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# MEMS and Sensors

## Overview

ST offers the widest range of **MEMS and sensors** covering a full spectrum of applications from low-power devices for **IoT** and battery-operated applications to high-end devices for accurate navigation and positioning, **Industry 4.0**, augmented virtual reality components and smartphones.

For Industry 4.0, ST provides a complete range of products suitable to be applied in early failure detection and systems where vibration, temperature, pressure, sound and acoustics analysis are needed.

The benefit of our is also available for - and -grade devices as well for fitness and medical applications.

<p>Product</p>  <h3>Accelerometers</h3> <p>Advanced power-saving features that make them the ideal choice for ultra-low-power applications.</p>	<p>Product</p>  <h3>Automotive sensors</h3> <p>Include digital accelerometers with low and high g full scale, and digital 3-axis gyroscopes.</p>	<p>Product</p>  <h3>e-Compasses</h3> <p>Include embedded self-test and smart power functionalities to minimize current consumption.</p>
<p>Product</p>  <h3>Gyroscopes</h3> <p>Analog and digital gyroscopes offer superior stability over time and temperature.</p>	<p>Product</p>  <h3>Humidity sensors</h3> <p>A planar capacitance technology that integrates humidity &amp; temp. sensors in the sensing element.</p>	<p>Product</p>  <h3>Industrial sensors</h3> <p>A broad range of sensors offer the high-performance, accuracy, calibration, size and temperature range required for industrial design.</p>
<p>Product</p>  <h3>Inertial Measurement Units (IMU)</h3> <p>Offer more compact, robust, and easy-to-assemble solutions compared to discrete MEMS products.</p>	<p>Product</p>  <h3>Infrared Sensors</h3> <p>ST's Infrared sensors (IR sensors) accurately detect object movements and sense human presence by measuring the IR radiation of objects within their field of view.</p>	<p>Product</p>  <h3>MEMS microphones</h3> <p>For all audio applications where small size, high sound quality, reliability &amp; affordability are required.</p>

Product



### Pressure sensors

Innovative MEMS techno to provide extremely high pressure resolution, in ultra-compact & thin packages.

Product



### Proximity sensors

FlightSense technology can be used in a host of application areas where accurate ranging is required.

Product



### Temperature sensors

Temp sensor ICs for a wide range of applications: industrial, consumer, medical and computer market segments.

Product



### T-Plus MEMS sensors

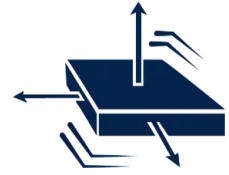
Temperature sensors with embedded MEMS motion and environmental sensor ICs.

# Accelerometers

## Overview

**Accelerometers** measure linear acceleration and are also used for other purposes such as inclination and vibration measurement.

MEMS accelerometers embed several useful features for motion and acceleration detection, including free-fall, wakeup, single/double-tap recognition, activity/inactivity detection, and 6D/4D orientation.



## Applications



### Smartphones, tablets and eReaders

- Motion detection
- Smart power saving
- Gesture recognition and gaming
- Display orientation



### Industrial applications

- Vibration monitoring and compensation
- Impact recognition and logging
- Tilt/inclination measurements
- Robotics



### Automotive applications

- Inclination / orientation detection
- Impact recognition and logging
- Vibration monitoring and compensation

## Accelerometer product types

ST state-of-the-art 3-axis **MEMS accelerometers** include general-purpose sensors, application-specific sensors, and sensors with an embedded machine learning core.

For **automotive applications**, the ST portfolio offers extended temperature range and **AEC-Q100 qualified** accelerometers such as the AIS32x family.

Devices for **industrial applications** include IISxxx family products, which are part of the **ST longevity program** that guarantees production for at least ten years from their launch date.

- General-purpose sensors
- Application-specific sensors
- Sensors with embedded machine learning core

## Discover the accelerometer portfolio



### Benefits

- Advanced power-saving features for ultralow-power applications
- Dedicated OIS SPIAUX interface
- Machine learning core
- Programmable finite state machine for custom-gesture recognition
- Advanced pedometer, step detector, and step counter
- Low-power mode, auto wake-up function, and FIFO buffer
- 2x2x1-mm packages available with 14- and 12-lead pinouts

## MEMS and Sensors/Accelerometers

Part Number	General Description	Package	Sensing Axes	Range (g) typ	Output Type	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max	Noise Density ( $\mu\text{g}/\sqrt{\text{Hz}}$ ) typ	Current Consumption ( $\mu\text{A}$ ) (Normal Mode) typ	Current Consumption ( $\mu\text{A}$ ) (Low power Mode) typ	Current Consumption ( $\mu\text{A}$ ) (Power Down Mode) typ
AIS25BA	MEMS digital output motion sensor: low noise, high bandwidth, 3-axis accelerometer with TDM interface	VFLGA 2.5X2.5X0.86 14L	X, Y, Z	$\pm 3.85$	Digital	1.71	1.8	1.99	-	2130	1280	10
AIS2DW12	MEMS digital output motion sensor: ultra-low-power 3-axis accelerometer for automotive applications	FLGA 2X2X1(MAX)MM 12L PITCH 0.5	X, Y, Z	$\pm 2; \pm 4$	Digital	1.62	1.8	3.6	120	5	0.38	0.05
AIS2IH	MEMS digital output motion sensor: high-performance 3-axis accelerometer for automobile applications	FLGA 2X2X1(MAX)MM 12L PITCH 0.5	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.62	1.8	3.6	90	140	0.67	0.1
AIS328DQ	Automotive 3-axis accelerometer, ultra low power, SPI/I2C digital output, AEC-Q100 qualified	QFN 24 4x4x1.8	X, Y, Z	$\pm 2; \pm 4; \pm 8$	Digital	2.4	3.3	3.6	218	250	-	1
AIS3624DQ	3-axis accelerometer for non-safety automotive applications, ultra low power, SPI/I2C digital output, AEC-Q100 qualified	QFN 24 4x4x1.8	X, Y, Z	$\pm 6; \pm 12; \pm 24$	Digital	2.4	3.3	3.6	600	350	-	1
H3LIS100DL	Ultra low power 3-axis accelerometer, SPI/I2C digital output MEMS motion sensor	LLGA 16 3x3x1.0	X, Y, Z	$\pm 100$	Digital	2.16	2.5	3.6	500	300	-	1
H3LIS200DL	Ultra low power 3-axis accelerometer, SPI/I2C digital output MEMS motion sensor, user-selectable full scales of $\pm 100\text{g}/\pm 200\text{g}$	LLGA 16 3x3x1.0	X, Y, Z	$\pm 100; \pm 200$	Digital	2.16	2.5	3.6	500	300	-	1
H3LIS331DL	Low power High-g 3-axis accelerometer, SPI/I2C digital output MEMS motion sensor, user-selectable full scales of $\pm 100\text{g}/\pm 200\text{g}/\pm 400\text{g}$	LLGA 16 3x3x1.0	X, Y, Z	$\pm 100; \pm 200; \pm 400$	Digital	2.16	2.5	3.6	1500	300	-	1
IIS2DH	Ultra low-power high performance 3-axes accelerometer with digital output for industrial applications	VFLGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.71	2.5	3.6	-	11	6	0.5
IIS2DLPC	MEMS digital output motion sensor: high-performance ultra-low-power 3-axis accelerometer for industrial applications	LGA2X2X0.7 12 LEADS	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.62	1.8	3.6	90	120	3	0.05
IIS2ICLX	High-accuracy, High-resolution, Low-power, 2-axis Digital Inclinometer with Embedded Machine Learning Core	LGA 5X5X1.7 16LD CERAMIC CAVITY	X, Y	$\pm 0.5; \pm 1; \pm 2;$	Digital	1.71	3.3	3.6	15	420	-	3
IIS328DQ	High-performance ultra-low-power 3-axis accelerometer with digital output for industrial applications	QFN 24 4x4x1.8	X, Y, Z	$\pm 2; \pm 4; \pm 8$	Digital	2.16	3.3	3.6	218	250	10	1
IIS3DHHC	High-resolution, high-stability 3-axis digital inclinometer for industrial applications	LGA 5X5X1.7 16LD CERAMIC CAVITY	X, Y, Z	$\pm 2.5$	Digital	1.71	2.8	3.6	45	2500	-	-
IIS3DWB	Ultra-wide bandwidth, low-noise, 3-axis digital vibration sensor	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	2.1	3	3.6	75	1100	-	3
LIS25BA	MEMS digital output motion sensor: low noise, high bandwidth, 3-axis accelerometer with TDM interface	VFLGA 2.5X2.5X0.86 14L	X, Y, Z	$\pm 3.85$	Digital	1.71	1.8	1.99	-	2130	1280	10
LIS2DE12	MEMS digital output motion sensor: ultra-low-power high-performance 3-axis "femto" accelerometer	VFLGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.71	2.5	3.6	-	6	-	0.5
LIS2DH12	MEMS digital output motion sensor: ultra-low-power high-performance 3-axis "femto" accelerometer	VFLGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.71	2.5	3.6	220	11	6	0.5
LIS2DS12	3-axis MEMS accelerometer, $\pm 2\text{g}/\pm 4\text{g}/\pm 8\text{g}/\pm 16\text{g}$ full scale, high-speed I2C/SPI digital output, ultra-low-power, high-performance acceleration sensor	VFLGA 2X2X0.86 12L	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.62	1.8	1.98	120	150	8	0.7
LIS2DTW12	MEMS digital output dual motion and temperature sensor	LGA2X2X0.7 12 LEADS	X, Y, Z	$\pm 2; \pm 4;$	Digital	1.62	1.8	3.6	90	90	3	0.05
LIS2DU12	Ultralow-power accelerometer with anti-aliasing & motion detection	LGA 2X2X0.74MAX 12 LEADS	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.62	1.8	3.6	287	-	6.1	0.02
LIS2DUX12	Ultralow-power accelerometer with AI & anti-aliasing	LGA 2X2X0.74MAX 12 LEADS	X, Y, Z	$\pm 2; \pm 4;$	Digital	1.62	1.8	3.6	220	-	6.2	0.01
LIS2DUXS12	Ultralow-power accelerometer with Qvar, AI, & anti-aliasing	LGA 2X2X0.74MAX 12 LEADS	X, Y, Z	$\pm 2; \pm 4;$	Digital	1.62	1.8	3.6	220	-	6.2	0.01
LIS2DW12	3-axis MEMS accelerometer, ultra low power, configurable single/double-tap recognition, free-fall, wakeup, portrait/landscape, 6D/4D orientation detections	LGA2X2X0.7 12 LEADS	X, Y, Z	$\pm 2; \pm 4; \pm 8; \pm 16$	Digital	1.62	1.8	3.6	90	90	3	0.05
LIS2HH12	3-axis accelerometer, $\pm 2\text{g}/\pm 4\text{g}/\pm 8\text{g}$ full scale, high-speed I2C/SPI digital output, ultra-low-power, integrated FIFO	VFLGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2; \pm 4; \pm 8$	Digital	1.71	2.5	3.6	-	110	-	5

LIS331DLH	3-axis digital accelerometer, ultra low power operational modes, advanced power saving, smart sleep to wake-up functions	LLGA 16 3x3x1.0	X, Y, Z	$\pm 2$ ; $\pm 4$ ; $\pm 8$	Digital	2.16	2.5	3.6	218	250	10	1
LIS3DH	3-axis MEMS accelerometer, ultra-low-power, $\pm 2g/4g/8g/16g$ full scale, high-speed I2C/SPI digital output, embedded FIFO, high-performance acceleration sensor, LGA 16 3x3x1.0 package	LLGA 16 3x3x1.0	X, Y, Z	$\pm 2$ ; $\pm 4$ ; $\pm 8$ ; $\pm 16$	Digital	1.71	2.5	3.6	220	11	6	0.5
LIS3DHH	3-axis accelerometer, ultra high resolution, low-noise, SPI 4-wire digital output, $\pm 2.5g$ full-scale	LGA 5X5X1.7 16LD CERAMIC CAVITY	X, Y, Z	$\pm 2.5$	Digital	1.71	2.8	3.6	45	2500	-	-
MIS2DH	3-axis accelerometer for medical/healthcare applications, $\pm 2g/\pm 4g/\pm 8g/\pm 16g$ user selectable full-scale	VFLGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2$ ; $\pm 4$ ; $\pm 8$ ; $\pm 16$	Digital	1.71	2.5	3.6	-	11	6	0.5
AIS2120SX	Automotive accelerometer for airbag, dual-axis hi-g accelerometer, AEC-Q100 qualified	SO-8	X, Y	$\pm 120$	Digital	3.1	3.3	3.5	-	6000	-	-

## Automotive Sensors

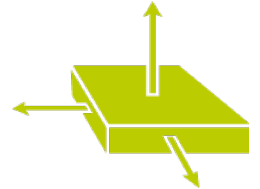
### Overview

ST offers a portfolio of **automotive sensors** qualified according to AEC-Q100 standards, including single, dual and 3-axis **accelerometers** (low and high g full scale), 3-axis **gyroscopes** and 6-axis **inertial modules (IMU)**, all with digital output.

#### Automotive MEMS accelerometers

ST's **low-g accelerometers** as and , have advanced power-saving features and an extended temperature range that make them the ideal choice for non-critical automotive applications, such as telematics, navigation, infotainment and security.

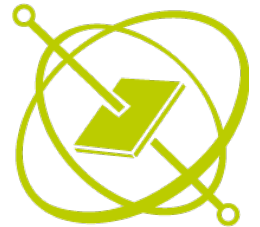
Our **high-g accelerometers** feature an extended temperature range and are suitable for airbag applications in vehicle safety restraint systems.



#### Automotive MEMS gyroscopes

Our 3-axis gyroscopes offer **superior stability over time and temperature**. ST's angular rate sensors guarantee the level of accuracy required by the most advanced navigation systems embedding dead reckoning.

ST's automotive-grade gyroscopes have a **single sensing structure** for motion measurement along all three orthogonal axes, while other solutions on the market rely on 2 or 3 independent structures. Our solution eliminates any interference between the axes that inherently degrades the output signal. The result is **increased accuracy** and **reliability** of motion-controlled functionalities.



#### Automotive 6-axis inertial module (IMU)

The , and are system-in-package featuring a **3D digital accelerometer** and a **3D digital gyroscope** with an extended temperature range up to +105 °C. It is designed to address automotive non-safety and sensor-assisted applications like dead reckoning and sensor fusion.



ST's MEMS automotive sensors are developed on the same technology platform used for high-volume MEMS at the core of many industrial and consumer applications.



## MEMS and Sensors/Automotive Sensors

Part Number	General Description	Package	Sensing Axes	Range (g) typ	Angular Rate Range (°/s) typ	Output Type	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max	Noise Density (µg/√Hz) typ	Angular Rate Noise Density (°/s/√Hz) typ	Current Consumption (µA) (Normal Mode) typ	Current Consumption (µA) (Low power Mode) typ	Current Consumption (µA) (Power Down Mode) typ
A3G4250D	3-axis digital gyroscope for automotive telematics, navigation applications, AEC-Q100 qualified	LGA 16 4x4x1.1	Yaw, Pitch, Roll	-	-	Digital	2.4	3	3.6	-	0.03	6100	1500	5
AIS2DW12	MEMS digital output motion sensor: ultra-low-power 3-axis accelerometer for automotive applications	FLGA 2X2X1(MAX)MM 12L PITCH 0.5	X, Y, Z	±2; ±4	-	Digital	1.62	1.8	3.6	120	-	5	0.38	0.05
AIS2IH	MEMS digital output motion sensor: high-performance 3-axis accelerometer for automobile applications	FLGA 2X2X1(MAX)MM 12L PITCH 0.5	X, Y, Z	±2; ±4; ±8; ±16	-	Digital	1.62	1.8	3.6	90	-	140	0.67	0.1
AIS328DQ	Automotive 3-axis accelerometer, ultra low power, SPI/I2C digital output, AEC-Q100 qualified	QFN 24 4x4x1.8	X, Y, Z	±2; ±4; ±8	-	Digital	2.4	3.3	3.6	218	-	250	-	1
AIS3624DQ	3-axis accelerometer for non-safety automotive applications, ultra low power, SPI/I2C digital output, AEC-Q100 qualified	QFN 24 4x4x1.8	X, Y, Z	±6; ±12; ±24	-	Digital	2.4	3.3	3.6	600	-	350	-	1
ASM330LHB	High-accuracy automotive 6-axis inertial module for car electronic control units with ASIL-B certification	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	-	0.0038	1300	-	3
ASM330LHH	Automotive 6-axis inertial module: 3D accelerometer and 3D gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	2	-	3.6	60	-	1300	-	3
ASM330LHHX	Automotive 6-axis inertial module with embedded machine learning core and dual operating modes	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	-	0.0038	1300	-	3
ASM330LHHXG1	High-accuracy 6-axis automotive inertial measurement unit (IMU) with embedded machine learning core and dual operating modes	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	60	0.005	1300	530	5
AIS21205X	Automotive accelerometer for airbag, dual-axis hi-g accelerometer, AEC-Q100 qualified	SO-8	X, Y	±120	-	Digital	3.1	3.3	3.5	-	-	6000	-	-

## e-Compasses

### Overview

ST's **eCompasses** include combo solutions built around a 3-axis digital accelerometer with a 3-axis digital magnetic sensor in a single **LGA package**, as well as standalone 3-axis digital magnetic sensors for designing solutions where the magnetic sensor must be located in a specific position on a printed circuit board.

Designed to accurately detect the direction and magnitude of external magnetic fields, ST's eCompasses use accelerometer measurements for tilt compensation, thus ensuring **very accurate compass headings** even when handheld or mobile devices are inclined.



### eCompasses: 3D accelerometer and 3D magnetometer

eCompasses combine a **high-performance low power** 3D accelerometer and 3D magnetometer with high dynamic range and temperature offset compensation. They offer 3 mGauss resolution and a wide range of full scales selectable by the user: from  $\pm 2$  to  $\pm 16$  g for acceleration and from  $\pm 4$  to  $\pm 50$  Gauss for magnetic fields.

eCompasses include smart power functions to **minimize current consumption** and an embedded self-test feature that allows the user to check that the sensor functions correctly in the final application.

The full range of products **offers new possibilities** for advanced navigation and location-based services in increasingly portable **consumer/industrial** devices such as tilt-compensated compasses, map rotation, intelligent power-saving for handheld devices, gaming and virtual reality input devices, position and free-fall detection, motion-activated functions, pedometers, display orientation, impact recognition and logging, vibration monitoring and compensation.

## MEMS and Sensors/e-Compasses

Part Number	General Description	Package	Sensing Axes	Range (g) typ	Magnetic Range (Gauss) typ	Output Type	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max	Current Consumption ( $\mu$ A) (Normal Mode) typ	Current Consumption ( $\mu$ A) (Low power Mode) typ	Current Consumption ( $\mu$ A) (Power Down Mode) typ
IIS2MDC	High accuracy, ultra-low-power ,3-axis digital output magnetometer	LGA2X2X0.7 12 LEADS	X, Y, Z	-	49	Digital	1.71	2.5	3.6	1130	25	1.5
ISM303DAC	High Performance,Low Power, compact 3D accelerometer and 3D Magnetometer module	LGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2$ ; $\pm 4$ ; $\pm 8$ ; $\pm 16$	49.152	Digital	1.71	-	1.98	1180	25	2.5
LIS2MDL	Magnetic sensor, digital output, 50 gauss magnetic field dynamic range, ultra-low power high performance 3-axis magnetometer	LGA2X2X0.7 12 LEADS	X, Y, Z	-	49.152	Digital	1.71	2.5	3.6	200	50	1.5
LIS3MDL	Digital output magnetic sensor : ultra-low-power, high-performance 3-axis magnetometer	VFLGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	-	16	Digital	1.9	-	3.6	270	40	1
LSM303AGR	Ultra-compact high-performance eCompass module: ultra-low power 3D accelerometer and 3D magnetometer	LGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2$ ; $\pm 4$ ; $\pm 8$ ; $\pm 16$	50	Digital	1.71	-	3.6	200	50	2
LSM303AH	e-Compass: 3D digital accelerometer, 3D digital magnetometer	LGA 2X2X1 12LD PITCH 0.5MM	X, Y, Z	$\pm 2$ ; $\pm 4$ ; $\pm 8$ ; $\pm 16$	30	Digital	1.71	1.8	1.98	200	50	2.5

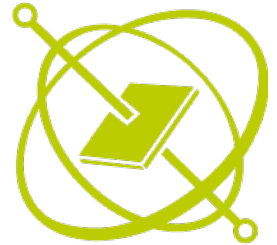
# Gyroscopes

## Overview

3-axis gyroscopes measure angular rate and are usually combined with an accelerometer in a common package to allow advanced algorithms like sensor fusion (for orientation estimation in 3D space). In that case we call them iNEMO (Inertial Modules) or more generally , which can also contain a magnetometer.

### Higher stability, accuracy and reliability

ST's **analog** and **digital gyroscopes** offer superior stability over time and temperature, with a resolution lower than 0.01 dps/ $\sqrt{\text{Hz}}$  for zero-rate level. This guarantees the level of **accuracy** required by the most advanced motion-based applications.



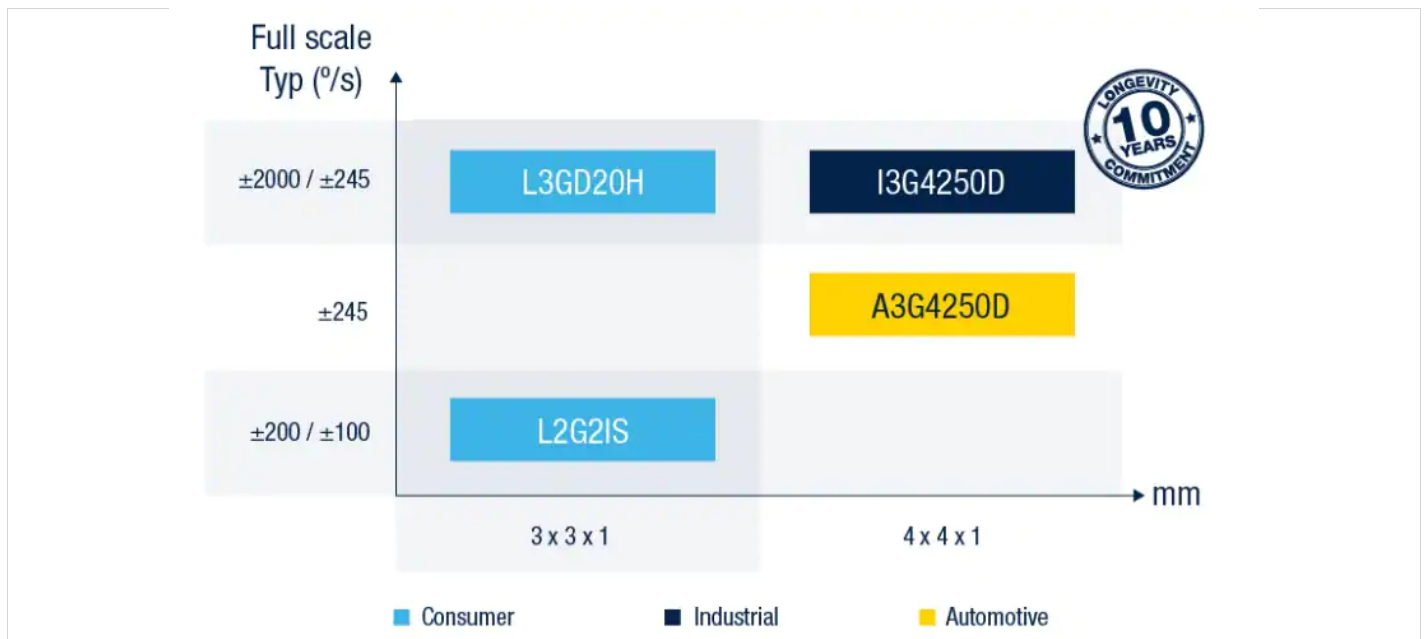
### 3-axis gyroscopes with 1 structure sensing

These **3-axis gyroscopes** have a single sensing structure for motion measurement along all three orthogonal axes, while other solutions on the market rely on two or three independent structures. ST's solution eliminates any interference between the axes that inherently degrades the output signal, increasing accuracy and reliability of motion-controlled functionalities.

### For a wide range of applications

ST's gyros measure angular velocity with a wide full-scale range (from 30 to 4000 dps) to meet the requirements of different applications, ranging from gesture recognition and image stabilization, to dead reckoning and personal navigation.

ST's angular rate sensors are already used in mobile phones, tablets, 3D pointers, game consoles, digital cameras and many other devices.



## **MEMS sensors for designs requiring long-term availability**

ST launches a new series of MEMS sensors that will stay in production for ten years starting from their date of introduction. These products take part to the 10 years' longevity commitment program, which assures, on selected parts, continuity and stability of supply for ST customers, especially those that design industrial applications and require long-term product availability.

The first 3 sensors joining the program are two new 3-axis accelerometers (IIS328DQ and IIS2DH) and a 3-axis gyroscope (I3G4250D) specifically intended for harsh industrial environments often characterized by extended temperature ranges and a high level of shocks and vibrations.

[Click here](#) for more information about the 10 years' longevity commitment program.

**MEMS and Sensors/Gyroscopes**

Part Number	General Description	Package	Sensing Axes	Angular Rate Range (°/s) typ	Output Type	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max	Angular Rate Noise Density (°/s/√Hz) typ	Current Consumption (μA) (Normal Mode) typ
A3G4250D	3-axis digital gyroscope for automotive telematics, navigation applications, AEC-Q100 qualified	LGA 16 4x4x1.1	Yaw, Pitch, Roll	-	Digital	2.4	3	3.6	0.03	6100
I3G4250D	3-axis gyroscope for industrial applications, digital output, extended operating temperature range	LGA 16 4x4x1.1	Yaw, Pitch, Roll	2000	Digital	2.4	3	3.6	0.03	6100

# iNEMO-Inertial Modules

## Overview

**iNEMO inertial modules** integrate complementary sensors in compact, robust, and easy-to-assemble inertial measurement units (IMU).

iNEMO system-in-packages (SiP) combine an accelerometer and a gyroscope in a monolithic 6-axis solution.

The integration of multiple sensor outputs ensures the highest accuracy of motion-sensing systems for the most demanding applications, such as enhanced gesture recognition, gaming, augmented reality, indoor navigation, and localization-based services.



## Applications



### Smartphones and personal electronics

- Motion tracking
- User interface
- Power optimization
- OIS/EIS
- Context recognition



### Wearables

- Activity monitoring
- Gesture recognition
- Power system optimization



### TWS/Wireless headsets

- User interface
- Bone conduction detection for speech enhanced
- Battery saving



### Virtual-augmented reality

- Motion tracking
- User interface
- Navigation



### Laptops

- User interface
- Advanced context recognition
- Battery saving
- System power optimization

## Growing iNEMO family of sensors

ST's iNEMO portfolio includes inertial measurement modules, modules with machine learning cores, and intelligent sensor processing units.

- **Inertial measurement modules**

These sensors offer application developers best-in-class motion sensing for orientation and gesture detection with more sophisticated features and capabilities than simple movement detection. These modules are designed with integrated hardware features and enable efficient and reliable motion tracking and contextual awareness.

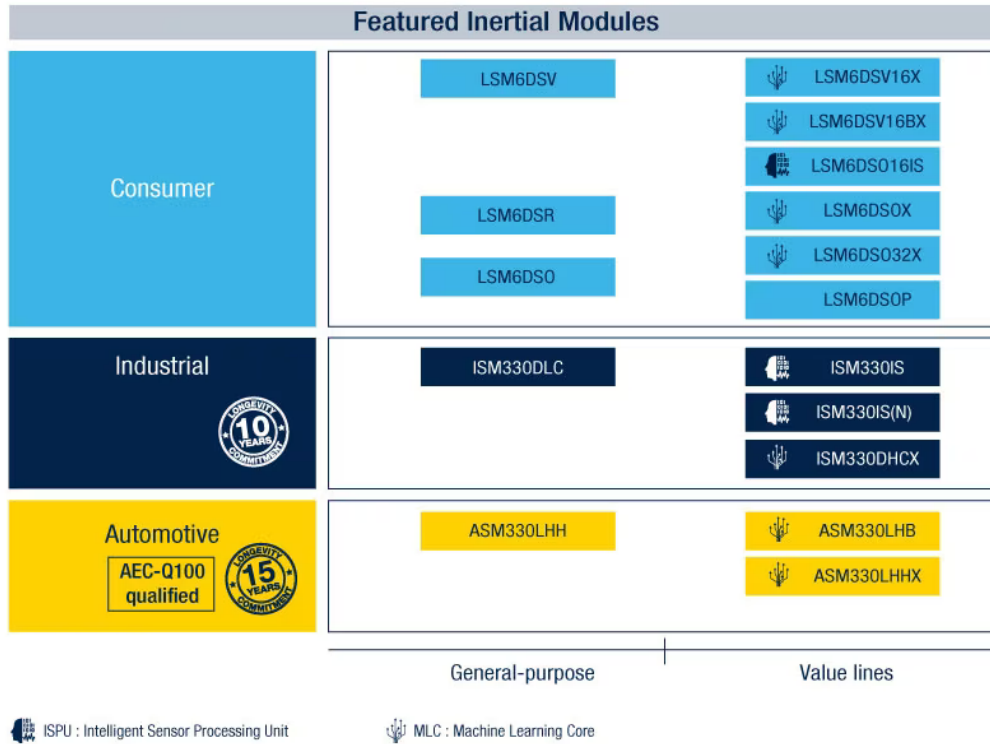
- **Sensors with embedded machine learning core**

iNEMO inertial modules with embedded save even more power at system level. The **MLC** is an in-sensor engine with classification-based AI algorithm (decision tree) able to run different tasks while the sensors are detecting motion data.

- **Sensors with intelligent sensor processing units**

This entirely new type of sensor is based on an extremely integrated, ultra-low-power circuit. **The intelligent sensor processing unit (ISPU)** is a tiny C programmable processor that can execute signal processing and AI algorithms in the sensor and is compatible with the most common development tools. ISPU sensors support signal processing and AI inference, machine learning and deep learning, and even binary neural networks, offering broad programming flexibility on a power budget in the order of microwatts.

## Discover iNEMO portfolio



### Benefits

- Best-in-class power consumption for always-on applications
- High accuracy over time and temperature for a superior motion and context experience
- High shock survivability guaranteeing very high robustness
- Local processing with ML algorithms and low microamp consumption
- Sensor AI programming flexibility



## MEMS and Sensors/iNEMO-Inertial Modules

Part Number	General Description	Package	Sensing Axes	Range (g) typ	Angular Rate Range (°/s) typ	Output Type	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max	Angular Rate Noise Density (°/s/√Hz) typ	Noise Density (µg/√Hz) typ	Current Consumption (µA) (Normal Mode) typ	Current Consumption (µA) (High Performance Mode) typ	Current Consumption (µA) (Low power Mode) typ	Current Consumption (µA) (Power Down Mode) typ
ASM330LHH	Automotive 6-axis inertial module: 3D accelerometer and 3D gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	2	-	3.6	-	60	1300	-	-	3
ASM330LHHX	Automotive 6-axis inertial module with embedded machine learning core and dual operating modes	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.0038	-	1300	-	-	3
ISM330DHCX	iNEMO inertial module with Machine Learning Core, Finite State Machine with digital output for industrial applications.	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.005	60	700	1200	32	3
ISM330DLC	iNEMO inertial measurement unit (IMU): 3D accelerometer and 3D gyroscope with digital output for industrial applications	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0038	75	500	750	350	10
ISM330IS	iNEMO inertial module: always-on 3D accelerometer and 3D gyroscope with embedded ISPU - intelligent sensor processing unit	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0034	-	-	-	-	3
LSM6DS3TR-C	iNEMO 6DoF inertial measurement unit (IMU), for entry level / mid-tier smart phones and Portable PC platforms	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.005	90	450	900	290	3
LSM6DSL	iNEMO 6DoF inertial measurement unit (IMU), for smart phones and battery operated IoT, Gaming, Wearable and Consumer Electronics. Ultra-low power and high accuracy	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.004	80	450	650	290	3
LSM6DSM	iNEMO 6DoF inertial measurement unit (IMU), for smart phones with OIS / EIS and AR/VR systems. Ultra-low power, high accuracy and stability	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0038	75	450	650	290	3
LSM6DSO	iNEMO 6DoF inertial measurement unit (IMU), with advanced Digital Function, Finite State Machine. For battery operated IoT, Gaming, Wearable and Consumer Electronics. Ultra-low power and high accuracy	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0038	70	-	550	-	3
LSM6DSO16IS	iNEMO inertial module: always-on 3D accelerometer and 3D gyroscope with ISPU - Intelligent Sensor Processing Unit	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0034	-	-	-	-	3
LSM6DSO32	iNEMO inertial module: always-on 3D accelerometer and 3D gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±4; ±8; ±16;	2000	Digital	1.71	1.8	3.6	0.0038	120	-	550	26	3
LSM6DSO32X	iNEMO inertial module: always-on 3D accelerometer and 3D gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±4; ±8; ±16;	2000	Digital	1.71	1.8	3.6	0.0038	120	-	550	26	3
LSM6DSOP	iNEMO Inertial Module: Always-on 3D Accelerometer and 3D Gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0038	-	-	550	-	3
LSM6DSOX	iNEMO inertial module with Machine Learning Core, Finite State Machine and advanced Digital Functions. Ultra-low power for battery operated IoT, Gaming, Wearable and Personal Electronics.	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0038	70	-	550	-	3
LSM6DSR	iNEMO Inertial Module: 3D Accelerometer and 3D Gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.005	60	700	1200	-	3
LSM6DSRX	iNEMO Inertial Module with Machine Learning Core, Finite State Machine and Advanced Digital Functions for High Accuracy Applications.	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.005	60	700	1200	-	3
LSM6DST	iNEMO inertial module: 3D accelerometer and 3D gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0034	-	-	-	-	3
LSM6DSTX	iNEMO inertial module with Machine Learning Core, Finite State Machine and advanced Digital Functions. Ultra-low power for battery operated IoT, Gaming, Wearable and Personal Electronics.	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0034	70	-	550	-	3
LSM6DSV	6-axis IMU with embedded sensor fusion, I3C, OIS/EIS for smart applications	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.0038	-	-	-	290	6
LSM6DSV16B	iNEMO inertial module: 3D accelerometer and 3D gyroscope	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.0035	70	-	-	-	6
LSM6DSV16BX	6-axis IMU with sensor fusion, AI, Qvar, hearable features for TWS	VFLGA2.5X3X.71 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.0028	70	-	-	-	6
LSM6DSV16X	6-axis IMU with embedded sensor fusion, AI, Qvar for high-end applications	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	4000	Digital	1.71	1.8	3.6	0.0028	-	-	-	290	6
LSM6DSV32X	6-axis inertial measurement unit (IMU) and AI sensor with 32 g accelerometer and embedded sensor fusion, Qvar for high-end applications	VFLGA2.5X3X.86 14L P.5 L.475X.25	X, Y, Z, Yaw, Pitch, Roll	±2; ±4; ±8; ±16	2000	Digital	1.71	1.8	3.6	0.0038	-	-	-	290	6

# Infrared (IR) Sensors

## Overview

ST's Infrared sensors (IR sensors) have been designed to accurately detect object movements and sense human presence by measuring the IR radiation of objects within their field of view.

There are several different technologies to support IR-based sensors, and ST offers the TMOS IR sensor solution to detect human or object presence and movement detection with high accuracy and low-power consumption, directly with a digital interface.



### TMOS IR sensor applications

ST's TMOS IR sensors enable various use cases detecting human or object presence/absence and movement around us.



#### Home Automation

Smart home/building  
Presence/Motion Detection



#### SMART Lighting

Presence/Motion Detection  
Energy saving



#### SMART IoT Home Appliance

Presence/Motion Detection  
Energy saving



#### Security Alarm System

Presence/Motion Detection  
Energy saving

### What is a TMOS IR sensor and how it works

TMOS stands for Thermal MOS. The sensor is fabricated with the unique technology of the CMOS-SOI process. The TMOS works by integrating the IR radiation emitted by objects in its field of view (FoV). This radiation reaches its MEMS-thermally-insulated gate, realized with the ST state-of-the-art.

### Infrared sensor types

ST's Infrared sensing technology is based on a thermally isolated MOS transistor array: IR radiation incident on gates can bias the MOS transistors which can be used to remotely sense temperature of objects or people. This innovative technology offers many advantages to system designers since it shows much greater sensitivity with respect to known and competitive technologies like PIR and capability to sense non-moving targets. These two key benefits enable new applications and permit significant system cost reduction, removing, for example, IR concentrators like Fresnel lenses.

### Key benefits of ST's TMOS IR sensors

- Presence detection for both stationary and moving objects
- No need of Fresnel lens to detect objects less than 4 meters
- Lower power consumption with embedded SMART algorithm
- Small package
- Digital interface

**MEMS and Sensors/Infrared (IR) Sensors**

Part Number	Operating Range Distance (m) max	Package	Package size (mm)	Supply Voltage (V) min	Supply Voltage (V) max	Operating Temperature (°C) max	Operating Temperature (°C) min
STHS34PF80	4	LGA 3.2X4.2X1.455MM 10L 0.5MM	3.2 x 4.2 x 1.455	1.7	3.6	85	-40

# MEMS Microphones

## Overview

A **MEMS microphone** is an electro-acoustic transducer housing a sensor (MEMS) and an application-specific integrated circuit (ASIC) in a single package.

The sensor converts variable incoming sound pressure to capacitance variations that the ASIC transforms into analog or digital output. The acoustic wave enters the microphone through a sound inlet in the top or bottom of the package, hence the **top or bottom** port nomenclature.

**MEMS microphones target all audio applications** where key requirements are small size, high sound quality, reliability, and affordability.



### ST's MEMS microphone applications

ST MEMS microphones find application in many fields, including **personal electronics, industrial, automotive, peripherals, and computers.**

Our best-in-class acoustic overload point (AOP) and signal-to-noise ratio (SNR) makes ST's MEMS microphones suitable for applications that require a very high dynamic range.



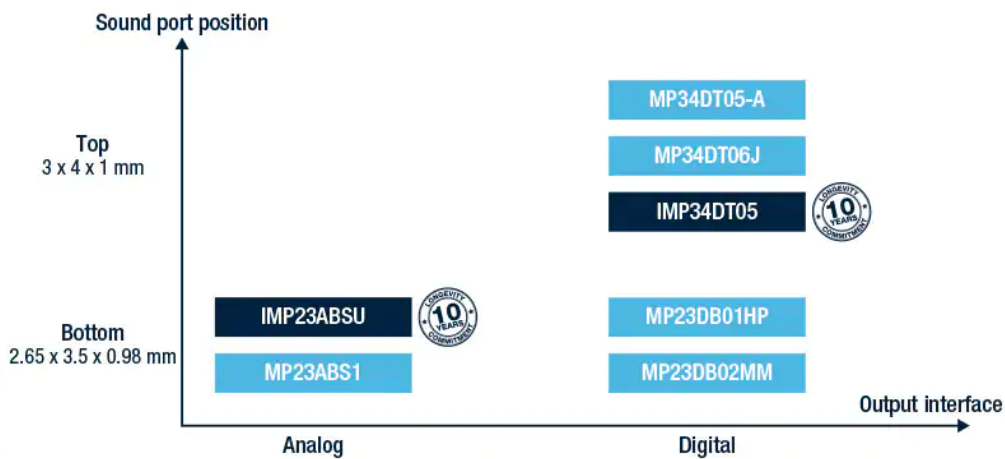
Very tight sensitivity matching allows optimization of **beamforming, sound source localization, and noise canceling** algorithms for multimicrophone arrays. These are key elements in voice activated applications like **smart home** and **smart speakers.**

The flat frequency response and high performance enable automotive applications like **hands-free call and e-Call, noise canceling, and in-car communications.**

Our low power consumption products extend the autonomy of **battery-operated applications.**

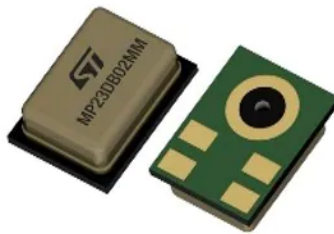
### Discover the MEMS microphones portfolio

Analog and digital MEMS microphones are available in metal and plastic packages that are extremely small and **ready for use in virtually any environment.**



#### Bottom port devices

Bottom port devices are designed in a 3.5x2.65x0.98mm metal package to improve product robustness and reliability. The substrate includes capacitance plating to **improve RF immunity**.



#### Top port devices

Top port devices are designed in a 3x4x1mm plastic package with a dedicated ground ring around the port hole for ESD robustness. The MEMS are positioned directly beneath the port hole to **maximize acoustic performance**.



#### Key benefits of ST MEMS microphones:

- omnidirectional
- high performance
- several performance modes
- low power consumption
- sensitivity matching
- high shock and temperature resistance
- small form factor



#### Developer resources

We offer a range of development tools and resources, including microphone coupon boards and example code to help developers reduce design time.

ST offers software and acoustic gasket simulation support to ensure rapid development of the best solution for your audio application needs. Check to find out more.

## Breakthrough digital bottom port microphone with multiple performance modes

Thanks to high performance and low current consumption, the MP23DB01HP MEMS microphone is the perfect choice for high-end personal electronics, computer, and automotive applications.

The multi-mode digital bottom-port microphone combines a best-in-class acoustic overload point (AOP) for handling input signals without distortion, very high signal-to-noise ratio (SNR) for far-field applications and accurate sensitivity matching.

Benefits include:

- Saves energy with multi-mode operation
- Enables voice command recognition
- Ultra-low distortion
- Flat frequency response
- PDM output and sensitivity matching
- Hardware and software evaluation tools and developer resources

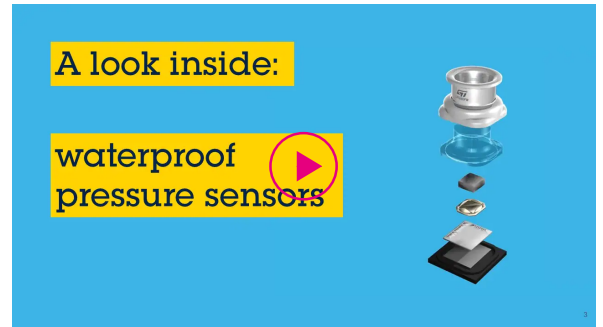
## MEMS and Sensors/MEMS Microphones

Part Number	General Description	Package	Output Type	Port location	Signal to noise ratio (dB) (A-weighted @ 1KHz)	Sensitivity (dB) (Normal Mode) typ	Sensitivity (dB) (Low power Mode) typ	Audio Frequency (Hz) min	Audio Frequency (kHz) max	Acoustic Overload Point (AOP) (dB SPL) (Normal Mode) typ	Acoustic Overload Point (AOP) (dB SPL) (Low power Mode) typ	Power Supply Rejection (PSR) (dBFS) (Normal Mode) typ	Power Supply Rejection (PSR) (dBFS) (Low power Mode) typ	Power Supply Rejection Ratio (PSRR) (dB) (Normal Mode) typ	Power Supply Rejection Ratio (PSRR) (dB) (Low power Mode) typ	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max	Supply Current (µA) (Normal Mode) typ	Supply Current (µA) (Low power Mode) typ	Operating Temperature (°C) min	Operating Temperature (°C) max
IMP23ABSU	Analog bottom port microphone with frequency response up to 80kHz for Ultrasound analysis and Predictive Maintenance applications	RHLGA 2.65X3.5X1.0 8(MAX)MM 4L	Analog	Bottom	64	-38	-	20	80000	130	-	-86	-	60	-	1.52	2.75	3.6	120	-	-40	85
IMP34DT05	MEMS audio sensor omnidirectional digital microphone for industrial applications	HCLGA 4MM X 3 MM X 1.00 MM MICRO	Digital	Top	64	-26	-	20	20000	122.5	-	-90	-	64	-	1.6	1.8	3.6	650	-	-40	85
MP23ABS1	High performance MEMS audio sensor single ended analog bottom-port microphone	RHLGA 2.65X3.5X1.0 8(MAX)MM 4L	Analog	Bottom	64	-38	-	20	20000	130	-	-86	-	60	-	1.52	2.75	3.6	120	-	-40	85
MP23DB01HP	MEMS audio sensor multi performance mode digital microphone	RHLGA 3.5X2.65X0.9 8 MM 4L	Digital	Bottom	65	-41	-24	20	20000	135	120	-85	-90	59	64	1.6	1.8	3.6	800	285	-40	85
MP23DB02MM	MEMS audio sensor multi performance mode digital microphone	RHLGA 3.5X2.65X0.9 8 MM 4L	Digital	Bottom	65	-26	-26	20	20000	122	122	-90	-90	64	64	1.6	1.8	3.6	800	285	-40	85
MP34DT05-A	MEMS audio sensor omnidirectional stereo digital microphone	HCLGA 4MM X 3 MM X 1.00 MM MICRO	Digital	Top	64	-26	-	20	20000	122.5	-	-90	-	64	-	1.6	1.8	3.6	650	-	-40	85
MP34DT06J	MEMS audio sensor omnidirectional stereo digital microphone	HCLGA 4MM X 3 MM X 1.00 MM MICRO	Digital	Top	64	-26	-	20	20000	122.5	-	-90	-	64	-	1.6	1.8	3.6	650	-	-40	85

# Pressure Sensors

## Overview

ST's tiny silicon pressure sensors use innovative MEMS technology to ensure extremely high-pressure resolution in ultra-compact and thin packages. The devices implement proprietary technology for the fabrication of pressure sensors on monolithic silicon chips, which eliminates wafer-to-wafer bonding and maximizes reliability.



### What makes ST pressure sensors unique?

#### Innovative MEMS technology

ST pressure sensors are designed using ST's VENSENS MEMS technology, which enables fabrication of a suspended membrane on the sensing element. It helps achieve highly accurate pressure measurements in an ultra-compact design with high reliability.

#### Advanced package

ST's unique fully molded package ensures high robustness to degradation caused by external mechanical and thermal stress, rendering our pressure sensors ideal for use in harsh environments.

### ST's MEMS pressure sensors applications

ST pressure sensors find applications in many fields, including **personal electronics**, **industrial**, and **IoT**. They enable accurate floor detection, enhanced location-based services, precise dead-reckoning calculations, advanced weather monitoring, and accurate water-depth sensing. Customers can choose from the barometer or waterproof pressure sensor families, depending on the targeted application and external conditions



#### Smartphones and personal electronics

- Activity recognition
- Indoor/outdoor vertical positioning
- Water depth monitoring
- GNSS applications



#### Industrial applications

- Asset tracking
- Take-off and landing recognition
- Leakage detection
- Weather station



#### IoT for Smart Home & City

- Smart filters
- Floor-type, dust bag content level
- Water level management

### Discover MEMS pressure sensors portfolio

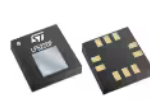
#### Digital barometer

Unique **fully molded package** providing high robustness to degradation by external mechanical and thermal stress

#### Waterproof pressure sensor

Designed in a cylindrical O-ring package featuring **potting gel element** that protects the electrical components from water





Applications	Features	Barometers	Waterproof sensors
Consumer	Single FS ~1260 hPa	LPS22DF LPS22HH	LPS27HHTW LPS27HHW
	Dual FS ~1260 hPa ~4060 hPa	LPS28DFW	
Industrial	Dual FS ~1260 hPa ~4060 hPa	ILPS22QS	ILPS28QSW



10-years longevity commitment



Sensors embedding Qvar technology

### Key features & benefits of MEMS pressure sensors

- High accuracy and low power consumption
- Thin, ultra-compact, fully molded packages
- Robust packages with cylindrical metal lid and potting gel to resist harsh conditions
- Embedded temperature compensation
- Absolute pressure range from 260 to 1260 hPa / 4060hPa
- Low-pressure noise
- Stability and performance in vertical positions

### Developer resources

We offer a range of development tools and resources to help developers implement digital barometers in their design, including evaluation boards, embedded software, and drivers. Check to find out more.



## MEMS and Sensors/Pressure Sensors

Part Number	General Description	Package size (mm)	Package Characteristic	Embedded compensation	Pressure noise (hPa) RMS	Pressure ODR (Hz) min	Pressure ODR (Hz) max	Operating pressure (hPa) min	Operating pressure (hPa) max	Current Consumption (µA) (High Performance Mode) typ	Current Consumption (µA) (Low power Mode) typ	Current Consumption (µA) (Power Down Mode) typ
ILPS22QS	Dual full-scale, 1260 hPa and 4060 hPa, absolute digital output barometer with embedded Qvar electrostatic sensor	2 x 2 x 0.73	Full-molded	true	0.004	1	200	260	1260	9.1	1.7	0.82
ILPS28QSW	Dual full-scale, 1260 hPa and 4060 hPa, absolute digital output barometer with Qvar detection in a water-resistant package	2 x 2 x 0.73	Cavity	true	0.004	1	200	260	1260	9.1	1.7	0.82
LPS22CH	High-performance MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer	2 x 2 x 0.76	Full-molded	true	0.0065	1	200	660	1160	12	4	0.9
LPS22DF	Low-power and high-precision MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer	2 x 2 x 0.73	Full-molded	true	0.004	1	200	260	1260	9.1	1.7	0.82
LPS22HB	MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer	2 x 2 x 0.76	Full-molded	true	0.0075	1	75	260	1260	12	3	1
LPS22HH	High-performance MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer	2 x 2 x 0.73	Full-molded	true	0.0065	1	200	260	1260	12	4	0.9
LPS25HB	Piezoresistive absolute pressure sensor, 260-1260 hPa, digital output barometer, I2C, SPI	2.5 x 2.5 x 0.76	Full-molded	true	0.01	1	25	260	1260	25	4	0.5
LPS27HHTW	MEMS pressure sensor: 260-1260 hPa absolute digital output barometer with embedded temperature sensor in water-resistant package	2.7 x 2.7 x 1.7	Cavity	true	0.007	1	200	260	1260	12	4	0.9
LPS27HHW	MEMS pressure sensor: 260-1260 hPa absolute digital output barometer with water resistant package	2.7 x 2.7 x 1.7	Cavity	true	0.007	1	200	260	1260	12	4	0.9
LPS28DFW	Dual full-scale, 1260 hPa and 4060 hPa, absolute digital output barometer with water-resistant package	2.8 x 2.8 x 1.95	Cavity	true	0.005	1	200	260	4060	7	4	0.9
LPS33K	MEMS pressure sensor: 300-1200 hPa absolute digital output barometer with potted gel package	3.3 x 3.3 x 2.9	Cavity	true	0.008	1	75	260	1260	2	4	-

# Proximity Sensors

## Overview

ST has introduced a new generation of high-performance **proximity and ranging sensors**, based on FlightSense™ Time-of-Flight (ToF) technology.

Unlike other proximity sensors that use simple IR (Infra-Red) technology, which only measure signal strength and can be affected by the object's reflectivity, FlightSense™ sensors directly measure distance to the object based on the time for emitted photons to be reflected, enabling **accurate distance ranging** regardless of the object's surface characteristics.

FlightSense™ products are packaged in "all-in-one" miniature module which contain the laser driver and emitter as well as the Single Photon Avalanche Diode (SPAD) light receiver that gives ST's sensors their **unrivaled ranging speed and reliability**.

This advanced ToF solution combines the benefits of ST's unique SPAD technology with our mature in-house imaging process and high-volume packaging facilities. It is ideally suited to a wide range of applications that require:

- Accurate and high-speed distance measurement
- Low power consumption
- Competitive system cost
- Easy integration with flexible mechanical design

**FlightSense™ technology** and ranging sensors can be used in a host of application area:

- Proximity sensing
- Camera autofocus and Video assist
- Vacuum cleaners, service robots and toys for wall following, cliff detection, collision avoidance
- Hover / landing assistance for drones
- Home appliances: Ambient light sensing, gesture recognition for light management, automatic doors control
- Special power-saving presence detection mode enables innovative auto-sleep/wake-on-approach use cases for PCs, notebooks and IoT devices
- Further applications include washroom automation in toilets, faucets or soap dispensers, and package counting to aid inventory management in vending machines or smart-shelf systems.

**FlightSense™ proximity and ranging sensors** are supplied with a complete documentation package, example source codes and a software API (application programming interface) which is compatible with a range of microcontrollers and processors. The application software development and the physical integration into customers' devices is easy thanks to the X-NUCLEO expansion board, breakout boards and associated development ecosystem.



**MEMS and Sensors/Proximity Sensors**

Part Number	General Description	Package	Operating Range Distance (m) max	Operating Temperature (°C) min	Operating Temperature (°C) max	Supply Voltage (V) min	Supply Voltage (V) max	Package size (mm)
VL53L0X	Time-of-Flight (ToF) ranging sensor	Optical	2	-20	70	2.6	3.5	4.4 x 2.4 x 1
VL53L1CB	Time-of-Flight (ToF) ranging sensor with advanced multi-zone and multi-object detection	Optical	8	-20	85	2.6	3.5	4.9 x 2.5 x 1.56
VL53L1CX	Time-of-Flight (ToF) ranging sensor based on ST's FlightSense technology	Optical	4	-20	85	2.6	3.5	4.9 x 2.5 x 1.56
VL53L3CX	Time-of-Flight (ToF) ranging sensor with multi target detection	Optical	5	-20	85	2.6	3.5	4.4 x 2.4 x 1
VL6180V1	Time-of-Flight (ToF) proximity sensor	Optical	0.6	-20	70	2.6	3	4.8 x 2.8 x 1.0
VL6180X	Time-of-Flight (ToF) proximity sensor and ambient light sensing (ALS) module	Optical	0.1	-20	70	2.6	3	4.8 x 2.8 x 1

# Temperature Sensors

## Overview

ST's **temperature sensor** portfolio includes both analog and digital temperature sensor ICs. Both types are suitable for a wide range of applications including industrial, consumer, portable, medical, home appliances and computer market segments, thanks to their high **accuracy** and **low-power consumption**.

The **analog** temperature sensors feature low power consumption, good linearity, and accuracy as high as  $\pm 0.5$  °C flat across the whole temperature operating range as wide as  $-55$  to  $+130$  °C and up to  $200$  °C (non-continuous).

The **digital** temperature sensors feature low power consumption as low as  $20$   $\mu$ A with up to 12-bit resolution able to digitize temperatures to a resolution up to  $0.0625$  °C to ensure high accuracy flat across the whole operating range as wide as  $-55$  to  $+125$  °C.

Additional features include an I2C/SMBus output with selectable addresses (up to 8), energy-saving one-shot temperature reading, a dedicated pin for interrupt or thermostat/comparator function and programmable threshold with hysteresis. Factory-calibrated, our digital sensors do not require any external components to measure temperature.

The STTS series with its onboard delta-sigma analog-to-digital converter (ADC) specifically targets DRAM DIMM modules in servers, desktops, and mobile personal computing platforms including laptops, as well as a variety of .

ST's temperature sensor IC portfolio is available in a wide range of packages ranging from insertion models such as the TO-92 to the smallest one on the market, the 6-lead UDFN package ( $2 \times 2 \times 0.5$  mm), for use in any environment and equipment.



## MEMS and Sensors/Temperature Sensors

Part Number	General Description	Package	I/O Interface	Resolution (b) nom	Operating Voltage (V) min	Operating Voltage (V) max	Operating Temperature (°C) max	Operating Temperature (°C) min	Accuracy (°C) typ	Precision (%) typ	Current Consumption (µA) (Normal Mode) typ	Current Consumption (µA) (Power Down Mode) typ
LM135	Precision Temperature Sensor	TO-92	-	-	-	-	150	-55	-	3	-	-
LM234	3-terminal adjustable current source	SO-8	-	-	-	-	100	-25	-	6	-	-
LM235	Precision Temperature Sensor	SO-8,TO-92	-	-	-	-	125	-40	-	3	-	-
LM334	Three Terminal Adjustable Current Source	SO-8	-	-	-	-	70	0	-	6	-	-
LM335	Precision Temperature Sensor	SO-8,TO-92	-	-	-	-	100	-40	-	3	-	-
STCN75	Digital temperature sensor IC, thermal watchdog, high-precision	MiniSO-8	SMBus/ I2C compatible	9	2.7	5.5	125	-55	0.5	-	125	1
STDS75	Digital temperature sensor and thermal watchdog	MiniSO-8	SMBus/ I2C compatible	9	2.7	5.5	125	-55	0.5	-	125	1
STLM20	Analog temperature sensor, ultra-low current 2.4 V, high precision	SOT323-5L,UFDPFN 4 1x1.3	-	-	2.4	5.5	130,85	-40,-55	0.5	-	4.8	0.02
STLM75	High-precision digital temperature sensor and thermal watchdog	MiniSO-8,SO-8	SMBus/ I2C compatible	9	2.7	5.5	125	-55	0.5	-	125	1
STTS2004	2.2 V memory module temperature sensor with a 4 Kb SPD EEPROM	TDFN8 2x3x0.75	SMBus/ I2C compatible	10	2.2	3.6	125	-20	0.5	-	160	3
STTS22H	Low-voltage, ultra-low-power, 0.5 °C accuracy I2C/SMBus 3.0 temperature sensor	UDFN 2X2X.55 6L PITCH0.65	I2C	16	1.5	3.6	125	-40	0.5	0.25	1.75	0.5
STTS75	Digital temperature sensor and thermal watchdog, delta-sigma analog-to-digital (ADC) converter, I2C interface	MiniSO-8,SO-8	SMBus/ I2C compatible	9	2.7	5.5	125	-55	0.5	-	75	1
STTS751	2.25 V low-voltage local digital temperature sensor	DFN6 2X2X0.5	SMBus/ I2C compatible	10	2.25	3.6	125	-40	0.5	-	50	3

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