

EC800N-CN

Reference Design

LTE Standard Module Series

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Status: Released



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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 |
| 1.1 | 2022-02-11 | Dylan LIU | Updated the control method of the external power amplifier enable pin of the analog audio interface (Sheet 1, Sheet 3, Sheet 4 and Sheet 11). |

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1 Reference Design

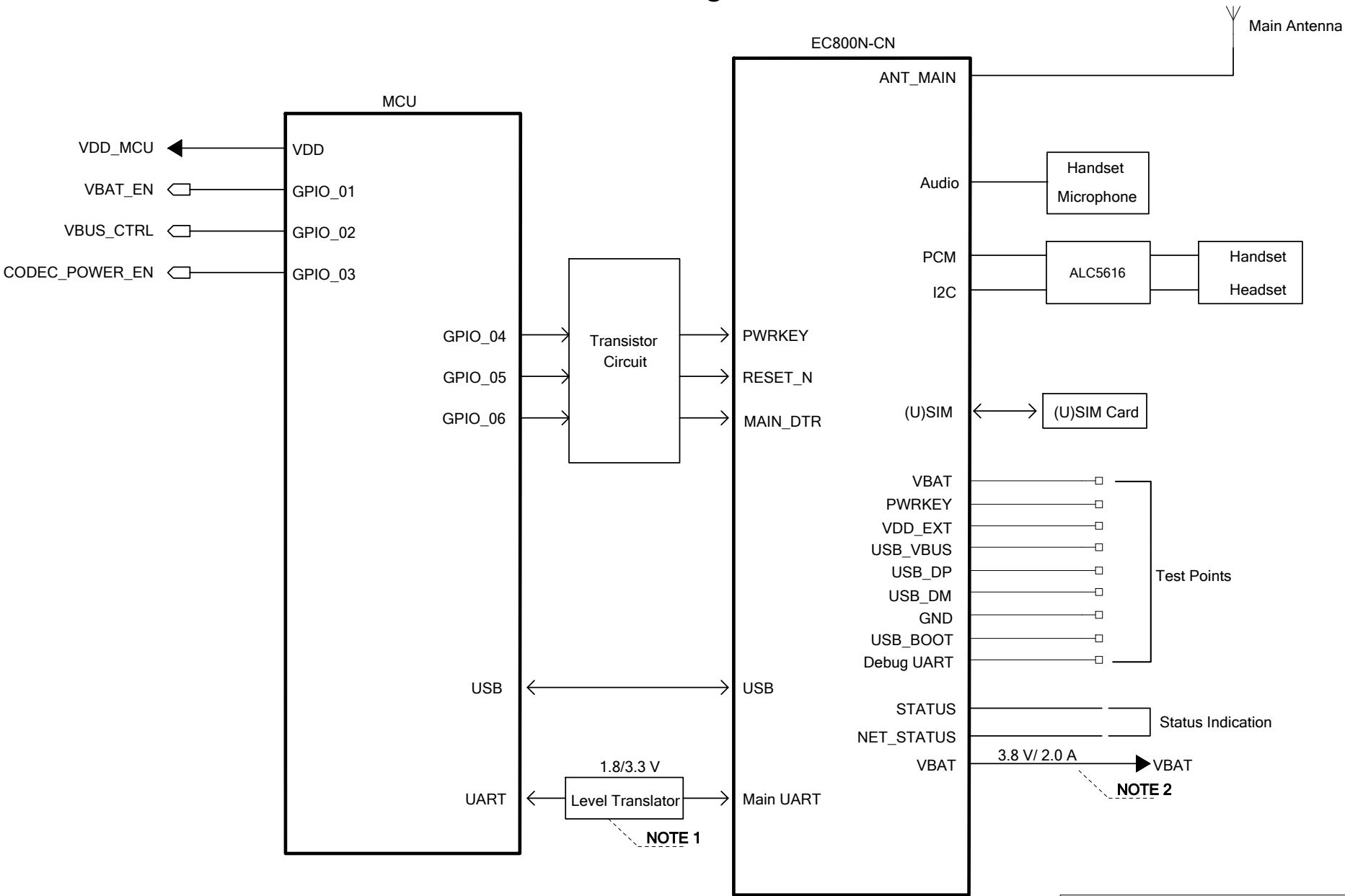
1.1. Introduction

This document provides the reference design for Quectel EC800N-CN module. The reference design mainly includes block diagrams of power supply, UART interface, (U)SIM interface, analog audio interfaces, etc.

1.2. Schematics

The schematics illustrated in the following pages are provided for your reference only.

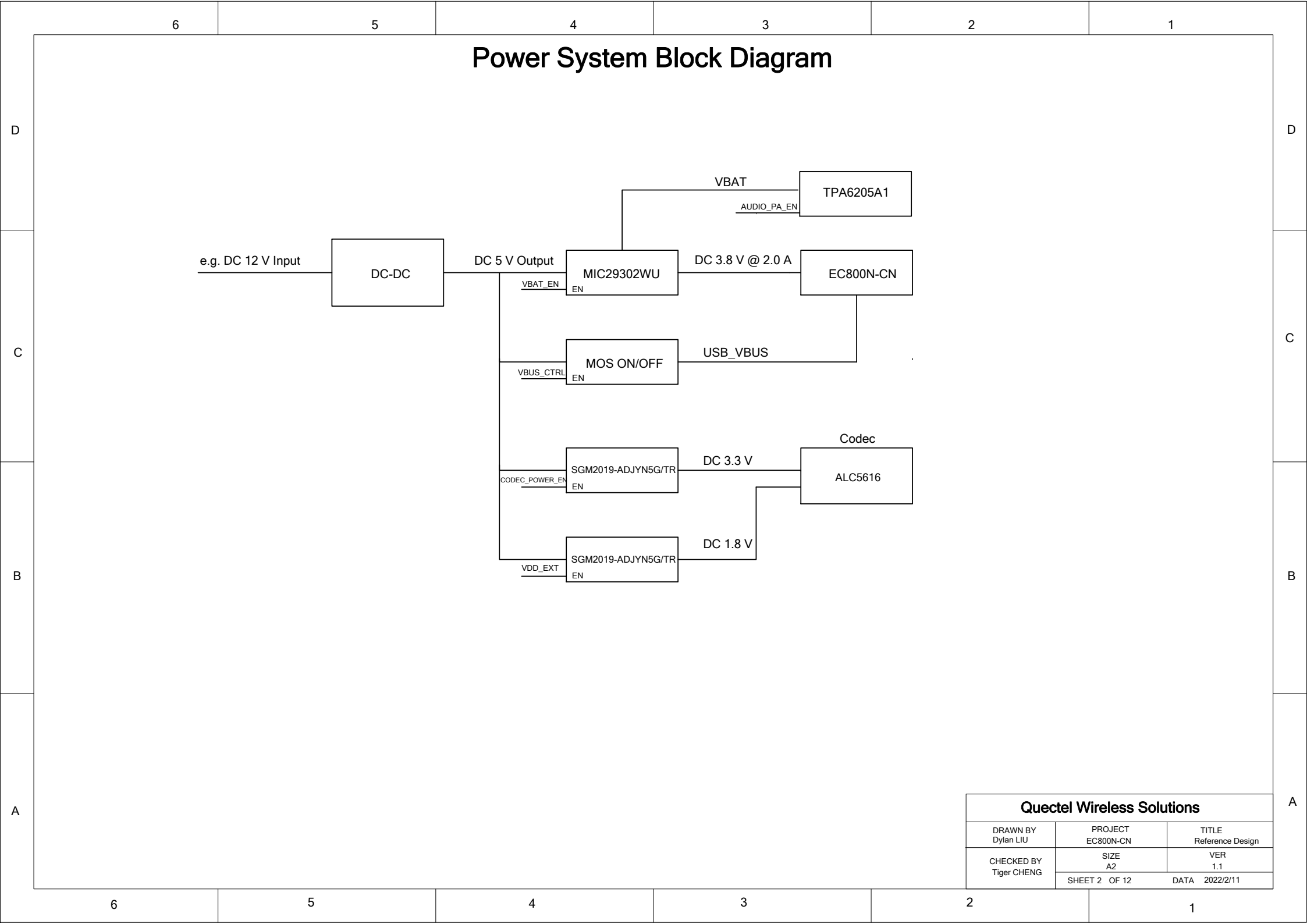
Block Diagram



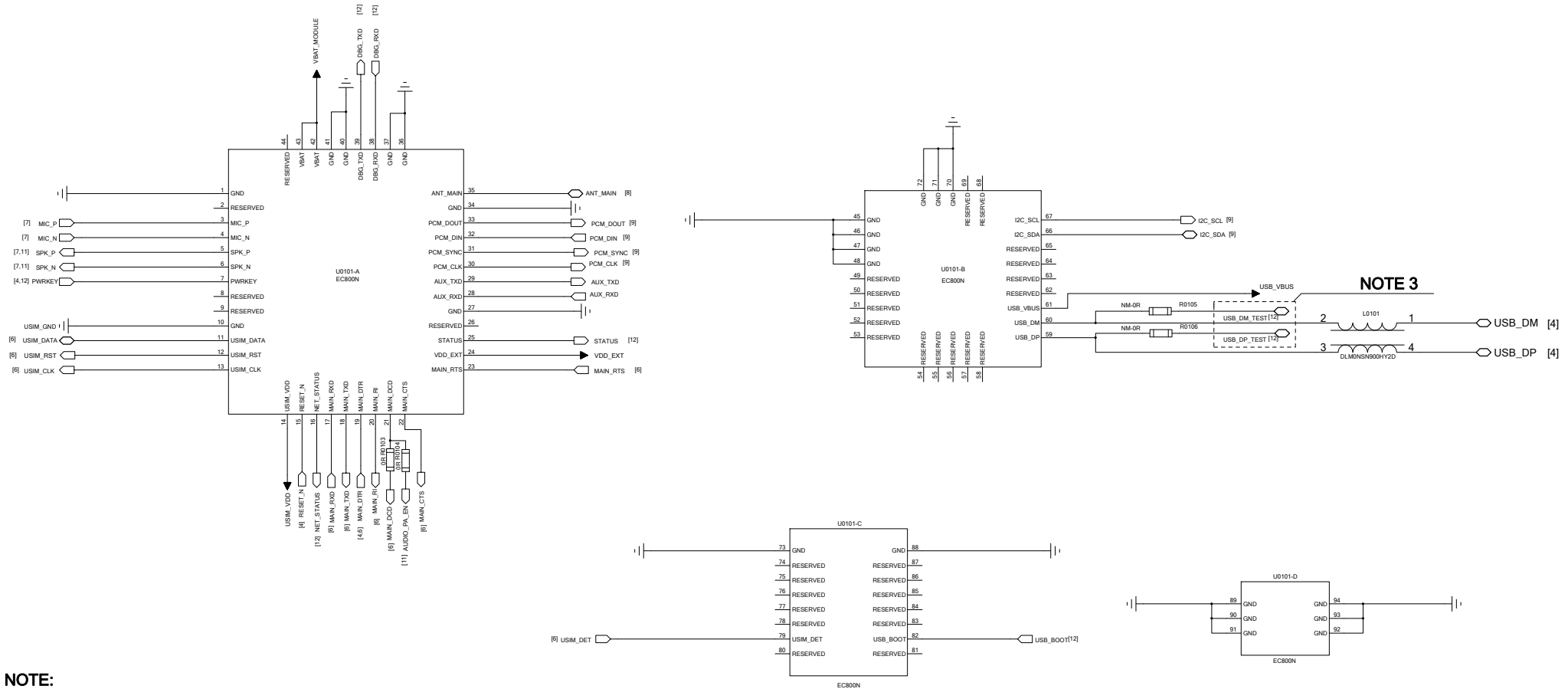
NOTE:

- 1. A transistor translation circuit or a voltage-level translator TXS0108EPWR provided by Texas Instruments is recommended.
- 2. The power supply should be able to provide sufficient current up to 2.0 A for EC800N-CN module.

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Module Interfaces



NOTE:

- All GND pins should be connected to ground, and keep unused & RESERVED pins unconnected.
- USB_BOOT cannot be pulled down to low level before the module is successfully startup.
- A common mode choke L0101 is recommended to be added in series between the module and your MCU in order to suppress EMI spurious transmission, and it should be placed close to the module. Meanwhile, it is recommended to reserve the test points for upgrading the firmware over USB interface and minimize the extra stubs of the trace. R0105 and R0106 should be placed close to the module to ensure the integrity of USB signal.

Note for Circuit Layout Design:

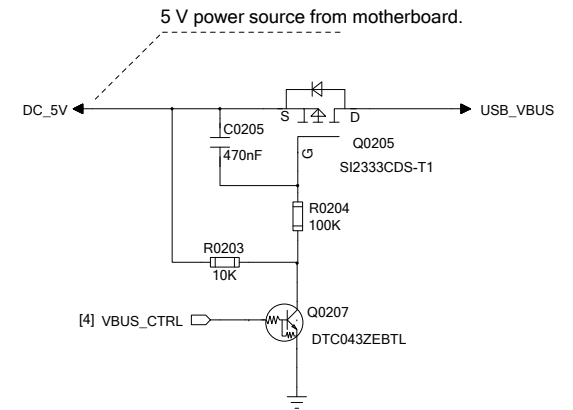
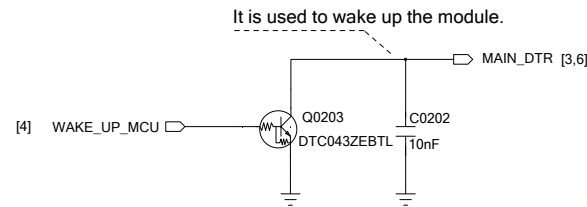
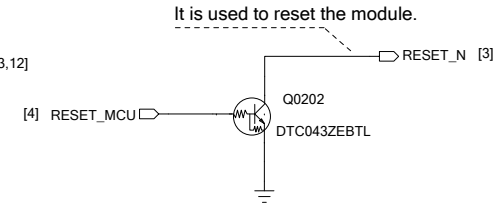
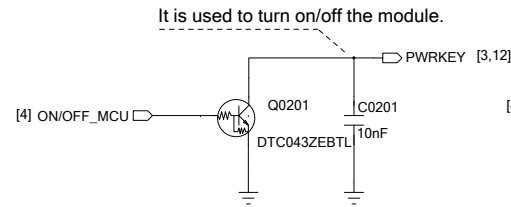
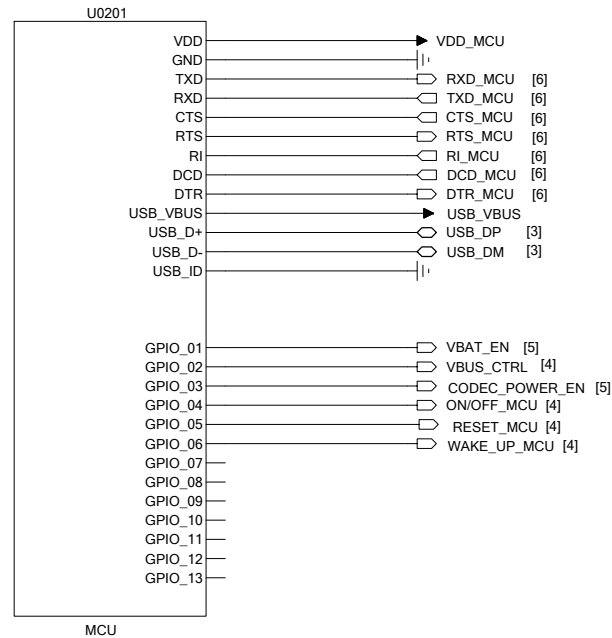
Please ensure that there is a complete reference ground plane below the module, and the ground plane is as close to the module layer as possible.

At least a 4-layer board design is recommended.

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MCU Interface



NOTE:

- U0201 represents your MCU. The power domain of GPIO interfaces of EC800N-CN is 1.8 V.
If the power domain of GPIO interfaces of U0201 is also 1.8 V, then the related level-shifting circuit is not needed.
- The USB interface of EC800N-CN only serves as a slave device and supports full-speed and high-speed modes of USB2.0.
To communicate with the USB interface, MCU needs to support USB host mode or OTG function. The USB_VBUS pin of the module should be powered by an external power system for USB detection, and VBUS_CTRL is used to turn on/off the USB_VBUS power supply.
- It is recommended to select the GPIO pins which are at low level by default of MCU as the control pins for PWRKEY and RESET_N of the module.
Please ensure that the load capacitance does not exceed 10 nF on PWRKEY and RESET_N pins.
- When the sleep function of the module is enabled, pull down MAIN_DTR can wake up the module from the sleep mode. You can choose either the open-collector control circuit or the level-shifting circuit on the "(U)SIM Design and UART Design" sheet in the design.
See *Quectel_EC800N-CN_Hardware Design* for the sleep and wakeup functions of the module.

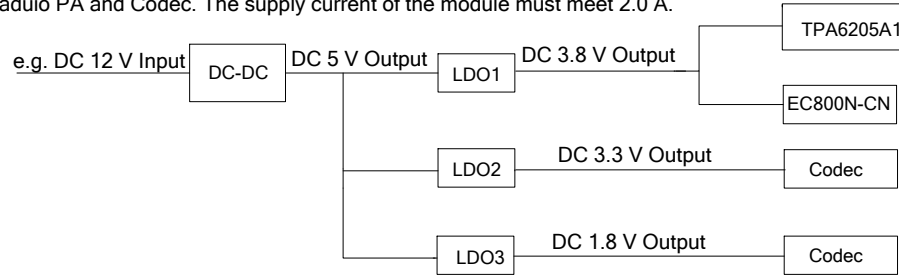
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Power Supply Design

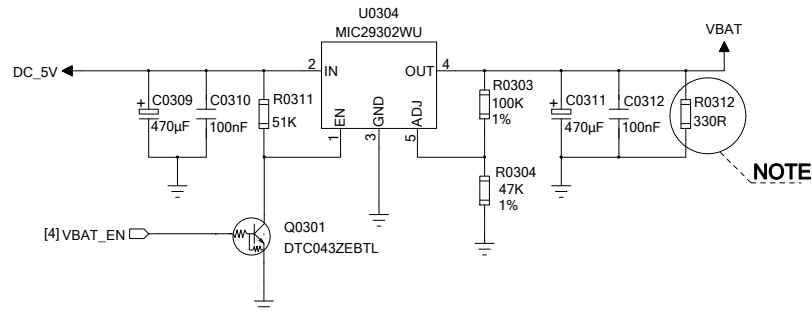
DC-DC Application

When the input voltage is above 7.0 V, use a DC-DC converter to convert the high input voltage to a 5.0 V output, and then use an LDO to convert it to 3.8 V, 3.3 V and 1.8 V to power the module, audio PA and Codec. The supply current of the module must meet 2.0 A.



LDO Application

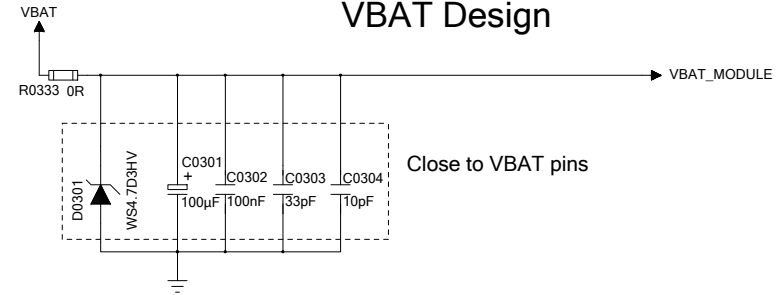
When the input voltage is below 7.0 V, use an LDO to convert the input voltage to 3.8 V.



$$VBAT = (R0303 / R0304 + 1) \times 1.24 = 3.88 \text{ V}$$

NOTE:
The recommended load current is greater than 10 mA.

VBAT Design

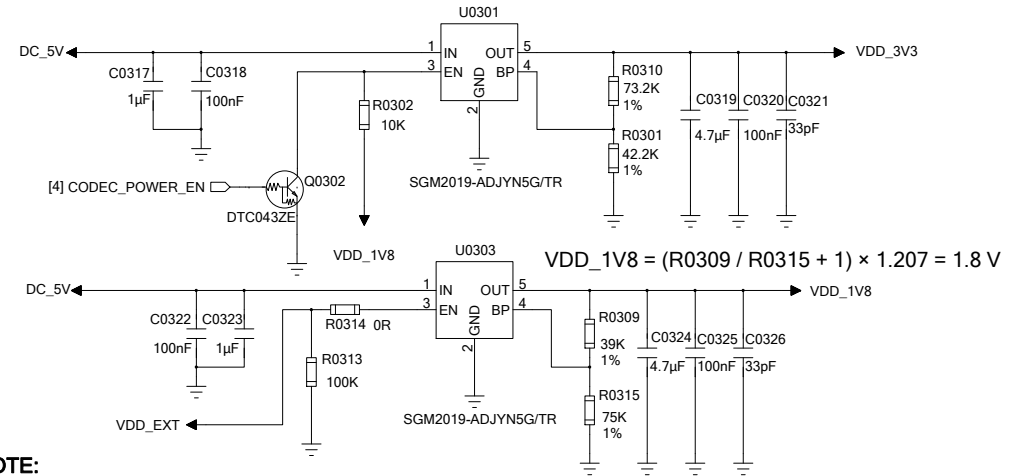


NOTE:

1. The power supply should be able to provide sufficient current up to 2.0 A for EC800N-CN.
2. The width of VBAT trace should be no less than 2 mm.
3. The typical operating voltage of VBAT is 3.8 V.

Power Supply for PCM Codec

$$VDD_3V3 = (R0310 / R0301 + 1) \times 1.207 = 3.3 \text{ V}$$



NOTE:

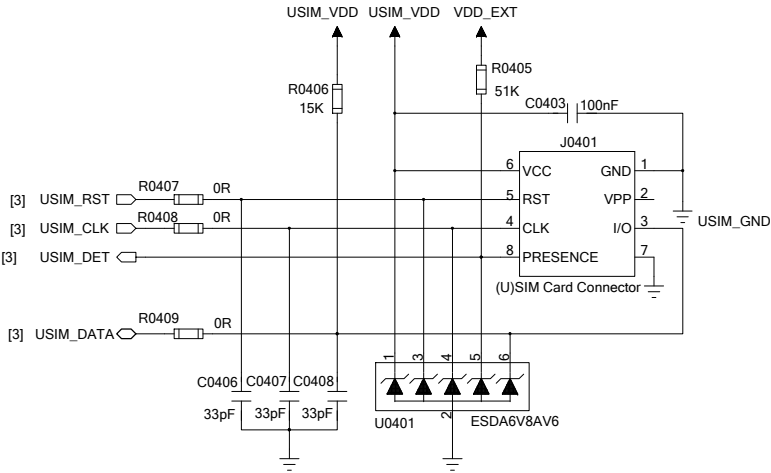
1. VDD_EXT is used to turn on/off the VDD_1V8 power supply.
CODEC_POWER_EN is used to turn on/off the VDD_3V3 power supply.
2. The following power-on/off sequences should be followed to ensure the audio codec works normally.
Power-on Sequence: power on VDD_1V8 first, and then VDD_3V3.
Power-off Sequence: power off VDD_3V3 first, and then VDD_1V8.

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(U)SIM Design and UART Design

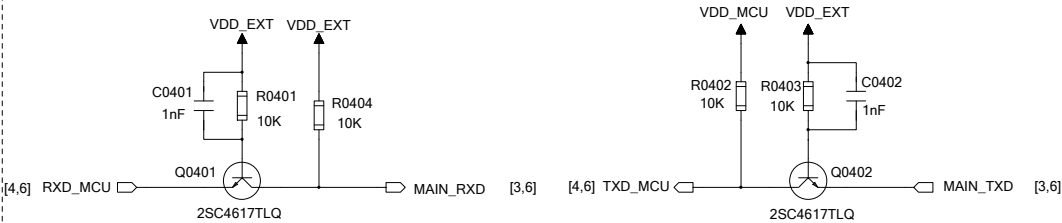
(U)SIM Interface Design



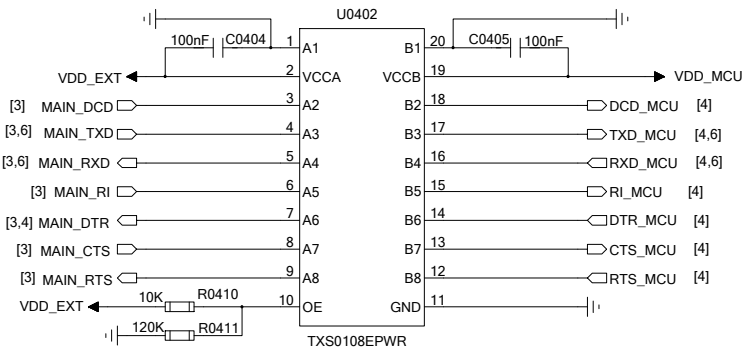
NOTE:

1. U0401 is recommended to be used to offer good ESD protection, and the parasitic capacitance should less than 15 pF.
2. The pull-up resistor R0406 can improve anti-jamming capability, and should be placed close to the (U)SIM card connector.
3. C0403's capacitance should be less than 1 μ F and it should be placed close to the (U)SIM card connector.
4. R0407-R0409 are used for debugging, and C0406-C0408 are used for filtering out RF interference.
5. For more information about the layout of (U)SIM interface, please refer to *Quectel_EC800N-CN_Hardware_Design*.

UART Translation - Transistor Solution



UART Translation - IC Solution



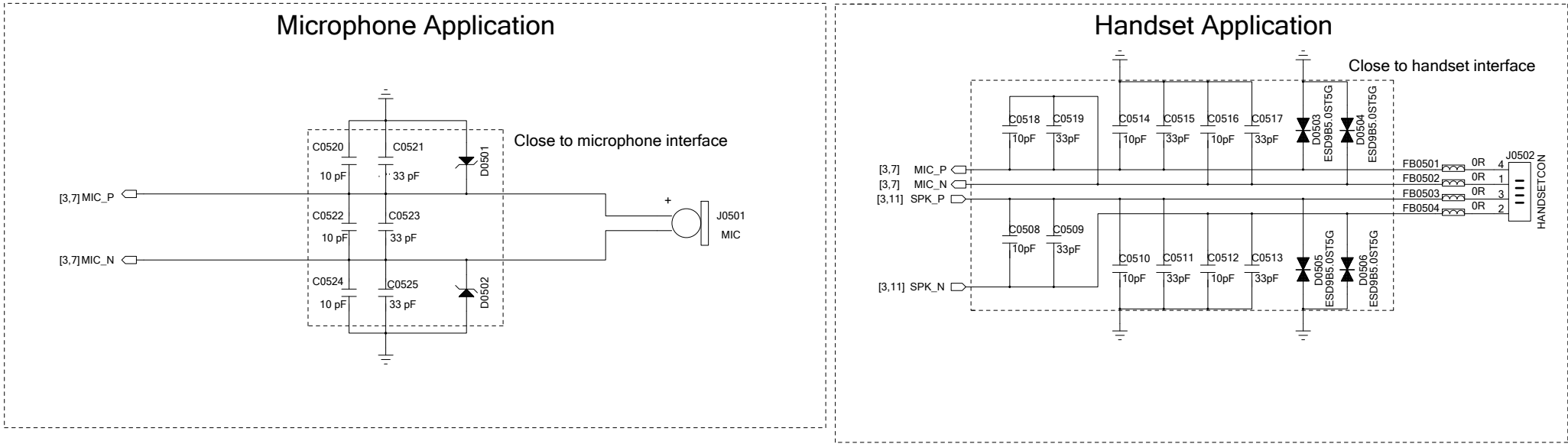
NOTE:

1. There are two translation solutions: transistor solution and IC solution, and it is recommended to select the latter.
2. The power supply of TXS0108EPWR's VCCA should not exceed that of VCCB. For more information, please refer to the datasheet from TXS0108EPWR.
3. The transistor solution is not suitable for applications with baud rates exceeding 460 kbps. The capacitors C0401 and C0402 of 1 nF can improve the signal quality.
4. MAIN_RTS and MAIN_DTR transistor circuits are similar to that of the MAIN_RXD interface. MAIN_CTS, MAIN_RI and MAIN_DCD transistor circuits are similar to that of the MAIN_TXD interface.

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Analog Audio Design

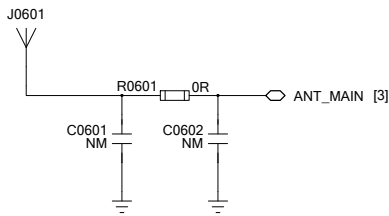


- NOTE:**
- 1. Both the MIC and SPK signal traces need to be routed as differential pairs.
 - 2. All MIC and SPK signal traces should be surrounded with ground on the layer and with ground planes above and below, and far away from noises sources.
 - 3. In the audio design, you can choose either the analog audio or the Codec.
It is not necessary to select both.
 - 4. The analog output can drive Earpiece. For larger power loads such as loudspeaker, an audio power amplifier should be added in the design.

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RF Interface Design

Main Antenna Circuit

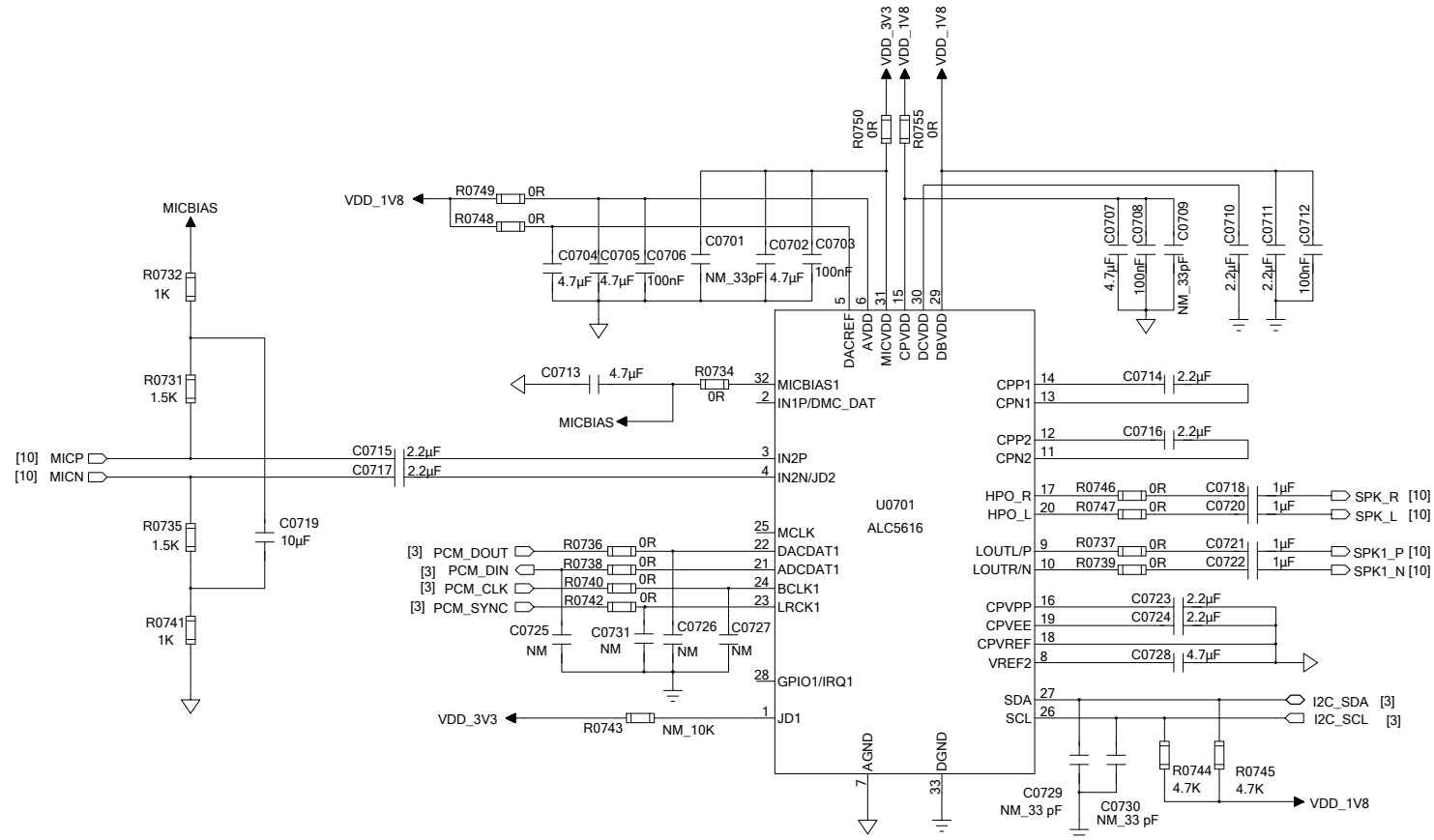


NOTE:
The single-ended impedance of the RF antenna is 50 Ω .

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Audio Codec Design (ALC5616)



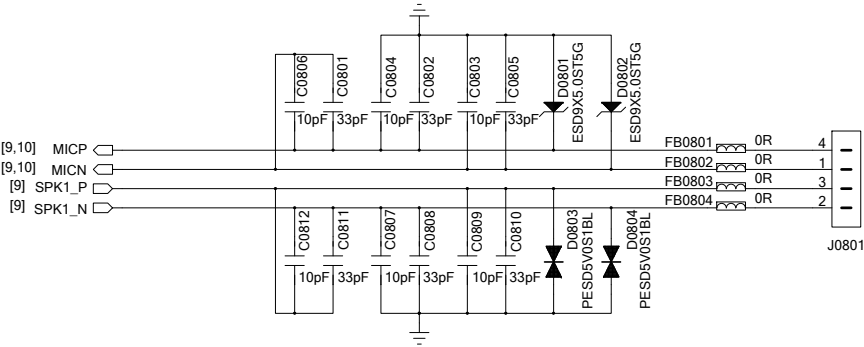
NOTE:

1. ALC5616 power-on sequence: DBVDD/I2C pull-up power/AVDD/DACREF/CPVDD → MICVDD → software initialization.
2. ALC5616 power-off sequence: disable Codec function by software → MICVDD → DBVDD/I2C pull-up power/AVDD/DACREF/CPVDD.
3. The module will automatically initialize the Codec via I2C interface after it is turned on successfully, so all power supplies for the Codec need to be powered on before that.
4. Please pay attention to the distinction between analog ground and digital ground. The analog ground and digital ground need to be connected with a 0 Ω resistor packaged as R-0805.
For more details, please refer to Sheet "Audio Codec Design (Analog Audio Interface)".
5. For more details, please refer to the datasheet of ALC5616.

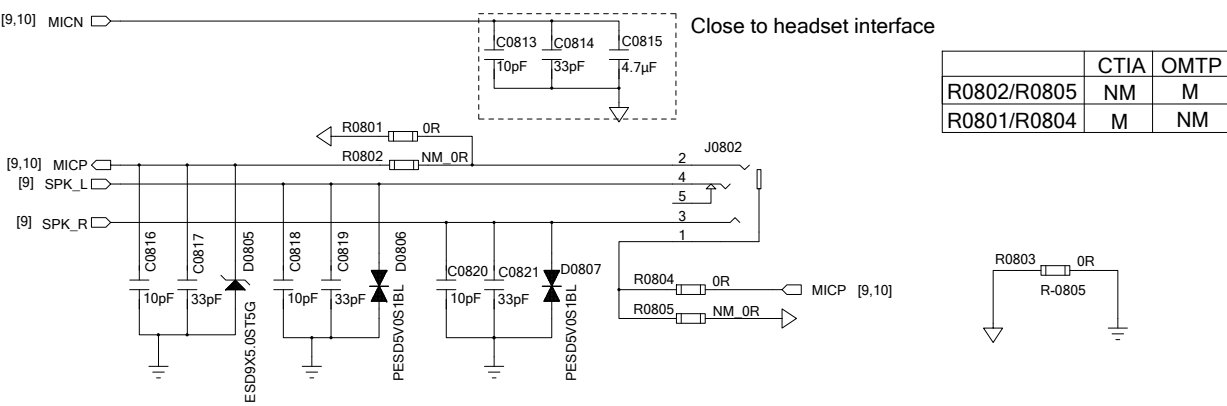
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Audio Codec Design (Analog Audio Interface)

Handset Application



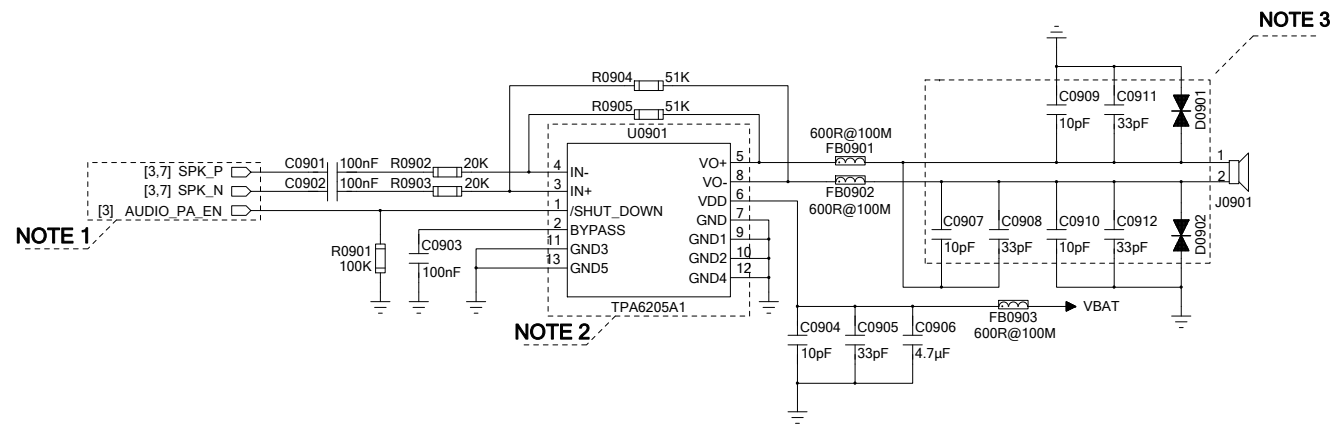
Headset Application



- NOTE:**
1. The Codec analog output can drive handset and headset. For larger power loads such as loudspeaker, an audio power amplifier should be added in the design.
 2. In handset applications, route the MIC and SPK signal traces as differential pairs respectively.
 3. In headset applications, route the MIC signal traces as a differential pair.
 4. All MIC and SPK signal traces shall be surrounded with ground on the layer and ground planes above and below, and far away from noises such as clock and DC-DC signals, etc.
 5. Please pay attention to the distinction between analog ground and digital ground. The analog ground and digital ground need to be connected with a 0 Ω resistor packaged as R-0805 (short-circuit through single point grounding).

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Module Analog Audio Design (Audio Power Amplifier)



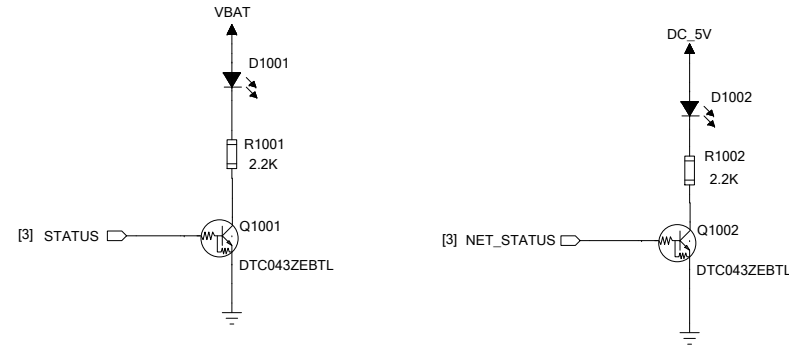
NOTE:

1. SPK_P and SPK_N are differential output channels that can be used for external audio amplifier.
It is recommended to use the module's MAIN_DCD pin to control the enable pin of the audio power amplifier (AUDIO_PA_EN) to eliminate POP.
For more information about AUDIO_PA_EN, please contact Quectel technical support.
2. The amplifier mode in this design is for reference only. Select the audio power amplifier with appropriate power according to actual needs.
3. Place filter capacitors and ESD protection components close to the speaker.
4. The selection of ESD device is related to the selection of audio power amplifier. Please ensure that the output audio voltage amplitude of audio power amplifier is within the maximum reverse working voltage range of ESD device under normal working condition, so as to avoid damage to ESD device.

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Other Designs

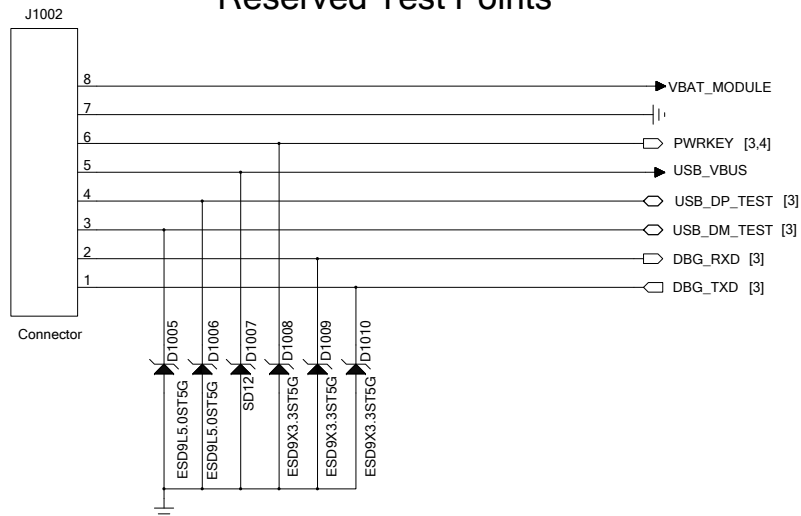
Indicators



NOTE:

1. For more details about STATUS and NET_STATUS, please refer to *Quectel_EC800N-CN_Hardware_Design*.
2. If the low current consumption is required when your device is in sleep, replace the power supply VBAT and DC_5V of the STATUS, NET_STATUS indicators with the external controllable ones, which can be turned off when the module is in sleep mode to reduce the power consumption.

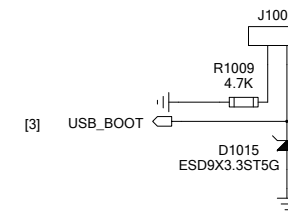
Reserved Test Points



NOTE:

1. Test points for both USB and debug UART interfaces are reserved for catching logs.
2. Test points for USB interface can also be reserved for firmware upgrade.
3. The junction capacitance of the ESD protection components on USB data lines should be less than 2 pF.
4. The debug UART interface supports 1.8 V power domain, and a level translator should be used if the power domain of your application is 3.3 V.

USB_BOOT Interface



NOTE:

1. Be sure to reserve the USB_BOOT interface design and test points.
2. You can pull down USB_BOOT to GND before module startup, and the module will enter emergency download mode when it is powered on. In this mode, the module supports firmware upgrade over USB interface.

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