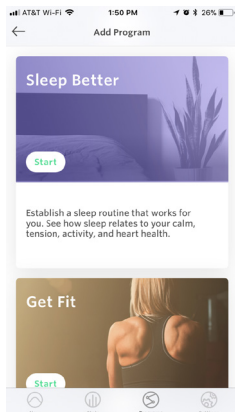


Spire

Making Clothes Smarter with Maxim Wearable Health AFE



Affixed to clothing, Spire Health Tag helps users track their sleep, activity, and stress levels.

Spire, headquartered in San Francisco, California, is the market leader in technologies for continuous respiration sensing, real-time interventions, and actionable feedback. The company's mission is to allow people to control their own mental and physical health by turning the real-time bio-signals its solutions capture into actionable data.

Challenge

- Meet stringent requirements for low power, small solution size, and high accuracy

Solution

- **MAX30110**
- **MAX17223**
- Wearable heart-rate algorithm

Benefits

- Low quiescent current, low power consumption, and small package sizes of ICs enabled company to meet its design goals
- Maxim support helped the company create its optimal design

Spire's newest offering is the Spire Health Tag, a device that, affixed to clothing, can monitor activity levels, heart rate, sleep quality, breathing patterns, and stress levels. The idea behind the device is to make it easy and comfortable for people to improve their sleep, reduce stress, and stay active. The Health Tag can be applied to clothing that people wear most frequently—think undergarments, pajamas, and exercise gear. The devices don't have to be charged, are equipped with a battery that lasts 1.5 years, and are washer- and dryer-safe. An accompanying app turns the data collected into insights, tailored to the user. For example, if the data reveals that the user has had a stressful morning, the app may suggest a quick breathing exercise. Similarly, if it looks like the user didn't get enough deep sleep, the app may suggest a workout to improve the sleep cycle.

"Part of the idea behind the Spire Health Tags is to make them pretty much impossible to forget to wear," noted Dylan Jackson, the company's lead embedded engineer.

CUSTOMER SUCCESS STORY: SPIRE

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- Dylan Jackson, Lead Embedded Engineer, Spire

Design Challenges

For the Spire engineering team, creating the Health Tag meant meeting stringent requirements around power, accuracy, and solution size. “Smart clothing has been discussed for a long time,” said Jackson, highlighting examples such as smart fabrics and clothing with embedded electronics. However, these types of applications are difficult to align with different clothing styles. “We recognized there was an opportunity to make something that is incredibly low power, incredibly small, and that can be attached to the clothing you already have,” he explained.

With its first product, the Spire Stone, the company was already using technologies to directly track breathing. To create the Health Tag, the engineers overhauled their approach to measure breathing with a new sensor and a new method of measurement. Since the devices are not rechargeable, power proved to be one of the biggest challenges. The device had to be operated by a coin-cell battery, where 2.7V is typical. Devising a rough power budget of active and sleep modes, the team recognized that components selected needed to be very low in voltage and quiescent current.

Solution and Benefits

Working closely with Maxim, the Spire team integrated the **MAX30110** pulse oximeter and heart-rate analog front-end (AFE) for wearable health and the **MAX17223** nanoPower synchronous boost converter into the Health Tag. The MAX30110, which offers full AFE power consumption under 25 μ A at 25sps and shutdown current of 1.4 μ A (typ), provides reflective or transmissive heart-rate, heart-rate-variability, and blood-oxygen monitoring. The MAX17223 boost converter provides 300nA of quiescent supply current into OUT, as well as True Shutdown mode that disconnects the output from the input without forward or reverse current. Both ICs are available in small packages. Both of the chips were pre-mass production when Spire began its development cycle, so support from Maxim was helpful.

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Given that every microamp of sleep current represents a couple of months of battery life, the very low power consumption of the MAX17223 boost converter in sleep mode makes a noticeable impact on battery life of the Spire Health Tag. The company is continuing to work with Maxim to refine algorithms and ensure high accuracy of its various monitors. Looking ahead, Spire will continue to explore a variety of new medical application areas, including sleep apnea, asthma, and chronic obstructive pulmonary disease.

Learn more at www.maximintegrated.com