1. Description

1.1. Project

Project Name	oscilloscope
Board Name	NUCLEO-L476RG
Generated with:	STM32CubeMX 6.0.0
Date	03/26/2024

1.2. MCU

MCU Series	STM32L4
MCU Line	STM32L4x6
MCU name	STM32L476RGTx
MCU Package	LQFP64
MCU Pin number	64

1.3. Core(s) information

Core(s)	Arm Cortex-M4

2. Pinout Configuration
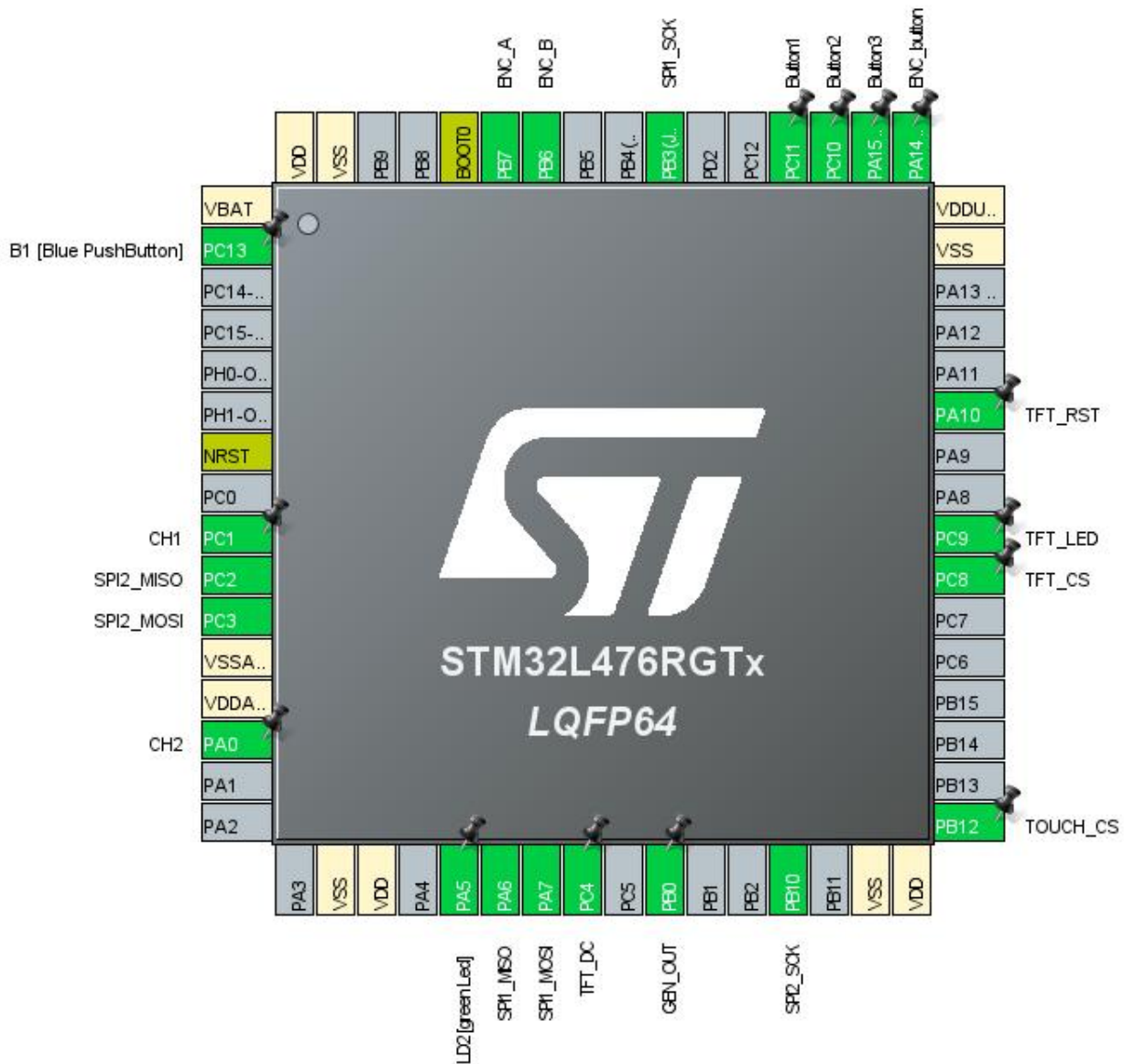
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
2	PC13	I/O	GPIO_EXTI13	B1 [Blue PushButton]
7	NRST	Reset		
9	PC1	I/O	ADC1_IN2	CH1
10	PC2	I/O	SPI2_MISO	
11	PC3	I/O	SPI2_MOSI	
12	VSSA/VREF-	Power		
13	VDDA/VREF+	Power		
14	PA0	I/O	ADC1_IN5	CH2
18	VSS	Power		
19	VDD	Power		
21	PA5 *	I/O	GPIO_Output	LD2 [green Led]
22	PA6	I/O	SPI1_MISO	
23	PA7	I/O	SPI1_MOSI	
24	PC4 *	I/O	GPIO_Output	TFT_DC
26	PB0	I/O	TIM3_CH3	GEN_OUT
29	PB10	I/O	SPI2_SCK	
31	VSS	Power		
32	VDD	Power		
33	PB12 *	I/O	GPIO_Output	TOUCH_CS
39	PC8 *	I/O	GPIO_Output	TFT_CS
40	PC9	I/O	TIM3_CH4	TFT_LED
43	PA10 *	I/O	GPIO_Output	TFT_RST
47	VSS	Power		
48	VDDUSB	Power		
49	PA14 (JTCK-SWCLK) *	I/O	GPIO_Input	ENC_button
50	PA15 (JTDI) *	I/O	GPIO_Input	Button3
51	PC10 *	I/O	GPIO_Input	Button2
52	PC11 *	I/O	GPIO_Input	Button1
55	PB3 (JTDO-TRACESWO)	I/O	SPI1_SCK	
58	PB6	I/O	TIM4_CH1	ENC_B
59	PB7	I/O	TIM4_CH2	ENC_A
60	BOOT0	Boot		
63	VSS	Power		
64	VDD	Power		

 * The pin is affected with an I/O function

4. Clock Tree Configuration
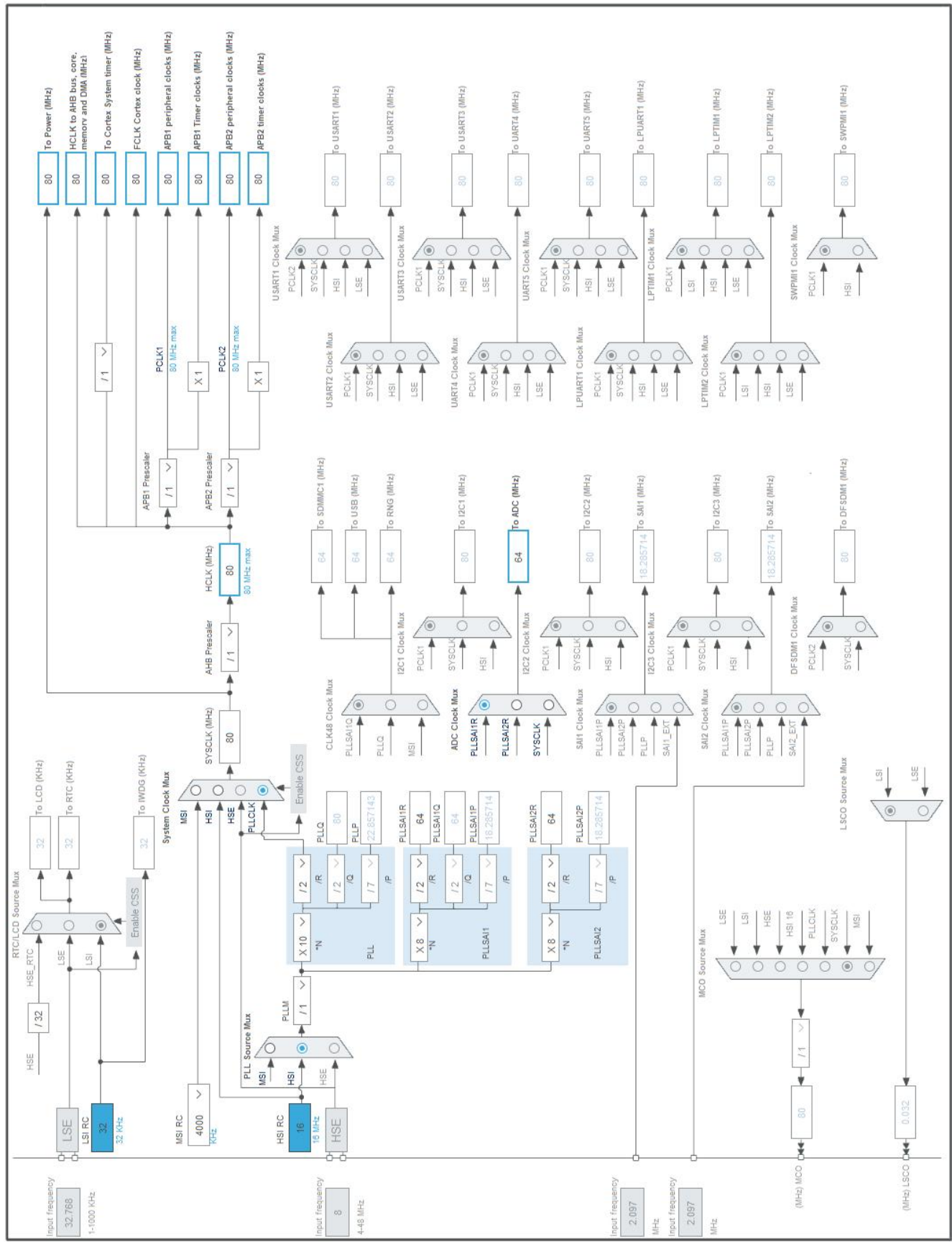
5. Software Project

5.1. Project Settings

Name	Value
Project Name	oscilloscope
Project Folder	E:\PWR\Semestr6\Sterowniki_robotow\STM32_oscilloscope\oscilloscope
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_L4 V1.16.0
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	No
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_SPI1_Init	SPI1
5	MX_SPI2_Init	SPI2
6	MX_TIM3_Init	TIM3
7	MX_ADC1_Init	ADC1
8	MX_TIM4_Init	TIM4

6. Power Consumption Calculator report

6.1. Microcontroller Selection

Series	STM32L4
Line	STM32L4x6
MCU	STM32L476RGTx
Datasheet	DS10198_Rev4

6.2. Parameter Selection

Temperature	25
Vdd	3.0

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	STOP2
Vdd	3.0	3.0
Voltage Source	Battery	Battery
Range	Range1-High	NoRange
Fetch Type	SRAM2	n/a
CPU Frequency	80 MHz	0 Hz
Clock Configuration	HSE PLL	ALL CLOCKS OFF
Clock Source Frequency	4 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	10.7 mA	1.18 µA
Duration	0.1 ms	0.9 ms
DMIPS	100.0	0.0
Ta Max	103.56	105
Category	In DS Table	In DS Table

6.5. Results

Sequence Time	1 ms	Average Current	1.07 mA
Battery Life	4 months, 10 days, 3 hours	Average DMIPS	100.0 DMIPS

6.6. Chart

Consumption Profile by Step

1:RUN

2:STOP2

Consumption (mA)

Time (ms)

Idd by Step — Average Current
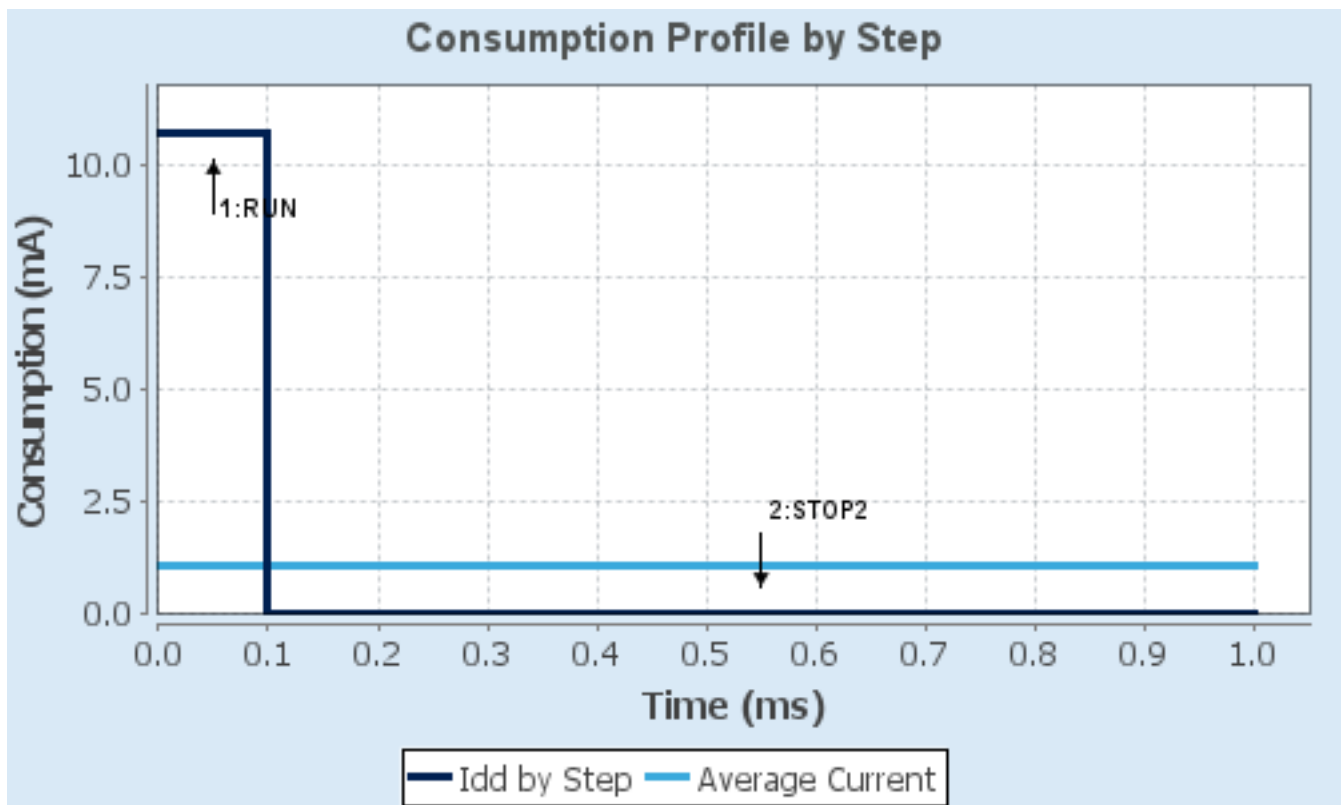
7. IPs and Middleware Configuration

7.1. ADC1

IN2: IN2 Single-ended

IN5: IN5 Single-ended

7.1.1. Parameter Settings:

ADCs_Common_Settings:

Mode	Independent mode

ADC_Settings:

Clock Prescaler	Asynchronous clock mode divided by 1
Resolution	ADC 12-bit resolution
Data Alignment	Right alignment
Scan Conversion Mode	Disabled
Continuous Conversion Mode	**Enabled ***
Discontinuous Conversion Mode	Disabled
DMA Continuous Requests	**Enabled ***
End Of Conversion Selection	End of single conversion
Overrun behaviour	Overrun data preserved
Low Power Auto Wait	Disabled

ADC_Regular_ConversionMode:

Enable Regular Conversions	Enable
Enable Regular Oversampling	Disable
Number Of Conversion	1
External Trigger Conversion Source	Regular Conversion launched by software
External Trigger Conversion Edge	None
Rank	1
Channel	Channel 2
Sampling Time	2.5 Cycles
Offset Number	No offset

ADC_Injected_ConversionMode:

Enable Injected Conversions	Disable

Analog Watchdog 1:

Enable Analog WatchDog1 Mode	false

Analog Watchdog 2:

Enable Analog WatchDog2 Mode	false

Analog Watchdog 3:

Enable Analog WatchDog3 Mode	false

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)	4 WS (5 CPU cycle)

RCC Parameters:

HSI Calibration Value	16
MSI Calibration Value	0
MSI Auto Calibration	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. 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)	2
Baud Rate	**40.0 MBits/s ***
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSSP Mode	Enabled
NSS Signal Type	Software

7.5. SPI2

Mode: Full-Duplex Master

7.5.1. Parameter Settings:

Basic Parameters:

Frame Format	Motorola
Data Size	**8 Bits ***
First Bit	MSB First

Clock Parameters:

Prescaler (for Baud Rate)	**16 ***
Baud Rate	**5.0 MBits/s ***
Clock Polarity (CPOL)	Low
Clock Phase (CPHA)	1 Edge

Advanced Parameters:

CRC Calculation	Disabled
NSSP Mode	Enabled
NSS Signal Type	Software

7.6. SYS

Timebase Source: SysTick

7.7. TIM3

Channel3: PWM Generation CH3

Channel4: PWM Generation CH4

7.7.1. Parameter Settings:

Counter Settings:

Prescaler (PSC - 16 bits value)	**79 ***
Counter Mode	Up
Counter Period (AutoReload Register - 16 bits value)	**999 ***
Internal Clock Division (CKD)	No Division
auto-reload preload	**Enable ***

Trigger Output (TRGO) Parameters:

Master/Slave Mode (MSM bit)	Disable (Trigger input effect not delayed)
Trigger Event Selection TRGO	Reset (UG bit from TIMx_EGR)

Clear Input:

Clear Input Source   Disable

PWM Generation Channel 3:

Mode   PWM mode 1

Pulse (16 bits value)   0

Output compare preload   Enable

Fast Mode   Disable

CH Polarity   High

PWM Generation Channel 4:

Mode   PWM mode 1

Pulse (16 bits value)   0

Output compare preload   Enable

Fast Mode   Disable

CH Polarity   High

7.8. TIM4
Combined Channels: Encoder Mode
7.8.1. 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 TRGO   Reset (UG bit from TIMx_EGR)

Encoder:

Encoder Mode   Encoder Mode TI1

_____ Parameters for Channel 1 _____

Polarity   Rising Edge

IC Selection   Direct

Prescaler Division Ratio   No division

Input Filter   0

_____ Parameters for Channel 2 _____

Polarity   Rising Edge

IC Selection   Direct

Prescaler Division Ratio   No division

Input Filter   0

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* 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	PC1	ADC1_IN2	Analog mode for ADC conversion	No pull-up and no pull-down	n/a	CH1
	PA0	ADC1_IN5	Analog mode for ADC conversion	No pull-up and no pull-down	n/a	CH2
SPI1	PA6	SPI1_MISO	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PA7	SPI1_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PB3 (JTDO-TRACESWO)	SPI1_SCK	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
SPI2	PC2	SPI2_MISO	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PC3	SPI2_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
	PB10	SPI2_SCK	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	
TIM3	PB0	TIM3_CH3	Alternate Function Push Pull	No pull-up and no pull-down	Low	GEN_OUT
	PC9	TIM3_CH4	Alternate Function Push Pull	No pull-up and no pull-down	Low	TFT_LED
TIM4	PB6	TIM4_CH1	Alternate Function Push Pull	No pull-up and no pull-down	Low	ENC_B
	PB7	TIM4_CH2	Alternate Function Push Pull	No pull-up and no pull-down	Low	ENC_A
GPIO	PC13	GPIO_EXTI13	**External Interrupt Mode with Falling edge trigger detection**	No pull-up and no pull-down	n/a	B1 [Blue PushButton]
	PA5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	LD2 [green Led]
	PC4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	TFT_DC
	PB12	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	TOUCH_CS
	PC8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	TFT_CS
	PA10	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	TFT_RST
	PA14 (JTCK-SWCLK)	GPIO_Input	Input mode	No pull-up and no pull-down	**n/a**	ENC_button
	PA15 (JTDI)	GPIO_Input	Input mode	No pull-up and no pull-down	**n/a**	Button3

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
	PC10	GPIO_Input	Input mode	No pull-up and no pull-down	**n/a**	Button2
	PC11	GPIO_Input	Input mode	No pull-up and no pull-down	**n/a**	Button1

8.2. DMA configuration

DMA request	Stream	Direction	Priority
SPI1_TX	DMA1_Channel3	Memory To Peripheral	Low
ADC1	DMA2_Channel3	Peripheral To Memory	Low

SPI1_TX: DMA1_Channel3 DMA request Settings:

Mode:	Normal
Peripheral Increment:	Disable
Memory Increment:	**Enable ***
Peripheral Data Width:	Byte
Memory Data Width:	Byte

ADC1: DMA2_Channel3 DMA request Settings:

Mode:	**Circular ***
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	0	0
System tick timer	true	0	0
DMA1 channel3 global interrupt	true	0	0
SPI1 global interrupt	true	0	0
DMA2 channel3 global interrupt	true	0	0
PVD/PVM1/PVM2/PVM3/PVM4 interrupts through EXTI lines 16/35/36/37/38	unused		
Flash global interrupt	unused		
RCC global interrupt	unused		
ADC1 and ADC2 interrupts	unused		
TIM3 global interrupt	unused		
TIM4 global interrupt	unused		
SPI2 global interrupt	unused		
EXTI line[15:10] 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
Prefetch fault, memory access fault	true	true	false
Undefined instruction or illegal state	true	true	false
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
DMA1 channel3 global interrupt	true	true	true
SPI1 global interrupt	true	true	true

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
DMA2 channel3 global interrupt	true	true	true

* User modified value

9. System Views

9.1. Category view

9.1.1. Current

Middleware

System Core	Analog	Timers	Connectivity	Multimedia	Security	Computing
DMA ✓	ADC1 ✓	TIM3 ✓	SPI1 ✓			
GPIO ✓		TIM4 ✓	SPI2 ✓			
NVIC ✓						
RCC ✓						
SYS ✓						

10. Docs & Resources

Type	Link
Datasheet	http://www.st.com/resource/en/datasheet/DM00108832.pdf
Reference manual	http://www.st.com/resource/en/reference_manual/DM00083560.pdf
Programming manual	http://www.st.com/resource/en/programming_manual/DM00046982.pdf
Errata sheet	http://www.st.com/resource/en/errata_sheet/DM00111498.pdf
Application note	http://www.st.com/resource/en/application_note/CD00160362.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/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/DM00042534.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/DM00085385.pdf
Application note	http://www.st.com/resource/en/application_note/DM00087593.pdf
Application note	http://www.st.com/resource/en/application_note/DM00129215.pdf
Application note	http://www.st.com/resource/en/application_note/DM00151811.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/DM00150423.pdf
Application note	http://www.st.com/resource/en/application_note/DM00209748.pdf

Application note	http://www.st.com/resource/en/application_note/DM00125306.pdf
Application note	http://www.st.com/resource/en/application_note/DM00141025.pdf
Application note	http://www.st.com/resource/en/application_note/DM00144612.pdf
Application note	http://www.st.com/resource/en/application_note/DM00148033.pdf
Application note	http://www.st.com/resource/en/application_note/DM00209768.pdf
Application note	http://www.st.com/resource/en/application_note/DM00216518.pdf
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/DM00269143.pdf
Application note	http://www.st.com/resource/en/application_note/DM00272912.pdf
Application note	http://www.st.com/resource/en/application_note/DM00223574.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/DM00260952.pdf
Application note	http://www.st.com/resource/en/application_note/DM00263732.pdf
Application note	http://www.st.com/resource/en/application_note/DM00269146.pdf
Application note	http://www.st.com/resource/en/application_note/DM00296349.pdf
Application note	http://www.st.com/resource/en/application_note/DM00327191.pdf
Application note	http://www.st.com/resource/en/application_note/DM00264868.pdf
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Application note	http://www.st.com/resource/en/application_note/DM00395696.pdf
Application note	http://www.st.com/resource/en/application_note/DM00445657.pdf

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Application note   http://www.st.com/resource/en/application_note/DM00536349.pdf

Application note   http://www.st.com/resource/en/application_note/DM00209772.pdf

Application note   http://www.st.com/resource/en/application_note/DM00476869.pdf

Application note   http://www.st.com/resource/en/application_note/DM00660597.pdf

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