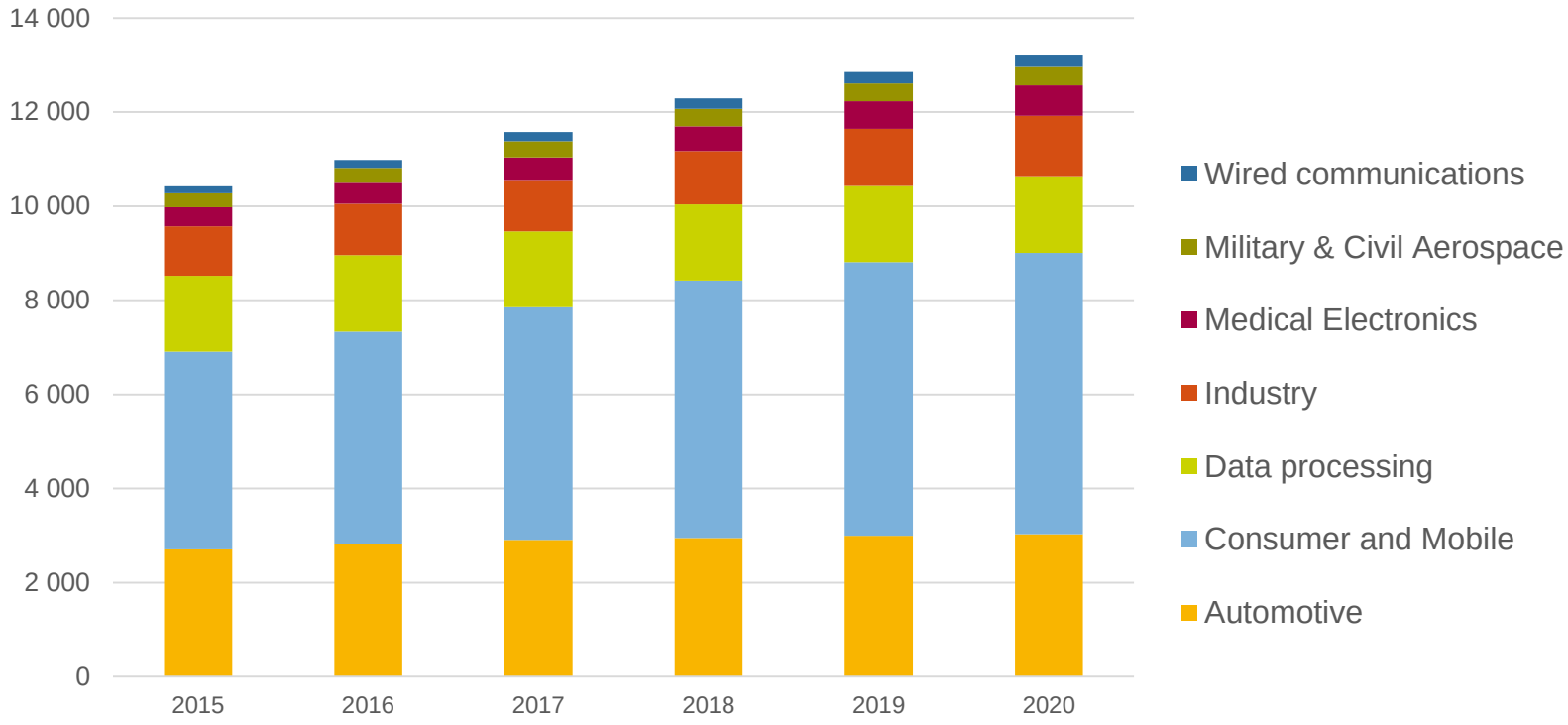
NXP BL SENSORS

SECURE CONNECTIONS
FOR A SMARTER WORLD

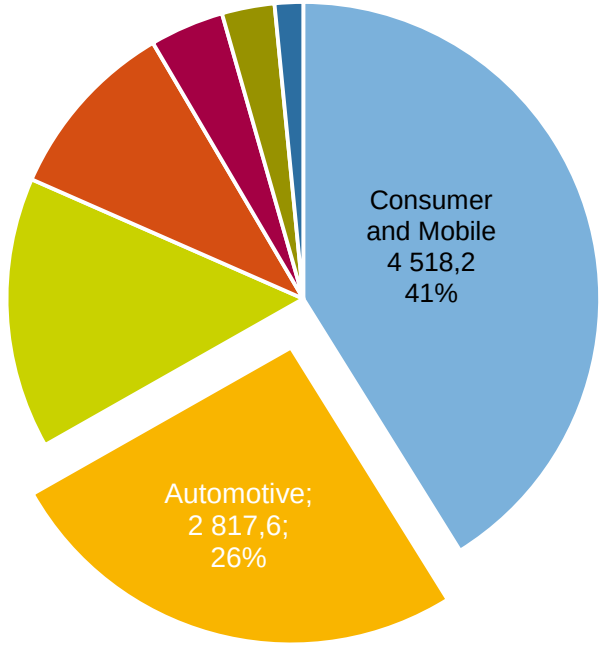
Total MEMS Market

Global MEMS Market (M$)



Source: IHS MEMS Market Tracker H1 2016

2016 MEMS Market (M$)



Medical - Industrial MEMS: ~ $2.0 billion, with moderate growth

BL Sensors: Introduction

Motion Sensor

Accelerometers, Gyro, Magnetometer Auto & IoT

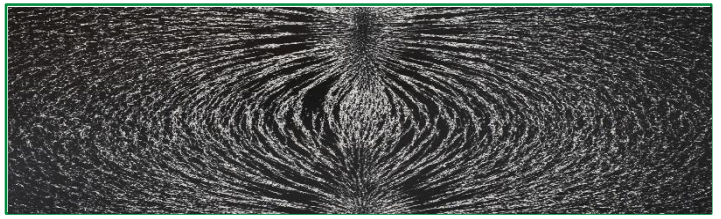
- All passive safety Tier-1's using NXP
- Next generation discrete & integrated UMEMS foundational for Auto & IoT
- Consumer/Industrial Gyroscope, e-compass & accelerometers.
- Active safety motion sensors

Pressure Sensors

TPMS, Engine Mgnt, Medical & Industrial pressure

- Investing lowest power, smallest size solutions
- High accuracy pressure - flow measurements
- E-inhalers pressure sensors
- Analog differential pressure sensors

Magnetic Sensors



Angular for Engine Control ABS Speed Sensors

- Angular sensors: engine control & steering
- Wheel speed sensors for ABS
- AMR→TMR transition foundational

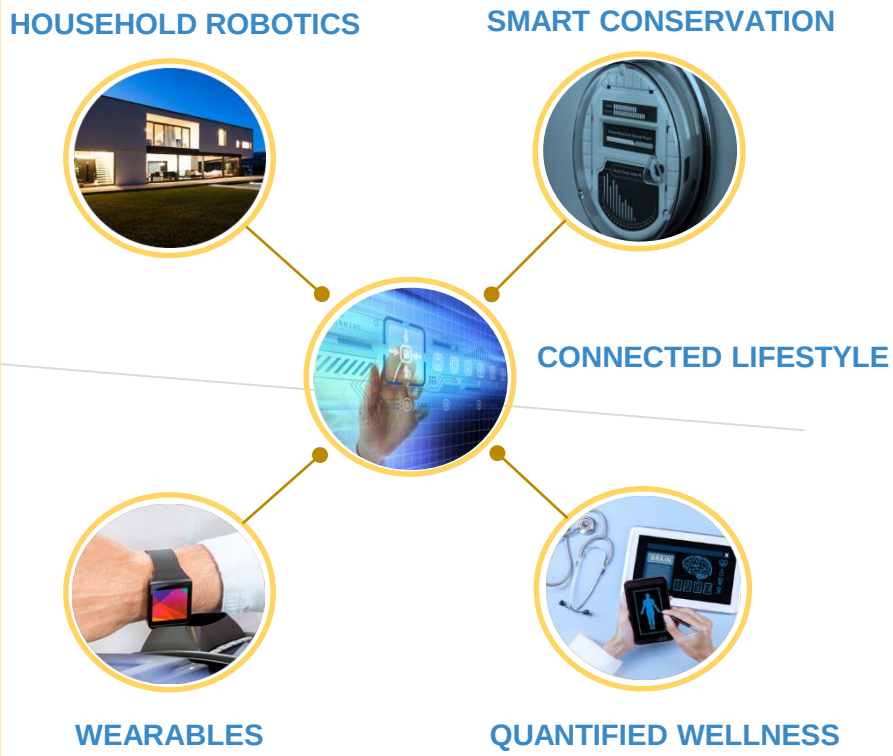
NXP Sensor Technology Supports key applications

Automotive

3 BILLION UNITS SHIPPED

- Magnetic (MR)
- Motion (MEMS)
- Pressure (MEMS)

Medical & Industrial



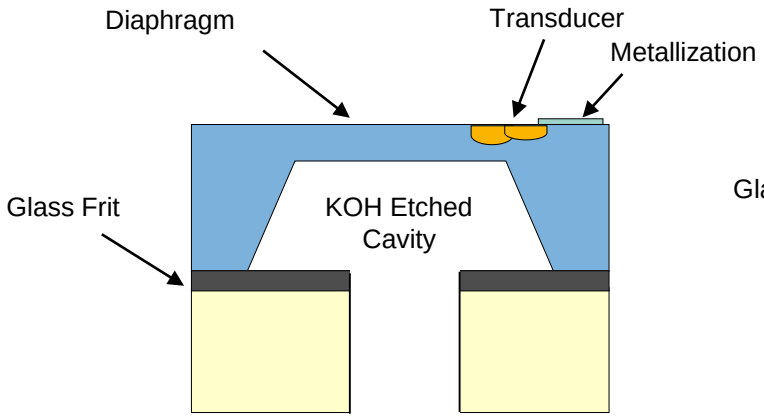
INDUSTRIAL MEDICAL PRESSURE SENSORS

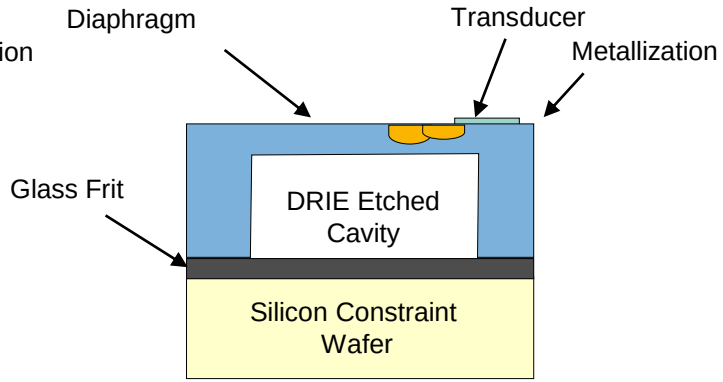
MEMS Pressure Sensor Technology

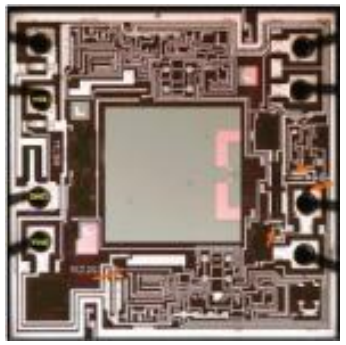
PRT- Bulk Micro machining

Legacy technology

Differential or Absolute configuration



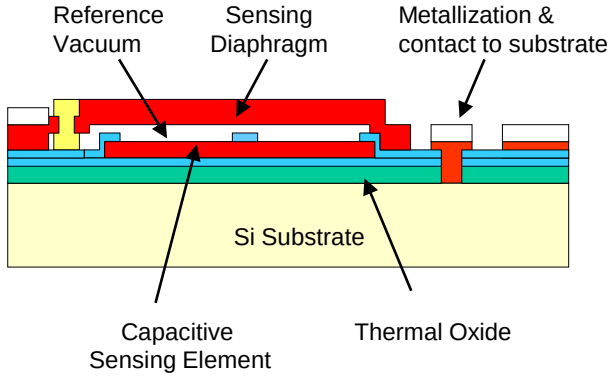


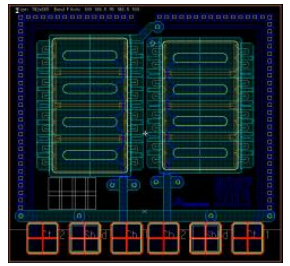


Pcell- Surface Micro machining

Used for all new automotive sensors

Absolute configuration only





Sketches and pictures not to scale

Pressure Sensors Family Overview

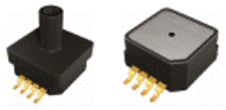
Pressure Sensor Family	Full scale pressure	Typical Applications
Barometric pressure	105, 110, 115, 130, 200 kPa abs.	Engine management, Altimetry, barometer
LPG and CNG	250, 300, 400 kPa abs.	Engine management LPG and CNG
Differential/Gauge low pressure	4, 6,10 kPa diff.	Industrial applications
Differential/Gauge Medium pressure	40, 50, 80, 100, 115 kPa diff.	Industrial and medical applications
Differential/Gauge High pressure	150, 200, 250, 500, 700, 1000 kPa diff.	Industrial applications
Vacuum Sensors	±2, ±7, ±25, ±50, ±115 kPa diff	Medical, Industrial applications
TPMS	450, 900, 1500 kPa abs.	Tire pressure monitoring

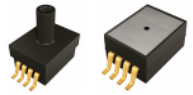

Unibody




SOP


Chip Pak


SSOP


M-Pak

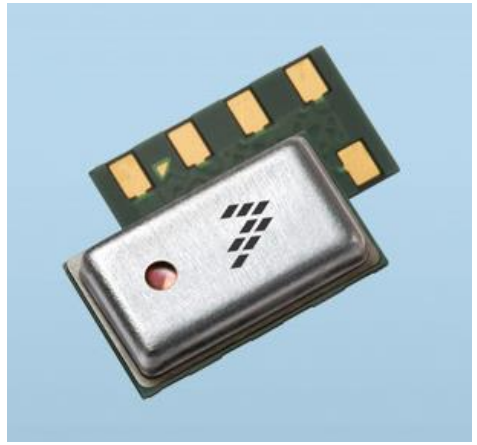

LGA


QFN

FXPQ3115BVT1: Biomedical Precision pressure sensor

Differentiating Points

- **Biomedically approved gel coating**
- Internally compensated, software is not needed
- Direct reading pressure in Pascals
- On-board intelligence
- Suited for smart metered dose inhalers (smart mdi). From simple triggering on inhalation flows to the dose characterization.



Product Features

- Pressure resolution: 1.5 Pa
- Pressure range: 20 – 110 kPa
- Calibrated pressure range: 50 – 110 kPa
- 1.95V to 3.6V supply voltage
- Variable output sampling rate (OST)
- I²C digital interface
- Interrupt driven events
- 32-Sample FIFO

Typical Applications

- Inhalers/Nebulizers
- CPAP Masks
- Medical Tablets
- Health Activity Monitors
- Oxygen Concentrators

Package

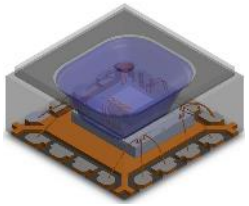
- 3 x 5 x 1.1 mm LGA

EV Samples: Now Upon Request
Qualification: Q4, 2016

AUTOMOTIVE BAROMETRIC PRESSURE SENSORS

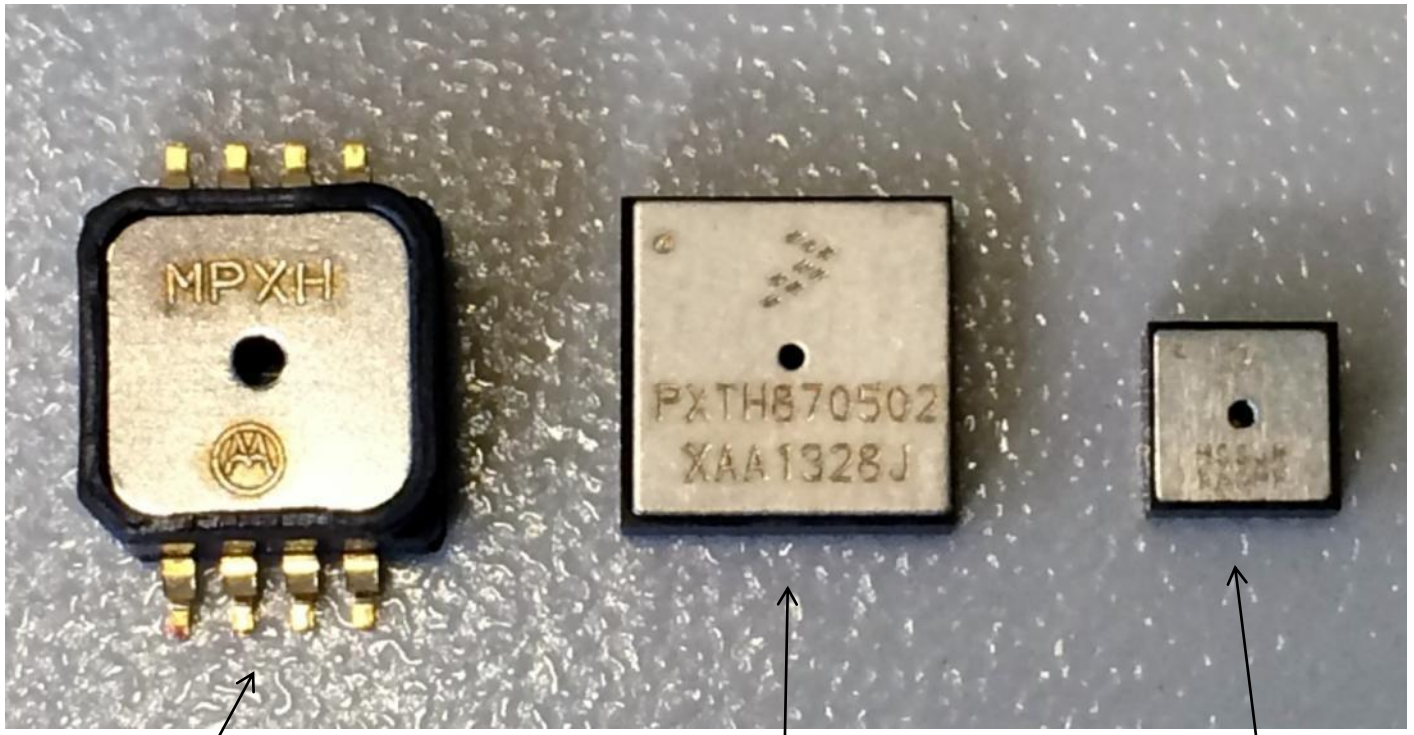
Automotive QFN4x4
New Absolute Pressure Sensor Platform

- **DBAP/AMAP** (digital or analog out)
  - Barometric Air Pressure Measurement
  - Engine Management BAP application
  - Engine Management MAP application
  - Engine Management Turbo application
  - **Engine Management LPG applications**
  - Comfort seating
  - Vacuum Brake booster



- Multiple pressure ranges
  115kPa, 250kPa, 450kPa, others
- ±1.0% accuracy (selected pressure and temperature range)
- Temperature Range: -40C to 130C
- Multi interface
  SPI, I2C, Analog
- Film assisted molding technology
- QFN 4x4x1.98mm package (16 leads)
- 2 die stacked – Pcell over ASIC
- Pressure sensor protected by chemical-resistant gel.

Package Evolution for Automotive Pressure Sensors



SSOP Package
MPXH6115

QFN7x7
TPMS gen 4

QFN4x4
DBAP/PSAT

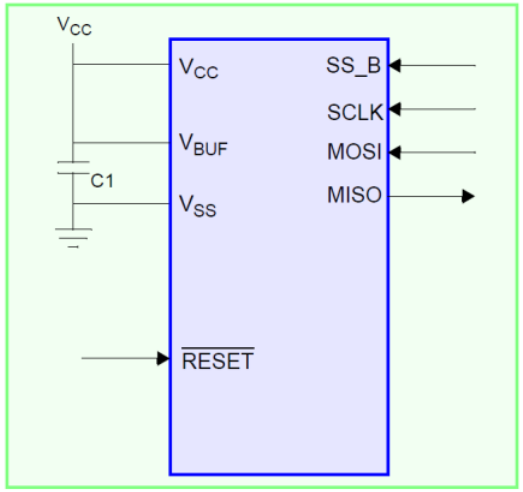
Digital Barometric Air Pressure Sensor

- **Product features**
  - Pressure Ranges
    - 15kPa to 115kPa, 40kPa to 115kPa (Samples now)
    - 15Kpa to 550Kpa high pressure (H2 2017)
    - Custom pressure range on demand
  - Maximum voltage range: -0.3V – 5.5V
  - Temperature Range: -40C to 130C
  - Accuracy: ±1.5% over full Pressure and Temperature Range
  - Digital Signal Processing
  - Standby current of 0.5mA
  - Low Power Sleep Mode with Wake on Select

- **32-Bit SPI Compatible Interface**
- **I2C Compatible Interface**
- **Analog Output**

- **Package: 4 mm x 4 mm x 1.98 mm Cavity QFN**
- **Automotive Qualified (AEC-Q100)**

SPI Application Diagram



LPN	Part Numbers	Description
DBAP	FXPS7115DS4T1	40-115 kPa, BAP Product Digital SPI Output
DBAP	FXPS7115DI4T1	40-115 kPa, BAP Product Digital I2C Output
DBAP	FXPS7015DS4T1	15-115 kPa, BAP Product Digital SPI Output
DBAP	FXPS7015DI4T1	15-115 kPa, BAP Product Digital I2C Output
AMAP	FXPS7015A4T1	15-115 kPa, Analog Output
AMAP	FXPS7250A4T1	20-250 kPa, Analog Output
AMAP	FXPS7450A4T1	20-450 kPa, Analog Output
AMAP	FXPS7550A4T1	20-550 kPa, Analog Output
AMAP	FXPS71500A4T1	50-1500 kPa, Analog Output

ACCELEROMETERS

Accelerometers

- Detect acceleration resulting from tilt, motion, shock, and vibration
- Single, dual, or triple axis sensing capability with wide g ranges
- Applications
  - Activity monitors
  - Anti-tampering
  - Asset tracking
  - Crash detection
  - Human machine interface
  - Inclinometer
  - Pedometer
  - Vehicle stability
  - Vibration monitoring

Accelerometers for the IoT / Industrial

MMA845x

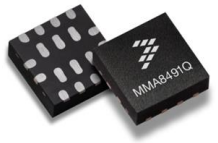
- **3 x 3 x 1 mm QFN**
- I²C output
- 0.25mg/count sensitivity
- Extended Features
  - FIFO
  - Configurable P/L trip angles
  - High Pass Filter

MMA865x

- **2 x 2 x 1 mm DFN**
- I²C output
- 1 mg/count sensitivity
- Extended Features
  - FIFO
  - Configurable P/L trip angles
  - High Pass Filter

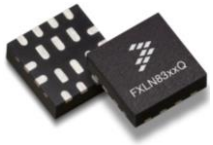
FXLS8962AF

- **2 x 2 x 1 mm DFN**
- SPI/I²C/ one wire output
- < **650nA** @ low ODR
- Cost Efficient
- **Up to ±16g**
- Rich Features
  - P/L detection
  - High Pass Filter
- 1.7V to 3.6V



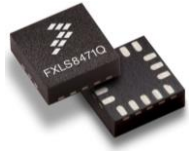
MMA849x

- **3 x 3 x 1 mm QFN**
- I²C output
- **XYZ tilt detection outputs**
- 700µs detection latency
- Trigger able sampling: 0.4µA/Hz



MMA83xx

- **3 x 3 x 1 mm QFN**
- **Analog output**
- **Up to ±16g**
- Up to 2.7kHz bandwidth
- 150 µg/√Hz noise density
- **-40° to 105°C**
- 1.7V to 3.6V

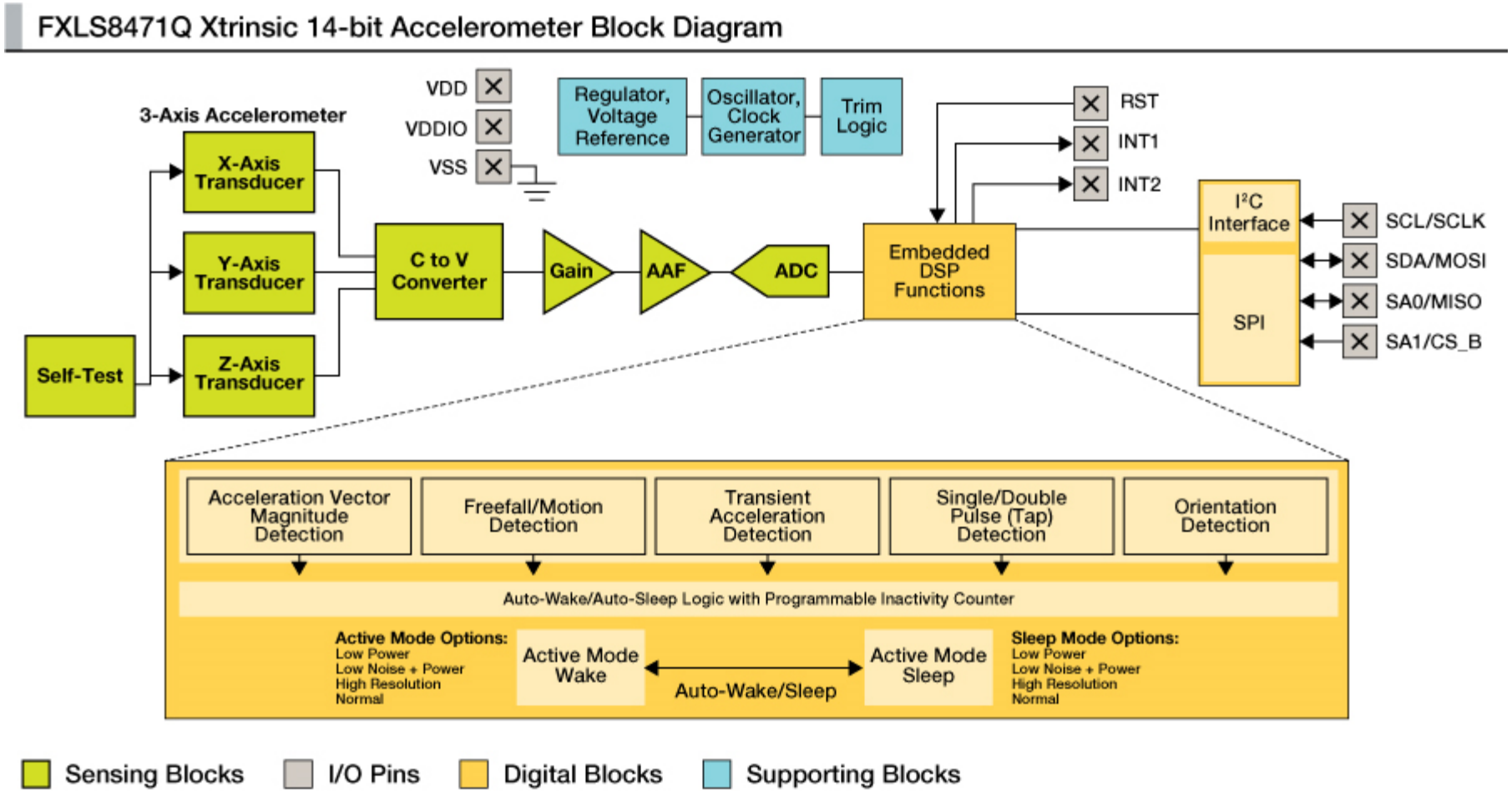


MMA8471

- **3 x 3 x 1 mm QFN**
- **SPI** /I²C output
- 0.25mg/count
- Extended Features
  - FIFO
  - Configurable P/L trip angles
  - High Pass Filter
  - **Vector magnitude**

Highest performance → Low cost → Lowest power → Tamper detection → Analog Industrial → Highest Performance

NXP Accelerometer typical block diagram



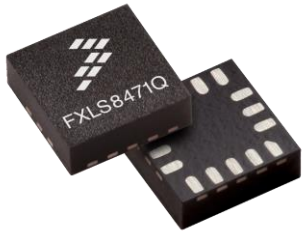
NXP 3 axis Accelerometer typical performance

Differentiating Points

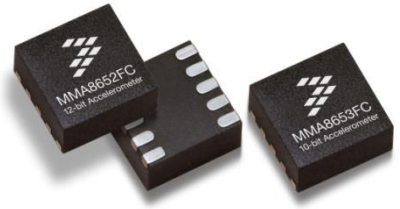
- Best-in-class **offset accuracy** for accurate tilt detection: ±20mg vs. ± 35-50mg for competition
- Superior **TCO** down to 0.15mg/°C and **temperature sensitivity** 0.008%/°C for accuracy over temperature
- Complete **integrated feature set** including
  - Vector magnitude, FIFO and high pass filter
  - Auto wake up/sleep mode
  - Portrait-landscape, motion, free fall & transient detect

Product Features

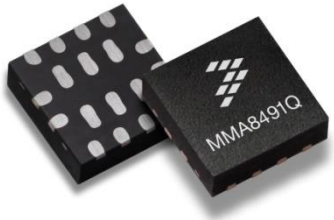
- SPI/I²C digital output interface w/interrupts
- 1.7 V/1.95 V to 3.6 V supply voltage
- ±2g/±4g/±8g or up to 16±g dynamically selectable range
- Output data rate (ODR) from 800 Hz to 1.563 Hz
- Programmable OS for power consumption/noise trade-off
- Benchmark Output Noise (<100ug/r Hz)
- Resolution up to 0.25mg/count for the 14-bit resolution



Package
3x3x1 mm QFN, 0.5 mm pitch



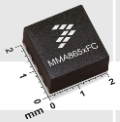
Package
2x2x1 mm DFN, 0.5 mm pitch



Package
3x3x1.05 mm DFN, 0.65 mm pitch

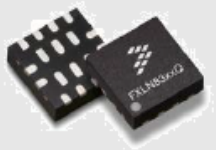
Digital Accelerometers

Key Products

	Sample	Production	Applications
MMA8451/52/53 3-axis ±2, ±4, ±8 g 10/12/14-bit **Digital I²C**			
• Embedded function and interrupt : (FIFO, High pass filter, P/L,…) • Ultra low noise (99 µg/√Hz), low TCO (0.15mg/°C) • High performance Consumer & Industrial • Down to 0.25mg/LSB sensitivity • 1.95...3.6 Volt, 3 x 3 x 1 mm QFN	Web	Now	Tilt Measurement Pedometer Power Management eCompass Asset Tracking Activity Monitor Sports Watch Fleet Management Remote Controls Appliance
FXLS8471 3-axis ±2, ±4, ±8 g 14-bit **Digital SPI or I²C**		Now	
• Embedded functions and interrupts (all + Vector magnitude) • High performance industrial grade • 1.95...3.6 Volt, 3 x 3 x 1 mm QFN			
MMA8652/53 3-axis ±2, ±4, ±8 g 10/12-bit **Digital I²C**	Web	Now	
• Embedded functions and interrupts (8652 same as MMA8451) • Software compatible with the MMA845x family • Low cost • 1.95...3.6 Volt, 2 x 2 mm DFN			
MMA8491 3-axis Tilt Sensor 14-bit **Digital I²C + 3 Logic Out**	Now	Now	Tamper Sensor Rolling Ball Switch Alarm/Security Freefall Detect Remote Control Low Power Wake-up
• Ultra low power down to 400 nA/hz, • 3 logic outputs to flag tilt on the 3 axis • I²C interface to read raw acceleration data • 1.95...3.6 Volt, 3 x 3 x 1 mm DFN			

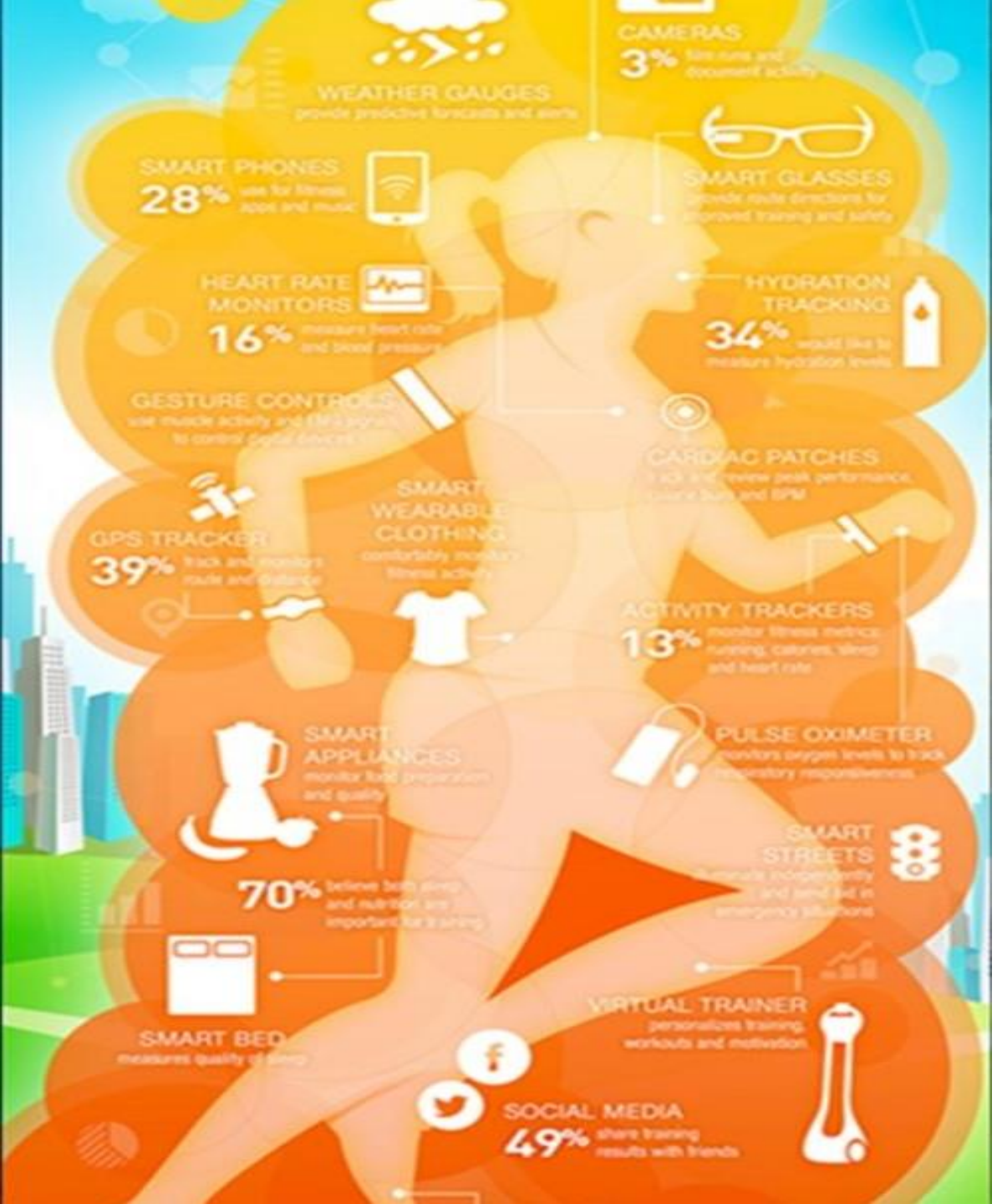
Drivers available on request

Analog Accelerometer family

	Sample	Production	Applications
FXLN8361 3-axis ±2/±8 g **Analog Out, low bandwidth**	Now	Now	Vibration Monitoring High Precision Industrial Control Sport Applications Preventive Maintenance
FXLN8362 3-axis ±4/±16 g **Analog Out, low bandwidth**	Now		
FXLN8371 3-axis ±2/±8 g **Analog Out, high bandwidth**	Now		
FXLN8372 3-axis ±4/±16 g **Analog Out, high bandwidth**	Now		
• High Bandwidth: up to 2.7 kHz on XY • Low Bandwidth : up to 1.1 kHz on XY • Low power 180 µA in running mode, low voltage • High performance industrial grade • -40°C to 105°C operating range • Sensitivity up to 229 mV/g • **1.7...3.6 Volt**, 3 x 3 x 1mm, 0.65mm pitch 12 pins QFN 			

Drivers available on request

INTELLIGENT SENSOR HUB



Intelligent Sensor hubs

- Provide algorithmic processing integrated with sensing
  - Pedometer algorithm embedded
  - System power management
  - Partitioning real time algorithms from user interface software
  - Smaller footprint
- Applications
  - Industrial vibration monitoring
  - Watches
  - Patient monitors
  - Ear buds
  - Inclinometer

MMA955x Sensor Products

Products	MMA9550	MMA9551	MMA9553	MMA9555	MMA9559	FXLC95000CL
Silicon	Accel + MCU	Accel + MCU	Accel + MCU	**Accel + MCU**	Accel + MCU	Accel + MCU
Package	3x3 LGA	3x3 LGA	3x3 LGA	**3x3 LGA**	3x3 LGA	3x5 LGA
User Flash	6.5 KBytes	4.5 KBytes	1 KBytes	**-**	14 Kbytes	128 Kbytes
User RAM	576 Bytes	452 Bytes	0.2 KBytes	**-**	1.5 Kbytes	16 Kbytes
Preloaded Functions	Infrastructure only functions	Infrastructure + Gestures	Infrastructure + Pedometer	**Orientation + Pedometer**	Lightweight Infrastructure	Open Platform / Sensor Hub

- MMA955xL devices are pre-loaded with application at the factory
- User can add custom software using the remaining portion of Flash memory
- **MMA9555: Full turnkey Pedometer Software and Orientation Detection.**

  Low-power pedometer with rich output information (117µA full running mode) :

  - **Step counting**
  - **Speed, distance, calorie count estimation**
  - **Activity level (rest, walking, jogging, running).**

GYROSCOPE

Gyroscopes

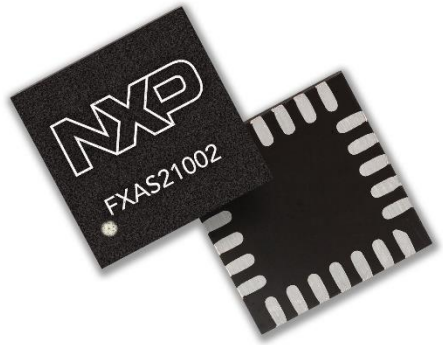
- Measure angular rate of a moving object, insensitive to linear motion
- 3-axis sensing capability with configurable ranges up to 4000 dps
- Applications
  - Activity tracking
  - Gyro-compensated compass
  - Human machine interface
  - **Sport applications**
  - Inertial measurement unit
  - Inertial navigation
  - **Robotics**
  - Virtual reality and augmented reality
  - Vehicle stability

FXAS21002C

3 Axis Gyro With Market Leading Power Consumption: Over 40% Better Than The Leading Competitors

- Differentiating points
  - Best-in-class power performance: 2.7 mA (Active), **1.6 mA (Ready**), 2uA (Standby)
  - Complete sensor fusion enablement suite

- Product features
  - Enhanced selectable full scale ranges: +/-250, +/-500, +/-1000, +/-2000, **+/-4000 dps suited for sport application**
  - Fast transition from standby to active mode (60 ms)
  - Expanded output data rates (ODR) from 12.5 Hz to 800Hz
  - Zero rate change over temperature: ±0.02dps/°C (XY), ±0.01dps/°C (Z)
  - Improved noise: angular random walk = 0.025 dps/rt(Hz)
  - Angular velocity resolution <0.2°/s
  - Programmable interrupts, power saving features
  - 1.95-3.6 V supply voltage



Package
4x4x1 mm QFN, 0.5 mm pitch

Gyroscopes for Robotics

- Single axis gyroscopes are often used in robotics
  - One typical use case involves a wheeled robot where translational motion is controlled with wheel encoders and turning is controlled by a z-axis gyro
  - Power consumption and package size are not critical in these applications.
  - Performance is important (Offset, Sensitivity, TCO, TCS, Noise, Linearity)

- The z-axis of FXAS21002 is significantly better than XY
  - Z-axis sensor is a higher performance design compared to the XY Sensor
  - This can help us in robotics as shown on next slide

FXAS21002 Z-axis Performance

- Z-axis is better than xy axes in critical parameters such as zero-rate offset, TCO, TCS, Cross Axis Sensitivity, Noise, and Linearity (See table and graph below)
- More details provided in Comprehensive CZ Report (Request from PLM, share under NDA)

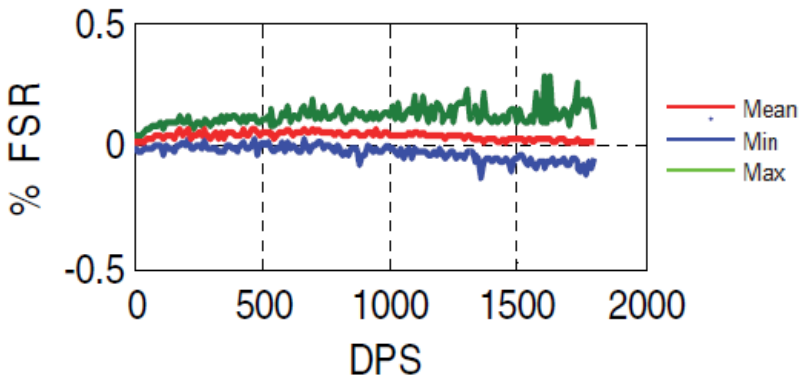
Parameter	Datasheet Typical Spec	x-axis			y-axis			z-axis		
		Mean	Sigma	μ + 1σ "Typical"	Mean	Sigma	μ + 1σ "Typical"	Mean	Sigma	μ + 1σ "Typical"
Zero-Rate Offset	± 50 LSB	4.1	11.9	± 16 LSB	-5.2	14.3	± 20 LSB	1.4	7.8	**± 9 LSB**
TCO	XY: ± 0.02 dps/°C Z: ± 0.01 dps/°C	0.004	0.01	± 0.014 dps/°C	0.001	0.011	± 0.012 dps/°C	0.003	0.007	**± 0.010 dps/°C**
TCS	XY: ± 0.08 %/°C Z: ± 0.01 %/°C	0.046	0.008	± 0.05 %/°C	-0.066	0.012	± 0.08 %/°C	0.002	0.004	**± 0.006 %/°C**
Cross-Axis Sensitivity	± 1.5%	-0.19	0.72	± 0.9%	0.6	0.78	± 1.4%	0.74	0.24	**± 1.0%**
Noise	25 mdps/√Hz	Median = 29.5 mdps/√Hz			Median = 25.1 mdps/√Hz			**Median = 16.9 mdps/√Hz**		
Bias Stability	Not specified	Mean = 19.7 deg/hr			Mean = 12.3 deg/hr			**Mean = 10.6 deg/hr**		

Not included on External Version

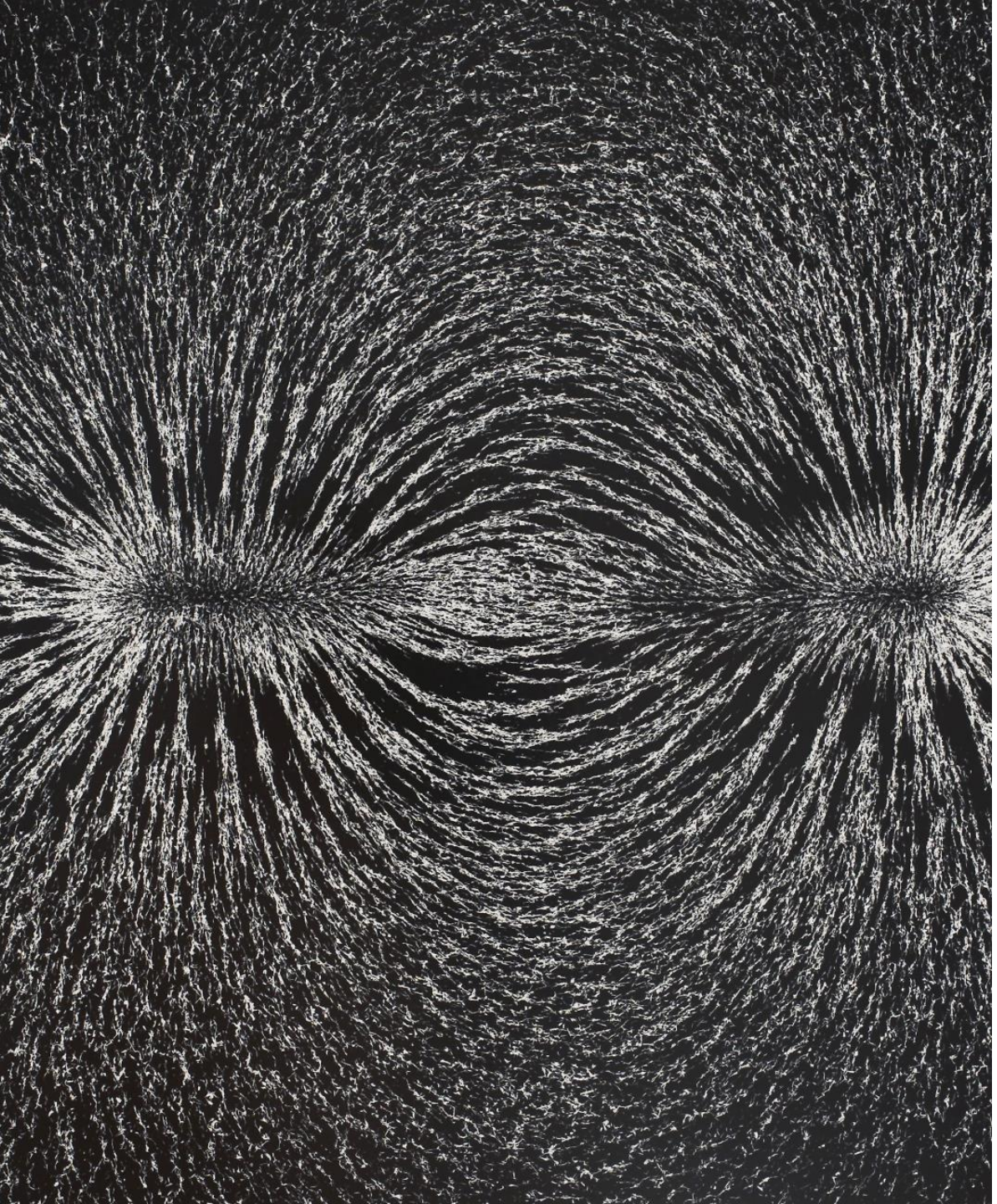
TCO and TCS are computed over range -40°C to 85°C
Zero-Rate Offset, Cross-Axis Sensitivity, and Noise are measured at 25°C
All parameters are Post Boardmount except Cross-Axis Sensitivity
Cross-Axis Sensitivity shown in table is worst case of 2 cross-axis values

Sample sizes are roughly 3 lots x 30 parts for all tests except Bias Stability
Bias Stability is based on random selection of 5 parts taken from noise study

Integral non-linearity (z-axis @ 25°C)



MAGNETOMETERS



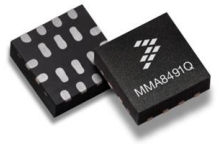
Magnetometers

- Measure direction and/or magnitude of a magnetic field
- Can be used to measure radial distances, angular positions and rates
- Applications
  - **Angular position monitor**
  - Angular rate monitor
  - **Anti-tampering**
  - Dosimeter
  - **Electronic compass**
  - **Magnetic field measurements**
  - **Wheel speed detection**

Magnetometers for the IoT

MAG3110

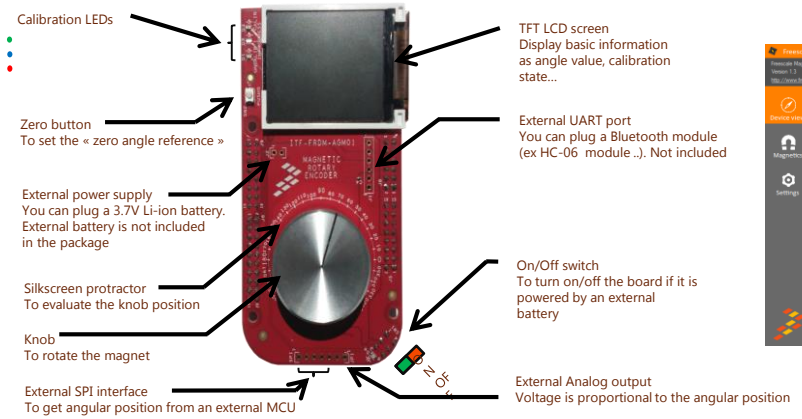
- **2 x 2 x 0.85 mm DFN**
- I²C output
- 0.10µT sensitivity
- 0.25 µT rms noise
- Magnetic calibration S/W support
- Up to 80Hz output data rate

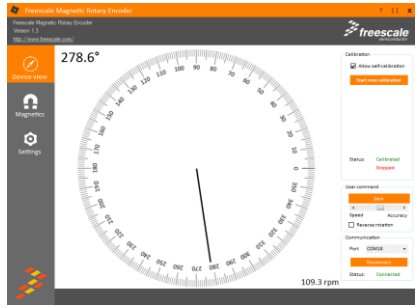


FXOS8700

- **3 x 3 x 1.2 mm QFN**
- I²C output
- **Accel + Mag combo**
- 1.6 to 800Hz output data rate
- Low power: 80µA @25 Hz
- Magnetic calibration S/W support
- Vector magnitude trigger

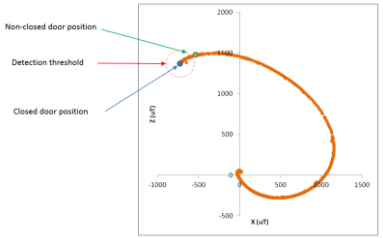
- Electronic compass (open source calibration library)
- Rotary encoder (open source library + Reference design)

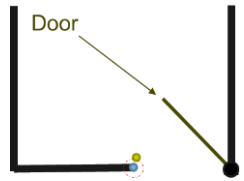




RD-KL46Z-MRE

- Door state detection (open source library + Reference design based on RD-KL25-AGPM01)





TIRE PRESSURE SENSORS

Why Tire Pressure Monitoring ?

- **Safety for everyone**
  - TPMS **Prevent roadside breakdown** and risk of road congestion
  - US tread act to **prevent roll over accidents**
  - **Regulation** around the world (including China)

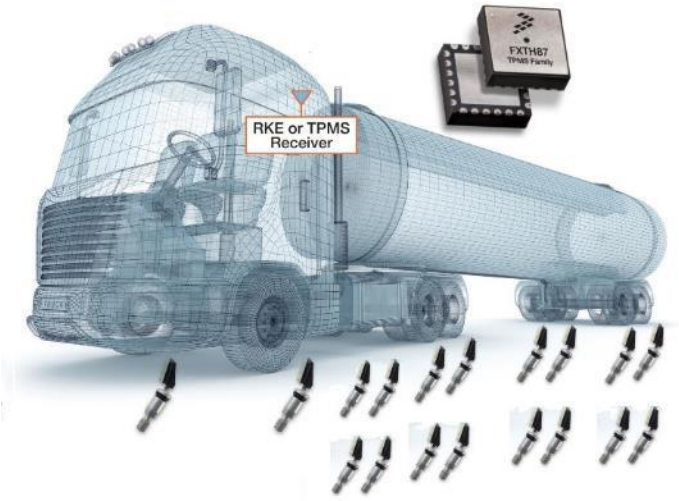
- **Cleaner world for everyone**
  - TPMS allows **optimum tire inflation** and thus fuel consumption and **CO2 emission reduction**
  - Maximizes tire life

- **Intelligent tires: A potential to be exploited**
  - Link tire information with chassis and **ADAS** system
  - Necessary building block for **automated driving**
  - Provides accurate **tire data** to the driver
  - **Filling assistant** app on smartphones
  - Fleets & Truck: enables better **tire management**

TPMS Potential Market Size

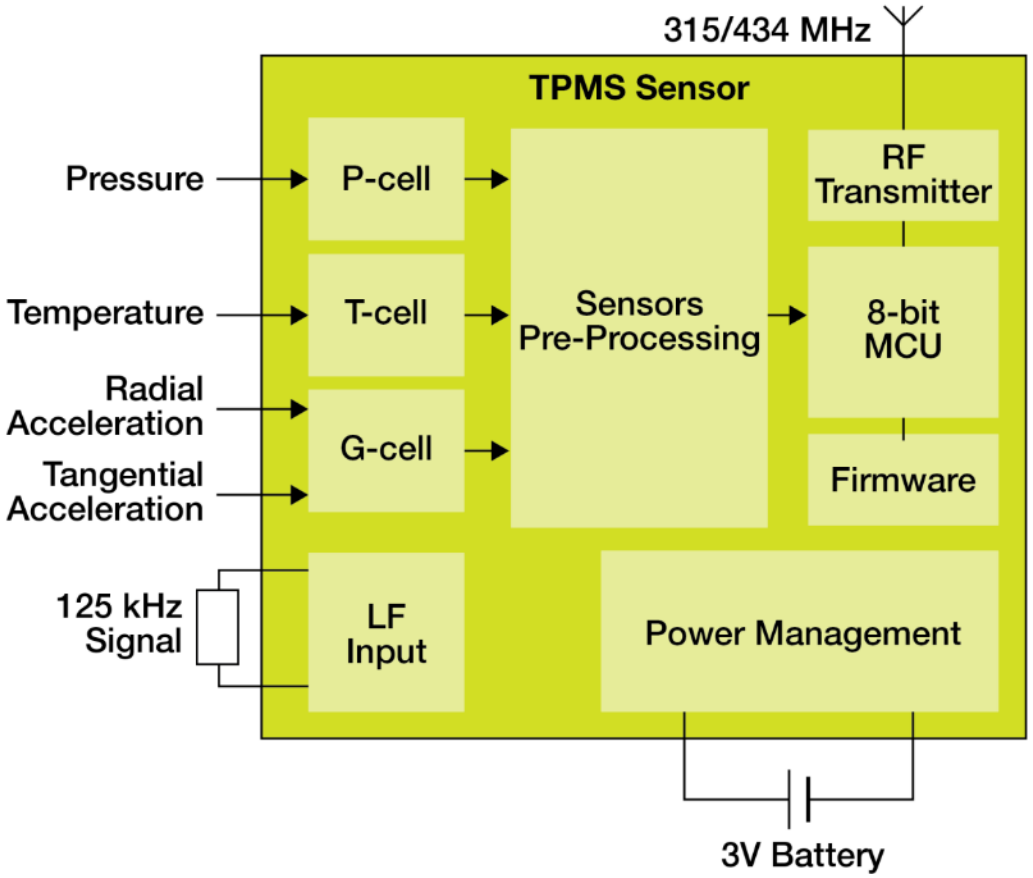
- **100 million new cars sold per year by the end of the decade**
  - 4 wheels per car + winter tires in some regions
  - Potential China impact: 25Mu car x 4 sensors = 100Mu sensors

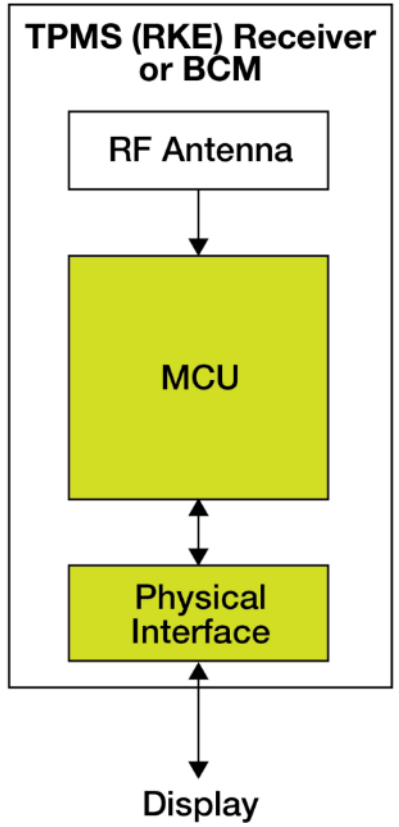
- **1 billion cars on the road worldwide today!**
  - Great aftermarket opportunity
  - Great potential for tire mounted solutions



- **Heavy trucks, buses, motorcycles, all vehicles with tires**

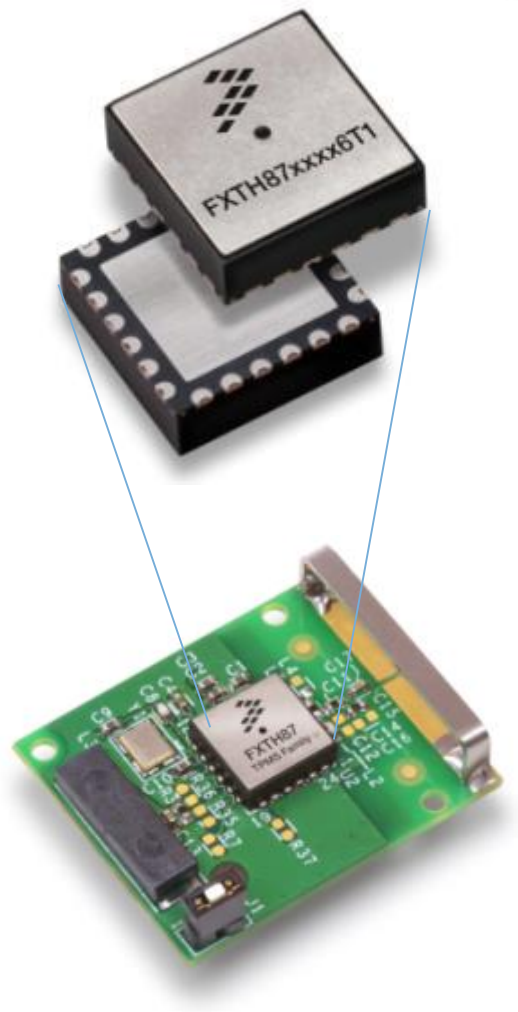
Tire Pressure Monitoring System Application Diagram





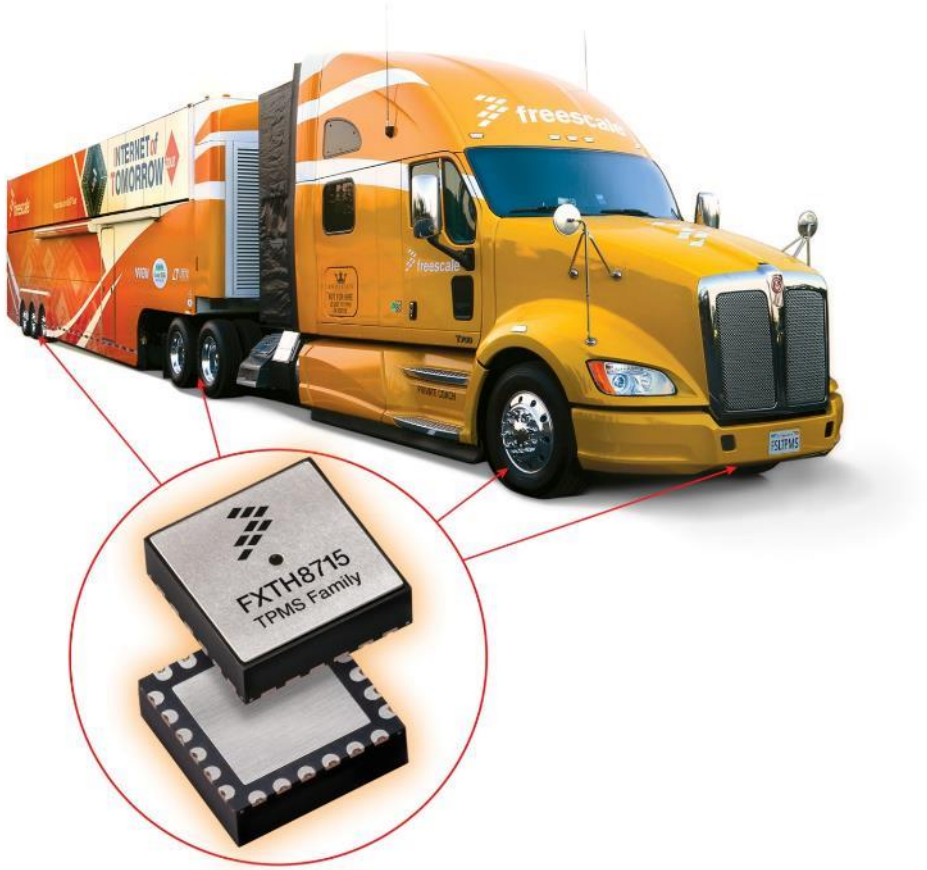
FXTH87 Tire Pressure Monitoring Sensor

- **Fully integrated TPMS sensor**
  - QFN 7x7x2.2 mm
- **Multiple pressure sensor ranges**
  - 450, 900 and 1500kPa
  - Ideal for passenger cars, trucks, aftermarket
- **Dual axis accelerometer** for extended sensing functionalities
- Embedded **MCU** and **dedicated TPMS Library**
  - Large Memory space for customer application
  - New SW library available
- **LF and RF** wireless interface
- **Volume production**
  - 450, 900kPa and 1500kPa released



Industry's best in class Truck TPMS Sensor

- **Highest level of integration**
  - Up to 1500 kPa pressure sensor
  - 1-/2-axis accelerometer
  - MCU with 315/434 MHz RF transmitter and LF receiver
  - **Most accurate device on the market**
- **Compact and Light weight**
  - 7 x 7 x 2.2 mm, 0.3g
  - Enable weight and space constrained TPMS modules
- **Single and Dual axis accelerometer**
  - Easy after market installation
  - Support all tire localization methods
- **8 kB flash for customer application**
  - Enable differentiated module features
- **In Production Now**



TPMS Implementation in Light or Heavy Vehicles

Modules installed on the valve stems

- Rim or valve stem mounted
- Pressure and temperature sensing
- Roll switch, wheel localization
- Battery operated
- Independent from the tires

Modules installed on the tire treads

- Tire mounted sensors
- Pressure, temperature, radial and
  tangential tire acceleration
- Battery operated or battery less
- Linked to the tire

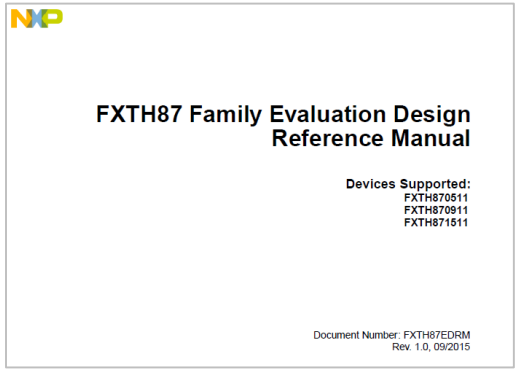
Modules installed on the tip of the valves

- Sensors mounted on top of the tire valves
- Pressure, temperature, radial tire acceleration
- Battery operated
- Common in aftermarket solutions

FXTH87 Eco-System

- **Evaluation Boards:** emulate typical customer wheel unit module containing FXTH87 sensor, LF coil, RF antenna, battery, and all passives
  - TPMS871511-315 (1500 kPa – 315 MHz)
  - TPMS871511-434 (1500 kPa – 434 MHz)

- **Application Notes / Reference Manuals for FXTH87 TPMS family**
  - **FXTH87EDRM:** FXTH87 Family Evaluation Design Reference Manual
  - **FXTH87XX22FWUG:** FXTH87xx22 Embedded Firmware User Guide
  - **AN4277:** Interfacing to NXP FXTH87xx In-Flash Firmware Routines Using C-language Constructors
  - **AN4391:** Using the FXTH87 Family of LF Receivers for TPMS Application
  - **AN1902:** Assembly Guidelines for QFN and DFN Packages to cover the QFN7x7mm packages
  - **AN5136:** Applying the Kinetis MKW01 as the receiver for the FXTH87 Tire Pressure Monitoring Sensor.



- **General support topics:**
  - **Assistance with implementing a wireless (LF/RF) boot-loader** to re-program customer application memory space.
  - **Assistance with selectively increasing customer application memory space** with the FXTH8715117T1 and FXTH8715027T1.
  - **Assistance with tuning RF matching network** to suit customer specific antenna choices

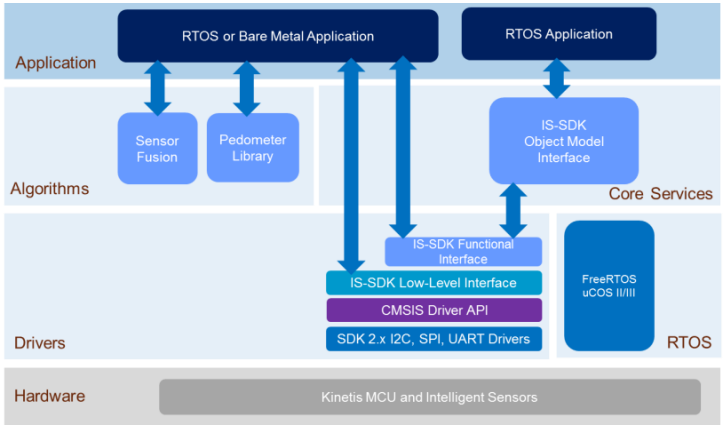
For further information please refer to: www.nxp.com/TPMS

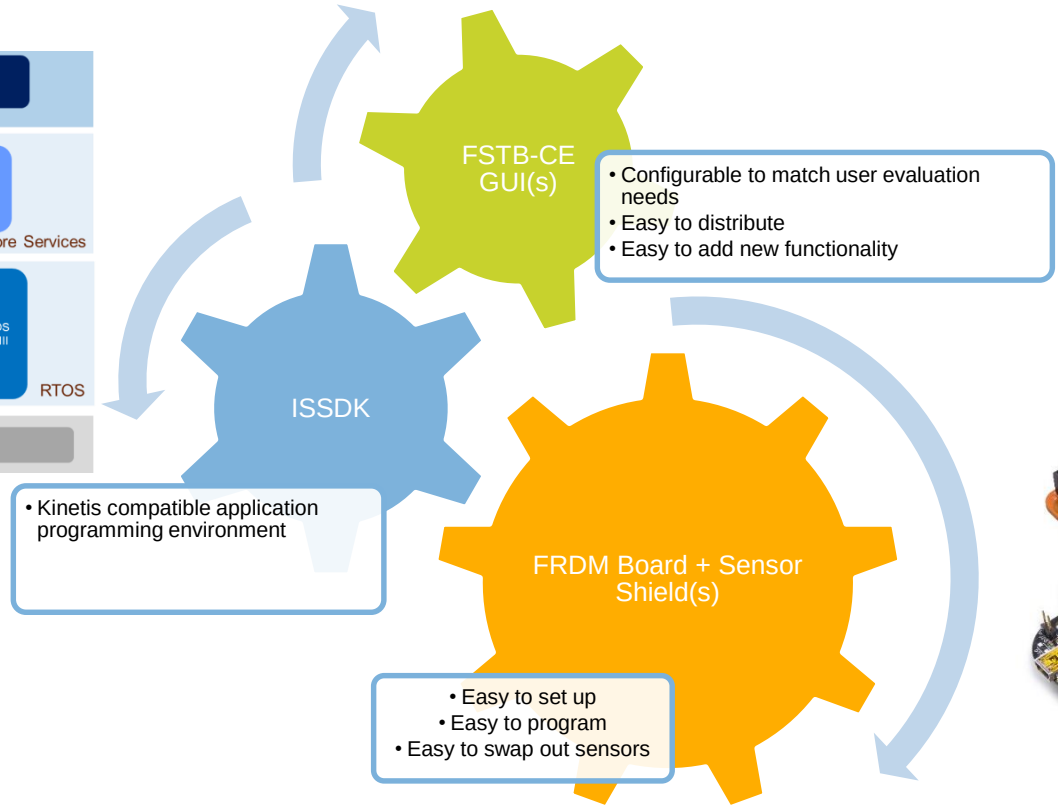
NXP TPMS Sensors are used by the following brands*

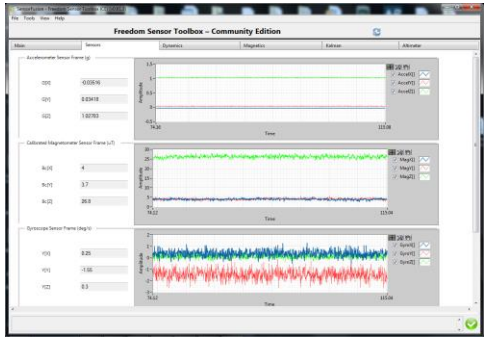
*Not an exhaustive list

ENABLEMENT

The Sensor Evaluation Ecosystem in a Nutshell







Freedom Sensor Toolbox Ecosystem Overview

Evaluation

- Kits - FRDM board + shield
- Example Applications
- Freedom Sensor Toolbox GUI

Prototyping

- Breakout boards
- ISSDK + Kinetis SDK + Driver Examples + Application Examples
- Algorithms + Examples

Product

- Customer Hardware
- Derived Applications & Algorithms
- ISSDK/ Kinetis SDK

Sensor Toolbox Board Repository

Sensor Toolbox Name	Board Type	Board Name
Sensor Toolbox for 9-Axis Solution	Demo Kits	FRDM-K22F-AGM01
		FRDM-K64F-AGM01
	Shield Board	FRDM-STBC-AGM01
	Breakout Board	BRKT-STBC-AGM01
Sensor Toolbox for FXLC95000CL Intelligent Motion Sensor	Demo Kit	FRDM-K22F-SA9500
	Shield Board	FRDM-STBC-SA9500
	Breakout Board	BRKT-STBC-SA9500
Sensor Toolbox for FXLS8471Q 3-Axis linear Accelerometer	Demo Kit	FRDMKL25-A8471
	Shield Board	FRDMSTBC-A8471
	Breakout Board	BRKTSTBC-A8471
Sensor Toolbox for MMA8491Q 3-Axis Digital Accelerometer	Demo Kit	FRDMKL25-A8491
	Shield Board	FRDMSTBC-A8491
	Breakout Boards	BRKTSTBC-A8491
Sensor Toolbox for MPL3115A2 Pressure Sensor/ Altimeter	Demo Kit	FRDMKL25-P3115
	Shield Board	FRDMSTBC-P3115
	Breakout Boards	BRKTSTBC-P3115
Sensor Toolbox for MPXV5004DP Analog Pressure Sensor	Shield Board	FRDMSTBCDP5004
	Breakout Boards	BRKTSTBCDP5004
Sensor Expansion board for multiple sensors	Shield Board	FRDM-FXS-MULT2-B

Breakout Board

Shield Board

KIT(Shield + MCU)

Supported Sensors

Sensor Part Number	Sensor Type	Interface
FXAS21002	Gyroscope	SPI I2C
FXLC95000	Intelligent Accelerometer	SPI I2C
FXLN83XX	Analog Accelerometer	via KSDK ADC and GPIO
FXLS8471	Digital Accelerometer	SPI I2C
FXLS8952	Digital Accelerometer	I2C
FXOS8700	Digital Accelerometer and Magnetometer	SPI I2C
MAG 3110	Digital Magnetometer	I2C
MMA845X	Digital Accelerometer	I2C
MMA8491	Digital Accelerometer	I2C
MMA865X	Digital Accelerometer	I2C
MMA9553	Intelligent Accelerometer	I2C
MPL3115	Digital Pressure	I2C

SECURE CONNECTIONS
FOR A SMARTER WORLD