

## *LMB54 Module Datasheet*

LMB54 is a low-power embedded Wi-Fi module that Tuya has developed. It consists of a highly integrated RF chip BK7231N and a few peripherals. LMB54 supports the Wi-Fi AP and STA modes.

LMB54 is built in with a 32-bit MCU whose running speed can be up to 120 MHz, a 2-MB flash memory, and a 256-KB RAM, to support the Tuya cloud connection. The MCU instructions specially extended for signal processing can effectively implement audio encoding and decoding.

## 1.1 Features

- The clock rate: 120 MHz
- Working voltage: 3.0 to 3.6V
- Peripherals: 5 PWMs and 1 UART
- Wi-Fi connectivity
  - 802.11 b/g/n
  - Channels 1 to 14@2.4 GHz
  - Support WEP, WPA/WPA2, and WPA/WPA2 PSK (AES) security modes
  - Up to +16 dBm output power in 802.11b mode
  - Support STA/AP/STA+AP working mode
  - Support SmartConfig and AP network configuration manners for Android and iOS devices
  - Onboard PCB antenna with a gain of 2.6 dBi
  - Working temperature: -40°C to 85°C

## 1.2 Applications

## 2 Module interfaces

The dimensions of LMB54 are 15.00±0.35 mm (W)×20.5±0.35 mm (L) ×2.8±0.15 mm (H). The dimensions of LMB54 are as follows:

Pin number	Symbol	Function
1	VDD	Vdd
2	P26/PWM5	GPIOP_26, which corresponds to P26 of the IC, PWM 5
3	P14	A common GPIO interface, which

		corresponds to P14 of the IC
4	P16	GPIOP_16
5	P24/PWM4	GPIOP_24, which corresponds to P24 of the IC, PWM 4
6	GND	GND
7	P22/ADC5/MOSI	(Not recommended for use. ) GPIOP_22, which corresponds to P22 of the IC. Programmed SPI
8	P21/ADC6/CSN	The pull-up resistor is needed during usage of customers. Do not connect it to the ground before the module is powered on. Correspond to P21 of the IC.
9	P6/PWM0	GPIOP_6, which corresponds to P24 of the IC, PWM 0
10	P7/PWM1	GPIOP_7, which corresponds to P24 of the IC, PWM 1
11	P10/U1_RX	UART1_RXD (user serial interface), which corresponds to P10 of the IC. Do not connect it to the VCC. By default, the MCU serial port should be in low-level or high-impedance state.
12	GND	GND
13	P11/U1_TX	UART1_TXD (user serial interface), which corresponds to P11 of the IC. Do not connect it to the VCC. By default, the MCU serial port should be in low-level or high-impedance state.
14	RSTN	RST
15	P20/SCK	(Not recommended for use. ) GPIOP_20, which corresponds to P20 of the IC. Programmed SPI
16	P0/U2_TX	UART2_TXD

17	P23/ADC3/MISO	ADC
18	EN	EN
19	P1/U2_RX	UART2_RXD
20	P8/PWM2	GPIOP_8, which corresponds to P24 of the IC, PWM 2
21	P9/PWM3	GPIOP_9, which corresponds to P24 of the IC, PWM 3
22	GND	GND

### 3 Electrical parameters

#### 3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum value	Unit
Ts	Storage temperature	-55	125	°C
V <sub>BAT</sub>	Power supply voltage	-0.3	3.9	V
ESD voltage (human body model)	TAMB-25°C	-4	4	KV
ESD voltage (machine model)	TAMB-25°C	-200	200	V

#### 3.2 Normal working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Working temperature	-40	-	85	°C
VBAT	Power supply voltage	3	3.3	3.6	V
VOL	I/O low level output	VSS	-	VSS+0.3	V
VOH	I/O high level output	VBAT-0.3	-	VBAT	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
I <sub>max</sub>	I/O drive current	-	6	20	mA

### 3.3 RF power consumption

Working status	Mode	Rate	Transmit power/receive	Average value	Peak value (Typical value)	Unit
Transmit	11b	11Mbps	+16dBm	81	240	mA
Transmit	11g	54Mbps	+15dBm	82	238	mA
Transmit	11n	MCS7	+14dBm	85	234	mA
Receive	11b	11Mbps	Constantly receive	73	82	mA
Receive	11g	54Mbps	Constantly receive	75	82	mA
Receive	11n	MCS7	Constantly receive	75	82	mA

### 3.4 Working current

Working mode	Working status, T <sub>a</sub> = 25°C	Average value	Maximum value (Typical value)	Unit
Quick network connection state (Bluetooth)	The module is in the fast network connection state and the Wi-Fi indicator flashes fast.	63	245	mA
Quick network connection state (AP)	The module is in the hotspot network connection state and the Wi-Fi indicator flashes slowly.	80	270	mA
Quick network connection state (EZ)	The module is in the fast network connection state and the Wi-Fi indicator flashes fast.	78	246	mA
Connected	The module is connected to the network and the Wi-Fi indicator is always on.	25	342	mA

Working mode	Working status, Ta = 25°C	Average value	Maximum value (Typical value)	Unit
Weakly connected	The module and the hotspot are weakly connected and the Wi-Fi indicator light is always on	205	350	mA
Disconnected	The module is disconnected and the Wi-Fi indicator is always off.	63	242	mA
Module disabled	The CEN pin of the module is connected to the ground.	330	-	uA

#### 4 RF parameters

##### 4.1 Basic RF features

Parameter	Description
Working frequency	2.412 to 2.484 GHz
Wi-Fi standard	IEEE 802.11 b/g/n (channels 1 to 14)
Data transmission rate	11b: 1, 2, 5.5, 11 (Mbps); 11g: 6, 9, 12, 18, 24, 36, 48, 54 (Mbps); 11n: HT20 MCS 0 to 7; 11n: HT40 MCS 0 to 7
Antenna type	PCB antenna

##### 4.2 Wi-Fi transmission performance

Parameter	Minimum value	Typical value	Maximum value	Unit
Average RF output power, 802.11b CCK Mode 11M	-	16	-	dBm
Average RF output power, 802.11g OFDM Mode 54M	-	15	-	dBm
Average RF output power, 802.11n OFDM Mode MCS7	-	14	-	dBm
Frequency error	-20	-	20	ppm

### 4.3 Wi-Fi receiving performance

Parameter	Minimum value	Typical value	Maximum value	Unit
PER<8%, RX sensitivity, 802.11b DSSS Mode 11M	-	-88	-	dBm
PER<10%, RX sensitivity, 802.11g OFDM Mode 54M	-	-74	-	dBm
PER<10%, RX sensitivity, 802.11n OFDM Mode MCS7	-	-73	-	dBm
PER<10%, RX sensitivity, Bluetooth LE 1M	-	-96	-	dBm

#### **OEM integration instructions:**

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

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

#### **Validity of using the module certification:**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

#### **End product labeling:**

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: **2AJK8-LMB54**".

#### **Information that must be placed in the end user manual:**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.



## **Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01**

### **2.2 List of applicable FCC rules**

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209

### **2.3 Specific operational use conditions**

The module LMB54 is a module with WIFI 2.4G function.

Operation Frequency: 2412~2462MHz

Type: PCB Antenna

Gain: 2.6 dBi

The module can be used for mobile or applications with a maximum 2.6dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.

### **2.4 Limited module procedures**

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

### **2.5 Trace antenna designs**

Not applicable. The module has its own antenna, and doesn't need a host's printed board microstrip trace antenna etc.

### **2.6 RF exposure considerations**

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

### **2.7 Antennas**

Antenna Specification are as follows:

Type: PCB Antenna

Gain: 2.6 dBi

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna;

The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

### **2.8 Label and compliance information**

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID:

**2AJK8-LMB54**" with their finished product.

### **2.9 Information on test modes and additional testing requirements**

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

Additional testing, Part 15 Subpart B disclaimer.

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

### **2.10 Additional testing, Part 15 Subpart B disclaimer**

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 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.

## **FCC STATEMENT :**

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

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

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 generate, 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.

## **FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.