

ESP8266-S1 WiFi Module

Extreme / Open / Small / Easy

Specification

Version 2.5

2022/4/28

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Note

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Amendment record

Version	Changed by	Time	Reason	Details
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1. Overview

WT8266-S2 Wi-Fi module is a low consumption, high performance Wi-Fi network control module designed by Shenzhen Unique Scales Co.,Ltd. It can meet the IoT application requirements in smart power grids, building automation, security and protection, smart home, remote health care etc.

The module's core processor ESP8266 integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor with smaller package size and 16 bit compact mode, main frequency support 80 MHz and 160 MHz, support RTOS, integrated Wi-Fi MAC / BB / RF / PA / LNA, on-board PCB antenna.

The module supports standard IEEE802.11 b / g / n protocol, a complete TCP / IP protocol stack. It can be used to host the application or to offload Wi-Fi networking functions from another application processor.

2. Main Features

- Operating Voltage: 3.3V
- Operating Temperature: -40-85°C
- CPU Tensilica L106
 - RAM 50KB (Available)
 - Flash 16Mbit/32Mbit (16Mbit default)
- System
 - 802.11 b/g/n
 - Integrated Tensilica L106 ultra-low power 32-bit micro MCU, with 16-bit RSIC. The CPU clock speed is 80MHz. It can also reach a maximum value of 160MHz.
 - WIFI 2.4 GHz, support WPA/WPA2
 - Ultra-Small 18.6mm*15.0mm
 - Integrated 10 bit high precision ADC
 - Integrated TCP/IP Stack
 - Integrated TR switch, balun, LNA, Power amplifier and matching network
 - Integrated PLL, Regulator and power source management components, +20 dBm output power in 802.11b mode
 - Supports antenna diversity
 - Deep sleep current < 20uA, Power down leakage current < 5uA
 - Rich interface on processor: SDIO 2.0, (H) SPI, UART, I2C, I2S, IRDA, PWM, GPIO
 - STBC, 1x1 MIMO, 2x1 MIMO, A-MPDU & A-MSDU aggregation & 0.4s guard interval
 - Wake up, build the connection and transmit packets in < 2ms
 - Standby power consumption < 1.0mW (DTIM3)
 - Support AT remote upgrades and cloud OTA upgrade
 - Support STA/AP/STA+AP operation modes

3. Hardware Specifications

3.1 System Diagram

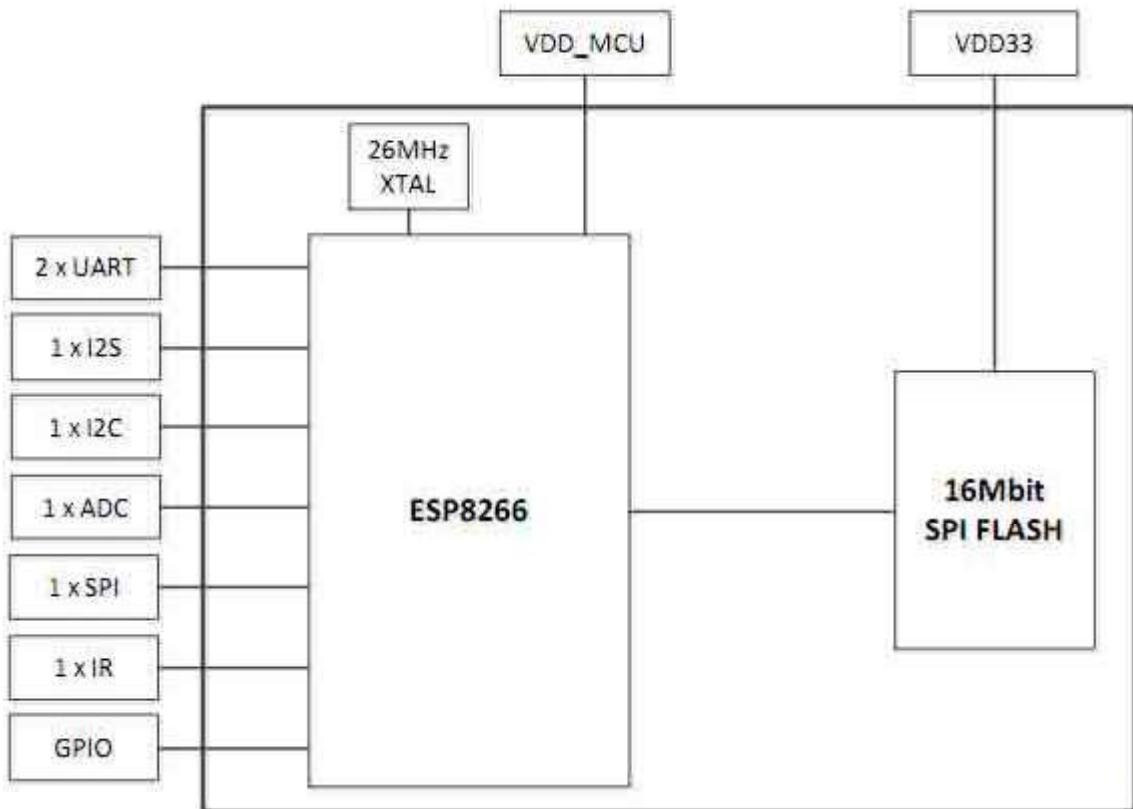


Figure-1 System Diagram

3.2 Pin Description



Figure-2 Physical Map (Top View)

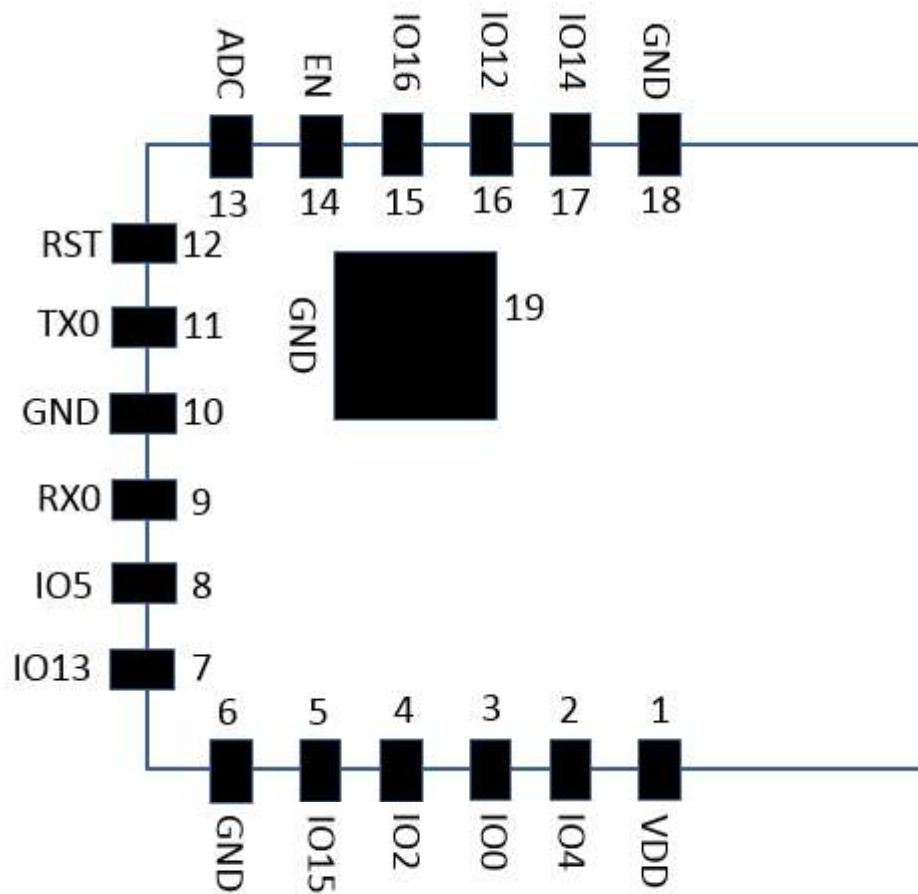


Figure-3 WT8266-S2 Pinout (Bottom View)

Table 1 Pin Definition and Description

Pin	Name	Description
1	VDD	3.3V supply (VDD)
2	IO4	GPIO4
3	IO0	GPIO0
4	IO2	GPIO2;UART1_TXD
5	IO15	GPIO15;MIDO;HSPICS;UART0_RTS
6	GND	GND
7	IO13	GPIO13; HSPI_MOSI;UART0_CTS
8	IO5	GPIO5
9	RX0	UART0_RXD;GPIO3
10	GND	GND
11	TX0	UART0_TXD;GPIO1
12	RST	Reset Module
13	ADC	Detecting chip VDD3P3 supply voltage or ADC pin input voltage (not available at the same time)

14	EN	Chip Enable. High: On, chip works properly; Low: Off, small current
15	IO16	GPIO16; Deep sleep wakeup, by connecting to RST pin
16	IO12	GPIO12;HSPI_MISO
17	IO14	GPIO14;HSPI_CLK
18	GND	GND
19	GND	GND PAD

Note:

Table-2 Pin Mode

Mode	IO15	IO0	IO2
UARTDownload Mode	Low	Low	High
Flash Boot Mode	Low	High	High

Table-3 Interface Description

Name	Pin	Function Description
HSPI Interface	IO12(MISO),IO13(MOSI),IO14(CLK),IO15(CS)	Can connect external SPI Flash, display and MCU etc.
PWM Interface	IO12(R),IO15(G),IO13(B)	The official demo provides 4-channel PWM (user can expand to 8-channel), can be used to control lights, buzzers, relays and motors, etc.
IR Interface	IO14(IR_T), IO5(IR_R)	The functionality of Infrared remote control interface can be implemented via software programming. NEC coding, modulation, and demodulation are used by this interface. The frequency of modulated carrier signal is 38KHz.
ADC Interface	ADC	ESP8266EX integrates a 10-bit precision SARADC. ADC_IN interface is used to test the power supply voltage of VDD3P3(Pin 3 and Pin 4), as well as the input voltage of TOUT (Pin 6). It can be used in sensors application.
I2C Interface	IO14(SCL), IO2(SDA)	Can connect to external sensor and display, etc.
UART Interface	UART0: TX0(U0TXD),RX0(U0RXD), IO15(RTS),IO13(CTS) UART1: IO2(TX0)	Devices with UART interfaces can be connected Download: U0TXD+U0RXD or GPIO2+U0RXD Communication: (UART0):U0TXD,U0RXD,MTDO(U0RTS),MTCK(U0CTS) Debug: UART1_RXD(GPIO2) Can be used to print debugging information By default, UART0 will output some printed information when the device is powered on and is booting up. If this issue exerts influence on some specific applications, users can exchange the inner pins of UART when initializing, that is to say, exchange U0TXD, U0RXD with U0RTS, U0CTS.

I2S Interface	I2S input: IO12 (I2SI_DATA); IO13 (I2SI_BCK); IO14 (I2SI_WS);	Mainly used for audio capturing, processing and transmission.
	I2S output: IO15 (I2SO_BCK); IO3 (I2SO_DATA); IO2 (I2SO_WS);	

3.3 Electrical Characteristic

3.3.1 Maximum Ratings

Table- 4. Maximum Ratings

Ratings	Condition	Value	Unit
Storage Temperature	/	-45 to 125	°C
Maximum Soldering Temperature	/	260	°C
Supply Voltage	IPC/JEDEC J-STD-020	+3.0 to +3.6	V

3.3.2 Recommended Operating Environment

Table -5 Recommended Operating Environment

Working Environment	Name	Min Value	Typical Values	Max Value	Unit
Operating Temperature	/	-40	20	85	°C
Supply Voltage	VDD	3.0	3.3	3.6	V

3.3.3 Digital Port Characteristics

Table -6 Digital Port Characteristics

Port	Typical Values	Min Value	Max Value	Unit
Input low logic level	VIL	-0.3	0.25VDD	V
Input high logic level	VIH	0.75vdd	VDD+0.3	V
Output low logic level	VOL	N	0.1VDD	V
Output high logic level	VOL	0.8VDD	N	V

3.4 Power Consumption

3.4.1 Operating Power Consumption

Table -7 Operating Power Consumption

Mode	Standard	Speed Rate	Typical Value	Unit
Tx	11b	1	215	mA

		11	197	
11g		6	197	
		54	145	
11n	MCS7		120	
Rx	All rates		56	mA

Note: RX mode data packet length is 1024 bytes;

3.4.2 Standby Power Consumption

The following current consumption is based on 3.3V supply and 25°C ambient with internal regulators. Values are measured at antenna port without SAW filter. All the transmission measurements values are based on 90% duty cycle, continuous transmission mode.

Table -8 Standby Power Consumption

Mode	Status	Typical Value				
Standby	Modem Sleep	15mA				
	Light Sleep	0.9mA				
	Deep Sleep	20uA				
	Off	0.5uA				
Power Save Mode (2.4G) (Low Power Listen disabled) ¹	DTIM period	Current Cons. (mA)	T1 (ms)	T2 (ms)	Tbeacon (ms)	T3 (ms)
	DTIM 1	1.2	2.01	0.36	0.99	0.39
	DTIM 3	0.9	1.99	0.32	1.06	0.41

①: Modem-Sleep requires the CPU to be working, as in PWM or I2S applications. According to 802.11 standards (like U-APSD), it saves power to shut down the Wi-Fi Modem circuit while maintaining a Wi-Fi connection with no data transmission. E.g. in DTIM3, to maintain a sleep 300ms-wake 3ms cycle to receive AP's Beacon packages, the current is about 15mA.

②: During Light-Sleep, the CPU may be suspended in applications like Wi-Fi switch. Without data transmission, the Wi-Fi Modem circuit can be turned off and CPU suspended to save power according to the 802.11 standard (U-APSD). E.g. in DTIM3, to maintain a sleep 300ms-wake 3ms cycle to receive AP's Beacon packages, the current is about 0.9mA.

③: Deep-Sleep does not require Wi-Fi connection to be maintained. For application with long timelags between data transmission, e.g. a temperature sensor that checks the temperature every 100s, sleep 300s and waking up to connect to the AP (taking about 0.3~1s), the overall average current is less than 1mA.

3.5 RF Characteristics

3.5.1 RF Configuration and General Specifications of Wireless LAN

Table-9 RF Configuration and General Specifications of Wireless LAN

Items	Specifications	Unit
Country/Domain Code	Reserved	—

Center Frequency	11b	2.412-2.472	GHz
	11g	2.412-2.472	GHz
	11n HT20	2.412-2.472	GHz
Rate	11b	1, 2, 5.5, 11	Mbps
	11g	6, 9, 12, 18, 24, 36, 48, 54	Mbps
	11n 1stream	MCS0, 1, 2, 3, 4, 5, 6, 7	Mbps
Modulation type	11b	DSSS	—
	11g/n	OFDM	—

3.5.2 RF Tx Characteristics

Table-10 Emission Characteristics

Mark	Parameters	Condition	Min Value	Typical Value	Max Value	Unit
Ftx	Input Frequency	—	2.412	—	2.484	GHz
Pout	Output Power					
	11b	1Mbps	—	19.5	—	dBm
		11Mbps	—	18.5	—	dBm
		54Mbps	—	16	—	dBm
		MCS7	—	14	—	dBm

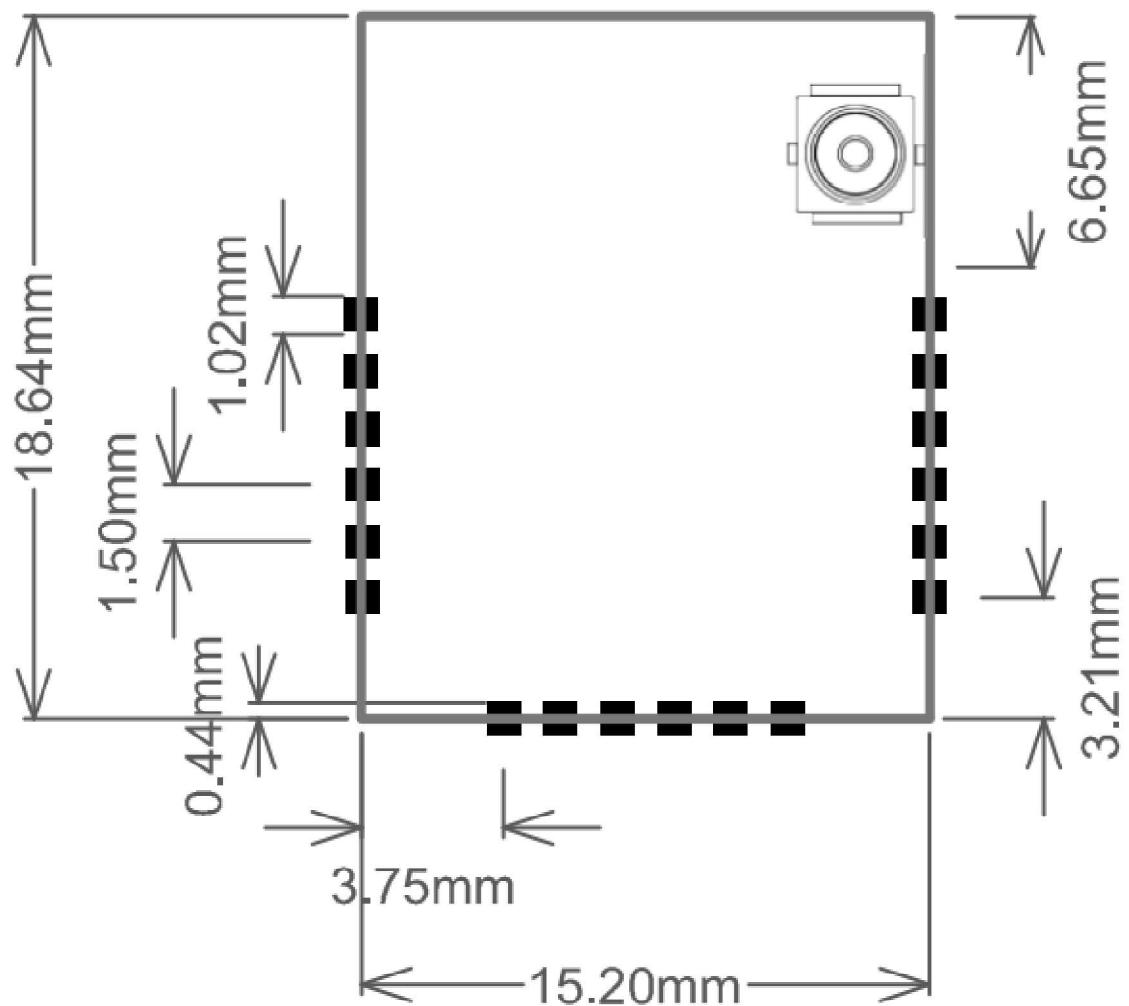
3.5.3 RF Rx Characteristics

Table-11 RF Receiving Characteristics

Mark	Parameters	Condition	Min Value	Typical Value	Max Value	Unit
Frx	Input Frequency	—	2.412	—	2.484	GHz
Srf	Sensitivity					
	DSSS	1 Mbps	—	-98	—	dBm
		11 Mbps	—	-91	—	dBm
	OFDM	6 Mbps	—	-93	—	dBm
		54 Mbps	—	-75	—	dBm
	HT20	MCS7	—	-71	—	dBm

4. Mechanical Dimensions

4.1 Module Size



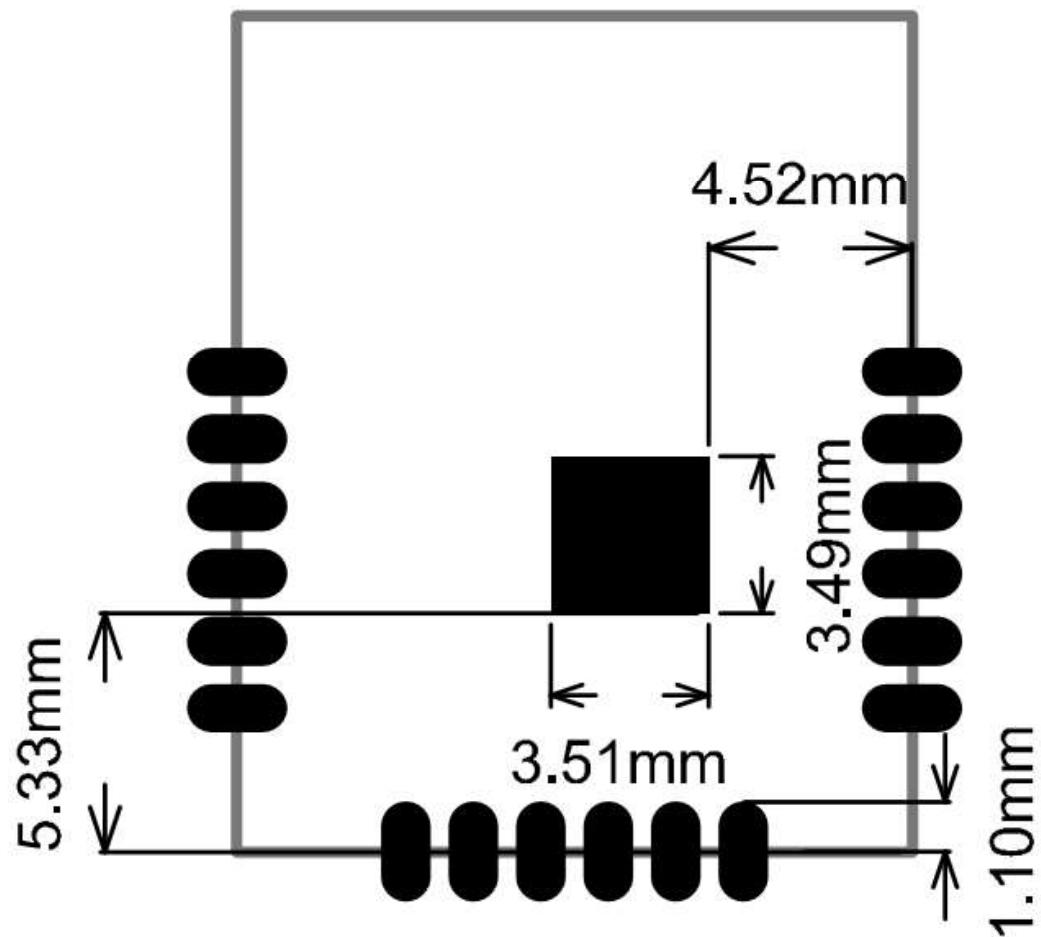


Figure -4-1 Module Size (reverse projection view)

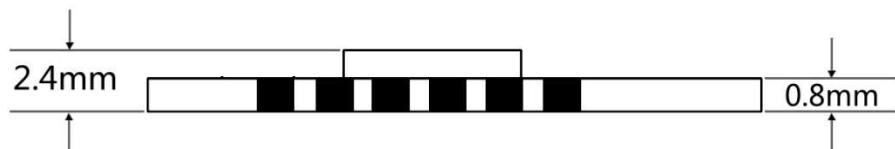


Figure -5 Module Size (Side View)

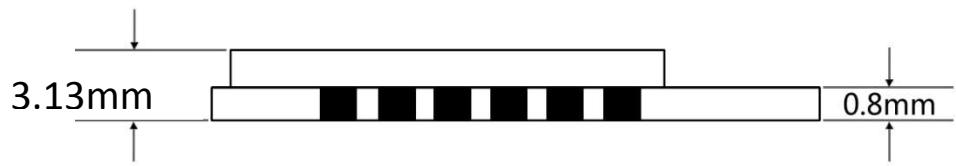


Figure -6 Module Size - shieldingcase (Side View)

4.2 Schematics

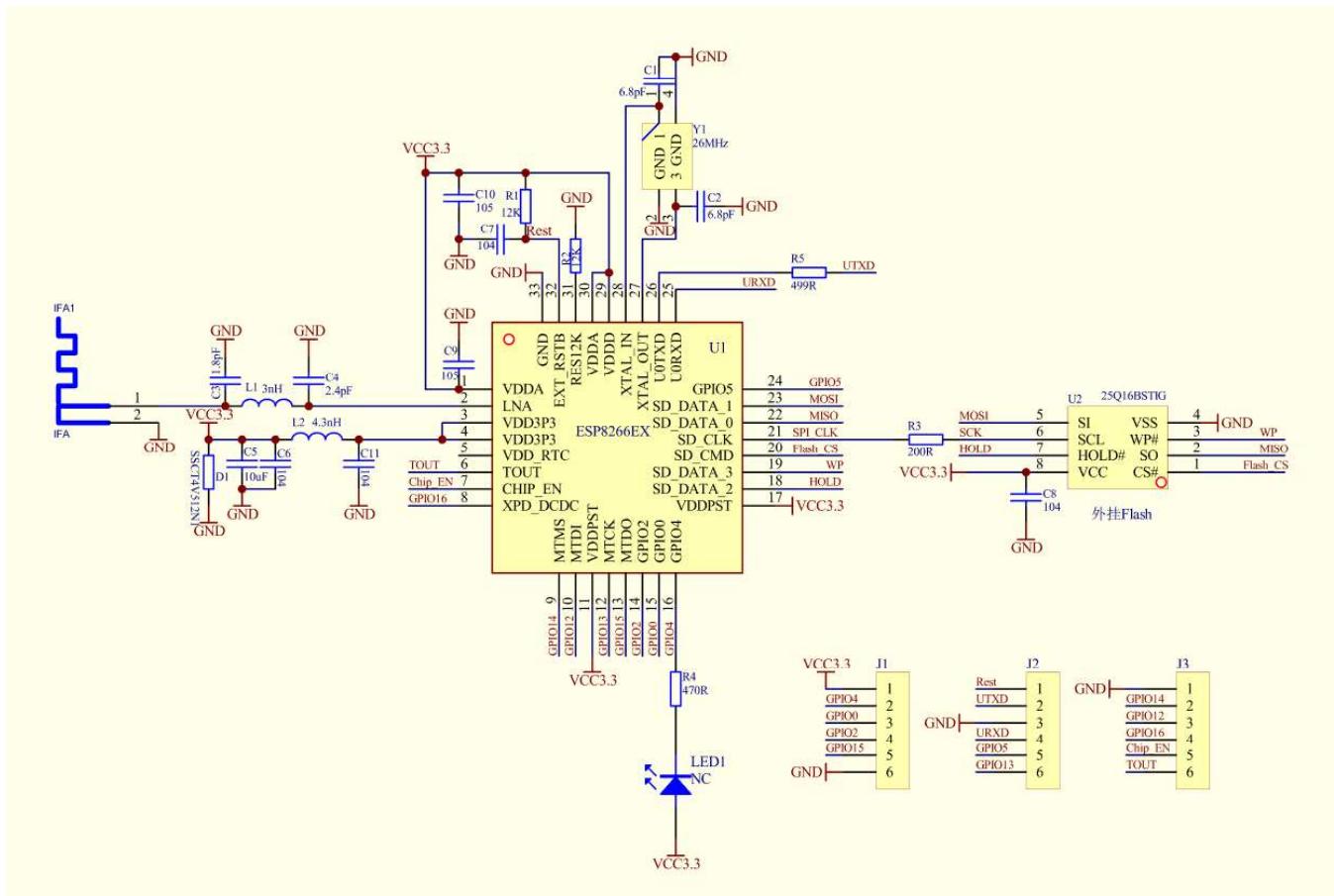


Figure -7 WT8266-S2 Schematics

6. Product Trial

- Forum: yangxianwen@lefu.cc

FCC regulatory conformance:

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.

NOTE: This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

RF Exposure

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2AVENESP8266". Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and
- (2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.
Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user

IC regulatory conformance

This device complies with CAN ICES-003 (B)/NMB-003(B).

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme à la norme CAN ICES-003 (B)/NMB-003 (B).

Cet appareil contient des émetteurs / récepteurs exempt (s) de licence qui sont conformes aux RSS exemptes de licence d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes:

- (1) Cet appareil ne doit pas provoquer d'interférences.
- (2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

RF Exposure

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d' exposition aux rayonnements de la IC établies pour un environnement non contrôlé. Cet équipement doit être installé et fonctionner à au moins 20cm de distance d'un radiateur ou de votre corps.

IC labeling requirement for the final end product:

The final end product must be labeled in a visible area with the following "Contains IC: 28067-ESP8266"

The Host Marketing Name (HMN) must be indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.

This radio transmitter [IC: 28067-ESP8266] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Frequency range	Manufacturer	Peak gain	Impedance	Antenna type
2412-2462MHz	Runicc	1.56dBi	50 Ω	FPC Antenna

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.³

Explanation: This module meets the requirements of FCC part 15C(15.247).

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT has a FPC Antenna, and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person’s body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2AVENESP8266.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a FPC Antenna, and the antenna use a permanently attached antenna which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: “Contains FCC ID: 2AVENESP8266, Contains IC: 28067-ESP8266”

2.9 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.