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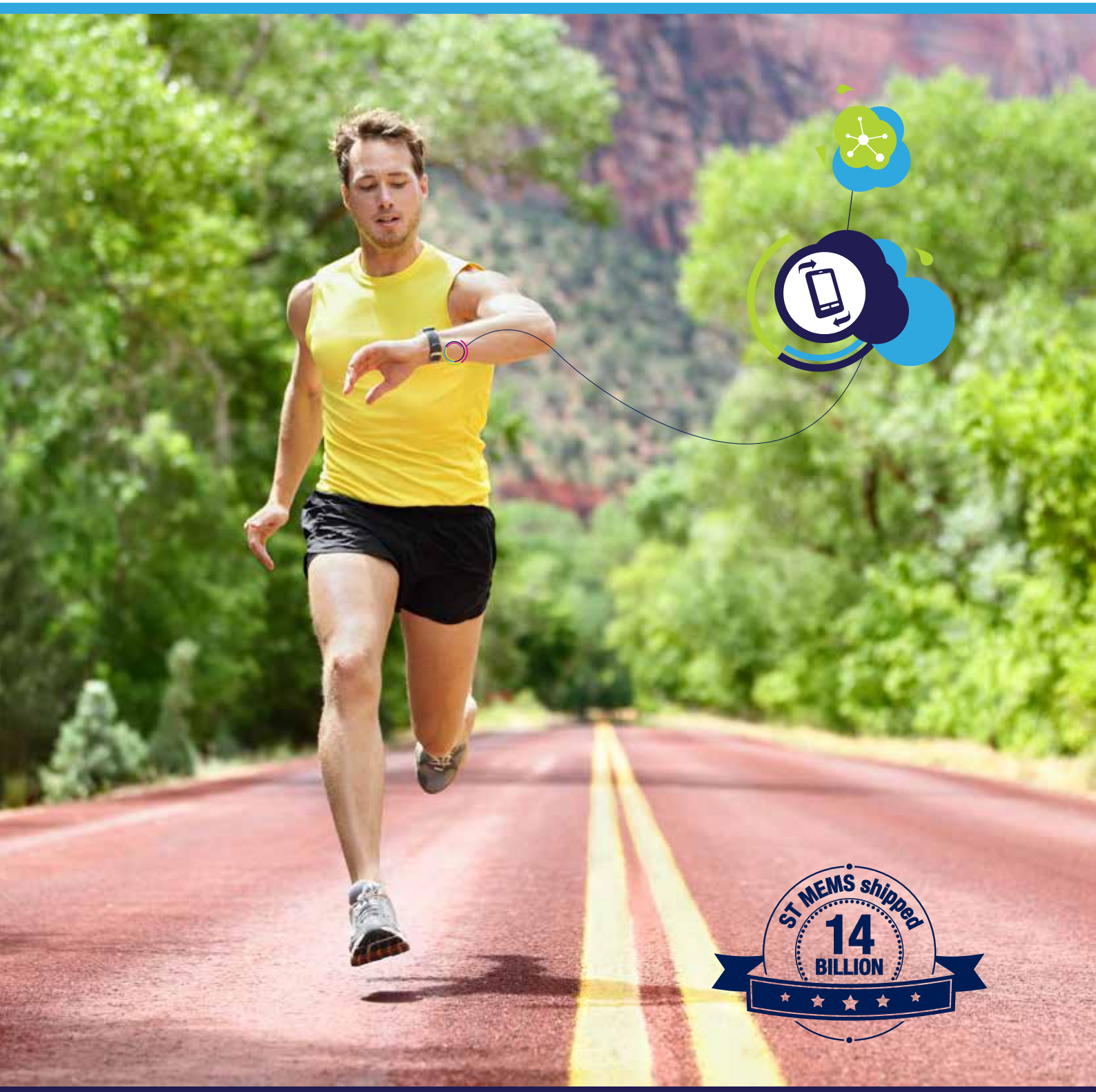
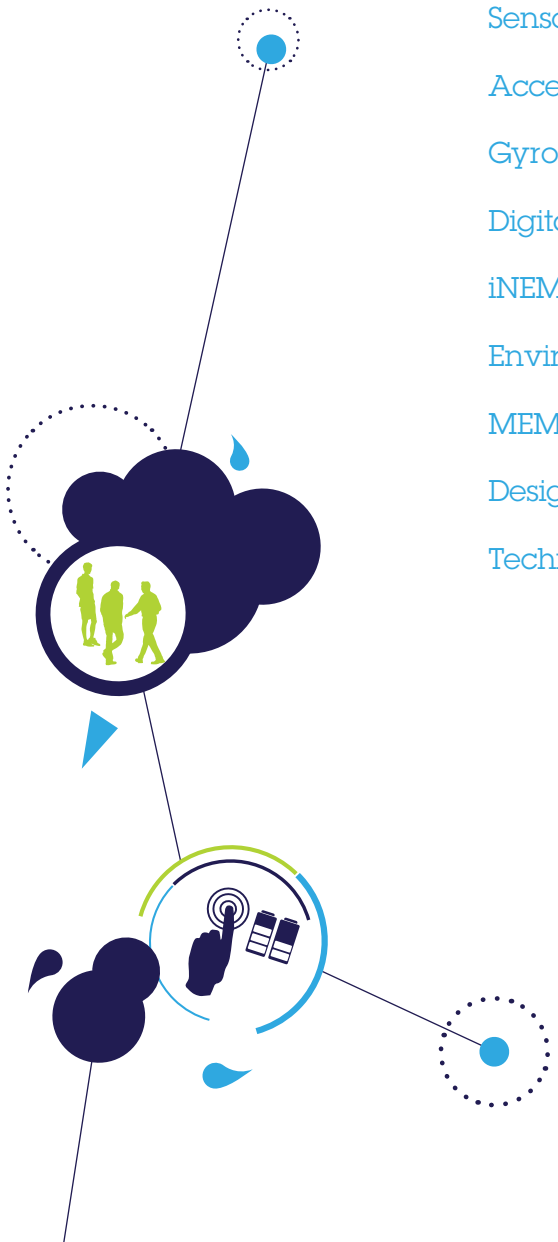
MEMS and Sensors

Smart Motion tracking, IoT and enhanced user experience



Content



The most diversified sensor supplier

For all your sensing needs, ST provides a complete solution

ST has shipped more than 14 billion micro-electromechanical sensors and 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.

- 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 security of supply
- High-performance sensor fusion to improve the accuracy of multi-axis 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

COMPLETE SOLUTION

- Large sensor portfolio
- Integrated HW + SW solutions
- 100% security of supply
- Scalability of solutions
- Quality is a must for ST
- ST is MEMS market leader
- STM32 Open Development Environment support

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.

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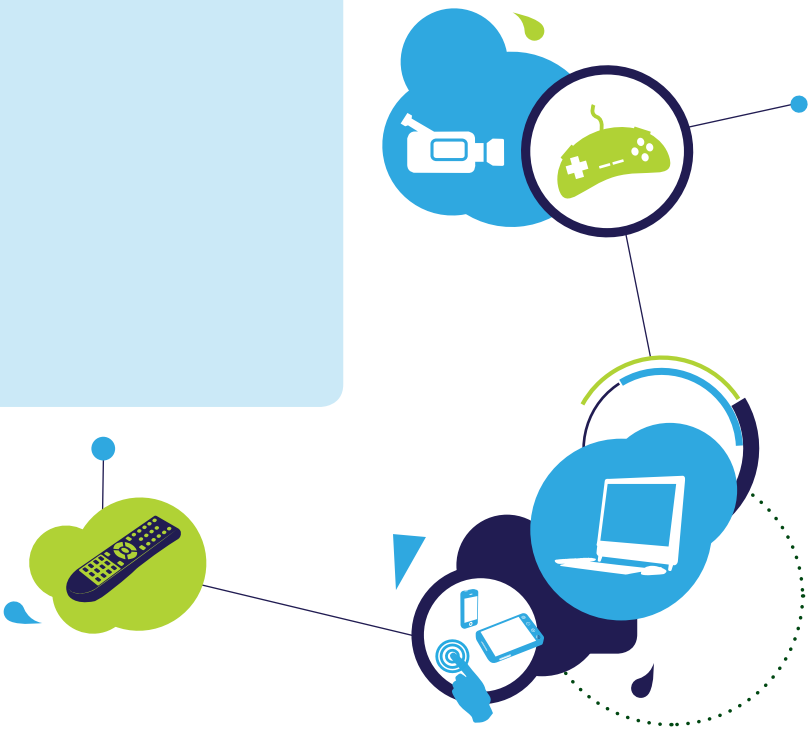
Sensors in your hand

All portable devices 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

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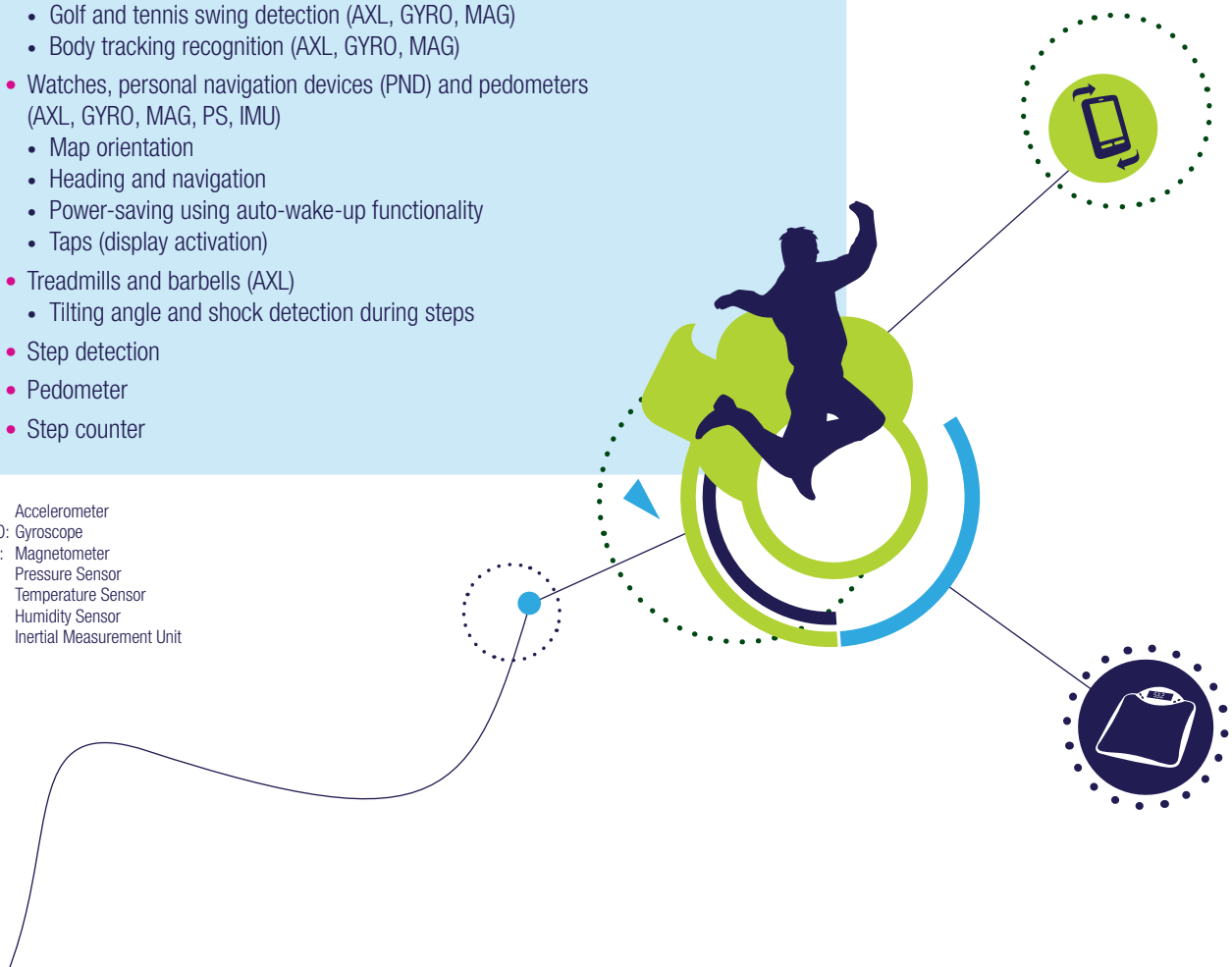

Sensors in your home/Smart appliances

Devices offer enhanced user interfaces helping to decrease 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
  - Respiratory equipment/humidifiers
- Electric, gas/water meters (AXL, MAG)
  - Anti-tamper mechanisms
- Home environment monitoring (TS, RH, PS)
  - Ambient temperature and relative humidity monitoring

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OIS: Optical Image Stabilization
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Sensors in your car

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

For industrial applications

KEY APPLICATION

- 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

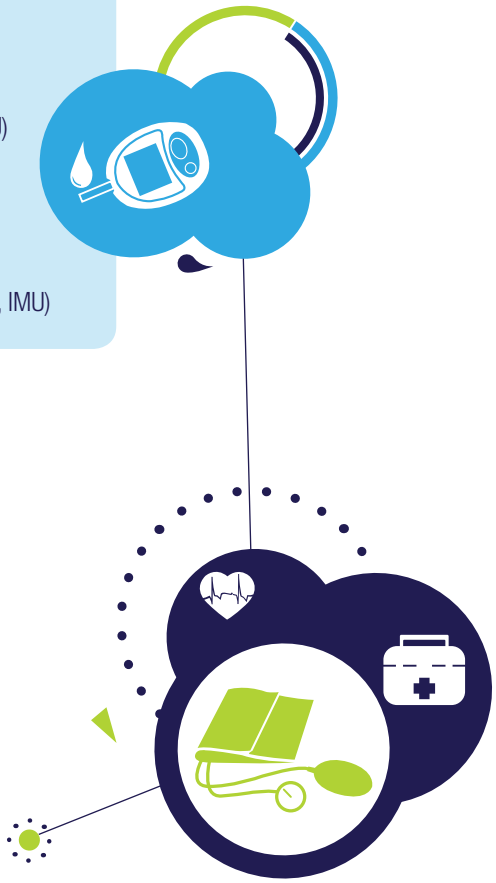
AXL: Accelerometer
GYRO: Gyroscope
MAG: Magnetometer
TS: Temperature Sensor
RH: Humidity Sensor
IMU: Inertial Measurement Unit
MIC: Microphones

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)



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OIS: Optical Image Stabilization
IMU: Inertial Measurement Unit

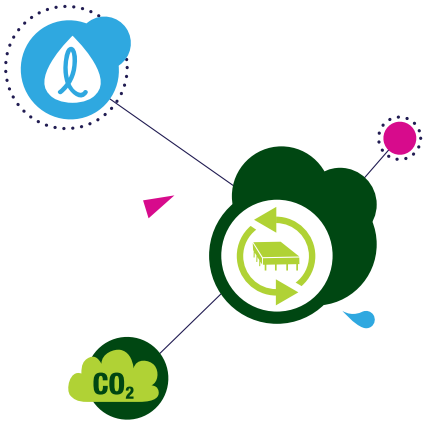
Accelerometers

Smart motion features with ultra-low power consumption

ST's state-of-the-art MEMS accelerometers include analog and digital sensors featuring up to ±400g acceleration full scale and from 1.62 to 3.6 V supply voltage. Accelerometers have advanced power-saving features that make them the ideal choice for ultra-low-power applications. These features include low-power mode, auto wake-up function and FIFO buffer that can be used to store data, thus reducing the host processor loading and system power consumption. The new generation of accelerometers, recently introduced by ST, makes a significant step forward in miniaturization, with packages sized 2x2x1 mm, and smart embedded functions such as pedometer suitable for wearable devices. ST's accelerometers are suitable for handheld portable applications such as mobile phones and PDAs, or any other application where low power consumption and reduced package size are required. ST's portfolio also includes accelerometers for automotive applications, such as the AIS32x family, with extended temperature range and AEC-Q100 qualified, and IISxxx products, that are part of ST's longevity program and will stay in production for ten years from the date of introduction.

BENEFITS

- High performance (high resolution and stability, wide bandwidth)
- Small footprint for ultra-compact solutions
- Low power consumption and ultra-low-power operating modes that allow 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



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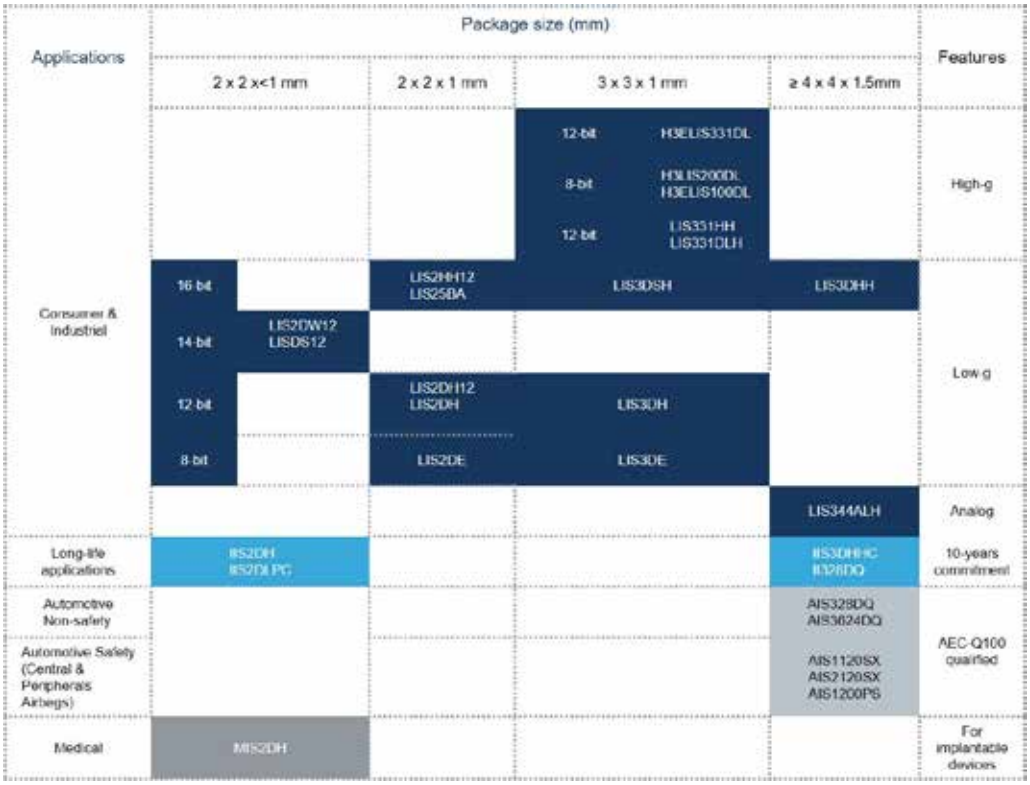
CO_2 -42%

-43%

ACCELEROMETERS



CONSUMER

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Key features
LIS2DW12	LGA12(2 x 2 x 0.7)	±2; ±4; ±8; ±16	90	14-bit, ultra-low-power, ultra-low-noise
LIS2DS12	LGA12(2 x 2x 0.8)	±2; ±4; ±8; ±16	120	14-bit ,FIFO, embedded smart functionalities (pedometer)
LIS3DH	LGA16(3 x 3 x 1)	±2; ±4; ±8; ±16	220	12-bit, FIFO, low-power
LIS2HH12	LGA12 (2 x 2 x 1)	±2; ±4; ±8	140	16-bit FIFO, temperature stability
LIS2DH12	LGA12 (2 x 2 x 1)	±2; ±4; ±8; ±16	220	12-bit, FIFO,low-power
LIS3DSH	LGA16 (3 x 3 x 1)	±2; ±4; ±6; ±8; ±16	150	14-bit, FIFO,low-power, temperature stability embedded programmable state machine

CONSUMER-SPECIAL PRODUCTS

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	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	16-bit,ultra-low-noise,excellent stability in temperatureand time
LIS331HH	LGA16(3 x 3 x 1)	±6;±12;±24	650	12-bit, low-power, high-G fullscale
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)

INDUSTRIAL

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Key features
IIS328DQ	QFN24(4 x 4 x 1.8)	±2; ±4; ±8	218	Low-power high performance 3-axis accelerometer with digital output for industrial applications
IIS2DH	LGA12 (2 x 2 x 1)	±2; ±4; ±8; ±16	220	3µA current consumption at 10HZODR; 185µA current consumption at wide bandwidth up to 2.3kHz and ODR 5.3kHz, temperature range up to105°C
IIS3DHHC	Ceramic LGA16(5 x 5 x 1.7)	±2	45	16-bit, very-low-noise, high-stability MEMS digital output motion sensor (inclinometer) for double signal integration
IIS2DLPC	LGA12 (2 x 2 x 0.7)	±2; ±4; ±8; ±16	90	High-performance, ultra-low-power 3-axis accelerometer for industrial applications

AUTOMOTIVE

Part number	Package/size (mm)	Typical full-scale (g)	Typical noise density (µg/√ Hz)	Key features
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

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 fullscale 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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CO_2 -33%

-32%

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

3-AXIS DIGITAL GYROSCOPES

Applications	Package size (mm)				Full scale typ (°/s)
	2 x 2 x 0.7	2.3 x 2.3 x 0.7	3 x 3 x 1	4 x 4 x 1	
Consumer & Industrial			L3GD20H		±2000 / ±245
Long-life applications				I3G4250D	
Automotive Non- safety				A3G4250D	±245
Optical image stabilization (OIS)	L20G20IS	L2G2IS			±200 / ±100

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 years longevity,.

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

Digital compasses

Accurate compass heading in any condition

ST's e-Compasses include combo solutions built with a 3-axis digital accelerometer and 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 sensormust 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 e-Compasses use accelerometermeasurements for tilt compensation, thus ensuring very accurate compass headings even when handheld ormobile devices are inclined.
ST's e-Compasses combine high dynamic rangewith temperature offset compensation.They offer 3 mgauss 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 e-Compasses include smart power functions tominimize 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 and position..

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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

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
LSM303C	LGA12 (2 x 2 x1)	Magnetic range X,Y,Z (Gauss): ±16 Acceleration full scale (g): ±2,±4,±8	MAG: HP 0.27, LP 0.04 ACC: HP 0.18	Ultra-compact, eCompass module: embedded basic functions.

INDUSTRIAL

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

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

FOCUS ON LSM6DSO

KEY ADVANTAGES

- Ultra low power: 0.55mA combo (15µA AXL in ULP)
- UI Interface : I3C / I2C / SPI
- Dedicated OIS SPIAUX interface
- Finite state machine for custom gesture recognition
- U/I –OIS full scale:
  - Gyro U/I-OIS independent full scale
  - XL independent up to ±8g
  - Self test XL and Gyro from OIS chain
- New pedometer 2.0
- Up to 9Kbytes of smart FIFO

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Parameter	LSM6DSO	LSM6DSM	LSM6DSL
Current consumption in High-performance mode (mA)	0.55	0.65	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	75	80
Gyro noise density in High-performance mode (mdps/√Hz)	3.8	3.8	4.0
ODR(Hz)	Accel:1 to 6664 Gyro:12.5 to 6664	Accel:1.6 to 6664 Gyro:12.5 to 6664	Accel:1.6 to 6664 Gyro:12.5 to 6664
Smart FIFOdepth	Up to 9 Kbytes	Up to 4 Kbytes	Up to 4 Kbytes
Sensor data collection	Yes	Yes	Yes
OIS/EIS	Yes/Yes	Yes/Yes	No/Yes
Sensorsync	Yes	Yes	Yes

Industrial inertial module: 3D accelerometer and 3D gyroscope

The ISM330DLC is a system-in-package featuring a high-performance 3D digital accelerometer and 3D digital gyroscope tailored for Industry 4.0 applications. In the ISM330DLC the sensing element of the accelerometer and of the gyro are implemented on the same silicon die, thus guaranteeing superior stability and robustness

The ISM330DLC has a full-scale acceleration range of ±2/±4/±8/±16 g and an angular rate range of ±125/±250/±500/±1000/±2000 dps. Delivering high accuracy and stability with ultra-low power consumption (0.75 mAin high-performance, combomode) enables, also in the industrial domain, long-lasting battery operated applications.

The ISM330DLC includes a dedicated configurable signal processing path with low latency, low noise and dedicated filtering specifically intended for control loop stability. Data from this dedicated signal path can be made available through an auxiliary SPI interface, configurable for both the gyroscope and accelerometer. High-performance, high-quality, small size and low power consumption together with high robustness to mechanical shock makes the ISM330DLC the preferred choice of system designers for the creation and manufacturing of versatile and reliable products.

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 the parts are fully tested with respect to temperature to ensure the highest quality level.

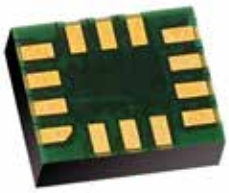
The sensing elements are manufactured using ST's proprietarymicromachining processes,while the IC interfaces are developed using CMOS technology that allows the design of a dedicated circuit which is trimmed to better match the characteristics of the sensing element.

The 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 that enables its usage in a broad range of automotive applications.

All the design aspects of the ASM330LHH have been 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



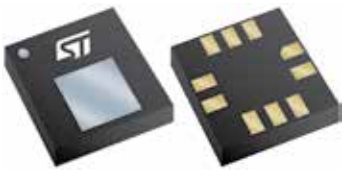
Environmental sensors

Collect humidity, atmospheric pressure and temperature accurate data for environmental awareness

STMicroelectronics offers a full kit of environmental sensors, including pressure, humidity and temperature sensors.These sensors rely on dedicated mechanical structures that guarantee the best performance even 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.

PRESSURE SENSOR

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.



BENEFITS

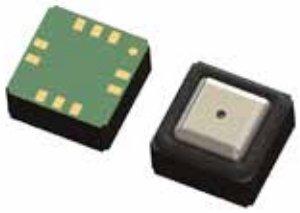
- Ultra-small footprint
- Low-power consumption
- Fully-molded package ensure stability and robustness in any condition and water resistance

Part number	Package (mm)	Pressure range (hPa)	Relative accuracy (hPa)	Absolute accuracy (hPa)	Noise	ODR (Hz)	Current consumption	Highshock survivability (g)	Advanced digital features	Reliability
LPS22HH	HLGA-10L, 2x2x0.73 Full-molded	260 to 1260	±0.025	±0.5	0.65Pa RMS (with embedded filter) 1.7Pa RMS (without embedded filter)	1, 10, 25, 50, 75, 100, 200	12µA @1Hz (high resolution mode) 4µA @1Hz (low power mode)	22.000	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	0.75Pa RMS (with embedded filter) 2Pa RMS (without embedded filter	1, 10, 25, 50, 75	12µA @1Hz (high resolution mode) 3µA @1Hz (low power mode)	22.000	32 samples FIFO/ Embedded compensation/ Interrupt/ I2C/SPI	
LPS25HB	HLGA-10L, 2.5x2.5x0.76 Full-molded	260 to 1260	±0.1	±1	1Pa RMS (with embedded filter) 3Pa RMS(without embedded filter)	1, 10, 25	25µA @1Hz (high resolution mode) 4µA @1Hz (low power mode)	10.000	32 samples FIFO/ Embedded compensation/ Interrupt/ I2C/SPI	

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

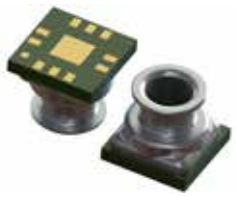
WATER-PROOF PRESSURE SENSOR

Waterproof pressure sensors are also availble in STs pressure sensors portfolio. The LPS35HW is an ultra-compact piezoresistive pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I2C or SPI from the sensing element to the application.The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.



The LPS33HW is a waterproof pressure sensor, resistant to chemicals like chlorine, bromine, salt water and also resistant to soaps or detergents.

Due to the sensor's high-performance built-in processor and the advanced formula of its water-resistant gel filling gives performance advantages and fast recovery between factory and store-shelf. The LPS33HW can withstand being submerged up to 90 meters,



Part number	Package (mm)	Pressure accuracy (hpa)	Relative accuracy (hpa)	Absolute range (hpa)	Noise hPa(RMS)	ODR (Hz)	Current consumption	Overpressure (*)	Advanced digital features
LPS33HW	CCLGA10L (3.3x3.3x2.9)	260 to 1260	±0.1	±1 after OPC ±2.5 before OPC	0.8Pa RMS(with embedded filter) 2Pa RMS(without embedded filter)	1, 10, 25, 50, 75	15µA @1Hz (high resolution mode) 3µA@1Hz (low power mode)	10ATM	FIFO for Pressure Sensor data Programmable Interrupt/Data ready
LPS33W	CCLGA10L (3.3x3.3x2.9)	260 to 1260	±0.1	±1 after OPC ±2.5 before OPC	0.8Pa RMS(with embedded filter) 2Pa RMS(without embedded filter)	1, 10, 25, 50, 75	15µA @1Hz (high resolution mode) 3µA @1Hz (low power mode)	1ATM	FIFO for Pressure Sensor data Programmable Interrupt/Data ready
LPS35HW	CCLGA10L (3.5x3.5x1.85)	260 to 1260	±0.1	±1 after OPC ±4 before OPC		1, 10, 25, 50, 75	15µA @1Hz (high resolution mode) 3µA @1Hz (low power mode)	5ATM	FIFO for Pressure Sensor data Programmable Interrupt/Data ready

Note(*): Water resistant

HUMIDITY AND TEMPERATURE SENSOR

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 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
- Allows 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, I^2C

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 and 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	General description	I/O Interface	Operating voltage min-max (V)
STCN75	MSOP(TSSOP8)	3 x 3 mm	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STDS75	MSOP(TSSOP8)	3 x 3 mm	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STLM75	MSOP(TSSOP8), SO-8	3 x 3 mm, 4.90 x 3.90 mm	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STTS75	MSOP(TSSOP8), SO-8	3 x 3 mm, 4.90 x 3.90 mm	Digital temperature sensor and thermal watchdog	SMBus/I²C compatible	2.7-5.5
STTS751	UDFN-6L	2 x 2 mm	2.25 V low-voltage local digital temperature sensor	SMBus/I²C compatible	2.25-3.6
STTS2002	TDFN8	2 x 3 mm	2.3 V memory module temperature sensor with a 2 Kb SPD EEPROM	SMBus/I²C compatible	2.3-3.6
STTS2004	TDFN8	2 x 3 mm	2.2 V memory module temperature sensor with a 4 Kb SPD EEPROM	SMBus/I²C compatible	2.2-3.6

ANALOG TEMPERATURE SENSOR

Part number	Package	Package size	General description	Operating voltage min-max (V)	Operating supply current typ (mA)
STLM20	UDFN-4L, SOT323-5L	1 x 1.30 mm, 2 x 1.25 mm	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 the ST's longevity program and will stay in production for ten years from the date of introduction

BENEFITS OF MEMS MICROPHONES

- 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

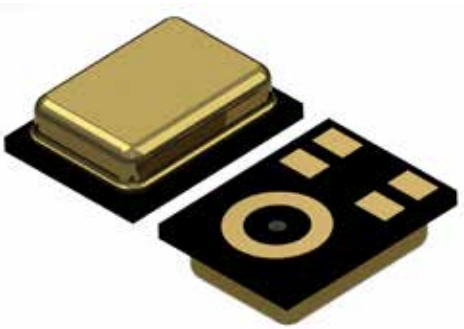
- Mobile phones
- Laptops
- Phablets
- Smartphones
- Digital cameras and camcorders
- Gaming
- Portable media players
- Hands-free devices
- Tablets
- Hearing aids
- Headsets
- Smart watches
- Automotive (e-Calls)
- Industrial
- Healt care

DIGITAL MEMS MICROPHONES

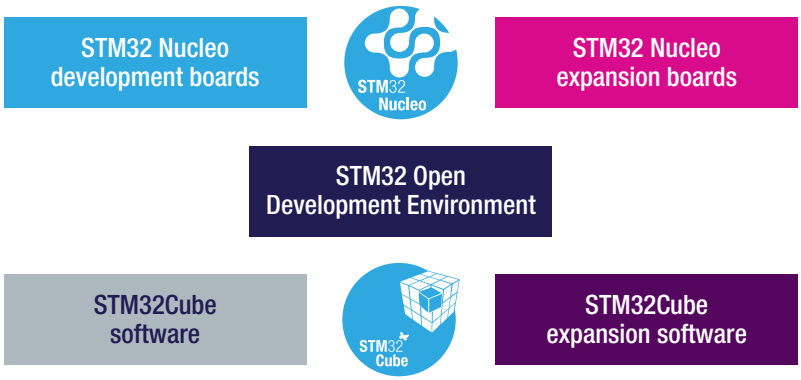
Part number	Top/bottom port	Package size (mm)	Supply Voltage (V)	SNR (dB)	Sensitivity (dBV)	AOP (dB spl)	Current consumption (µA)
IMP34DT05	Top	3 x 4 x 1	1.6 to 3.6	64	-26±3	122.5	650
MP34DT05-A	Top	3 x 4 x 1	1.6 to 3.6	64	-26±3	122.5	650
MP34DT06J	Top	3 x 4 x 1	1.6 to 3.6	64	-26±1	122.5	650

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-IKS01A2 is a MEMS inertial and environmental sensor evaluation board system. It is compatible with the Arduino UNOR3 connector layout, and is designed around STMicroelectronics's LSM6DSL3D accelerometer + 3D gyroscope, the LSM303AGR3D accelerometer and 3D magnetometer, the HTS221humidity sensor and the LPS22HB pressure sensor.
The board can also be used to evaluate other sensors,by connecting the DIL24 adapters.
The X-NUCLEO-IKS01A2 interfaces with the STM32 microcontroller via the I2Cpin, and it is possible to change the default I2C port.

X-NUCLEO-IKS01A1

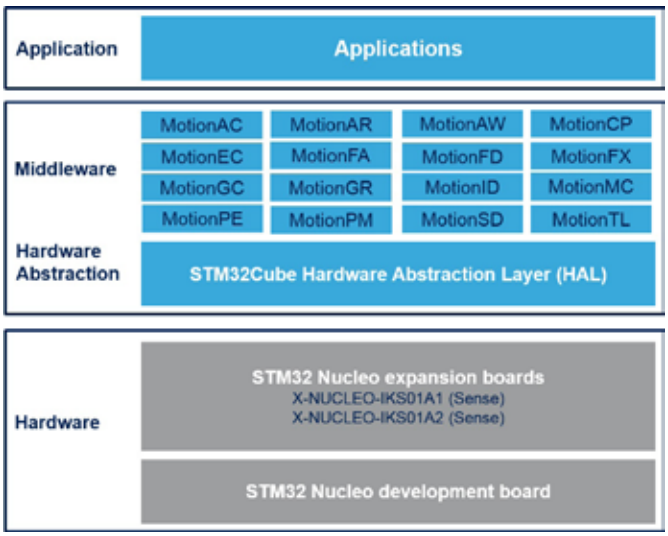
STEVAL-MKI160V1

X-CUBE-MEMS-XT1 SOFTWARE EXPANSION

The sensor solution libraries included in the X-CUBE-MEMS-XT1 software expansion offer developers a useful tool to rapidly develop and evaluate application based on real-time data from ST's MEMS sensors.

Built on STM32Cube software technology for ease of portability across different STM32 microcontroller series, the expansion software package provides advanced motion libraries for microcontrollers based on ARM Cortex Nucleo-64 development boards with high-performance STM32F4 MCU or ultra-low-power STM32L0,STM32L1,STM32L4MCU.

X-CUBE-MEMS-XT1includes also Low Level and High Level drivers, BSP layer for motion, temperature, humidity and pressure sensors.



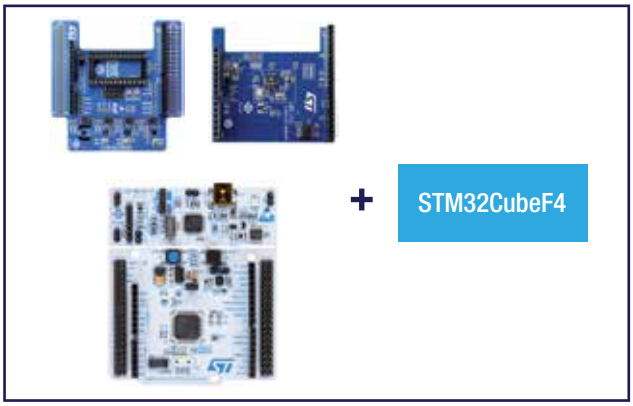
To learn more and to download the X-CUBE-MEMS-XT1 Sensor and DSP algorithm expansion software pack for STM32, visit :
https://www.st.com/embedded-software/x-cube-mems-xt1.html

MULTI-SENSOR, BLUETOOTH APPLICATION DEVELOPMENT PLATFORM

The BLUEMICROSYSTEM1 framework uses Bluetooth Low Energy, inertial (e.g. motion MEMS) and environmental (e.g. humidity, pressure, temperature) sensors. It enables fusing together and transmitting real-time sensor data to a smartphone (Android- or iOS-based) via Bluetooth. BLUEMICROSYSTEM1 provides an implementation example for the STM32F4 Nucleo platform equipped with the MEMS and environmental sensor expansion board (X-NUCLEO-IKS01A1) and the Bluetooth low energy expansion board (X-NUCLEO- IDB04A1).

BLUEMICROSYSTEM1 is suitable for all applications and markets, including IoT and wearables, that need to effectively sense, process and transmit valuable information with very low power consumption and high performance.

Open.Framework:
BlueMicrosystem1 application development platform



ANDROID APP ON Google play

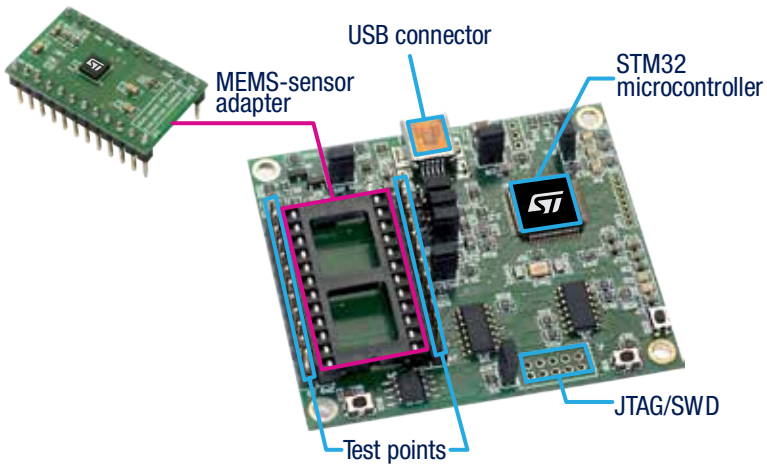
Available on the App Store

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
Adapter board	LPS22HH	STEVAL-MKI192V 1
	LSM6DSO	STEVAL-MKI196V 1
	LPS22HB	STEVAL-MET001V 1
	LIS344ALH	STEVAL-MKI015V 1
	LIS331HHTR	STEVAL-MKI092V 2
	LIS3DH	STEVAL-MKI105V 1
	AIS328DQ	STEVAL-MKI110V 1
	A3G4250D	STEVAL-MKI125V 1
	LIS3DSH	STEVAL-MKI134V 1
	LIS2DH	STEVAL-MKI135V 1
	L3GD20H	STEVAL-MKI136V 1
	LIS3MDL	STEVAL-MKI137V 1
	HTS221	STEVAL-MKI141V 2
	LPS25H	STEVAL-MKI142V 1
	LIS2DH12	STEVAL-MKI151V 1
	H3LIS331DL	STEVAL-MKI153V 1
	AIS3624DQ	STEVAL-MKI158V 1
	LSM9DS1	STEVAL-MKI159V 1
	LSM6DS3	STEVAL-MKI160V 1
	LSM303C	STEVAL-MKI163V 1
	LIS2HH12	STEVAL-MKI164V 1
	LPS25HB	STEVAL-MKI165V 1
	H3LIS100DL	STEVAL-MKI166V 1
	H3LIS200DL	STEVAL-MKI167V 1
	IIS2DH	STEVAL-MKI168V 1
	I3G4250D	STEVAL-MKI169V 1
	IIS328DQ	STEVAL-MKI170V 1
	LSM303AGR	STEVAL-MKI172V 1
	LSM303AH	STEVAL-MKI173V 1
	LIS2DS12	STEVAL-MKI174V 1
	LIS2DE12	STEVAL-MKI175V 1
	LSM6DS3H	STEVAL-MKI176V 1
	LPS35HW	STEVAL-MKI177V 1
	LSM6DSL	STEVAL-MKI178V 1
	LSM6DSL	STEVAL-MKI178V 2
	LIS2DW12	STEVAL-MKI179V 1
	LIS3DHH	STEVAL-MKI180V 1
	LIS2MDL	STEVAL-MKI181V 1
	ISM330DLC	STEVAL-MKI182V 1
	ISM330DLC	STEVAL-MKI182V 2
	LPS33HW	STEVAL-MKI183V 1
	ISM303DAC	STEVAL-MKI184V 1
	IIS2MDC	STEVAL-MKI185V 1
	IIS3DHHC	STEVAL-MKI186V 1
	L20G20IS	STEVAL-MKI188V 1
	LSM6DSM	STEVAL-MKI189V 1
	IIS2DLPC	STEVAL-MKI191V 1
	LSM6DSM, LIS2MDL, LPS22HB, HTS221	STREF-MKI128V 6
	MP34DT01-M	X-NUCLEO-CCA02M1

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' 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.

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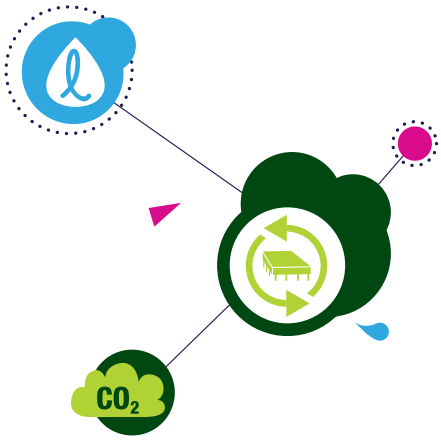
SUSTAINABLE TECHNOLOGY



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 into account during the design phase the environmental impact of our products
- 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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