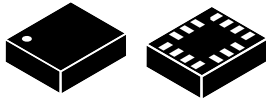
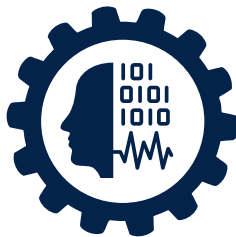


## iNEMO inertial module: always-on 3-axis accelerometer and 3-axis gyroscope with ISPU - intelligent sensor processing unit



LGA-14L  
(2.5 x 3.0 x 0.83 mm) typ.



### Features

- 3-axis accelerometer with selectable full scale:  $\pm 2/\pm 4/\pm 8/\pm 16$  g
- 3-axis gyroscope with selectable full scale:  $\pm 125/\pm 250/\pm 500/\pm 1000/\pm 2000$  dps
- Embedded ISPU: ultra-low-power, high-performance programmable core to execute signal processing and AI algorithms in the edge for a seamless digital-life experience
- Low-power consumption: 0.59 mA in high-performance mode, 0.46 mA in low-power mode (gyroscope + accelerometer only, ISPU not included)
- Low noise: 70  $\mu\text{g}/\sqrt{\text{Hz}}$  in high-performance mode
- Sensor hub feature to efficiently collect data from additional external sensors (up to 4 external sensors)
- SPI / I<sup>2</sup>C serial interface
- Analog supply voltage: 1.71 V to 3.6 V with independent IO supply (1.62 V)
- Temperature range from -40 to +85 °C
- Embedded temperature sensor
- Compact footprint: 2.5 mm x 3 mm x 0.83 mm
- ECOPACK, RoHS and “Green” compliant

### Applications

- Industrial robots
- Asset tracking
- Anomaly detection and condition monitoring
- Event detection in alarms and smart homes
- Complex motion detection and gesture recognition for personal health
- IoT and connected devices

### Description

The ISM330IS is a system-in-package featuring a 3-axis digital accelerometer and a 3-axis digital gyroscope, boosting performance at 0.59 mA in high-performance mode and enabling always-on low-power features for optimal motion results in industrial and IoT solutions.

The ISM330IS has a full-scale acceleration range of  $\pm 2/\pm 4/\pm 8/\pm 16$  g and an angular rate range of  $\pm 125/\pm 250/\pm 500/\pm 1000/\pm 2000$  dps.

The ISM330IS features programmable interrupts and an on-chip sensor hub which includes up to 6 sensors: the internal accelerometer & gyroscope and 4 external sensors.

The ISM330IS embeds a new ST category of processing, ISPU (intelligent sensor processing unit) to support real-time applications that rely on sensor data. The ISPU is an ultra-low-power, high-performance programmable core which can execute signal processing and AI algorithms in the edge. The main benefits of the ISPU are C programming, debugging and an enhanced ecosystem with libraries and 3<sup>rd</sup> party tools/IDE.

#### Product status link

[ISM330IS](#)

#### Product summary

Order code	ISM330ISTR
Temperature range [°C]	-40 to +85
Package	LGA-14L (2.5 x 3 x 0.83 mm)
Packing	Tape and reel

#### Product label



Its optimized ultra-low-power hardware circuitry for real-time execution of the algorithms is a state-of-the-art feature for any wireless sensor node from small equipment or accessories to enterprise solutions for Industry 5.0 (for example, anomaly detection, asset tracking, factory automation, and so forth).

The ISM330IS is available in a plastic land grid array (LGA) package.

## 1 Overview

The ISM330IS is a system-in-package featuring a high-performance 3-axis digital accelerometer and 3-axis digital gyroscope which embeds an **ISPU (intelligent sensor processing unit)**.

**ISPU** is the new ST category of processing: it is an ultra-low-power, high-performance programmable core with high computational efficiency which can execute signal processing and AI algorithms on the real-time data from the sensor(s). It is compatible with the most common tools to enable flexible development and supports both machine learning and deep learning, offering broad options and freedom for programming.

**ISPU** is equipped with 32 kbytes of program RAM, 8 kbytes of data RAM and an FPU supporting addition, subtraction, and multiplication.

The ISM330IS features programmable interrupts and an on-chip sensor hub which includes up to 6 sensors: 2 internal (accelerometer and gyroscope) and 4 external sensors.

The sensor hub is accessible from the ISPU.

Like the entire portfolio of MEMS sensor modules, the ISM330IS leverages the robust and mature in-house manufacturing processes already used for the production of micromachined accelerometers and gyroscopes.

The sensing elements are manufactured using specialized micromachining processes, while the IC interfaces are developed using CMOS technology that allows the design of a dedicated circuit which is trimmed to better match the characteristics of the sensing element.

The ISM330IS is available in a small plastic land grid array (LGA) package of 2.5 x 3.0 x 0.83 mm to address ultra-compact solutions.

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## 2 ISPU (intelligent sensor processing unit)

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The ISM330IS embeds a general-purpose core, a new ST category of processing, called ISPU (intelligent sensor processing unit). Its optimized ultra-low-power hardware circuitry for the real-time execution of the algorithms is a state-of-the-art feature for any wireless sensor node from small equipment or accessories to enterprise solutions for Industry 5.0 (for example, anomaly detection, asset tracking, factory automation, and so forth).

A toolchain allows developing in C code and loading any custom program in the core, with the only limitation being the available memory size of the program.

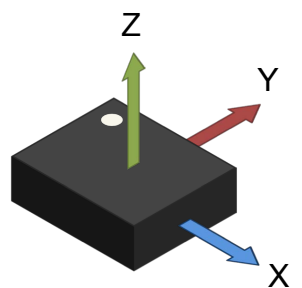
Several algorithms running on the ISPU can generate interrupts to wake up the host processor accordingly.

The ISPU core includes an 8 kbyte RAM for data storage and a dedicated 32 kbyte RAM for program memory in order to have maximum configurability. The program of the ISPU, hosted in volatile memory, should be loaded at power-up of the device by an external host through the SPI/I<sup>2</sup>C interface.

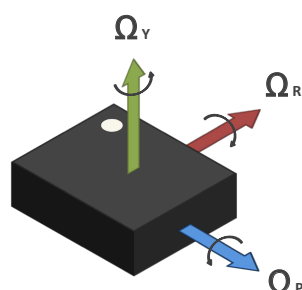
The ISM330IS is internally organized as follows:

- the sensor core (with 8-bit registers) which communicates with the user over the SPI or I<sup>2</sup>C and handles the sensor features (from settings to outputs);
- the processing core: ISPU which is based on 32-bit registers and communicates with the user through the 8-bit interface registers of the sensor core.

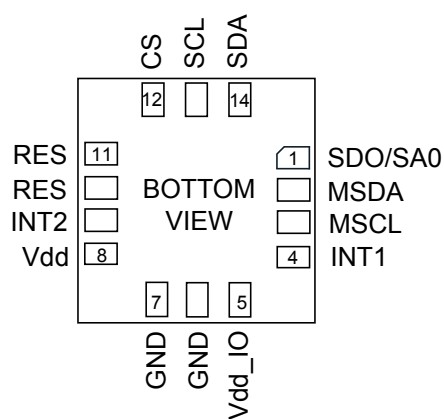
### 3 Pin description

**Figure 1. Pin connections**


Direction of detectable acceleration (top view)



Direction of detectable angular rate (top view)

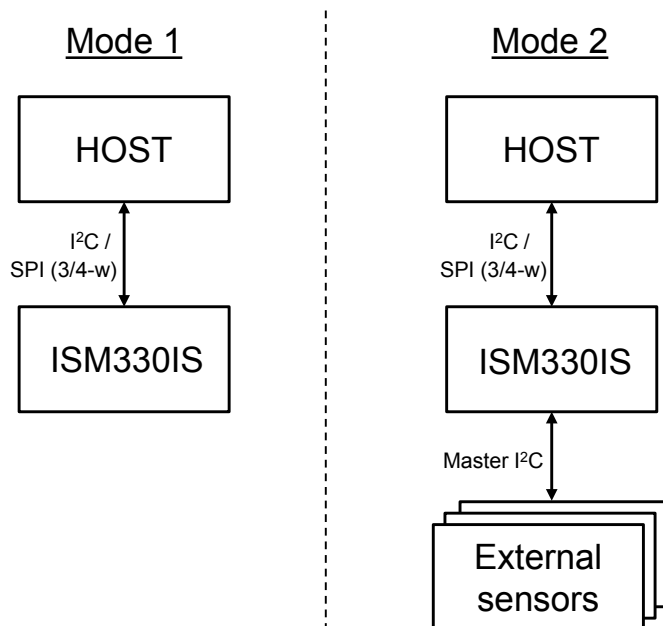


### 3.1 Pin connections

The ISM330IS offers flexibility to connect the pins in order to have two different mode connections and functionalities. In detail:

- **Mode 1:** I<sup>2</sup>C or SPI (3- and 4-wire) serial interface is available.
- **Mode 2:** I<sup>2</sup>C or SPI (3- and 4-wire) serial interface and I<sup>2</sup>C interface master for external sensor connections are available.

Figure 2. ISM330IS connection modes



In the following table each mode is described for the pin connections and function.

**Table 1. Pin description**

Pin#	Name	Mode 1 function	Mode 2 function
1	SDO/SA0	SPI 4-wire interface serial data output (SDO) I <sup>2</sup> C least significant bit of the device address (SA0)	
2	MSDA	Connect to Vdd_IO or GND	I <sup>2</sup> C serial data master (MSDA)
3	MSCL	Connect to Vdd_IO or GND	I <sup>2</sup> C serial clock master (MSCL)
4	INT1	Programmable interrupt 1	
5	Vdd_IO <sup>(1)</sup>	Power supply for I/O pins	
6	GND	0 V supply	
7	GND	0 V supply	
8	Vdd <sup>(1)</sup>	Power supply	
9	INT2	Programmable interrupt 2	Programmable interrupt 2 (INT2) I <sup>2</sup> C master external synchronization signal (MDRDY)
10	RES	Leave unconnected <sup>(2)</sup>	
11	RES	Connect to Vdd_IO or leave unconnected <sup>(2)</sup>	
12	CS	I <sup>2</sup> C/SPI mode selection (1: SPI idle mode / I <sup>2</sup> C communication enabled; 0: SPI communication mode / I <sup>2</sup> C disabled)	
13	SCL	I <sup>2</sup> C serial clock (SCL) SPI serial port clock (SPC)	
14	SDA	I <sup>2</sup> C serial data (SDA) SPI serial data input (SDI) 3-wire interface serial data output (SDO)	

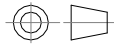
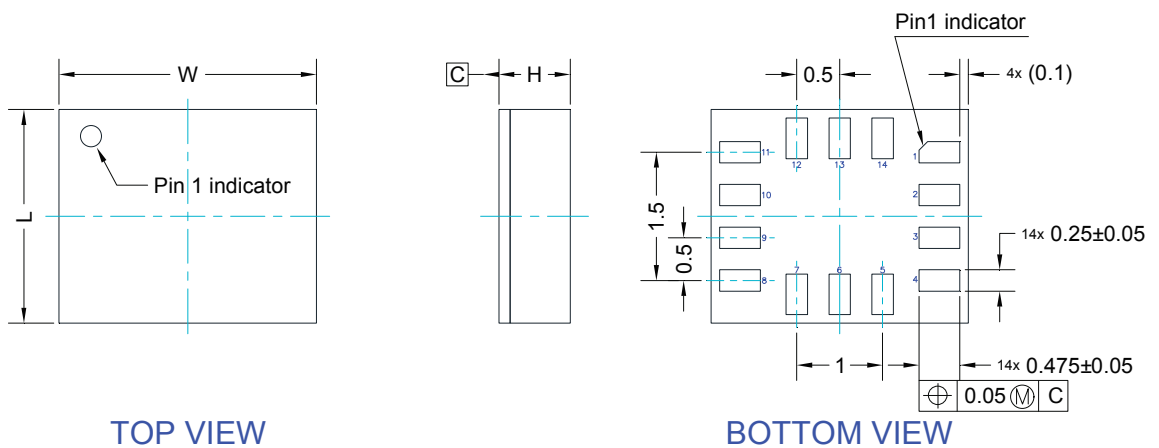
1. Recommended 100 nF filter capacitor.
2. Leave pin electrically unconnected and soldered to PCB.

## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 LGA-14L package information

**Figure 3. LGA-14L 2.5 x 3.0 x 0.86 mm package outline and mechanical data**



Dimensions are in millimeter unless otherwise specified  
 General tolerance is  $\pm 0.1$  mm unless otherwise specified

#### OUTER DIMENSIONS

ITEM	DIMENSION [mm]	TOLERANCE [mm]
Length [L]	2.50	$\pm 0.1$
Width [W]	3.00	$\pm 0.1$
Height [H]	0.86	MAX

DM00249496\_5



## 4.2 LGA-14 packing information

Figure 4. Carrier tape information for LGA-14 package

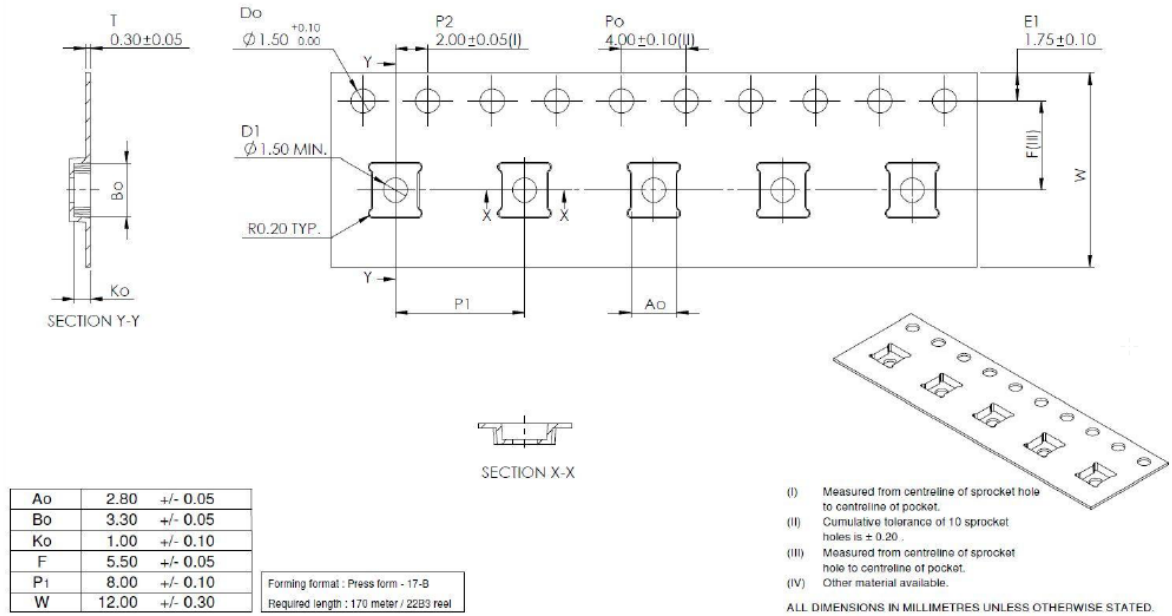


Figure 5. LGA-14 package orientation in carrier tape

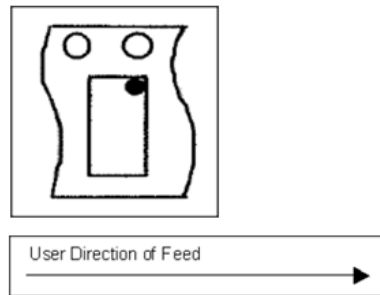


Figure 6. Reel information for carrier tape of LGA-14 package

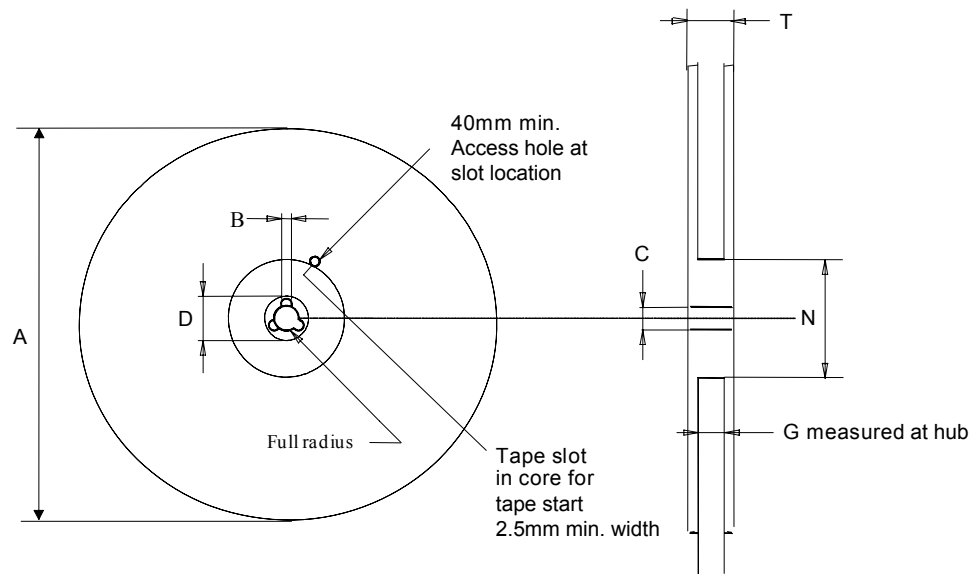


Table 2. Reel dimensions for carrier tape of LGA-14 package

Reel dimensions (mm)	
A (max)	330
B (min)	1.5
C	13 ±0.25
D (min)	20.2
N (min)	60
G	12.4 +2/-0
T (max)	18.4

## Revision history

**Table 3. Document revision history**

Date	Version	Changes
15-Nov-2021	1	Initial release
10-Mar-2022	2	Added <a href="#">Applications</a> Textual updates throughout data brief

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