NEW PRODUCT ANNOUNCEMENT
Sept 2024

MEMS PRESSURE SENSORS

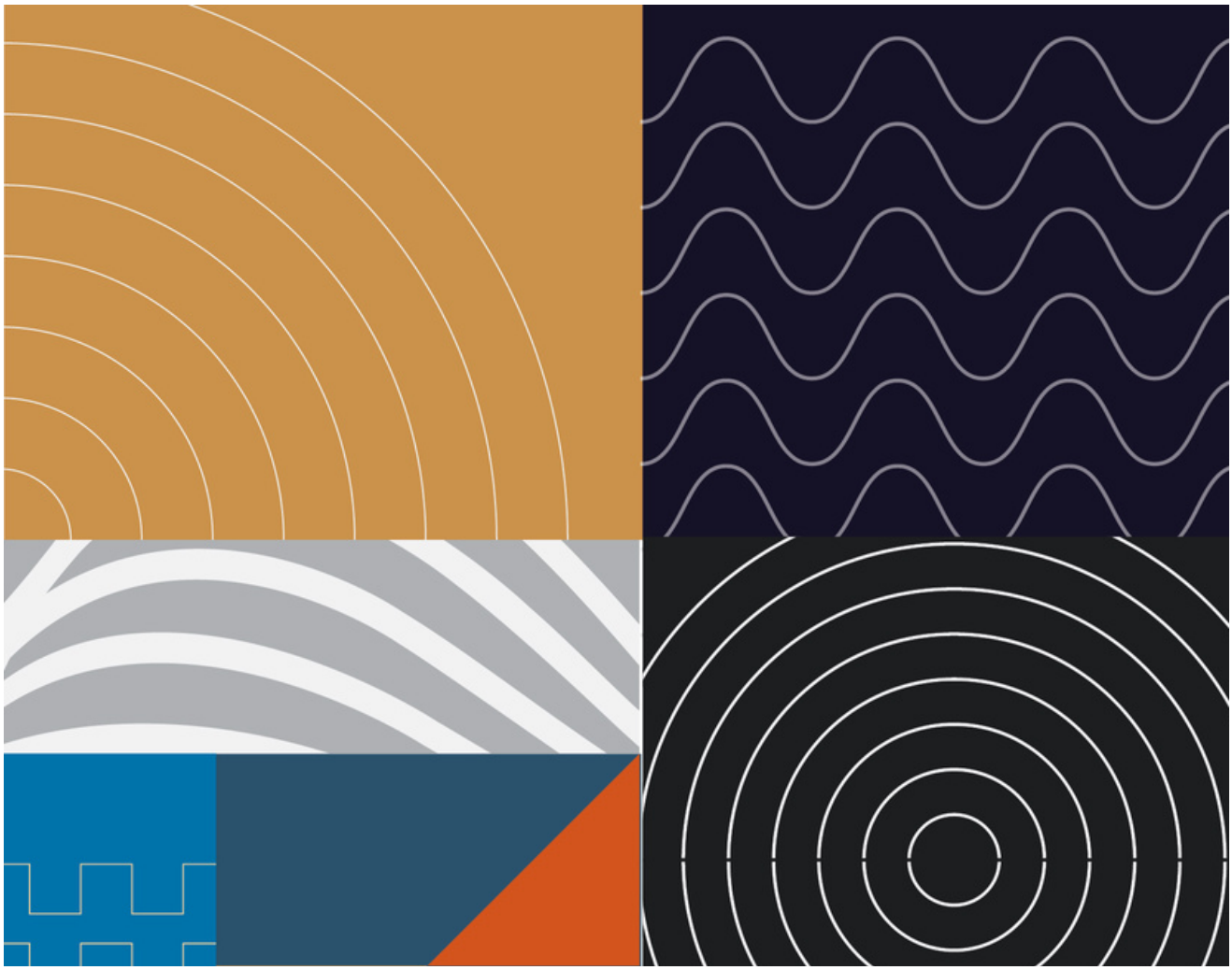

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Table of Contents

New Product Introduction

PUI Audio is excited to introduce the new, smaller digital MEMS pressure sensor, the PSD0401120. This highly accurate and compact piezoresistive pressure sensor measures pressure by detecting changes in resistance caused by applied force. It converts mechanical pressure into a digital signal, making it ideal for precise applications across various industries, including automotive, security, medical, consumer and industrial automation.

PSD0401120 Digital Pressure Sensor

At its core, the PSD0401120 is a silicon piezoresistive pressure-sensitive network constructed using MEMS fabrication and structure creation technology.

The pressure sensitive network consists of an elastic film and four resistors integrated on the film. The four resistors form a Wheatstone bridge structure. Pressure applied to the elastic film deforms the bridge's resistors, generating a voltage output signal that is linearly proportional to the applied pressure.

The sensor's small size, high sensitivity, and reliability make it perfect for integration into systems where space is limited, providing accurate and consistent pressure measurements.

The **PSD0401120** is a high-resolution, 30kPa to 120kPa waterproof pressure sensor in a compact 10-pin LGA surface mount package. It features high accuracy and low current consumption pressure and temperature sensing. The digital output uses an I2C interface. The PSD0401120 combines high-linearity pressure sensor with an ultra-low-power 24-bit delta-sigma analog-to-digital converter (ΔΣADC). The pressure sensor is factory calibrated, storing the calibration coefficients in on-board memory. The calibration coefficients are used by the ΔΣADC as it processes the sensor's analog output. The PSD0401120 also includes a temperature sensor with a nominal resolution of 0.1°C.

The **PSD0401120** I2C bus uses the SCL (Serial Clock) and SDA (Serial Data) signal pins. The I2C interface maximizes compatibility with the communication interfaces on a wide range of popular micro-controllers and system-on-chip (SOC) devices.

Key Features	Applications
• Pressure range: 30kPa to 120kPa • Temperature resolution: 0.1°k/LSB • 24-bit ΔΣADC • I2C serial interface • 3.3VDC nominal power supply voltage • 3.55mm x 3.55mm x 1.40mm surface-mount 10-pin LGA package • Water resistant to 100m	• Barometers • Mobile altimeters • Indoor and outdoor navigation systems • Security Applications like break-in detection • Floor detection in buildings • Industrial pressure and temperature sensing systems • Pressure and temperature logging systems • Adventure and sports watches • Weather stations

PUI Audio Pressure Sensor Selection Chart

Pressure Range (kPa)	Power Supply Voltage Range (V)	Interface A= Analog Output D = Digital Output	Form Factor (mm, X, Y, Z axis)	Devices
-40 ≤ P ≤ 40	4.7 ≤ V_S ≤ 5.3	A	7.00 x 7.00 x 9.50	PSA071040
0 ≤ P ≤ 700	1.5 ≤ V_S ≤ 5.4	A	1.50 x 1.00 x 0.90	PSA0201700
30 ≤ P ≤ 200	1.8 ≤ V_S ≤ 5.0	D	6.40 x 6.20 x 3.05	PSD0603130
30 ≤ P ≤ 120	1.8 ≤ V_S ≤ 3.6	D	3.55 x 3.55 x 1.40	PSD0401120 **New!**

Functional Description: PSD0401120

The PSD0401120 uses a MEMS piezoresistive absolute pressure sensor as a pressure detecting element. The digital output is a serial data bit stream, containing data that is proportional to the local ambient atmospheric pressure. The pressure sensor's analog output is amplified by a two-state programmable-gain preamplifier (PGA). The preamplifier features very low noise magnitude in the low-frequency signal bandwidth. Its input offset voltage is minimized through chopper-stabilization and auto-zeroing techniques.

The preamplifier drives the 24-bit delta-sigma analog to digital converter (ΔΣADC), whose output is processed by a digital filter and DSP (state-machine) that together filters noise and applies temperature and linearity compensation. The DSP is configured using programmable bits. Once conversion, linearization, and compensation are complete, the final digital value is made available as an I2C serial bit stream.

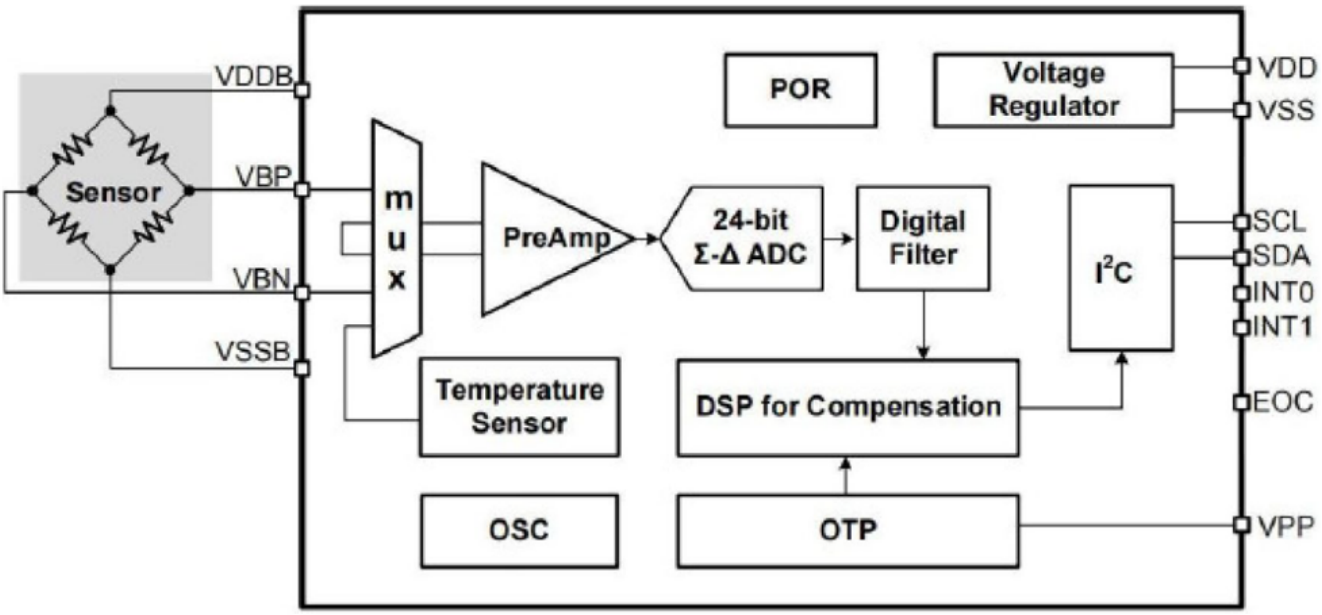

Figure 1: PSD0401120 block diagram

Read more detailed Application guide available in the specification

Application Examples: Security

A pressure sensor can be an integral part of a security system. Its pressure sensing ability is used to detect changes in air pressure within a defined space. These changes can indicate events such as opening or closing doors, opening or closing windows, or even more subtle disturbances such as a window breaking (break-in detection) or even the movement of a person within the space.

Original Equipment Manufacturers (OEMs) can design a framework that combines data from multiple sensors to produce more accurate, reliable, and comprehensive information than could be obtained from any individual sensor alone. This technique is essential in various applications, including security systems, autonomous vehicles, robotics, and more. Below is an architecture for a security application utilizing a pressure sensor.

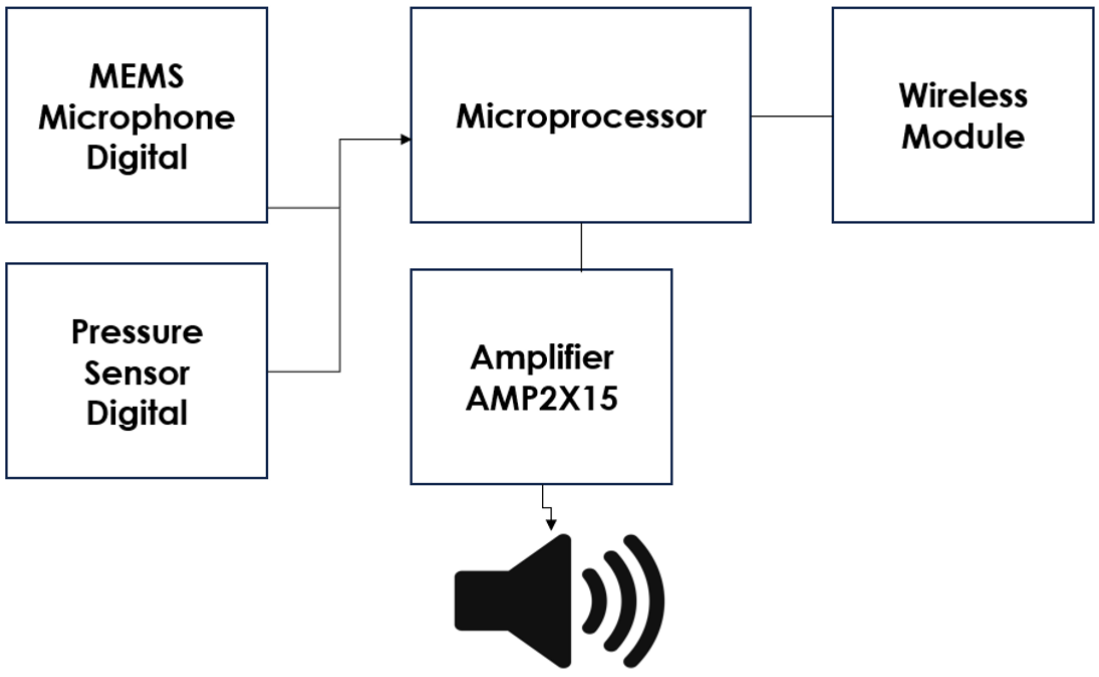

Figure 2. Multi-sensor security system.

Architecture for Security Application

1. **Pressure Sensors:** The PSD0603130 is ideal for this application in that the nominal static air pressure is 100kPa, centered in this pressure sensor's input range. For applications that require smaller surface devices, the PSD0401120 can be used where the static air pressure is in the upper end of this pressure sensor's input range.

2. **Microphones:** Capture acoustic events. The DMM-4026-B-I2S-R's I2S interface simplifies digital data transfer between the microphone's output and the applications processor's i2S digital interface. This microphone's high -26dBFS sensitivity ensures that even the slightest noise or acoustic event is detected, allowing the system to signal intrusion.

3. **Microcontroller/Microprocessor:** The ESP32 microcontroller's generous I/O provides all the digital interface flexibility necessary for a security system. Not only does it have the flexibility of multiple I2C buses, it also has an I2S interface necessary for the microphone previously mentioned. The gathered sensor data is then processed using the controller's embedded programming with the help of sensor event-detect algorithms to determine if a room has experienced unwanted entry. Together, the microcontroller is the central monitoring system that receives all sensor data, determines if a threat condition has occurred, and triggers an appropriate response. This system also provides all necessary user control in the form of a control panel or through a companion application.

4. **Alarm/Speaker-** Provides audible alert when an event is detected. Connect the speaker to a digital output of the microcontroller through a transistor or MOSFET if needed for power amplification.

5. **Wireless Communication Module:** One of the subsystem advantages is its built-in Wi-Fi and Bluetooth connectivity functionality, which can ease system monitoring.

Workflow

1. **Event Detection:**
   - **Pressure Sensor:** This sensor monitors ambient air pressure within the room. When a door or window is opened or closed, or when there is a sudden pressure change (e.g., glass breakage), the sensor detects this change.
   - **Microphones**: These capture acoustic signatures of specific events such as glass breaking, footsteps, or door creaks.

2. **Data Processing:**
   - The **microcontroller** receives and logs raw data from the pressure sensors and microphones and does any necessary manipulation to ensure that it is made ready for processing and interpretation by the software's event-detection algorithms. It analyzes historical data for patterns to improve future event detection.
   - The algorithm processes this data to distinguish between normal and suspicious activities. It does so by analyzing patterns and correlations between pressure changes and acoustic events that occur because of physical changes in a room.

3. **Event Classification and Response:**
   - The event-detection algorithm classifies the detected event (e.g., glass breakage, intrusion, door opening).
   - Based on the classification, the system triggers an appropriate response, such as primarily sounding an alarm and sending a notification to the user's mobile device and contacting security monitoring services and law enforcement personnel.

4. **Alert Transmission:**
   - The system's wireless communication module sends the alert and event details to the central monitoring system.

Conclusion

Our new MEMS pressure sensors offer high linearity and stability with a waterproof, miniaturized design. Their compact footprint and low power consumption make them ideal for medical, industrial, security, and consumer applications.

The architecture presented provides a robust solution for integrating pressure sensors in security applications, ensuring reliable detection and prompt responses to potential threats. For more information or application-specific questions, feel free to reach out to us. This reference design can be fully customized to meet the unique requirements of your application, ensuring optimal performance across a various use cases.

View our offerings at:

MEMS Pressure Sensors

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