Turtle Board

LoRa Node Development Kit

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Document version

Version	Time	Description
V1.0	2019-03-01	Documents creating
V1.0	2021-05-20	Document structure update

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Content

1. Description

1.1 Overview

The turnkey Turtle board solution can be used immediately. Support standard LoRaWAN protocol and RadioShuttle protocol. The included RadioShuttle radio protocol software enables node-to-node communication without additional routers and servers. The Turtle LoRa board by HelTec Automation can run 10 years on AAA batteries (standard or rechargeable NiMH) using the "RadioShuttle" LoRa wireless low-energy protocol software.

Turtle board are available in two product variants:

Table 1.1 Product model list

No.	Model	Description
1	Turtle Board -L	470~510MHz working LoRa frequency, used for China mainland (CN470) LPW band.
2	Turtle Board-F	For EU868, IN865, US915, AU915, AS923, KR920 and other LPW networks with operating frequencies between 863~928MHz.

1.2 About RadioShuttle protocol

RadioShuttle Protocol is a node-to-node LoRa wireless communication protocol software. Compare with LoRaWAN(TM), which is capable of efficiently sending

messages in a fast and secure way, any node can work as a gateway. We also provide the MQTT server and IOS / Android APP examples source code.

Table 1.2

LoRaWAN™	RadioShuttle
Concentrator required	No concentrator required, the station uses regular LoRa module
Network subscription fees (If use MQTT server)	No monthly fees
One large radio cell	Many small independent radio cells
Busy network in a radius of many kilometers	Small networks with no interference
Single point of failure (Concentrator)	Automatic transmitting power adjustment – longer battery life
High latency, larger spreading factor, e.g. SF11 (1320 ms)	Low latency, small spreading factor, e.g. SF7 (120 ms)

1.3 Product features

- CE Certificate;
- Microprocessor: STM32L432KC (32-bit ultra-low power MCU) with LoRa node chip SX1276;
- Micro USB interface with complete protection measures such as voltage regulation, ESD protection, and short circuit protection;
- Onboard AAA x 2 battery holder, USB / battery power automatically switch;
- Reserve IPEX and SMA antenna interfaces for LoRa use;
- Programming and debugging interface can be combined with our downloader;
- Support DFU protocol, which can be downloaded conveniently via USB (combined

with “RadioShuttle STM32 Utility”);

- Professional software support (ARM Mbed IDE);
- Provide Standard LoRaWAN protocol routines;
- Good RF circuit design and perfect low-power design (sleep current: 4uA), which is convenient for IoT application vendors to quickly verify solutions and deploy applications.

2. Pin Definition

2.1 Pin assignment

Turtle Board Pinmap (v1.0)

Comment	Mbed	Turtle		Left		USB		Right		Turtle	Mbed	Comment
			VDD	1			1	VIN				Alternative input voltage (3.4-5V)
			GND	2			2	GND				
UART RX for debugger	UART2/PWM/ADC	RX	PA15	3			3	VDD				
SWO for debugger	SPI1,3-SCK/ADC	SWO	PB3	4			4	PA9	SCL	UART1/I2C1-SCL/ADC/PWM	Optional use for sensors/OLED	
	I2C3-SDA/ADC/SPI1,3-MISO	-	PB4	5			5	PA10	SDA	UART1/I2C1-SDA/ADC/PWM		
LoRa-DIO1			DIO1	6			6	PA8	USB pwr	ADC/PWM	Input high when USB powered	
	I2C3-SDA/ADC/SPI1,3-MOSI	-	PB5	7			7	PB1	LED (red)	ADC/PWM	Status blinks/LoRa RX	
	UART1/I2C1-SCL/ADC/PWM	-	PB6	8			8	PB0	LED2 (green)	ADC/PWM	CPU busy/LoRa TX	
LoRa-DIO2			DIO2	9			9	VREF			VREF+ output/input	
	UART1/ADC	-	PB7	10			10	PA3	VEXT-SW	UART2/ADC/PWM/LPUART	Switch (high = VEXT off, low = VEXT on)	
LoRa-SCK		SCK	PA5	11			11	PA2	TX	UART2/ADC/PWM/LPUART	UART TX for debugger	
LoRa-MISO		MISO	PA6	12			12	PA1	RST-LoRa	ADC/PWM/SPI1-SCK		
LoRa-MOSI		MOSI	PA7	13			13	PA0	LoRa-DIO0		LoRa-DIO0 (RX/TX/CAD interrupts)	
VDD voltage switchable		Power	VEXT	14			14	VEXT	Power		VDD voltage switchable	

In use with LoRa chip
In use with debugger, otherwise available
Free to use (without debugger)
Custom use when bridge resistor is removed

Debugger

		Left			Right			
RX	PA15	1	2	PB3	SWO	SPI1,2-SCK/ADC		
TX	PA2	3	4	NRST	NRST		MCU reset	
SWCLK	PA14	5	6	VDD				
SWDIO	PA13	7	8	GND				

VDD	Voltage between 2.1-3.6V
VIN	Alternative external voltage input (3.4-5V)
VEXT	Switchable VDD voltage for external consumers
VREF	VREF input when VREF+ bridge is removed
VBAT	Batteries source 2.1-3.6V is supported

2.2 Pin description

Header P1

Table 2-2-1 Pin description

No.	Name	Type	Function
1	VDD	P	3.3V Input/Output.
2	GND	P	Ground.
3	PA15	I/O	PA15, USART2_RX, PWM, ADC.
4	PB3	I/O	PB3, SWO, SPI1_SCK, SPI3_SCK, ADC.
5	PB4	I/O	PB4, IIC3_SDA, SPI1_MISO, SPI3_MISO, ADC.
6	DIO1	O	LoRa_DIO1.
7	PB5	I/O	PB5, IIC3_SDA, SPI1_MOSI, SPI3_MOSI, ADC.
8	PB6	I/O	PB6, USART1_TX, IIC1_SCL, PWM, ADC.
9	DIO2	O	LoRa_DIO2
10	PB7	I/O	PB7, USART1_RX, ADC.

11	PA5	I/O	PA5, SPI1_SCK, LoRa_SCK.
12	PA6	I/O	PA6, SPI1_MISO, LoRa_MISO.
13	PA7	I/O	PA7, SPI1_MOSI, LoRa_MOSI.
14	VEXT	I/O	Output 3.3V, power supply for external device.

Header P2

Table 2-2-2 Pin description

No.	Name	Type	Function
1	VIN	P	5V Input/Output.
2	GND	P	Ground.
3	VDD	P	3.3V Input/Output.
4	PA9	I/O	PA9, USART1_TX, IIC1_SCL, PWM, ADC.
5	PA10	I/O	PA10, USART1_RX, IIC1_SDA, PWM, ADC.
6	PA8	I/O	PA8, PWM, ADC.
7	PB1	I/O	PB1, RED_LED, PWM, ADC.
8	PB0	I/O	PB0, GREEN_LED, PWM, ADC.
9	VREF	I/O	VREF+.
10	PA3	I/O	PA3, USART2_RX, LPUART1_RX, PWM, ADC, VEXT Control.
11	PA2	I/O	PA2, USART2_RX, LPUART1_TX, PWM, ADC.
12	PA1	I/O	PA1, SPI1_SCK, PWM, ADC, LoRa_RST.
13	PA0	I/O	PA0, LoRa_DIO0.
14	VEXT	I/O	Output 3.3V, power supply for external device.

Header P3

Table 2-2-3 Pin description

No.	Name	Type	Function
1	PA15	I/O	PA15, USART2_RX, PWM, ADC.
2	PB3	I/O	PB3, SWO, SPI1_SCK, SPI3_SCK, ADC.
3	PA2	I/O	PA2, USART2_RX, LPUART1_TX, PWM, ADC.
4	NRST	I	RESET.
5	PA14	I/O	PA14, SWCLK.
6	VDD	P	3.3V Input/Output.
7	PA13	I/O	PA13, SWDIO.
8	GND	P	Ground.

3. Specifications

3.1 General specifications

Table 3-1: General specifications

Parameters	Description
Master Chip	STM32L432KC(Ultra-low-power 32-bit MCU+FPU ARM® Cortex®-M4)
LoRa Chipset	SX1276
Frequency	470~510 MHz, 863~923 MHz
Max TX Power	19dB ± 1dB
Receiving sensitivity	-135 dBm
Hardware Resource	USART x 3; SPI x 2; I2C x 2; SAI x 1; 12-bits ADC input x 1; 12-bits DAC output x 2; GPIO x 18
Memory	256KB internal FLASH; 64KB internal SRAM
Interface	Micro USB x 1; LoRa Antenna interface(SMA) x 1; 14 x 2.54 pin x 2+4 x 2.54 pin x 2(Debug interface)
Battery	AAA Lithium x 2
Operating temperature	-20 ~ 70 ℃
Dimensions	73.5 x 31.5 x 24 mm
Low Power	Deep Sleep 4uA

3.2 Power supply

Except when USB or 5V Pin is connected separately, lithium battery can be connected to charge it. In other cases, only a single power supply can be connected.

Table 3-2: Power supply

Power supply mode	Minimum	Typical	Maximum	Company
USB powered(≥500mA)	4.7	5	6	V
Lithium battery(≥250mA)	1.8	3	3	V
5V pin(≥500mA)	4.7	5	6	V
3V3 pin(≥150mA)	2.7	3.3	3.5	V

3.3 Power output

Table 3-3: Power output

Output Pin	Minimum	Typical	Maximum	Company
3.3V Pin			500	mA
5V Pin (USB Powered only)		Equal to the input current		
Vext Pin			350	mA

3.4 Power characteristics

Table 3-4: Power characteristics

Mode	Condition	Min.	Typical	Max.	Company
Power Consumption(mA)	LoRa 10dB output		50		mA
	LoRa 12dB output		60		mA
	LoRa 15dB output		110		mA
	LoRa 20dB output		130		mA

3.5 LoRa RF characteristics

3.5.1 Transmit power

Table3-5 Transmit power

Operating frequency band	Maximum power value/[dBm]
470~510	19 ± 1
867~870	19 ± 1
902~928	19 ± 1

3.5.2 Receiving sensitivity

The following table gives typically sensitivity level of the Turtle board-(L/H).

Table3-6: Receiving sensitivity

Signal Bandwidth/[KHz]	Spreading Factor	Sensitivity/[dBm]
125	SF12	-135
125	SF10	-130
125	SF7	-124

3.6 Operation Frequencies

Turtle board(F) supports LoRaWAN frequency channels and models corresponding table.

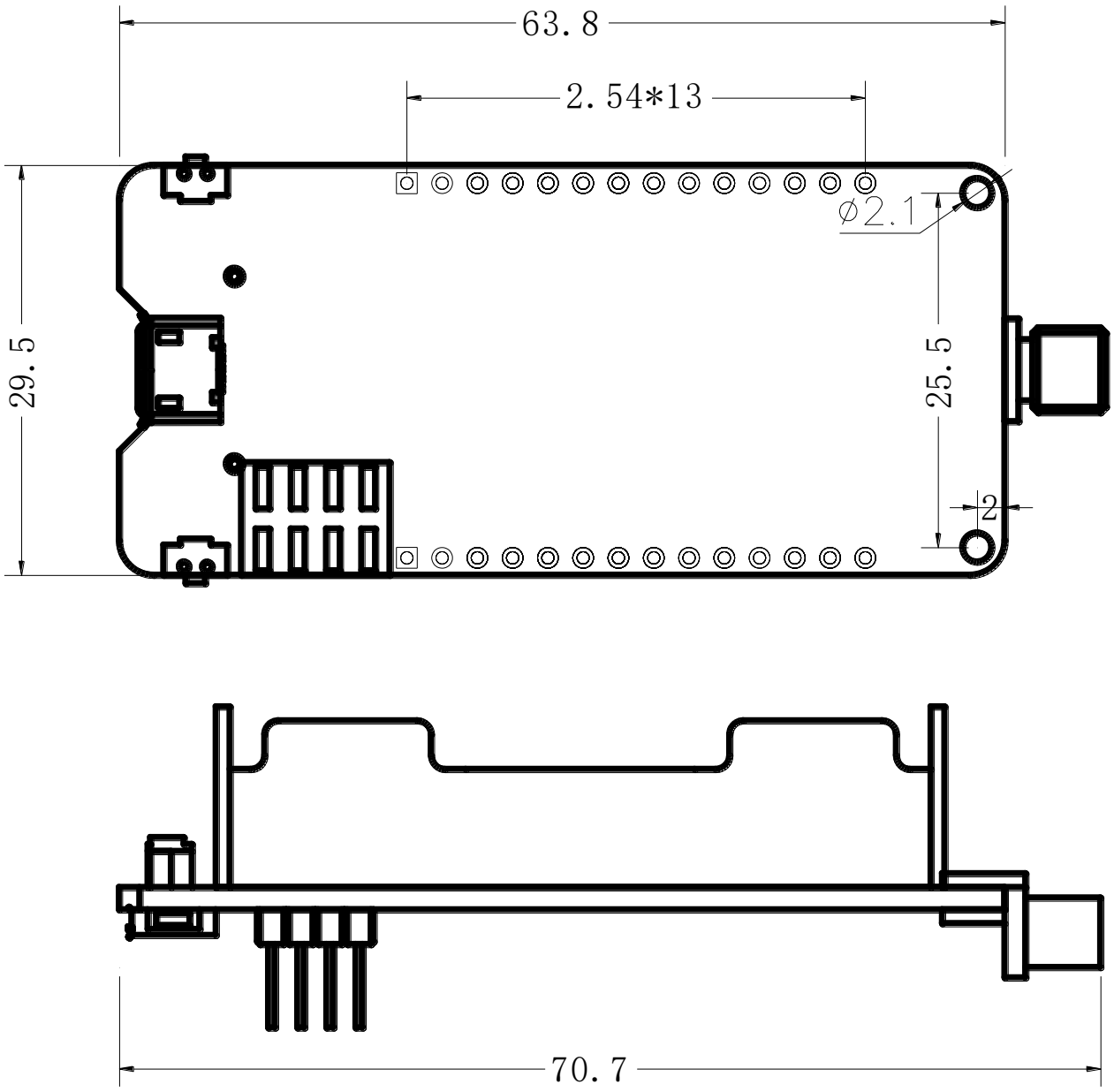
Table3-7: Operation Frequencies

Region	Frequency (MHz)	Model

EU433	433.175~434.665	Turtle Board-L
CN470	470~510	Turtle Board-L
IN868	865~867	Turtle Board-F
EU868	863~870	Turtle Board-F
US915	902~928	Turtle Board-F
AU915	915~928	Turtle Board-F
KR920	920~923	Turtle Board-F
AS923	920~925	Turtle Board-F

4. Hardware resource

4.1 Physical dimensions



5. Resource

5.1 Relevant Resource

- Pin map
- Downloadable resource

5.2 Contact Information

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