

ST industrial inclinometers

Overview of industrial sensors



ST industrial accelerometers portfolio



Tilt sensing with inclinometers and IMUs



Development tools + SW for tilt sensing

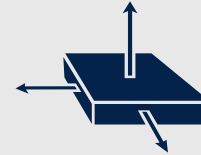


ST sensors for industry 4.0

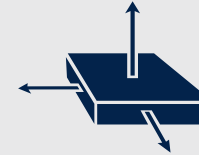
A complete portfolio



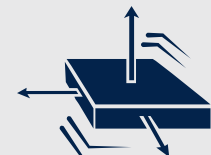
High-g shock
accelerometers



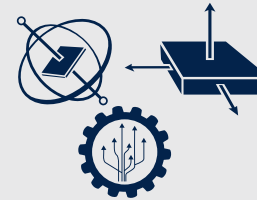
Inclinometers



Vibration sensors



6-axis IMU
+ Machine Learning



High performance

High accuracy

High reliability

High-bandwidth
microphones



Pressure sensors



Humidity sensors



Temperature sensors





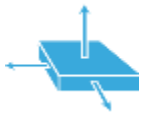
Industrial accelerometers

General purpose

Inclinometers

Vibration Sensor

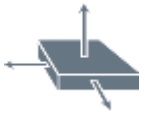
IIS2DH



2 x 2 x 1 mm

- Low Power
- Wide BW (2 kHz)

IIS328DQ



4 x 4 x 1.8 mm

- Extended Top: -40°C +105°C
- QFN Package

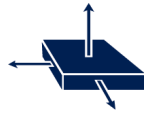
IIS2DLPC



2 x 2 x 0.7 mm

- Ultra low power
- High versatility: on the fly changes from ultra low power to high resolution/high performance modes

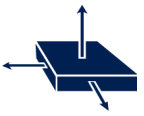
IIS3DHHC



5 x 5 x 1.7 mm

- **3 axis digital Inclinometer**
- High resolution and stability over temperature and time
- High End Ceramic Package

IIS2ICLX



5 x 5 x 1.7 mm

- Cur Cons: **0.42 mA**
- FS: **± 0.5/1.0/2.0/3.0**

- **2 axis digital Inclinometer**
- **Enhanced machine Learning Core and FSM**

- Ultra High resolution and stability over temperature and time
- Low Power
- Extended Top: **-40°C +105°C**

Coming soon

IIS3DWB



2.5 x 3 x 0.86 mm

- **3-axis Digital axel**
- **Ultra Wide and Flat Bandwidth (>5Khz)**
- Low Noise (75 µg/√Hz)
- Low power (1.1mA)
- Extended Top: **-40°C +105°C**
- **Ideal for Vibration Monitoring**

Accelerometer



Inclinometers

Inclinometers



Static
tilt measure

Inclinometers measure the angle of an object relying on the projection of the acceleration of gravity on the sensing axes



Antenna
pointing,
platform
leveling and
stabilization



Robotics and
Industrial
automation



industrial
vehicles and
construction
machines



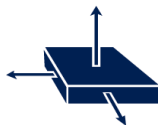
Installation and
monitoring of
equipment, solar
panels



Precise
leveling
instruments



Building and
infrastructure
condition
monitoring



IIS3DHHX

3-axis digital Inclinometer

IIS2ICLX

2-axis digital Inclinometer

Coming soon



Dynamic
tilt measure

Dynamic Inclinometers implement sensor data fusion from accelerometer and gyroscope to measure reliably the angle of an object when it is not in stationary conditions and thus subjected to spurious accelerations



Antenna
pointing,
platform
leveling and
stabilization



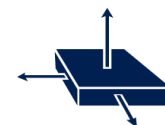
Robotics



industrial
vehicles,
mining, cranes



Inclinometers for
autonomous
vehicles



ISM330DHCX

6-axis IMU



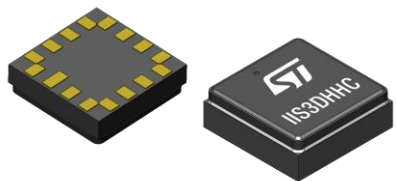


Industrial Inclinometers Portfolio

High Accuracy Inclinometer Portfolio

IIS3DHHC

3-axis digital Inclinometer



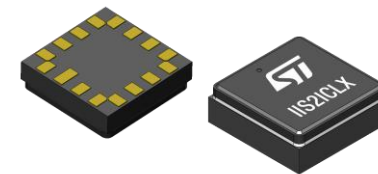
High accuracy **3-axes** Digital Inclinometer

- High-stability over temperature and time
- ± 2.5 g Full Scale
- Offset change vs Temp < 0.4 mg/°C
- Low noise (45 μ g/ $\sqrt{\text{Hz}}$)
- Operating temperature range $-40 \div 85^\circ\text{C}$

IIS2ICLX

Coming soon

2-axis digital Inclinometer



Ultra high-accuracy, high-resolution, low-power, **2-axis** Digital Inclinometer

- High resolution, High Accuracy ($< 0.5^\circ$ over Temp. and Time)
- ± 0.5 g to ± 3 g Full Scale
- Offset change vs Temp < 0.075 mg/°C
- Ultra low noise (15 μ g/ $\sqrt{\text{Hz}}$)
- Low power (0.42mA)
- Operating temperature range $-40 \div 105^\circ\text{C}$
- Programmable Machine Learning Core & Finite State Machines to integrate AI algorithms





Industrial 6-axis IMU

6-axis IMU

I3G4250D



4 x 4 x 1 mm

- 3 Axis Digital Gyro
- High linearity and stability over temperature and time

ISM330DLC



2.5 x 3 x 0.86 mm

- Dual Channel output
- Low Power
- Smart Features
- Axel with wide BW (3kHz) and low noise

- Cur Cons HP: **0.75 mA** combo
- FS: **gyro** up to **2000 dps**; **axel** up to **16 g**

ISM330DHCX



2.5 x 3 x 0.86 mm



- Enhanced machine Learning Core and FSM
- High Accuracy and stability: (BI : 3°/hr)
- Accelerometer with wide BW (3kHz) and low noise

- Cur Cons HP: **0.90 mA** gyro; **1.2 mA** combo
- FS: **gyro** up to **4000 dps**; **axel** up to **16 g**
- Extended Top: **-40°C +105°C**





ISM330DHCX

6-axis IMU with Machine Learning Core

Key Features

- **Configurability**
 - Angular rate range: from ± 125 dps up to ± 4000 dps
 - Axel Full Scale: from ± 2 g up to ± 16 g
 - Low power and high-performance modes
- **High Accuracy, Stability and linearity over temperature and time**
 - Gyro Offset vs T ± 0.005 dps/ $^{\circ}\text{C}$ (typ)
 - **Gyro Bias Instability 3 $^{\circ}$ /hr (typ)**
 - Rate Noise Density 5 mdps/ $\sqrt{\text{Hz}}$ (typ)
 - Axel Noise Density 60 $\mu\text{g}/\sqrt{\text{Hz}}$ (typ) – ODR up to 6.6kHz
- **Programmability & digital features**
 - **Programmable Machine Learning Core & Finite State Machines to integrate AI algorithms**
 - 9 kB Embedded FIFO
 - Sensor Hub
- **Extended operating temperature range from -40 to +105 $^{\circ}\text{C}$**

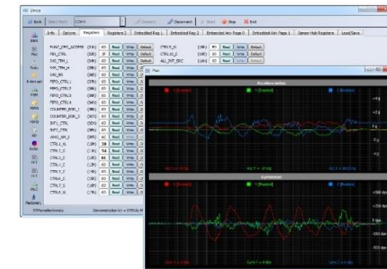
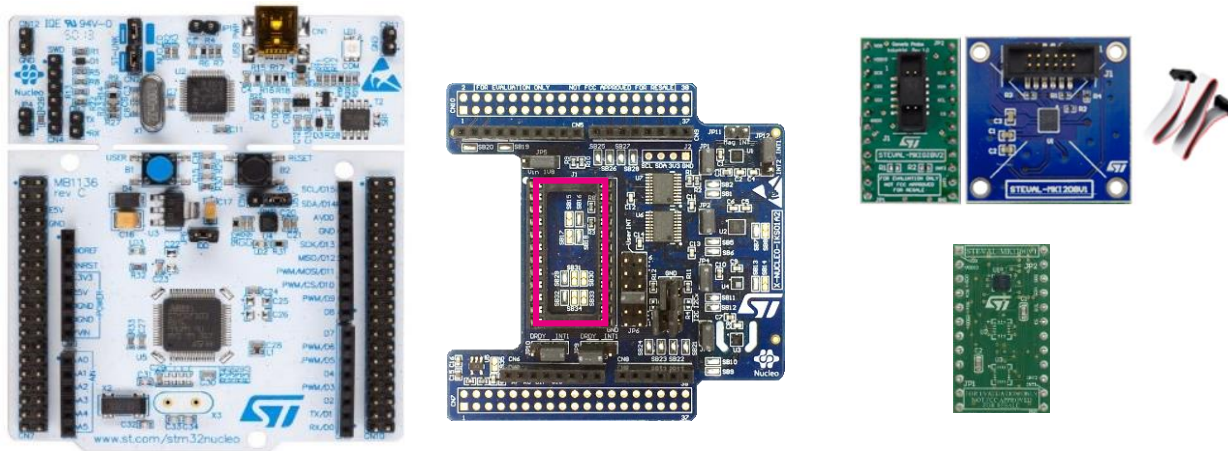


LGA 14L
2.5x3x0.86 mm



Quick & modular prototyping

STM32 Nucleo with expansion board, tool and Unicleo GUI



Software package:
UNICLEO GUI
with
X-CUBE-MEMS1

STM32 NUCLEO with X-NUCLEO EXPANSION
X-NUCLEO-IKS02A1
and optional dedicated Adapter Board

Currently Supported Industrial Sensors

IMU	ISM330DLC ISM330DHCX
Accelerometer	IIS2DH IIS2DLPC
Inclinometer	IIS2ICLX*
Magnetometer	IIS2MDC
Microphones	ISM303DAC IMP34DT05
Temperature	STTS22H

*Coming soon

...on X-NUCLEO-IKS02A1



Software libraries for inclinometers

Accuracy/Calibration



Measuring



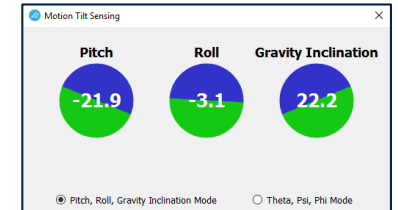
Stationary
applications



Static
Tilt Measure

MotionTL (in X-CUBE-MEMS1) for 3-axis accelerometers

- Static Tilt measure: 3 axis inclinometers (Q3/2020 for 2-axes)
- Accelerometer calibration
- Tilt angles Pitch & Roll + Gravity inclination



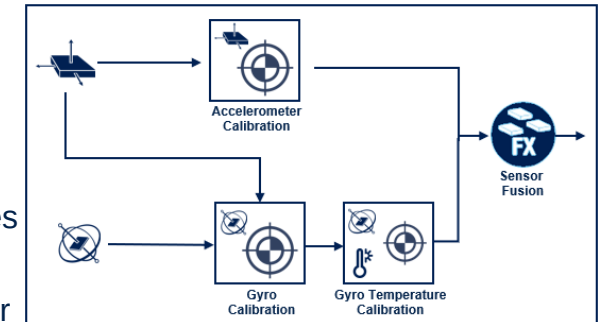
Moving
machinery



Dynamic
Tilt Measure

MotionDI (in X-CUBE-MEMS1) for 6-axis IMUs

- Accelerometer Calibration
- Gyroscope calibration
- 6-axis sensor fusion accurate orientation angles in presence of vibrations and motion
- Tilt angles Pitch & Roll + Yaw & Rotation vector

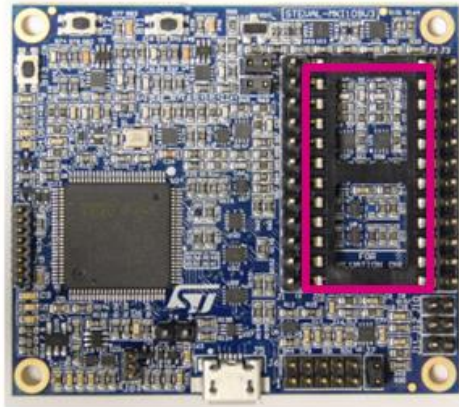


Deep sensor performance evaluation

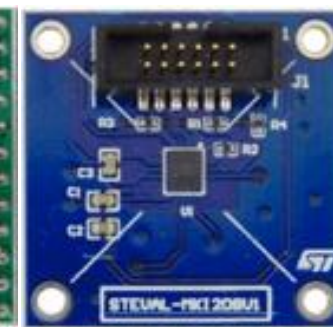
For any sensor in the portfolio
A powerful Tool & GUI to capture and process data and assess sensor performance

Professional MEMS motherboard

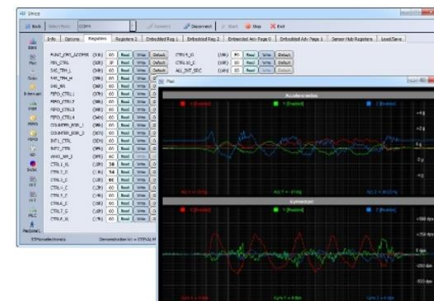
Evaluation board (adapter)



Professional MEMS motherboard
STEVAL-MKI109V3



Different flavors of DIL24 adapter board
STEVAL-MKI186V1 for IIS3DHH



Software package:
UNICO-GUI

Linux → STSW-MKI109L,
Mac OS X → STSW-MKI109M,
Windows → STSW-MKI109V

