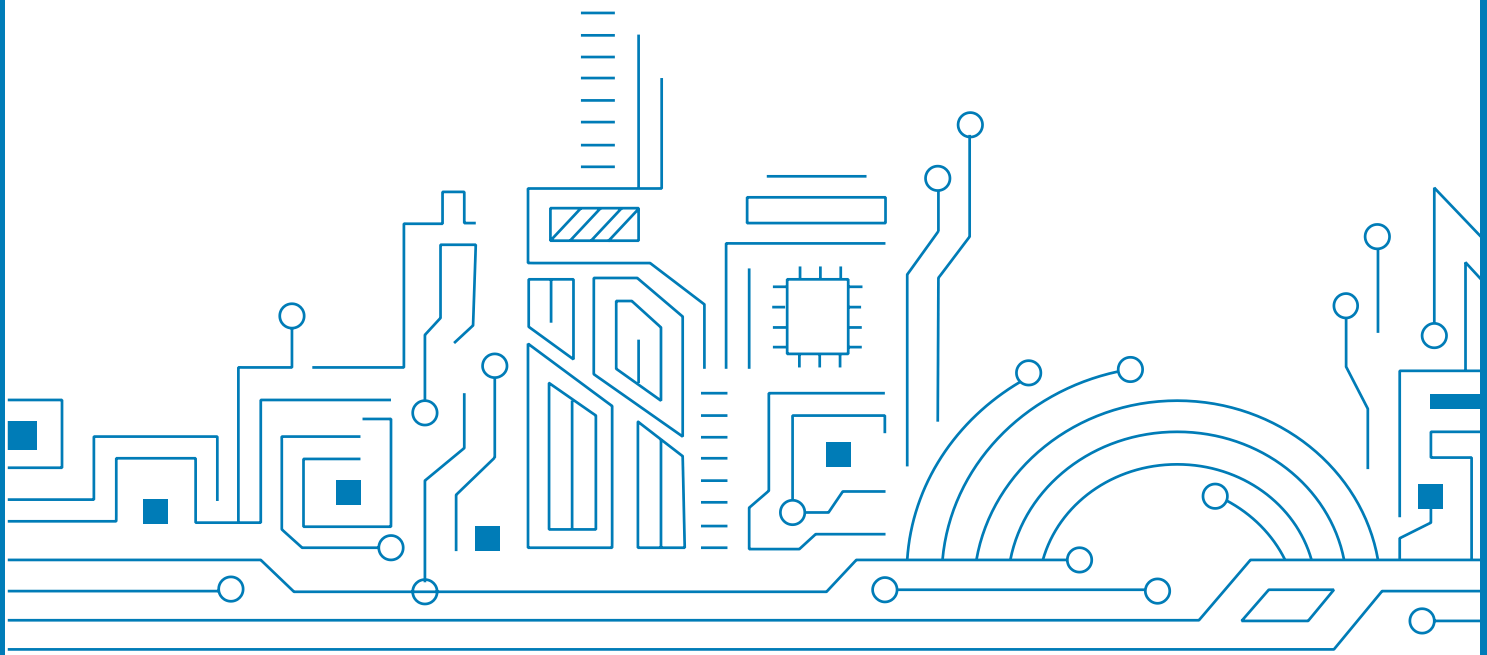
Multi-Band Multi-System RTK Positioning Module

TAU1312

Datasheet V1.0



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1 SYSTEM OVERVIEW

1.1 Overview

TAU1312 is a high-performance dual-band RTK positioning module, which is based on the state of the art CYNOSURE III architecture. It supports BDS-3 (BeiDou Navigation Satellite System 3). Besides, it is capable of tracking BDS, GPS, GLONASS, Galileo, QZSS, and SBAS, etc. TAU1312 integrates efficient power management architecture, while providing high precision, high sensitivity and low power GNSS solutions which make it suitable for navigation applications on automotive and consumer electronics, as well as fleet management.

1.2 Features

- Supports BDS, GPS, GLONASS, Galileo, QZSS, and SBAS
- Compact size for high precision industry
- Integrated Real Time Kinematics (RTK)
- State-of-art low power consumption
- Supports multi-band multi-system high-precision raw data output, easy for 3rd party integration
- Highly integrated module, the best cost-effective high precision GNSS solution

1.3 Module photo

Figure 1 TAU1312 module photo

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1.4 Block diagram

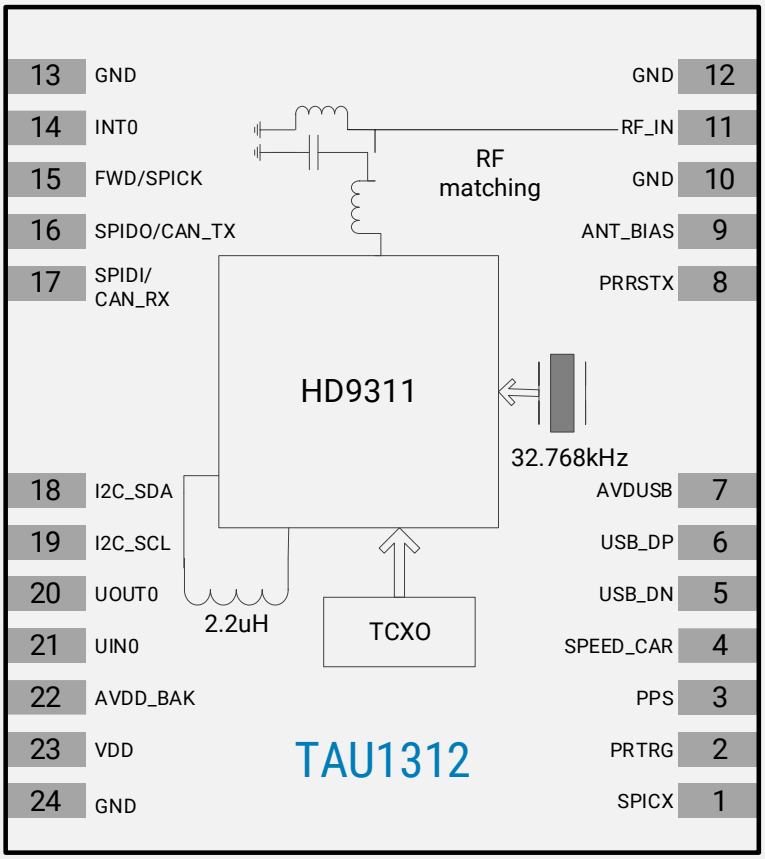

Figure 2 Block diagram

1.5 Specifications

Table 1 Specifications

Parameter	Specification	
GNSS Tacking channel	40 channels	
GNSS Reception	GPS/QZSS: L1C/A, L2C, L5	
	BDS: B1I, B2I, B2a, B3I	
	GLONASS: L1, L2	
	Galileo: E1, E5a	
	SBAS	
Update rate	PVT	10Hz Max.
	RTK	5Hz Max.
Position accuracy [1]	GNSS	2.5m CEP
	SBAS	2.0m CEP
	D-GNSS	<1.0m CEP
	RTK	1.5cm+1ppm(H)
		6.5cm+1ppm(V)
Velocity & Time accuracy	GNSS	0.1m/s CEP

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Parameter	Specification	
	1PPS	20ns
Time to First Fix (TTFF)	Hot start	2 secs
	Cold start	24 secs
	RTK convergence	<10s
Sensitivity	Cold start	-148dBm
	Hot start	-158dBm
	Reacquisition	-160dBm
	Tracking & navigation	-162dBm
Operating limit	Velocity	515 m/s
	Altitude	18,000m
Safety supervision	Antenna short circuit detection	
	Low voltage detection	
Serial interface	USB	1
	SPI	1
	UART	1
	I2C	1
	CAN [2]	1
Protocol	NMEA 0183 Protocol Ver. 4.00/4.10 Cynosure GNSS Receiver Protocol	
Operating condition	Main voltage	1.8 ~ 3.6V
	Digital I/O voltage	1.8 ~ 3.6V
	Backup voltage	1.8 ~ 3.6V
Power consumption	GPS+QZSS, L1 band	22mA [3]
	GNSS, L1+L5 band	34mA [4]
	GNSS, L1+L2 band	34mA [5]
	Standby	12uA [6]
Operating temperature	-40 °C ~ +85 °C	
Storage temperature	-40 °C ~ +85 °C	
Package	12.2mm x 16.0mm x 2.4mm 24-pin stamp hole	
Certification	RoHS & REACH	

* *[1] Demonstrated with a good external LNA*
* *[2] Only customized firmware supported*
* *[3] Open sky conditions, GPS+QZSS, L1 band, 16 tracked Satellites*
* *[4] Open sky conditions, GPS+BDS+GLONASS+Galileo, L1+L5 band, 32 tracked Satellites*
* *[5] Open sky conditions, GPS+BDS+GLONASS+Galileo, L1+L2 band, 32 tracked Satellites*
* *[6] Standby under RTC mode, wake up by PRTRG and RTC time-out*

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1.6 GNSS Reception

Table 2 GNSS reception table

P/N	RF mode	GPS/QZSS					BDS					GLONASS		Galileo			IRNSS	SBAS
		L1CA	L1C	L2C	L5	L6	B1I	B1C	B2I	B2a	B3I	L1	L2	E1	E5	E6	L5	L1
TAU1312	A (L1+ L5)	•	-	-	•	-	•	-	-	•	-	•	-	•	•[1]	-	-	•
	B (L1+ L2)	•	-	•[1]	-	-	•	-	•	-	-	•	•	•	-	-	-	•
	C (L1+ L6)	•	-	•[2]	-	-	•	-	-	-	•	•	-	•	-	-	-	•

* *[1] Supports E5a and Pilot channel only*
* *[2] Supports L2CM*

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2 PIN DESCRIPTION

2.1 Pin assignment

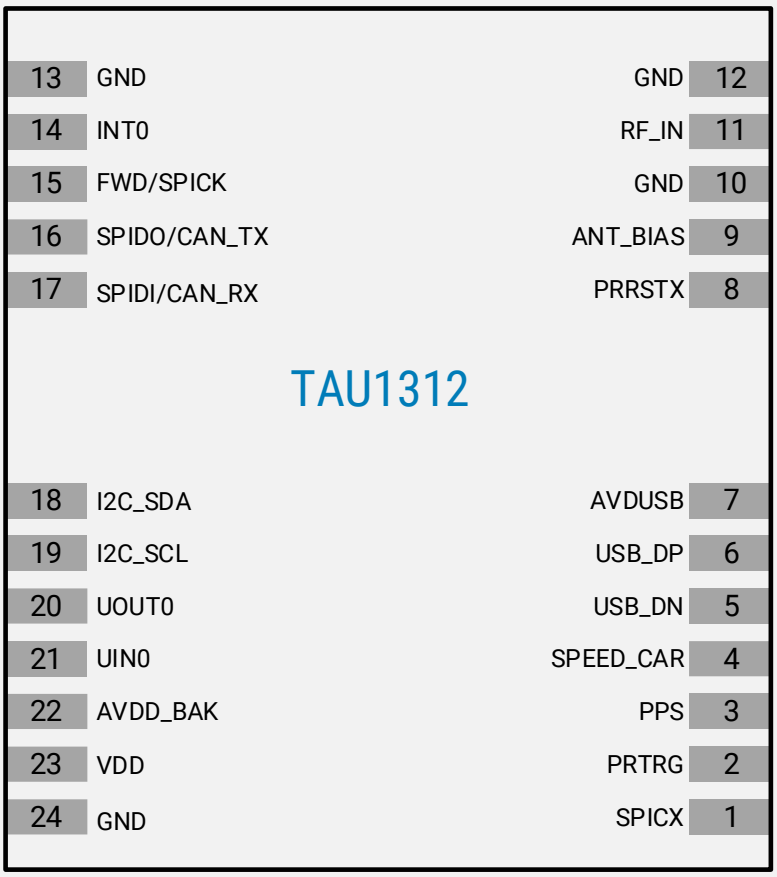

Figure 3 Pin assignment (top view)

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2.2 Detailed pin descriptions

Table 3 Detailed pin descriptions

Function	Symbol	No.	I/O	Description
Power	VDD	23	Power	Main voltage supply. Provide clean and stable supply.
	GND	10,12, 13,24	VSS	Assure a good GND connection to all GND pins of the module, preferably with a large ground plane.
	AVDD_BAK	22	Power	Backup voltage supply. It is recommended to connect a backup supply voltage to AVDD_BAK in order to enable warm and hot start features. Moreover, AVDD_BAK is a must for the system running. If no backup power is available, connect AVDD_BAK to the main power supply.
	AVDUSB	7	Power	USB voltage supply. To use the USB interface, connect this pin to 3.0-3.6V.
Antenna	RF_IN	11	I	Use a controlled impedance of 50Ω for the routing from RF_IN pin to the antenna or the antenna connector.
	ANT_BIAS	9	O	RF section output voltage. The ANT_BIAS pin can be used to supply powers to an external active antenna.
UART	UOUT0	20	O	UART0 serial data output.
	UIN0	21	I	UART0 serial data input.
USB	USB_DN	5	I/O	USB I/O line. USB bidirectional communication pin. Leave it floating if not used.
	USB_DP	6	I/O	
SPI	SPICX	1	O	SPI chip select
	FWD/SPICK	15	O	SPI clock
	SPIDO/CAN_TX	16	O	SPI data or CAN data output. Leave it floating if not used.
	SPIDI/CAN_RX	17	I	SPI data or CAN data input. Leave it floating if not used.
I2C	I2C_SDA	18	I/O	I^2C data. Leave it floating if not used.
	I2C_SCL	19	O	I^2C clock. Leave it floating if not used.
System	PRTRG	2	I	Mode selection, or the trigger input in deep sleep mode to wake up the system
	PRRSTX	8	I	External reset, low active
	PPS	3	O	Time pulse output (PPS)
	SPEED_CAR	4	I	Speed pulse. Leave it floating if not used. Default GPIO.
	INT0	14	O	External interrupt. Leave it floating if not used. Default GPIO.

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3 ELECTRICAL CHARACTERISTICS

3.1 Absolute Maximum Rating

Table 4 Absolute rating

Symbol	Parameter	Min.	Max.	Unit
VDD	Power input for the main power domain	-0.5	3.63	V
AVDD_BAK	Power input for the backup power domain	-0.5	3.63	V
AVDUSB	USB supply voltage	-0.5	3.6	V
$T_{storage}$	Storage temperature	-40	85	°C
T_{solder}	Solder reflow temperature	--	260	°C

3.2 IO Characteristics

3.2.1 PRRSTX and PRTRG

Table 5 PRRSTX and PRTRG

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I_{IZ}	Input leakage current	--	--	--	+/-1	uA
V_{IH}	Input high voltage	--	AVDD_BAK*0. 7	--	AVDD_BAK	V
V_{IL}	Input low voltage	--	0	--	AVDD_BAK*0.3	V
C_i	Input capacitance	--	--	--	10	pF
R_{PU}	Pull-up resistance	--	18	--	84	kOhm

3.2.2 USB I/O

Table 6 USB signal

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I_{IZ}	Input leakage current	--	--	--	+/-10	uA
V_{IH}	Input high voltage	--	AVDUSB*0.9	--	AVDUSB	V
V_{IL}	Input low voltage	--	0	--	AVDUSB*0.1	V
V_{OH}	Output high voltage	I_{OH}=10 mA, AVDUSB =3.3V	2.35	--	--	V
V_{OL}	Output low voltage	I_{OL}=10 mA, AVDUSB =3.3V	--	--	0.5	V
R_{PUIDEL}	Pull-up resistance, idle state	--	0.9	--	1.575	kOhm
$R_{PUACTIVE}$	Pull-up resistance, active state	--	1.425	--	3.09	kOhm

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3.2.3 Others

Table 7 Others

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I_{IZ}	Input leakage current	--	--	--	+/-1	uA
V_{IH}	Input high voltage	--	VDD*0.7	--	VDD	V
V_{IL}	Input low voltage	--	0	--	VDD*0.3	V
V_{OH}	Output high voltage	I_{OH}=11.9 mA, VDD=3.3V	2.64	--	--	V
		I_{OH}=2.8 mA, VDD=1.8V	1.53	--	--	V
V_{OL}	Output low voltage	I_{OL}=7.9 mA, VDD=3.3V	--	--	0.4	V
		I_{OL}=3.9 mA, VDD=1.8V	--	--	0.45	V
C_i	Input capacitance	--	--	--	11	pF
R_{PU}	Pull-up resistance	-	35	--	84	kOhm

3.3 DC Characteristics

3.3.1 Operating Conditions

Table 8 Operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDD	Power input for the main power domain	1.8	3.3	3.6	V
AVDD_BAK	Power input for the backup power domain	1.8	3.3	3.6	V
AVDUSB	USB power input	3.0	3.3	3.6	V
ICC_{max}	Maximum operating current @ VDD	--	--	200	mA
T_{env}	Operating temperature	-40	--	85	°C
$T_{storage}$	Storage temperature	-40	--	85	°C

3.3.2 Power Consumption

Table 9 Power consumption

Symbol	Parameter	Measure Pin	Typ.	Unit
I_{CCRX1}[1]	Run Mode (GPS+QZSS, L1 only)	VDD[3]	22	mA
I_{CCRX2}[2]	Run Mode (All GNSS, L1+L5)	VDD[3]	34	mA
I_{CCDBM}	Standby mode	AVDD_BAK[4]	12	uA

* *[1] GPS+QZSS, L1 band only, 16 tracking channels, position fixed*
* *[2] All GNSS, L1 + L5 band, 32 tracking channels, position fixed*
* *[3] Condition: VDD=3.3V@Room Temperature; All Pins Open.*
* *[4] Condition: AVDD_BAK=3.3V@Room Temperature; All Pins Open.*

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4 HARDWARE DESCRIPTION

4.1 Connecting power

TAU1312 positioning module has two power supply pins: VDD and AVDD_BAK. The VDD pin provides the main supply voltage, and the AVDD_BAK pin provides the backup supply voltage. In order to ensure the positioning performance, please control the ripple of the module power supply. It is recommended to use the LDO above 100mA.

If the power for VDD pin is off, the real-time clock (RTC) and battery backed RAM (BBR) are supplied through the AVDD_BAK pin. Thus, orbit information and time can be maintained and will allow a Hot or Warm start. If no backup battery is connected, the module performs a cold start at every power up if not aiding data are sent to the receiver.

Note: *If no backup supply is available, connect the AVDD_BAK pin to VDD.*

4.2 Antenna design

There isn't built-in LNA and SAW in the GNSS module. It is recommended to use an active antenna with gain less than 50dB and the noise figure less than 1.5dB. The module has built-in short circuit detection and open circuit detection function, which can detect the status of normal connection, and send out antenna status prompt message in NMEA data.

- Short circuit protection
  - The module includes internal short circuit antenna detection. Once an overcurrent is detected at the ANT_BIAS port, the module will cut off this power supply automatically to prevent permanent damages.
- Open circuit detection
  - The module can detect an open circuit in the antenna. Users can judge it from antenna status messages.

4.3 Reset and mode control

The operation mode of GNSS module is controlled by PRRSTX (nRESET) and PRTRG (BOOT) pin.

- Leave PRRSTX and PRTRG pins floating while the module is in normal operation.
- When system powers up or PRRSTX pin is pulled from "Low" to "High", the module will execute an external reset (If the power for AVDD_BAK is always on, this external reset will not affect the ephemeris data in the backup domain).
  - Keeping PRTRG pin floating during system power-up or the external reset (PRRSTX from "Low" to "High"), system will enter User Normal Mode.
  - Drive PRTRG pin to "Low" or connect PRTRG to GND directly (not by pull-down resistance) during system power-up or the external reset (PRRSTX from "Low" to "High"), system will enter BootROM Command Mode at PRTRG is released from "Low" to floating state, and be ready for the upgrade command.
- When connecting PRRSTX and PRTRG to any host IO, DO NOT use a pull-up or pull-down resistance.

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4.4 Serial interfaces

The module provides a TTL Universal Asynchronous Receiver / Transmitter (UART) interface. The data format is: 1 start bit, 8 data bits, 1 stop bit, no checksum, and the default baud rate is 115200 bps. While the module powers on, there is NMEA data outputs. The upper computer can set the operation mode and baud rate of the module through serial interface.
When the module is applied to the specific application where the main supply needs to be cut, in this case, it is recommended to cut the serial interface connection at the same time or set the serial port to input mode or high impedance state.

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5 MECHANICAL SPECIFICATION

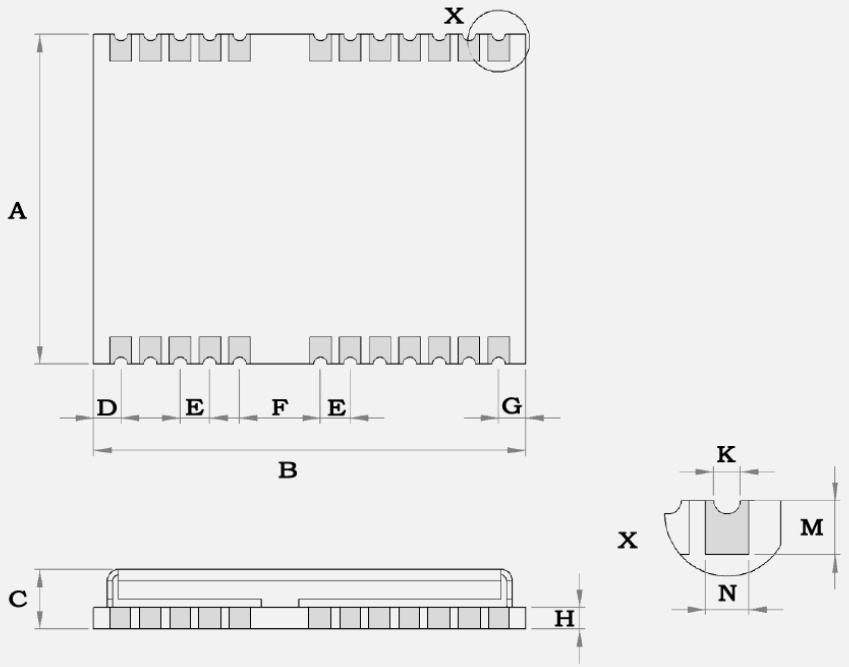

Figure 4 Dimensions

Table 10 Dimensions

Symbol	Min.(mm)	Typ.(mm)	Max.(mm)
A	12.0	12.2	12.4
B	15.8	16.0	16.2
C	2.2	2.4	2.6
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H	--	0.8	--
K	0.4	0.5	0.6
M	0.8	0.9	1.0
N	0.7	0.8	0.9

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6 MINIMAL DESIGN

This is a minimal design for TAU1312 GNSS module. When connecting to an active antenna, make sure there is a 39nH(L1) inductance soldered as shown in the following figure. When it is connected to a passive antenna, there is no need to use the 39nH inductance. Finally, it needs to make sure that the RF line from RF_IN pin to antenna connector meets the 50Ω coplanar waveguide impedance.

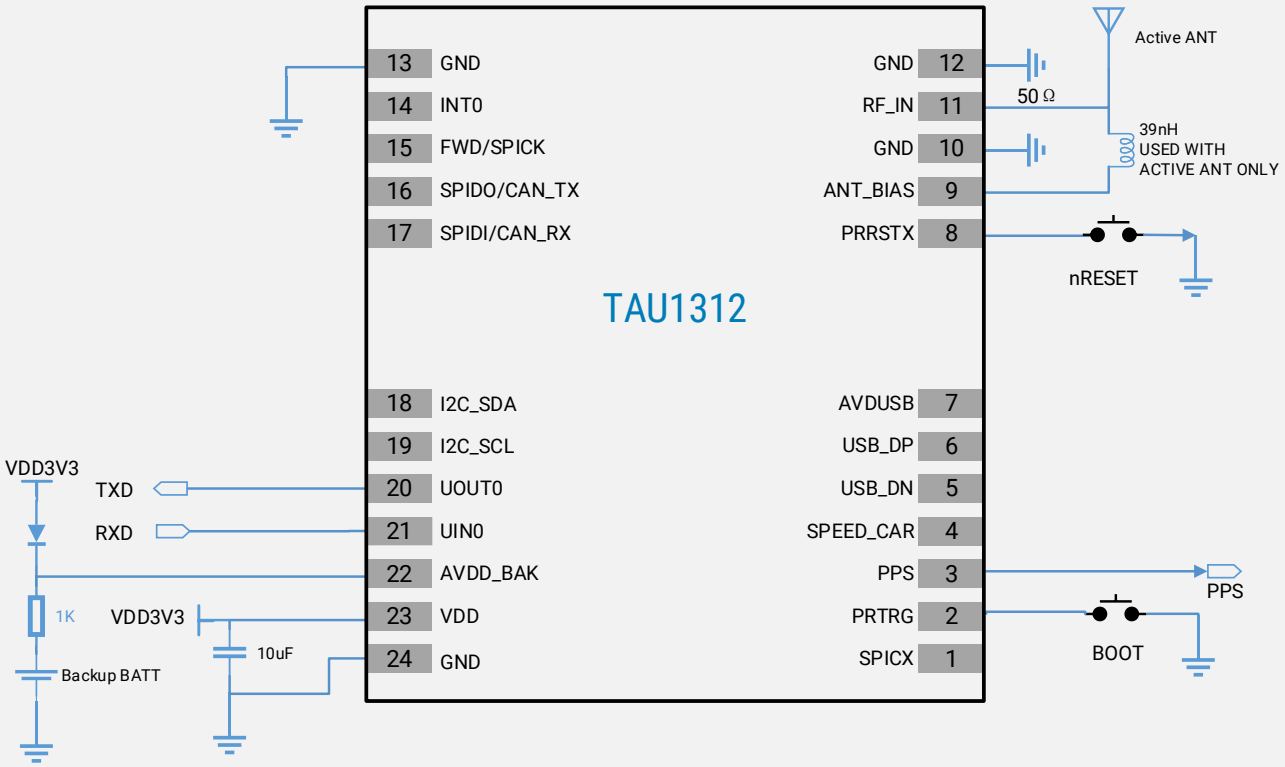

Figure 5 Minimal application diagram

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7 PRODUCT HANDLING

7.1 ESD Handling Precautions

TAU1312 module which contains highly sensitive electronic circuitry is an Electrostatic-sensitive Device (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GNSS module!

- Unless there is a galvanic coupling between the local GND (i.e. the workbench) and the PCB GND, then the first point of contact when handling the PCB must always be between the local GND and PCB GND.
- Before mounting an antenna patch, connect ground of the device.
- When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10 pF, coax cable ~50 – 80 pF/m, soldering iron, …)
- To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.
- When soldering RF connectors and patch antennas to the receiver's RF pin, make sure to use an ESD safe soldering iron (tip).

7.2 ESD protection measures

TAU1312 GNSS positioning module is sensitive to static electricity. Whenever handling it, particular care must be exercised to reduce the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account.

- Add ESD Diodes to the RF input part to prevent electrostatics discharge.
- Do not touch any exposed antenna area.
- Add ESD Diodes to the UART interface.

7.3 Moisture sensitivity level

The Moisture Sensitivity Level (MSL) of the GNSS module is MSL3.

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8 REVISION HISTORY

Revision	Date	Author	Status / Comments
V1.0	2020-06	Vita Wu	First release

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