

# TI Automotive mmWave Radar Solution

Automotive 76~81GHz mmWave sensor



# Automotive Radar Applications



## CORNER RADAR

- Single chip radar sensor solution
- Integrated DSP, Memory
- >130m Range using single chip
- ~170m using 2 chip



## IMAGING RADAR

- Cascaded radar sensor solution
- >350m Range
- < 1 deg angular accuracy



## RADAR FOR PARKING

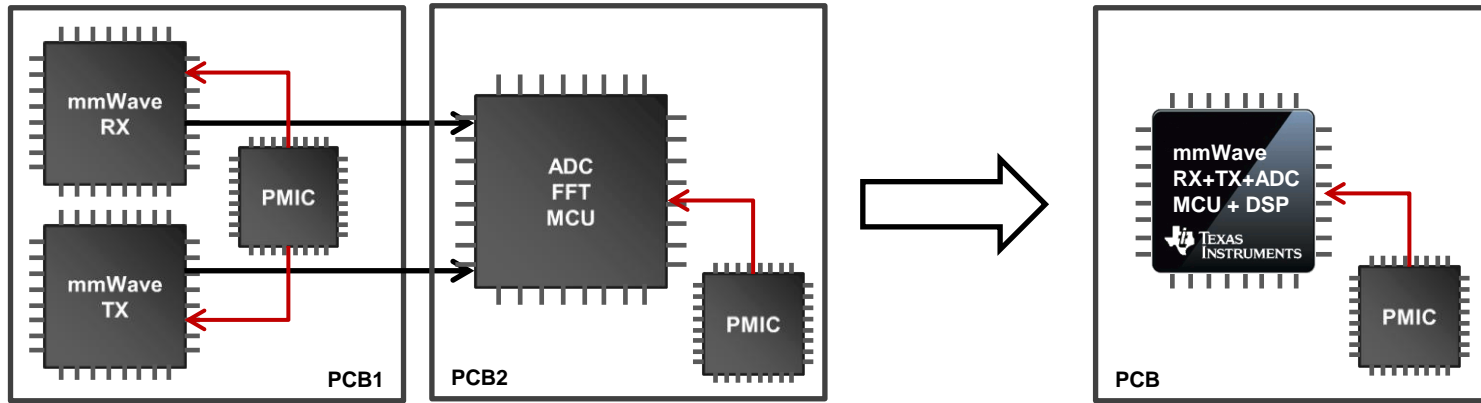
- Antenna on package solution
- Multimodal/Multi functional
- High resolution and wide field of view



## Body & Incabin Sensing

- Automatic Door opener
- Driver Vital Sign Detection
- Occupant Detection
- Gesture detection

# TI introduce the first Single Chip mmWave IC



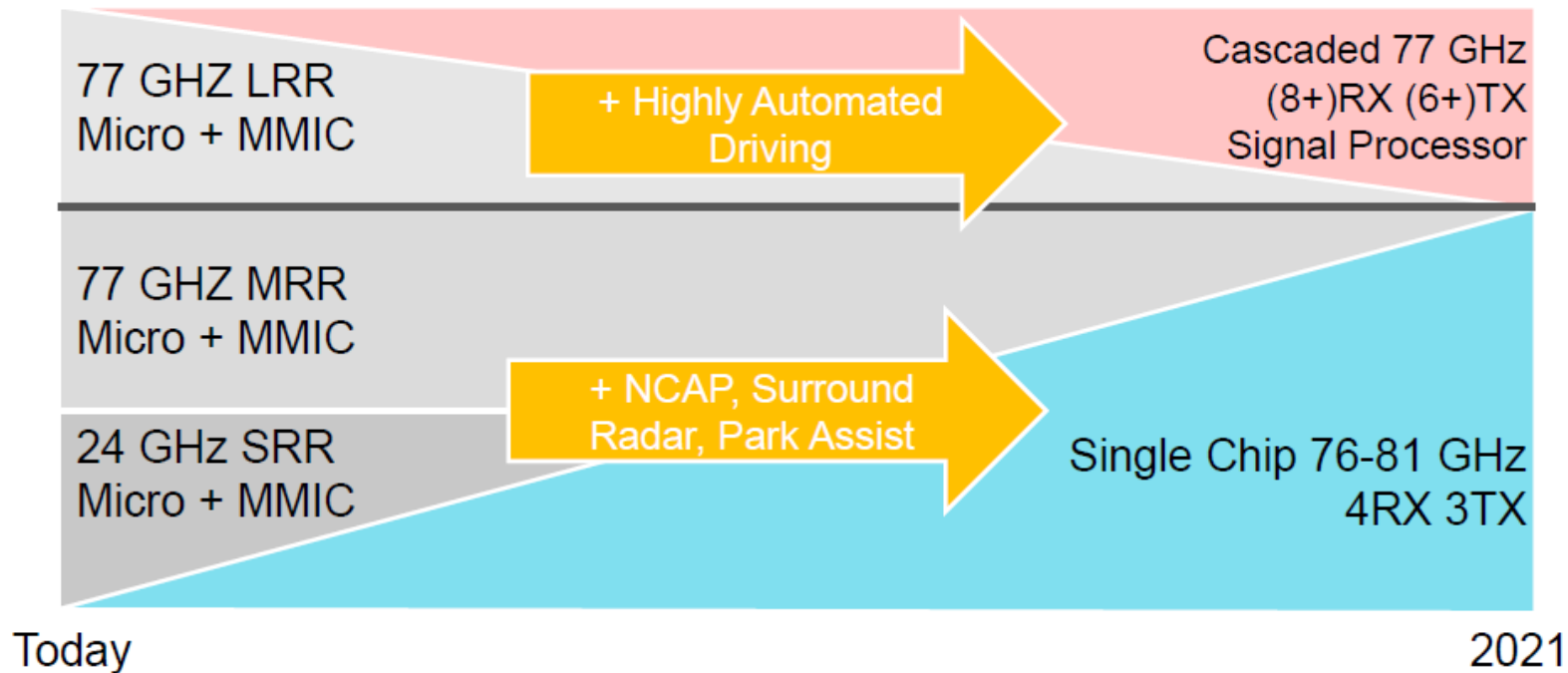
## Discrete Multi-Chip mmWave Sensor

- Discrete solution – expensive
- Complex and critical signal routes
- Unconventional packaging
- Prone to noise
- Lack of system level observability
- Crude implementation of RF and Baseband safety

## TI Single-Chip mmWave Sensor

- Smaller in size
- Simpler design
- Built in monitoring and calibration (ASIL)
- High Resolution, less false positives
- Programmable core
- Lower Power

# Trend in Radar sensors

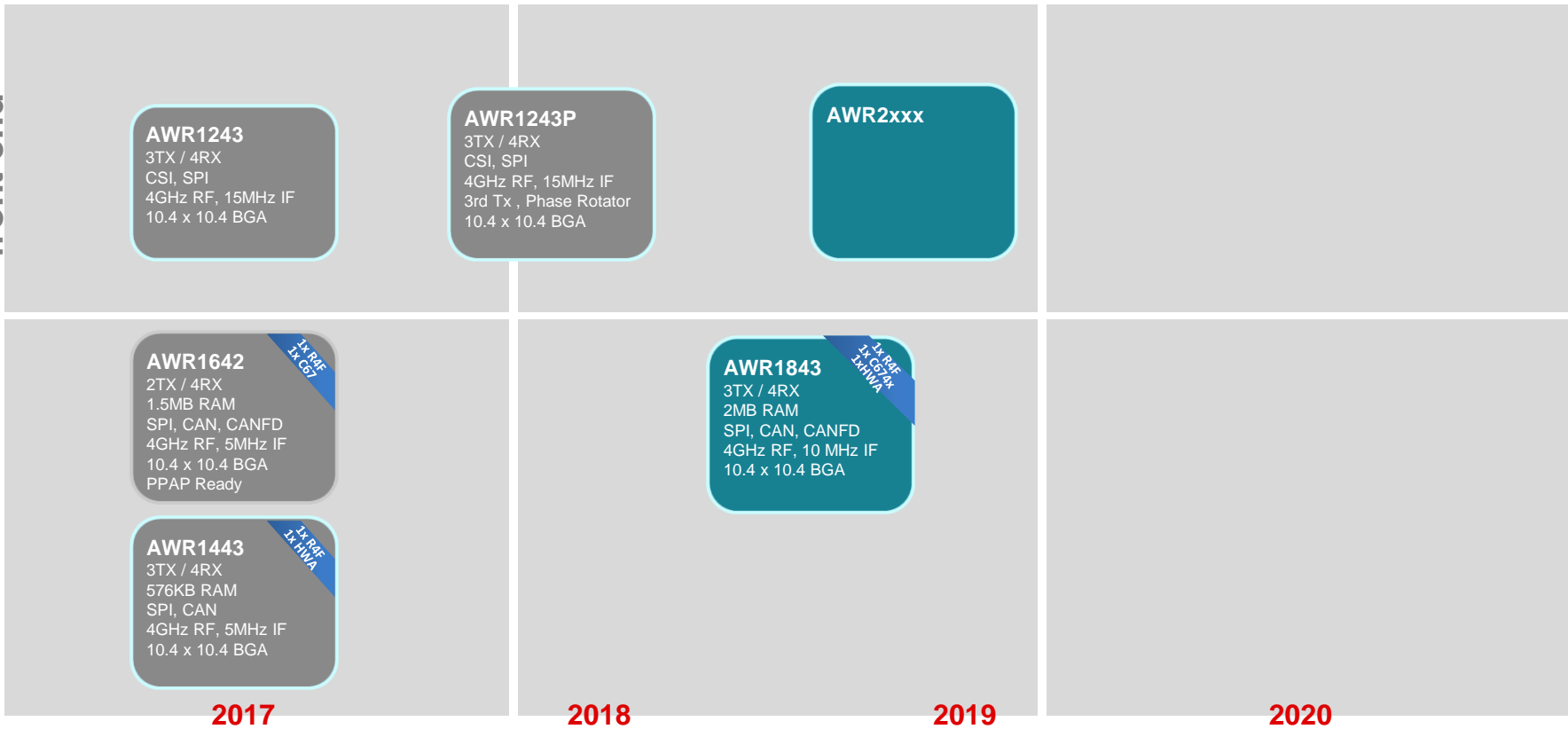


# Automotive radar roadmap

Production
  Sampling
  Development
  Concept

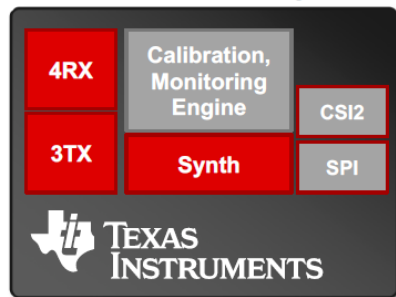
High performance front end

Single chip



# Automotive mmWave Sensors

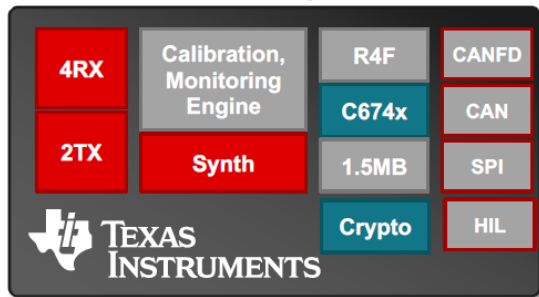
## AWR1243



### Radar Sensor

- **Use Cases**
  - Imaging Radar Sensor
    - 2x or 4x AWR12 (cascade) + External DSP
  - MRR and LRR
- **ASIL-B capable**
- **PPAP/Production: Now**

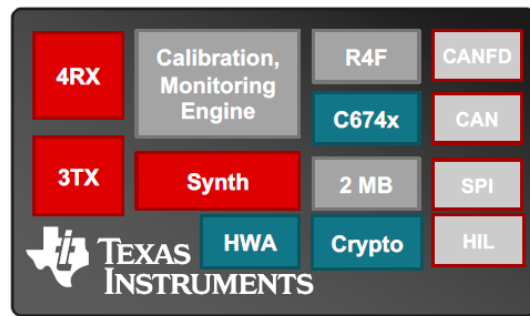
## AWR1642



### Radar Sensor + DSP

- **Use Cases**
  - SRR Single chip Radar
    - 100m Cross traffic Alert
  - Body sensing, Occupant sensing, Vital sign monitoring
- **ASIL-B capable**
- **PPAP/Production: Now**

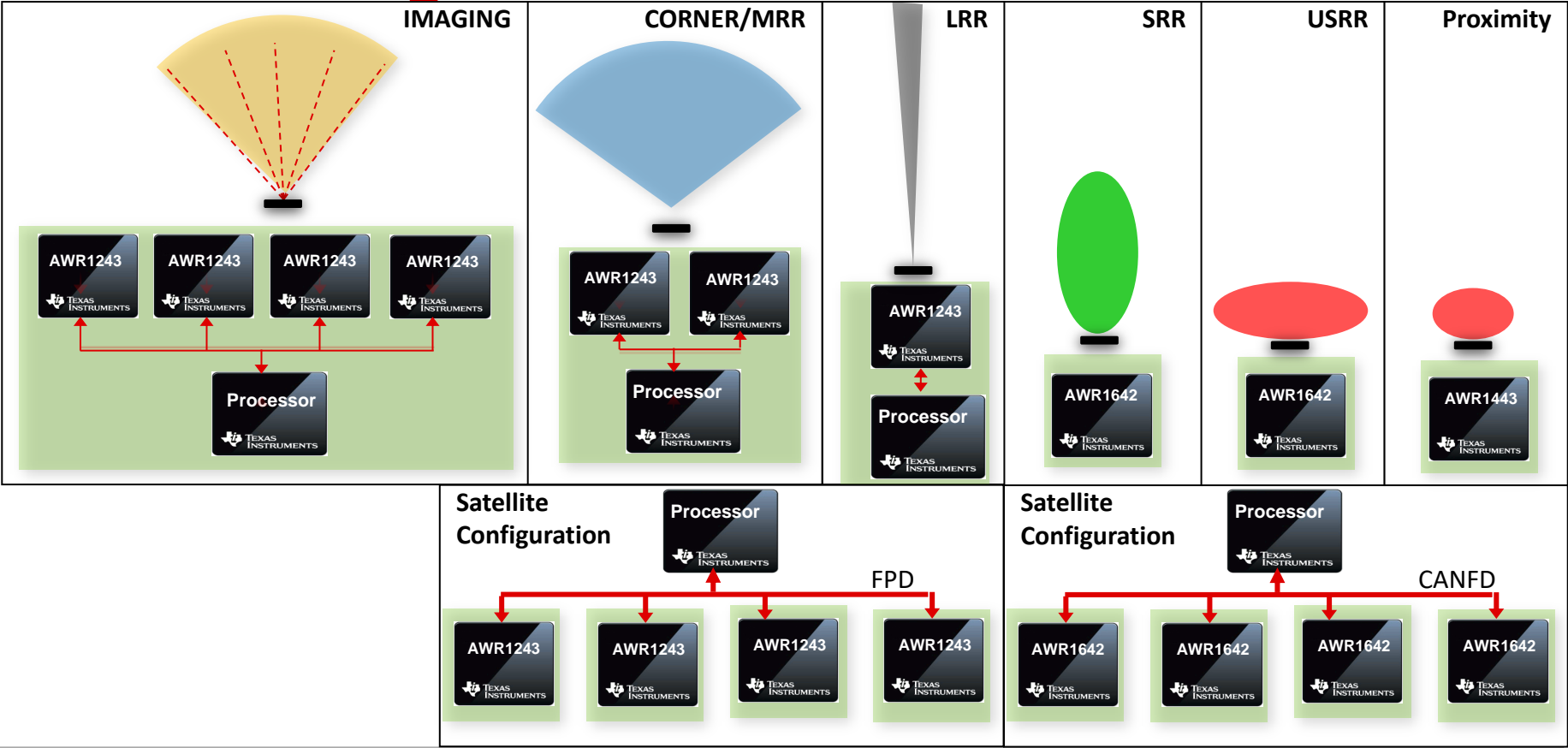
## AWR1843



### Radar Sensor + DSP

- **Use Cases**
  - Parking w/ height measurement
  - MRR single chip radar
- **ASIL-B capable**
- **Sampling: July 2018**
- **PPAP/RTM: 2Q19**

# Sensor configuration with TI mmWave solutions



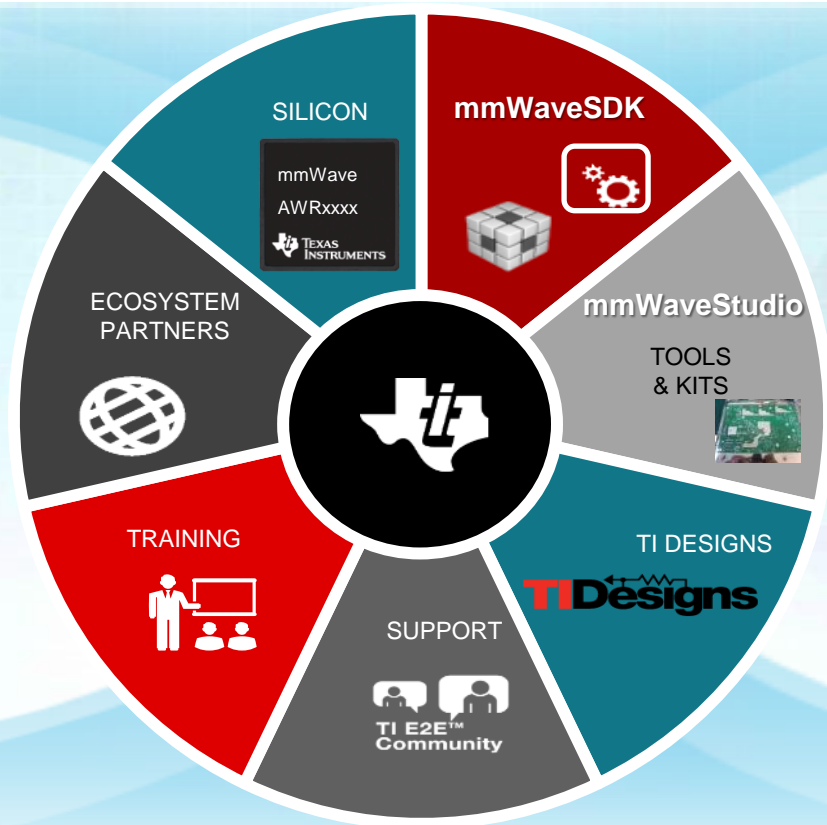
# Delivering mmWave sensing solutions

  
INDUSTRIAL

  
AUTOMOTIVE

  
ANALYTICS

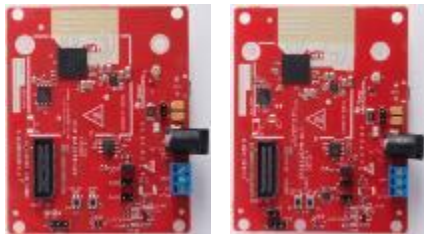
  
MACHINE VISION





# Hardware Platforms

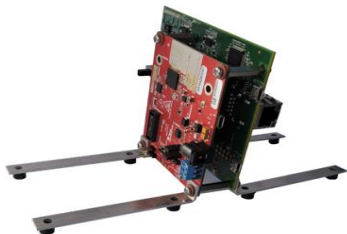
## AWR1443/AWR1642 AWR1642-ODS EVM



85 x 65mm

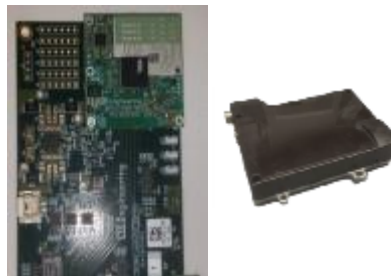
- Enables evaluation of single chip radar
- Proximity sensor demo on AWR1443 EVM
- SRR demo on AWR1642 EVM
- Environment: mmWave-SDK

## AWR1x + DCA1000EVM



- Enables RF performance evaluation
- Raw ADC capture into PC and then post process
- mmWave Studio to visualize object range/velocity/angle
- Environment: DFP and mmWave Studio

## AWR1243 + TDA3x



- Enables radar algorithm and MRR/LRR application development on TDA3x
- Enables vehicle validation/demonstration
- Environment: DFP and TDA3x Radar SDK

## AWR1x sensor module AWR1x starter kit



34 x 38mm

- Enables radar algorithm and proximity/SRR application development on AWR1443/AWR1642
- Enables vehicle validation/demonstration

# Short Range Radar Reference Design Using AWR1642 EVM: *TIDEP-0092*

## Features

- ❑ **Today:**
  - Single chip solution with DSP integration and 1.5MB of on chip RAM for application programming.
  - Detected cloud point/objects up to 80m sent over UART interface to a PC for visualization using mmWave SDK
  - Clustering & Tracking of objects up to 100m+ at 40cm resolution, +/-60 deg FOV
  - Velocity resolution algorithm
  - Better detections and minimum memory configuration
  - Stream object data over Ethernet via a data capture card
  - Occupancy grid detection

## Benefits

- Single Chip solution with DSP integration excluding dependence on external processor.
- Small form factor and low power.
- High spatial and velocity resolution at 77GHz
- Cost optimized BOM
- Reference processing chain and higher layer algorithms

## Target Applications

- Blind Spot detection
- Lane Change assistance
- Cross Traffic alert
- Parking Assistance

## Tools & Resources

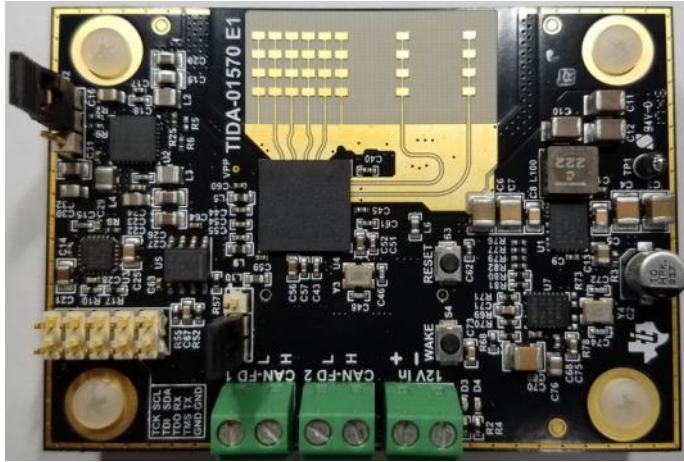
- **TI Design Link:**  
<http://www.ti.com/tool/TIDEP-0092>
- **Design Files:** Schematics, BOM, Gerbers
- **Software:**  
<http://www.ti.com/tool/TIDEP-0092>

### Device Documents

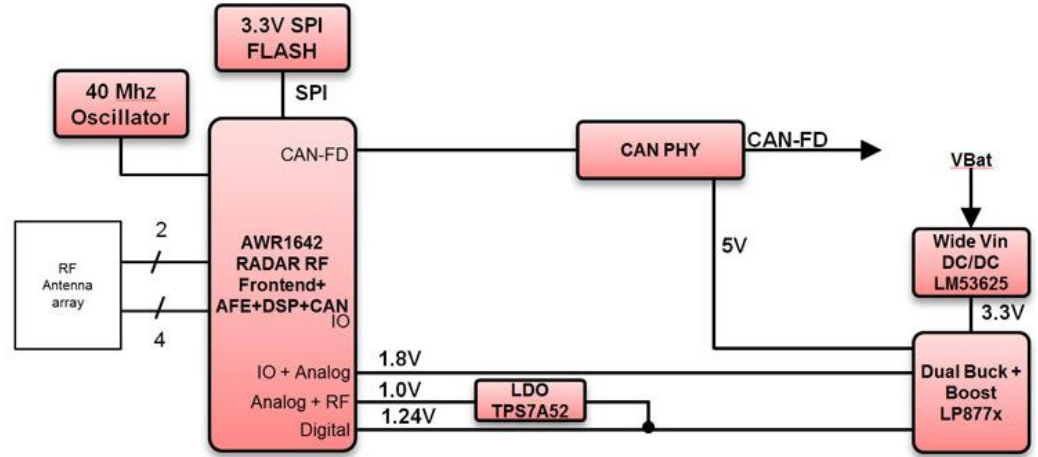
- [www.ti.com/product/AWR1642](http://www.ti.com/product/AWR1642)



# Automotive 77GHz Radar Module Reference Design: TIDA-01570



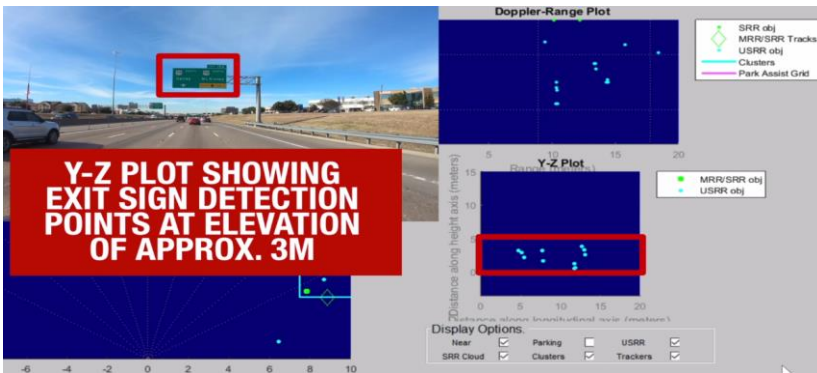
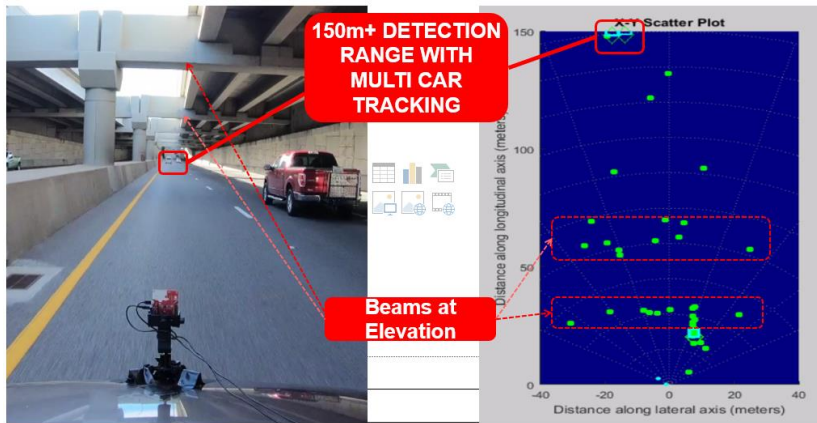
50mm x 71mm



TIDA-01570 block diagram

<http://www.ti.com/tool/TIDA-01570>

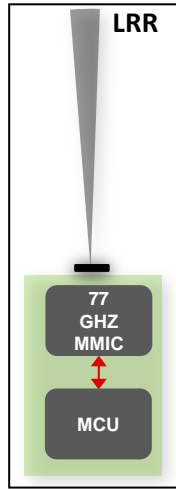
# Corner Radar Using Single Chip Radar Sensor AWR1843



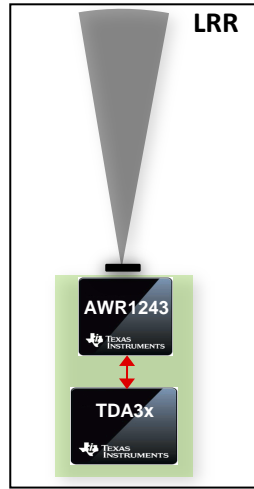
## Key Features

- **Single chip drives smallest form factor and lowest cost sensor**
  - World's first RFCMOS single chip sensor already in production, enabling processing at the edge
- **High precision and accurate detection up to 150m**
  - Ultra-wide bandwidth enables separation of objects as close as 4cm
  - Detection of 200+ objects with multi-mode
- **mmWave-SDK, reference designs and system level learnings enable faster TTM**
  - Safety monitoring, device calibration, optimized power architecture, reference algorithms

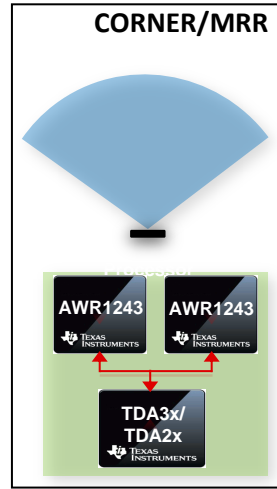
# Enabling Level2+ automation with high performance cascade



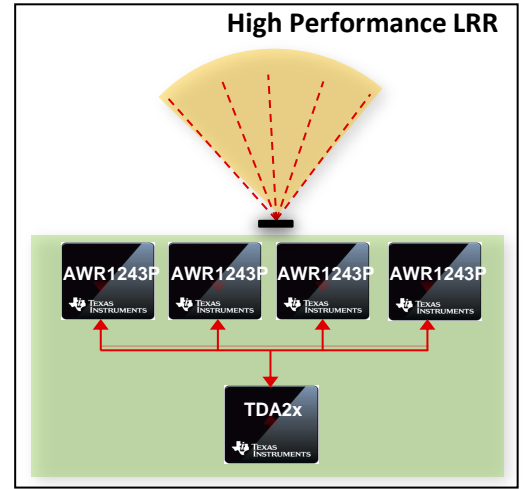
**Today**  
Resolution in 10s of m  
Coarse Doppler resolution  
100 km/h relative velocity



5cm resolution  
Low Doppler ambiguity  
300km/h relative velocity



+  
4x angular resolution



+  
beam steering  
< 1° angular resolution

Curbs/Overhanging objects



Overhead bridges/tunnels

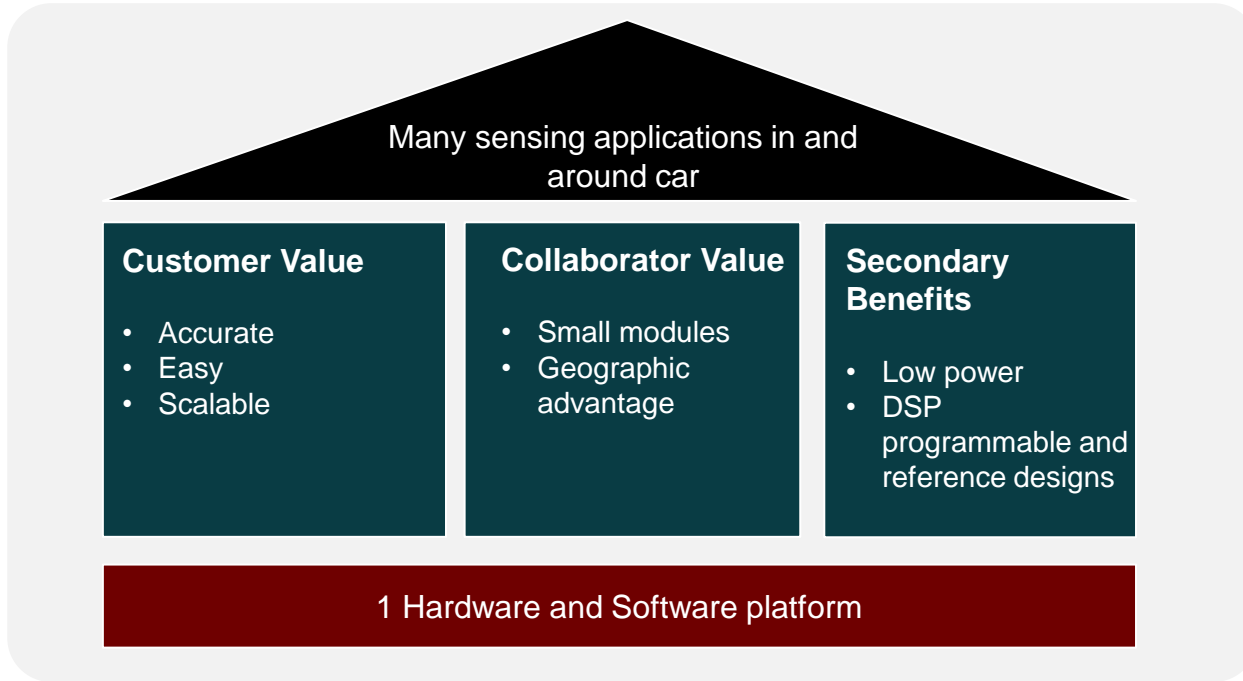


Dense urban scenarios



# Adjacent Markets

One platform several applications



## Applications



# Key market segments

## Obstacle Detection Sensor

- Car/Door Openers
- Park Assistance
- Suspension control
- Detection of ice/water on road



## Vehicle Occupant Detection

- Child Left behind
- Intrusion detection
- Occupant classification (adult or child) for air bag deployment



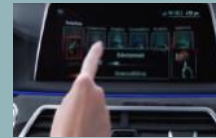
## Driver Vital Sign Monitoring

- Driver/Passenger Heart rate
- Driver sleep state detection
- Passenger ill/pass out



## Swipe/Kick to open

- Kick to open tailgate
- HMI screen change
- Knob control
- Panes open/close

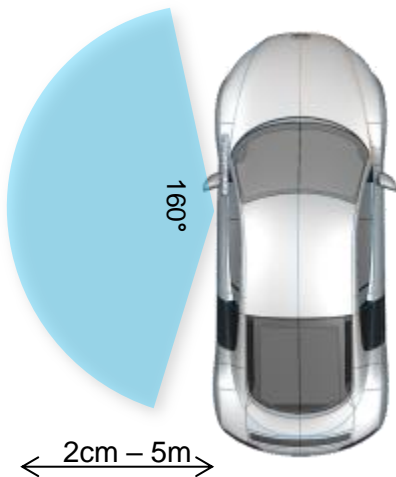


SOP 2018 +





# Near range 3D obstacle detection (Body & Chassis)



## Why 77GHz radar

- Sense obstacle in the vicinity of car door to avoid collision and damage
- Single chip and small form factor that can go even “**inside**” a door-handle OR side-mirror OR door-cladding – Scalable to multiple locations
- Works under bright sunlight, pitch darkness, snow, fog
- Detection in elevation and azimuth directions with sub mm range accuracy
- Offers more range than any comparable sensing technology
- Easy algorithm implementation on single chip



# Obstacle detection using AWR1642BOOST-ODS

## Features

- Near range 3D obstacle detection
- Single chip solution with DSP integration and 1.5MB of on chip RAM for application programming.
- Parameters
  - Range: 4 cm - 15m
  - Resolution : 4 cm
  - FOV: +/-80 deg Azimuth, +/-80 deg Elevation

## Target Applications

- Automotive
  - Obstacle detection around Car door/trunk
  - Parking Assist

## Tools & Resources

- **Tool folder link**  
EVM page available and code on TI Resource explorer  
Early software available for evaluation now
- **Device datasheets links:**
  - AWR1642BOOST-ODS – Available to order

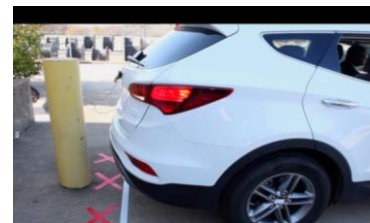
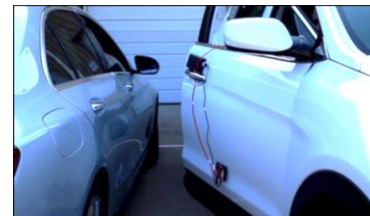
## Benefits

### TI

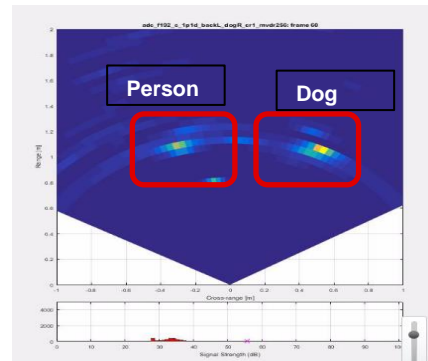
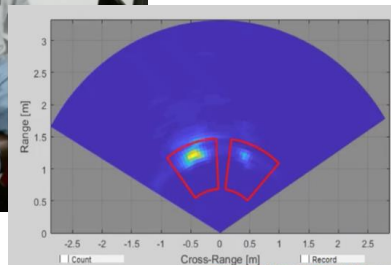
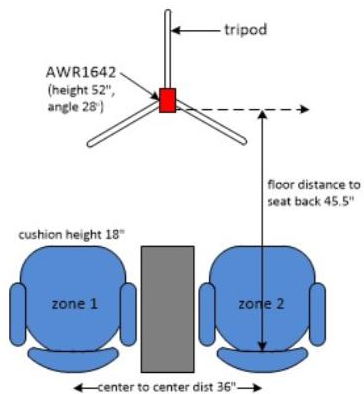
- Accurate, Low power single chip sensor for near range 3D obstacle detection applications against existing solutions

### Customer Collateral

- HW/SW reference to jump start on the system design
- 3D Obstacle detection and elevation algorithm reference
- Processing chain reference



# Vehicle Occupant Detection Reference Design: TIDEP-01001



<http://www.ti.com/tool/TIDEP-01001>

# TI E2E Forum – e2e.ti.com

The screenshot displays the TI E2E Forum interface for the mmWave Sensors section. The page features a search bar at the top, navigation links for Forums, Blogs, Groups, TI Training, IMDS, and Metrics, and a language selector for 简体中文. The main content area lists several discussions with their titles, reply counts, view counts, and the latest poster with the date and time of their post. A right-hand sidebar contains buttons for Go to Sensor Products, Forums, FAQ, and Options, along with a section for TI E2E Top Contributors and a Reward & Recognition Program link.

Welcome to the mmWave Sensors Section of TI E2E Support Community. Be sure to search for questions others may have asked related to AWR and IWR Sensors. Ask questions, explore ideas, and help solve problems with fellow engineers.

All recent questions and discussions | By date | Descending

- POSTPONED: mmWave Webinar Series Announcement (New dates and registration included)**  
5 Replies 1821 Views  
Latest post by Akash Gondalia  
Mar 15, 2018 2:02 AM
- VOTE NOW: Suggestions for new mmWave Webinars**  
2 Replies 502 Views  
Latest post by Tom Lindeman69  
Feb 10, 2018 3:57 AM
- mmWave Industrial Toolbox -- Preview Documents**  
1 Reply 2958 Views  
Latest post by BhavinKharadi  
Aug 22, 2017 8:18 AM
- PLEASE READ : mmWave Forum Guidelines**  
1 Reply 2935 Views  
Latest post by \_Nic  
May 17, 2017 3:07 AM
- Learn More About mmWave Sensor Devices**  
1 Reply 3445 Views  
Latest post by \_Nic  
May 17, 2017 3:06 AM
- Linux/IWR1443: R4F source code**  
0 Replies 6 Views  
Latest post by user548456  
Apr 2, 2018 1:57 PM
- AWR1243: Antenna Pattern**  
1 Reply 32 Views  
Latest post by Akash Gondalia  
Apr 2, 2018 11:41 AM
- AWR1642: TIDEP-0092 EKF Tracker for cross traffic situation?**  
0 Replies 16 Views  
Latest post by James Austrial  
Apr 2, 2018 10:00 AM
- AWR1642: How to read GPADC data out?**  
3 Replies 71 Views  
Latest post by Adam Yao94020  
Apr 2, 2018 9:42 AM
- CCS/IWR1443BOOST: IWR1443BOOST**  
0 Replies 0 Views  
Latest post by Ling Fei Zhang  
Apr 2, 2018 9:27 AM

Go to Sensor Products  
Forums  
FAQ  
Options

TI E2E Top Contributors

Top Contributors | Top TI Contributors

Rahul Kumar85 | Santhana Raj | radarjunkie | peter mccormick  
Ryan Elith | wendy | Clem | Sandra Brenda

Reward & Recognition Program  
Become a Top Contributor  
View Top Contributors

# TI Training – training.ti.com

The screenshot shows the TI Training website homepage. At the top, there is a navigation bar with the Texas Instruments logo, a search bar containing 'mmWave', and a 'Login/Register' link. Below this is a red banner with 'TI Training' on the left and 'Feedback' and 'Global' on the right. The main content area features a large heading 'TI Training' with the tagline 'Learn. Solve. Innovate.' and a sub-headline: 'From fundamentals to deep dives, our extensive training program offers thousands of online training courses to help you design with TI products, tools, software, and applications.' A 'Get started now' link is provided. Under 'Browse training by:', there are four categories: 'Applications & designs', 'Products', 'Tools & software', and 'Live training', each with an icon. A featured course 'TI mmWave Sensors' is highlighted with a blue background and text: 'Watch the training series for the world's most precise single-chip millimeter wave sensor available today.' To the right, there are sections for 'View popular' and 'View latest releases', each listing several training series. The footer contains a list of links (About TI, Careers, Contact us, etc.), copyright information (© Copyright 1995-2016 Texas Instruments Incorporated), and social media icons.

TI training and training X  
Secure | https://training.ti.com

TEXAS INSTRUMENTS

mmWave

Login/Register

TI Training

Feedback Global

## TI Training

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[Get started now](#)

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- Applications & designs
- Products
- Tools & software
- Live training

**TI mmWave Sensors**

Watch the training series for the world's most precise single-chip millimeter wave sensor available today.

100+ started

**View popular**

- High Volt Interactive Training Series
- TI Precision Labs
- Power Supply Design Seminar 2018 Training Series
- TI Robotics System Learning Kit (TI-RSLK)
- mmWave Training Series

**View latest releases**

- How High-Voltage Isolation Technology Works
- Power Supply Design Seminar 2018 Training Series
- Getting Started MSP430G2553 Value Line LaunchPad Workshop Series
- MSP430 Workshop Series
- Managing heat dissipation with DC/DC switching regulators

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# TI Resource Explorer – dev.ti.com

The screenshot shows the TI Resource Explorer web application. The browser address bar displays `dev.ti.com/tires/#/`. The page header includes the title "TI Resource Explorer" and a search bar with the placeholder text "Select a Device or Board".

The main content area is divided into two columns. The left column features a tree view of resources, with the "mmWave Sensors" folder expanded and highlighted by a red box. The tree view includes the following items:

- C2000Ware - v1.00.05.00 - (12202)
- C2000Ware\_DigitalPower\_SDK - v1.01.00.00 - (45)
- mmWave Training - v1.6.2 - (23)
- mmWave Sensors - (116)
  - Industrial Toolbox - v2.5.0 - (93)
    - Antenna Database - (2)
    - Chirp Database - (9)
    - Experiments - (8)
    - Labs - (74)
      - Drone Altitude Demo - (3)
      - Intelligent Lighting and Factory Automation Demo - (3)
      - mmWave SDK Demo - 14xx - (3)
      - mmWave SDK Demo - 16xx - (4)
      - Water vs Ground Classification Demo - (4)
      - Vital Signs Demo - (6)
      - 4K FFT Stitching Algorithm - (3)
      - High Accuracy Range Measurement - 14xx - (3)
      - High Accuracy Range Measurement - 16xx - (4)
      - ROS Point Cloud Visualizer - (5)
      - Fluid Level Transmitter with mmWave - (2)
      - Autonomous Robotics with ROS for mmWave - (7)
      - Gesture Recognition - Twirl Example - (4)
      - Gesture Recognition - Swipe Example - (4)
      - People Counting Demo - (6)
      - Short Range Radar - (4)
      - Traffic Monitoring - (6)
      - Zone Occupancy Detection - 14xx - (3)
  - Automotive Toolbox - v2.1.2 - (23)
    - Labs - (23)
      - Driver Vital Signs - (6)
      - Short Range Radar - (5)
      - Vehicle Occupant Detection - (4)
      - Obstacle Detection - (4)
      - Object Data Over CAN - (4)
- MSP430Ware - v3.80.04.05 - (76284)
- TM4C ARM Cortex-M4F MCU - v2.1.3.156 - (367)
- Sitara - v1.02.00.00 - (375)

The right column displays a "Welcome to Resource Explorer" message, followed by a tip: "Are you new to Resource Explorer? Try the Quick Tour to help you navigate Resource Explorer." Below this, a grid of resource cards is shown, each featuring a TI logo and a specific resource name:

- C2000Ware
- SimpleLink CC32XX SDK AWS IoT Plugin
- SimpleLink CC32XX SDK Azure IoT Plugin
- SimpleLink Sensor and Actuator Plugin
- SimpleLink CC13x0 SDK
- SimpleLink CC13x2 SDK
- SimpleLink CC2640R2 SDK
- SimpleLink CC2640R2 SDK BLE Example Pack
- SimpleLink CC26X2 SDK
- SimpleLink CC32XX SDK