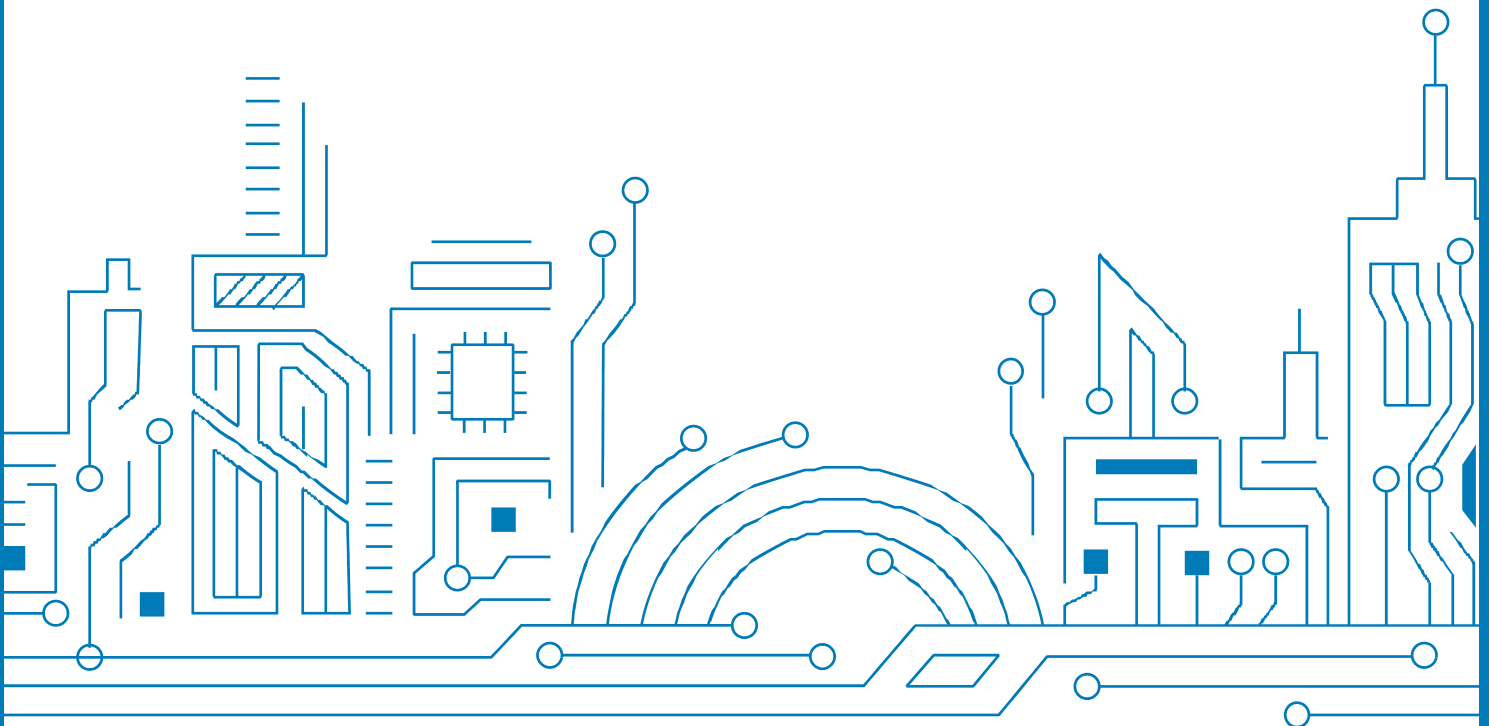


GNSS Positioning Module

TAU1113

Datasheet V1.7



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About the Document

■ Basic info

Document applies to	TAU1113
Document type	Datasheet
Revision and date	V1.7/2024-07
Product status	Preliminary

■ 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 General Description

TAU1113 is a cost-effective low power GNSS positioning module based on CYNOSURE III Lite GNSS SoC chip. It supports GPS/QZSS, BDS, Galileo, GLONASS and SBAS. The module features SAW, LNA, flash memory as well as an antenna supervisor in a compact form factor.

TAU1113 is a versatile receiver that can be used with active and passive antennas, making it an excellent choice for a wide range of applications such as tracking, telematics and navigation. The fast start-up in combined with the lower power consumption and the very low backup current make the TAU1113 particularly suitable for use in battery-powered devices, e.g., for asset tracking.

1.2 Features

- Versatile GNSS module supporting GPS/QZSS, BDS, Galileo, GLONASS and SBAS
- Low current consumption of only 16 mA for GPS/QZSS
- Backup current of only 15 μ A
- Active and passive antennas supported thanks to built-in SAW and LNA
- Supports Allystar's free-of-charge A-GNSS service for minimal startup times
- Pin-compatible with previous generation TAU1103, TAU1105 and many mainstream GNSS modules

Table 1 TAU1113

Product	GNSS								Feature				Interface				Accuracy			Grade		
	GNSS system mode	Band (S/D/T)	GPS/QZSS	BDS	GLONASS	Galileo	NavIC	SBAS	Built-in LNA	Programmable (flash)	Data logging	D-GNSS	Oscillator	UART	I2C	USB	SPI	Meter	Sub-meter	Centimeter	Industrial	Automotive
TAU1113-1010A00E	01	S	●		●			●	●	●	●	●	T	●				●			●	
	02	S	●		●	●		●	●	●	●	●	T	●				●			●	
	03	S	●	●		●		●	●	●	●	●	T	●				●			●	

T = TCXO

1.3 Module Photo



Figure 1 TAU1113 module

1.4 Block Diagram

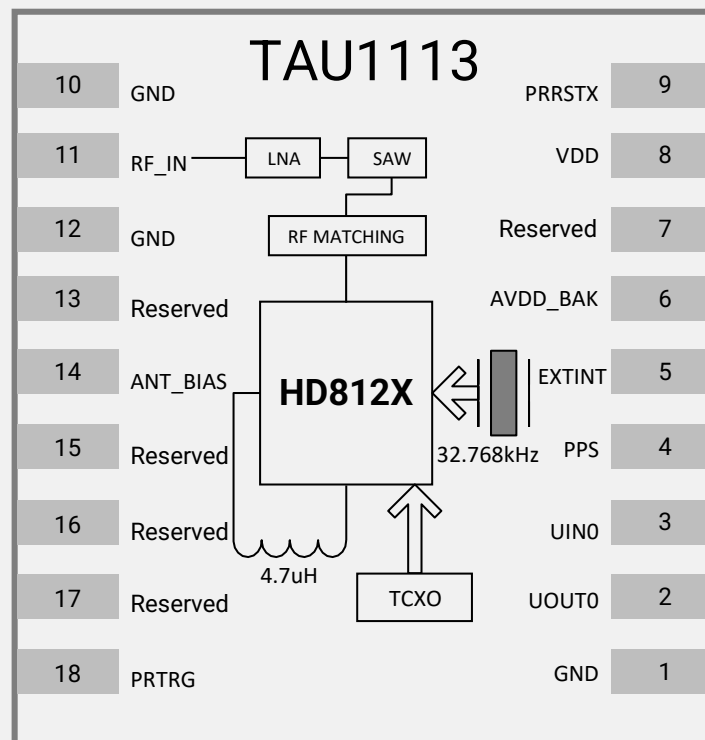


Figure 2 Block diagram

1.5 Specifications

Table 2 Specifications

Parameter	Specification		
GNSS channels	88 in total		
GNSS reception	GPS/QZSS: L1C/A		
	GLONASS: G1		
	Galileo: E1		
	BDS: B1I		
	SBAS: L1 (SDCM, WAAS, EGNOS, GAGAN and MSAS)		
Updating rate	5 Hz maximum		
Position accuracy ^[1]	GNSS	1.5m CEP	
	GNSS (with SBAS)	< 1.0m CEP	
Velocity & Time accuracy	GNSS	0.1 m/s CEP	
	1PPS	20 ns	
Sensitivity ^[2]	Cold start	-148 dBm	
	Hot start	-156 dBm	
	Reacquisition	-158 dBm	
	Tracking	-163 dBm	
Operating condition	Main voltage	2.0-3.63 V	
	Digital I/O voltage	2.0-3.63 V	
	Backup voltage	1.8-3.63 V	
Power consumption	Tracking	GPS/QZSS+Galileo+GLONASS+SBAS	21 mA @ 3.3V
		GPS/QZSS+GLONASS+SBAS	20 mA @ 3.3V
		GPS/QZSS+Galileo+BDS+SBAS	17 mA @ 3.3V
		GPS/QZSS	16 mA @ 3.3V
	Acquisition	GPS/QZSS+Galileo+GLONASS+SBAS	21 mA @ 3.3V
		GPS/QZSS+GLONASS+SBAS	21 mA @ 3.3V
		GPS/QZSS+Galileo+BDS+SBAS	17 mA @ 3.3V
		GPS/QZSS	16 mA @ 3.3V
	Standby mode	15 uA @ 3.3V	
Serial interface	UART	1	
Protocol	NMEA 0183 Protocol Ver.3.01/4.00/4.10 (Default) Cynosure GNSS Receiver Protocol		
Operating limit	Velocity	515 m/s	
	Altitude	18,000m	
Antenna supervision	Antenna short circuit protection and open circuit detection		
Operating temperature	-40°C to +85°C		
Storage temperature	-40°C to +85°C		

Package	10.1x9.7x2.5 mm 18-pin LCC
Certification	RoHS, REACH, FCC, CE-RED

* [1] Open sky condition.

* [2] Demonstrated with a good external LNA.

Table 3 Time To First Fix (TTFF)

Parameter	GPS/QZSS+Galileo+ GLONASS+SBAS	GPS/QZSS+GLONASS+ SBAS	GPS/QZSS+Galileo +BDS+SBAS	GPS/QZSS
Hot start	2s	2s	2s	1s
Cold start	26s	28s	28s	28s

2 PIN DESCRIPTION

2.1 Pin Assignment

10	GND	PRRSTX	9
11	RF_IN	VDD	8
12	GND	Reserved	7
13	Reserved	AVDD_BAK	6
14	ANT_BIAS	EXTINT	5
15	Reserved	PPS	4
16	Reserved	UIN0	3
17	Reserved	UOUT0	2
18	PRTRG	GND	1*

**TAU1113
Top View**

Figure 3 Pin assignment (top view)

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

2.2 Detailed Pin Descriptions

Table 4 Detailed pin descriptions

Function	Symbol	No.	I/O	Description
Power	VDD	8	Power	Main power supply voltage input.
	GND	1, 10, 12	VSS	Assure a good GND connection to all GND pins of the module, preferably with a large ground plane.
	AVDD_BAK	6	Power	Backup power supply voltage input. Backup power is needed in order to enable warm and hot start features. Backup power is a must for system working. If no backup power is available, connect AVDD_BAK to the main power supply.
Antenna	RF_IN	11	I	RF signal input. Use a controlled impedance of 50Ω for the routing from RF_IN pin to the antenna or the antenna connector.
	ANT_BIAS	14	O	Antenna bias voltage output. The ANT_BIAS pin can be used to power an external active antenna, and the current should be no more than 25 mA.
UART	UOUT0	2	O	UART0 serial data output.
	UIN0	3	I	UART0 serial data input.
Other	PRTRG	18	I	Mode selection, or the trigger input in deep sleep mode to wake up the system.
	PRRSTX	9	I	External reset, low active
	PPS	4	O	Setting for time pulse output (PPS). Leave it floating if not used.
	EXTINT	5	I	A trigger pin to external interrupt. Leave it floating if not used.
	Reserved	7, 13, 15, 16, 17	-	Reserved. Leave it floating if not used.

3 ELECTRICAL CHARACTERISTICS

3.1 Absolute Maximum Rating

Table 5 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
V _I max	Digital I/O pin input voltage	-0.5	3.6	V
T _{storage}	Storage temperature	-40	85	°C
T _{solder}	Solder reflow temperature	-	260	°C
VESD (HBM)	Maximum tolerable ESD level	-	2000	V

3.2 IO Characteristics

3.2.1 PRRSTX and PRTRG

Table 6 PRRSTX and PRTRG

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I _{IZ}	Input leakage current	--	-	-	+/-1	uA
V _{IH}	Input high voltage	--	AVDD_BAK* 0.67	-	AVDD_BAK	V
V _{IL}	Input low voltage	--	0	-	AVDD_BAK*0.27	V
V _{OH}	Output highvoltage	I _{OH} = 5.3 mA, AVDD_BAK = 3.3V	2.64	-	-	V
		I _{OH} = 1.2 mA, AVDD_BAK = 1.8V	1.53	-	-	V
V _{OL}	Output low voltage	I _{OL} = 3.9 mA, AVDD_BAK = 3.3V	-	-	0.4	V
		I _{OL} = 1.9 mA, AVDD_BAK = 1.8V	-	-	0.45	V
C _i	Input capacitance	--	-	-	11	pF
R _{PU}	Pull-up resistance	--	35	-	84	kΩ

3.2.2 Others

Table 7 Others

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I _{IZ}	Input leakage current	--	--	--	+/-1	uA
V _{IH}	Input high voltage	--	VDD*0.67	--	VDD	V
V _{IL}	Input low voltage	--	0	--	VDD*0.27	V
V _{OH}	Output high voltage	I _{OH} = 5.3 mA, VDD = 3.3V	2.64	--	--	V
V _{OL}	Output low voltage	I _{OL} = 3.9 mA, VDD = 3.3V	--	--	0.4	V
C _i	Input capacitance	--	--	--	11	pF
R _{PU}	Pull-up resistance	--	35	--	84	kΩ

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	3.63	V
AVDD_BAK	Backup battery voltage	1.8	3.3	3.63	V
ICC _{max}	Maximum operating current @ VDD	--	--	200	mA
T _{env}	Operating temperature	-40	--	85	°C
V _{ANT_BIAS}	Antenna bias voltage	--	VDD-0.15 ^[1]	--	V

* [1] Condition: tested at high, low, and room temperature, with 0.1V deviation.

3.3.2 Power Consumption

Table 9 Power consumption

Parameter		Measure Pin	Typ.	Unit
Tracking	GPS/QZSS+Galileo+GLONASS+SBAS	VDD ^[1]	21	mA
	GPS/QZSS+GLONASS+SBAS		20	
	GPS/QZSS+Galileo+BDS+SBAS		17	
	GPS/QZSS		16	
Acquisition	GPS/QZSS+Galileo+GLONASS+SBAS		21	
	GPS/QZSS+GLONASS+SBAS		21	
	GPS/QZSS+Galileo+BDS+SBAS		17	
	GPS/QZSS		16	
Standby mode		AVDD_BAK ^[2]	15	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

In order to ensure the positioning performance, please control the ripple of the module power supply. It is recommended to use the LDO with max output current above 100 mA.

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 the AVDD_BAK needs to be supplied separately, please make sure the voltage is greater than or equal to the main voltage.

Note: If no backup supply is available, connect the AVDD_BAK pin to the main power supply. Floating state is not recommended.

4.2 Antenna Design

There is a built-in LNA and SAW in the GNSS module. It is recommended to use either a passive or an active antenna with gain less than 30 dB.

The module has built-in short circuit protection and open circuit detection functions, which can detect the antenna status of normal connection, open circuit, and short circuit, and send out the 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. PRTRG pin cannot work alone when the module operates normally. PRRSTX pin can reset the system. Users **MUST** retain PRTRG and PRRSTX pins in the design to ensure that the Boot mode is accessible in case that there is no firmware written in the embedded chip.

- 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.

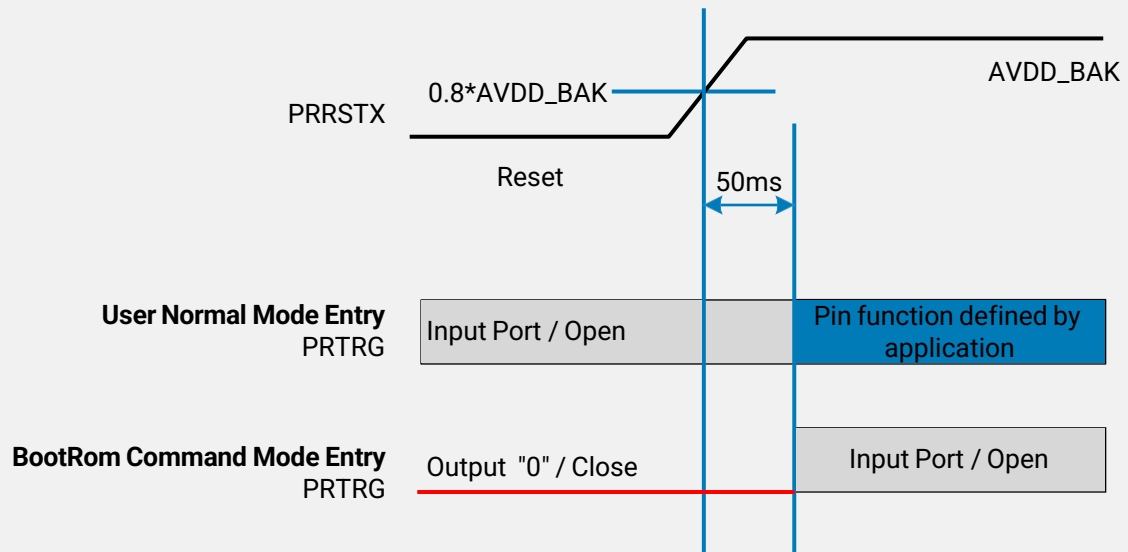


Figure 4 Timing of mode entry with host controller

5 DEFAULT MESSAGE

Table 10 Default messages

Interface	Settings
UART output	9600 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	9600 baud, 8 data bits, no parity bit, 1 stop bit, autobauding disabled. Automatically accepts the following protocols without need of explicit configuration: HD binary sentence, NMEA The GNSS receiver supports interleaved HD Binary and NMEA messages.
Timepulse (1 Hz Nav)	1 pulse per second, synchronized at rising edge, pulse length 100 ms.

* 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.

6 MECHANICAL SPECIFICATION

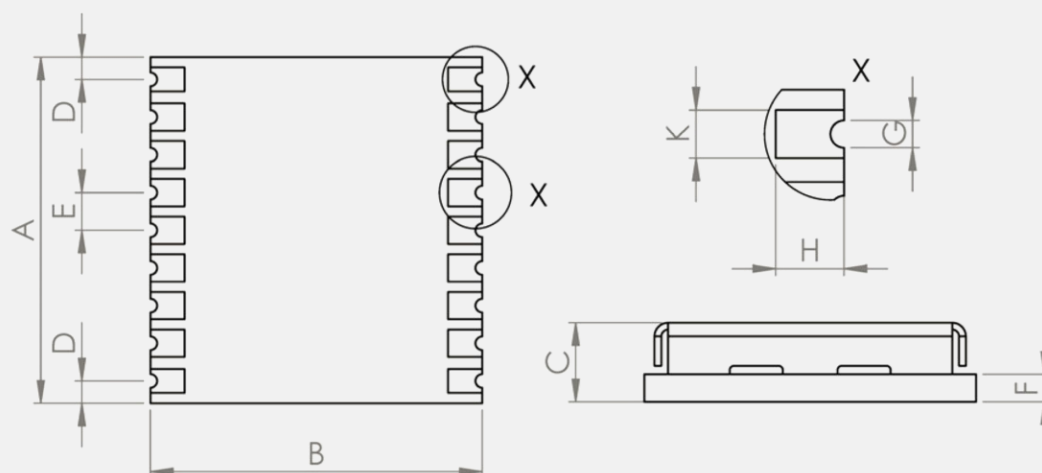


Figure 5 Dimensions

Table 11 Dimensions

Symbol	Min. (mm)	Typ.(mm)	Max. (mm)
A	9.9	10.1	10.3
B	9.5	9.7	9.9
C	2.3	2.5	2.7
D	0.55	0.65	0.95
E	1.0	1.1	1.2
F	0.6	0.8	-
G	0.4	0.5	0.6
H	0.8	0.9	1.0
K	0.7	0.8	0.9

7 REFERENCE DESIGN

7.1 Minimal Design

The minimal design of TAU1113 shows as below. The 39 nH 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.

Note: Do not keep the AVDD_BAK pin open. There is no diode between AVDD_BAK and VDD inside the module. The AVDD_BAK can be powered by VDD through an external diode, or an external independent power supply.

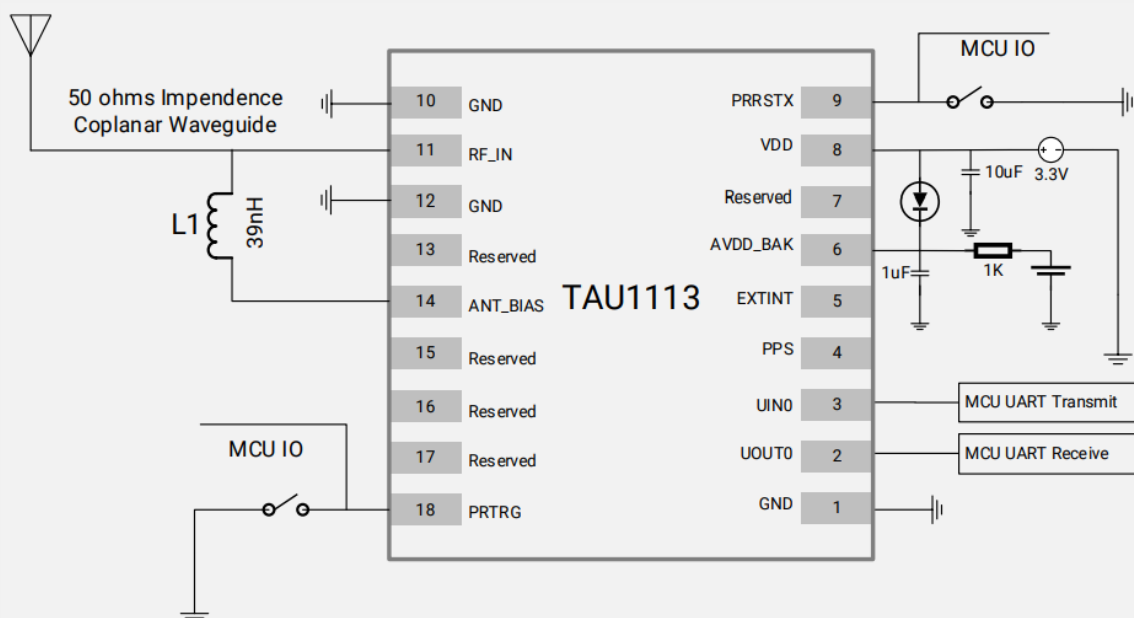


Figure 6 Minimal application diagram

7.2 PCB Footprint Reference

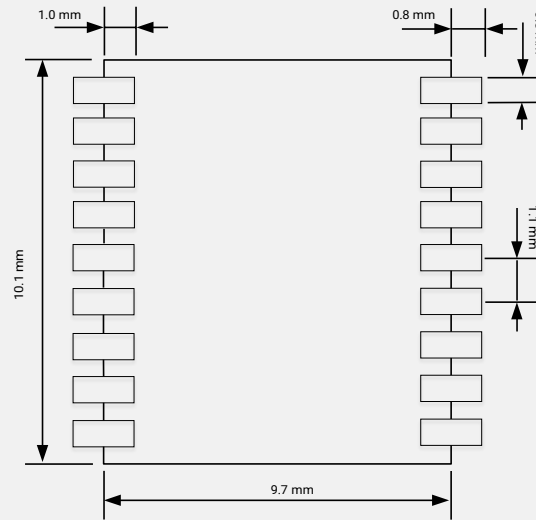


Figure 7 PCB Footprint Reference

7.3 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 0.5 mm.
- (2) The width of RF routing between RF port to antenna interface should be wider than 0.2 mm. 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.

8 PRODUCT PACKAGING AND HANDLING

8.1 Packaging

8.1.1 Packaging Notes

TAU1113 GNSS module 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	Packing box	Shipping carton
				

8.1.2 Tape and Reel

TAU1113 modules are 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.

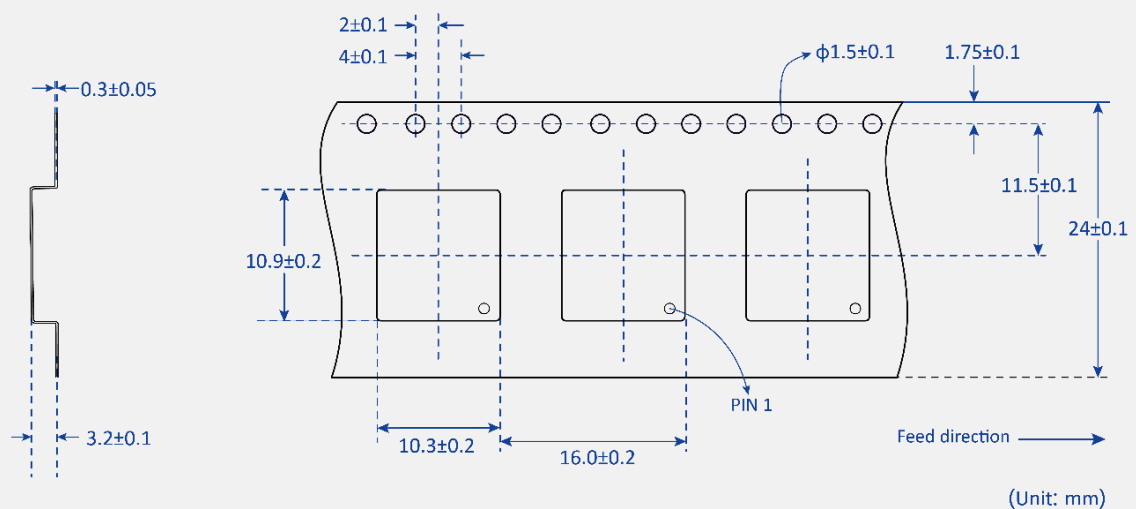


Figure 8 Tape dimensions

The TAU1113 modules are deliverable in quantities of 1000 pcs on a reel. The figure below shows the dimensions of reel for TAU1113.

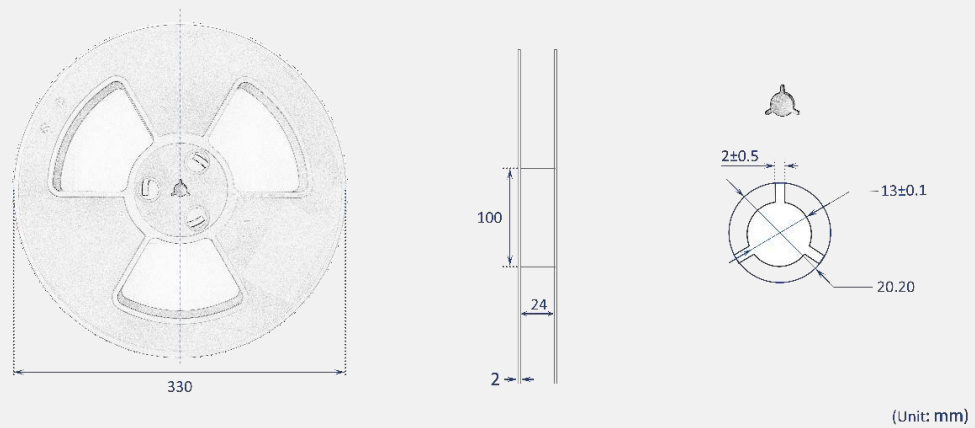


Figure 9 Reel dimensions

8.1.3 Shipment Packaging

The reels of TAU1113 are packed in the sealed bags in a box and shipped by shipping cartons. Up to five boxes (1000 pcs in total) can be packed in one shipping carton.

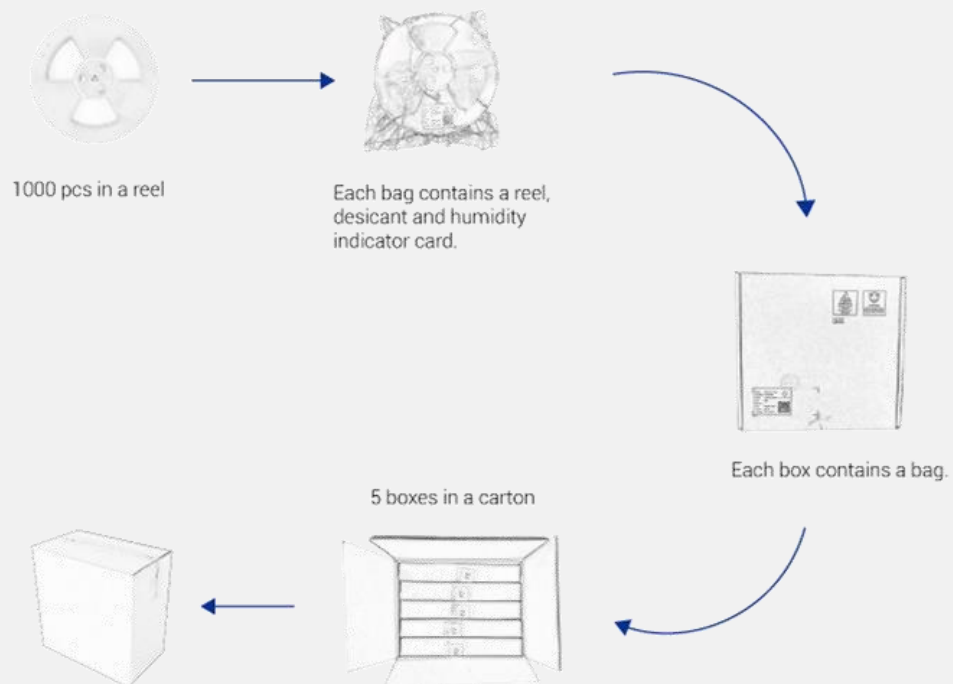


Figure 10 Packaging

8.2 Storage

In order to prevent moisture intake and protect against electrostatic discharge, TAU1113 is packaged together with a humidity indicator card and desiccant to absorb humidity.

8.3 Handling

8.3.1 ESD Handling Precautions

The TAU1113 module that contains highly sensitive electronic circuitry is 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).



8.3.2 ESD Protection Measures

This series of GNSS positioning modules 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.

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

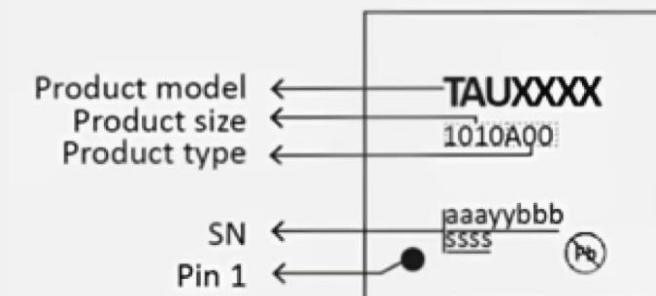
8.3.3 Moisture Sensitivity Level

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

9 LABELING AND ORDERING INFORMATION

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

9.1 Labeling



Symbol	Explanation	Instance
TAUXXXX	Product model	TAU1113
1010A00	1010 represents the product size.	1010A00
	A00 means the product type.	
aaayybbbssss	Serial number	351190010001

9.2 Ordering info

Table 13 Ordering codes

Ordering No.	Product Information
TAU1113-1010A00E ^[1]	Concurrent GNSS LCC Module, TCXO, Flash, 10.1*9.7 mm, 1000 pieces/reel.

* [1] See Table 1 for the GNSS systems supported.

10 RELATED DOCUMENTS

- [1] Recommended Reflow Profile
- [2] Satrack User Manual
- [3] Allystar Common Commands
- [4] GNSS Protocol Specification

11 REVISION HISTORY

Revision	Date	Reviser	Status/Comments
V1.0	2021-12	Cao Min	Initial release.
V1.1	2021-12	Cao Min	Updates parameters in operating mode
V1.2	2022-07	Cao Min	Deletes I ² C support Updates PRTRG and PRRSTX pins configuration for Boot mode Updates maximum power input for VDD and AVDD_BAK. Modifies the Grade classification Updates the product general description in Section 1.1 and features in Section 1.2 Updates the updating rate, position accuracy, power consumption, and sensitivity, adds FCC and CE-RED certification in Table 2 Adds Table 3 and updates TTFF Adds maximum tolerable ESD level in Table 5 Updates MSL to MSL3
V1.3	2022-08	Cao Min	Updates the total GNSS channels in Table 2
V1.4	2022-08	Cao Min	Adds the antenna bias voltage in Table 8
V1.5	2022-10	Cao Min	Updates the chip description in section 1.1 Modifies the minimum backup supply voltage Optimizes the backup battery supply instruction in section 4.1
V1.6	2024-01	Cao Min	Deletes the Software Interface chapter Updates the package specification
V1.7	2024-07	Cao Min	Updates the labeling information



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