Keywords: heart rate, fitness monitor, wireless

APPLICATION NOTE 5492

Heart-Rate/Fitness Monitors Go Wireless

By: John DiCristina
Sep 18, 2012

Abstract: This article explains the recent trend in heart-rate and fitness monitors to go wireless to eliminate cables to allow free movement, and allow convenient data collection without the need to plug in their devices. It details a typical wireless system, using the MAX1472 crystal-referenced phase-locked loop (PLL) VHF/UHF transmitter.

Click here for an overview of the wireless components used in a typical radio transceiver.

Fitness monitors track and record physical activity with the goal of improving a person's physical fitness. This is done by sensing or measuring a number of parameters such as heart rate, temperature, distance, and time. A wristwatch device collects the information to display to the user. A heart-rate chest strap measures pulse and sometimes temperature, provides conditioning of the cardiac signal before data conversion, and wirelessly transmits the data to the wristwatch display. An optional foot-pod shoe insert measures a runner's cadence to determine the distance traveled, and it wirelessly transmits that data to the wristwatch display (**Figure 1**). Some fitness monitors use GPS to measure the distance traveled, eliminating the need for a foot pod. In all these systems the trend is to go wireless to eliminate cables that could interfere with movement, or just make it very inconvenient by forcing users to "plug-in" their monitors to collect the data.

Figure 1. Sneakers with a wireless connection to a digital wristwatch can capture and record a runner's

activities and provide valuable feedback for training analysis.

Design Parameters

The wristwatch monitors the workout in real time and records the results in an on-board memory device or within the microcontroller unit (MCU). It uploads this data to a PC using a USB cable or wirelessly through a dongle plugged into a USB port on the PC. For such systems, the RF transmitters need to be low power because they are powered by small batteries and also due to FCC regulations. The low transmitter power means that good antenna design is critical for reliable data transfer, even though the transmit distance is typically less than two meters. Amplitude shift keying (ASK) transmission is recommended for this application because it offers better sensitivity than frequency shift keying (FSK) and, thus, enables lower power transmission. Minimizing the transmit time with a low duty cycle and powering down the transmitter in between each transmission can save additional power.

All the individual elements of the fitness monitor, except for the PC dongle, are worn by the user and are battery powered. Thus, small size and low power are critical design parameters. The heart-rate chest strap and foot-pod shoe insert are usually powered by a primary coin-cell battery. The wristwatch display can be powered either by a primary coin-cell or a rechargeable battery, which is charged through an AC adapter or USB cable. A simple segmented LCD with an optional backlight is used for the wristwatch display.

The overall system, shown in **Figure 2**, combines the RF interface, power management to maximize battery life, and various interfaces to the sensors and host systems. For the RF portion of the system, one potential solution, as shown in **Figure 3** uses the MAX1472, a crystal-referenced phase-locked loop (PLL) VHF/UHF transmitter designed to transmit OOK/ASK data in the 300MHz to 450MHz frequency range. The device supports data rates up to 100kbps, and delivers an adjustable output power of more than +10dBm into a 50Ω load. The crystal-based architecture of the MAX1472 eliminates many of the common problems with SAW transmitters by providing greater modulation depth, faster frequency settling, higher tolerance of the transmit frequency, and reduced temperature dependence.

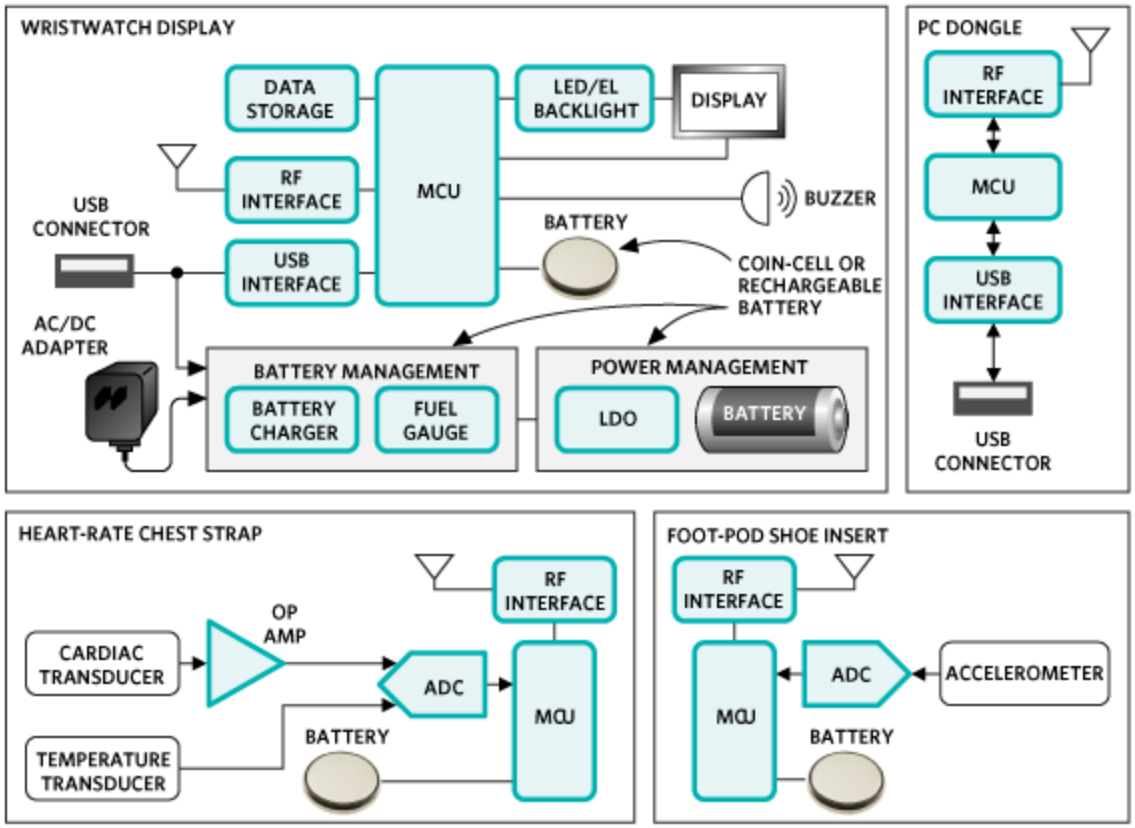

Figure 2. A typical data collection system for the heart-rate monitor consists of several subsystems. The wristwatch display/data storage unit (upper left), the wireless dongle to connect to the host computer (upper right), the heart-rate chest strap (lower left) and the shoe insert (lower right). Each of these subsystems requires a low-power wireless module.

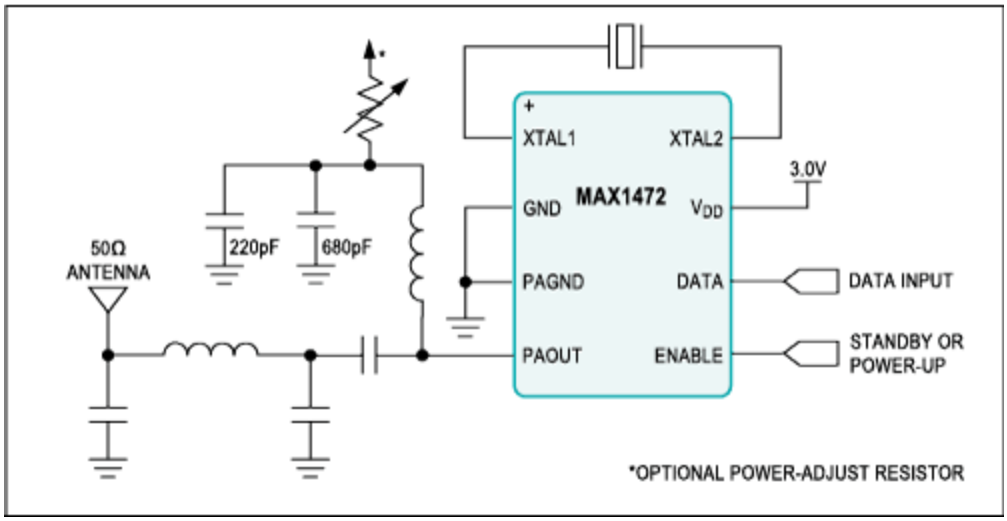

Figure 3. A low-power RF transmitter, based on the MAX1472, delivers a serial data stream using OOK/ASK modulation.

Related Parts		
MAX1472	300MHz-to-450MHz Low-Power, Crystal-Based ASK Transmitter	Free Samples

More Information
For Technical Support: http://www.maximintegrated.com/support
For Samples: http://www.maximintegrated.com/samples
Other Questions and Comments: http://www.maximintegrated.com/contact