

WIRELESS COMMUNICATION AND RADAR: IMEC'S IP LICENSING OFFERING

Imec pioneers compact, high-throughput, and power efficient solutions for next-generation radar sensing and wireless communication. Wireless communication solutions target millimeter (mm)-wave applications and ultralow-power (ULP) applications, i.e. Bluetooth Low Energy (BLE) and Low-Power Wide-Area Network (LPWAN). Imec's prototype radios and building blocks are offered, through a white-box intellectual property (IP) licensing model. Our portfolio includes record-breaking ADCs, fractional-N ADPLL for 2.4GHz/sub-GHz, power management unit (PMU) for IoT applications, ultralow-power (ULP) radios, 28GHz communication for 5G, 140GHz communication for beyond 5G and AR/VR, 60GHz radar for battery powered small devices, 79GHz radar for automotive, and 140GHz radar for non-contact vital signs monitoring and gesture recognition.

BUSINESS MODEL FOR PROTOTYPE IP WHITE-BOX LICENSING

Our prototype IP licensing model includes:

- A world-wide commercial license for modifying and using this prototype IP in licensee's products
- A transparent technology transfer of the design databases (e.g., RTL source code, analog/RF IC design schematics and layout), measurement results and simulation results, reports and know-how on the design
- An interactive multi-day training for licensee's designers
- Remote support by imec experts during product design by the licensee's team

RECORD-BREAKING ADCS IN CMOS TECHNOLOGY

Imec offers record-breaking ADCs in CMOS technology, including efficient high-speed ADCs for mm-wave applications, and ULP successive approximation (SAR) ADCs:

	CMOS TECHNOLOGY	RESOLUTION	SPEED	POWER CONSUMPTION
	90nm UMC	9-bit	40MS/s	0.8mW
	40nm LP TSMC	10-bit	60MS/s	1.2mW
	40nm LP TSMC	12-bit	200MS/s	1.6mW
	28nm HPM	11-bit	400MS/s	2.1mW
	28nm HPM	14-bit	300MS/s	3.2mW
	28nm HPM	12-bit	600MS/s	14.2mW
	16nm FinFET	14-bit	300MS/s	3.6mW
	16nm FinFET	11-bit	600MS/s	6mW
	16nm FinFET	13-bit	3200Ms/s	61mW
High speed	90nm UMC	5-bit	1.25GS/s	2.5mW
High speed	90nm UMC	5-bit	1.75GS/s	2.2mW
High speed	40nm LP TSMC	6-bit	3.5GS/s	4.1mW
High speed	40nm GP TSMC	7-bit	3.5GS/s	6.2mW
High speed	28nm HPM	7-bit	3.5GS/s	6.2mW
ULP SAR ADC	90nm TSMC	5-bit	0.5-1GS/s	0.47-1.6mW
ULP SAR ADC	40nm TSMC	13-bit	6.4MS/s	46uW
ULP SAR ADC	90nm/40nm TSMC	9-bit	16MS/s	33uW
ULP SAR ADC	90nm TSMC	7-to-10-bit	0-8MS/s	3.56uW at 2MS/s (scales dynamically with sampling rate)

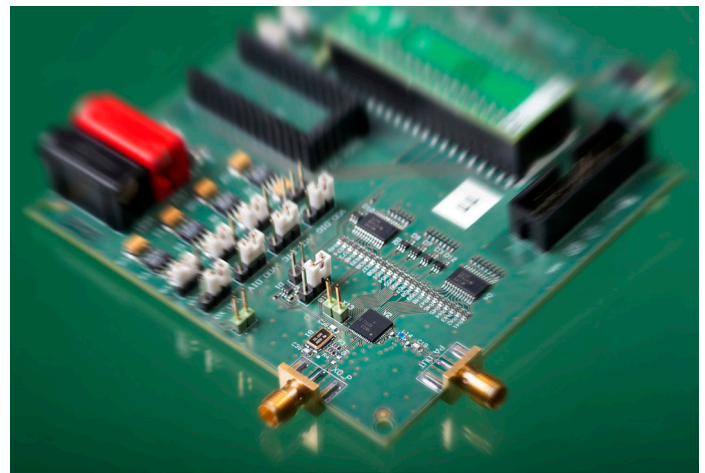
KEY BUILDING BLOCKS OF RADIOS: ADPLL AND PMU

Two key building blocks of wireless communication radios are available for IP white-box licensing: a fractional-N all-digital phase-locked loop (ADPLL) for 2.4GHz/sub-GHz communication, and a highly efficient power management unit (PMU) for Internet-of-Things applications. The PMU is realized in 40nm TSMC technology, the ADPLL is available in 40nm and 28nm TSMC technology.

FULL ULTRALOW-POWER RADIOS FOR IOT APPLICATIONS

Imec offers full ULP radio prototypes operating in the sub-GHz, 2.4GHz, and up-to-10GHz frequency ranges. The offering includes:

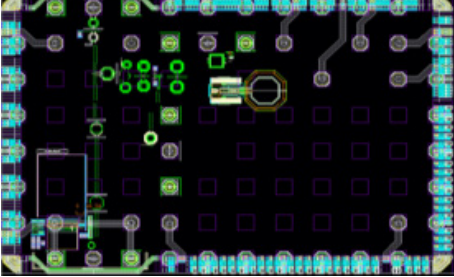
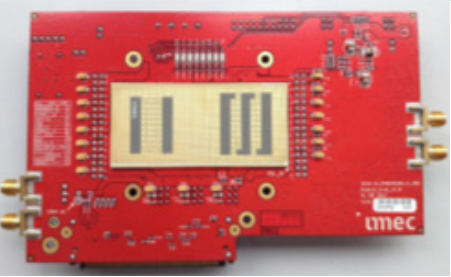
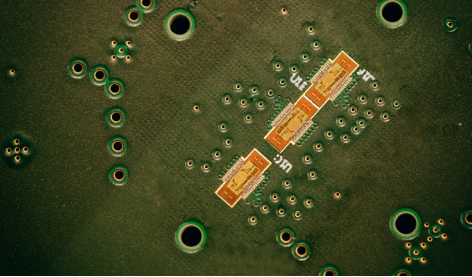
- 802.15.4z compliant UWB radios (TSMC 28nm)
- 2.4GHz low-power BLE and 802.15.4 radios, supporting Bluetooth 5 (TSMC 90nm/40nm)
- sub-GHz radios for 802.15.4g and 802.11ah HaLow (TSMC 40nm)
- 400MHz radios for implantable applications (TSMC 40nm)
- Wake-up receivers for IoT applications, w. BLE support (TSMC 90nm/40nm)
- 802.15.4a compliant UWB radios (TSMC 90nm)



ADPLL

IMEC'S CMOS RADAR DESIGN IP

Imec offers state-of-the-art radar chip design in CMOS technology. The offering covers:

60GHz	79GHz	140GHz
		
Small IoT devices	Automotive	Compact MIMO radar
License-free operation in ISM band	Phase-modulated digital radar	Small motions, e.g. hand gestures, heartbeat
Sub-10mW	Full 2X2 SoC for large MIMO arrays	1.5cm range resolution
Small MIMO footprint	Towards 1° resolution	High motion sensitivity
		6mm ² chip incl. antennas

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