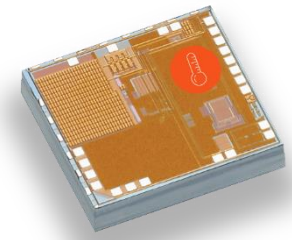
Fully-Passive UHF RFID Sensor Monitoring

Features

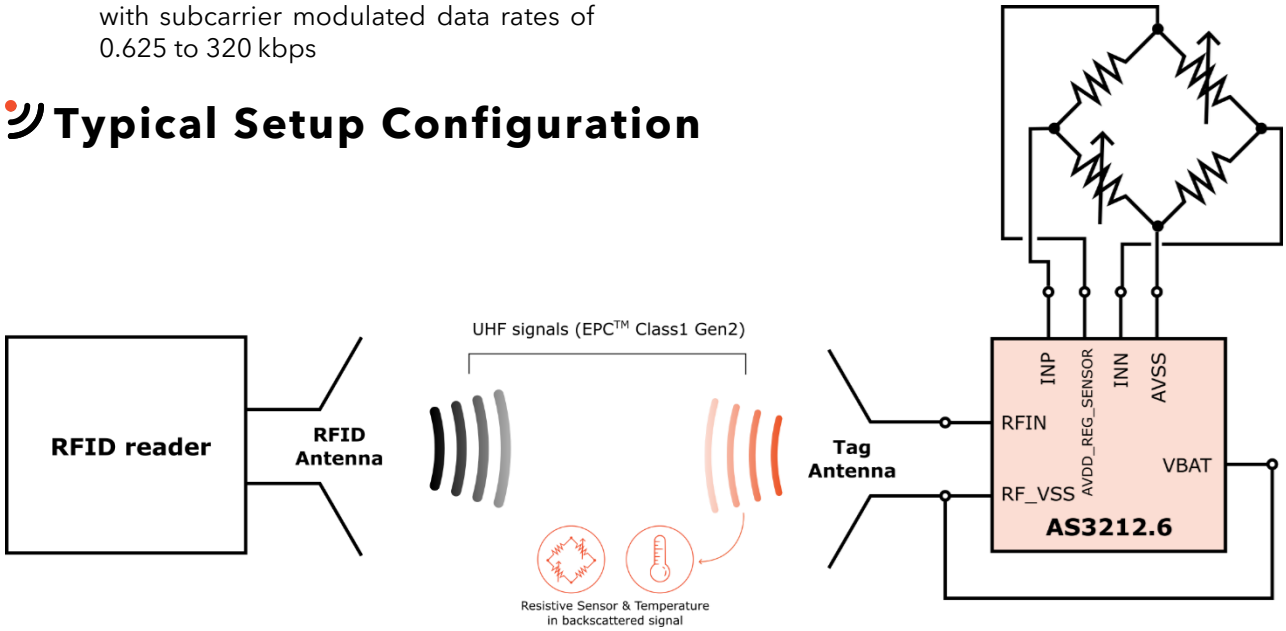
- ✓ EPC™ Class1 Gen2 compliant
- ✓ Embedded Temperature Sensor
- ✓ Extended Temperature Range -40 to +125 °C
- ✓ Fully passive
- ✓ Sensitivity < -15 dBm (up to 7 meters reading range)
- ✓ Battery assistance as an option for increased reading range
- ✓ 512 bits of non-volatile memory (EEPROM) organized 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
- ✓ Supply chain management, tracking and tracing
- ✓ Resistive sensors monitoring

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, following EPC standard.

AS3212.6 is the product variant embedding both a biasing circuitry for external resistive sensors, and an internal Temperature sensor, along with their acquisition channel, including a Switched Capacitor Amplifier (SCA) and a 10-bit Analog to Digital Converter (ADC).

Pin description

QFN24

Marking view
Dimensions 4 x 4 x 0.5 mm

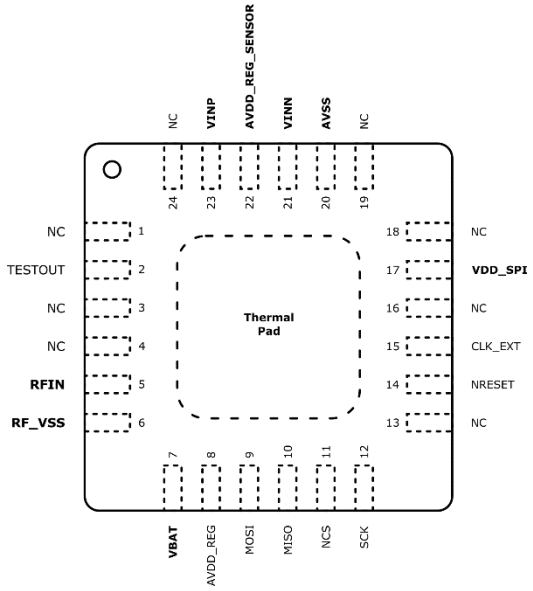


Figure 1: QFN24 pinout

Notes:
For RFID applications, pads 5, 6, 7, 20, 21, 22, 23 & the thermal pad should be considered. Most of the others are for SPI communication (not described here) and should be left floating.

Bare Die

Active area (pads side) view
Dimensions 1300 x 1300 µm

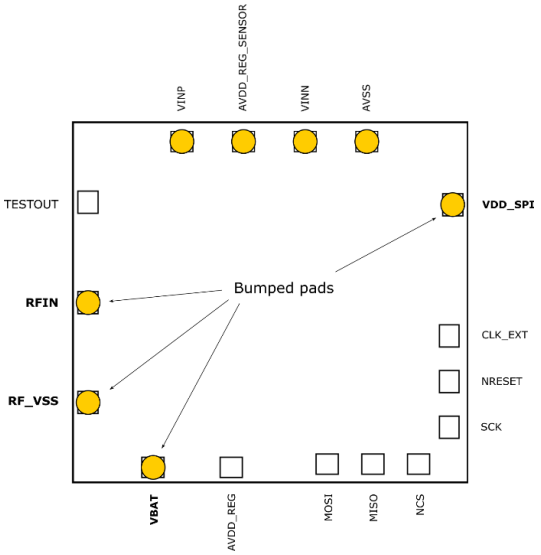


Figure 2: Bare die pinout.

Notes:
IO pads are on the top.
DXF files available on www.as321X.com

Pin	Name	Type	I/O	Description
2	TEST_OUT	D	O	Digital output test pin
5	RFIN	RF	I	Antenna input
6	RF_VSS	A	I	For antenna connection only (RF ground)
7	VBAT	A	I	External Supply in BAP operation [1.8V;2.5V] * **Connect to RF_VSS in passive operation**
8	AVDD_REG	A	O	1.0V Regulated Power Supply
9	MOSI	D	I	1.8V SPI MOSI signal
10	MISO	D	O	1.8V SPI MISO signal
11	NCS	D	I	1.8V SPI Chip Select
12	SCK	D	I	1.8V SPI Clock signal
14	NRESET	D	I	1.8V external reset for digital part in SPI mode
15	CLK_EXT	D	I	External clock for digital part in SPI mode
17	VDD_SPI	A	I	SPI 1.8V Power supply
20	AVSS	A	I	Sensor ground pin
21	VINN	A	I	Negative input for ext resistive sensor (differential)
22	AVDD_REG_ SENSOR	A	O	1.0V External Sensor Power Supply
23	VINP	A	I	Positive input for ext resistive sensor (differential)
1, 3, 4, 13, 16, 18, 19, 24	NC	NA	--	Not Connected

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

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

Package	Body size	Shipment condition	Comment
QFN	4 x 4 x 0.5 mm	Waffle box	10 units/box
		Tray [45 x 18]	MOQ 100 chips
Bare die	1.3 x 1.3 x 0.254 * mm	Waffle box	400 dies per box. Bumped dies
		Full 8" wafer	Wafer diced on frame. >15K known good dies per wafer; emap provided Bumping option.

Table 2: Delivery format

* On demand: custom thinning to any value from 128 to 780 µm.

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		µA
RF Characteristics @25 °C					
Input Impedance *	Die form @ Pin=-10dBm Fcarrier = 866MHz Fcarrier = 915MHz		 7-j406 8.5-j383		 Ω Ω
	QFN24 @ Pin=-10dBm Fcarrier = 866MHz Fcarrier = 915MHz		 23-j213 30-j195		 Ω Ω
Write sensitivity in passive mode			-12		dBm
Read sensitivity in passive mode			-13		dBm
RF sensitivity in passive mode for internal temp and ext res sensors	1kΩ resistive sensor in Wheatstone bridge		-12		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

QFN24 package

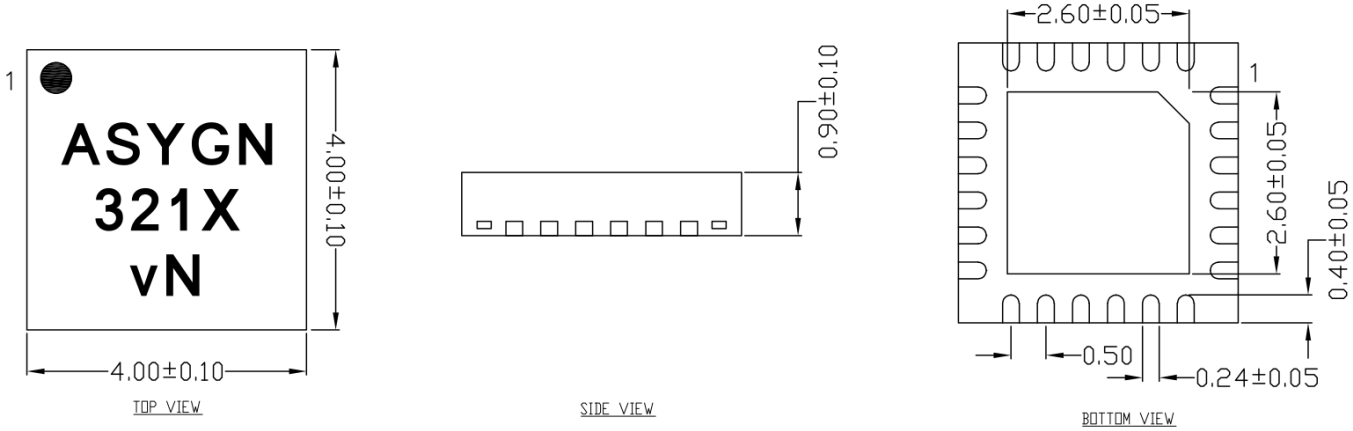


Figure 3: QFN24 package drawings

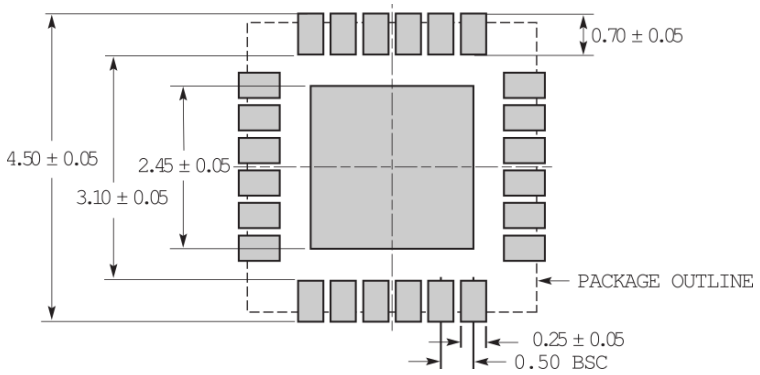


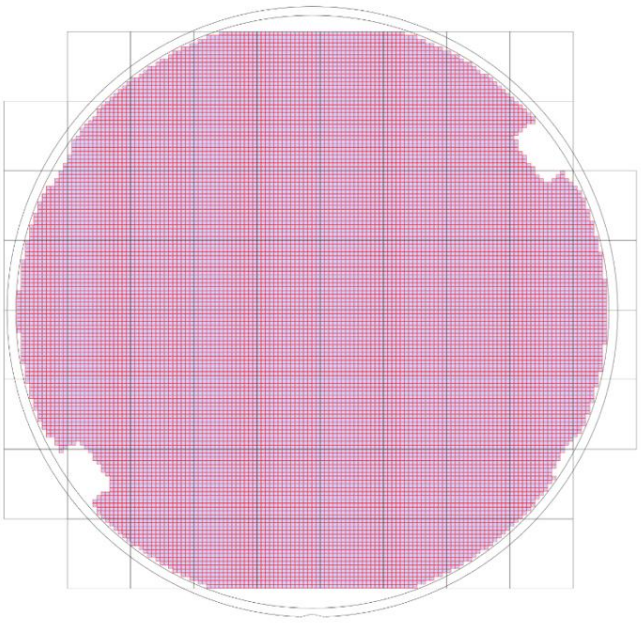
Figure 4: QFN24 recommended landing pattern

Bare dies in 200 mm wafer

Wafer information:

- ✓ 200 mm wafers on blue foil
- ✓ Wafer Thickness: 254 µm *
- ✓ Number of good dies / wafer: >15K

Chip Size	X = 1.3 mm Y = 1.3 mm
Reticle Size	X/cell = 15 ** Ycell = 18 **
Offset Value	X = -7.78 mm ** Y = -10.809 mm **
Alignment Mark	(77.8, 64.5) ** (-77.8, -54.5) **
Alignment Mark Tolerant Distance	0.8 mm
Notch reserved distance	9 mm
Start distance	9 mm
Ring edge	3 mm
Photo die number	16157 **



* On demand: custom thinning to any value from 128 to 780 µm.
** To Be Confirmed

Die information:
Dimensions: 1.3 x 1.3 x 0.254 mm
DXF of the bumped die available on the support website.

Bump properties:

- Pads size: 70µm x 77µm
- Passivation opening: 66µmx73µm
- Bumps type: Electroplating Au bumps, 25 µm thickness

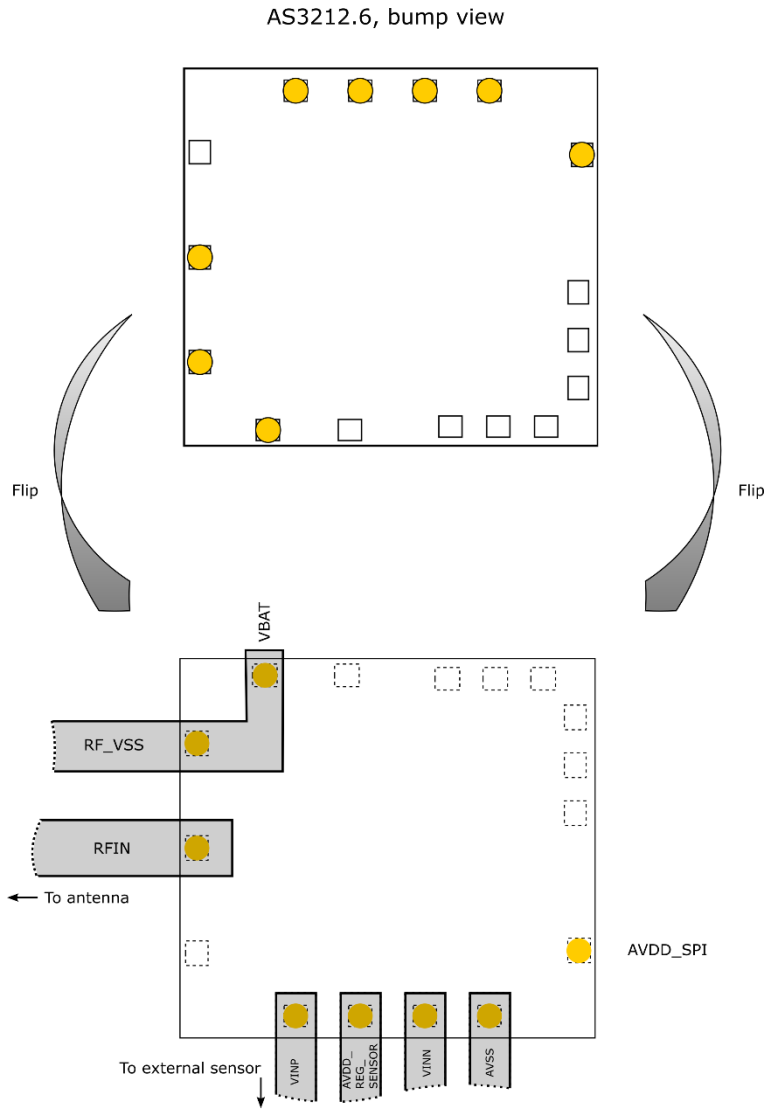


*Figure 5: Recommended landing pattern for flip-chip assembly of bumped dies (front assembly view, **flipped die**)*

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
1.0	2022-11-09	Initial version
1.1	2023-02-10	p8: minor update
2.0	2024-01-10	Document reorganized
2.1	2024-01-31	Minor corrections

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