WIFI Module -LM1 Module User Guide

1. Overview

WIFI Module -LM1 is an embedded wirelesscontrol WiFi module developed by Shenzhen LINGAN Intelligent Technology Co., Ltd. With efficient power usage, compact design and reliable performance, it could be applied to smart home products such as Wi-Fi smart socket, Smart switches, Wi-Fi light bulbs, etc.

The module's core processor ESP8266 integrates an enhanced version of Tensilica's L106 Diamond series 32-bit MCU, with 16-bit RISC processor, support 80MHz and 160MHz frequency and Real-Time Operating System (RTOS), integrates Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna.

The ESP8266 module supports standard IEEE802.11 b/g/n protocol, with complete TCP/IP stack. Users can use this module as existing device, adding networking function, build independent network controller.

2. Main characteristics

2.1 Hardware Parameters

☐ Operating Voltage：3.3V（3.0 ~ 3.6V）

☐ Operating Temperature：-40 - 85°C

☐ CPU Tensilica L106

o RAM 50KB（Available）

o Flash 8Mbit

System

o 802.11 b/g/n

o Frequency Range 2.4 GHz ~ 2.5 GHz（2400 M ~ 2483.5 M）

o Built-in Tensilica L106 Low power consumption 32-bit processor, support 80 MHz and 160MHz frequency, RTOS.

o WIFI @2.4 GHz，support WPA/WPA2 security mode.

o Support UART、I2C、GPIO、PWM、SDIO、SPI、ADC、PWM、IR

o Built-in 10 bit high-precision ADC

o Support TCP、UDP、HTTP、FTP

o Built-in TR switch、 balun、 LNA、 power amplifier and matching network

o Built-in PLL、 voltage stabilizer and 802.11 b: +20 dBm Tx power.

o Average working current 80mA,deep-sleep current holding current 20uA,cut-off current less than 5uA.

o Can be used as application processor SDIO 2.0、 SPI、 UART

o Within 2ms wake up、 connect and send packet.

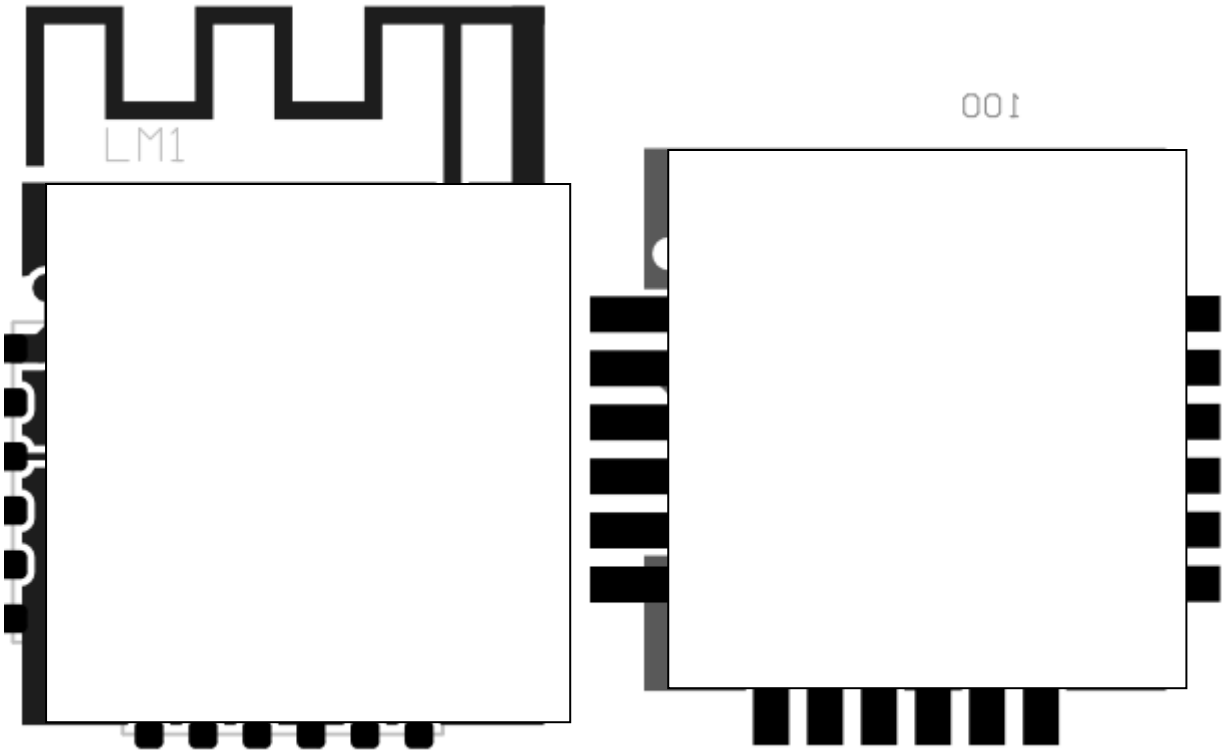
o Standby power less than 1.0mW (DTIM3)

o Support Firmware and SDK for fast on-chip programming, cloud server development and UART Download

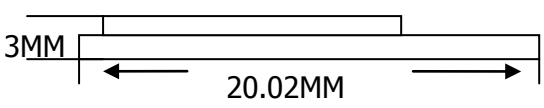
o Support Station / SoftAP / SoftAP + Station wireless network mode

o Module size is 20mm * 15.0mm * 3.0mm

3. Pin Definitions



Pin layout （front view）



Module size-BOOT（lateral view）

Pin definitions and description

pin	name	description
1	EN	Chip enable High level: valid, the module works normally (default pull-up via 10KΩ resistor) Low: The chip is off and the current is very low
2	TOUT	Detect chip VDD3P3 supply voltage or TOUT pin input voltage (both can not be used simultaneously)
3	IO14	GPIO14:HSPI_CLK
4	IO12	GPIO12:HSPI_MISO
5	IO13	GPIO13: HSPI_MISO:UARTO_CTS
6	IO15	GPIO15:MIDO:HSPICS:UARTO_RTS
7	IO0	GPIO0 UART download: It is recommended to pull down the 1K resistor and it can be grounded directly, but it is not recommended. FLASH start: floating or external pull:
8	IO2	GPIO2: UART1_TXD
9	IO4	GPIO4
10	IO5	GPIO5
11	URXD	UART0_RXD, UART Downloaded receiver ; GPIO3
12	UTXD	UART0_TXD, UART Downloaded sender, vacant or externally pulled high ; GPIO1
13	VCC	3.3V Supply (VDD) Note: The maximum output current of the external power supply is recommended to be above 500mA.
14	GND	Grounding

4. Functional Description

4.1 MCU

The ESP8266EX integrates a Tensilica L106 32-bit RISC processor, support 80MHz and 160MHz frequency,and support the Real-TimeOperating System (RTOS),Wi-Fi stack only takes 20% processing power, allow other 80% of the processing power to beavailable for user application programming and development.

The MCU can work through the following interfaces and other parts of chip:

• Programmable RAM/ROM interfaces (iBus), which can be connected with memory controller, and can also be used to visit flash.

• Data RAM interface (dBus), which can connected with memory controller.

• AHB interface which can be used to visit the register

4.2 Memory

4.2.1 Built-in SRAM and ROM

The use of SRAM base on Demo SDK,SRAM space available to users is assigned as below.

☐ RAM < 50 kB (under the Station mode andconnects to the router, programmable space accessible in heap + data section isaround 50 kB).

Currently there is no programmable ROM on ESP8266EX,and user programs are stored in SPI flash.

4.2.2 SPI Flash

☐ ESP8266EX chip supports external FLASH using SPI interface,supports up to 16 MB memory capacity SPI Flash theoretically.☐

ESP8266-S3 module is configured with SPI Flash of 8Mbit,can meet users'continuous demands.

4.3 GPIO Interface definitions and description

Interface	Pin	Description
SPI	IO12(MISO),IO13(MOSI),IO14(CLK),IO15(CS)	Can read and write SPI as the host,also can communicate with external MCU as slaves.Under overlap mode,can share SPI with Flash,switch through different CS
PWM	IO12(R), IO15(G), IO13(B)	Currently the PWM interface has four channels, and users can extend the channels to 8 channels. The PWM interface can be used to control LED lights, buzzers, relays, motors, etc
IR	IO14 (IR_T), IO5(IR_R)	The functionality of the infrared remote control interface can be implemented via software programming. NEC coding, modulation and demodulation are used by this interface. The frequency of the modulated carrier signal is 38KHz
ADC	TOUT	The interface is used to test the power supply voltage of VDD3P3 (pin3 and pin4), as well as the input voltage of TOUT (pin6),these two functions cannot be used simultaneously. It can also be used in sensors.
I2C	IO14 (SCL), IO2 (SDA)	It can interface sensors and display screens.

UART	UART0:TXD(U0TXD),RXD(U0RXD),IO15(RTS),IO13(CTS)	It can interface other UART devices For firmware downloading: U0TXD+U0RXD or GPIO2+U0RXD For communication: UART0: U0TXD, U0RXD, MTDO(U0RTS), MTCK(U0CTS) For debugging: UART1_TXD (GPIO2) can be used to print debugging information.
	UART1:IO2 (TXD)	By default, UART0 will output some printed information when the device is powered on. For the applications that are sensitive to this feature, users can exchange the pins of UART during system initialization, that is, exchange U0TXD, U0RXD with U0RTS, U0CTS.On the hardware, MTDOMTCK is connected to the corresponding external MCU serial port to communicate.
I2S	I2S input: IO12(I2SI_DATA);IO13(I2SI_BCK); IO14(I2SI_WS)	Mainly used for audio capture,processing and transmission.
	I2S output: IO15(I2SO_BCK);IO3(I2SO_DATA); IO2(I2SI_WS)	

5. Electrical Characteristics

5.1 Power Consumption

ModeStatusTypical value

Standby mode

Modem Sleep 15mA

Light Sleep 0.9mA

Deep Sleep 20uA

Off 0.5uA

Regular work（average current）80mA

Receive (Rx) 801.11b，1024 bytes packet length,-80 dBm 50mA

Receive (Rx) 801.11g，1024 bytes packet length，-70 dBm 56mA

Receive (Rx) 801.11n，1024 bytes packet length，-65 dBm 56mA

Notes①: Modem-sleep mode is used in the applications that require the CPU to be working, as in PWM orI2S applications. According to 802.11 standards (like U-APSD), it shuts down the Wi-Fi Modemcircuit while maintaining a Wi-Fi connection with no data transmission to optimize powerconsumption. E.g. in DTIM3, maintaining a sleep of 300 ms with a wakeup of 3 ms cycle to receive AP's Beacon packages at interval requires about 15mA current.

②: During Light-sleep mode, 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 consumption according to the 802.11 standards (U-APSD). E.g. in DTIM3, maintaining a sleep of 300 ms with a wakeup of 3ms to receive AP's Beacon packages at interval requires about 0.9mA current.

③: During Deep-sleep mode, Wi-Fi is turned off. For applications with long time lags between data transmission.e.g. A temperature sensor that detects the temperature every 100s, sleeps for 300s and wakes up to connect to the AP (taking about 0.3 ~ 1s), the overall average current is less than 1mA.

Above power consumption data is measured by internal voltage regulator,based on

the 3.3V power supply and 25 degrees ambient temperature.

All of the emission data is measured in continuous emission mode,based on 90% duty cycle.

All measurements are based on the absence of the SAW filter and are tested at the antenna interface.

5.2 RFCharacteristics

RF Parameters

Input frequency 2400 / 2483.5 MHz

Input resistance / 50 / ohm

Input reflection / / -10 dB

Receiving sensitivity

CCK，1Mbps / -98 / dBm

CCK，11Mbps / -91 / dBm

6Mbps（1/2 BPSK） / -93 / dBm

54Mbps（3/4 64-QAM） / -75 / dBm

HT20，MCS7（65Mbps，72.2Mbps）/ -72 / dBm

Adjacent Channel Rejection

OFDM，6Mbps / 37 / dB

OFDM，54Mbps / 21 / dB

HT20，MCS0 / 37 / dB

HT20，MCS7 / 20 / dB

5.3 Digital port features

Input low level VIL -0.3 0.25 VDD V

Input high level VIH 0.75 VDD VDD + 0.3 V

Output low level VOL N 0.1 VDD V

Output high level VOL 0.8 VDD N V

5.4 Maximum Rated Value

Storage Temperature / -40 to 125 °C

Maximum Soldering temperature / 260 °C

Power supply voltage IPC/JEDEC J-STD-020 +3.0 to +3.6 V

5.5 Ramp Up

Ramp rate（Ts Max. to T L） Maximum 3°C/s

Warm-up

Minimum temperature value（Ts Min.）

Typical temperature value（Ts Typ.）

Maximum temperature value（Ts Max.）

Time（Ts）

Minimum temperature value150°C

Typical temperature value175°C

Maximum temperature value 200°C

Time 60 ~ 180s

Ramp rate（T L to Tp） Maximum 3°C/s

Above duration time：temperature（T L ）/ time（T L ） 270°C / 60 ~ 150 s

Peak value of temperature（Tp） Maximum temperature value 260 °C,last for 10s

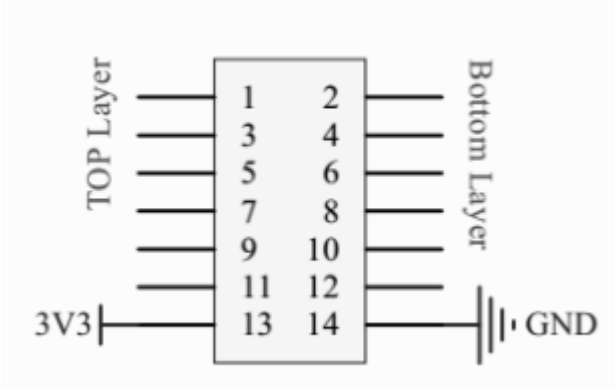
Target value of temperature（Tp target value） 260°C + 0 / -5°C

Within sustained peak value lasts for 20 ~ 40s

Tiltingrate of temperature fall（TsMax.to T L ） Maximum value 6°C /s

The longest time from 25°C to peak value of temperature is 8 minutes.

6. Minimization system



Explanation

1) Maximum output current of module IO is 12mA;

2) Typical value of module power supply is 3.3V DC;

3) ESP8266 module firmware downloading needs to meet below condition: IO0 connects to GND,then power on; After finished;IO0 doesn't need to connect to GND,and then power supply to the module again;

4) URXD connects to MCU TXD,and UTXD connects to MCU RXD.

8. Peripheral layout suggestions

WIFI Module -LM1 Integrates high-speed GPIO and peripheral interface,it may come about serious switch noise.If there are more higher requirement on power consumption and EMI characteristic for some applications,we suggest connecting 10 ~ 100 ohms resistance on the digital I/O line. In this way,it can prevent excessive current when power on/off ,and can make the signal more stable.Resistance connection also can prevent ESD.

ATTENTION

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) This device and its antenna(s) must not be co‑located with any other transmitters except in accordance with FCC multi‑transmitter product procedures. Referring to the multi‑transmitter policy, multiple‑transmitter(s) and module(s) can be operated simultaneously without C2P.

3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end‑user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio‑frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and

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

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains FCC ID: 2AJK8-LM1". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.