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# KERNEL MASTERS

## Raayan Mini [ARM Cortex M0/M3/M4] Rev 4.0/4.1

## User Manual

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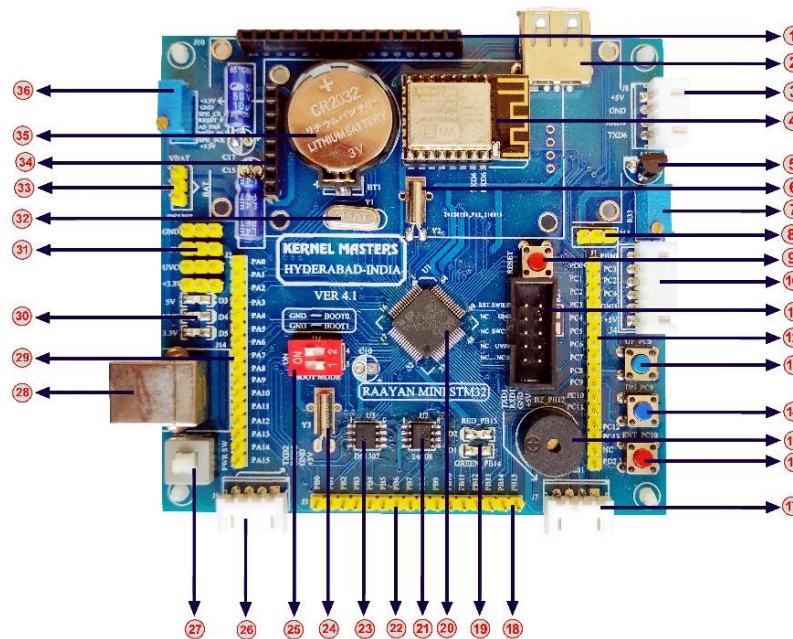


### 1. Introduction to Raayan Mini Board

#### 1.1. Board Overview

The STM32 Based Raayan Mini Development board allows users to easily develop applications with the STM32F401RBTx high-performance microcontroller with the Arm® Cortex®-M4 32-bit core. It includes everything required either for beginners or experienced users to get started quickly. The Raayan Mini Development board also features programmable user buttons and an RG LED for custom applications. STM32 Based Raayan Mini Development board comes with the STM32 comprehensive free software libraries and examples available with the STM32CubeF4 MCU Package. Figure 1-1 shows a photo of the Raayan Mini Development Board.

**Figure 1-1. Raayan Mini Development Board**



1.16x2 LCD	9.Reset	17.Uart - 1	26.Uart_2	33.VBat
2.USB	10.CAN_out	18.Port_B	27.Power Switch	34.TFT_Lcd
3.Uart - 6	11.Debugger	19.User_LED	28.USB-A	35.Battery
4.Bluetooth / Wi-fi	12.Port_C	20.STM32F401RBT6	29.Port_A	36.LCD Trim POT
5.LM35	13.Switch_UP	21.EEPROM	30.Power_LED's	
6.XTAL-32.7 kHz	14.Switch_DN	23.RTC	31.Power_Pin's	
7.ADC POT	15.Buzzer	24.XTAL-32.7 kHz	32.XTAL_8Mhz	
8.Pull_UP / Pull_Down	16.Switch_ENT	25.Boot Switch	33.VBat	

### 1.2. Kit Contents

The Raayan Mini STM32 Development Board Kit contains the following items:

- Raayan Mini Development Board (STM32F401RBTx)
- ST-Link Serial wire Debugger
- USB – TTL module
- USB Type A to B cable
- Jumper wires
- User manual

### 1.3. Getting Started

Follow the sequence below to configure the Raayan Mini STM32F4 Development Board and launch application:

1. Check the switch positions of BOOT0, BOOT1 pins on the board.
2. Connect the STM32F4 Development board to a PC with a USB cable Type-A to B through USB connector J14 to power the board.
3. Press the push button SW5 (PWR SW). LEDs D3, D4, D5 then lights up.
4. The board runs a preloaded Board test application. The 16 X 2 LCD or the TFT display shows “Welcome to KM” followed by some test cases for testing the board and peripherals. Perform each test cases as shown in the display until all the peripherals are tested OK.
5. Discover the STM32F401RBT6 features and develop the application using available source code and libraries.
6. Connect the ST LINK to CN1 before flashing your application code to the microcontroller.

### 1.4. Features

Your Raayan Mini Development board includes the following features:

- STM32F401RBT6 microcontroller featuring 32-bit Arm® Cortex®-M4 with FPU core, Up to 128-Kbytes of Flash memory and 64-Kbytes of RAM.
- On-board ST-LINK Serial wire debugger/programmer
- 5 LEDs:
  - 3 Power LEDs and 2 user LEDs
- On-board Buzzer
- 16 X 2 Monochrome LCD interface with GPIO
- TFT LCD interface with SPI
- DS1307 RTC interface with I2C
- AT24C02 EEPROM interface with I2C
- LM35 Temperature Sensor interface with ADC
- ESP Wi-Fi module interface with UART



- USB Type A interface
- Flexible power-supply options: ST-LINK, USB Type B connector
- Expansion Headers supports,
  - GPIO ports with interrupt capability
  - I2C interface (1Mbit/s, SMBus/PMBus)
  - Up to 3 USARTs (2 x 10.5 Mbit/s, 1 x 5.25 Mbit/s), ISO 7816 interface, LIN, IrDA, modem control)
  - SPI interface (up to 42 Mbits/s at fCPU= 84 MHz), SPI2 and SPI3 with muxed full-duplex I2S to achieve audio class accuracy via internal audio PLL or external clock
- External application power supply: 3 V and 5 V
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE.

### 1.5. Specifications

Table 1-1 summarizes the specifications for the Raayan Mini STM32F4 Development Board.

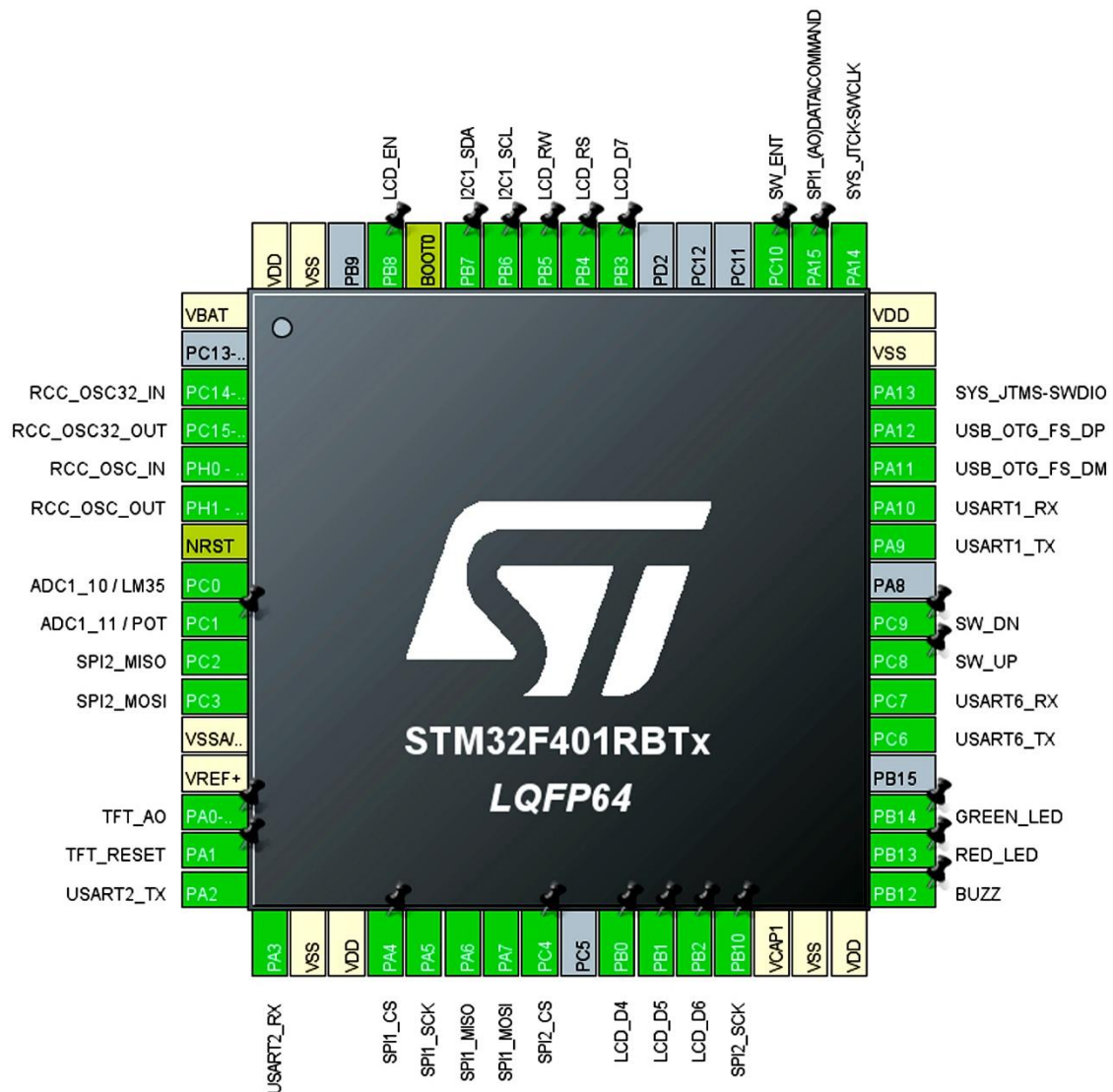
**Table 1-1. Raayan Mini STM32F4 Development Board Specifications**

Parameter	Value
Board supply voltage	4.75 VDC to 5.25 VDC from USB Device Type A to B cable (connected to a PC)
Dimensions	(L x W x H)
Break-out power output	<ul style="list-style-type: none"> <li>• 3.3 VDC (current rating)</li> <li>• 5.0 VDC (current rating)</li> </ul>
RoHS status	Compliant

## 1.6. Raayan Mini Pin diagram

Figure 1-2. Raayan Mini STM32 Development Board Pin Diagram

# RAAYAN MINI V 4.0

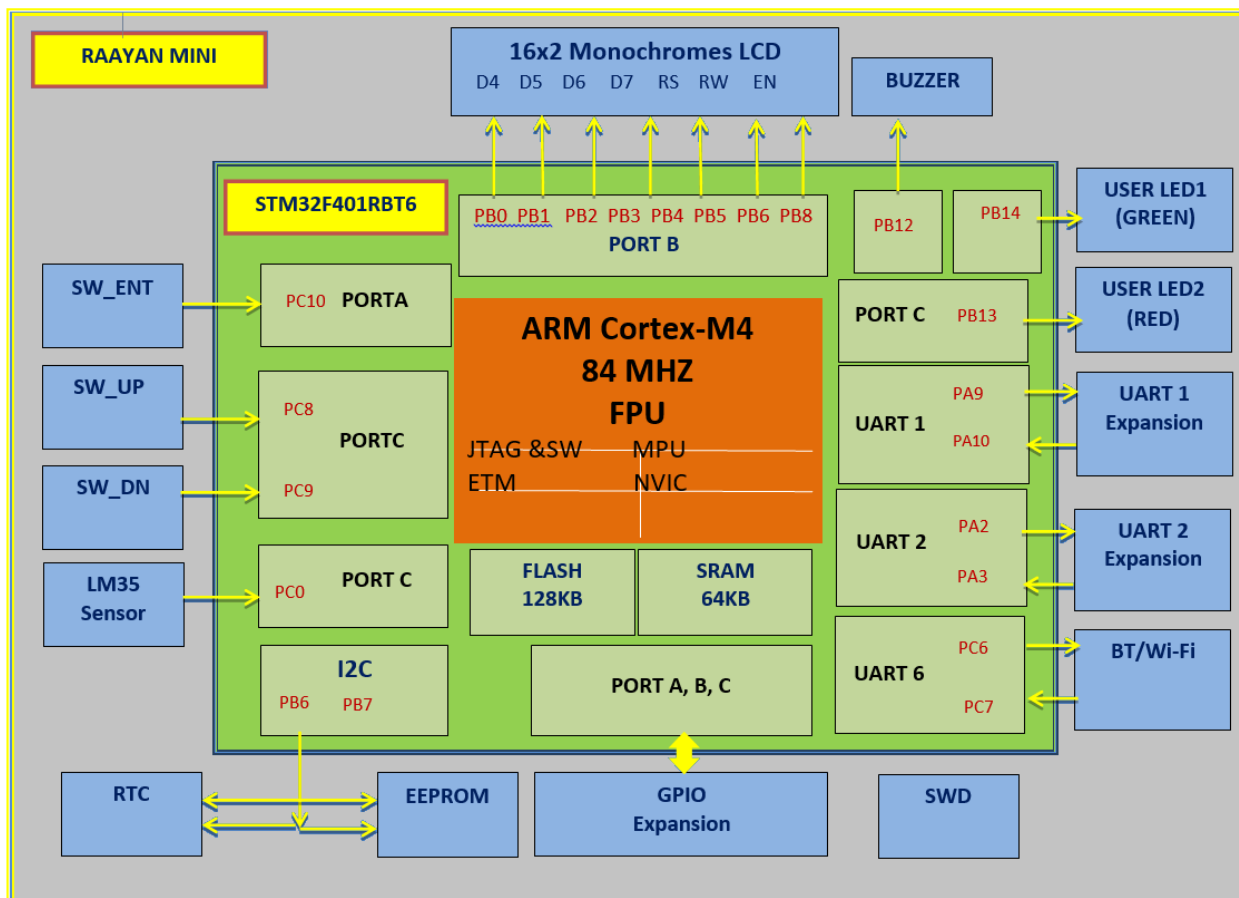


## 2. Hardware Description

### 2.1. Raayan Mini Board Block Diagram

The Raayan Mini STM32F4 Development Board includes a STM32F401RBT6 microcontroller and a serial wire debugger as well as a range of useful peripheral features.

**Figure 2-1. Raayan Mini STM32F4 Development Board Block Diagram**



## 2.2. Functional Description

### 2.2.1. Microcontroller

The STM32F401RBT6 is a high performance 32-bit ARM Cortex-M4 based microcontroller with 128-kB Flash memory, 64-kB SRAM and a frequency of up to 84MHz. The Cortex<sup>®</sup>-M4 core features a Floating point unit (FPU) single precision which



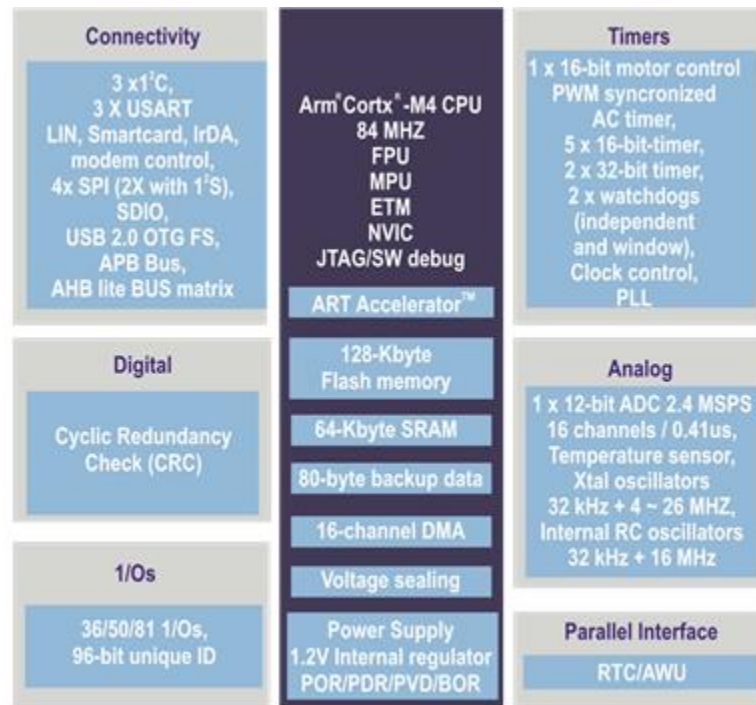
## Raayan Mini [ARM Cortex M0/M3/M4] Rev 4.0/4.1

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supports all Arm single-precision data-processing instructions and data types. (See the STM32F401RBT6 microcontroller data sheet.)

It also implements a full set of DSP instructions and a memory protection unit (MPU) which enhances application security. All devices offer one 12-bit ADC, a low-power RTC, six general-purpose 16-bit timers including one PWM timer for motor control, two general-purpose 32-bit timers. They also feature standard and advanced communication interfaces.

**Figure 2-2. STM32F401RBT6 Specifications**



The STM32F401RBT6 microcontroller is factory-programmed with a Board test program. The Board test program resides in on-chip Flash memory and runs each time power is applied, unless the Board test application has been replaced with a user program.

### 2.2.2. ST-Link V2 Debugger

The ST-LINK/V2 is an in-circuit debugger and programmer for the STM8 and STM32 microcontrollers. Raayan Mini board uses serial wire debugging (SWD) interface to communicate with the STM32 microcontroller located on the development board. The SWD can be connected to CN1 connector on the board.

Figure 2-3. ST LINK Serial Wire Debugger schematics

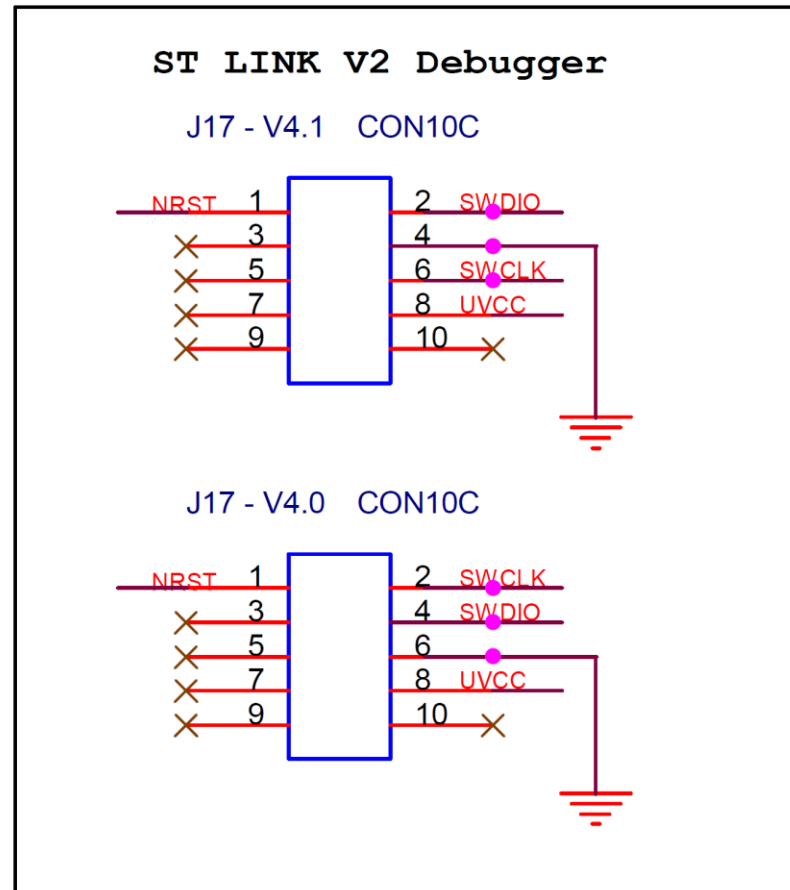


Table 2-1. ST LINK Serial Wire Debugger signals

GPIO Pin	Pin function	Device
PA13	GPIO	SWDIO
PA14	GPIO	SWCLK

The main difference between Raayan Mini board version 4.0 and version 4.1 lies in the SWD interface.

- a) Raayan Mini STM32F4 Development Board version 4.0
- b) Raayan Mini STM32F4 Development Board version 4.1

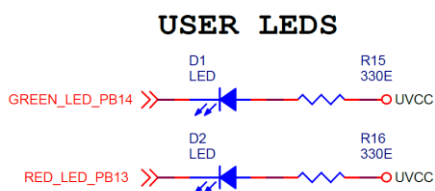
## 2.2.2. User Switches and User LEDs

The Raayan Mini STM32F4 Development Board comes with five LEDs of which two LEDs can be configured for use in custom applications. The other 3 LEDs represent the power input to the board. Three user switches and one buzzer are also included on the board namely SW\_ENT (Enter), SW\_DN and SW\_UP respectively. All these can be used for some purposes in the user's custom application. Table 2-2 shows how these features are connected to the pins on the microcontroller.

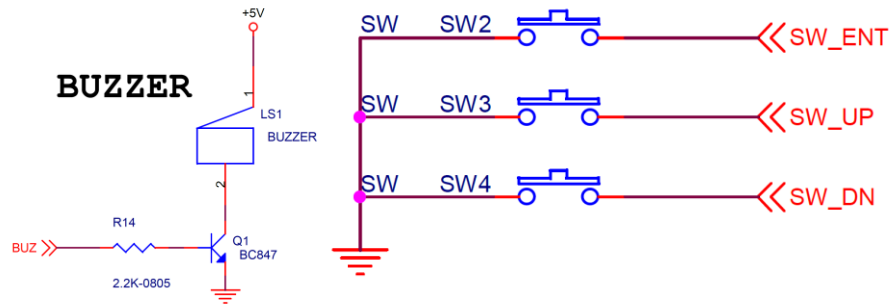
**Figure 2-4. Raayan Mini STM32F4 Development Board LEDs, Switches and Buzzer schematics**

**Table 2-2. User Switches, LED and Buzzer signals**

GPIO Pin	Pin Function	Device
PB12	GPIO	BUZZER
PB13	GPIO	USR_LED2(Red)
PB14	GPIO	USR_LED1(Green)
PC8	GPIO	SW_UP(SW3)
PC9	GPIO	SW_DN(SW4)
PC10	GPIO	SW_ENT(SW2)



## POWER LEDS



## 2.2.3. Display

The Raayan Mini STM32F4 Development Board version 4.0/4.1 offers two display options.

### a) 16x2 Monochrome LCD Display

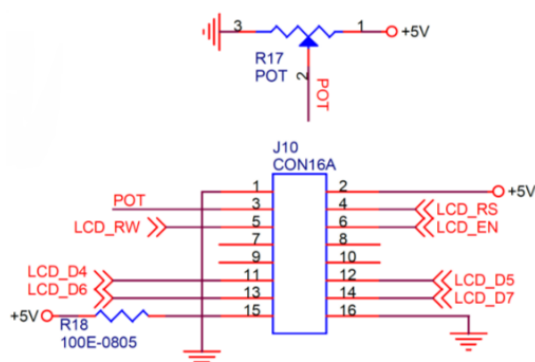
The Raayan Mini STM32F4 Development Board has provision for mounting a 16 x 2 Monochrome LCD display on board and can be used in custom user applications. The LCD can also be removed if it is not required for some application. It is also provided with an LCD trim pot to adjust the brightness/contrast of LCD screen. Only one display can be mounted on board at a time. Table 2-3 shows how the LCD pins are connected to the microcontroller.

**Figure 2-5. Raayan Mini STM32F4 Development Board LCD Display schematics**

**Table 2-3. 16x2 Monochrome LCD signals**

GPIO Pin	Pin function	Device
PB0	GPIO	LCD_DATA_4
PB1	GPIO	LCD_DATA_5
PB2	GPIO	LCD_DATA_6
PB3	GPIO	LCD_DATA_7
PB4	GPIO	LCD_RS
PB5	GPIO	LCD_RW
PB8	GPIO	LCD_EN

## 16x2 LCD



### b) TFT-LCD Display

The second option is a 262K-color, graphic type TFT-LCD display. It can also be mounted on top of the board. It consists of 396 source line and 162 gate line driving circuits. This is capable of connecting directly to an external microprocessor, and accepts Serial Peripheral Interface (SPI), 8-bit/9-bit/16-bit/18-bit parallel interface. Table 2-4 shows how these pins are connected to the microcontroller.

**Table 2-4. TFT LCD signals**

GPIO Pin	Pin function	On-Board Function	Device
PA0	GPIO	GPIO	TFT_A0
PA1	GPIO	GPIO	TFT_RESET
PA4	GPIO	SPI1_CS	TFT_CS
PA5	GPIO	SPI1_SCK	TFT_SCK
PA7	GPIO	SPI1_MOSI	TFT_SDA

### 2.2.4. Boot Mode Switch

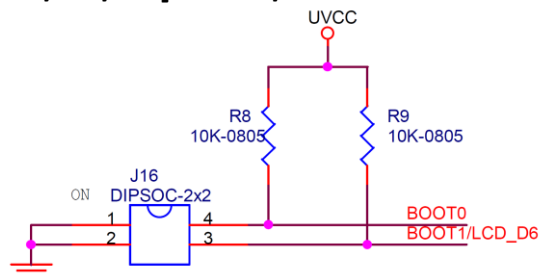
At startup, boot switch is used to select one out of three boot options:

- Boot from user flash
- Boot from system memory
- Boot from embedded SRAM

**Figure 2-6. Raayan Mini STM32F4 Development Board Boot switch schematics**

**Table 2-5. Boot modes**

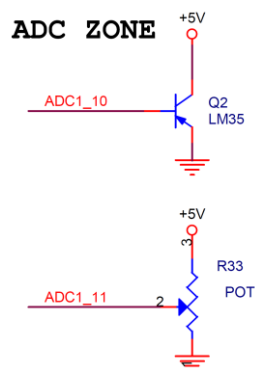
Boot mode selection pins		Boot mode	Aliasing
BOOT1	BOOT2		
X	0	Main Flash memory (default)	Main Flash memory is selected as the boot space
0	1	System memory	System memory is selected as the boot space
1	1	Embedded SRAM	Embedded SRAM is selected as the boot space



### 2.2.5. Analog to Digital Converter

The Raayan Mini Development board has two on-board analog devices which is one LM35 temperature sensor and one potentiometer. These devices are internally connected to ADC1\_10 and ADC1\_11 analog channels respectively. To convert the sensor output voltage into a digital value, one 12-bit analog-to-digital converter is embedded and shares up to 16 external channels, performing conversions in the single-shot or scan mode.

**Figure 2-7. Raayan Mini STM32F4 Development Board ADC Schematic**



GPIO Pin	Pin function	On-Board Function	Device
PC0	GPIO	ADC1_IN10	LM35 sensor
PC1	GPIO	ADC1_IN11	Potentiometer

**Table 2-6. Analog devices pin configuration**

### 2.2.6. USART Zone

The Development Board provides three dedicated UART headers which helps in communicating various peripherals or sensors that may be used in your custom projects. UART headers are named J7, J8 AND J9 respectively. J7 is UART1, J8 is UART6 and J9 is UART2 respectively. In Raayan Mini board versions 3.0, 4.0 and 4.1, UART6 is internally connected to the Wi-Fi module (ESP8266) provided on board. These STM32F4 microcontroller, ADC, UART and Wi-Fi combination can also be used as a platform for making many IoT projects.

**Figure 2-8. Raayan Mini STM32F4 Development Board UART schematics**



## USART ZONE

### USART OUPUTS

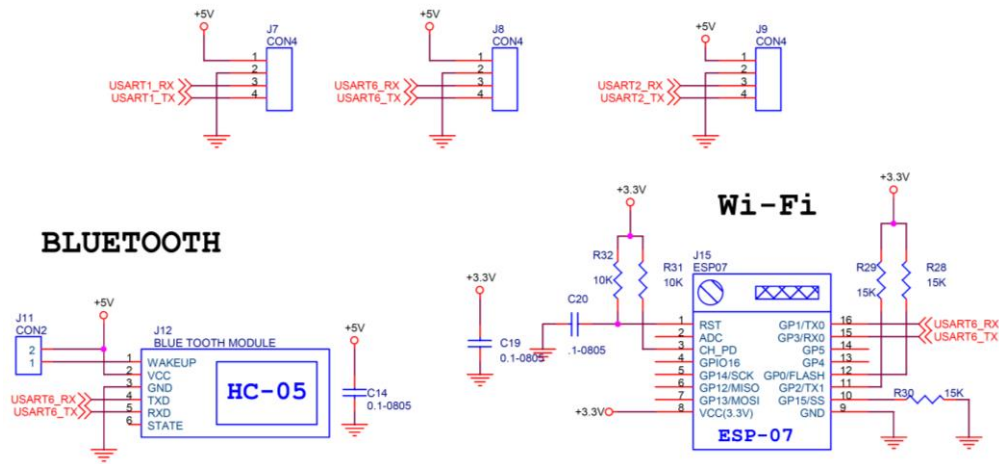


Table 2-7. USART Pin configuration

GPIO Pin	Pin Function	On-Board Function
PA9	GPIO	UART1_TX
PA10	GPIO	UART1_RX
PA2	GPIO	UART2_TX
PA3	GPIO	UART2_RX
PC6	GPIO	UART6_TX
PC7	GPIO	UART6_RX

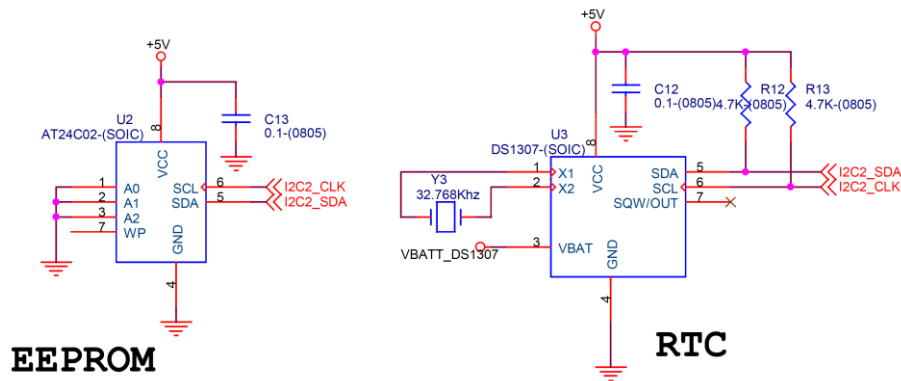
### 2.2.7. I2C Zone

The Raayan Mini Development Board has extended one I2C bus for connecting slaves. I2C2 is the master and is already connected to two slaves on the board. One is EEPROM (slave address is 0X50H) and the second slave is RTC (slave address is 0X68H).

Figure 2-9. Raayan Mini STM32F4 Development Board I2C schematics

Table 2-8. I2C Pin Configuration

GPIO Pin	Pin Function	On-Board Function
PB6	GPIO	I2C1_CLK
PB7	GPIO	I2C1_SDA



### 2.2.8. SPI Zone

The SPI interface can be configured for communication in master mode and slave mode. The Raayan Mini Development board provides SPI1 as master which can be interfaced to another SPI device. The Table 2-9 shows the pin configuration for SPI.

**Table 2-9. SPI Pin Configuration**

GPIO Pin	Pin Function	On-Board Function
PA4	GPIO	SPI1_NSS
PA5	GPIO	SPI1_SCK
PA6	GPIO	SPI1_MISO
PA7	GPIO	SPI1_MOSI

### 2.2.9. CAN Zone

Raayan Mini STM32F4 Development Board version 4.0/4.1 offers the option for connecting an external Controller Area Network (CAN) controller that implements the CAN specification, Version 2.0B. It is capable of transmitting and receiving both standard and extended data and remote frames. This CAN controller interfaces with microcontrollers (MCUs) via an industry standard Serial Peripheral Interface (SPI).

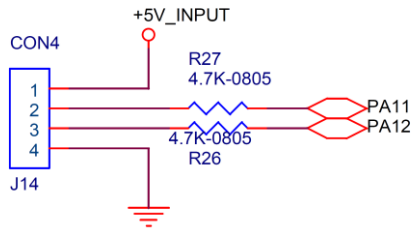
**Table 2-10. CAN-SPI Pin Configuration**

GPIO Pin	Pin function	On-Board Function	Device
PB10	GPIO	SPI2_SCK	CAN_SCK
PC2	GPIO	SPI2_MISO	CAN_SO
PC3	GPIO	SPI2_MOSI	CAN_SI
PC4	GPIO	SPI2_CS	CAN_CS

### 2.2.9. Power supply

The power supply is provided by the host PC through the USB cable, or by an external 5V power supply. 5V and 3V3 can be used as output power supplies when another application board is connected to the corresponding pins, power consumption must be lower than 100 mA.

## POWER SUPPLY



**Figure 2-10. Raayan Mini STM32F4 Development Board Power supply schematics**

### 2.2.10. Oscillators

The Raayan Mini STM32F4 Development Board provides an external 32.768-KHz crystal (Y3) as the clock source for external RTC. Another 32.768-KHz crystal (Y2) serves as clock for internal RTC. This board also uses an 8 MHz crystal (Y1) to complete the STM32F401RBT6 microcontroller main internal clock circuit.

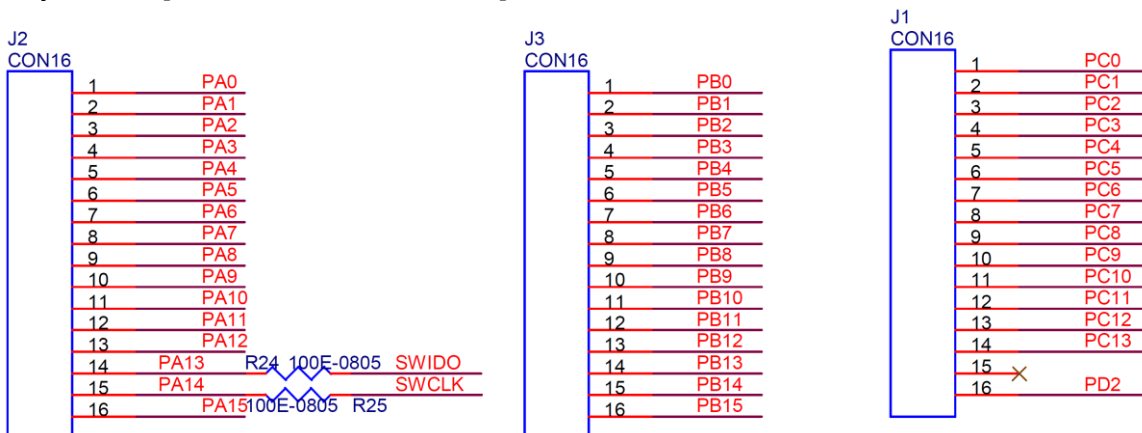
### 2.2.11. Electrically Erasable and Programmable Read-Only Memory (EEPROM)

The Raayan Mini STM32F4 Development Board provides an EEPROM of size 8K with 2-wire serial interface bus, I2C compatible. It is internally Organized 128 x 8 (1K), 256 x 8 (2K), 512 x 8 (4K), 1024 x 8 (8K) or 2048 x 8 (16K). It also has a write Protect Pin for Hardware Data Protection.

### 2.2.12. Real Time clock (RTC)

The Raayan Mini STM32F4 Development Board provides an external RTC. It is a low power, full binary-coded decimal (BCD) serial Real Time Clock. Address and data are transferred serially through an I2C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. An external crystal (32.7 KHz) is also provided exclusively for RTC.

### 2.2.13. Expansion Headers



**Figure 2-11. Raayan Mini STM32F4 Development Board GPIO Header schematics**

The three rows of stackable headers are mapped to most of the GPIO pins of the STM32F401RBT6 microcontroller. These rows are labeled as connectors J1, J2, and J3. Each pin has to be configured in their respective GPIO Port Mode register as shown below as per your requirement of your project.

**Table 2-11. STM32F401 MuX/Pad Configuration**

GPIOIX_MODER		
0	0	GPIO - Input
0	1	GPIO - Output
1	0	Alternate Function
1	1	Analog mode

All 48 header pins represents the GPIO Port C, Port A and Port B respectively. These GPIO pins can be configured according to the functionality required by the users.

**Table 2-12. J1 Connector**

J1 Pin	STM32F4 MCU Pin	Port	GPIO	On-board Function	Analog Function	AF00 SYS_AF	AF01 TIM1/TIM2	AF02 TIM3/TIM4 / TIM5	AF03 TIM9/TIM10/TIM11	AF04 I2C1/I2C2 / I2C3	AF05 SPI1/SPI2/I2S2/SPI3/I2S3/SPI4	AF06 SPI2/I2S2/SPI3/I2S3	AF07 SPI3/I2S3 /USART1 /USART2	AF08 USART6	AF09 I2C2/I2C3	AF10 OTG1_FS	AF11 SDIO	AF12	AF13	AF14	AF15
1.01	8	Port C	PC0	-	ADC1_IN10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
1.02	9		PC1	-	ADC1_IN11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
1.03	10		PC2	CAN_SO	ADC1_IN12	-	-	-	-	-	SPI2_MISO	I2S2ext_SD	-	-	-	-	-	-	-	-	EVENT OUT
1.04	11		PC3	CAN_SI	ADC1_IN13	-	-	-	-	-	SPI2_MOSI /I2S2_SD	-	-	-	-	-	-	-	-	-	EVENT OUT
1.05	24		PC4	CAN_CS	ADC1_IN14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
1.06	25		PC5	-	ADC1_IN15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
1.07	37		PC6	USART6_TX	-	-	-	TIM3_CH1	-	-	I2S2_MCK	-	-	USART6_TX	-	-	-	SDIO_D6	-	-	EVENT OUT
1.08	38		PC7	USART6_RX	-	-	-	TIM3_CH2	-	-	-	I2S3_MCK	-	USART6_RX	-	-	-	SDIO_D7	-	-	EVENT OUT
1.09	39		PC8	SW_UP	-	-	-	TIM3_CH3	-	-	-	-	-	USART6_CK	-	-	-	SDIO_D0	-	-	EVENT OUT
1.1	40		PC9	SW_DN	-	MCO_2	-	TIM3_CH4	-	I2C3_SDA	I2S_CKIN	-	-	-	-	-	-	SDIO_D1	-	-	EVENT OUT
1.11	51		PC10	SW_ENT	-	-	-	-	-	-	-	SPI3_SCK/I2S3_CK	-	-	-	-	-	SDIO_D2	-	-	EVENT OUT
1.12	52		PC11	-	-	-	-	-	-	-	I2S3ext_SD	SPI3_MISO	-	-	-	-	-	SDIO_D3	-	-	EVENT OUT
1.13	53		PC12	-	-	-	-	-	-	-	-	SPI3_MOSI /I2S3_SD	-	-	-	-	-	SDIO_CK	-	-	EVENT OUT
1.14	2	Port D	PC13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
1.15			NC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.16	54	Port D	PD2	-	-	-	-	TIM3_ETR	-	-	-	-	-	-	-	-	-	SDIO_CMD	-	-	EVENT OUT

Table 2-13. J2 Connector

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J2 Pin	STM32F4 MCU Pin	Port	GPIO	On-board Function	Analog Function	AF00 SYS_AF	AF01 TIM1/TIM2	AF02 TIM3/TIM4/ TIM5	AF03 TIM9/TIM10/ TIM11	AF04 I2C1/I2C2/ I2C3	AF05 SPI1/SPI2/ 2S2/SPI3/I2S3/SPI4	AF06 SPI2/I2S2/ SPI3/I2S3	AF07 SPI3/I2S3/ USART1/ USART2	AF08 USART6	AF09 I2C2/ I2C3	AF10 OTG1_FS	AF11	AF12 SDIO	AF13	AF14	AF15
2.01	14	Port A	PA0	TFT_A0	ADC1_IN0	-	TIM2_CH1/ TIM2_ETR	TIM5_CH1	-	-	-	-	USART2_CTS	-	-	-	-	-	-	-	EVENT OUT
2.02	15		PA1	TFT_RESET	ADC1_IN1	-	TIM2_CH2	TIM5_CH2	-	-	-	-	USART2_RTS	-	-	-	-	-	-	-	EVENT OUT
2.03	16		PA2	USART2_TX	ADC1_IN2	-	TIM2_CH3	TIM5_CH3	TIM9_CH1	-	-	-	USART2_TX	-	-	-	-	-	-	-	EVENT OUT
2.04	17		PA3	USART2_RX	ADC1_IN3	-	TIM2_CH4	TIM5_CH4	TIM9_CH2	-	-	-	USART2_RX	-	-	-	-	-	-	-	EVENT OUT
2.05	20		PA4	TFT_CS	ADC1_IN4	-	-	-	-	-	SPI1_NSS	SPI3_NSS/ I2S3_WS	USART2_CK	-	-	-	-	-	-	-	EVENT OUT
2.06	21		PA5	TFT_SCK	ADC1_IN5	-	TIM2_CH1/ TIM2_ETR	-	-	-	SPI1_SCK	-	-	-	-	-	-	-	-	-	EVENT OUT
2.07	22		PA6	SPI1_MISO	ADC1_IN6	-	TIM1_BKIN	TIM3_CH1	-	-	SPI1_MISO	-	-	-	-	-	-	-	-	-	EVENT OUT
2.08	23		PA7	TFT_SDA	ADC1_IN7	-	TIM1_CH1_N	TIM3_CH2	-	-	SPI1_MOSI	-	-	-	-	-	-	-	-	-	EVENT OUT
2.09	41		PA8	-	-	MCO_1	TIM1_CH1	-	-	I2C3_SCL	-	-	USART1_CK	-	-	OTG_FS_SOF	-	-	-	-	EVENT OUT
2.10	42		PA9	USART1_TX	-	-	TIM1_CH2	-	-	I2C3_SMB	-	-	USART1_TX	-	-	OTG_FS_VBUS	-	-	-	-	EVENT OUT
2.11	43		PA10	USART1_RX	-	-	TIM1_CH3	-	-	-	-	-	USART1_RX	-	-	OTG_FS_ID	-	-	-	-	EVENT OUT
2.12	44		PA11	-	-	-	TIM1_CH4	-	-	-	-	-	USART1_CTS	USART6_TX	-	OTG_FS_DM	-	-	-	-	EVENT OUT
2.13	45		PA12	-	-	-	TIM1_ETR	-	-	-	-	-	USART1_RTS	USART6_RX	-	OTG_FS_DP	-	-	-	-	EVENT OUT
2.14	46		PA13	-	-	JTMS_SWDIO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
2.15	49		PA14	-	-	JTCK_SWCLK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
2.16	50		PA15	-	-	JTDI	TIM2_CH1/ TIM2_ETR	-	-	-	SPI1_NSS	SPI3_NSS/ I2S3_WS	-	-	-	-	-	-	-	-	EVENT OUT



Table 2-14. J3 Connector

J3 Pin	STM32F4 MCU Pin	Port	GPIO	On-board Function	Analog Function	AF00	AF01	AF02	AF03	AF04	AF05	AF06	AF07	AF08	AF09	AF10	AF11	AF12	AF13	AF14	AF15
						SYS_AF	TIM1/TIM2	TIM3/TIM4/TIM5	TIM9/TIM10/TIM11	I2C1/I2C2/I2C3	SPI1/SPI2/I2S2/SPI3/I2S3/SPI4	SPI2/I2S2/SPI3/I2S3	SPI3/I2S3/USART1/USART2	USART6	I2C2/I2C3	OTG1_FS		SDIO			
3.01	26	Port B	PB0	LCD_DATA_4	ADC1_IN8	-	TIM1_CH2N	TIM3_CH3	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
3.02	27		PB1	LCD_DATA_5	ADC1_IN9	-	TIM1_CH3N	TIM3_CH4	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
3.03	28		PB2	LCD_DATA_6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
3.04	55		PB3	LCD_DATA_7	-	JTDO-SWO	TIM2_CH2	-	-	-	SPI1_SCK	SPI3_SCK/I2S3_CK	-	-	I2C2_SDA	-	-	-	-	-	EVENT OUT
3.05	56		PB4	LCD_RS	-	JTRST	-	TIM3_CH1	-	-	SPI1_MISO	SPI3_MISO	I2S3ext_SD	-	I2C3_SDA	-	-	-	-	-	EVENT OUT
3.06	57		PB5	LCD_RW	-	-	-	TIM3_CH2	-	I2C1_SMBA	SPI1_MOSI	SPI3_MOSI/I2S3_SD	-	-	-	-	-	-	-	-	EVENT OUT
3.07	58		PB6	I2C1_SCL	-	-	-	TIM4_CH1	-	I2C1_SCL	-	-	USART1_TX	-	-	-	-	-	-	-	EVENT OUT
3.08	59		PB7	I2C1_SDA	-	-	-	TIM4_CH2	-	I2C1_SDA	-	-	USART1_RX	-	-	-	-	-	-	-	EVENT OUT
3.09	61		PB8	LCD_EN	-	-	-	TIM4_CH3	TIM10_CH1	I2C1_SCL	-	-	-	-	-	-	-	SDIO_D4	-	-	EVENT OUT
3.10	62		PB9	-	-	-	-	TIM4_CH4	TIM11_CH1	I2C1_SDA	SPI2_NSS/I2S2_WS	-	-	-	-	-	-	SDIO_D5	-	-	EVENT OUT
3.11	29		PB10	CAN_SCK	-	-	TIM2_CH3	-	-	I2C2_SCL	SPI2_SCK/I2S2_CK	-	-	-	-	-	-	-	-	-	EVENT OUT
3.12	30		PB11	-	-	-	TIM2_CH4	-	-	I2C2_SDA	-	-	-	-	-	-	-	-	-	-	EVENT OUT
3.13	33		PB12	BUZZER	-	-	TIM1_BKIN	-	-	I2C2_SMBA	SPI2_NSS/I2S2_WS	-	-	-	-	-	-	-	-	-	EVENT OUT
3.14	34		PB13	USER_LED2 (RED)	-	-	TIM1_CH1N	-	-	-	SPI2_SCK/I2S2_CK	-	-	-	-	-	-	-	-	-	EVENT OUT
3.15	35		PB14	USER_LED1 (GREEN)	-	-	TIM1_CH2N	-	-	-	-	I2S2ext_SD	-	-	-	-	-	-	-	-	EVENT OUT
3.16	36		PB15	-	-	RTC_REFN	TIM1_CH3N	-	-	-	SPI2_MISO	SPI2_MOSI/I2S2_SD	-	-	-	-	-	-	-	-	EVENT OUT

## 3. Software Development

This chapter provides general information on software development as well as instructions for Flash memory programming.

### 3.1. Software Description

### 3.2. Source Code

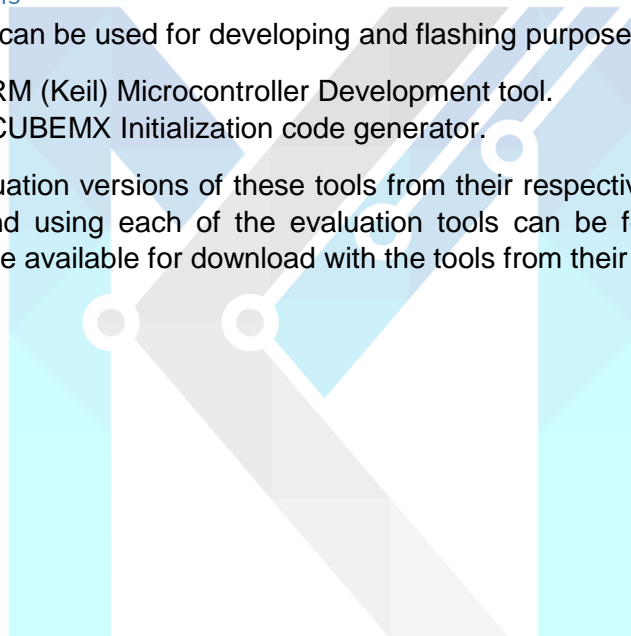
<https://github.com/raayanmini>

### 3.3. Tool Options

Following tools can be used for developing and flashing purpose.

1. MDK-ARM (Keil) Microcontroller Development tool.
2. STM32CUBEMX Initialization code generator.

Download evaluation versions of these tools from their respective websites. Instructions on installing and using each of the evaluation tools can be found in the Quick start guides which are available for download with the tools from their respective websites.



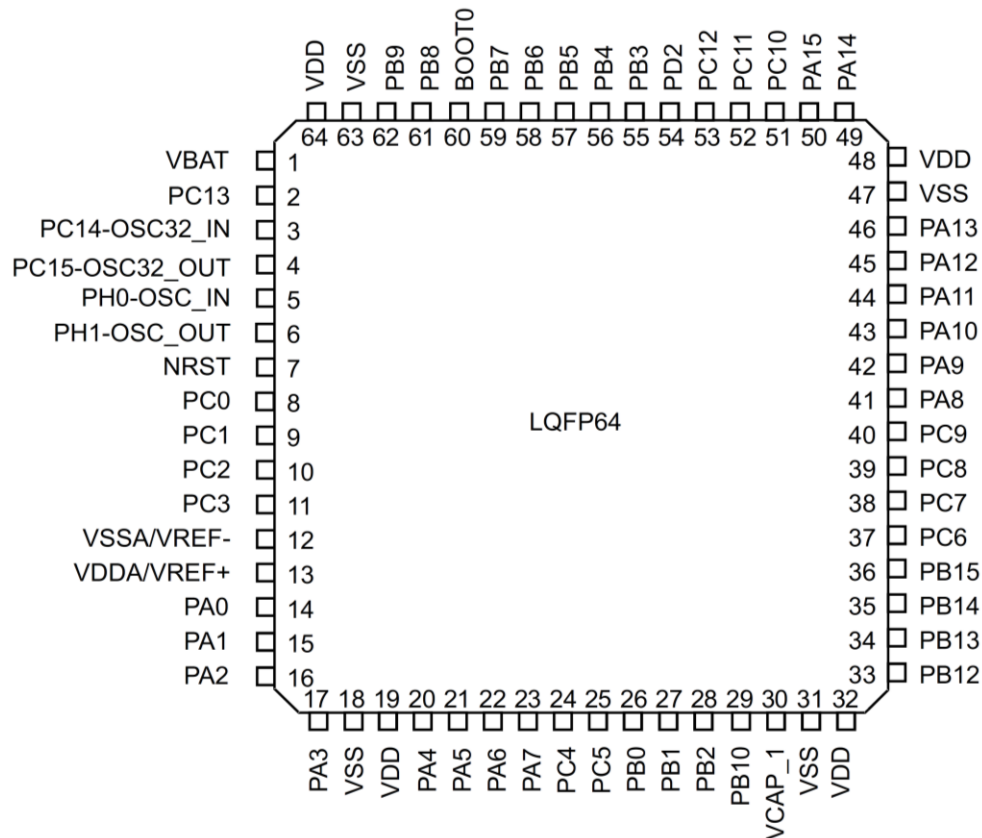
## 4. References, PCB Layout, and Bill of Materials

### 4.1. References

- MDK-ARM ([www.keil.com/arm/rvmdkkit.asp](http://www.keil.com/arm/rvmdkkit.asp))
- STM32CubeMX([www.st.com/en/development-tools/stm32cubemx.html](http://www.st.com/en/development-tools/stm32cubemx.html))

### 4.2. Pin out Diagram

**Figure 4-1. STM32F401RBT6 LQFP64 pin out**



## 4.3. Component Locations

Figure 4-2. Raayan Mini STM32F4 Development Board Component Locations (Top View)

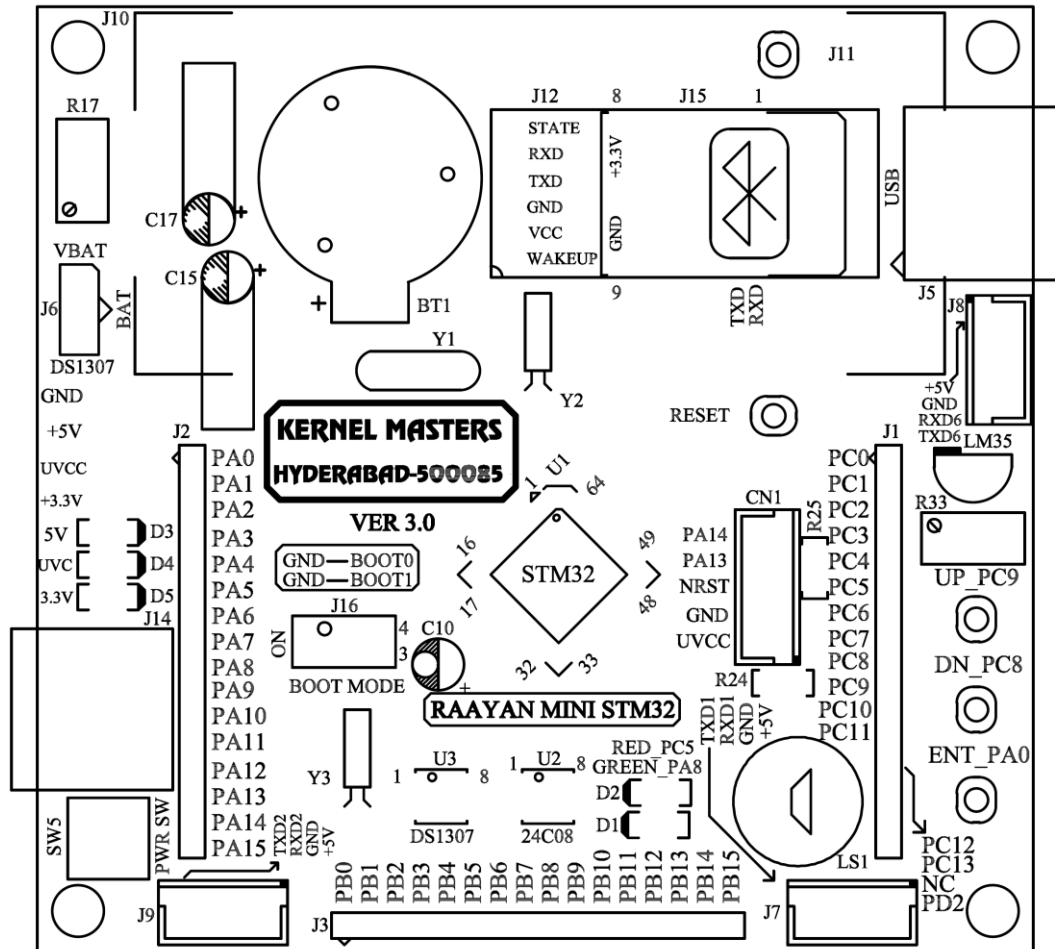


Figure 4-3. Raayan Mini STM32F4 Development Board Component Locations (Bottom View)

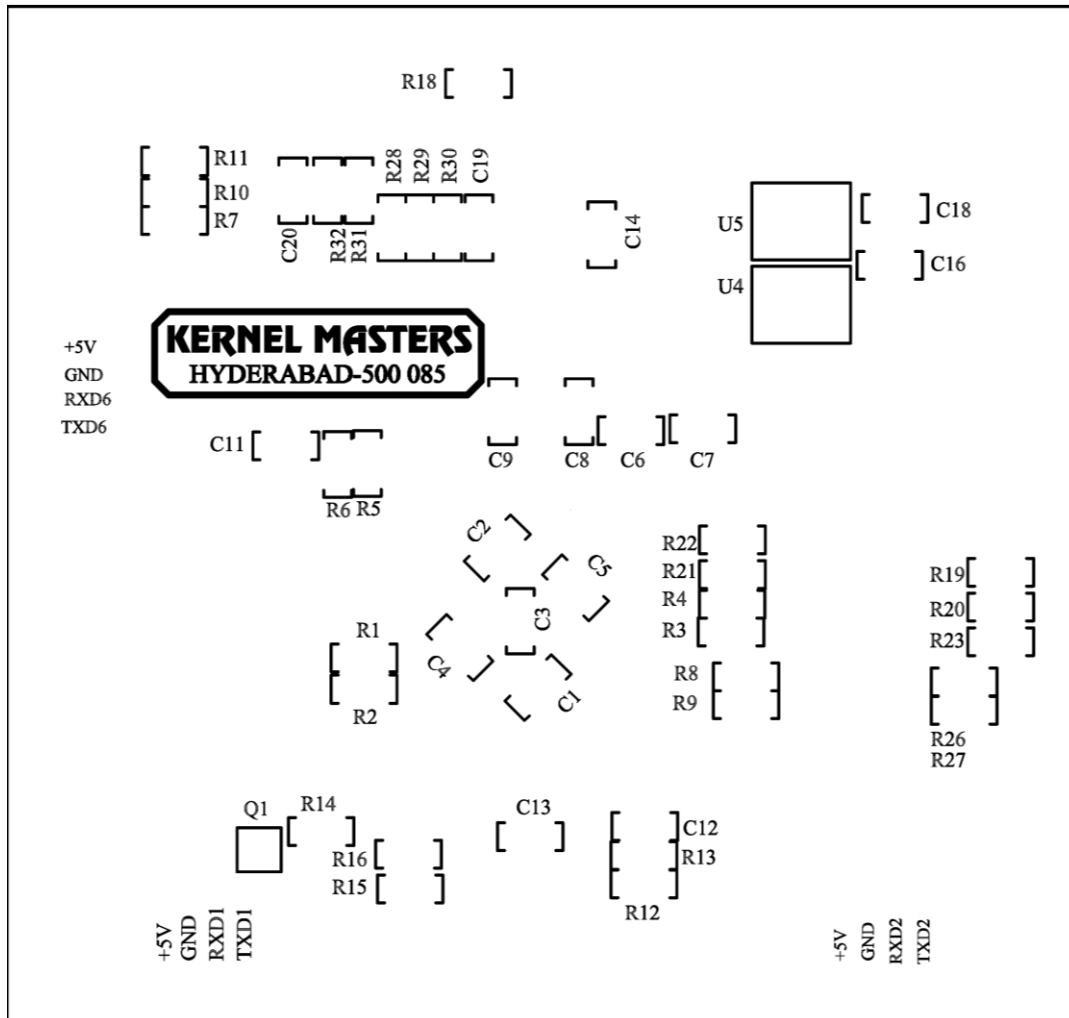
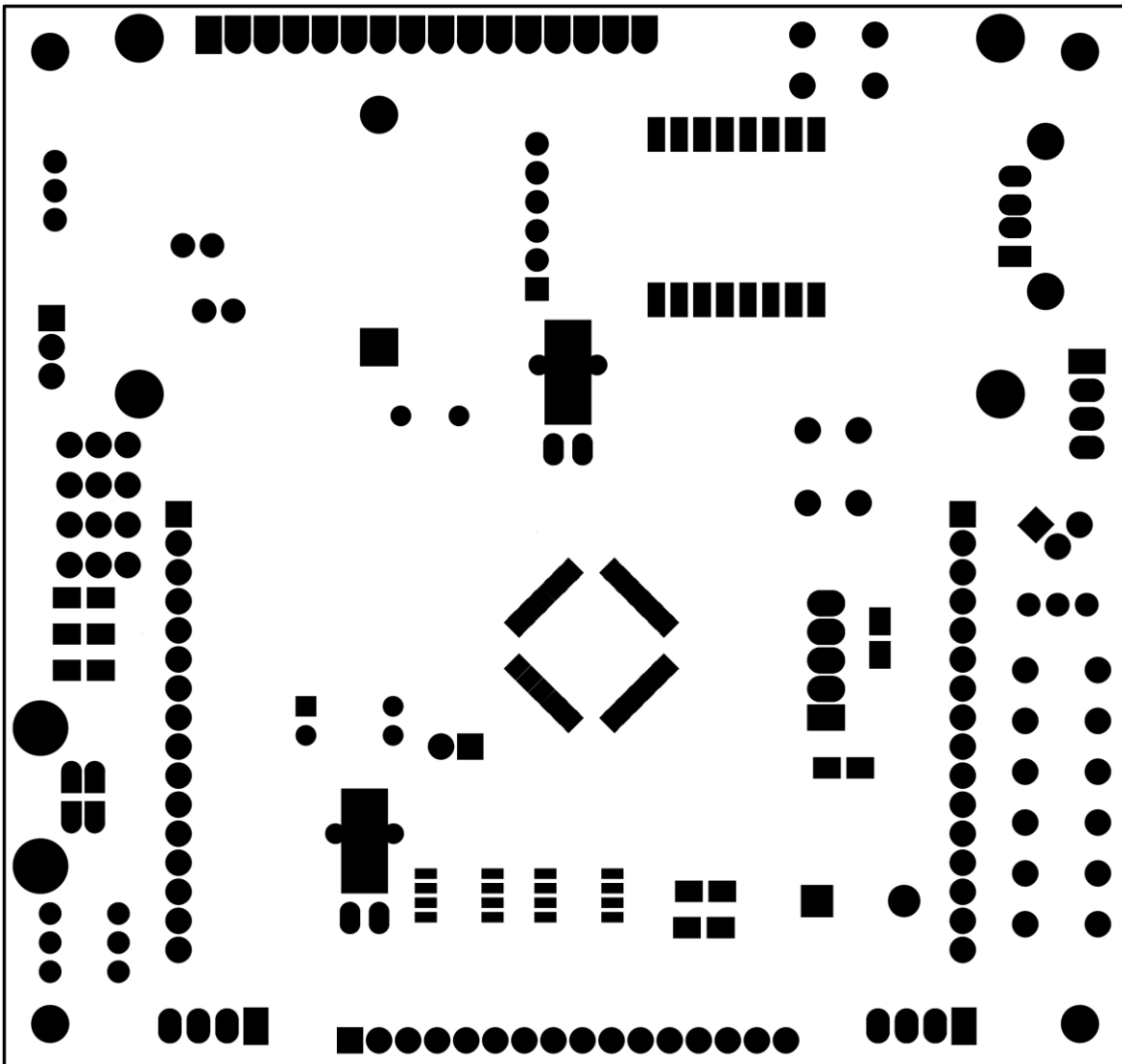


Figure 4-4. Raayan Mini STM32F4 Development Board



## 4.4 Bill of Materials (BOM)

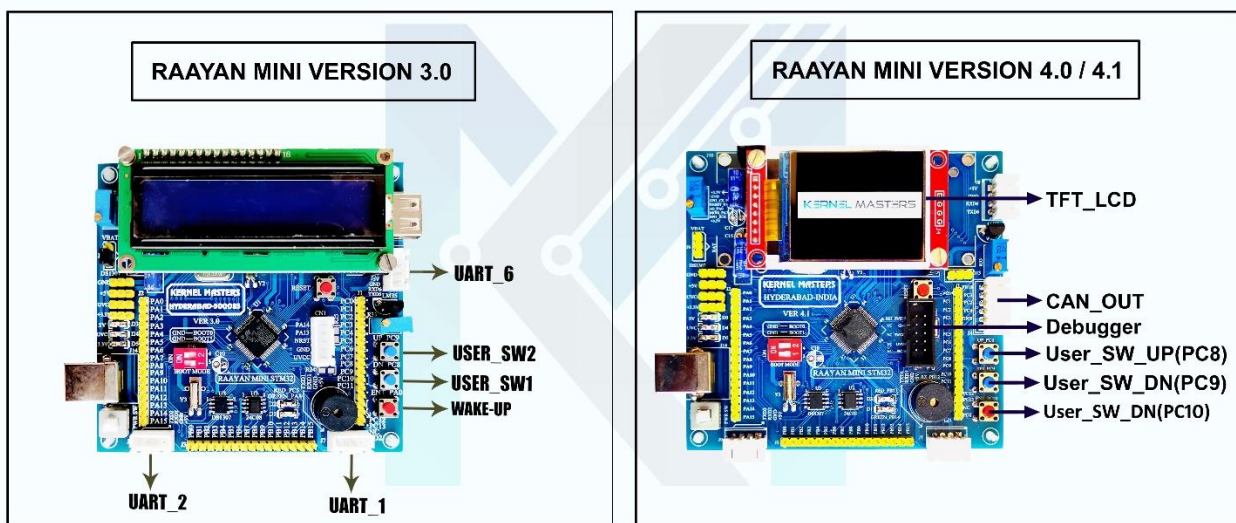


Table 4-1 shows the bill of materials for the Raayan Mini STM32F4 Development board.



## Appendix A

Raayan Mini board version 3.0 vs version 4.0/4.1



## Appendix B

### Schematics



This section contains the complete schematics for the Raayan Mini STM32F4 Development board.

