
STM32
CubeMX

1. Description

1.1. Project

Project Name	Ch2i_RAK3172_Phy_PingPong
Board Name	custom
Generated with:	STM32CubeMX 6.9.0
Date	09/05/2023

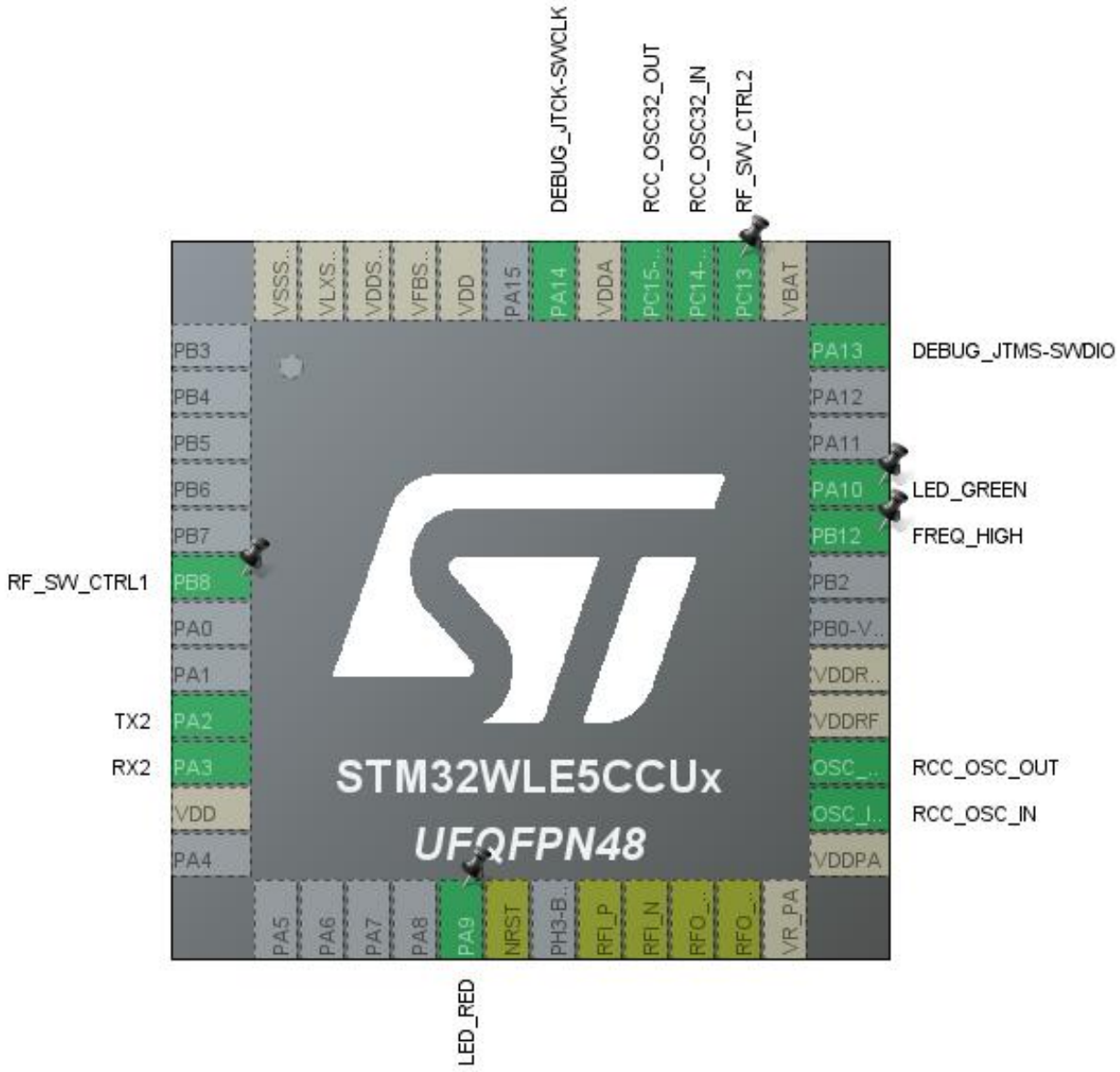
1.2. MCU

MCU Series	STM32WL
MCU Line	STM32WLEx
MCU name	STM32WLE5CCUx
MCU Package	UFQFPN48
MCU Pin number	48

1.3. Core(s) information

Core(s)	ARM Cortex-M4

2. Pinout Configuration

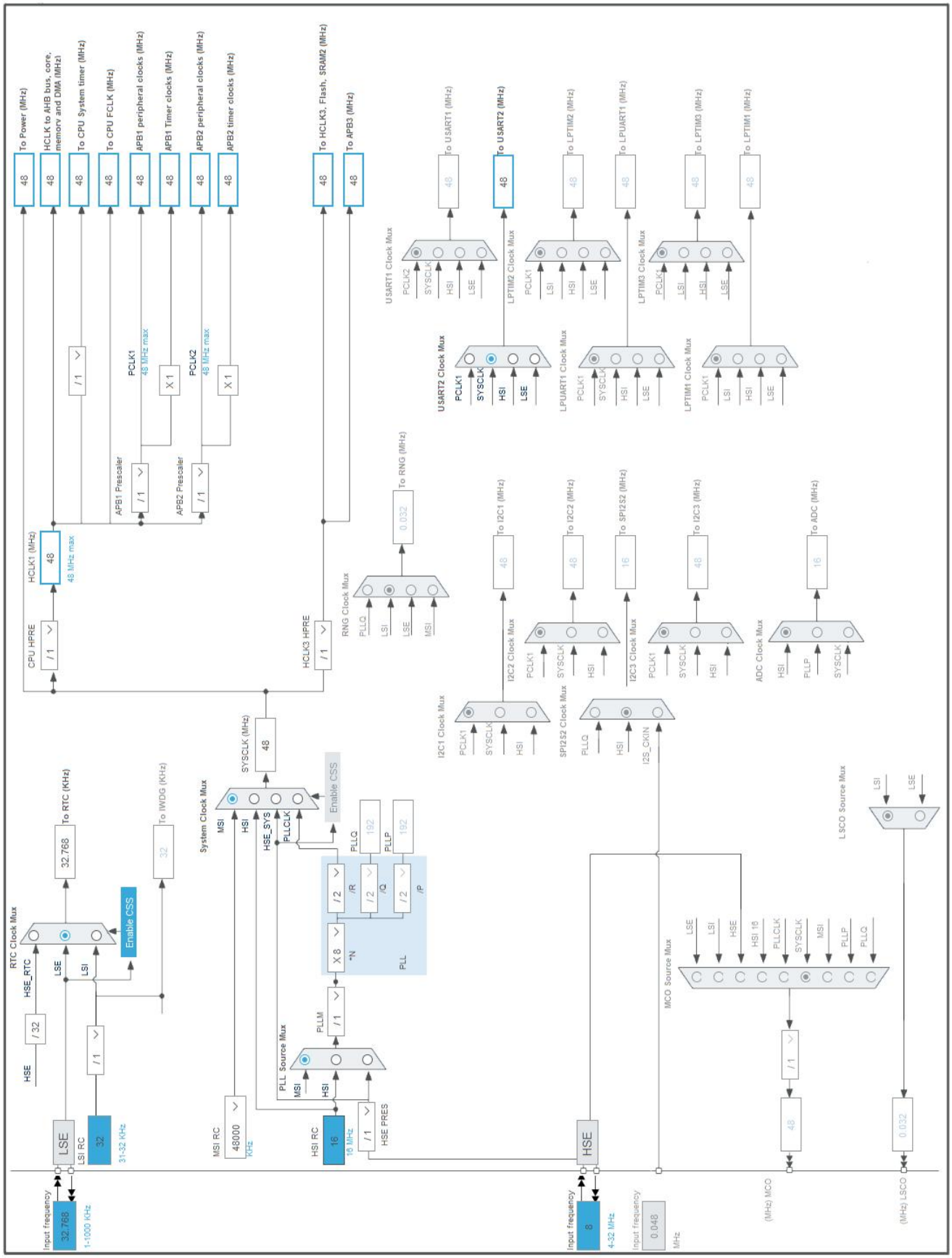


3. Pins Configuration

Pin Number UFQFPN48	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
6	PB8 *	I/O	GPIO_Output	RF_SW_CTRL1
9	PA2	I/O	USART2_TX	TX2
10	PA3	I/O	USART2_RX	RX2
11	VDD	Power		
17	PA9 *	I/O	GPIO_Output	LED_RED
18	NRST	Reset		
20	RFI_P	MonoIO		
21	RFI_N	MonoIO		
22	RFO_LP	MonoIO		
23	RFO_HP	MonoIO		
24	VR_PA	Power		
25	VDDPA	Power		
26	OSC_IN	MonoIO	RCC_OSC_IN	
27	OSC_OUT	MonoIO	RCC_OSC_OUT	
28	VDDRF	Power		
29	VDDRF1V55	Power		
32	PB12 *	I/O	GPIO_Input	FREQ_HIGH
33	PA10 *	I/O	GPIO_Output	LED_GREEN
36	PA13	I/O	DEBUG_JTMS-SWDIO	
37	VBAT	Power		
38	PC13 *	I/O	GPIO_Output	RF_SW_CTRL2
39	PC14-OSC32_IN	I/O	RCC_OSC32_IN	
40	PC15-OSC32_OUT	I/O	RCC_OSC32_OUT	
41	VDDA	Power		
42	PA14	I/O	DEBUG_JTCK-SWCLK	
44	VDD	Power		
45	VFBSMPS	Power		
46	VDDSMPS	Power		
47	VLXSMPS	Power		
48	VSSSMPS	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	Ch2i_RAK3172_Phy_PingPong
Project Folder	D:\Projects\Ch2i_RAK3172_Phy_PingPong\Ch2i_RAK3172_Phy_PingPong_Wor
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_WL V1.3.0
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	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	SystemClock_Config	RCC
2	MX_DMA_Init	DMA
3	MX_GPIO_Init	GPIO
4	MX_SUBGHZ_Init	SUBGHZ
5	MX_USART2_UART_Init	USART2
6	MX_SubGHz_Phy_Init	SUBGHZ_PHY
7	MX_RTC_Init	RTC

1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32WL
Line	STM32WLEx
MCU	STM32WLE5CCUx
Datasheet	DS13105_Rev7

1.2. Parameter Selection

Temperature	25
Vdd	3.0

1.3. Battery Selection

Battery	Li-SOCL2(AAA700)
Capacity	700.0 mAh
Self Discharge	0.08 %/month
Nominal Voltage	3.6 V
Max Cont Current	10.0 mA
Max Pulse Current	30.0 mA
Cells in series	1
Cells in parallel	1

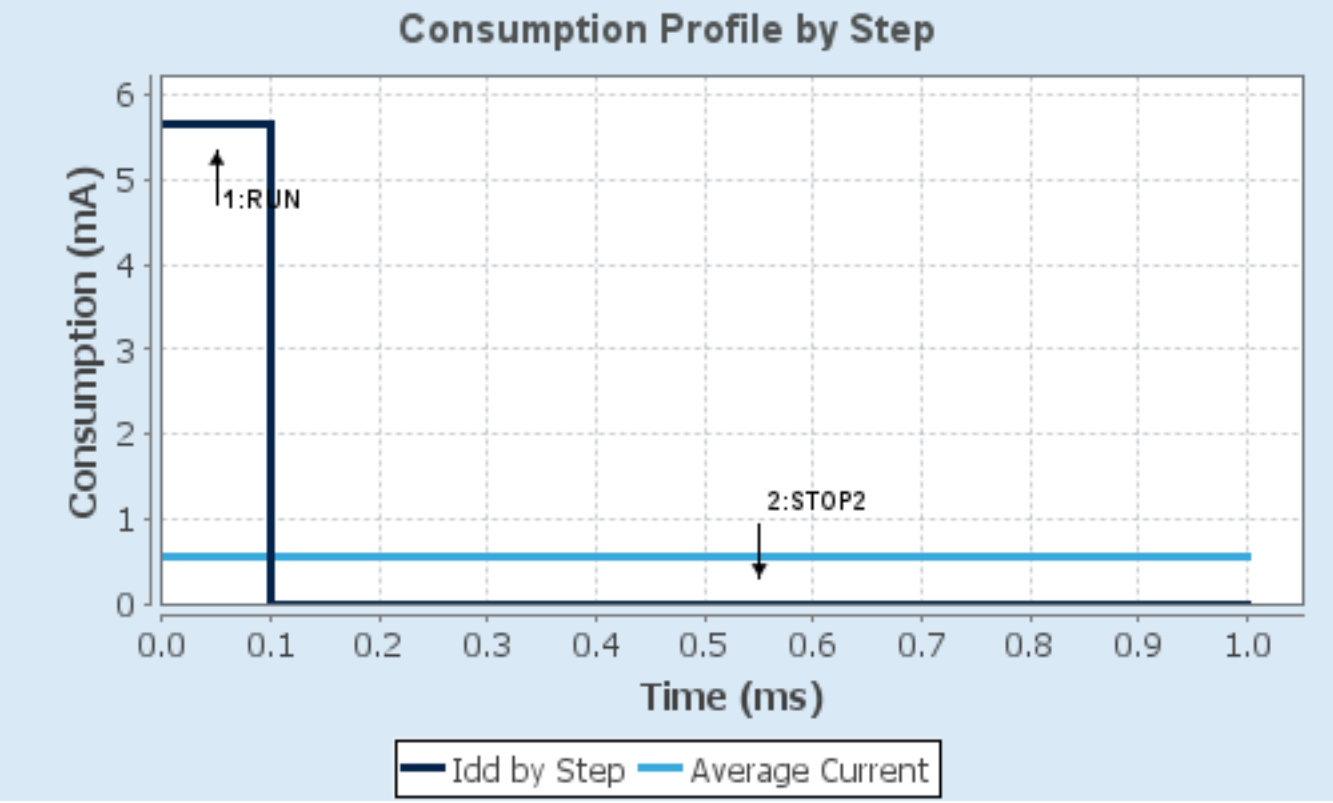
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP2
Vdd	3.0	3.0
Voltage Source	Battery	Battery
Range	Range1-Medium/SMPS-OFF	NoRange
Fetch Type	SRAM1	NA
CPU Frequency	48 MHz	0 Hz
Clock Configuration	MSI	ALL_CLOCKS_OFF
Clock Source Frequency	48 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	5.65 mA	885 nA
Duration	0.1 ms	0.9 ms
DMIPS	60.0	0.0
Ta Max	124.53	125
Category	In DS Table	In DS Table

1.5. Results

Sequence Time	1 ms	Average Current	565.8 µA
Battery Life	1 month, 21 days, 1 hour	Average DMIPS	60.0 DMIPS

1.6. Chart


Consumption Profile by Step
Consumption (mA)
6
5
4
3
2
1
0
1:RUN
2:STOP2
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Time (ms)
Idd by Step
Average Current

2. Peripherals and Middlewares Configuration

2.1. ADV_TRACE

mode: Enabled

2.2. DEBUG

JTAG and Trace: Serial Wire

2.3. MISC

mode: Enabled

2.4. RCC

High Speed Clock (HSE): Crystal/Ceramic Resonator

Low Speed Clock (LSE) : Crystal/Ceramic Resonator

2.4.1. Parameter Settings:

System Parameters:	
VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Disabled
Data Cache	Enabled
Flash Latency(WS)	2 WS (3 CPU cycle)
RCC Parameters:	
HSI Calibration Value	64
MSI Calibration Value	0
MSI Auto Calibration	Enabled
HSE Startup Timout Value (ms)	100
LSE Startup Timout Value (ms)	5000
LSE Drive Capability	LSE oscillator low drive capability
Power Parameters:	
Power Regulator Voltage Scale	Power Regulator Voltage Scale 1

2.5. RTC

mode: Activate Clock Source

mode: Activate Calendar

Alarm A: Internal Alarm A

2.5.1. Parameter Settings:

General:

Asynchronous Predivider value	**RTC_PREDIV_A ***
Bin Mode	**Free running Binary mode ***
SSRU Underflow Interrupt	Enabled

Alarm A:

Free running 32 bit value	0
Binary AutoControl	RTC_ALARMSUBSECONDBIN_AUTOCLR_YES
Free running 32 bit mask	SS[31:0] are compared and must match to activate alarm.

2.6. SEQUENCER
mode: Enabled

2.7. SUBGHZ
mode: Activated

2.7.1. Parameter Settings:

Baudrate Prescaler Value	**4 ***

2.8. SYS
Timebase Source: None

2.9. TIMER
mode: Enabled

2.10. TINY_LPM
mode: Enabled

2.11. USART2
Mode: Asynchronous

2.11.1. 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
ClockPrescaler	1
Fifo Mode	**Enable ***
Txfifo Threshold	1 eighth full configuration
Rxfifo Threshold	1 eighth full configuration

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	Enable
DMA on RX Error	Enable
MSB First	Disable

2.12. SUBGHZ_PHY

mode: Enabled

2.12.1. SubGHz_Phy application:

Application selection:

Application	**Advanced template ***
Application configuration recommendations	!! Please read carefully Information panel below!!

sys_conf:

Trace verbose level	VLEVEL_M
Enable Application Logging	true
Disable Low Power Mode	**true ***

app_subghz_phy:

RF Frequency	**917300000 ***
Modem used	LoRa
LoRa bandwidth	0: 125 kHz
LoRa spreading factor	SF7
LoRa coding rate	1: 4/5

LoRa preamble length	8
LoRa symbol timeout	5
LoRa fix length payload on	false
LoRa IQ inversion	false
Payload length	64

board settings:

Probes Lines in Platform Settings	false

2.12.2. SubGHz_Phy middleware:

radio_conf:

Radio maximum wakeup time (in ms)	1

radio_board_if:

Select radio Driver	**Bsp via extSettings ***

mw_log_conf:

Enable Middleware log	true

2.12.3. Platform Settings:

RTC	RTC
USART	USART2

*** User modified value**

3. System Configuration

3.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
DEBUG	PA13	DEBUG_JTMS-SWDIO	n/a	n/a	n/a	
	PA14	DEBUG_JTCK-SWCLK	n/a	n/a	n/a	
RCC	OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	
	OSC_OUT	RCC_OSC_OUT	n/a	n/a	n/a	
	PC14-OSC32_IN	RCC_OSC32_IN	n/a	n/a	n/a	
	PC15-OSC32_OUT	RCC_OSC32_OUT	n/a	n/a	n/a	
USART2	PA2	USART2_TX	Alternate Function Push Pull	No pull-up and no pull-down	Low	TX2
	PA3	USART2_RX	Alternate Function Push Pull	No pull-up and no pull-down	Low	RX2
GPIO	PB8	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	RF_SW_CTRL1
	PA9	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LED_RED
	PB12	GPIO_Input	Input mode	No pull-up and no pull-down	**n/a**	FREQ_HIGH
	PA10	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LED_GREEN
	PC13	GPIO_Output	Output Push Pull	No pull-up and no pull-down	Low	RF_SW_CTRL2

3.2. DMA configuration

DMA request	Stream	Direction	Priority
USART2_TX	DMA1_Channel1	Memory To Peripheral	Low

USART2_TX: DMA1_Channel1 DMA request Settings:

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

3.3. NVIC configuration

3.3.1. 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	15	0
RTC Tamper, RTC TimeStamp, LSECSS and RTC SSRU Interrupts	true	0	0
DMA1 Channel 1 Interrupt	true	2	0
USART2 Interrupt	true	2	0
RTC Alarms (A and B) Interrupt	true	0	0
SUBGHZ Radio Interrupt	true	0	0
PVD and PVM detector	unused		
FLASH (CFI) global Interrupt	unused		
RCC Interrupt	unused		

3.3.2. NVIC Code generation

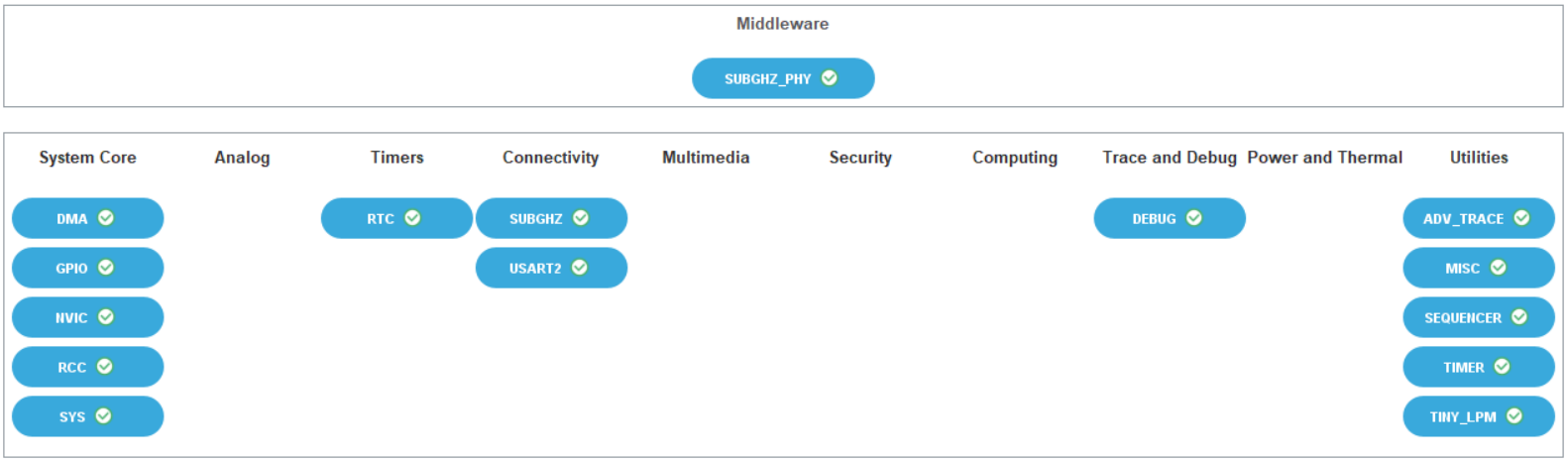
Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
Non maskable interrupt	false	true	false
Hard fault interrupt	false	true	false
Memory management fault	false	true	false
Prefetch fault, memory access fault	false	true	false
Undefined instruction or illegal state	false	true	false
System service call via SWI instruction	false	true	false
Debug monitor	false	true	false
Pendable request for system service	false	true	false
System tick timer	false	true	false
RTC Tamper, RTC TimeStamp, LSECSS and RTC SSRU Interrupts	false	true	true
DMA1 Channel 1 Interrupt	false	true	true
USART2 Interrupt	false	true	true
RTC Alarms (A and B) Interrupt	false	true	true
SUBGHZ Radio Interrupt	false	true	true

*** User modified value**

4. System Views

4.1. Category view

4.1.1. Current



5. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32wl_bsdl.zip
HW Models	https://www.st.com/resource/en/hw_model/stm32wl_reference_board_mb1720-xo_ios_shield.7z
IBIS models	https://www.st.com/resource/en/ibis_model/stm32wl_ibis.zip
System View Description	https://www.st.com/resource/en/svd/stm32wl_svd.zip
Bill of Materials	https://www.st.com/resource/en/bill_of_materials/mb1720_bom.zip
Bill of Materials	https://www.st.com/resource/en/bill_of_materials/mb1789_hp_bom.zip
Bill of Materials	https://www.st.com/resource/en/bill_of_materials/mb1789_lp_bom.zip
Bill of Materials	https://www.st.com/resource/en/bill_of_materials/mb1791_bom.zip
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Bill of Materials	https://www.st.com/resource/en/bill_of_materials/mb1842_bom.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1720_bdp.zip
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Specifications	
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1791_bdp.zip
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Presentations	https://www.st.com/resource/en/product_presentation/stm32-stm8_embedded_software_solutions.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32_eval-tools_portfolio.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32_stm8_functional-safety-packages.pdf

Presentations	https://www.st.com/resource/en/product_presentation/stm32-stm8_software_development_tools.pdf
Presentations	https://www.st.com/resource/en/product_presentation/microcontrollers_stm32wl_series_product_overview.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32cubemonitor-wireless-longrange_rftest.pdf
Presentations	https://www.st.com/resource/en/product_presentation/stm32wba-series-product-overview.pdf
Flyers	https://www.st.com/resource/en/flyer/flnucleolrwan.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32nucleo.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32wl.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32wba.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32wbxm.pdf
Application Notes	https://www.st.com/resource/en/application_note/an1181-electrostatic-discharge-sensitivity-measurement-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an1709-emc-design-guide-for-stm8-stm32-and-legacy-mcus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an2606-stm32-microcontroller-system-memory-boot-mode-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an2639-soldering-recommendations-and-package-information-for-leadfree-ecopack-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an2834-how-to-get-the-best-adc-accuracy-in-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an2867-oscillator-design-guide-for-stm8afals-stm32-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3126-audio-and-waveform-generation-using-the-dac-in-stm32-products-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3155-usart-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4013-stm32-crossseries-timer-overview-stmicroelectronics.pdf

Application Notes	https://www.st.com/resource/en/application_note/an4229-how-to-implement-a-vocoder-solution-using-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4277-using-stm32-device-pwm-shutdown-features-for-motor-control-and-digital-power-conversion-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4286-spi-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4655-virtually-increasing-the-number-of-serial-communication-peripherals-in-stm32-applications-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4750-handling-of-soft-errors-in-stm32-applications-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4759-using-the-hardware-realtime-clock-rtc-and-the-tamper-management-unit-tamp-with-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4776-generalpurpose-timer-cookbook-for-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4803-highspeed-si-simulations-using-ibis-and-boardlevel-simulations-using-hyperlynx-si-on-stm32-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4894-eeprom-emulation-techniques-and-software-for-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5027-interfacing-pdm-digital-microphones-using-stm32-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5036-thermal-management-guidelines-for-stm32-applications-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5225-usb-typec-power-delivery-using-stm32-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5406-how-to-build-a-lora-application-with-stm32cubewl-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5407-optimized-rf-

	board-layout-for-stm32wl-series-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5408-migrating-from-stm32l0-stm32l1-and-stm32l4-series-associated-with-sx12xx-transceivers-to-stm32wl-series-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5409-stm32cube-mcu-package-examples-for-stm32wl-series-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5457-rf-matching-network-design-guide-for-stm32wl-series-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5480-how-to-build-a-sigfox-application-with-stm32cubewl-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5543-enhanced-methods-to-handle-spi-communication-on-stm32-devices-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5568-ultralowpower-features-of-stm32wl-series-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5690-vrefbuf-peripheral-applications-and-trimming-technique-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5664-rssi-and-snr-for-lora-modulation-on-stm32wl-series-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4899-stm32-microcontroller-gpio-hardware-settings-and-lowpower-consumption-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5612-esd-protection-of-stm32-mcus-and-mpus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5796-stm32wl-series-rf-bench-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5156-introduction-to-stm32-microcontrollers-security-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5646-32-mhz-hse-oscillator-selection-for-stm32wl-series-mcus-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an5042-how-to-calibrate-the-hse-clock-for-rf-applications-on-stm32-wireless-mcus-stmicroelectronics.pdf

Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/an1202_freertos_guide-freertos-guide-stmicroelectronics.pdf
Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/an1602_semihosting_in_truestudio-how-to-do-semihosting-in-truestudio-stmicroelectronics.pdf
Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/an1801_stm32cubeprogrammer_in_truestudio-installing-stm32cubeprogrammer-in-truestudio-stmicroelectronics.pdf
Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/atollic_editing_keyboard_shortcuts-atollic-editing-keyboard-shortcuts-stmicroelectronics.pdf
Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/iar_to_atollic_truestudio_migration_guide-truestudio-for-arm-migration-guide-iar-embedded-workbench-to-truestudio-stmicroelectronics.pdf
Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/stm32cubemx_installation_in_truestudio-stm32cubemx-installation-in-truestudio-stmicroelectronics.pdf
Application Notes for related Tools & Software	https://www.st.com/resource/en/application_note/an4657-stm32-inapplication-programming-iap-using-the-usart-stmicroelectronics.pdf
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