EC200U Series

Reference Design

LTE Standard Module Series

Version: 1.0

Date: 2021-08-09

Status: Released

Our aim is to provide customers with timely and comprehensive service. For any assistance, please contact our company headquarters:

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About the Document

Revision History

Version	Date	Author	Description
-	2021-02-10	Kyle CHEN	Creation of the document
1.0	2021-08-09	Kyle CHEN/ Nathan LIU	First official released

Contents

1 Reference Design

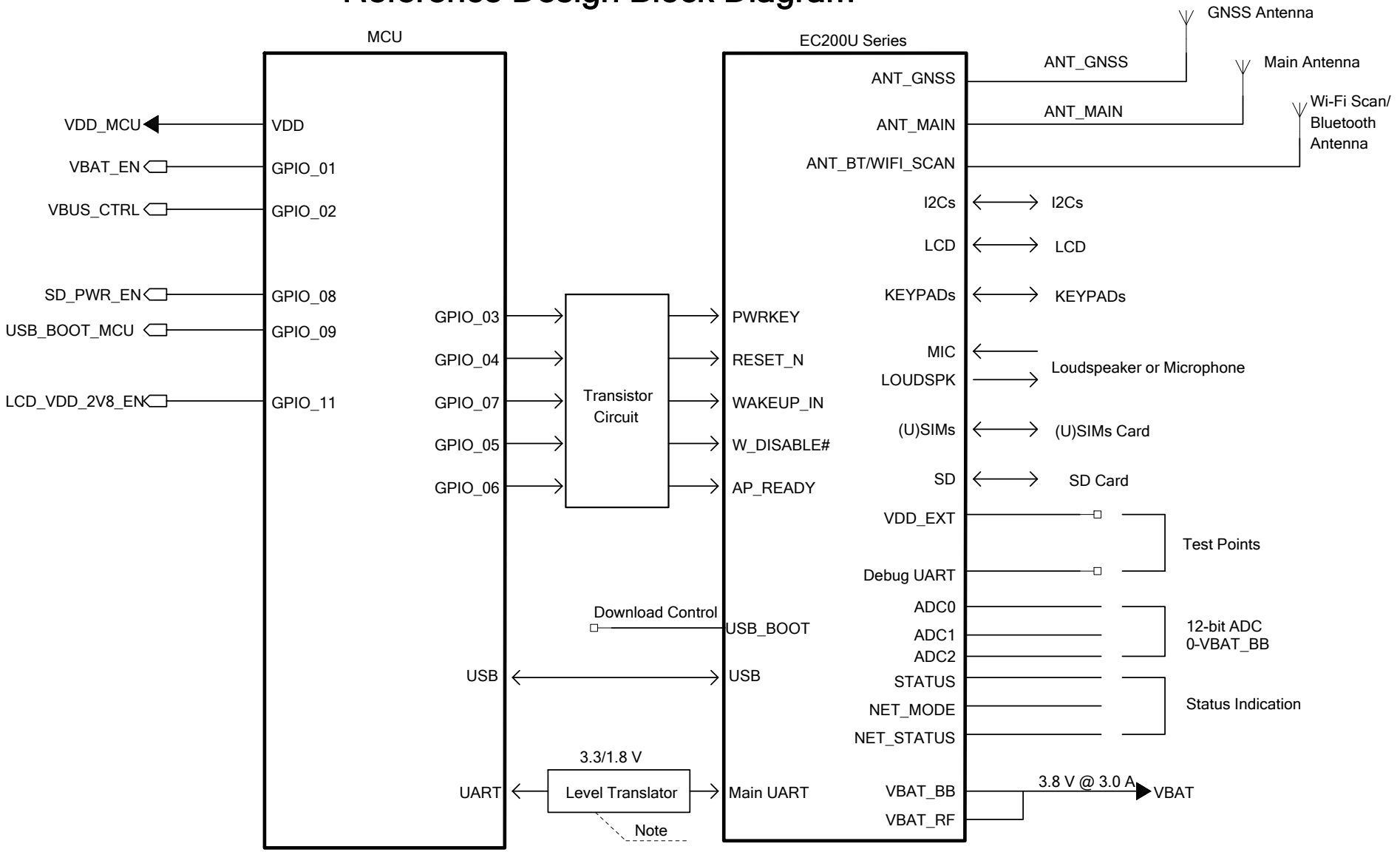
1.1. Introduction

This document provides the reference design for Quectel EC200U series module, including block diagram, module interface, MCU interface, power supply design, antenna interface, (U)SIM interface, analog audio, UART interface, SD card interface, LCD, matrix keyboard, USB_BOOT download interface and other designs.

1.2. Schematics

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

Reference Design Block Diagram



Note:

It is recommended to use a level translation circuit or a level translator TXS0108EPWR provided by Texas Instruments.

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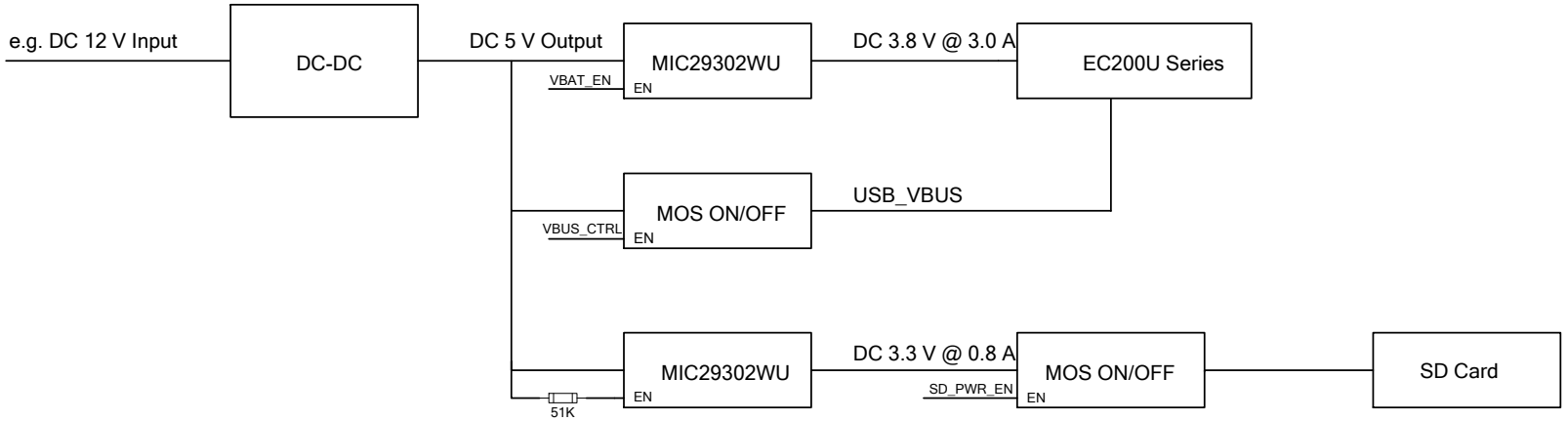
Power Supply Block Diagram



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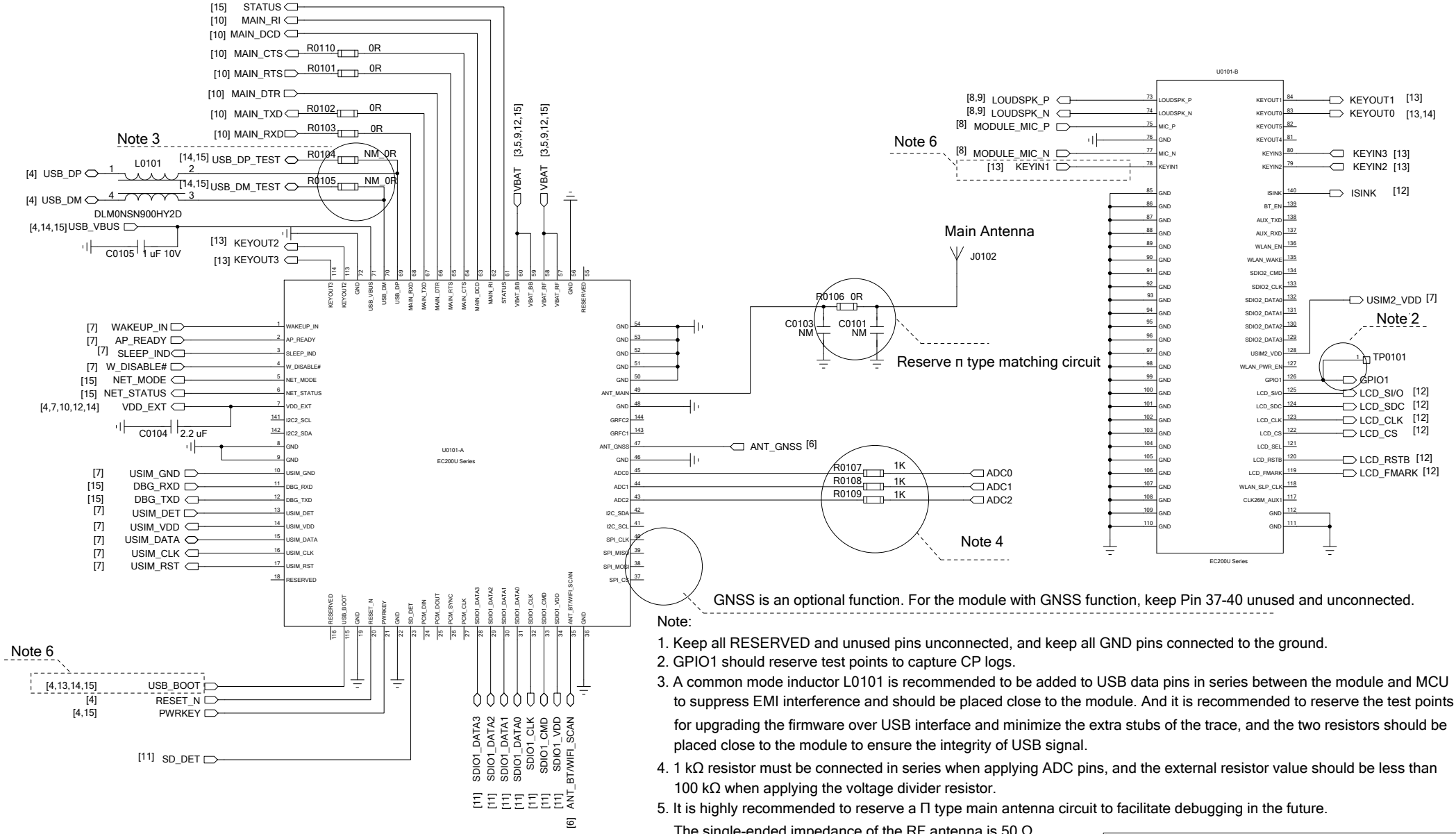
Module Interface



GNSS is an optional function. For the module with GNSS function, keep Pin 37-40 unused and unconnected.

Note:

1. Keep all RESERVED and unused pins unconnected, and keep all GND pins connected to the ground.
2. GPIO1 should reserve test points to capture CP logs.
3. A common mode inductor L0101 is recommended to be added to USB data pins in series between the module and MCU to suppress EMI interference and should be placed close to the module. And it is recommended to reserve the test points for upgrading the firmware over USB interface and minimize the extra stubs of the trace, and the two resistors should be placed close to the module to ensure the integrity of USB signal.
4. 1 kΩ resistor must be connected in series when applying ADC pins, and the external resistor value should be less than 100 kΩ when applying the voltage divider resistor.
5. It is highly recommended to reserve a Π type main antenna circuit to facilitate debugging in the future. The single-ended impedance of the RF antenna is 50 Ω.
6. USB_BOOT and KEYIN1 must not be pulled up before the module starts up successfully.

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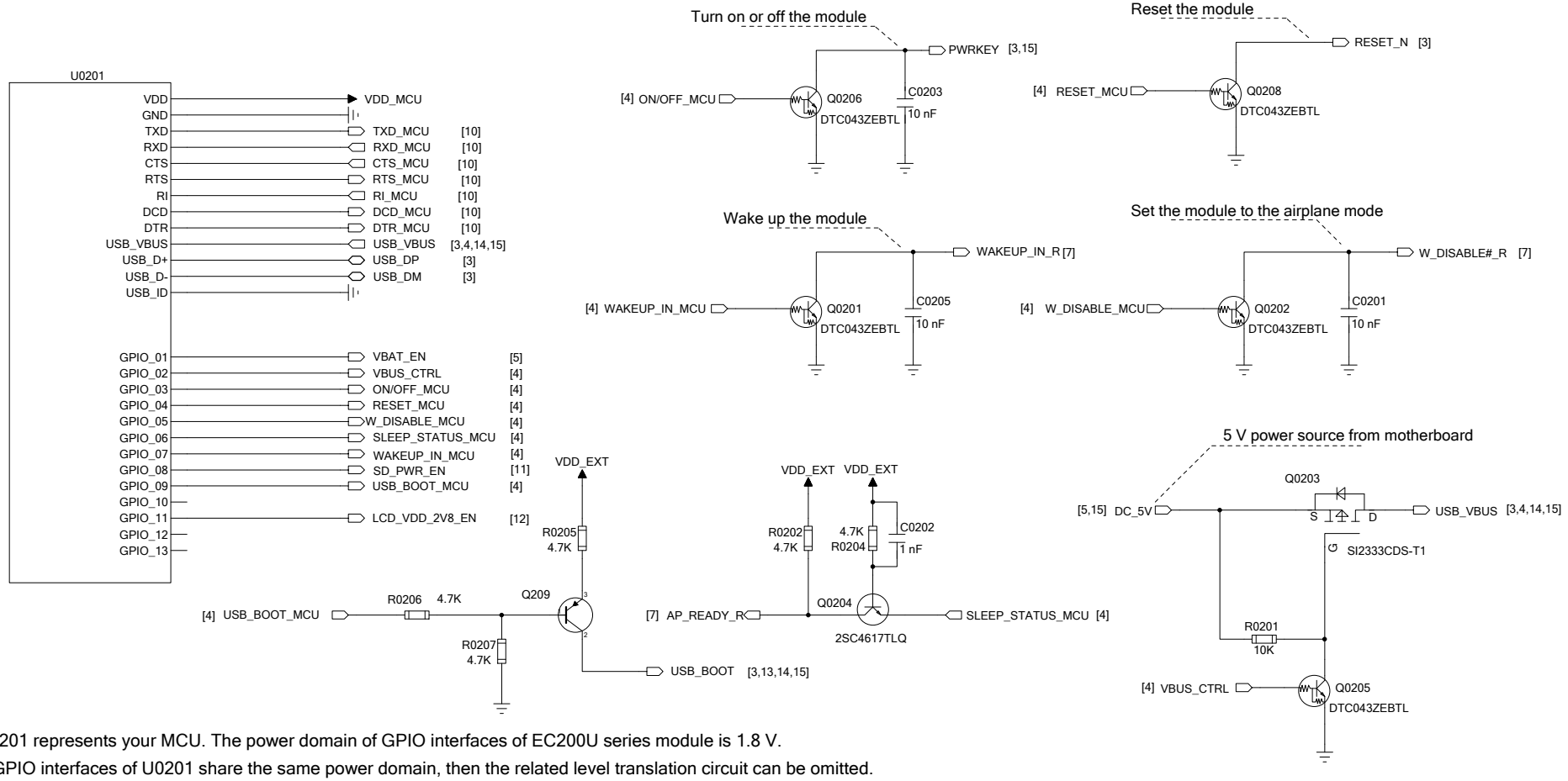
MCU Interface



Note:

1. U0201 represents your MCU. The power domain of GPIO interfaces of EC200U series module is 1.8 V.
   If GPIO interfaces of U0201 share the same power domain, then the related level translation circuit can be omitted.
2. The USB interface of EC200U series only serves as a slave device and supports full-speed and high-speed modes of USB 2.0.
   To communicate with the USB interface, MCU needs to support USB host 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.
3. It is recommended to select the default low-level GPIO pins of MCU as the control pins for PWRKEY and RESET_N of the module.
   Please ensure that there is no capacitance with the maximum value exceeding 10 nF on PWRKEY and RESET_N pins.
4. The USB_BOOT_MCU pin is at high level by default when the MCU is powered on to prevent the MCU from powering on the transistor Q209 to conduct the module in the download mode. Transistor or reserving through-hole or keys can be applied to avoid such situation.

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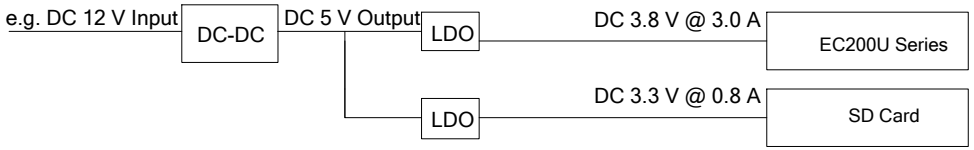
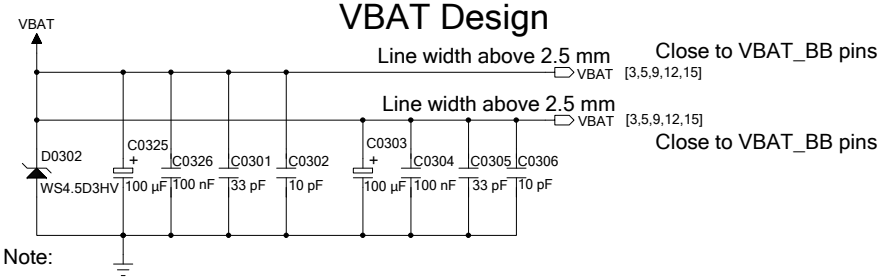
Power Supply Design

DC-DC Application

When the input voltage is above 7.0 V, use a DC-DC converter to convert a high input voltage into a 5.0 V first, and then respectively convert to 3.8 V and 3.3 V typical voltages by LDOs.



VBAT Design

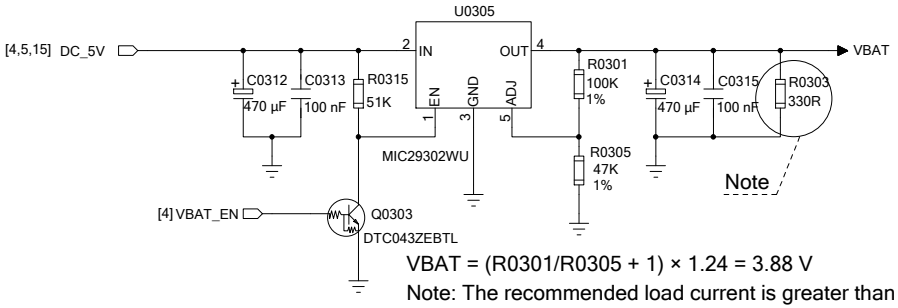


Note:

1. VBAT current should meet the rated output capacity of 3.0 A. If you select the module that does not support the GSM frequency band, you can select a power supply with a current capability of 2.0 A.
2. VBAT_BB and VBAT_RF pins should be divided into two separated paths in star structure.
3. The recommended operating voltage of VBAT is 3.3-4.3 V.

LDO Application

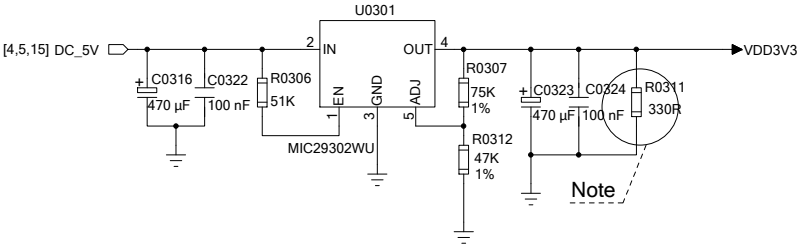
When the input voltage is below 7.0 V, convert to 3.8 V power supply for the module by LDO.



VBAT = (R0301/R0305 + 1) × 1.24 = 3.88 V

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

Power Supply for SD Card



VDD3V3 = (R0307/R0312 + 1) × 1.24 = 3.3 V

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

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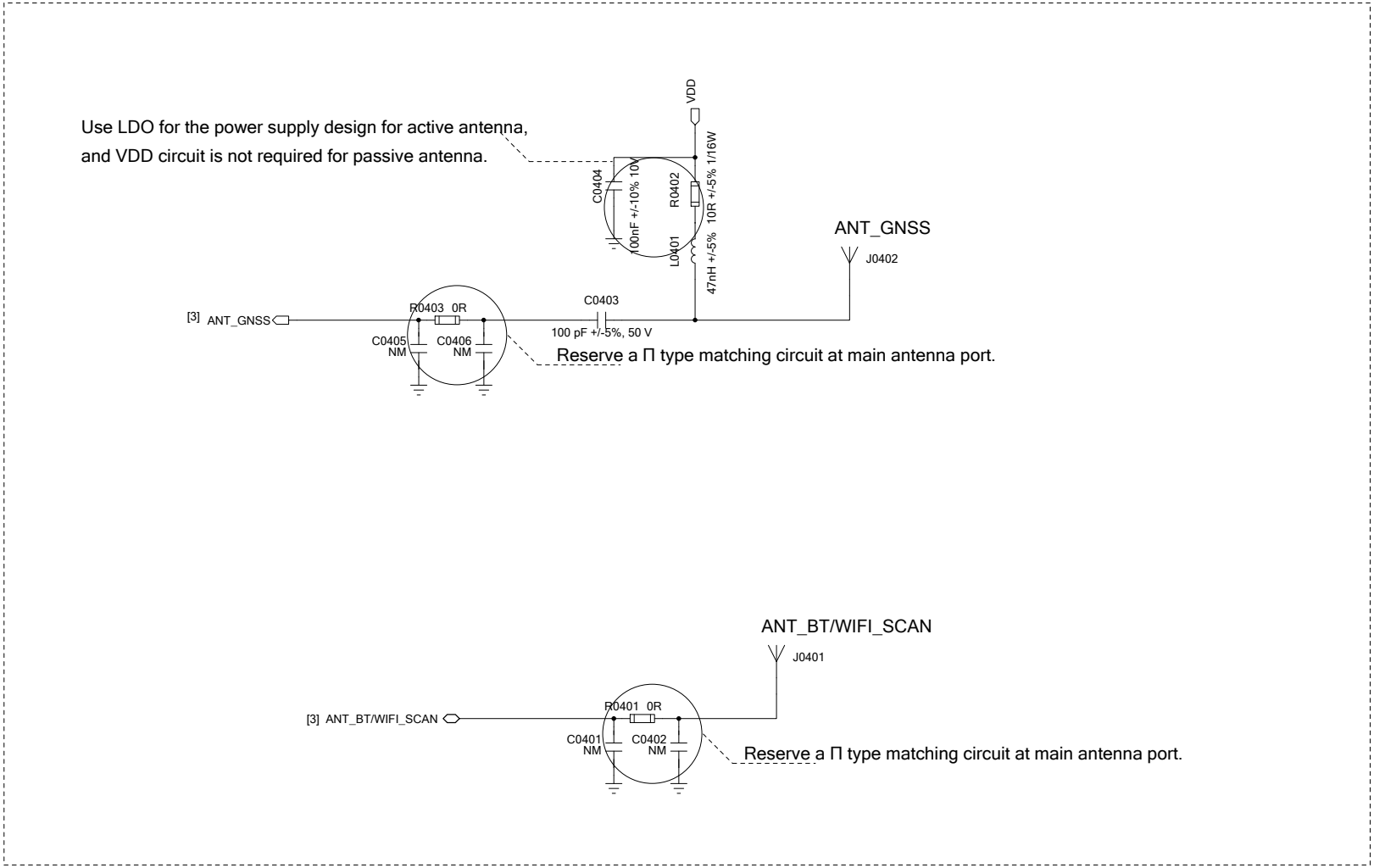
Antenna Interface



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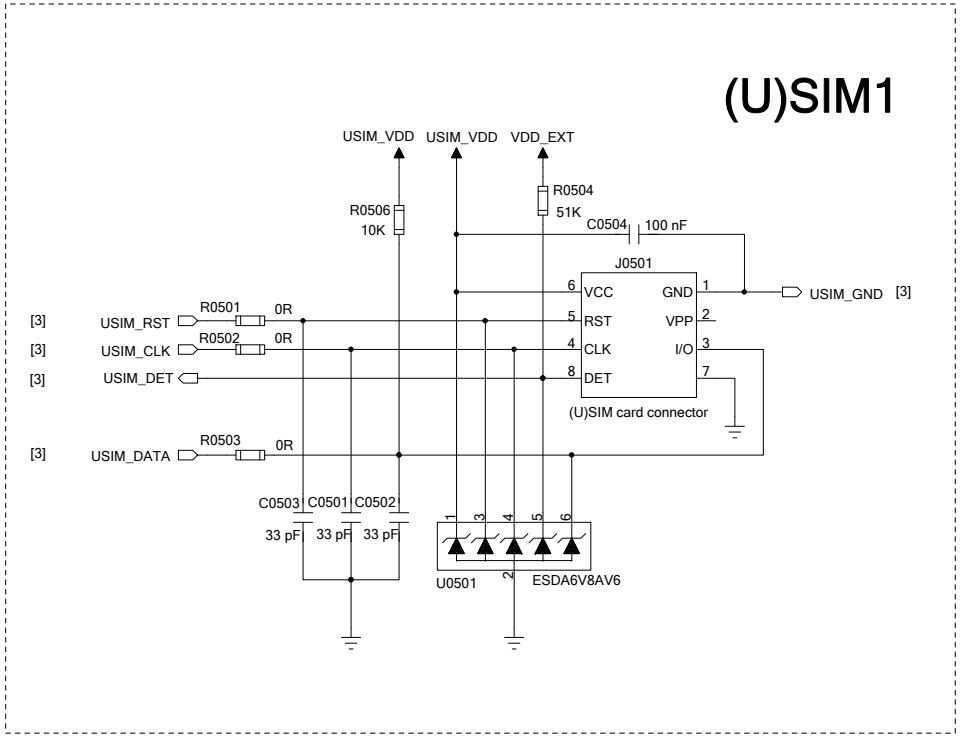
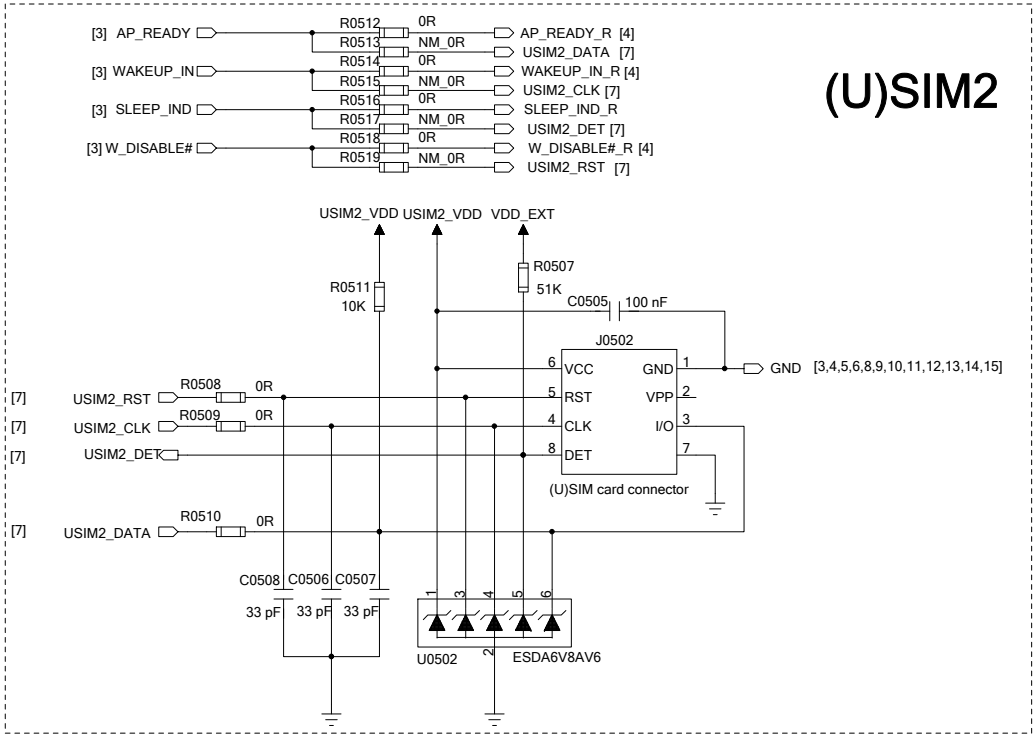
(U)SIM Interface Design





Note:

1. U0501 and U0502 are recommended to be used to offer good ESD protection, and the parasitic capacitance should not be more than 15 pF.
2. The GND of the (U)SIM card connector is recommended to be connected to the module's USIM_GND to avoid being interfered by the ground of (U)SIM card connector, and also can be connected to the ground of PCB if your PCB has a complete ground plane.
3. The pull-up resistor R0506 and R0511 can improve anti-jamming capability, and should be placed close to the (U)SIM card connector.
4. R0501-R0503 and R0508-R0510 are used for debugging, and C0501-C0503 and C0506-C0508 are used for filtering out EGSM900 interference.
5. The capacitances of C0504 and C0505 should be less than 1 μF and the two capacitors should be placed close to the (U)SIM card connector.
6. For more information about the layout of (U)SIM interface, please refer to *Quectel_EC200U_Series_Hardware_Design*.
7. The (U)SIM2 function is not available to the module by default. If you require DSDS (dual SIM dual standby), select the specific firmware version. Please consult Quectel Technical Supports for details.

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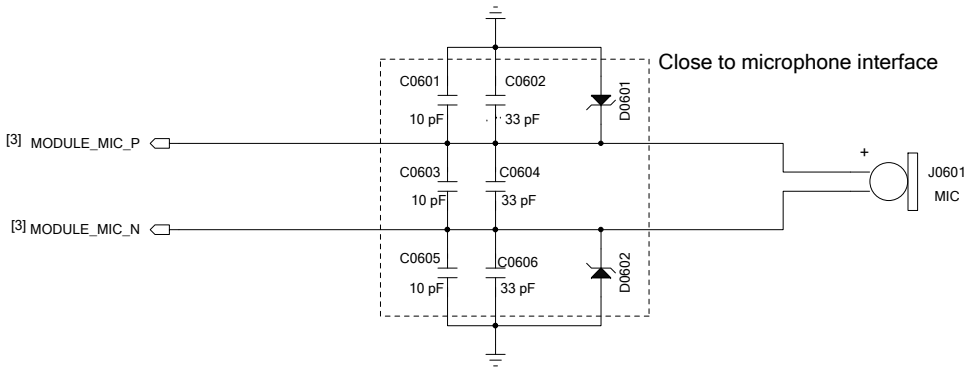
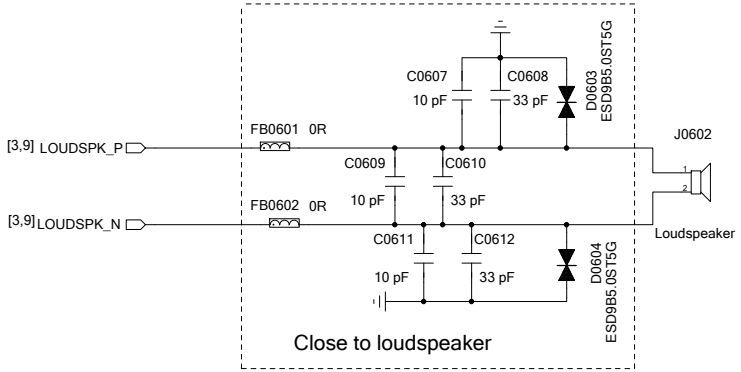
Analog Audio Design

Microphone Application



Loudspeaker Interface



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.
3. The loudspeaker has a built-in power amplifier with a default configuration of Class AB. And the output power of such power amplifier is 500 mW for Class AB and 800 mW for Class D.

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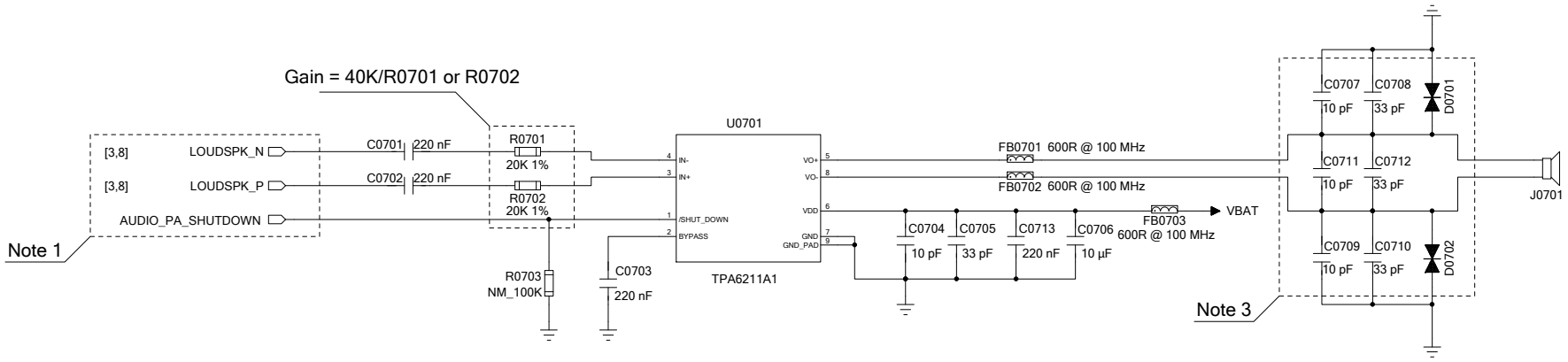
Analog Audio Design (Audio Power Amplifier)



Note:

1. LOUDSPK_N and LOUDSPK_P are differential output channels, which can be used for external audio power amplifiers. To eliminate POP noise, the AUDIO_PA_SHUTDOWN signal of the enable pin of the power amplifier is recommended to be controlled by the GPIO pin of the module. Please contact Quectel Technical Supports for details.
2. Choose the audio power amplifier with appropriate power according to the actual demand.
3. Place filter capacitors and ESD protection components close to the loudspeaker.

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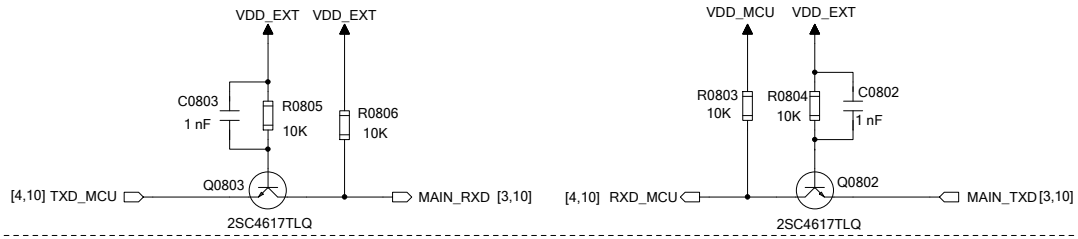
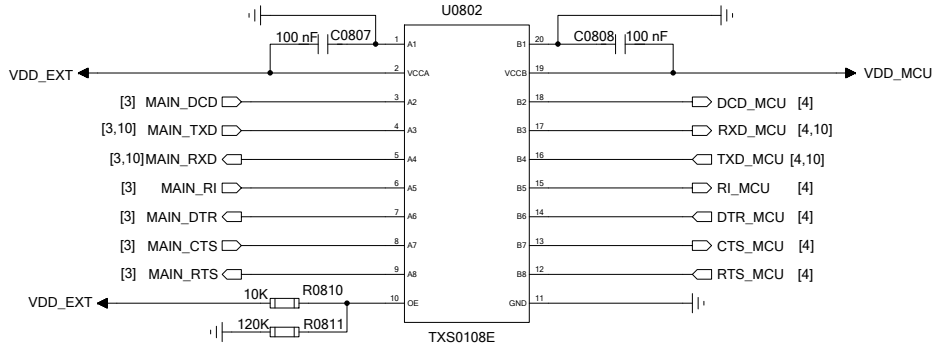
UART Interfaces Design

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 TXS0108E's VCCA should not exceed that of VCCB. For more information, please refer to the datasheet from TXS0108E datasheet.
3. The transistor circuit solution is applicable to applications with a baud rate of not exceeding 460 kbps.
   The 1 nF capacitors C0802 and C0803 can improve the signal quality.
4. The UART hardware flow control pins CTS and RTS adopt direct connection, that is, the RTS of the module is connected to the RTS of the MCU, and the CTS of the module is connected to the CTS of the MCU. Pay attention to the direction of signal.
   TXD and RXD adopt a cross connection, that is, the TXD and RXD of the module are respectively connected to the RXD and TXD of the MCU.
5. The MAIN_RTS and MAIN_DTR transistor circuits are similar to that of the MAIN_RXD.
   The MAIN_CTS, MAIN_RI and MAIN_DCD transistor circuits are similar to that of the MAIN_TXD.

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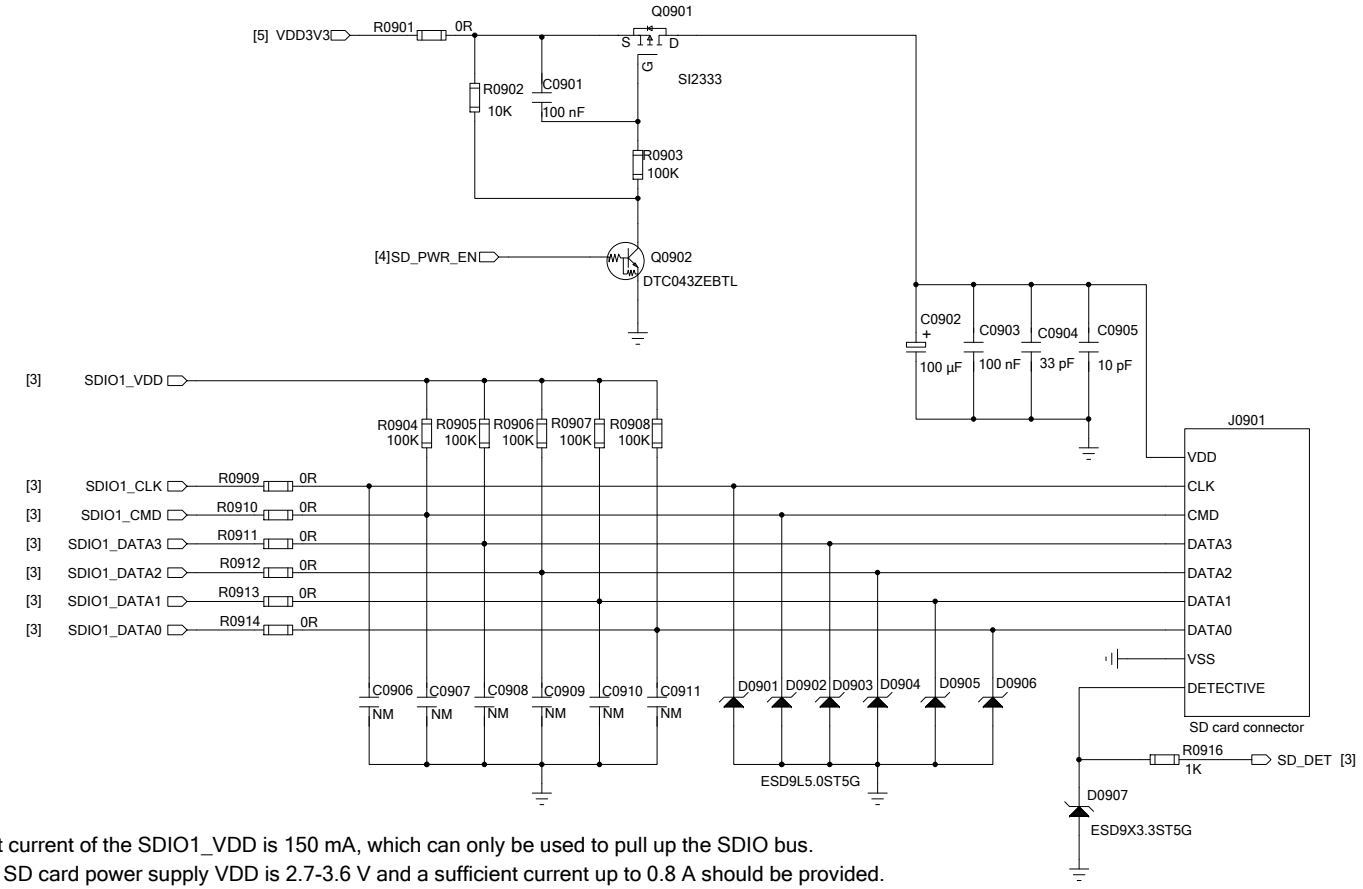
SD Card Interface Design



Note:

1. The maximum output current of the SDIO1_VDD is 150 mA, which can only be used to pull up the SDIO bus.
2. The voltage range of SD card power supply VDD is 2.7-3.6 V and a sufficient current up to 0.8 A should be provided.
3. To avoid the jitter of bus, pull-up resistors R0904-R0908 are recommended to be added to SDIO data lines. SDIO1_VDD should be used as the pull-up power. The values of these resistors are among 10-100 kΩ and the recommended value is 100 kΩ.
4. In order to adjust the signal quality, it is recommended to add 0 Ω resistors R0909-R0914 in series between the module and the SD card connector. The bypass capacitors C0906-C0911 are reserved and not mounted by default.
5. It is recommended to add ESD protection components near the pins of SD card connector. The parasitic capacitance of ESD protection components should be less than 15 pF.
6. Keep SDIO signals far away from other sensitive circuits/signals such as RF circuits, analog signals, as well as noise signals such as clock and DC-DC signals, etc.
7. Route SDIO signals with 50 Ω ±10 % impedance. It is important to route SDIO signals surrounded with ground on the layer and ground planes above and below, and the total trace length should be less than 50 mm.
8. It is recommended to keep the trace length difference among SDIO1_CLK and SDIO1_DATA[0:3] as well as SDIO1_CMD less than 1 mm.
9. Make sure the adjacent trace spacing is two times of the trace width and the load capacitance of SDIO bus should be less than 15 pF.

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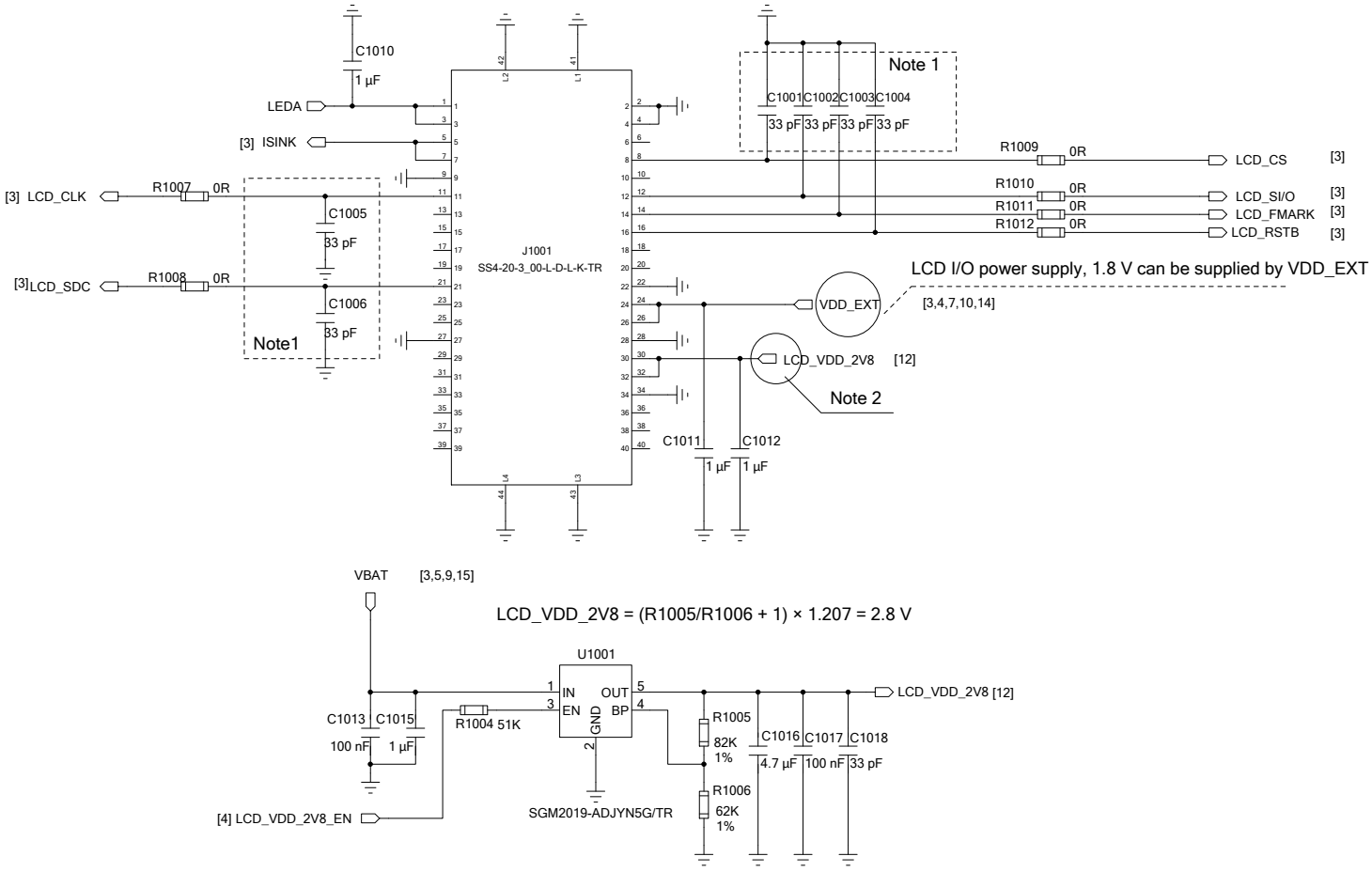
LCD Design



Note:

1. The 33 pF capacitors on signal pins are reserved and can be mounted or not mounted according to the actual debugging situation.
2. The power supply LCD_VDD_2V8 can be designed by yourselves.

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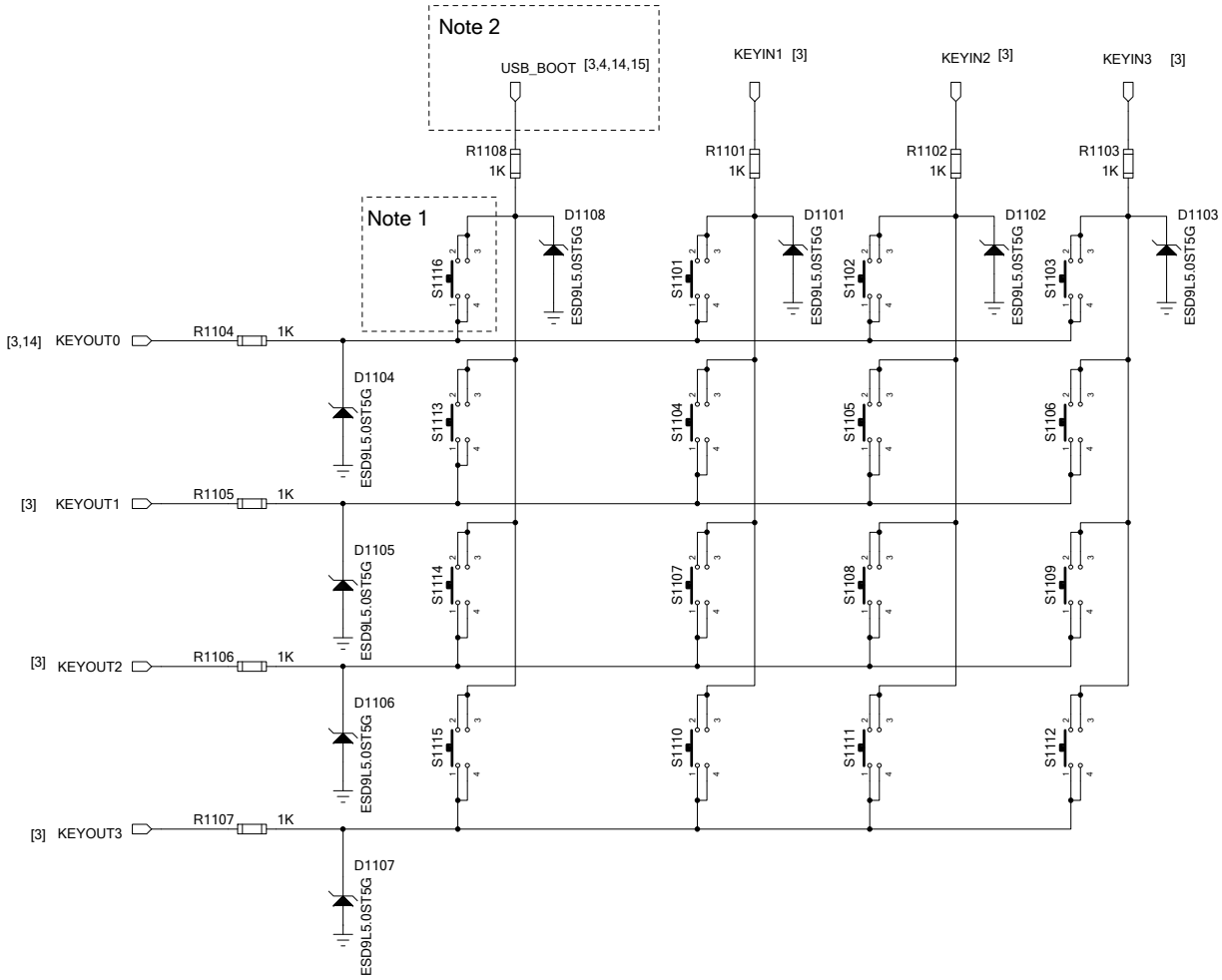
Matrix Keyboard Design



Note:

1. Press the scan keys by "USB_BOOT+KEYOUT0" before the module is powered on, and the module can enter the download mode after being powered on.
2. After the module is turned on normally, the USB_BOOT pin can be used as KEYIN0, which can be combined with other key pins to form the matrix keyboard.

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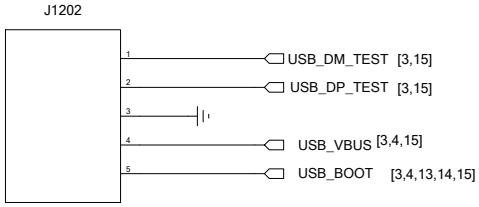
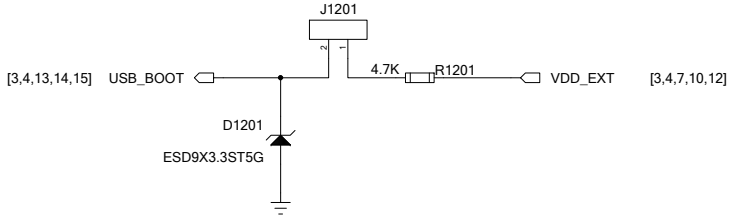
Download Method

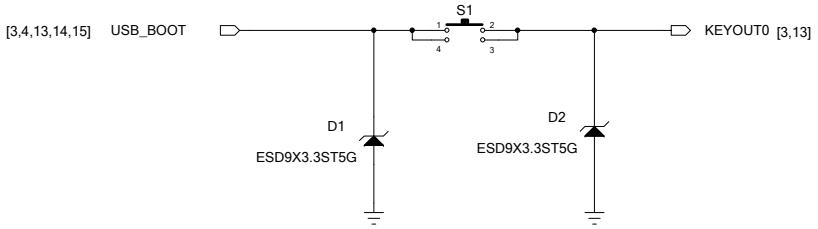
USB Download Interface Design



USB_BOOT Interface Design Method I



USB_BOOT Interface Design Method II



Note:

1. When the module needs to upgrade the firmware, it must firstly enter the download mode. There are two ways to make the module enter the download mode:
   Method I: Short-circuit USB_BOOT and VDD_EXT before the module is powered on, and the module will enter the download mode after being powered on;
   Method II: Press the keys composed of "USB_BOOT+KEYOUT0" before the module is powered on, and the module will enter the download mode after being powered on.
2. Be sure to reserve the USB_BOOT interface download circuit (choose one of the two methods) to upgrade the firmware.
   If your application has a scan key design, it is recommended to adopt the download circuit design of method II, that is, enter the download mode through the keys, which is convenient for the module to upgrade the firmware.

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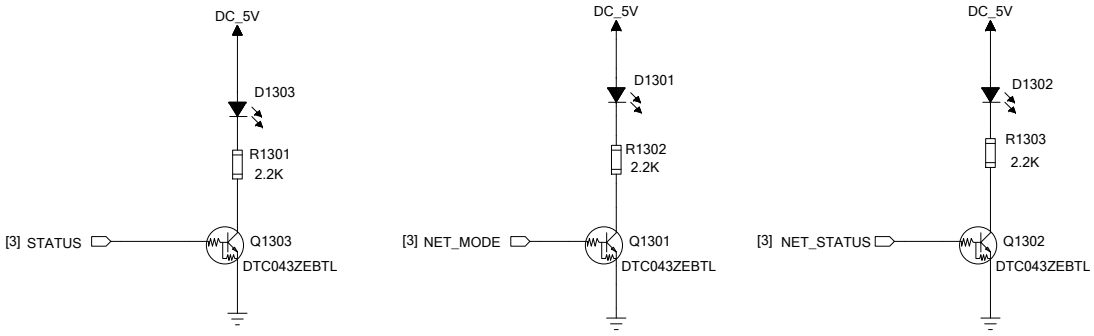
Other Designs

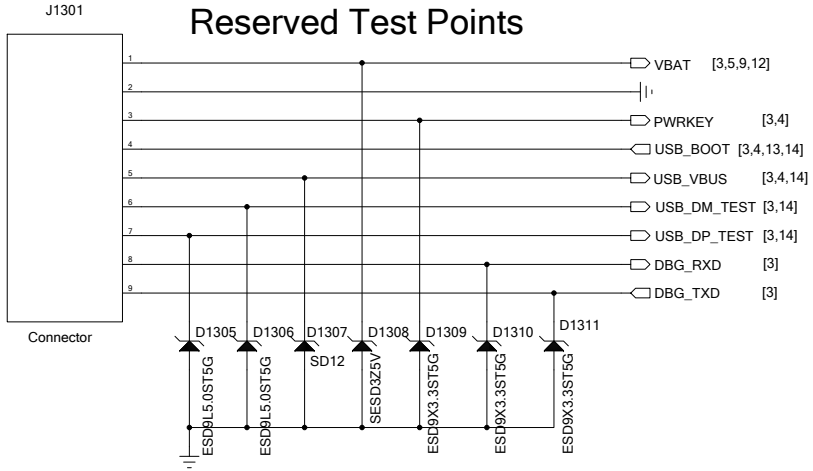
Indicators



Note:

1. For more details about NET_MODE and NET_STATUS, please refer to *Quectel_EC200U_Series_Hardware_Design.*
2. If the low current consumption is required when the your application is in sleep status, replace the power supply (DC_5V) of the STATUS, NET_MODE, 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 capturing logs.
2. Test points for USB interface also can be reserved for firmware upgrade.
3. The parasitic capacitance of the ESD protection components on USB data lines should be less than 2 pF.
4. 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. The debug UART interface only supports 921600 bps baud rate.
5. When the module needs to upgrade the firmware, it must firstly enter the download mode.
   Pull up USB_BOOT to VDD_EXT before the module is powered on, the module will enter download mode.

Quectel Wireless Solutions		
DRAWN BY King MA	PROJECT EC200U Series	TITLE Reference Design
CHECKED BY Kyle CHEN/King MA	SIZE A2	VER 1.0
	SHEET 15OF 15	DATE 2021/8/9