



High performance accelerometers ULP for Consumer, Industrial and Automotive

General Purpose Accelerometers



Automotive Accelerometers



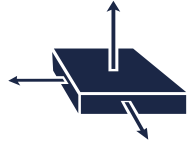
Accelerometers low power features



Demo Setup



life.augmented



General Purpose Accelerometers use cases

LIS2DE12

IIS2DLPC

LIS2DH12

IIS2DH

LIS2DW12 / LIS2DTW12

IIS328DQ

LIS2DU12

H3LIS331DL



Consumer

Industrial

ST Advantage

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



IoT / Wearables
Activity tracking / Pedometer



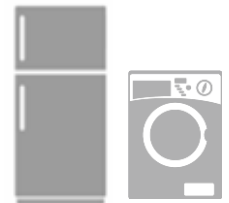
People monitoring
Freefall / Man-down / Activity



Alarms
Tilt / Wake-up



Asset tracking
Shock/Wake-up



White Goods
Vibration / Tilt



Predictive maintenance & Monitoring
Vibration / Tilt



Industrial
Positioning / Tilt





Consumer Accelerometers

High
Performance



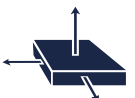
LIS2DS12



2.0 x 2.0 x 0.86 mm

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

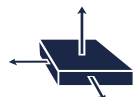
LIS2HH12



2.0 x 2.0 x 1.0mm

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

LIS2DH12



2.0 x 2.0 x 1.0 mm

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

Low noise, low power

LIS2DWT12



2.0 x 2.0 x 0.7 mm

LIS2DW12

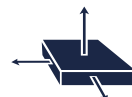


2.0 x 2.0 x 0.7 mm

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

Ultra Low Power

LIS2DU12



2.0 x 2.0 x 0.7 mm

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

FS = full scale

ODR = output data rate

HPM = high performance mode

FIFO = first in first out



life.augmented

Low Power





Industrial Motion Sensors

IIS328DQ



4 x 4 x 1.8 mm

- Extended operating temp: -40°C +105°C
- QFN Package

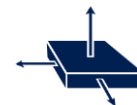
IIS2DH



2 x 2 x 1 mm

- Low power
- Wide bandwidth (2 kHz)

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

IIS3DWB



2.5 x 3 x 0.86 mm

- **3-axis digital accelerometer**
- **Ultra wide and flat bandwidth (6 kHz)**
- Low noise (75 $\mu\text{g}/\sqrt{\text{Hz}}$)
- Low power (1.1mA)
- Extended operating temperature: -40°C +105°C
- **Ideal for vibration monitoring**

Vibration Sensor

IIS2ICLX



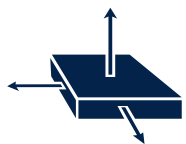
5 x 5 x 1.7 mm



- **2 axis digital inclinometer**
- **Machine Learning Core and Finite State Machine**
- FS: $\pm 0.5/1.0/2.0/3.0$
- Ultra high resolution and stability over temperature & time
- Low power (0.42 mA)
- Extended operating temperature: -40°C +105°C

Inclinometer





Accelerometers AIS2DW12 and AIS2IH for low power consumption and high performance

3-axis accelerometer

- AIS2DW12.
- From $\pm 2g$ up to $\pm 4g$.
- Low power consumption.



3-axis accelerometer

- AIS2IH.
- From $\pm 2g$ up to $\pm 16g$.
- High performance.



Key benefits and features

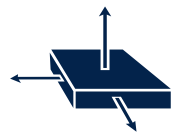
- Configurable operation modes for low power consumption.
- Current consumption 0.38 μA .
- LGA-12pin package: 2 mm x 2 mm.



Key benefits and features

- Low power and high performance modes.
- Noise 90 $\mu g/\sqrt{Hz}$, offset drift $\pm 0.2mg/^\circ C$.
- High temperature $+115^\circ C$.
- LGA-12pin package: 2 mm x 2 mm.





AIS2DW12 three axis accelerometer for low power consumption applications: **KeyFob**



KeyFob application description

Security against
Relay Attacks

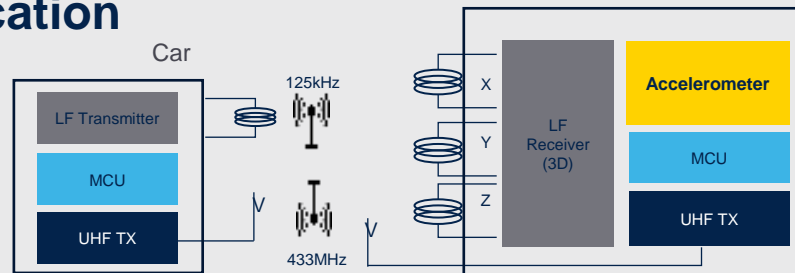


Attacker A

Attacker B

Key

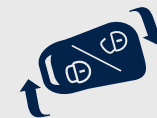
RF communication
only when
KeyFob
in motion



Key application requirements

**Battery
life**

**Shock
& drop**



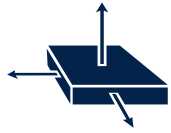
AIS2DW12

**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

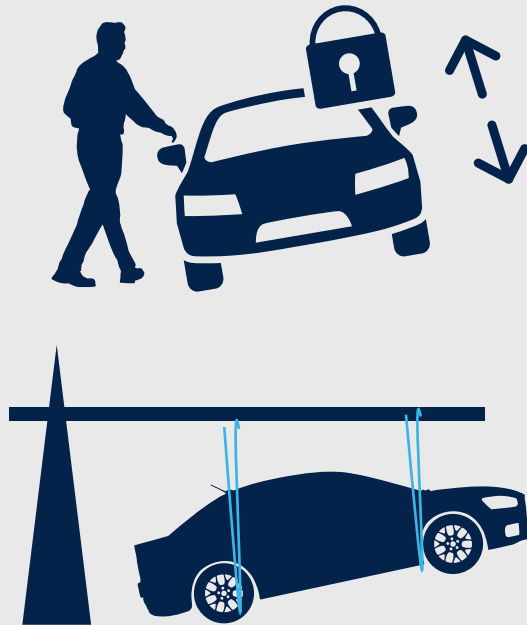


AIS2IH three axis accelerometer for high performance applications: **Car Alarm**



Car alarm application description

Vibration and tilt measurement

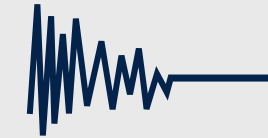


Key application requirements

Accurate
tilt



Precision



Low drift



Low offset

$\pm 20 \text{ mg}$

Sensitivity
tolerance

$\pm 0.5\%$

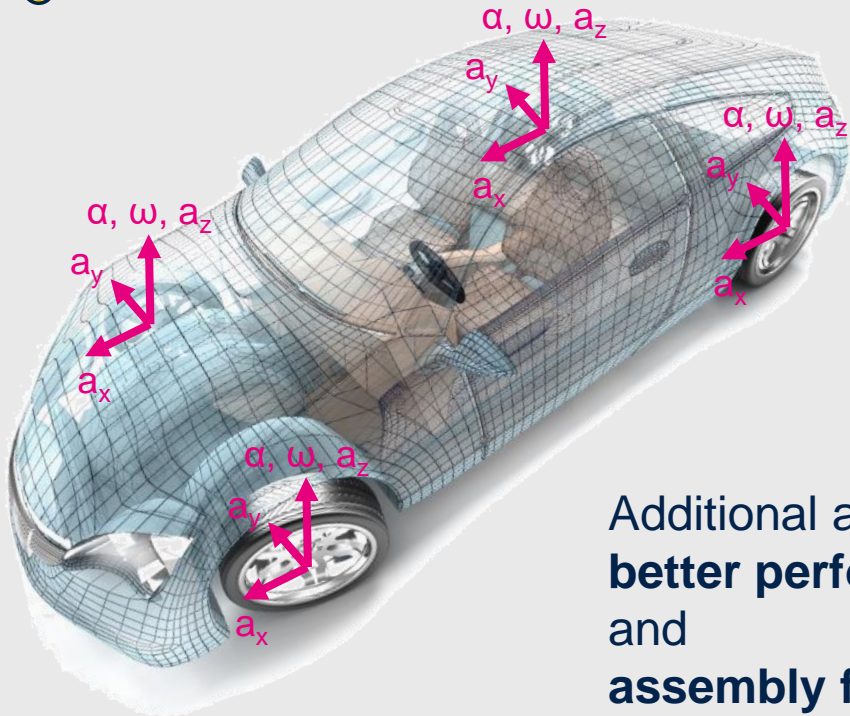
Stability over
temperature

Offset:
 $\pm 0.2 \text{ mg}/^\circ\text{C}$
Sensitivity:
 $\pm 0.01\%/^\circ\text{C}$

AIS2IH

AIS2IH three axis accelerometer for high performance applications: **Suspension**

Suspension application description



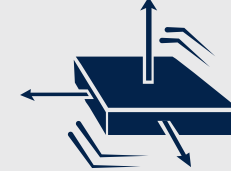
Additional axis for
better performance
and
assembly flexibility

Key application requirements

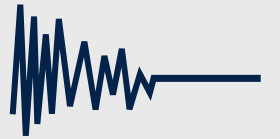
Ambient
temperature



Low, medium
accelerations



Precision



AIS2IH

**High
temperature
3-axis accel.**

115°C

**Configurable
ranges**

±2g ±4g
±8g ±16g

Low noise

Typ.
90 µg/√Hz





LIS2DW12

High Performance, Ultra-low power 3-axis Accelerometer

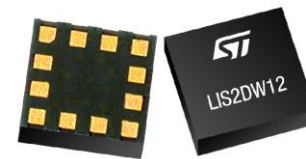
Key features

- Acceleration range: $\pm 2/\pm 4/\pm 8/\pm 16$ g
- Enhanced flexibility with embedded FIFO
- Flexibility: **low power consumption** (less than 1 μ A) or **low-noise performance** (down to 90 μ g/ $\sqrt{\text{Hz}}$) 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



2 x 2 x 0.7mm



Wireless Sensor
Node (IoT)



Smart Watch



Wrist Bands



Headsets



Asset Trackers



Alarm Systems





LIS2DU12

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



2 x 2 x 0.7mm

Key features

- Acceleration range: $\pm 2/\pm 4/\pm 8/\pm 16$ g
- Enhanced flexibility with embedded **FIFO up to 128 samples**
- **Low current consumption**
 - 3.4 μ A at 100Hz with **Anti-Alias Filter**
 - 5.8 μ A 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
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Wireless Sensor
Node (IoT)



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Wrist Bands



Headsets

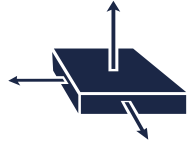


Asset Trackers



Alarm Systems





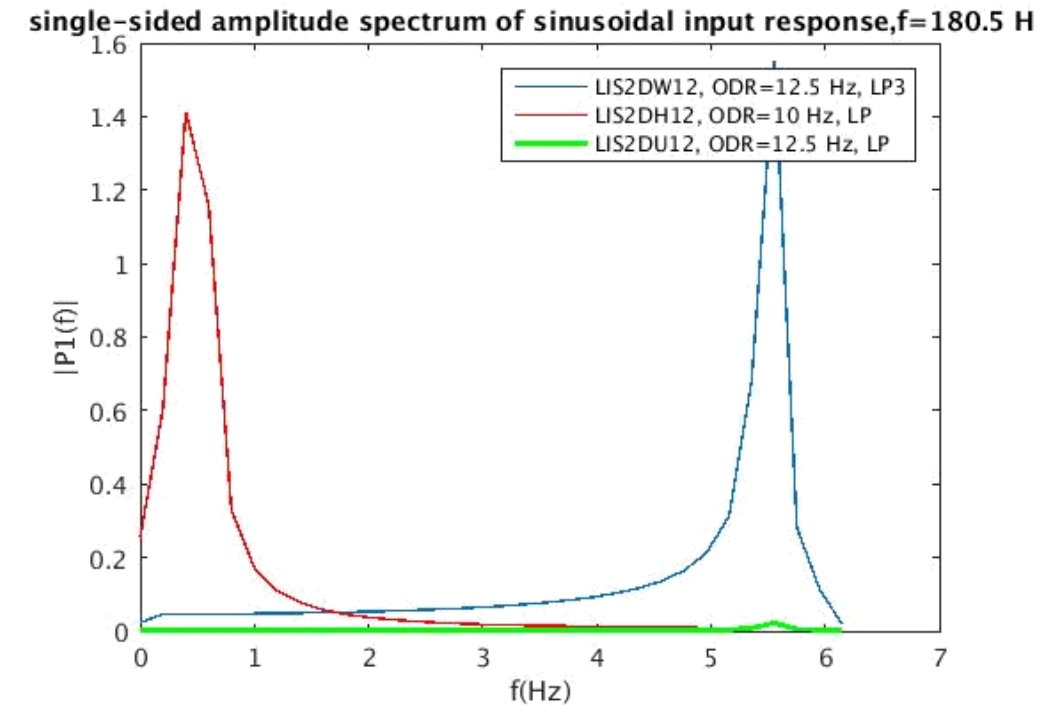
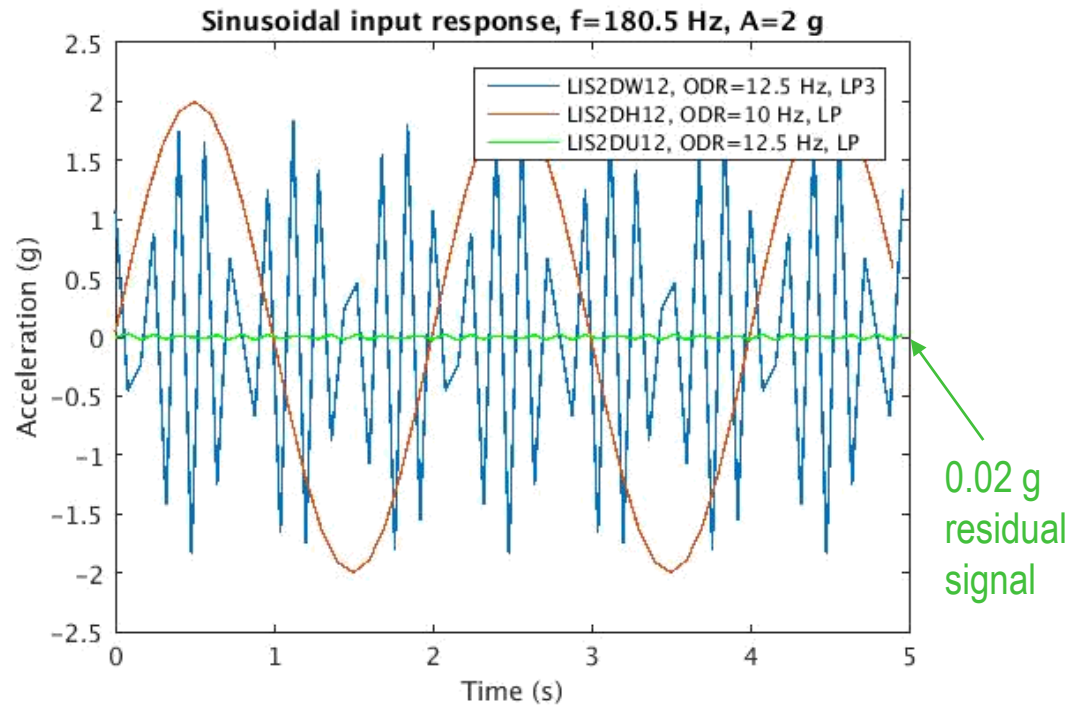
LIS2DU12

Anti-alias filter at work

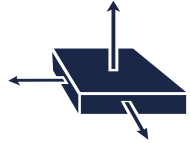
Input signal @180.5 Hz, with 2 g amplitude corresponding to a vibration signal of a mobile phone.



Disturbing signal
Phone vibrating



The LIS2DU12 is immune from the disturbing signal

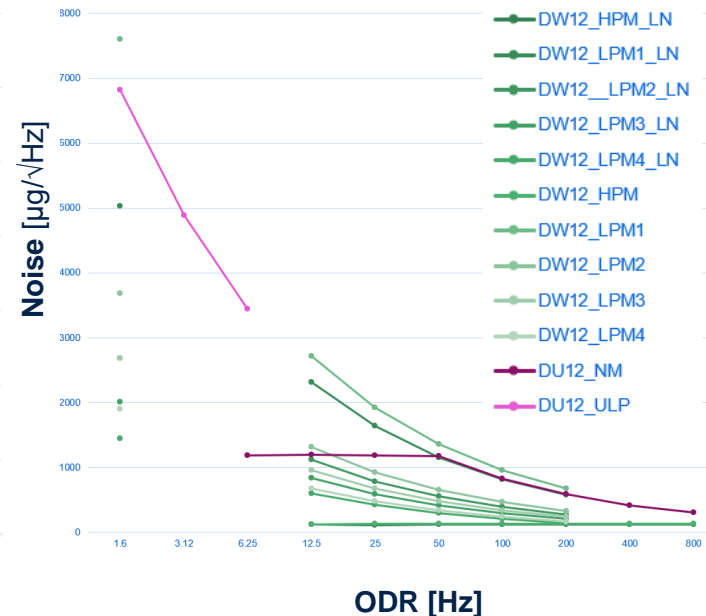
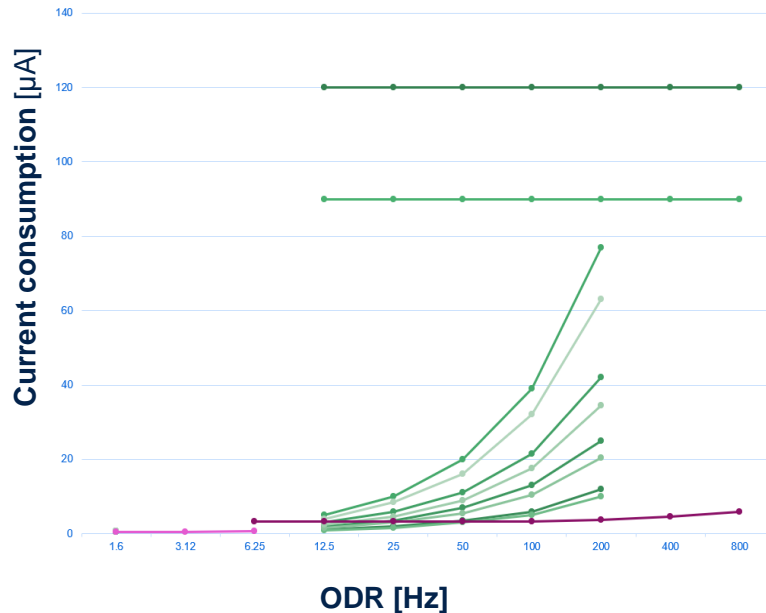


LIS2DW12 or LIS2DU12?

Each application has its own accelerometer, FS $\pm 8g$

ODR (output data rate) [Hz]

Noise [$\mu g/\sqrt{Hz}$] // Current consumption [μA]



LIS2DW12 low noise and flexibility are unmatched especially at **low ODR**



<100Hz

Which ODR is your application running at?



>100Hz

LIS2DU12 ultra low power consumption and AAF (Anti Alias Filter) are the perfect match at **high ODR**

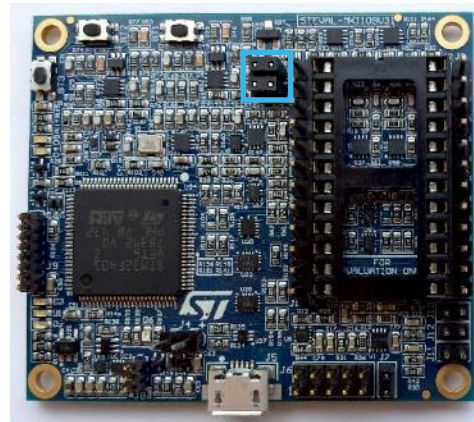
FS = full scale
ODR = output data rate

BW = bandwidth
Power consumption at BW = ODR/2



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
(STEWAL-MKI109V3)



AIS2IH



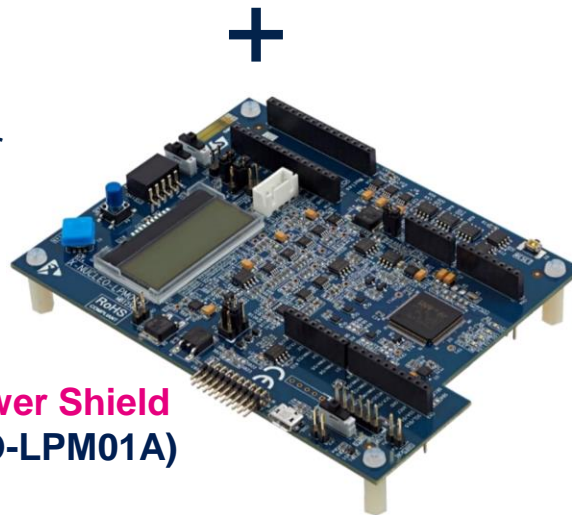
**DIL 24
adapter**

(STEWAL-MKI218V1)



Unico – GUI for PC
(STSW-MKI109W/L/M)

- 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)

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