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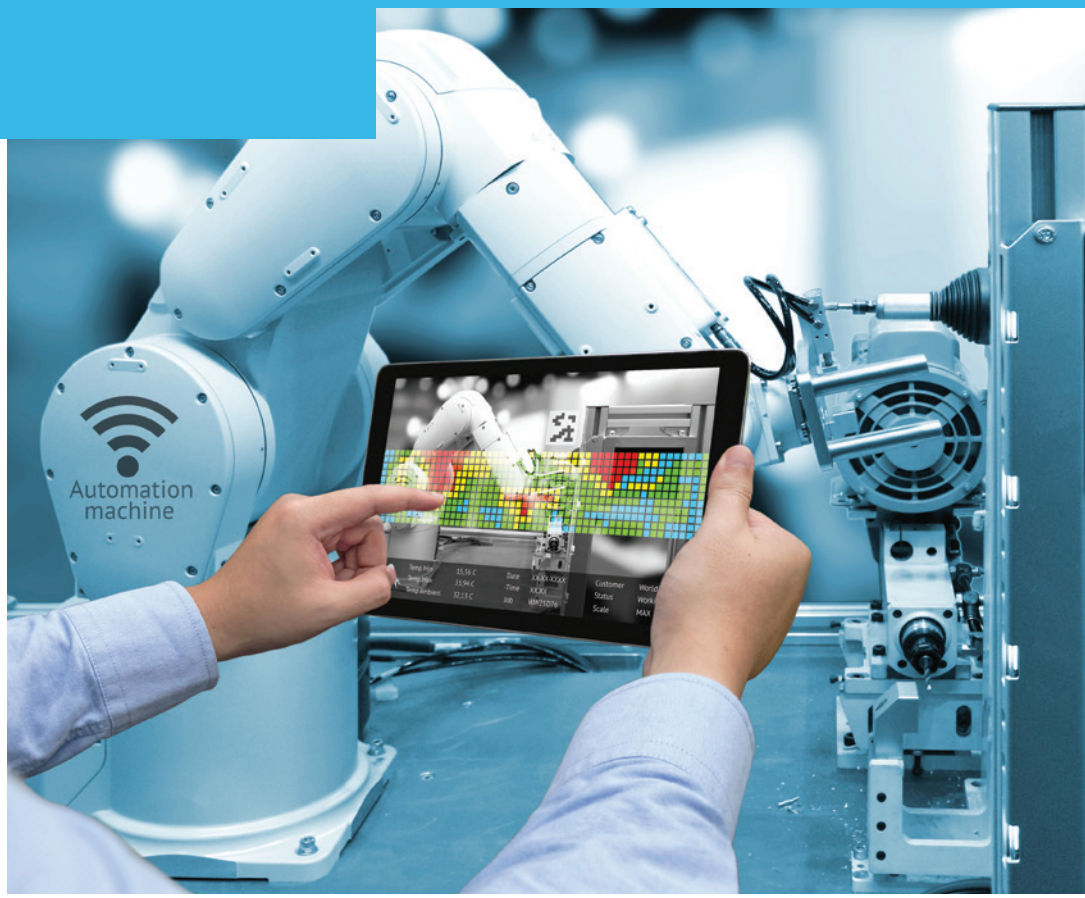
MEMS and Sensors
Smart Motion tracking, IoT for an enhanced user experience

Contents

Our solutions to match your needs



A COMPLETE SOLUTION

- Large sensor portfolio
- Integrated HW & SW solutions
- 100% security of supply
- Scalability of solutions
- Quality is at the heart of our offering
- ST is a market leader in MEMS solutions
- Compatible with STM32 Open Development Environment

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ST PROVIDES A COMPLETE SOLUTION FOR ALL YOUR SENSING NEEDS

ST has one of the industry's most extensive MEMS portfolio including accelerometers, gyroscopes, digital compasses, inertial modules, MEMS microphones, and environmental sensors including pressure, temperature and humidity sensors.

- A unique sensor portfolio, from discrete to fully-integrated solutions, to meet all design needs
- High-volume manufacturing capacity to provide cost-competitive solutions, fast time-to-market and secure supply
- High-performance sensor fusion to improve the accuracy of multiaxis sensor systems in order to enable new emerging and highly-demanding applications, such as indoor navigation and location-based services
- High-quality products, already tested in different application fields, including mobile, portable, gaming, consumer, automotive and health care segments
- Multiple sites dedicated to MEMS, with full in-house dual sourcing, guaranteeing 100% security of supply

ST's leadership continues with a strong commitment to Sustainable Technology, delivering motion MEMS products with decreasing environmental impact, generation after generation, providing improved life quality by bringing environmental and social benefits to end users.

Sensors
in your hand

SENSORS ENHANCE USER EXPERIENCE. HANDHELDS BECOME EASY-TO-USE AND FUN

CONSUMER APPLIANCES

- Smartphones and tablets (AXL, GYRO, MAG, PS, RH, IMU, Microphones)
  - Motion tracking for gesture-based user interfaces
  - Electronic compasses
  - Location-based services
  - Heading and navigation
  - Relative humidity sensing
- Gaming devices (AXL, GYRO, MAG)
  - Accurate detection of orientation and angular rate
- Remote control (AXL, GYRO, MAG, Microphones)
  - Gesture recognition and pointing (3D mouse)
- Notebooks and ultrabooks (AXL, GYRO, MAG, TS)
  - Sensor hub
  - Hard-disk protection
  - Lid closure
  - Orientation
- Cameras (DSC/DVD) (AXL, GYRO)
  - OIS and user interfaces

AXL: Accelerometer
GYRO: Gyroscope
MAG: Magnetometer
PS: Pressure Sensor
TS: Temperature Sensor
RH: Humidity Sensor
OIS: Optical Image Stabilization
IMU: Inertial Measurement Unit

Sensors in your training

SENSORS FOR IMPROVING YOUR FITNESS WORKOUT

FITNESS AND WELLNESS APPLICATIONS

- Athlete performance monitoring
  - Movement recognition through shoes and wearable sensors (AXL, IMU)
  - Golf and tennis swing detection (AXL, GYRO, MAG)
  - Body tracking recognition (AXL, GYRO, MAG)
- Watches, Personal Navigation Devices (PND) and pedometers (AXL, GYRO, MAG, PS, IMU)
  - Map orientation
  - Heading and navigation
  - Power-saving using auto-wake-up functionality
  - Taps (display activation
- Treadmills and barbells (AXL)
  - Tilting angle and shock detection during steps
- Step detection
- Pedometer
- Step counter

AXL: Accelerometer
GYRO: Gyroscope
MAG: Magnetometer
PS: Pressure Sensor
TS: Temperature Sensor
RH: Humidity Sensor
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Sensors in your home
Smart appliances

CONNECTED DEVICES OFFER ENHANCED USER INTERFACES LEADING TO A DECREASE IN ENERGY CONSUMPTION

HOME APPLIANCES

- Home alarm systems and car garages (AXL, MAG, Microphones)
  - Vibration and shock detection
  - Detection of door open/close position
- White goods (AXL, GYRO, PS, RH, IMU, TS, IMU)
  - Control of basket rotation (washing machines)
  - Power consumption optimization
  - Vibration detection for noise reduction and maintenance
  - Detection of door open/close position
  - Fluid column pressure measurement
- Smart home automation control (TS, RH)
  - Heating, ventilation and air conditioning (HVAC, PS)
  - Relative humidity level monitoring and weather stations
  - Incubators, refrigerator crispers and storage
  - Breathing equipment/humidifiers
- Electric, gas/water meters (AXL, MAG)
  - Anti-tamper mechanisms
- Home environment monitoring (TS, RH, PS)
  - Ambient temperature and relative humidity monitoring

AXL: Accelerometer
GYRO: Gyroscope
MAG: Magnetometer
PS: Pressure Sensor
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Sensors in your car

ST offers a portfolio of MEMS automotive sensors compliant with AEC-Q100 specifications. Our automotive sensor portfolio includes digital accelerometers with low and high-g full scales, 6-axis IMUs and digital 3-axis gyroscopes.

FOR SAFER CARS AND EASIER NAVIGATION

AUTOMOTIVE

- Telematics
  - E-Calls (AXL)
  - Black boxes and crash detection (AXL)
  - Fleet tracking (AXL, GYRO, IMU)
  - Driver's behavior tracking (AXL, GYRO, IMU)
  - Key fobs (AXL)
- Security
  - Car alarms and anti-theft systems (AXL)
  - Tilt detection (AXL)
- Navigation
  - 3D navigation (AXL, GYRO, IMU)
  - Dead reckoning (AXL, GYRO, IMU)
- Safety
  - SRS with rollover detection (AXL, GYRO, IMU)
  - Hill-start assist, head safety light leveling and braking assistance (AXL)
  - Vehicle dynamics, stability control (AXL, GYRO, IMU)
  - Electronic suspensions (AXL, GYRO, IMU)
  - Tire pressure monitoring systems (AXL)
  - Smart tires (AXL)

AXL: Accelerometer
GYRO: Gyroscope
MAG: Magnetometer
MIC: Microphones
TS: Temperature Sensor
RH: Humidity Sensor
IMU: Inertial Measurement Unit

Sensors at work

ST offers a broad range of sensors specifically tailored for Industry 4.0 and delivering high-performance and accuracy, high reliability, extended operating temperature range, very compact size and low power consumption.

FOR INDUSTRIAL APPLICATIONS

KEY APPLICATIONS

- Predictive maintenance and early failure detection AXL, TS, MAG, MIC
- Vibration monitoring AXL. MIC
- Industrial IoT and connected devices AXL, GYRO, MAG, IMU, TS, PS, RH
- Robotics, automation and drones AXL, High/g AXL, GYR, IMU, MAG, PS, TS
- Power saving and motion-activated functions AXL, IMU,MAG
- Appliances AXL, MAG, TS, RH, PS
- Inertial navigational systems and motion tracking AXL, GYR, IMU, MAG
- Antenna and platform pointing, leveling and stabilization AXL,GYR, MAG
- Optical image and lens stabilization AXL, GYR, IMU
- Anti-tampering in smart meters AXL, MAG
- Precision inclinometer and leveling instruments AXL
- Positional and distance sensor MAG
- Presence detection, magnetic switch MAG
- Variable magnetic field monitoring MAG
- Asset and parcel tracking, monitoring and shock detection and logging AXL, High/g AXL, GYR, IMU, TS, PS, RH, MIC
- Building and structure monitoring AXL, TS, RH, PS

AXL: Accelerometer
GYRO: Gyroscope
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OIS: Optical Image Stabilization
IMU: Inertial Measurement Unit

Sensors in health care

FOR ADVANCED MEDICAL APPLICATIONS

MEDICAL

- Implantable medical devices (AXL)
  - Pacemakers, defibrillators and neuro-stimulators
- Concussion detection in sports (high g AXL)
  - Helmets, patches and mouth guards
- Motion detection and body motion reconstruction (AXL, GYRO, MAG, PS, IMU)
  - Man-down and personal emergency response systems (PERS)
  - Rehabilitation and training
  - Improved straight line motion and tilt detection for safety
- Instrument guidance in surgery (AXL, GYRO, IMU)
- Healthcare mobility aids including wheelchairs and scooters (AXL, GYRO, PS, IMU)

AXL: Accelerometer
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Accelerometers

BENEFITS

- High performance (high resolution and stability, wide bandwidth)
- Small footprint for ultra-compact solutions
- Low power consumption and ultra-low-power operating modes which enable advanced power
- saving and smart sleep-to-wake-up functions
- Practical and easy-to-use built-in features
- Embedded state machines enable custom motion recognition reducing system complexity
- Pinout compatibility
- FIFO

HIGH-PERFORMANCE, LOW-POWER SMART SOLUTIONS

ST is one of the most established MEMS manufacturers worldwide and its accelerometers portfolio ranges from ultra-low power solutions to high performance devices.

The low-power core of accelerometers can deliver a current consumption as low few hundreds nA which enhances the operating life of the most power-consuming applications.ST's accelerometers include digital features such as wake up, inactivity detection, 4D/6D orientation, double-tap recognition, pedometers, free fall detection, programmable Finite State Machine, and embedded FiFo. A high level of integrating combined with a 2 x 2 mm accelerometer footprint and enhanced features significantly improve end-application user experience and battery life.

ST's accelerometer portfolio is designed to fit all the needs of the consumer smartphones, tablet, notebooks, wearable, IoT, etc), industrial (predictive maintenance, vibration monitoring, condition monitoring, shock detection, industrial IoT, etc) and automotive (inertial navigation systems, key fobs, alarms) application requirements.

A line of products dedicated to industrial applications (standard accelerometers, vibrometers, inclinometers) with a 10-year supply guarantee (10-year longevity program) as well as automotive-grade accelerometers are also available.

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Consumer

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Current consumption (Low Power Mode)	Key features
LIS2DTW12	LGA12 (2 x 2 x 0.7)	±2; ±4; ±8; ±16	90	3 µA	Temperature sensor combined with a 3-axis MEMS accelerometer
LIS2DW12	LGA12 (2 x 2 x 0.7)	±2; ±4; ±8; ±16	90	3 µA	14-bit, ultra-low-power, ultra-low-noise
LIS2DS12	LGA12 (2 x 2x 0.8)	±2; ±4; ±8; ±16	120	8 µA	14-bit, FIFO, embedded smart functionalities (pedometer)
LIS3DH	LGA16 (3 x 3 x 1)	±2; ±4; ±8; ±16	220	6 µA	12-bit, FIFO, low-power
LIS2HH12	LGA12 (2 x 2 x 1)	±2; ±4; ±8	140	-	16-bit FIFO, temperature stability
LIS2DE12	VFLGA12 (2X2X1)	±2; ±4; ±8; ±16	-	-	10-bit FIFO, 6D/4D detection
LIS2DH12	LGA12 (2 x 2 x 1)	±2; ±4; ±8; ±16	220	6 µA	12-bit, FIFO, low-power

Consumer-focused products

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Current consumption (Low Power Mode)	Key features
LIS25BA	VFLGA14 (2.5 x 2.5 x 0.86)	± 3.85	1% thd+noise	-	16-bit, low-noise, high-bandwidth filtering, TDM interface, specific for Audio reading
LIS3DHH	Ceramic LGA16 (5 x 5 x 1.7)	± 2.5	45	1280	16-bit, ultra-low-noise, excellent stability in temperature and time
LIS344ALH	LGA16 (4 x 4 x 1.5)	± 2; ± 6	50	-	Low noise, analog output
H3LISxxxDL	LGA16 (3 x 3 x 1)	± 100; ± 200; ± 400	15000	-	High-G full scale, low power consumption (ideal for high shock detection)

Application-specific accelerometers

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Current consumption (Low Power Mode)	Key features
IIS2ICLX	Ceramic cavity LGA-16 (5 x 5 x 1.7 mm)	± 2; ± 4; ± 8	218	2.5	High-accuracy, high-resolution, low power, 2-axis digital inclinometer with embedded Machine Learning Core
II3DWB	LGA-14L (2.5 x 3.0 x 0.83 mm)	±2; ±4; ±8; ±16	75	-	Ultra-wide bandwidth, low-noise, 3-axis digital vibration sensor

Industrial sensors

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Current consumption (Low Power Mode)	Key features
IIS3DWB	LGA14 (2.5x3x0.83)	±2; ±4; ±8; ±16	75	-	Vibration sensor: Ultra-wide bandwidth, low-noise 3-axis digital accelerometer, very low power
IIS328DQ	QFN24 (4 x 4 x 1.8)	±2; ±4; ±8	218	10 µA	Low-power high performance 3-axis accelerometer with digital output for industrial
IIS2DH	LGA12 (2 x 2 x 1)	±2; ±4; ±8; ±16	220	6 µA	3 µA current consumption at 10HZODR; 185 µA current consumption at wide bandwidth up to 2.3 kHz and ODR 5.3 kHz, temperature range up
IIS3DHHC	Ceramic LGA16 (5 x 5 x 1.7)	±2	45	-	3-axis digital Inclinometer, very-low-noise, high stability digital output motion sensor
IIS2DLPC	LGA12 (2 x 2 x 0.7)	±2; ±4; ±8; ±16	90	3 µA	High-performance, ultra-low-power 3-axis accelerometer for industrial applications

Automotive sensors

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Key features
AIS2DW12	FLGA12 (2 x 2 x 1)	± 2; ± 4	220	AEC-Q100 qualified, ultra-low power, 3-axis digital accelerometer. Superior robustness to mechanical shocks and drops. Ideal for key fob applications.
AIS328DQ	QFN24 (4 x 4 x 1.8)	± 2; ± 4; ± 8	218	AEC-Q100 qualified, temperature range -40 to +105 °C
AIS3624DQ	QFN24 (4 x 4 x 1.8)	± 6; ± 12; ± 24	600	AEC-Q100 qualified, ideal for emergency calls, high full scale, temperature range -40 to+105 °C
AIS1120X/ AIS2120SX	SO8	± 120	-	AEC-Q100 qualified, airbag central unit temperature range -40 to+105 °C
AIS1200PS	SO16	± 200	-	AEC-Q100 qualified, airbag satellite sensor temperature range -40 to +125 °C

Medical

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Key features
MIS2DH	LGA12 (2 x 2 x 1)	±2; ±4; ±8; ±16	220	Specifically designed for medical applications including Class IIIFDA implantable devices

Note: a complete list of part numbers is available at www.st.com/accelerometers

Gyroscopes

BENEFITS

- Wide full-scale range (from ±65 to ±2000 dps) for optical image stabilization (OIS) smart user interfaces and gaming
- Low noise and lowpower consumption to address the best accuracy in demanding application (as VR/AR, OIS) and extend battery life
- Stability in temperature and time
- Fast start-up for high responsiveness

SUPERIOR ACCURACY AND STABILITY OVER TIME AND TEMPERATURE

ST's analog and digital gyroscopes offer superior stability over time and temperature, with competitive low noise level for excellent level of accuracy today required by the most advanced motion-based applications. These 3-axis gyroscopes have a unique 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 advantage is to eliminate any interference between the axes that inherently degrades the output signal, increasing accuracy and reliability of motion-controlled functionalities.

ST's gyros measure angular velocity with a wide full-scale range (from 100 to 2000 dps) to meet the requirements of a variety applications, ranging from gesture recognition and image stabilization, to dead reckoning and personal navigation. ST's angular rate sensors are already common in mobile phones, tablets, 3D pointers, game consoles, digital cameras and many other devices.

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3-axis digital gyroscopes

Part number	Package/size (mm)	Typical full scale (dps)	Typical noise density (dps/√Hz)	Key features
A3G4250D	LGA16 (4 x 4 x 1.1)	± 245	0.03	AEC-Q100 qualification, low noise and high/stability over temperature
L20G20IS	LGA (2 x 2 x 0.7)	±100/±200	0.038	OIS: 2-axis ultra-compact, stability in temperature, low noise, fast start-up time
L2G2IS	LGA (2.3 x 2.3 x 0.7)	±100/±200	0.06	OIS: 2-axis compact package, stability in temperature
L3GD20H	LGA16 (3 x 3 x 1.0)	± 245/±500/±2000	0.011	UI: 3-axis, low-power, FIFO, embedded temperature sensor
I3G4250D	LGA16 (4 x 4 x 1.1)	± 245/±500/±2000	0.03	10-year longevity

Note: a complete list of part numbers is available at www.st.com/gyroscopes

Digital magnetometers

BENEFITS

- Superior sensing precision combined with low power consumption
- Wide magnetic range with high sensitivity magnetic-scale range
- Ultra low magnetic offset and low noise
- Compact package footprint, pinout compatible with 2x2 accelerometer

ACCURATE COMPASS HEADING IN ANY CONDITION

ST's magnetometers include combo solutions built with a 3-axis digital accelerometer and a 3-axis digital magnetic sensor in a single Land Grid Array (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 magnetometers use accelerometer measurements for tilt compensation, thus ensuring very accurate compass headings even when handheld or mobile devices are inclined.

ST's magnetometers combine high dynamic range with temperature offset compensation. They offer 3 mg gauss resolution and a wide range of full scales selectable by the user: from ± 2 to ± 16 g for acceleration and from ± 4 to ± 50 gauss for magnetic fields. ST's magnetometers include smart power functions to minimize current consumption and an embedded self-test feature that allows the user to check that the sensor runs correctly in the end-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 and position. ST offers also e-compass devices as part of ST's longevity program, so that stay in production for ten years from the date of introduction addressing industrial application needs.

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Consumer

Part number	Package/size (mm)	Typical range	Idd(mA)	Description
LIS2MDL	LGA12 (2 x 2 x 0.7)	Magnetic range X,Y,Z (Gauss): ±50	MAG: HP 0.2 ,LP 0.05	Ultra-low-power, high performance, offset cancellation
LIS3MDL	LGA12 (2 x 2 x1)	Magnetic range X,Y,,Z (Gauss): ±4, ±8, ±12, ±16	MAG: HP 0.27, LP 0.04	Ultra-low-power, high-performance, High ODR
LSM303AGR	LGA12 2 x 2 x1)	Magnetic range X,Y,Z (Gauss): ±50 Acceleration full scale (g): ±2,±4,±8,±16 g	MAG: HP 0.2, LP 0.05 ACC: HP 0.18, LP 0.01	High-performance, low-power eCompass module, offset cancellation
LSM303AH	LGA12 (2 x 2 x1)	Magnetic range X,Y,Z (Gauss): ±30 Acceleration full scale (g): ±2,±4,±8,±16 g	MAG: HP 0.2, LP 0.05 ACC: HP 0.16, LP 0.01	Ultra-compact high-performance eCompass module: with offset cancellation and embedded pedometer

Industrial

These devices belong the 10Y longevity program

Part number	Package/size (mm)	Typical range	Idd(mA)	Description
IIS2MDC	LGA12 (2 x 2 x 0.7)	Magnetic range (Gauss): ±50	MAG: HP 0.2, LP 0.05	High accuracy, ultra- low- power, 3-axis digital output magnetometer
ISM303DAC	LGA12 (2 x 2 x 1)	Magnetic range (Gauss): ±50 Acceleration full scale (g): ±2,±4,±8,±16 g	0.032 LP combo mode 1.45 HP combo mode	3-axis magnetometer + 3-axis accelerometer, high performance, low power, compact

iNEMO*
inertial modules

KEY ADVANTAGES

- Ultra-low power: 0.55 mA combo (15 µA AXL in ULP)
- UI Interface: SPI/I2C & MIPI I3C^{SM}
- Dedicated OIS SPIAUX interface
- Machine Learning Core
- Programmable Finite State Machine for custom-gesture recognition
- Advanced pedometer, step detector and step counter
- Up to 9 Kbytes of smart FIFO

ACCELEROMETER + GYROSCOPE SIP SOLUTION FEATURING MULTIPLE DEGREES OF FREEDOM

iNEMO* inertial modules integrate complementary types of sensors to offer more compact, robust, and easy-to-assemble solutions compared to discrete MEMS products.

iNEMO* System-in-Packages (SiP) combine an accelerometer, gyroscope and magnetometer in a monolithic 6-axis or 9-axis solution.The integration of multiple sensor outputs brings motion sensing systems to the level of accuracy required for the most demanding applications, such as enhanced gesture recognition, gaming, augmented reality, indoor navigation, pedestrian dead reckoning, wearables, OIS/EIS and localization-based services...

One of the most revolutionary aspects of our new generation of smart sensors is their embedded Machine Learning Core (MLC), included in the sensor itself, to move algorithms from the host application processor to the MEMS sensor.

Find out more about Machine Learning in sensors on our dedicated page.

Configuration examples for embedded Machine Learning Core features are available on our website and in the GitHub Repository for Machine Learning.

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Parameter	LSM6DSOX	LSM6DSRX	LSM6DSM
Current consumption in high-performance mode (mA)	0.55	1.2	0.65
Current consumption in low-power mode (mA)	0.26	0.29	0.29
(µg/√Hz) Noise density in high-performance mode @2g Accelerometer	70	60	75
Gyro noise density in high-performance mode (mdps/√Hz)	3.8	5	3.8
ODR(Hz)	Accel:1 to 6664 Gyro:12.5 to 6664	Accel:1.6 to 6667 Gyro:12.5 to 6667	Accel:1.6 to 6664 Gyro:12.5 to 6664
Smart FIFO depth	Up to 9 Kbytes	Up to 4 Kbytes	Up to 4 Kbytes
Machine Learning Core	Yes	Yes	No
Sensor data collection	Yes	Yes	Yes
OIS/EIS	Yes / Yes	Yes / Yes	No / Yes
Sensor sync	Yes	Yes	Yes

Note: Applications notes on the LSM6DSOX, the LSM6DSRX and the LSM6DSM are available.

Industrial inertial module: 3D accelerometer and 3D gyroscope

The ISM330DHCX is a System-in-Package featuring a high-performance 3D digital accelerometer and 3D digital gyroscope tailored for Industry 4.0 applications. The ISM330DHCX has a full-scale acceleration range of ± 2/± 4/± 8/± 16 g and a wide angular rate range of ± 125/± 250/± 500/± 1000/± 2000/± 4000 dps that enable its usage in a broad range of applications.

All the design aspects and the calibration of the ISM330DHCX have been optimized to reach superior accuracy, stability, extremely low noise and full data synchronization.

An unmatched set of embedded features (machine learning core, programmable FSM, FIFO, sensor hub, event decoding and interrupts) are enablers for implementing smart and complex sensor nodes which deliver high performance at very low power.

The ISM330DHCX works at an extended temperature range up to + 105 °C and is available in a 14-lead plastic Land Grid Array (LGA) package.

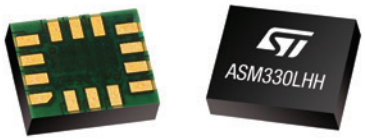
Automotive inertial module: 3D accelerometer and 3D gyroscope

The ASM330LHH is a System-in-Package featuring a 3D digital accelerometer and a 3D digital gyroscope with an extended temperature range up to + 105 °C and designed to address automotive non-safety applications. The ASM330LHH is AEC-Q100-compliant and industrialized through a dedicated MEMS production flow to meet automotive reliability standards. All components were tested with respect to temperature to ensure the highest quality level.

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

The ASM330LHH has a full-scale acceleration range of ± 2/± 4/± 8/± 16 g and a wide angular rate range of ± 125/± 250/± 500/± 1000/± 2000/± 4000 dps so it can be implemented in a broad range of automotive applications.

All the design aspects of the ASM330LHH SiP are optimized to reach superior output stability, extremely low noise and full data synchronization to the benefit of sensor-assisted applications like dead reckoning and sensor fusion.



AEC-Q100 COMPLIANT

PPAP LEVEL-3 AVAILABLE

Environmental sensors

ST offers a full kit of environmental sensors, including pressure, umidity and temperature sensors. These sensors rely on dedicated mechanical structures that guarantee the best performanceeven in challenging environmental conditions. They are adopted in many wearable devices to monitor health and for fitness programs, in smart home or other industrial applications to monitor weather conditions and guarantee good equipment safety.

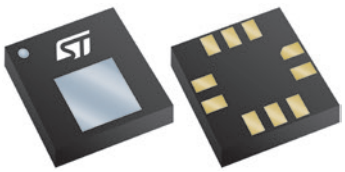
BENEFITS

- Ultra-high performance
- Low-power consumption
- Fully-molded package ensure stability and robustness in any condition and water resistance

COLLECT ACCURATE HUMIDITY, ATMOSPHERIC PRESSURE AND TEMPERATURE DATA FOR ENVIRONMENTAL AWARENESS

Pressure sensors

ST's absolute digital output barometer integrates ST's consolidated pressure sensor with the new fully molded package to further improve robustness, reliability and moisture resistance while reducing package thickness.



Part number	Package (mm)	Pressure range (hPa)	Relative accuracy (hPa)	Absolute accuracy (hPa)	Noise	ODR (Hz)	Current consumption	Standby current (µA)	Advanced digital features	Reliability
LPS22HH	HLGA-10L, 2x2x0.73 Full-molded	260 to 1260	±0.025	±0.5	0.65 Pa (with filter) 1.7 Pa (without filter)	1, 10, 25, 50, 75, 100, 200	12 µA @1 Hz (high resolution mode) 4 µA @1 Hz (low power mode)	0.9	128 samples FIFO/ Embedded compensation/ Interrupt/ I2C/I3C^{SM}/ SPI	• Full molded PKG with small holes • Improved moisture resistance. • Improved shock/vibration suppression
LPS22HB	HLGA-10L, 2x2x0.76 Full-molded	260 to 1260	±0.1	±1	0.75 Pa (with filter) 2 Pa (without filter)	1, 10, 25, 50, 75	12 µA @1 Hz (high resolution mode) 3 µA @1 Hz (low power mode)	1	32 samples FIFO/ Embedded compensation/ Interrupt/ I2C/SPI	
LPS25HB	HLGA-10L, 2.5x2.5x0.76 Full-molded	260 to 1260	±0.1	±1	1 Pa (with filter) 3 Pa (without filter)	1, 10, 25	25 µA @1 Hz (high resolution mode) 4 µA @1 Hz (low power mode)	1	32 samples FIFO/ Embedded compensation/ Interrupt/ I2C/SPI	
LPS22HD	HLGA-10L, 2x2x0.76 Full-molded	260 to 1260	± 0.1	± 1	0.75 Pa (with filter) 2 Pa (without filter)	1, 10, 25, 50, 75, 100, 200	12 µA @1 Hz (high resolution mode) 3 µA @1 Hz (low power mode)	1	32 samples FIFO/ Embedded compensation/ Interrupt/ I2C/SPI	

Note: a complete list of part numbers is available at www.st.com/pressure

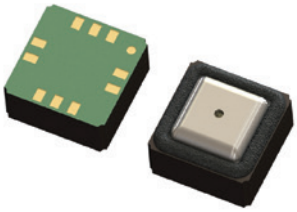
Water-proof pressure sensors

Waterproof pressure sensors are available in ST's pressure sensor portfolio.

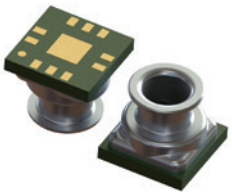
The LPS27HHW piezoresistive absolute pressure sensor comes in an ultra-compact package size. It enables high-pressure accuracy with embedded temperature compensation. The device comprises a sensing element and an IC interface which communicates through I²C, MIPI I3CSM or SPI from the sensing element to the application.

ST offers a wide portfolio with different package sizes and types. These devices can be implemented in wearable, consumer or industrial applications which require a high quality level of water proofing under water or from liquids.

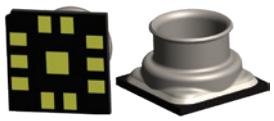
Innovative packages



CCLGA 10L (3.5 x 3.5 x 1.85 mm)



CCLGA 10L (3.3 x 3.3 x 2.9 mm)



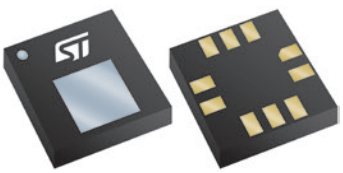
CCLGA 10L (2.7 x 2.7 x 1.7 mm)

Part number	Package (mm)	Pressure accuracy (hpa)	Relative accuracy (hpa)	Absolute range (hpa)	Noise hPa(RMS)	ODR (Hz)	Current consumption	Overpressure (*)	Advanced digital features
LPS27HHW	CCLGA10L (2.7x2.7x1.7)	260 to 1260	± 0.025	± 0.5 hPa	0.7 Pa (with filter) 1.8 Pa (without filter	1, 10, 25, 50, 75,100, 200	12 µA @1 Hz (high resolution mode) 4 µA@1 Hz (low-power mode)	10 ATM	FIFO for 128 x Pressure & Temperature/ Interrupt / Embedded temperature compensation / I2C & SPI & I3C
LPS33HW	CCLGA10L (3.3x3.3x2.9)	260 to 1260	± 0.1	± 2.5 hPa	0.8 Pa (with filter) 2 Pa (without filter)	1, 10, 25, 50, 75	15 µA @1 Hz (high resolution mode) 3 µA@1 Hz (low power)	10 ATM	FIFO for 32 x Pressure & Temperature/ Interrupt / Embedded temperature compensation / I2C & SPI
LPS33K	CCLGA4L (3.3 x 3.3 x 2.9)	300 to 1200	± 0.1	± 3 hPa	0.8 Pa (with filter) 2 Pa (without filter)	1, 10, 25, 50, 75	15 µA @1 Hz (high resolution mode) 4 µA @1 Hz (low power)	10 ATM	Embedded temperature compensation / I2C / 4-pin footprint
LPS33W	CCLGA10L (3.3x3.3x2.9)	260 to 1260	± 0.1	± 3 hPa	0.8 Pa (with filter) 2 Pa (without filter)	1, 10, 25, 50, 75	15 µA @1 Hz (high resolution mode) 3 µA @1 Hz (low power)	IP x 8	FIFO for 32 x Pressure & Temperature/ Interrupt / Embedded temperature compensation / I2C & SPI
LPS35HW	CCLGA10L (3.5x3.5x 1.85)	260 to 1260	± 0.1	± 4 hPa	1 Pa (with filter) 3 Pa (without filter)	1, 10, 25, 50, 75	15 µA @1 Hz (high resolution mode) 3 µA @1 Hz (low power mode)	5 ATM	FIFO for 32 x Pressure & Temperature/ Interrupt / Embedded temperature compensation / I2C & SPI

Note(*): Water resistant

Humidity and temperature sensors

The HTS221 is an ultra-compact sensor that measures relative humidity and temperature. Housed in a tiny but robust HLGA package (2 x 2 x 0.9 mm), the HTS221 sensor is suitable for wearable and portable devices and all applications where comfort, health and safety might be negatively impacted by humidity and temperature variations.



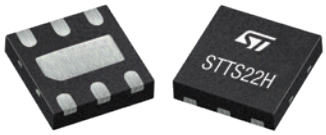
BENEFITS

- Ultra-small footprint
- Low-power consumption to address wearable devices
- Enables customized calibration for best design flexibility
- Humidity accuracy: ± 3.5% rH, 20 to +80% rH
- Temperature accuracy: ± 0.5 °C,15 to +40 °C

Part number	General description	Package	Supply voltage min-max (V)	Humidity (RH) min-max (% RH)	Interfaces
HTS221	Capacitive digital sensor for relative humidity and temperature	HLGA-6L 2 x 2 x 0.9 mm	1.7-3.6	0-100	SPI, I²C

Temperature sensors

ST's temperature sensors temperature sensors include both analog and digital temperature sensor ICs. Both types are suitable for use in a wide range of applications, such as industrial, consumer, medical and computer market segments. The analog temperature sensors feature low-power consumption, good linearity, and can operate over a temperature range as wide as -55 to +130 °C. The digital temperature sensors feature low power consumption, up to 12-bit resolution and can operate over a temperature range as wide as -55 to +125 °C.



2 x 2 x 0.5 mm

BENEFITS

- Small footprint
- High accuracy
- Dual alarm
- One-shot mode for energy saving

Digital temperature sensors

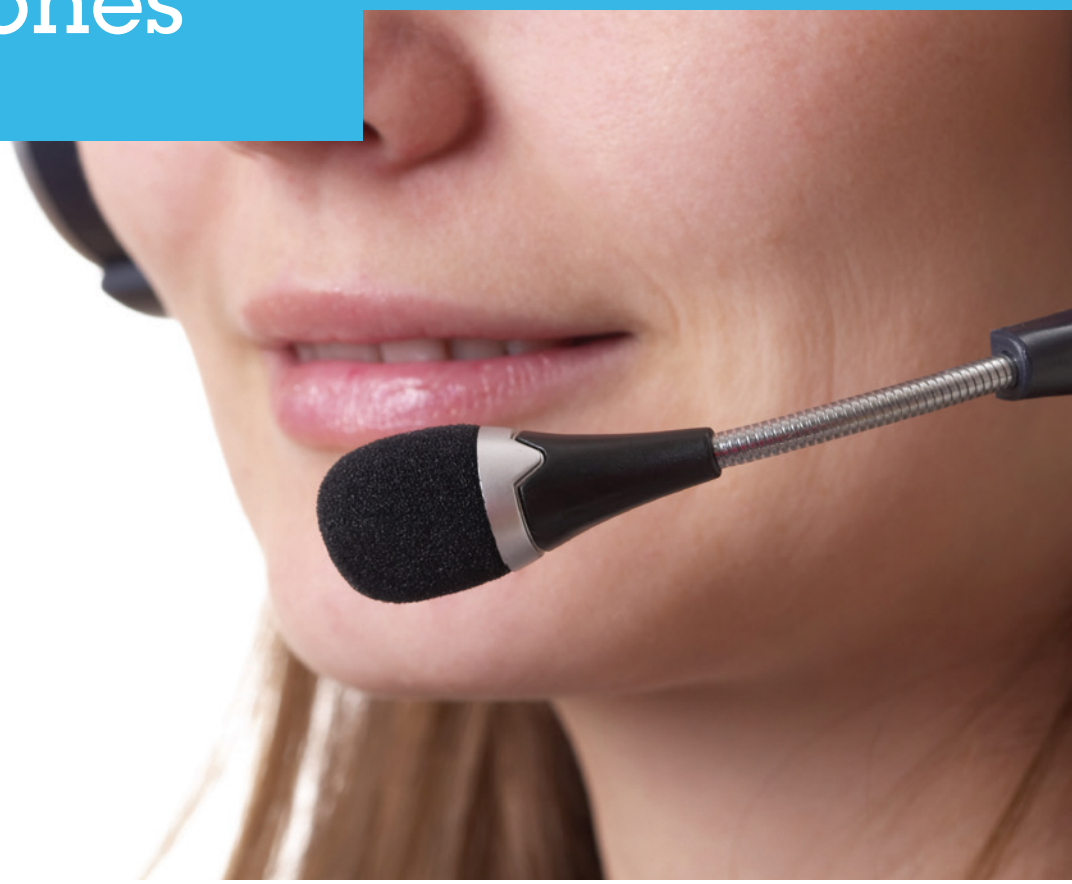
Part number	Package	Package size (mm)	General description	I/O Interface	Operating voltage min-max (V)
STTS22H	UDFN-6L	2 x 2 x 0.5	Low-voltage, Ultra-low-power, 0.5°C accuracy	SMBUS3.0/I²C compatible	1.5-3.6
STCN75	MSOP (TSSOP8)	3 x 3	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STDS75	MSOP (TSSOP8)	3 x 3	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STLM75	MSOP (TSSOP8), SO-8	3 x 3, 4.90 x 3.90	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STTS75	MSOP (TSSOP8), SO-8	3 x 3, 4.90 x 3.90	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STTS751	UDFN-6L	2 x 2	2.25 V low-voltage local digital temperature sensor	SMBus/I²C compatible	2.25-3.6
STTS2004	TDFN8	2 x 3	2.2 V memory module temperature sensor with a 4 Kb SPD EEPROM	SMBus/I²C compatible	2.2-3.6

Analog temperature sensors

Part number	Package	Package size (mm)	General description	Operating voltage min-max (V)	Operating supply current typ (mA)
STLM20	UDFN-4L, SOT323-5L	1 x 1.30, 2 x 1.25	Ultra-low current 2.4 V precision analog temperature sensor	2.4-5.5	0.008

Note: a complete list of part numbers is available at www.st.com/tempsensors

MEMS analog and digital microphones



CRYSTAL-CLEAR AUDIO QUALITY WITH THE SIZE, COST AND VOLUME PRODUCTION OF MEMS SENSORS

MEMS microphones target all audio applications where small size, high sound quality, reliability and affordability are key requirements. ST's MEMS microphones are designed, developed and manufactured inside ST, creating an industry-unique vertical integrated supply chain. Both analog- and digital-input as well as top and bottom port solutions are available. The IMP34DT05 intended for industrial applications is part of ST's longevity program and will stay in production for ten years from the date of introduction.

KEY BENEFITS

- Enhanced performance
  - High stability of sensitivity after reflow
  - Very stable unit-to-unit performance
- Consolidated micromachining technology
  - New applications enabled: stereo capture, noise cancellation, beam forming
- High shock resistance

TARGETED APPLICATIONS

- IoT
- Laptops
- Smart home
- Digital cameras and camcorders
- Gaming
- Portable media players
- Hands-free devices
- Tablets
- Hearing aids
- Headsets
- Smart watches
- Automotive (e-calls, Hands-free call, noise cancelling)
- Industrial
- Health care

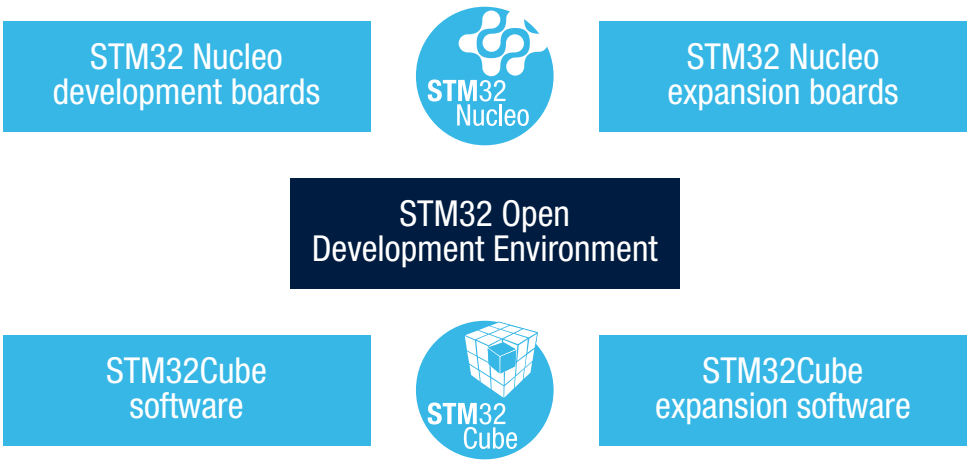
Digital MEMS microphones

Part number	Top/bottom port	Package size (mm)	Supply Voltage (V)	SNR (dB)	Sensitivity (dBV)	AOP (dB spl)	Current consumption (µA)
IMP34DT05	Top	3 x 4 x 1	1.6 to 3.6	64	-26 ± 3	122.5	650
MP34DT05-A	Top	3 x 4 x 1	1.6 to 3.6	64	-26 ± 3	122.5	650
MP34DT06J	Top	3 x 4 x 1	1.6 to 3.6	64	-26 ± 1	122.5	650
MP23DB01HP	Bottom	3.5 x 2.65 x 0.98	1.6 to 3.6	65 (NM) 64 (LP)	-41± 1 (NM) -24± 1 (LP)	135 (NM) 120 (LP)	800 (NM) 285 (LP)

Analog MEMS microphones

Part number	Top/bottom port	Package size (mm)	Supply Voltage (V)	SNR (dB)	Sensitivity (dBV)	AOP (dB spl)	Current consumption (µA)
MP23ABS1	Bottom	3.5 x 2.65 x 0.98 (Metal)	1.52 to 3.6	64	-38	130	120

Design support



OPEN DEVELOPMENT ENVIRONMENT

The STM32 Open Development Environment (STM32 ODE) is an open, flexible, easy and affordable way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs.

The STM32 ODE is made up of four elements:

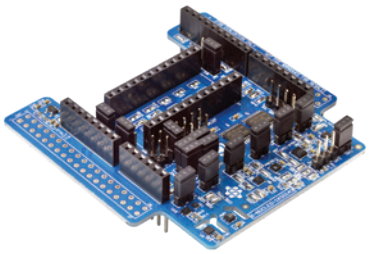
- STM32 Nucleo development boards. A comprehensive range of affordable development boards for all STM32 microcontroller series, with unlimited unified expansion capability, and with integrated debugger/programmer.
- STM32 Nucleo expansion boards. Boards with additional functionality to add sense, control, connectivity, power, audio or other functions as needed. The expansion boards are plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking the expansion boards.
- STM32Cube software. A set of free-of-charge tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer, middleware and the STM32CubeMX PC-based configurator and code generator.
- STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards and compatible with the STM32Cube software framework.

The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, mbed and GCC-based environments.

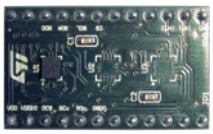
Focus on the new nucleo expansion board for sensors

The X-NUCLEO-IKS01A3 is a MEMS inertial and environmental sensor evaluation board system. It is compatible with the Arduino UNO R3 connector layout and features the LSM6DSO 3-axis accelerometer + 3-axis gyroscope, the LIS2MDL 3-axis magnetometer, the LIS2DW12 3-axis accelerometer, the HTS221 humidity and temperature sensor, the LPS22HH pressure sensor, and the STTS751 temperature sensor.

The board can also be used to evaluate other sensors by connecting the DIL24 adapters. The X-NUCLEO-IKS01A3 interfaces with the STM32 microcontroller via the I²C pin, and it is possible to change the default I²C port.



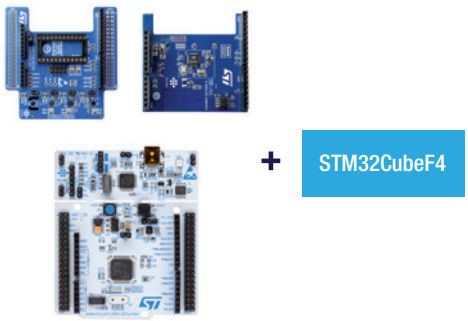
X-NUCLEO-IKS01A3



STEVAL-MKI160V1

UNICO

Open.Framework:
BlueMicrosystem1 application development platform



Download STM32CubeF4

ANDROID APP ON Google play

Available on the App Store

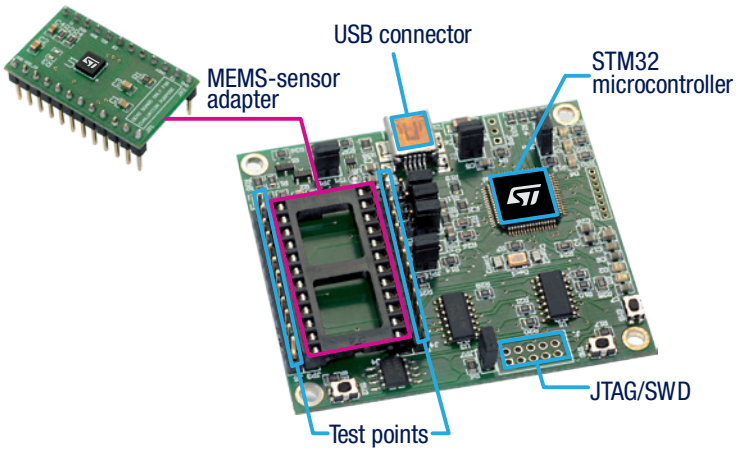
Design support for non-safety automotive and industrial sensors

With an extensive expertise in sensor integration and the development of new applications, ST can assist customers in their design-in phase.

ST's evaluation kits and firmware allows a real-time evaluation of sensor performance in customer applications.

ST offers a complete evaluation solution including:

- A full set of DIL24 MEMS non-safety automotive and industrial adapters supporting fast prototyping
- eMotion motherboard compatible with all adapters and based on an STM32 microcontroller
- UNICO graphic user interface for direct and real-time access to the sensor outputs and configuration registers.



Board	Description	Order code
Motherboard	ST MEMS motherboard is based on the high performance STM32F103 32-bit ARM Cortex™-M3 MCU Interfaces: USB connector and JTAG/SWD for debugging DFU-compatible for USB microprocessor firmware updates Compatible with all ST MEMS adapters	STEVAL-MKI109V2 STEVAL-MKI109V3

The list of the available adapters is included below

Accelerometers

Device	Order code
LIS344ALH	STEVAL-MKI015V1
LISS331HHTR	STEVAL-MKI092V2
LIS3DH	STEVAL-MKI105V1
AIS328DQ	STEVAL-MKI110V1
LIS2DH12	STEVAL-MKI151V1
H3LIS331DL	STEVAL-MKI153V1
AIS3624DQ	STEVAL-MKI158V1
LIS2HH12	STEVAL-MKI164V1
H3LIS100DL	STEVAL-MKI166V1
H3LIS200DL	STEVAL-MKI167V1
IIS2DH	STEVAL-MKI168V1
LIS2DS12	STEVAL-MKI174V1
LIS2DE12	STEVAL-MKI175V1
LIS2DW12	STEVAL-MKI179V1
LIS3DHH	STEVAL-MKI180V1
IIS3DHHC	STEVAL-MKI186V1
LIS2DTW12	STEVAL-MKI190V1
IIS2DLPC	STEVAL-MKI191V1
IIS2ICLX	STEVAL-MKI209V1K
IIS3DWB	STEVAL-MKI208V1

Gyroscopes

Device	Order code
A3G4250D	STEVAL-MKI125V1
I3G4250D	STEVAL-MKI169V1
L20G20IS	STEVAL-MKI188V1

MEMS microphones

Device	Order code
MP34DT05-A	STEVAL-MIC001V1
MP34DT06J	STEVAL-MIC0021
IMP34DT05	STEVAL-MIC003V1
MP23ABS1	STEVAL-MIC004V1
MP23DB01HP	STEVAL-MIC006V1

iNEMO™ inertial modules

Device	Order code
LSM6DSRX	STEVAL-MKI195V1
LSM9DS1	STEVAL-MKI159V1
LSM6DS3	STEVAL-MKI160V1
LSM6DS3H	STEVAL-MKI176V1
LSM6DSL	STEVAL-MKI178V2
ISM330DHCX	STEVAL-MKI207V1
ISM330DLC	STEVAL-MKI182V2
LSM6DSM	STEVAL-MKI189V1
ASM330LHH	STEVAL-MKI193V1
LSM6DSR	STEVAL-MKI194V1
LSM6DSO	STEVAL-MKI196V1
LSM6DSOX	STEVAL-MKI197V1

e-Compasses

Device	Order code
LIS3MDL	STEVAL-MKI137V1
LSM303AGR	STEVAL-MKI172V1
LSM303AH	STEVAL-MKI173V1
LIS2MDL	STEVAL-MKI181V1
ISM303DAC	STEVAL-MKI184V1
IIS2MDC	STEVAL-MKI185V1

Environmental sensors

Device	Order code
LPS22HB	STEVAL-MET001V1
HTTS221	STEVAL-MKI141V2
LPS25H	STEVAL-MKI142V1
LPS25HB	STEVAL-MKI165V1
LPS27HHW	STEVAL-MKI213V1
LPS35HW	STEVAL-MKI177V1
LPS33HW	STEVAL-MKI183V1
LPS22HH	STEVAL-MKI192V1
LPS33W	STEVAL-MKI205V1
LPS33K	STEVAL-MKI214V1
STTS22H	STEVAL-MKI200VIK
STTS751	STEVAL-MKI198V1K
STLM20	STEVAL-MKI199V1K
STTS75	STEVAL-MKI201V1K
STDS75	STEVAL-MKI202V1K
STCN75	STEVAL-MKI203V1K
STLM75	STEVAL-MKI204V1K

Technical support

Technical documents

To see all technical documents and files for a specific product, go to www.st.com/sensors and select the product you are interested in through our product catalogue. Each part number has a corresponding web page where you can easily find all associated technical documents and resources.

Developers's links

- For more information about STM32ODE: www.st.com/stm32ode
- To download Open Software suites: www.st.com/opensoftware
- For more information about expansion boards: www.st.com/x-nucleo
- To take part to our forums: www.st.com/e2e

Online support

For technical support or questions about product availability, pricing, where-to-buy, or other related issues, go to www.st.com/onlinesupport.

More information and support

- Visit www.st.com for valuable online information and support on our products.
- Find the right MEMS and Sensors and instantly access documentation from the ST Sensor Finder.
- Ask, learn, share, discuss, and engage with MEMS and Sensors ST Community.
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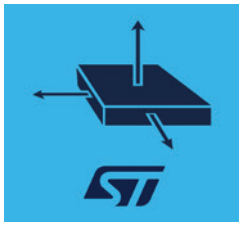

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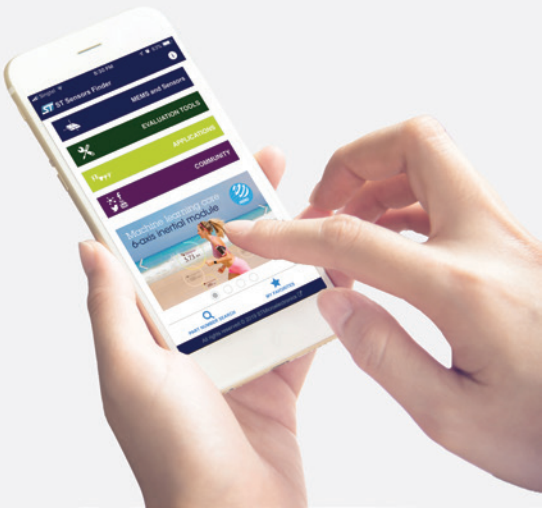
Find the sensor you need with our mobile app



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Sustainable Technology

ST's Sustainable Technology Program provides a single, consistent framework for all the different programs that we implement to reduce the impact of our products on the environment and improve quality of life for the end user. The program includes three main domains:

- Compliance with legislation and with customers' requirements
- Eco-design to measure and take the environmental impact of our products into account during the design phase
- Responsible products which identify innovative products that provide clear environmental and social benefits to society

ST's motion MEMS products within sustainable technology

- All motion MEMS products are ECOPACK® compliant
- Improvements in our manufacturing technologies and product design have reduced our products' carbon footprint by up to 44% and water footprint up to 43%(1)
- Products identified as socially responsible:
  - H3LIS331DL is suited for concussion detection (3-STAR rating(2))
  - AIS328DQ and A3G4250D are accelerometers and gyroscopes used for navigation and telematics (2-STAR rating(2))
  - LIS2DH12 and LSM303C are recommended for fitness monitoring applications (1-STAR rating(2))

Product family	Carbon footprint evolution [%]	Water footprint evolution [%]
	CO_2	
Accelerometers	-42	-43
Gyroscopes	-33	-32
Digital compasses	-44	-42
Inertial modules	-32	-33

(1) Screening LCA results for cradle-to-gate scope. Use phase is excluded. Values are reported as average for the whole product family in comparison to previous generation. For more information about eco-design, visit http://www.st.com/eco-design

(2) For more information about Star responsible product ratings, visit http://www.st.com/responsible_products

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