

EC800K&EG800K Series

Reference Design

LTE Standard Module Series

Version: 1.0

Date: 2024-01-11

Status: Released



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About the Document

Revision History

Version	Date	Author	Description
-	2023-10-20	Kelly WANG/ Stefan FAN	Creation of the document
1.0	2024-01-11	Kelly WANG/ Stefan FAN	First official release

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1 Reference Design

1.1. Introduction

This document provides the reference design for Quectel EC800K&EG800K series modules, including block diagrams of module design, and designs of power supply, USIM and UART.

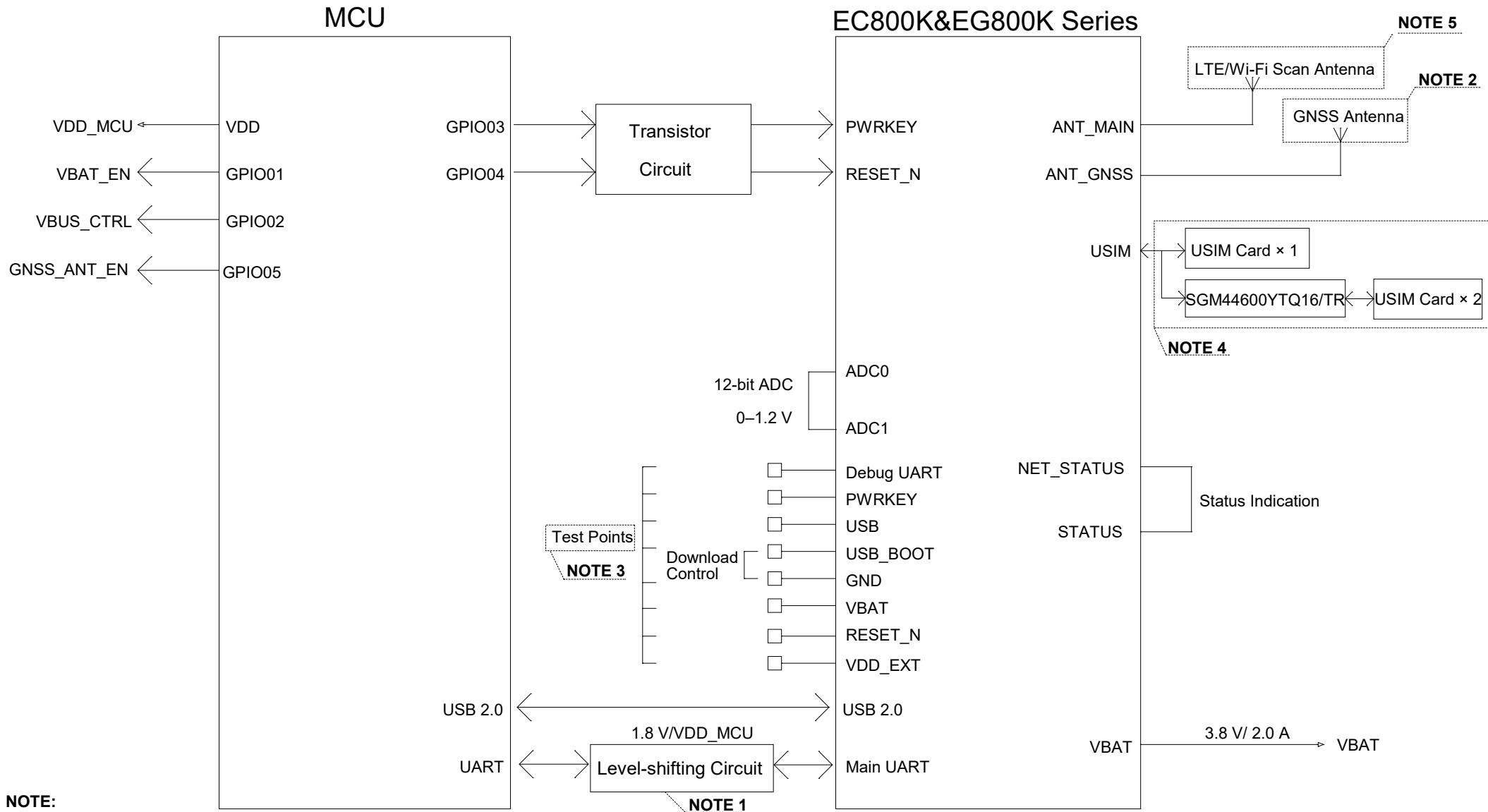
1.2. Schematics

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

NOTE

It is required to confirm the applicability and price from the supplier about the IC involved in the reference design.

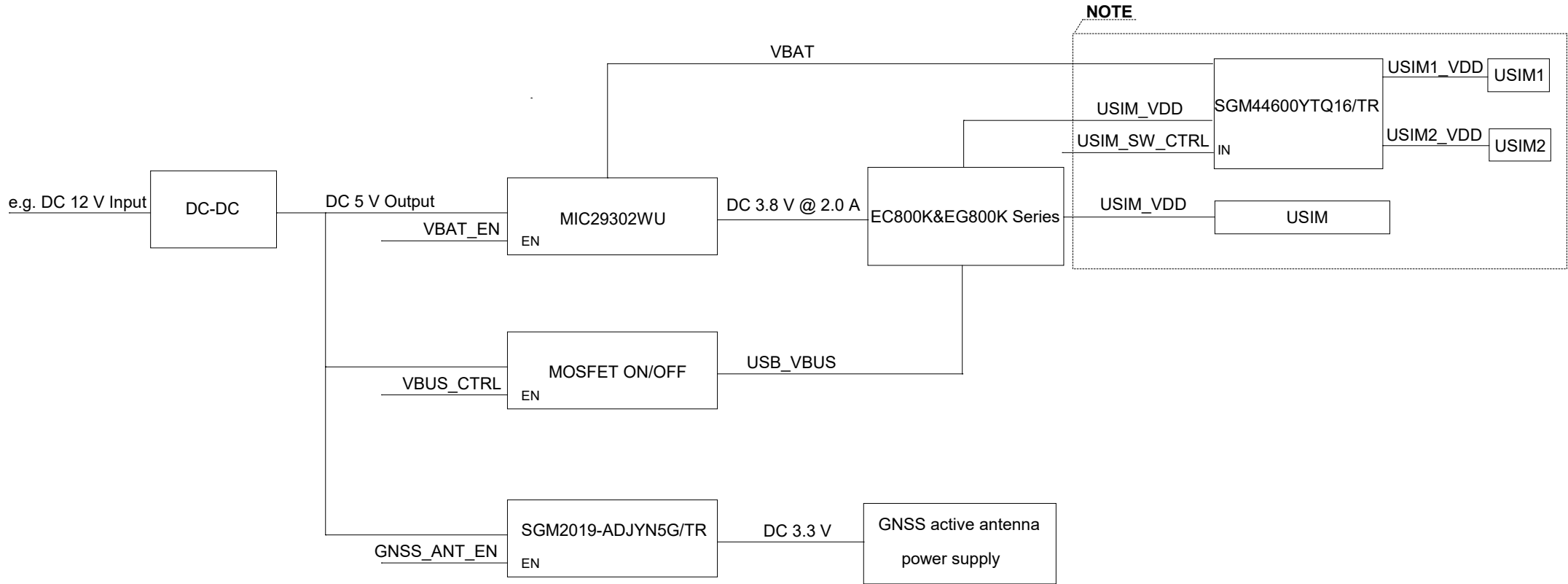
Block Diagram



NOTE:

1. A transistor solution or an IC solution TXS0108EPWR provided by Texas Instruments is recommended.
2. Only EG800K-CN supports GNSS function.
3. Test points must be reserved for DBG_TXD/RXD, USB_DP/DM and USB_VBUS. It is recommended to reserve test points for VDD_EXT, USB_BOOT, PWRKEY and VBAT. If RESET_N is unused, it is recommended to reserve a test point.
4. The module supports single USIM card interface by default. If dual USIM card function is required, the analog switch must be added for your design.
5. Wi-Fi Scan function is optional for EC800K-CN, and the function is supported by EG800K-CN, while EG800K-EU does not support the function. Wi-Fi Scan function shares the same antenna interface with main antenna, thus the two functions cannot be used at the same time.

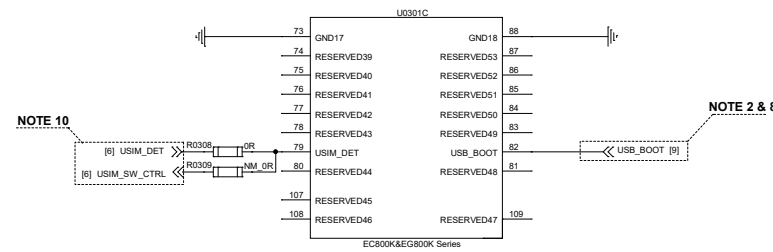
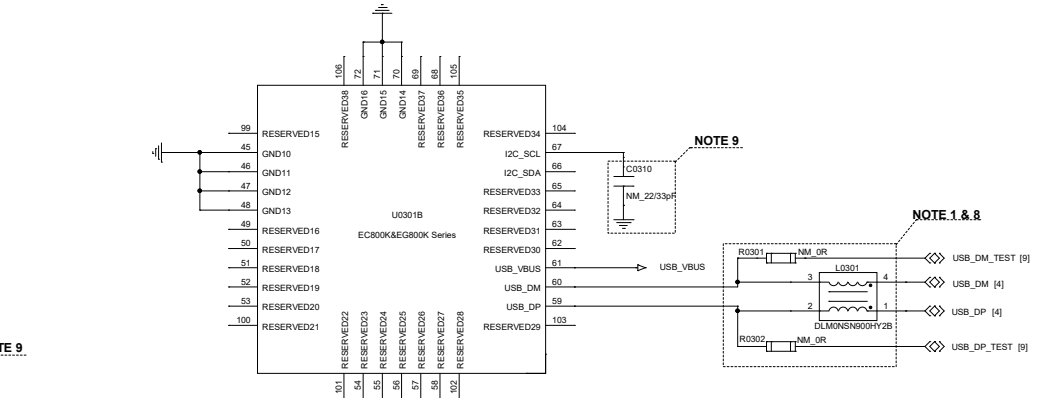
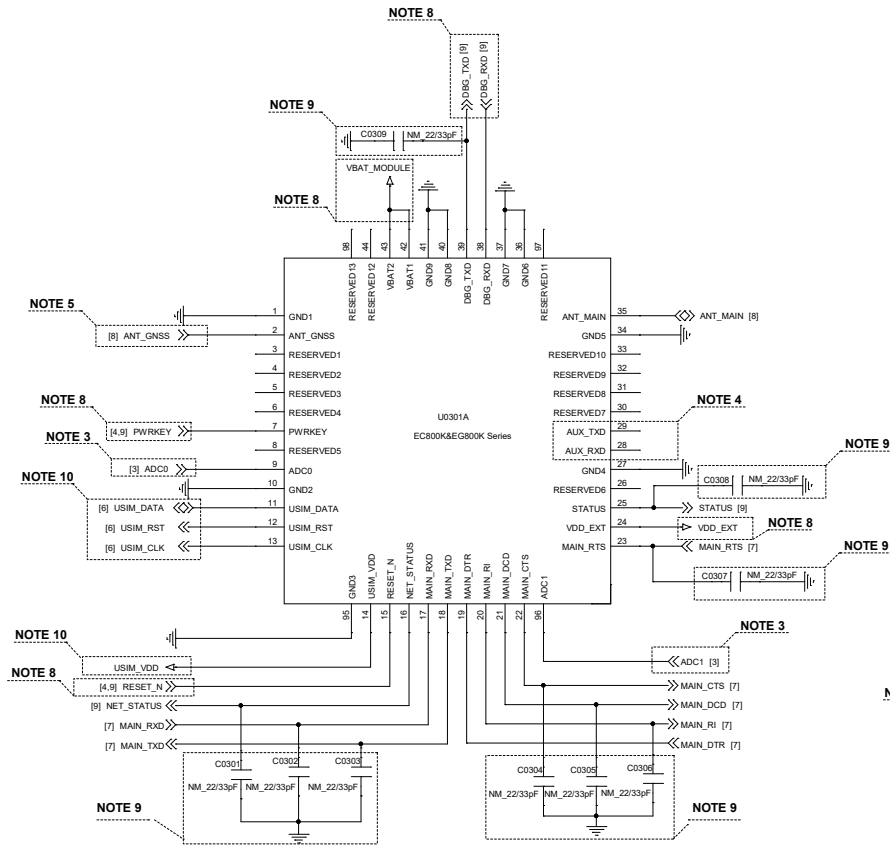
Power System Block Diagram



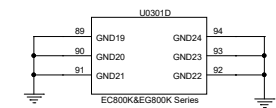
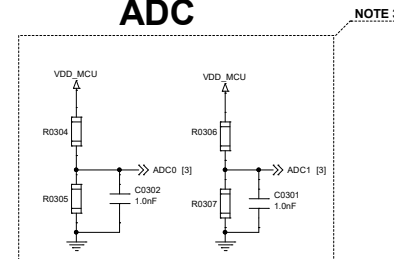
NOTE:

The module supports single USIM card interface by default. If dual USIM card function is required, the analog switch must be added for your design, and the module does not support USIM card hot-plug detect function in such case.

Module Interfaces



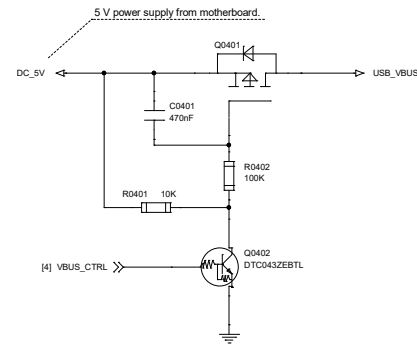
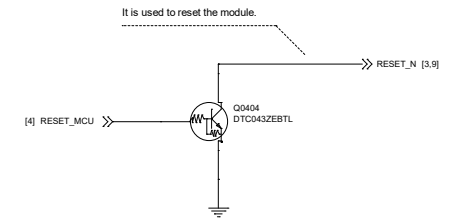
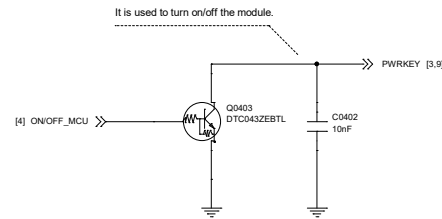
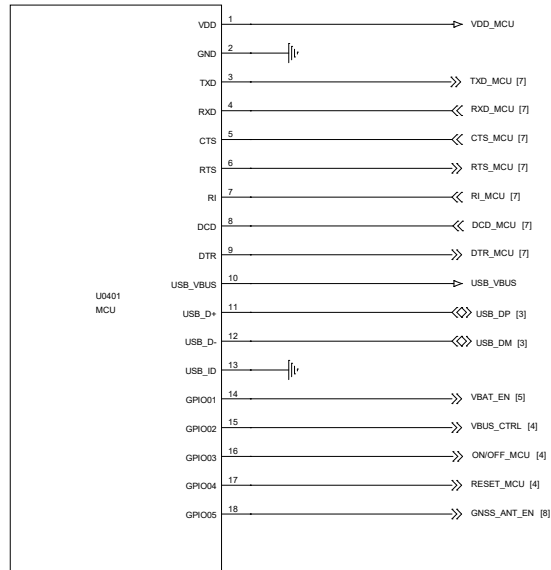
ADC



NOTE:

- It is recommended to add a common mode choke L0301 in series between the module and your MCU to suppress EMI. Additionally, test points must be reserved over USB_DP and USB_DM for firmware upgrades, and it is recommended to minimize extra trace stubs. Place L0301 and two resistors, R0301 and R0302, close to the module to ensure USB signal integrity.
- USB_BOOT cannot be pulled down to low level before the module starts up successfully. Otherwise, the module will enter forced download mode when it starts up.
- The voltage input range of ADC0 and ADC1 is 0–1.2 V. A voltage divider circuit with two resistors must be used for ADC0 and ADC1 voltage inputs respectively, and the required resistance of the two resistors (R0304 and R0306) that connected to VDD_MCU is between 100 kΩ and 1 MΩ. The accuracy of the resistors directly affects ADC sampling error. It is recommended to use resistors with 1% accuracy. For higher ADC accuracy, resistors with 0.5% accuracy are recommended.
- Only EC800K-CN and EG800K-EU support auxiliary UART function.
- Only EG800K-CN supports GNSS function.
- Connect all GND pins to ground, and keep unused and RESERVED pins open.
- Ensure an uninterrupted reference ground plane below the module, with minimal distance between the ground plane and the module layer. Avoid routing other traces on the first layer adjacent to the module layer. At least four-layer board design is recommended.
- Test points must be reserved for DBG_TXD/RXD, USB_DP/DM and USB_VBUS. It is recommended to reserve test points for VDD_EXT, USB_BOOT, PWRKEY and VBAT. If RESET_N is unused, it is recommended to reserve a test point.
- If pins 16–18, 20–23, 25, 39 and 67 of module are required, the 22 pF or 33 pF filter capacitors should be reserved and placed near the pins, and the return path for current of capacitors to the main ground should be as short as possible. The capacitance should be selected according to the actual debugging situation.
- The module supports single USIM card interface by default. If dual USIM card function is required, the analog switch must be added for your design and the module does not support USIM card hot-plug detect function in such case.

MCU Interfaces



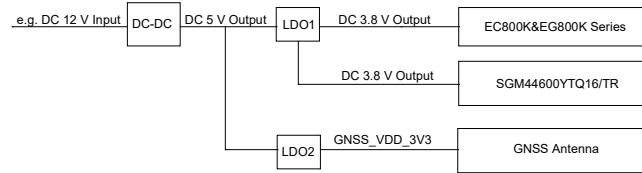
NOTE:

1. If the power domain of your MCU (U0401) is also 1.8 V, the level-shifting circuit is not necessary as it matches the 1.8 V power domain of the module's GPIO interfaces.
2. The USB interface of the module can only serve as a slave device and support full-speed and high-speed modes of USB 2.0. To communicate with the USB interface, MCU needs to support USB host mode or OTG function.
For USB detection, the USB_VBUS pin of the module should be powered by an external power system. Use VBUS_CTRL to control the on/off state of the USB_VBUS power supply.
3. It is recommended to choose MCU GPIO pins with a default low level to control the module's PWRKEY and RESET_N pins. Ensure that the load capacitance on these pins does not exceed 10 nF.

Power Supply Design

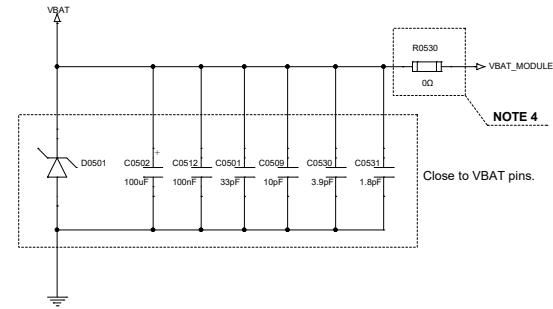
DC-DC Application

When the input voltage is above 7.0 V, use a DC-DC converter to convert the high input voltage to 5.0 V, and then use LDOs to convert it to 3.8 V and 3.3 V to power the module, analog switch and GNSS antenna.



Note:
Only EG800K-CN supports GNSS function.

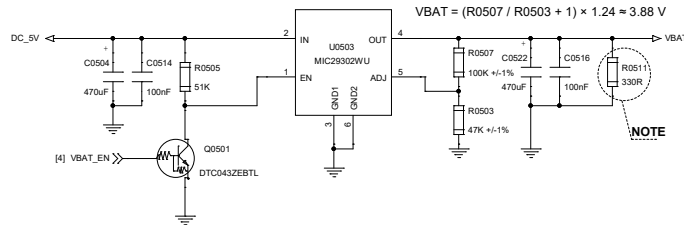
VBAT Design



- NOTE:**
1. The power supply for the module should be capable of supplying a minimum current of 2.0 A.
 2. The width of VBAT trace should be at least 2 mm.
 3. The recommended operating voltage range for VBAT is 3.4 V to 4.3 V, with a typical value of 3.8 V.
 4. It is recommended to reserve a 0 Ω resistor (minimum package size: R-0603) near the VBAT pins for future debugging purposes.

LDO Application

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



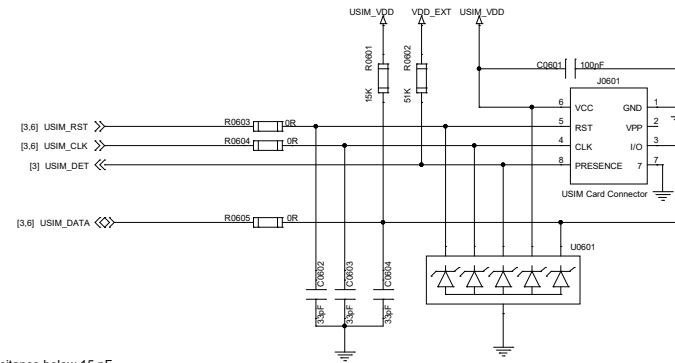
NOTE:
The recommended load current should exceed 10 mA.

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DRAWN BY	Kelly WANG/Stefan FAN	CHECKED BY	Tk HUANG/Shawn HU
DATE	Thursday, January 11, 2024	SIZE	A2
		SHEET	5 OF 9

USIM Card Interface Design

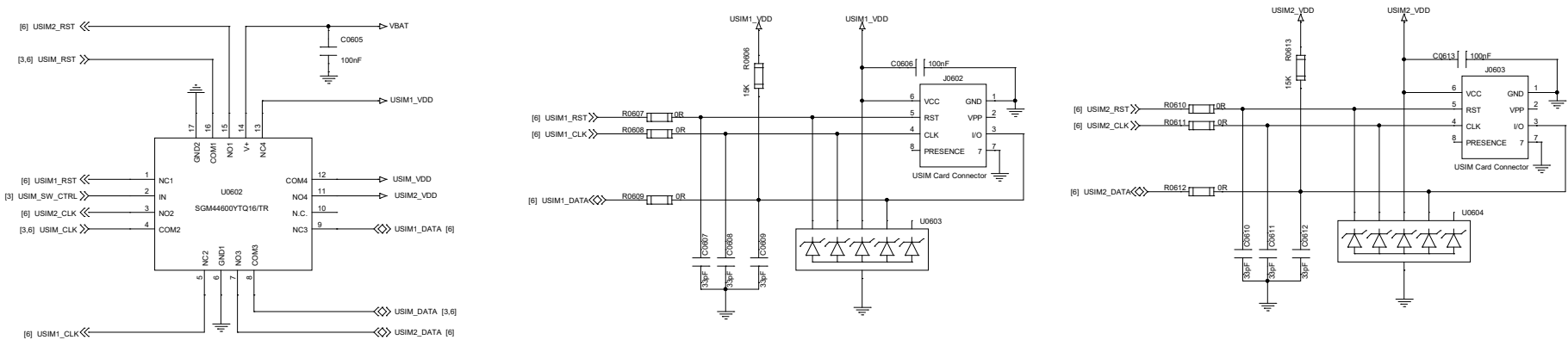
Single USIM Card Interface Design



NOTE:

1. It is recommended to use U0601 for effective ESD protection with a parasitic capacitance below 15 pF.
2. For USIM_DATA, it is recommended to add a 15 kΩ pull-up resistor R0601 near the USIM card connector to improve the anti-jamming capability of the USIM card.
3. R0603–R0605 are used for debugging, and C0602–C0604 are used for filtering out RF interference.
4. C0601's capacitance should be less than 1 μF and it should be placed close to the USIM card connector.

Dual USIM Card Interface Design (SGM44600YTQ16/TR)



NOTE:

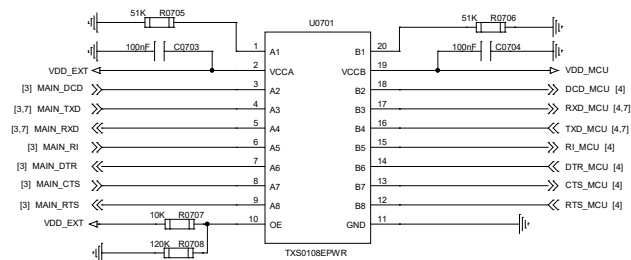
1. It is recommended to use U0603 and U0604 for effective ESD protection with a parasitic capacitance below 15 pF.
2. For USIM1_DATA and USIM2_DATA, it is recommended to add 15 kΩ pull-up resistors R0606 and R0613 respectively near the USIM card connector to improve the anti-jamming capability of the USIM card.
3. R0607–R0612 are used for debugging, and C0606–C0612 are used for filtering out RF interference.
4. The capacitance of C0606 and C0613 should be less than 1 μF and it should be placed close to the USIM card connector.
5. If dual USIM card function is required, the analog switch must be added for your design and the module does not support USIM card hot-plug detect function in such case.

UART Interface Design

UART Level-shifting Circuit - Transistor Solution



UART Level-shifting Circuit - IC Solution

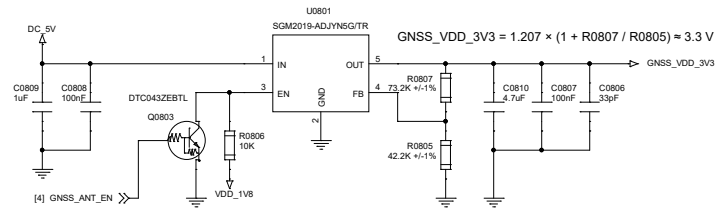


NOTE:

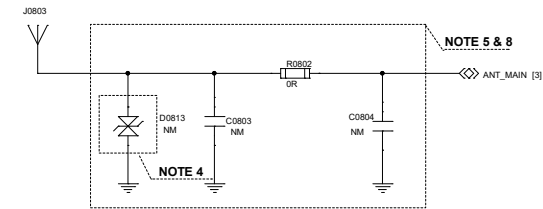
1. There are two level-shifting solutions: transistor solution and IC solution, and it is recommended to select the latter one.
2. The power supply of TXS0108EPWR's VCCA should not exceed that of VCCB. For more information, see the datasheet of TXS0108EPWR.
3. The transistor solution is not suitable for applications with high baud rates exceeding 460 kbps. The capacitors C0701 and C0702 of 1 nF can improve the signal quality.
4. MAIN_RTS and MAIN_DTR's level-shifting circuits are similar to that of the MAIN_RXD.
MAIN_CTS, MAIN_RI and MAIN_DCD's level-shifting circuits are similar to that of the MAIN_TXD.
5. Only EC800K-CN and EG800K-EU support auxiliary UART function.
6. To increase the stability of UART communication, it is recommended to add UART hardware flow control design.

Antenna Interface Design

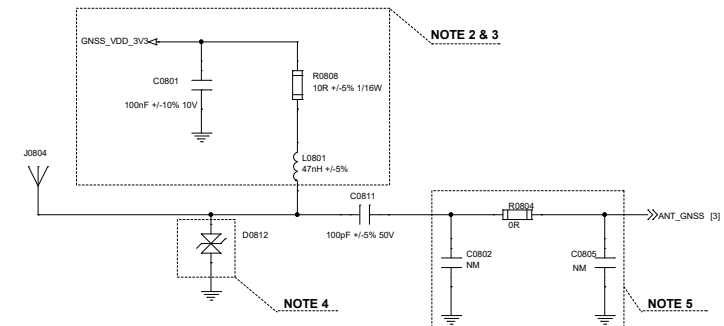
GNSS Active Antenna Power Supply



LTE/Wi-Fi Scan Antenna Design



GNSS Antenna Design

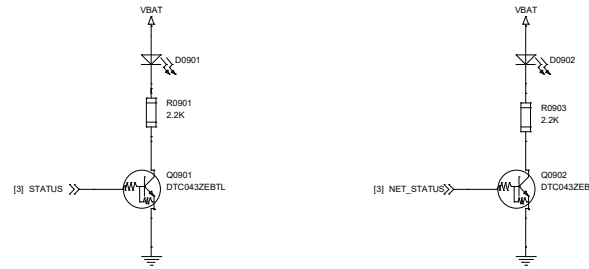


NOTE:

1. Only EG800K-CN supports GNSS function.
2. For active antennas, select an external LDO according to the active antenna types. For passive antennas, the VDD circuit is not necessary.
3. L0801, R0808, C0801 are recommended to be placed close to the RF traces during layout.
4. The junction capacitance of the ESD protection component on the antenna interface is recommended to be less than 0.05 pF.
5. Reserve a Π-type matching circuit at antenna interface.
6. The single-ended impedance of the RF antenna is 50 Ω, and length should be minimized.
7. The external active antenna power supply voltage range is 2.8 V to 4.3 V, with a typical value of 3.3 V.
The power supply voltage can be designed according to the power supply requirements of the selected active antenna.
8. Wi-Fi Scan function is optional for EC800K-CN, and the function is supported by EG800K-CN, while EG800K-EU does not support the function.
Wi-Fi Scan function shares the same antenna interface with main antenna, thus the two functions cannot be used at the same time.

Other Designs

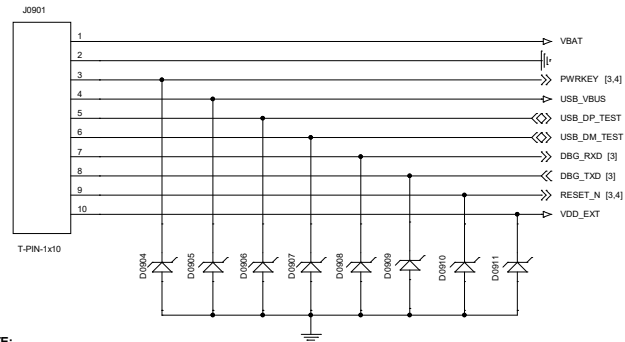
Indicators



NOTE:

1. For more details about STATUS and NET_STATUS, see the hardware design document of the module.
2. To minimize the module's power consumption during the sleep mode of your device, replace the power supply (VBAT) of the STATUS and NET_STATUS indicators with externally controllable sources and turn off the indicators when the module is in sleep mode.

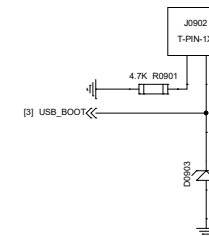
Reserved Test Points



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 traces should be less than 2 pF.
4. The debug UART interface supports a 1.8 V power domain.
If your application operates at 3.3 V, use a voltage-level translator.

USB_BOOT Interface



NOTE:

1. Make sure to reserve the USB_BOOT interface design and it is recommended to reserve a test point for this pin.
2. Before turning on the module, pull USB_BOOT down to GND to activate the forced download mode.
This mode enables firmware upgrades via the USB interface.
3. The 6.0 and above version of QFlash tool must be used for firmware upgrading.

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