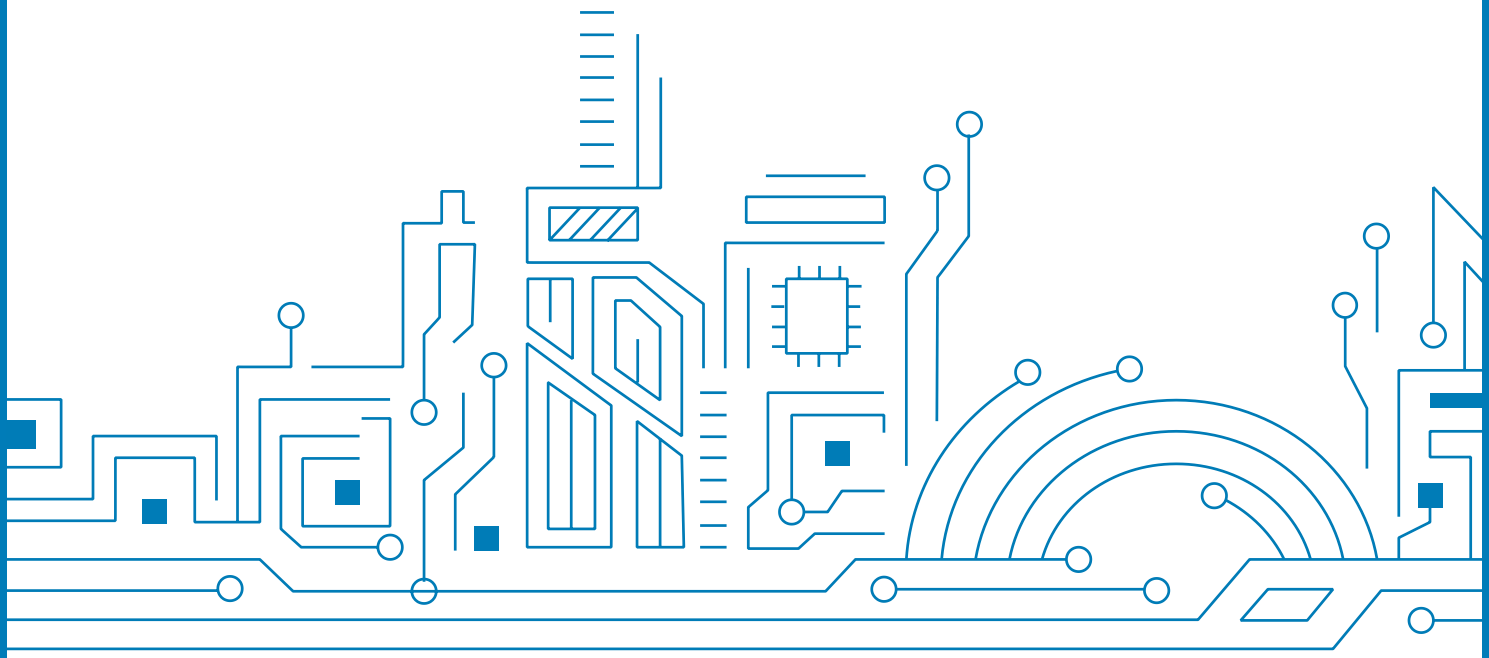
GNSS Positioning Module

TAU1114

Datasheet V1.4



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About the Document

■ Basic info

Document applies to	TAU1114
Document type	Datasheet
Revision and date	V1.4/2024-04
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.

Product	Ordering code	Built-in inductor
TAU1114	TAU1114-1216A00E	--
	TAU1114-1216B00E	Yes

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1 SYSTEM OVERVIEW

1.1 General Description

TAU1114 is a cost-effective GNSS positioning module based on CYNOSURE III Lite GNSS SoC chip supporting GPS/QZSS, BDS, Galileo, GLONASS, and SBAS at a low current consumption. It is a versatile module that features SAW, LNA, flash memory as well as an antenna supervisor and can be used with active and passive antennas.

TAU1114 is fit for a wide range of applications in tracking, telematics, and navigation. It is pin compatible with many mainstream GNSS modules, making it the perfect choice to upgrade existing design, be it for a lower power consumption or to avoid excessive lead times.

1.2 Features

- Versatile GNSS module supporting GPS/QZSS, BDS, Galileo, GLONASS, and SBAS
- Low power consumption design
- Active and passive antennas supported thanks to built-in SAW and LNA
- Support Allystar's free-of-charge A-GNSS service for minimal startup times
- Pin-compatible with mainstream GNSS modules

Table 1 TAU1114

Product	GNSS							Feature						Interface				Accuracy			Grade	
	Band (S/D/T)	GPS/QZSS	BDS	GLONASS	Galileo	NavIC	SBAS	Built-in LNA	Programmable (flash)	Data logging	D-GNSS	Oscillator	Built-in inductor	UART	I2C	USB	SPI	Meter	Sub-meter	Centimeter	Industrial	Automotive
TAU1114-1216A00E	S	●	★	★	○		○	●	●	●	●	T		●	○		○	●			●	
TAU1114-1216B00E	S	●	★	★	○		○	●	●	●	●	T	●	●	○		○	●			●	

T = TCXO ○ = Supported upon request ★ = Alternative support, default as GLONASS

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1.3 Module Photo



Figure 1 TAU1114 module

1.4 Block Diagram

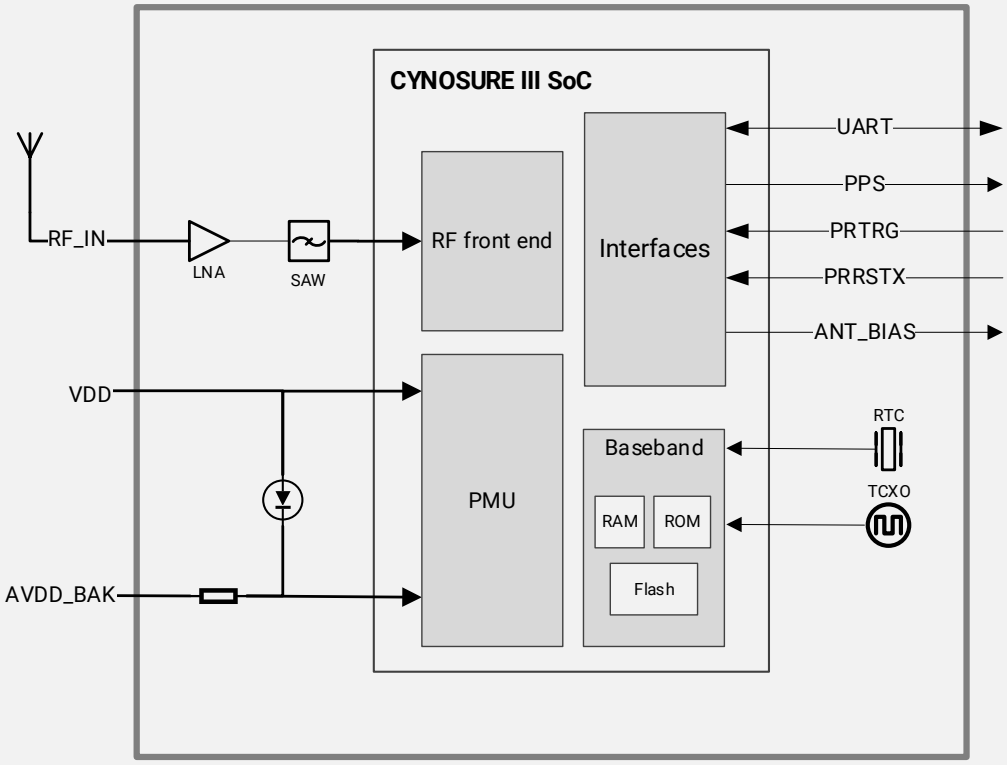


Figure 2 Block diagram

1.5 Specifications

Table 2 Specifications

Parameter	Specification
GNSS channels	88 in total
GNSS reception	GPS/QZSS: L1C/A
	GLONASS: G1
	Galileo[1]: E1
	BDS[1]: B1I, B1C

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Parameter	Specification		
	SBAS: L1 (SDCM, WAAS, EGNOS, GAGAN and MSAS)		
Updating rate	1 Hz by default, 5 Hz max.		
Position accuracy[2]	GNSS	1.5m CEP	
Velocity & Time accuracy	GNSS	0.1 m/s CEP	
	1PPS	20 ns	
TTFF	Hot start	1s	
	Cold start	28s	
Sensitivity[3]	Cold start	-148 dBm	
	Hot start	-156 dBm	
	Reacquisition	-158 dBm	
	Tracking	-163 dBm	
Operating condition	Main voltage	2.0V-3.63V	
	Digital I/O voltage	2.0V-3.63V	
	Backup voltage	1.8V-3.63V	
Power consumption	Tracking	GPS/QZSS+ GLONASS	19 mA @ 3.3V
		GPS/QZSS	16 mA @ 3.3V
	Acquisition	GPS/QZSS+ GLONASS	20 mA @ 3.3V
		GPS/QZSS	19 mA @ 3.3V
	Standby mode	15 uA @ 3.3V	
Serial interface	UART[4]	2	
	SPI[1]	1	
	I2C[1]	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	12.2x16.0x2.4 mm 24-pin LLC		
Certification	RoHS, REACH, FCC, CE-RED		

* *[1] Supported upon request*
* *[2] Open sky condition.*
* *[3] Demonstrated with a good external LNA*
* *[4] Default as UART0. UART1 is supported upon request.*

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2 PIN DESCRIPTION

2.1 Pin Assignment

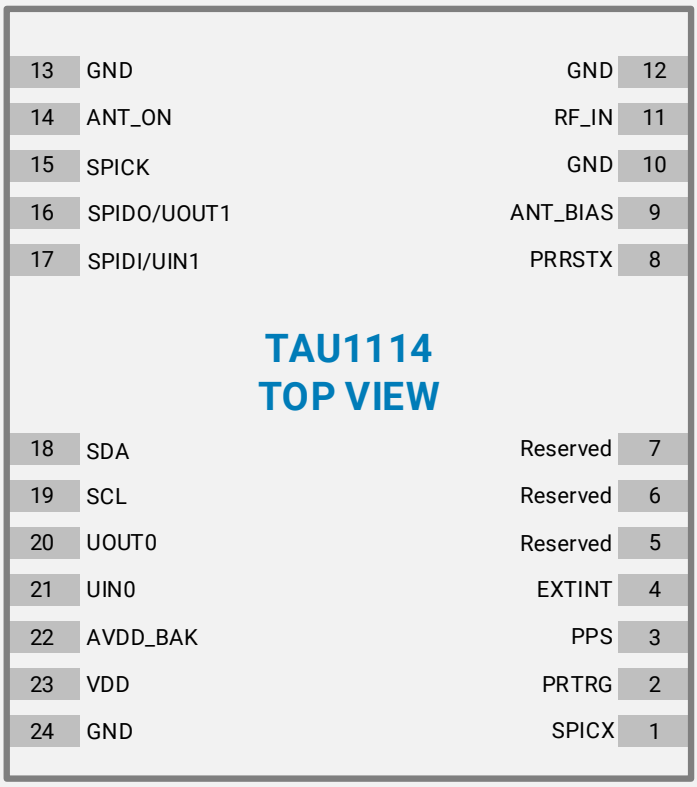


Figure 3 Pin assignment (top view)

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

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2.2 Detailed Pin Descriptions

Table 3 Detailed pin descriptions

Function	Symbol	Pin No.	I/O	Description
Power	VDD	23	Power	Main power supply voltage input DC 3.3V±10%
	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 power supply voltage input.
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	9	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	20	O	UART serial data output.
	UIN0	21	I	UART serial data input.
SPI/UART[1]	SPICX	1	O	SPI chip selection. Leave it floating if not used.
	SPICK	15	O	SPI clock. Leave it floating if not used.
	SPIDO/UOUT1	16	O	SPI data output or UART1 serial data output. Default as UART1. Leave it floating if not used.
	SPIDI/UIN1	17	I	SPI data input, or UART1 serial data input. Default as UART1. Leave it floating if not used.
I²C[1]	SDA	18	I/O	I2C data. Leave it floating if not used.
	SCL	19	I/O	I2C clock. Leave it floating if not used.
Other	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). Leave it floating if not used.
	EXTINT	4	I	A trigger pin to external interrupt. Leave it floating if not used.
	ANT_ON	14	O	A trigger pin to enable external antenna output. Leave it floating if not used.
	Reserved	5, 6, 7	--	Reserved. Leave it floating if not used.

* *[1] Supported upon request*

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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
VI_{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 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×0.67	--	AVDD_BAK	V
V_{IL}	Input low voltage	--	0	--	AVDD_BAK×0.27	V
V_{OH}	Output high voltage	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 6 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

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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 7 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
V_{RF_IN}[2]	Antenna input voltage	VDD-0.25[1]	--	--	V

* *[1] Condition: tested at high, low, and room temperature, with 0.1V deviation.*
* *[2] VRF_IN is the antenna bias voltage after the feed resistance. TAU1114-1216B00E can output the antenna power to the RF_IN pin only.*

3.3.2 Power Consumption

Table 8 Power consumption

Parameter		Measure Pin	Typ.	Unit
Tracking	GPS/QZSS+ GLONASS	VDD[1]	19	mA
	GPS/QZSS		16	
Acquisition	GPS/QZSS+ GLONASS		20	
	GPS/QZSS		19	
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.*

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4 HARDWARE DESCRIPTION

4.1 Connecting Power

The module has two power supply pins: VDD and AVDD_BAK. 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 VDD or leave it floating.*

4.2 Power on Sequence

A permanent damage may occur with inappropriate power on sequence. So, please follow the rules below during design. To meet the requirement of controlling the power on/off sequence of the module, please connect the external reset pin (PRRSTX) to the MCU.

When both backup and main supply power on from their off state, external reset (PRRSTX) must be active and hold more than 10 ms after both backup supply and main supply reach the minimum operating voltage. The system power on sequence is illustrated in Figure 4 System power on sequence.

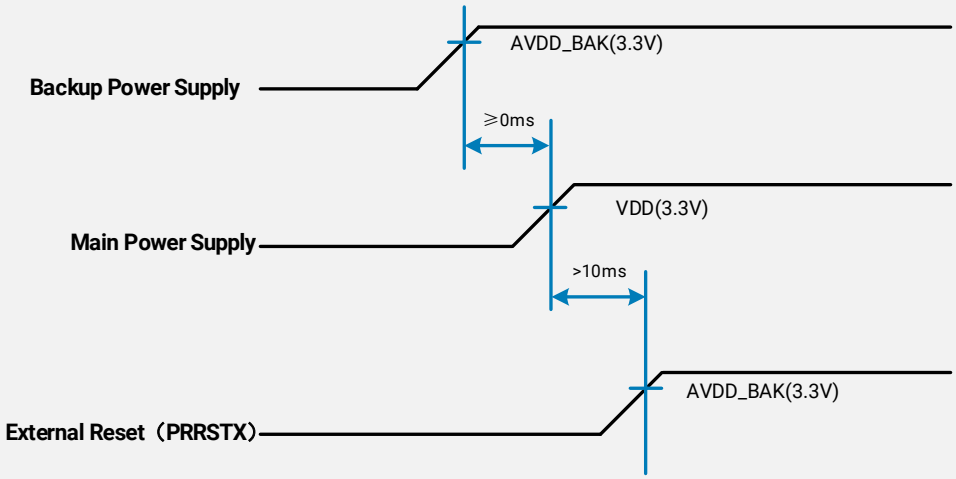


Figure 4 Power on sequence

4.3 Antenna Design

There is a built-in LNA and SAW in the GNSS module. It is recommended to use an active antenna with gain between 15 dB to 30 dB and a noise figure less than 1.5 dB.

The module has built-in short circuit protection and open circuit detection functions, which can detect

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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.

4.4 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. Please be aware that UART1 cannot be used for firmware upgrade.

- 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 MCU IO IO, DO NOT use the pull-up or pull-down resistance.

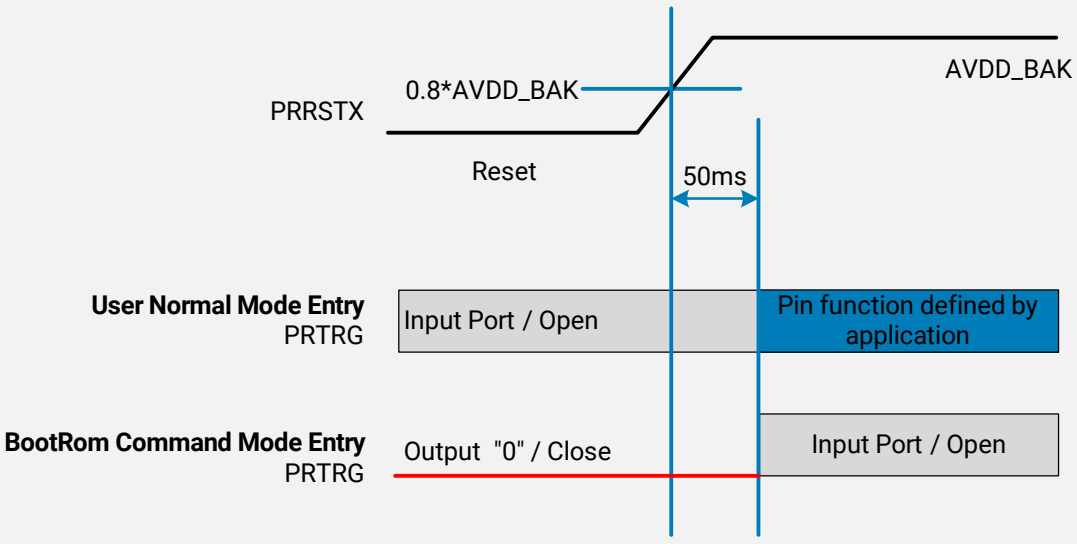


Figure 5 Timing of mode entry with host controller

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Table 9 Minimum reset timing

Parameter	Symbol	Pin	Condition	Min.	Typ.	Max.	Unit
Reset timing	t_{RSTL}	PRRSTX	Connected to a stable power source, and TCXO clock remains stable.	100	--	--	mS

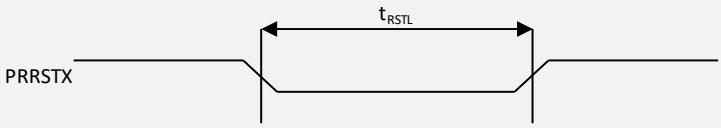


Figure 6 Reset timing

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 pulse per second, synchronized at rising edge, pulse length 100 ms.

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

The default configuration and output information of UART0 and UART1 are identical, among which UART1 cannot be used for firmware upgrade. If the UART is connected well to the MCU when VDD is off, a high UART level may cause residual power on VDD, leading to power on failure. Therefore, when VDD is off, it is advisable to disconnect the UART or set MCU_UART to the input or high resistance state.

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6 MECHANICAL SPECIFICATION

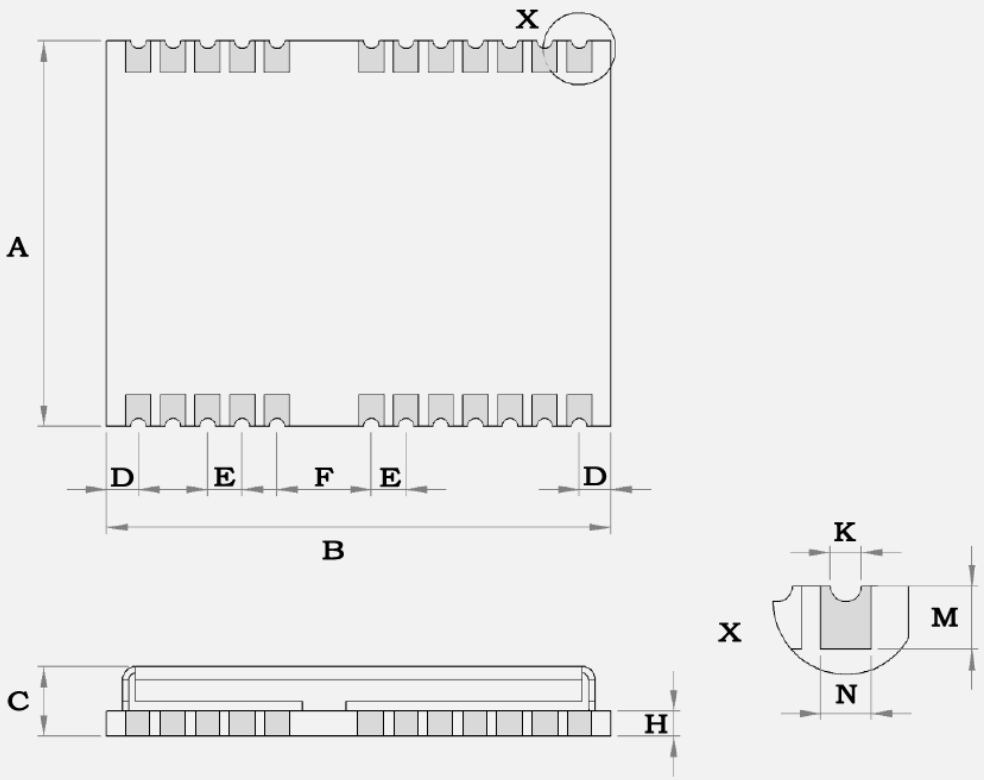


Figure 7 Dimensions

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

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7 REFERENCE DESIGN

7.1 Minimal Design

The minimal design of TAU1114-1216A00E shows as Figure 8. The 39 nH inductor is used only when an active antenna is connected, and no need with a passive antenna. The built-in RF_Choke inductor functions to power the active antenna in TAU1114-1216B00E, as shown in Figure 9. The characteristic impedance from RF_IN pin to the antenna connector should be 50Ω.

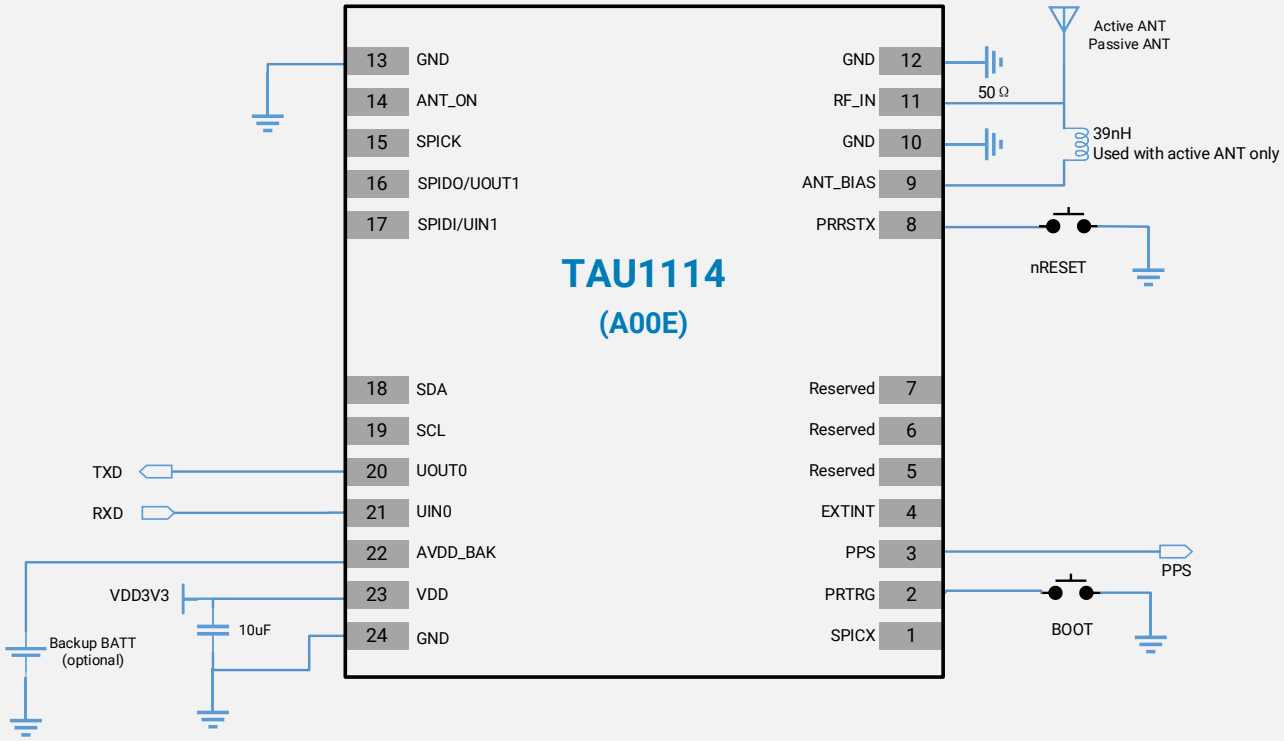


Figure 8 TAU1114-1216A00E

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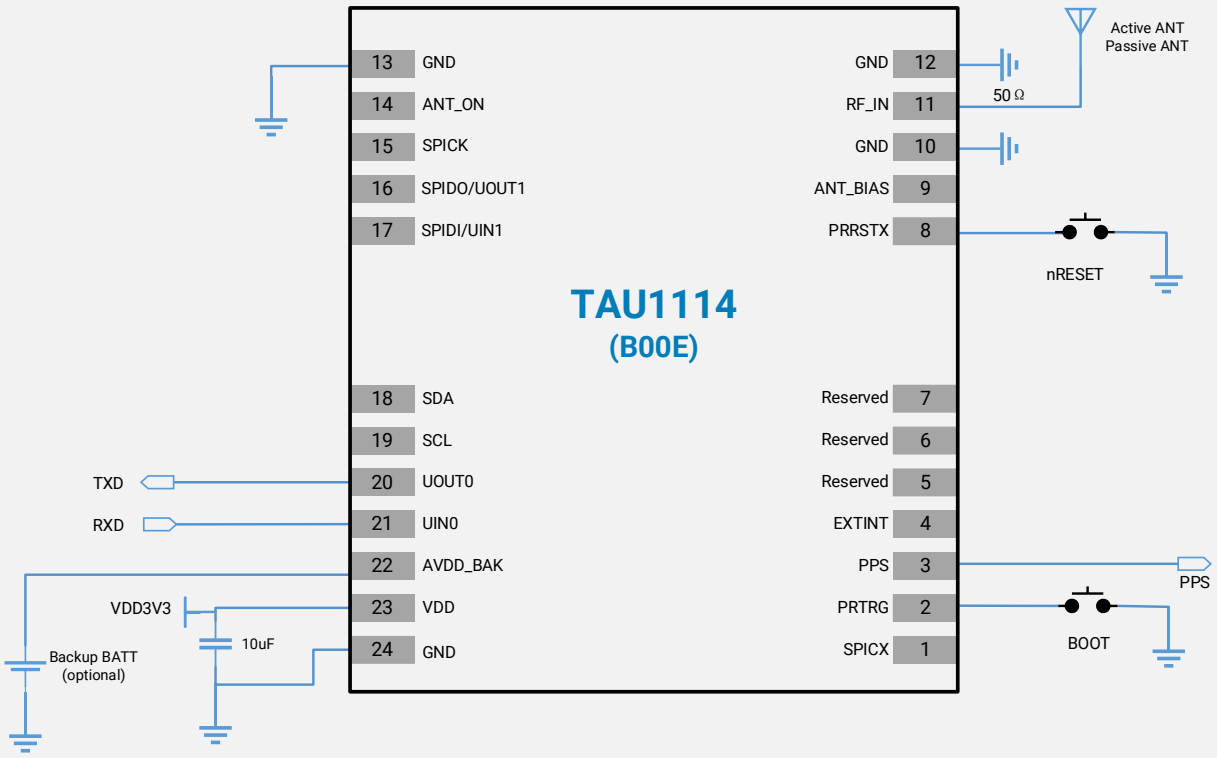


Figure 9 TAU1114-1216B00E

7.2 PCB Footprint Reference

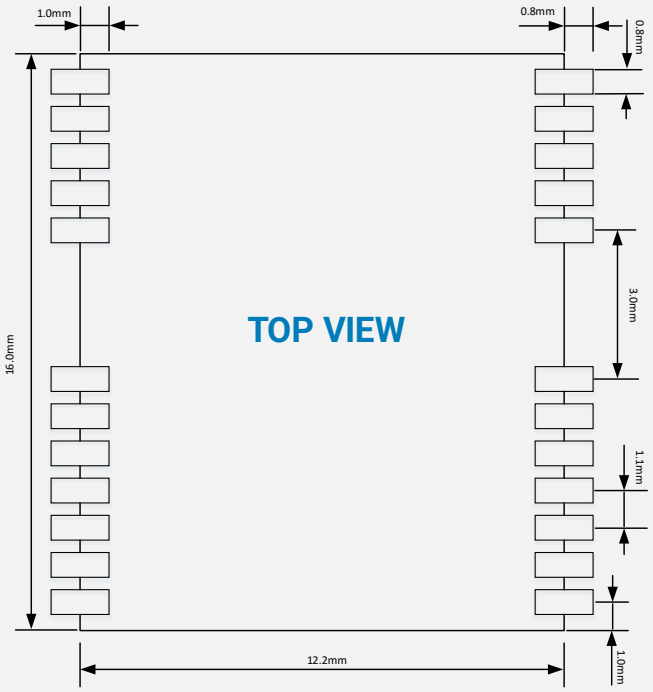


Figure 10 PCB Footprint Reference

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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.

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8 PRODUCT PACKAGING AND HANDLING

8.1 Packaging

8.1.1 Packaging Notes

TAU1114 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

TAU1114 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.

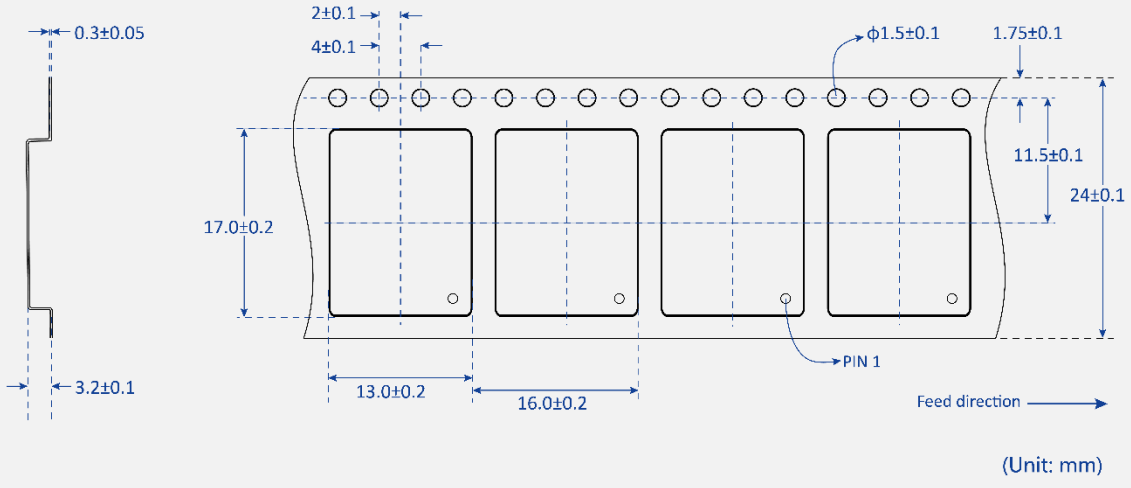


Figure 11 Tape dimensions

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The TAU1114 modules are deliverable in quantities of 1000 pcs on a reel. The figure below shows the dimensions of reel for TAU1114.

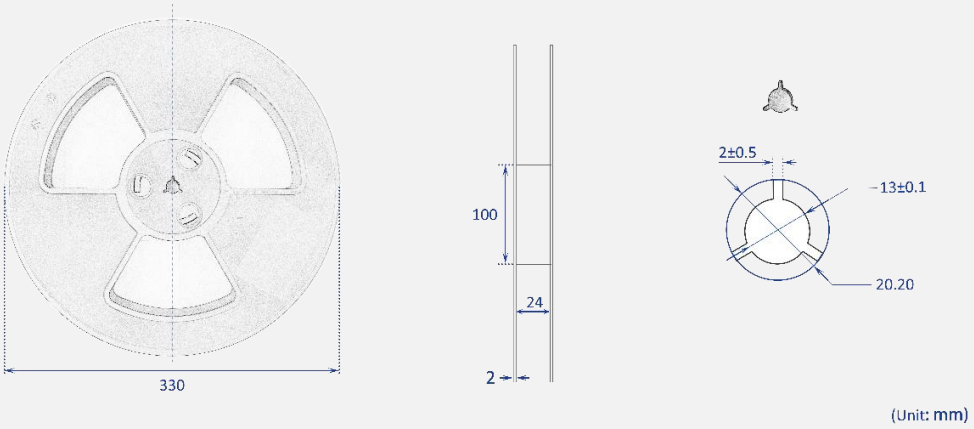


Figure 12 Reel dimensions

8.1.3 Shipment Packaging

The reels of TAU1114 are packed in the sealed bags in a box and shipped by shipping cartons. Up to five boxes (5000 pcs in total) can be packed in one shipping carton.

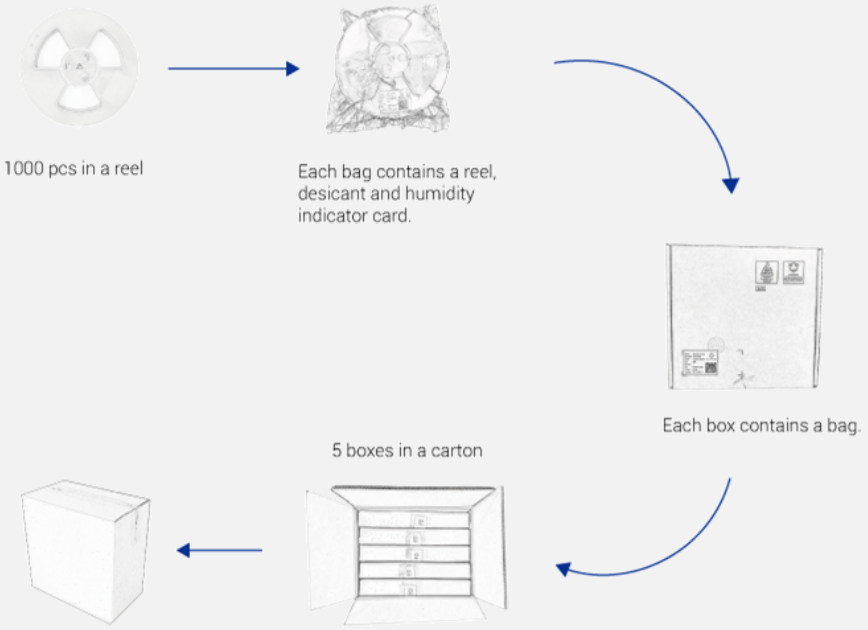


Figure 13 Packaging

8.2 Storage

In order to prevent moisture intake and protect against electrostatic discharge, TAU1114 is packaged together with a humidity indicator card and desiccant to absorb humidity.

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8.3 Handling

8.3.1 ESD Handling Precautions

The TAU1114 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

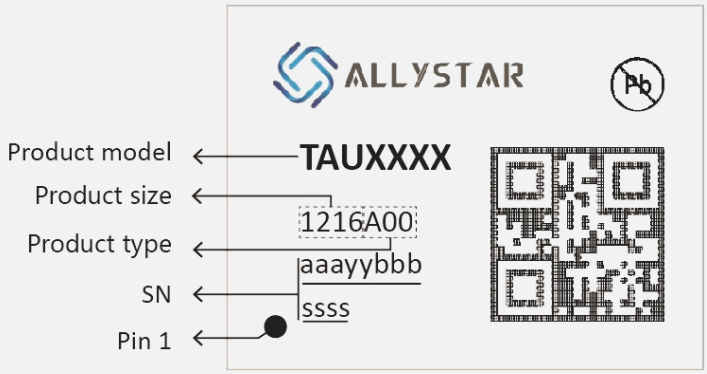
The Moisture Sensitivity Level (MSL) of the GNSS module is MSL3.

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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	TAU1114
1216A00	1216 represents the product size.	1216A00, 1216B00
	A00 means the product type.	
aaayybbbssss	Serial number	351190010001

9.2 Ordering info

Table 13 Ordering codes

Ordering No.	Product information
TAU1114-1216A00E[1]	Concurrent GNSS LCC Module, TCXO, Flash, 12.2*16 mm, 1000 pieces/reel.
TAU1114-1216B00E[1]	Concurrent GNSS LCC Module with built-in inductor, TCXO, Flash, 12.2*16 mm, 1000 pieces/reel.

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

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10 RELATED DOCUMENTS

[1] Recommended Reflow Profile

[2] Satrack User Manual

[3] Allystar Common Commands

[4] GNSS Protocol Specification

11 REVISION HISTORY

Revision	Date	Revised by	Status/Comments
V1.0	2022-07	Cao Min	Initial release.
V1.1	2022-08	Cao Min	Updates the total GNSS channels in Table 2
V1.2	2022-08	Cao Min	Adds the antenna bias voltage in Table 7
V1.3	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
V1.4	2024-04	Cao Min	Adds the ordering code TAU1114-1216B00E Deletes the software interface chapter Updates the package hierarchy

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