

How Low-Power 60-GHz mmWave Radar Sensors Enable High-Accuracy Sensing in More Applications Than Ever Before



Radar-based sensor ICs are becoming a popular sensing technology due to their long-range capabilities, high-motion sensitivity, and privacy capabilities. With their high accuracy, radar sensors are widely used in automotive and industrial markets for applications such as blind spot detection, collision detection, people presence and motion detection. In recent years, 60-GHz and 77-GHz radar sensors have replaced 24-GHz radar sensors – delivering higher resolution, improved accuracy, and smaller form-factors. These radar bands have also enabled several new applications in both automotive and industrial markets such as child presence detection in vehicles and elderly fall detection in hospitals.

Despite the unique advantages of radar sensing, high-performance 60-GHz and 77-GHz SoC sensors have traditionally been limited in applications that may use them because of their high-power consumption.

Newer radar sensors like the IWR6432 and AWR6432 consume less power through the use of low-power architecture and can enable radar to be deployed in new industrial, personal electronics, and automotive applications. With built in sleep modes and efficient duty cycling operations, these low power radars can enable a sensing system to detect motion and intelligently decide when to act, within a power budget of <5 mW. This can bring high performance radar sensing to battery powered and limited line power applications that previously could not make use of it.

This article explores how homes, factories, personal electronics and automotive designs can benefit from low-power radar sensors.

See our 60-GHz radar for video doorbells demo video



TI low-power, 60-GHz radar sensors enable expanded features including detection up to 20 m, tracking up to three people simultaneously and more. Watch the video, "[Using 60-GHz radar sensors in video doorbells](#)" to see them in action.

Low-Power Radar Sensing for Building Automation

To support the next generation of smart homes and cities, homes and office spaces must be smarter, more interconnected, efficient, safer and provide higher comfort level to the people. An awareness of environment and artificial intelligence is needed to achieve these objectives. Sensors like the IWR6432 help meet designers demands for more energy efficient and intelligent sensing. These devices consume only 2 mW to 5 mW on an average at lower duty cycles, due to deep sleep modes, a critical feature for interconnected homes and buildings with sensors that need to sense continuously for longer durations. Despite consuming lower power than previous generations of millimeter wave (mmWave) radar sensors, these devices deliver the level of intelligence needed for modern smart home and city application through on-chip data processing capabilities – enabling motion detection, gesture recognition and decision making at the edge.

Examples of supported applications include motion and presence detection sensors for home and office security, smart thermostats and HVAC systems for automatic climate control based on sensing occupancy rate, lawn mowers, vacuum and service robots that can sense small objects even in dark and provide more comfort to users through higher efficiency.



Figure 1. Sensing Building Automation Applications (Video Doorbell and Home Security Camera)

Low-Power Radar Sensing for Factory Automation

To meet the growing demand for consumer goods being shipped worldwide, manufacturers need increased efficiency in their manufacturing process automation and intelligent transportation. Safer interaction between the humans and machines with smart and reliable sensors that create a “safety net” that enables machines to detect objects accurately and quickly.

Automated guided vehicles (AGVs) and automated machine robots (AMRs) equipped with sensors can see the obstacles including humans and maneuver from point A to point B along planned routes. Low-power mmWave sensors allow for longer operating times for AGVs and AMRs, and the lower cost enables easier adoption of the technology.

In a residential context, IWRL6432 sensors in a robotic lawn mowers and vacuum cleaners can detect smaller obstacles which other sensing technologies fail to detect. The lower power consumption enables devices to operate for a longer duration before recharge of batteries.





Figure 2. Sensing in Factory Automation Applications (Lawn Mowers, Logistic Robots and Vacuum Cleaners)

Low-Power Radar Sensing for Personal Electronics

With the integration of small-form factor 60-GHz sensor, Laptops and notebooks can now sense onlooker presence, television can detect presence of people and turn on, can detect gestures and provide a personalized user experience. Fitness devices and smart watches can estimate heart rate and breathing rate of people providing context of health that can make people adopt healthier life style.



Figure 3. Sensing in Personal Electronics Applications (Laptops, Television and Home Theater Systems, and Sound Bars)

Low-Power Radar Sensing for In-Cabin Automotive Applications

In the automotive market, there is a growing trend of sensors being brought into the vehicle for in-cabin presence detection and monitoring— partly driven by safety regulations like the European New Car Assessment Program (Euro NCAP). Starting in 2025, Euro NCAP will award points to vehicles that can sense and alert when a child is left behind in a parked vehicle.

Low-power 60-GHz mmWave radar sensors can help automotive OEMs meet these regulatory requirements while optimizing total sensor system cost by scaling a single sensor for multiple functions, as shown in [Figure 4](#).

High-performance 60-GHz radar sensors are often used for in-cabin applications because of their detection sensitivity and ability to classify motion, but require ultra-low power consumption in order to replace the ultrasonic based sensors commonly used for intrusion sensing today. Read the article “[Meet Euro NCAP Child Presence Detection requirements with low-power 60-GHz mmWave radar sensors](#)” to learn more.

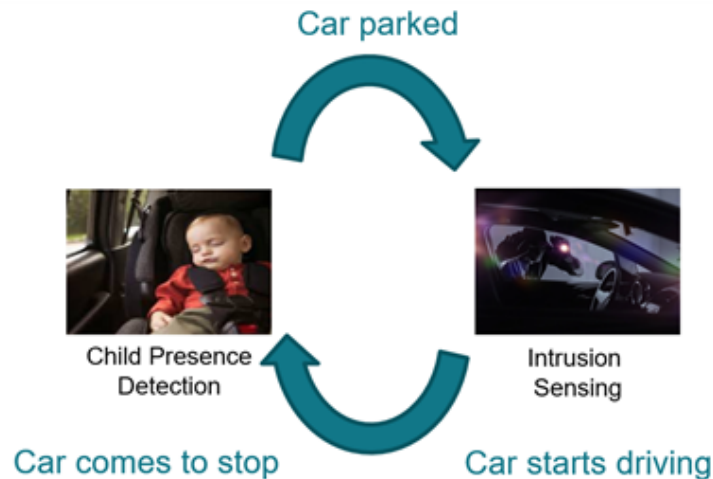


Figure 4. Each Stage of the Automotive Vehicle Lifecycle Has Different Requirements for In-Cabin Sensing Performance or Power Consumption

Low-power 60-GHz radar sensors enable newer sensing applications in markets where strict power budgets previously limited sensing capabilities > 20 meters with high accuracy. As innovation continues in this space, design engineers can develop smaller, more capable applications that will make our world more interconnected and our homes and buildings “smarter.”

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