MC65-OpenCPU
Reference Design

GSM/GPRS/GNSS Module Series

Rev. MC65-OpenCPU_Reference_Design_V1.0

Date: 2019-11-01

Status: Released

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About the Document

History

Revision	Date	Author	Description
1.0	2019-11-01	Andy ZHAO	Initial

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1 Reference Design

1.1. Introduction

This document provides the reference design for Quectel MC65-OpenCPU module. And the reference design includes block diagram, module design, power supply, MCU and watchdog control, audio interfaces, (U)SIM interface, UART interfaces, etc.

1.2. Power-on/off Scenarios of Module

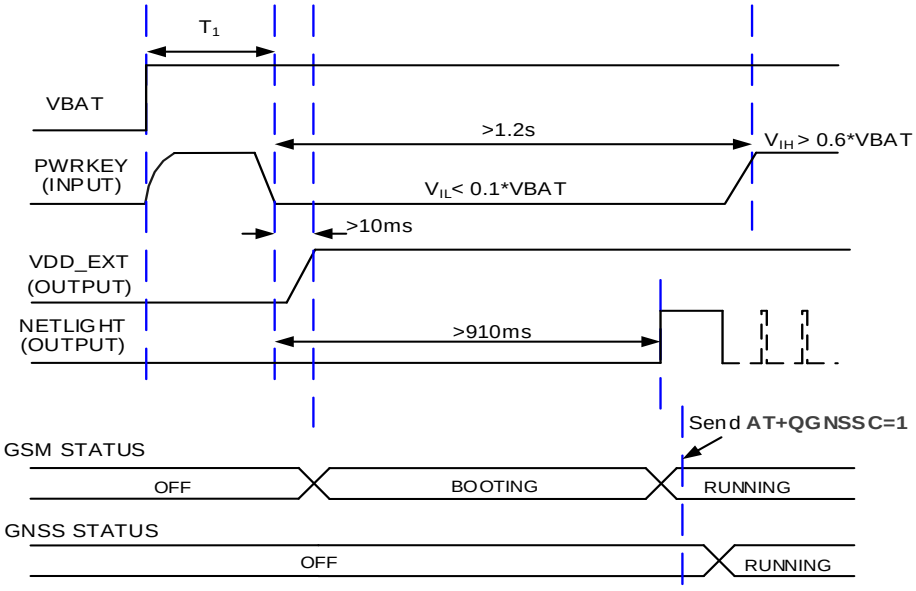


Figure 1: Timing of Turning on the Module

NOTE

Make sure the VBAT voltage is stable before pulling down the PWRKEY pin. T1 (the time between powering on VBAT and pulling off PWRKEY) is recommended to be 100ms.

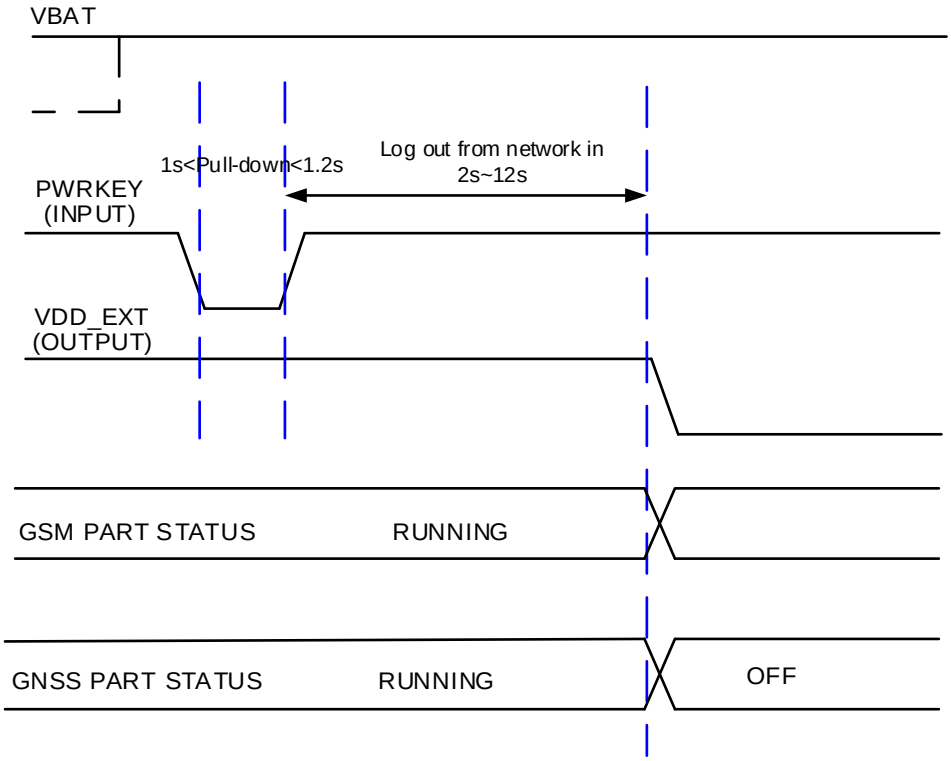


Figure 2: Timing of Turning off the Module

1.3. Power-off Scenario of GNSS Part of the Module

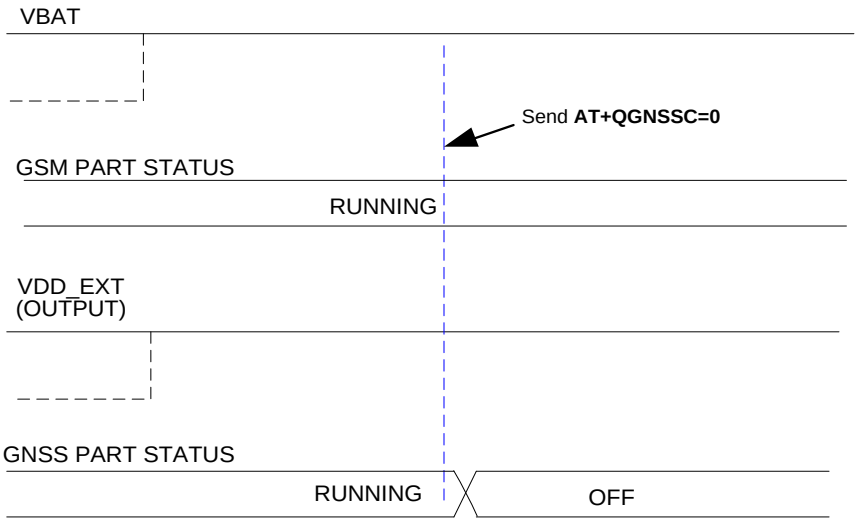
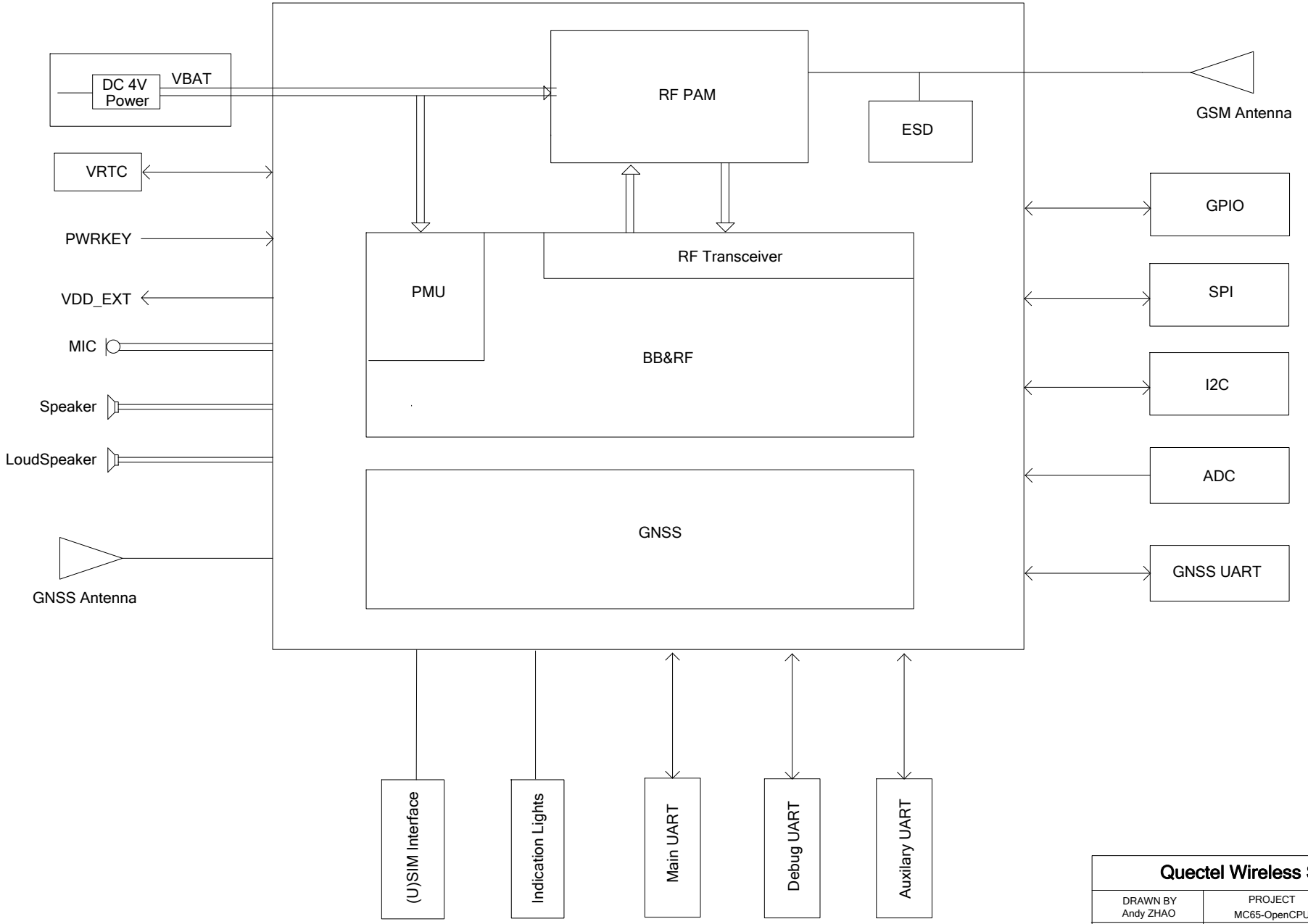


Figure 3: Timing of Turning off GNSS Part of the Module

1.4. Schematics

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

Block Diagram



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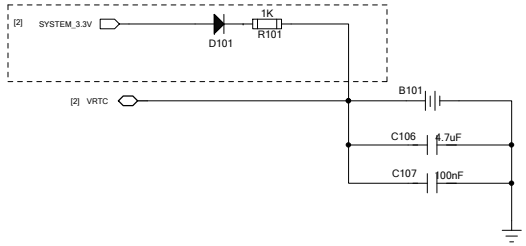
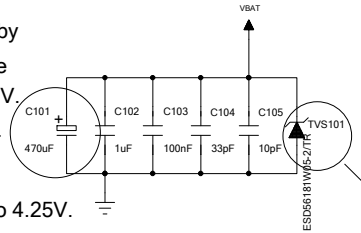
Module Interfaces



1. Power supply of SYSTEM_3.3V or battary is available.
2. When VBAT is turned off, the VRTC power supply is used to maintain the RTC time.

Capacitance of C101 should be chosen by debugging to ensure the voltage after the maximum dropping is no less than 400mV.

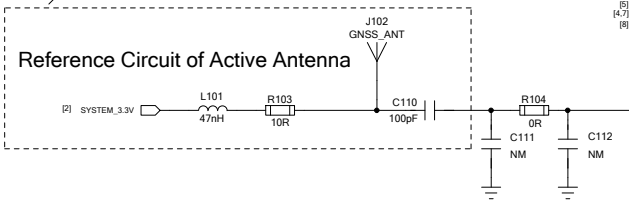


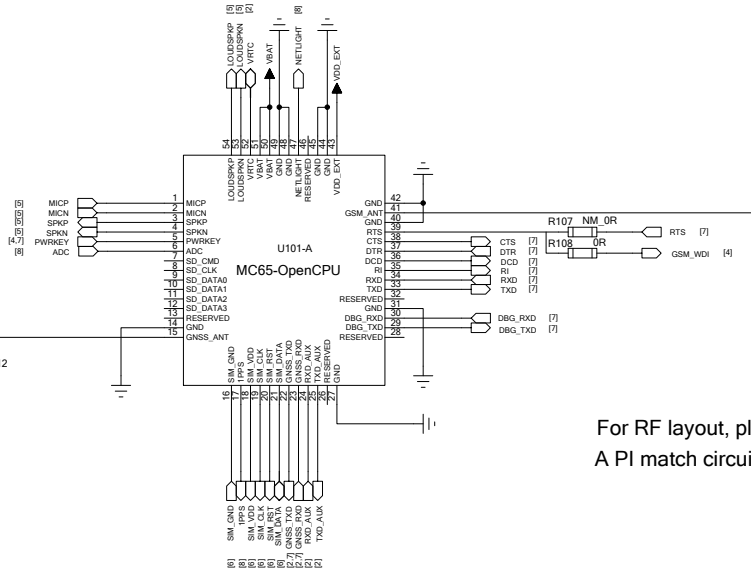
A TVS is recommended to be added close to the VBAT pin.

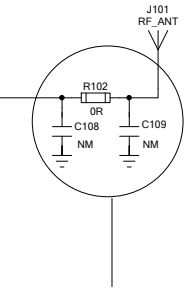
1. VBAT voltage ranges from 3.45V to 4.25V.
2. The maximum drain current of the module is around 1.6A in burst time (577us).
3. The width of VBAT trace is recommended to be more than 2mm.
4. These capacitances are placed in ascending order of their capacitance values, and the smaller the capacitance value is, the closer the capacitor is to the VBAT pin.

Antenna Type	Active Antenna Power Supply Circuit
Active	Need
Passive	No need

An LNA is integrated inside the module, and passive antenna is recommended.

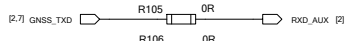


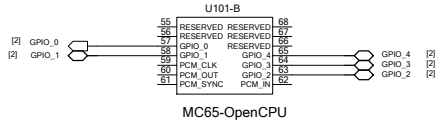


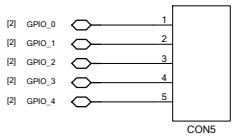


For RF layout, please refer to *Quectel_RF_Layout_Application_Note*.
A PI match circuit is recommended to be added.

Auxiliary and GNSS UART Port Connection in All-in-one Solution.







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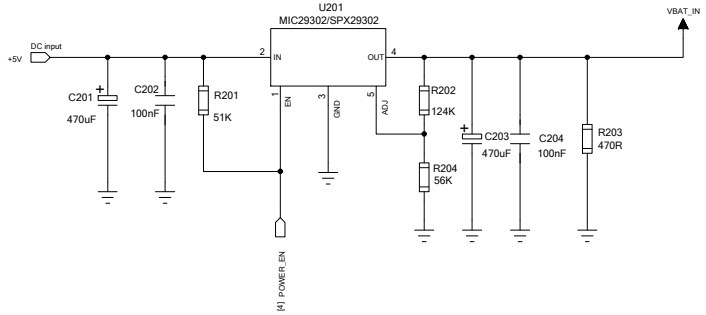
Power Supply

Note:

The voltage converter should provide a minimum current of 2.0A.

LDO Application

It is used when the DC input voltage is below 7V.

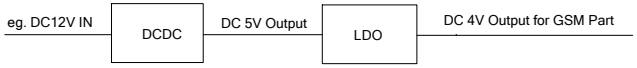


U201 requires a minimum load current of 7mA. When it is used, R203 must be mounted.

If low power design is needed, then an LDO with lower power consumption should be selected.

DC-DC Application

1. It can be used when the input voltage is above 7V in vehicle application.
2. The DC-DC converter is used to convert the voltage to 5V, which is then converted to 4V by LDO for GSM part.



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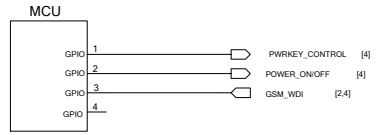
MCU and Watchdog Control Circuits

Notes:

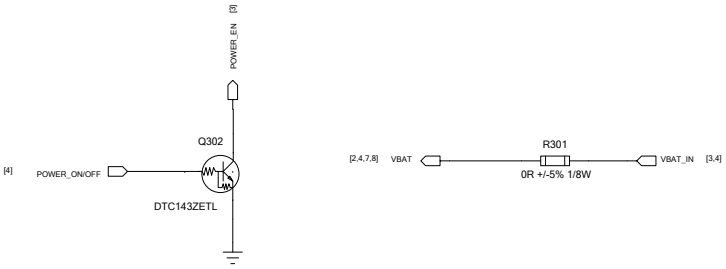
1. In order to ensure the stability of the OpenCPU system, the watchdog circuit or MCU can be used to monitor the status of the module. And when the module works abnormally, it can be powered off and restarted.
2. Customers can choose to use the watchdog scheme or MCU control solution according to their own application requirement.

MCU Control Circuit

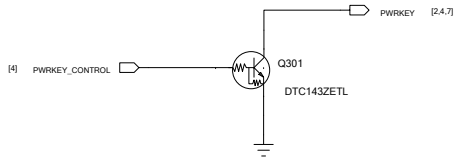
MCU GPIO Port



MCU Control Power Circuit

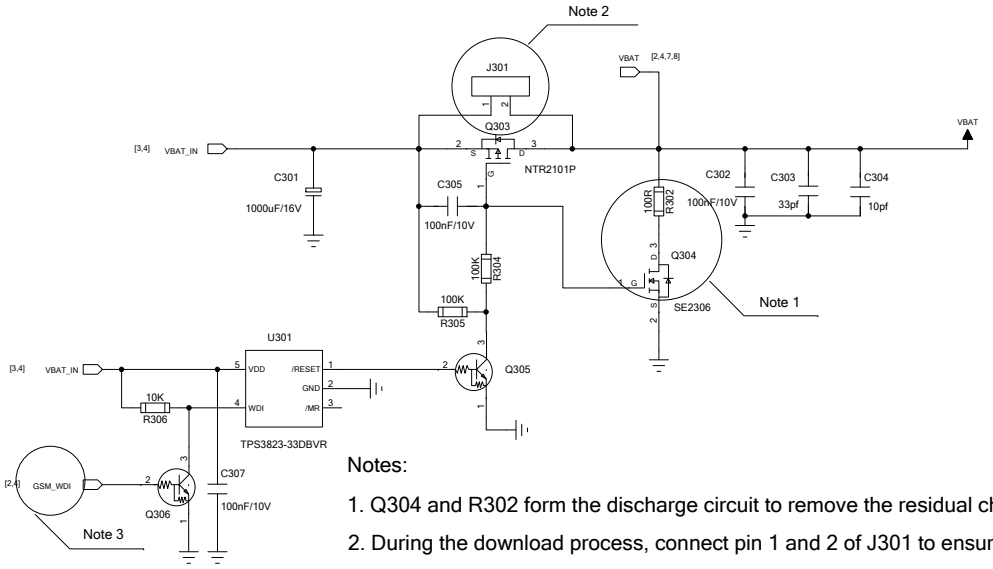


MCU Control Turn-on/off Circuit



Watchdog Control Circuit

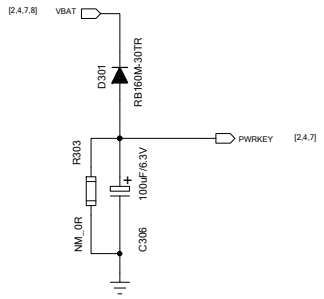
Watchdog Control Power Circuit



Notes:

1. Q304 and R302 form the discharge circuit to remove the residual charge on PWRKEY and VBAT.
2. During the download process, connect pin 1 and 2 of J301 to ensure the normal power supply to the module.
3. The GPIO of module that can be connected to the WDI pin of the watchdog is DCD/RI/RTS/CTS.

Automatic Boot Circuit When Powering On the Module



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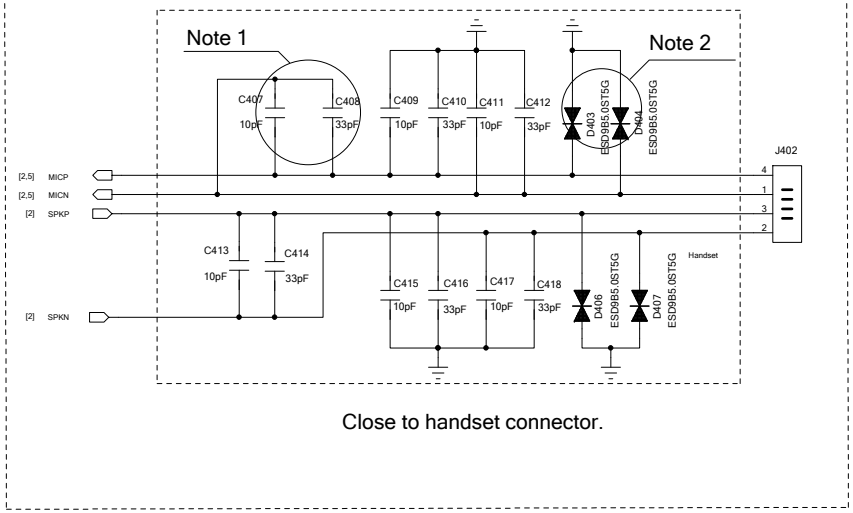
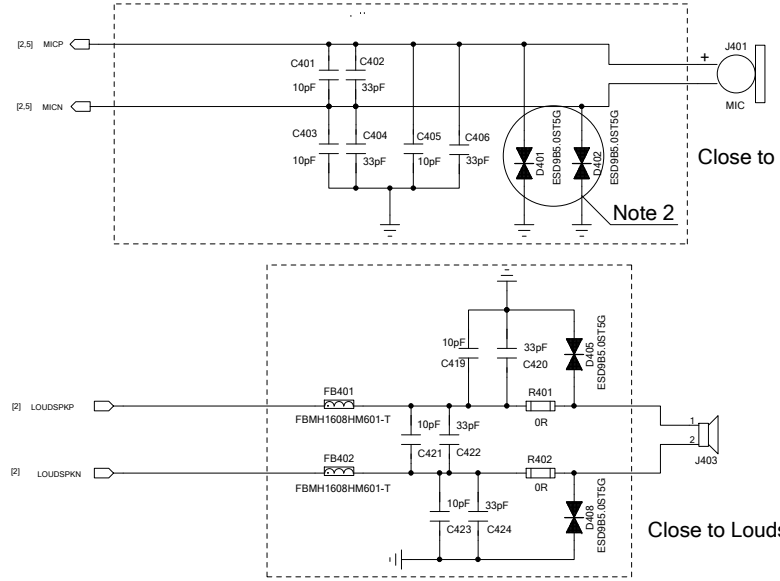
Audio Design

Handset Application of AIN/AOUT1



Close to handset connector.

LoudSpeaker Application of AIN/AOUT2



Close to Loudspeaker.

Notes:

1. 10pF & 33pF capacitors are used for filtering TDD noise.
2. These components are used to enhance the ESD protection performance of MIC lines, and thus are strongly recommended to be reserved.
3. The AIN channel of the module can provide a bias voltage for the microphone.
4. AOUT1 is capable of driving 32Ω load.
5. AOUT2 is capable of driving 8Ω load.
6. AOUT2 channel supports differential signals and does not support single signals.

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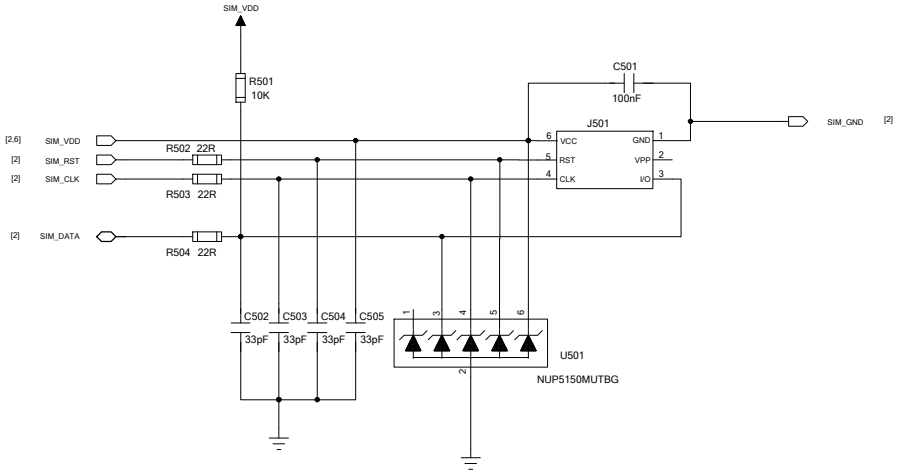
(U)SIM Interface



Notes:

1. Keep the placement of (U)SIM card connector as close as possible to the module. Keep the trace length as less than 200mm as possible.
2. Keep (U)SIM card signals away from RF and VBAT traces.
3. Ensure the trace between the ground of module and that of (U)SIM card connector is short and wide. Keep the trace width of ground no less than 0.5mm to maintain the same electric potential; C501 should be placed close to the (U)SIM card connector and its capacitance value should not exceed 1uF.
4. To avoid cross talk between SIM_DATA and SIM_CLK, keep them away from each other and surround them with ground separately.
5. U501 should be placed near the SIM card connector to ensure ESD protection performance of (U)SIM card, and its parasitic capacitance should be no more than 50pF.
6. The pull-up resistor on SIM_DATA line can improve anti-jamming capability when long layout trace and sensitive occasion are applied, and should be placed close to the (U)SIM card connector.
7. Ground traces of (U)SIM card connector are recommended to be routed separately to pin 16 ("SIM_GND") of the module.

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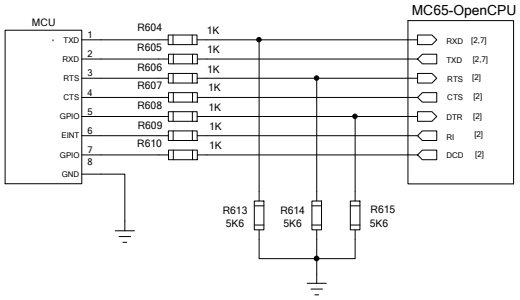
UART Interfaces

Electrical characteristics of the module's input and output port:

VOHmin=0.85×VDD_EXT
VOLmax=0.15×VDD_EXT
VILmax=0.25×VDD_EXT
VIHmin=0.75×VDD_EXT
VIHmax=VDD_EXT+0.2V
VDD_EXT=2.8V (Typ.)

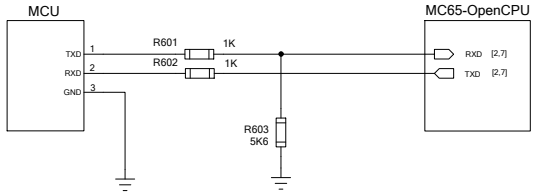
Connection of Full-function UART Port for 3.3V System



Notes:

1. CTS/RTS will be used for hardware flow control when mass data has been sent.
2. When AT+QSCLK=1 is set on the module, customer's application can control the module to enter or exit from the sleep mode through DTR pin. When DTR is set to high level, and there is no hardware interrupt,such as GPIO interrupt or data on serial port, the module will enter into sleep mode automatically.
3. RI will output an indication signal when activity such as voice call or SMS is coming.
4. DCD is mainly applied in modem communication (PPP). The active status represents that the communication link has been set up.
5. Please pay attention to the level match of UART in product application.

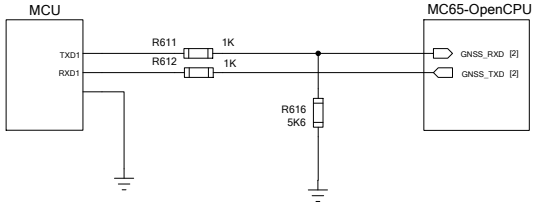
Connection of Three-wire UART Port for 3.3V System



Please pay attention to the level match of UART in product application.

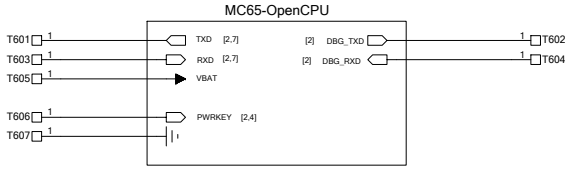
Connection of GNSS UART Port for 3.3V System in Stand-alone Solution

In All-in-one Solution, the circuit design is not needed and thus can be ignored.



Please pay attention to the level match of UART in product application.

It is recommended to reserve the test points for upgrading the firmware and debugging.
Debug UART can be used for firmware upgrade and debugging.



Please pay attention to the level match of UART in product application.

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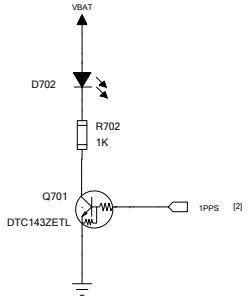
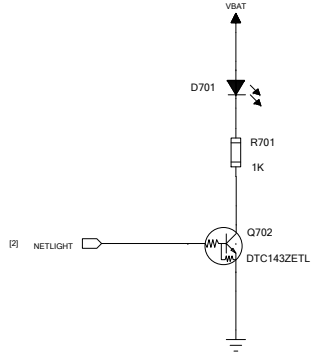
MCU Control and Driver Circuits

1PPS Indication



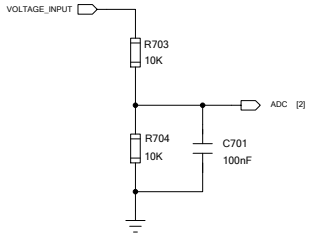
The 1PPS indicator will blink at 1Hz frequency after position fixing.

Network Status Indication



NETLIGHT Pin indicates the network status.

Reference Circuit of ADC



Notes:

1. The voltage range of ADC input channel is from 0V to 1.8V.
2. Please select a high-precision divider resistor with a resistance value of 10KΩ or higher.

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Pin Multiplexing Function Table

Pin Number	Pin Name	Mode 1	Mode 2	Mode 3	Mode 4	Reset State	Output Capability (mA)
7	SD_CMD	SD_CMD	GPIO	EINT	SPI_CS	I/PU	4
8	SD_CLK	SD_CLK	GPIO	EINT	SPI_CLK	LO	4
9	SD_DATA0	SD_DATA0	GPIO	EINT		I/PU	4
10	SD_DATA1	SD_DATA1	GPIO	EINT	SPI_MOSI	I/PU	4
11	SD_DATA2	SD_DATA2	GPIO	EINT	SPI_MISO	I/PU	4
12	SD_DATA3	SD_DATA3	GPIO	EINT		I/PU	4
35	RI	RI	GPIO	I2SCL	EINT	I/PD	4
36	DCD	DCD	GPIO	I2SDA	EINT	I/PD	4
37	DTR	DTR	GPIO	EINT	SIM_PRESENCE	I/PD	4
38	CTS	CTS	GPIO	EINT	EINT	I/PD	4
39	RTS	RTS	GPIO	EINT		I/PD	4
47	NETLIGHT	NETLIGHT	GPIO	EINT		I/PD	4
59	PCM_CLK	PCM_CLK	GPIO	EINT		HO	4
60	PCM_OUT	PCM_OUT	GPIO	EINT		O/PD	4
61	PCM_SYNC	PCM_SYNC	GPIO	EINT		HO	4
62	PCM_IN	PCM_IN	GPIO	EINT		HO	4

Notes:

1. "Reset state" represents the state of each pin after reset (“I”: Input, “O”: Output. “PD”: Pull down, “PU”: Pull up, “HO”: High output, “LO”: Low output).
2. Electrical characteristics of module's input or output port:

   VOHmax=VDD_EXT
   VOHmin=2.0V
   VILmax=0.67V
   VIHmin=1.7V
   VIHmax=VDD_EXT+0.3V
   VDD_EXT=2.8V (Typ.)