SWDIO | n/a | n/a | n/a | |
| | PA14 | SYS_JTCK-SWCLK | n/a | n/a | n/a | |
| TIM1 | PA8 | TIM1_CH1 | Alternate Function Push Pull | n/a | High * | MOTOR_RPWM |
| | PA9 | TIM1_CH2 | Alternate Function Push Pull | n/a | High * | MOTOR_LPWM |
| TIM2 | PA0-WKUP | TIM2_CH1 | Alternate Function Push Pull | n/a | Medium * | SERVO_ARM |
| | PA1 | TIM2_CH2 | Alternate Function Push Pull | n/a | Medium * | SERVO_CLAW |
| USART1 | PB6 | USART1_TX | Alternate Function Push Pull | n/a | High * | |
| | PB7 | USART1_RX | Input mode | No pull-up and no pull-down | n/a | |
| GPIO | PC13-TAMPER-RTC | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LED_BUILTIN |
| | PA4 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | NRF_CSN |
| | PB12 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Medium * | MOTOR_R1 |
| | PB13 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Medium * | MOTOR_R2 |
| | PB14 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Medium * | MOTOR_L1 |
| | PB15 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Medium * | MOTOR_L2 |
| | PA10 | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | SONAR_ECHO |
| | PA11 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Medium * | SONAR_TRIG |
| | PA12 | GPIO_Output | Output Open Drain * | No pull-up and no pull-down | Medium * | ONEWIRE |
| | PA15 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | NRF_CE |
| | PB5 | GPIO_EXTI5 | External Interrupt Mode with Falling edge trigger detection | No pull-up and no pull-down | n/a | NRF_IRQ |

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|----|-----|-------------|------------------|-----------------------------|-----------|------------|
| | PB8 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | LIGHTS |
| | PB9 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | BUZZER |

8.2. DMA configuration

| DMA request | Stream | Direction | Priority |
|-------------|---------------|----------------------|----------|
| ADC1 | DMA1_Channel1 | Peripheral To Memory | Low |

ADC1: DMA1_Channel1 DMA request Settings:

Mode: Normal
Peripheral Increment: Disable
Memory Increment: **Enable ***
Peripheral Data Width: Half Word
Memory Data Width: Half Word

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 |
| Prefetch 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 |
| DMA1 channel1 global interrupt | true | 0 | 0 |
| EXTI line[9:5] interrupts | true | 0 | 0 |
| TIM4 global interrupt | true | 0 | 0 |
| PVD interrupt through EXTI line 16 | | unused | |
| Flash global interrupt | | unused | |
| RCC global interrupt | | unused | |
| ADC1 and ADC2 global interrupts | | unused | |
| TIM1 break interrupt | | unused | |
| TIM1 update interrupt | | unused | |
| TIM1 trigger and commutation interrupts | | unused | |
| TIM1 capture compare interrupt | | unused | |
| TIM2 global interrupt | | unused | |
| TIM3 global interrupt | | unused | |
| SPI1 global interrupt | | unused | |
| USART1 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 |
| Prefetch fault, memory access fault | true | true | false |
| Undefined instruction or illegal state | true | true | false |
| System service call via SWI instruction | true | false | false |
| Debug monitor | true | false | false |
| Pendable request for system service | true | false | false |
| System tick timer | true | false | false |

| Enabled interrupt Table | Select for init sequence ordering | Generate IRQ handler | Call HAL handler |
|--------------------------------|-----------------------------------|----------------------|------------------|
| DMA1 channel1 global interrupt | true | true | true |
| EXTI line[9:5] interrupts | true | true | true |
| TIM4 global interrupt | true | true | true |

* User modified value

9. System Views

9.1. Category view

9.1.1. Current

Middleware

FREERTOS 

System Core

Analog

Timers

Connectivity

Computing

DMA 

ADC1 

TIM1 

SPI1 

GPIO 

TIM2 

USART1 

NVIC 

TIM3 

RCC 

SYS 

10. Software Pack Report

10.1. Software Pack selected

| Vendor | Name | Version | Component |
|--------------------|----------|---------|--|
| STMicroelectronics | FreeRTOS | 0.0.1 | Class : CMSIS Group : RTOS2 SubGroup : FreeRTOS Version : 10.2.0 Class : RTOS Group : Core Version : 10.2.0 |

11. Docs & Resources

| Type | Link |
|--------------------|---|
| Datasheet | http://www.st.com/resource/en/datasheet/CD00161566.pdf |
| Reference manual | http://www.st.com/resource/en/reference_manual/CD00171190.pdf |
| Programming manual | http://www.st.com/resource/en/programming_manual/CD00228163.pdf |
| Programming manual | http://www.st.com/resource/en/programming_manual/CD00283419.pdf |
| Errata sheet | http://www.st.com/resource/en/errata_sheet/CD00190234.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00160362.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00164185.pdf |
| Application note | http://www.st.com/resource/en/application_note/CD00167326.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 |
| Application note | http://www.st.com/resource/en/application_note/DM00024853.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00032987.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00033267.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00033344.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00042534.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00052530.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00073742.pdf |
| Application note | http://www.st.com/resource/en/application_note/DM00080497.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/DM00156964.pdf
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Application note http://www.st.com/resource/en/application_note/DM00272912.pdf
Application note http://www.st.com/resource/en/application_note/DM00236305.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/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/DM00395696.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