

Intelligent automation with the new antenna-on-package (AoP) mmWave sensors

Simplifying Sensing with Industrial mmWave Sensors

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Webinar Outline

- mmWave technology benefits
- TI mmWave portfolio and offering
- Antenna on package benefits and specs
- Key markets
- Q&A

mmWave Sensors – Technology Overview

What is mmWave sensing

- Electromagnetic waves used for detecting the world around the sensor
- mmWave sensors measure high accuracy **range**, **velocity** and **angle** of remote objects

When to use mmWave sensing?

- **High precision range measurement** – tank level probing, displacement sensing, and vibration monitoring
- **Smarter infrastructure** – occupancy sensing, traffic monitoring, lighting control, gesture recognition
- **Advanced navigation for mobile transport** – robotics, drone sense and avoid, landing assistance, forklift collision avoidance
- **Automotive** - Adaptive cruise control, automatic emergency brake, lane change assist, and more



Benefits of mmWave sensing

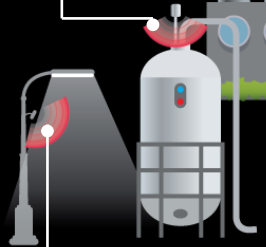
- mmWave technology is **robust against environmental influences** such as bad light and weather conditions and extreme temperatures
- RFCMOS technology enables analog/digital integration in a **low-power, small, single-chip** solution
- **Unprecedented accuracy** using highly linear signal generation, ultrawide resolution, and robust calibration/monitoring of RF sensing

IWR mmWave Sensors

TI's single chip mmWave sensors integrate a DSP, MCU and RF front-end to detect range, velocity and angle

Level sensing

Measure tank fluid level with unprecedented accuracy for inventory control and early leak detection



Forklifts

Detect objects in obstructed views for intelligent safety



Robotics

Unprecedented accuracy at the micrometer level



Doors & Gates

Open doors for approaching people and ignore by passing people



Drones

Enable autonomous flight for building, land surveying and delivering packages



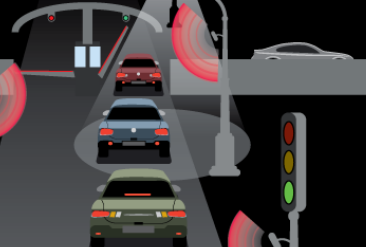
People counting

Detect people in a zone of interest and trigger actions



Perimeter security

Enabling security systems with motion sensitive detection and tracking



Traffic monitoring

Detect traffic location and volume more accurately



Intelligent street lighting

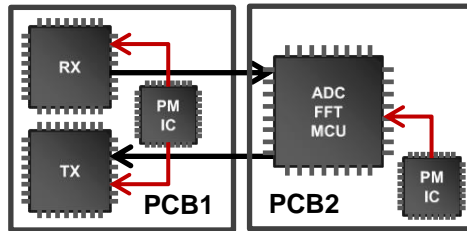
Sensing performance that improves pedestrian safety and provides power/cost savings through intelligent triggering of lighting



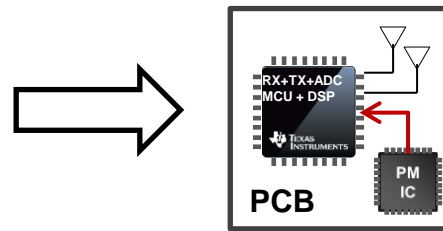
TI mmWave Portfolio

TI Innovation – Single-Chip CMOS

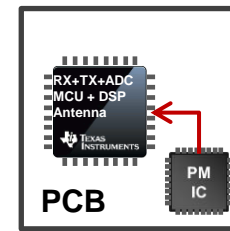
Discrete – RF front-end only



Single chip – integrated DSP



Integrated Antenna-on-package



Discrete Multi-Chip mmWave Sensor

- Complex and critical signal routes
- Unconventional packaging
- Prone to noise
- Lack of system level monitoring
- Crude implementation of safety

TI Single-Chip mmWave Sensor

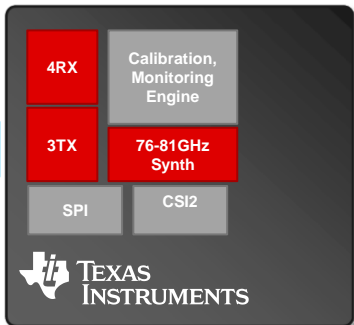
- Smaller in size
- Simpler design
- Built in monitoring (SIL)
- High resolution and accuracy
- Programmable core with differentiated SDK/Algorithms
- Lower Power

TI Single-Chip mmWave Sensor w/Integrated Antenna-on-Package

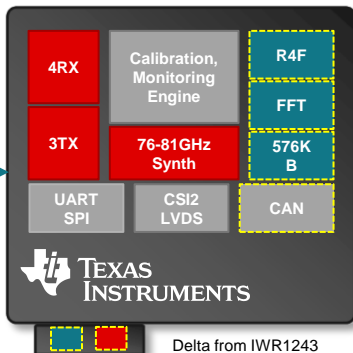
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Industrial mmWave Sensors Portfolio Snapshot

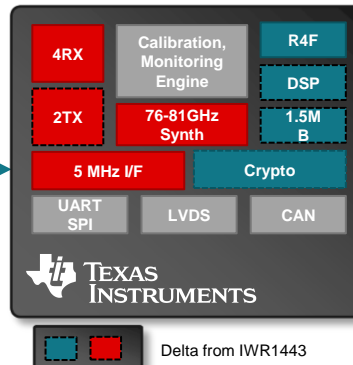
mmWave Sensor Front end
xWR1243



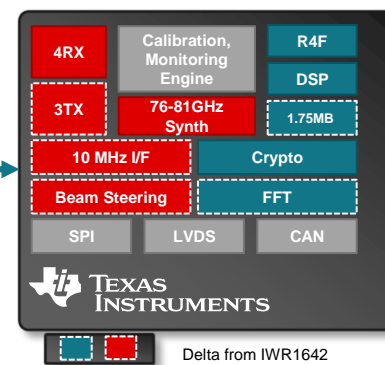
mmWave Sensor + HWA
IWR1443



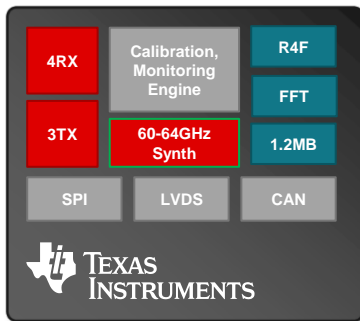
mmWave Sensor + DSP
IWR1642



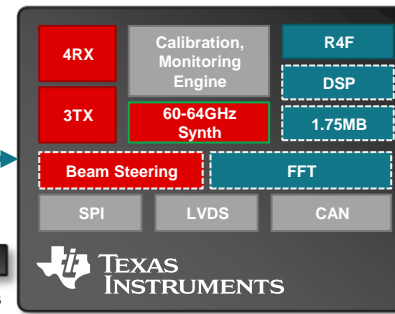
mmWave Sensor + HWA + DSP
IWR1843



IWR6443 - Concept



IWR6843/ AOP



TI Information – Selective Disclosure

Unified SDK / Reusable SW

Connectivity ecosystem



Functional Mode configuration with Regular IWR6843 ISK

Basic Use Case



Standalone development with CCS

SW Development, **Long range** People counting, Surveillance, Industrial Transport, Robotics



Functional Mode configuration with IWR6843 ISK-ODS

Basic Use Case



Standalone development with CCS

SW Development (**short distance** People counting, gesture, Proximity, robotics, automated doors etc)



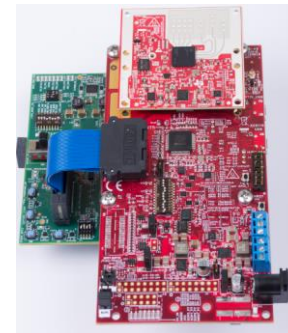
Functional Mode configuration with IWR6843AOP

Basic Use Case



Standalone development with CCS

SW Development (**short distance** People counting, gesture, Proximity, robotics, Automated doors etc)



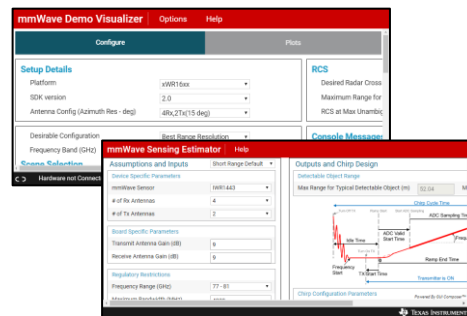
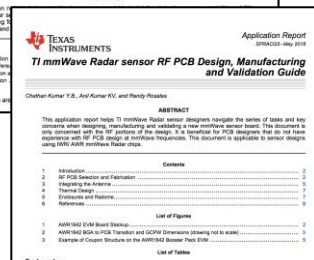
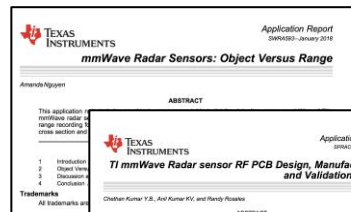
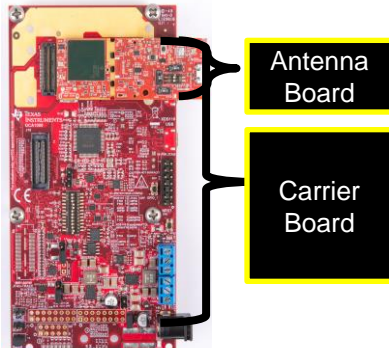
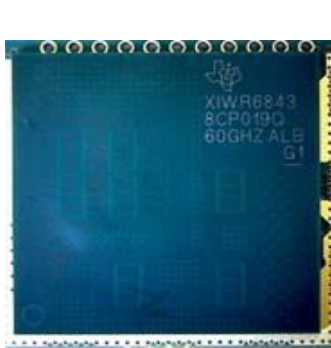
With DCA1000 data capture card on a Camera mount stand



DCA1000 + Carrier board + Module

Data Collection System / Algo Development

mmWave Sensors available in 60GHz band – with AoP!



New Products

Including Antenna-on-Package!

- Enable the design of your next generation RF sensor without antenna expertise
- Leverage sensors in any applications per 60GHz regulations

Evaluation Modules

Evaluate performance with modular EVM

- Prototype with multiple antennas and AoP
- Designed for modular reuse with multiple 3P antennas
- User Guide and EVM unboxing video all available on TI.com

Technical Documents

Documents designed to educate

- Guides to help get started using various tools and answer FAQs
- Application notes to address software, hardware and manufacturing

Tools & Software

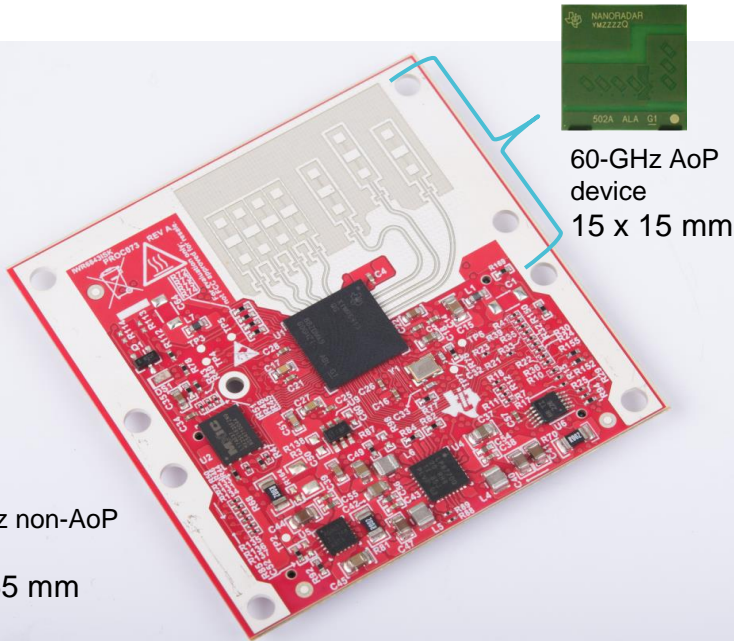
Enable self evaluation and prototyping

- Use sensing estimator for analyzing performance trade-offs
- Leverage the same SDK as 77GHz
- Use application-specific algorithms in open source

Antenna on Package (AoP)

Antenna-on-Package Design

- Next level of innovation in intelligent autonomy at the edge for new and existing industrial systems
- Reduces complexities of radio frequency design and simplifies manufacturing process
- Meaningful savings of system space and cost
 - 75% smaller than 24-GHz



60-GHz AoP device
15 x 15 mm

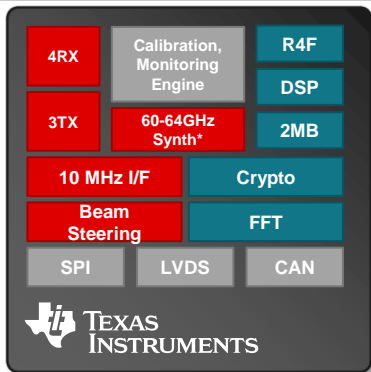
60-GHz non-AoP board
55 x 55 mm

Key Benefits

- Small form factor
 - Integrates antenna directly in the package
 - 15mm x 15mm footprint
 - 75% smaller than 24GHz and 40% smaller than 60 GHz non AOP
- Reduced design and manufacturing cost and complexity for system design/ faster time to market
 - Simple / cheaper FR4 board design
 - Customers do not need EM & RF expertise
 - Saves approximately 3-6 months of antenna development time
 - Estimated savings ~50% of system cost vs. non AOP* @ 10KU
- Higher efficiency (lower loss) compared to modules with similar antennas
 - Zero board routing loss*
 - ~+2dBi total gain* from AOP board vs. non-AOP
- Opportunity for Certification reuse
 - Similar layout and acceptable RF performance characteristics
 - Antenna type must be the same
 - Antenna gain must be the same or less

Antenna-on-Package Superset device specs*

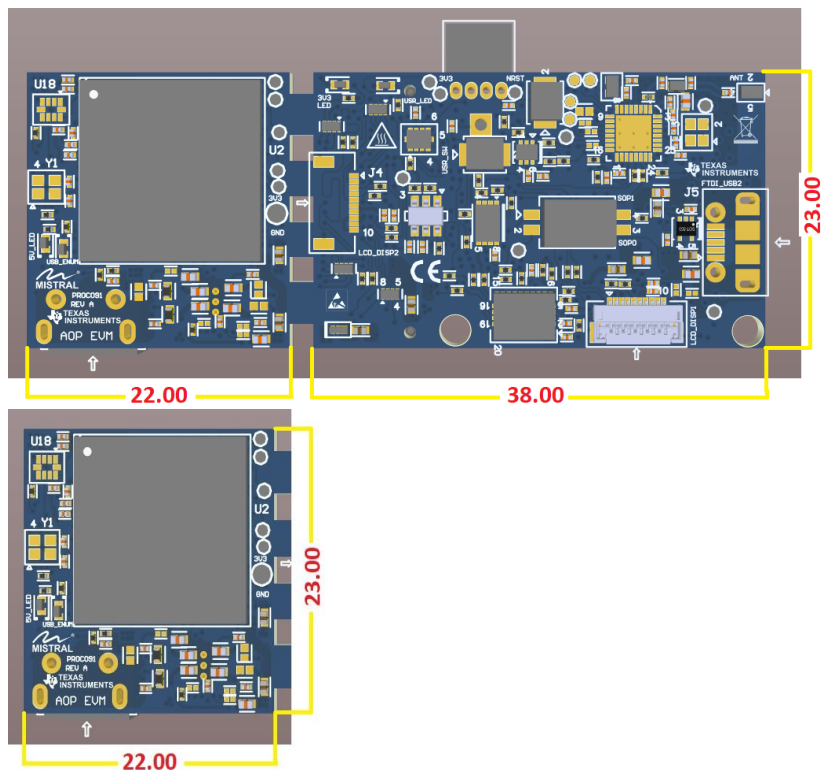
IWR6843 ODS + AoP



- **Mid range (100m+) detection and object tracking supported by advanced algorithms**
 - Perimeter Security/Surveillance Augmentation
 - People Counting
 - Traffic Monitoring
- Fully programmable with MCU & DSP
- **SW compatible with 77GHz portfolio**
- Superset for IWR6843

Operation Mode	Angle	Maximum Range Detection of Human	Maximum Range Detection of Car
MIMO	0° (Boresight)	50m	100m
	+/- 65°	15m	30m
TX Beam Steering	0° (Boresight)	65m	135m
	+/- 65°	20m	45m

Mission Board- Features

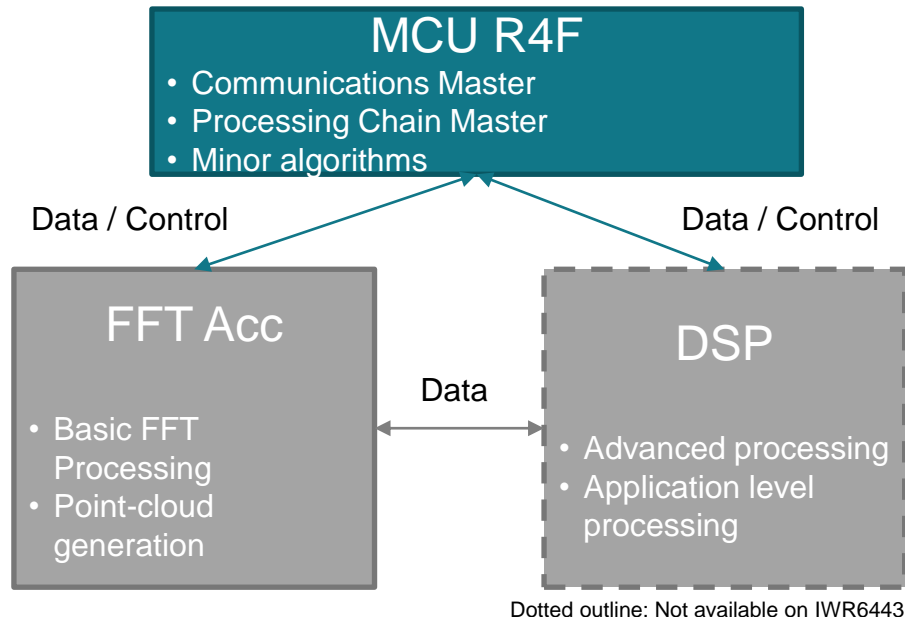


- Stand alone AOP board
- Mates with carrier board for debugging and flashing

- Data streaming and configuration via UART
- Flashing of binary through UART
- Powered using onboard USB connector
- Small form factor, 22 x 23 mm
- Flashing and functional SOP mode available through SOP switch
- Onboard PMIC, QSPI flash and EEPROM

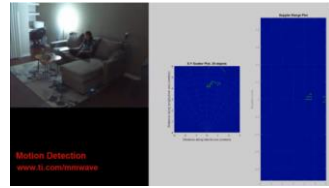
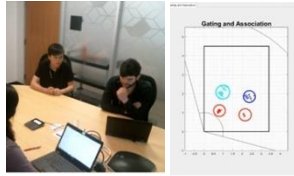
Scalable SW platform

- Software scalability for customers from IWR6843 to 6843 AOP
- Processing chain that scales from FFT-only to FFT + DSP
- APIs and Drivers maintained across all 60GHz and AOP variants
- Out of the Box software for AOP devices



Key Markets

Industrial Radar – “Building Automation”



Building Security and Video surveillance

Adjacent/Reuse:

- Stand/Sit/lying
- Vital Signs
- Outdoor security
- HVAC
- Elevators

[Learn More about mmWave for People Counting](#)

Highlights

- Long range motion detection and tracking
- False detection mitigation
- Motion tracking in low/no visibility

[Video](#)



Automated Doors and Gates

Adjacent/Reuse:

- Stand/Sit/lying

[Learn More about mmWave for Automated doors](#)

Highlights

- One sensor for multiple lanes due to wider FoV
- AOA capability prevents false triggers
- Velocity of arrival can be measured to open door faster or slower
- Motion tracking to prevent false trigger

Industrial Radar – “Robotics”



Zone Occupancy / Area Scanner

Adjacent/Reuse:

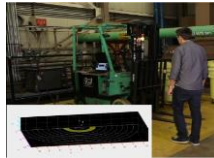
- Presence Detection in PE applications
- EV charging
- Empty parking spots

[Learn More about mmWave for Area Scanning](#)

Highlights

- Can sense and alert workers in danger zone
- Autonomous decisions can be implemented in machine using radar
- Using range and velocity measurements various levels of shutdown can be implemented

[Link to video](#)



Autonomous Robotics

Adjacent/Reuse:

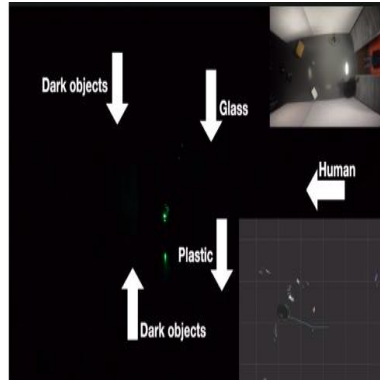
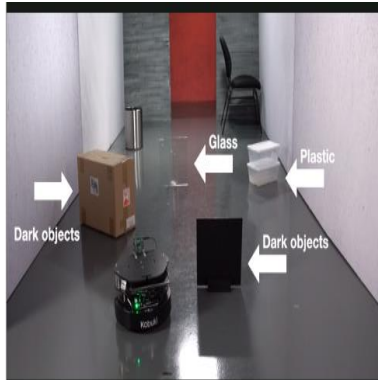
- Vacuum cleaners
- Lawn mowers
- Forklifts
- Construction equipment
- Agriculture equipment

[Learn More about mmWave for Robotics](#)

Highlights

- Small footprint for sleek robot designs
- Ability to see various materials (glass, plastic, carton, etc.)
- Interfaces with Robotics Operation System (ROS)
- Can sense and avoid object even in low/no visibility
- Detection of multiple objects over a wide field of view
- User programmable field of view

[Link to video](#)



Industrial Radar – “Gesture”



Gesture recognition

Adjacent/Reuse:

- PE applications
- Medical

[Learn More about mmWave for Gesture](#)

Highlights

- Small footprint to fit into small products
- Ability to see through casing
- Close range motion tracking for no-touch control
- Programmable user configuration for various application

[Link to video](#)



Visit www.ti.com/iwr