MS2131

Hardware Design Guide

Issue 02

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About This Document

Change History

Issue	Date	Chapter	Note
V1.0	2014-9-20	All	Initial Release
V1.1	2017-1-13	6.3.2	Modify Peripheral Staking Requirements

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1 Introduction

This document describes the MS2131's hardware specifications, port design requirements, design guide, and working principles. The next five chapters describe the MS2131's specifications and design requirements of its host. Chapter 6 to Chapter 9 provide details of the MS2131'S working principles and design guides. Chapter 10 introduces the MS2131's electrical features and reliability.

Upon learning this document, you will understand the MS2131's port standards, electricity supply characteristics, design requirements, and product information. The document provides you reference for related design.

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2 Precautions

This chapter describes the precautions for using the MS2131, especially for the user device or host design. If not properly used, the MS2131 may not function normally and require design changes on the host.

1. The MS2131 has strict peripheral power supply requirement. Strictly follow the design requirements in Chapter 7 when designing the power supply circuits. Otherwise, cases may occur that the board restarts in 2G large power events.
2. The MS2131 has its antennas embedded. Strictly follow the stacking design requirements in section 5.4 "Antenna Design Requirements" when designing a host. Otherwise, the antennas may deteriorate. As a result, exceptions, such as network access failures and call failures, may occur and adversely affect user experience.

TIP

Pay attention to the preceding precautions, especially for designing the host.

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3 MS2131 Overall Description

3.1 About This Chapter

This chapter describes the MS2131's basic information, functions, circuit diagram, and application ports to help you understand its application scenarios and feasible functions for future usage and integration.

3.2 Product Information

HUAWEI MS2131 (MS2131 for short) is a wireless terminal device that implements high-speed wireless network access and supports various network modes as follows:

- HSPA+ (High Speed Packet Access+)
- UMTS (Universal Mobile Telecommunications System)
- EDGE (Enhanced Data Rates for Global Evolution)
- GPRS (General Packet Radio Service)
- GSM (Global System for Mobile Communications)

The MS2131 supports the following services:

- HSUPA-based packet services
- HSPA+/UMT-based high-speed packet services
- EDGE/GPRS-based packet services
- WCDMA/GSM short message service (SMS)

The MS2131 can be connected to a host over a USB port to implement data card functions.

In the coverage area of the HSPA+/UMTS or EDGE/GPRS/GSM network, you can access wireless networks, use SMS for communication, send and receive emails, and more.

An enhanced user experience is ensured by the MS2131 as it provides high-speed connectivity, reliable performance, and convenient operations. With the Universal Plug and Play (UPnP) service, the MS2131 can be connected to USB port–supported devices to implement the 2G/3G communication. The MS2131 authentication is independent from its peripherals, and therefore, users do not need to authenticate the MS2131 by themselves.

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3.3 Function Overview

Table 3-1 Product features

Product Features	Description
Working bands	HSPA+/WCDMA 2100/1900/900/850 MHz EDGE/GPRS/GSM 1800/1900/900/850 MHz
Chipset platform	Hi6758
Working temperature	–20°C to +55°C
Storage temperature	–40°C to +70°C
Power voltage	4.75 V to 5.25 V (5 V is recommended)
Protocol	WCDMA/HSPA/HSPA+ (R7)
AT commands	For details, see *AT Command Interface Specification*.
Application interfaces	One standard SIM card slot (3 V or 1.8 V)
	USB2.0 port
Antenna interface	Embedded FPC support antenna
	TS-5 external antenna port
SMS	Text messages in TEXT mode
Data services	WCDMA CS domain: UL 64 kbps/DL 64 kbps WCDMA/HSPA+ PS domain: DL 21 Mbps(64QAM)/UL 5.76 Mbps HSDPA Category 14 GSM CS domain: 9.6/14.4 kbps GPRS: UL 85.6 kbps/DL 85.6 kbps EDGE: only DL 236.8 kbps
Physical features	Dimensions: 85 mm x 27 mm x 12.3 mm (33.5 in x 10.6 in x 4.8 in) Weight: about 22 g
Certification	CE, FCC, and GCF

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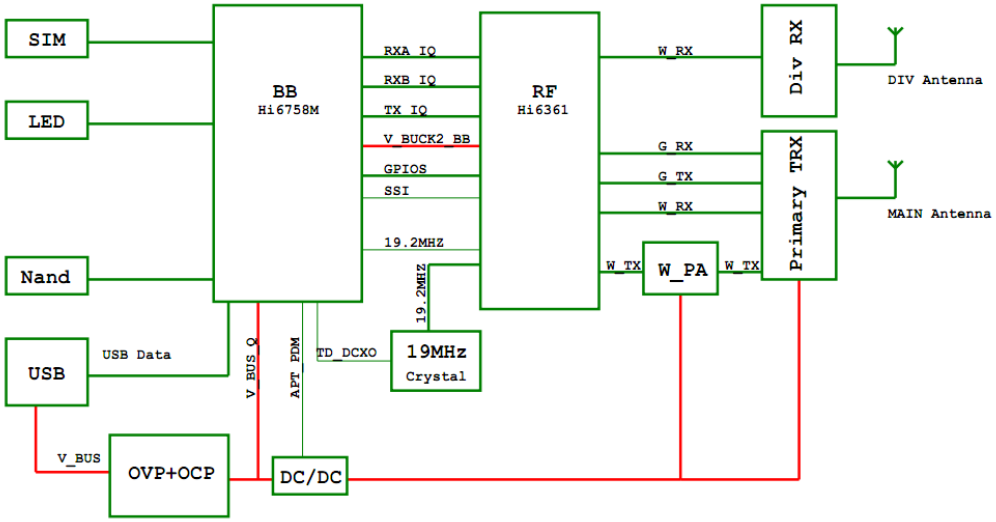
3.4 Circuit Diagram

The MS2131 contains the following functional modules, as shown in Figure 3-1.

- Baseband processor (BB) and RF processor (RTR)
- Nand flash
- 19.2 MHz crystal resonator
- RF circuit
- Antenna
- USB2.0 port

Figure 3-1 MS2131function block diagram



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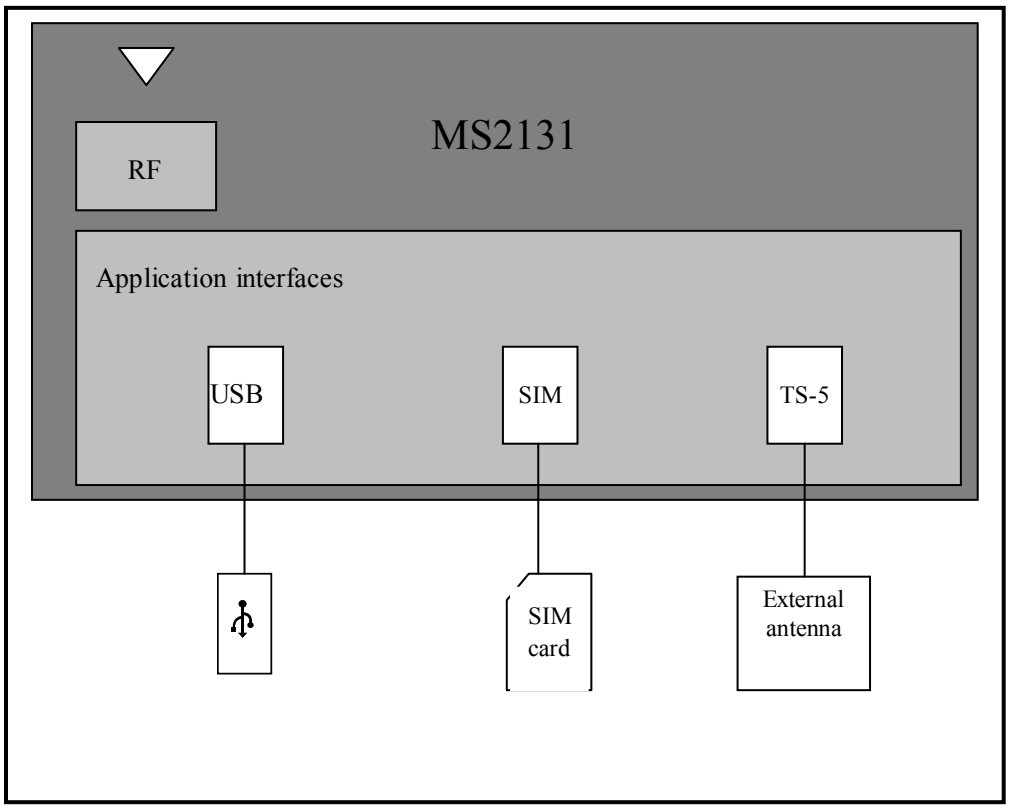
3.5 Port Application Diagram

The MS2131 contains the following ports, as shown in Figure 3-2.

- USB2.0 port
- SIM card slot (1.8 V or 3.0 V)
- TS-5 external antenna port

Figure 3-2 MS2131 application diagram



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4 MS2131 Interface Features and Design Requirements

4.1 About This Chapter

This chapter describes the port connector specifications and usage requirements of the MS2131. Strictly follow the specified design requirements when designing the interface circuits of a host.

4.2 MS2131 Interface Introduction

4.2.1 USB Port and Reference Circuits

The MS2131 communicates with the host over the USB port, which supports the USB2.0 protocol. The MS2131 has the USB signals adjusted and provides build-out circuits. The host must be able to perform impedance matching and protection. Figure 4-1 shows the reference circuits.

Table 4-1 Signals on the USB port

Pin No.	Signal Name	I/O	Description
1	USB_D+	I/O	USB differential data signal+
2	USB_D-	I/O	USB differential data signal-

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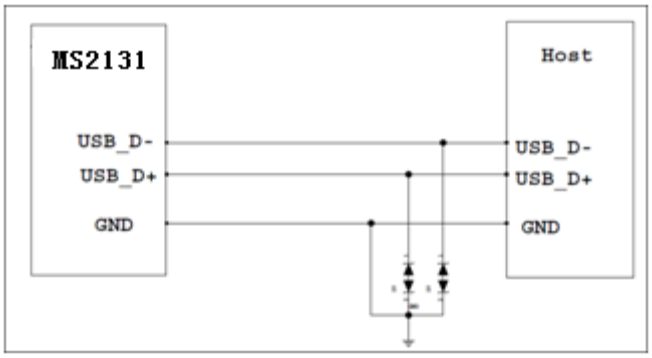
Figure 4-1 USB port reference circuit diagram



NOTE

- The serial impedance of the USB differential data cables depends on the actual situation. The USB cable routing design must strictly follow the USB2.0 protocol requirements. Cable routing must be differentiated mode. The control impedance must be 90 Ω.
- Electro-static discharge (ESD) components must be as close to the USB port as possible. It is recommended that you use components with a rated reverse working voltage of 5 V and a junction capacitance less than 10 pF.

4.2.2 Power Port Introduction

Table 4-2 Power pins

Signal Name	I/O	Description	Direct Current Features (V)		
			Minimum Value	Typical Value	Maximum Value
GND	P	Power ground			
VBUS	P	USB power supply	4.75	5	5.25

The working power of the MS2131 is provided through the USB port with an input voltage range from 4.75 V to 5.25 V (typical value: 5 V). Ensure that the power pins are properly connected during the use of the MS2131 as to maintain its normal performance.

When the MS2131 is dedicated for different applications, attach importance to the power supply design. In some network environments, when the MS2131works at its largest power capacity (for example, when it works in GSM mode, a USB voltage dip may occur. Therefore, make sure the power supply voltage for the host is 3.5 V at the minimum. Otherwise, the MS2131 may restart.

External power supplies with the current output capacity larger than 2 A are recommended and that a capacitor of larger than 300 µF and a decoupling capacitor of 0.1 µF must be paralleled at the power port of the host. When the MS2131 works in GSM mode, its peak current can reach 2 A. To prevent the MS2131's voltage from dropping to lower than 3.5 V and help ensure the MS2131 function properly, place a large-capacity capacitor (at least 300 µF) near the USB port.

If the host is powered by batteries, configure a control switching diode or current limiting chip between the battery power and the MS2131 power port. If a DC/DC converter or

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low-dropout regulator (LDO) is used for the power supply, the transient current capacity must be considered.

4.3 SIM Card Port Introduction

A standard SIM card port is embedded in the MS2131. The port supports the 3.0 V and 1.8 V SIM cards. No external design is required.

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5 MS2131 RF Features and Design Requirements

5.1 About This Chapter

This chapter describes the MS2131's RF parameters, such as its working bands and wireless performance specifications, to help you understand the basic MS2131 RF features. As the design of the host imposes a great impact on the MS2131's wireless performance, this chapter provides detailed requirements for the host layout and stacking design. The antenna test environment is also introduced to help you understand the wireless performance test methods for the MS2131.

5.2 Working Bands

Table 5-1 describes the working bands that the MS2131 supports.

Table 5-1 MS2131 working bands

Working Band	Tx	Rx
UMTS Band I	1920–1980 MHz	2110–2170 MHz
UMTS Band II	1850–1910 MHz	1930–1990 MHz
UMTS Band V	824–849 MHz	869–894 MHz
UMTS Band VIII	880–915 MHz	925–960 MHz
GSM1900	1850–1910 MHz	1930–1990 MHz
GSM1800	1710–1785 MHz	1805–1880 MHz
GSM 900	880–915 MHz	925–960 MHz
GSM 850	824–849 MHz	869–894 MHz

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5.3 Wireless Performance Specifications

5.3.1 TIS

Total Isotropic Sensitivity (TIS) is an important specification that determines the MS2131's receiving performance. Table 5-2 describes the TIS specifications of the MS2131.

Table 5-2 MS2131 TIS specifications

Frequency Band	W2100	W1900	W900	W850	G1900	G1800	G900	G850
TIS specification (dBm)	–103	–101.5	–100	–98.5	–98.5	–100	–100	–98.5

NOTE
The preceding design specifications can be realized only when the MS2131 is in optimal layout with comprehensive shielding measures. Strictly follow the antenna design and stacking requirements to help realize the optimal MS2131 performance.

5.3.2 TRP

Total Radiated Power (TRP) is an important transmission performance specification of the MS2131. Table 5-3 describes the optimal TRP specifications of the MS2131.

Table 5-3 MS2131 TRP specifications

Frequency Band	W2100	W1900	W900	W850	G1900	G1800	G900	G850
TRP specification (dBm)	18	16.5	18	16.5	22.5	24	27	25.5

NOTE
The preceding TRP specifications can be realized only when the MS2131 is in optimal layout. Therefore, strictly follow the antenna design and stacking requirements to help realize the optimal MS2131 performance.

5.4 Antenna Design Requirements

The MS2131 has its antennas embedded and therefore, you do not need to design the antenna. To ensure the MS2131 antenna performance, the following layout requirements shall be met:

1. The USB dongle be connected to a PCB that has a dimension not less than 10 cm x 10 cm (L x W) (as ① in Figure 5-2). The larger the PCB, the better the antenna performance can be.
2. If the PCB is approximately a square, the layout shown in Figure 5-2 (excluding the ② part) be adopted. The USB dongle is placed in the upper or lower part of the PCB side

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(as ③ in Figure 5-2). It is not recommended that the USB dongle be placed in the middle of the PCB (as ⑧ and ⑨ in Figure 5-4).

3. The USB socket must be properly grounded to the PCB to ensure the optimal antenna performance. It is not recommended that the PCB extend to the side of the USB dongle. If this is required (as ② in Figure 5-2), reserve a minimum distance of 5 mm between the USB dongle and the PCB.
4. Ensure that the USB dongle is in an open area without any other metals shielding around (such as an earpiece or loudspeaker), except for cases of recommended layouts. If metals cannot be avoided, a distance larger than 2 cm is required between the USB dongle and the metal.
5. If there are other antennas in auxiliary devices, the antennas must keep a distance from the USB dongle to avoid coupling.
6. If the diversity antenna (as ④ in Figure 5-2) is in one side of the USB dongle, the clearance opening should be faced outwards (as shown in Figure 5-2) to ensure the optimal antenna performance.
7. In order to minimize devices' impact to the USB dongle, corollary equipment must be filtered or shielded
8. Do not place any components that adversely affect the antenna performance on the top of the USB dongle, especially of the main antenna (as ⑤ in Figure 5-2). The antenna performance will decrease by at least 1.5 dB if any adverse effect occurs.
9. It do not place any metal components around the antenna. Reference Figure 5-3.

Follow the preceding requirements to ensure the optimal MS2131 performance. If any discrepancy exists, the MS2131 may fail to connect to the network or provide data, voice, or SMS services.

Figure 5-1 MS2131 antenna area

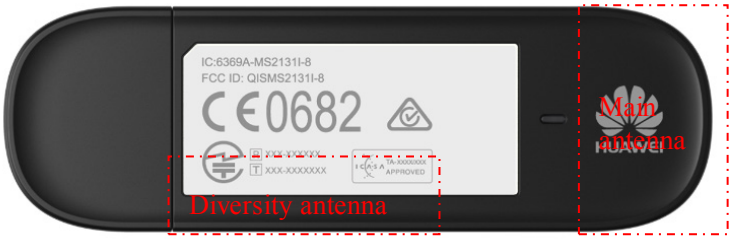

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Figure 5-2 Recommended peripheral layout for the MS2131

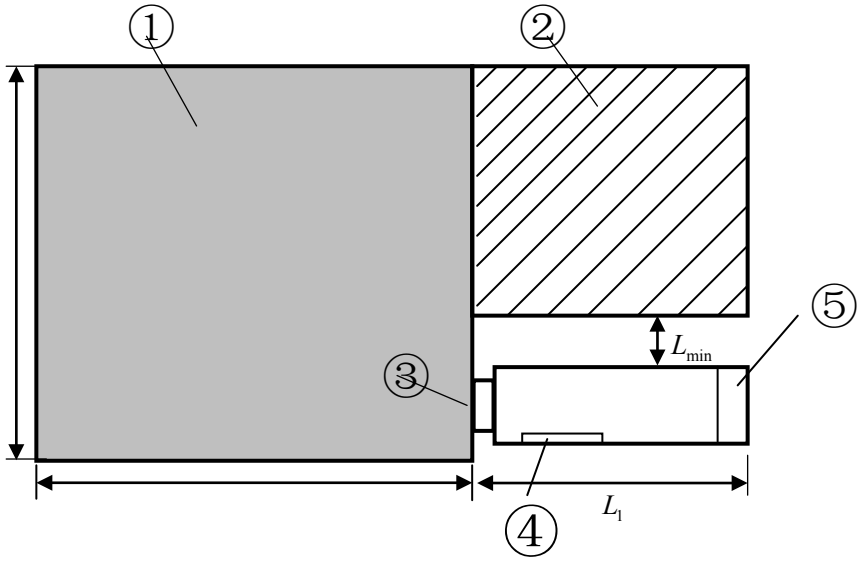
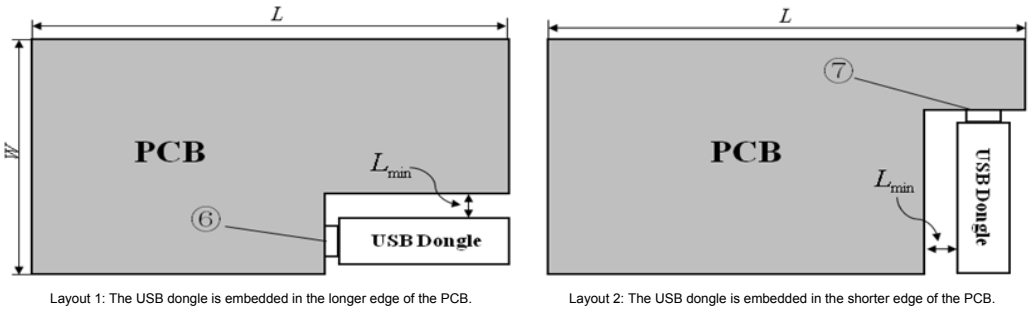


Figure 5-3 Two common PCB layouts



Layout 1: The USB dongle is embedded in the longer edge of the PCB.

Layout 2: The USB dongle is embedded in the shorter edge of the PCB.

If the terminal device is a rectangle (such as a POS device), the layouts shown in Figure 5-3 are recommended.

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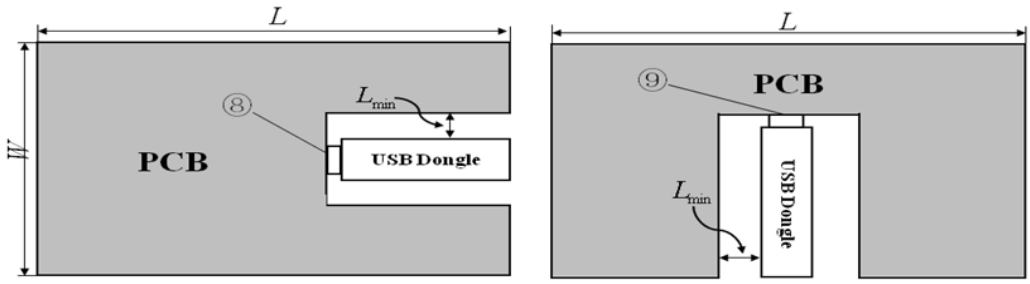
Figure 5-4 Two incorrect layouts



Layout 1: The USB dongle is embedded in the middle of the shorter edge.

Layout 2: The USB dongle is embedded in the middle of the longer edge.

Figure 5-4 shows two incorrect layouts with the USB dongle embedded in the middle of the PCB. The omni-directivity of the antenna deteriorates and the efficiency decreases due to the closed space where the antennas are.

CAUTION

Strictly follow the antenna layout requirements and the stacking requirements specified in section 6.3.2 "MS2131 Peripheral Staking Requirements" when designing the system. If you fail to follow the requirements, the TRP and TIS specifications of the MS2131 will deteriorate, and exceptions, such as network access failures and call failures, will occur.

5.5 Antenna Test Environment

The tests of antenna efficiency, gain, radiation pattern, and TRP and TIS specifications can be performed in a microwave testing chamber. The following describes the test items in detail:

- Passive tests:
  - Antenna efficiency
  - Antenna gain
  - Antenna radiation pattern
  - Envelope correlation coefficient
- Active tests:
  - TRP: GSM and WCDMATIS: GSM and WCDMA

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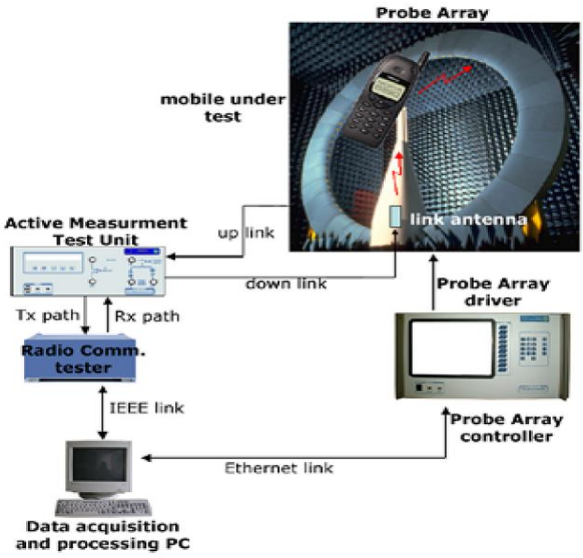
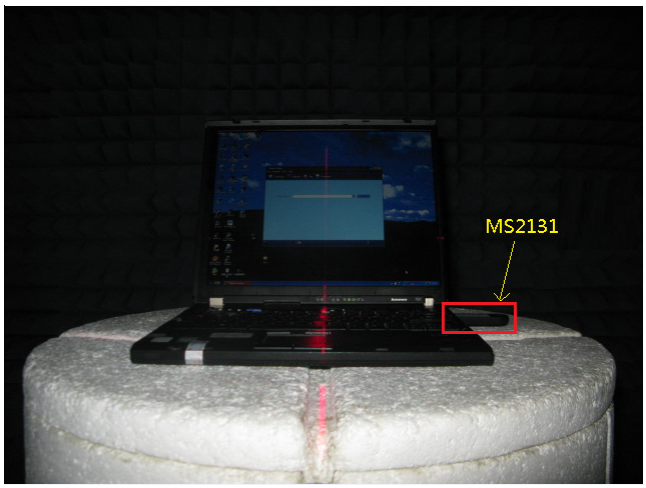
Figure 5-5 SATIMO microwave testing chamber system



- Auxiliary dedicated test platform:

Design the MS2131 dedicated test platform based on the stacking layout in Figure 5-2. Figure 5-6 shows the platform where a Thinkpad T61 is used. This dedicated platform simulates the actual system layout to the maximum extent and all the tests and commissioning on the MS2131 are performed in the platform.

Figure 5-6 Dedicated test platform



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6 MS2131 Structure Features and Design Requirements

6.1 About This Chapter

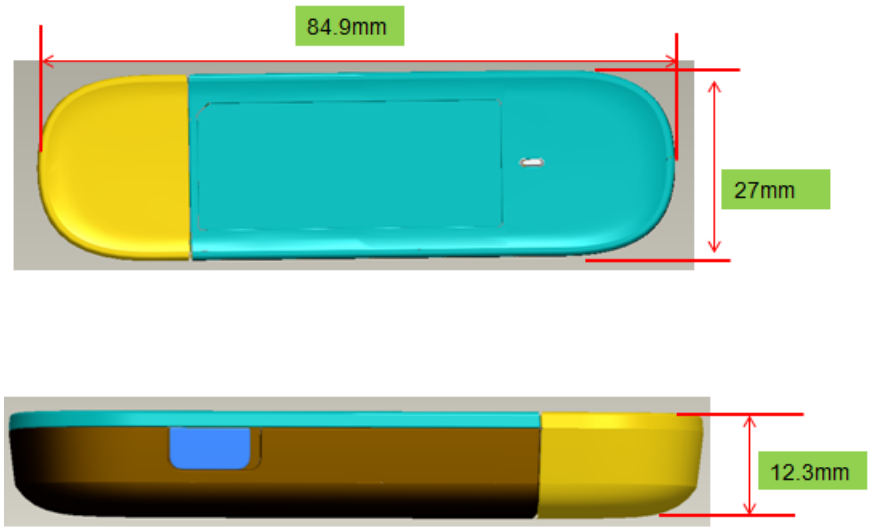
This chapter describes the MS2131 structure features, including the system dimensions and design requirements addressing the host structure. This chapter also describes the USB connector dimensions and its design requirements and guides addressing the host structure.

6.2 Dimensions and Weight

The MS2131 has dimensions of 84.9 mm x 27 mm x 12.3 mm (including the USB cap) and weighs about 30.0 g.

Figure 6-1 shows the outline dimensions of the MS2131.

Figure 6-1 MS2131 dimensions



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6.3 MS2131 Design Requirements Addressing the Host Structure

6.3.1 USB Connector Outline Dimensions

A standard USB2.0 connector, shown in Figure 6-2, is used for the MS2131. The thickness of the PCB where the connector is inserted must range from 0.6 mm to 1.0 mm. The recommended thickness is 0.8 mm.

Figure 6-2 USB connector for the MS2131

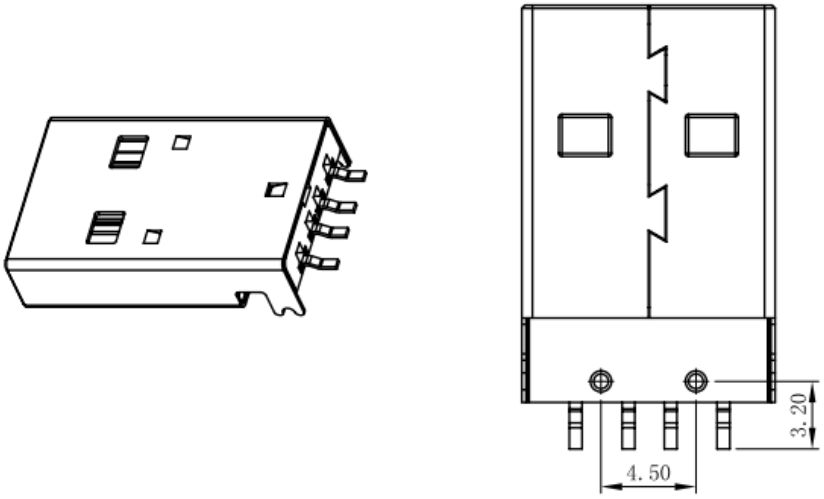

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Figure 6-3 Dimensions of the USB connector

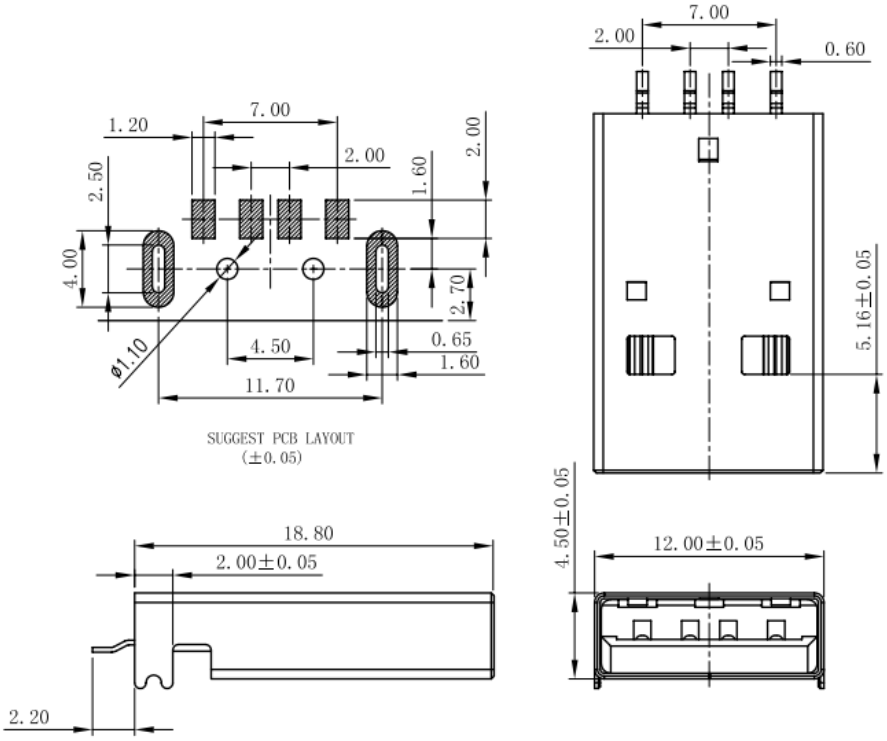

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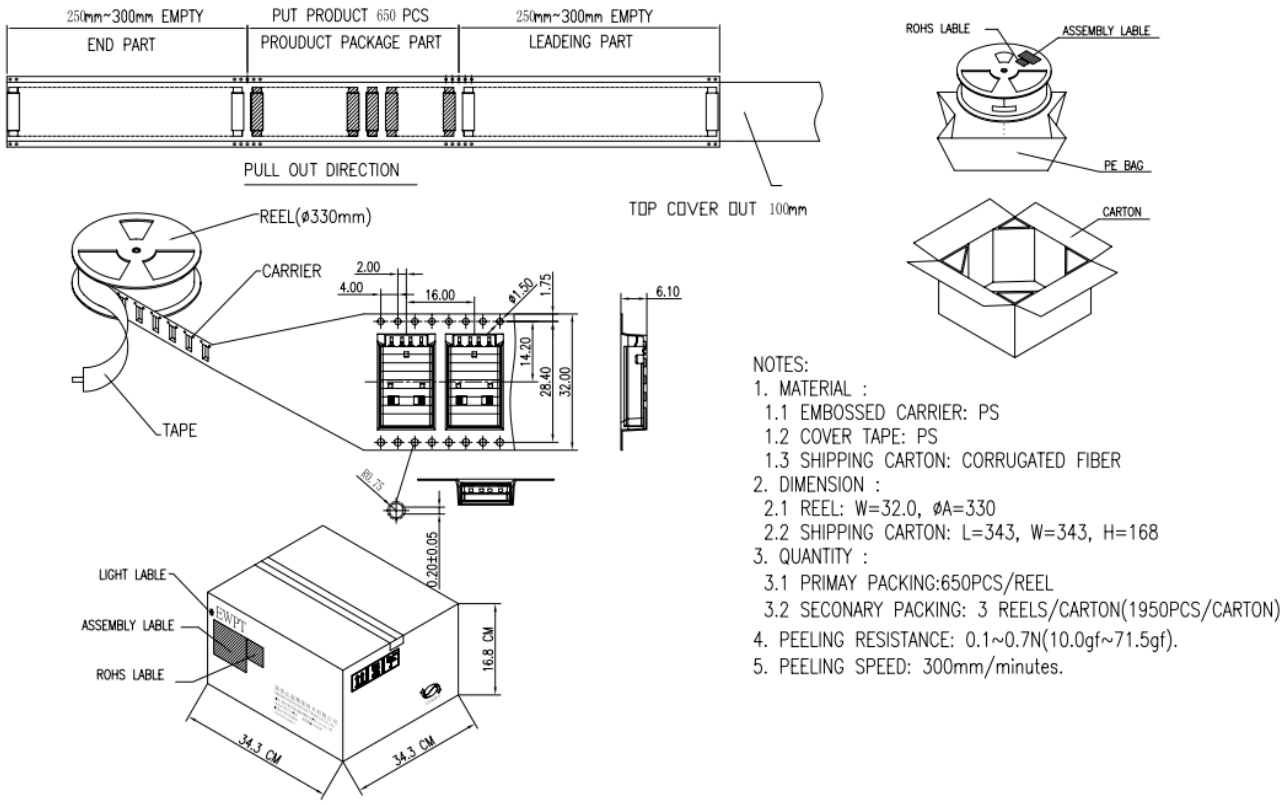
Figure 6-4 Package of the MS2131 USB connector (unit: mm)



6.3.2 MS2131 Peripheral Staking Requirements

When the MS2131 is used in conjunction with the other device，the customer must complete the design in accordance with the following rules，otherwise it will affect the wireless performance of MS2131. Detailed rules as follows:

- The customer should be according to the requirements of antenna in section 5.4 to complete the design firstly，when the MS2131 is used with other device.

- The USB interface between other device and the MS2131，the D+/D- digital line and VBUS line must be routed at inner layer and packaged with the ground.

- It recommended that the LC parallel resonant network should be reserved at the D+/D- digital line of the USB interface which is between other device and MS2131 to reduce the influence of harmonics on low frequency.

- It recommended that the two sides of the component of the interface should leakage of copper on the PCB surface.

- It recommended that the other high speed communication interfaces such as other USB interface, SIDO, PCIE, MIPI and so on must be routed at inner layer and packaged with the ground, and the component of the interface should be shielded，also we suggest the component of the interface keep 10mm away from the side of the MS2131.

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- If there are some digital storage unit, such as SIM card, SD card, Flash and so on, these components and the Peripheral device must be shielded，and keep 10mm away from the side of the MS2131.

- If there are some Communication FPC boards，such as the LCD，the Touch，the MIC，and the SPK+， the FPC board suggest doing EMI processing，and the FPC cables should not be placed near the MS2131.

- If there are some fast switching circuit, such as DCDC circuit, PMU power management circuit, and other circuit that can produce a large electric current ，they must be shielded，and keep 10mm away from the side of the MS2131.

- If there are some clock circuit, such as the TCXO circuit，they must be shielded， and keep 10mm away from the side of the MS2131.

- If there are other baseband signal processing circuit or control circuit, they must be shielded，and keep 10mm away from the side of the MS2131.

- If there are other RF communication unit, such as WIFI,BT,GPS,NFC and so on, they must be shielded， and keep 10mm away from the side of the MS2131.

- Some test points for high speed digital signal should be placed far away from the MS2131 about 5mm.

In addition, other components or circuit which can produce strong EMI should be shielded and placed far away from the MS2131.

NOTE

We have given some design rules above for customers to solve the strong interference. If the customers are unable to meet the design rules, it may decrease the MS2131 performance even the MS2131 cannot work normally.

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7 MS2131 Power Design Guide

7.1 About This Chapter

This chapter describes the MS2131's power features and power supply requirements in different scenarios and its power consumption data in sleep mode. For details about the power supply circuit over which the host powers an embedded MS2131, see section 7.6 "Peripheral Power Design Requirements."

7.2 MS2131 Power Supply

The working power of the MS2131 is provided through the USB port with an input voltage ranging from 4.75 V to 5.25 V (typical value: 5 V).

7.3 MS2131 Power Requirements in 2G Mode

This section describes the MS2131 power features when in use in 2G mode. The power consumption of the MS2131 increases with its transmit power. Transmit power, also called uplink power, is the amount of power used during transmission from a wireless terminal to a base station.

The Time Division Multiple Access (TDMA) uses GSM as the access method, and therefore, the MS2131 transmits signals only in slots specified by the base station. Each GSM transmission cycle has eight slots, 577 µs each. The MS2131 transmits power in one out of the eight slots. As calculated, each GSM transmission cycle lasts 4.61 ms and the transmission duration lasts 577 µs. This transmission mode is called "burst". The better signal reception quality is, the less power consumption of the MS2131 will produce, and vice versa. The maximum power consumption is 33 dBm (GSM900).

Figure 7-1 shows the GSM working principle.

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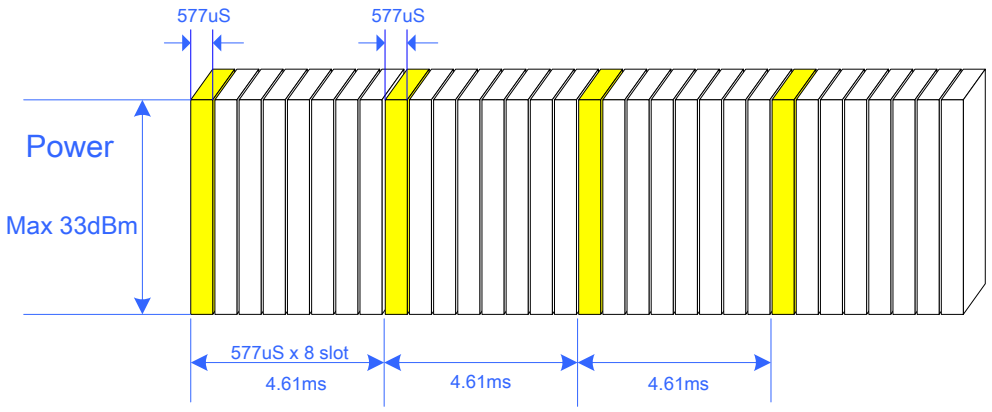
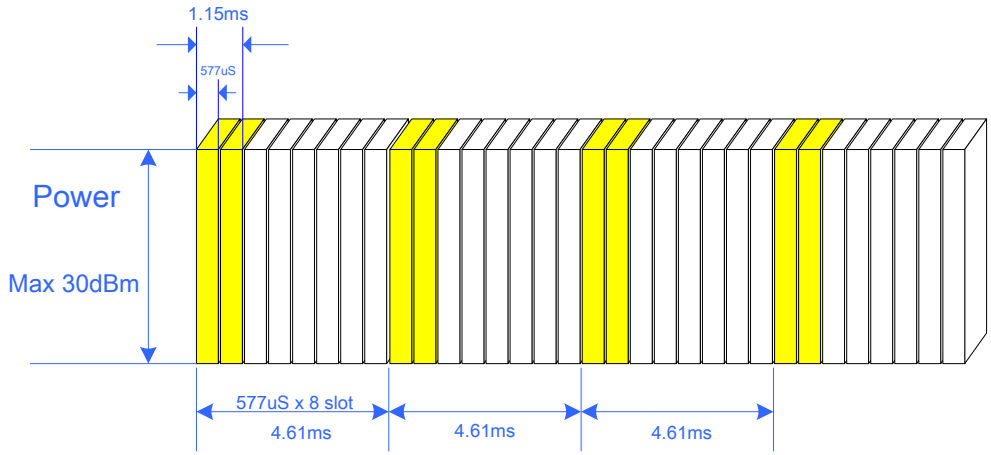
Figure 7-1 GSM working principle



For GPRS mode, the uplink transmission occurs in two or more than two continuous slots, as shown in Figure 7-2.

Figure 7-2 GPRS working principle



In GSM mode, the MS2131 power transmission occurs in cycles and has transient changes during each transmission, as shown in Figure 7-3.

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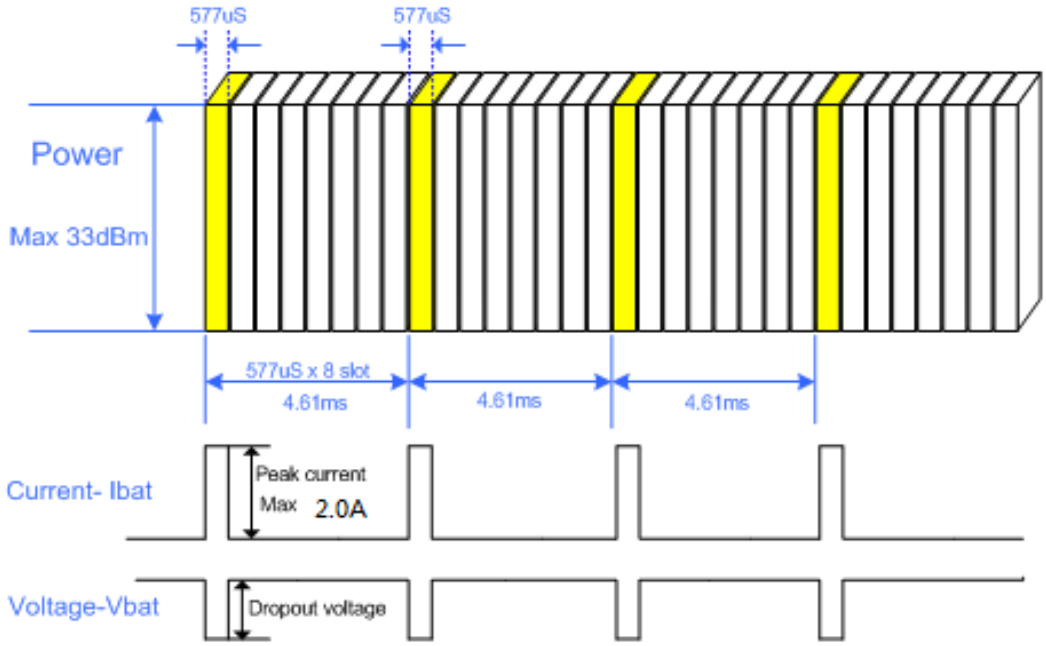
Figure 7-3 Transient power changes



Seen from Figure 7-3, the GMS power amplifier (PA) performs the transmission in the transmission slots. In case of poor signal reception, the PA transmission power may reach 33 dBm. The transient MS2131 power supply current may reach 2 A and a voltage drop then occurs.

The following are two reasons accounting for the MS2131 power supply voltage drop:

- The transient response function of the power supply cannot meet the requirement for the 2 A transient output within several microseconds.
- There is output impedance at the MS2131 power connector, and the currents are large.

When the transmission slot ends, the GSM PA shuts down, the power supply current then drops, and the voltage resumes. After 4.651 ms, another transmission slot comes, causing a voltage drop again.

Therefore, the MS2131 operating in 2G mode must have good transient response performance and small internal resistance to prevent voltage drop. Considering the product cost and that the MS2131 can operate within a certain range of voltages, the minimum voltage of the power supply is 3.5 V.

7.4 MS2131 Power Requirements in 3G Mode

In a 3G network, no correlation exists between the transmission power and time.

Figure 7-4 shows the transmission power in a 3G network.

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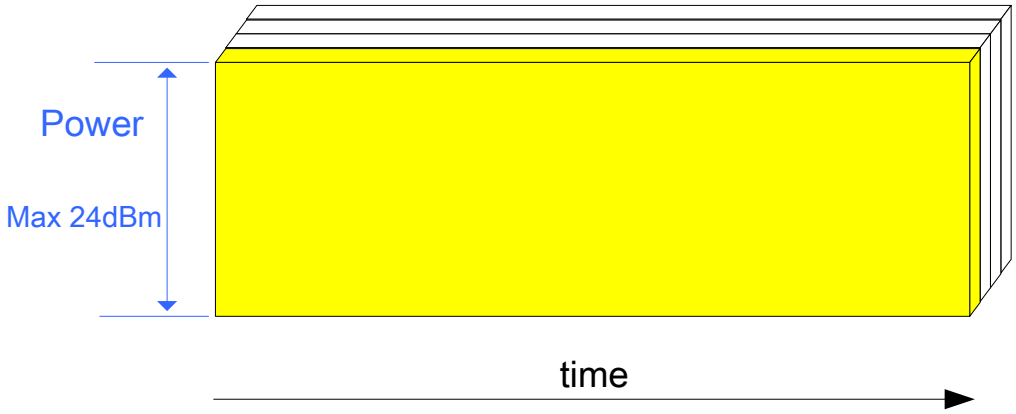
Figure 7-4 3G network transmission



7.5 MS2131 Power Consumption Features

The maximum transmission power capacity for a wireless terminal in a 3G network is 24 dBm while the maximum transient power supply current is about 2 A. Therefore, a minimum current output capacity of 800 mA at average is required to satisfy the load requirements. The following specifications are for reference only:

Power consumption in a 3G network with a 7.2 Mbps download speed and an RF power capacity of 10 dB: 5 V and less than 250 mA

Power consumption in a 3G network with a 2 Mbps download speed and an RF power capacity of 22 dB: 5 V and less than 500 mA

Power consumption in standby mode with a 3G network connected: 5 V and less than 100 mA

7.6 Peripheral Power Design Requirements

Power supplied to the MS2131 must have a minimum general current of 800 mA and a minimum transient current of 2 A. The peripheral power design must be dedicated to these requirements, to help the MS2131 bear the power supply voltage drop for transmission in GSM mode.

To address the voltage drop, the following requirements must be met for peripheral power design:

- Reducing the peripheral power impedance (including the power cable routing to the MS2131)
- Adding energy storage capacitors
- Using the dynamic response function of power module chips

7.6.1 Recommended Power Supply Structure

A power structure of a DC-DC output, power supply over a switching diode, and a current limiting circuit is recommended. The host can then be enabled to control the MS2131 power

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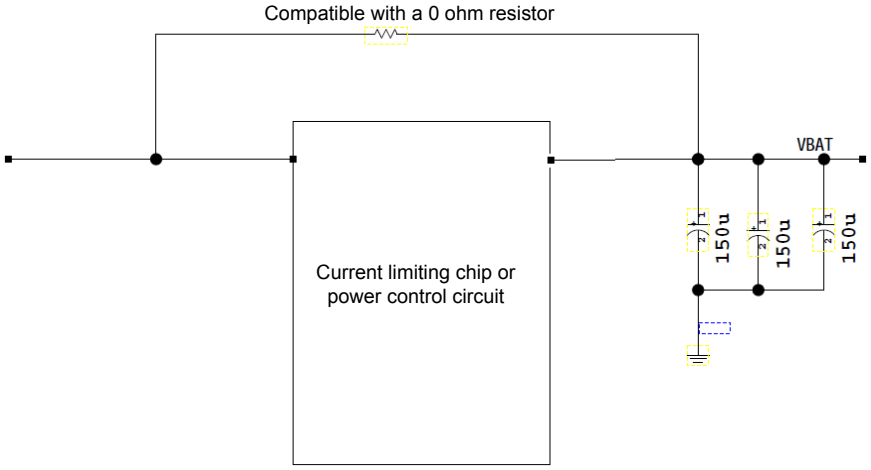
switch and disconnect the power to the MS2131 when exceptions occur. The DC impedance of the current limiting circuit or switching diode must be less than 50 mΩ. To avoid an oversize impedance, reserve space for a 0 Ω resistor for compatible purpose.

Figure 7-5 Recommended power structure



7.6.2 Derating Requirements

It is recommended that an 85% derating capacity be provided for the external power supply voltage and current. If a DC/DC converter or LDO is used, ensure its derating capacity and transient conductivity.

7.6.3 Peripheral Power Supply Design Rules

The peripheral power supply design rules for the MS2131 are described as follows:

1. The power cable routing path must be as wide as possible to bear currents larger than 2 A during transmission in GSM mode.
2. A large-capacity capacitor (at least 300 uF) must be placed near the USB port to prevent its voltage from dropping lower than 3.5 V. Energy storage capacitors used for must be placed near the MS2131 as much as possible to ensure optimal discharge performance of the capacitors.
3. Overvoltage and anti-reversion diodes must be connected to external power supply connectors to protect the power circuits when exceptions occur.
4. If the host supplies power to the MS2131 over a DC/DC converter, the converter must be able to bear the 2 A transient current.
5. The USB power cable voltage fluctuates in GSM mode. Therefore, do not route sensitive signal cables near the USB power cable.

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8 MS2131 PCB Design Guide

This chapter describes the PCB interconnection design requirements and precautions for the host. Complying with these requirements and following these precautions help ensure the performance of the MS2131 when interconnected with the host and reduce user costs.

8.1 General PCB Design Rules

- To ensure the signal integrity and conductivity between the MS2131 and its peripherals, maximize the power cable routing width. Ensure a conductivity of 2 A.
- The two surfaces of USB differentiated signal must be surrounded by grounds and the impedance must be controlled in a proper range. Do not interrupt the signal with strong interference or sensitive signals.

8.2 Power Design

The power design is a key factor for the MS2131 performance, which has impacts on the following specifications:

- EMC performance
- Radio modulation spectrum
- Phase and receiving sensitivity

The general power design rules are described as follows:

- Ensure a good power quality. Reduce the power ripple for a switched-mode power supply and noise interference for a linear power supply.
- Place the filter capacitors for the power supply as close to the power pins for the USB connector as possible. Place the capacitor with less capacitance closer to the power pins. Use capacitors of 150 µF, 4.7 µF, 10 nF, 100 pF, and 33 pF.

Try to minimize the voltage drop caused by the power cable routing and ensure a conductivity of 2 A.

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8.3 Cable Routing Rules

8.3.1 Power Design

The power consumption of the MS2131 varies by network standard. Working in GSM mode, the MS2131 has a peak current of larger than 2 A. To ensure a sufficient power capacity and minimize the voltage drop caused by cable routing, a 100-mil cable routing width is recommended and the finish copper thickness is 1 OZ. If possible, maximize the power cable routing width.

8.3.2 USB Signal Cable Routing Design

The impedance for the USB signal cable on the user PCB must be 90 Ω. The impedance is dependent on the dielectric constant, cable width, and the distance from the ground. Figure 8-1 and Figure 8-2 show the structures and stacking designs of the 90 Ω impedance microstrips and strip lines that can be adopted for the cabling impedance design.

Figure 8-1 Microstrip structure

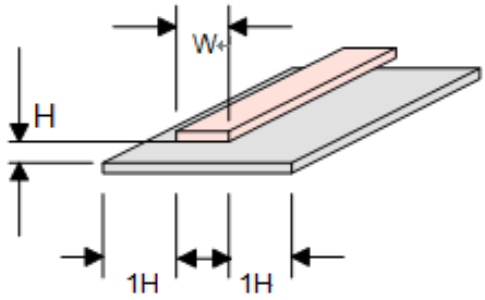
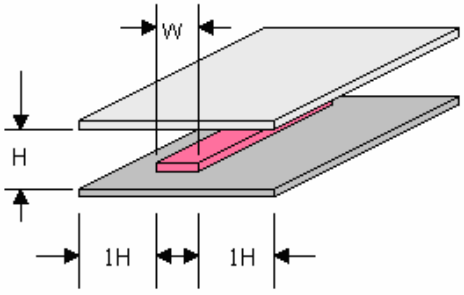


Figure 8-2 Strip line structure



You can use either of the preceding ways to design the 90 Ω cabling impedance.

Note that the USB signal cabling impedance must be dedicatedly designed and the two sides of the USB must be fully surrounded by grounds.

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8.3.3 Grounding Measure

- To protect the USB signals from interference and sensitive sources, surround the USB surfaces by grounds.
- Ensure the continuity of reference grounds for all signal cables to avoid cross division. Ensure a minimum loop path for each signal cable.

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9 MS2131 ESD Design Guide

9.1 PCB Design Recommendations for the Host

1. A four-layer or six-layer PCB is recommended. Two-layer PCBs are not recommended.
2. Use a large-capacity ceramic bypass capacitor and decoupling capacitor on the MS2131 power supply. Place the capacitors within 30 mils from the connector. The PCB cable routing width must be at least 20 mils. Deploy dedicated power cable plane and ground or tight power and ground grid. Use a transient voltage suppressor (TVS) for external electrical overstress (EOS) protection. It is recommended that a component that has a peak power larger than 100 W at 8/20 µs be used.
3. If the signal cable length is larger than 300 mm (12 inches), surround the sides of the signal cables by grounds. Drill holes on the grounds to connect them to the main ground.
4. When connecting the host to the MS2131, ensure the grounding reliability.
5. Use TVSs at the joint between the MS2131 and the host. The TVS on the male connector must have a parasitic capacitance less than 1 pF while the TVS on the power supply must have a peak power larger than 100 W at 8/20 µs

9.2 Shell Design Recommendations for the Host

The MS2131 comes with ESD protection. The SIM card and connector have high requirements for ESD protection.

To prevent users from directly touching the SIM card area, cover the area with a mechanical part.

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10 MS2131 Electrical and Reliability Features

10.1 About This Chapter

This chapter describes the electrical and reliability features of the MS2131 interfaces, including:

- Ultra working conditions
- Working and storage environment
- Power features
- Reliability features
- ESD features

10.2 Ultra Working Conditions

WARNING

Table 10-1 lists the working condition limitation for the MS2131. Permanent damage may be caused to the MS2131 if used beyond the conditions.

Table 10-1 Ultra working conditions of the MS2131

Symbol	Parameter	Minimum Value	Maximum Value	Unit
VBUS	External power supply	–0.3	5.25	V

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10.3 Working and Storage Environment

Table 10-2 lists the working and storage environment for the MS2131.

Table 10-2 Working and storage environment for the MS2131

Parameter	Minimum Value	Maximum Value	Unit
Normal working temperature	–20	55	°C
Storage temperature	–40	70	°C
Humidity range	5	95	%

10.4 Power Features

10.4.1 Input Power

Table 10-3 lists the specifications for the MS2131 input power.

Table 10-3 Specifications for the MS2131 input power

Parameter	Minimum Value	Typical Value	Maximum Value	Ripple	Unit
VBUS	4.75	5	5.25	< 50 mVpp (0 Hz to 2.5 GHz)	V

10.4.2 Working Current

The MS2131 working current is specified in section 11.1 "Appendix One MS2131 Power Consumption Data in Different Scenarios", obtained from a test using direct current and having a typical power supply of 5 V.

10.5 Reliability Features

Table 10-4 describes the MS2131 reliability test conditions and results.

Table 10-4 MS2131 reliability test conditions and results

Test Item		Test Result	Test Parameter
1	Drop test in common temperature	PASS	0.8 m for six surfaces

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Test Item		Test Result	Test Parameter
2	Weight bearing test	PASS	70 kgf for 2s on the front and rear surfaces
3	Pressing test	PASS	120 N for the surfaces
4	Bending test	PASS	2 kgf for 1min
5	Twisting test	PASS	0.5 Nm for 500 times
6	Swapping/disassembling endurance test	PASS	Connecting to an antenna for 3000 times
7	Working vibration	PASS	Sine wave vibration 1. Frequency range: 5 to 500 Hz 2. Acceleration: 2G 3. Sweep frequency: 0.5 oct/min 4. Test duration: three directions (X, Y, and Z), 2h for each direction Random Vibration 1. Frequency range: 5 to 500 Hz 2. PSD: 0.04 g^2/Hz 3. Test duration: three directions (X, Y, and Z), 1h for each direction
8	Working shock	PASS	1. Half sine wave with an acceleration speed of 300 m/s^2 2. Pulse duration: 11 ms 3. Shock times: Six directions, three times for each direction, 18 times in total
9	Low-temperature storage	PASS	–40°C for 24 hours with all specifications, functions, and mechanical performance remaining normal
10	High-temperature storage	PASS	85°C for 24 hours with all specifications, functions, and mechanical performance remaining normal
11	Low-temperature operation	PASS	–20°C for 24 hours with all RF specifications and electrical performance remaining normal (during developing phase)
12	High-temperature operation	PASS	55°C for 24 hours with all RF specifications and electrical performance remaining normal (during developing phase)
13	Damp heat cycling	PASS	Raise the humidity to 95% within 1h and keep the test chamber temperature at 25°C. Raise the temperature to 55°C within 3h and keep the humidity at 95%. Keep the temperature at 55°C and the humidity at 95% for 9h. Decrease the temperature to 25°C within 3h and keep the humidity at 95%. Keep the test chamber temperature at 25°C and humidity at 95% for 9h. The preceding operations are one cycle. Perform two cycles for the test.

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Test Item		Test Result	Test Parameter
14	Temperature shock	PASS	Use two chambers. Keep the temperature at –40°C for one hour and then 70°C for another hour at a maximum interval of 20 seconds. Perform 24 cycles for this test.
15	Solar radiation	PASS	1120 W/m² for 20h and dark for 4h. Perform three cycles for the test.
16	Salt fog test	PASS	Keep the density at 5% for 8h for the entire system.
17	High temperature and high humidity	PASS	1. Power on the sample. Ensure the sample functions at a maximum transmit power. 2. Test temperature: 55±1°C 3. Test humidity: 95±2% RH 4. Test duration: 168h 5. Test time point: 48h, 96h, 144h, and 168h 6. Restoration temperature and duration: 25°C for 2h
18	Temperature cycle test	PASS	1. Power on the sample. Ensure the sample functions at a maximum transmit power. 2. Temperature change ranges: –10±1°C to +55±1°C 3. Temperature change rate: 10°C/min 4. Number of recycles: 120 cycles, one cycle including 30min at low temperature and 30min at high temperature
19	Radiated emission (RE)	PASS	Frequency range: 30 MHz–6 GHz Criterion: CISPR22 Class B
20	Conducted emission (CE)	PASS	Frequency range: 150 KHz–30 MHz Criterion: CISPR22 Class B
21	Radiated spurious emission (RSE)	PASS	Frequency range: 30 MHz–12.75 GHz
22	ESD	PASS	Interference voltage: Air discharge: 10 kV; contact discharge 6 kV Criterion: TT/TR
23	Radiated susceptibility (RS)	PASS	Frequency range: 80 MHz–2.7 GHz. No test is required for the main working bands. Interference field strength: 4 V/m (80% AM is performed) Criterion: CT/CR

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CAUTION

The MS2131 has dedicated ESD requirements. To ensure the proper connection between the MS2131 and the user interface board reference ground, it is recommended that copper studs or other low-impedance metal fasteners be used for the copper exposure (to connect to an interface reference ground) of the positioning holes on the user interface board.

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11 Appendix

11.1 Appendix One MS2131 Power Consumption Data in Different Scenarios

Table 11-1 MS2131 working current (5 V) in common scenarios

Description	Bands	Current	Units	Notes/Configuration
HSDPA/WCDMA	UMTS bands	50	mA	Power up and idle (DRX cycle = 8 [2.56 sec])
		230	mA	Phone call (TX power = 10 dBm)
		230	mA	DL Rate = 7.2 Mbps (TX power = 10 dBm)
GSM/GPRS/EDGE	GSM bands	50	mA	Power up and idle (MFRMS = 5 [1.175 sec])
		140	mA	Phone call (TX power = 10 dBm)

Table 11-2 Peak working currents in GPRS mode

Bands	Averaged Current	Peak Current	Units	TX Power	TX slot
GPRS 850	230	1640	mA	PCL = 5	1 Up/1 Down
GPRS 900	240	1540	mA	PCL = 5	1 Up/1 Down
GPRS 1800	180	1000	mA	PCL = 2	1 Up/1 Down
GPRS 1900	160	1050	mA	PCL = 0	1 Up/1 Down

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Table 11-3 Working currents in all WCDMA service scenarios

Description	Bands	Current	Units	TX power (dBm)
WCDMA	Band I(W2100)	200	mA	1
		230		10
		400		22
	Band II (W1900)	200	mA	1
		230		10
		300		22
	Band V(W850)	200	mA	1
		240		10
		350		22
	Band VIII(W900)	200	mA	1
		240		10
		380		22
HSDPA	Band I(W2100)	220	mA	1
		250		10
		410		22
	Band II (W2100)	220	mA	1
		250		10
		330		22
	Band V(W850)	220	mA	1
		250		10
		380		22
	Band VIII(W900)	220	mA	1
		250		10
		410		22

NOTE
Values in Table 11-3 are average values obtained from a certain number of test samples.

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11.2 Appendix Two MS2131 OTA Data

Table 11-4 MS2131 TIS

Description	Bands	Channel	Test Value	Units
WCDMA	Band I(W2100)	10562	-104	dBm
		10700		
		10838		
	Band II (W1900)	9662	-104	dBm
		9800		
		9938		
	Band V(W850)	4357	-103	dBm
		4408		
		4458		
	Band VIII(W900)	2937	-102	dBm
		3012		
		3088		
GSM	GSM 850	128	-102	dBm
		190		
		251		
	GSM 900	975	-102	dBm
		37		
		124		
	GSM 1800	512	-103	dBm
		698		
		885		
	GSM 1900	512	-103	dBm
		661		
		810		

NOTE
Values in Table 11-4 are average values obtained from a certain number of test samples, which are tested in the stacking conditions shown in Figure 5-2. The tests are implemented with a PC. If the stacking fails to meet requirements made in section 5.4 "Antenna Design Requirements", the MS2131 performance may worsen compared with data in Table 11-4.

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Table 11-5 MS2131 TRP

Description	Bands	Channel	Test Value	Units
WCDMA	Band I(W2100)	9612	19	dBm
		9750		
		9888		
	Band II (W1900)	9662	14	dBm
		9800		
		9938		
	Band V(W850)	4132	19.5	dBm
		4183		
		4233		
	Band VIII(W900)	2712	19.5	dBm
		2787		
		2863		
GSM	GSM 850	128	27.5	dBm
		190		
		251		
	GSM 900	975	29	dBm
		37		
		124		
	GSM 1800	512	24	dBm
		698		
		885		
	GSM 1900	512	23.5	dBm
		661		
		810		

NOTE

The preceding values are average values obtained from a certain number of test samples. Figure 5-2 shows the MS2131 deployed in a PCB. Samples are tested deployed in the board. If the PCB is not designed as required in section 5.4 "Antenna Design Requirements", the MS2131 performance may worsen compared with data in Table 11-4.

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11.3 Appendix Three MS2131 Thermal Test

Thermal Test
Report of Huawei

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A Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
CDMA	Code Division Multiple Access
DL	Down link
DTE	Data Terminal Equipment
EDGE	Enhanced Data Rate for GSM Evolution
EMI	Electro Magnetic Interference
ESD	Electro- Static discharge
GND	Ground
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System of Mobile communication
HSDPA	High Speed Downlink Packet Access
NC	Not connected
PCM	Pulse-code modulation
USB	Universal Serial BUS
WCDMA	Wideband CODE division multiple access

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