DISCOVER THE WORLD OF SENSORS

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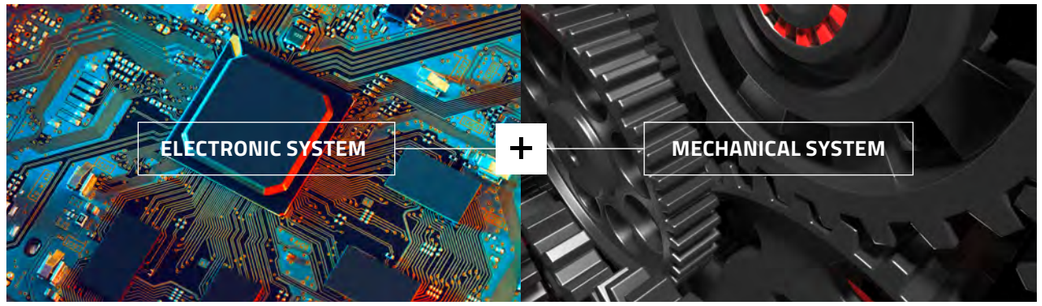
INTRODUCTION

What is a sensor component?

A system to measure a physical dimension and to translate into an electrical value! Sensors are basically analog with infinite resolution, but data to and from the cloud is transferred digital. Analog sensor values must therefore be digitized. Conversion can be done in external AD converters when using a analog sensor cell or the conversion can be all done internally, within the sensor system, when using a MEMS sensor. Digital MEMS sensors help to save time, processor bandwidth and board space.



MEMS sensors

In a microcontroller the typical semiconductor can only control current and voltages. In a Micro-Electro-Mechanical System (MEMS), additional mechanical structures are used. This means that three-dimensional structures are usually added to the starting material silicon by etching processes. This allows the design of membranes (WSEN-PADS) or movable finger structures (WSEN-ITDS).

Combined sensors

Some sensors actually consist of multiple sensor elements in the same housing like the combined Humidity and Temperature sensor WSEN-HIDS or the combined Pressure and Temperature sensor WSEN-PADS.

This has advantages when:

- Space is at a premium (Diverse sensors in one housing require less space than single sensors)
- Power supply is limited (Multifunction sensors typically require less power than multiple single sensors)
- Price matters (a single, slightly larger, package is generally less expensive than several smaller ones.
- Measurement accuracy must be improved (Short cable runs between the contained sensors are more easily shielded within a package than connections made to the outside.
- Additional data can be calculated (in some cases, additional information can be calculated from measured values of combination sensors)

Additional Advantages of integrated sensors

- ✔ Surface mounted device (SMD)
- ✔ Silicon based
- ✔ Fully calibrated
- ✔ Integrated DSP
- ✔ Digital interface (I²C, SPI)

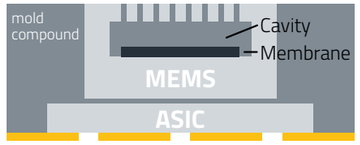
Longlife availability (10 years)

To avoid additional wiring in end device it is more and more common to replace the cables with wireless connectivity solutions like radio modules from Würth Elektronik. This requires especially sensors to be very energy-efficient, i.e. offering a very low power consumption. With that achievement a wireless sensor network can be operated on battery by ten years and more.

INTRODUCTION

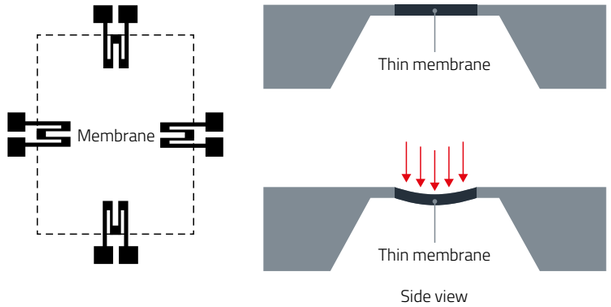
Functionality of a MEMS Pressure Sensor

A MEMS pressure sensor is based on a thin membrane. Typically two principles are used. The first principle is based on a change in resistance of integrated resistors caused by the deflection of the membrane. The second principle is based on a capacitive effect: a counter electrode is located below the membrane and based on the deflection of the membrane, the distance and thus the capacitance is changed.



A MEMS pressure sensor is more expensive in comparsion to a MEMS Acceleration Sensor due to:

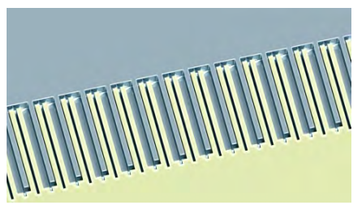
- → Direct contact to the environment
- → Packaging is more complex



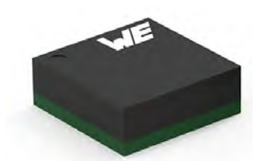
Source: https://www.radiolocman.com/review/article.html?id=148185

Functionality of a MEMS Acceleration Sensor

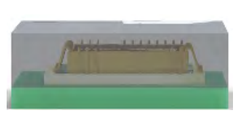
The sensor is a MEMS based capacitive acceleration sensor with an integrated ASIC. The acceleration sensors production approach is the creation of finger structures. One side is fixed, the other side is flexibly suspended. The sensor measures the acceleration or vibration through MEMS capacitive sensing principle. If this system gets accelerated, the distance changes between the fixed and movable structure. This change in distance causes a change in the electrical capacitance (capacitor principle), which could be measured electrically and serves as a reference value for acceleration.



Movable plates

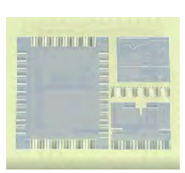


Sensor



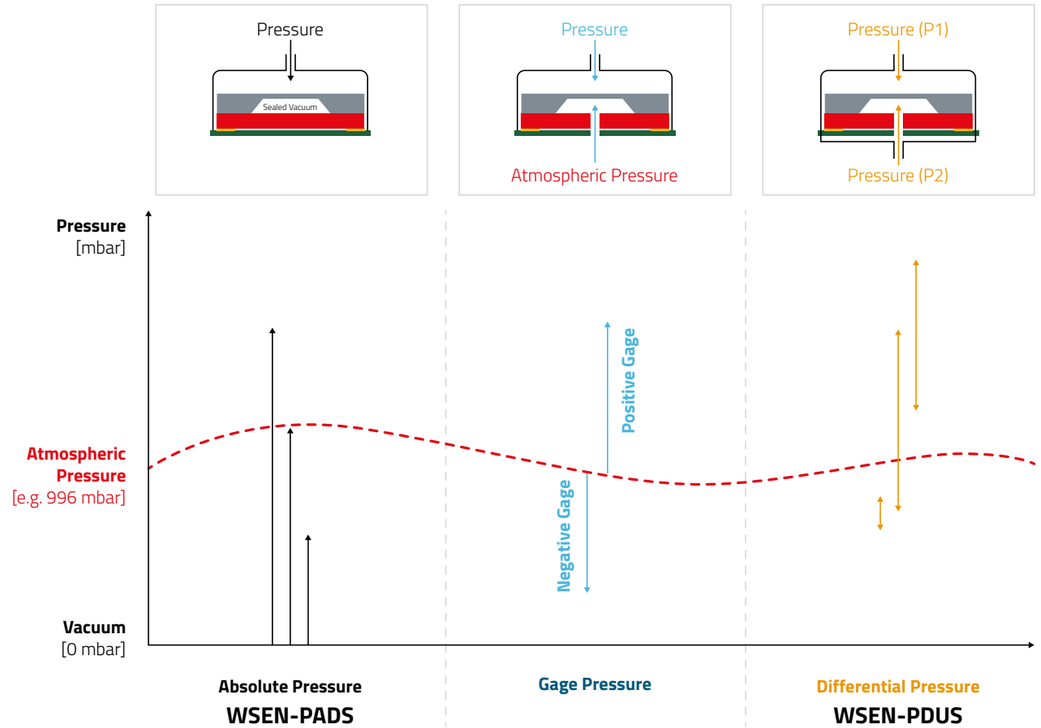
MEMS & ASIC Stack

ASIC



MEMS

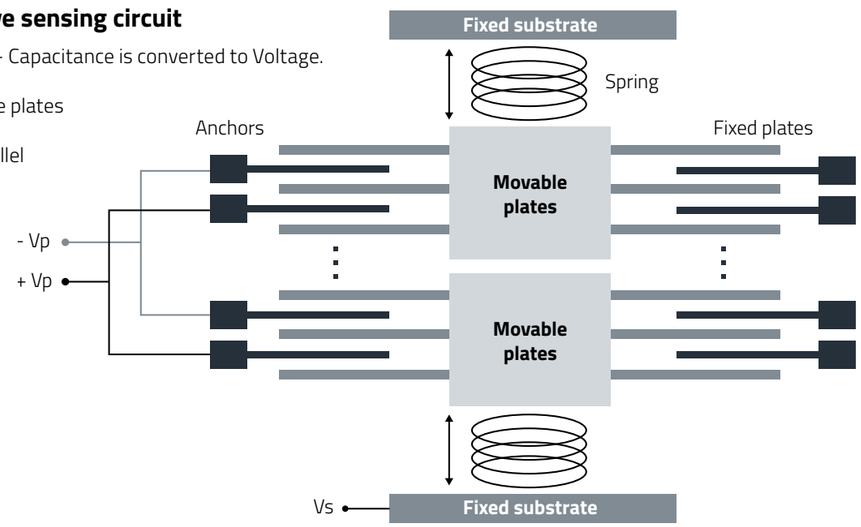
Which pressure sensor do I need?



MEMS capacitive sensing circuit

Simple explanation - Capacitance is converted to Voltage.

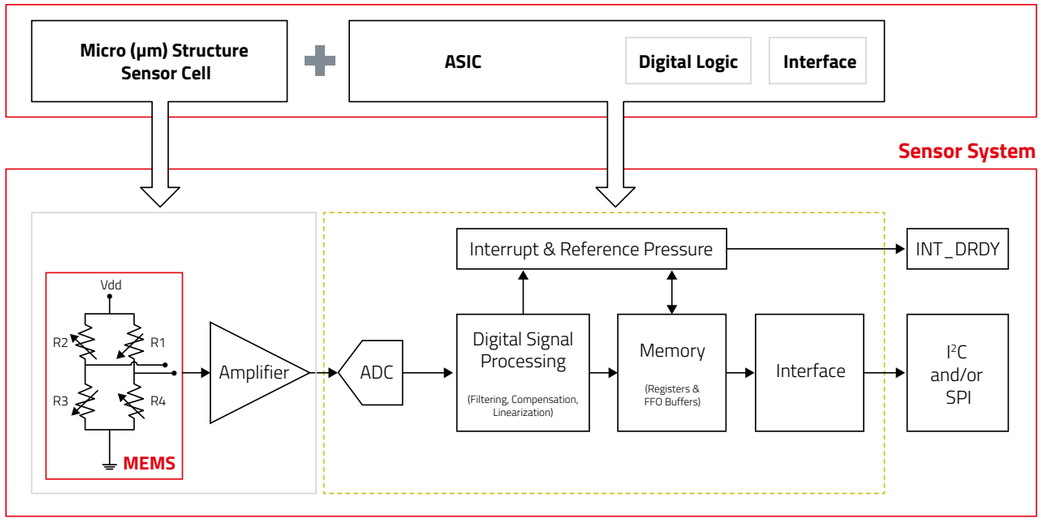
- Fixed and movable plates
- Capacitance in pF
- Capacitors in parallel
- ΔC ~ Vout



INTRODUCTION

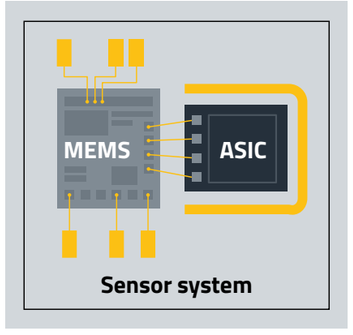
Bock Diagram

The best way to explain the function of MEMS sensors is a block diagram. The biggest difference to conventional (analog) sensors is that not only the actual measuring cell but also the complete processing can be integrated to achieve a very small sensor system. This eliminates any analog data processing on application level and a digital signal can be used directly by a microcontroller. Since a complete system is combined in one component, a complete factory calibration is also possible.



Micro-Electro-Mechanical System - Unit

- Bulk- or surface micromachining to create mechanical structures
- Very small dimensions possible
- Able to detect very small changes in physical dimension



Application-Specific-Integrated Circuit - Unit

Analog front end:

- Amplifying the signal
- Multiplexing in case of different sensor elements
- Conversion from analog to digital value

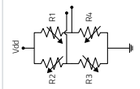
Digital logic:

- Filtering
- Compensation and linearization
- Registers and buffering

Interfaces:

- I²C – digital interface
- Interrupt for special scenarios

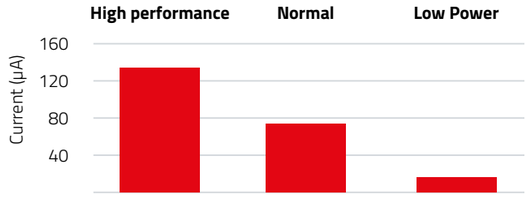
Comparison Analog vs Digital sensor

	Analog sensor	Digital sensor
		
Dimension	Mostly several parts needed, bigger formfactor	All-in-one, smaller formfactor
Costs	Several components like sensor, external resistors, stable voltage supply, ADC are needed	MEMS sensor covers the whole sensor system
Calibration	Field/system calibration needed (at multiple temperatures)	Off-the-shelf calibrated
Accuracy	System accuracy = sensor element + measuring circuitry	Sensor accuracy = System accuracy
Measuring	Mostly non-linear	Fully compensated and calibrated
Power Consumption	Voltage divider constantly drains power	Very low power, sleep mode between active sense cycles
Data Quality	Contact and load resistance as well as the absolute voltage supply level will have an influence on the accuracy. Additional inaccuracy based on the ADC has to be considered.	Stable output signal (digital value), additional possibilities to verify correct data transmission like parity or CRC. Also sensor status information can be sent.
Integration	External circuitry	Simple I/O pins with direct values from sensor

Different Modes for different Needs

Typically the mode selection is a tradeoff between current consumption and accuracy/noise.

- High Performance mode with highest data rate
- Normal mode as a perfect compromise
- Low power mode with lowest power consumption



SENSOR GUIDE

How to find the suiting product?

This Sensor Guide will help you to find a solution for your application! Answer the following questions, as far as you to be able to take a decision.

If there is any need of support: Contact us!
wireless-sales@we-online.com

1. Sensing medium

Which medium do you want to measure?

- ☐ Temperature
- ☐ Humidity
- ☐ Pressure absolute
- ☐ Pressure differential
- ☐ Acceleration
- ☐ other:_____

2. Interface

Which interface do you want to use?

- ☐ I2C
- ☐ SPI
- ☐ Analog
- ☐ other:_____

3. Environment

In which environment will your application be used?

- ☐ Indoor
- ☐ Outdoor
- ☐ Industrial
- ☐ Home Automation
- ☐ other:_____

4. Accuracy Requirements

What are the key requirements for the accuracy of the sensor?

- ☐ High accuracy:_____
- ☐ Medium accuracy:_____
- ☐ Accuracy doesn't matter
- ☐ other:_____

5. Characteristics requirements

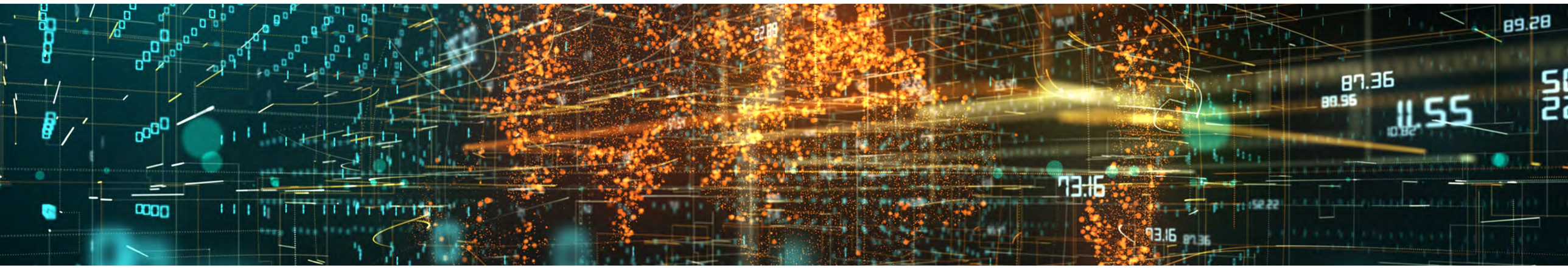
What are the additional requirements for the characteristics of the sensor?

- ☐ Energy consumption:_____
- ☐ Operating supply voltage:_____
- ☐ Output data rate
- ☐ Size:_____
- ☐ Media resistance:_____
- ☐ other:_____

6. Use Case / Application

What is the use case / the application of the sensor element / sensor system?

- ☐ Sensor network
- ☐ Environment measuring
- ☐ Process control / automation
- ☐ Redundancy
- ☐ Event triggering / decision support
- ☐ other:_____



PRODUCTS

WSEN-TIDS
Temperature Sensor IC

Product Features

Cut&Tape: No MOQ and small packing units

Long term availability

Small size

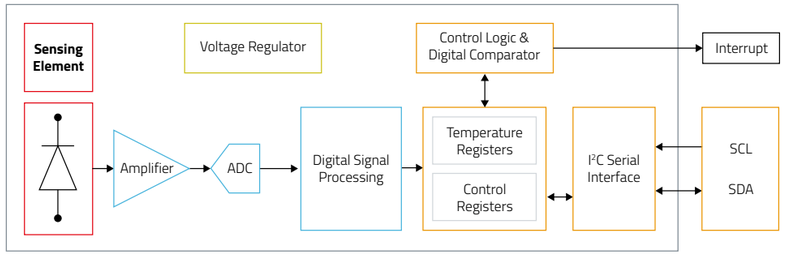
Low Power Consumption

- Silicon based digital temperature sensor
- High accuracy (up to ±0.25 °C typ.)
- Fully calibrated 16 bit temperature output
- Low current consumption of 1.75 µA typ
- Size: 2 x 2 x 0.55 mm
- Selectable output data rate up to 200 Hz
- I²C digital communication interface
- Programmable temperature threshold and interrupt
- 2 selectable I²C addresses

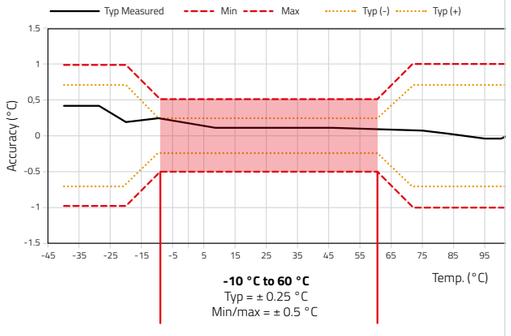
Order Code	$T_{RANGE\ min}$ (°C)	$T_{RANGE\ max}$ (°C)	RES_T (bits)	ODR_{min} (Hz)	ODR_{max} (Hz)	$V_{DD\ min}$ (V)	$V_{DD\ max}$ (V)
2521020222501	-40	125	16	25	200	1.5	3.6

T_{RANGE}: Measurement range [min.]; RES_T: Resolution [typ.]; ODR_{min}: Output data rate [min.]; ODR_{max}: Output data rate [max.]; $V_{DD\ min}$: Operating supply voltage [min.]; $V_{DD\ max}$: Operating supply voltage [max.]

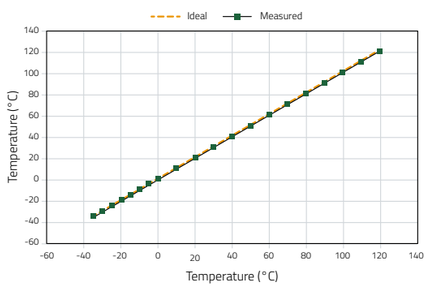
Block Diagram



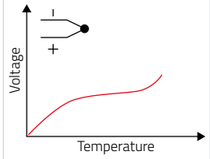
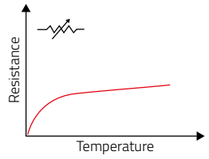
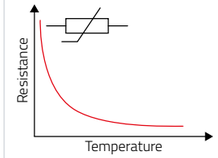
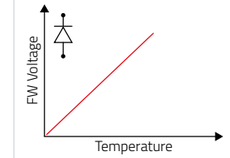
WSEN-TIDS Accuracy



WSEN-TIDS Linearity



Comparsion of sensor types

	Thermocouple	RTD	Thermistor	MEMS
				
Measurement range	-250 °C to 2500 °C	-250 °C to 700 °C	-100 °C to 250°C	-55°C to 150°C
Accuracy	Average (require CJC)	Highest	Average	High
Sensitivity	Low-average	Average	High	High
Linearity	Average	Good	Low	Highest
Peripheral Circuits/ Calibration	CJC; Amplifier; Scaling	Resistance correction; Scaling	Scaling	No
Footprint	Large	Medium	Small	Smallest
Price	Moderate	Very high	Low	Low

CJC= Cold Junction Compensation → Reference Calibration

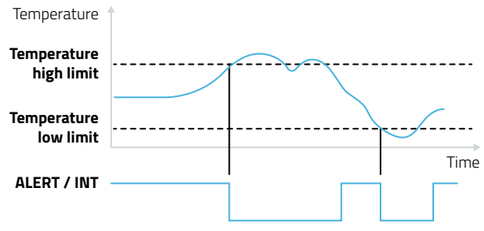
Mounting examples based on application

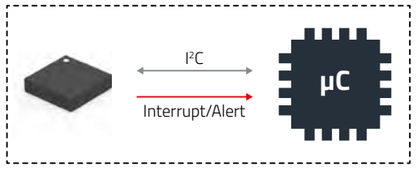
Focus on PCB temperature

Focus on ambient temperature

Focus on device temperature or Heat Source

Power saving through interrupt output

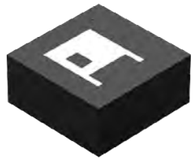




we-online.com/WSEN-TIDS

Webinar:
Digital silicon-based temperature sensors for industrial applications

PRODUCTS



WSEN-HIDS
Humidity Sensor with integrated Temperature Sensor

Product Features

Cut&Tape: No MOQ and small packing units

Long term availability

Small size

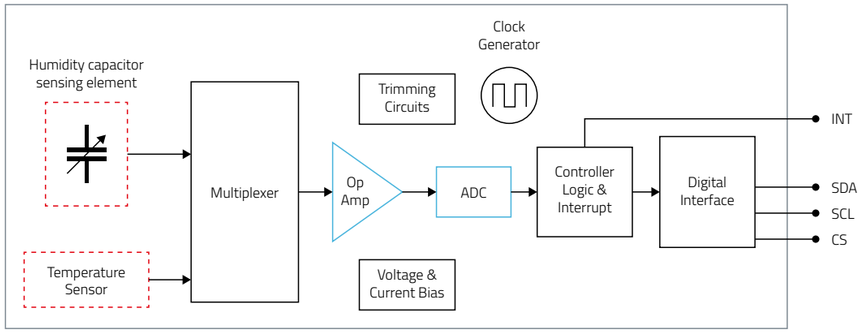
Low Power Consumption

- MEMS based capacitive sensing principle
- Relative humidity range 0% to 100%
- Embedded analog to digital converter
- Fully calibrated 16 bit humidity and temperature output
- Size: 2 x 2 x 0.9 mm
- I²C and SPI communication interface
- Selectable output data rate up to 12.5 Hz
- Operating temperature range: -40 °C to 120 °C

Order Code	$H_{RANGE\ min}$ (% rH)	$H_{RANGE\ max}$ (% rH)	RES_T (bits)	ODR_{min} (Hz)	ODR_{max} (Hz)	$V_{DD\ min}$ (V)	$V_{DD\ max}$ (V)
2525020210001	0	100	16	1	12.5	1.7	3.6

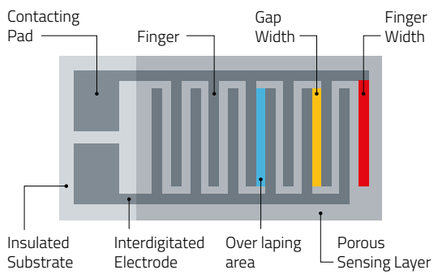
$H_{RANGE\ min}$: Measurement range [min.]; $H_{RANGE\ max}$: Measurement range [max.]; RES_T: Resolution [typ.]; ODR_{min}: Output data rate [min.]; ODR_{max}: Output data rate [max.]; $V_{DD\ min}$: Operating supply voltage [min.]; $V_{DD\ max}$: Operating supply voltage [max.]

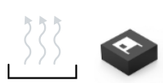
Block Diagram



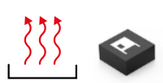
Working Principle

- Capacitive Sensing technology
- The humidity sensor is a small capacitor consisting of a hygroscopic dielectric material placed between a pair of electrodes. The change in the humidity in atmosphere will affect the dielectric constant which results in change in the capacitance represents the moisture % in atmosphere
- Integrated heater to remove condensated water on sensor surface





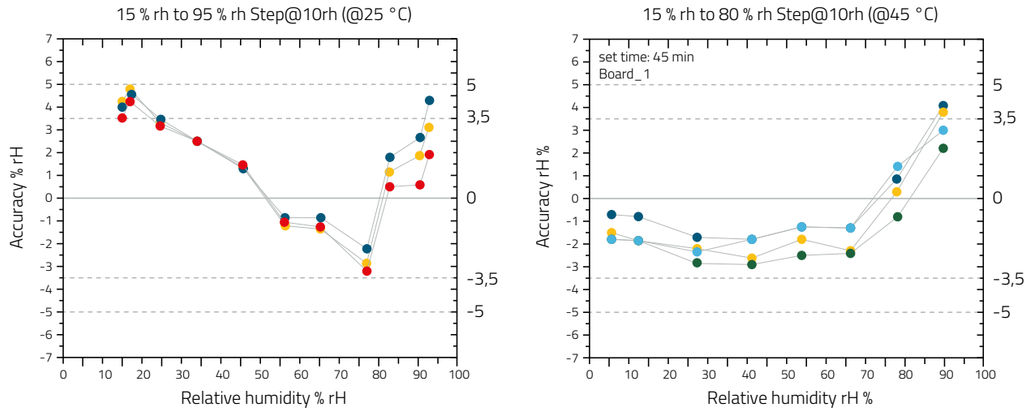
Heater OFF



Heater ON

$$Capacitance = \varepsilon_r \varepsilon_0 \frac{A}{d} \ (Farad)$$

Accuracy

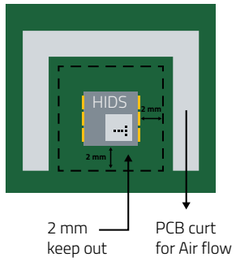


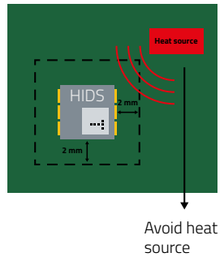
Temperature sensor accuracy

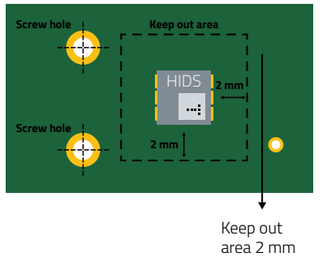
Temperature Sensor	Measurement Range	Test Condition	Accuracy
Measurement Range	-40 °C to 120 °C	From 15 °C to 40 °C	+/- 0.5 °C
		From 0 °C to 60 °C	+/- 1 °C

PCB layout recommendations

The combined Humidity and Temperature Sensor is high is very sensitive to the environment. Therefore it is recommended to follow the design guidelines strictly. Details can be found in our Application Note.







we-online.com/WSEN-HIDS

PRODUCTS

WSEN-ITDS
3 Axis Acceleration Sensor

Product Features

Cut&Tape: No MOQ and small packing units

Long term availability

Small size

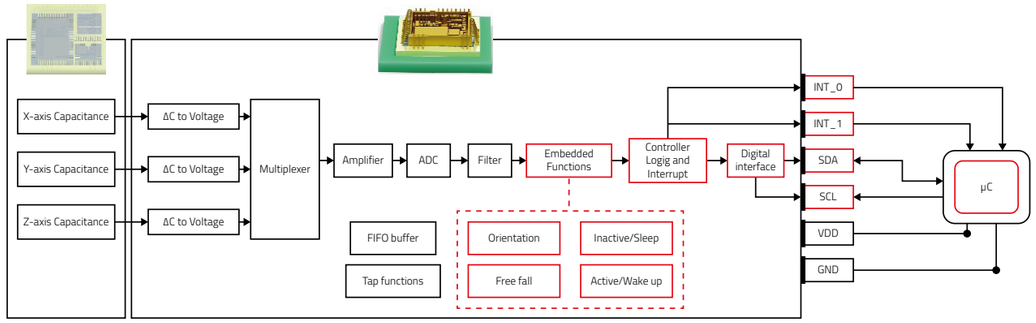
Low Power Consumption

- MEMS based capacitive sensing principle
- 14 bit output resolution
- Full scale ±2 g, ±4 g, ±8 g, ±16 g
- Bandwidth up to 1600 Hz
- 32 level FIFO buffer
- Size: 2 x2 x 0.7 mm
- Embedded temperature sensor
- I²C digital communication interface
- Temperature range: -40 °C up to +85 °C

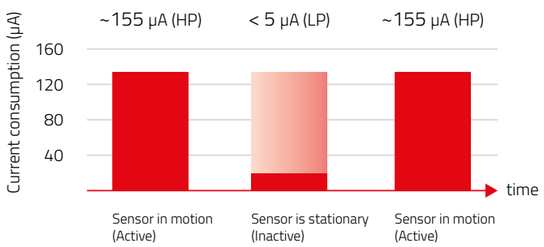
Order Code	a_{RANGE}	RES_a (bits)	ODR_{max} (Hz)	f_{BW} (Hz)	$V_{DD\,min}$ (V)	$V_{DD\,max}$ (V)
2533020201601	±2/ ±4/ ±8/ ±16 *g*	14	1600	400	1.7	3.6

a_{RANGE}: Acceleration range [typ.]; RES_a: Resolution [max.]; ODR_{max}: Output data rate [max.]; f_{BW}: Bandwidth [max.]; $V_{DD\,min}$: Operating supply voltage [min.]; $V_{DD\,max}$: Operating supply voltage [max.]

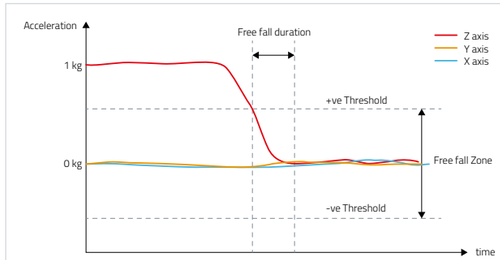
Block Diagram



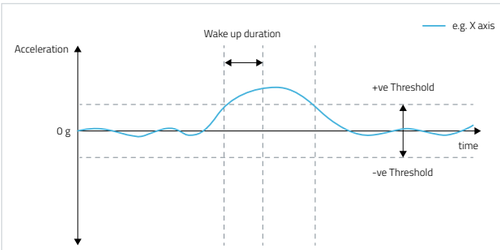
Automatic operating mode change for low battery power application



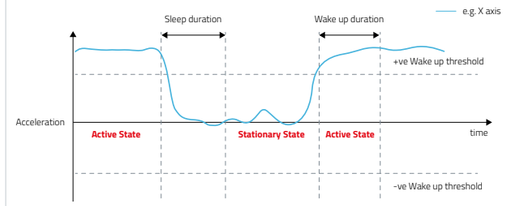
Embedded Functions



Free fall

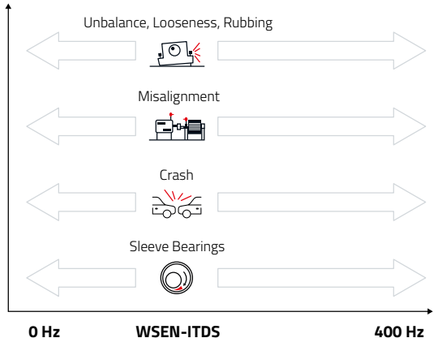


Sleep and wake up

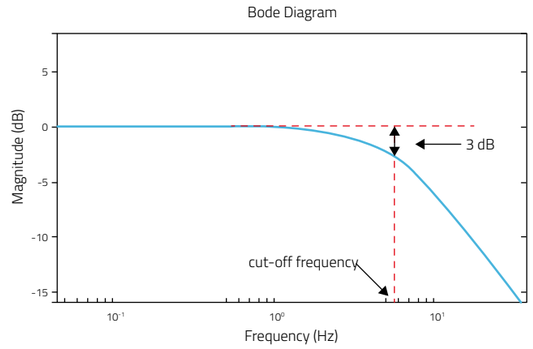


Stationary/Active

Application: Low Vibration detection – Bandwidth as a key factor



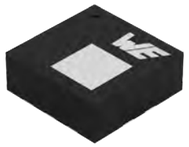
Bandwidth cutoff frequency at 400 Hz



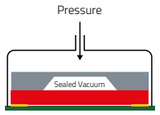
we-online.com/WSEN-ITDS

Webinar:
Accelerate your IoT development project with our MEMS 3-axis sensor

PRODUCTS



WSEN-PADS
Absolute Pressure Sensor



Product Features

Cut&Tape: No MOQ and small packing units

Long term availability

Small size

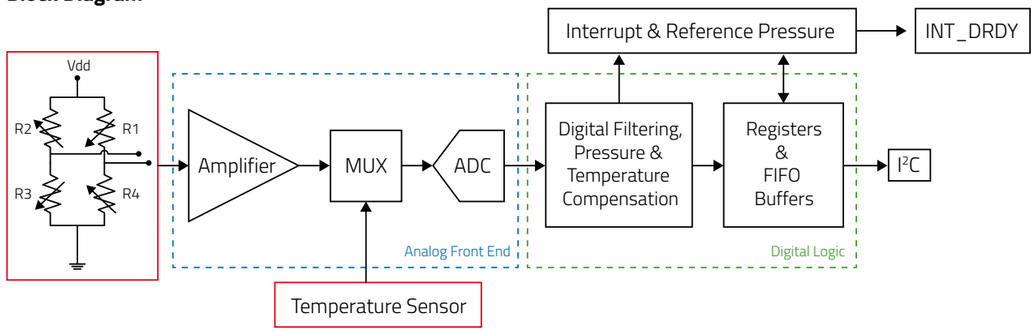
Low Power Consumption

- MEMS based piezo-resistive sensing principle
- 24 bit pressure output resolution
- Selectable output data rate up to 200 Hz
- 128 level FIFO buffer
- Low current consumption of 0.9 µA typ.
- Size: 2 x 2 x 0.8 mm
- Embedded temperature sensor
- I²C digital communication interface
- Application specific interrupt event setting
- Temperature range: -40 °C up to +85 °C (16-bits)
- ±1 mbar absolute accuracy

Order Code	$P_{RANGE\ min}$ (kPa)	$P_{RANGE\ max}$ (kPa)	RES_P (bits)	ODR_{min} (Hz)	ODR_{max} (Hz)	$V_{DD\ min}$ (V)	$V_{DD\ max}$ (V)
2511020213301	26	126	24	1	200	1.7	3.6

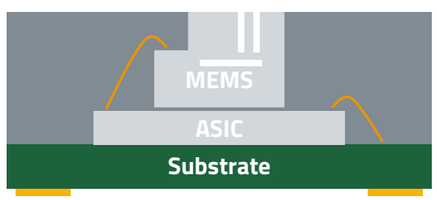
$P_{RANGE\ min}$: Measurement range [min.]; $P_{RANGE\ max}$: Measurement range [max.]; RES_P: Resolution (ADC) [typ.]; ODR_{min}: Output data rate [min.]; ODR_{max}: Output data rate [max.]; $V_{DD\ min}$: Operating supply voltage [min.]; $V_{DD\ max}$: Operating supply voltage [max.]

Block Diagram



Additional Advantages of the integrated sensor

- Fully molded package
- Increased robustness
- Contamination risk reduced
- Improved moisture and dust resistance
- Multiple vent holes



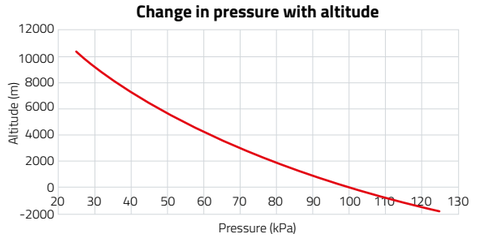
Is WSEN-PADS suitable for my application?

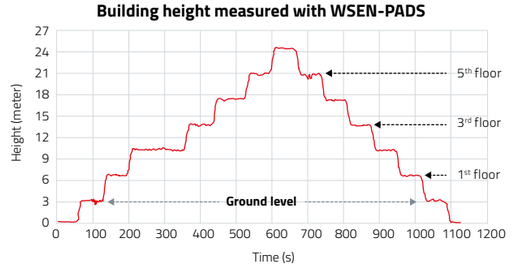
This absolute pressure sensor is housed in a small package suitable for surface mounting on a printed circuit board (PCB). That's why the WSEN-PADS is also known as a board-level sensor. This makes it ideal for consumer applications where the pressure on the PCB can be measured, e.g. B. in an altimeter or a sports watch, but this sensor is not suitable for the high temperatures of liquids or gases. It is also not adequately protected against dust, moisture or the chemicals commonly used for cleaning in industry. Industrial sensors are usually robustly packaged. They are usually made of corrosion-resistant material such as stainless steel and are threaded so they can be attached to pipes and storage tanks.

WSEN-PADS for Altitude measurements

An altemeter is an instrument that measures the height/altitude above a fixed level. Almost linear co-relation between the atmospheric pressure and the altitude enables the use of absolute pressure sensors as Altimeters. With the Built-in features like filters, offset calibration, temperature compensation etc., WSEN-PADS acts as a precise Altimeters and could be even used for indoor applications like, building height and floor detection.

Relationship between atmospheric pressure and altitude





$$h = 44330.77 \times \left[1 - \left(\frac{P}{P_0}\right)^{\frac{1}{5.256}}\right]$$

H = Altitude
P = Pressure at altitude h
P_0 = Pressure at sea level or reference

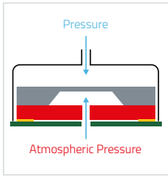
- Indoor Navigation
- Floor detection
- Drone's: Maintaining constant altitude

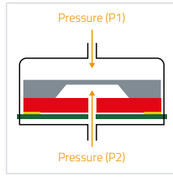
we-online.com/WSEN-PADS

Webinar:
Currently under pressure? Discover our new MEMS pressure sensors

PRODUCTS

WSEN-PDUS
Differential Pressure Sensor





Product Features

Cut&Tape: No MOQ and small packing units

Long term availability

Small size

Custom calibration values possible

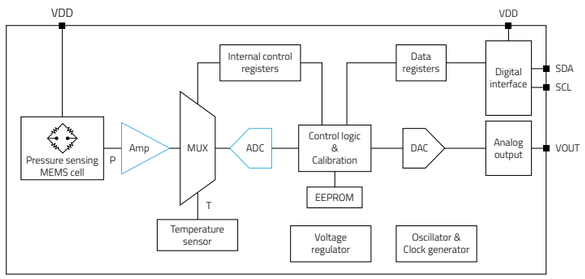
- MEMS based piezo-resistive sensing principle
- Very high accuracy (up to ±0.25 % FSS tolerance)
- Different transfer functions from ±0.1 kPa to 1 MPa
- 15 bit digital & 11 bit analog pressure output resolution
- Size: 13.8 x 8 x 7.55 mm
- Embedded temperature sensor
- Analog & I²C digital communication interface
- Temperature range: -25 °C up to +85 °C

Order Code	$P_{RANGE\ min}$ (kPa)	$P_{RANGE\ max}$ (kPa)	ACC_{P_TOT}	$V_{DD\ min}$ (V)	$V_{DD\ max}$ (V)
2513130810001	-0.1	0.1	±2.5 %FSS	4.75*	5.25*
2513130810101	-1	1	±0.75 %FSS		
2513130810201	-10	10	±0.75 %FSS		
2513130810401	-100	1000	±0.25 %FSS		
2513130810301	0	100	±0.25 %FSS		
2513130815401	0	1500	±0.25 % FSS		

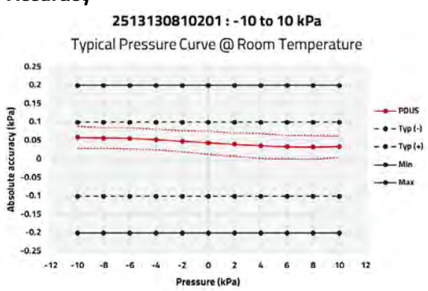
$P_{RANGE\ min}$: Measurement range [min.]; $PR_{ANGE\ max}$: Measurement range [max.]; ACC_{P_TOT}: Total accuracy [typ.]; $V_{DD\ min}$: Operating supply voltage [min.]; $V_{DD\ max}$: Operating supply voltage [max.]

* other voltage values e.g. 3.3 V available, see customization next page

Block Diagram



Accuracy

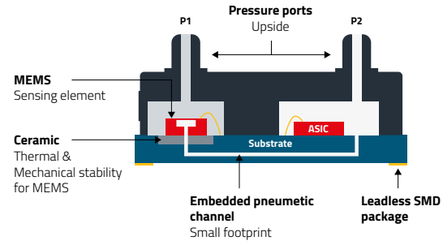


Conversion Table

1	Pa			0.01	mBar
2.5	Pa			0.025	mBar
10	Pa			0.1	mBar
0.1	kPa	1	hPa	1	mBar
1	kPa	10	hPa	10	mBar
10	kPa	100	hPa	100	mBar
26	kPa	260	hPa	260	mBar
100	kPa	1000	hPa	1	Bar
126	kPa	1260	hPa	1.26	Bar
1000	kPa	10,000	hPa	10	Bar

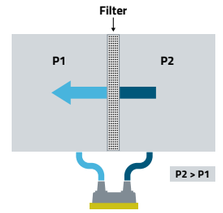
Construction compared to Absolute Pressure

- The sensor package is a bit different from the Absolute pressure sensor. It has two pressure ports on the topside. Port P1 is exposed to the top side of the MEMS sensing element.
- The MEMS sensing element is placed on a ceramic substrate. Silicon and the Ceramic have a similar temperature co-efficient, thermal stress can be minimized. This significantly improves the Mechanical stability of the MEMS. For the reference pressure P2, a pneumetic channel is embedded inside the PCB of the sensor. It comes in a reflow solderable SMD package.



Typcial Application - Heating, Ventilation and Air Conditioning (HVAC)

Air Filter Monitoring



Ventilator & Fan Control

Air Pressure Control

P1 = P2 → No Filter or Clean Filter

P2 > P1 → Clean Filter (Pre-defined)

P2 >> P1 → Change Filter Alert

we-online.com/WSEN-PDUS

SENSOR
SOFTWARE DEVELOPMENT KIT

Communication with the sensors is done by reading from and writing to registers via I²C and/or SPI interfaces. The manuals and app notes describe the usage of the sensors on register level. The Sensors SDK is an abstraction layer that provides functions and data types which handle the low-level communication with the sensor at register level for you. This allows easy access to the functions behind the registers.

The SDK is Open source, written in C, ready-to-use in customer software and can also be modified by customers as required by their application.

we-online.com/Sensor-SDK

Features

- Conversion of sensor readings (raw data to user units) for different sensor configurations.
- Communication layer (I²C, SPI) - pre-configured and ready-to-use for each type of sensor.
- Configuration and control of e.g.
  - Data rates
  - Operating modes
  - Interrupts
  - Buffering and batch transfer of sensor readings (FIFO)
  - Embedded functions (e.g. free-fall detection for acceleration sensor or detection of high/low pressure events for absolute pressure sensor)

Extensive examples for both basic and advanced usage - providing an overview of the sensor's functionality, low-threshold way of getting acquainted with the sensors (-> prototyping)

Basic usage

E.g. operating modes, data rates, interpreting raw data, one shot sensor read

Advanced usage

E.g. Embedded functions, interrupts, buffering of data (FIFO)

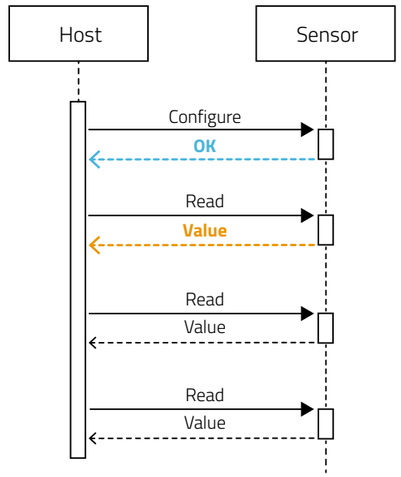
"Plug-and-play" support

"Plug-and-play" support of currently two STM32 microcontrollers (STM32G031, STM32L432) - SDK structure allows adaption to other STM controllers and porting to other MCUs by replacing platform-specific functions (basically functions performing low-level communication via I²C or SPI and setting up Clocks, Timers, GPIOs and Interrupts).

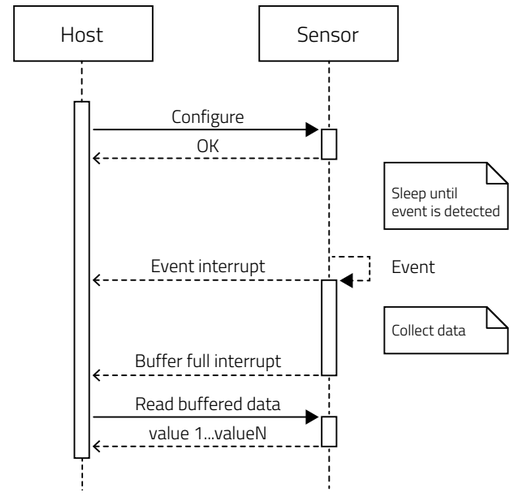
A **graphic** showing two simplified use-cases, such as reading single values triggered by the host or reading a batch of buffered values triggered by a sensor event (such as wake-up, free-fall etc.).

The left hand flow of the graphic matches the code comparison below.

Reading single values triggered by the host



Reading a batch of buffered values triggered by a sensor



Code Comparison „Reading single values“ – With and without SDK

WITHOUT SDK
Short but not readable

Init:
1. Write value 0x64 into register 0x20
2. Write value 0x0C into register 0x21
3. Write value 0x04 into register 0x25

4. Wait until bit 0 of register 0x27 is ‘1’
5. Read registers 0x28 to 0x2D, combine pairs into 16 bit values for x,y and z
6. Multiply with “acceleration sensitivity” value to convert raw values to user units

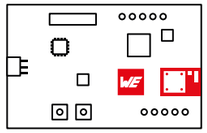
WITH SDK
Longer but readable

Init:
1. SetOutputDataRate(200Hz)
2. EnableHighPerformanceMode(true)
3. EnableBlockDataUpdate(true)
4. EnableAutoIncrement(true)
5. EnableLowNoise(true)
6. SetFullScale(2g)

7. Wait until IsAccelerationDataReady() returns true
8. getAccelerationsData(x,y,z)

ADDED VALUES

Development Tools



Eval Boards

- Easy testing
- No problem with hand soldering of small sensors
- I²C directly accessable

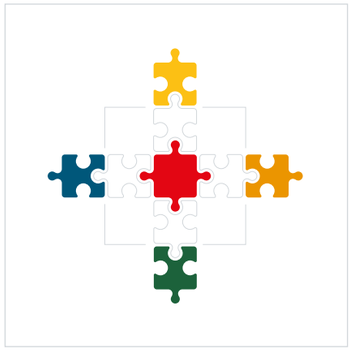
we-online.com/EVAL-SENS

More information on page 151

FeatherWing

- Adafruit standard
- Easy connectable
- For complex system tests

More information on page 154



Software Development Kit

- Typically as C-Files, for mobile Apps platform specific languages
- For comfortable coding of:
  – The HOST-controller system
  – PC Applications & Mobile Apps
- Code examples in Application notes and Manuals

we-online.com/WSEN-SDK

AppNotes

AppNote: MEMS Sensor PCB Design and Soldering Guidelines

we-online.com/ANM001

Human Fall Detection with 3-Axis MEMS Acceleration Sensor

we-online.com/ANM002

Pressure Altimeter using Absolute Pressure Sensor WSEN-PADS

we-online.com/ANM003

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

KEEP IT SIMPLE!
SENSE WITH MEMS

MEMS Sensor Portfolio & Customer Service

Sensors are an integral part of every future application. Measuring temperature, humidity, pressure or acceleration has never been easier. Take advantage of services like our Software Development Kit and Evaluation Boards available off-the-shelf. Detailed documentations as well as the direct support by trained engineers will leave no questions open. With excellent measuring accuracy and long-term stability, the sensors provide high precision and accurate output values with intelligent on-chip interrupt functions.

Combine sensors and wireless connectivity – start your IoT application today:
www.we-online.com/sensors

- Support by engineers within 24 h
- Excellent measuring accuracy
- Factory calibrated & ready to use
- On-chip interrupt functions
- Implemented algorithms
- SPI & I²C digital interfaces


3 Axis Acceleration
WSEN-ITDS


Temperature Sensor IC
WSEN-TIDS


Absolute Pressure
WSEN-PADS


Differential Pressure
WSEN-PDUS


Humidity
WSEN-HIDS

#SensewithMEMS

SOFTWARE TOOLS

IoT will become intelligent when hardware and software work harmoniously together!

Würth Elektronik provides a variaty of software development kits (SDK) and software tools to test the wireless connection and to speed up the design processes. All tools and software development kits, can be downloaded for free in our online shop as required by their application.

GitHub

Würth Elektronik eiSos GitHub page

In order to ensure ease-of-use for the developers, all our SDK are available on the GitHub platform. Please visit the Würth Elektronik eiSos GitHub page to find the latest version of our SDKs.

github.com/WurthElektronik

Wireless Connectivity Software Development Kit (SDK)

The aim of the Wireless Connectivity SDK is to minimize the effort required on customer side to enable his host MCU to communicate with Würth Elektronik eiSos radio modules. It contains the implementation of all available commands in pure C-code. In order to integrate any Würth Elektronik eiSos wireless module, the user has to simply port the corresponding C-code to his host processor. This significantly reduces the time needed for developing the software interface to the radio module.

we-online.com/WCO-SDK

Smart commander tool

The WE Smart Commander is an easy-to-use PC software that enables complete control of the Würth Elektronik eiSos wireless modules through an intuitive GUI. This tool along with the evaluation boards allow quick prototyping and testing of various features of the radio modules.

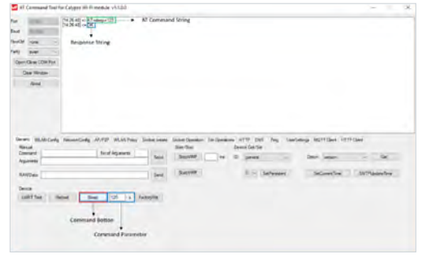
- Simple setup
- Intuitive interface
- Color coded Packet interpretation
- 100% log traceability

The Smart Commander itself is an executable and does not require installation. It will create folders and files on the hard drive e.g. for log file storing. However, the serial-to-USB FTDI converter chip (i.e. FT232R) on the evaluation platform or USB dongles requires special drivers to be installed for proper operation. To use USB dongles or evaluation boards of Würth Elektronik eiSos wireless connectivity modules, the Virtual COM Port (VCP) drivers have to be installed by following the "Installation Guides" of FTDI found under:

we-online.com/SmartCommander

AT commander tool

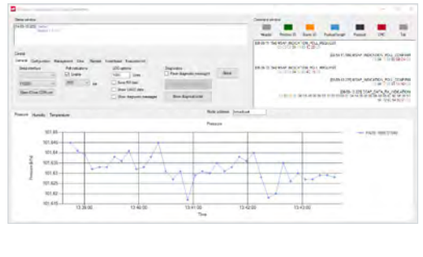
The AT command tool is a simple PC software that enables complete control of the Calypso Wi-Fi module via the AT Command interface. This tool offers an intuitive graphical user interface that enables the user to interact with the Calypso and understand the syntax and semantics of the AT command interface. The AT command tool works out-of-the-box with the Calypso evaluation board. This tool along with the Calypso evaluation board allows quick prototyping and testing of various features of the Calypso Wi-Fi module.



we-online.com/AT-Commander

Wirepas commander tool

The Wirepas module Commander is an easy-to-use PC software that enables complete control of the Wirepas module via its command interface. This tool offers an intuitive graphical user interface that enables the user to interact with the wireless module and understand the communication protocol between the module and the connected host.



The Wirepas module Commander along with the Wirepas module allows quick prototyping and testing of various features of the Wirepas mesh network.

we-online.com/Wirepas-Commander

ACC-Tool

The "ACC V3" is a tool to update and configure certain Würth Elektronik eiSos modules. The supported features will include the search and upload of new firmwares as well as the modification of the available configuration parameters. It allows full user control over all supported products, as in the range of the producer's intentions, always referring to the respective manual of the connected module.
Due to current export legal restrictions, we are required to control the provision of software. To download the software, please contact our technical support or your local sales representative directly.

Contact technical support:

support@we-online.com
we-online.com/find-your-engineer

we-online.com/ACC

SOFTWARE TOOLS

Adrastea Commander

The Adrastea Commander is a simple PC tool to interact with the EV-Boards of the Würth Elektronik eiSos cellular module via AT Command interface. This offers evaluation of Adrastea-I module capabilities and features. It is simplified for the configuration of the module using AT commands without knowledge of the protocols. Quick selection and Command List allows to save and send AT commands with a mouse click.

The Adrastea Commander tool makes easy evaluation of GNSS functionality of Adrastea-I module. The Adrastea Commander tool also offers data usage estimation to get an idea how much data is required for the application.

we-online.com/Adrastea-Commander

Proteus Connect App SDKs and source code for BLE

The proteus connect SDKs enable development of software applications for smart devices that connect and exchange data with BLE modules from Würth Elektronik eiSos. The Proteus connect SDK is available for the following platforms:

Android

github.com/WurthElektronik/Proteus-Connect-Android

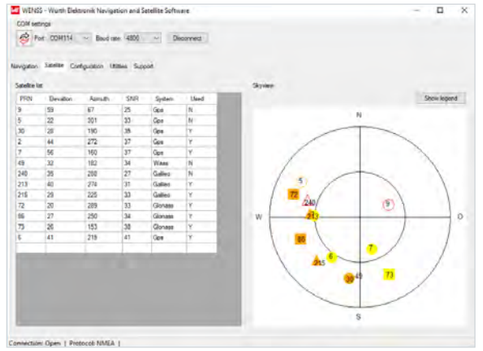
iOS

github.com/WurthElektronik/Proteus-Connect-iOS

Windows

github.com/WurthElektronik/Proteus-Windows-SDK

WENSS - Würth Elektronik Navigation Satellite Software



Würth Elektronik Navigation and Satellite Software, WENSS for short, is a simple PC tool to interact with the EV-Boards of the Würth Elektronik eiSos positioning modules using the UART interface. It allows:

- Taking into operation of the EV-board
- Bidirectional communication with the GNSS module
- Evaluation of module capabilities and features
- Getting familiar with module protocols, sentences and commands
- Configuration of the module without knowledge of the protocols
- Parsing of sentences and commands

Experienced users have the opportunity to use WENSS for more advanced configurations. Therefore it allows an easy evaluation of positioning application.

we-online.com/WENSS

ACCESSORIES
WIRELESS CONNECTIVITY

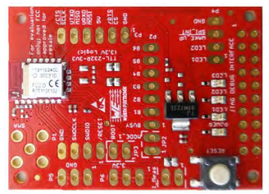
Radio Module

A radio module is a A-component, which is used for wireless communication between devices such as control systems, remote controls, sensors et cetera.

USB Radio Stick

A USB Radio Stick consists of radio module along with a serial-to-USB adapter that enables direct connection to any USB compatible device. A FTDI serial-to-USB converter chip FT231X connects the USB interface of the Radio stick to the UART pins of the integrated radio module.

- Including all necessary certification
- Can be used Plug&Play



Mini – Evaluation Board

The mini evaluation board is an intuitive, application oriented and cost effective version of the Evaluation kit. It offers the possibility to develop hard- and software for the radio module.

- Not assembled with connectors and pinheaders
- Intended for experienced developers

A PCB containing only one radio module to access all pins without any soldering effort. Can be used Plug&Play to connect a radio module directly to any host microcontroller by lose wires.

Evaluation Kit

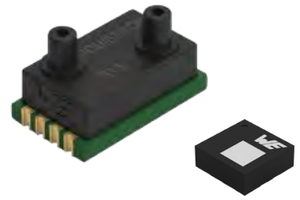
The Evaluation Kit contains all necessary equipment like

- USB cable
- USB radio stick (if required)
- A 2nd evaluation board (for e.g. long range tests)
- Antennas (if external antenna configuration is chosen)

The included Evaluation board offers the user the possibility to develop hard- and software for the compatible radio module. It can be connected to an USB port of a PC.

- Equipped with a multi-pin connector (which is connected to all pins of the RF module)
- Jumpers allow the module to be disconnected (from components such as the USB interface)

ACCESSORIES
SENSORS



Sensor (Component)

A sensor is a A-component, which is used to produce an output signal for the purpose of sensing a physical phenomenon.

Sensor Node

The sensor nodes function is to repeatedly read the respective sensor values via I²C and send them via Wirepas mesh network to a sink device. It contains:

- The Wirepas radio module Thetis-I
- Several Würth Elektronik eiSos sensors
  - WSEN-PADS
  - WSEN-HIDS
  - WSEN-TIDS
- CR2032 battery holder

Evaluation Board

The evaluation board of the sensor provides an opportunity to verify the sensor performance and develop a prototype using an external processor.

- Can be directly plugged to another kit using the mounted I²C and SPI interface pins
- Can also be placed on a bread board using through hole pin header connections

Sensor Shield for Arduino

The evaluation board "Sensor Shield for Arduino" is a stackable extention board for the Arduino (UNO and DUE) board. It can be used to connect all Sensor EVAL-Boards:

- WSEN-HIDS
- WSEN-TIDS
- WSEN-ITDS
- WSEN-PADS
- WSEN-PDUS

WE ADAFRUIT FEATHERWINGS

Würth Elektronik eiSos presents, a range of FeatherWing development boards that are open source and fully compatible with the Feather form factor. Through these development boards WE brings a range of wireless connectivity modules, sensors and power modules to the Feather ecosystem.

Adafruit Feather is a complete line of development boards from Adafruit and other developers that are both standalone and stackable. They're able to be powered by LiPo batteries for on-the-go use or by their micro-USB plugs for stationary projects. Feathers are flexible, portable, and as light as their namesake.

FeatherWings are stacking boards and add functionality and room for prototyping. At its core, the Adafruit Feather is a complete ecosystem of products - and the best way to get your project flying.

Supercharge your prototyping for easy and fast solution testing.

Sensor FeatherWing (2501000201291)

- Acceleration sensor (WSEN-ITDS)
- Absolute Pressure sensor (WSEN-PADS)
- Temperature sensor (WSEN-TIDS)
- Humidity sensor (WSEN-HIDS)
- Sparfun QWIIC connector to enable easy access to hundreds of extension boards

Thyone-I Wireless FeatherWing (2611059021001)

- Proprietary 2.4 GHz RF-Module
- Connecting wirelessly up to 300 m
- Microchip ATECC608B secure element for encryption and authentication
- Connect to Thyone-I modules or USB-Sticks

Calypso Wi-Fi FeatherWing (2610039025001)

- 2.4 GHz Wi-Fi connectivity
- Easy connection to Smart Devices
- Secure data transfer to the cloud
- UART-to-Wi-Fi bridge

MagI³C Power FeatherWing (2601157100001)

- Input from industrial voltage rails of 9V, 12V, 15V, 18V, 24V or from 5V USB
- Output 5V and 3.3V to power the Feather system

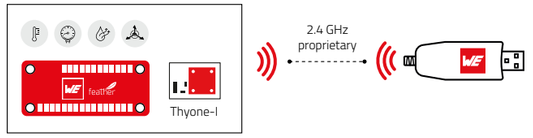
Connect any Feather Microcontroller

Choose any from a range of microcontroller boards from the Adafruit family.

FEATHERWINGS APPLICATION EXAMPLES

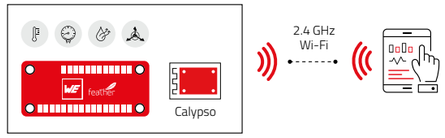
EXAMPLE 1: Built up a Proprietary Network

- Select a microprocessor of your choice from the Adafruit Feather ecosystem
- Use the Sensor FeatherWing for measuring condition parameters like temperature, air pressure, humidity and acceleration
- Send data with the Thyone-I FeatherWing on 2.4 GHz proprietary radio
- Thyone-I USB radio stick or another Thyone-I FeatherWing can receive the data and you get access to all information
- Even various tags could be connected wirelessly
- We support you with libraries and examples available on Github for some microcontrollers



EXAMPLE 2: Connect with Wi-Fi

- Select a microprocessor of your choice from the Adafruit Feather ecosystem
- Use the Sensor FeatherWing for measuring condition parameters like temperature, air pressure, humidity and acceleration
- Send out data with the Calypso FeatherWing on 2.4 GHz Wi-Fi
- Receive data on smart devices or server structures



EXAMPLE 3: Sensor to Cloud

Another simple application example is described here with the combination of an Adafruit Feather M0 Express with our Sensor FeatherWing and Calypso Wi-Fi FeatherWing.

A typical IoT application consists of sensing the environment through sensors, collecting the sensor data and forwarding it to a cloud. The cloud platform then provides options for further processing and visualization of the data. In this example, the data is read from the sensors of the Sensor FeatherWing and forwarded to a cloud platform via the Calypso Wi-Fi FeatherWing.

Currently, the data can be sent to one of the following cloud platforms: **Microsoft Azure** and **Amazon AWS**. Sample code and further documentation can be found on our Sensor2CloudConnectivity Github page.

4 sensors to measure environmental data:
- Temperature
- Humidity
- Acceleration
- Absolute Pressure

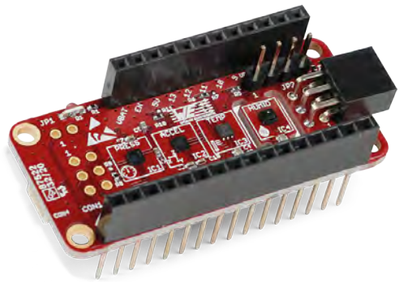
An Adafruit Feather M0 acts as managing director.

The Calypso Wi-Fi FeatherWing collects the sensor data and passes it on to any cloud.

GitHub

github.com/WurthElektronik/FeatherWings

SENSOR
FEATHER WING



Sensor FeatherWing

Environment and motion sensing

feather

Characteristics

Temperature | Pressure | Humidity | Acceleration

- All the four sensors are connected over the shared I²C bus
- In Adafruit Feather form-factor
- Compatible with QWIIC-connect from Sparkfun
- Easy to expand with our WE FeatherWings and hundreds of already existing boards with the Feather and QWIIC form-factor
- Arduino (C/C++) drivers and code examples available on Github

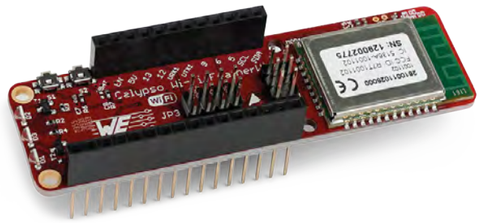
Applications

- Development of IoT applications
- Rapid prototyping
- Collection of environmental data

ADDED VALUES

- ✔ Hardware design files available for download
- ✔ Drivers in C/C++ for all WE components
- ✔ Examples including source code in C/C++
- ✔ Extensive documentation including step-by-step guides

CALYPSO WI-FI
FEATHER WING



Calypso Wi-Fi FeatherWing

2.4 GHz Wi-Fi Connectivity

feather

Characteristics

Security and encryption | Global availability 2.4 GHz licence free band | Smart antenna selection

- 2.4 GHz IEEE 802.11 b/g/n Wi-Fi Connectivity
- Full TCP/TLS stack with IPv4 and IPv6
- Out-of the box implementation of several commonly used network applications like SNTP, DHPv4, DHCPv6, mDNS, HTTP(S), MQTT
- Direct and secure connection to cloud
- Low power modes for battery operated system
- Secure boot, secure storage and secure connectivity

Applications

- Rapid development of IoT applications
- Easy to use platform for learning, experimenting and prototyping cloud connectivity applications
- Collect sensor data, store it in a data-base and then visualize the data

App Note

Calypso Cloud Connectivity

we-online.com/ANR023

ADDED VALUES

- ✔ Hardware design files available for download
- ✔ Drivers in C/C++ for all WE components
- ✔ Examples including source code in C/C++
- ✔ Extensive documentation including step-by-step guides

THYONE-I WIRELESS FEATHER WING

Thyone-I Wireless FeatherWing

2.4 GHz Proprietary Wireless connectivity

feather

Characteristics

Long life battery driven application with sleep current = 0.4 µA

Global availability 2.4 GHz license free band

Mesh

Encyrption

- FeatherWing with proprietary 2.4 GHz RF module
- Wireless connection with up to 300 m
- Data Encryption (AES128)
- Integrated security/authentication IC
- Point -to-point connection to Thyone-I module or Thyone-I USB stick
- Mesh network capable
- Low power modes of operation
- In Adafruit Feather form factor

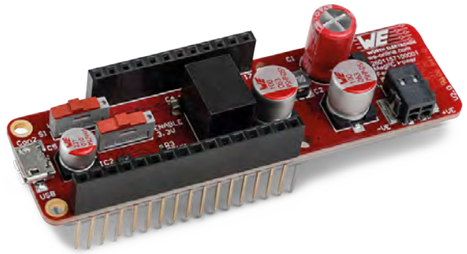
Applications

- Development of IoT applications
- Fast prototyping
- Low power sensor node

ADDED VALUES

- Hardware design files available for download
- Drivers in C/C++ for all WE components
- Examples including source code in C/C++
- Extensive documentation including step-by-step guides

MAGI³C POWER FEATHER WING



MagI³C Power FeatherWing

Power the Feather stack with any industrial power source

feather

Characteristics

- Industrial Input 6 V - 36 V
- EN55032 Class B compliant
- Internal soft-start
- Thermal shutdown

- Operating input voltage of 9 V, 12 V, 15 V, 18 V and 24 V industrial rails
- Maximum 36 V input voltage
- Additional USB connector for 5 V input voltage to select by switch
- Transformation of industrial input voltage to 5 V
- Transformation of 5 V to 3.3 V
- Enable functionality and mode selection available to control and tune performance of MagI³C MicroModule

Applications

Supply the FeatherWing system with power from industrial power sources.

ADDED VALUES

- Hardware design files available for download
- Extensive documentation including step-by-step guides

ACCESSORIES

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2608011024000	Proteus-I	Bluetooth® LE 4.2 with integrated antenna	2608019024001	-	-
2608011124000	Proteus-I	Bluetooth® LE 4.2 with RF pad	2608019324001	-	2600130021 (Himalia)
2608011024010	Proteus-II	Bluetooth® LE 5.0 with integrated antenna	2608019024011	2608036024011	-
2608011124010	Proteus-II	Bluetooth® LE 5.0 with RF pad	2608019324011	2608036024011	2600130021 (Himalia)
2611011024000	Proteus-III	Bluetooth® LE 5.1 with smart antenna selection	2611019024001 Mini Eval Board**: 2611069024001	2611036024001	2600130021 (Himalia)
2611011024010	Proteus-III-SPI	Bluetooth® LE 5.1 with SPI interface	2611119024011	-	2600130021 (Himalia)
2612011024000	Proteus-e	Bluetooth® LE 5.1 module	2612019024001	-	2600130021 (Himalia)
2610011025000	Calypso	2.4 GHz Wi-Fi module	2610019225001	-	2600130021 (Himalia)
2603011021000	Triton	2.4 GHz proprietary module with integrated antenna	2603019021001	-	-
2603011121000	Triton	2.4 GHz proprietary module with RF pad	2603019321001	-	2600130021 (Himalia)
2606031021000	Thalassa	2.4 GHz proprietary module with integrated antenna	2606039021001	2606046021001	-
2606031121000	Thalassa	2.4 GHz proprietary module with RF pad	2606039221001	2606046021001	2600130021 (Himalia)
2606031321000	Thalassa	2.4 GHz proprietary module with U.FL connector	-	2606046021001	2600130021 (Himalia)
2607011111000	Titania	169 MHz proprietary module with RF pad	2607019211001	2607046211001	2600130011 (Helike)
2605031141000	Thadeus	434 MHz proprietary module with RF pad	2605039241001	-	2600130041 (Herse)
2605041181000	Tarvos-I	868 MHz proprietary module with RF pad	2605049281001	2605056081001	2600130081 (Hyperion-I) 2600130082 (Hyperion-II)
2607021181000	Tarvos-II	868 MHz proprietary module with RF pad	2607029281001	2607056281001	2600130081 (Hyperion-I) 2600130082 (Hyperion-II)
2609011081000	Tarvos-III	868 MHz proprietary module with integrated antenna	-	2609026281001	-
2609011181000	Tarvos-III	868 MHz proprietary module with RF pad	2609019281001	2609026281001	2600130081 (Hyperion-I) 2600130082 (Hyperion-II)
2609031181000	Thebe-II	868 MHz proprietary module with RF pad	2609039281001	-	2600130081 (Hyperion-I) 2600130082 (Hyperion-II)
2607021191000	Telesto-I	915 MHz proprietary module with RF pad	2607029291001	2607056291001	2600130083 (Hydra-I)
2607021191010	Telesto-II	915 MHz proprietary module with RF pad	2607029291011	2607056291011	2600130083 (Hydra-I)
2609011091000	Telesto-III	915 MHz proprietary module with integrated antenna	-	2609026291001	-
2609011191000	Telesto-III	915 MHz proprietary module with RF pad	2609019291001	2609026291001	2600130083 (Hydra-I)
2609041191000	Themisto-I	915 MHz proprietary module with RF pad	2609049291001	-	2600130083 (Hydra-I)
2611011021000	Thyone-I	2.4 GHz proprietary module; smart antenna selection	2611019021001 Mini Eval Board*: 2611079021001 Long Range Board: 2611017221001	2611036021001	2600130021 (Himalia)
2611011021010	Thetis-I	2.4 GHz Wirepas Mesh module	2611019021011	2611086021011	2600130021 (Himalia)

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2615011136000	Adrastea-I	LTE-M / NB-IoT Cellular module with GNSS	2615029236001	-	-

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2612011022000	Ophelia-I	2.4 GHz radio module without firmware	2612019022001	-	2600130021 (Himalia)

* Connector Kit 699100

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2611011024020	Setebos-I	2.4 GHz radio module with proprietary and Bluetooth® LE 5.1 radio protocol	2611129024021	-	2600130021 (Himalia)

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2607011113000	Mimas-I	169 MHz wM-BUS module	2607019213001	2607046213001	2600130011 (Helike)
2605041183000	Metis-I	868 MHz wM-BUS module	2605049283001	2605056083001	2600130081 (Hyperion-I) 2600130082 (Hyperion-II)
2607021183000	Metis-II	868 MHz wM-BUS module	2607029283001	2607056283001	
2607056283011	Metis-II	868 MHz wM-BUS radio simulation USB-Stick	-	-	
2607057283011	Metis-Analyzer Tool	868 MHz wM-BUS radio Analyzer USB-Stick	-	-	

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2613011037000	Elara-I	GPS, GLONASS with Integrated Antenna	2613019037001	-	-
			Extended EV-Kit with Thyone-I RF interface: 2613019037011	2611036021001	
2613021137000	Elara-II	GPS, GLONASS with RF pad	2613029237001	-	2600130016 (Halimede-I) 7488920157 (WE-MCA)
			Extended EV-Kit with Thyone-I RF interface: 2613029237011	2611036021001	
2614011037000	Erinome-I	GPS, GLONASS, Galileo, BeiDou with Integrated Antenna	2614019037001	-	-
			Extended EV-Kit with Thyone-I RF interface: 2614019037011	2611036021001	
2614021137000	Erinome-II	GPS, GLONASS, Galileo, BeiDou with RF pad	2614029237001	-	2600130016 (Halimede-I) 7488920157 (WE-MCA)
			Extended EV-Kit with Thyone-I RF interface: 2614029237011	2611036021001	

Order Code	Name	Information	Eval Board
2533020201601	WSEN-ITDS	3 axis acceleration sensor	2533203301691
2521020222501	WSEN-TIDS	Temperature sensor	2521020222591
2525020210001	WSEN-HIDS	Humidity sensor	2525020210091
2511020213301	WSEN-PADS	Absolute pressure sensor	2511223013391
2513130810001	WSEN-PDUS	Differential pressure sensor (-0.1 - 0.1 kPa; -1-1 mbar)	2513254510091
2513130810101	WSEN-PDUS	Differential pressure sensor (-1-1 kPa; -10-10 mbar)	2513254510191
2513130810201	WSEN-PDUS	Differential pressure sensor (-10-10 kPa; -0.1-0.1 bar)	2513254510291
2513130810301	WSEN-PDUS	Differential pressure sensor (0-100 kPa; 0-1 bar)	2513254510391
2513130810401	WSEN-PDUS	Differential pressure sensor (-100-1000 kPa; -1-10 bar)	2513254510491
2513130815401	WSEN-PDUS	Differential pressure sensor (0-1500 kPa; 0-15 bar)	2513254515491

Order Code	Name	Information	Eval Board	USB-Stick	Antenna
2501000101291	Arduino-Shield	Sensor Shield for ArduinoI	-	-	-
2501000201291	Sensor FeatherWing	WSEN-ITDS, -PADS, -TIDS, -HIDS integrated	-	-	-
2611059021001	Thyone-I FeatherWing	Proprietary 2.4 GHz RF-Module Connection	-	2611036021001	2600130021 (Himalia)
2610039025001	Calypso FeatherWing	Wi-Fi-Connection 2.4 GHz	-	-	2600130021 (Himalia)