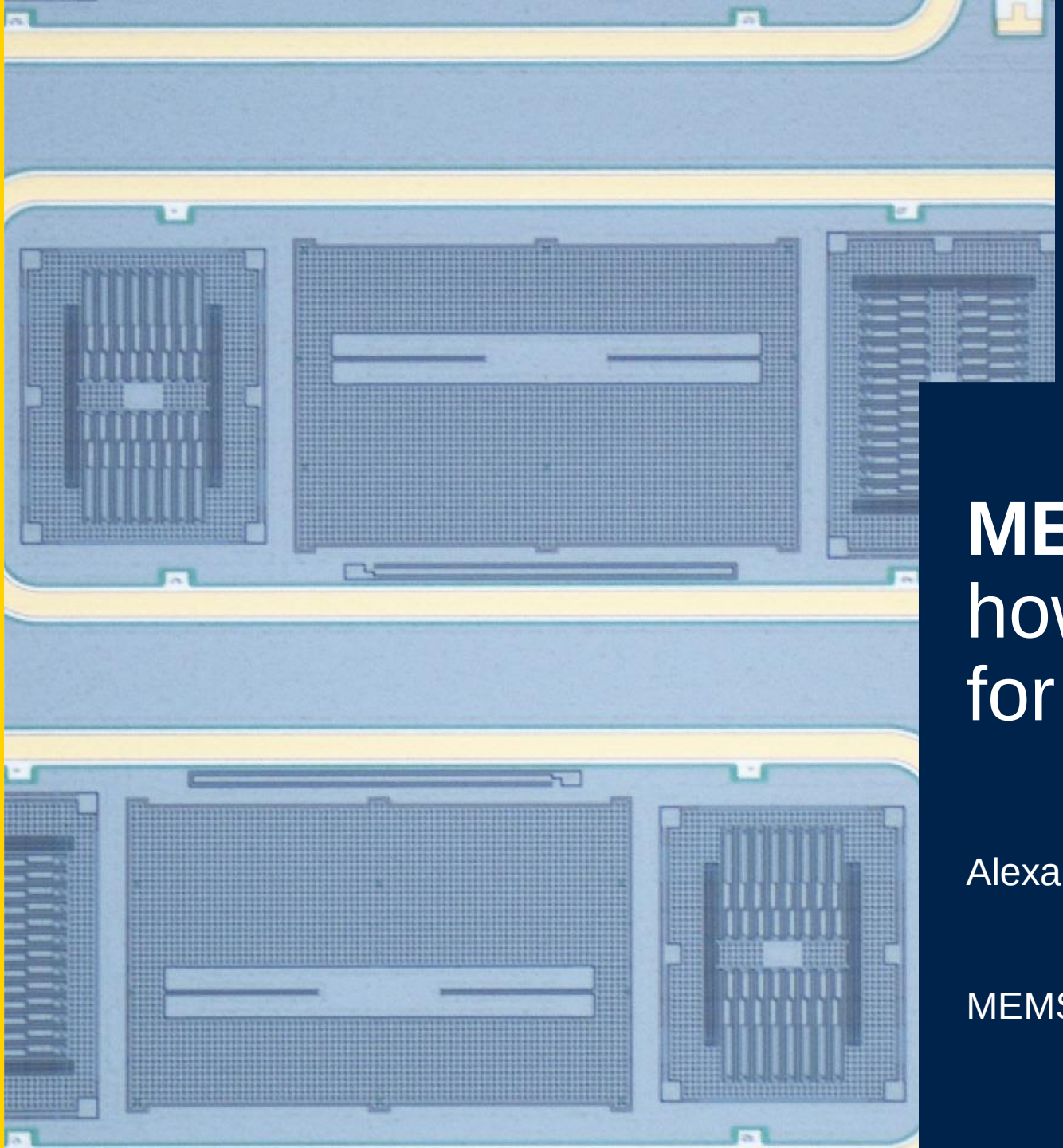


life.augmented

MEMS Accelerometers: how to pick the perfect fit for any application

Alexandra GOGONEA

MEMS and Sensors Marketing and Application Team

Agenda

1 MEMS Technology

Agenda

1 MEMS Technology

2 Accelerometers use case and relevant parameters for selection

Agenda

1 MEMS Technology

2 Accelerometers use case and relevant parameters for selection

3 Portfolio overview and application examples

- Consumer (asset tracking, IoT/wearables)
- Automotive (key fob, car alarm)
- Industrial (anti-tampering, vibration monitoring)

life.augmented

Agenda

1 MEMS Technology

2 Accelerometers use case and relevant parameters for selection

3 Portfolio overview and application examples

- Consumer (asset tracking, IoT/wearables)
- Automotive (key fob, car alarm)
- Industrial (anti-tampering, vibration monitoring)

4 Hands-on experience using a 3-axis accelerometer

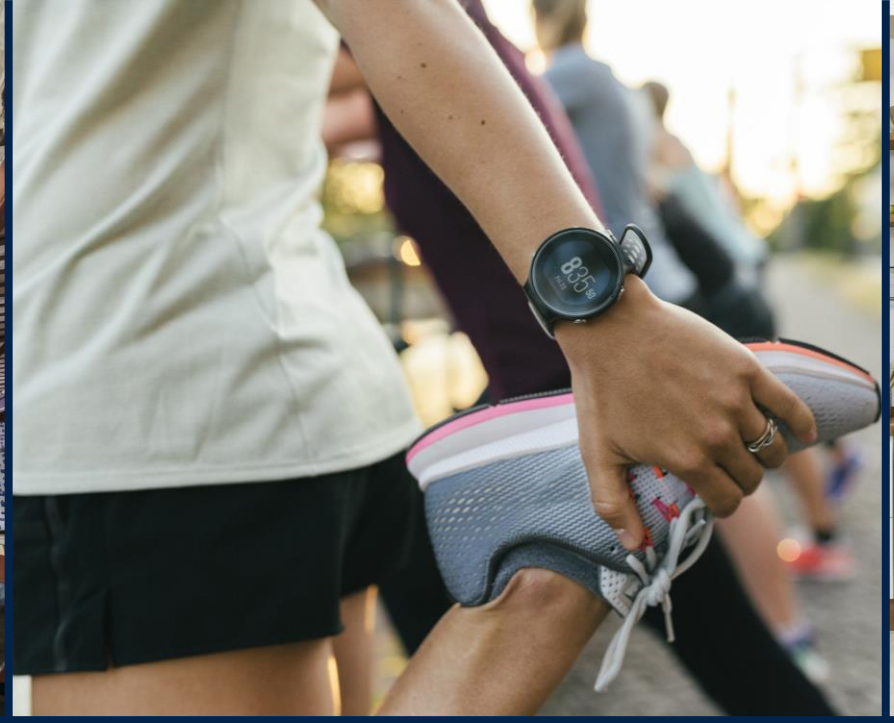
- Evaluation boards
- Demo

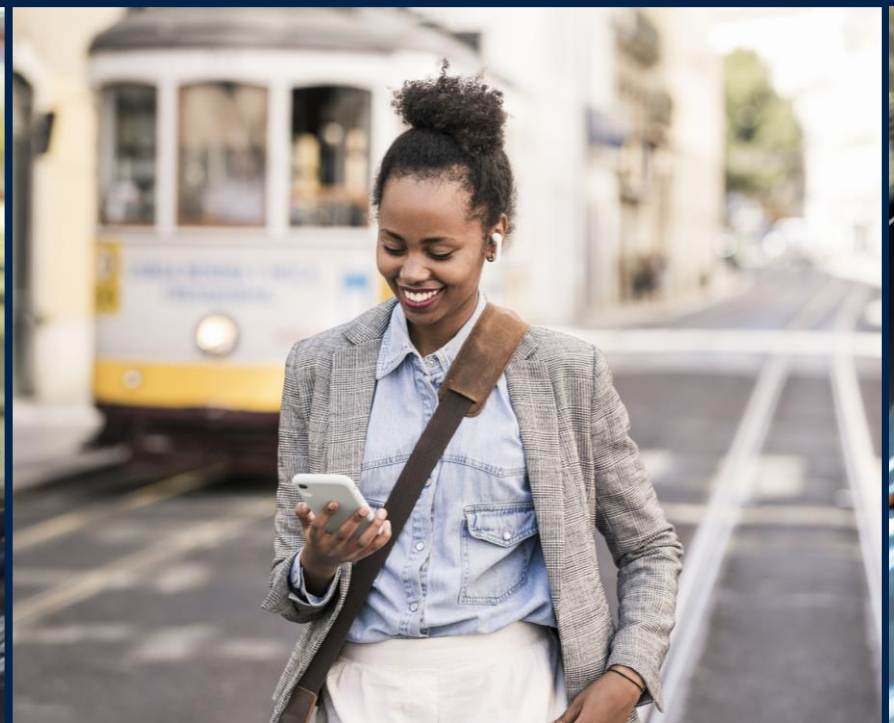
life.augmented

Agenda

1. MEMS Technology
2. Accelerometers use case and relevant parameters for selection
3. Portfolio overview and application examples
   - Consumer (asset tracking, IoT/wearables)
   - Automotive (key fob, car alarm)
   - Industrial (anti-tampering, vibration monitoring)
4. Hands-on experience using a 3-axis accelerometer
   - Evaluation boards
   - Demo
5. Takeaways

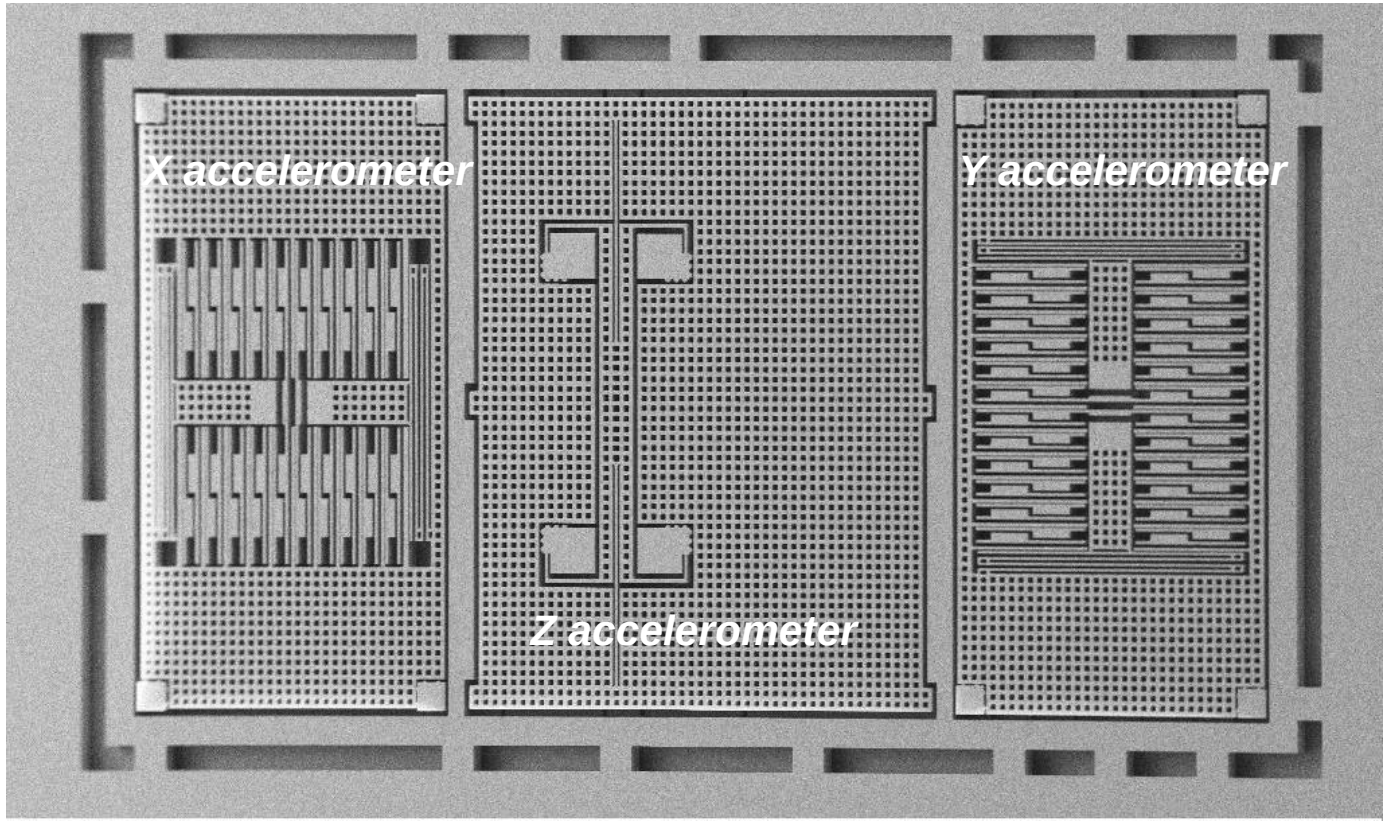
life.augmented

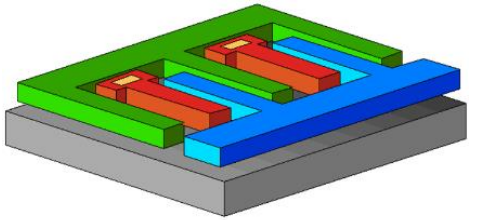




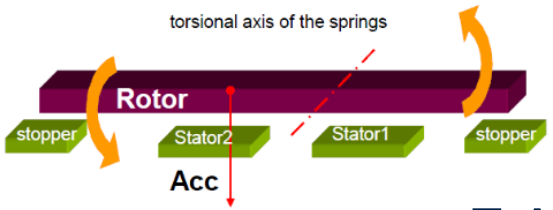
3-axis accelerometer

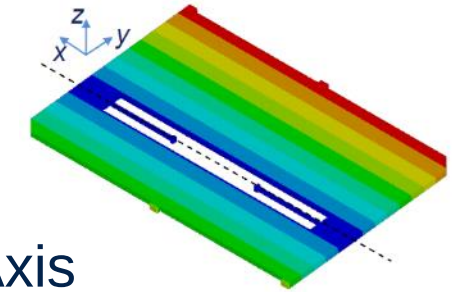
THELMA = **Th**ick **E**pitaxial **L**ayer for **M**icro-gyroscopes & **A**ccelerometers





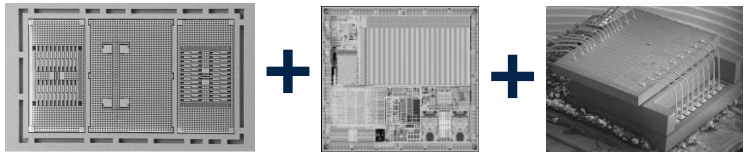
X / Y Axes



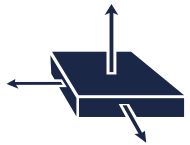


Z Axis

Transducer + ASIC + Package



Accelerometers use cases



LIS2DE12	IIS2DLPC
LIS2DH12	IIS2DH
LIS2DW12 / LIS2DTW12	IIS2ICLX / IIS3DHHC
LIS2DU12	IIS3DWB
H3LIS331DL	AIS2IH
AIS328DQ / AIS3624DQ	AIS2DW12

Consumer | Industrial | Automotive

ST Advantage

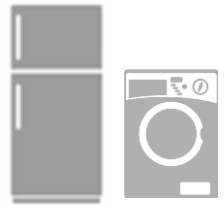
- Flexibility Power Consumption vs. Noise
- Anti-alias Filter
- Embedded Digital Features
- Small size

Asset tracking
Shock/Wake-up

IoT / Wearables
Activity tracking / Pedometer

People monitoring
Freefall / Man-down / Activity

Alarms
Tilt / Wake-up



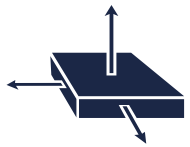
White Goods
Vibration / Tilt

Industrial
Positioning / Tilt

Predictive maintenance & Monitoring
Vibration / Tilt

Car crash / Car alarms
Tilt / Movement

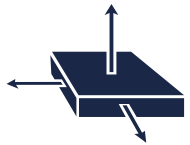
life.augmented



Relevant parameters for accelerometers selection

- **Package**
- **Noise**
- **Full scale (low and high-g)**
- **Output data rate**
- **Zero-g level accuracy**
- **Filters and bandwidth**
- **Resolution**
- **Power consumption**

life.augmented



Relevant parameters for accelerometers selection

Package

Noise

Full scale (low and high-g)

Output data rate

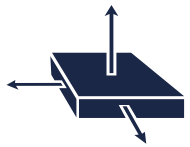
Zero-g level accuracy

Filters and bandwidth

Resolution

Power consumption

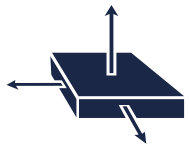
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

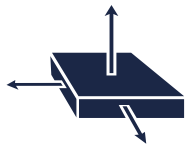
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

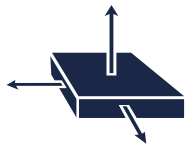
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

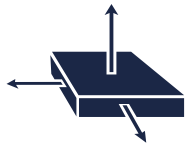
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

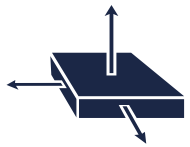
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

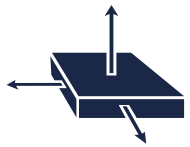
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

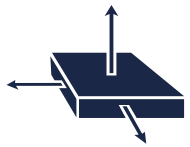
life.augmented



Relevant parameters for accelerometers selection

Package	**Noise**
Full scale (low and high-g)	**Output data rate**
Zero-g level accuracy	**Filters and bandwidth**
Resolution	**Power consumption**

life.augmented



Relevant parameters for accelerometers selection

- **Package**
- **Noise**
- **Full scale (low and high-g)**
- **Output data rate**
- **Zero-g level accuracy**
- **Filters and bandwidth**
- **Resolution**
- **Power consumption**

life.augmented

2/3-axis Digital Accelerometers Overview

consumer

LIS2DE12 — 2 x 2 x 1 mm
- Full scales of ±2g/±4g/
- ±8g/±16g

LIS2DH12 — 2 x 2 x 1 mm
- High flexibility power vs. noise
- Multiple noise / Power configurations
- Android stationary / motion detection

LIS2HH12 — 2 x 2 x 1 mm
- Ultra low power accelerometer with **Anti Alias Filter**

LIS2DW12 — 2 x 2 x 0.7 mm

LIS2DU12 — 2 x 2 x 0.7 mm

LIS3DHH — 5 x 5 x 1.7 mm
- 3-axis, ±2.5 g full-scale
- Ultra-high-resolution and low-noise

H3LIS331DL — 3 x 3 x 1 mm
- **±100g/±200g/±400g** dynamically selectable full scales
- **Shock/impact detection**

automotive

AIS328DQ — 4 x 4 x 1 mm
- 3 axis digital
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for Navigation and Anti-theft**

AIS2IH — 2 x 2 x 0.93 mm
- Ultra low power 3 axis
- Extended Top: -40°C +115°C
- **Package with wettable flanks**
- **Ideal for Tilt / inclination and motion activated functions**

AIS3624DQ — 4 x 4 x 1 mm
- 3 axis digital
- FS: up to **24 g** (mid-g range)
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for e-Call**

AIS2DW12 — 2 x 2 x 0.93 mm
- Ultra low power 3 axis digital Superioir robustness to mechanical shock and drops
- **Package with wettable flanks**
- **Ideal for Key fob**

industrial

IIS2DH — 2 x 2 x 1 mm
- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC — 2 x 2 x 0.7 mm
- High flexibility power vs. noise
- Multiple noise / Power configurations
- **Industrial controls, anti-tampering, security, motion activated functions**

industrial application specific

IIS3DHHC — 5 x 5 x 1.7 mm
- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX — 5 x 5 x 0.7 mm
- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time
- **Leveling instruments / Structural health**

IIS3DWB — 2.5 x 3 x 0.83 mm
- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density
- **Preventive maintenance**

life.augmented

Consumer | Industrial | Automotive | AEC-Q100

LONGEVITY 10 YEARS COMMITMENT

2/3-axis Digital Accelerometers Overview

consumer

LIS2DE12 — 2 x 2 x 1 mm
LIS2DH12 — 2 x 2 x 1 mm
LIS2HH12 — 2 x 2 x 1 mm
LIS2DW12 — 2 x 2 x 0.7 mm
LIS2DU12 — 2 x 2 x 0.7 mm

- Full scales of ±2g/±4g/ ±8g/±16g
- High flexibility power vs. noise
- Multiple noise / Power configurations
- Android stationary / motion detection
- Ultra low power accelerometer with **Anti Alias Filter**

LIS3DHH — 5 x 5 x 1.7 mm

- 3-axis, ±2.5 g full-scale
- Ultra-high-resolution and low-noise

H3LIS331DL — 3 x 3 x 1 mm

- **±100g/±200g/±400g** dynamically selectable full scales
- **Shock/impact detection**

automotive

AIS328DQ — 4 x 4 x 1 mm

- 3 axis digital
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for Navigation and Anti-theft**

AIS2IH — 2 x 2 x 0.93 mm

- Ultra low power 3 axis
- Extended Top: -40°C +115°C
- **Package with wettable flanks**
- **Ideal for Tilt / inclination and motion activated functions**

AIS3624DQ — 4 x 4 x 1 mm

- 3 axis digital
- FS: up to **24 g** (mid-g range)
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for e-Call**

AIS2DW12 — 2 x 2 x 0.93 mm

- Ultra low power 3 axis digital Superioir robustness to mechanical shock and drops
- **Package with wettable flanks**
- **Ideal for Key fob**

industrial

IIS2DH — 2 x 2 x 1 mm

- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC — 2 x 2 x 0.7 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations
- **Industrial controls, anti-tampering, security, motion activated functions**

industrial application specific

IIS3DHHC — 5 x 5 x 1.7 mm

- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX — 5 x 5 x 0.7 mm

- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time
- **Leveling instruments / Structural health**

IIS3DWB — 2.5 x 3 x 0.83 mm

- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density
- **Preventive maintenance**

life.augmented

Consumer | Industrial | Automotive | AEC-Q100

LONGEVITY 10 YEARS COMMITMENT

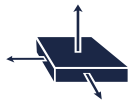
Consumer

ST accelerometers

Delivering the best performance at the lowest power and smallest size

High Performance

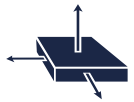
LIS2DS12



2.0 x 2.0 x 0.86 mm

- ±2/±4/±8/±16g FS
- Resolution: 10/12/14 bit
- 0g level offset accuracy ±30mg
- Step detection/counter
- ODR: 1Hz – 6.4kHz

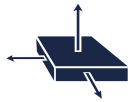
LIS2HH12



2.0 x 2.0 x 1.0mm

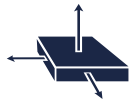
- ±2/±4/±8g FS
- Resolution: 8/10/16 bit
- 0g level offset accuracy ±30mg
- ODR: 10Hz – 800Hz

LIS2DE12



2.0 x 2.0 x 1.0 mm

LIS2DH12



2.0 x 2.0 x 1.0 mm

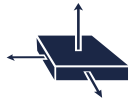
- ±2/±4/±8/±16g FS
- Resolution: 8/10/12 bit
- 0g level offset accuracy ±40mg
- ODR: 1Hz – 5.376kHz

Low noise, low power

LIS2DWT12

2.0 x 2.0 x **0.7 mm**

LIS2DW12

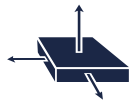


2.0 x 2.0 x **0.7 mm**

- ±2/±4/±8/±16g FS
- Resolution: 12/14 bit
- 0g level offset accuracy ±20mg
- ODR: one shot, 1Hz – 5.376kHz
- 10 operating modes
- Noise: 90µg/√Hz
- Power consumption: 120µA in HPM (@50Hz)
- 32 samples FIFO
- Temperature sensors option (*T)

Ultra Low Power

LIS2DU12



2.0 x 2.0 x **0.7 mm**

- ±2/±4/±8/±16g FS
- Resolution: 12 bit
- 0g level offset accuracy ±30mg
- ODR: one shot, 1.6Hz – 800Hz
- Power consumption: 3.4µA @100Hz with Anti-Alias Filter
- 128 samples FIFO
- I3C output interface mipi

Low Power

FS = full scale
ODR = output data rate
HPM = high performance mode
FIFO = first in first out

life.augmented

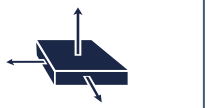
Consumer

ST accelerometers

Delivering the best performance at the lowest power and smallest size

High Performance

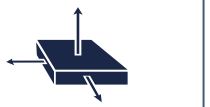
LIS2DS12



2.0 x 2.0 x 0.86 mm

- ±2/±4/±8/±16g FS
- Resolution: 10/12/14 bit
- 0g level offset accuracy ±30mg
- Step detection/counter
- ODR: 1Hz – 6.4kHz

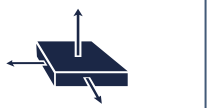
LIS2HH12



2.0 x 2.0 x 1.0mm

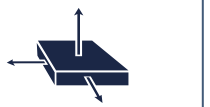
- ±2/±4/±8g FS
- Resolution: 8/10/16 bit
- 0g level offset accuracy ±30mg
- ODR: 10Hz – 800Hz

LIS2DE12



2.0 x 2.0 x 1.0 mm

LIS2DH12



2.0 x 2.0 x 1.0 mm

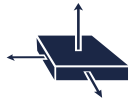
- ±2/±4/±8/±16g FS
- Resolution: 8/10/12 bit
- 0g level offset accuracy ±40mg
- ODR: 1Hz – 5.376kHz

Low noise, low power

LIS2DWT12

2.0 x 2.0 x **0.7 mm**

LIS2DW12

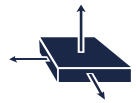


2.0 x 2.0 x **0.7 mm**

- ±2/±4/±8/±16g FS
- Resolution: 12/14 bit
- 0g level offset accuracy ±20mg
- ODR: one shot, 1Hz – 5.376kHz
- 10 operating modes
- Noise: 90µg/√Hz
- Power consumption: 120µA in HPM (@50Hz)
- 32 samples FIFO
- Temperature sensors option (*T)

Ultra Low Power

LIS2DU12



2.0 x 2.0 x **0.7 mm**

- ±2/±4/±8/±16g FS
- Resolution: 12 bit
- 0g level offset accuracy ±30mg
- ODR: one shot, 1.6Hz – 800Hz
- Power consumption: 3.4µA @100Hz with Anti-Alias Filter
- 128 samples FIFO
- I3C output interface mipi

Low Power

FS = full scale
ODR = output data rate
HPM = high performance mode
FIFO = first in first out

life.augmented

LIS2DW12

High Performance, Ultra-low power 3-axis Accelerometer

2 x 2 x 0.7mm

Key features

- Acceleration range: ±2/±4/±8/±16 g
- Enhanced flexibility with embedded FIFO
- Flexibility: **low power consumption** (less than 1 µA) or **low-noise performance** (down to 90 µg/√Hz) with five settings in high performance and low power modes

Advanced digital features

Dedicated internal engine to process motion and acceleration detection:

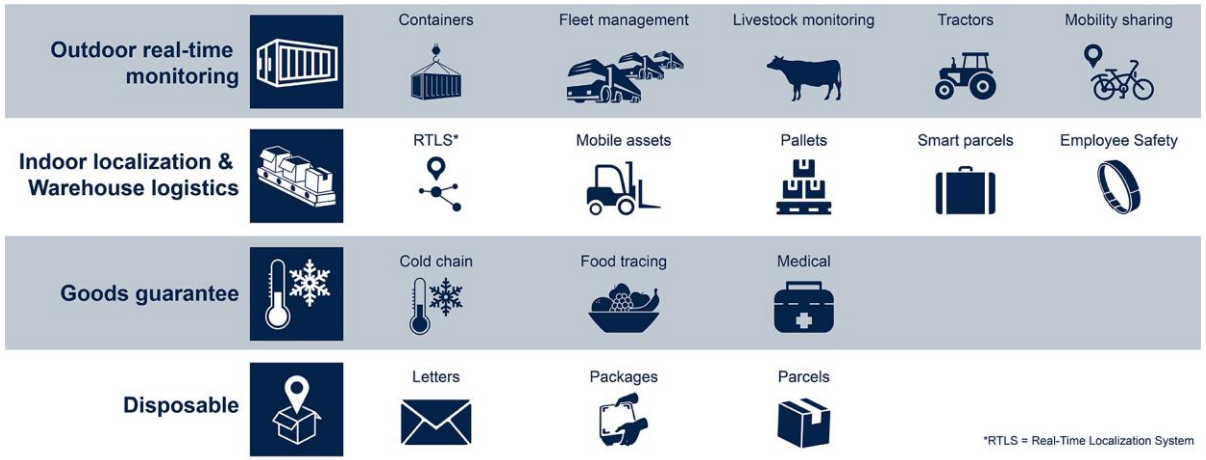
- Free-fall wakeup
- 6D/4D orientation
- Tap and double-tap recognition
- Activity / inactivity recognition

Wireless Sensor Node (IoT) | Smart Watch | Wrist Bands | Headsets | Asset Trackers | Alarm Systems

life.augmented

LIS2DW12 Accelerometer for Asset tracking

Asset tracking application description



Monitor motion, free-fall, shock, impact and vibration during transportation and storage

Key application requirements

Battery life

Free fall / motion wake-up

LIS2DW12

Benchmark low power consumption	Best-in-class embedded features
0.38 µA @ 1.6 Hz 5 µA @ 100 Hz Wake-up interrupt Data on demand	Dedicated internal engine to process motion and acceleration detection

life.augmented

LIS2DU12

High Performance, Ultra-low power with Anti-Alias Filter 3-axis Accelerometer

2 x 2 x 0.7mm

Key features

- Acceleration range: ±2/±4/±8/±16 g
- Enhanced flexibility with embedded **FIFO up to 128 samples**
- **Low current consumption**
  - 3.4µA at 100Hz with **Anti-Alias Filter**
  - 5.9µA at 800Hz with **Anti-Alias Filter**
- I3C interface option

Advanced digital features

Dedicated internal engine to process motion and acceleration detection:

- Free-fall wakeup
- 6D/4D orientation
- Tap and double-tap recognition
- Activity / inactivity recognition

Wireless Sensor Node (IoT) | Smart Watch | Wrist Bands | Headsets | Asset Trackers | Alarm Systems

life.augmented

LIS2DU12 Accelerometer for IoT / wearable application

IoT / Wearable application description

Monitor motion, activity tracking, motion activated gestures, tap/double detection, step counter

Key application requirements

Battery life

Motion wake-up / gesture

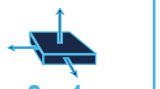
LIS2DU12

Benchmark low power consumption	Best-in-class embedded features
0.45 µA @ 1.6 Hz 5.9 µA @ 800 Hz Wake-up interrupt Data on demand	Dedicated internal engine to process motion and acceleration detection

life.augmented

2/3-axis Digital Accelerometers Overview

consumer

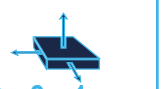
LIS2DE12

2 x 2 x 1 mm

- Full scales of ±2g/±4g/
- ±8g/±16g

LIS2DH12

2 x 2 x 1 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations
- Android stationary / motion detection

LIS2HH12

2 x 2 x 1 mm

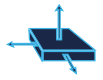
- Ultra low power accelerometer with **Anti Alias Filter**

LIS2DW12

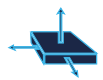
2 x 2 x 0.7 mm

LIS2DU12

2 x 2 x 0.7 mm

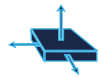
LIS3DHH

5 x 5 x 1.7 mm

- 3-axis, ±2.5 g full-scale
- Ultra-high-resolution and low-noise

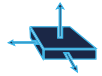
H3LIS331DL

3 x 3 x 1 mm

- **±100g/±200g/±400g** dynamically selectable full scales
- **Shock/impact detection**

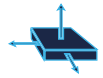
automotive

AIS328DQ

4 x 4 x 1 mm

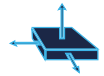
- 3 axis digital
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for Navigation and Anti-theft**

AIS2IH

2 x 2 x 0.93 mm

- Ultra low power 3 axis
- Extended Top: -40°C +115°C
- **Package with wettable flanks**
- **Ideal for Tilt / inclination and motion activated functions**

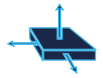
AIS3624DQ

4 x 4 x 1 mm

- 3 axis digital
- FS: up to **24 g** (mid-g range)
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for e-Call**

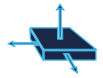
AIS2DW12

2 x 2 x 0.93 mm

- Ultra low power 3 axis digital Superioir robustness to mechanical shock and drops
- **Package with wettable flanks**
- **Ideal for Key fob**

industrial

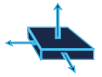
IIS2DH

2 x 2 x 1 mm

- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC

2 x 2 x 0.7 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations
- **Industrial controls, anti-tampering, security, motion activated functions**

industrial application specific

IIS3DHHC

5 x 5 x 1.7 mm

- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX

5 x 5 x 0.7 mm

- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time
- **Leveling instruments / Structural health**

IIS3DWB

2.5 x 3 x 0.83 mm

- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density
- **Preventive maintenance**

life.augmented

Consumer | Industrial | Automotive | AEC-Q100

Automotive Inertial MEMS sensors

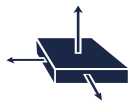
Automotive

AEC-Q100

High Performance

Low Power

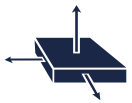
AIS328DQ



4 x 4 x 1.8 mm

- 3 axis digital
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for Navigation and Anti-theft**

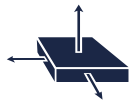
AIS3624DQ



4 x 4 x 1.8 mm

- 3 axis digital – Mid-g range axel
- FS: up to **24 g**
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for e-Call**

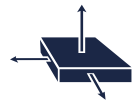
AIS2DW12



2 x 2 x 0.93 mm

- Ultra low power 3 axis digital
- Superioir robustness to mechanical shock and drops
- Cur Cons : 0.67uA @3V @1.6Hz
- FS: ±2g/±4g
- ODR 1.6 Hz to 100Hz
- **Package with wettable flanks**
- **Ideal for Key fob**

AIS2IH



2 x 2 x 0.93 mm

- High performance 3 axis digital
- High versatility: on the fly changes from ultra low power to high resolution/high performance mode
- FS: ±2g/±4g/**±8g/±16g**
- ODR 1.6 Hz to 1.6kHz
- **Package with wettable flanks**
- Extended Top: **-40°C +115°C**
- **Ideal for Navigation, Anti-theft, Tbox**

life.augmented

Automotive

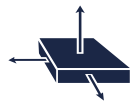
AEC-Q100

Automotive Inertial MEMS sensors

High Performance

Low Power

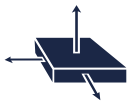
AIS328DQ



4 x 4 x 1.8 mm

- 3 axis digital
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for Navigation and Anti-theft**

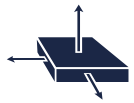
AIS3624DQ



4 x 4 x 1.8 mm

- 3 axis digital – Mid-g range axel
- FS: up to **24 g**
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for e-Call**

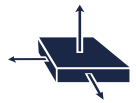
AIS2DW12



2 x 2 x 0.93 mm

- Ultra low power 3 axis digital
- Superioir robustness to mechanical shock and drops
- Cur Cons : 0.67uA @3V @1.6Hz
- FS: ±2g/±4g
- ODR 1.6 Hz to 100Hz
- **Package with wettable flanks**
- **Ideal for Key fob**

AIS2IH



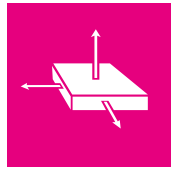
2 x 2 x 0.93 mm

- High performance 3 axis digital
- High versatility: on the fly changes from ultra low power to high resolution/high performance mode
- FS: ±2g/±4g/**±8g/±16g**
- ODR 1.6 Hz to 1.6kHz
- **Package with wettable flanks**
- Extended Top: **-40°C +115°C**
- **Ideal for Navigation, Anti-theft, Tbox**

life.augmented

AIS2DW12

Ultra-low power 3-axis Accelerometer



2 x 2 x 0.7mm

Key features

- Acceleration range: ±2/±4 g
- Configurable operation modes for low power consumption
- Current consumption 0.38 µA

Advanced digital features

Dedicated internal engine to process motion and acceleration detection:

- Free-fall wakeup
- Motion / no-motion
- 6D/4D orientation
- Activity / inactivity recognition

Car Alarm
Anti-theft
device

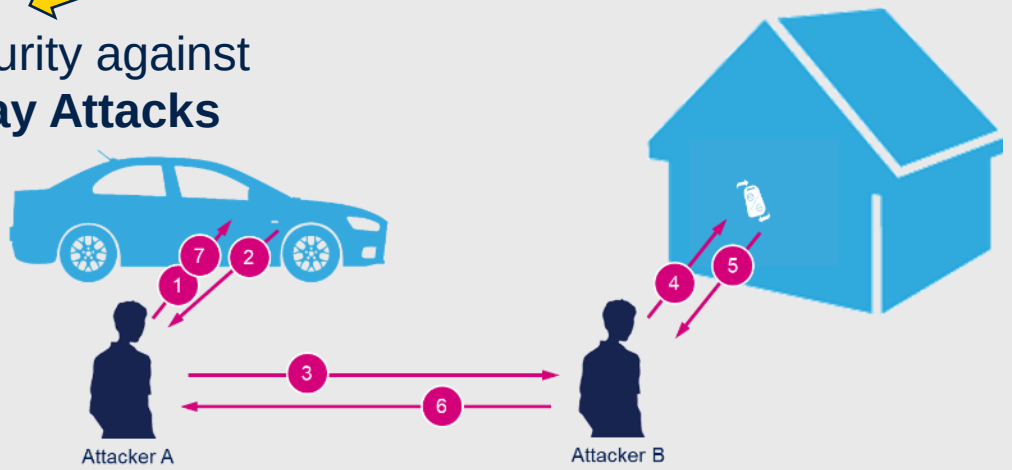
Telematics and
black boxes

life.augmented

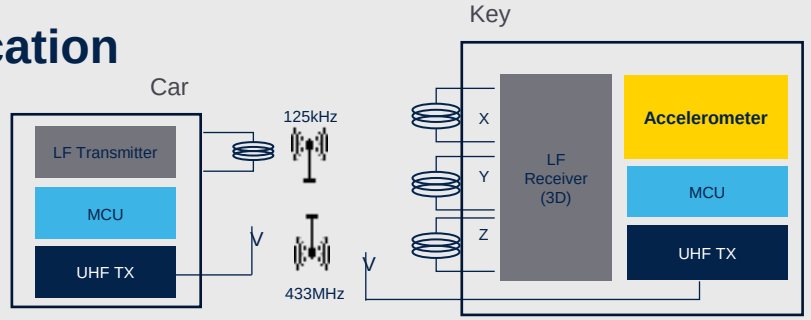
AIS2DW12 three axis accelerometer for low power consumption applications: **Key Fob**

KeyFob application description

Security against
Relay Attacks



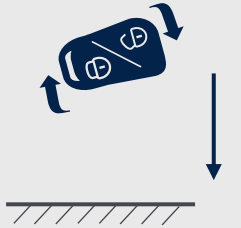
RF communication
only when
KeyFob
in motion



Key application requirements

Battery life

Shock & drop



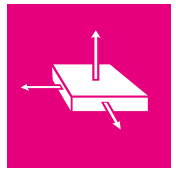
AIS2DW12

Benchmark low power consumption	Best-in-class robustness
0.38 µA @ 1.6 Hz 5 µA @ 100 Hz Wake-up interrupt Data on demand	Mechanical shock: 10,000 g for 0.2 ms KeyFob drop: 100 x 3m to concrete

life.augmented

AIS2IH

High Performance 3-axis Accelerometer



2 x 2 x 0.7mm

Key features

- Acceleration range: ±2/±4/±8/±16 g
- Enhanced flexibility with embedded FIFO
- Low power and high-performance modes
- Noise 90 µg/√Hz, offset drift ±0.2mg/°C
- High temperature +115°C

Advanced digital features

Dedicated internal engine to process motion and acceleration detection:

- Free-fall wakeup
- 6D/4D orientation
- Tap and double-tap recognition
- Activity / inactivity recognition

Car Alarm
Anti-theft device

Telematics and black boxes

Infotainment

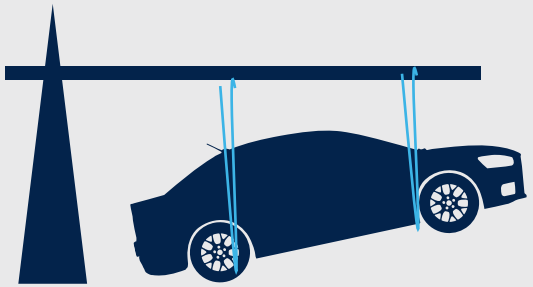
In-dash car navigation

life.augmented

AIS2IH three axis accelerometer for high performance applications: **Car Alarm**

Car alarm application description

Vibration and tilt measurement



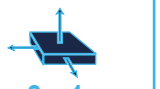
Key application requirements

	Accurate tilt	Precision	Low drift
	Low offset	Sensitivity tolerance	Stability over temperature
AIS2IH	±20 mg	±0.5%	Offset: ±0.2 mg/°C Sensitivity: ±0.01%/°C

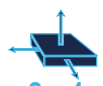
life.augmented

2/3-axis Digital Accelerometers Overview

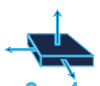
consumer

LIS2DE12

2 x 2 x 1 mm

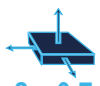
- Full scales of ±2g/±4g/
- ±8g/±16g

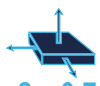
LIS2DH12

2 x 2 x 1 mm

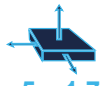
- High flexibility power vs. noise
- Multiple noise / Power configurations
- Android stationary / motion detection

LIS2HH12

2 x 2 x 1 mm

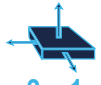
- Ultra low power accelerometer with **Anti Alias Filter**

LIS2DW12

2 x 2 x 0.7 mm

LIS2DU12

2 x 2 x 0.7 mm

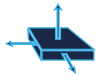
LIS3DHH

5 x 5 x 1.7 mm

- 3-axis, ±2.5 g full-scale
- Ultra-high-resolution and low-noise

H3LIS331DL

3 x 3 x 1 mm

- **±100g/±200g/±400g** dynamically selectable full scales
- **Shock/impact detection**

automotive

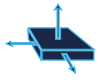
AIS328DQ

4 x 4 x 1 mm

- 3 axis digital
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for Navigation and Anti-theft**

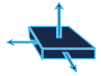
AIS2IH

2 x 2 x 0.93 mm

- Ultra low power 3 axis
- Extended Top: -40°C +115°C
- **Package with wettable flanks**
- **Ideal for Tilt / inclination and motion activated functions**

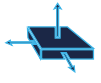
AIS3624DQ

4 x 4 x 1 mm

- 3 axis digital
- FS: up to **24 g** (mid-g range)
- Extended Top: -40°C +105°C
- QFN Package
- **Ideal for e-Call**

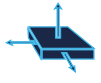
AIS2DW12

2 x 2 x 0.93 mm

- Ultra low power 3 axis digital Superioir robustness to mechanical shock and drops
- **Package with wettable flanks**
- **Ideal for Key fob**

industrial

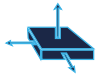
IIS2DH

2 x 2 x 1 mm

- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC

2 x 2 x 0.7 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations
- **Industrial controls, anti-tampering, security, motion activated functions**

industrial application specific

IIS3DHHC

5 x 5 x 1.7 mm

- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX

5 x 5 x 0.7 mm

- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time
- **Leveling instruments / Structural health**

IIS3DWB

2.5 x 3 x 0.83 mm

- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density
- **Preventive maintenance**

life.augmented

Consumer | Industrial | Automotive | AEC-Q100

Industrial

Industrial Digital Accelerometers

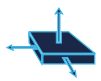
- Industrial IoT and connected devices
- Anti-tampering
- Industrial tools and factory equipment
- Impact recognition and logging
- Smart power and motion-activated functions

- Vibration monitoring
- Tilt/inclination measurements
- Robotics and industrial automation

- Precision inclinometers
- Antenna pointing and platform levelling
- Structural health monitoring
- Installation and monitoring of equipment

- Predictive maintenance
- Condition monitoring
- Test and measurements

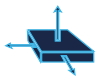
IIS2DH



2 x 2 x 1 mm

- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC

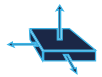


2 x 2 x 0.7 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations

Industrial

IIS3DHHC



5 x 5 x 1.7 mm

- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX

5 x 5 x 0.7 mm

- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time

IIS3DWB

2.5 x 3 x 0.83 mm

- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density

Industrial application specific

life.augmented

Industrial

Industrial Digital Accelerometers

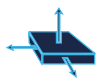
- **Industrial IoT and connected devices**
- **Anti-tampering**
- **Industrial tools and factory equipment**
- **Impact recognition and logging**
- **Smart power and motion-activated functions**

- **Vibration monitoring**
- **Tilt/inclination measurements**
- **Robotics and industrial automation**

- **Precision inclinometers**
- **Antenna pointing and platform levelling**
- **Structural health monitoring**
- **Installation and monitoring of equipment**

- **Predictive maintenance**
- **Condition monitoring**
- **Test and measurements**

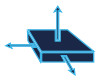
IIS2DH



2 x 2 x 1 mm

- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC

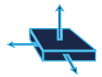


2 x 2 x 0.7 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations

Industrial

IIS3DHHC



5 x 5 x 1.7 mm

- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX

5 x 5 x 0.7 mm

- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time

IIS3DWB

2.5 x 3 x 0.83 mm

- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density

Industrial application specific

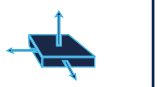
life.augmented

Industrial

Industrial Digital Accelerometers

- **Industrial IoT and connected devices**
- **Anti-tampering**
- **Industrial tools and factory equipment**
- **Impact recognition and logging**
- **Smart power and motion-activated functions**
- **Vibration monitoring**
- **Tilt/inclination measurements**
- **Robotics and industrial automation**
- **Precision inclinometers**
- **Antenna pointing and platform levelling**
- **Structural health monitoring**
- **Installation and monitoring of equipment**
- **Predictive maintenance**
- **Condition monitoring**
- **Test and measurements**

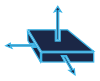
IIS2DH



2 x 2 x 1 mm

- Full scales of ±2g/±4g/±8g/±16g
- 3 operating modes: low-power, normal, high-resolution mode

IIS2DLPC

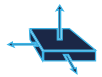


2 x 2 x 0.7 mm

- High flexibility power vs. noise
- Multiple noise / Power configurations

Industrial

IIS3DHHC



5 x 5 x 1.7 mm

- **3-axis inclinometer**
- ±2.5 g full-scale
- Ultra-low noise density 45 µg/√Hz
- Excellent stability over temp (<0.4mg/°C) and time

IIS2ICLX

5 x 5 x 0.7 mm

- **2-axis inclinometer**
- ±0.5/±1/±2/±3g full-scale
- Ultra-low noise density **15 µg/√Hz**
- Excellent stability over temp (**<0.075mg/°C**) and time

IIS3DWB

2.5 x 3 x 0.83 mm

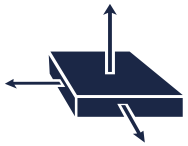
- **3-axis vibration** sensor
- Ultra-wide and flat freq. response up to **6KHz**
- Ultra-low noise density

Industrial application specific

life.augmented

IIS2DLPC

High-performance, ultra-low power 3-axis accelerometer for industrial applications



2 x 2 x 0.7mm

Key features

- Selectable full scale: ±2/±4/±8/±16 g
- Ultra-low **power consumption**:
  - 50nA in power-down mode
  - Below 1uA in active low-power mode
  - 120 µA in high-performance mode
- Single data conversion on demand
- Very low **noise**: down to **90 µg/√Hz**

Advanced features

Dedicated internal engine to process motion and acceleration detection:

- Free-fall wakeup
- 6D/4D orientation
- Tap and double-tap recognition
- Activity / inactivity recognition

Industrial asset tracking

IIoT, Robotics and Factory equipment

Healthcare devices

Appliances

Anti-Tampering devices

life.augmented

IIS2DLPC for anti-tampering in industrial applications

Anti-tampering application description

Determine if there has been any tampering to a smart meter / industrial locker, by sensing the acceleration and comparing to a user defined threshold and generate an interrupt

Key application requirements

Current consumption
Noise level

Motion detection

IIS2DLPC

< 1uA in active low-power mode

120 µA in high-performance mode

Dedicated internal engine to process motion and acceleration detection

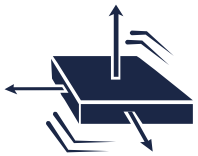
Noise: down to 90 µg/√Hz

Wake-up interrupt in case of event detection

life.augmented

IIS3DWB

Ultra-wide bandwidth, low-noise, 3-axis digital vibration sensor



2.5 x 3 x 0.83mm

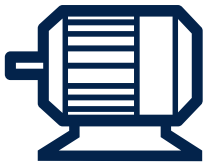
Key features

- Selectable full scale: ±2/±4/±8/±16 g
- Ultra-low noise density: down to **75 µg/√Hz** in 3-axis mode / 60 µg/√Hz in single-axis mode
- Ultra Wide **Bandwidth 6kHz (ODR @26.6kHz)**
- -40 to **105°C** temperature range

Advanced features

- Embedded features (Filters, FIFO, Temperature sensor, Self-Test)
- Interrupts for wake-up / activity - inactivity / FIFO thresholds

Vibration monitoring



Predictive maintenance

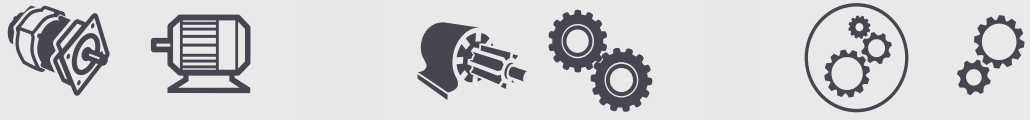
Test and measurements

ODR = Output Data Rate

life.augmented

IIS3DWB for vibration monitoring

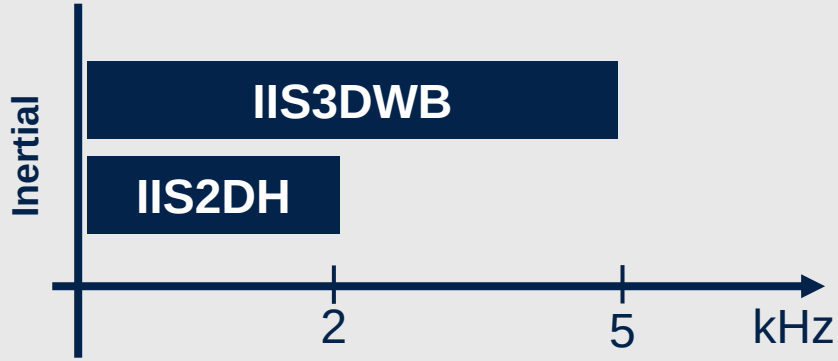
Vibration monitoring application description



Unbalance
Looseness
Misalignment

Roller Bearings
Gearing
Cavitation

Bearings
Gear boxes
Lubrication



Vibration analysis as part of product/system maintenance, to predict potential failure and prevent unscheduled downtime

Key application requirements

Frequency response
Embedded filtering

Sensitivity
Noise level
Temp range

IIS3DWB

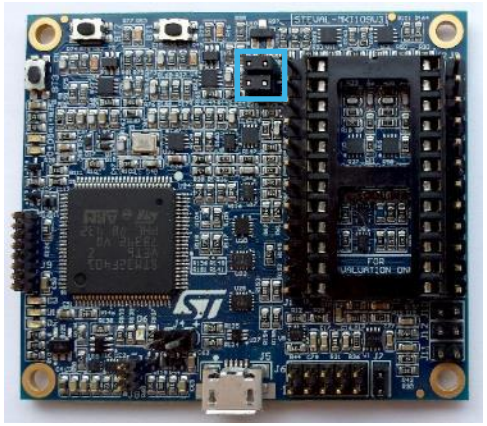
Ultra-wide and flat **Eliminates frequency aliasing**	**High stability of the sensitivity over temperature and against mechanical shocks**
from dc to 6 kHz (±3 dB point)	• ±1% typ • down to 75 µg/√Hz in 3-axis mode • -40 to +105 °C

life.augmented

Hands-on with 3-axis accelerometer LIS2DW12

Demo setup
Evaluation boards and tools for current consumption measurements in different use cases

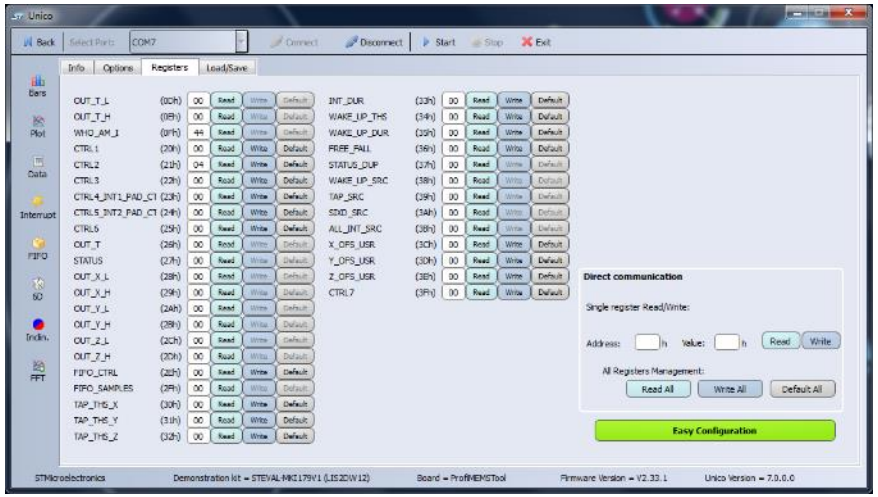
- Disconnect J13 to disconnect VDD from board
- Use a jumper cable to provide power to DIL24 board
- Connect GND as well



Professional MEMS tool
(STEVAL-MKI109V3)

LIS2DW12

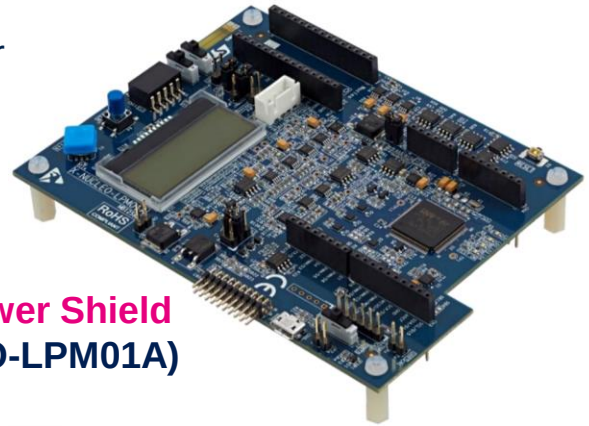
DIL 24 adapter
(STEVAL-MKI179V1)



Unico – GUI for PC
(STSW-MKI109W/L/M)

- Easy setup of the sensors
- Registers configuration
- Advanced embedded features

- Use the white connector (CN14) for power output
- Refer to UM2243 8.3 Power supply connections of a target board with basic connector CN14



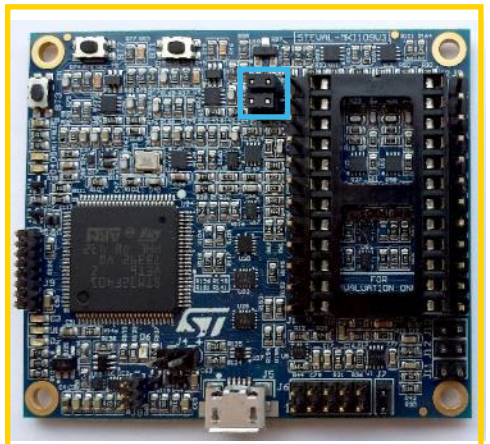
STM32 Power Shield
(X-NUCLEO-LPM01A)

- Two operating modes (stand-alone or PC-controlled)
- Graphical PC application (STM32CubeMonitor-Power)

life.augmented

Demo setup
Evaluation boards and tools for current consumption measurements in different use cases

- Disconnect J13 to disconnect VDD from board
- Use a jumper cable to provide power to DIL24 board
- Connect GND as well

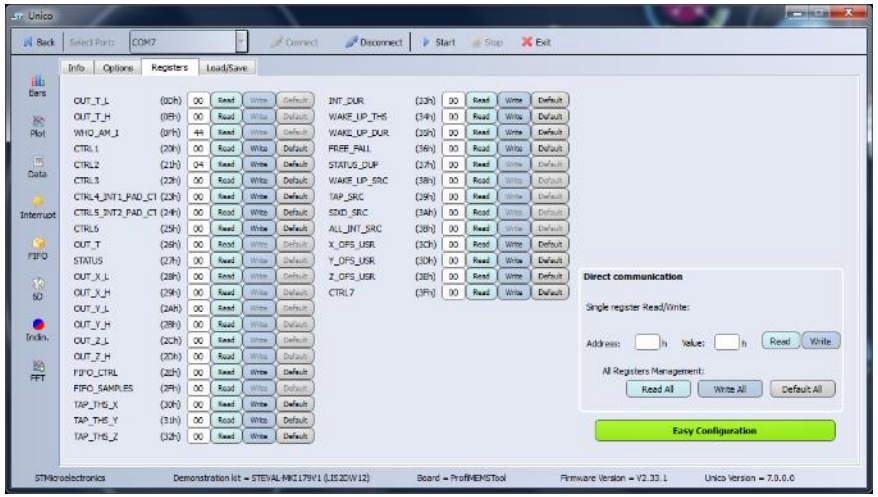


Professional MEMS tool
(STEVAL-MKI109V3)

+

LIS2DW12

DIL 24 adapter
(STEVAL-MKI179V1)

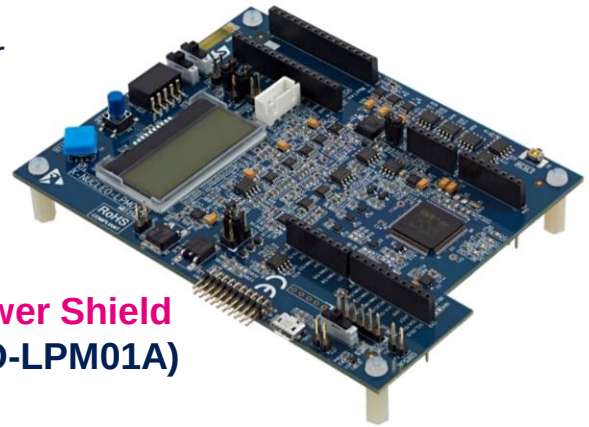


Unico – GUI for PC
(STSW-MKI109W/L/M)

- Easy setup of the sensors
- Registers configuration
- Advanced embedded features

+

- Use the white connector (CN14) for power output
- Refer to UM2243 8.3 Power supply connections of a target board with basic connector CN14



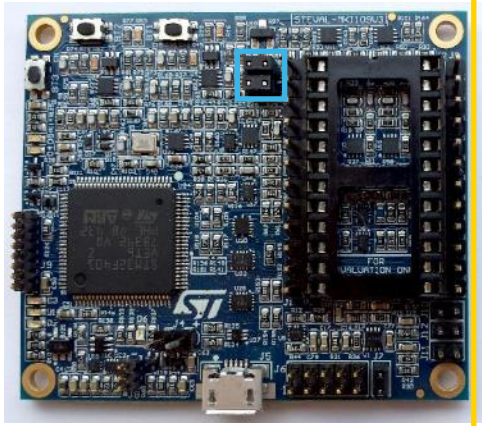
STM32 Power Shield
(X-NUCLEO-LPM01A)

- Two operating modes (stand-alone or PC-controlled)
- Graphical PC application (STM32CubeMonitor-Power)

life.augmented

Demo setup
Evaluation boards and tools for current consumption measurements in different use cases

- Disconnect J13 to disconnect VDD from board
- Use a jumper cable to provide power to DIL24 board
- Connect GND as well



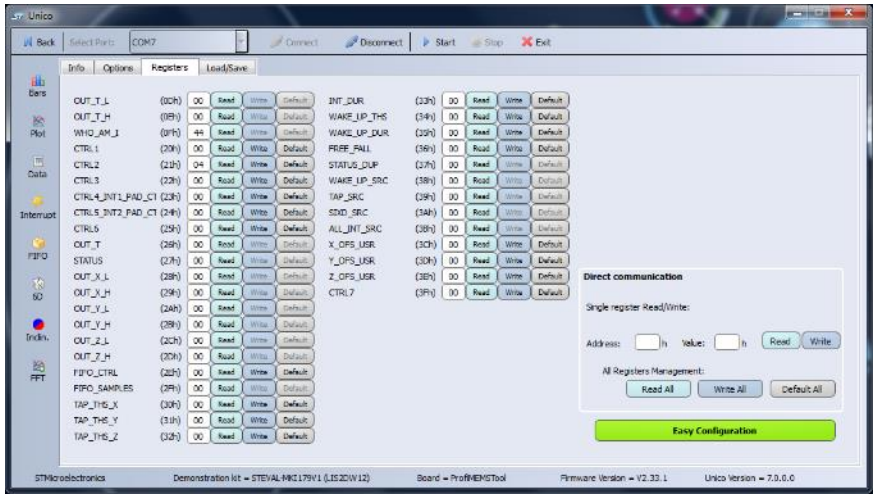
Professional MEMS tool
(STEVAL-MKI109V3)

LIS2DW12

+

DIL 24 adapter

(STEVAL-MKI179V1)

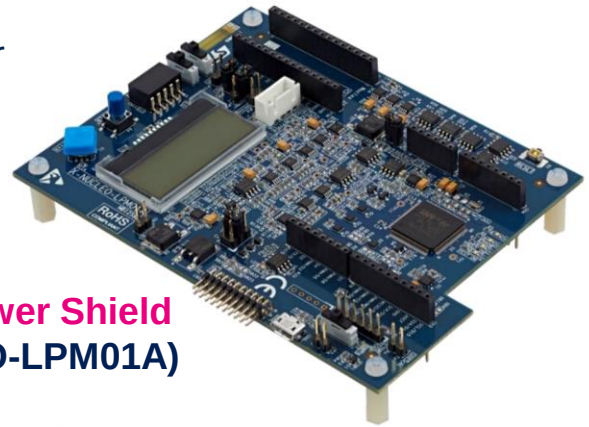


Unico – GUI for PC
(STSW-MKI109W/L/M)

- Easy setup of the sensors
- Registers configuration
- Advanced embedded features

- Use the white connector (CN14) for power output
- Refer to UM2243 8.3 Power supply connections of a target board with basic connector CN14

+



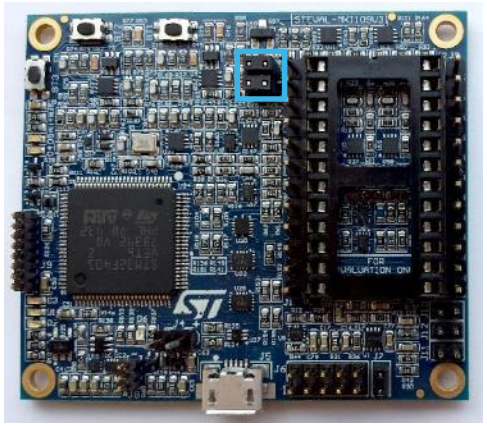
STM32 Power Shield
(X-NUCLEO-LPM01A)

- Two operating modes (stand-alone or PC-controlled)
- Graphical PC application (STM32CubeMonitor-Power)

life.augmented

Demo setup
Evaluation boards and tools for current consumption measurements in different use cases

- Disconnect J13 to disconnect VDD from board
- Use a jumper cable to provide power to DIL24 board
- Connect GND as well

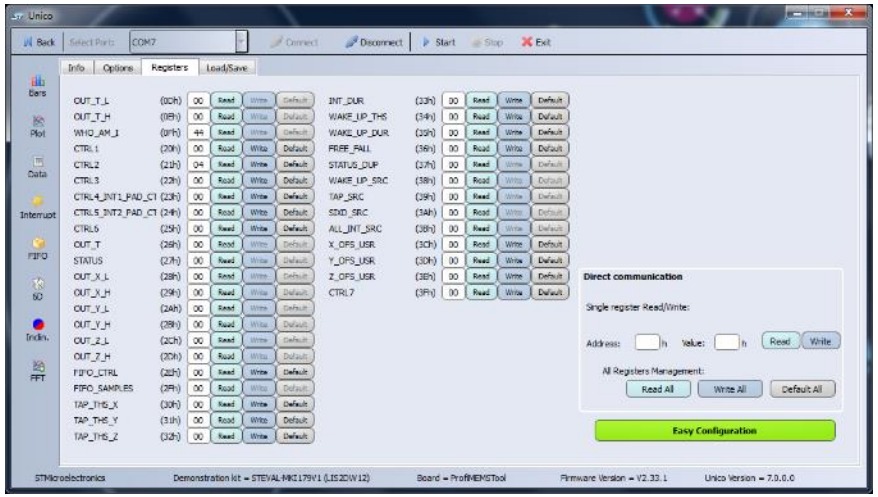


Professional MEMS tool
(STEVAL-MKI109V3)

+

LIS2DW12

DIL 24 adapter
(STEVAL-MKI179V1)

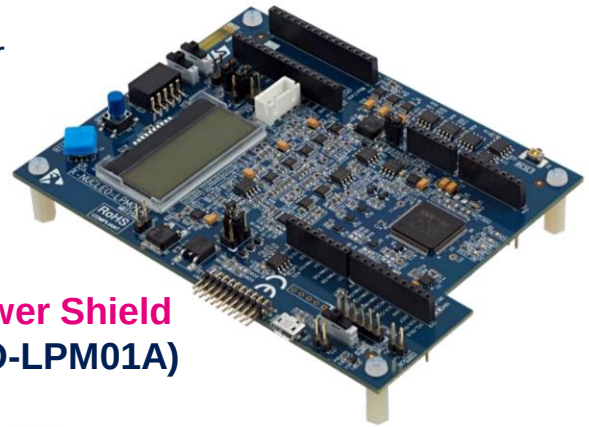


Unico – GUI for PC
(STSW-MKI109W/L/M)

- Easy setup of the sensors
- Registers configuration
- Advanced embedded features

- Use the white connector (CN14) for power output
- Refer to UM2243 8.3 Power supply connections of a target board with basic connector CN14

+



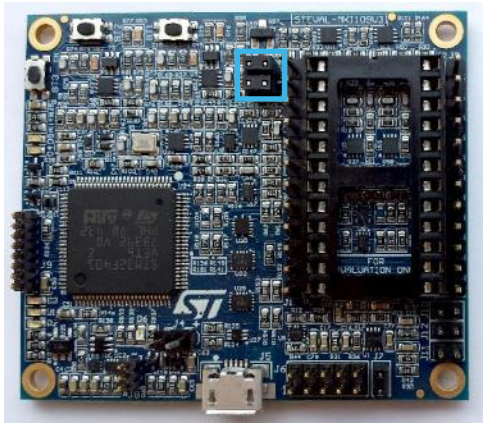
STM32 Power Shield
(X-NUCLEO-LPM01A)

- Two operating modes (stand-alone or PC-controlled)
- Graphical PC application (STM32CubeMonitor-Power)

life.augmented

Demo setup
Evaluation boards and tools for current consumption measurements in different use cases

- Disconnect J13 to disconnect VDD from board
- Use a jumper cable to provide power to DIL24 board
- Connect GND as well

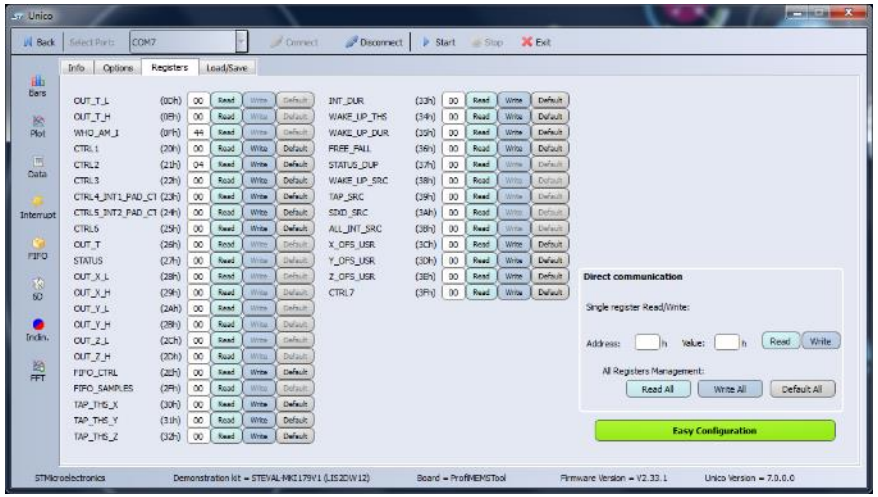


Professional MEMS tool
(STEVAL-MKI109V3)

+

LIS2DW12

DIL 24 adapter
(STEVAL-MKI179V1)

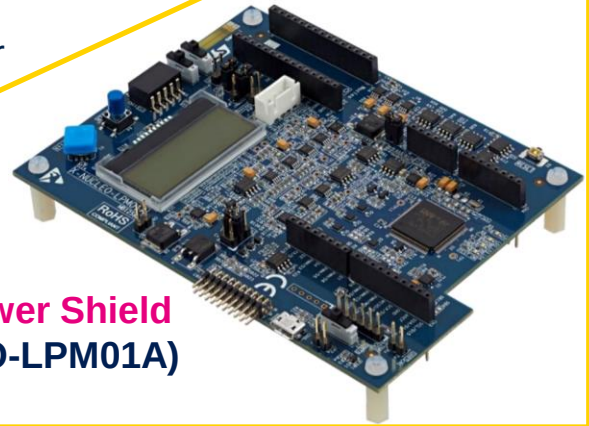


Unico – GUI for PC
(STSW-MKI109W/L/M)

- Easy setup of the sensors
- Registers configuration
- Advanced embedded features

- Use the white connector (CN14) for power output
- Refer to UM2243 8.3 Power supply connections of a target board with basic connector CN14

+



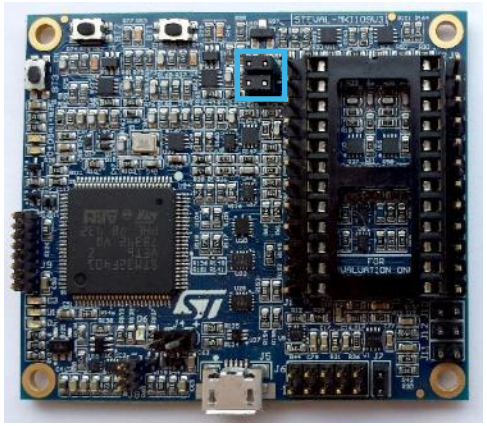
STM32 Power Shield
(X-NUCLEO-LPM01A)

- Two operating modes (stand-alone or PC-controlled)
- Graphical PC application (STM32CubeMonitor-Power)

life.augmented

Demo setup
Evaluation boards and tools for current consumption measurements in different use cases

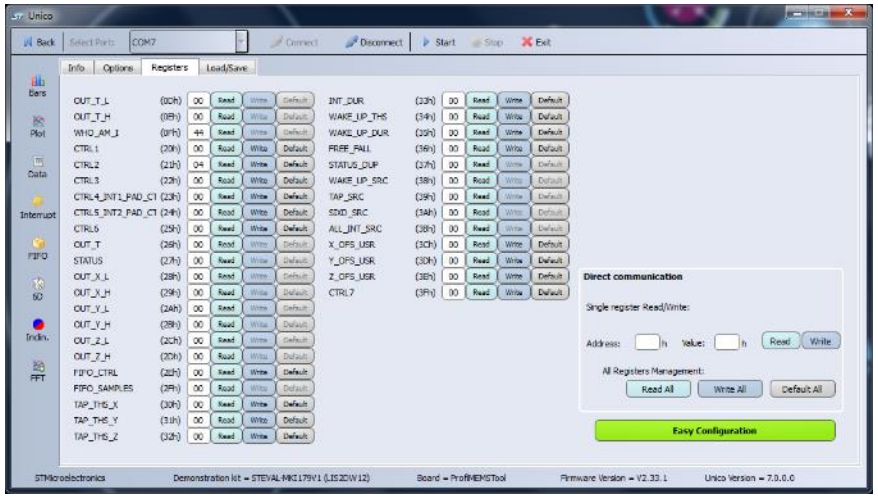
- Disconnect J13 to disconnect VDD from board
- Use a jumper cable to provide power to DIL24 board
- Connect GND as well



Professional MEMS tool
(STEVAL-MKI109V3)

LIS2DW12

DIL 24 adapter
(STEVAL-MKI179V1)

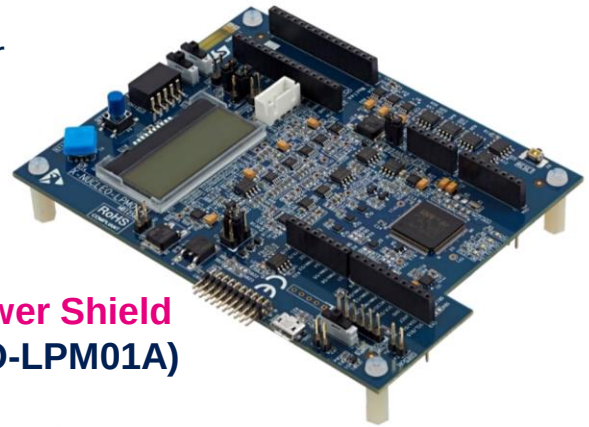


Unico – GUI for PC
(STSW-MKI109W/L/M)

- Easy setup of the sensors
- Registers configuration
- Advanced embedded features

+

- Use the white connector (CN14) for power output
- Refer to UM2243 8.3 Power supply connections of a target board with basic connector CN14



STM32 Power Shield
(X-NUCLEO-LPM01A)

- Two operating modes (stand-alone or PC-controlled)
- Graphical PC application (STM32CubeMonitor-Power)

life.augmented

Demo (5min)

Online Resources

Explore further through Webinars

Premium Content

How to jumpstart your **Asset Tracking Design** with Sensors and Solutions from ST?

Learn how to build asset tracking applications using **ST's best-in-class sensor technology and wireless connectivity solutions**

Link to webinar

Are you developing an **Automotive Application**?

Learn how ST's **automotive-grade inertial sensors enable precise positioning** to keep track of a vehicle's position and movement

Link to webinar

Are you developing an **Industrial Condition Monitoring Application**?

Learn to use **ST's industrial development kit** to easily create datalogging and **predictive maintenance** applications through machine learning techniques

Link to webinar

Static and Dynamic Inclinometers for Industrial Applications

Learn how to create innovative solutions with **high accuracy industrial-grade MEMS motion sensors**

Link to webinar

life.augmented

Documentation for Accelerometers

Application Notes:

- AN5038 – LIS2DW12: always-on 3D accelerometer
- AN5326 – AIS2DW12: ultra-low-power 3-axis accelerometer for automotive applications
- AN5538 – AIS2IH: high-performance 3-axis accelerometer for automobile applications
- AN5201 – IIS2DLPC: high-performance ultra-low-power 3-axis accelerometer for industrial applications
- AN5444 – IIS3DWB: ultra-wide bandwidth, low-noise, 3-axis digital vibration sensor

Design Tips:

- DT0126 – Low-power application design with ST's MEMS accelerometers
- DT0100 – Setting up free-fall recognition with ST's MEMS accelerometers
- DT0097 – Setting up 6D orientation detection with ST's MEMS accelerometers
- DT0140 – Tilt computation using accelerometer data for inclinometer applications
- DT0105 – 1-point or 3-point tumble sensor calibration
- DT0053 – 6-point tumble sensor calibration
- DT0059 – Ellipsoid or sphere fitting for sensor calibration
- DT0076 – Compensating for accelerometer installation error

Brochures

Link – Solutions for Condition Monitoring

Link – Solutions for Asset Tracking Applications

life.augmented

More information available http://www.st.com/sensors

Takeaways

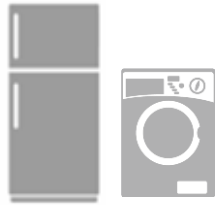
- ST Accelerometers a great fit for any application
- Documentation, tools and development kit for thorough evaluation
- ST support is one click away

Asset tracking
Shock/Wake-up

IoT / Wearables
Activity tracking / Pedometer

Alarms
Tilt / Wake-up

People monitoring
Freefall / Man-down / Activity



White Goods
Vibration / Tilt

Predictive maintenance & Monitoring
Vibration / Tilt

Car crash / Car alarms
Tilt / Movement

Industrial
Positioning / Tilt

life.augmented

Our technology starts with You

Find out more at www.st.com/accelerometer

life.augmented