



1. Description

1.1. Project

| | |
|-----------------|-------------------|
| Project Name | SmartCar |
| Board Name | custom |
| Generated with: | STM32CubeMX 6.1.1 |
| Date | 03/19/2021 |

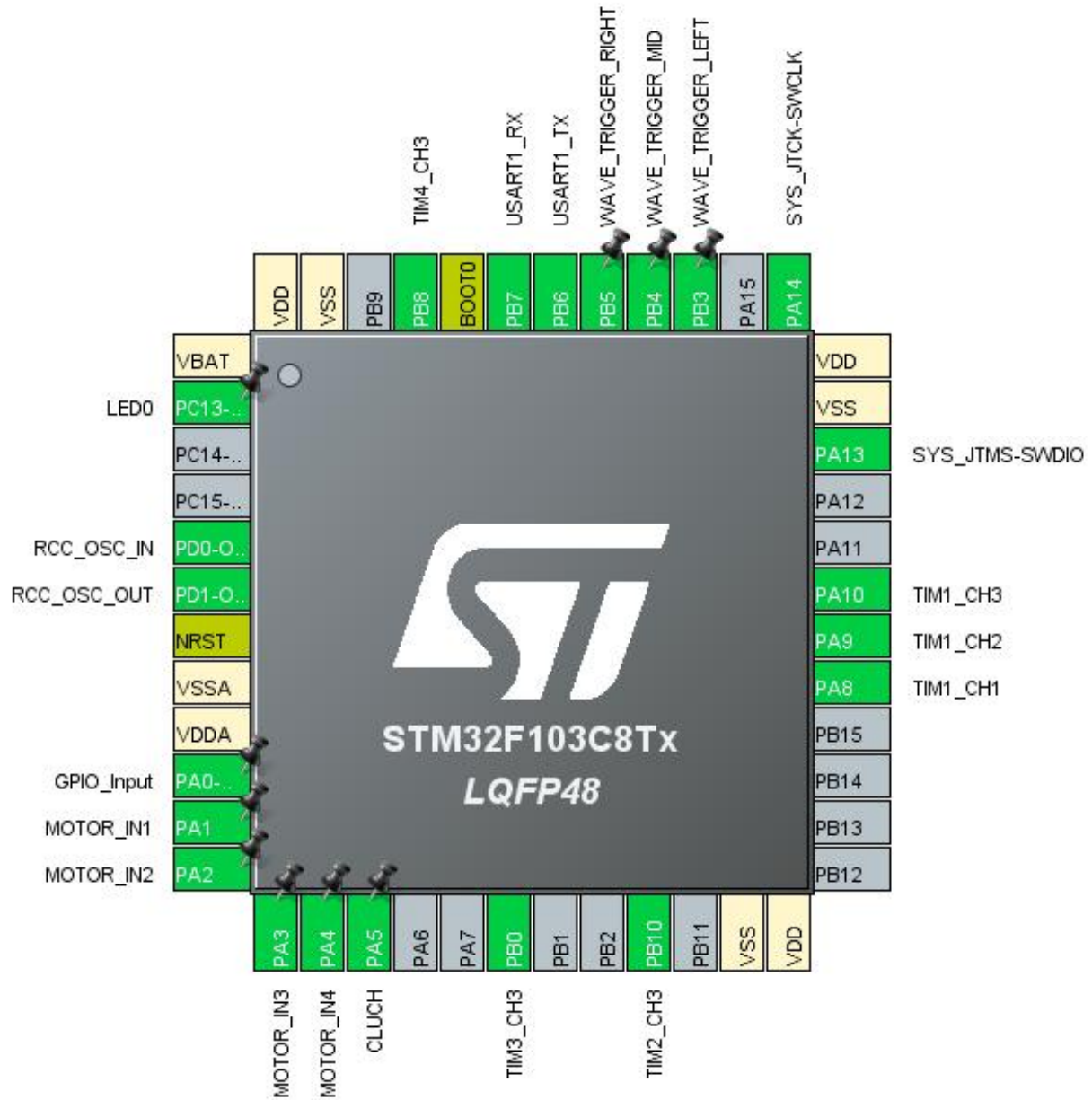
1.2. MCU

| | |
|----------------|---------------|
| 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

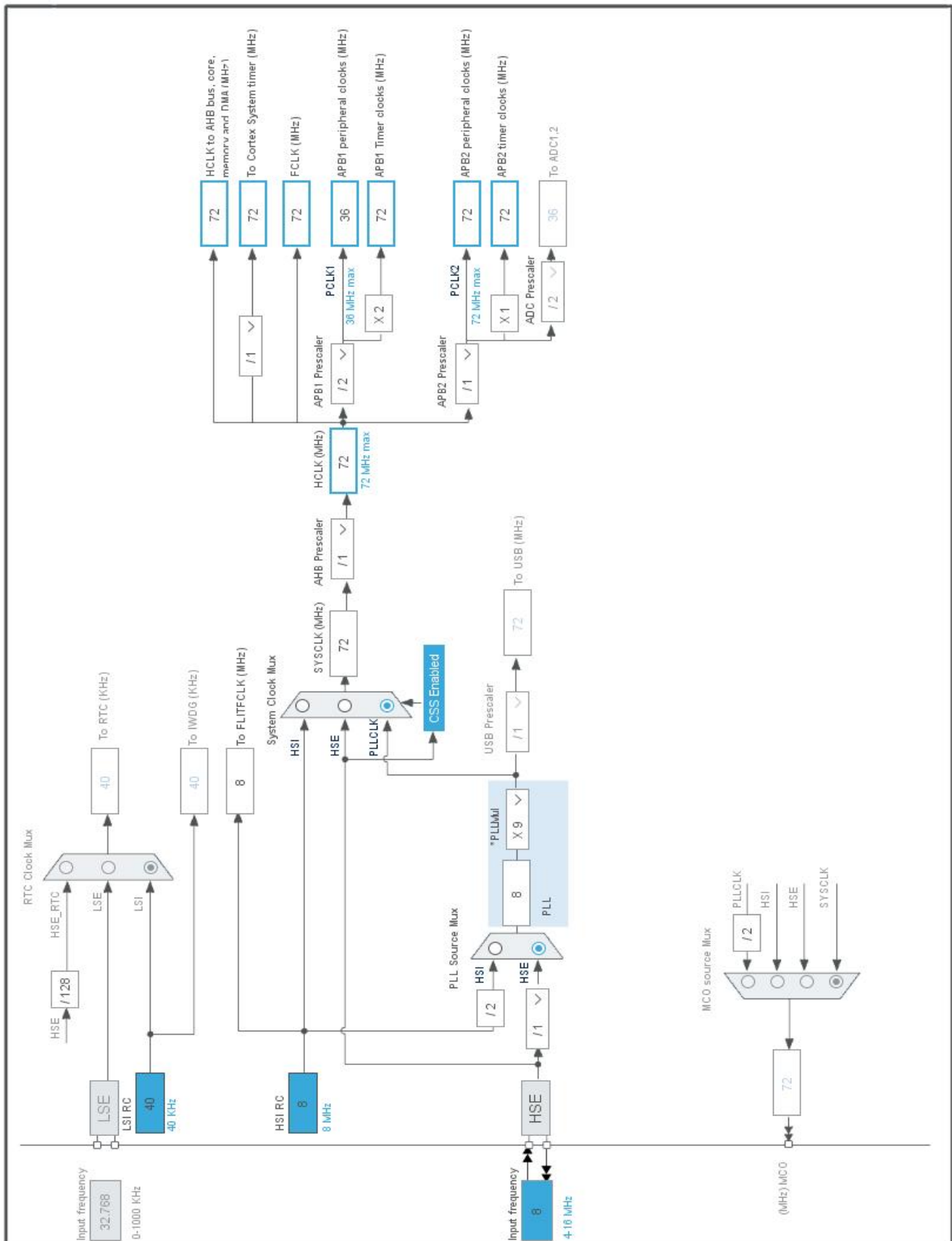


3. Pins Configuration

| 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 | LED0 |
| 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 | GPIO_Input | |
| 11 | PA1 * | I/O | GPIO_Output | MOTOR_IN1 |
| 12 | PA2 * | I/O | GPIO_Output | MOTOR_IN2 |
| 13 | PA3 * | I/O | GPIO_Output | MOTOR_IN3 |
| 14 | PA4 * | I/O | GPIO_Output | MOTOR_IN4 |
| 15 | PA5 * | I/O | GPIO_Output | CLUCH |
| 18 | PB0 | I/O | TIM3_CH3 | |
| 21 | PB10 | I/O | TIM2_CH3 | |
| 23 | VSS | Power | | |
| 24 | VDD | Power | | |
| 29 | PA8 | I/O | TIM1_CH1 | |
| 30 | PA9 | I/O | TIM1_CH2 | |
| 31 | PA10 | I/O | TIM1_CH3 | |
| 34 | PA13 | I/O | SYS_JTMS-SWDIO | |
| 35 | VSS | Power | | |
| 36 | VDD | Power | | |
| 37 | PA14 | I/O | SYS_JTCK-SWCLK | |
| 39 | PB3 * | I/O | GPIO_Output | WAVE_TRIGGER_LEFT |
| 40 | PB4 * | I/O | GPIO_Output | WAVE_TRIGGER_MID |
| 41 | PB5 * | I/O | GPIO_Output | WAVE_TRIGGER_RIGHT |
| 42 | PB6 | I/O | USART1_TX | |
| 43 | PB7 | I/O | USART1_RX | |
| 44 | BOOT0 | Boot | | |
| 45 | PB8 | I/O | TIM4_CH3 | |
| 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 | SmartCar |
| Project Folder | D:\Desktop\smart-car |
| Toolchain / IDE | MDK-ARM V5 |
| Firmware Package Name and Version | STM32Cube FW_F1 V1.8.3 |
| Application Structure | Advanced |
| Generate Under Root | No |
| 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 all used libraries into the project folder |
| 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 | Peripheral Instance Name |
|------|---------------------|--------------------------|
| 1 | MX_GPIO_Init | GPIO |
| 2 | SystemClock_Config | RCC |
| 3 | MX_TIM1_Init | TIM1 |
| 4 | MX_TIM3_Init | TIM3 |
| 5 | MX_USART1_UART_Init | USART1 |
| 6 | MX_TIM2_Init | TIM2 |
| 7 | MX_TIM4_Init | TIM4 |

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 |

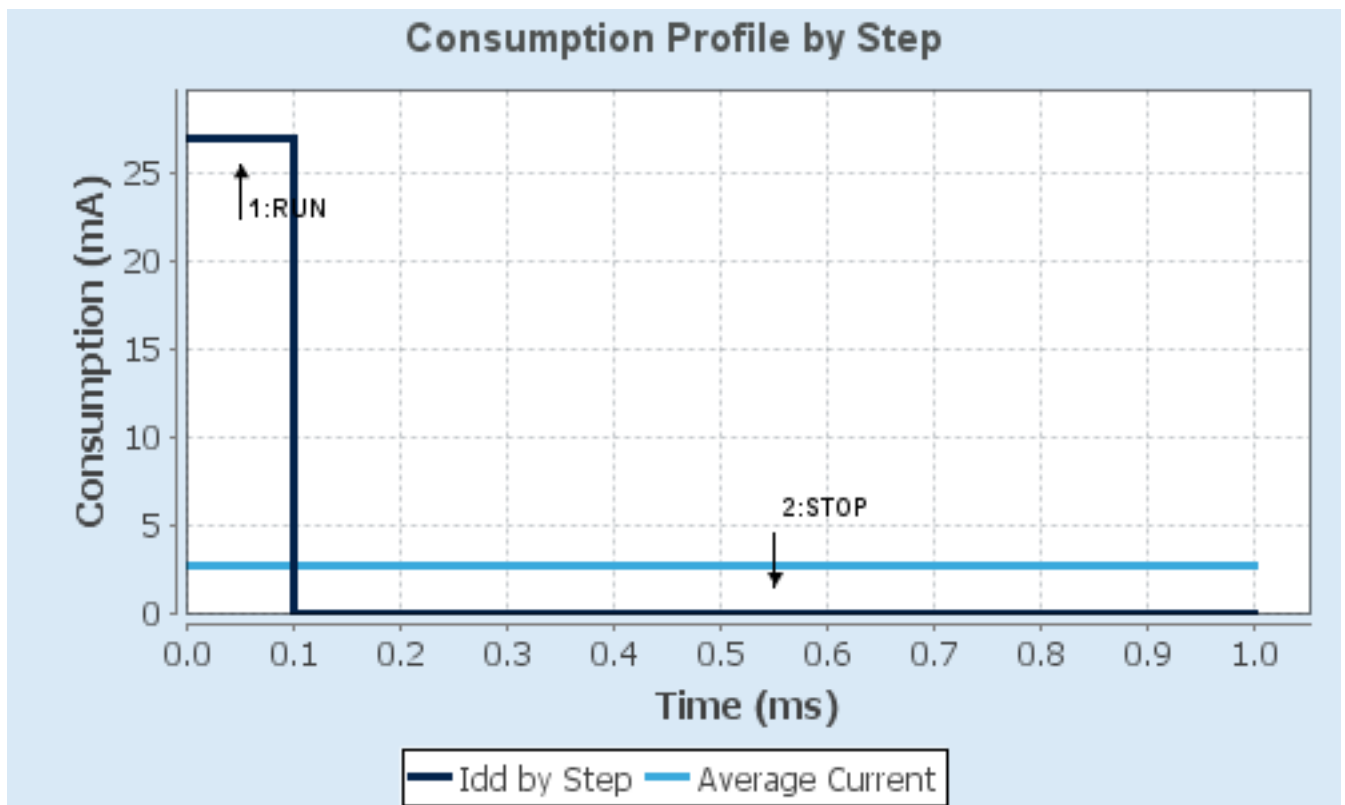
6.4. Sequence

| | | |
|-------------------------------|-------------|--------------|
| 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. Peripherals and Middlewares Configuration

7.1. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

7.1.1. Parameter Settings:

System Parameters:

| | |
|-------------------|--------------------|
| VDD voltage (V) | 3.3 |
| Prefetch Buffer | Enabled |
| Flash Latency(WS) | 2 WS (3 CPU cycle) |

RCC Parameters:

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

7.2. SYS

Debug: Serial Wire

Timebase Source: SysTick

7.3. TIM1

Channel1: PWM Generation CH1

Channel2: PWM Generation CH2

Channel3: PWM Generation CH3

7.3.1. Parameter Settings:

Counter Settings:

| | |
|---|-----------------|
| Prescaler (PSC - 16 bits value) | 71 * |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value) | 20000 * |
| Internal Clock Division (CKD) | No Division |
| Repetition Counter (RCR - 8 bits value) | 0 |
| auto-reload preload | Enable * |

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 (OSSl) 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

PWM Generation Channel 3:

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

7.4. TIM2

Channel3: Input Capture direct mode

7.4.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value) **7199 ***
Counter Mode Up
Counter Period (AutoReload Register - 16 bits value) 65535
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) |

Input Capture Channel 3:

| | |
|-----------------------------|-------------|
| Polarity Selection | Rising Edge |
| IC Selection | Direct |
| Prescaler Division Ratio | No division |
| Input Filter (4 bits value) | 0 |

7.5. TIM3

Channel3: Input Capture direct mode

7.5.1. Parameter Settings:

Counter Settings:

| | |
|---|---------------|
| Prescaler (PSC - 16 bits value) | 7199 * |
| Counter Mode | Up |
| Counter Period (AutoReload Register - 16 bits value) | 65535 |
| 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) |

Input Capture Channel 3:

| | |
|-----------------------------|-------------|
| Polarity Selection | Rising Edge |
| IC Selection | Direct |
| Prescaler Division Ratio | No division |
| Input Filter (4 bits value) | 0 |

7.6. TIM4

Channel3: Input Capture direct mode

7.6.1. 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 |
| 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) |

Input Capture Channel 3:

| | |
|-----------------------------|-------------|
| Polarity Selection | Rising Edge |
| IC Selection | Direct |
| Prescaler Division Ratio | No division |
| Input Filter (4 bits value) | 0 |

7.7. USART1

Mode: Asynchronous

7.7.1. Parameter Settings:

Basic Parameters:

| | |
|-------------|---------------------------|
| Baud Rate | 115200 |
| Word Length | 8 Bits (including Parity) |
| Parity | None |
| Stop Bits | 1 |

Advanced Parameters:

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

7.8. FREERTOS

Interface: CMSIS_V2

7.8.1. Config parameters:

API:

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

Versions:

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

Kernel settings:

| | |
|--------------------|-----------------|
| USE_PREEMPTION | Enabled |
| CPU_CLOCK_HZ | SystemCoreClock |
| TICK_RATE_HZ | 1000 |
| MAX_PRIORITIES | 56 |
| MINIMAL_STACK_SIZE | 128 |

| | |
|-----------------------------------|----------|
| MAX_TASK_NAME_LEN | 16 |
| USE_16_BIT_TICKS | Disabled |
| IDLE_SHOULD_YIELD | Enabled |
| USE_MUTEXES | Enabled |
| USE_RECURSIVE_MUTEXES | Enabled |
| USE_COUNTING_SEMAPHORES | Enabled |
| QUEUE_REGISTRY_SIZE | 8 |
| USE_APPLICATION_TASK_TAG | Disabled |
| ENABLE_BACKWARD_COMPATIBILITY | Enabled |
| USE_PORT_OPTIMISED_TASK_SELECTION | Disabled |
| USE_TICKLESS_IDLE | Disabled |
| USE_TASK_NOTIFICATIONS | Enabled |
| RECORD_STACK_HIGH_ADDRESS | Disabled |

Memory management settings:

| | |
|--------------------------|------------------|
| Memory Allocation | Dynamic / Static |
| TOTAL_HEAP_SIZE | 3072 |
| 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 | Enabled |
| USE_STATS_FORMATTING_FUNCTIONS | Disabled |

Co-routine related definitions:

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

Software timer definitions:

| | |
|------------------------|---------|
| USE_TIMERS | Enabled |
| TIMER_TASK_PRIORITY | 2 |
| TIMER_QUEUE_LENGTH | 10 |
| TIMER_TASK_STACK_DEPTH | 256 |

Interrupt nesting behaviour configuration:

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

7.8.2. Include parameters:

Include definitions:

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

7.8.3. Advanced settings:

Newlib settings (see parameter description first):

| | |
|----------------------|----------|
| USE_NEWLIB_REENTRANT | Disabled |
|----------------------|----------|

Project settings (see parameter description first):

| | |
|-----------------------|---------|
| 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 |
|--------|-----------------|----------------|------------------------------|-----------------------------|-----------|--------------------|
| 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 | |
| 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 | Low | |
| | PA9 | TIM1_CH2 | Alternate Function Push Pull | n/a | Low | |
| | PA10 | TIM1_CH3 | Alternate Function Push Pull | n/a | Low | |
| TIM2 | PB10 | TIM2_CH3 | Input mode | No pull-up and no pull-down | n/a | |
| TIM3 | PB0 | TIM3_CH3 | Input mode | No pull-up and no pull-down | n/a | |
| TIM4 | PB8 | TIM4_CH3 | Input mode | No pull-up and no pull-down | n/a | |
| 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 | Pull-up * | Low | LED0 |
| | PA0-WKUP | GPIO_Input | Input mode | No pull-up and no pull-down | n/a | |
| | PA1 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | MOTOR_IN1 |
| | PA2 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | MOTOR_IN2 |
| | PA3 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | MOTOR_IN3 |
| | PA4 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | MOTOR_IN4 |
| | PA5 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | CLUCH |
| | PB3 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | WAVE_TRIGGER_LEFT |
| | PB4 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | WAVE_TRIGGER_MID |
| | PB5 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | WAVE_TRIGGER_RIGHT |

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 |
| 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 |
| TIM2 global interrupt | true | 5 | 0 |
| TIM3 global interrupt | true | 5 | 0 |
| TIM4 global interrupt | true | 5 | 0 |
| USART1 global interrupt | true | 6 | 0 |
| PVD interrupt through EXTI line 16 | unused | | |
| Flash global interrupt | unused | | |
| RCC global interrupt | unused | | |
| TIM1 break interrupt | unused | | |
| TIM1 update interrupt | unused | | |
| TIM1 trigger and commutation interrupts | unused | | |
| TIM1 capture compare 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 | false | true | true |
| Hard fault interrupt | false | true | false |
| Memory management fault | false | true | false |
| Prefetch fault, memory access fault | false | true | false |
| Undefined instruction or illegal state | false | true | false |
| System service call via SWI instruction | false | false | false |
| Debug monitor | false | true | false |
| Pendable request for system service | false | false | false |
| System tick timer | false | true | true |
| TIM2 global interrupt | false | true | true |
| TIM3 global interrupt | false | true | true |
| TIM4 global interrupt | false | true | true |
| USART1 global interrupt | false | true | true |

*** User modified value**

9. System Views

9.1. Category view

9.1.1. Current

Middleware

FREERTOS 

System Core

DMA

GPIO 

IVIC 

RCC 

SYS 

Analog

Timers

TIM1 

TIM2 

TIM3 

TIM4 

Connectivity

USART1 

Computing

10. 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

Application note http://www.st.com/resource/en/application_note/DM00209695.pdf

Application note http://www.st.com/resource/en/application_note/DM00220769.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/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

Application note http://www.st.com/resource/en/application_note/DM00725181.pdf