
STM32
CubeMX

1. Description

1.1. Project

Project Name	Seeed-LoRa-E5
Board Name	custom
Generated with:	STM32CubeMX 6.8.1
Date	05/09/2023

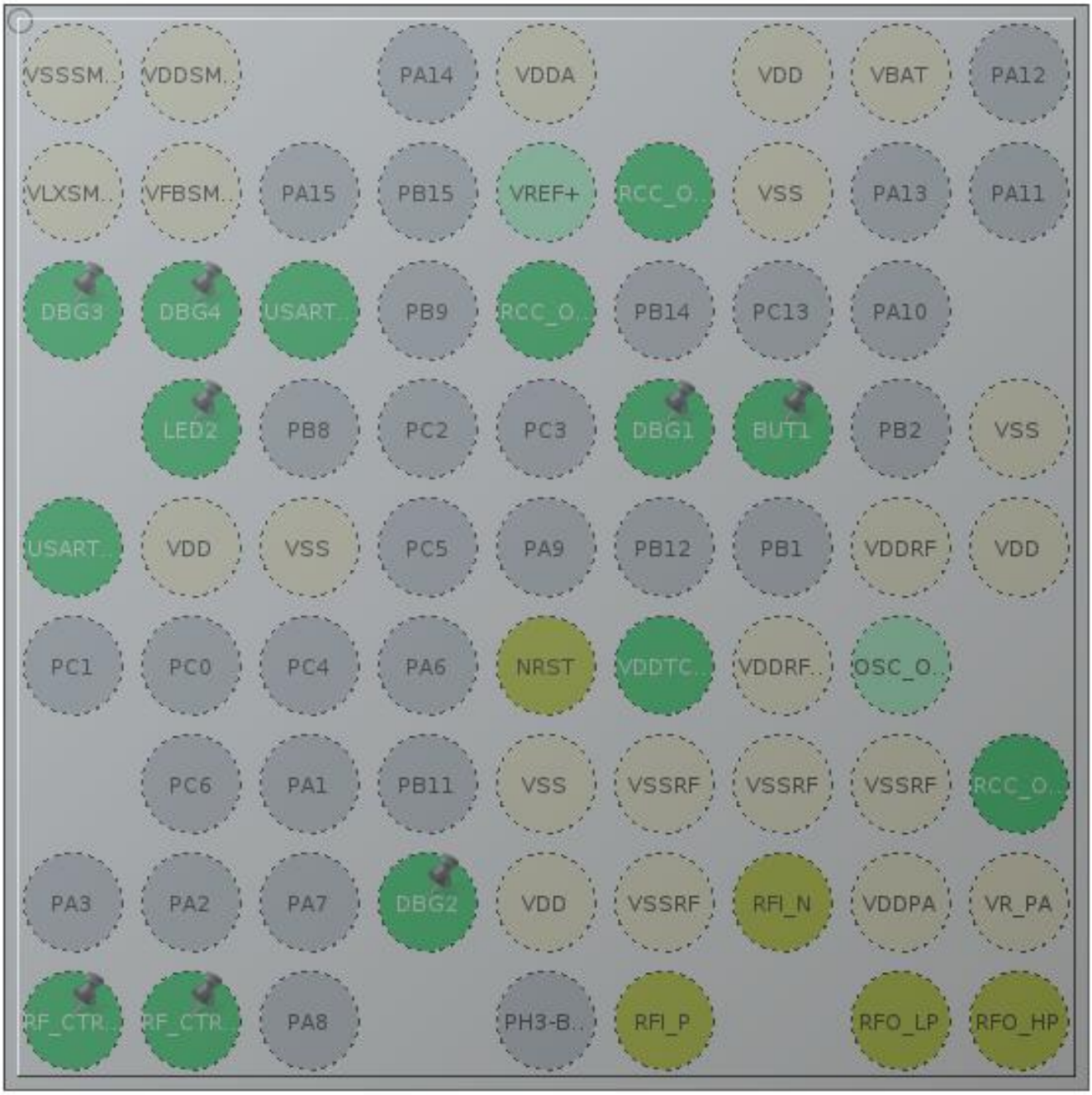
1.2. MCU

MCU Series	STM32WL
MCU Line	STM32WLEx
MCU name	STM32WLE5JCIx
MCU Package	UFBGA73
MCU Pin number	73

1.3. Core(s) information

Core(s)	ARM Cortex-M4

2. Pinout Configuration



UFBGA73 (Top view)

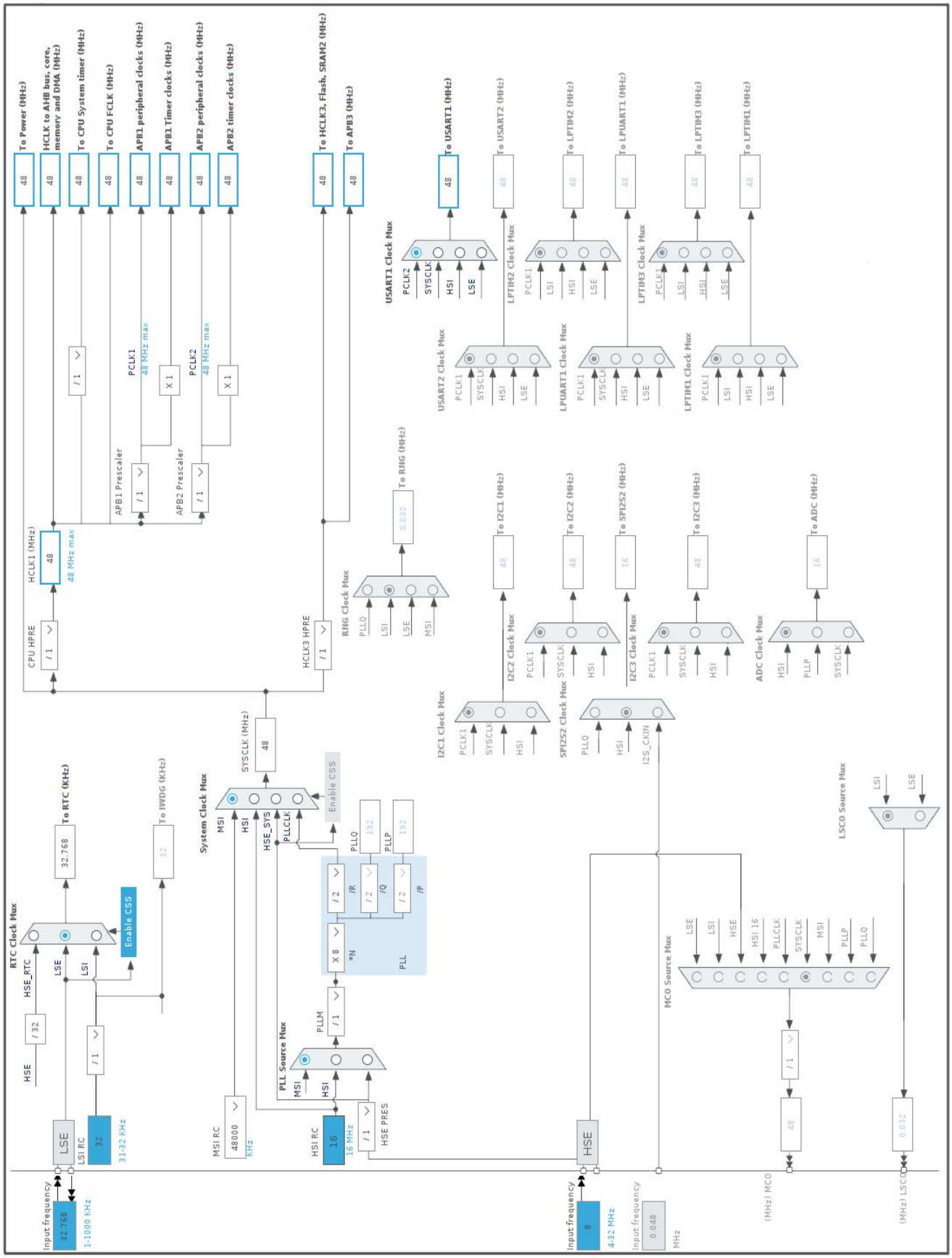
3. Pins Configuration

Pin Number UFBGA73	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
A1	VSSSMPS	Power		
A2	VDDSMPS	Power		
A5	VDDA	Power		
A7	VDD	Power		
A8	VBAT	Power		
B1	VLXSMPS	Power		
B2	VFBSMPS	Power		
B6	PC14-OSC32_IN	I/O	RCC_OSC32_IN	
B7	VSS	Power		
C1	PB3 *	I/O	GPIO_Output	DBG3
C2	PB4 *	I/O	GPIO_Output	DBG4
C3	PB7	I/O	USART1_RX	USARTx_RX
C5	PC15-OSC32_OUT	I/O	RCC_OSC32_OUT	
D2	PB5 *	I/O	GPIO_Output	LED2
D6	PA0 *	I/O	GPIO_Output	DBG1
D7	PB13	I/O	GPIO_EXTI13	BUT1
D9	VSS	Power		
E1	PB6	I/O	USART1_TX	USARTx_TX
E2	VDD	Power		
E3	VSS	Power		
E8	VDDRF	Power		
E9	VDD	Power		
F5	NRST	Reset		
F6	PB0-VDD_TCXO	I/O	VDDTCXO	
F7	VDDRF1V55	Power		
G5	VSS	Power		
G6	VSSRF	Power		
G7	VSSRF	Power		
G8	VSSRF	Power		
G9	OSC_IN	MonoIO	RCC_OSC_IN	
H4	PB10 *	I/O	GPIO_Output	DBG2
H5	VDD	Power		
H6	VSSRF	Power		
H7	RFI_N	MonoIO		
H8	VDDPA	Power		
H9	VR_PA	Power		

Pin Number UFBGA73	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
J1	PA4 *	I/O	GPIO_Output	RF_CTRL1
J2	PA5 *	I/O	GPIO_Output	RF_CTRL2
J6	RFI_P	MonoIO		
J8	RFO_LP	MonoIO		
J9	RFO_HP	MonoIO		

* The pin is affected with an I/O function

4. Clock Tree Configuration



5. Software Project

5.1. Project Settings

Name	Value
Project Name	Seeed-LoRa-E5
Project Folder	/home/dana/STM32CubeIDE/workspace_1.12.1/Seeed-LoRa-E5
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	Yes
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_GPIO_Init	GPIO
3	MX_DMA_Init	DMA
4	MX_RTC_Init	RTC
5	MX_ADC_Init	ADC
6	MX_USART1_UART_Init	USART1
7	MX_SUBGHZ_Init	SUBGHZ
8	MX_LoRaWAN_Init	LORAWAN

6. Power Consumption Calculator report

6.1. Microcontroller Selection

Series	STM32WL
Line	STM32WLEx
MCU	STM32WLE5JCIx
Datasheet	DS13105_Rev7

6.2. Parameter Selection

Temperature	25
Vdd	3.0

6.3. 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

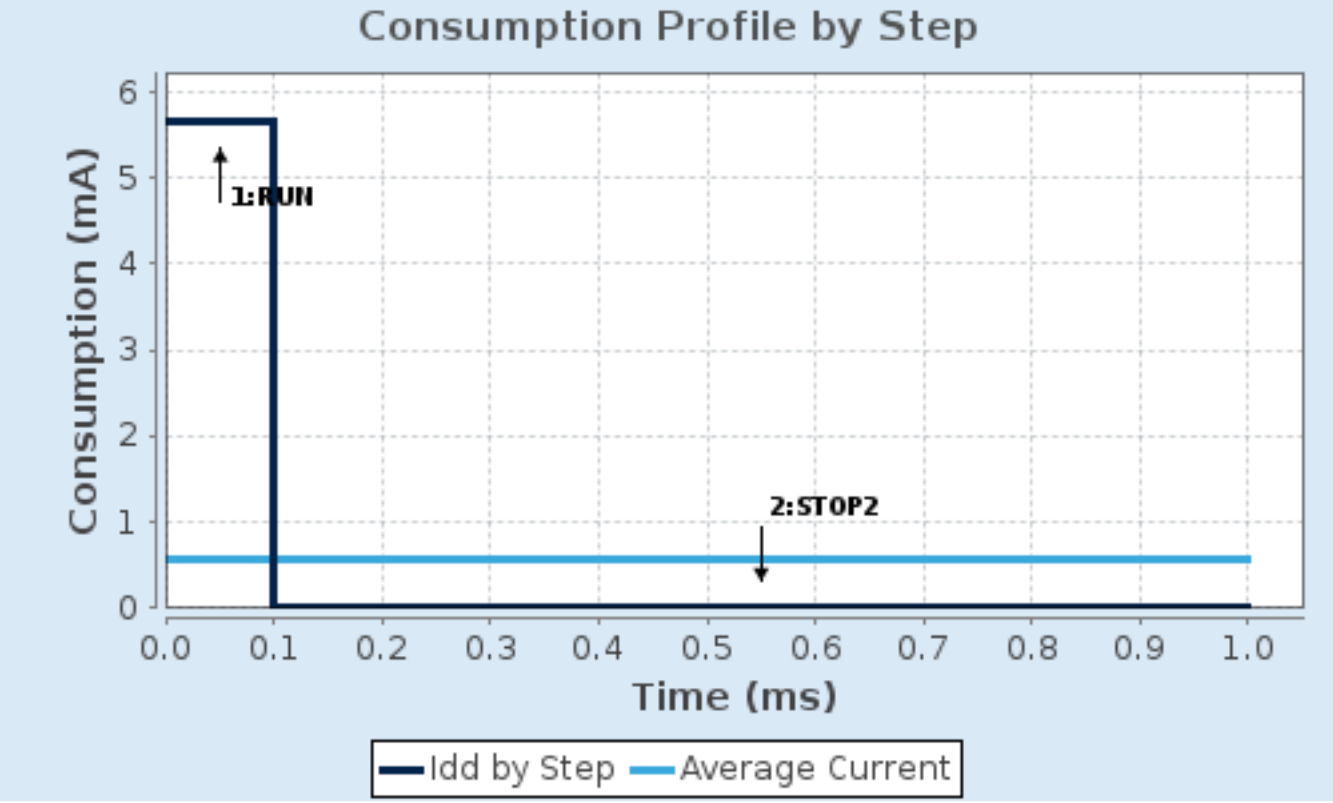
6.4. Sequence

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	124.47	125
Category	In DS Table	In DS Table

6.5. Results

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

6.6. 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

7. Peripherals and Middlewares Configuration

7.1. ADC

mode: Temperature Sensor Channel

mode: Vrefint Channel

7.1.1. Parameter Settings:

ADC_Settings:

Clock Prescaler	**Synchronous clock mode divided by 4 ***
Resolution	ADC 12-bit resolution
Calibration	Disable
Data Alignment	Right alignment
Scan Conversion Mode	Disabled
End Of Conversion Selection	End of single conversion
Low Power Auto Wait	Disabled
Auto Off	Disabled
Continuous Conversion Mode	Disabled
Discontinuous Conversion Mode	Disabled
External Trigger Conversion Source	Regular Conversion launched by software
External Trigger Conversion Edge	None
DMA Continuous Requests	Disabled
Overrun behaviour	**Overrun data overwritten ***
Sequencer	Sequencer set to fully configurable
SamplingTime Common 1	**160.5 Cycles ***
SamplingTime Common 2	**160.5 Cycles ***
Oversampling Mode	Disabled
Trigger Frequency	High frequency

ADC_Regular_ConversionMode:

Enable Regular Conversions	Disable

7.2. ADV_TRACE

mode: Enabled

7.3. MISC

mode: Enabled

7.4. RCC

High Speed Clock (HSE): TCXO

Low Speed Clock (LSE) : Crystal/Ceramic Resonator

7.4.1. 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

7.5. RTC

mode: Activate Clock Source

mode: Activate Calendar

Alarm A: Internal Alarm A

7.5.1. 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_NO ***
Free running 32 bit mask	SS[31:0] are compared and must match to activate alarm.

7.6. SEQUENCER
mode: Enabled

7.7. SUBGHZ
mode: Activated

7.7.1. Parameter Settings:

Baudrate Prescaler Value	**4 ***

7.8. SYS
Timebase Source: None

7.9. TIMER
mode: Enabled

7.10. TINY_LPM
mode: Enabled

7.11. USART1
Mode: Asynchronous

7.11.1. 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

7.12. LORAWAN

mode: Enabled

7.12.1. LoRaWAN application:

Application selection:

Application	**End Node skeleton ***
Application configuration recommandations	!! Please read carefully Information panel below!!

board settings:

Send Tx on Timer or Button Evt	TX_ON_TIMER
Probes Lines in Platform Settings	**true ***

lora_app:

Active region	**LORAMAC_REGION_US915 ***
Transmition duty cycle	10000
Application user port	2
Switch class port	3
Default class	CLASS_A
Default handler message state	Unconfirmed message
Handler Adaptive Data Rate	On
Default activation type	OTAA
Force rejoin at each reboot	true
Default Tx output power	TX_POWER_0
Default Unicast ping slots periodicity	4
Default reponse timeout for class b and class c confirmed downlink frames in milli seconds.	8000

sys_conf:

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

7.12.2. LoRaWAN commissioning:

Commissioning:

Public network	true
Current network ID	0

se-identity:

App/Join EUI	01,01,01,01,01,01,01,01
Application key	**9B,0C,9A,82,E6,74,A5,11,B9,E5,26,A9,11,87,EB,84 ***
Network key	**8B,0C,9A,82,E6,74,A5,11,B9,E5,26,A9,11,87,EB,84 ***
Network session key	2B,7E,15,16,28,AE,D2,A6,AB,F7,15,88,09,CF,4F,3C
Application session key	2B,7E,15,16,28,AE,D2,A6,AB,F7,15,88,09,CF,4F,3C

lorawan_conf:

Enable Key read access	true

7.12.3. LoRaWAN middleware:

lorawan_conf:

Region(s) selection	please select the desired region(s) in the list below
Region Asia freq: 923	false
Region Australia freq: 915	false
Region China freq: 470	false
Region China freq: 779	false
Region Europe freq: 433	false
Region Europe freq: 868	true
Region Korea freq: 920	false
Region India freq: 865	false
Region USA freq: 915	true
Region Russia freq: 864	false
Enable Hybrid mode	false
Enable LoRaMAC ClassB	false
Enable the context management storage	**true ***
Select the LoRaWAN Link Layer specification version	**v1.0.4 ***
Enable the additional LoRaWAN packages	false

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

7.12.4. Platform Settings:

ADC	ADC
RTC	RTC
USART	USART1
Debug Line 1	PA0
Debug Line 2	PB10
Debug Line 3	PB3
Debug Line 4	PB4

*** 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	PC14-OSC32_IN	RCC_OSC32_IN	n/a	n/a	n/a	
	PC15-OSC32_OUT	RCC_OSC32_OUT	n/a	n/a	n/a	
	PB0-VDD_TCXO	VDDTCXO	n/a	n/a	n/a	
	OSC_IN	RCC_OSC_IN	n/a	n/a	n/a	
USART1	PB7	USART1_RX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	USARTx_RX
	PB6	USART1_TX	Alternate Function Push Pull	No pull-up and no pull-down	**Very High ***	USARTx_TX
GPIO	PB3	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	DBG3
	PB4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	DBG4
	PB5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	LED2
	PA0	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	DBG1
	PB13	GPIO_EXTI13	**External Interrupt Mode with Falling edge trigger detection**	**Pull-up ***	**n/a**	BUT1
	PB10	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	DBG2
	PA4	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	RF_CTRL1
	PA5	GPIO_Output	Output Push Pull	No pull-up and no pull-down	**Very High ***	RF_CTRL2

8.2. DMA configuration

DMA request	Stream	Direction	Priority
USART1_TX	DMA1_Channel1	Memory To Peripheral	Low

USART1_TX: DMA1_Channel1 DMA request Settings:

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

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	15	0
RTC Tamper, RTC TimeStamp, LSECSS and RTC SSRU Interrupts	true	0	0
DMA1 Channel 1 Interrupt	true	2	0
USART1 Interrupt	true	2	0
EXTI Lines [15:10] Interrupt	true	0	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		
ADC 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	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
USART1 Interrupt	false	true	true

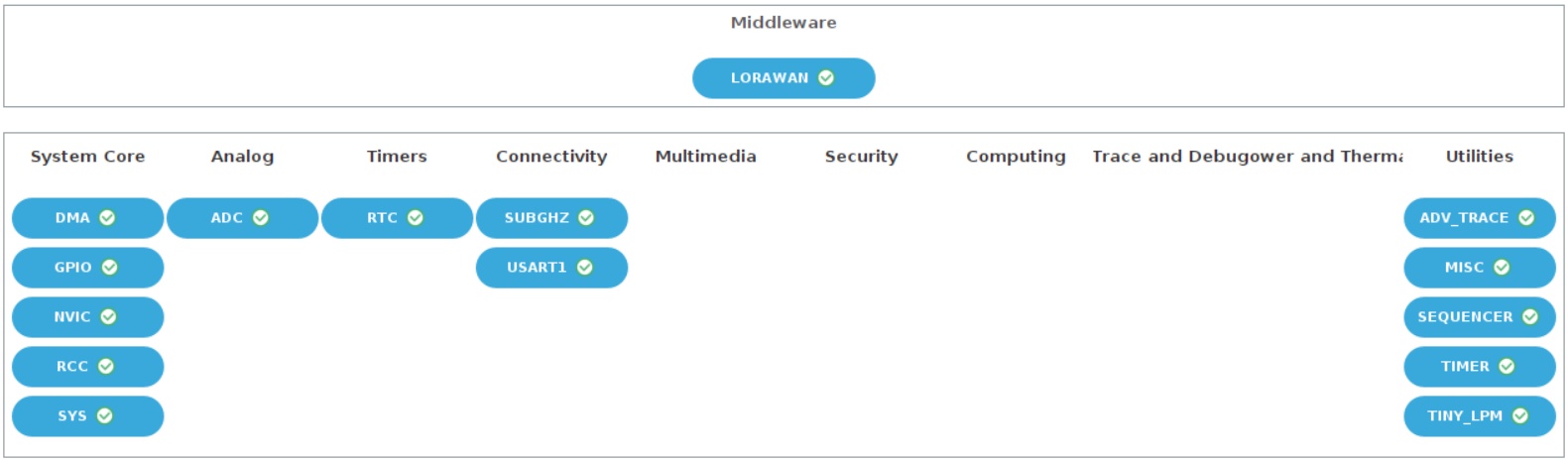
Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
EXTI Lines [15:10] Interrupt	false	true	true
RTC Alarms (A and B) Interrupt	false	true	true
SUBGHZ Radio Interrupt	false	true	true

*** User modified value**

9. System Views

9.1. Category view

9.1.1. Current



10. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32wl_bsdl.zip
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
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
Bill of Materials	https://www.st.com/resource/en/bill_of_materials/mb1792_bom.zip
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
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1720_manufacturing.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1789_hp_bdp.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1789_hp_manufacturing.zip
Board	https://www.st.com/resource/en/board_manufacturing_specification/mb17

Manufacturing Specifications	89_lp_bdp.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1789_lp_manufacturing.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1791_bdp.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1791_manufacturing.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1792_bdp.zip
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Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1842_bdp.zip
Board Manufacturing Specifications	https://www.st.com/resource/en/board_manufacturing_specification/mb1842_manufacturing.zip
Schematic Pack	https://www.st.com/resource/en/schematic_pack/mb1720_schematics.zip
Schematic Pack	https://www.st.com/resource/en/schematic_pack/mb1789_hp_schematic.zip
Schematic Pack	https://www.st.com/resource/en/schematic_pack/mb1789_lp_schematic.zip
Schematic Pack	https://www.st.com/resource/en/schematic_pack/mb1791_schematic.zip
Schematic Pack	https://www.st.com/resource/en/schematic_pack/mb1792_schematic.zip
Schematic Pack	https://www.st.com/resource/en/schematic_pack/mb1842_schematic.zip
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
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/flstm32wbvl.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/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/an5042-precise-hse-frequency-and-startup-time-tuning-for-stm32-wireless-mcus-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
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