

ULTRALOW-POWER BT4.0/4.2/5.0/802.15.4 RADIO

DESCRIPTION

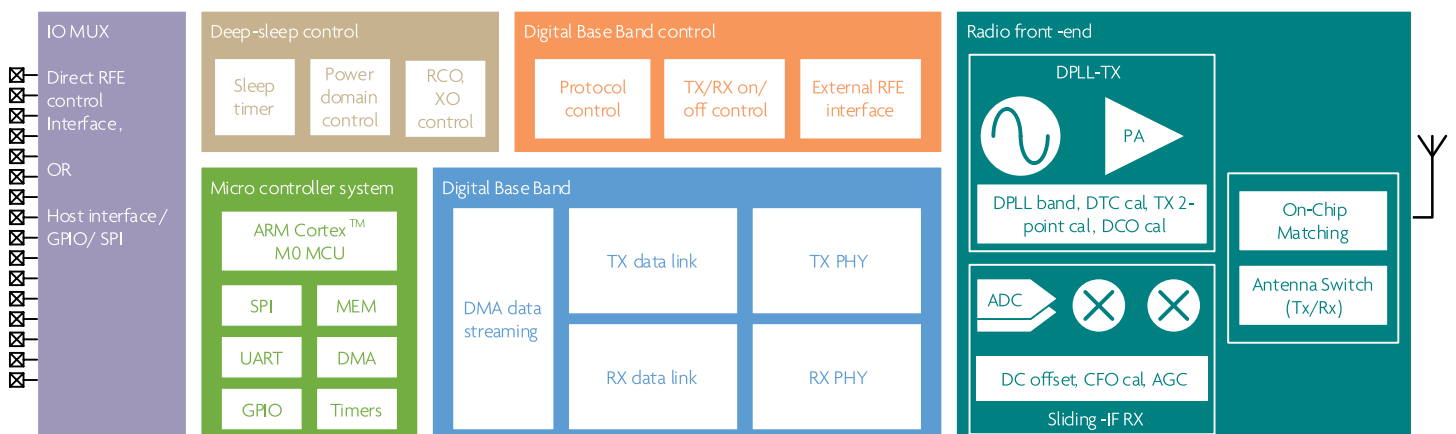
Imec's 2.4GHz multi-standard radio achieves best-in-class performance at world's lowest power consumption. The radio supports Bluetooth V4.0, 4.2 and 5.0 (draft) (a.k.a. Bluetooth Low Energy or Bluetooth Smart), as well as the IEEE802.15.4 (a.k.a. ZigBee) standard and provides a proprietary 4Mbps high speed mode. It complies with the FCC and ETSI regulations and delivers an output power up to 3.6dBm (w. external matching).

This highly integrated, full transceiver includes an RF front-end including matching network and Tx/Rx antenna switch, digital baseband, microcontroller and memories. It is complete with an energy efficient BLE protocol stack by ARM/Wicentric, as well as 18 standardized, and a few proprietary, profiles. The ultralow-power consumption guarantees battery lifetimes up to several years on a coin cell battery.

The ULP radio uses an advanced polar transmitter / sliding-IF receiver architecture and digital-style circuits. The two-point modulation Tx is based on a sub-mW All-Digital PLL (DPLL) and a Digital Power Amplifier (PA). It has extensive self-calibration such as DCO

bank selection and amplitude control, 2-point gain calibration and PA harmonic reduction. The receiver is based on an energy-efficient sliding-IF architecture and has integrated offset calibration, digital RSSI and advanced Automatic Gain Calibration and Carrier Frequency Offset estimation algorithms.

The digital baseband includes all PHY processing, as well as the data link features for (de-)whitening, (de-)spreading, CRC and BCH (de-)coding. It is power optimized, including extensive clock and power gating, optimized HW/SW register interfaces and HW accelerators like event time-stamping for protocol support.



The use of the AMBA AHB/APB bus enables straightforward control of the MCU. It is implemented with scan chains as part of a design-for-test strategy. The IC is integrated with ESD protection on all I/Os, including the RF ports.

For future developments, the DBB and MCU are also mapped onto a Xilinx Artix7 FPGA board with direct interface to the RF front-end part of the radio IC. This alternative platform enables further development and testing of the latest features in new releases of the standard, or proprietary additions.

This radio has been extensively evaluated with third party equipment, such as Rohde&Schwarz® CBT/CBT32 Bluetooth® Tester.

EVALUATION BOARDS

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

- ARTEMIS 3.0 PCB: Allows complete evaluation of the 2.4 GHz multi-standard SoC as well as demonstration including the ARM Cortex™ M0 core and the ARM/Wicentric BLE stack and profiles.
- Artemis 3.0 PCB + Xilinx Artix7 FPGA: enables further development and testing of additional DBB features while connecting to the RF front-end part of the 2.4GHz multi-standard IC.

KEY FEATURES

Multi-standard 2.4Ghz radio

- Bluetooth Low Energy (BLE) / Bluetooth Smart
- 4.0, 4.2 and 5.0 (Draft, 2Mbps)
- IEEE 802.15.4 (a.k.a. ZigBee)
- 4Mbps proprietary mode

Ultralow-power (ULP) consumption

- Rx: < 5.6mW
- Tx: < 8.4mW @ 0dBm (w. on-chip matching)
- Tx: < 7.9mW @ 0dBm (w. off-chip matching)

Best-in-class sensitivity

- 93dBm @30.6% PER in BLE 4.0 mode
- 95dBm @1% PER in 802.15.4 mode

Highly integrated

- Single RF port (zero external RF components), integrated ARM Cortex™ M0 core, 128kB SRAM and peripherals (SPI, UART, GPIO)

ARM/WICENTRIC BLE 4.0 PROTOCOL STACK AND APP. PROFILES

DESIGNED IN TSMC 40nmLP FOR 1V NOMINAL SUPPLY

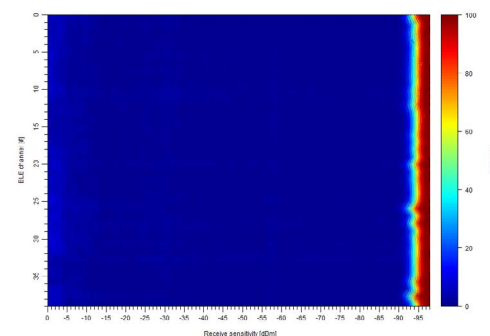
APPLICATIONS

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

BLE SPECIFICATIONS

Frequency band	2.4 - 2.48GHZ
Power consumption	Rx: < 5.6mW Tx: < 8.4mW @ 0dBm (w. On-chip matching) Tx: < 7.9mW @ 0dBm (w. off-chip matching) Sleep <1.5uW
Tx maximum output power	0.6dBm w. On-chip matching 3.6dBm w. Off-chip matching
Tx fsk error (ble 4.0) Tx evm (802.15.4)	<6% <4%
Tx spurious emission	<-41dBm
Rx sensitivity	-93dBm @ 30.6% PER (BLE 4.0) -95dBm @ 1% PER (802.15.4)
In-band channel rejection with wanted @ -67dbm	Adjacent C/I: -4dB Alternate C/I: -25dB
Out-of-band blocker*	-30dBm
Intermodulation	-50dBm
Nominal supply	1V
Technology	TSMC 40nm LP CMOS

* with exception at image frequency



Comprehensive radio evaluation with R&S® CBT Bluetooth® tester

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