EPC C1 Gen2 UHF RFID IC
Fully-Passive Sensor Monitoring

Description

AS3213C is an EPC^{TM} Class-1 Generation-2 compliant IC for UHF RFID applications. The chip offers advanced performance in sensor acquisition mode, due to an ultra-low power internal acquisition channel. It can be powered either by a battery or by the RF energy transmitted from a reader. In a Battery Assisted Passive (BAP) configuration, the AS3213C offers an increased reading range compared to passive RFID solutions.

AS3213C embeds 512 bits of low power non-volatile memory (EEPROM) that is organized in 4 banks as described in EPC Gen 2 standard. The chip supports the EPC data structure which is compliant with the EPC Global Tag Data Standards, Version 1.10, and is delivered with a Unique Identifier (UID) to ensure full traceability.

The chip integrates an acquisition channel and biasing circuitry for external capacitive sensors, including an on-chip amplifier suitable for capacitive sensor measurements, and a 10-bit Analog to Digital Converter (ADC). In addition to the acquisition channel, AS3213C features an internal temperature sensor, allowing single-chip measurements. Both single capacitance and differential sensors (deltaC) can be monitored by this IC.

The chip supports a temperature range from -40°C to +125°C.

All features are available either in passive or BAP mode. Sensor data are available on demand by standard readers using a simple read command in the User memory as defined in the EPC protocol. There is no need for any custom command or pre-charge sequence. It is fully compliant with standard readers.

AS3213C also provides digital interface for advanced applications such as machine to machine communication. It is made by a standard slave SPI and offers programmability and functionality setup. It also allows to trig data acquisition through the internal digital interface. Both the RF interface and the SPI bus provide the same functions.

AS3213C ICs are available either packaged in a QFN24 package or as bare dies (for wirebonding or bumped).

Features

- ✓ EPC Gen2 compliant
- ✓ Fully passive
- ✓ 512-bit non-volatile memory (EEPROM)
- ✓ 48-bit manufacturer programmed IC Serial Number
- ✓ 192 bits for UII/EPC encoding
- ✓ 96 bits for User data
- ✓ 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
- ✓ **Integrated amplifier and 10-bit ADC for external capacitive sensor data monitoring**
- ✓ **Integrated temperature sensor for external sensor data compensation**
- ✓ Serial Peripheral Interface (SPI) Bus
- ✓ Battery assistance for increasing reading range
- ✓ 1.0V Regulated power supply available on IO
- ✓ Extended temperature range: -40°C to +125°C

Applications

- ✓ Condition monitoring (pressure, temperature, humidity, vibration…)
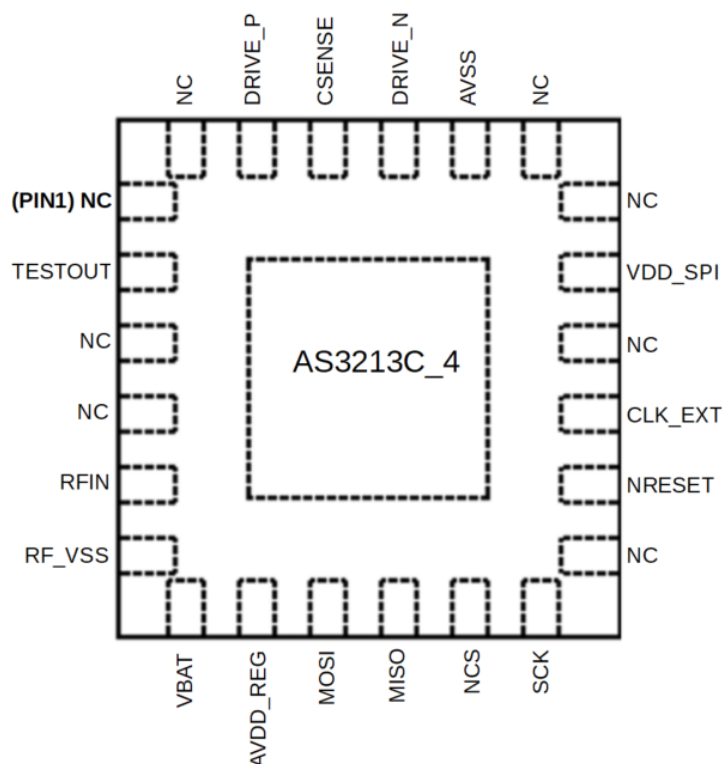- ✓ Supply chain management, tracking and tracing
- ✓ Capacitive sensors monitoring

Revision History

Revision	Date	Comment
1.0	2022-11-09	Initial version
1.1	2023-02-10	p8: minor update

Table of Content

Pin Description: QFN24 4mm x 4mm x 0.5mm (Top View)

Pin	Name	Type	I/O	Description
1	NC	NA		Not Connected
2	TEST_OUT	D	O	Digital output test pin
3	NC	NA		Not Connected
4	NC	NA		Not Connected
5	RFIN	RF	I	Antenna input
6	RF_VSS	A	I	For antenna connection only (RF ground)
7	VBAT	A	I	External Power Supply in BAP operation [1.8V;2.5V] (*) **Needs to be connected to AVSS 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
13	NC	NA		Not Connected
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
16	NC	NA		Not Connected
17	VDD_SPI	A	I	SPI 1.8V Power supply
18	NC	NA		Not Connected
19	NC	NA		Not Connected
20	AVSS	A	I	Sensor ground pin
21	DRIVE_N	A	O	Negative drive output for external capacitance
22	CSENSE	A	I	Sense input to monitor capacitance value
23	DRIVE_P	A	O	Positive drive output for external capacitance
24	NC	NA		Not Connected

A: Analog, D: Digital   (*) For write operation in the NVM, the power supply needs to be higher than 2.2V.

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Pin Description : Bare Die 1300µm x 1300µm (Top View)

Note:
On this view, the IO pads of the IC are on the top.
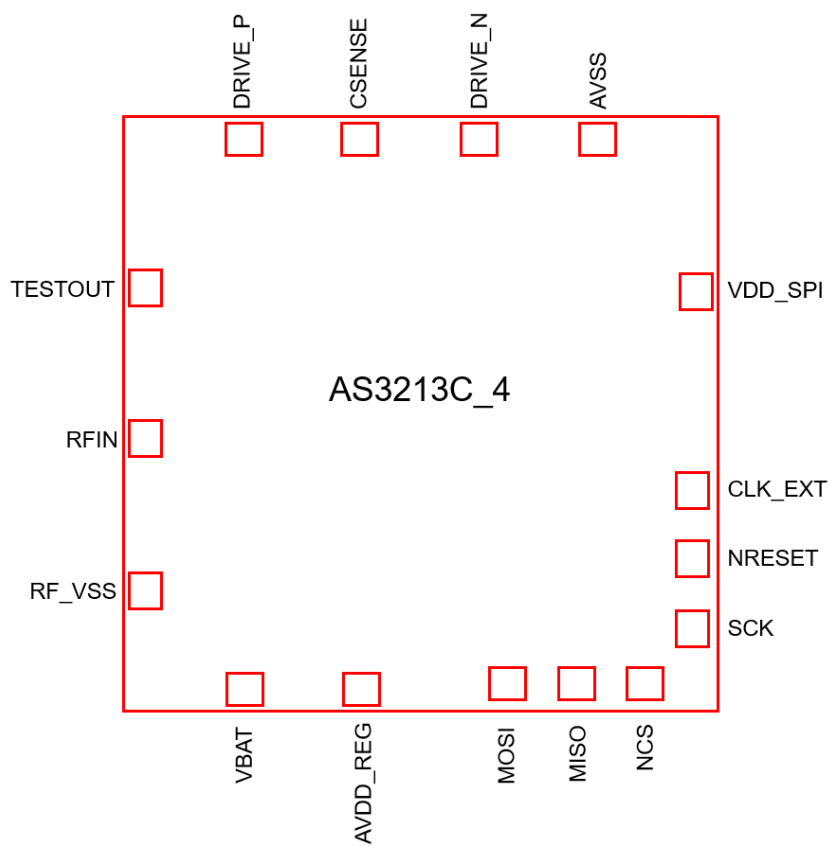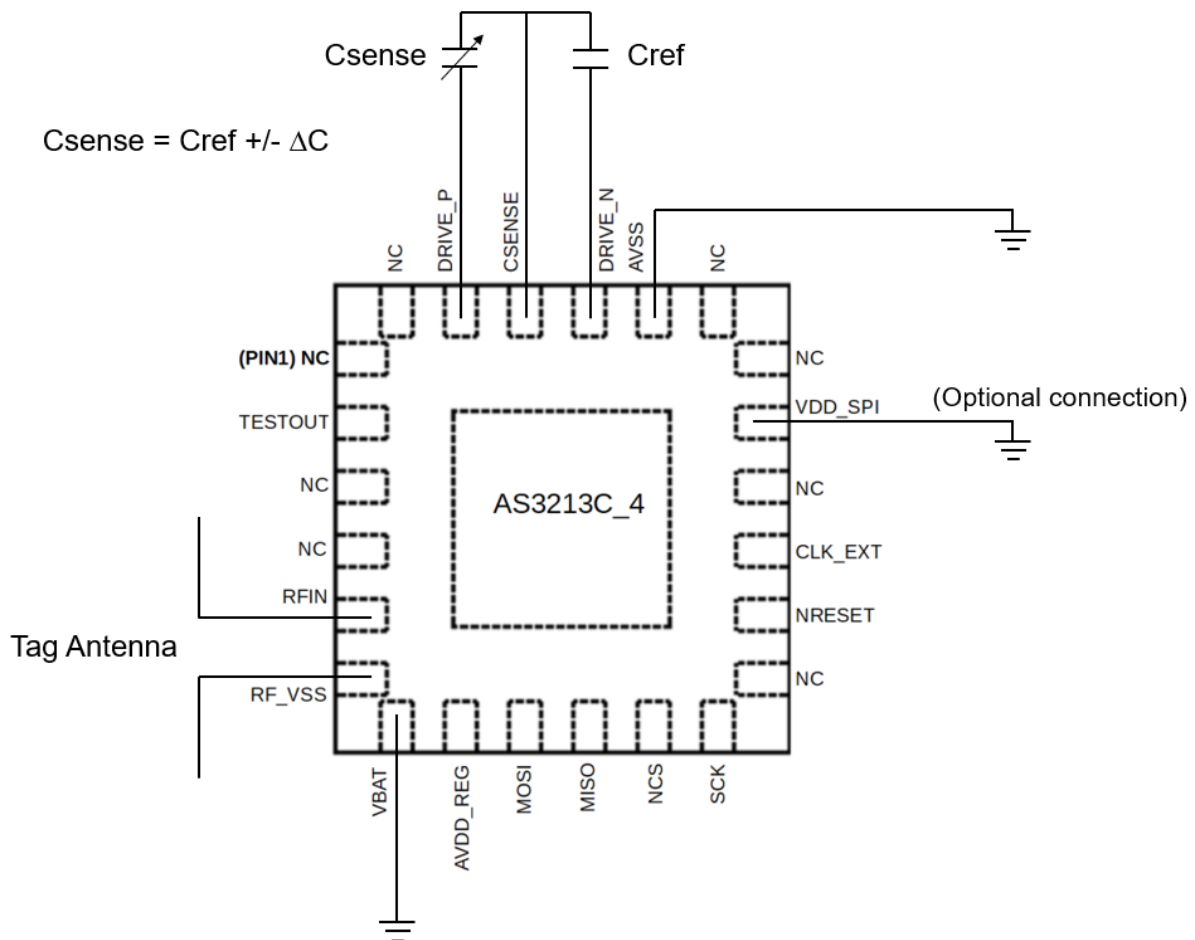

DXF files are available on request.

Typical Applications

External capacitive sensor in differential passive operation

In this application, the sensor consists of two capacitances. The acquisition channel monitors the capacitance difference between Csense and Cref. The output voltage is therefore given by the equation

$$Voutdiff = 2 \times \frac{\Delta C}{Cfeedback}$$

where Cfeedback is selectable by configuration bits available in the EPC bank.

In passive mode, the needed energy is provided by the RF field. The external power supply pin VBAT needs to be connected to GND to avoid active mode to turn on. It is recommended (not mandatory) to connect VDD_SPI to GND too, to avoid any unwanted activation of the SPI mode. NRESET, CLK_EXT and the SPI inputs can be left floating (they are pulled down internally).

External capacitive sensor in single-ended passive operation

In this application, the sensor consists of a single capacitance. The acquisition channel monitors the capacitance difference between Csense and an internal reference capacitance. This reference capacitance is selectable by configuration bits available in the EPC bank. The output voltage is therefore given by the equation

$$Voutdiff = 2 \times \frac{Csense - Creference}{Cfeedback}$$

where Cfeedback is selectable by configuration bits available in the EPC bank.
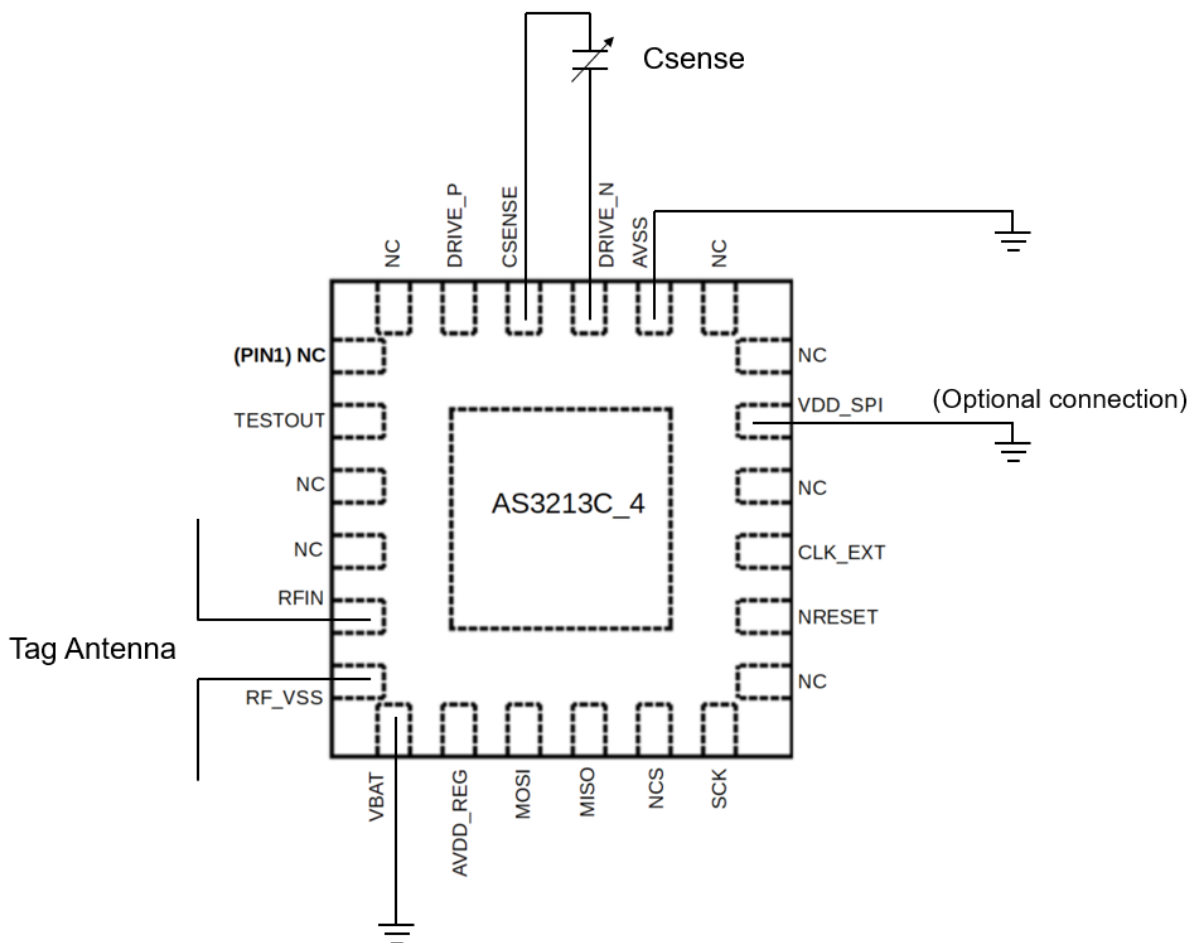
Note (see p22):
The configuration of the IC needs to be adjusted for this operation: the single-ended mode must be enabled.

More information is available on request in the form of Application Notes. Some of them can be found on the following support site: https://as321x.asygn.com/

Specification

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	Tstorage	-50	150	°C
Voltage on all pads/pins except AVSS	Vpin	0	3.3	V
RF power into pad/pin RFIN	Pmax		15	dBm
Electrostatic discharge on all pads except RFIN	VESD	-1000	1000	V
Electrostatic discharge on RFIN	VESD_RF	-500	500	V

ESD are Human Body Model (HBM) values.

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

Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Operating temperature	Toperating	-40	+125	°C
Max RF power at RFIN	Pmax_op		15	dBm
RF carrier frequency	Fcarrier	860	960	MHz

Electrical Characteristics at 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit
Battery voltage for EEPROM read operation	Vread	0.9		3.3	V
Battery voltage for EEPROM power check, erase, and write operations	Vwrite	1.8		3.3	V
Average battery current in Sleep mode (No RF applied to the antenna)	Isleep		3.8		uA

RF Characteristics @25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Impedance (*)	Zin_passive	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	Pwrite_passive			-12		dBm
Read sensitivity in passive	Pread_passive			-13		dBm
Read sensitivity in passive mode with internal temperature and external capacitive sensors	Pread_sensor	With 3pF external sensor capacitance		-12		dBm
Write sensitivity in BAP	Pwrite_bap	VBAT=2.2V		-16		dBm
Read sensitivity in BAP	Pread_bap	VBAT=2.2V		-16		dBm

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

Package information

TOP VIEW

0.175±0.050 TYP

4

PIN 1

A

4   2.4

A

2.4

SIDE VIEW

0.635

6°

4   3.7   3.5

0.175±0.050 TYP

0.84

SECTION A-A

BOTTOM VIEW

0.50 TYP

0.25 TYP

PIN 1

2.4
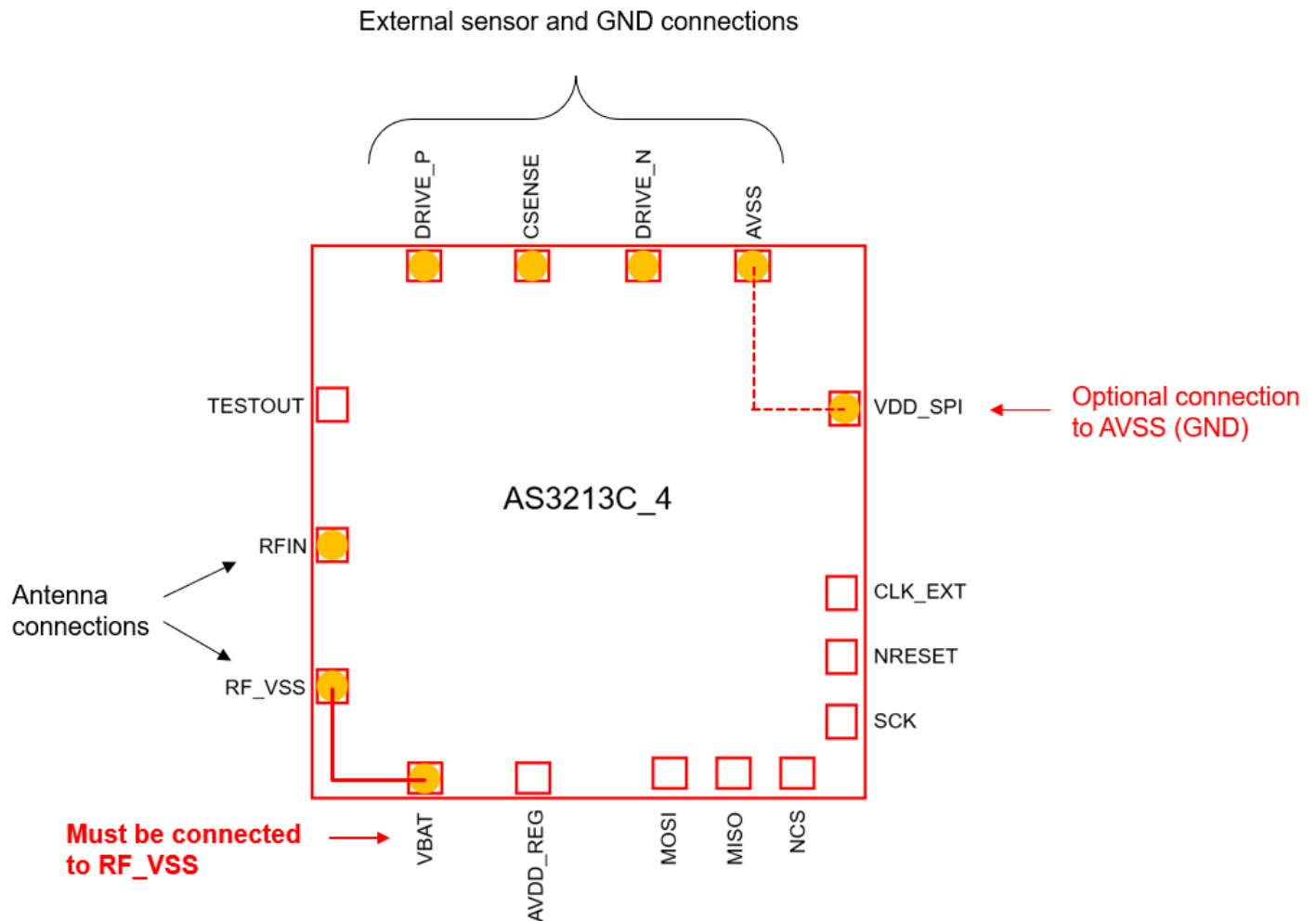
2.5 TYP

4

0.4
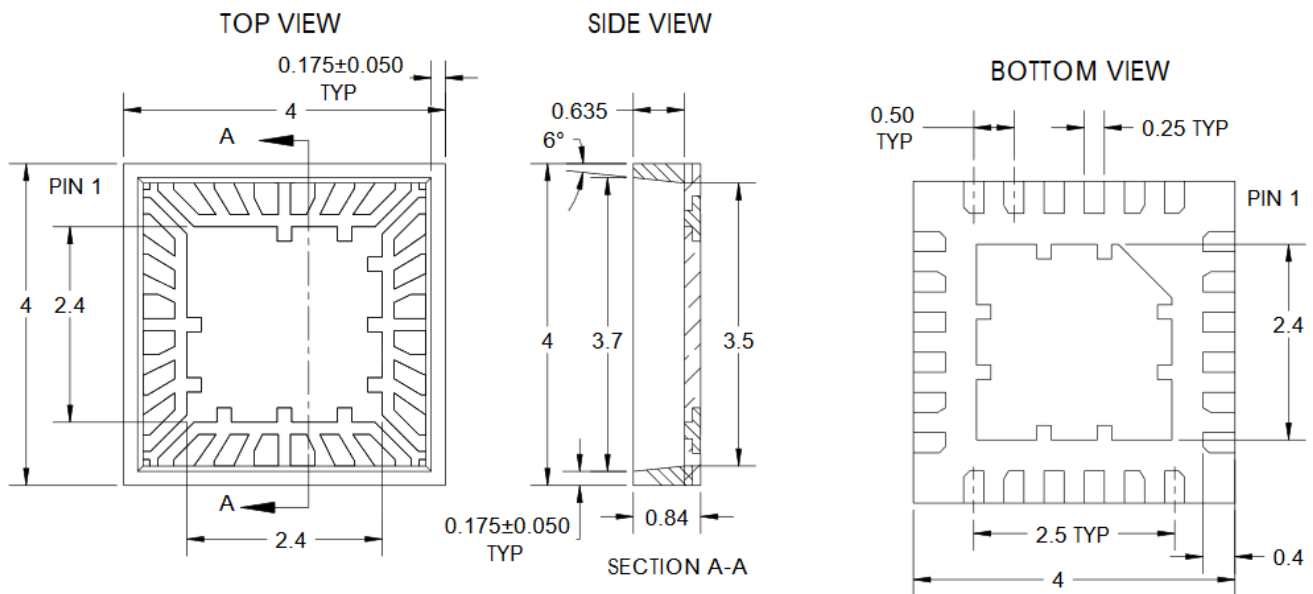
Bare Dies Information

Bumps (DXF available on demand)

Main information concerning bumps are listed below:
- Wafer Thickness : 254µm
- Pads size: 70µm x 77µm
- Passivation opening: 66µm x 73µm
- Bumps type: Accu bumps (Au)
- Bumps thickness: 45µm
- Bumps diameter: 80µm

Note:
On this view, the IO pads and the bumps are on the top.

Product Support

www.asygn.com
support@asygn.com