

LG290P (03)

Reference Design

GNSS Module Series

Version: 1.0

Date: 2024-08-19

Status: Released



At Quectel, our aim is to provide timely and comprehensive services to our customers. If you require any assistance, please contact our headquarters:

Quectel Wireless Solutions Co., Ltd.

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: info@quectel.com

Or our local offices. For more information, please visit:

<http://www.quectel.com/support/sales.htm>.

For technical support, or to report documentation errors, please visit:

<http://www.quectel.com/support/technical.htm>.

Or email us at: support@quectel.com.

Legal Notices

We offer information as a service to you. The provided information is based on your requirements and we make every effort to ensure its quality. You agree that you are responsible for using independent analysis and evaluation in designing intended products, and we provide reference designs for illustrative purposes only. Before using any hardware, software or service guided by this document, please read this notice carefully. Even though we employ commercially reasonable efforts to provide the best possible experience, you hereby acknowledge and agree that this document and related services hereunder are provided to you on an “as available” basis. We may revise or restate this document from time to time at our sole discretion without any prior notice to you.

Use and Disclosure Restrictions

License Agreements

Documents and information provided by us shall be kept confidential, unless specific permission is granted. They shall not be accessed or used for any purpose except as expressly provided herein.

Copyright

Our and third-party products hereunder may contain copyrighted material. Such copyrighted material shall not be copied, reproduced, distributed, merged, published, translated, or modified without prior written consent. We and the third party have exclusive rights over copyrighted material. No license shall be granted or conveyed under any patents, copyrights, trademarks, or service mark rights. To avoid ambiguities, purchasing in any form cannot be deemed as granting a license other than the normal non-exclusive, royalty-free license to use the material. We reserve the right to take legal action for noncompliance with abovementioned requirements, unauthorized use, or other illegal or malicious use of the material.

Trademarks

Except as otherwise set forth herein, nothing in this document shall be construed as conferring any rights to use any trademark, trade name or name, abbreviation, or counterfeit product thereof owned by Quectel or any third party in advertising, publicity, or other aspects.

Third-Party Rights

This document may refer to hardware, software and/or documentation owned by one or more third parties ("third-party materials"). Use of such third-party materials shall be governed by all restrictions and obligations applicable thereto.

We make no warranty or representation, either express or implied, regarding the third-party materials, including but not limited to any implied or statutory, warranties of merchantability or fitness for a particular purpose, quiet enjoyment, system integration, information accuracy, and non-infringement of any third-party intellectual property rights with regard to the licensed technology or use thereof. Nothing herein constitutes a representation or warranty by us to either develop, enhance, modify, distribute, market, sell, offer for sale, or otherwise maintain production of any our products or any other hardware, software, device, tool, information, or product. We moreover disclaim any and all warranties arising from the course of dealing or usage of trade.

Privacy Policy

To implement module functionality, certain device data are uploaded to Quectel's or third-party's servers, including carriers, chipset suppliers or customer-designated servers. Quectel, strictly abiding by the relevant laws and regulations, shall retain, use, disclose or otherwise process relevant data for the purpose of performing the service only or as permitted by applicable laws. Before data interaction with third parties, please be informed of their privacy and data security policy.

Disclaimer

- a) We acknowledge no liability for any injury or damage arising from the reliance upon the information.
- b) We shall bear no liability resulting from any inaccuracies or omissions, or from the use of the information contained herein.
- c) While we have made every effort to ensure that the functions and features under development are free from errors, it is possible that they could contain errors, inaccuracies, and omissions. Unless otherwise provided by valid agreement, we make no warranties of any kind, either implied or express, and exclude all liability for any loss or damage suffered in connection with the use of features and functions under development, to the maximum extent permitted by law, regardless of whether such loss or damage may have been foreseeable.
- d) We are not responsible for the accessibility, safety, accuracy, availability, legality, or completeness of information, advertising, commercial offers, products, services, and materials on third-party websites and third-party resources.

Copyright © Quectel Wireless Solutions Co., Ltd. 2024. All rights reserved.

About the Document

| Document Information | |
|----------------------|------------------------------|
| Title | LG290P (03) Reference Design |
| Subtitle | GNSS Module Series |
| Document Type | Reference Design |
| Document Status | Released |

Revision History

| Version | Date | Description |
|---------|------------|--------------------------|
| - | 2023-11-30 | Creation of the document |
| 1.0 | 2024-08-19 | First official release |

Contents

About the Document.....3

Contents.....4

1 Reference Design.....5

1.1. Introduction5

1.2. Reference Schematics and Design Checklists.....5

1 Reference Design

1.1. Introduction

This document provides the reference design of Quectel LG290P (03) GNSS module, including the design of block diagram, MCU circuit and power supply, module interfaces and antenna interface. It also comprises SCH and PCB design checklists.

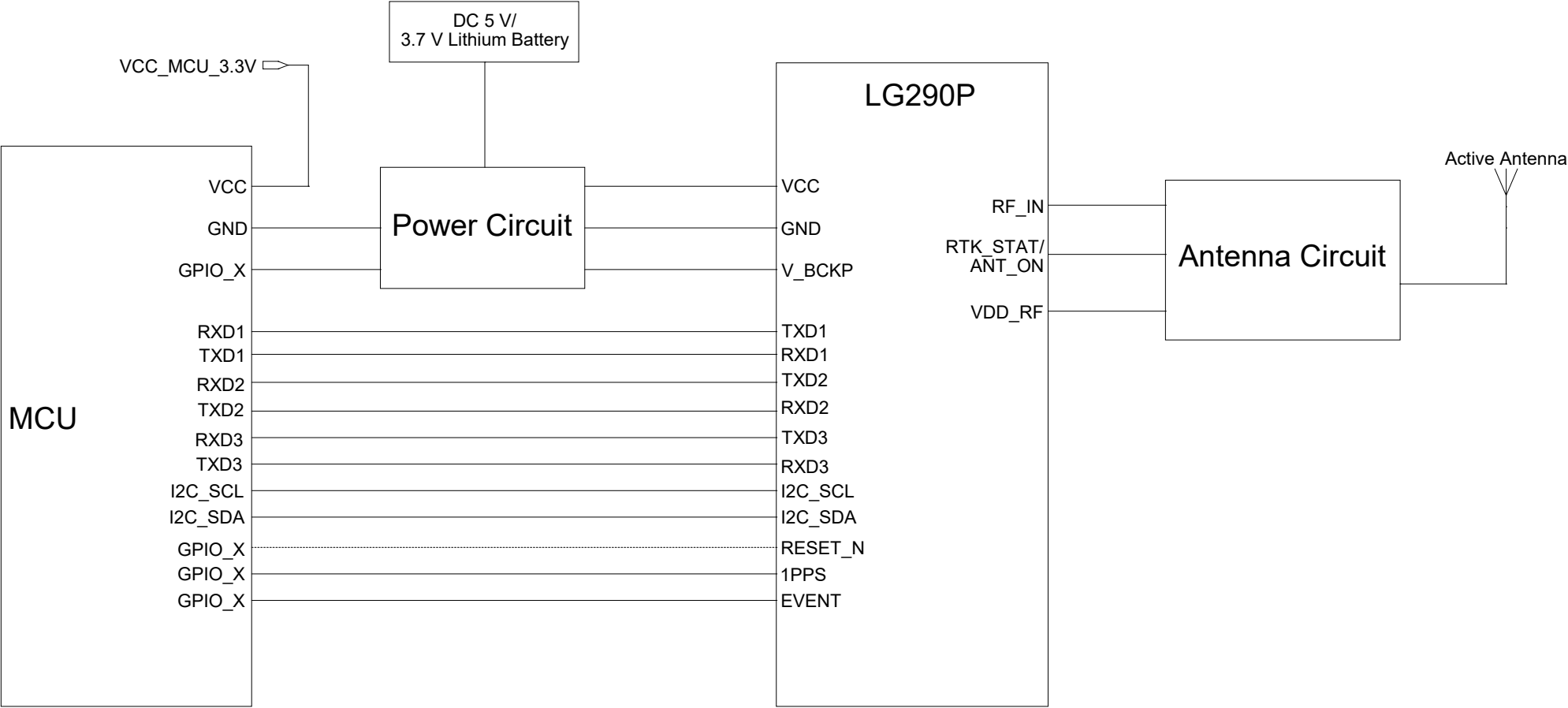
1.2. Reference Schematics and Design Checklists

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

NOTE

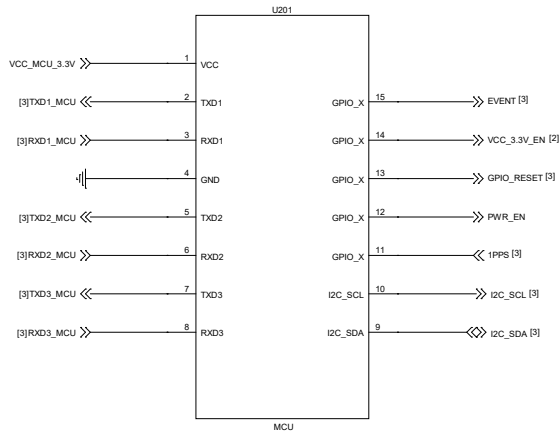
Quectel also provides design review services. It is strongly recommended that you submit your schematics and PCB designs to Quectel Technical Support for a formal review.

Block Diagram

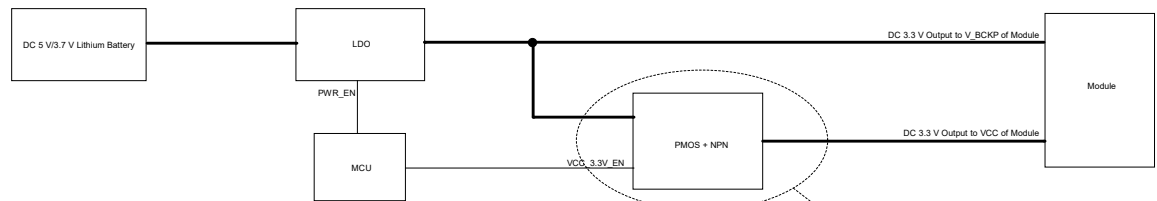


MCU Circuit and Power Supply

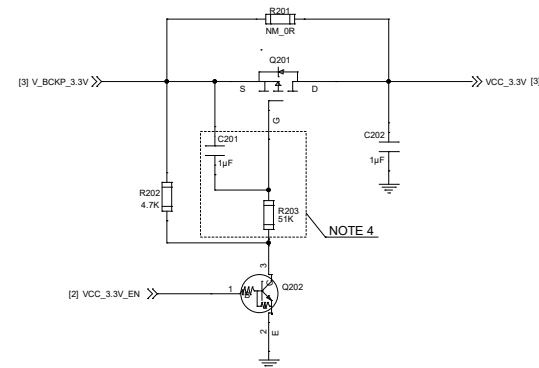
MCU Circuit



Power Supply Circuit



VCC Power Supply Control Circuit

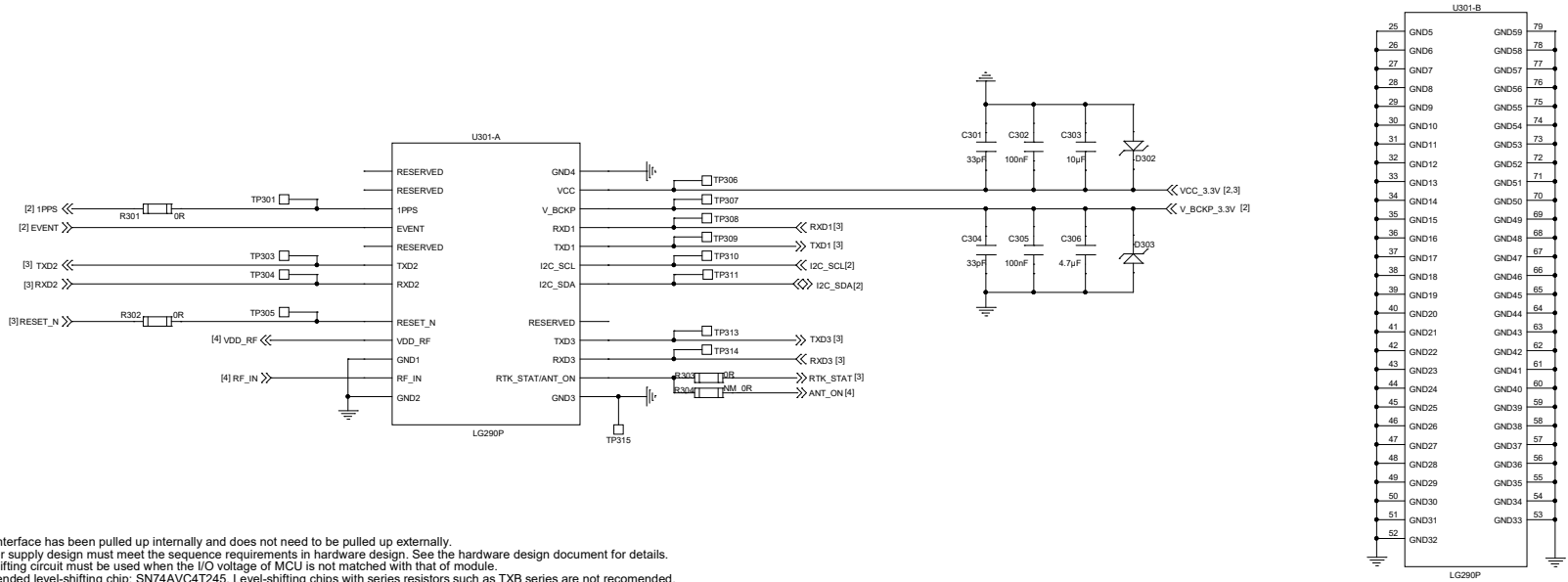


NOTE:

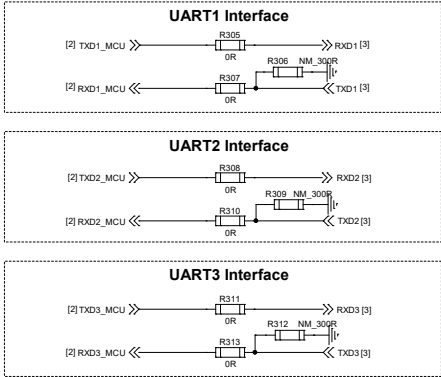
- Ensure the power supply is controlled by MCU to save power or restart the module when the module enters abnormal state.
- The VCC should be controlled by the MCU and the V_BCKP should always be powered if hot (warm) start is needed.
- Select the appropriate lithium battery capacity according to the power consumption of the GNSS module.
- C201 and R203 form a soft start circuit. The capacitance (C201) and resistance (R203) can be adjusted to set the soft start time according to your requirement.

Module Interfaces

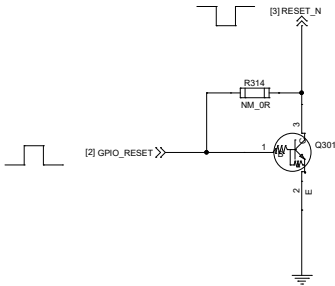
Module Interfaces



UART Interface Circuits

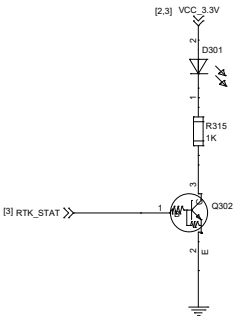


RESET_N Circuit



- NOTE:**
1. The RESET_N pin is internally pulled up to VCC with a 20 kΩ resistor, thus no external pull-up circuit is allowed for this pin. An OC drive circuit is recommended to control the RESET_N pin.
 2. The RESET_N must be connected so that it can be used to reset the module if the module enters an abnormal state.

RTK_STAT Circuit

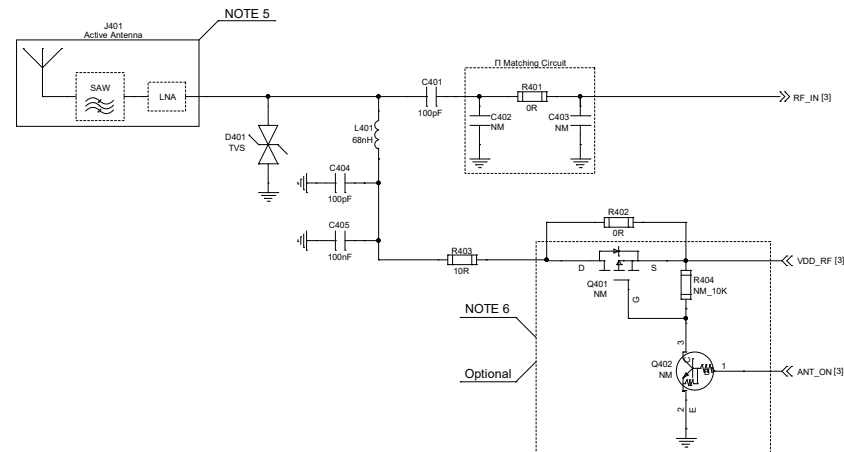


- NOTE:**
1. If the RTK_STAT outputs a high level, it indicates that the module enters the RTK fixed mode.
 2. If the pin outputs a low level, it indicates that the module exits the RTK fixed mode.

Quectel Wireless Solutions

| | | | |
|----------|-------------------------|------------|-----------|
| PROJECT | LG290P (R3) | VER | 1.0 |
| DRAWN BY | Vijay ZHAO/Yasuo MAO | CHECKED BY | Storm BAO |
| DATE | Monday, August 19, 2024 | SIZE | A2 |
| | | SHEET | 3 OF 4 |

Antenna Interface



- NOTE:**
- 1. R401, C402 and C403 form a π matching circuit for antenna impedance matching. By default, R401 is 0 Ω , C402 and C403 are not mounted.
 - 2. D401 is an electrostatic discharge (ESD) protection device to protect RF components inside the module from the damage caused by ESD through the antenna interface.
 - 3. The impedance of the RF trace line on the main PCB should be controlled to 50 Ω and the trace length should be kept as short as possible.
 - 4. L401 is used for preventing the RF signal from leaking into the VDD_RF and preventing noise propagation from the VDD_RF to the antenna.
 - 5. To further mitigate the impact of out-of-band signals on GNSS module performance, you must choose the active antenna whose SAW filter is placed in front of the LNA in the internal framework. DO NOT place the LNA in the front.
 - 6. The VDD_RF pin is used by default. Please select the relevant design according to the actual usage.
 - 7. See the hardware design document for details.
 - 8. The passive antenna is not recommended.

Table 1: SCH Design Checklist

| Pin No. | Pin Name | Checklist | Result | | | Comment |
|---------|----------|--|--------|------|-----|---------|
| | | | Pass | Fail | N/A | |
| 1 | RESERVED | The RESERVED pin must be left N/C. | | | | |
| 2 | RESERVED | The RESERVED pin must be left N/C. | | | | |
| 3 | 1PPS | Connect to the GPIO of the MCU. | | | | |
| 4 | EVENT | Connect to the GPIO of the MCU. | | | | |
| 5 | RESERVED | The RESERVED pin must be left N/C. | | | | |
| 6 | TXD2 | Connect to MCU through 0 Ω resistors or a level-shifting circuit. Reserve test points. | | | | |
| 7 | RXD2 | | | | | |
| 8 | RESET_N | Connect to the GPIO of the MCU through a 0 Ω resistor (not mounted by default) or an OC drive circuit to control the module reset. Reserve a test point. | | | | |
| 9 | VDD_RF | Supplies power for an external active antenna or LNA. | | | | |
| 10 | GND | Reference ground of the module. The GND pin must be connected to ground. | | | | |
| 11 | RF_IN | <ol style="list-style-type: none"> 1. π matching circuit must be added for impedance modification. 2. It is recommended to select an ESD protection device with junction capacitance lower than 0.6 pF. 3. The inductor used in the power supply circuit of the active antenna is at least 68 nH and the inductor's pad which is close to RF_IN should be placed on the RF line. | | | | |
| 12 | GND | Reference ground of the module. The GND pin must be connected to ground. | | | | |

| Pin No. | Pin Name | Checklist | Result | | | Comment |
|---------|------------------|---|--------|------|-----|---------|
| | | | Pass | Fail | N/A | |
| 13 | GND | Reference ground of the module. The GND pin must be connected to ground. | | | | |
| 14 | RTK_STAT/ANT_ON* | <ol style="list-style-type: none"> 1. RTK_STAT is recommended to connect to an indication circuit. 2. ANT_ON is connected to the transistor's base to control the power supply of VDD_RF for an external LNA or active antenna. | | | | |
| 15 | RXD3 | Connect to MCU through 0 Ω resistors or a level-shifting circuit. Reserve test points. | | | | |
| 16 | TXD3 | | | | | |
| 17 | RESERVED | The RESERVED pin must be left N/C. | | | | |
| 18 | I2C_SDA | Connect to MCU through 0 Ω resistors or a level-shifting circuit. Reserve test points. | | | | |
| 19 | I2C_SCL | | | | | |
| 20 | TXD1 | Connect to MCU through 0 Ω resistors or a level-shifting circuit. Reserve test points. | | | | |
| 21 | RXD1 | | | | | |
| 22 | V_BCKP | <ol style="list-style-type: none"> 1. It is recommended to place a TVS, and a combination of a 4.7 μF, a 100 nF and a 33 pF decoupling capacitor near the V_BCKP pin. 2. Ensure that V_BCKP is controlled by MCU. 3. Reserve a test point. 4. V_BCKP must be connected to power supply for startup, and it should always be powered if hot (warm) start is needed. | | | | |
| 23 | VCC | <ol style="list-style-type: none"> 1. It is recommended to place a TVS, and a combination of a 10 μF, a 100 nF and a 33 pF decoupling capacitor near the VCC pin. 2. Ensure that VCC is controlled by MCU. | | | | |

| Pin No. | Pin Name | Checklist | Result | | | Comment |
|---------|----------|--|--------|------|-----|---------|
| | | | Pass | Fail | N/A | |
| | | 3. Reserve a test point. | | | | |
| 24~79 | GND | Reference ground of the module. The GND pin must be connected to ground. | | | | |

NOTE

1. If the I/O voltage of MCU is not matched with the module, a level-shifting circuit must be selected.
2. All GND pins must be connected to ground and reserved a GND test point. Leave RESERVED and unused pins N/C (not connected).
3. Quectel also provides design review services. It is strongly recommended that you submit your schematics and PCB designs to Quectel Technical Support for a formal review.

Table 2: PCB Design Checklist

| Pin No. | Pin Name | Checklist | Result | | | Comment |
|---------|----------|--|--------|------|-----|---------|
| | | | Pass | Fail | N/A | |
| 1 | RESERVED | / | | | | |
| 2 | RESERVED | / | | | | |
| 3 | 1PPS | <ol style="list-style-type: none"> 1. Surround the signal trace with ground. 2. Avoid routing near strong interference. 3. Keep the routing as short as possible and keep fewer vias to avoid parasitic capacitance and inductance. | | | | |
| 4 | EVENT | Surround the signal trace with ground, and avoid routing near the strong interference. | | | | |
| 5 | RESERVED | / | | | | |
| 6 | TXD2 | <ol style="list-style-type: none"> 1. Surround the signal traces with ground. 2. Keep the routing short and stay away from interference. | | | | |
| 7 | RXD2 | | | | | |
| 8 | RESET_N | Surround the signal trace with ground, and avoid routing near the strong interference. | | | | |
| 9 | VDD_RF | Power routing should be surrounded by GND and avoid being parallel with other line(s). | | | | |
| 10 | GND | <ol style="list-style-type: none"> 1. Confirm that there are no isolated shapes in the ground layer. 2. Module GND pads must be completely covered by the ground plane. | | | | |
| 11 | RF_IN | 1. The characteristic impedance of the RF signal line(s) is kept at 50 Ω , and the RF trace is as short and straight as possible, with smooth lines (without bumps, with consistent geometry—it would be ideal for the footprints to be blended into the RF trace, with curved rather than sharp angles). | | | | |

| Pin No. | Pin Name | Checklist | Result | | | Comment |
|---------|------------------|---|--------|------|-----|---------|
| | | | Pass | Fail | N/A | |
| | | 2. Ensure that there are no vias in the RF signal path. 3. Ensure that RF signal path is surrounded by ground. 4. RF signal line(s) and GNSS antenna are kept away from noise sources such as MCU(s), crystal(s) and other RF antenna(s). | | | | |
| 12 | GND | 1. Confirm that there are no isolated shapes in the ground layer. 2. Module GND pads must be completely covered by the ground plane. | | | | |
| 13 | GND | 1. Confirm that there are no isolated shapes in the ground layer. 2. Module GND pads must be completely covered by the ground plane. | | | | |
| 14 | RTK_STAT/ANT_ON* | 1. Surround the signal trace with ground. 2. Avoid routing near strong interference. | | | | |
| 15 | RXD3 | 1. Surround the signal traces with ground. 2. Keep the routing short and stay away from interference. | | | | |
| 16 | TXD3 | | | | | |
| 17 | RESERVED | / | | | | |
| 18 | I2C_SDA | 1. Surround the signal trace with ground. 2. Keep the routing short and stay away from interference. | | | | |
| 19 | I2C_SCL | | | | | |
| 20 | TXD1 | 1. Surround the signal traces with ground. 2. Keep the routing short and stay away from interference. | | | | |
| 21 | RXD1 | | | | | |
| 22 | V_BCKP | 1. The power supply first passes through the TVS, and then through the subsequent components. | | | | |

| Pin No. | Pin Name | Checklist | Result | | | Comment |
|---------|----------|---|--------|------|-----|---------|
| | | | Pass | Fail | N/A | |
| | | 2. The capacitors are placed near the power supply pin in descending order of capacitance. At least one GND via must be placed near the grounded end of the capacitor. If needed, there should be more than one GND via to meet the requirements. 3. The power routing and sensitive signal routings (with Clock, USB, MIPI, RF, etc.) must be isolated. | | | | |
| 23 | VCC | 1. The power supply first passes through the TVS, and then through the subsequent components. 2. The capacitors are placed near the power supply pin in descending order of capacitance. At least one GND via must be placed near the grounded end of the capacitor. If needed, there should be more than one GND via to meet the requirements. 3. The routing width of the power supply is at least 1 mm per ampere. The longer the routing, the wider it should be. The power routing and sensitive signal routings (with Clock, USB, MIPI, RF, etc.) must be isolated. | | | | |
| 24–75 | GND | 1. Confirm that there are no isolated shapes in the ground layer. 2. Module GND pads must be completely covered by the ground plane. | | | | |

NOTE

Quectel also provides design review services. It is strongly recommended that you submit your schematics and PCB designs to Quectel Technical Support for a formal review.