



1. Description

1.1. Project

Project Name	BeeBrain
Board Name	custom
Generated with:	STM32CubeMX 6.14.0
Date	05/10/2025

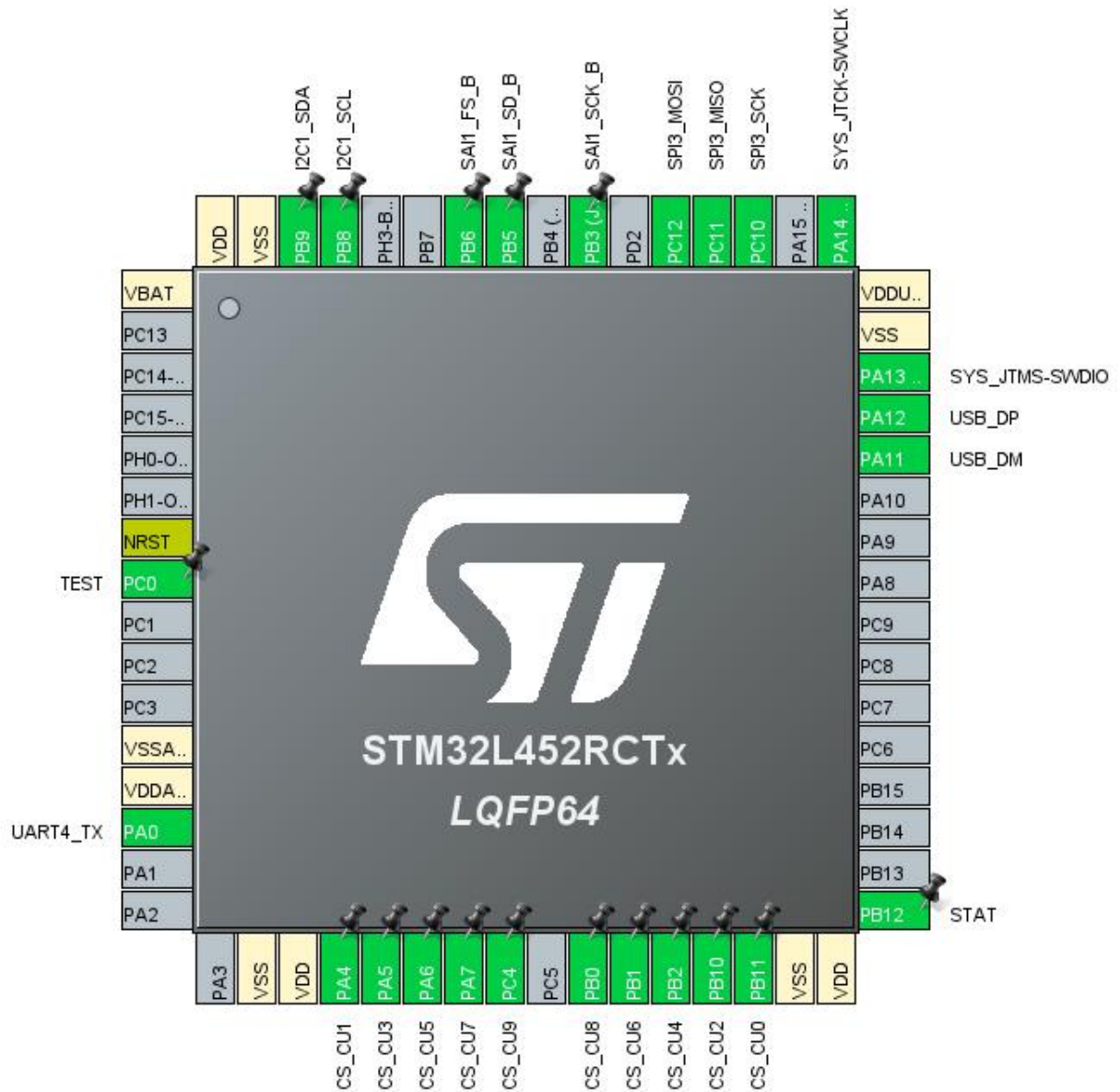
1.2. MCU

MCU Series	STM32L4
MCU Line	STM32L4x2
MCU name	STM32L452RCTx
MCU Package	LQFP64
MCU Pin number	64

1.3. Core(s) information

Core(s)	Arm Cortex-M4
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2. Pinout Configuration



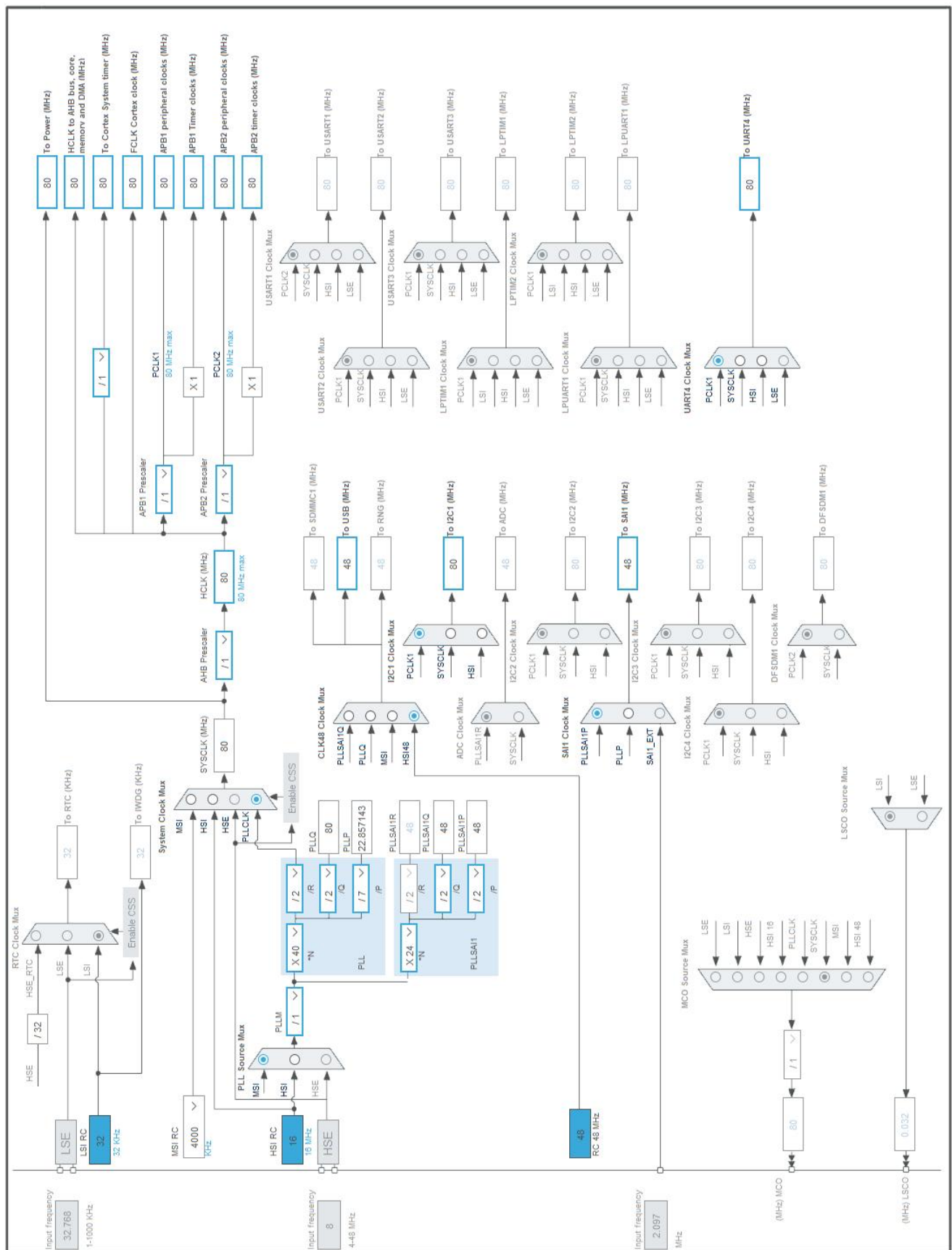
3. Pins Configuration

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
1	VBAT	Power		
7	NRST	Reset		
8	PC0 *	I/O	GPIO_Input	TEST
12	VSSA/VREF-	Power		
13	VDDA/VREF+	Power		
14	PA0	I/O	UART4_TX	
18	VSS	Power		
19	VDD	Power		
20	PA4 *	I/O	GPIO_Output	CS_CU1
21	PA5 *	I/O	GPIO_Output	CS_CU3
22	PA6 *	I/O	GPIO_Output	CS_CU5
23	PA7 *	I/O	GPIO_Output	CS_CU7
24	PC4 *	I/O	GPIO_Output	CS_CU9
26	PB0 *	I/O	GPIO_Output	CS_CU8
27	PB1 *	I/O	GPIO_Output	CS_CU6
28	PB2 *	I/O	GPIO_Output	CS_CU4
29	PB10 *	I/O	GPIO_Output	CS_CU2
30	PB11 *	I/O	GPIO_Output	CS_CU0
31	VSS	Power		
32	VDD	Power		
33	PB12 *	I/O	GPIO_Output	STAT
44	PA11	I/O	USB_DM	
45	PA12	I/O	USB_DP	
46	PA13 (JTMS/SWDIO)	I/O	SYS_JTMS-SWDIO	
47	VSS	Power		
48	VDDUSB	Power		
49	PA14 (JTCK/SWCLK)	I/O	SYS_JTCK-SWCLK	
51	PC10	I/O	SPI3_SCK	
52	PC11	I/O	SPI3_MISO	
53	PC12	I/O	SPI3_MOSI	
55	PB3 (JTDO/TRACESWO)	I/O	SAI1_SCK_B	
57	PB5	I/O	SAI1_SD_B	
58	PB6	I/O	SAI1_FS_B	
61	PB8	I/O	I2C1_SCL	
62	PB9	I/O	I2C1_SDA	
63	VSS	Power		

Pin Number LQFP64	Pin Name (function after reset)	Pin Type	Alternate Function(s)	Label
64	VDD	Power		

* The pin is affected with an I/O function

4. Clock Tree Configuration



1. Power Consumption Calculator report

1.1. Microcontroller Selection

Series	STM32L4
Line	STM32L4x2
MCU	STM32L452RCTx
Datasheet	DS11912_Rev3

1.2. Parameter Selection

Temperature	25
Vdd	3.0

1.3. 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

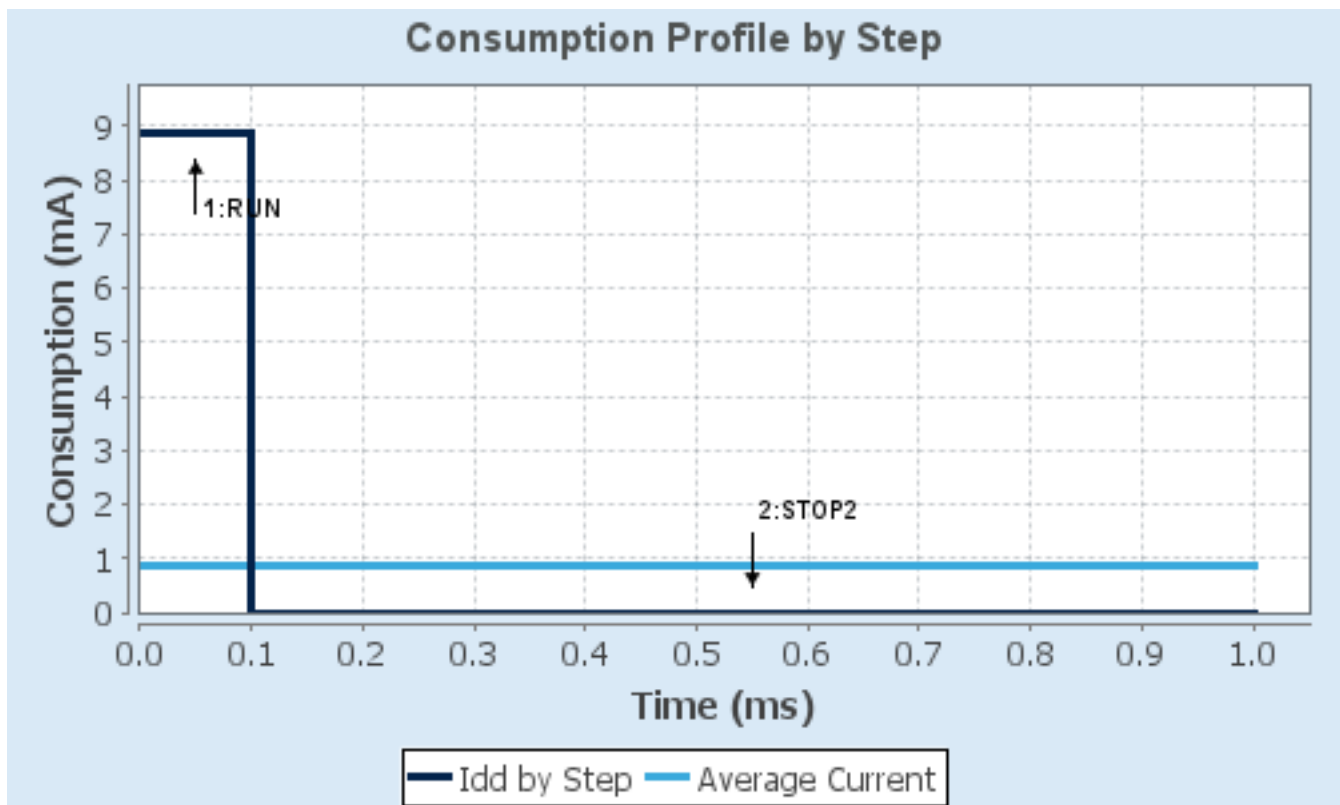
1.4. Sequence

Step	Step1	Step2
Mode	RUN	STOP2
Vdd	3.0	3.0
Voltage Source	Battery	Battery
Range	Range1-High	NoRange
Fetch Type	FLASH	n/a
CPU Frequency	80 MHz	0 Hz
Clock Configuration	HSE BYP PLL	ALL CLOCKS OFF
Clock Source Frequency	4 MHz	0 Hz
Peripherals		
Additional Cons.	0 mA	0 mA
Average Current	8.85 mA	2.05 μ A
Duration	0.1 ms	0.9 ms
DMIPS	100.0	0.0
Ta Max	103.78	105
Category	In DS Table	In DS Table

1.5. Results

Sequence Time	1 ms	Average Current	886.84 μ A
Battery Life	5 months, 6 days, 23 hours	Average DMIPS	100.0 DMIPS

1.6. Chart



2. Software Project

2.1. Project Settings

Name	Value
Project Name	BeeBrain
Project Folder	D:\GIT\Brain
Toolchain / IDE	STM32CubeIDE
Firmware Package Name and Version	STM32Cube FW_L4 V1.18.1
Application Structure	Advanced
Generate Under Root	Yes
Do not generate the main()	No
Minimum Heap Size	0x200
Minimum Stack Size	0x400

2.2. 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

2.3. 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_I2C1_Init	I2C1
5	MX_SAI1_Init	SAI1
6	MX_SPI3_Init	SPI3
7	MX_USB_DEVICE_Init	USB_DEVICE
8	MX_UART4_Init	UART4

3. Peripherals and Middlewares Configuration

3.1. I2C1

I2C: I2C

3.1.1. Parameter Settings:

Timing configuration:

Custom Timing	Disabled
I2C Speed Mode	Standard Mode
I2C Speed Frequency (KHz)	100
Rise Time (ns)	100
Fall Time (ns)	100
Coefficient of Digital Filter	0
Analog Filter	Enabled
Timing	0x10D19CE4 *

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

3.2. RCC

3.2.1. Parameter Settings:

System Parameters:

VDD voltage (V)	3.3
Instruction Cache	Enabled
Prefetch Buffer	Disabled
Data Cache	Enabled
Flash Latency(WS)	4 WS (5 CPU cycle)

RCC Parameters:

HSI Calibration Value	64
MSI Calibration Value	0
MSI Auto Calibration	Disabled
HSE Startup Timeout Value (ms)	100
LSE Startup Timeout Value (ms)	5000

Power Parameters:

Power Regulator Voltage Scale	Power Regulator Voltage Scale 1
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3.3. SAI1

Mode: Master

mode: I2S/PCM Protocol

3.3.1. Parameter Settings:

SAI B:

Synchronization Inputs	Asynchronous
Basic Parameters	
Audio Mode	Master Receive *
Output Mode	Mono *
Companding Mode	No companding mode
Protocol Parameters	
Protocol	I2S Standard
Data Size	24 Bits *
Number of Slots (only Even Values)	2
Clock Parameters	
Master Clock Divider	Enabled
Audio Frequency	16 KHz *
Real Audio Frequency	15.625 KHz *
Error between Selected	-2.34 % *
Advanced Parameters	
Fifo Threshold	Empty
Output Drive	Disabled

3.4. SPI3

Mode: Full-Duplex Master

3.4.1. 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

3.5. SYS

Debug: Serial Wire

Timebase Source: SysTick

3.6. UART4

Mode: Single Wire (Half-Duplex)

3.6.1. 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:

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

3.7. USB

mode: Device (FS)

3.7.1. Parameter Settings:

Basic Parameters:

Speed	Full Speed 12MBit/s
Physical interface	Internal Phy
Sof Enable	Disabled

Power Parameters:

Low Power	Enabled *
Link Power Management	Enabled *
Battery Charging	Enabled *

3.8. USB_DEVICE

Class For FS IP: Communication Device Class (Virtual Port Com)

3.8.1. Parameter Settings:

Basic Parameters:

USBD_MAX_NUM_INTERFACES (Maximum number of supported interfaces)	1
USBD_MAX_NUM_CONFIGURATION (Maximum number of supported configuration)	1
USBD_MAX_STR_DESC_SIZ (Maximum size for the string descriptors)	512
USBD_SELF_POWERED (Enabled self power)	Enabled
USBD_DEBUG_LEVEL (USBD Debug Level)	0: No debug message
USBD_LPM_ENABLED (Link Power Management)	1: Link Power Management supported

Class Parameters:

USB CDC Rx Buffer Size	256 *
USB CDC Tx Buffer Size	2048

3.8.2. Device Descriptor:

Device Descriptor:

VID (Vendor Identifier)	1155
LANGID_STRING (Language Identifier)	English(United States)
MANUFACTURER_STRING (Manufacturer Identifier)	STMicroelectronics

Device Descriptor FS:

PID (Product Identifier)	22336
PRODUCT_STRING (Product Identifier)	STM32 Virtual ComPort
CONFIGURATION_STRING (Configuration Identifier)	CDC Config
INTERFACE_STRING (Interface Identifier)	CDC Interface

*** User modified value**

4. System Configuration

4.1. GPIO configuration

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
I2C1	PB8	I2C1_SCL	Alternate Function Open Drain	No pull-up and no pull-down	Very High *	
	PB9	I2C1_SDA	Alternate Function Open Drain	No pull-up and no pull-down	Very High *	
SAI1	PB3 (JTDO/TRACESWO)	SAI1_SCK_B	Alternate Function Push Pull	No pull-up and no pull-down	Low	
	PB5	SAI1_SD_B	Alternate Function Push Pull	No pull-up and no pull-down	Low	
	PB6	SAI1_FS_B	Alternate Function Push Pull	No pull-up and no pull-down	Low	
SPI3	PC10	SPI3_SCK	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
	PC11	SPI3_MISO	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
	PC12	SPI3_MOSI	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
SYS	PA13 (JTMS/SWDIO)	SYS_JTMS-SWDIO	n/a	n/a	n/a	
	PA14 (JTCK/SWCLK)	SYS_JTCK-SWCLK	n/a	n/a	n/a	
UART4	PA0	UART4_TX	Alternate Function Open Drain	Pull-up	Very High *	
USB	PA11	USB_DM	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
	PA12	USB_DP	Alternate Function Push Pull	No pull-up and no pull-down	Very High *	
GPIO	PC0	GPIO_Input	Input mode	No pull-up and no pull-down	n/a	TEST
	PA4	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU1
	PA5	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU3
	PA6	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU5
	PA7	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU7
	PC4	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU9
	PB0	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU8
	PB1	GPIO_Output	Output Push Pull		Low	CS_CU6

IP	Pin	Signal	GPIO mode	GPIO pull/up pull down	Max Speed	User Label
				Pull-up *		
	PB2	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU4
	PB10	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU2
	PB11	GPIO_Output	Output Push Pull	Pull-up *	Low	CS_CU0
	PB12	GPIO_Output	Output Push Pull	Pull-up *	Low	STAT

4.2. DMA configuration

DMA request	Stream	Direction	Priority
SAI1_B	DMA2_Channel7	Peripheral To Memory	High *
SPI3_RX	DMA2_Channel1	Peripheral To Memory	Low
SPI3_TX	DMA2_Channel2	Memory To Peripheral	Low
UART4_TX	DMA2_Channel3	Memory To Peripheral	Low
UART4_RX	DMA2_Channel5	Peripheral To Memory	Low

SAI1_B: DMA2_Channel7 DMA request Settings:

Mode: **Circular ***
 Peripheral Increment: Disable
 Memory Increment: **Enable ***
 Peripheral Data Width: Word
 Memory Data Width: Word

SPI3_RX: DMA2_Channel1 DMA request Settings:

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

SPI3_TX: DMA2_Channel2 DMA request Settings:

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

UART4_TX: DMA2_Channel3 DMA request Settings:

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

Memory Data Width: Byte

UART4_RX: DMA2_Channel5 DMA request Settings:

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

4.3. NVIC configuration

4.3.1. 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
DMA2 channel1 global interrupt	true	0	0
DMA2 channel2 global interrupt	true	0	0
DMA2 channel3 global interrupt	true	0	0
DMA2 channel5 global interrupt	true	0	0
USB event interrupt through EXTI line 17	true	0	0
DMA2 channel7 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		
I2C1 event interrupt	unused		
I2C1 error interrupt	unused		
SPI3 global interrupt	unused		
UART4 global interrupt	unused		
SAI1 global interrupt	unused		
FPU global interrupt	unused		

4.3.2. 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

Enabled interrupt Table	Select for init sequence ordering	Generate IRQ handler	Call HAL handler
System tick timer	false	true	true
DMA2 channel1 global interrupt	false	true	true
DMA2 channel2 global interrupt	false	true	true
DMA2 channel3 global interrupt	false	true	true
DMA2 channel5 global interrupt	false	true	true
USB event interrupt through EXTI line 17	false	true	true
DMA2 channel7 global interrupt	false	true	true

* User modified value

5. System Views

5.1. Category view

5.1.1. Current

Middleware

USB_DEVICE ✓

System Core

Analog

Timers

Connectivity

Multimedia

Security

Computing

DMA ✓

GPIO ✓

IVIC ✓

RCC ✓

SYS ✓

I2C1 ✓

SPI3 ✓

UART4 ✓

USB ✓

SAI1 ✓

6. Docs & Resources

Type	Link
BSDL files	https://www.st.com/resource/en/bsdl_model/stm32l4_bsd.zip
IBIS models	https://www.st.com/resource/en/ibis_model/stm32l4_ibis.zip
System View Description	https://www.st.com/resource/en/svd/stm32l4_svd.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_b-l462e-cell1_discovery_cellular_kit_product_overview.pdf
Presentations	https://www.st.com/resource/en/product_presentation/microcontrollers-stm32-family-overview.pdf
Presentations	https://www.st.com/resource/en/product_presentation/microcontrollers-stm32l4-series-product-overview.pdf
Brochures	https://www.st.com/resource/en/brochure/brstm32ulp.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32l4.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32nucleo.pdf
Flyers	https://www.st.com/resource/en/flyer/flstm32trust.pdf
Magazine Articles	https://www.st.com/resource/en/magazine/design-elektronik_august2017.pdf
Magazine Articles	https://www.st.com/resource/en/magazine/design-elektronik_october2016.pdf
Product Certifications	https://www.st.com/resource/en/certification_document/sesip-2000002-01-cert.pdf
Product	https://www.st.com/resource/en/certification_document/sesip-2000002-

Certifications	01-st2.pdf
Product	https://www.st.com/resource/en/certification_document/psa-
Certifications	certificate_stm32l4.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/an3126-audio-and- waveform-generation-using-the-dac-in-stm32-products- stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an3154-can-protocol- used-in-the-stm32-bootloader-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/an3156-usb-dfu- protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4221-i2c-protocol- used-in-the-stm32-bootloader-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/an4555-getting-started- with-stm32l4-series-and-stm32l4-series-hardware-development- stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4566-extending-the- dac-performance-of-stm32-microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4612-migrating-from- stm32l1-series-to-stm32l4-series-and-stm32l4-series-microcontrollers- stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4616-migrating-from- stm32f401-and-stm32f411-lines-to-stm32l4-series-and-stm32l4-series- microcontrollers-stmicroelectronics.pdf
Application Notes	https://www.st.com/resource/en/application_note/an4621-stm32l4-and- stm32l4-ultralowpower-features-overview-stmicroelectronics.pdf

- Application Notes https://www.st.com/resource/en/application_note/an4629-adc-hardware-oversampling-for-microcontrollers-of-the-stm32-l0-and-l4-series-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4649-migrating-from-stm32f1-series-to-stm32l4-series--stm32l4-series-microcontrollers-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/an4726-stm32cube-firmware-examples-for-stm32l4-series-and-stm32l4-series-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4729-stm32l0l4-firewall-overview-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4730-using-the-firewall-embedded-in-stm32l0l4l4-series-mcus-for-secure-access-to-sensitive-parts-of-code-and-data-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4746-optimizing-power-and-performance-with-stm32l4-and-stm32l4-series-microcontrollers-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/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/an4809-migrating-between-stm32l0-series-and-stm32l4-series--stm32l4-series-microcontrollers-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4821-migrating-from-stm32f405415-line-and-stm32f407417-line-to-stm32l4-series-and-stm32l4-series-microcontrollers-stmicroelectronics.pdf
- Application Notes https://www.st.com/resource/en/application_note/an4831-migrating-from-

stm32f2x5-line-to-stm32l4-series-and-stm32l4-series-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4832-migrating-from-stm32f303-line-to-stm32l4-series-and-stm32l4-series-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4989-stm32-microcontroller-debug-toolbox-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4990-getting-started-with-sigmadelta-digital-interface-on-applicable-stm32-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an4995-using-an-electromyogram-technique-to-detect-muscle-activity-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an5012-analogtodigital-audio-conversion-example-using-stm32l4-series-microcontroller-peripherals-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/an5105-getting-started-with-touch-sensing-control-on-stm32-microcontrollers-stmicroelectronics.pdf

Application Notes https://www.st.com/resource/en/application_note/an5138-migrating-from-stm32l4-and-stm32l4-to-stm32l5-series-microcontrollers-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/an4760-quadspi-interface-on-stm32-microcontrollers-and-microprocessors-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/an4991-how-to-wake-up-an-stm32-microcontroller-from-lowpower-mode-with-the-usart-or-the-lpuart-stmicroelectronics.pdf
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