Task-12

Group-3

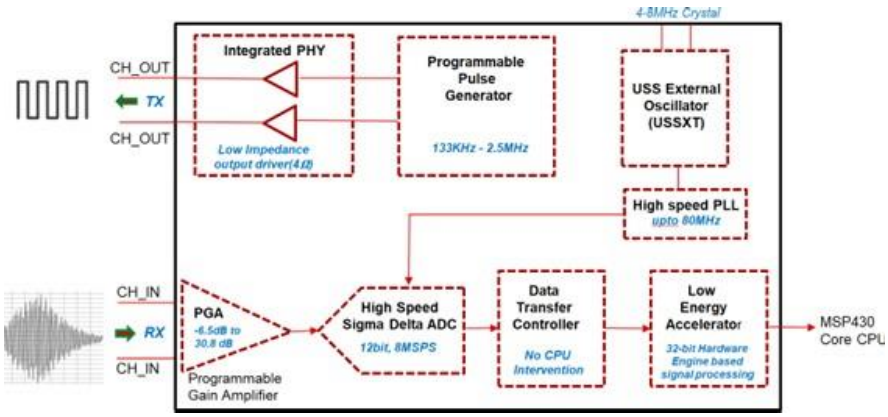
- **Ultrasonic sensing detects water leaks for improved conservation - from TI**
- **Infineon Technologies PASCO2V15 XENSIVT™ PAS CO2 5V Sensor**

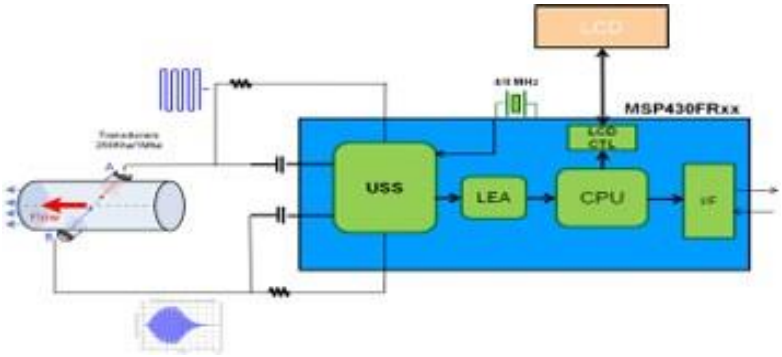
Prepare a tech report covering the Objective, Scope, IC technology, significance and the novelty (if any) of the Product

Ultrasonic sensing detects water leaks for improved conservation - from TI

Objective

The objective of this report is to present an ultrasonic leak detection solution developed by Texas Instruments (TI). This solution leverages ultrasonic sensing technology to detect individual drops of water at very low flow rates, enhancing water conservation efforts by identifying leaks that traditional mechanical methods may miss.





Scope

This report covers:

1. An overview of the ultrasonic leak detection system.
2. The setup and configuration of the system.
3. The significance and advantages of using ultrasonic technology for leak detection.
4. The novelty and technical aspects of the integrated circuits (IC) used in the solution.

IC Technology

TI's ultrasonic leak detection solution utilizes a single-chip ultrasonic sensing subsystem (USS) that includes a programmable pulse generator (PPG), a high-speed sigma-delta analog-to-digital converter (ADC) with a programmable gain amplifier (PGA), and a low-energy accelerator (LEA). This subsystem can autonomously excite and capture ultrasonic waveforms for high-resolution leak detection measurements. Key components and their functions include:

- **EVM430-FR6043**: An evaluation module used for testing, featuring a graphical user interface (GUI) for configuration.
- **Jiakang 2-MHz Transducers**: Ultrasonic transducers providing high sensitivity for detecting individual water drops.
- **MSP430FR6043**: A microcontroller that manages the USS and facilitates low-power operation with an average current consumption of less than 3 µA.

Significance

Traditional leak detectors, which rely on mechanical impellers or surface sensing, often fail to detect small leaks until significant water damage has occurred. In contrast, ultrasonic technology can detect minor differences in the speed of sound in water pipes, providing the resolution necessary to identify small leaks early. This early detection can prevent substantial water waste and potential damage to infrastructure, making it a valuable tool for both residential and industrial applications. Utility companies are particularly interested in this technology as it enables the monetization of small leaks that would otherwise go undetected.

Novelty

The novelty of TI's ultrasonic leak detection system lies in its use of an analog-to-digital-based cross-correlation approach to determine ultrasonic time-of-flight (ToF) with higher accuracy than traditional threshold-based techniques. This method enhances the precision of leak detection. Additionally, the system's ability to operate autonomously with low power consumption is significant, ensuring that it is energy-efficient and suitable for long-term use in various environments. The integration of the LEA with the MSP CPU within the ultrasonic sensing subsystem further highlights the advanced design and efficiency of the solution.

Conclusion

TI's ultrasonic leak detection solution represents a significant advancement in water conservation technology. By enabling the detection of small leaks that traditional methods cannot identify, this system offers a proactive approach to water management and infrastructure protection. The innovative use of ultrasonic sensing technology, coupled with low-power operation and high-resolution detection, underscores the product's importance and potential impact on the market. The provided demo source code, schematics, and detailed documentation facilitate the development and deployment of this technology in diverse applications, promoting wider adoption and enhanced water conservation efforts.

Reference

https://www.ti.com/lit/pdf/slaa965