EC800N-CN

Hardware Design

LTE Standard Module

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Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating the module. Manufacturers of the cellular terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.

Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.

Switch off the cellular terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.

Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.

Cellular terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.

The cellular terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.

In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other cellular terminals. Areas with explosive or potentially explosive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders.

About the Document

Revision History

Version	Date	Author	Description
-	2021-12-07	Dylan LIU/ Evan ZOU	Creation of the document
1.0	2021-12-20	Dylan LIU/ Evan ZOU	First official release

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1 Introduction

This document defines the EC800N-CN module and describes its air interface and hardware interfaces which are connected with your applications.

With this document, you can quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. The document, coupled with application notes and user guides, makes it easy to design and set up mobile applications with the module.

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, or argument, it indicates that the function, feature, interface, pin, AT command, or argument is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of such model is currently unavailable.

2 Product Overview

2.1. Frequency Bands and Functions

EC800N-CN is an LTE-FDD and LTE-TDD wireless communication module, which provides data connectivity on LTE-FDD and LTE-TDD networks. It also provides voice functionality for your specific applications. The following table lists the frequency bands supported by the EC800N-CN module.

Table 2: Frequency Bands of EC800N-CN

Mode	Frequency Bands
LTE-FDD	B1/B3/B5/B8
LTE-TDD	B34/B38/B39/B40/B41

With a compact profile of 17.7 mm × 15.8 mm × 2.4 mm, EC800N-CN can meet almost all requirements for M2M applications such as automation, metering, tracking, security, router, wireless POS, mobile computing device, PDA phone, tablet PC, etc.

EC800N-CN is an SMD type module which can be embedded in applications through its 94 pins, including 44 LCC pins and 50 LGA pins.

2.2. Key Features

The following table describes the detailed features of EC800N-CN module.

Table 3: Key Features of EC800N-CN

Features	Details
Power Supply	● Supply voltage range: 3.4–4.5 V ● Typical supply voltage: 3.8 V

Transmitting Power	● Class 3 (23 dBm ±2 dB) for LTE-FDD bands ● Class 3 (23 dBm ±2 dB) for LTE-TDD bands
LTE Features	● Supports up to Cat 1 FDD and TDD ● Supports 1.4/3/5/10/15/20 MHz RF bandwidth ● LTE-FDD: Max. 10 Mbps (DL), Max. 5 Mbps (UL) LTE-TDD: Max. 7.5 Mbps (DL), Max. 1 Mbps (UL)
Internet Protocol Features	● Supports TCP/UDP/PPP/NTP/NITZ/FTP/HTTP/PING/CMUX/ HTTPS/FTPS/SSL/FILE/MQTT/MMS/SMTP/SMTPS protocols ● Supports PAP and CHAP for PPP connections
SMS	● Text and PDU modes ● Point-to-point MO and MT ● SMS cell broadcast ● SMS storage: (U)SIM card and ME, ME by default
(U)SIM Interface	● Supports USIM/SIM card: 1.8/3.0 V
Audio Features	● Supports one digital audio interface: PCM interface ● Supports one analog audio input and one analog audio output ● Supports echo cancellation and noise suppression
PCM Interface	● Used for audio function with external codec
USB Interface	● Compliant with USB 2.0 specification (slave only); with maximum transmission rates up to 480 Mbps ● Used for AT command communication, data transmission, software debugging and firmware upgrade ● Supports USB serial drivers for: Windows 7/8/8.1/10, Linux 2.6–5.14, Android 4.x–11.x, etc.
UART Interfaces	● **Main UART:** Used for AT command communication and data transmission Baud rate: 115200 bps by default Supports RTS and CTS hardware flow control ● **Debug UART:** Used for the output of partial logs Baud rate: 115200 bps ● **Auxiliary UART ***
AT Commands	● Compliant with *3GPP TS 27.007, 27.005* and Quectel enhanced AT commands
Network Indication	● NET_STATUS to indicate the network connectivity status
Antenna Interfaces	● Main antenna interface (ANT_MAIN) ● 50 Ω impedance

Physical Characteristics	● Size: (17.7 ±0.15) mm × (15.8 ±0.15) mm × (2.4 ±0.2) mm ● Weight: approx. 1.38 g
Operating Temperature	● Operating temperature range: -35 to +75 °C [1] ● Extended temperature range: -40 to +85 °C [2] ● Storage temperature range: -40 to +90 °C
Firmware Upgrade	● Via USB interface or DFOTA
RoHS	● All hardware components are fully compliant with EU RoHS directive

2.3. Functional Diagram

The following figure shows a block diagram of EC800N-CN and illustrates the major functional parts.

- Power management
- Baseband
- Radio frequency
- Peripheral interfaces

[1] Within operating temperature range, the module meets 3GPP specifications.
[2] Within extended temperature range, the module remains the ability to establish and maintain functions such as voice, SMS, data transmission, etc., without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as P_{out}, may exceed the specified tolerances of 3GPP. When the temperature returns to the operating temperature range, the module meets 3GPP specifications again.

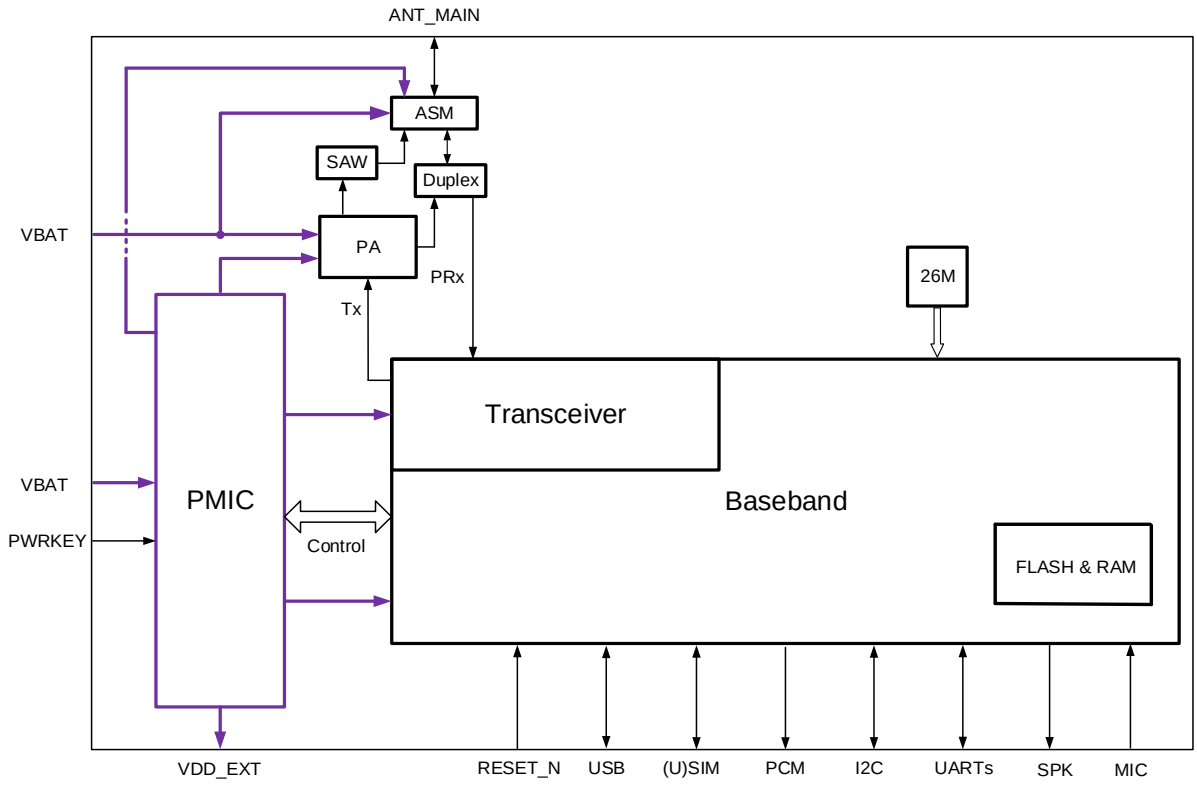


Figure 1: Functional Diagram

2.4. EVB

To help you develop applications with the module, Quectel provides an evaluation board (UMTS & LTE EVB), USB to RS-232 converter cable, earphone, antenna and other peripherals to control or test the module. For more details, see ***document [1]*** .

3 Application Interfaces

3.1. General Description

EC800N-CN module is equipped with 44 LCC pins and 50 LGA pins. The following interfaces are described in detail in subsequent chapters:

- Power supply
- (U)SIM interface
- USB interface
- UART interfaces
- Analog audio interfaces
- PCM and I2C interfaces
- Network status indication
- USB_BOOT interface
- STATUS

3.2. Pin Assignment

The following figure shows the pin assignment of EC800N-CN module.

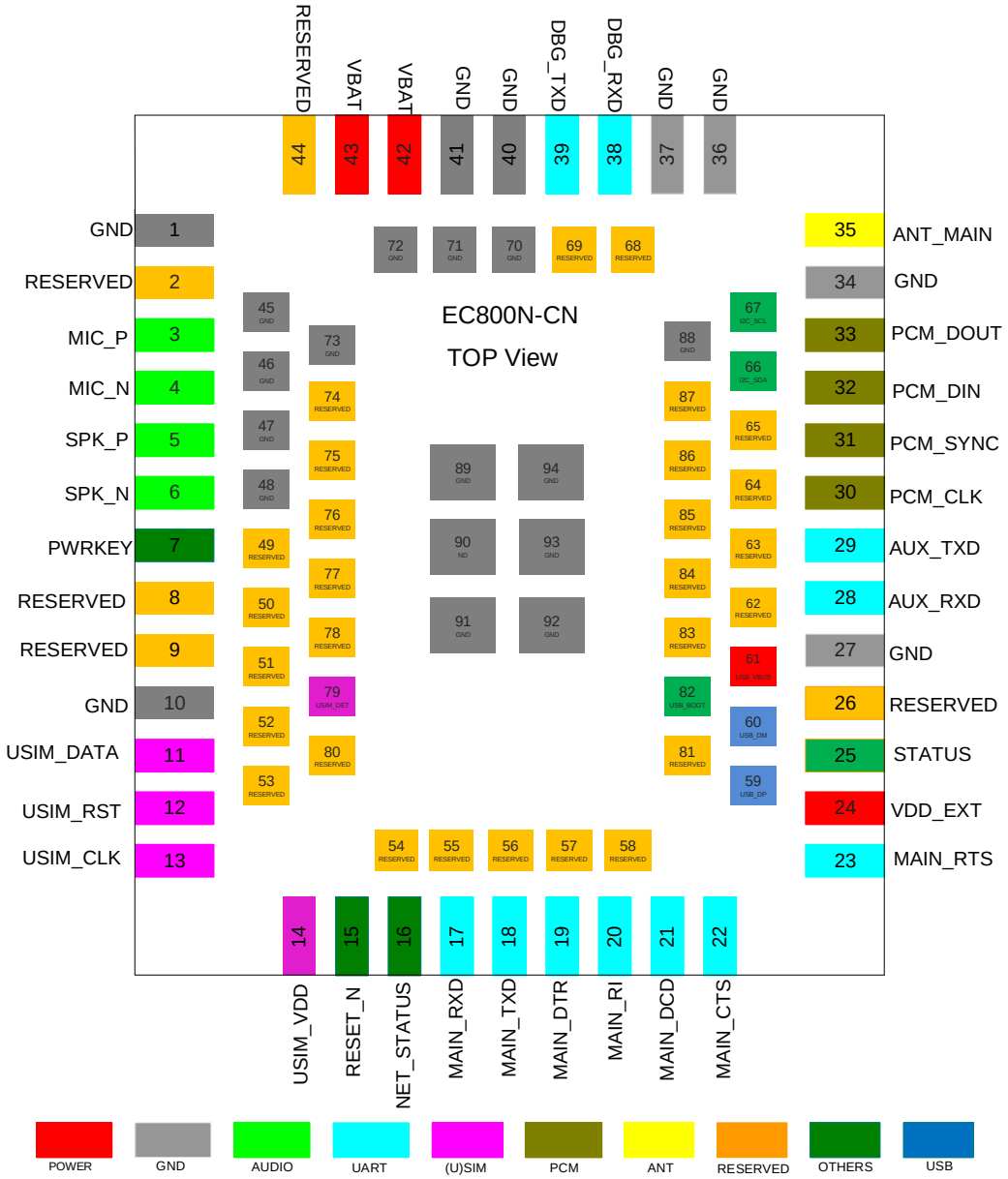


Figure 2: EC800N-CN Module Pin Assignment (Top View)

NOTE

1. USB_BOOT cannot be pulled down to low level before the module is successfully startup.
2. All GND pins should be connected to ground, and keep unused and RESERVED pins unconnected.

3. Ensure that there is a complete reference ground plane below the module, and the ground plane is as close to the module layer as possible. At least a 4-layer board design is recommended.

3.3. Pin Description

The following tables show the pin definition and description of EC800N-CN module.

Table 4: I/O Parameters Definition

Type	Description
AI	Analog Input
AO	Analog Output
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
OD	Open Drain
PI	Power Input
PO	Power Output

Table 5: Pin Description

Power Supply Input					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VBAT	42 43	PI	Power supply for the module	Vmax = 4.5 V Vmin = 3.4 V Vnom = 3.8 V	It must be provided with sufficient current up to 2.0 A. It is recommended to add TVS diode externally.
GND	1, 10, 27, 34, 36, 37, 40, 41, 45–48, 70–73, 88–94				

Power Supply Output					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VDD_EXT	24	PO	Provide 1.8 V for external circuit	Vnom = 1.8 V $I_O$max = 50 mA	Power supply for external GPIO's pull-up circuits. If unused, keep it open.
Turn on/off					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
PWRKEY	7	DI	Turn on/off the module	V_{IL}max = 0.5 V Vnom = VBAT	Pull down PWRKEY for a period of time to power on/off. See ***Chapter 3.7*** for more details.
RESET_N	15	DI	Reset the module	V_{IL}max = 0.5 V Vnom = 1.6 V	Active Low. If unused, keep it open.
Status Indication					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
NET_STATUS	16	DO	Indicate the module's network activity status	V_{OH}min = 1.35 V V_{OL}max = 0.45 V	1.8 V power domain. If unused, keep it open.
STATUS	25	DO	Indicate the module's operation status	V_{OH}min = 1.35 V V_{OL}max = 0.45 V	
USB Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
USB_DP	59	AIO	USB differential data (+)		USB 2.0 compliant. Requires differential impedance of 90 Ω. If unused, keep it open.
USB_DM	60	AIO	USB differential data (-)		
USB_VBUS	61	AI	USB connection detect	Vmax = 5.25 V Vmin = 3.0 V Vnom = 5.0 V	Typical: 5.0 V If unused, keep it open.

(U)SIM Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
USIM_DATA	11	DIO	(U)SIM card data	**1.8 V (U)SIM:** V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{OL}max = 0.45 V V_{OH}min = 1.35 V **3.0 V (U)SIM:** V_{IL}max = 1.0 V V_{IH}min = 1.95 V V_{OL}max = 0.45 V V_{OH}min = 2.55 V	
USIM_RST	12	DO	(U)SIM card reset	**1.8 V (U)SIM:** V_{OL}max = 0.45 V V_{OH}min = 1.35 V **3.0 V (U)SIM:** V_{OL}max = 0.45 V V_{OH}min = 2.55 V	
USIM_CLK	13	DO	(U)SIM card clock	**1.8 V (U)SIM:** V_{OL}max = 0.45 V V_{OH}min = 1.35 V **3.0 V (U)SIM:** V_{OL}max = 0.45 V V_{OH}min = 2.55 V	
USIM_VDD	14	PO	(U)SIM card power supply	Iomax = 50 mA **1.8 V (U)SIM:** Vmax = 1.9 V Vmin = 1.7 V **3.0 V (U)SIM:** Vmax = 3.05 V Vmin = 2.7 V	Either 1.8 V or 3.0 V (U)SIM card is supported and can be identified automatically by the module.
USIM_DET	79	DI	(U)SIM card hot-plug detect	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	1.8 V power domain. If unused, keep it open.
Main UART Interface					

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
MAIN_RXD	17	DI	Main UART receive	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	1.8 V power domain. If unused, keep it open.
MAIN_TXD	18	DO	Main UART transmit	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
MAIN_DTR	19	DI	Main UART data terminal ready	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	
MAIN_RI	20	DO	Main UART ring indication	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
MAIN_DCD	21	DO	Main UART data carrier detect	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
MAIN_CTS	22	DO	DTE clear to send signal from DCE	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	Connect to DTE's CTS. 1.8 V power domain. If unused, keep it open.
MAIN_RTS	23	DI	DTE request to send signal to DCE	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	Connect to DTE's RTS. 1.8 V power domain. If unused, keep it open.
Debug UART Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
DBG_RXD	38	DI	Debug UART receive	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	1.8 V power domain. If unused, keep it open.
DBG_TXD	39	DO	Debug UART transmit	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
Auxiliary UART Interface*					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
AUX_RXD	28	DI	Auxiliary UART receive	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V	1.8 V power domain. If unused, keep it open.

				V_{IH}max = 2.0 V	
AUX_TXD	29	DO	Auxiliary UART transmit	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
PCM & I2C Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
I2C_SDA	66	OD	I2C serial data		Used for external Codec. An external 1.8 V pull-up resistor is required. If unused, keep it open.
I2C_SCL	67	OD	I2C serial clock		
PCM_CLK	30	DO	PCM clock	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	1.8 V power domain. If unused, keep it open.
PCM_SYNC	31	DO	PCM data frame sync	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
PCM_DIN	32	DI	PCM data input	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	
PCM_DOUT	33	DO	PCM data output	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
Analog Audio Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
MIC_P	3	AI	Microphone analog input (+)		If unused, keep it open.
MIC_N	4	AI	Microphone analog input (-)		
SPK_P	5	AO	Analog audio differential output (+)		The interface can drive 32 Ω speaker with power rate at 37 mW. It can also be used to drive external power amplifier devices if the output power rate cannot meet the demand. If unused, keep it open.
SPK_N	6	AO	Analog audio differential output (-)		

Antenna Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
ANT_MAIN	35	AIO	Main antenna interface		50 Ω impedance.
USB_BOOT Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
USB_BOOT	82	DI	Force the module into emergency download mode	V_{IL}min = -0.3 V V_{IL}max = 0.6 V V_{IH}min = 1.2 V V_{IH}max = 2.0 V	1.8 V power domain. Active low. This pin cannot be pulled down to low level before the module is successfully startup if the emergency download mode is not necessary. It is recommended to reserve test points.
RESERVED Pins					
Pin Name	**Pin No.**				**Comment**
RESERVED	2, 8, 9, 26, 44, 49–58, 62–65, 68, 69, 74–78, 80, 81, 83–87				Keep these pins unconnected.

3.4. Operating Modes

Table 6: Overview of Operating Modes

Modes	Details	
Normal Operation	Idle	Software is active. The module remains registered on the network, and it is ready to send and receive data.
	Talk/Data	Network connection is ongoing. In this mode, the power consumption is decided by network setting and data transfer rate.
Minimum Functionality Mode	**AT+CFUN=0** can set the module to a minimum functionality mode without removing the power supply. In this case, both RF function and (U)SIM card are invalid.	

Airplane Mode	**AT+CFUN=4** can set the module to airplane mode. In this case, RF function is invalid.
Sleep Mode	In this mode, the current consumption of the module is reduced to the minimal level. During this mode, the module can still receive paging message, SMS, voice call and TCP/UDP data from the network normally.
Power Down Mode	In this mode, the module's power supply is cut off by its power management IC. The software is inactive and the serial interfaces are not accessible, while the VBAT pins are still powered.

NOTE

For more details about AT command, see ***document [2]***.

3.5. Power Saving

3.5.1. Sleep Mode

EC800N-CN is able to reduce its current consumption to a minimal level during sleep mode. The following section describes ways to let EC800N-CN module enter sleep mode.

3.5.1.1. UART Application

If the host communicates with the module via UART interfaces, the following preconditions can make the module enter sleep mode.

- Execute **AT+QSCLK=1** to enable sleep mode.
- Drive MAIN_DTR high.

The following figure shows the connection between the module and the host.

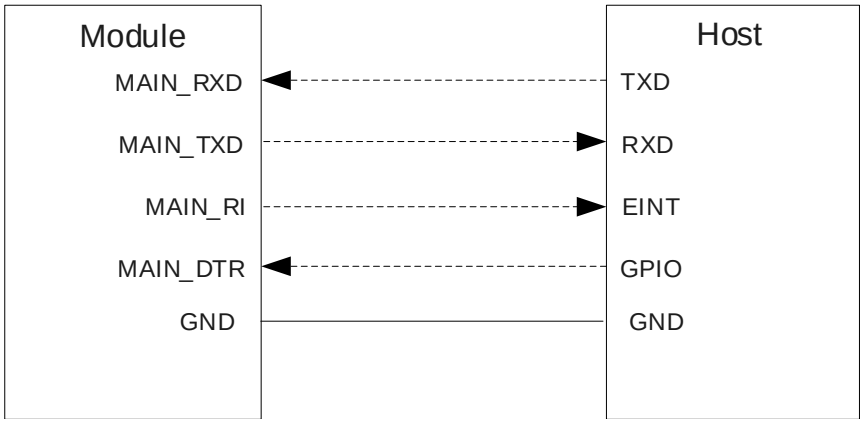


Figure 3: Sleep Mode Application via UART

- Drive MAIN_DTR low will wake up the module.
- When the module has a URC to report, the URC will trigger the behavior of MAIN_RI pin. See ***Chapter 3.17*** for details about MAIN_RI behaviors.

3.5.1.2. USB Application with USB Remote Wakeup Function

If the host supports USB suspend/resume and remote wakeup functions, the following three preconditions must be met at the same time to let the module enter sleep mode.

- Execute **AT+QSCLK=1** to enable the sleep mode.
- Ensure the MAIN_DTR is held at high level or keep it open.
- The host's USB bus, which is connected with the module's USB interface, enters suspend state.

The following figure shows the connection between the module and the host.

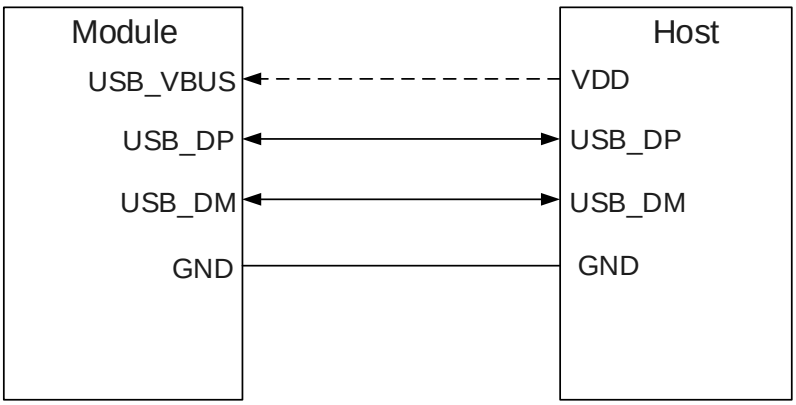


Figure 4: Sleep Mode Application with USB Remote Wakeup

- You can wake up the module by sending data to it through USB.
- When the module has a URC to report, the module sends remote wake-up signals to wake up the host via the USB bus.

3.5.1.3. USB Application with USB Suspend/Resume and RI Function

If the host supports USB suspend/resume, but does not support remote wakeup function, the MAIN_RI signal is needed to wake up the host. The following three preconditions must be met at the same time to let the module enter sleep mode.

- Execute **AT+QSCLK=1** to enable the sleep mode.
- Ensure the MAIN_DTR is held at high level or keep it open.
- The host's USB bus, which is connected with the module's USB interface, enters suspend state.

The following figure shows the connection between the module and the host.

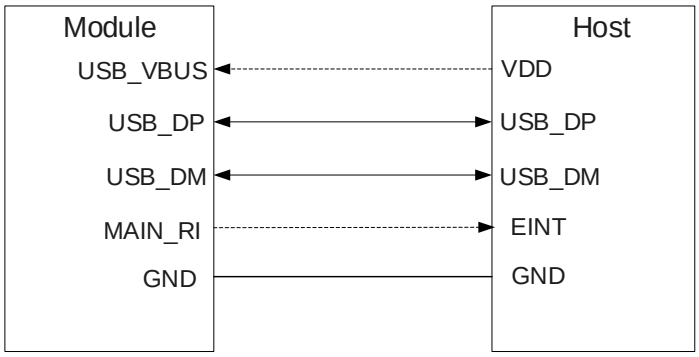


Figure 5: Sleep Mode Application with MAIN_RI

- You can wake up the module by sending data to it through USB.
- When the module has a URC to report, the URC will trigger the behavior of MAIN_RI pin. See ***Chapter 3.17*** for details about MAIN_RI behavior.

3.5.1.4. USB Application without USB Suspend Function

If the host does not support USB suspend function, disconnect USB_VBUS with an external control circuit to let the module enter sleep mode.

- Execute **AT+QSCLK=1** to enable the sleep mode.
- Ensure the MAIN_DTR is held at high level or keep it open.
- Disconnect USB_VBUS.

The following figure shows the connection between the module and the host.

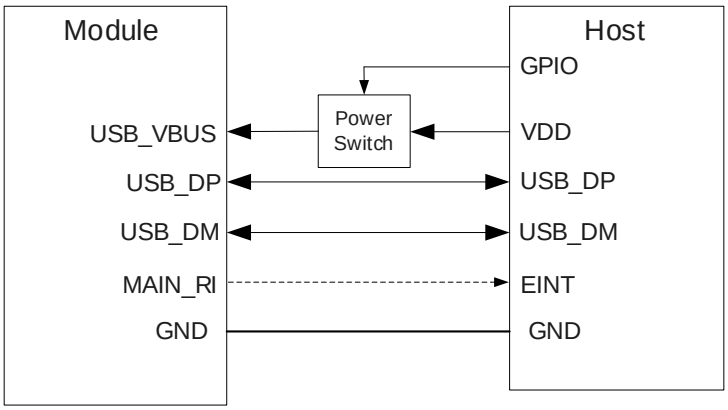


Figure 6: Sleep Mode Application without Suspend Function

You can wake up the module by switching on the power switch to supply power to USB_VBUS.

NOTE

Pay attention to the level match shown in dotted line between the module and the host shown in the circuit diagrams of ***Chapter 3.5.1***.

3.5.2. Airplane Mode

When the module enters airplane mode, the RF function does not work and all AT commands related to the RF function are inaccessible. The following ways can be used to let the module enter airplane mode.

Software:
AT+CFUN=<fun> provides the choice of the functionality level through setting **<fun>** into 0, 1 or 4.

- **AT+CFUN=0:** Minimum functionality mode. Both (U)SIM and RF functions are disabled.
- **AT+CFUN=1:** Full functionality mode (by default).
- **AT+CFUN=4:** Airplane mode. RF function is disabled.

3.6. Power Supply

3.6.1. Power Supply Pins

EC800N-CN module provides two VBAT pins dedicated for connection with the external power supply.

The following table shows the pin definition of VBAT and GND.

Table 7: VBAT and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VBAT	42, 43	Power supply for the module	3.4	3.8	4.5	V
GND	1, 10, 27, 34, 36, 37, 40, 41, 45–48, 70–73, 88–94	Ground	-	0	-	V

3.6.2. Voltage Stability Requirements

The power supply range of EC800N-CN module is from 3.4 V to 4.5 V. Make sure the input voltage never drops below 3.4 V. The following figure shows the voltage drop during burst transmission.

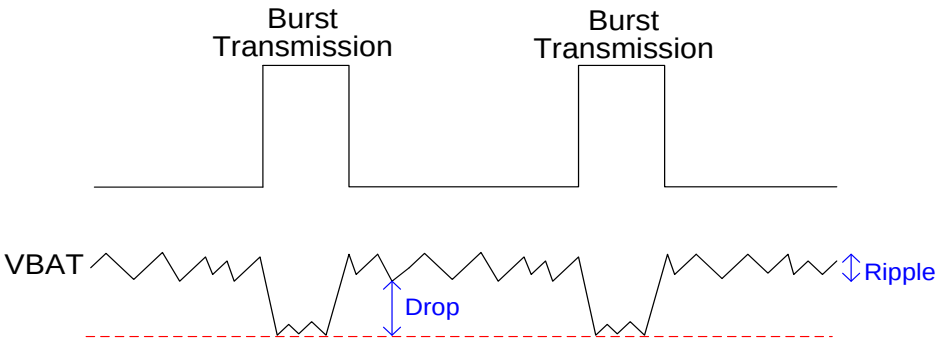


Figure 7: Power Supply Limits during Burst Transmission

To decrease voltage drop, use a bypass capacitor of about 100 μF with low ESR (ESR = 0.7 Ω). It is recommended to reserve three multi-layer ceramic chip (MLCC) capacitors (100 nF, 33 pF and 10 pF) with the best ESD performance, and place these capacitors close to the VBAT pins. The width of VBAT trace should be no less than 2 mm. In principle, the longer the VBAT trace is, the wider it should be.

In addition, in order to ensure the stability of power source, it is suggested that a WS4.5D3HV TVS diode of which reverse stand-off voltage is 4.7 V and peak pulse power is up to 2550 W should be used. The following figure shows the star structure of the power supply.

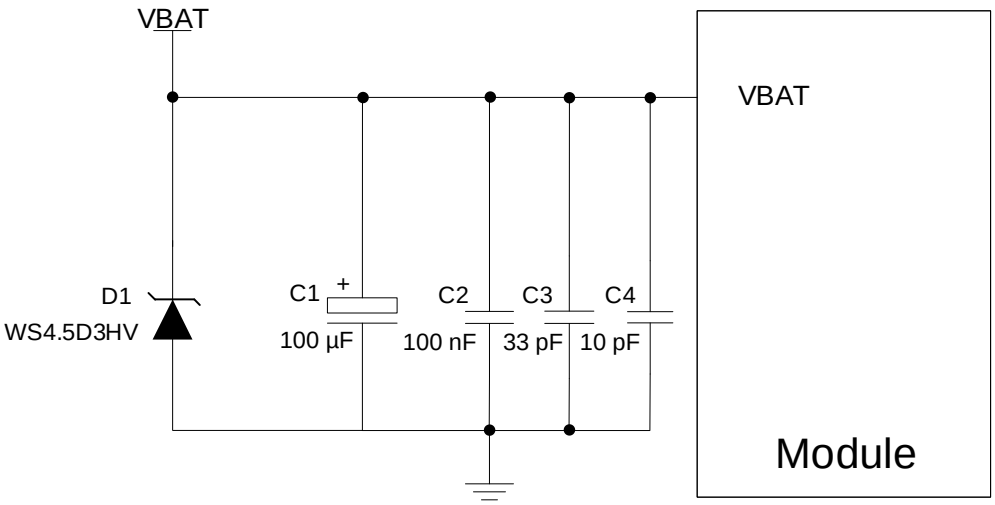


Figure 8: Star Structure of Power Supply

3.6.3. Reference Design for Power Supply

Power design for the module is very important. The power supply should be able to provide sufficient current up to 2.0 A for EC800N-CN. If the voltage drop between the input and output is not too high, use an LDO to supply power for the module. If there is a big voltage difference between the input source and the desired output (VBAT), use a buck converter as the power supply.

The following figure shows a reference design for +5 V input power source. The circuit is designed using the LDO of Micrel's MIC29302WU. The typical output of the power supply is about 3.8 V and the maximum load current is 3.0 A.

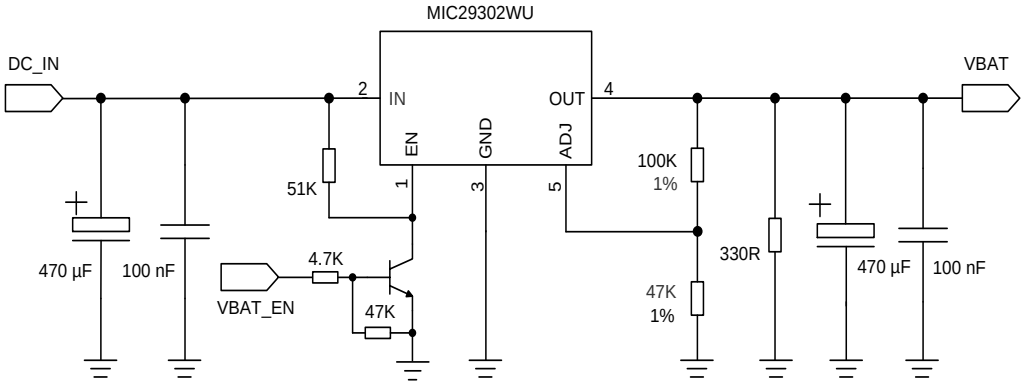


Figure 9: Reference Circuit of Power Supply

3.7. Turn on and Turn off

3.7.1. Turn on with PWRKEY

Table 8: Pin Description of PWRKEY

Pin Name	Pin No.	I/O	Description	Comment
PWRKEY	7	DI	Turn on/off the module	Pull down PWRKEY for a period of time to power on/off.

When the module is in power down mode, you can turn it on to normal mode by driving the PWRKEY pin low for at least 500 ms. It is recommended to use an open drain/collector driver to control the PWRKEY. A simple reference circuit is illustrated in the following figure.

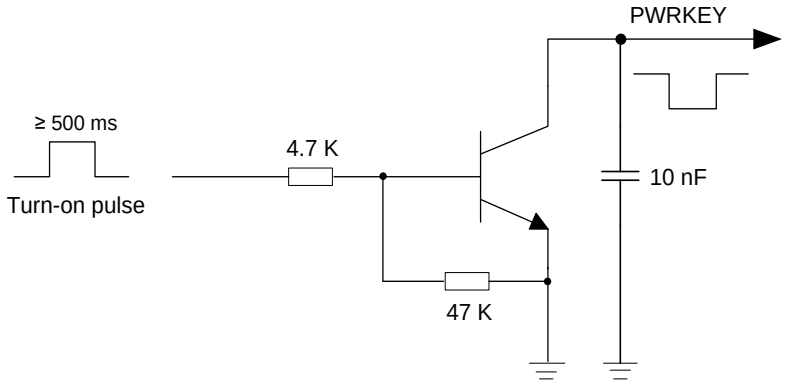


Figure 10: Turing on the Module Using Driving Circuit

Another way to control the PWRKEY pin is using a button directly, a TVS component is indispensable to be placed nearby the button for ESD protection. A reference circuit is shown in the following figure.

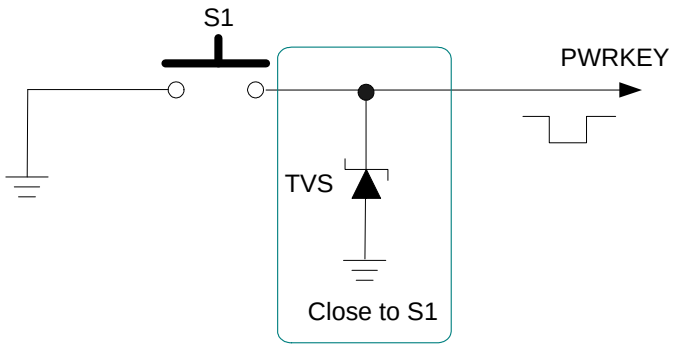


Figure 11: Turing on the Module Using Button

The power-up scenario is illustrated in the following figure.

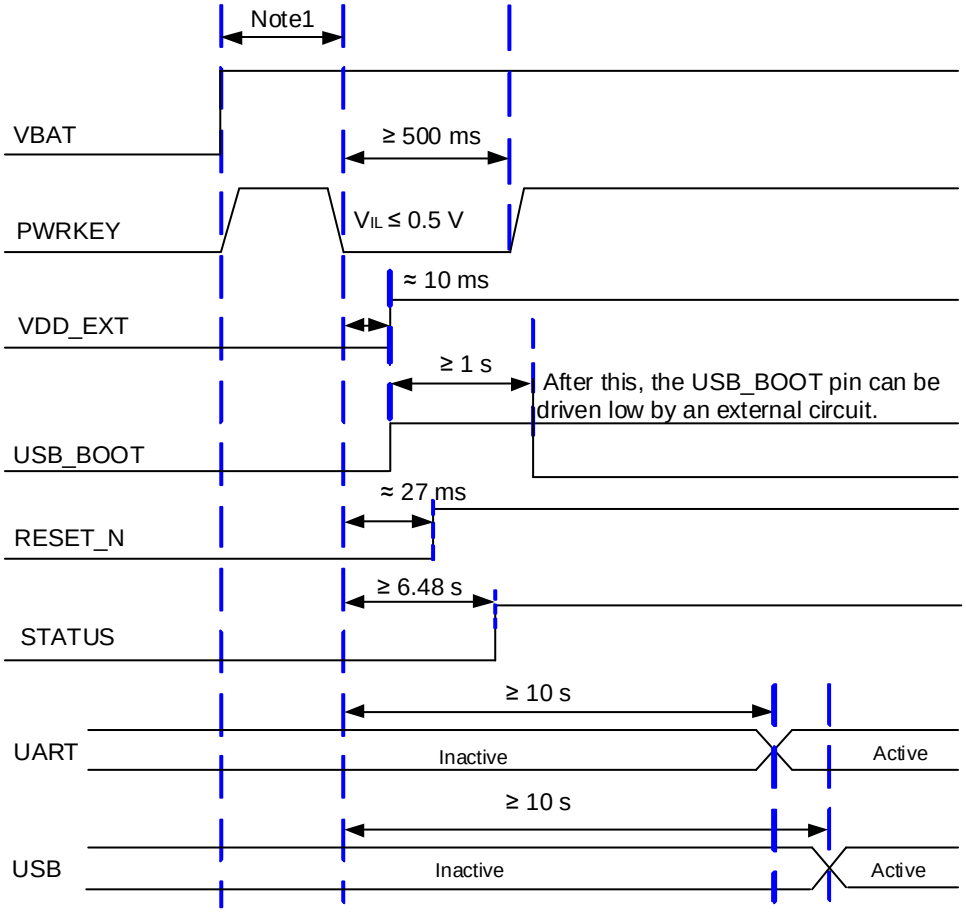


Figure 12: Power-up Timing

NOTE

1. Make sure that VBAT is stable before pulling down PWRKEY pin. It is recommended that the time difference between powering up VBAT and pulling down PWRKEY pin is no less than 30 ms.
2. PWRKEY can be pulled down directly to GND with a recommended 4.7 kΩ resistor if the module needs to be powered on automatically and shutdown is not needed.

3.7.2. Turn off

The following procedures can be used to turn off the module normally:

- Use the PWRKEY pin.
- Use **AT+QPOWD** command.

3.7.2.1. Turn off with PWRKEY

Drive the PWRKEY pin low for at least 650 ms and then release PWRKEY. After this, the module executes power-down procedure. The power-down scenario is illustrated in the following figure.

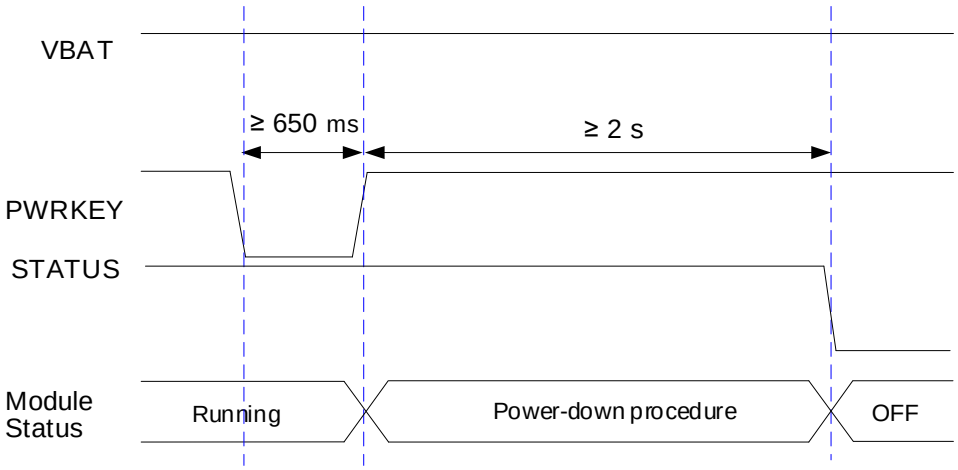


Figure 13: Power-down Timing

3.7.2.2. Turn off with AT Command

It is also a safe way to use **AT+QPOWD** to turn off the module, which is similar to turning off the module via the PWRKEY pin. See ***document [2]*** for details about **AT+QPOWD**.

NOTE

1. To avoid damaging internal flash, do not switch off the power supply when the module works normally. Only after shutting down the module with PWRKEY or AT command can you cut off the power supply.
2. When turning off module with the AT command, keep PWRKEY at high level after the execution of the command. Otherwise, the module will be turned on again after successfully turn-off.

3.8. Reset

The RESET_N pin can be used to reset the module. You can reset the module by driving RESET_N low for at least 300 ms and then releasing it.

Table 9: Pin Description of RESET_N

Pin Name	Pin No.	I/O	Description	Comment
RESET_N	15	DI	Reset the module	Active low If unused, keep it open.

The recommended circuit is similar to the PWRKEY control circuit. You can use an open drain/collector driver or button to control RESET_N.

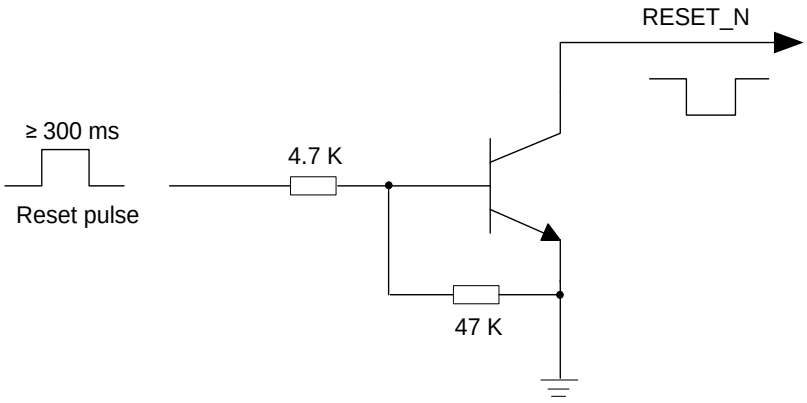


Figure 14: Reference Circuit of RESET_N by Using Driving Circuit

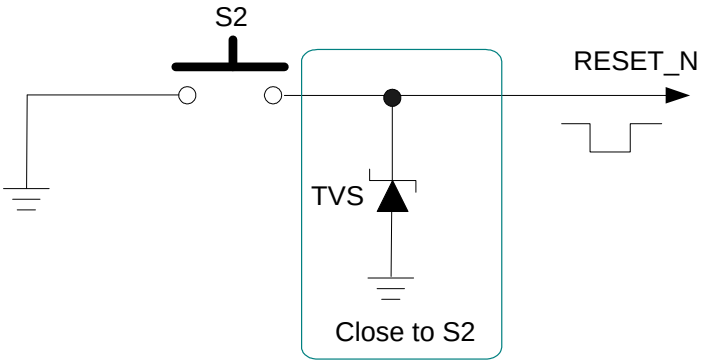


Figure 15: Reference Circuit of RESET_N by Using Button

The reset scenario is illustrated in the following figure.

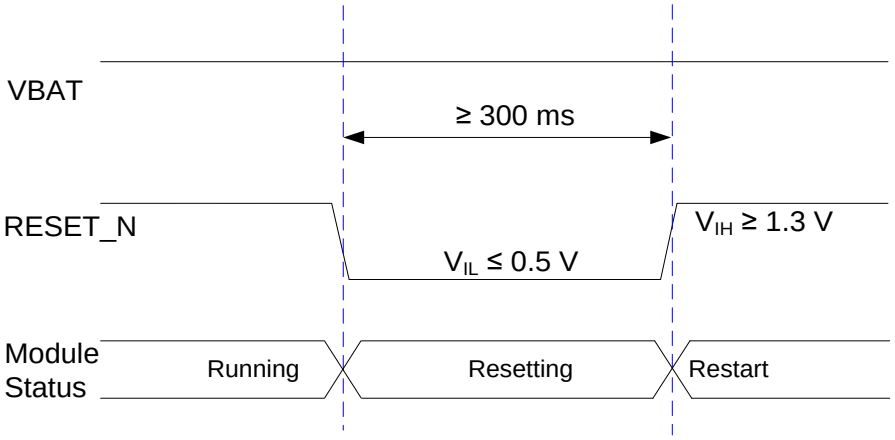


Figure 16: Timing of Resetting the Module

NOTE

1. Use RESET_N only when you fail to turn off the module with the **AT+QPOWD** and PWRKEY.
2. Ensure that the load capacitance does not exceed 10 nF on PWRKEY and RESET_N pins.
3. The RESET_N signal is sensitive to interference, so it is recommended to route the trace as short as possible and surround it with ground.
4. RESET_N only resets the internal baseband chip of the module and does not reset the power management chip.

3.9. (U)SIM Interface

EC800N-CN module provides one (U)SIM interface. The (U)SIM interface circuitry meets ETSI and IMT-2000 requirements. Either 1.8 V or 3.0 V (U)SIM card is supported.

Table 10: Pin Definition of (U)SIM Interface

Pin Name	Pin No.	I/O	Description	Comment
USIM_DATA	11	DIO	(U)SIM card data	
USIM_RST	12	DO	(U)SIM card reset	
USIM_CLK	13	DO	(U)SIM card clock	
USIM_VDD	14	PO	(U)SIM card power supply	Either 1.8 V or 3.0 V (U)SIM card

				is supported and can be identified automatically by the module.
USIM_DET	79	DI	(U)SIM card hot-plug detect	1.8 V power domain If unused, keep it open.

EC800N-CN module supports (U)SIM card hot-plug via the USIM_DET pin, and both high and low level detection are supported. The function is disabled by default, and see **AT+QSIMDET** in ***document [2]*** for more details.

The following figure shows a reference design for (U)SIM card interface with an 8-pin (U)SIM card connector.

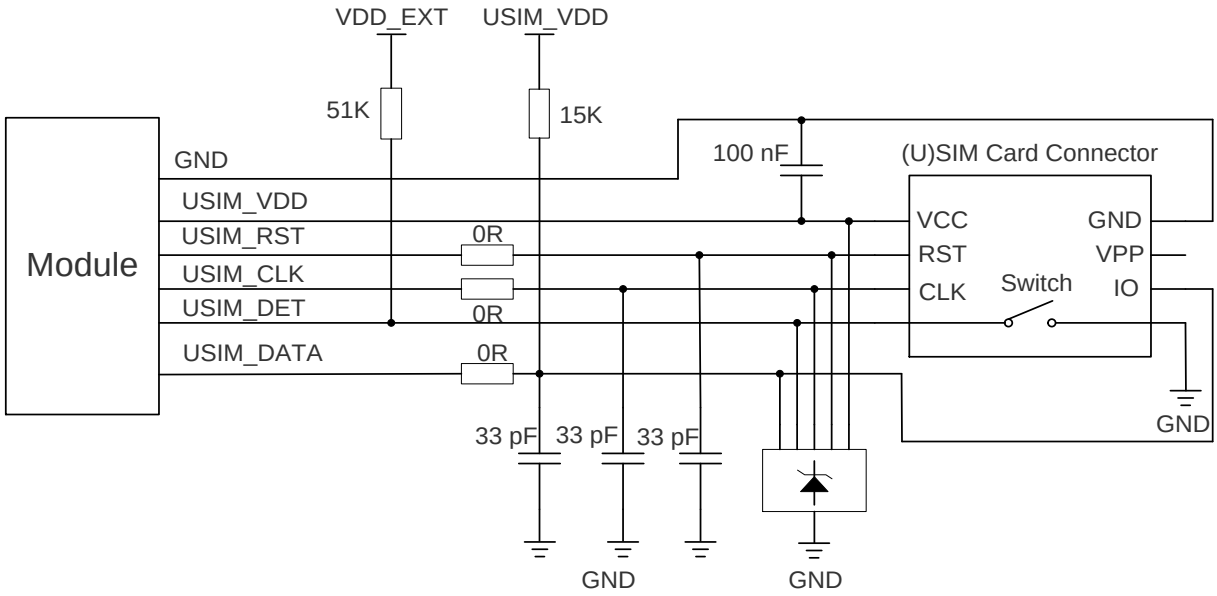


Figure 17: Reference Circuit of (U)SIM Interface with an 8-pin (U)SIM Card Connector

If the function of (U)SIM card hot-plug is not needed, please keep USIM_DET disconnected. A reference circuit for (U)SIM card interface with a 6-pin (U)SIM card connector is illustrated in the following figure.

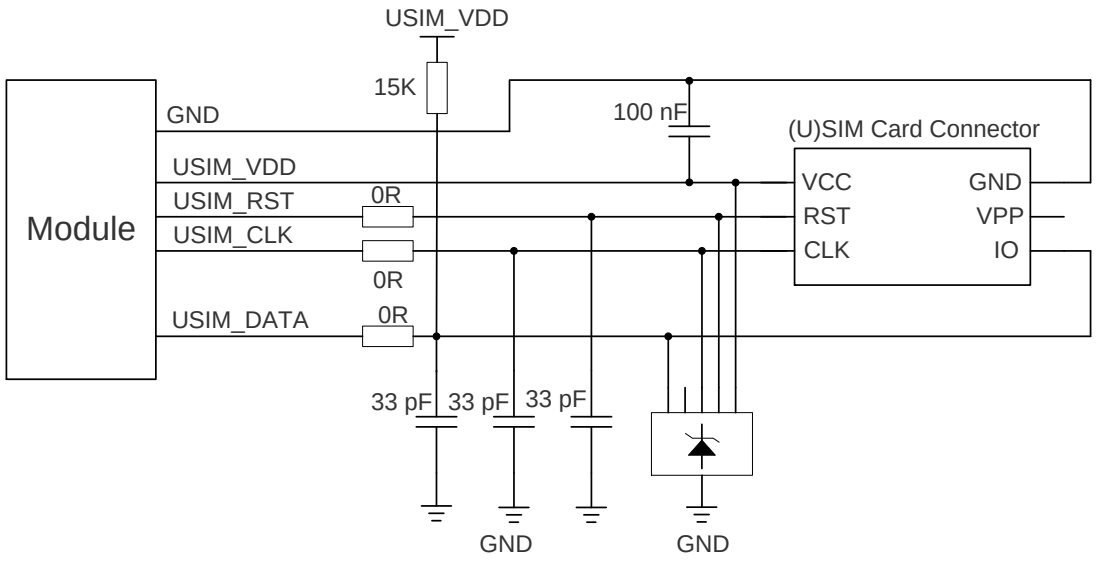


Figure 18: Reference Circuit of (U)SIM Interface with a 6-pin (U)SIM Card Connector

To enhance the reliability and availability of the (U)SIM card in application, follow the criteria below in (U)SIM circuit design:

- Place the (U)SIM card connector as close to the module as possible. Keep the trace length as short as possible, at most 200 mm.
- Keep (U)SIM card signals away from RF and VBAT traces.
- Ensure the USIM_VDD has a bypass capacitor less than 1 μF, and the capacitor should be close to the (U)SIM card connector.
- To avoid cross-talk between USIM_DATA and USIM_CLK, keep them away from each other and shield them with surrounded ground.
- To offer good ESD protection, add a TVS diode array of which the parasitic capacitance should be less than 15 pF. Add 0 Ω resistors in series between the module and the (U)SIM card to facilitate debugging. The 33 pF capacitors in parallel on USIM_DATA, USIM_CLK and USIM_RST lines are used for filtering interference of EGSM900. Additionally, keep the (U)SIM peripheral circuit close to the (U)SIM card connector.
- The pull-up resistor on USIM_DATA can improve anti-jamming capability of the (U)SIM card. If the (U)SIM card traces are too long, or the interference source is relatively close, it is recommended to add a pull-up resistor near the (U)SIM card connector.

3.10. USB Interface

EC800N-CN provides one integrated Universal Serial Bus (USB) interface which complies with the USB 2.0 specification and supports full-speed (12 Mbps) and high-speed (480 Mbps) modes. The USB interface can only serve in the slave mode. It is used for AT command communication, data transmission, software debugging and firmware upgrade. The following table shows the pin definition of USB interface.

Table 11: Pin Description of USB Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_DP	59	AIO	USB differential data (+)	USB 2.0 compliant. Requires differential impedance of 90 Ω. If unused, keep it open.
USB_DM	60	AIO	USB differential data (-)	
USB_VBUS	61	AI	USB connection detect	Typical: 5.0 V If unused, keep it open.

For more details about the USB 2.0 specifications, please visit http://www.usb.org/home.

Reserve test points for debugging and firmware upgrade in your design. The following figure shows a reference circuit of USB interface.

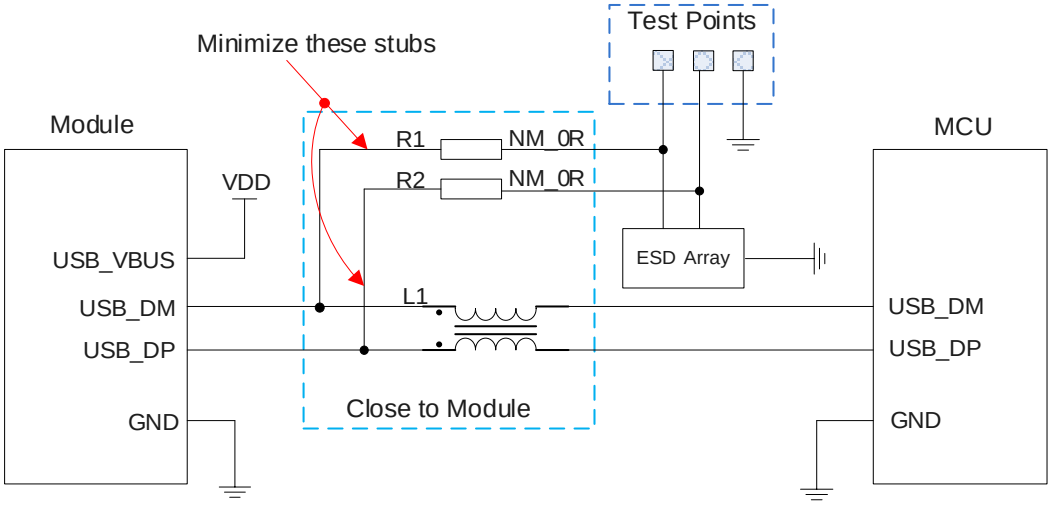


Figure 19: Reference Circuit of USB Application

A common mode choke L1 is recommended to be added in series between the module and MCU to suppress EMI spurious transmission. Meanwhile, the 0 Ω resistors (R1 and R2) should be added in series between the module and the test points to facilitate debugging, and the resistors are not mounted by default. To ensure the signal integrity of USB data lines, L1, R1 and R2 must be placed close to the module, and resistors R1 and R2 should be placed close to each other. Keep the extra stubs of trace as short as possible.

When designing the USB interface, you should follow the following principles to meet USB 2.0 specification.

- Route the USB signal traces as a differential pair with ground surrounded. The impedance of USB differential trace is 90 Ω.
- Do not route signal traces under crystals, oscillators, magnetic devices and RF signal traces.
- Pay attention to the selection of the ESD component on the USB data line. Its parasitic capacitance should not exceed 2 pF and should be placed as close as possible to the USB interface.

3.11. UART Interfaces

The EC800N-CN module provides three UART interfaces: one main UART interface, one debug UART interface and one auxiliary UART interface*. Their features are described below.

- Main UART interface supports 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps, 921600 bps and 1 Mbps baud rates, and the default baud rate is 115200 bps. This interface supports RTS and CTS hardware flow control, and is used for data transmission and AT command communication.
- Debug UART interface supports 115200 bps baud rate. It is used for partial log output.
- Auxiliary UART interface is under developement.

Table 12: Pin Definition of Main UART Interface

Pin Name	Pin No.	I/O	Description	Comment
MAIN_RXD	17	DI	Main UART receive	1.8 V power domain. If unused, keep it open.
MAIN_TXD	18	DO	Main UART transmit	
MAIN_DTR	19	DI	Main UART data terminal ready	
MAIN_RI	20	DO	Main UART ring indication	
MAIN_DCD	21	DO	Main UART data carrier detect	
MAIN_CTS	22	DO	DTE clear to send signal from DCE	Connect to DTE's CTS. 1.8 V power domain. If unused, keep it open.
MAIN_RTS	23	DI	DTE request to send signal to DCE	Connect to DTE's RTS. 1.8 V power domain. If unused, keep it open.

Table 13: Pin Definition of Debug UART Interface

Pin Name	Pin No.	I/O	Description	Comment
DBG_RXD	38	DI	Debug UART receive	1.8 V power domain. If unused, keep it open.
DBG_TXD	39	DO	Debug UART transmit	

Table 14: Pin Definition of Auxiliary UART Interface

Pin Name	Pin No.	I/O	Description	Comment
AUX_RXD*	28	DI	Auxiliary UART receive	1.8 V power domain. If unused, keep it open.
AUX_TXD*	29	DO	Auxiliary UART transmit	

The EC800N-CN module provides a 1.8 V UART interface. Use a level shifter if the application is equipped with a 3.3 V UART interface. A level shifter TXS0108EPWR provided by Texas Instruments is recommended. The following figure shows a reference design.

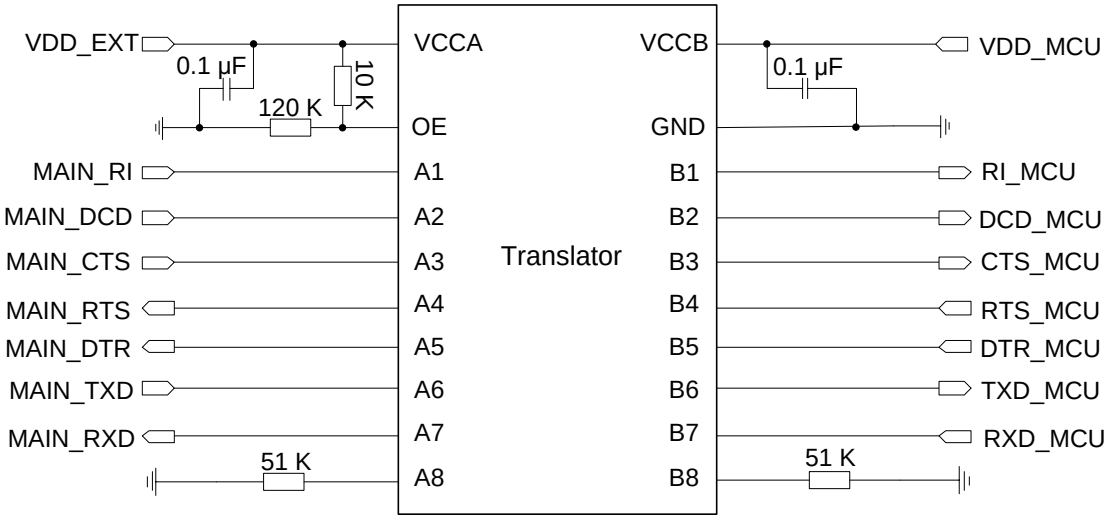


Figure 20: Reference Circuit with Translator Chip

Visit http://www.ti.com for more information.

Another example with transistor circuit is shown as below. For the design of circuits shown in dotted lines, see that shown in solid lines, but pay attention to the direction of connection.

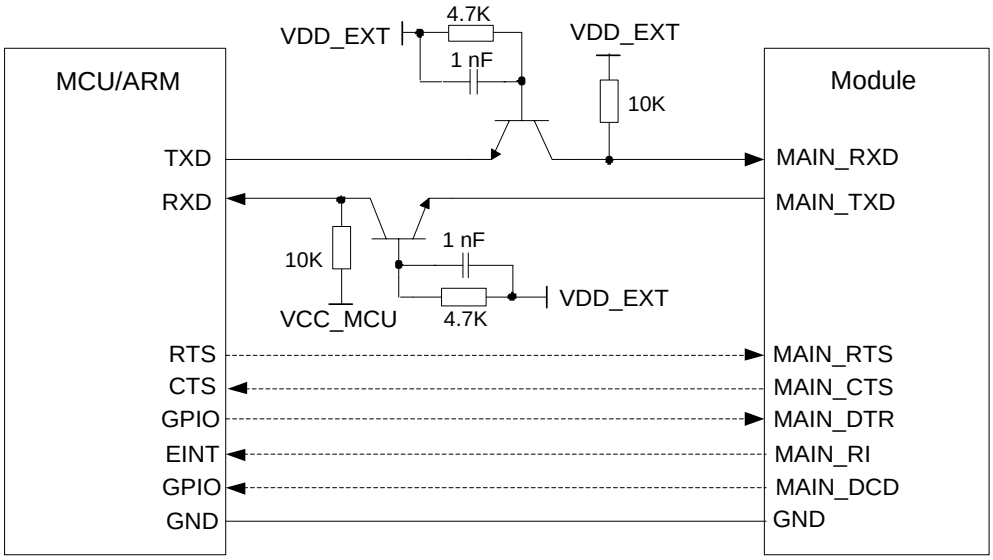


Figure 21: Reference Circuit with Transistor Circuit

NOTE

1. Transistor circuit solution is not suitable for applications with baud rates exceeding 460 kbps.
2. Please note that the module CTS is connected to the host CTS, and the module RTS is connected to the host RTS.

3.12. Analog Audio Interfaces

The EC800N-CN module provides one analog input channel and one analog output channel. The pin definitions are shown in the following table.

Table 15: Pin Definition of Audio Interfaces

Pin Name	Pin No.	I/O.	Description	Comment
MIC_P	3	AI	Microphone analog input (+)	If unused, keep it open.
MIC_N	4	AI	Microphone analog input (-)	
SPK_P	5	AO	Analog audio differential output (+)	The interface can drive 32 Ω speaker with power rate at 37 mW. It can also be used to drive
SPK_N	6	AO	Analog audio differential output (-)	

	external power amplifier devices if the output power rate cannot meet the demand. If unused, keep it open.

- AI channels are differential input channels, which can be applied to microphone input (usually an electret microphone is used).
- AO channels are differential output channels, which can be used in receiver or loudspeaker (with an external audio power amplifier) output. This channel can support both voice output and ringtones.

You can use the **AT+QMIC** command to adjust the input gain of the microphone, or **AT+CLVL** command to adjust the volume gain output to the handset . The **AT+QSIDET** command is used to set the side tone gain. For details, please see ***document [3].***

3.12.1. Audio Interfaces Design Considerations

It is recommended to use the electret microphone with dual built-in capacitors (e.g. 10 pF and 33 pF) to filter out RF interference, thus reducing TDD noise. The 33 pF capacitor is applied to filter out RF interference when the module is transmitting at EGSM900. Without this capacitor, TDD noise could be heard. The 10 pF capacitor here is used to filter out RF interference at DCS1800. Please note that the resonant frequency point of a capacitor largely depends on the material and production technique. Therefore, you need to discuss with your capacitor vendors to choose the most suitable capacitor to filter out high-frequency noises.

The severity degree of the RF interference in the voice channel during GSM transmitting largely depends on the application design. In some cases, EGSM900 TDD noise is more severe; while in other cases, DCS1800 TDD noise is more obvious. Therefore, a suitable capacitor can be selected based on the test results. The filter capacitor on the PCB should be placed as close as possible to the audio device or audio interface, and the wiring should be as short as possible. The filter capacitor should be passed before reaching other connection points.

To decrease radio or other signal interference, RF antennas should be placed away from audio interfaces and audio traces. Power traces cannot be parallel with and also should be far away from the audio traces.

The differential audio traces must be routed according to the differential signal layout rule.

3.12.2. Microphone Interface Design

The microphone channel reference circuit is shown in the following figure.

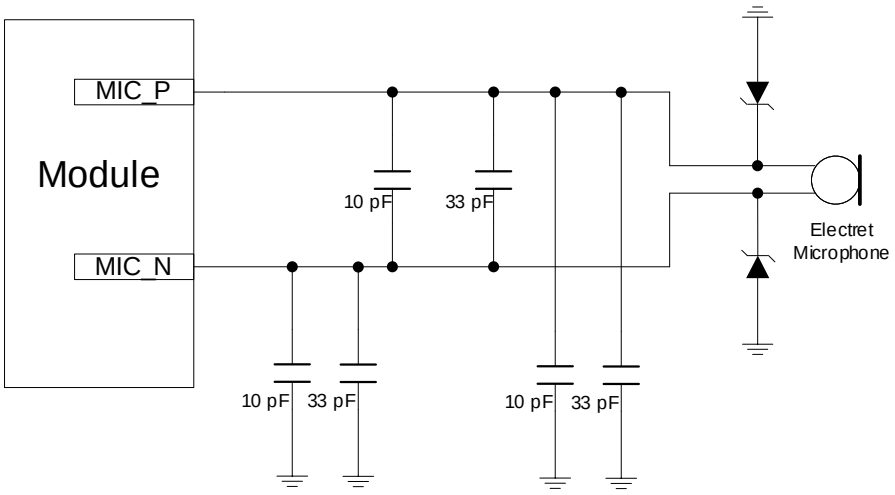


Figure 22: Reference Design for Microphone Interface

NOTE

MIC channel is sensitive to ESD, so it is not recommended to remove the ESD components used for protecting the MIC.

3.12.3. Receiver & Loudspeaker Interface Design

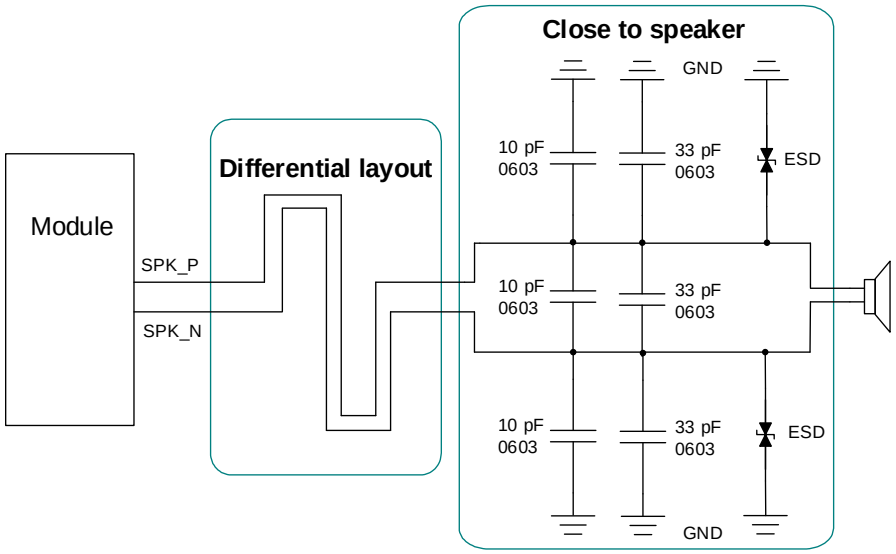


Figure 23: Reference Design for Receiver Interface

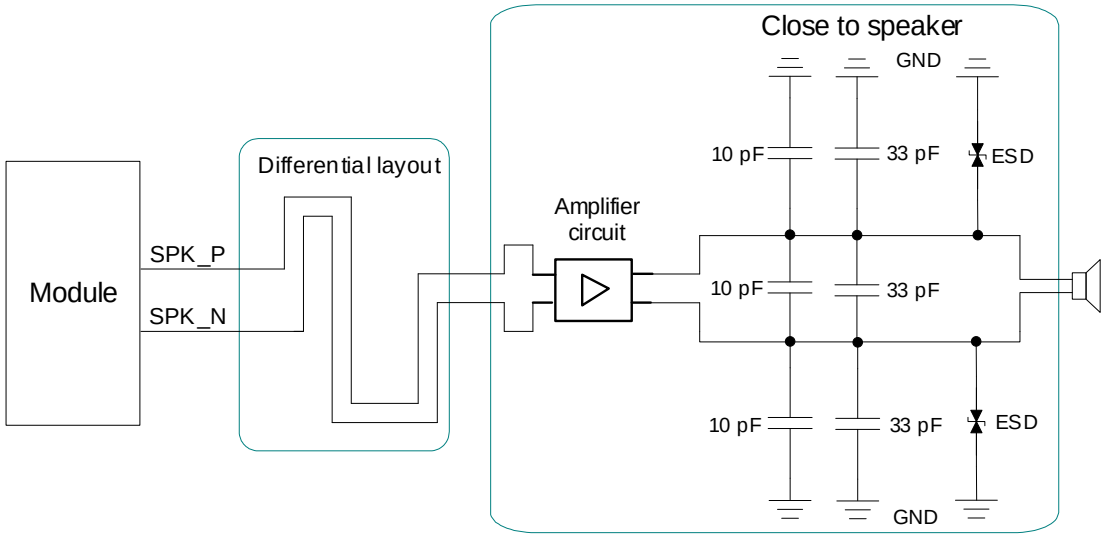


Figure 24: Reference Circuit of Audio Amplifier (external) Output

For differential input and output audio power amplifiers, please visit http://www.ti.com/ to obtain the required devices. There are also many audio power amplifiers with the same performance to choose from on the market.

3.12.4. Audio Frequency Electrical Characteristics

Table 16: Audio Interface Characteristic Parameters

Parameter			Min.	Typ.	Max.	Unit
AOUT	Differential output	Load	16	32	-	Ω
		Common mode voltage	-	0.9	-	V
		Differential voltage	0	-	1.4	V_{pp}
		Output Power	-	20	37	mW
AIN	Differential input	MICBIAS	0	1.75	1.85	V
		Differential voltage	-	-	1.4	V_{pp}

3.13. PCM and I2C Interfaces

EC800N-CN module provides one Pulse Code Modulation (PCM) interface and one I2C interface. PCM interface supports the following two modes:

- Short frame mode：Module can be used as the slave device* and master device
- Long frame mode*：Module can only be used as the master device

In short frame mode，data is sampled on the falling edge of PCM_CLK, and sent on the rising edge. The falling edge of PCM_SYNC represents the high effective bit. In this mode, the PCM interface supports 256 kHz, 512 kHz, 1024 kHz, and 2048 kHz PCM_CLK at 8 kHz PCM_SYNC, and 4096 kHz PCM_CLK at 16 kHz PCM_SYNC.

In long frame mode，data is sampled on the falling edge of PCM_CLK，and sent on the rising edge. The rising edge of PCM_SYNC represents the high effective bit. In this mode, the PCM interface supports 256 kHz, 512 kHz, 1024 kHz and 2048 kHz PCM_CLK at 8 kHz, 50% duty cycle PCM_SYNC.

EC800N-CN supports 16-bit linear encoding format. The following two figures are the short frame mode timing diagram (PCM_SYNC = 8 kHz, PCM_CLK = 2048 kHz) and the long frame mode timing diagram (PCM_SYNC = 8 kHz, PCM_CLK = 256 kHz).

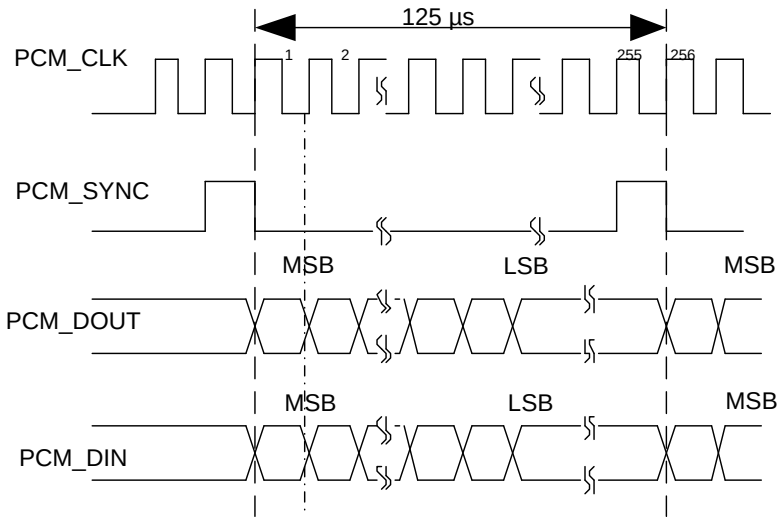


Figure 25：Timing of Short Frame Mode

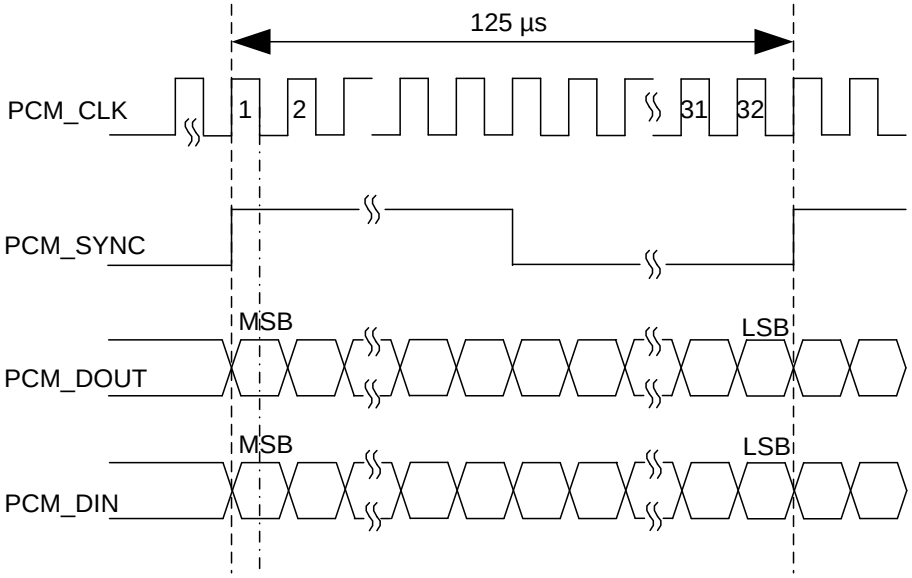


Figure 26：Timing of Long Frame Mode

The following table shows the pin definition of PCM and I2C interfaces.

Table 17: Pin Definition of PCM and I2C Interfaces

Pin Name	Pin No.	I/O	Description	Comment
PCM_CLK	30	DO	PCM clock	1.8 V power domain. If unused, keep it open.
PCM_SYNC	31	DO	PCM data frame sync	
PCM_DIN	32	DI	PCM data input	
PCM_DOUT	33	DO	PCM data output	
I2C_SCL	67	OD	I2C serial clock	Used for external Codec. An external 1.8 V pull-up resistor is required. If unused, keep it open.
I2C_SDA	66	OD	I2C serial data	

The clock and mode can be configured through AT commands, and the default configuration is short frame mode, PCM_CLK = 2048 kHz, PCM_SYNC =8 kHz. For details, please see the **AT+QDAI** command in ***document [3]***.

The following figure shows a reference design of PCM and I2C interfaces with external Codec IC.

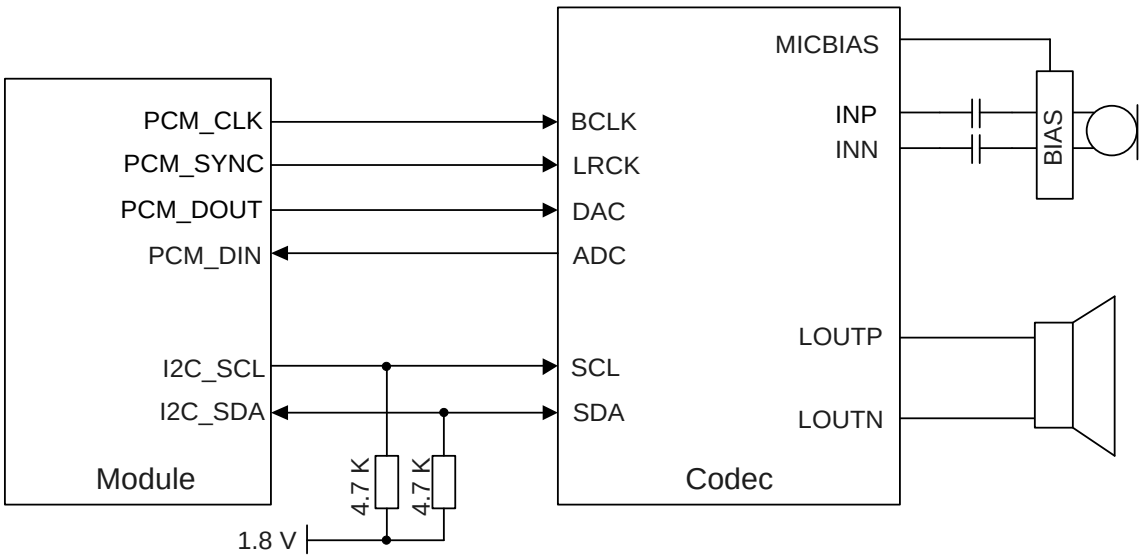


Figure 27: Reference Circuit of PCM and I2C Application with Audio Codec

NOTE

1. It is recommended to reserve an RC (R = 22 Ω, C = 22 pF) circuit on the PCM traces, especially for PCM_CLK.
2. The module can only be used as a master device in applications related to PCM and I2C interfaces.

3.14. Network Status Indication

The network indication pin can drive the network status indicators. The module provides a network status indication pin: NET_STATUS. The following tables describe the pin definition and logic level changes in different network status.

Table 18: Pin Definition of Network Connection Status/Activity Indication

Pin Name	Pin No.	I/O	Description	Comment
NET_STATUS	16	DO	Indicate the module's network activity status	1.8 V power domain. If unused, keep it open.

Table 19: Working State of Network Connection Status/Activity Indication

Pin Name	Logic Level Changes	Network Status
NET_STATUS	Flicker slowly (200 ms high/1800 ms low)	Network searching
	Flicker slowly (1800 ms high/200 ms low)	Idle
	Flicker quickly (125 ms high/125 ms low)	Data transfer is ongoing
	Always High	Voice calling

A reference circuit is shown in the following figure.

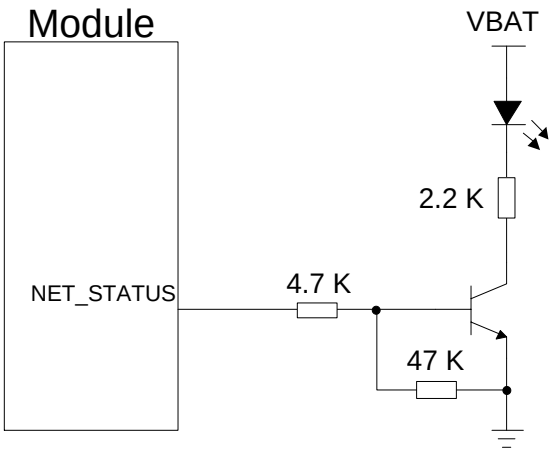


Figure 28: Reference Circuit of Network Status Indication

3.15. USB_BOOT Interface

EC800N-CN module provides a USB_BOOT pin. You can pull down USB_BOOT to GND before start-up, and the module will enter emergency download mode when it is powered on. In this mode, the module supports firmware upgrade over USB interface.

Table 20: Pin Definition of USB_BOOT Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_BOOT	82	DI	Force the module into emergency download mode	1.8 V power domain. Active low. This pin cannot be pulled down to

	low level before the module is successfully startup if the emergency download mode is not necessary. It is recommended to reserve test points.It is recommended to reserve test points.

The following figures show a reference circuit and timing sequence for entering emergency download mode of USB_BOOT interface.

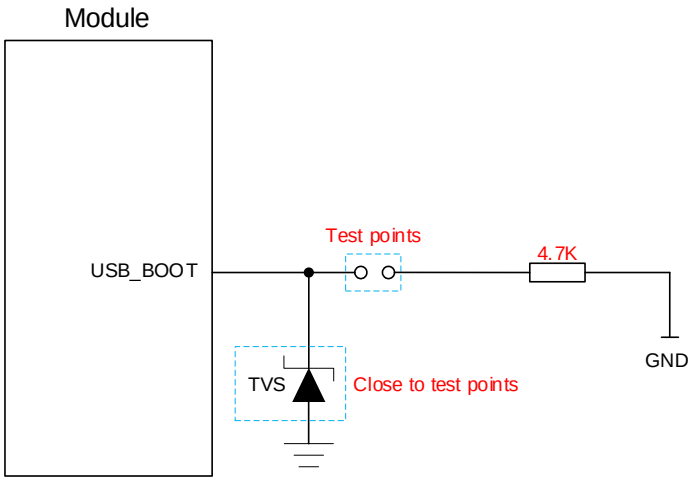


Figure 29: Reference Circuit of USB_BOOT Interface

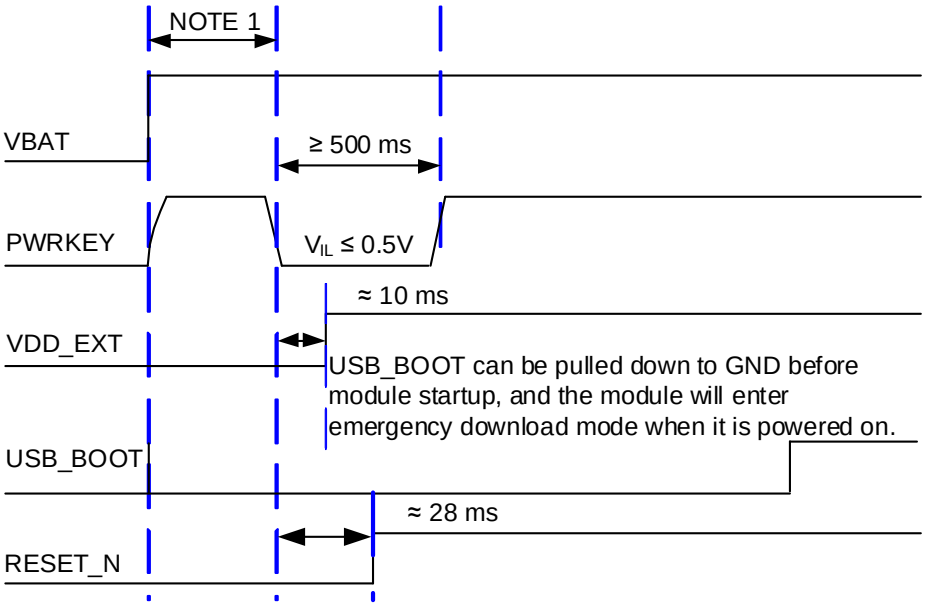


Figure 30: Timing Sequence for Entering Emergency Download Mode

NOTE

1. Make sure that VBAT is stable before pulling down PWRKEY pin. It is recommended that the time between powering up VBAT and pulling down PWRKEY pin is no less than 30 ms.
2. When using MCU to control module to enter the emergency download mode, please follow the above timing sequence. Directly connect the test points as shown in ***Figure 29*** can manually force the module to enter download mode.

3.16. STATUS

The STATUS pin indicates the module's operation status. When the module is powered on normally, the STATUS will output high level. The following table describes the pin definition of STATUS.

Table 21: Pin Definition of STATUS

Pin Name	Pin No.	I/O	Description	Comment
STATUS	25	DO	Indicate the module's operation status	1.8 V power domain. If unused, keep it open.

A reference circuit is shown as below:

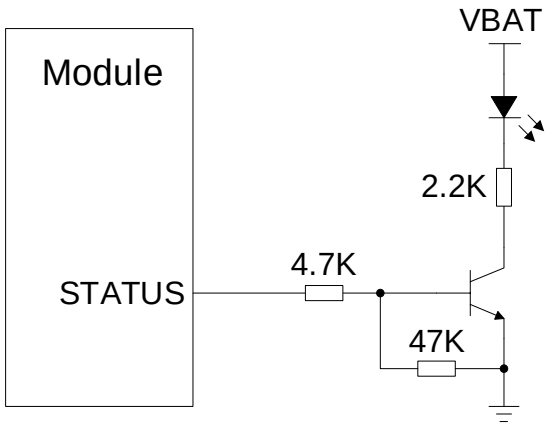


Figure 31: Reference Circuits of STATUS

3.17. RI

You can configure MAIN_RI behaviors with **AT+QCFG= "risignaltype", "physical"**. Thus, no matter on which port a URC is presented, the URC only triggers the behaviors of MAIN_RI pin. See ***document [2]*** for details.

NOTE

The **AT+QURCCFG** allows you to set the main UART, USB AT port or USB modem port as the URC output port. The USB AT port is the URC output port by default.

You can configure RI behaviors flexibly. The default behavior of the RI is shown as below.

Table 22: Default Behaviors of the RI

State	Response
Idle	MAIN_RI keeps at high level.
URC	MAIN_RI outputs 120 ms low pulse when a new URC returns.

4 Antenna Interface

EC800N-CN module provides a main antenna interface. The impedance of antenna port is 50 Ω.

4.1. Antenna Interface & Frequency Bands

4.1.1. Pin Definition

Table 23: Pin Definition of Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN	35	AIO	Main antenna interface	50 Ω impedance

4.1.2. Operating Frequency

Table 24: EC800N-CN Operating Frequencies

3GPP Band	Transmit	Receive	Unit
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-TDD B34	2010–2025	2010–2025	MHz
LTE-TDD B38	2570–2620	2570–2620	MHz
LTE-TDD B39	1880–1920	1880–1920	MHz
LTE-TDD B40	2300–2400	2300–2400	MHz
LTE-TDD B41	2535–2675	2535–2675	MHz

4.1.3. Reference Design

A reference design of ANT_MAIN antenna is shown as below. A π-type matching circuit should be reserved for better RF performance. The capacitors are not mounted by default.

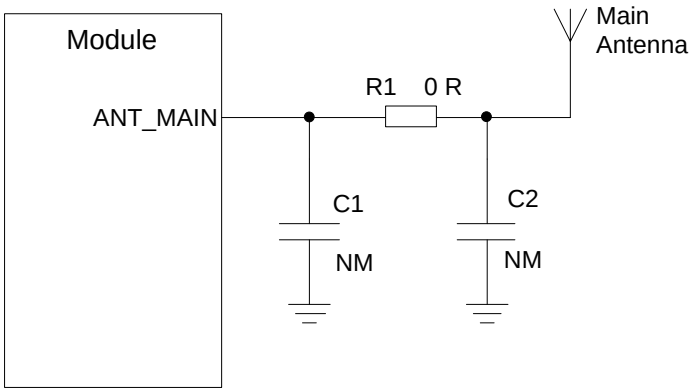


Figure 32: Reference Circuit of RF Antenna

NOTE

Place the π-type matching components (R1, C1 and C2) as close to the antenna as possible.

4.1.4. RF Routing Guidelines

For user's PCB, the characteristic impedance of all RF traces should be controlled to 50 Ω. The impedance of the RF traces is usually determined by the trace width (W), the materials' dielectric constant, the height from the reference ground to the signal layer (H), and the spacing between RF traces and grounds (S). Microstrip or coplanar waveguide is typically used in RF layout to control characteristic impedance. The following are reference designs of microstrip or coplanar waveguide with different PCB structures.

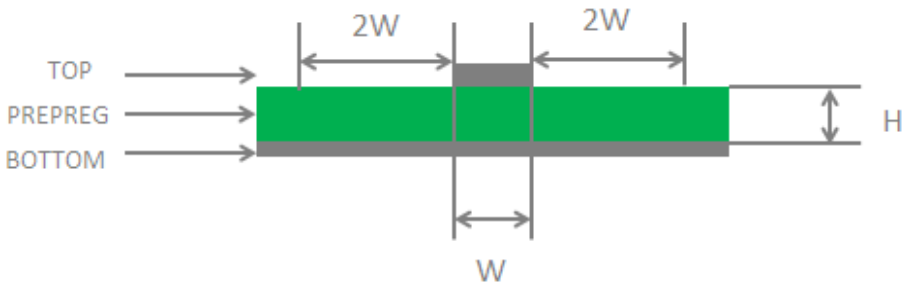


Figure 33: Microstrip Design on a 2-layer PCB

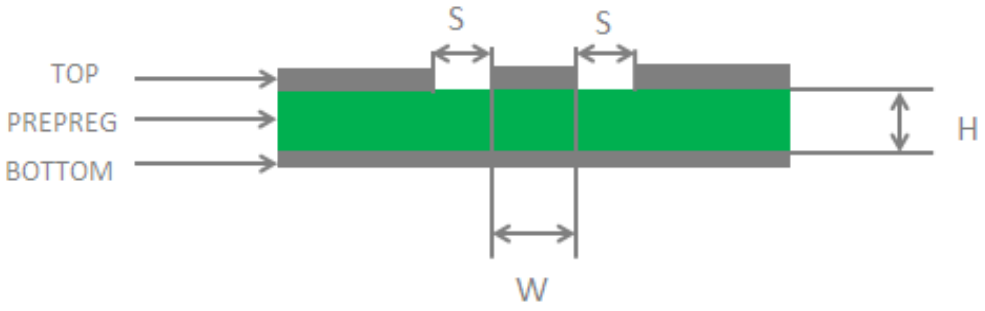


Figure 34: Coplanar Waveguide Design on a 2-layer PCB

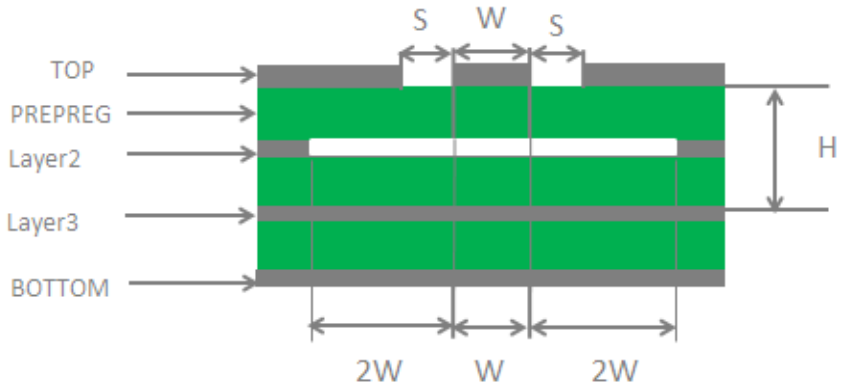


Figure 35: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

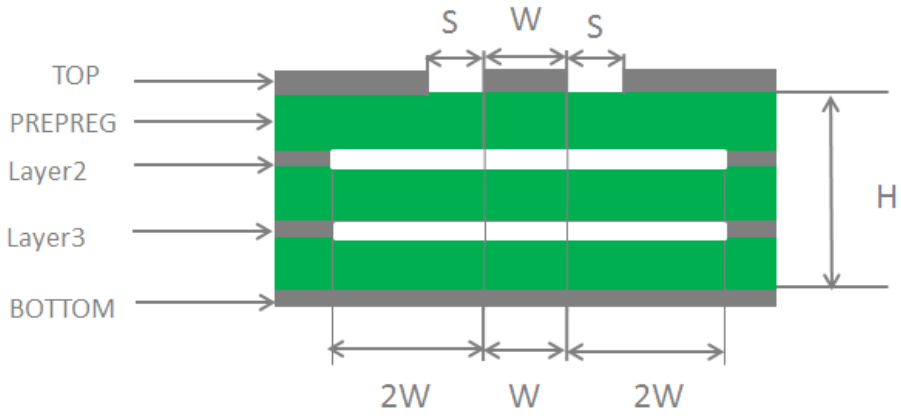


Figure 36: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, follow the principles below in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω.
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be no less than two times the width of RF signal traces (2 × W).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see ***document [4].***

4.2. Antenna Installation

4.2.1. Antenna Design Requirements

The following table shows requirements of Main Antenna.

Table 25: Antenna Requirements

Type	Requirements
LTE	VSWR: ≤ 2 Efficiency: > 30 % Max. input power: 50 W Input impedance: 50 Ω Cable insertion loss: ● < 1 dB: LB (< 1 GHz) ● < 1.5 dB: MB (1 – 2.3 GHz) ● < 2 dB: HB (> 2.3 GHz)

4.2.2. RF Connector Recommendation

If RF connector is used for antenna connection, it is recommended to use U.FL-R-SMT connector provided by Hirose.

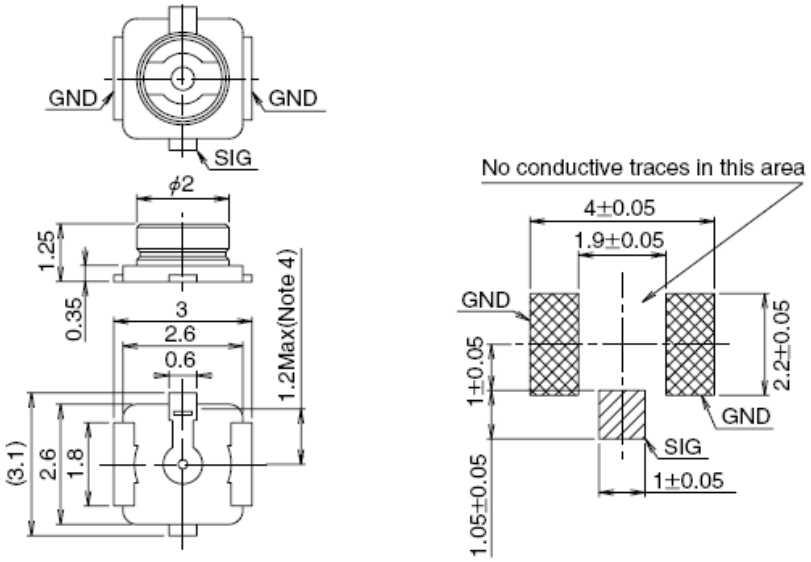


Figure 37: Dimensions of the U.FL-R-SMT Connector (Unit: mm)

U.FL-LP serial connectors listed in the following figure can be used to match the U.FL-R-SMT.

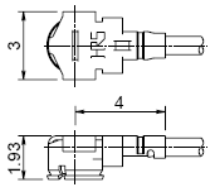
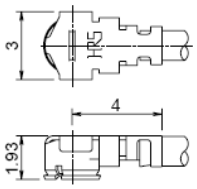
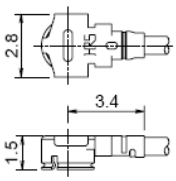
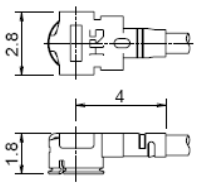
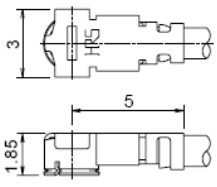
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 0.81mm Coaxial cable	Dia. 1mm Coaxial cable	Dia. 1.37mm Coaxial cable
Weight (mg)	53.7	59.1	34.8	45.5	71.7
RoHS	YES				

Figure 38: Mechanicals of U.FL-LP Connectors

The following figure describes the space factor of mated connector.

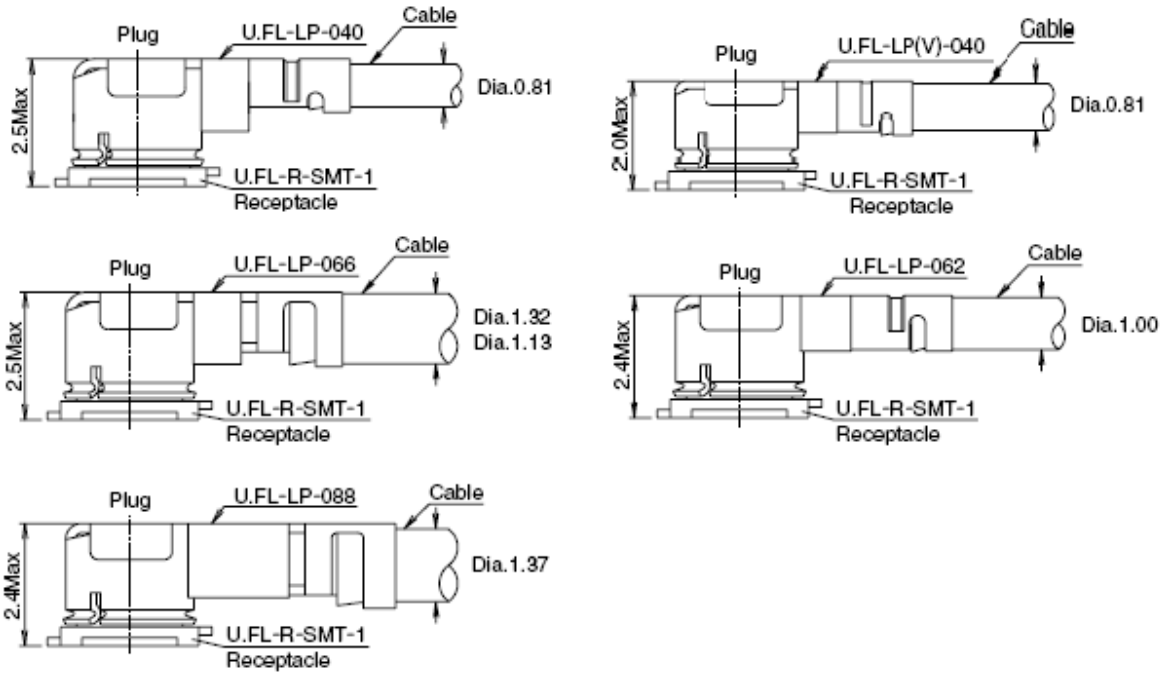


Figure 39: Space Factor of Mated Connector (Unit: mm)

For more details, please visit http://hirose.com.

5 Reliability, Radio and Electrical Characteristics

5.1. Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital and analog pins of the module are listed in the following table.

Table 26: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT	-0.3	6.0	V
USB_VBUS	-0.3	5.5	V
Peak Current of VBAT	-	2.0	A
Voltage at Digital Pins	-0.3	2.3	V

5.2. Power Supply Ratings

Table 27: Module Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VBAT	Power supply for the module	The actual input voltages must be kept between the minimum and maximum values.	3.4	3.8	4.5	V
I_{VBAT}	Peak supply current (during transmission slot)	Maximum power control level	-	1.5	2.0	A

USB_VBUS	USB connection detection	3.0	5.0	5.25	V

5.3. Operating and Storage Temperatures

Table 28: Operating and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operating Temperature Range [3]	-35	+25	+75	ºC
Extended Temperature Range [4]	-40	-	+85	ºC
Storage Temperature Range	-40	-	+90	ºC

5.4. Power Consumption

Table 29: EC800N-CN Current Consumption

Description	Conditions	Typ.	Unit
OFF state	Power down	34	μA
Sleep state	**AT+CFUN=0** (USB disconnected)	1.009	mA
	AT+CFUN=4 (USB disconnected)	1.088	mA
	LTE-FDD @ PF = 32 (USB disconnected)	1.90	mA
	LTE-FDD @ PF = 64 (USB disconnected)	1.49	mA
	LTE-FDD @ PF = 64 (USB suspend)	1.65	mA
	LTE-FDD @ PF = 128 (USB disconnected)	1.30	mA

[3] Within operating temperature range, the module is 3GPP compliant.
[4] Within extended temperature range, the module remains the ability to establish and maintain functions such as voice, SMS, data transmission, etc., without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as Pout, may exceed the specified tolerances of 3GPP. When the temperature returns to the operating temperature range, the module meets 3GPP specifications again.

	LTE-FDD @ PF = 256 (USB disconnected)	1.19	mA
	LTE-TDD @ PF = 32 (USB disconnected)	1.93	mA
	LTE-TDD @ PF = 64 (USB disconnected)	1.52	mA
	LTE-TDD @ PF = 64 (USB suspend)	1.66	mA
	LTE-TDD @ PF = 128 (USB disconnected)	1.30	mA
	LTE-TDD @ PF = 256 (USB disconnected)	1.19	mA
Idle state	LTE-FDD @ PF = 64 (USB disconnected)	16.36	mA
	LTE-FDD @ PF = 64 (USB connected)	28.55	mA
	LTE-TDD @ PF = 64 (USB disconnected)	16.39	mA
	LTE-TDD @ PF = 64 (USB connected)	28.59	mA
LTE data transfer	LTE-FDD B1	504	mA
	LTE-FDD B3	467	mA
	LTE-FDD B5	506	mA
	LTE-FDD B8	501	mA
	LTE-TDD B34	193	mA
	LTE-TDD B38	197	mA
	LTE-TDD B39	173	mA
	LTE-TDD B40	183	mA
	LTE-TDD B41	199	mA

5.5. Tx Power

The following table shows the RF output power of EC800N-CN module.

Table 30: RF Output Power

Frequency Bands	Max. RF Output Power	Min. RF Output Power
LTE-FDD B1/B3/B5/B8	23 dBm ±2 dB	< -39 dBm
LTE-TDD B34/B38/B39/B40/B41	23 dBm ±2 dB	< -39 dBm

5.6. Rx Sensitivity

The following table shows conducted RF receiving sensitivity of EC800N-CN module.

Table 31: EC800N-CN Conducted RF Receiving Sensitivity

Frequency Bands	Receiving Sensitivity (Typ.)			3GPP (SIMO)
	Primary	Diversity	SIMO	
LTE-FDD B1 (10 MHz)	-99.0 dBm	-	-	-96.3 dBm
LTE-FDD B3 (10 MHz)	-98.5 dBm	-	-	-93.3 dBm
LTE-FDD B5 (10 MHz)	-97.5 dBm	-	-	-94.3 dBm
LTE-FDD B8 (10 MHz)	-98.0 dBm	-	-	-93.3 dBm
LTE-TDD B34 (10 MHz)	-99.5 dBm	-	-	-96.3 dBm
LTE-TDD B38 (10 MHz)	-100 dBm	-	-	-96.3 dBm
LTE-TDD B39 (10 MHz)	-99.5 dBm	-	-	-96.3 dBm
LTE-TDD B40 (10 MHz)	-100 dBm	-	-	-96.3 dBm
LTE-TDD B41 (10 MHz)	-99.5 dBm	-	-	-94.3 dBm

5.7. ESD

If the static electricity generated by various ways discharges to the module, the module maybe damaged to a certain extent. Thus, please take proper ESD countermeasures and handling methods. For example, wearing anti-static gloves during the development, production, assembly and testing of the module; adding ESD protective components to the ESD sensitive interfaces and points in the product design.

The following table shows electrostatics discharge characteristics of the module.

Table 32: Electrostatics Discharge Characteristics (25 ºC, 45 % Relative Humidity)

Tested Interfaces	Contact Discharge	Air Discharge	Unit
VBAT, GND	±5	±10	kV
Antenna Interface	±5	±10	kV
Other Interfaces	±0.5	±1	kV

6 Mechanical Information

This chapter describes the mechanical dimensions of the module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.2 mm unless otherwise specified.

6.1. Mechanical Dimensions

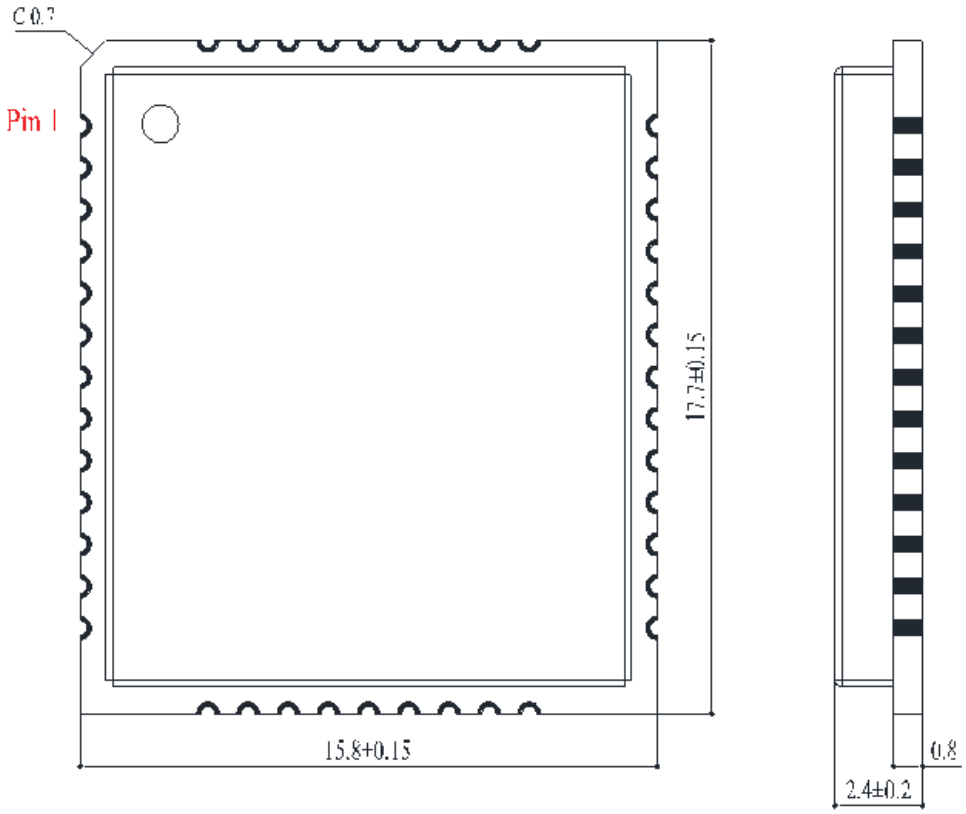


Figure 40: Module Top and Side Dimensions

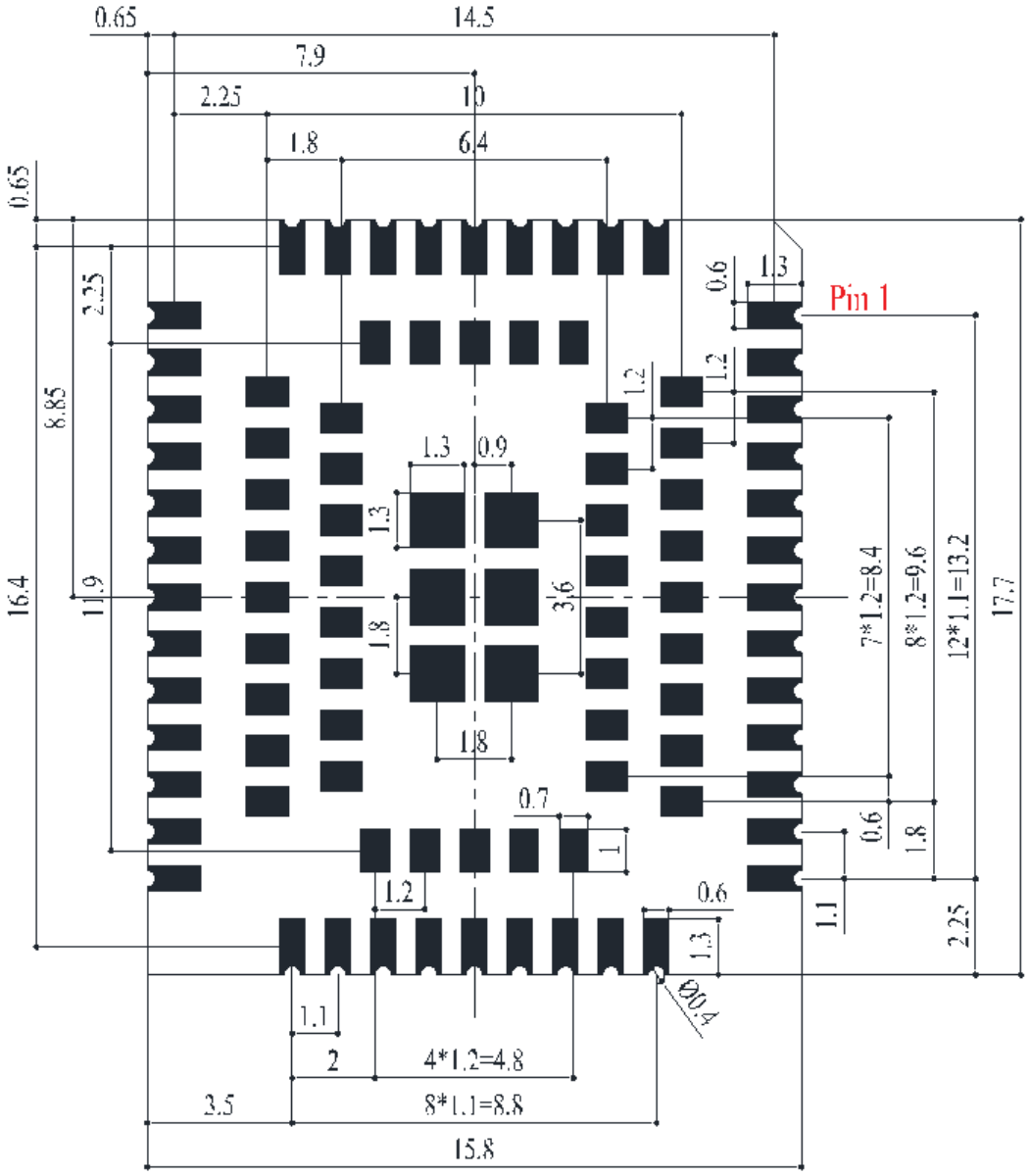


Figure 41: Module Bottom Dimensions (Bottom View)

NOTE

The package warpage level of the module conforms to *JEITA ED-7306* standard.

6.2. Recommended Footprint

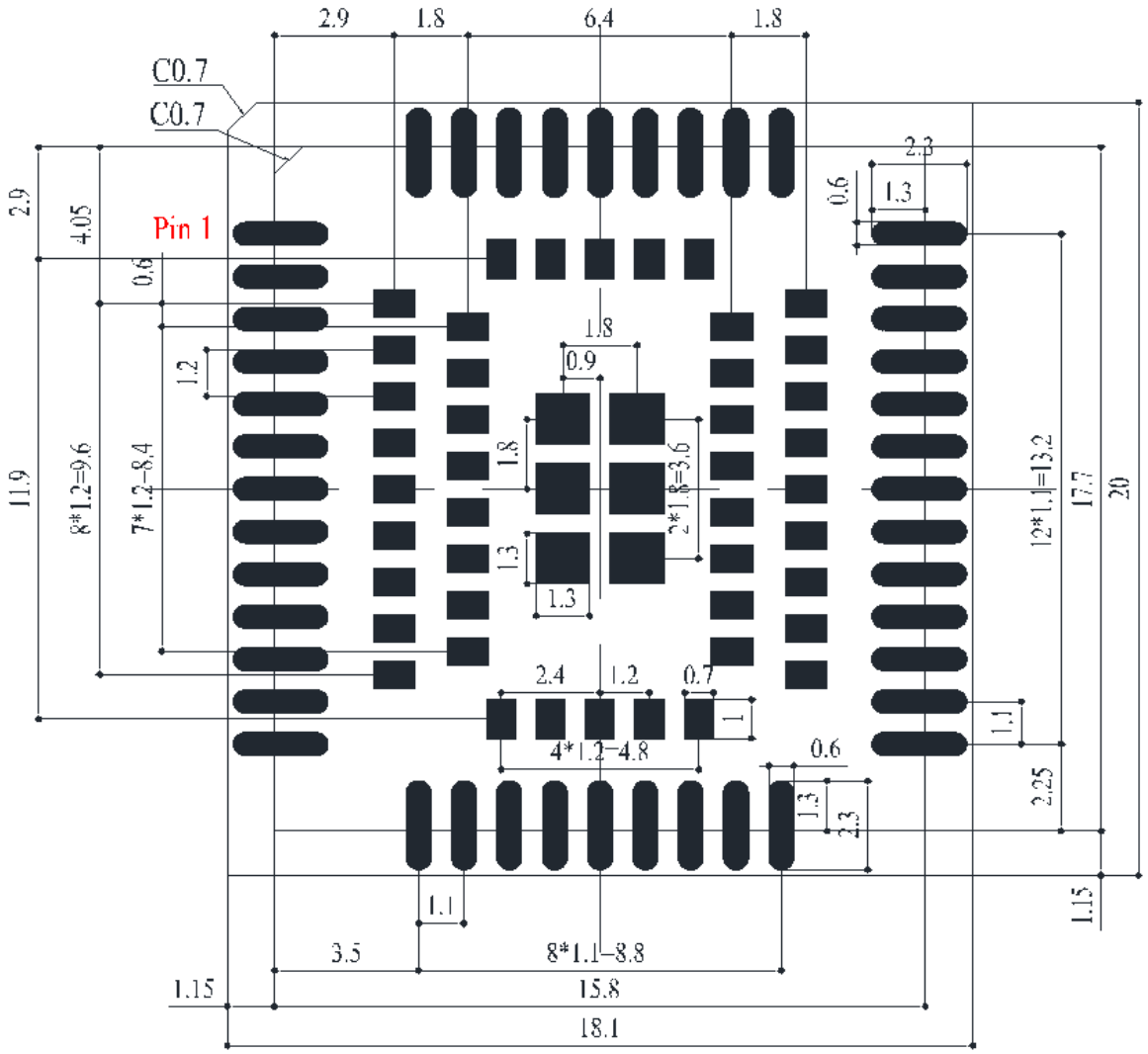


Figure 42: Recommended Footprint (Top View)

NOTE

Keep at least 3 mm between the module and other components on the motherboard to improve soldering quality and maintenance convenience.

6.3. Top and Bottom Views

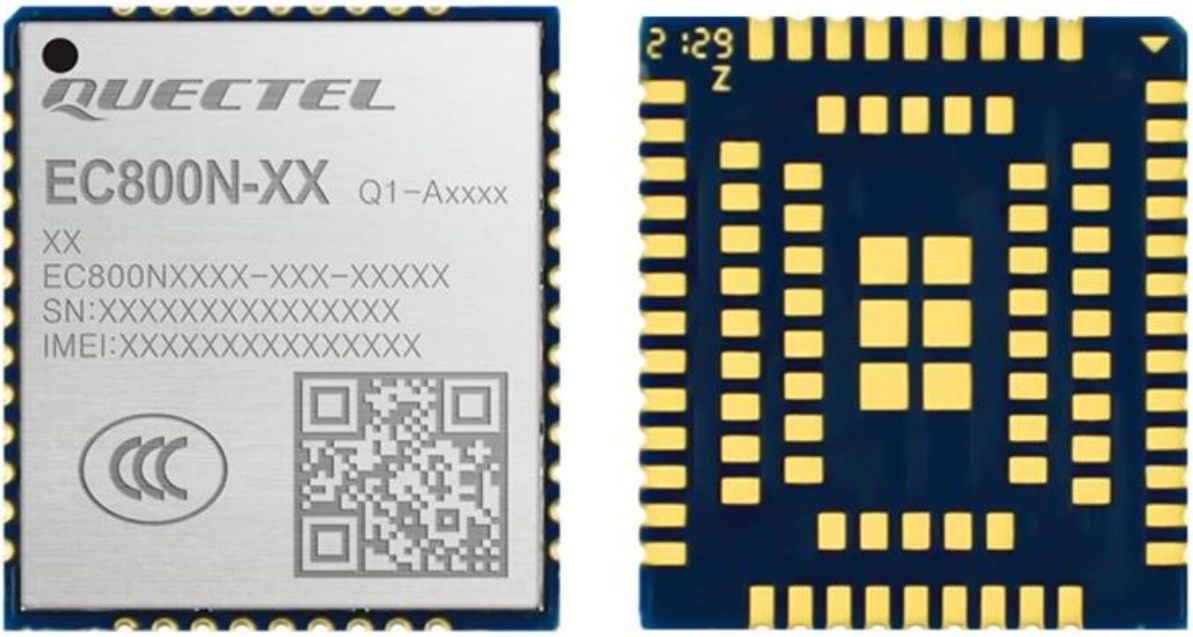


Figure 43: Top View and Bottom View of the Module

NOTE

Images above are for illustration purpose only and may differ from the actual module. For authentic appearance and label, please refer to the module received from Quectel.

7 Storage, Manufacturing and Packaging

7.1. Storage Conditions

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

1. Recommended Storage Condition: The temperature should be 23 ±5 °C and the relative humidity should be 35–60 %.

2. The storage life (in vacuum-sealed packaging) is 12 months in Recommended Storage Condition.

3. The floor life of the module is 168 hours [5] in a plant where the temperature is 23 ±5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g. a drying cabinet).

4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:

   - The module is not stored in Recommended Storage Condition;
   - Violation of the third requirement above occurs;
   - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
   - Before module repairing.

5. If needed, the pre-baking should follow the requirements below:

   - The module should be baked for 8 hours at 120 ±5 °C;
   - All modules must be soldered to PCB within 24 hours after the baking, otherwise they should be put in a dry environment such as in a drying oven.

[5] This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. And do not remove the packages of tremendous modules if they are not ready for soldering.

NOTE

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. All modules must be soldered to PCB within 24 hours after the baking, otherwise put them in the drying oven. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

7.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.15–0.20 mm. For more details, see ***document [5].***

The peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is strongly recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

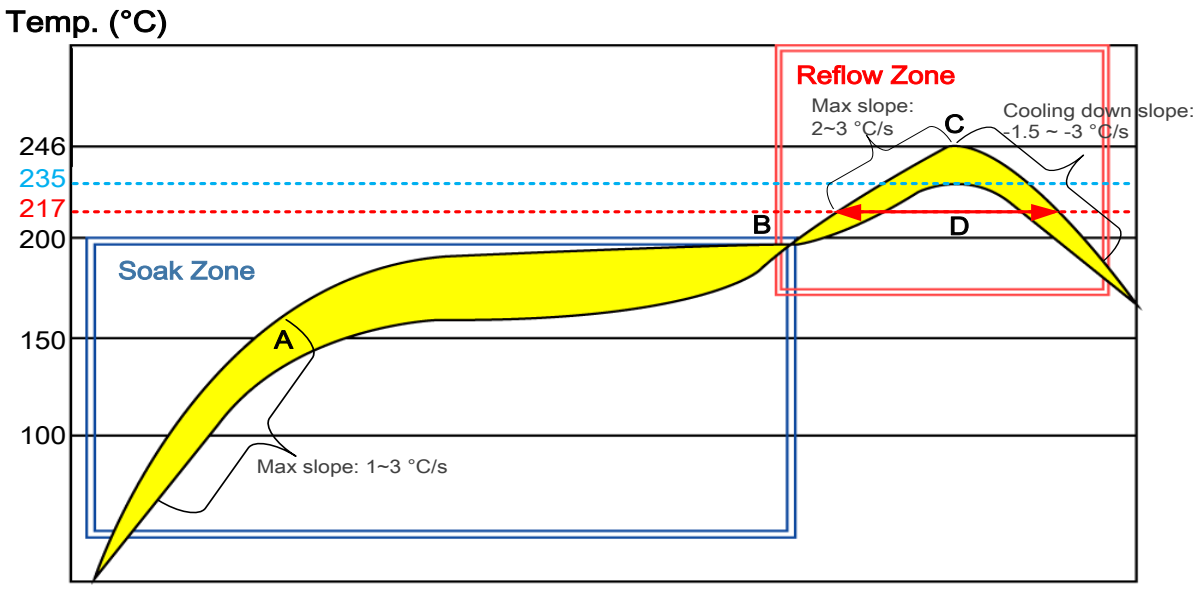


Figure 44: Recommended Reflow Soldering Thermal Profile

Table 33: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Max slope	1–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Max slope	2–3 °C/s
Reflow time (D: over 217 °C)	40–70 s
Max temperature	235–246 °C
Cooling down slope	-1.5 to -3 °C/s
Reflow Cycle	
Max reflow cycle	1

NOTE

1. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.
2. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
3. If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.
4. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
5. Due to the complexity of the SMT process, please contact Quectel Technical Supports in advance for any situation that you are not sure about, or any process (e.g. selective soldering, ultrasonic soldering) that is not mentioned in ***document [5]***.

7.3. Packaging Specifications

The module adopts carrier tape packaging and details are as follow:

7.3.1. Carrier Tape

Dimension details are as follow:

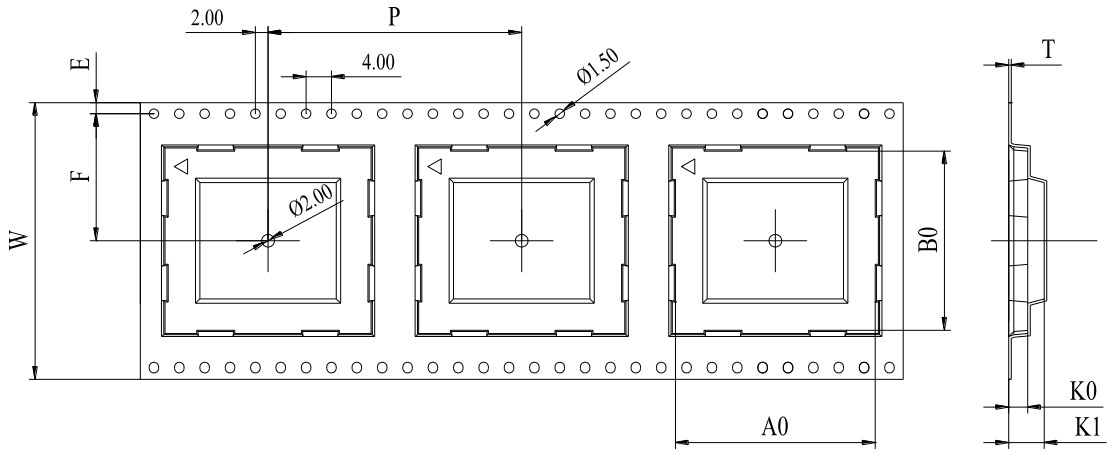


Figure 45: Carrier Tape Dimension Drawing

Table 34: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
32	24	0.4	16.2	18.1	2.8	7.6	14.2	1.75

7.3.2. Plastic Reel

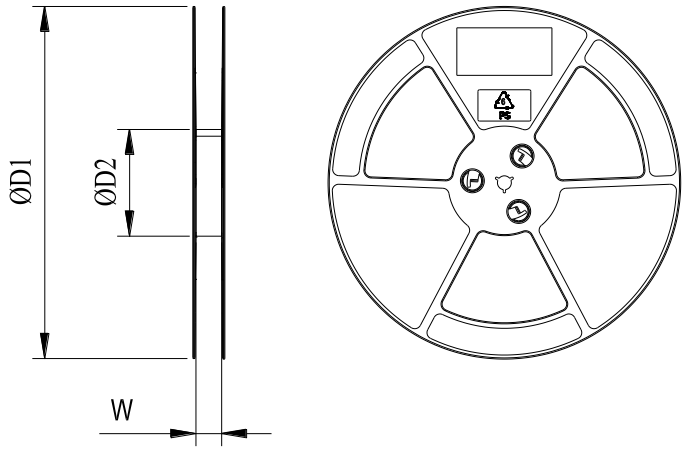
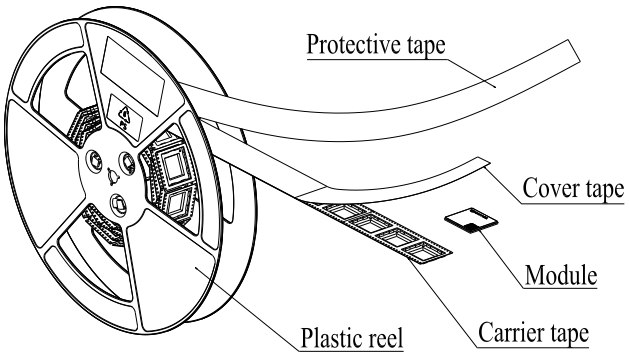


Figure 46: Plastic Reel Dimension Drawing

Table 35: Plastic Reel Dimension Table (Unit: mm)

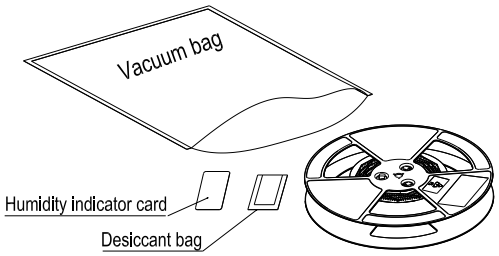
øD1	øD2	W
330	100	32.5

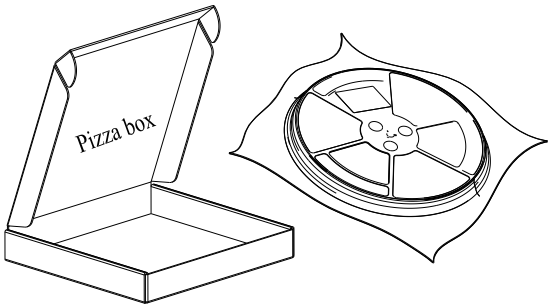
7.3.3. Packaging Process



Place the module into the carrier tape and use the cover tape to cover them; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. One plastic reel can load 250 modules.

Place the packaged plastic reel, humidity indicator card and desiccant bag into a vacuum bag, then vacuumize it.





Place the vacuum-packed plastic reel into a pizza box.

Put 4 pizza boxes into 1 carton and seal it. One carton can pack 1000 modules.

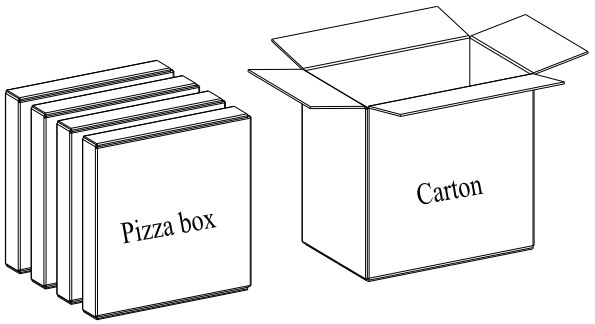


Figure 47: Packaging Process

8 Appendix References

Table 36: Related Documents

Document Name
[1] Quectel_UMTS&LTE_EVB_User_Guide
[2] Quectel_LTE Standard(A)_Series_AT_Commands_Manual
[3] Quectel_LTE Standard(A)_Series_Audio_Application_Note
[4] Quectel_RF_Layout_Application_Note
[5] Quectel_Module_SMT_User_Guide

Table 37: Terms and Abbreviations

Abbreviation	Description
ARM	Advanced RISC Machine
bps	bit(s) per second
CHAP	Challenge Handshake Authentication Protocol
CTS	Clear to Send
DFOTA	Delta Firmware Upgrade Over-The-Air
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance

ETSI	European Telecommunications Standards Institute
EVB	Evaluation Board
FDD	Frequency Division Duplex
FTP	File Transfer Protocol
FTPS	FTP-SSL: FTP over SSL / FTP Secure
GND	Ground
GPIO	General-Purpose Input/Output
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IMT-2000	International Mobile Telecommunications 2000
LCC	Leadless Chip Carrier (package)
LDO	Low-dropout Regulator
LGA	Land Grid Array
LTE	Long Term Evolution
M2M	Machine to Machine
Mbps	Megabits per second
MCU	Microcontroller Unit/Microprogrammed Control Unit
ME	Mobile Equipment
MIC	Microphone
MMS	Multimedia Messaging Service
MQTT	Message Queuing Telemetry Transport
MSL	Moisture Sensitivity Levels
NITZ	Network Identity and Time Zone / Network Informed Time Zone.
NTP	Network Time Protocol
PAP	Password Authentication Protocol

PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PING	Packet Internet Groper
PMIC	Power Management IC
PPP	Point-to-Point Protocol
RoHS	Restriction of Hazardous Substances
RTS	Request to Send
RXD	Receive Data (Pin)
SMS	Short Message Service
SMT	Surface Mount Technology
SMTP	Simple Mail Transfer Protocol
SMTPS	Simple Mail Transfer Protocol Secure
SPK	Speaker
SSL	Secure Sockets Layer
TCP	Transmission Control Protocol
TDD	Time Division Duplex
TVS	Transient Voltage Suppressor
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module

Vmax	Maximum Voltage
Vnom	Nominal Voltage
Vmin	Minimum Voltage
V_{IH}max	Maximum High-level Input Voltage
V_{IH}min	Minimum High-level Input Voltage
V_{IL}max	Maximum Low-level Input Voltage
V_{IL}min	Minimum Low-level Input Voltage
V_{OH}min	Minimum High-level Output Voltage
V_{OL}max	Maximum Low-level Output Voltage
VBAT	Voltage at Battery (Pin)
VSWR	Voltage Standing Wave Ratio