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G7A

Hardware User Guide

GNSS Module
Issue 1.8
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Notice

This document provides a guide for users to use G7A.

This document is intended for system engineers (SEs), development engineers, and test engineers.

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Contents

Figures

Tables

About This Document

Scope

This document is applicable to the G7A module. It describes the G7A information, function interface design, and characteristics.

The reference designs in this guide are for reference only. You need to perform designs based on actual scenarios and conditions in the process of application design. If you have any questions, you can contact Neoway technical support.

Audience

This document is intended for system engineers (SEs), development engineers, and test engineers.

Change History

Issue	Date	Change	Author
1.0	2018-08	Initial release.	Zhuo Jianzheng
1.1	2019-07	• Deleted the I2C function description. • Updated the bottom dimensions.	Gong Hualiang
1.2	2019-08	• Corrected the label picture. • Corrected the acquisition and tracking channel quantity.	Gong Hualiang
1.3	2020-11	Corrected the bottom view of the module and adjusted the uniform direction of the picture.	Gong Hualiang
1.4	2021-07	• Updated the variants and bands. • Added the recommended power supply design circuit. • Added the recommended level shifting circuit. • Updated the reference design of an active antenna. • Added the label description.	Wu Zhenglin Zheng Xicheng
1.5	2022-01	• Updated the variant and bands supported in section 2.1 "Product Overview." • Updated the operating voltage in section 2.3 "Basic	Wu Zhenglin

		Features"	
1.6	2022-03	Updated the block diagram in section 2.2 "Block Diagram"	Wu Zhenglin
1.7	2022-10	• Modified the timing precision to <30 ns in Table 7-1 • Modified the VDD_IO pin description in Table 4-2	Wu Zhenglin
1.8	2022-12	• Updated product overview in section 2.1 . • Updated block diagram in section 2.2 . • Updated basic features in section 2.3 . • Updated pin description in 4.2 . • Updated description in section 5.1 “Power Interface” • Updated description in section 5.1 “Reset Interface” • Updated description in section 5.1 “UART Interface” • Updated description in section 5.4 “Antenna Interface” • Updated description in section 5.5.2 “1PPS” • Updated ESD protection characteristics in section 6.3 . • Updated GNSS technical parameter in Table 7-1. • Added G7A-B2 label figure in section 8.2 . • Updated description in section 8.3.2 .	Wu Zhenglin

Conventions

Symbol	Description
	Indicates danger or warning. This information must be followed. Otherwise, a catastrophic module or user device failure or bodily injury may occur.
	Indicates caution. This symbol alerts the user to important points about using the module. If these points are not followed, the module or user device may fail.
	Indicates instructions or tips. This symbol provides advices or suggestions that may be useful when using the module.

Related Documents

Neoway_G7A_Datasheet

Neoway_G7A_Product_Specification_Guide

Neoway_G2_G7A_Commands_Manual

Neoway_G7A_EVK_User_Guide

Neoway_Reflow_Soldering_Guidelines_For_Surface-Mounted_Modules

1 Safety Recommendations

Ensure that this product is used in compliance with the requirements of the country and environment. Read the following safety recommendations to avoid bodily injuries or damages of the product or workplace:

- Do not use this product at any places with a risk of fire or explosion.

  If this product is used in a place with flammable gas or dust, such as propane gas, gasoline, and flammable spray, it will cause an explosion or a fire.
- Disable the wireless communication function in places where wireless communication is prohibited.

  Do not use this product that can interfere with other electronic devices in environments, such as hospitals and airplanes.

Follow the requirements below during the application design and use of this product:

- Do not disassemble this product without permission from Neoway. Otherwise, we are entitled to refuse to provide further warranty.
- Design your application correctly based on the hardware user guide. Connect this product to a stable power supply and route traces following fire safety standards.
- Avoid touching the pins of this product to prevent damages caused by ESD.

2 About G7A

This chapter introduces the product overview, block diagram, and basic features of the G7A module.

2.1 Product Overview

G7A is a GNSS module that supports BDS, GPS, and GLONASS. G7A adopts a unified chipset that integrates baseband and RF. It is a high-sensitivity, low-power consumption and cost-effective positioning/navigation solution for positioning/navigation products including vehicle, handheld, and wearable terminals.

G7A is equipped with 18 pads, which are introduced in LCC package, and has dimensions of 10.6 mm x 9.7 mm x 2.2 mm. With industrial-grade high performance, the module is suitable for positioning/navigation products including in-vehicle, in-boat, handheld, and wearable terminals..

Table 2-1 lists the models and bands that G7A supports.

Table 2-1 Variant and bands

Model	GPS	BDS	GLONASS	GAGAN
B1	L1 supported	B1 supported	-	-
B2	L1 supported	-	L1 supported	

G7A-B1 supports BDS third-generation navigation and positioning.

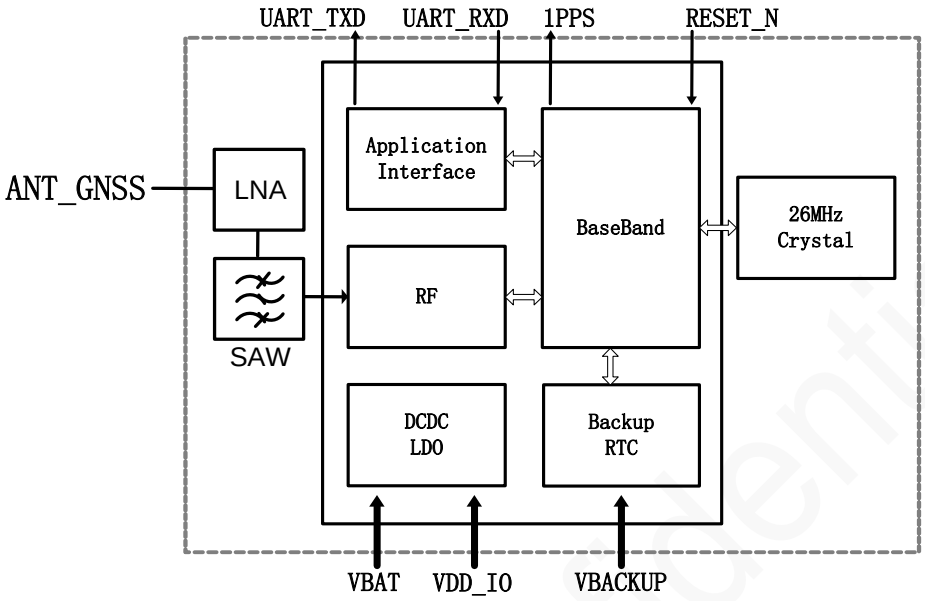
2.2 Block Diagram

G7A series modules internally consist of the following functional units:

- Baseband chip
- 26 MHz crystal oscillator
- Power manager
- RF section
- Digital interfaces (UART)

- Real-time clock backup area

Figure 2-1 Block diagram



2.3 Basic Features

Feature	Description		
Physical features	• Dimensions: (10.6±0.15) mm × (9.7±0.15) mm × (2.2±0.2) mm • Package: LCC • Weight: about 0.52 g		
Temperature range	Operating: -40°C to +85°C Storage: -45°C to +125°C		
Operating voltage	VBAT: 2.7 V to 3.6 V DC; typical value: 3.3 V DC		
Operating current	Sleep mode[1]: 10 μA		
	Continuous positioning mode[2]:	Multi-mode	30 mA
		Single-mode	28 mA
Application interface	GNSS antenna, 50 Ω characteristic impedance		
	One UART interface, at most 256000 bps		
AT command	Neoway extension commands		
Certification approval	RoHS and CE		

Sleep mode[1)]: The module enters the idle mode after VBAT is not powered, and only the RTC backup part works properly. The power and clocks of all other functions are shut down. After VBAT is supplied power, the module enters the continuous positioning mode. To support hot start and warm start, VBACKUP must be able to continuously supply power after VBAT is shut down. If quick positioning is required, it is recommended that VBACKUP continuously supply power.

Continuous positioning mode[2)]: The acquisition engine is enabled all the time, and it will automatically switch to the tracking status to decrease the operating current after obtaining valid location information and all ephemeris and almanac data. If a command is sent by using UART, the system mode can be switched to BDS, GPS, GLONASS, or any combinations of them, for example, BDS+GPS, GPS+GLONASS, or GPS.

3 Reference Standards

G7A module design references the following standards:

- BeiDou Satellite Navigation Terminology, Number: BD110001-2015
- BDS/GNSS Receiver Navigation and Positioning Data Output Format, Number: BD410004-2015
- BDS/GNSS Receiver RF Integrated Circuit General Specifications, Number: BD420001-2015
- BDS/GNSS Signal Simulator Performance Requirements and Test Methods, Number: BD420012-2015

4 Module Pins

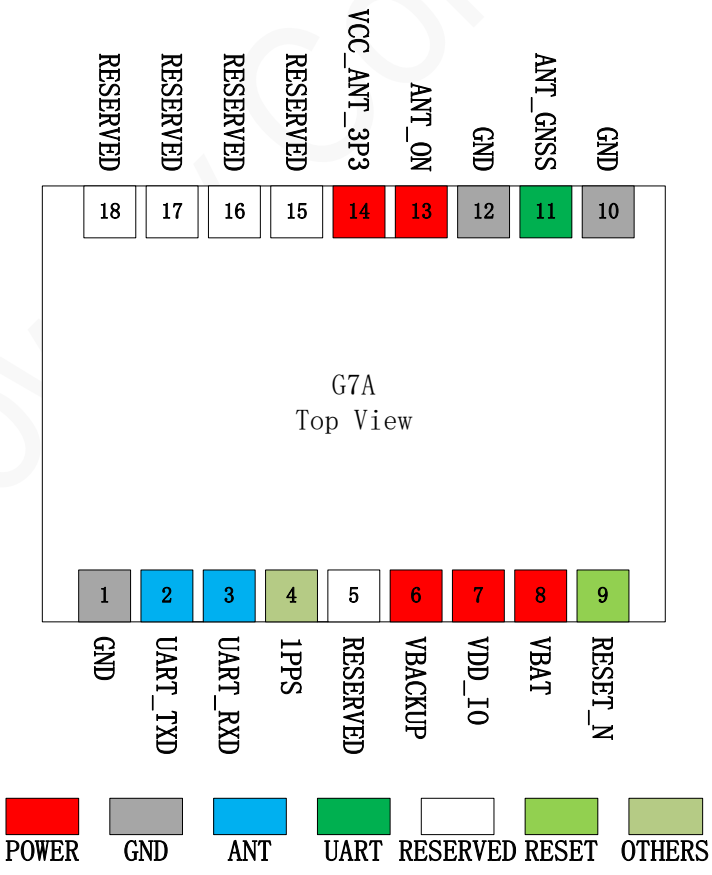
There are 18 pins on G7A, and pads use LCC package. G7A supports the following functional interfaces:

- Power supply interfaces
- Serial interface
- 1PPS

4.1 Pin Layout

The following figure shows the pin layout of G7A.

Figure 4-1 Pin layout of G7A (top view)



4.2 Pin Description

The following table provides the IO type description and DC characteristics.

RESERVED pins are used for external expansion or internal use of the module. Leave them floating.

Table 4-1 IO type description and DC characteristics

IO Type	Description	
B	Digital input/output, COMS logic level.	
DO	Digital output, COMS logic level.	
DI	Digital input, COMS logic level.	
PO	Power output.	
PI	Power input.	
AO	Analog output.	
AI	Analog input.	
DC characteristics description		
P1	Digital IO voltage	3.3 V DC characteristics: V_{OH} = 2.9 V - 3.3 V, V_{OL} = 0 V - 0.4 V V_{IH} = 2.4 V - 3.6 V, V_{IL} = -0.3 V - 0.6 V

Table 4-2 Pin description

Pin Name	Pin No.	I/O	Function	DC Characteristics	Remarks
Power interface					
VBAT	8	PI	Main power input of the module.	2.7 V to 3.6 V (typical value: 3.3 V)	Used to supply a maximum current of 100 mA.
VDD_IO	7	PI	IO power input of the module.	2.7 V to 3.6 V (typical value: 3.3 V)	Used to supply power to digital IO. It is recommended to connect this pin to VBAT.
VBACKUP	6	PI	Backup power input.	1.4 V to 3.6 V (typical value: 3.3 V) I_{norm} = 10 uA	Used to supply power to RTC and backup RAM.

					Leave this pin floating if it is not used.
VCC_ANT_3P3	14	PO	Power supply for external RF components.	2.7 V to 3.6 V (typical value: 3.3 V)	Used to supply power to an external LNA or active antenna. Leave this pin floating if it is not used.
GND	1, 10, 12				All GND pins must be grounded.
Control interface					
RESET_N	9	DI	Module reset input.	P1	Triggered by a low level to reset the module.
RF interface					
ANT_GNSS	11	AI	RF signal input.		For details, see chapter 5 "Application Interfaces."
UART interface					
UART_TXD	2	DO	Data sending	P1	They are used for data transmission. Leave these pins floating if they are not used.
UART_RXD	3	DI	Data receiving.	P1	
Other interfaces					
ANT_ON	13	DO		3.3 V power output	It can be used to control the enabling of the external LNA or antenna. In idle mode, it outputs low level. Leave this pin floating if it is not used.
1PPS	4	DO		P1	Pulled up by default. Pulse per second signal output. Leave this pin floating if it is not used.
RESERVED	5, 15, 16, 17, 18				Reserved pins. Leave them floating.

5 Application Interfaces

G7A provides the power, UART, 1PPS, and other interfaces to meet the functional requirements of customers in different application scenarios.

This chapter describes how to design each interface and provides reference designs and guidelines.

5.1 Power Interface

The schematic design and PCB layout of the power supply part are the most critical process in application design, and they will determine the performance of customers' applications. Read the design guidelines of power supply and comply with the correct design principles to obtain the optimal circuit performance.

5.1.1 VBAT

Signal	Pin no.	I/O	Function description	Remarks
VBAT	8	PI	Power input of the module.	2.7 V to 3.6 V (typical value: 3.3 V)
VDD_IO	7	PI	IO power input	2.7 V to 3.6 V (typical value: 3.3 V)
VBACKUP	6	PI	Backup power input	1.4 V to 3.6 V (typical value: 3.3 V) Used for RTC and backup power supply for RAM. Leave this pin unconnected if unused.
GND	1, 10, 12			Ensure that all GND pins are grounded.

5.1.2 VBAT

Signal	Pin no.	I/O	Function description	Remarks
VBAT	8	PI	Module power input	2.7 V to 3.6 V (typical value: 3.3 V)

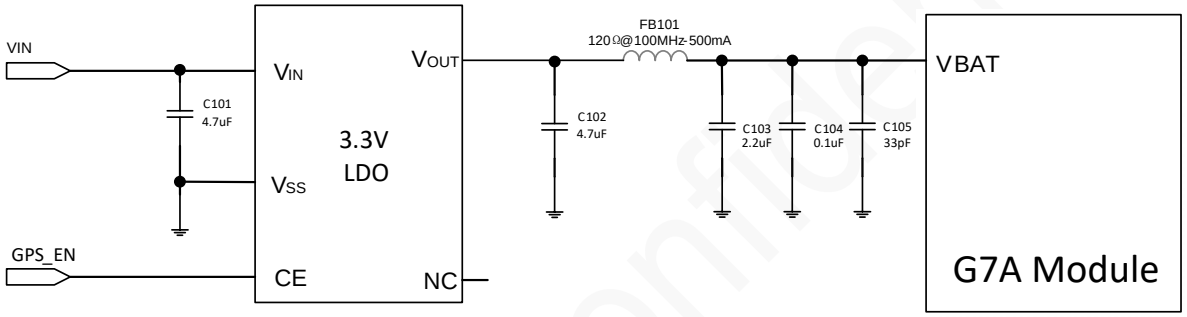
The power supply design covers two parts: schematic design and PCB layout.

Schematic Design

It is only recommended to use the 3.3 V low-noise LDO for power supply, and it cannot shared with other loads. In addition to this, no other power supply solution is recommended.

VBAT is the main power input pin of the module. Its input voltage ranges from 2.7 V to 3.6 V, and the typical value is 3.3 V. VBAT supplies power to baseband and RF components in the module. The performance of the VBAT power supply, such as the load capacity, ripple, noise, power supply rejection ratio, directly affects the module performance and stability. The following figure shows the recommended power supply design.

Figure 5-1 Recommended power supply design



- To ensure the best performance of the module, low-noise and high-PSRR LDO for power supply is required. It is recommended to select an LDO with an output noise voltage less than 40 μV_{RMS} and a power supply rejection ratio greater than -70 dB.
- It is recommended to use low-ESR chip multilayer ceramic capacitors, and the capacitor withstand voltage should be greater than 1.5 times the power supply voltage.
- Place beads and bypass capacitors to be near the module to filter out high-frequency interference from the power supply.

PCB Design Guidelines

The power circuit design is important, and the PCB layout and routing are also important. The following lists some precautions for power cable routing and layout on PCBs:

- The bypass capacitors should be placed close to the power supply pin of the module to filter out high-frequency noise signals in the power supply.
- For the main power loop of the module, the PCB routing width must ensure that the 100 mA current can be passed safely, and there should be no obvious loop voltage drop. The PCB

routing width should be at least 0.1 mm to ensure that the ground plane of the power supply part is as complete as possible.

- GNSS is a noise-sensitive circuit and should be kept away from noise-prone components or circuits, such as audio circuits, RF circuits, and DC-DC power supply.
- To ensure an optimal performance of the module, keep it far away from heat source on your applicable PCB.

5.1.3 VDD_IO

Pin Name	Pin No.	I/O	Function Description	Remarks
VDD_IO	7	PI	IO power input.	2.7 V to 3.6 V (typical value: 3.3 V).

VDD_IO is the pin of the power supply for digital IO of the module. It is recommended to connect it to VBAT in your applications.

5.1.4 VBACKUP

Pin Name	Pin No.	I/O	Function Description	Remarks
VBACKUP	6	PI	Backup power input.	1.4 V to 3.6 V (typical value: 3.3 V) Used to supply power to RTC and backup RAM. Leave this pin floating if it is not used.

VBACKUP is the pin of the backup power supply for the module. It is used to supply power to RTC and backup RAM after VBAT is shut down so that the module can save key ephemeris and almanac data for hot start, warm start, and ephemeris computation.

The input voltage of the backup power supply ranges from 1.4 V to 3.6 V. The recommended value is 3.3 V/3.0 V. It can be connected to a button battery or capacitor.

5.2 Reset Interface

Pin Name	Pin No.	I/O	Function Description	Remarks
RESET_N	9	DI	System reset.	Triggered by low level. Leave this pin floating if it is not used.

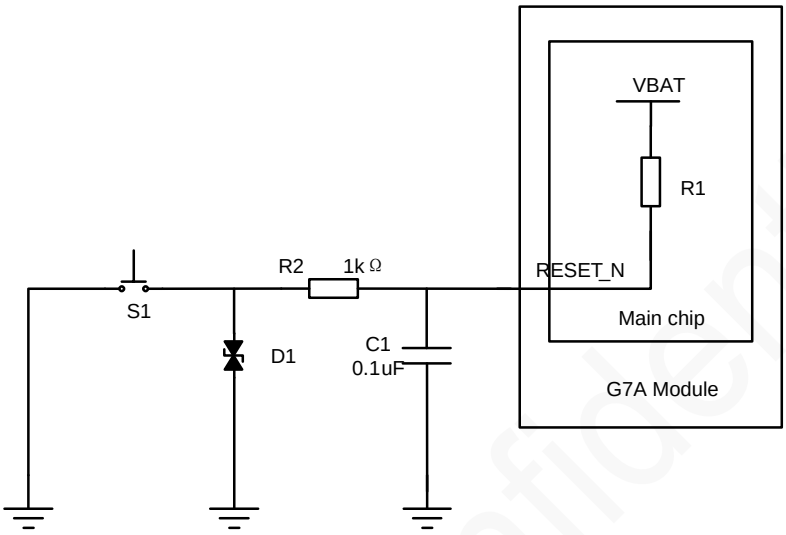
When the module is in power-on mode, the RESET_N pin can trigger module reset if a low-level pulse

of more than 160 ms is input. Figure 5-4 shows the reset process.

Two methods can be used to reset the module.

- Button-controlled reset circuit

Figure 5-2 Resetting the module by using a button



- MCU-controlled reset circuit

If you use a 1.8V/2.8V/3.3V MCU-controlled system to set the module, it is recommended to add triodes for isolation. For details, see Figure 5-3.

Figure 5-3 Resetting the module by using an MCU

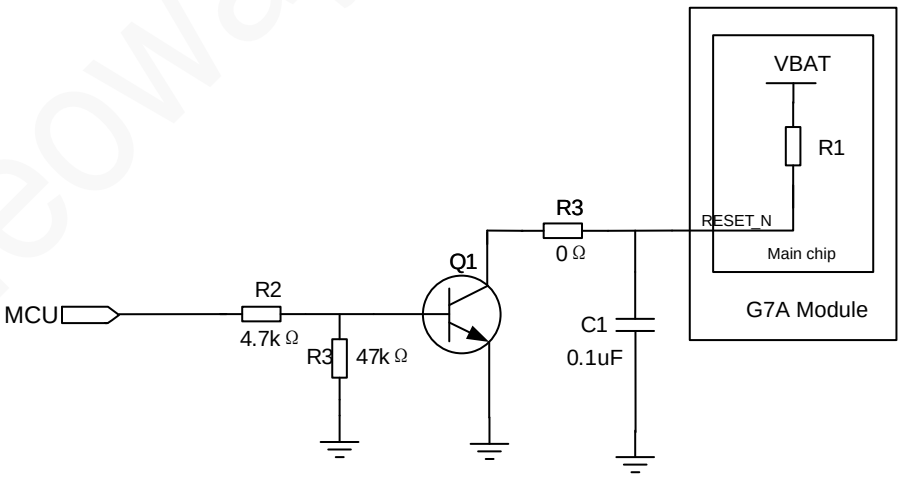
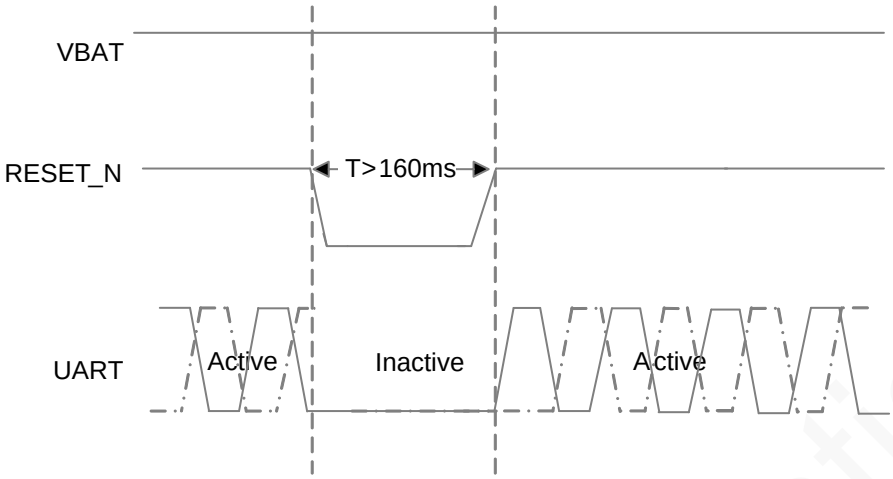


Figure 5-4 shows the reset process of the G7A module.

Figure 5-4 Reset process of the G7A module

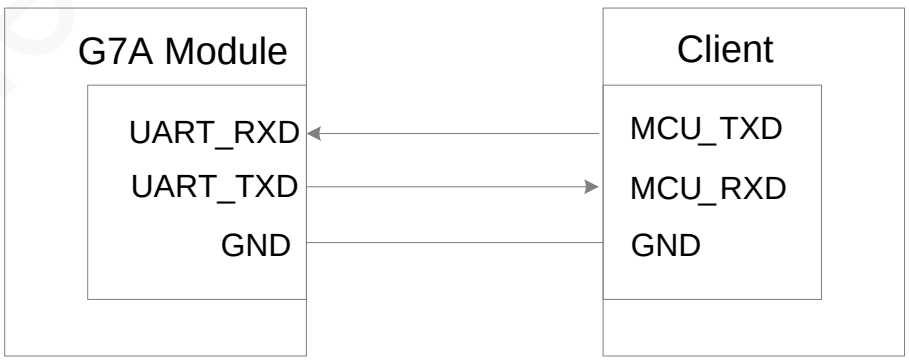


5.3 UART Interface

Pin Name	Pin No.	I/O	Function Description	Remarks
UART_TX	2	DO	Data sending.	-
UART_RX	3	DI	Data receiving.	-

G7A can provide one UART interface. The UART interface outputs NMEA data at UTC second boundary. The MCU can set the working mode, baud rate, and select UART by using AT commands. The module supports a baud rate ranging from 4800 bps to 256000 bps. The default baud rate is 9600 bps. Data format: 1 start bit, 8 data bits, 1 stop bit, no checksum bit. The following figure shows the reference design of UART connections.

Figure 5-5 Reference design of UART connections



Schematic Design Guidelines

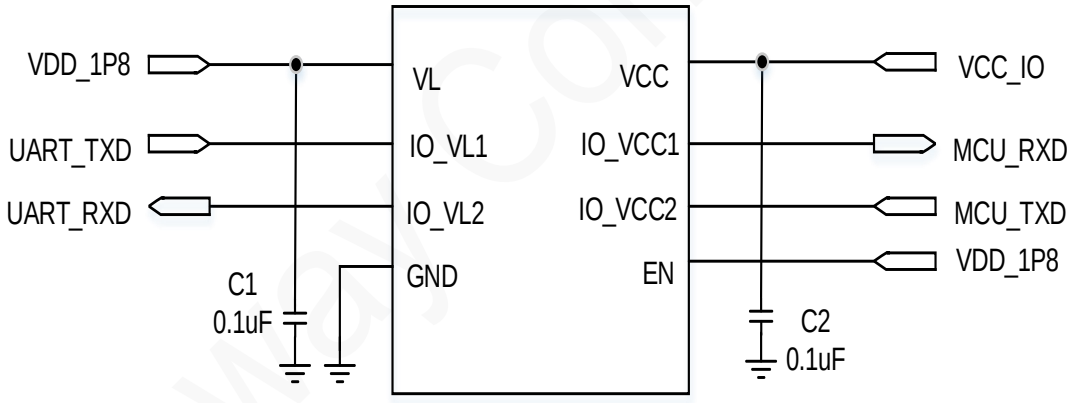
- Pay attention to the correspondence between signal flow direction and connection.
- It is prohibited to use diodes for voltage-level translation.
- If the logic voltage of UART does not match that of the MCU, add a voltage-level translation circuit outside the module. Three voltage-level translation circuits are recommended based on the differences in logic levels and rates.

The actual parameter values of the components used in the voltage-level translation circuit should be adjusted according to the actual test results. Note the differences between different circuit voltage-level translation solutions.

- Voltage-level translation chip circuit

  If the UART baud rate is greater than 115200 bps, it is recommended to design the voltage-level translation solution by referring to the recommended voltage-level translation circuit 1. As shown in Figure 5-6.

Figure 5-6 Recommended voltage-level translation circuit 1

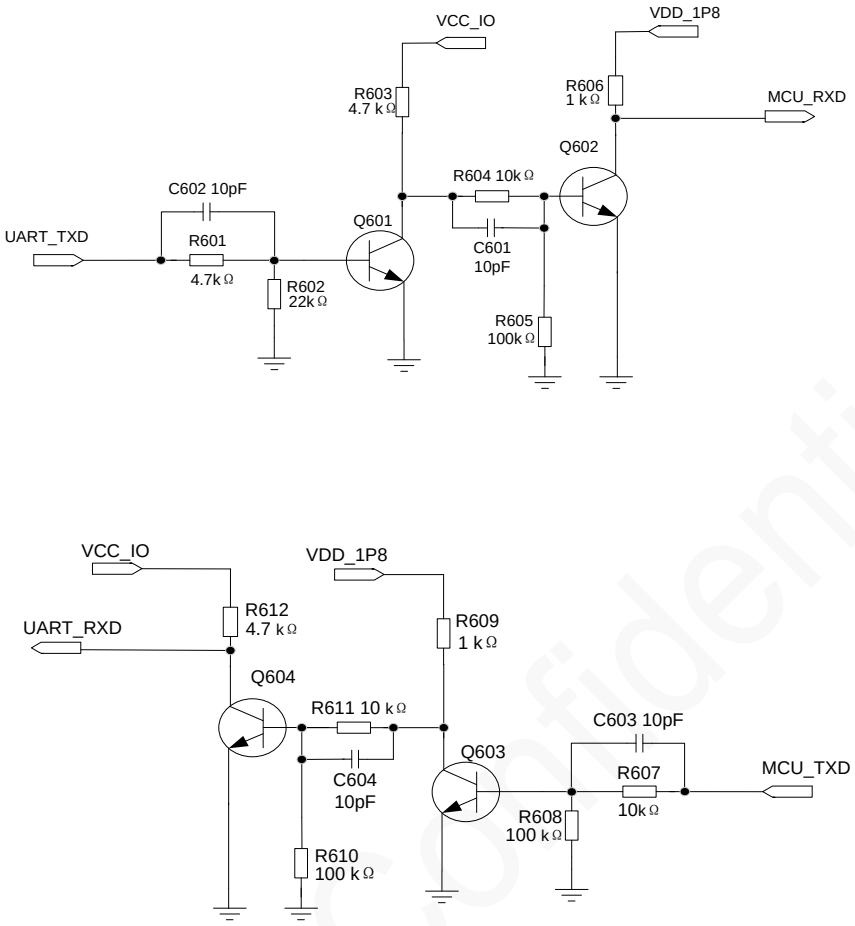


  - VL is the reference voltage for IO_VL1 and IO_VL2, and the voltage range is 1.5 V - 5.5 V.
  - VCC is the reference voltage for IO_VCC1 and IO_VCC2, and the voltage range is 1.5 V - 5.5 V.
  - EN is an enable pin, which works at a voltage of greater than VL-0.2 V. In the above circuit, the EN pin is directly connected to VDD_1P8 and the level translator chip is always working.

- Dual-triode voltage-level translation circuit

  If the UART baud rate is not greater than 115200 bps, it is recommended to design the voltage-level translation solution by referring to the recommended voltage-level translation circuit 2.

Figure 5-7 Recommended voltage-level translation circuit 2



MCU_TXD and MCU_RXD are the sending and receiving ports of MCU respectively, and UART_TXD and UART_RXD are the sending and receiving ports of module respectively. VCC_IO is the IO voltage of MCU and VDD_1P8 is the IO voltage of the module.

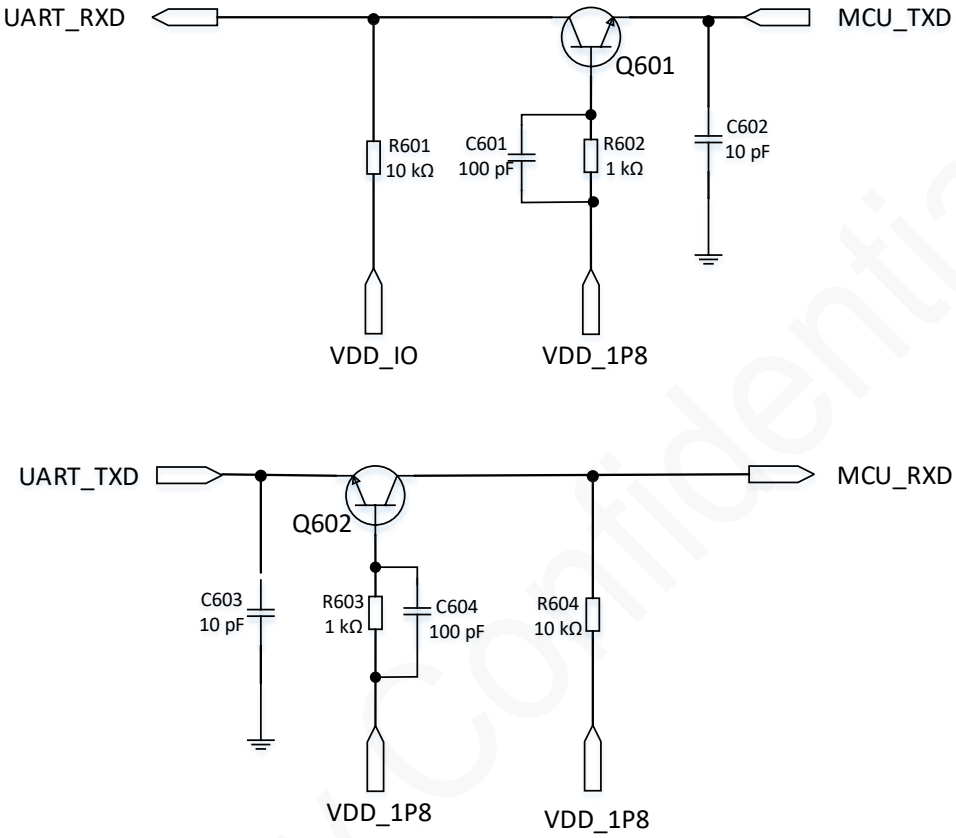
Related components:

- R601/R603/R604/R607/R611/R612: 2 kΩ to 10 kΩ. The higher the operating rate of the UART port, the smaller the resistance value.
- R606/R609: 1 kΩ to 4.7 kΩ. The higher the operating rate of the UART port, the smaller the resistance value.
- Q601/Q602/Q603/Q604: MMBT3904. High-rate transistors are recommended.
- C601/C602/C603/C604: To accelerate the turn-on and turn-off of the triode, it is recommended to reserve the PCB position and confirm whether patch is required according to the actual test situation.

- Single-triode voltage-level translation circuit

If the UART communications rate exceeds 115200 bps, and the high level of MCU_UART is 1.8 V and low level VIL ≤200 mV, it is recommended to design the voltage-level translation solution by referring to the recommended voltage-level translation circuit 3.

Figure 5-8 Recommended voltage-level translation circuit 3



Related components:

- R601/R604: 2 kΩ to 10 kΩ. The higher the operating rate of the UART port, the smaller the resistance value.
- R602/R603: 1 kΩ to 4.7 kΩ. The higher the operating rate of the UART port, the smaller the resistance value.
- Q601/Q602: MMBT3904. High-rate transistors are recommended.
- C601/C604: To accelerate the turn-on and turn-off of the triode, it is recommended to reserve the PCB position and confirm whether to attach components according to the actual test situation.
- C602/C603: filter capacitor. 10 pF is recommended.

In all the reference designs in this section, the send and receive directions included in the module peripheral interface pin naming is based on the module, and the peripheral pin naming is based on the peripheral component itself. For example, UART_TXD of the module is the pin for the module to send data, and MCU_RXD is the pin for the MCU to receive data. These two pins should be connected.

In the process of selecting and designing peripheral components, check whether the manufacturer's naming of pin signals is from the perspective of the module or component.

5.4 Antenna Interface

Pin Name	Pin No.	I/O	Function Description	Remarks
ANT_GNSS	11	AI	RF signal input.	-

G7A provides one GNSS antenna interface. The antenna interface can connect active antennas and passive antennas, receive GNSS satellite signals, and implement satellite timing and positioning functions. This chapter describes how to control the G7A antenna interface impedance and conduct active antenna design, and provides recommended antenna specifications to guide customer application design.

5.4.1 GNSS Impedance Control

Pin 11 of the G7A module is the GNSS RF interface, and its impedance characteristic is required to be 50 Ω. The following figure shows the internal structure of the GNSS RF in the module. Control the impedance of the traces between the module interface and antenna to ensure the RF performance. A matching network, such as L network, T network, and π network, is mandatory between the module interface and antenna. π network is recommended.

Figure 5-9 Internal connections of the GNSS module

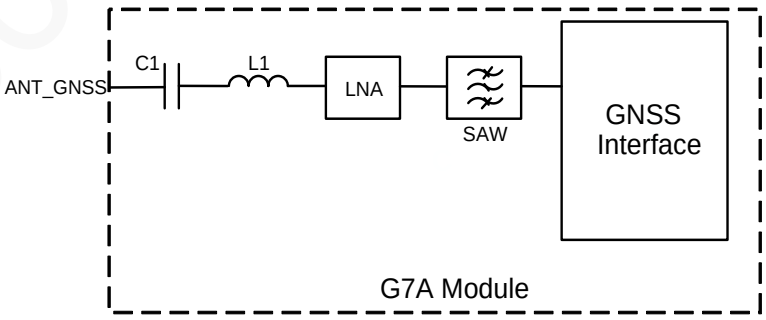


Figure 5-10 L network

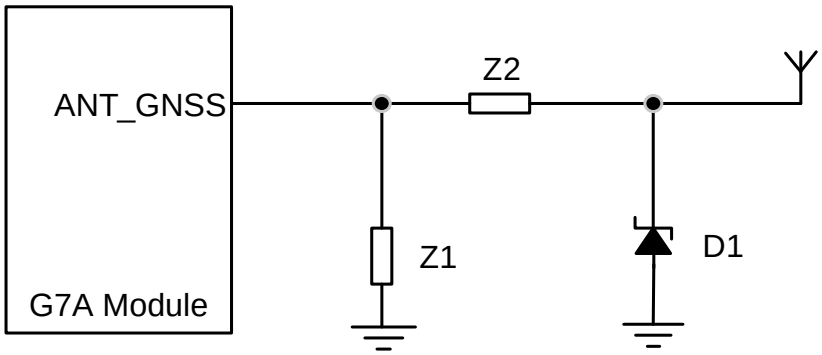


Figure 5-11 T network

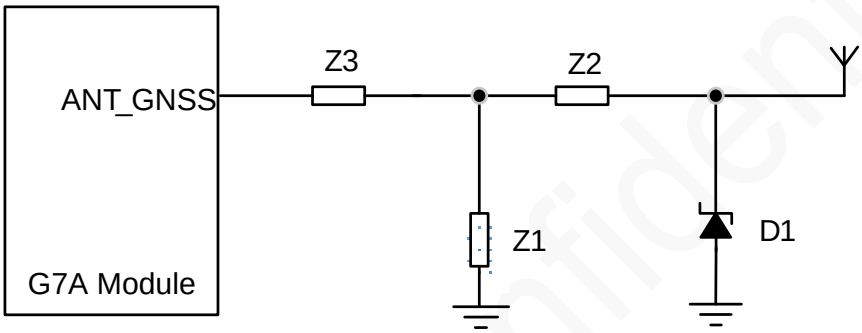
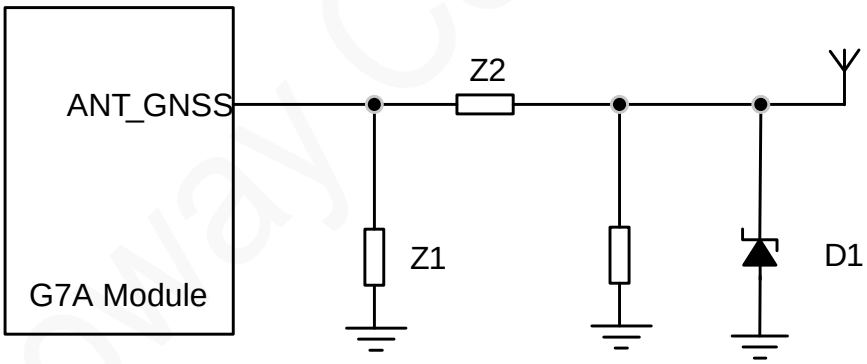


Figure 5-12 π network



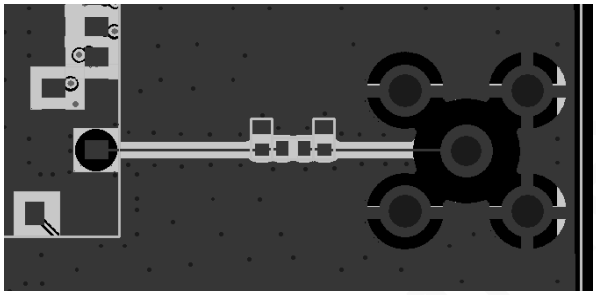
Schematic design guidelines:

- Components in the above figures must be capacitors, inductors, and 0 Ω resistors. Place these RLC components as close to the antenna interface as possible.
- Add an ESD protector if the antenna might generate static electricity. TVS diodes with ultra-low junction capacitance can be used. TVS diodes with junction capacitance not greater than 0.5 pF are recommended. Ensure that the reverse breakdown voltage of TVS diodes is greater than 10 V (above 15 V is recommended).
- G7A embeds an LNA, and no external LNA is required if a passive GNSS antenna is used. If an active antenna is used, it is recommended to connect SAW externally.

PCB design guidelines:

- Lay the ground copper foil around the RF connector. Dig as many ground holes as possible on the ground copper foil to ensure that the ground impedance is as small as possible.
- The trace between G7A and the antenna connector, should be as short as possible. Control the trace impedance to 50 Ω.
- If you adopt an SMA connector, a big RF solder pad might result in great parasitic capacitance, which will affect the antenna performance. It is recommended to remove the copper on the first and second layers under the RF solder pad, as shown in the following figure.

Figure 5-13 Recommended RF PCB design

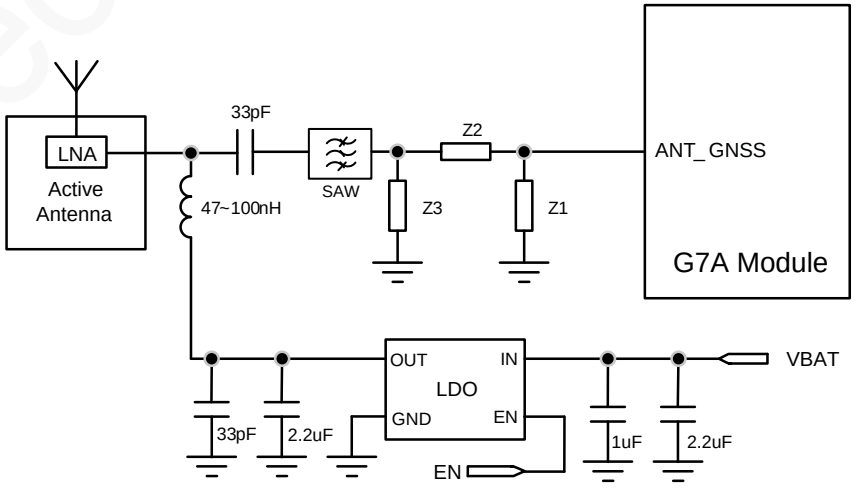


- On the PCB, keep the RF signals and components far away from digital circuits, power supplies, electronic transformers, power inductors, clocks, etc.

5.4.2 Reference Design of an Active GNSS Antenna

After the active GNSS antenna receives GNSS satellite signals, the LNA amplifies the signals and then transmits them to the ANT_GNSS (pin 11 of G7A) through the feeder and PCB traces (between LNA and the module's antenna, it is recommended to connect an SAW externally). The reference circuit diagram is shown in the following figures.

Figure 5-14 Reference design of an active antenna



For PCB design of SAW, make adjustment according to the actual SAW selection.

Schematic design guidelines:

- For the matching circuit design between the GNSS interface and antenna, refer to schematic design guidelines in section 5.4.1 "GNSS Impedance Control."
- If there is a requirement for power consumption in the application, it is recommended to use the design of an active antenna (with control).

  In continuous positioning mode, ANT_ON outputs high level, Q901 and Q902 are switched on simultaneously, and VCC_ANT_3P3 supplies power to the active antenna.

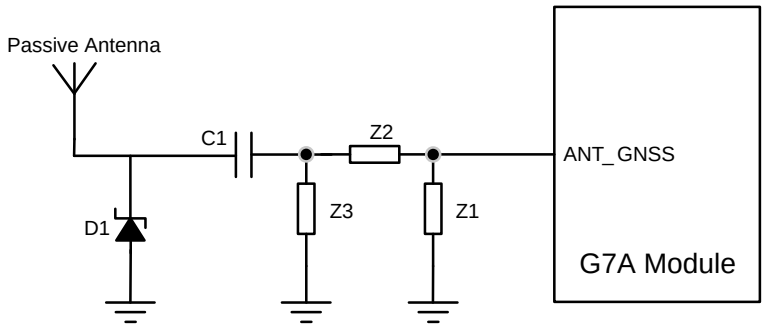
  In idle mode, ANT_ON outputs low level, Q901 and Q902 are switched off, and the power for the active antenna is shut down to reduce the module power consumption.
- For the U901 selection, refer to the LDO of the recommended power supply design circuit, and the output voltage value is determined according to the power supply voltage range of the active antenna.

PCB design guidelines:

- For the guidelines of PCB design between the GNSS interface and antenna, refer to PCB design guidelines in section 5.4.1 "GNSS Impedance Control."
- 50 Ω impedance control is required for the feeder and PCB traces, and the traces cannot be excessively long. The power supply of the active antenna is fed by the 47 to 100 nH inductor through the signal traces of the antenna.
- Common active antennas supply power from 3.3 V to 5 V. The active antenna itself consumes little power, but requires the low noise coefficient LDO to supply power to the antenna through an inductor with an inductance range of 47 nH to 100 nH, as shown in the preceding figures.
- The layout and cabling of the GNSS RF part and other antennas should be as far away as possible in the design to prevent the two parts from interfering with each other and affecting the RF performance. If the layout of the PCB is not well designed, interference with GNSS may occur.

5.4.3 Reference Design of an Passive GNSS Antenna

After the passive GNSS antenna receives GNSS satellite signals, the antenna amplifies the signals and then transmits them to the ANT_GNSS (pin 11 of G7A) through PCB traces. The reference circuit diagram is shown in the following figures.



PCB design guidelines:

See the PCB design guidelines in section 5.4.1 .

5.4.4 Recommended Antenna Specifications

Table 5-1 Recommended antenna specifications

Antenna Type	Parameter	Specifications	Remarks
Passive antenna	Frequency	GPS:1575.42 MHz BDS:1561.098 MHz GLONASS:1602.5625 MHz	The antenna frequency matches the module model.
	Bandwidth	> 5 MHz	-
	Polarization	Right-hand circularly polarized (RHCP)	-
	Standing wave ratio (SWR)	< 1.5	-
	Gain (antenna)	≥ 2 dBi	-
	Efficiency	≥ 40%	-
Active antenna	Frequency	GPS:1575.42 MHz BDS:1561.098 MHz GLONASS:1602.5625 MHz	The antenna frequency matches the module model.
	Bandwidth	>5 MHz	-
	Polarization	RHCP	-
	SWR	< 1.5	-
	Gain (internal LNA or amplifier)	18±2 dB	If the antenna gain is too high, RF performance of the module may be reduced.
	Gain (antenna)	≥ 2 dBi	-
	Efficiency	≥ 40%	-

	Noise coefficient	<1.5 dB	-
	Operating voltage	3.0±0.3 V	-

5.5 Other Functional Interfaces

Pin Name	Pin No.	I/O	Function Description	Remarks
ANT_ON	13	DO	3.3 V power output	It can be used to control the enabling of the external LNA or antenna. In idle mode, it outputs low level. Leave this pin floating if it is not used.
1PPS	4	DO	P1	Pulled up by default. Pulse per second signal output. Leave this pin floating if it is not used.
RESERVED	5, 15, 16, 17, 18			Reserved pins. Leave them floating.

5.5.1 ANT_ON

In continuous positioning mode, ANT_ON outputs 3.3 V. It is used to control the enabling of the external LNA or antenna. In idle mode, ANT_ON outputs low level. For details about the application circuit, see the reference design of an active antenna (with control).

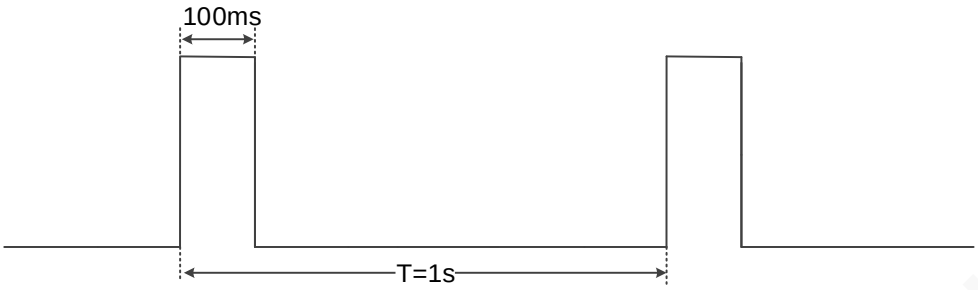
Pin Name	Pin No.	I/O	Function Description	Remarks
ANT_ON	13	DO	3.3 V power output	It can be used to control the enabling of the external LNA or antenna. In idle mode, it outputs low level. Leave this pin floating if it is not used.

5.5.2 1PPS

Pin Name	Pin No.	I/O	Function Description	Remarks
1PPS	4	DO	P1	Pull-up by default. Output in PPS signal, with precision less than 30 ns. Leave this pin unconnected if unused.

1PPS is a pulse per second signal with an amplitude of 3.3V and a duty cycle of 10%, and it is mainly used for GNSS timing with precision less than 30 ns. Figure 5-15 shows the timing of 1PPS signals.

Figure 5-15 Timing of 1PPS signals



PCB design guidelines:

- It is recommended to route 1PPS signal traces in the inner layer of the PCB and the routing should follow the design rules of high-speed digital signals. Surround the upper and lower layers, the front and rear, left and right of the traces with ground.
- Keep 1PPS signals far away from noise-sensitivity signals, such audio circuit, RF circuit, DC-DC power supply circuit, and antenna.

6 Electrical Characteristics and Reliability

This chapter describes the electrical characteristics and reliability of the G7A module, including the input voltage and current of the power supply, current consumption in different states, the operating and storage temperature ranges, and the ESD protection characteristics.

6.1 Electrical Characteristics

If the voltage is excessively low, the module might fail to start. If the voltage is excessively high or there is a voltage burst during the startup, the module might be damaged permanently.

Table 6-1 G7A working conditions

Signal		Minimum Value	Typical Value	Maximum Value
VBAT	V_{in}	-0.3 V	3.3 V	4.5 V
	I_{in}	-	-	100 mA
VDD_IO	V_{in}	-0.3 V	3.3 V	4.5 V
VBACKUP	V_{in}	-0.3 V	3.3 V	4.5 V

Table 6-2 G7A working conditions (recommended)

Signal	Description	Minimum Value	Typical Value	Maximum Value
VBAT	Main power supply	2.7 V	3.3 V	3.6 V
VDD_IO	IO power supply	2.7 V	3.3 V	3.6 V
VBACKUP	Backup power supply	1.4 V	3.3 V/3.0 V	3.6 V

Table 6-3 Current consumption of the G7A module (typical)

Module Status		Current Consumption (Typical)
Continuous positioning	Multi-mode	30 mA
	Single-mode	28 mA

6.2 Temperature Characteristics

Table 6-4 Temperature characteristics of the G7A module

Parameter	Minimum Value	Typical Value	Maximum Value
Operating temperature	-40°C	25°C	85°C
Storage temperature	-45°C	-	125°C

If the module works in an environment where the temperature exceeds the thresholds of the operating temperature range, some RF performance indicators of the module may deteriorate. However, it will not have a large impact on the normal use of the module.

6.3 ESD Protection Characteristics

Electronic products need to pass ESD tests. The following table shows the ESD capability of key pins of the module. It is recommended to add ESD protection based on the application industry of the product to ensure product quality when designing a product.

Test environment: humidity 45%; temperature 25°C

Table 6-5 ESD protection characteristics of the G7A module

Test Point	Contact Discharge	Air Discharge
GND	±8 kV	±15 kV
ANT	±8 kV	±15 kV
Shielding cover	±8 kV	±15 kV

Test data in the above table is obtained from tests performed using an G7A EVB.

7 RF Characteristics

G7A supports GNSS multi-mode positioning. This chapter describes the RF characteristics of G7A.

Table 7-1 GNSS characteristics

Parameter		Description		
GPS L1 operating frequency		1575.42±1.023 MHz		
GLONASS operating frequency		1597.5 MHz to 1605.9 MHz		
BDS operating frequency		1559.1 MHz to 1563.1 MHz		
Sensitivity	Positioning system	GPS	GPS+BDS	GPS+GLONASS
	Cold start acquisition	-148 dBm	-148 dBm	-148 dBm
	Hot start acquisition	-156 dBm	-156 dBm	-156 dBm
	Re-acquisition	-158 dBm	-158 dBm	-158 dBm
	Tracking	-162 dBm	-162 dBm	-162 dBm
Positioning precision (open space)	Horizontal	< 3 m (CEP50)		
	Vertical	< 4.5 m (CEP50)		
Speed precision (open space)		< 0.1 m/s		
TTFF (@-130 dBm[3])	Hot start	1s		
	Cold start	32s		
	Re-acquisition	1s		
Timing precision		<30 ns		
Timing update frequency		Default frequency: 1 Hz; maximum frequency:10 Hz		
Baud rate		Default rate: 9600 bps; minimum rate: 4800 bps; maximum rate: 256000 bps		
Power consumption (@instrument[4])	Acquisition	Typical value of 30 mA@3.3 V		
	Tracking	Typical value of 28 mA@3.3 V		
	Idle	Typical value of 10 μA@3.3 V		
GNSS data type		NMEA-0183		
GNSS antenna type		Passive antenna/active antenna		

Certification approval	RoHS and CE

@-130 dBm[3]: initial signal strength that is set on the simulator.

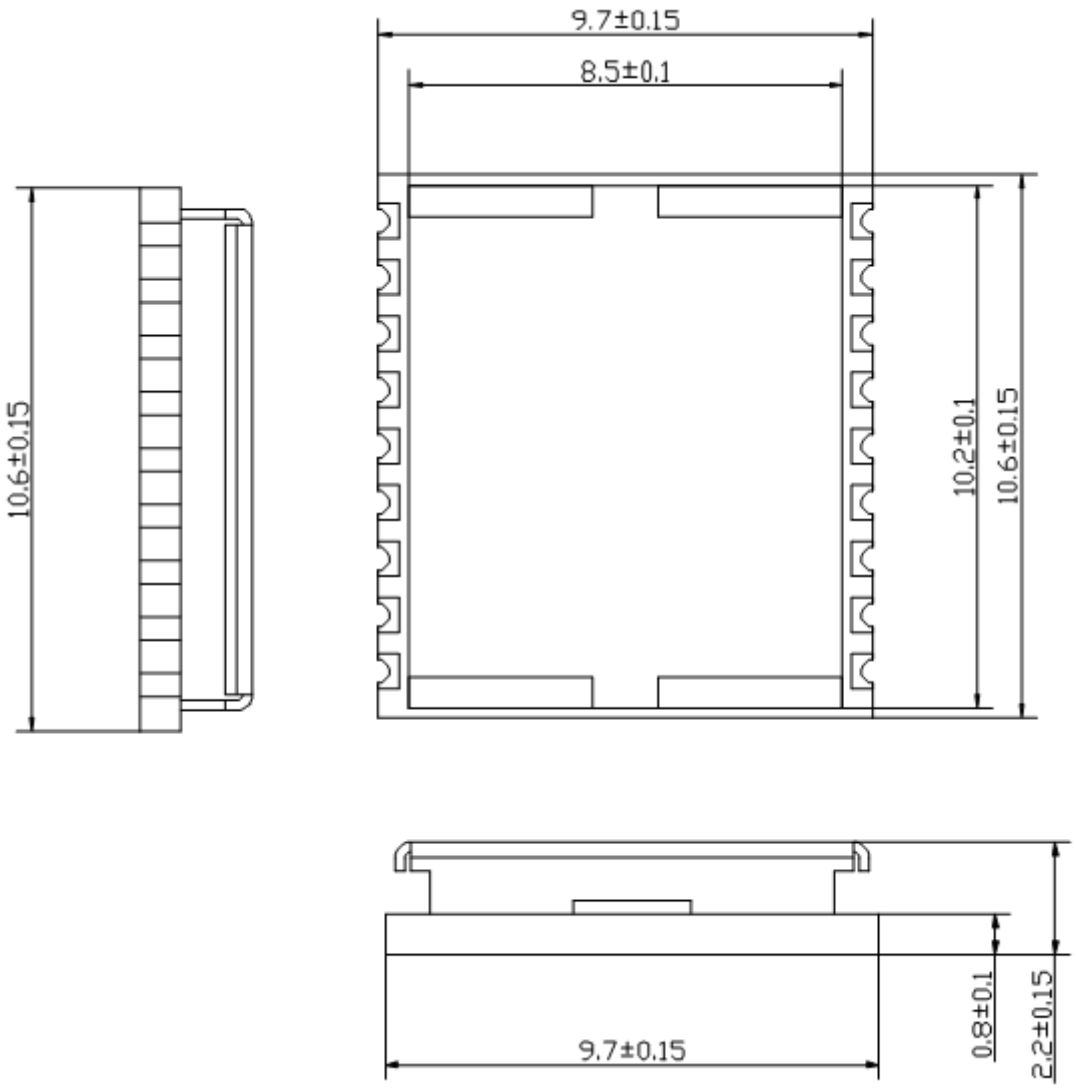
@instrument[4]: power consumption for the test on the simulator.

8 Mechanical Characteristics

This chapter describes the mechanical characteristics of the G7A module.

8.1 Dimensions

Figure 8-1 G7A top and side view dimensions (unit: mm)



8.2 Labeling

The label is printed using anti-deformation, anti-fading, and high-temperature resistant materials and can withstand a high temperature of 260°C.

Figure 8-2 G7A-B1 label

Figure 8-3 G7A-B2 label

The figures above are only for reference.

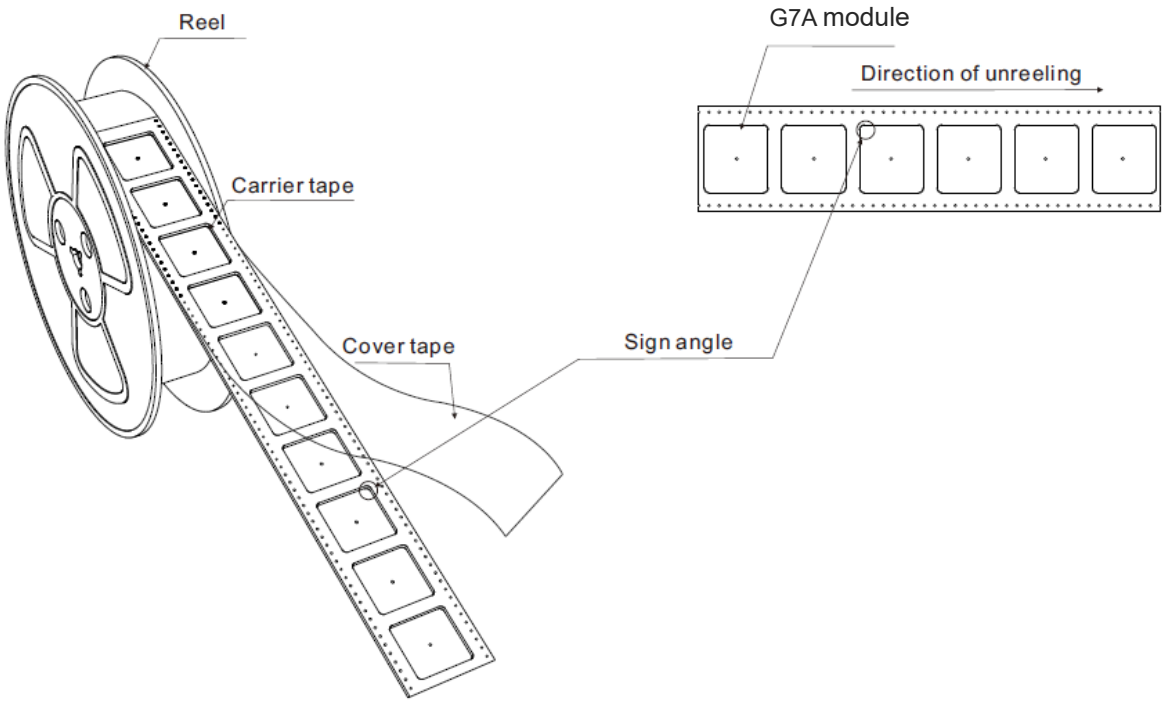
8.3 Packaging

The G7A module uses a surface-mount method for furnace welding. A moisture-proof packaging method prevents the product from being moist from production to customer use. That is, a processing method, such as using the aluminum foil bag, desiccant, humidity indicator card, or vacuum, is used to ensure the dryness of the product and prolong its lifetime.

8.3.1 Reel and Tape

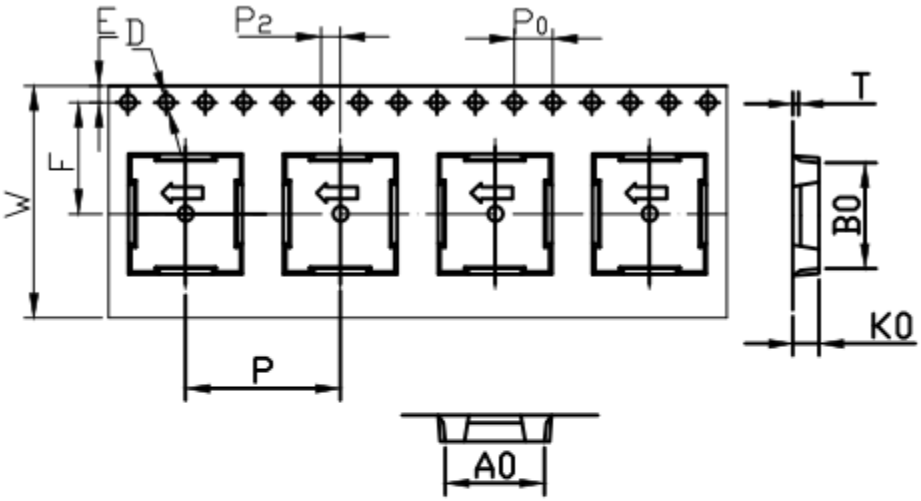
G7A modules in mass production are delivered in the following packaging.

Figure 8-4 Reel and tape package example



Tape details

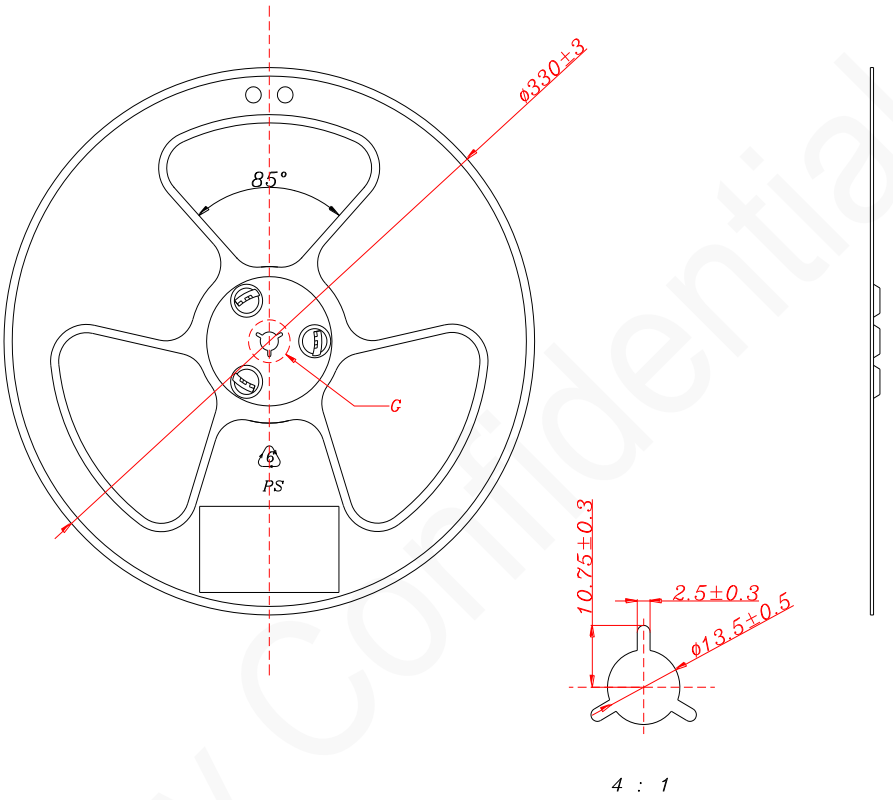
Figure 8-5 Tape details



ITEM	W	A0	B0	K0	K1	P	F	E	D	D1	P0	P2
DIM	24.0 +0.30 -0.10	10.1 +0.10 -0.10	11.0 +0.10 -0.10	2.7 +0.10 -0.10	0.00 +0.10 -0.10	16.0 +0.10 -0.10	11.5 +0.10 -0.10	1.75 +0.10 -0.10	1.50 +0.10 -0.00	0.00 +0.25 -0.00	4.00 +0.10 -0.10	2.00 +0.10 -0.10

Reel details

Figure 8-6 Reel details



8.3.2 Moisture Sensitivity Level

N738-CN series modules are Moisture Sensitive Devices (MSD) in accordance to the IPC/JEDEC specification.

The Moisture Sensitivity Level (MSL) relates to the required packaging and handling precautions. The MSL standard is available in IPC/JEDEC J-STD-020.

- Recommended storage condition: the temperature should be less than 40°C and the relative humidity should be less than 90%.
- The storage life (in vacuum-sealed packaging): 12 months in Recommended Storage Condition.
- Production environment condition: 30°C/60%

After the module is unpacked, if it is exposed to air for a long time, the module will get damped, and may be damaged during reflow soldering or laboratory soldering; bake it before mounting the module and the baking conditions depend on the moisture degree. It is recommended to bake the module at temperatures higher than 120 degrees for more than 6 hours. Do not bake Neoway modules while contained in a . For baking, place modules individually onto the oven tray.

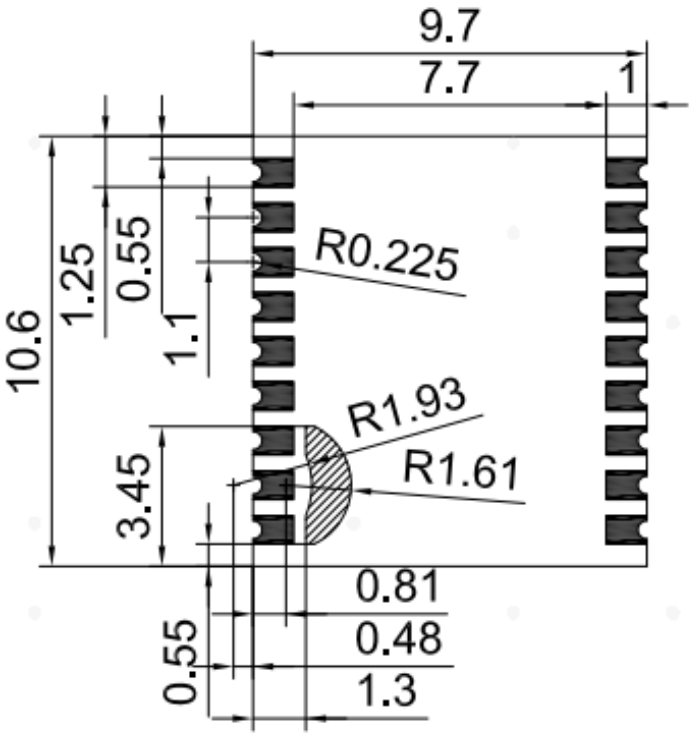
9 Assembly

This chapter describes the G7A module PCB package, application PCB package, and technical points related to SMT.

9.1 Module PCB Package

Do not route traces, dig holes, or lay copper in the area under the module. Otherwise, print green ink or white ink on the surface.

Figure 9-1 Bottom view of the G7A module PCB package (unit: mm)



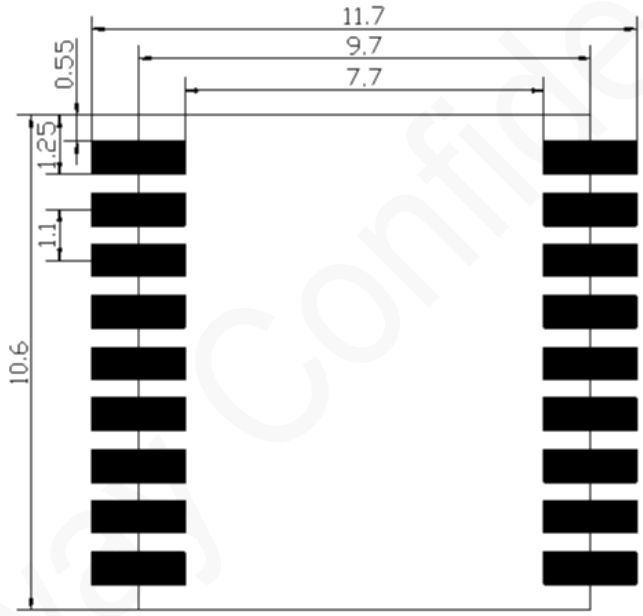
9.2 Application PCB Package

G7A uses the 18-pin LCC package. The recommended PCB package is as follows:

Only GND via-holes and pour coppers are allowed in the shaded area "" of the PCB package to ensure the proper operation of the module.

To achieve higher yield during module production, it is recommended that the distance between other components on the PCB board and the module pads be at least 3 mm to avoid the risk of tin connection when using stepped stencil.

Figure 9-2 Top view of the recommended G7A application PCB package (unit: mm)



9.3 Stencil

The recommended stencil thickness is at least 0.15 mm to 0.20 mm.

9.4 Solder Paste

The solder paste volume and the PCB flatness play key roles in the production yield. Do not use solder pastes with lead that use a module technique that is different from Neoway module technique.

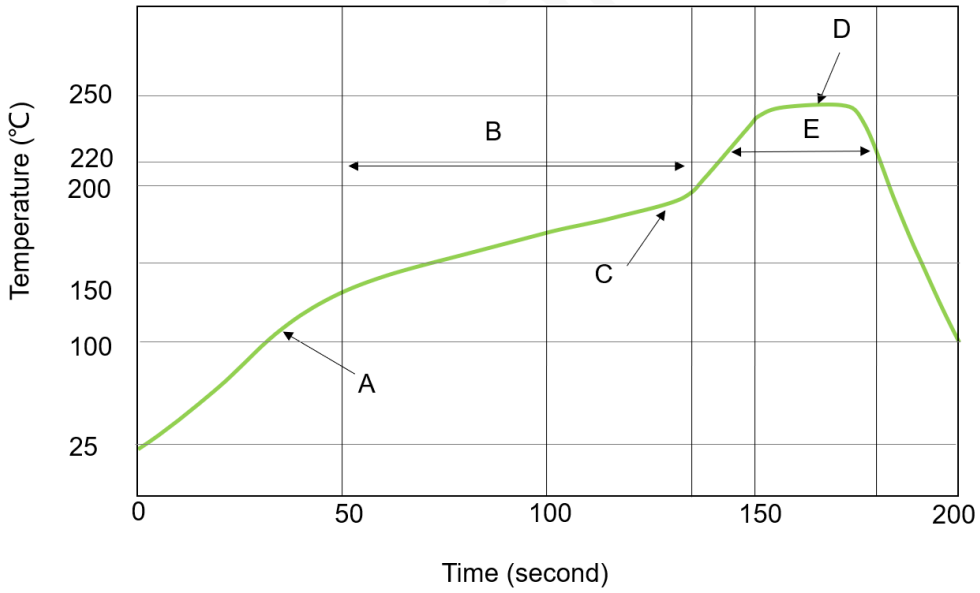
- The melting temperature of solder pastes with lead is 35°C lower than that of solder pastes without lead. The temperature in the reflow process parameters is also lower than that of solder pastes without lead, and less time is consumed correspondingly. It is easy to cause the LCC in the module to be in the semi-melted state after the second reflow soldering, resulting in poor soldering.
- If customers must use solder pastes with lead, ensure that the reflow temperature is kept at 220°C for more than 45 seconds and the peak temperature reaches 240°C.

9.5 SMT Furnace Temperature Curve

Neoway will not provide a warranty for thermal component exceptions caused by improper temperature control.

Thin or long PCB might bend during SMT. Therefore, use loading tools during the SMT and reflow soldering process to avoid poor solder joint caused by PCB bending.

Figure 9-3 SMT furnace temperature curve



Technical parameters:

- Ramp-up rate: 1°C/sec to 4°C/sec
- Ramp-down rate: -3°C/sec to -1°C/sec
- Soaking zone: 150–180°C, time: 60–100s

- Reflow zone: > 220°C, time: 40–90s
- Peak temperature: 235–245°C

For information about important notes in G7A storage and mounting, refer to *Neoway_Reflow_Soldering_Guidelines_For_Surface-Mounted_Modules*.

When manually desoldering the module, use heat guns with great opening, adjust the temperature to about 245°C (depending on the type of the solder paste), and heat the module till the solder paste is melt. Then gently remove the module using tweezers. Do not shake the module in high temperatures while removing it. Otherwise, the components inside the module might get misplaced and cannot be repaired.

A Abbreviations

Abbreviation	Full Name
CEP	Circular Error Probable
DC	Direct Current
ESD	Electronic Static Discharge
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GLONASS	Global Navigation Satellite System
GAGAN	GPS-Aided GEO Augmented Navigation
I/O	Input/Output
LCC	Leadless Chip Carriers
LNA	Low Noise Amplifier
SAW	Surface Acoustic Wave
NMEA	National Marine Electronics Association
PPS	Pulse Per Second
TTFF	Time To First Fix
UART	Universal Asynchronous Receiver-Transmitter