

RADAR TECHNOLOGIES FOR AUTOMOTIVE AND IoT

Imec has a proven track record in developing a broad range of top-notch radar sensors for different application fields, including a 60 GHz radar for IoT applications, a 79 GHz SoC for automotive, and a single-chip 140 GHz radar for vital-signs detection and gesture recognition. Imec's radar technology covers two tracks: imaging radar technology – enabling “LiDAR-like” ultra-high resolution for next-generation automotive, security and manufacturing industry; and radar technology for IoT – enabling the size, power, cost and performance for any smart device, in any application context.

APPLICATION & CHALLENGES

Radars use electromagnetic waves for 3D-position and motion sensing of objects. Today, radar is a commonplace technology used in a wide range of markets: aerospace, automotive, consumer electronics, and the manufacturing industry. Imec's radar technology has some key assets that are indispensable for these markets.

- E.g. for autonomous driving, current-day radars do not achieve a sufficiently high angular resolution. Increased angular resolution is required to be able to clearly separate multiple targets. And this at an acceptable cost & power, while maintaining the radar's unique capability to detect target velocity even at high speeds.
- In the context of IoT, existing technology is often too bulky, costly and power-hungry. Very small, low-power technology is required to enable “radar-in-everything”. Imec works on the required technology to enable new applications and the use of radar in new markets.

- For consumer electronics, imec's radar technology has several benefits: small size due to high integration of the RFIC into the package and module; and low power consumption due to excellent mm-wave design and duty-cycling enabled.

IMEC'S IMAGING RADAR TECHNOLOGY

Imec offers next-generation imaging radar technology. Currently, a 79 GHz dual-channel radar SoC using digital modulation is available for licensing. The digital radar design enables large arrays and detection of high-velocity targets. At constant maximum unambiguous velocity, imec's technology can enable up to 25x larger array compared to typical fast-chirp frequency-modulating radars.

Moreover, it exploits standard CMOS technology for high-speed baseband processing at a low-power budget. It avoids complex chirp-based PLLs typically required for frequency modulation, and has attractive interference properties, key for dense automotive deployment.

Furthermore, imec actively researches implementation of large imaging arrays at 140 GHz, where high bandwidth can enable high-range resolution, while shrinking down large arrays to acceptable levels. Partner with imec to access our state-of-the-art technology while it is being developed!

IMEC'S RADAR TECHNOLOGY FOR IoT

Low-power radar can be a key enabling technology for battery-powered consumer electronics devices, and for devices with an always-on sensor while not compromising stand-by power consumption. Tiny chips integrated into small radar modules, with high-performance antennas enable a whole new set of applications: e.g. people counting and tracking, activity recognition, vital-signs monitoring and gesture recognition. Integrating machine-learning compute blocks, optimized for the type of applications mentioned above, close to the analog front-end, is a final ingredient to reduce power consumption.

In the IoT space, imec offers a license to its wideband 60 GHz CMOS low-power radar transceiver design. Furthermore, at 140 GHz, imec has developed on-chip antenna technology to reduce the system size beyond anything in products today. This tiny self-contained 140 GHz device, enables radar-in-everything. Talk to us today to see how our technology can help your breakthroughs in new and existing applications:

- Accurate finger / hand-gesture detection
 - Ultra-compact human-machine interface (HMI) – e.g. for screen bezels, smartwatches, tablets, small home-automation systems...
 - Future augmented and virtual reality (AR/VR) solutions with intuitive motion detection and object interaction
- High-quality vital signs detection for health monitoring
 - Heartbeat monitoring
 - Respiration monitoring
- Radar-based sensing for smart professional buildings
 - Fine-resolution person detection
 - Person-robot interactions
 - Surveillance and security applications

R&D RADAR PLATFORMS & TOOLS

Imec's radar technologies are developed and tested in R&D radar platforms. If you want to know how imec's technology could affect your future application idea, partner with us to access our state-of-the-art R&D radar platforms.

Imec licenses a comprehensive radar system modelling suite, implemented in MATLAB(r) and validated with silicon-proven parameters. The software allows a.o.:

- a full radar system design environment, i.e. from RF to digital postprocessing,
- calculating Doppler, range and angle for FMCW, PMCW and OFDM waveforms,
- what-if analysis for various waveform's properties and analyse module performance specifications and interference characteristics.

Finally, the modules and antenna design capabilities of the RF and Imec's advanced packaging R&D group are well aligned with industry roadmaps.

BUSINESS MODELS

- IP licensing
- Collaborative R&D for chip design and application development

	60 GHz TRX	79 GHz SOC	140 GHz TRX
Technology	28mm CMOS	28mm CMOS	28mm CMOS
Antenna	SISO module	MIMO module	on-chip
Frequency [GHz]	60	79	140
Bandwidth [GHz]	6	2	10
Range resolution [cm]	2.5	7.5	1.5
Channels	1 TX - 1 RX	2 TX - 2 RX	1 TX - 1 RX
EIRP or TX power [dBm]	8.1 (EIRP)	10 (TX)	11.5 (EIRP)
Noise Figure [dB]	12.9	12	8
IF Bandwidth [MHz]	20	1000	17
Chip size [mm ²]	4.1	10	6.5
Power consumption [mW]	62	1500	500

| Summary of imec's radar performance

CONTACT US
WWW.CONTACTIMEC.COM

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