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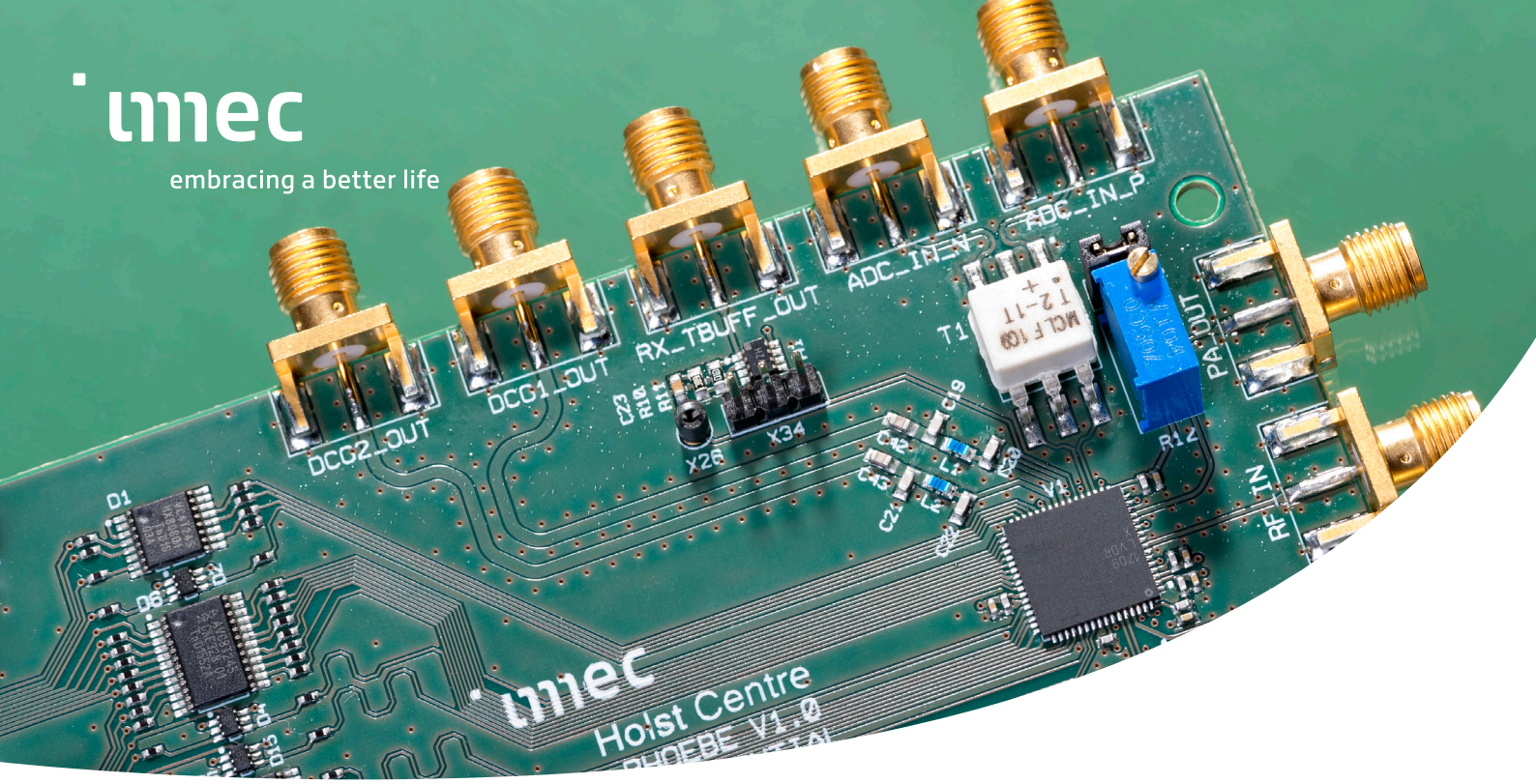


NEXT-GEN BLE 5 0.8V ULP SMALL AREA RADIO IN TSMC 40NM CMOS

Imec's Next-Gen BLE 5.0 Radio is a silicon-proven design featuring a digital-intensive receiver architecture to achieve ultra-low power consumption (<2.3mW AFE), low nominal supply operation (0.8V) and small area (AFE <0.6mm2).

DESCRIPTION

Imec's 2.4GHz Next-Gen BLE 5 radio delivers best-in-class performance at world's lowest power consumption. The analog-front end (AFE) supports Bluetooth V5, 4.2 and 4.0 and IEEE 802.15.4 (Thread, Zigbee). It complies with the FCC and ETSI regulations and delivers an output power up of 2dBm.

The ULP radio uses an advanced digital transmitter and a zero-IF phase-tracking receiver architecture., as well as fully integrated on-chip matching. The novel transceiver architecture achieves ultra low power consumption at 0.8V nominal voltage supply, boosting battery lifetime.

The phase-tracking receiver tracks the input RF frequency by a fast frequency-tracking loop in parallel with the ADPLL. The fast frequency-tracking loop is implemented by a single-branch down-mixer chain. Comparing to conventional IQ down-conversion, this RX chain saves a factor 2 on die area and power consumption. An LNTA is adopted, instead of an LC-loaded LNA, further reducing the die area. The digital assistance loop offers extra filtering to improve the interference performance and CFO tolerance of the receiver.

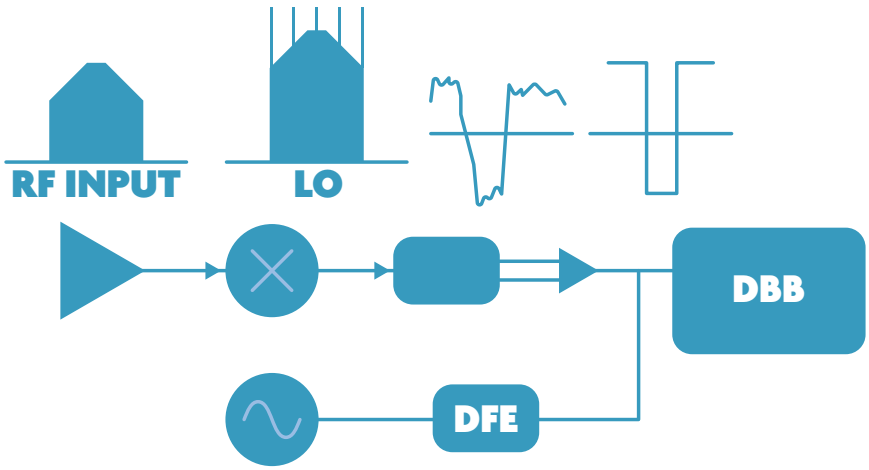
The two-point modulation Tx is based on a sub-mW All-Digital PLL (ADPLL) and a Digital Power Amplifier (DPA). It has extensive self-calibration such as DCO bank selection and 2-point gain calibration.

APPLICATIONS

- Smart watches and wearables
- Smart phone accessories
- Hearing aids and audio applications
- Remote controllers
- Home and commercial automation

FUTURE-PROOF DIGITAL-INTENSIVE PHASE- TRACKING RECEIVER ARCHITECTURE

A novel phase-tracking receiver architecture tracks the input RF frequency by a fast frequency-tracking loop in parallel with the ADPLL using a single-branch down-mixer chain. This RX chain requires half the die area and half the power consumption of conventional IQ down-conversion solutions. The digital assistance loop offers extra filtering to improve the interference performance and CFO tolerance of the receiver.



EVALUATION BOARDS

Imec provides evaluation boards on request to prospective customers and partners interested in licensing imec's radio designs and IP.

- **Phoebe 1.0 PCB**: allows evaluation of the 2.4GHz BLE AFE for BER– and PER-based performance

KEY FEATURES

- **Multi-standard 2.4GHz AFE**
  - Bluetooth Low Energy (BLE) 4.0, 4.2 and 5 IEEE 802.15.4 (Thread, Zigbee)
- **Advanced architecture for nm-CMOS**
  - Phase-tracking receiver, with single down-mixing instead of IQ All-Digital PLL
  - Digital transmitter and digital PA TSMC 40nm, at 0.8V nominal supply
- **Low cost**
  - <0.6mm2 silicon area (AFE)
  - RF fully integrated with on-chip matching (<0.2mm2)
  - No external RF components, crystal-only
- **Ultra-low power consumption**
  - Rx AFE: <2.3mW BLE (4.0)
  - Tx AFE: <6.2mW @ 2dBm
- **Best-in-class sensitivity**
  - -95dBm BER in BLE 4.0 mode (1Mbps)
  - -91dBm BER in BLE 5.0 mode (2Mbps)
- **Interference robust**
  - >-17dBm OOB
  - No image issue (zero-IF architecture)
- **Designed in TSMC 40nm ULP for 0.8V nominal supply**

SPECIFICATIONS

Frequency band	2.4-2.48GHz
Power consumption	Rx AFE: <2.3mW (BLE 4.0) Tx AFE: <6.2mW @ 2dBm
Tx output power (Max)	2dBm (max)
Tx FSK Error (BLE 4.0)	<3%
Tx spurious emission	<-41dBm
Rx sensitivity	-95dBm BER (BLE 4.0, 1Mbps) -91dBm BER (BLE 5, 2Mbps)
Adjacent Channel Rejection (ACR)	Adjacent C/I: -18dBc @2MHz Alternate C/I: -30dBc @3MHz
Out-of-band blocker	>-17dBm
Intermodulation	-41dBm
Nominal supply	0.8V
Technology	TSMC 40nm ULP CMOS

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