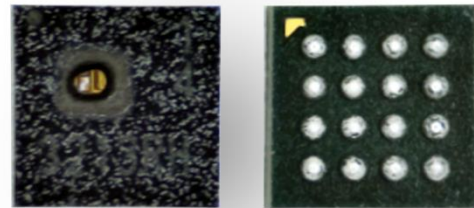


Fully-Passive UHF RFID Humidity Sensor

Features

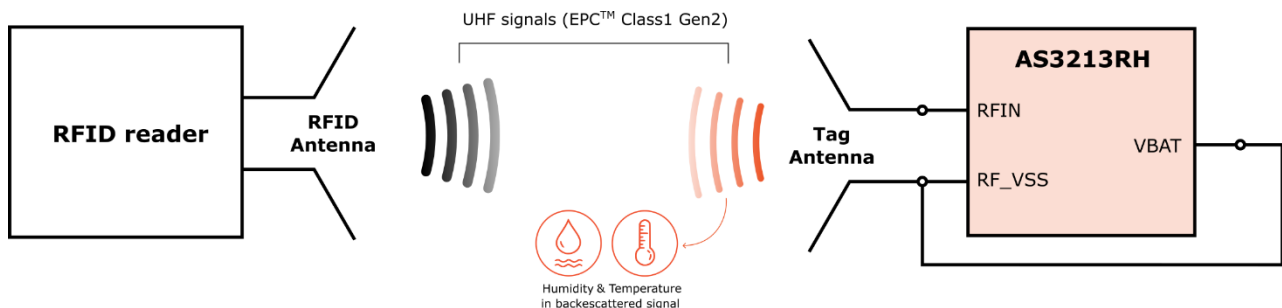
- ✓ EPC™ Class1 Gen2 compliant
- ✓ **Embedded Temperature & Humidity Sensor**
- ✓ **Extended Temperature Range -40 to +125 °C**
- ✓ Fully passive
- ✓ Sensitivity < -15 dBm (up to 7 meters reading range)
- ✓ Battery assistance as an option for increased reading range
- ✓ 512 bits of non-volatile memory (EEPROM) organized in 4 banks (UII/EPC, User, TID, Reserved)
- ✓ Forward link data rates: 26.7 to 128 kbps assuming equiprobable data
- ✓ Return link data rates: 40 to 640 kbps with subcarrier modulated data rates of 0.625 to 320 kbps



Applications

- ✓ Condition monitoring (RH, water presence, isolation...)
- ✓ Supply chain management, tracking and tracing
- ✓ Agriculture sensing

Typical Setup Configuration



Description

AS321x is a family of passive UHF RFID chips embedding an analog sensor interface and internal sensors. AS321x chips are fully compliant with EPC™ Class-1 Generation-2 for UHF RFID applications and RAIN-RFID standards, so they can be interfaced by any standard reader, with no need for any custom command or pre-charge sequence, and achieve state-of-the-art sensitivity performance, including sensor biasing and readout.

In a Passive mode, the harvested energy from the RF field is enough to enable all tag functionality, including sensor measurements. A battery can be added to increase the reading range (Battery-

Assisted-Passive configuration, BAP).

Each chip embeds 512 bits of low-power non-volatile memory (EEPROM) organized in 4 banks supporting the EPC data structure, and delivered with a Unique Identifier (UID) to ensure full traceability. Sensor data are available on demand by a simple read command in the memory.

AS3213RH is the product variant embedding both an internal humidity and an internal temperature sensor along with their acquisition channel, including an amplifier and a 10-bits Analog to Digital Converter (ADC).

Package Description

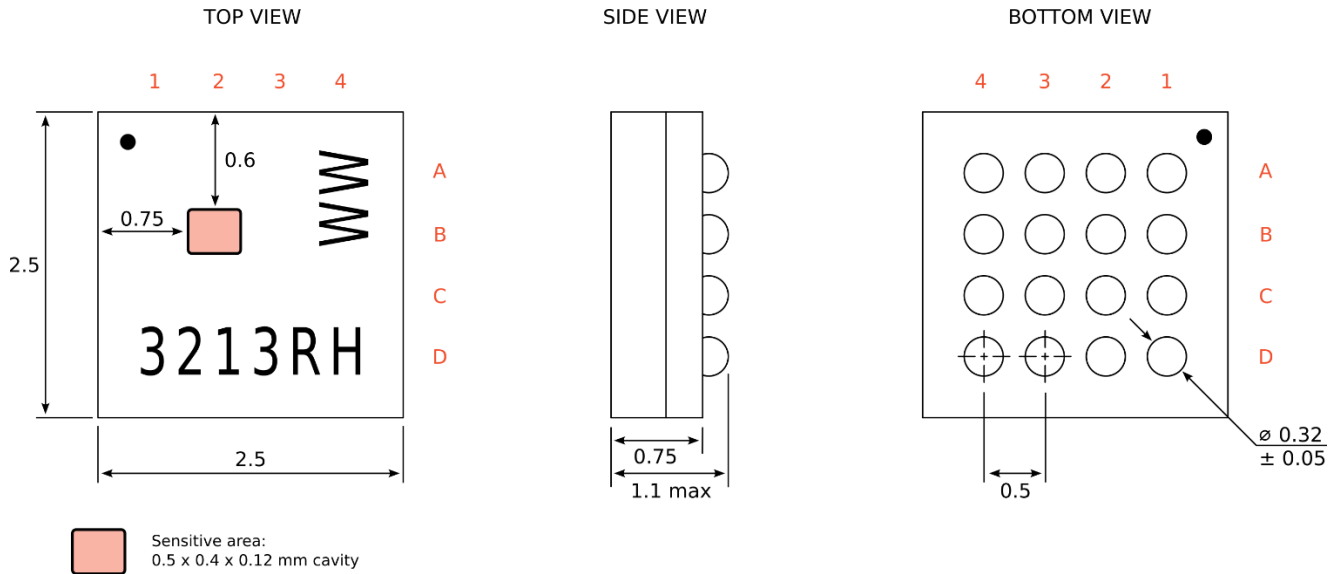


Figure 1: BGA16 package drawings

Ball alloy: SAC305 (96.5% Sn / 3% Ag / 0.5% Cu)

It is recommended to electrically connect RF_VSS pins with VBAT and VDD_SPI together. All other pins except RFIN should be mechanically connected, not electrically.

Pin	Name	Type	I/O	Description
A1	RF_VSS	RF	I	For antenna connection only (RF ground)
A2	RF_VSS	RF	I	For antenna connection only (RF ground)
A3	VBAT	A	I	External Power Supply in BAP operation [1.8V;2.5V] * Connect to RF_VSS in passive operation
A4	VDD_SPI	A	I	SPI 1.8 V Power supply
B1	NC	--	--	Not Connected
B2	NC	--	--	Not Connected
B3	NC	--	--	Not Connected
B4	CLK_EXT	D	I	External clock for digital part in SPI mode (SPI_EN=1)
C1	RFIN	RF	I	Antenna input
C2	MISO	D	O	1.8V SPI MISO signal
C3	SPI_EN	D	I	1.8V SPI SPI enable signal
C4	NRESET	D	I	1.8 V external reset for digital part in SPI mode (SPI_EN=1)
D1	RFIN	RF	I	Antenna input
D2	MOSI	D	I	1.8 V SPI MOSI signal
D3	NCS	D	I	1.8 V SPI Chip Select
D4	SCK	D	I	SPI 1.8V Clock signal

Table 1: BGA pinout table. A: Analog, D: Digital

* For write operation in the NVM, power supply should be higher than 2.2V.

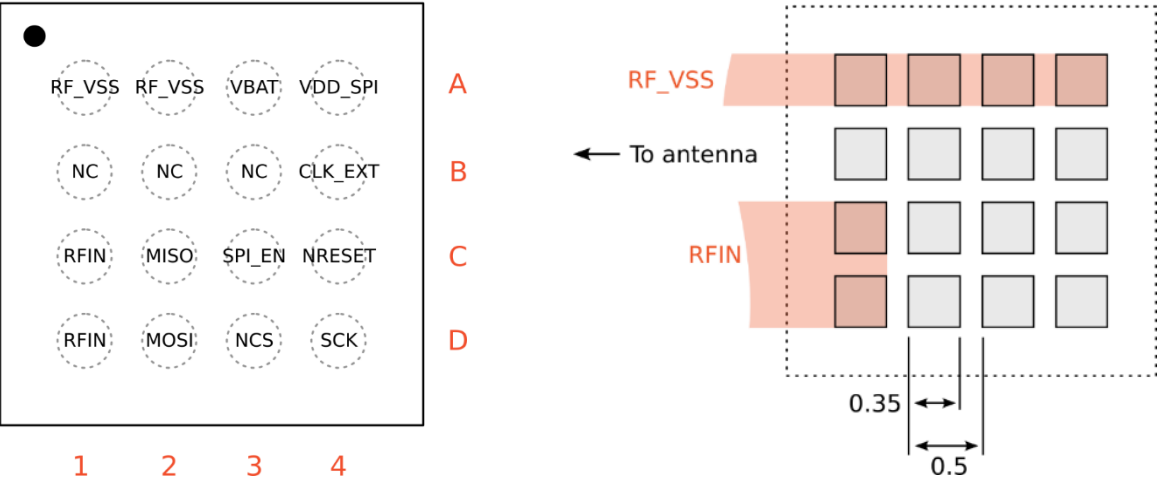


Figure 2: BGA16 pinout (left, TOP VIEW) and recommended landing pattern (right, TOP VIEW)

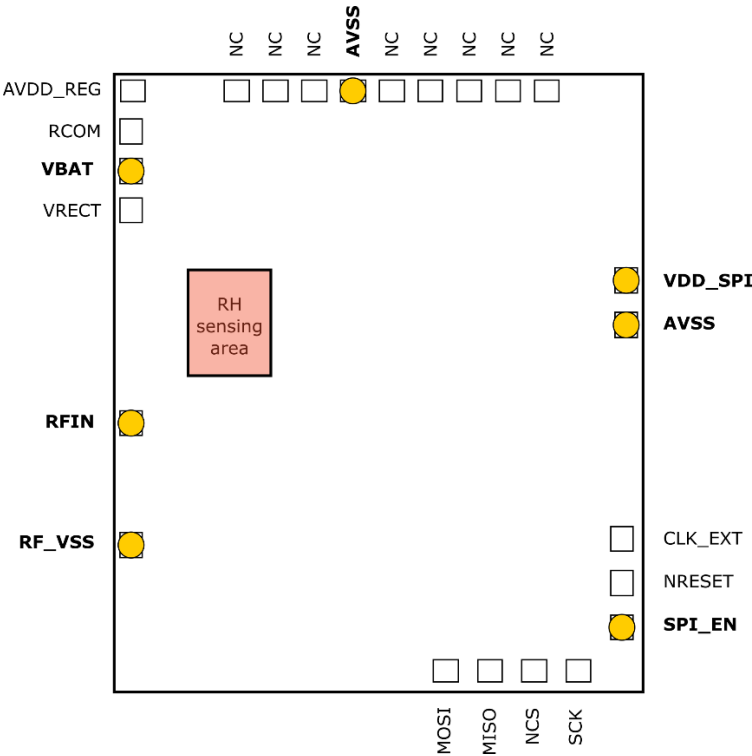


Figure 3: Bare die pinout, active area (pads side) view

Package	Body size	Shipment condition	Comment
BGA	2.5 x 2.5 x 1 mm	Tape & reel	See Figure 4
Bare die	1.68 x 1.44 x 0.254 mm	Waffle box	For R&D only

Table 2: Delivery format

Specifications

Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
Storage Temperature	-50	150	°C
Voltage on all pads/pins (except GND)	0	3.3	V
RF power into pad/pin RFIN		15	dBm
Electrostatic discharge on all pads except RFIN	-1000	1000	V
Electrostatic discharge on RFIN	-500	500	V

Table 3: Absolute maximum ratings

ESD are Human Body Model (HBM) values.

Stresses above these listed maximum ratings may cause device permanent damages. Exposure beyond specified operating conditions may affect device reliability or cause malfunction.

Performances Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating conditions					
Operating temperature		-40		+125	°C
Max RF power at RFIN				15	dBm
RF carrier frequency		860		960	MHz
Electrical Characteristics @25 °C					
Battery voltage for EEPROM read operation		0.9		3.3	V
Battery voltage for EEPROM power check, erase, and write operations		1.8		3.3	V
Average battery current in Sleep mode (No RF applied to the antenna)			3.8		uA
RF Characteristics @25 °C					
Input Impedance *	Die form @ Pin=-10dBm				
	Fcarrier = 866MHz		7-j406		Ω
	Fcarrier = 915MHz		8.5-j383		Ω
	QFN24 @ Pin=-10dBm				
	Fcarrier = 866MHz		23-j213		Ω
	Fcarrier = 915MHz		30-j195		Ω
Write sensitivity in passive mode			-12		dBm
Read sensitivity in passive mode			-13		dBm
Write sensitivity in BAP	VBAT=2.2V		-16		dBm
Read sensitivity in BAP	VBAT=2.2V		-16		dBm

Table 4: Specifications table

* Curves giving the impedance according to the carrier frequency can be provided on request.

Delivery information

Tape & Reel data

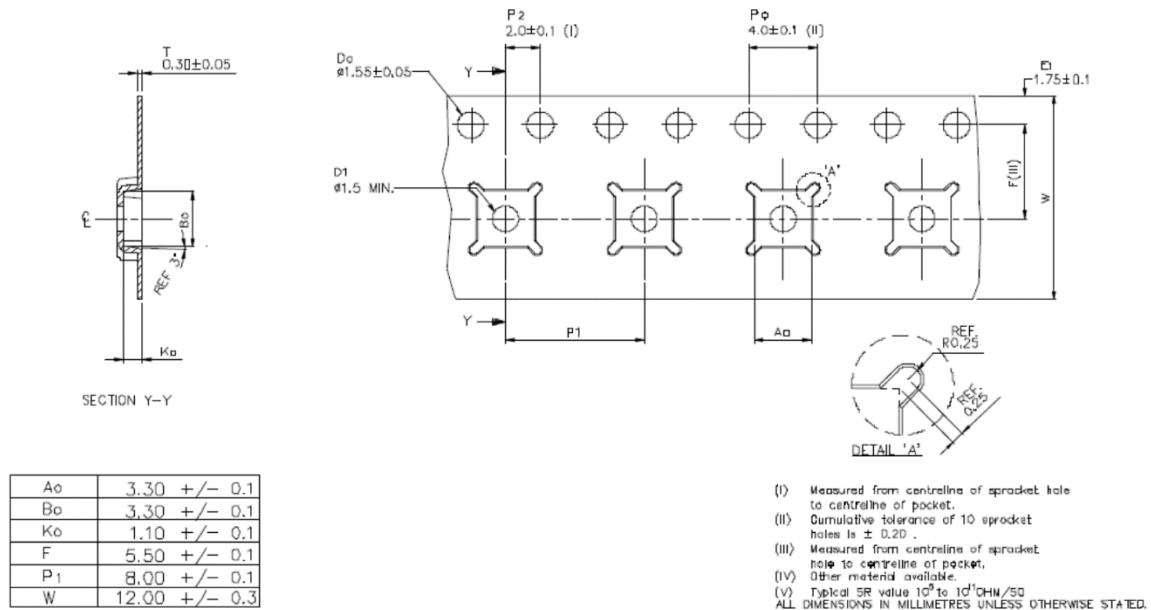


Figure 4: Tape & Reel drawings.

Product Support

Application Notes can be found on ASYGN support site: <https://as321x.asygn.com/>

General company information: www.asygn.com

Customer support mail: support@asygn.com

Revision History

Revision	Date	Comment
0.1	2023-06-22	Creation
0.2	2023-06-23	Corrections of: Head & Footer titles, legends of figures 1 & 2
0.3	2023-10-18	Addition of tape & reel informations + ball alloy
0.4	2024-01-24	Addition of bare die informations

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