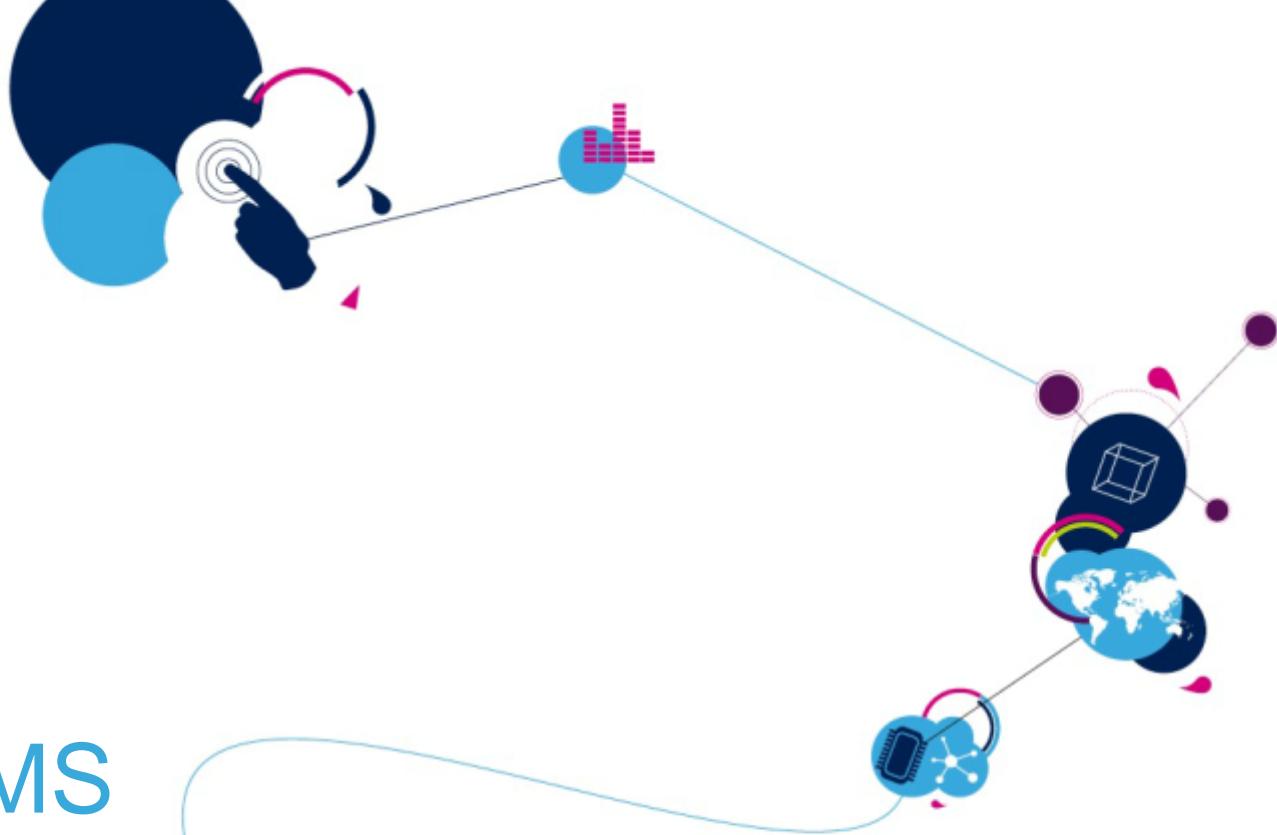


# Motion MEMS



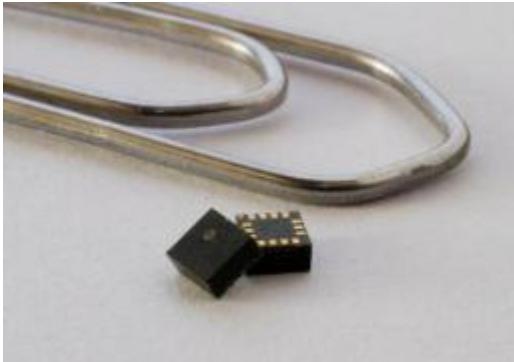
# Products focus for 15Q1

2

- 3-axis Digital Accelerometer: [LIS3DSH](#) / [LIS2DH12](#) / [LIS2HH12](#) /
- 3-axis Digital High-g Accelerometer: [H3LIS331DL](#)
- 3-axis Magnetometer and 6-axis e-Compass: [LIS3MDL](#) / [LSM303C](#)
- 6 & 9-axis iNEMO IMU: [LSM6DS3](#)
- 3-axis Automotive Digital Accelerometer: [AIS328DQ](#)
- 3-axis Automotive Digital Gyroscope: [A3G4250D](#)
- Environmental Sensors: [LPS25HB](#) / [HTS221](#)
- Microphones: [MP23AB02B](#) / [MP34DT](#) / [MP34DB](#)

# 12bit Accelerometers – LIS2DH12

- 3-Axis Digital SPI/I2C Accelerometer from  $\pm 2$  to  $\pm 16$  g
- High number of embedded features (Filters, FIFO, Temperature sensor, Self-Test)
  - Up to **12 bit** resolution
  - **Very low power:**



- **2  $\mu$ A** in **Normal mode** (1 Hz)

**6  $\mu$ A/11  $\mu$ A** in **Low Power/Normal** (50 Hz)

- **0.5  $\mu$ A** in **Power down mode**

- LIS2DH12: 2x2x1 **LGA-12**

LIS3DH\*



- 3x3x1  
Package Size

Sensors Presentation

# High Performance Accelerometers – LIS3DSH & LIS2HH12

- Full-scale ranges:  $\pm 2$ , 4, 6, 8,  $\pm 16$ g
- ODR from 3.125 to 1600Hz

## LIS3DSH



- High performances:
  - 16-bit data output, 14-bit resolution
  - **Low noise** ( $150 \mu\text{g}/\sqrt{\text{Hz}}$ )
  - **2 Finite State Machines** (up to 16 states) for interrupt generation
  - FIFO, Self-Test, Temp Sensor
- Power consumption:
  - $11 \mu\text{A}$  in Active mode (3.1Hz)
  - $2 \mu\text{A}$  in Power down mode

- Full-scale ranges:  $\pm 2$ , 4g,  $\pm 8$ g
- ODR from 10 to 800Hz

## LIS2HH12



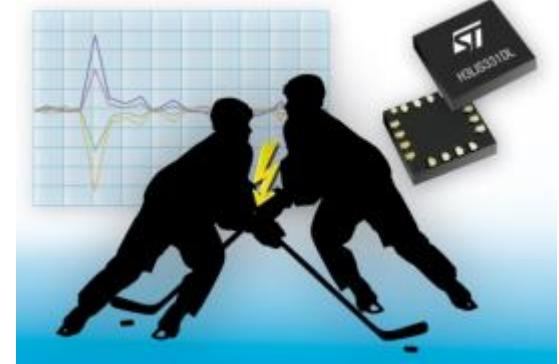
- High performances:
  - 16-bit data output, 14-bit resolution
  - **Low noise** ( $150 \mu\text{g}/\sqrt{\text{Hz}}$ )
  - **Low 0g offset and low Temperature impact**
  - Short turn on time
  - FIFO, Self-Test, Temperature sensor (8 digit  $^{\circ}\text{C}$ )

Key Features  
High Performances 3-axis Accel  
Embedded Features

- Power consumption:
  - $180 \mu\text{A}$  @ 100-800Hz
  - $50 \mu\text{A}$  @ 10Hz
  - $5 \mu\text{A}$  @ PD mode

# High-g Accelerometer – H3LIS331DL

- 3-Axis digital accelerometer
- 3 selectable full scales:  **$\pm 100, 200, 400 \text{ g}$**
- **12 bit resolution**
- Low power:  $300\mu\text{A}$  in active mode,  **$10 \mu\text{A}$  in low power** and  $1 \mu\text{A}$  in power down mode
- ODR user selectable: from 0.5 to 1000 Hz
- Targeted applications:
  - **Impact measurements in sports** (event monitoring)
  - **Shock detection in tools** (medical instruments, equipment)
  - **Parcel monitoring** (insurance purposes)



**Key features**

**High g full scale**

**Standard 3x3 package**



## MEMS eCompass



### LIS3MDL Features

- 3-axis standalone digital magnetometer:
  - $\pm 4, \pm 8, \pm 12, \pm 16$  gauss FS
  - Typical resolution **3 mGauss RMS**
  - ODR on single mode operation from **0.625 to 80 Hz**
  - I<sup>2</sup>C/SPI
- **Self-test embedded**
- Performing management for **High field saturation**
- Power consumption (@ODR=20Hz):
  - 270 $\mu$ A in High resolution
  - 40 $\mu$ A in Low power
  - 1 $\mu$ A in Power down

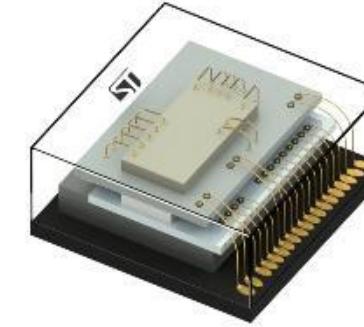
#### Key Features

Stand alone magnetometer in 2x2  
Self test & High field behavior  
Flexibility in resolution vs. consumption



# Digital Compass LIS3MDL- LSM303C

6



### LSM303C Features

- 3A with dynamically selectable full-scale
  - **LSM303C:** high performing accelerometer
- 3M (16bit):  $\pm 16$ Gs full-scale
  - Resolution selectable to adapt power consumption
  - Self-test
- Embedded temperature sensor
- IPs for FreeFall, movement detection & magnetic field detection
- I<sup>2</sup>C/SPI interfaces
- LGA-12, 2x2, P2P compatible with LIS2DH12, LIS2HH12

#### Key Features

6-axis in a small 2x2 Package  
Resolution selectable  
Magnetic range:  $\pm 16$ Gs



# iNEMO Ultra - LSM6DS3

## The 6X Ultra

### Ultra low power

Industry leading low power performance for 3A+3G combo  
Down to **0.6mA** in always-on mode

**20% better** than the best alternative solution

### Ultra performing

Industry-**best resolution** for gyroscope and accelerometer

Gyroscope rate noise down to **7mdps/vHz** (typ.)  
Accelerometer rate noise down to **90µg/vHz** (typ.)

### Ultra smart

Embedded efficient and reliable motion tracking, pedometer and context awareness

**Saving power and enabling faster system reaction time**

### Ultra small size

Tiny size to fit in the smallest, wearable and Internet of Things devices

**2.5mm x 3.0mm x 0.8mm**

### Ultra capable

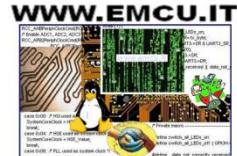
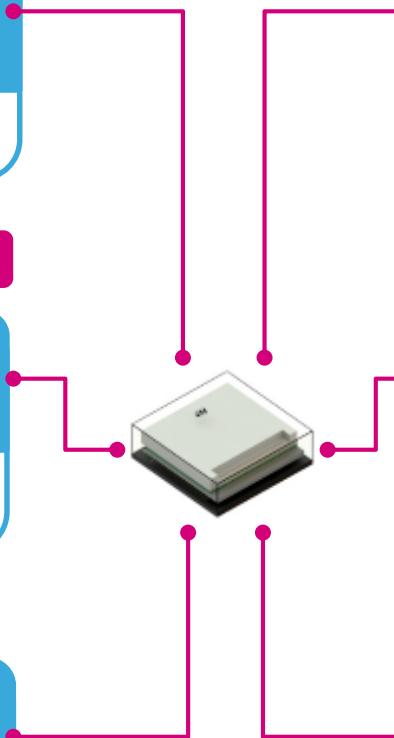
**8kbytes** “smart” FIFO memory to batch more data before system wake-up

**2 times larger** than the best alternative solution

### Ultra scalable

Ideal companion for the ultra-low power STM32 family of microcontrollers

**The best combination of 6-axis sensor plus sensor hub**



# 6 & 9-axis IMU Roadmap Evolution

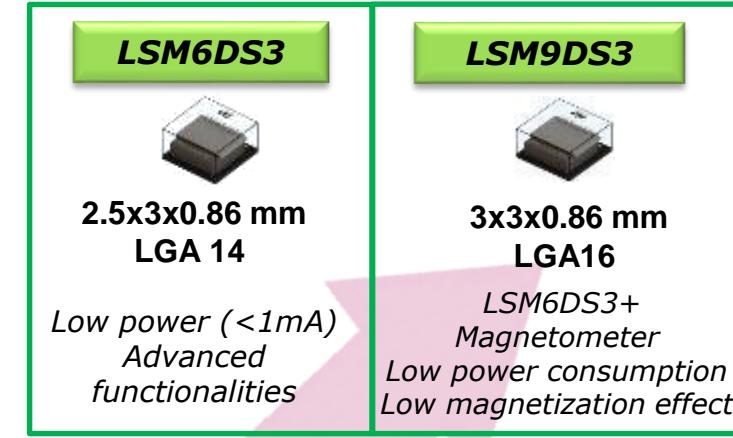
Note

Focus Product

2015  
Focus Product

Legacy Product

Business running



# 6 & 9-axis IMU Roadmap Evolution

**LSM9DS1** as **Focus Product** already in high volume production, and for this it can guarantee a longer life time.

Technically it distinguishes itself versus the LSM9DS0 (4x4mm): for the improved performance/lower noise, smaller size (3.5x3mm), lower power, and A+G sync output can be relevant in the customer final application.

At the same time we can push the **LSM6DS3 + LIS3MDL**: if for this kind of application the size is not a constraint, and with LSM6DS3 we can benefit higher temperature stability and offer higher magnetometer Board Design flexibility

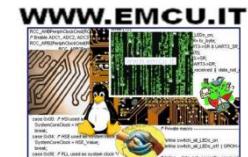
In this case we will provide test boards STM32F401 Nucleo + LSM6DS3 Extension board

new 9-axis LSM9DS3 based on (LSM6DS3 + magnetometer ): scheduling is not yet defined and could be for the end of the year

**LSM9DS1**



3x3.5x1 mm  
LGA24





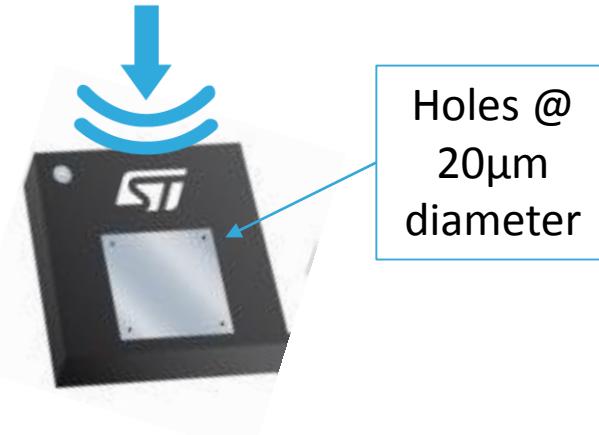
# Environmental Sensors



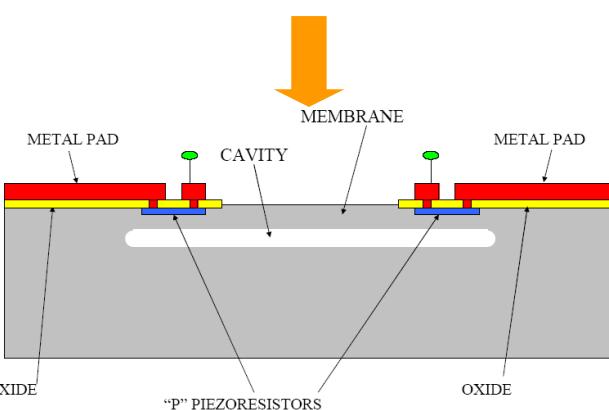
# Barometric Sensor - LPS25HB

## LPS25HB

### Absolute Pressure Sensor



Pressure



### Features

- 260 to 1260 mbar absolute pressure
- High-resolution mode: up to 0.010 mbar RMS
- Low power consumption: 4 $\mu$ A
- Embedded FIFO
- Selectable ODR from 1 Hz to 25 Hz
- Embedded temperature compensation
- Interruptions on thresholds
- SPI / I<sup>2</sup>C
- Supply voltage: 1.7 to 3.6 V
- P2P & SW compatible with LPS25H
- Temperature range: -30 to 105°C

### Key Features

Low power and High Resolution  
Water resistant and robust package

# HTS221

## Humidity Sensor

12

### HTS221



- **Features**

- Humidity and temperature sensor
- 0 to 100% RH range
- -40 to 120 °C temperature range
- Low Power Consumption
  - 1 µA @ 1Hz ODR
- **Humidity Accuracy** – ±3.5%RH (20%RH to 80%RH)
- SPI and I<sup>2</sup>C interfaces
- **Self-Test**
- Supply voltage: 1.7 to 3.6 V

### Key Features

- ±3.5%RH Accuracy
- 2x2 Package
- Low Power

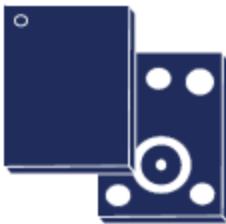
\*MM target: Q2/2015

Sensors Presentation



# Microphones

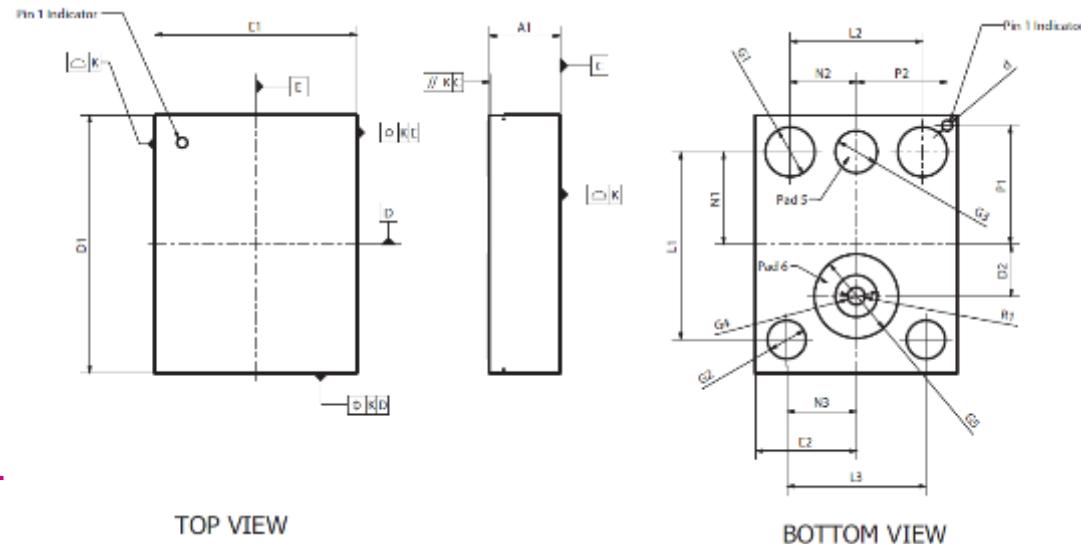




# MP33AB01/01H

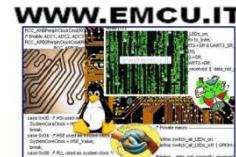
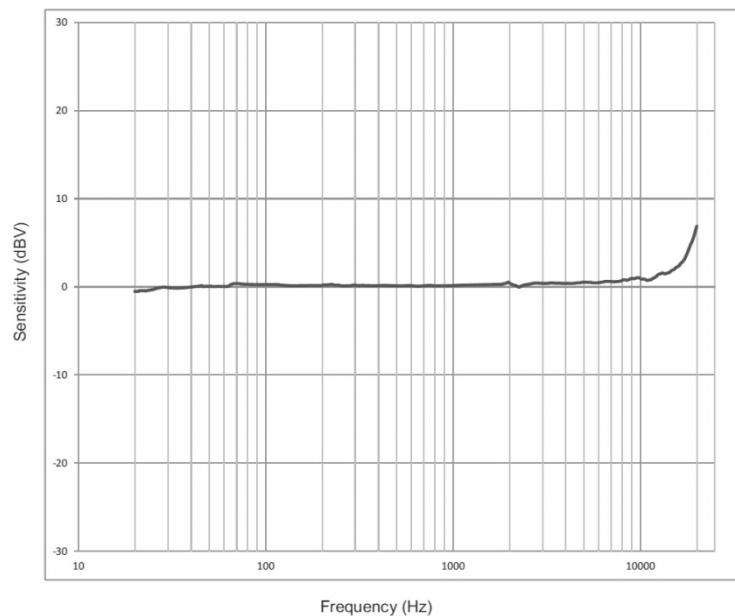
14

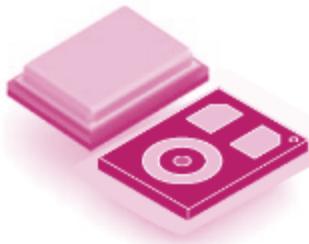
- Dimension: 3.76x2.95x1.0 mm
- Omni-directional sensitivity
- Analog output interface
- Acoustic overload point: 125dBSPL
- SNR:
  - 63 dB (MP33AB01)
  - **66 dB (MP33AB01H)**
- Sensitivity:
  - -38dBV ±3 dB (typical)
- Supply voltage: 1.5V to 3.6V DC
- Current consumption: 250 µA



TOP VIEW

BOTTOM VIEW

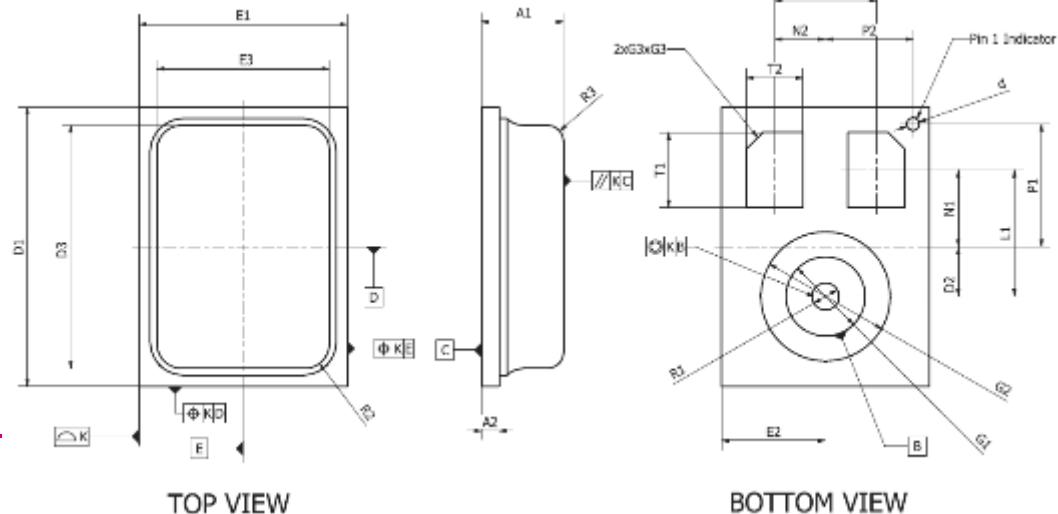




# MP23AB02B

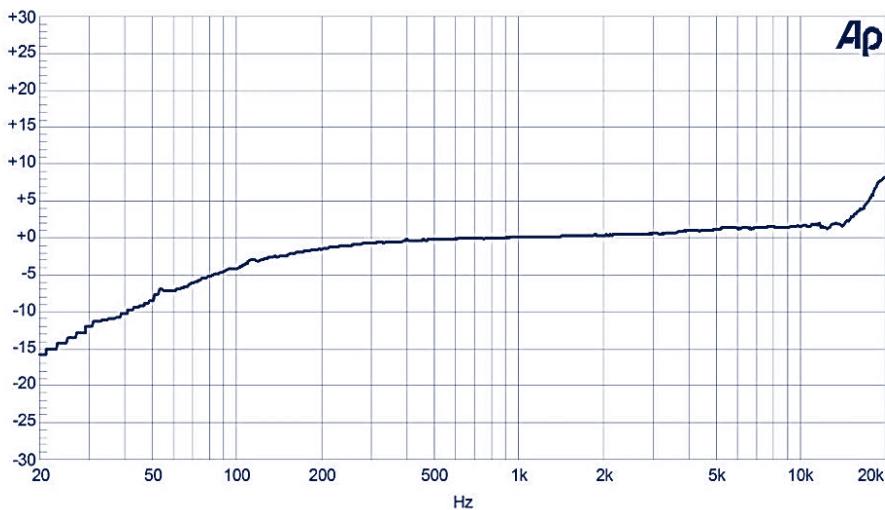
15

- Dimension: 3.35x2.5x0.98mm
- Omni-directional sensitivity
- Analog output interface
- Acoustic overload point: 125dBSPL
- SNR: 64dB
- Sensitivity:
  - -38dBV ±3 dB (typical)
- Supply voltage: 1.6V to 3.6V DC
- Current consumption: 150 µA



TOP VIEW

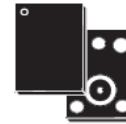
BOTTOM VIEW



# Digital & Analog Microphones

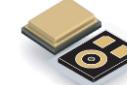
## Roadmap Evolution

**MP33AB01**  
**MP33AB01H**



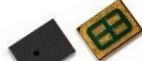
**3.76x2.95x1 mm**  
*Bottom Port*  
**SNR 63-66dB**  
**AOP 125dB**  
**SENS ±3dB**

**MP23AB02B**



**2.5x3.35x.98 mm**  
*Bottom Port*  
**SNR 64dB**  
**AOP 125dB**  
**SENS ±3dB**

**MP34DT01**  
**MP34DT01-M**  
**MP34DTW01**



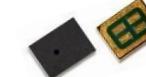
**3x4x1 mm**  
*Top Port*  
**SNR 60-63dB**  
**AOP 120dB-145dB**  
**SENS ±3dB**

**MP34DB01**  
**MP34DB02**



**3x4x1 mm**  
*Bottom Port*  
**SNR 62.6dB**  
**AOP 120dB**  
**SENS ±3dB**

**MP34DT04**



**3x4x1 mm**  
*Top Port*  
**SNR 64.3dB**  
**AOP 120dB**  
**SENS ±3dB**

**MP23DB01MM**



**2.65x3.5x0.98 mm**  
*Bottom port*  
**SNR 64dB**  
**AOP 120dB**  
**Sens +/- 1dB**  
**Multimode**

2014

2015

# Tools, SW & Evaluation Kits

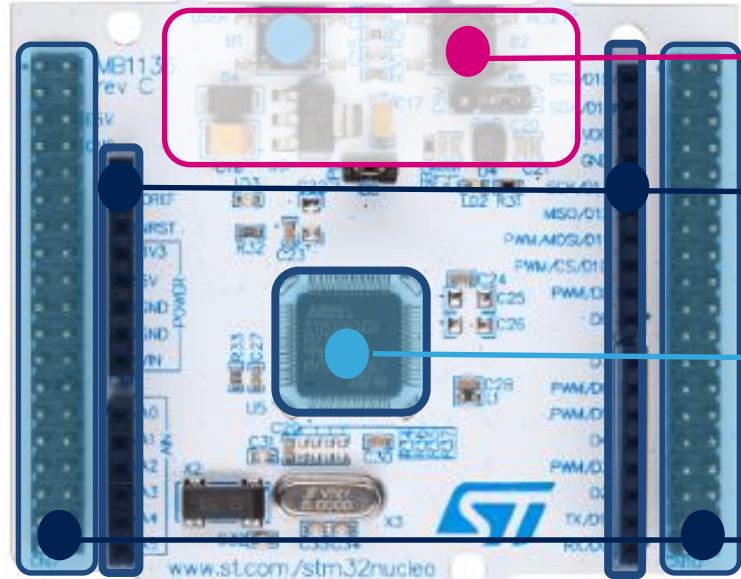
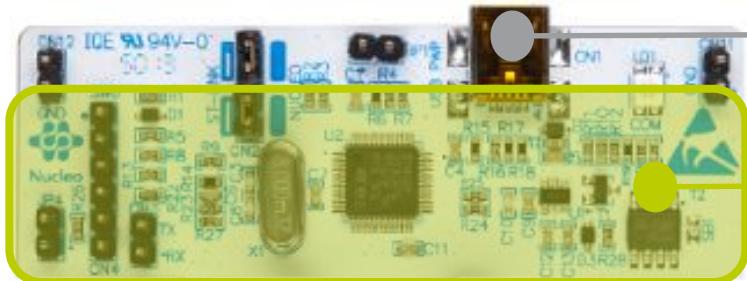


**SILICA**  
An Avnet Company



**ST** life.augmented

# Nucleo: a new approach for MEMS & Sensors Tools



STM32 Nucleo features

Flexible board power supply :  
through USB or external source

Integrated ST-Link/V2-1:  
mass storage device flash programming

2 push buttons, 2 color Leds

Arduino extension connectors :  
easy access to add-ons

One STM32 MCU flavor with 64 pins

Morpho extension headers :  
direct access to all MCU I/Os



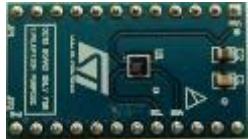
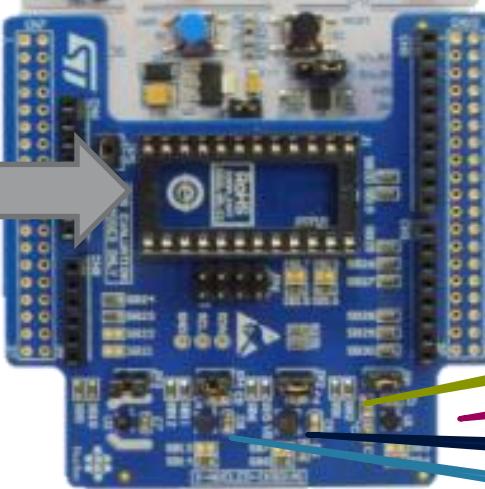
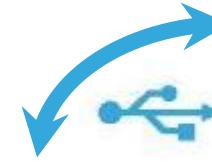
# ST also provide ready-to-use Tools: MEMS & Sensor X-NUCLEO-IKS01A

ST Software Package

**INEMO SW FUSION**

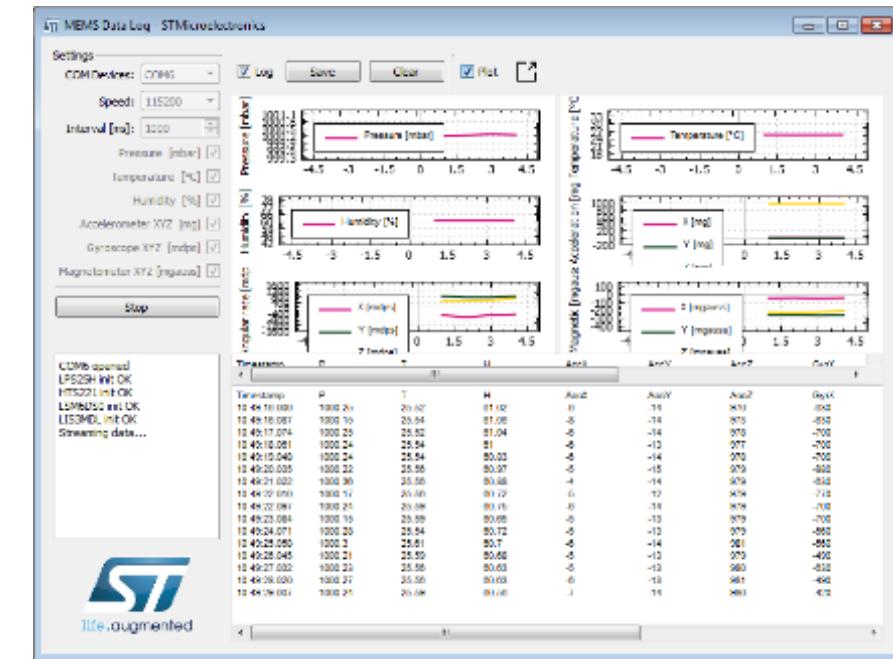
Low Level Drivers

Algorithms Libraries



DIL24

STEVAL-MKIxxxVx



**LSM6DS0**

- 6-axis Motion

**LIS3MDL**

- Magnet

**LPS25H**

- Pressure

**HTS221**

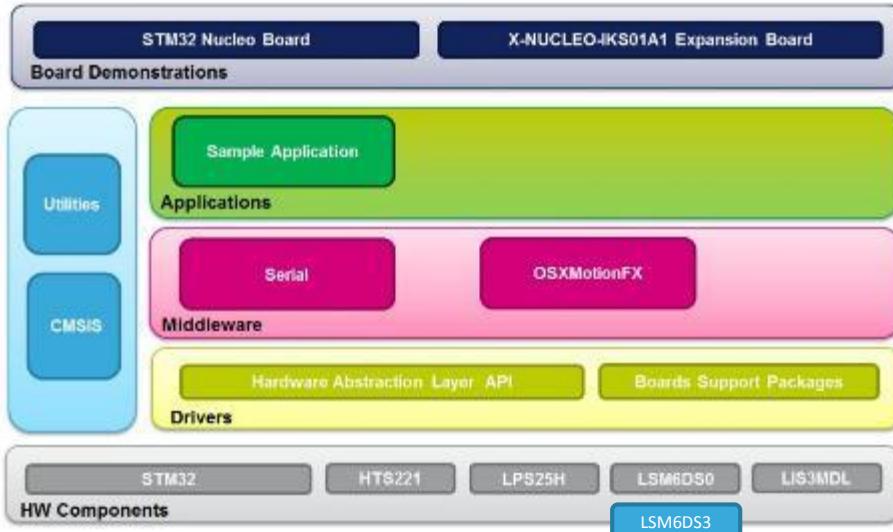
- Humidity + Temp

X-NUCLEO-IKS01A1

## Real-time motion-sensor data fusion software expansion

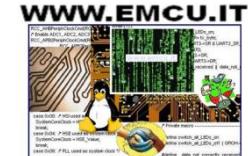
### OsxMotionFX firmware package includes

- Real-time motion 6 and 9-axis sensor fusion
- OsxMotionFX software features:
  - 9-axis fusion (accelerometer + gyroscope + magnetometer)
  - 6-axis fusion (accelerometer + gyroscope)
  - Gyroscope bias calibration
  - Magnetometer calibration
- Sample PC GUI application to transmit real time sensor fusion data for NUCLEO-F401 board



### Development Toolchains and Compilers

- IAR Embedded Workbench for ARM (EWARM) toolchain V7.30 + ST-Link
- RealView Microcontroller Development Kit (MDK-ARM) toolchain V5.12 + ST-LINK
- Atollic TrueSTUDIO® for ARM® Pro V5.2.1 + ST-LINK



Coming soon !

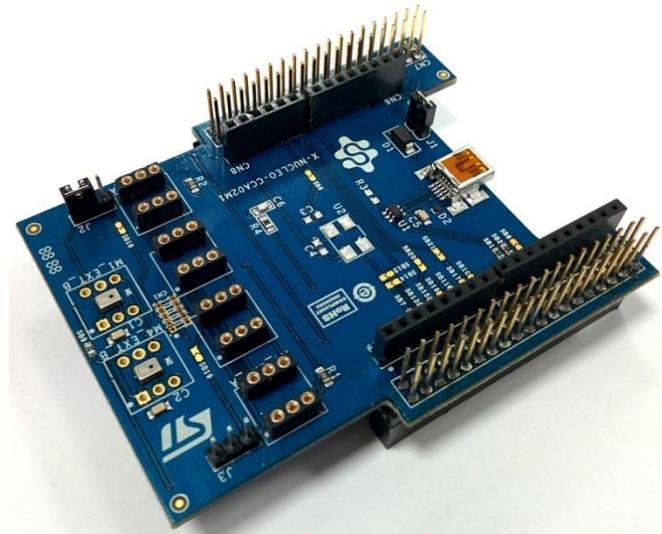
# X-NUCLEO-CCA02M1

## MEMS MICs expansion board

- The X-NUCLEO-CCA02M1 is a MEMS microphone evaluation board system.
- It is compatible with the **Morpho connector** layout, and is designed around STMicroelectronics' latest microphones.

### Key HW Features

- 2x MP34DT01-M:** digital MEMS microphone with PDM (Pulse Density Modulation) data output
- 4x MEMS MICs coupon boards connectors:** easy system expansibility
- 1x miniUSB FS connector:** for USB audio data streaming



X-NUCLEO-CCA02M1



MEMS MICs  
coupon board

Coming soon !

# Open.AUDIO

## MEMS MICs SW libraries

22

- **PDM Library (part of X-CUBE-MEMSMIC1)**

- Converts digital MEMS microphone PDM signal to the PCM format

- **SOUND SOURCE LOCALIZATION**

- using a MEMS microphone array, it can estimate the angle of arrival of the audio signal

- **BEAMFORMING**

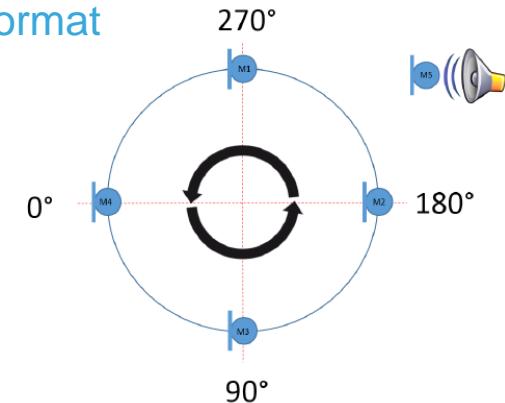
- using a MEMS microphone (omnidirectional) array, the library enables to create a virtual directional microphone

- **AEC**

- Acoustic Echo Cancelation (Speex based)

- **BLUEVOICE**

- Speech audio data transfer over BLE RF link



- For more info contact:
  - [enrico.marinoni@silica.com](mailto:enrico.marinoni@silica.com) (FAE)
  - [roberto.rossetti@silica.com](mailto:roberto.rossetti@silica.com) (BDM)