Empower Wearable Electronics by Turning Down the Current

Introduction

Wearable devices that include a Global Positioning System (GPS), such as smart jewelry and wrist watches, provide good examples where low-power, low-noise front-ends can go a long way. The battery-powered smart jewelry, once activated, calls and transmits a location to an emergency contact. Additionally, you can set goals for your active minutes, calories burned, and distance traveled (Figure 1).

In this article, we will discuss the design challenges encountered when selecting the GPS' low-power LNA for the smart jewelry system.

Figure 1. Smart Jewelry

Smart Jewelry GPS Functionality

Smart jewelry uses the GPS to provide location information. GPS signals originate in satellites with a predetermined 1575.42MHz carrier frequency. The signals travel through the earth's atmosphere to the surface. On land, a smart jewelry's antenna acquires the GPS signal. Following the antenna, there are receiving electronics that consist of a low-noise amplifier (LNA), GPS tuner, and microcontroller (Figure 2).

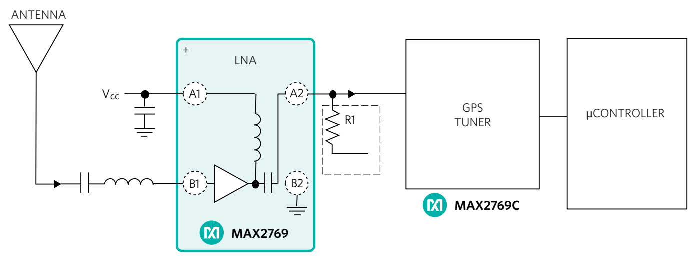

Figure 2. GPS Receiver Front-End Circuitry

The receiving electronics for the smart jewelry require a low-power LNA. The LNA gains a very low-level signal without significantly degrading the signal-to-noise ratio (SNR) or introducing distortion. The GPS tuner contains additional LNAs, filter, programmable gain amplifier (PGA) and a multi-bit analog-to-digital converter (ADC). The microcontroller further manages the GPS tuner's digital output by translating the signal to coordinates. With this system, it is important to understand that a GPS coordinate misread or a sudden loss of power can trigger a range of experiences, from a minor frustration to a life-threatening event.

Tackling the Low-Power Challenge

The size of the smart jewelry dictates the type of battery selection. Appropriate batteries for this application are the button zinc air, lithium, silver oxide, or alkaline. The nominal voltage of the zinc air cell is 1.2V, the silver oxide and alkaline cell is 1.5V.

The size and type of battery limits the number of ampere-hours available. The electronics in Figure 2 must operate with low-power dissipation, while remaining within the battery voltage limitations.

The power dissipation of the LNA is equal to the power supply voltage times the quiescent supply current. Since there is no output load incurred from the GPS tuner, the LNA's power dissipation remains consistent throughout the GPS receiver's operation as signals travel from the antenna to the GPS tuner.

Wearable Device Power Consumption

Figure 3 compares five LNAs in terms of their package size, power dissipation, and typical gain. The power dissipation calculation of all products is equal to (minimum specified power) x (typical specified supply current).

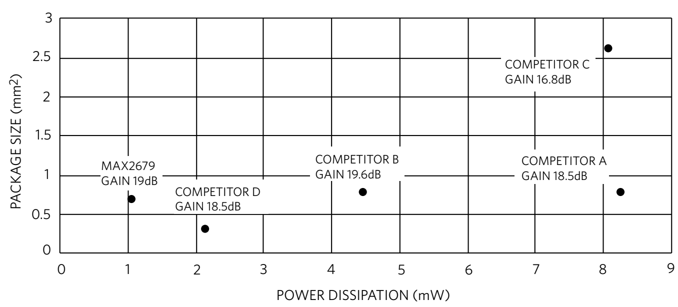

Figure 3. Package Size vs. Power Dissipation of Several LNAs

In this figure, the location of the better power performing device is closest to the bottom left axis. The best-performing power dissipation device is the MAX2679 at 1.08mW. The power dissipation of a related LNA device, the MAX2679B (not shown), is nearly equivalent to the MAX2679 at 1.17mW. This low-power level of operation makes both devices a good fit for the smart jewelry application.

The supply range is from 1.08V to 1.98V, but these devices can operate with battery voltages down to 0.7V, which is consistent with zinc air, silver oxide, or alkaline batteries. With typical MAX2679 and MAX2679B supply currents of 1mA and 650µ A, inclusive, the low-power dissipation makes these devices a preferred choice for handheld GPS applications.

The GPS tuner and microcontroller also consume power during operation. The key to controlling the power dissipation with all these devices is to have low operating currents as well as shutdown capability.

The MAX2679 and MAX2679B have a shutdown feature to turn off the entire chip, typically to 0W of power. The shutdown feature is a useful battery conservation feature, when the smart jewelry is inactive or in a sleep mode.

Long-Lasting Wearables

Wearable instruments with GPS, such as smart jewelry or wrist watches, require low-power, low-noise, and small form-factor devices on the GPS receiver's front-end. The MAX2679 and MAX2679B low-noise, low-power LNAs have these characteristics including a package form factor that is 0.83mm x 0.83mm. These devices ensure that the power dissipation of the front-end GPS receiver circuit is low and well-controlled.

Numerous LNAs are available to address the issue of receiving GPS small-signals, but a device with low-power dissipation makes the smart jewelry application a longer lasting solution. If you combine this characteristic with a small compact chip, your wearable appliance will point towards a long-lasting, compact solution.

Glossary

GPS: Global Positioning System

LNA: Low-Noise Amplifier

Learn more:

Low Noise Amplifiers (LNAs)

MAX2679 GPS/GNSS Ultra-Low Current Low-Noise Amplifiers

MAX2679B GPS/GNSS Ultra-Low Current Low-Noise Amplifiers

MAX2769C Universal GNSS Receiver

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