Sensors for Medical Applications

Motion and pressure sensors designed for high functionality, accuracy and reliability

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OVERVIEW

NXP is a leading high-volume sensor provider with an extensive selection of accelerometers, magnetometers, pressure sensors and touch sensors for medical applications. We combine premium materials, advanced micromachining techniques, thin-film metallization and bipolar semiconductor processing to provide accurate, highly reliable products at competitive prices for exceptional patient care and affordability.

Medical Sensor Portfolio Overview

MEDICAL SENSOR PORTFOLIO

Medical Applications	Pressure Sensors	Motion Sensors	Differentiators
Hearing aid/Earphones		MMA8652FCR1, FXLS8962AFR1	Tap detect to turn on/off the hearing aid, low-power consumption in active mode, small size, quick capture of the pulse (10-40 ms), accurate pulse detection block, full-scale range
Insulin pens, pumps and pods	MPL3115A2, FXPQ3115BV, MPL3150A2	MMA8451QR1, MMA8652FCR1, FXLS8471QR1	Highly precise pressure, high sensitivity, power saving/ auto shutoff when not in use
Smart inhalers	MPL3115A2, FXPQ3115BV	MMA8451QR1, FXLS8471QR1	Small form factor, high sensitivity, power saving/auto shutoff when not in use, inhaler posture detection for controller medicine dispensation
Powered patient bed	MPX2010DP, MPX5010DP	MMA8451QR1, FXOS8700CQ, FXLS8962AFR1	Robust packaging, high sensitivity, fully amplified accurate tile detection function
Patient activity monitor	MPL3115A, FXPQ3115BV	MMA8652FCR1, FXOS8700CQ, FXLS8471QR1	Active and standby power, auto shutoff when not in use, fits into a small space, full-scale range and bandwidth
Invasive and non-invasive blood pressure monitors, fetal heart rate monitors	MPX2300DT1, MPX2301DT1, MPXM2053GS, MP3V5050	MMA8451QR1, FXLS8471QR1	High-quality, high volume production, biocompatibility
Negative pressure wound management	MPL3115A2, MPL115A, MPL3150A2, MPXV5100G, FXPQ3115BV	MMA8451QR1, MMA8652, FXLS8471	Small package height, multiple porting options
Respiratory monitoring	MPXV5004GC6T1, MPXV7002DP, MPL3115A2, FXPQ3115BV	MMA8451QR1	High sensitivity, high volume production, patient activity monitoring, Barometric and differential pressure measurement, Orientation and tilt detection
Smart pill box and telehealth	MPX5010DP, MPXM2010GS	MMA8451QR1, MMA8652FCR1	Patients pills adherence monitoring, reminders based on inactivity on pillbox, extra dosage alert, tamper detection

Benefits:

- Robust and reliable designs
- More than 30 years of sensor innovation
- Our next-generation sensors feature an ideal balance of intelligent integration, logic, and customizable platform software to enable smarter, more differentiated applications.
- Trusted supplier with long-term product commitments

Target applications:

- Hearing aids and earphones
- Inhalers and ventilators
- Spirometer and respiratory therapy devices
- Hospital beds
- Non-invasive and invasive blood pressure monitors
- Wound management
- Smart sleep/snoring relief (position-dependent snoring detection/alert)
- Fetal heart rate monitors
- Drug delivery systems
- Patient monitoring systems
- Sleep apnea

Sensor Use in Specific Products

HEARING AIDS AND EARPHONES

Hearing aids amplify incoming sounds to the ear and help hearing-impaired individuals hear better in both quiet and noisy situations. Low-power, digital and adaptative filtering are key design elements for reducing environmental noise so that the product only amplifies desired signals and sends them to the speaker. An inertial sensor can enable gesture recognition in high-end units where a shake motion could turn on the hearing aid or change the volume.

Use cases

- Tamper detection, theft detection (on motion detection when not in use),
- Power saving using Auto-Wake/Sleep
- Freefall detection for elderly patients
- Tap detection to turn on/off and modulate volume
- Posture monitoring
- Dizziness detection with accelerometers

Critical factors

- Tap detection for hearing aid power on/off
- Low-power consumption in active mode for extended battery life
- Small size
- Quick pulse capture (10–40 ms)
- Accurate pulse detection block
- Full-scale range
- HPF enabled (remove static g)

Sensor	Function within Product
MMA8652FCR1	Small 3-axis accelerometer with low power consumption
FXLS8962AFR1	3-axis accelerometer with digital features for inertial event detection

INSULIN PENS, PUMPS AND PODS

Insulin pens, pumps and pods deliver insulin as part of a diabetes mellitus treatment. Though diabetes is a very common health concern in today's world, tight glycemic control and early diagnosis can greatly reduce the number and severity of medical complications. True glycemic control maintains a person's blood glucose level within a physiologically acceptable range with a closed-loop insulin delivery system. This system requires miniaturization and coordination of three components: a safe and reliable insulin infusion device, an accurate and stable glucose sensor, and a control system that regulates insulin delivery according to blood glucose variations assessed by the glucose sensor.

Use cases

- Accelerometer to provide wake-up and usage monitoring
- Accelerometer to guide handling (i.e., orientation detection, appropriate shaking) for dispersing medicine
- * Accelerometer for activity monitoring correlation

Critical factors

- The U.S. diabetes monitoring, treatment and drug delivery market includes:
  - – Traditional glucose blood meters
  - – Continuous glucose monitoring (cgm) systems
  - – Blood glucose test strips
  - – Lancets and lancing devices
  - – Modern insulin, insulin syringes
  - – Modern insulin pens
  - – Pen needles
  - – Insulin pumps

Market trends

- Modern insulin is the fastest-growing area of the diabetes monitoring, treatment and drug delivery market

Sensor	Function within Product
MMA8451QR1, MMA8652FCR1	Orientation and shock detection
FXLS8471QR1	3-axis accelerometer with digital features for inertial event detection
MPL3115A2, FXPQ3115BV, MPL3150A2	Provides barometric Pressure readings

Sensor Use in Specific Products

SMART INHALERS

Use cases

- Power saving/auto shutoff when not in use
- Inhaler posture detection
- Shake detection for controller medicine dispensation
- Detects when patient starts breathing into inhaler
- Allows inhaler to deliver the correct amount of medication by utilizing tidal breathing pattern
- Eliminates the need for patient to align breathing with medication release

Critical factors

- Biomedical-compatible component
- Pressure range
- Critical temperature range
- Accuracy
- Repeatability
- Active power consumption
- ODR (100 Hz)
- Sensitivity

Sensor	Function within Product
FXPQ3115BV	Bio-compatible absolute pressure sensor for inhalation detection and very low power consumption.
MMA8451QR1, FXLS8471QR1	3-axis accelerometer for power saving/auto shutoff when not in use, inhaler posture detection for controller medicine dispensation

RESPIRATORY MONITORING

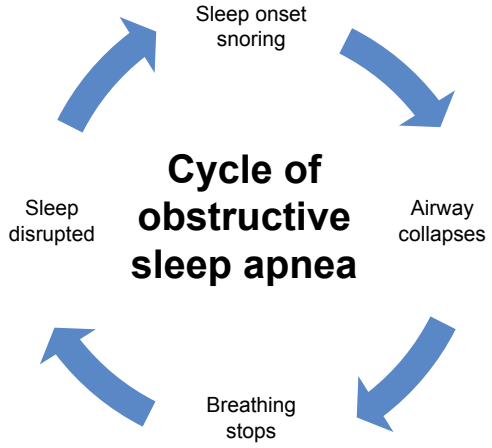
Use cases

- Continuous positive airway pressure (CPAP) respiratory treatment for sleep apnea
- Gauge pressure sensors measure airflow and barometric pressure sensors are used to avoid altitude deviation of the delivered pressure
- Motion sensors compensate for inaccurate readings due to improper tilt and provide motion tracking information for patient care
- Controlled by smartphone, next-generation non-contact sleep apnea solutions use motion sensors along with an active sonar system with algorithms to extract hypopnea, obstructive apnea, and central apnea information from sonar signal changes; motion sensors track chest and abdomen movements due to breathing

Critical factors

- Biomedical compatible component
- Absolute, gauge and differential pressure configurations
- Sensitivity
- Accuracy
- Pressure range
- ODR (~100 Hz)

Sensor	Function within Product
MPL3115A2, FXPQ3115BV, MPL3150A2	Differential pressure sensors for air pressure management and flow rate
MPL3115A2 or FXPQ3115BV	Barometric measurement
MMA8451QR1	Orientation and angle 3-axis accelerometer with embedded functions



Sensor Use in Specific Products

POWERED PATIENT BED

A simple hospital bed has evolved into a highly networked appliance that integrates sophisticated processors to monitor patient status and control the bed's power-assisted functions. The result is a more comfortable bed that is easier for healthcare professionals to move and adjust.

Use cases

- Prevent muscle necrosis, pressures sores, or ulceration
- Accelerometer detects accurate angle for comfort
- Accelerometer detects when bed is moving and when it is stable
- The above use cases are applicable for:
  - Therapeutic beds—ICU beds, regular medical beds, birthing beds, pediatric beds, support surfaces
  - Specialized segments—bariatric beds, air fluidized and low air loss bed systems
  - Peripheral segments—bedding, mattress replacements, overlays

Critical factors

- Pressure range
- Accuracy
- Sensitivity
  - Battery life status while in use

Sensor	Function within Product
MPXM2010GS, MPX5010DP	Pressure sensors provide proper air pressure for ideal comfort and memory settings
MMA8451QR1, FXOS8700CQ, FXLS8962AFR1	3-axis accelerometer with flexible user-programmable options

PATIENT ACTIVITY MONITOR

Use cases

- Freefall detection
- Pedometer
- Accelerometers for motion wake, tamper detection, patient posture
- Blood pressure monitor module enabling barometric pressure measurement with protective gels and ports

Critical factors

- Low active power to extend battery life status while in use
- Low standby power with auto shutoff when not in use
- Small size to fit into a small space
- Full-scale range and bandwidth to capture full motion profile

Sensor	Function within Product
MMA8652FCR1	3-axis accelerometer with flexible user-programmable options and two configurable interrupt pins for overall power savings
FXOS8700CQ	Orientation, motion, vibration, shock, fall, g-force, altitude changes
MPL3115A2, FXPQ3115BV, MPL3150A2	Provides barometric pressure monitoring and altimetry

Sensor Use in Specific Products

BLOOD PRESSURE MONITOR (INVASIVE)

Use cases

- Standard invasive blood pressure monitoring kit—sterile, single-use kit that relays blood pressure info from a pressure monitoring catheter to a patient monitoring system

Critical factors

- Integrated temperature compensation and calibration
- Ratiometric analog output
- Polysulfone case material (medical, class V approved)

Sensor	Function within Product
MPX2300DT1 and MPX2301DT1	Pressure sensor, 6 V, 0/40 kPa packaged specially for medical applications
MPXM2053GS	Differential/Gauge pressure sensors up to 115 kPa
MP3V5050	Vacum pressure sensor
MMA8451QR1	3-axis accelerometer with flexible user-programmable options

NEGATIVE PRESSURE WOUND MANAGEMENT

Use cases

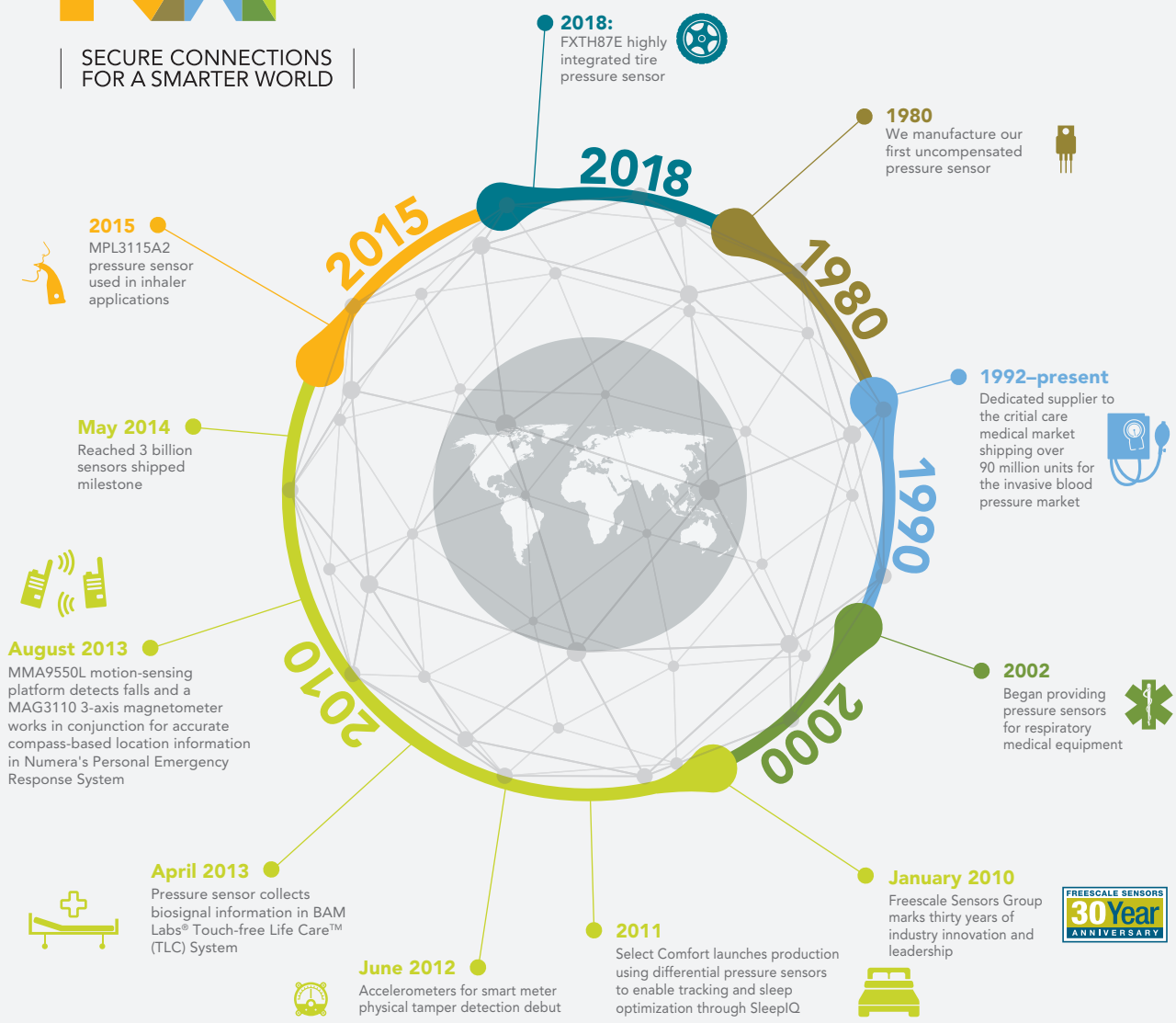
- Non-invasive localized negative pressure for acute, sub-acute, and chronic wounds
- Motion sensors can correlate movement, posture and vibration that may require higher pressure
- Motion sensors provide low-power wakeup and user interface

Critical factors

- Media compatibility
- Biomedical-compatible components (in contact with body)
- Disposable
- Gauge/absolute
- Sensitivity
- Accuracy
- Pressure range

Sensor	Function within Product
MPL3115A2, MPL115A or FXPQ3115BV	Vacuum sensor, barometric measurement
MPXV5100GC6U	Available in differential and gauge configurations
MMA8451QR1 or MMA8652FCR1	Orientation and shock detection

SECURE CONNECTIONS
FOR A SMARTER WORLD



For current information about NXP products and documentation, please visit www.nxp.com/sensors.

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