

# Near-Zero Power Fully Integrated CMOS Temperature Sensor

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## BACKGROUND

With the planned proliferation of the Internet-of-Things, billions of power limited wireless sensing devices are expected to be sold worldwide. Within that group is a large subset of applications in which temperature sensing will be important. Needed for this application space are ultra-small and ultra-low-power temperature sensors.

## TECHNOLOGY DESCRIPTION

Researchers at UC San Diego have an invention which is a state-of-the-art CMOS temperature sensor operating in the sub-nanowatt regime. The design is fabricated in 65 nm CMOS and measurement from 8 samples reveal a maximum temperature error of  $\pm 1.38^{\circ}\text{C}$  ( $\pm 0.73^{\circ}\text{C}$ ) and  $+0.77/-0.41^{\circ}\text{C}$  when operating from 0 to  $100^{\circ}\text{C}$  after two-point (three-point) calibration without and with trimming, respectively. Operating from a 0.5 V supply, the 8 samples consumed an average power of 763 pW at  $20^{\circ}\text{C}$ , which after a 0.3 s conversion time results in 230 pJ/conversion.

## APPLICATIONS

Application areas will include food safety, pharmaceutical processing and storage, industrial, commercial and home applications as well as animal health monitoring.

## ADVANTAGES

The lowest power temperature sensor developed to date that is compatible with standard CMOS processes.

## STATE OF DEVELOPMENT

A working prototype in silicon has been developed and is available for evaluation.

## INTELLECTUAL PROPERTY INFO

This invention is patent pending and available for licensing.

## PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Published Application	<a href="#">WO 2020/081423</a>	04/23/2020	2019-099

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## OTHER INFORMATION

### KEYWORDS

CMOS temperature sensor, fully integrated, internet of things, near-zero power sub-nW, temperature sensor, ultra-low power

### CATEGORIZED AS

- ▶ **Sensors & Instrumentation**
  - ▶ Environmental Sensors
  - ▶ Medical
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