# 1. Description

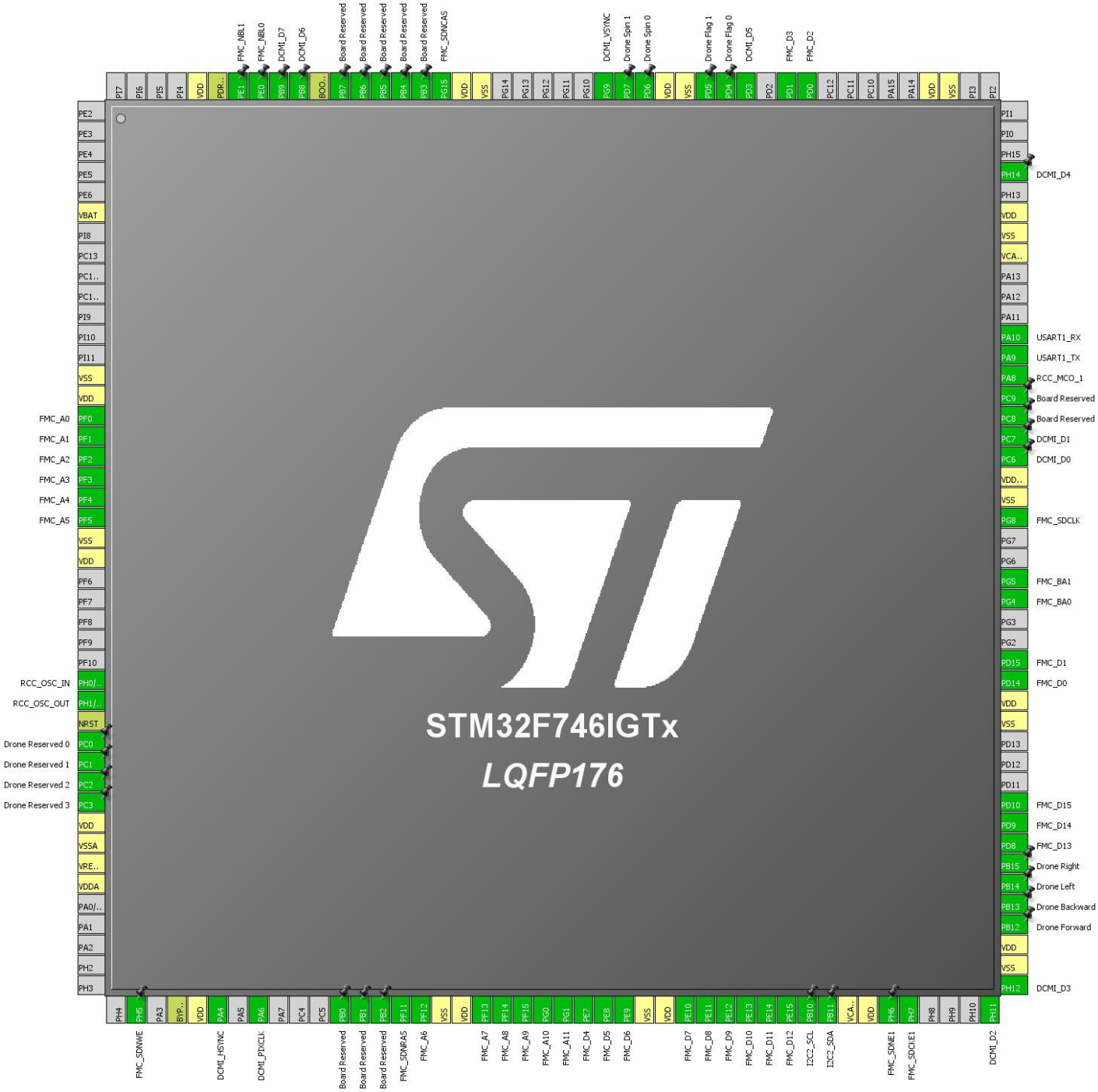
## 1.1. Project

| | |
|---|---|
| Project Name | CameraDriver |
| Board Name | CameraDriver |
| Generated with: | STM32CubeMX 4.22.0 |
| Date | 07/31/2017 |

## 1.2. MCU

| | |
|---|---|
| MCU Series | STM32F7 |
| MCU Line | STM32F7x6 |
| MCU name | STM32F746IGTx |
| MCU Package | LQFP176 |
| MCU Pin number | 176 |

# 2. Pinout Configuration



# 3. Pins Configuration

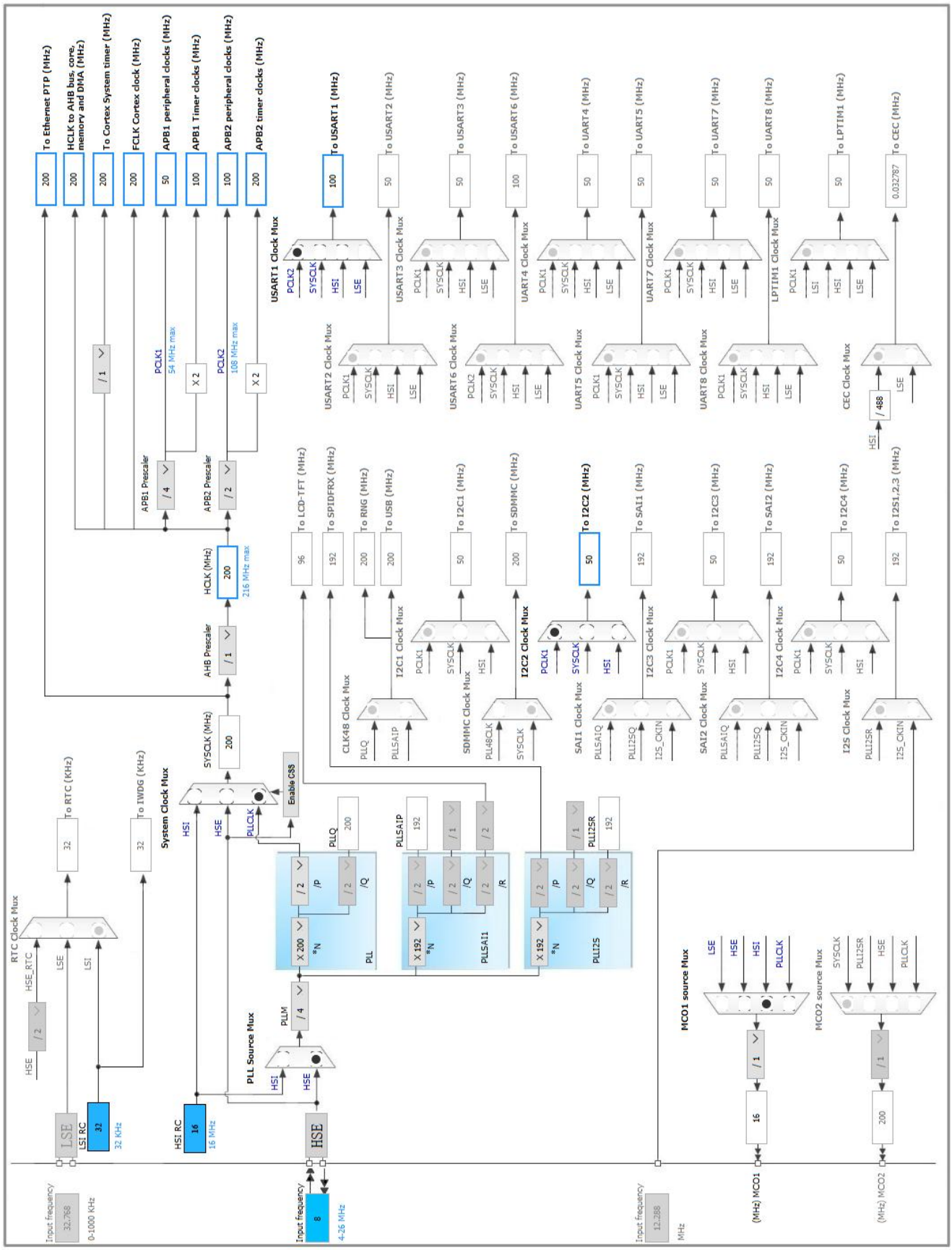
| Pin Number LQFP176 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 6 | VBAT | Power | | |
| 14 | VSS | Power | | |
| 15 | VDD | Power | | |
| 16 | PF0 | I/O | FMC_A0 | |
| 17 | PF1 | I/O | FMC_A1 | |
| 18 | PF2 | I/O | FMC_A2 | |
| 19 | PF3 | I/O | FMC_A3 | |
| 20 | PF4 | I/O | FMC_A4 | |
| 21 | PF5 | I/O | FMC_A5 | |
| 22 | VSS | Power | | |
| 23 | VDD | Power | | |
| 29 | PH0/OSC_IN | I/O | RCC_OSC_IN | |
| 30 | PH1/OSC_OUT | I/O | RCC_OSC_OUT | |
| 31 | NRST | Reset | | |
| 32 | PC0 * | I/O | GPIO_Output | Drone Reserved 0 |
| 33 | PC1 * | I/O | GPIO_Output | Drone Reserved 1 |
| 34 | PC2 * | I/O | GPIO_Output | Drone Reserved 2 |
| 35 | PC3 * | I/O | GPIO_Output | Drone Reserved 3 |
| 36 | VDD | Power | | |
| 37 | VSSA | Power | | |
| 38 | VREF+ | Power | | |
| 39 | VDDA | Power | | |
| 46 | PH5 | I/O | FMC_SDNWE | |
| 48 | BYPASS_REG | Reset | | |
| 49 | VDD | Power | | |
| 50 | PA4 | I/O | DCMI_HSYNC | |
| 52 | PA6 | I/O | DCMI_PIXCLK | |
| 56 | PB0 * | I/O | GPIO_Output | Board Reserved |
| 57 | PB1 * | I/O | GPIO_Output | Board Reserved |
| 58 | PB2 * | I/O | GPIO_Output | Board Reserved |
| 59 | PF11 | I/O | FMC_SDNRAS | |
| 60 | PF12 | I/O | FMC_A6 | |
| 61 | VSS | Power | | |
| 62 | VDD | Power | | |
| 63 | PF13 | I/O | FMC_A7 | |
| 64 | PF14 | I/O | FMC_A8 | |

| Pin Number LQFP176 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 65 | PF15 | I/O | FMC_A9 | |
| 66 | PG0 | I/O | FMC_A10 | |
| 67 | PG1 | I/O | FMC_A11 | |
| 68 | PE7 | I/O | FMC_D4 | |
| 69 | PE8 | I/O | FMC_D5 | |
| 70 | PE9 | I/O | FMC_D6 | |
| 71 | VSS | Power | | |
| 72 | VDD | Power | | |
| 73 | PE10 | I/O | FMC_D7 | |
| 74 | PE11 | I/O | FMC_D8 | |
| 75 | PE12 | I/O | FMC_D9 | |
| 76 | PE13 | I/O | FMC_D10 | |
| 77 | PE14 | I/O | FMC_D11 | |
| 78 | PE15 | I/O | FMC_D12 | |
| 79 | PB10 | I/O | I2C2_SCL | |
| 80 | PB11 | I/O | I2C2_SDA | |
| 81 | VCAP_1 | Power | | |
| 82 | VDD | Power | | |
| 83 | PH6 | I/O | FMC_SDNE1 | |
| 84 | PH7 | I/O | FMC_SDCKE1 | |
| 88 | PH11 | I/O | DCMI_D2 | |
| 89 | PH12 | I/O | DCMI_D3 | |
| 90 | VSS | Power | | |
| 91 | VDD | Power | | |
| 92 | PB12 * | I/O | GPIO_Output | Drone Forward |
| 93 | PB13 * | I/O | GPIO_Output | Drone Backward |
| 94 | PB14 * | I/O | GPIO_Output | Drone Left |
| 95 | PB15 * | I/O | GPIO_Output | Drone Right |
| 96 | PD8 | I/O | FMC_D13 | |
| 97 | PD9 | I/O | FMC_D14 | |
| 98 | PD10 | I/O | FMC_D15 | |
| 102 | VSS | Power | | |
| 103 | VDD | Power | | |
| 104 | PD14 | I/O | FMC_D0 | |
| 105 | PD15 | I/O | FMC_D1 | |
| 108 | PG4 | I/O | FMC_BA0 | |
| 109 | PG5 | I/O | FMC_BA1 | |
| 112 | PG8 | I/O | FMC_SDCLK | |
| 113 | VSS | Power | | |

| Pin Number LQFP176 | Pin Name (function after reset) | Pin Type | Alternate Function(s) | Label |
|---|---|---|---|---|
| 114 | VDDUSB | Power | | |
| 115 | PC6 | I/O | DCMI_D0 | |
| 116 | PC7 | I/O | DCMI_D1 | |
| 117 | PC8 * | I/O | GPIO_Output | Board Reserved |
| 118 | PC9 * | I/O | GPIO_Output | Board Reserved |
| 119 | PA8 | I/O | RCC_MCO_1 | |
| 120 | PA9 | I/O | USART1_TX | |
| 121 | PA10 | I/O | USART1_RX | |
| 125 | VCAP_2 | Power | | |
| 126 | VSS | Power | | |
| 127 | VDD | Power | | |
| 129 | PH14 | I/O | DCMI_D4 | |
| 135 | VSS | Power | | |
| 136 | VDD | Power | | |
| 142 | PD0 | I/O | FMC_D2 | |
| 143 | PD1 | I/O | FMC_D3 | |
| 145 | PD3 | I/O | DCMI_D5 | |
| 146 | PD4 * | I/O | GPIO_Output | Drone Flag 0 |
| 147 | PD5 * | I/O | GPIO_Output | Drone Flag 1 |
| 148 | VSS | Power | | |
| 149 | VDD | Power | | |
| 150 | PD6 * | I/O | GPIO_Output | Drone Spin 0 |
| 151 | PD7 * | I/O | GPIO_Output | Drone Spin 1 |
| 152 | PG9 | I/O | DCMI_VSYNC | |
| 158 | VSS | Power | | |
| 159 | VDD | Power | | |
| 160 | PG15 | I/O | FMC_SDNCAS | |
| 161 | PB3 * | I/O | GPIO_Output | Board Reserved |
| 162 | PB4 * | I/O | GPIO_Output | Board Reserved |
| 163 | PB5 * | I/O | GPIO_Output | Board Reserved |
| 164 | PB6 * | I/O | GPIO_Output | Board Reserved |
| 165 | PB7 * | I/O | GPIO_Output | Board Reserved |
| 166 | BOOT0 | Boot | | |
| 167 | PB8 | I/O | DCMI_D6 | |
| 168 | PB9 | I/O | DCMI_D7 | |
| 169 | PE0 | I/O | FMC_NBL0 | |
| 170 | PE1 | I/O | FMC_NBL1 | |
| 171 | PDR_ON | Reset | | |
| 172 | VDD | Power | | |

* The pin is affected with an I/O function

# 4. Clock Tree Configuration



# 5. IPs and Middleware Configuration

## 5.1. DCMI

**DCMI: Slave 8 bits External Synchro**

### 5.1.1. Parameter Settings:

**Mode Config:**

| | |
|---|---|
| Pixel clock polarity | **Active on Rising edge *** |
| Vertical synchronization polarity | Active Low |
| Horizontal synchronization polarity | Active Low |
| Frequency of frame capture | All frames are captured |
| JPEG mode | Disabled |

**Interface Capture Config:**

| | |
|---|---|
| Byte Select Mode | Interface captures all received bytes |
| Line Select Mode | Interface captures all received lines |

## 5.2. FMC

*SDRAM 1*

**Clock and chip enable: SDCKE1+SDNE1**

**Internal bank number: 4 banks**

**Address: 12 bits**

**Data: 16 bits**

**Byte enable: 16-bit byte enable**

### 5.2.1. SDRAM 1:

**SDRAM control:**

| | |
|---|---|
| Bank | SDRAM bank 2 |
| Number of column address bits | 8 bits |
| Number of row address bits | 12 bits |
| CAS latency | **2 memory clock cycles *** |
| Write protection | Disabled |
| SDRAM common clock | **2 HCLK clock cycles *** |
| SDRAM common burst read | **Enabled *** |

| | |
|---|---|
| SDRAM common read pipe delay | **1 HCLK clock cycle *** |

**SDRAM timing in memory clock cycles:**

| | |
|---|---|
| Load mode register to active delay | **2 *** |
| Exit self-refresh delay | **6 *** |
| Self-refresh time | **4 *** |
| SDRAM common row cycle delay | **6 *** |
| Write recovery time | **2 *** |
| SDRAM common row precharge delay | **2 *** |
| Row to column delay | **2 *** |

## *5.3. I2C2*

**I2C: I2C**

### 5.3.1. Parameter Settings:

**Timing configuration:**

| | |
|---|---|
| I2C Speed Mode | Standard Mode |
| I2C Speed Frequency (KHz) | 100 |
| Rise Time (ns) | 0 |
| Fall Time (ns) | 0 |
| Coefficient of Digital Filter | 0 |
| Analog Filter | Enabled |
| Timing | **0x00C0EAFF *** |

**Slave Features:**

| | |
|---|---|
| Clock No Stretch Mode | Disabled |
| General Call Address Detection | Disabled |
| Primary Address Length selection | 7-bit |
| Dual Address Acknowledged | Disabled |
| Primary slave address | 0 |

## *5.4. RCC*

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

**mode: Master Clock Output 1**

### 5.4.1. Parameter Settings:

**System Parameters:**

| | |
|---|---|
| VDD voltage (V) | 3.3 |
| Flash Latency(WS) | 6 WS (7 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 Over Drive | Enabled |
| Power Regulatror Voltage Scale | Power Regulator Voltage Scale 1 |

## *5.5. SYS*

**Timebase Source: SysTick**

## *5.6. USART1*

**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 |
| Single Sample | Disable |

**Advanced Features:**

| | |
|---|---|
| Auto Baudrate | Disable |
| TX Pin Active Level Inversion | Disable |
| RX Pin Active Level Inversion | Disable |
| Data Inversion | Disable |
| TX and RX Pins Swapping | Disable |
| Overrun | **Disable *** |

| | |
|---|---|
| DMA on RX Error | **Disable *** |
| MSB First | Disable |

*** User modified value**

# 6. System Configuration

## 6.1. GPIO configuration

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| DCMI | PA4 | DCMI_HSYNC | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PA6 | DCMI_PIXCLK | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PH11 | DCMI_D2 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PH12 | DCMI_D3 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PC6 | DCMI_D0 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PC7 | DCMI_D1 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PH14 | DCMI_D4 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PD3 | DCMI_D5 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PG9 | DCMI_VSYNC | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PB8 | DCMI_D6 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| | PB9 | DCMI_D7 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| FMC | PF0 | FMC_A0 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF1 | FMC_A1 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF2 | FMC_A2 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF3 | FMC_A3 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF4 | FMC_A4 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF5 | FMC_A5 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PH5 | FMC_SDNWE | Alternate Function Push Pull | **Pull-down *** | Very High | |
| | PF11 | FMC_SDNRAS | Alternate Function Push Pull | **Pull-down *** | Very High | |
| | PF12 | FMC_A6 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF13 | FMC_A7 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF14 | FMC_A8 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PF15 | FMC_A9 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PG0 | FMC_A10 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PG1 | FMC_A11 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE7 | FMC_D4 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE8 | FMC_D5 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE9 | FMC_D6 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE10 | FMC_D7 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE11 | FMC_D8 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | | | | | | |

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| | PE12 | FMC_D9 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE13 | FMC_D10 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE14 | FMC_D11 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE15 | FMC_D12 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PH6 | FMC_SDNE1 | Alternate Function Push Pull | **Pull-down *** | Very High | |
| | PH7 | FMC_SDCKE1 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD8 | FMC_D13 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD9 | FMC_D14 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD10 | FMC_D15 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD14 | FMC_D0 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD15 | FMC_D1 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PG4 | FMC_BA0 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PG5 | FMC_BA1 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PG8 | FMC_SDCLK | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD0 | FMC_D2 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PD1 | FMC_D3 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PG15 | FMC_SDNCAS | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE0 | FMC_NBL0 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| | PE1 | FMC_NBL1 | Alternate Function Push Pull | **Pull-up *** | Very High | |
| I2C2 | PB10 | I2C2_SCL | Alternate Function Open Drain | Pull-up | **Very High *** | |
| | PB11 | I2C2_SDA | Alternate Function Open Drain | Pull-up | **Very High *** | |
| 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 | |
| | PA8 | RCC_MCO_1 | Alternate Function Push Pull | No pull-up and no pull-down | Low | |
| USART1 | PA9 | USART1_TX | Alternate Function Push Pull | Pull-up | **Very High *** | |
| | PA10 | USART1_RX | Alternate Function Push Pull | Pull-up | **Very High *** | |
| GPIO | PC0 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Reserved 0 |
| | PC1 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Reserved 1 |
| | PC2 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Reserved 2 |
| | PC3 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Reserved 3 |
| | | | | | | |

| IP | Pin | Signal | GPIO mode | GPIO pull/up pull down | Max Speed | User Label |
|---|---|---|---|---|---|---|
| | PB0 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB1 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB2 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB12 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Forward |
| | PB13 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Backward |
| | PB14 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Left |
| | PB15 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Right |
| | PC8 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PC9 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PD4 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Flag 0 |
| | PD5 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Flag 1 |
| | PD6 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Spin 0 |
| | PD7 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Drone Spin 1 |
| | PB3 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB4 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB5 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB6 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |
| | PB7 | GPIO_Output | Output Push Pull | No pull-up and no pull-down | Low | Board Reserved |

## 6.2. DMA configuration

| DMA request | Stream | Direction | Priority |
|---|---|---|---|
| DCMI | DMA2_Stream1 | Peripheral To Memory | Low |

*DCMI: DMA2_Stream1 DMA request Settings:*

| | |
|---|---|
| Mode: | **Circular *** |
| Use fifo: | **Enable *** |
| FIFO Threshold: | Full |
| Peripheral Increment: | Disable |
| Memory Increment: | **Enable *** |
| Peripheral Data Width: | **Word *** |
| Memory Data Width: | 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 |
| USART1 global interrupt | true | 0 | 0 |
| DMA2 stream1 global interrupt | true | 0 | 0 |
| DCMI global interrupt | true | 0 | 0 |
| PVD interrupt through EXTI line 16 | unused | | |
| Flash global interrupt | unused | | |
| RCC global interrupt | unused | | |
| I2C2 event interrupt | unused | | |
| I2C2 error interrupt | unused | | |
| FMC global interrupt | unused | | |
| FPU global interrupt | unused | | |

*** User modified value**

# 7. Power Consumption Calculator report

## 7.1. Microcontroller Selection

| | |
|---|---|
| Series | STM32F7 |
| Line | STM32F7x6 |
| MCU | STM32F746IGTx |
| Datasheet | 027590_Rev4 |

## 7.2. Parameter Selection

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

# 8. Software Project

## 8.1. Project Settings

| Name | Value |
|---|---|
| Project Name | CameraDriver |
| Project Folder | E:\\\\Camera\CameraDrone |
| Toolchain / IDE | MDK-ARM V5 |
| Firmware Package Name and Version | STM32Cube FW_F7 V1.7.0 |

## 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 | Yes |
| 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 |