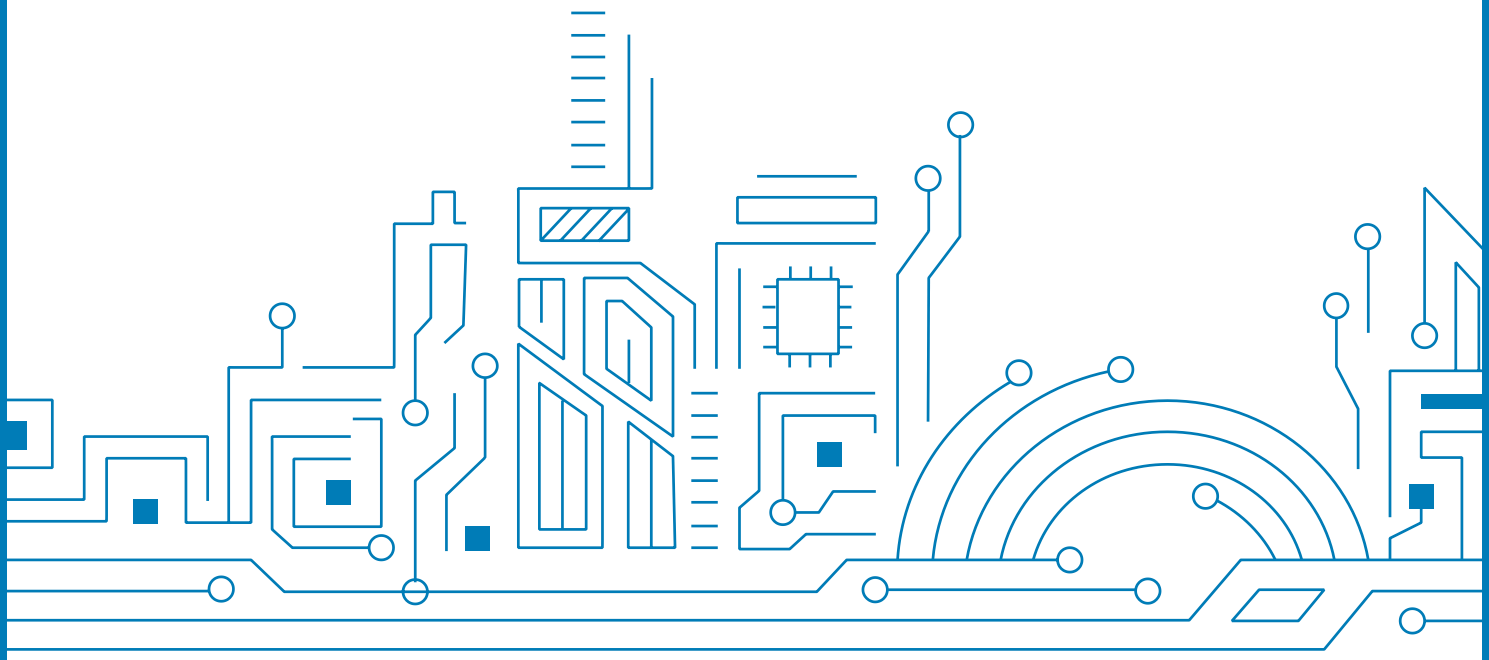
GNSS Raw Data Module

TAU1304

Datasheet V1.2



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About the Document

■ Basic info

Document applies to	TAU1304
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Revision and date	V1.2/2021-07
Product status	Mass production

■ Product status description

In development	Objective specification. Revision may be released in later status.
Engineering sample	Product specifications tested on early. Revision may be released in later status.
Preliminary	Product specifications come from small production. Revision may be released in later status.
Mass production	Final product specification to mass market.

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1 SYSTEM OVERVIEW

1.1 Overview

The TAU1304 module is based on the HD9300 GNSS chip. It is a positioning system that combines GPS, BeiDou, GLONASS, Galileo, and QZSS to provide a high precision positioning and navigation solution. The TAU1304 supports single-band multi-system high-precision raw data output for 3rd party integration and application.

1.2 Features

- Supports GPS, BDS, GLONASS, Galileo, and QZSS
- Active antenna short circuit protection
- Configurable peripheral IO pins
- Low power consumption
- Single supply with wide voltage range
- Single-band multi-system raw data output following standard RTCM Protocol

Table 1 TAU1304

Product	GNSS						Features						Interface				Accuracy			Grade		
	Band (S/D/T)	GPS	BDS	GLONASS	Galileo	IRNSS	Build-in LNA	Programmable (flash)	Data logging	D-GNSS	Oscillator	Raw Data	UART	I2C	USB	SPI	Meter	Sub-meter	Centimeter	Standard	Professional	Automotive
TAU1304-1216A00	S	●	●	●	●			●	●	●	T	●	●	○	○	○			●		●	

T= TCXO ○=Supported upon request with special FW

1.3 Module photo

Figure 1 TAU1304 module photo

1.4 Block diagram

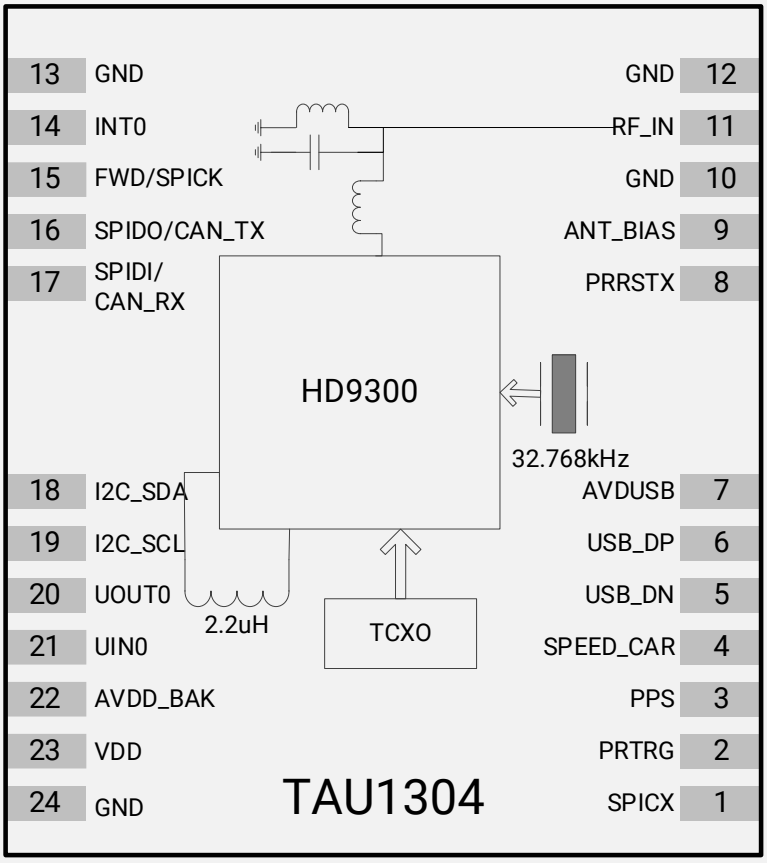


Figure 2 Block diagram

1.5 Specifications

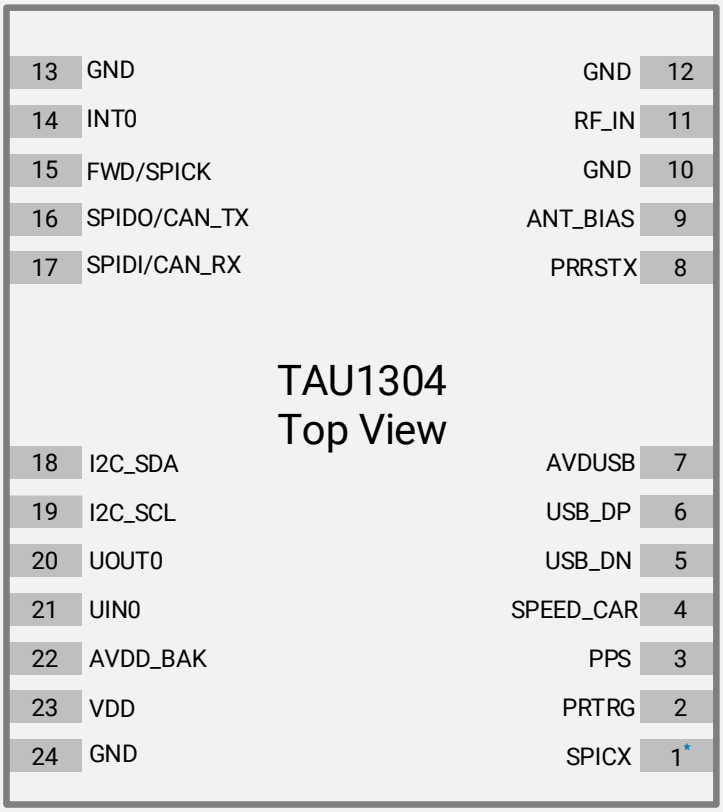
Table 2 Specifications

Parameter	Specification	
GNSS tracking channels	40	
GNSS reception	GPS/QZSS: L1C/A BDS: B1I GLONASS: L1OF Galileo: E1	
Update rate	Maximum 10Hz	
Position accuracy[1]	GNSS	2.5m CEP
	D-GNSS	<1m CEP
Velocity & Time accuracy	GNSS	0.1m/s CEP
	D-GNSS	0.05m/s CEP
	1PPS	20ns
Time to First Fix(TTFF)	Hot start	1 sec
	Cold start	28 secs
Sensitivity	Cold Start	-148dBm
	Hot Start	-158dBm
	Reacquisition	-160dBm
	Tracking & Navigation	-162dBm
Operating condition	Main voltage	2.0 ~ 3.6V
	Digital I/O voltage	1.8 ~ 3.6V
	Backup voltage	1.8 ~ 3.6V
Power consumption	Operative	31mA@3.3V
	Standby	13uA
Interfaces	UART	1
	USB[2]	1
	SPI (master/slave) [2]	1
	I^2C[2]	1
Protocol	RTCM 3.0/3.2/2.3/2.4[3] NMEA 0183 Protocol Ver. 4.00/4.10 Cynosure GNSS Receiver Protocol	
Operating limit	Velocity	515 m/s
	Altitude	18,000 m
Operating temperature	-40 °C ~ +85 °C	
Storage temperature	-40 °C ~ +85 °C	
Dimensions	12.2mm x 16.0mm x 2.4mm	
Certification	RoHS & REACH	

* *[1] Open sky, single band, demonstrated with a good external LNA*
* *[2] Supported upon request with special FW*
* *[3] RTCM 2.3 and 2.4 are supported upon request with special FW*

2 PIN DESCRIPTION

2.1 Pin assignment



* *Pin 1 aligns to the circular hole on module cover.*

Figure 3 Pin assignment (top view)

2.2 Detailed pin descriptions

Table 3 Detailed pin descriptions

Function	Symbol	No.	I/O	Description
Power	VDD	23	Power	Main power supply voltage.
	GND	10, 12, 13, 24	VSS	Ground
	AVDD_BAK	22	Power	Backup power supply voltage input.
	AVDUSB	7	Power	USB power supply voltage.
Antenna	RF_IN	11	I	The connection to the antenna must be routed on the PCB. Use a controlled impedance of 50Ω to connect RF_IN 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[1]	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[1]	SPICX	1	O	SPI chip select
	FWD/SPICK	15	O	SPI clock
	SPIDO/CAN_TX	16	O	SPI data output
	SPIDI/CAN_RX	17	I	SPI data input
I2C/CAN[1]	I2C_SDA	18	I/O	I2C data input
	I2C_SCL	19	I/O	I2C clock output
System	PRTRG	2	I	Mode selection, or wake up signal
	PRRSTX	8	I	External reset, low active
	PPS	3	O	Configuration Time pulse signal (one pulse per second by default). Leave it floating if not used. Default is GPIO.
	SPEED_CAR[1]	4	I	External interrupt pin, leave it floating if not used
	INT0	14	I	The INT0 pin can be used to turn on and off an optional external LNA.

* *[1] Supported upon request with special FW*

3 ELECTRICAL CHARACTERISTICS

3.1 Absolute maximum rating

This module contains devices to protect the inputs from high static voltage damage. However, it is advisable to take appropriate precautions to avoid application of any voltage higher than the specified maximum rated voltages. Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

Table 4 Absolute rating

Symbol	Parameter	Min.	Max.	Unit
VDD	Power supply voltage	-0.5	3.6	V
AVDD_BAK	Backup battery voltage	-0.5	3.6	V
AVDUSB	USB supply voltage	-0.5	3.6	V
VI_{max}	Input pin voltage	-0.5	3.6	V
$T_{storage}$	Storage temperature range	-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	kΩ
$R_{PUACTIVE}$	Pull-up resistance, active state	--	1.425	--	3.09	kΩ

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
V_{OL}	Output low voltage	I_{OL}=7.9 mA, VDD=3.3V	--	--	0.4	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 supply voltage	2.0	3.3	3.6	V
AVDD_BAK	Backup battery voltage	1.8	3.3	3.6	V
AVDUSB	USB supply voltage	2.6	3.3	3.6	V
I_{ANT_BIAS}	ANT_BIAS output current	-	-	35	mA
V_{ANT_BIAS}	ANT_BIAS output voltage	-	VDD-0.2	-	V
T_{env}	Operating temperature range	-40	--	85	°C

3.3.2 Power Consumption

Table 9 Power consumption

Symbol	Parameter	Measure Pin	Typ.	Unit
I_{CCRX1}	Average tracking current (GNSS, L1 only)	VDD[1]	31	mA
I_{CCDBM}	Standby Mode	AVDD_BAK[2]	13	uA

* *[1] Condition: VDD=3.3V@Room Temperature; All Pins Open.*
* *[2] Condition: AVDD_BAK=3.3V@Room Temperature; All Pins Open.*

4 HARDWARE DESCRIPTION

4.1 Connecting power

TAU1304 positioning module has up to three power supply pins: VDD, AVDD_BAK and AVDUSB.

4.1.1 VDD: Main supply voltage

The main power is supplied through the VDD pin to the module. During operation, the current drawn by the module can vary by some orders of magnitude, especially if enabling low-power operation modes. For this reason, it is important that the supply circuitry is able to support the peak power for a short time.

4.1.2 AVDD_BAK: Backup supply voltage

If the main supply 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 no aiding data are sent to the receiver.
Note: *If no backup supply is available, connect the AVDD_BAK pin to VDD or leave it floating.*

4.1.3 AVDUSB: USB supply voltage

The USB interface is powered through the AVDUSB pin.

4.1.4 ANT_BIAS: Output voltage for active antenna

An active antenna or external LNA is powered through the ANT_BIAS pin.

4.2 Power on/off Sequence

The module has two independent power domains (backup and main domain). In data backup mode, main power supply can be completely shut down for further power reduction for ultra-low power application.

4.2.1 Initial system power on

When both backup and main supply power on from their off state, external reset (PRRSTX) must be active and hold more than 5ms after both backup supply and main supply reach the minimum operating voltage. Initial system power on sequence is illustrated in Figure 4.

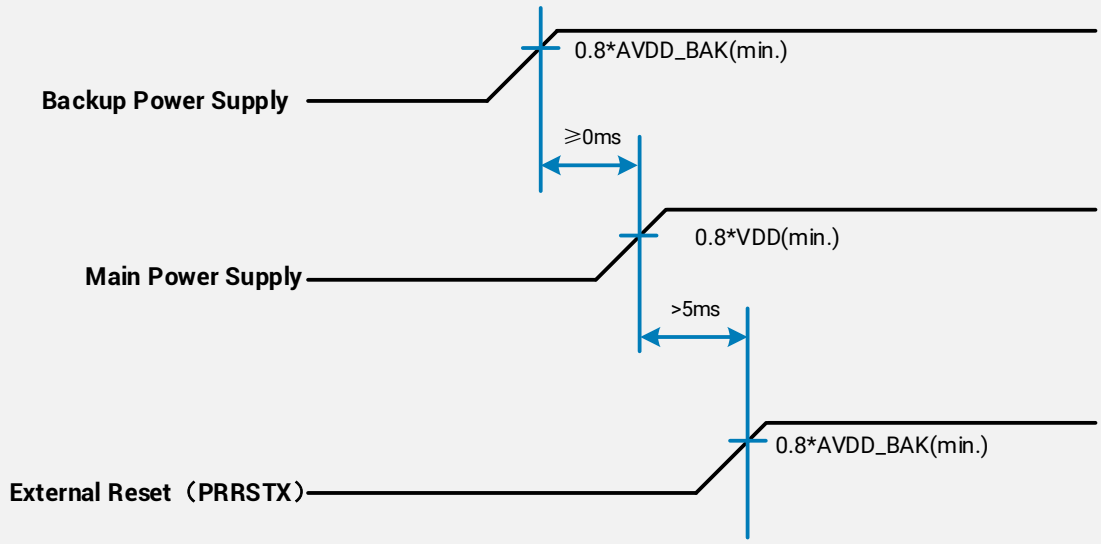


Figure 4 Initial system power on sequence

4.2.2 Main power supply off/on in application

If application intends to shut down main power supply (VDD) while keep backup power supply (AVDD_BAK) alive to save backup data, the following rules should be applied:

External reset (PRRSTX) must be active when main power supply is under power off. In this case, external reset must be hold active more than 5ms after main power supply resumes to minimum operating voltage. Main power on sequence in application is illustrated in Figure 5.

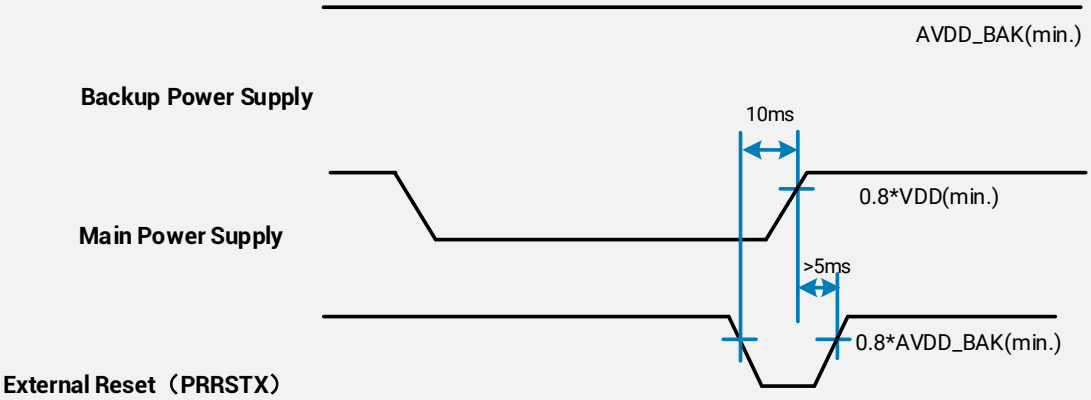


Figure 5 Main power on sequence

4.3 Antenna design

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 protection and open circuit detection functions, 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 restrict the current output automatically to protect from damage.
- **Open circuit detection**
  - The module can detect an open circuit in the antenna. Users can judge it from antenna status messages.

4.4 Reset and mode control

The operation mode of GNSS module is controlled by PRRSTX (nRESET) and PRTRG (BOOT) pin. While the module works in normal operation, leave PRRSTX and PRTRG pins floating if there is no upgrading or reset demands, or others.

- Keep PRTRG pin floating during system power-up or the external reset (PRRSTX from low to high), and the module will enter **User Normal Mode**.
- When the module powers up or PRRSTX from low to high, the module will execute an **external reset**. (If the power for AVDD_BAK is always on, the external reset will not affect the ephemeris data in the backup domain)
- 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), and the system enters **BootROM Command Mode** at PRTRG pin being released from low to floating state, and ready for firmware upgrading command.
- When connecting PRRSTX and PRTRG to any host IO, DO NOT use the pull-up or pull-down resistance.

4.5 Interfaces

4.6 Serial interfaces

Table 10 Default message

Interface	Settings
UART output	115200 baud, 8 data bits, no parity bit, 1 stop bit Configured to transmit both NMEA and HD Binary protocols, but only the following NMEA (and no HD Binary sentence) messages have been activated at start-up: GGA, GSA, GSV, RMC, ZDA, TXT-ANT
UART input	115200 baud, 8 data bits, no parity bit, 1 stop bit, autobauding disabled Automatically accepts following protocols without need of explicit configuration: HD binary sentence, NMEA, RTCM The GNSS receiver supports interleaved HD binary and NMEA messages.
Timepulse (1Hz Nav)	1 pulse per second, synchronized at rising edge, pulse length 100ms

* *Refer to GNSS_Protocol_Specification for information about other settings.*

When the module is applied to the specific application, users can shut off the main power in order to further reduce the power consumption. To avoid the high level in serial interface influencing the normal operation, it is highly suggested to cut off the serial port when shut off the main power. Otherwise, please set the serial port to input mode or high impedance state with pull-down resistor.

4.6.1 USB

USB version 2.0 FS compatible interface can be used for communication as an alternative to the UART.

- Supports USB 2.0 full speed
- Full Speed: 12 Mbps
- Supports Windows XP/7/8/10 OS®

4.6.2 SPI

The Serial Peripheral Interface (SPI) supports SPI protocol. The SPI protocol allows a full-duplex, synchronous and serial communication to external devices. And SPI supports master mode. SPI features:

- Full-duplex synchronous communication
- Master/slave mode is programmable
- The frequency of SPICK clock is programmable

4.6.3 I2C

The I2C interface is a serial input & output port, operating as a master & slave device.

- Master / Slave transmitting & receiving
- Speed support: 100Kps, 400Kps

5 MECHANICAL SPECIFICATION

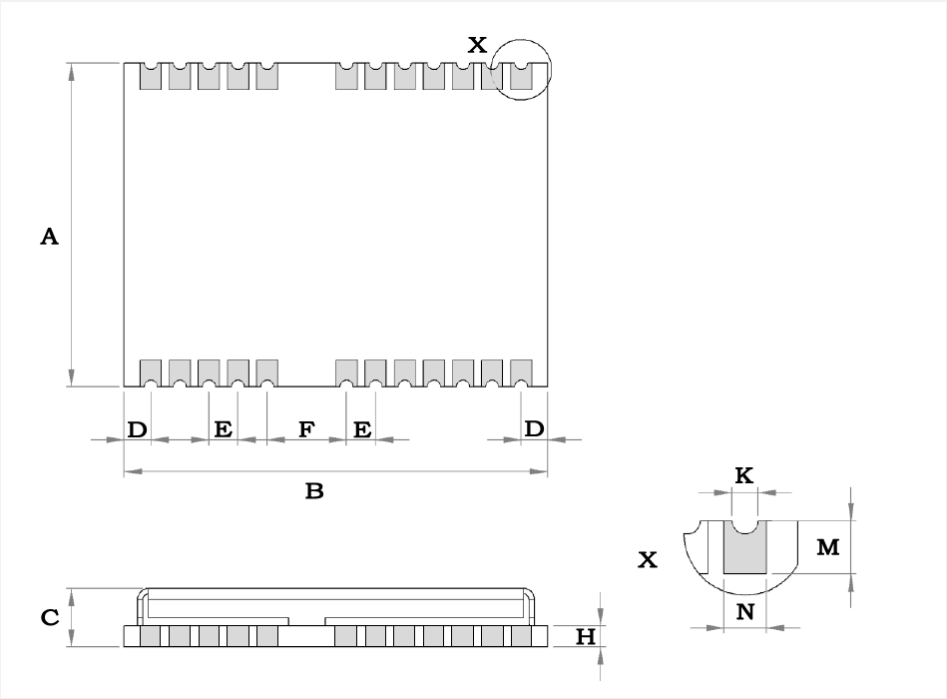


Figure 6 Dimensions

Table 11 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
H	--	0.8	--
K	0.4	0.5	0.6
M	0.8	0.9	1.0
N	0.7	0.8	0.9

6 REFERENCE DESIGN

6.1 Minimal Design

This is a minimal design for TAU1304 GNSS module. The 82nH inductor is used only when an active antenna is connected, and no need with a passive antenna. The characteristic impedance from RF_IN pin to the antenna connector should be 50Ω.

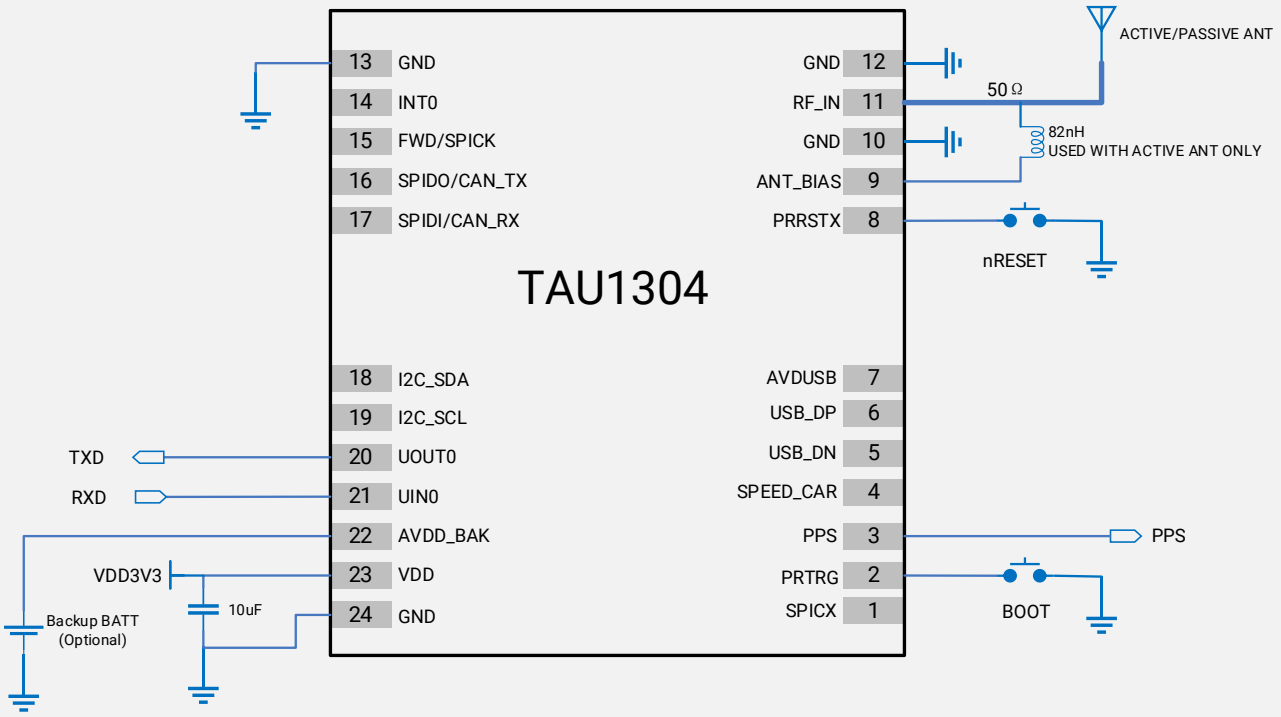


Figure 7 Minimal application diagram

6.2 PCB Footprint Reference

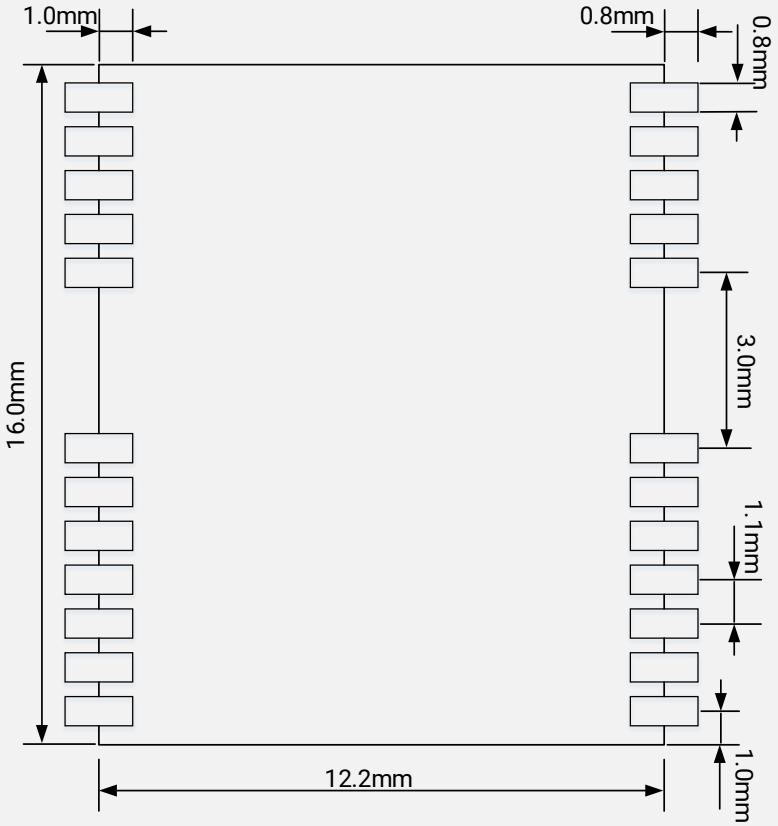


Figure 8 PCB Footprint Reference

6.3 Layout Notes

(1) A decoupling capacitor should be placed close to VDD pin of the module, and the width of power routing should be more than 0.5mm;
(2) The width of RF routing between RF port to antenna interface should be wider than 0.2mm. The characteristic impedance of RF routing between RF port to antenna interface should be controlled to 50Ω.
(3) It is recommended that the routing from RF port to antenna interface refers to the second layer, and no routing are recommended on the layer.
(4) Do not place the module close to any EMI source, like antenna, RF routing, DC/DC or power conductor, clock signal or other high-frequency switching signal, etc.

7 PRODUCT PACKAGING AND HANDLING

7.1 Packaging

7.1.1 Packaging Notes

TAU1304 is a Moisture Sensitive Device (MSD) and Electrostatic Sensitive Device (ESD). During the packing and shipping, it is strictly required to take appropriate MSD handling instructions and precautions. The table below shows the general packing hierarchy for the standard shipment.

Table 12 Packing hierarchy

Module	Reel	Sealed bag	Shipping carton
			

7.1.2 Tape and Reel

TAU1304 is delivered as hermetically sealed, reeled tapes in order to enable efficient production, production lot set-up and tear-down. The figure below shows the tape dimensions.

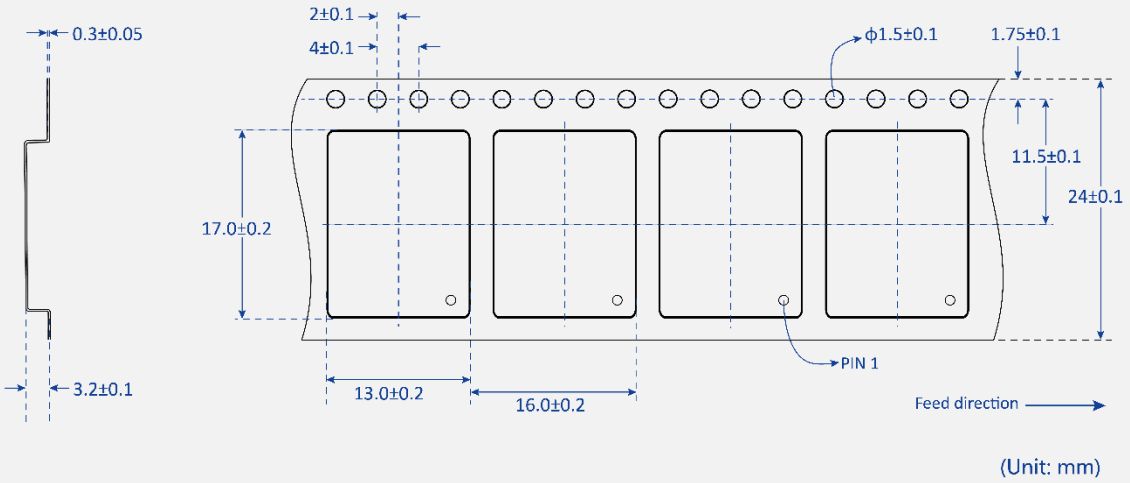


Figure 9 Tape dimensions

TAU1304 is deliverable in quantities of 1000pcs on a reel. The figure below shows the dimensions of reel for TAU1304.

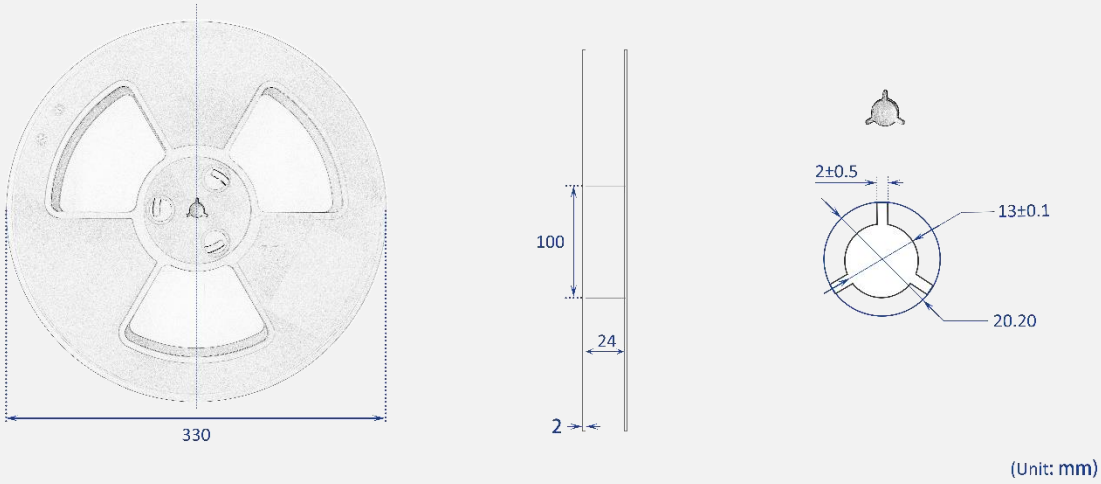


Figure 10 Reel dimensions

7.1.3 Shipment Packaging

The reels of TAU1304 are packed in the sealed bags and shipped by shipping cartons. Up to five sealed bags (5000pcs in total) can be packed in one shipping carton.

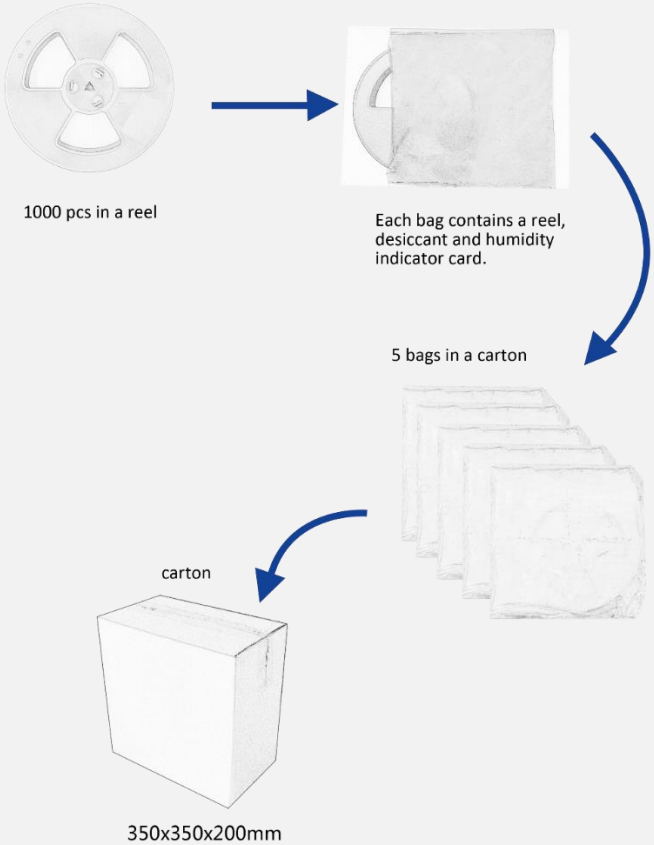


Figure 11 Packaging

7.2 Storage

In order to prevent moisture intake and protect against electrostatic discharge, TAU1304 is packaged together with a humidity indicator card and desiccant to absorb humidity.

7.3 Product handling

7.3.1 ESD Handling Precautions

TAU1304 which contains highly sensitive electronic circuitry is an Electrostatic-sensitive Device (ESD). Observe precautions for handling! Failure to observe these precautions may 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).

7.3.2 ESD protection measures

The GNSS positioning module is sensitive to static electricity. Whenever handling the module, 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:

1) Adds ESD Diodes to the RF input part to prevent electrostatics discharge.
2) Do not touch any exposed antenna area.
3) Adds ESD Diodes to the UART interface.

7.3.3 Moisture sensitivity level

The Moisture Sensitivity Level (MSL) of the GNSS module is MSL4.

8 LABELING AND ORDERING INFORMATION

Labeling and ordering information help customers get more about Allystar products.

8.1 Labeling

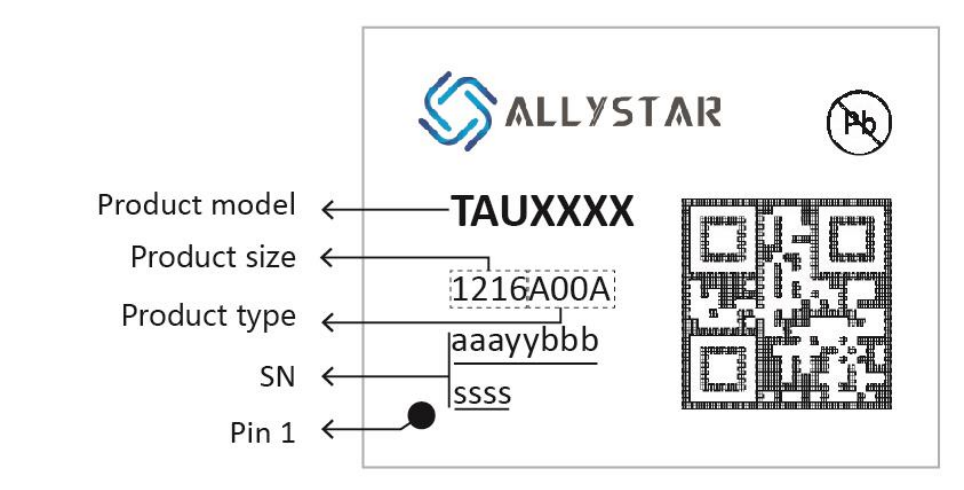


Table 13 Labeling content

Symbol	Explanation	Instance
TAUXXXX	Product model	TAU1304
1216A00A	1216 represents the product size.	1216A00
	A00 means the product type.	
	Second A refers to sales area code. Different code for different sales area.	E (for Europe market)
aaayybbbssss	Serial number	351190010001

8.2 Ordering info

Table 14 Ordering codes

Ordering No.	Product
TAU1304-1216A00E	Concurrent GNSS LCC Module, TCXO, ROM, 12.2*16mm, 1000 pieces/reel, Europe market.
TAU1304-1216A00H	Concurrent GNSS LCC Module, TCXO, ROM, 12.2*16mm, 1000 pieces/reel, India market.
TAU1304-1216A00R	Concurrent GNSS LCC Module, TCXO, ROM, 12.2*16mm, 1000 pieces/reel, Russia market.

9 RELATED DOCUMENTS

[1] Satrack User Manual

[2] Allystar Common Commands

[3] Recommended Reflow Profile

[4] GNSS_Protocol_Specification

10 REVISION HISTORY

Revision	Date	Author	Status / Comments
V1.0	2020-03-02	Vita Wu	Start version, first released
V1.1	2020-12	Vita Wu	Deletes SBAS support. Improves *Section 4.4 Reset and mode control.* Simplifies PIN description in *Section 2.2.* Improves mechanical specification. Improves layout notes in Section 6.3. Clarifies power on/off sequence in Section 4.2. Deletes 1K resistor in the minimal design diagram. Localization. Updates description about short circuit protection in Section 4.3. Other wording improvements. Localization.
V1.2	2021-07	Vita Wu	Adds labeling and ordering info. Details default settings. Adds related document list. Adds document info section. Updates operative VDD to 2.0~3.6V.

www.allystar.com

info.gnss@allystar.com

Headquarters

Allystar Technology (Shenzhen) Co., Ltd.
Address: 5F, Building No.4, Winlead Intelligent Park, No.3, FaDa road (middle), Bantian Subdistrict, LongGang District, Shenzhen City, Guangdong Province, China.

Calgary Office

Allystar Technology (Canada) Ltd.
Address: Unit 288, 3553 31 Street NW Calgary, Alberta, Canada T2L 2K7