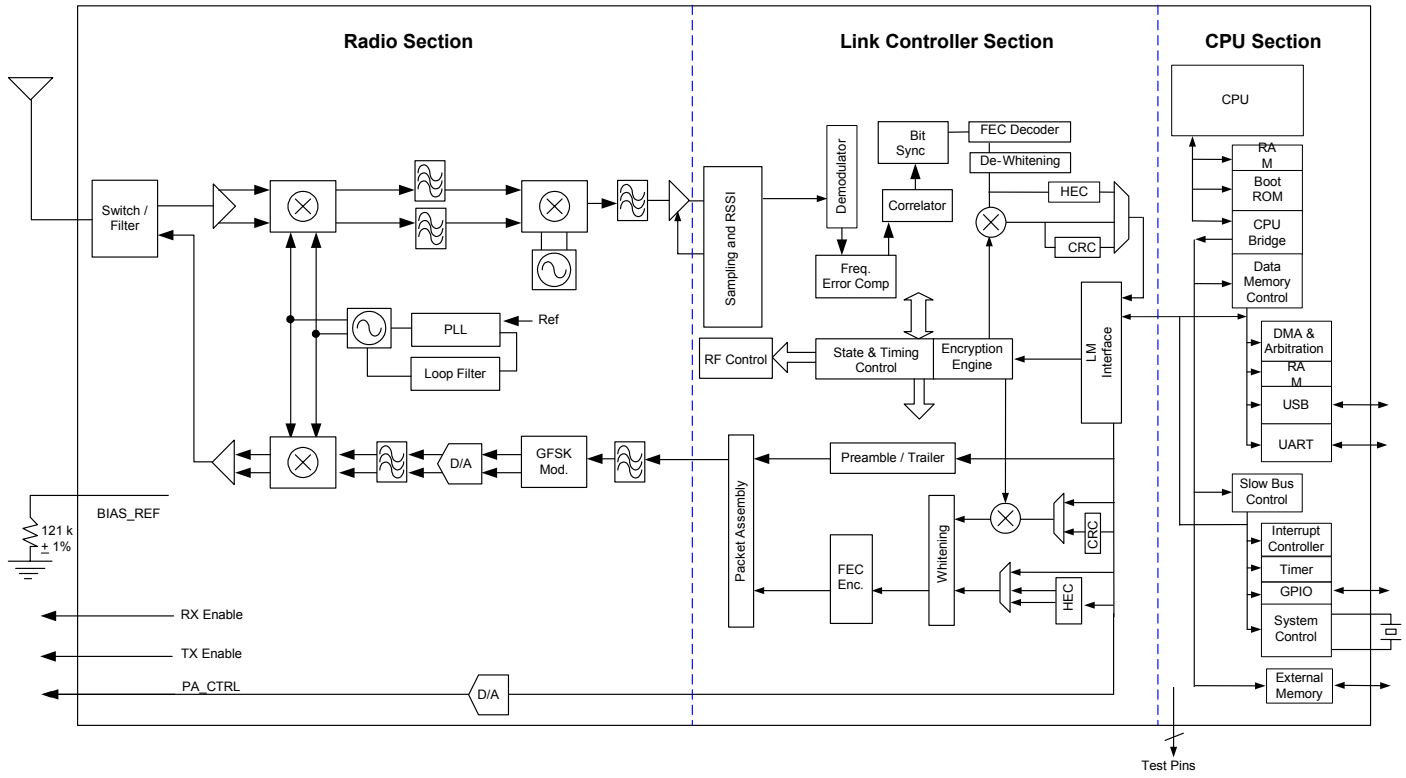
Zeevo TC2000 Radio Design Features

This document provides a description of the major design features of the Zeevo TC2000 single chip Bluetooth radio. There are two sections, the first describes the radio design, and the second identifies how the design features ensure that the TC2000 will not interfere with other electronic devices.

1 Functional Description

The radio section consists of the following four blocks: antenna interface, receiver, transmitter, and synthesizer. The TC2000 implements an IF-enhanced, direct-conversion receiver architecture. This provides the selectivity benefits of the direct conversion architecture without the associated drawbacks of dual high-gain amplifiers and dual analog-to-digital converters.



Zeevo TC2000 Block Diagram

1.1 Antenna Interface

The TC2000 integrates the Tx/Rx switch, and matching network into a single package providing for a very simple user interface. Our design eliminates the need for complicated external RF circuitry, which simplifies the product design. The only controlled impedance trace required is a short length of 50-ohm transmission line from the TC2000 to the antenna. No external Balun circuits are required.

1.2 Receiver

The first stage of the receiver uses a direct-conversion architecture with high-selectivity, integrated low-pass IF filters and relatively low gain. This is followed by an up conversion to a low IF frequency where a single processing path is used to amplify the IF signal to the desired level. By using a low IF for the second stage, high-gain amplifiers may be used without concerns for DC offset or gain and phase matching. This results in a receiver that achieves very high selectivity with low filter complexity. It does not suffer from degraded selectivity at the image frequency and achieves lower overall power consumption.

- Direct conversion with 1.5 MHz second IF
- Linear (non-limiting) receiver IF chain
- Automatic gain control
- Digital demodulator
- Digital frequency error compensation

1.3 Transmitter

The transmitter is comprised of two primary functional blocks: the IF section and PA/Upconverter. The IF section converts the digital signal to analog and performs signal conditioning to ensure the spectral emission requirements are satisfied. The analog signal is directly up-converted and amplified. The output of the PA is multiplexed with the receiver in the antenna interface block. The PA supports the power requirement for a Class 2 Bluetooth product.

- Direct conversion with digital GFSK quadrature modulation
- Dual, 10 bit transmit DACs

1.4 PLL Synthesizer

The PLL synthesizer phase locks an integrated voltage-controlled oscillator to a 12 MHz external crystal reference. The PLL synthesizer, including loop filter, is fully integrated and no additional external components are required.

- Direct LO minimizes spurious emissions

1.5 Baseband Radio Modem

The baseband modem consists of the demodulator, modulator, receiver/transmitter self-calibration, transmitter/receiver burst timing control, and transmitter burst spectral shaping.

2 Radio Interference Design Considerations

2.1 Frequency Stability

Transmit frequency stability is ensured by the following design features:

- TC2000 includes extensive on-chip temperature compensation
    - Temperature compensated bandgap voltage references

- Temperature compensated bias currents
- Self calibrated VCO center frequency
- Completely integrated RF interface directly connects to antenna.

2.2 Spurious Suppression

The TC2000 contains a fully integrated radio and antenna interface. Spurious interference; from the VCO, CPU and receiver, is avoided by good isolation provided by the design and layout of the IC. An Integrated RF shield is included in the TC2000 to reduce interference from other components.

All bias lines are bypassed with caps placed close to the pins, and the TC2000 is well grounded to ensure correct performance.

2.3 Modulation Quality and Bandwidth

The digital modulation techniques employed on the TC2000 ensure quality performance and high image rejection to minimize occupied bandwidth. Digital modulation is inherently temperature insensitive, and all critical filter bandwidths are phase locked to the 12MHz crystal

2.4 RF output power

The PA gain is digitally controlled and is self compensating. This ensures that the output power is stable and well controlled.

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