QUINTIC

QS9321 Bluetooth 4.0 Low Energy Module

User Manual

Version 1.4
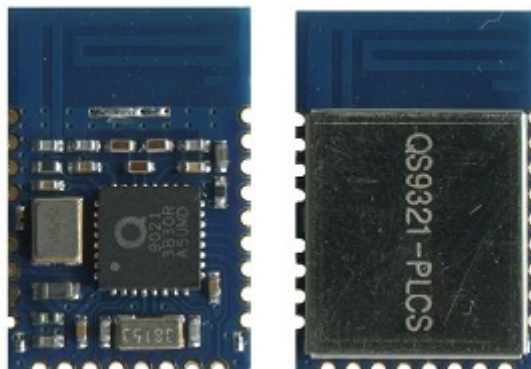
VERSION HISTORY

Version	Comment
0.1	First draft
0.9	Update pin out description
1.0	First release
1.1	Add the photo of QS9321 with shielding box
1.2	Change transparent transfer baud rate to 115200. Connect Pin19 to Vin in figure 1 and 7
1.3	Add CE note
1.4	Add model definition, Layout Guide instruction and Soldering Recommendations

Table of Contents

1 Key Features

◆ **Bluetooth® 4.0 Low Energy wireless module**

- Frequency bands: 2400MHz to 2483.5MHhz
- 1Mbps on air data rate
- Slave and Master mode operation
- Support up to 8 simultaneous links in master mode
- 128-bit AES coprocessor
- Complete BLE protocol stack and application profiles

◆ **Integrated 32-bit Cortex-M0 MCU with**

- 64KB system memory
- 128KB flash

◆ **Ultra Low Power Consumption**

- 2uA deep sleep mode
- 3uA sleep mode (32kHz RC OSC on)
- DC-DC mode
    - 9.25mA RX current at 3V
    - 8.8mA TX current @0dBm Tx power at 3V
- Non DC-DC mode
    - 13.6mA RX current at 3V
    - 13.3mA TX current @0dBm Tx power at 3V
- Integrated DC-DC converter and LDO
- Single 2.4V~3.6V power supply

◆ **High Performance**

- -95dBm RX sensitivity (Non DC-DC mode)
- -93dBm RX sensitivity (DC-DC mode)
- Tx power from -20dBm to 4dBm
- Excellent link budget up to 99dB

◆ **Complete Protocol Stack and Profile**

- Bluetooth® v4.0
- Bluetooth® v4.0 host stack including L2CAP , SMP, ATT, GATT, GAP
- Qualified application profiles and services
- Controller subsystem QDID: B021031
- Host stack subsystem QDID: B021098
- Profile subsystem QDID: B021946

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◆ **Ease of Design**

- Small form factor: QS93221-PLCS, 12x18x2.4mm; QS9321-PLCM, 12x18x1.8mm
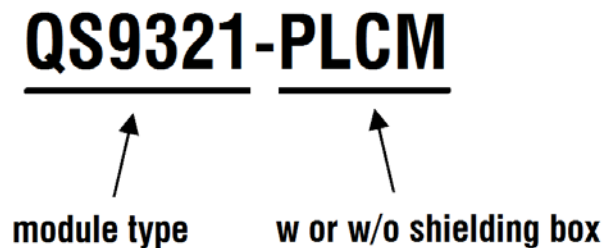- Easy to use command set over UART/SPI to communicate with App MCU

◆ **Application**

- Sports & Fitness
- Healthcare & Wellness
- Remote Control
- PC Peripherals (mouse, keyboard)
- Mobile Phone Accessories
- Home/building Automation
- Industrial automation
- Wireless Sensor Networks

2 Description

2.1 Model Definition

QS9321-PLCM

module type · w or w/o shielding box

Explain: 1. QS9321-PLCM, without shielding box, FCC ID: 2AB359321-1.
      2. QS9321-PLCS, with shielding box, the circuit design is the same as QS9321-PLCM,
        FCC ID: 2AB359321-0.

2.2 Module description

QS9321 is a compact, surface mount Bluetooth 4.0 Low Energy (BLE) compliant wireless module. It integrates an advanced single-chip BLE SoC chip – QN9021 with RF circuit and PCB antenna in a compact module. Embedded 16 MHz and 32.678 kHz crystals are used for clock generation. Impedance matching provides optimal radio performance with extremely low spurious emissions.
Small size gives good radiation efficiency with low price even when the module is used in layouts with very limited space and easy modular handling.

QS9321 offers all Bluetooth low energy features: radio, stack, profiles and application space for customer applications, so no external processor is needed. QS9321 can also be used to transfer raw data between each other through the factory built-in application.

The pre-qualified module enables users to add Bluetooth Low Energy to traditional products within the shortest time. QS9321 is leading the way for the new generation of Bluetooth low energy modules.
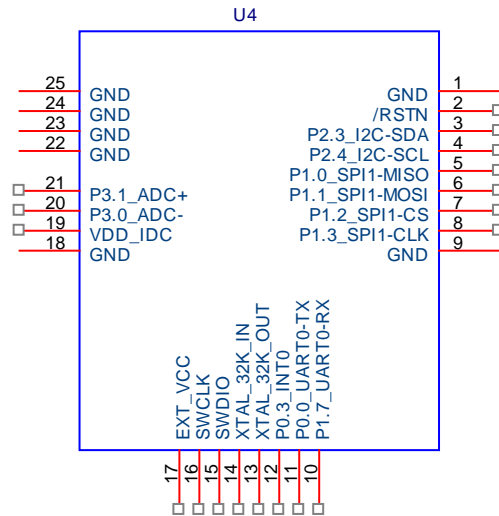
3 Pin out

Figure 1   PCB Antenna pin out

Table 1 Pin out description

PIN	NAME	FUNCTION	DESCRIPTION
1	GND	Ground	Should be connected to ground plane on application PCB
2	/RSTN	Digital Input	Hardware reset, active low.
3	P2.3/SDA	Digital in/out	GPIO / I2C data with pull-up
4	P2.4/SCL	Digital in/out	GPIO / I2C clock
5	P1.0/SPI_MISO	Digital in/out	GPIO / SPI data master in/slave out
6	P1.1/SPI_MOSI	Digital in/out	GPIO / SPI data master out/slave in
7	P1.2/SPI_CS	Digital in/out	GPIO / SPI chip select
8	P1.3/SPI_CLK	Digital in/out	GPIO / SPI clock
9	GND	Ground	Should be connected to ground plane on application PCB
10	P1.7/UART_RX	Digital input	GPIO / UART RX data input
11	P0.0/UART_TX	Digital output	GPIO / UART TX data output
12	P0.3/INT0	Digital in	GPIO / Interrupt
13	32K_CLOCK1	Analog in	Not connected
14	32K_CLOCK2	Analog out	Not connected
15	SWDIO	Digital in/out	SWD data with pull-up
16	SWCLK	Digital in	SWD clock input with pull-up
17	VCC	Power	Power supply (2.4~3.6V)
18	GND	Ground	Should be connected to ground plane on application PCB
19	VDD_IDC	Power	Not connected

20	P3.0/ADC-	Analog in	GPIO / ADC-
21	P3.1/ADC+	Analog in	GPIO / ADC+
22	GND	Ground	Should be connected to ground plane on application PCB
23	GND	Ground	Should be connected to ground plane on application PCB
24	GND	Ground	Should be connected to ground plane on application PCB
25	GND	Ground	Should be connected to ground plane on application PCB

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4 *Electrical Characteristics*

Table 2 Recommended Operating Conditions

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
VCC	Power supply	Relative to GND	2.4	3.0	3.6	V
TA	Operating temperature		-40	+25	+85	℃

Table 3 Current Consumption

SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Icc	Deep sleep mode		2		uA
	Sleep mode		3		uA
	Idle mode (w/o DC-DC)		0.84		mA
	MCU @8MHz (w/o DC-DC)		1.35		mA
	RX mode(w/o DC-DC)		13.6		mA
	RX mode (w/t DC-DC)		9.25		mA
	TX mode @0dBm Txpower (w/o DC-DC)		13.3		mA
	TX mode @0dBm Txpower (w/t DC-DC)		8.8		mA

(Typical values are T$_A$ = 25℃ and VCC =3V)

Notes:

1. Current Consumption includes analog and digital.

2. Depend on IO conditions.

3. **Deep sleep mode:** digital regulator off, no clocks, POR, RAM/register content retained

4. **Sleep mode:** digital regulator off, 32k RC OSC on, POR, sleep timer on, and RAM/register content retained

5. **Idle:** 16MHz OSC on, no radio or peripherals, 8 MHz system clock and MCU idle (no code execution)

6. **MCU@8 MHz:** MCU running at 8 MkHz RC OSC clock, no radio or peripherals

7. **RX sensitivity** is -95dBm sensitivity when DC-DC is disabled.

8. **RX sensitivity** is -93dBm sensitivity when DC-DC is enabled.

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5 Layout and Physical Dimensions

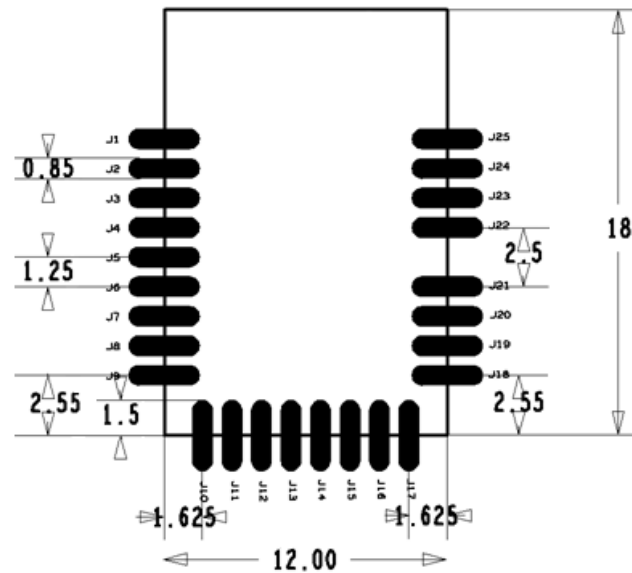## 5.1 Physical dimensions

Figure 2   Physical dimensions and pinout (mm)

5.2 Layout guide

For optimal performance of the antenna place the module at the position of the PCB as shown in the following figures. Do not place any metal (traces, components, battery etc.) within the clearance area of the antenna. Connect all the GND pins directly to a solid GND plane. Place the GND vias as close to the GND pins as possible. Use good layout practices to avoid any excessive noise coupling to signal lines or supply voltage lines.

Place nothing around the antenna for the high antenna performance as shown in Figure 3. If can't layout as aforesaid, avoid placing GND plane closer than 5 mm as shown in Figure 4 and any other dielectric material closer than 1 mm from the antenna as shown in Figure 5. Anything closer than this distance from the antenna will detune the antenna to lower frequencies and reduce the RF power.
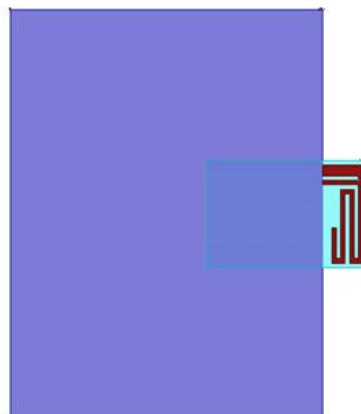

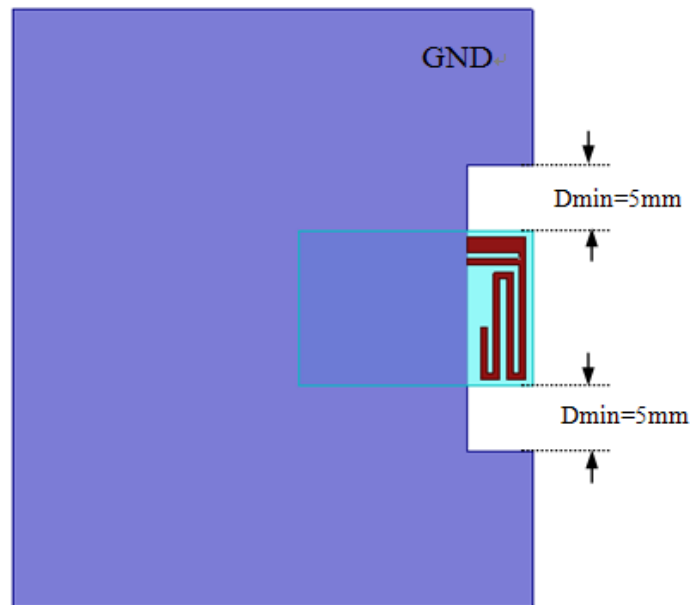**Figure 3   Layout for high performance**
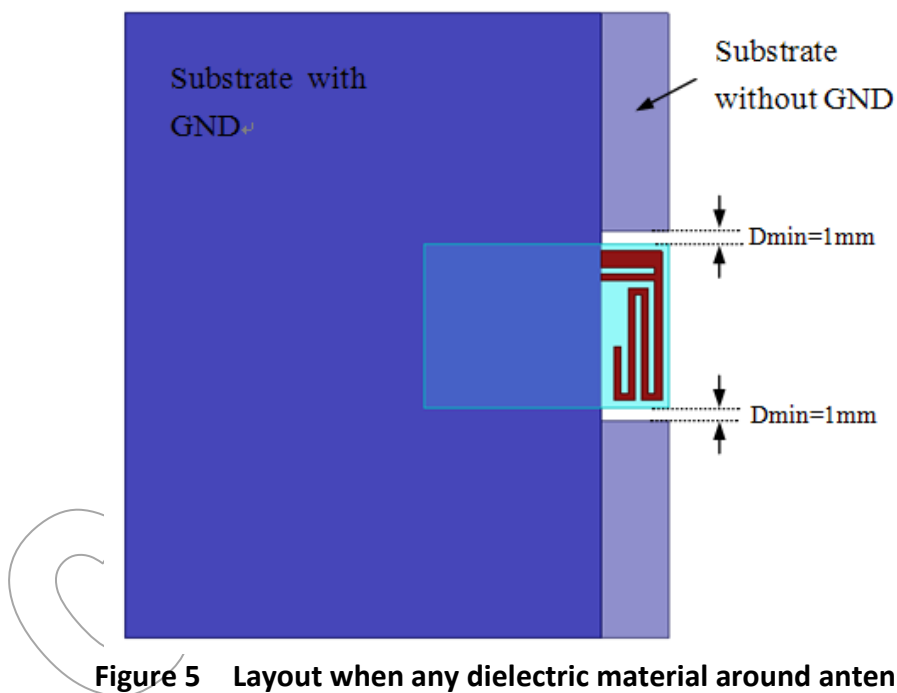
Figure 4   Layout when GND plane around antenna

Figure 5   Layout when any dielectric material around antenna

6 *Soldering Recommendations*

QS9321 is compatible with industrial standard reflow profile for Pb-free solders. The reflow profile used is dependent on the thermal mass of the entire populated PCB, heat transfer efficiency of the oven and particular type of solder paste used. Consult the datasheet of particular solder paste for profile configurations.. Since the profile used is process and layout dependent, the optimum profile should be studied case by case. Thus following recommendation should be taken as a starting point guide.

- Refer to technical documentations of particular solder paste for profile configurations

- Avoid using more than one flow.

- Aperture size of the stencil should be 1:1 with the pad size.

7 *Application Reference*

QS9321 is based on Quintic's QN9021 chip. When QS9321 is used as a MCU with BLE feature, program flow can refer to the QN9021's user manual.

When QS9321 is used as only a RF module for transfer raw data though BLE 4.0 wireless system by the built-in application, the reference circuit schematic and programming guide see the following section.
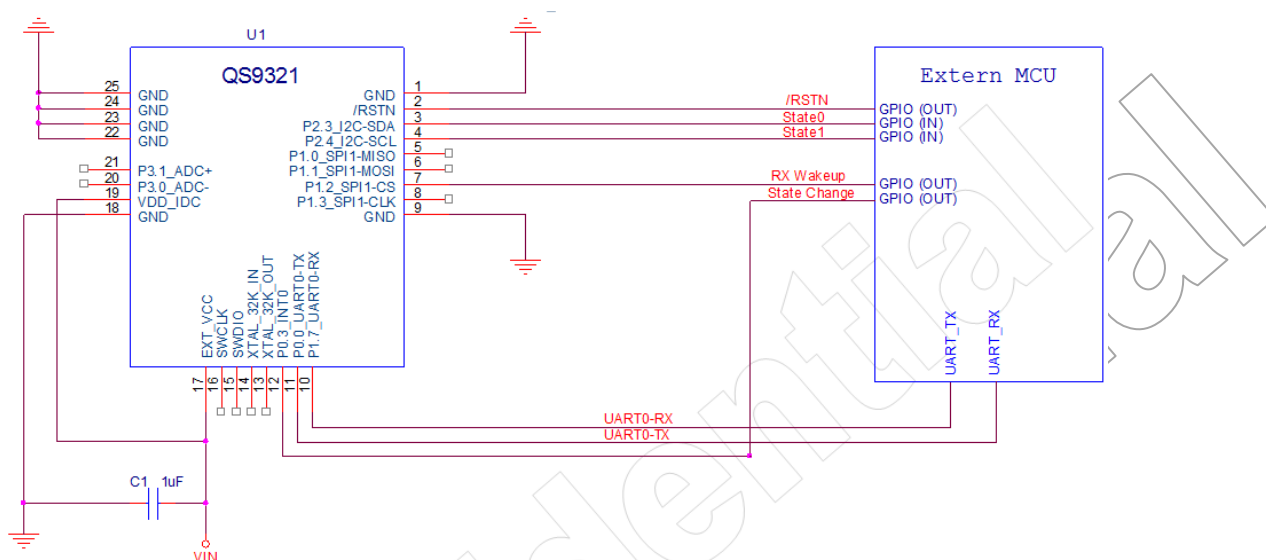
7.1 Reference circuit schematic
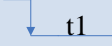

Figure 6   Reference circuit schematic

7.2 Feature

- UART Baud Rate : 115200
- Length of frame: <=120byte

7.3 Software

(a) State indicate

P23(output)	P24(output)	STATE
0	0	Sleep
0	1	Advertise
1	0	Connect Empty
1	1	Connect Full

(b) State change：

GPIO	Function	timer cycle	Remark
P03	State change	⌐ t1 ⌐	t1>=1ms ;Falling edge
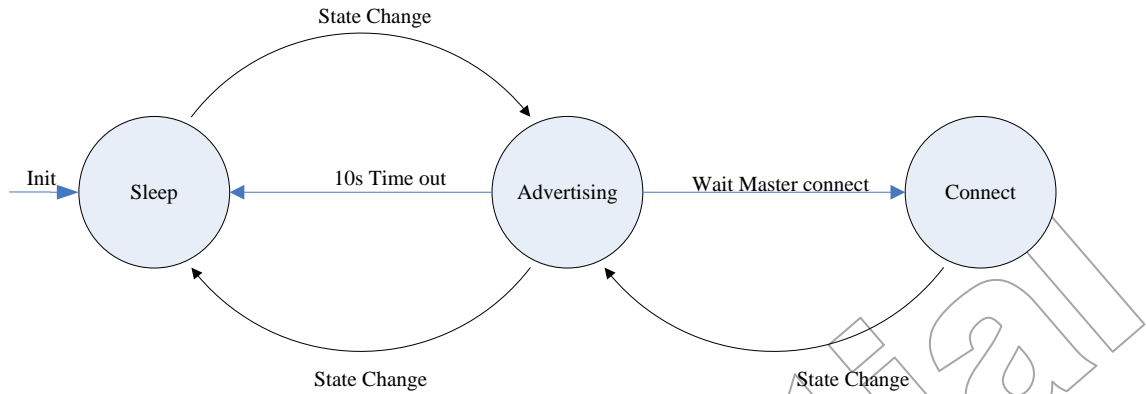
Figure 7   state change

(c) Data transmit

GPIO	Function	timer cycle	Remark
P12	RX Wakeup	⌐	Falling edge
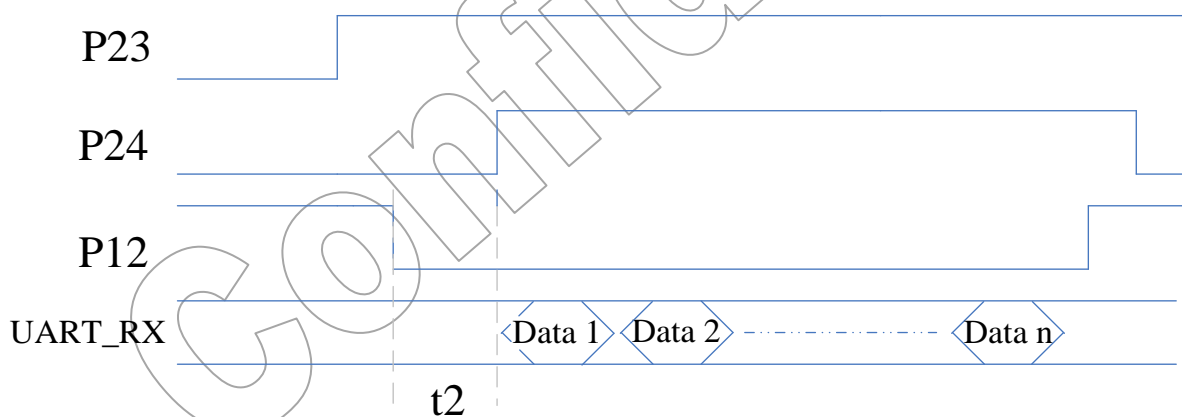
Figure 8   Waveform of module receiving UART data

NOTE: (1) T2>=1ms.

     (2) RX Wakeup pin should keep low until one frame sent completed.

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Figure 9   Flow chart of control

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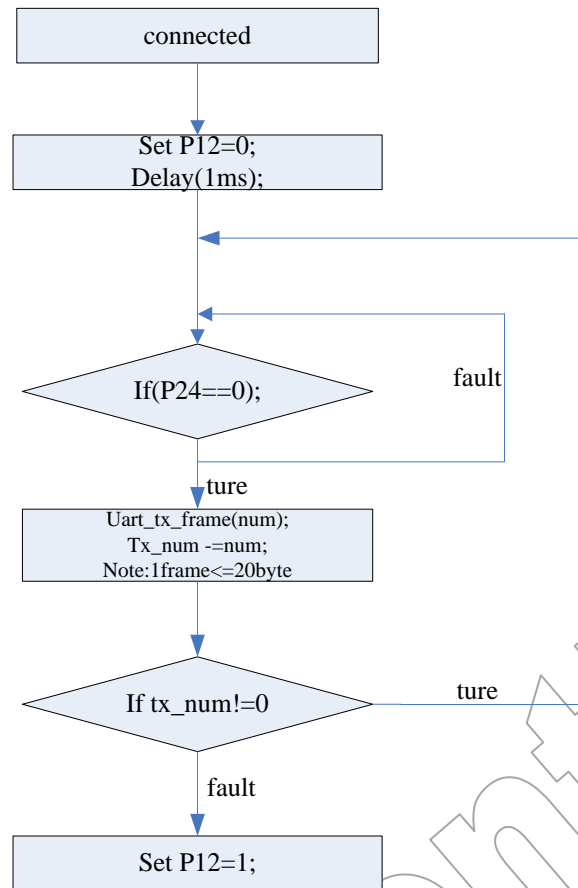Page 12 of 13

Note:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference.

(2) this device must accept any interference received, including interference that may cause undesired operation.

changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Please notice that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID:2AB359321-1 or FCC ID: 2AB359321-0" any similar wording that expresses the same meaning may be used.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 5mm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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