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Low-power bluetooth microcontroller design using clock gating and gray code state encoding

Abstract

The number of applications for wireless Bluetooth devices is on the rise this decade. However, power consumption has become a major concern as the demand for more functionality on a single chip increases. Furthermore, since the device has a limited battery capacity, high power consumption limits the chip's long-term operation. Therefore, low-power architecture becomes crucial in these devices. To minimize the power consumption, this work implements a clock gating and a Gray code state encoding in a Bluetooth microcontroller system-on-chip (SoC). Four operation state is being tested to measure switching activity: Bluetooth transmission test, sleep test, timer test, and UART test. This design targets 180 nm Silterra CMOS technology with the system working at 16 MHz. Synopsys System on Chip EDA tools is used to perform the gate-level simulation and power analysis. The experimental result showed that the system's power consumption decreased by 86% when applying clock gating. Implementing a Gray code state encoding on the bridge reduces the power consumption further by up to 42 µW.

Keywords:

Digital circuits, Microcontroller, Energy use and applications, Batteries