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TUTORIAL 4686

Important Design Considerations for Heart-Rate and Fitness Monitors

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Abstract: This tutorial introduces the different types of heart-rate and fitness monitors and highlights the types of data collected by each. Also discussed are data communications, including USB and RF transmission, and the importance of low-power design for these portable, battery-powered devices.

Overview

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. Some fitness monitors use GPS to measure the distance traveled, eliminating the need for a foot pod.

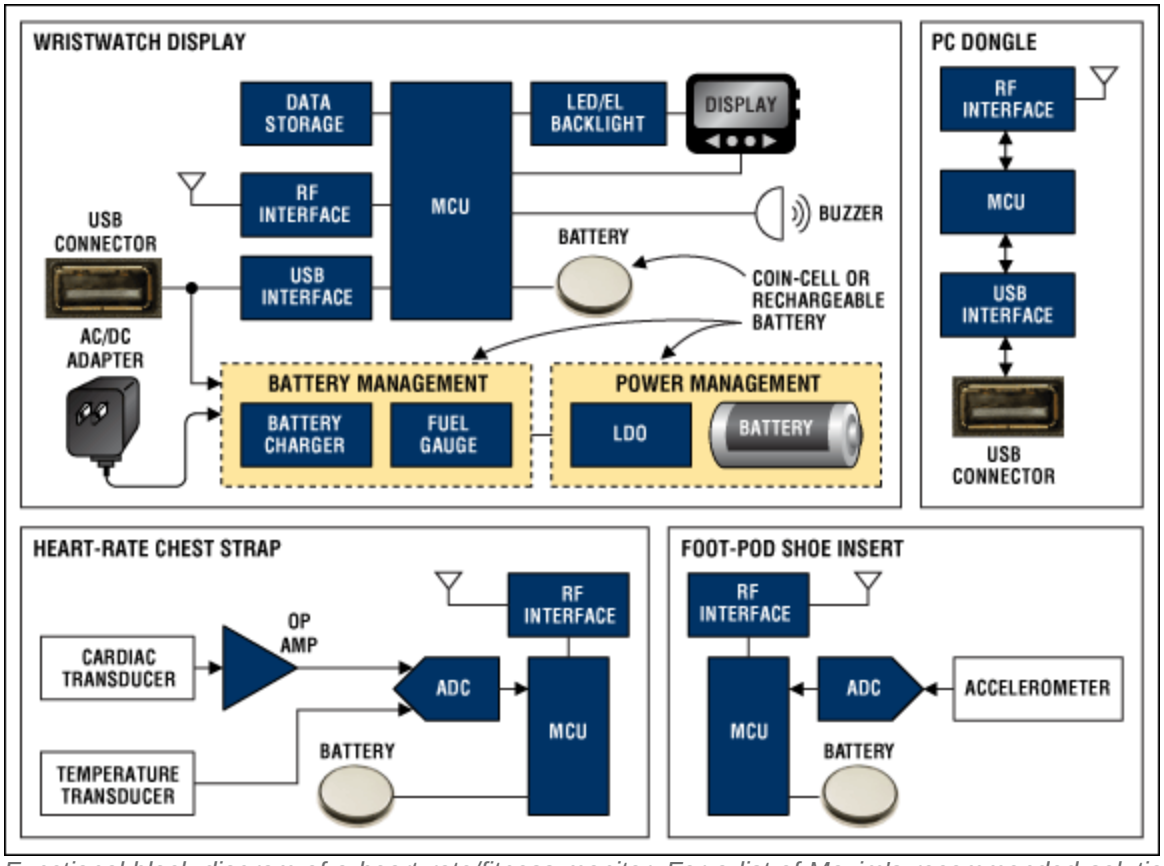

Heart-rate fitness monitor

Design Parameters

The wristwatch monitors the workout in real time and records the results in an onboard memory device or within the 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.

The RF transmitters need to be low power because they are powered by small batteries and because of 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. ASK transmission is recommended for this application because it offers better sensitivity than 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-segment LCD with an optional backlight is used for the wristwatch display.



Functional block diagram of a heart-rate/fitness monitor. For a list of Maxim's recommended solutions for heart-rate/fitness monitors, please go to: www.maximintegrated.com/heartrate.

Related Parts

DS2745	Low-Cost I²C Battery Monitor	Free Samples
DS2756	High-Accuracy Battery Fuel Gauge with Programmable Suspend Mode	Free Samples
DS2780	Stand-Alone Fuel Gauge IC	Free Samples
DS2782	Stand-Alone Fuel Gauge IC	Free Samples
MAX11600	2.7V to 3.6V and 4.5V to 5.5V, Low-Power, 4-/8-/12-Channel, 2-Wire Serial 8-Bit ADCs	Free Samples
MAX11605	2.7V to 3.6V and 4.5V to 5.5V, Low-Power, 4-/8-/12-Channel, 2-Wire Serial 8-Bit ADCs	Free Samples
MAX1162	16-Bit, +5V, 200ksps ADC with 10µA Shutdown	Free Samples
MAX1227	12-Bit 300ksps ADCs with FIFO, Temp Sensor, Internal Reference	Free Samples
MAX1229	12-Bit 300ksps ADCs with FIFO, Temp Sensor, Internal Reference	Free Samples
MAX1231	12-Bit 300ksps ADCs with FIFO, Temp Sensor, Internal Reference	Free Samples
MAX13481E	±15kV ESD-Protected USB Transceivers with External/Internal Pullup Resistors	Free Samples
MAX13483E	±15kV ESD-Protected USB Transceivers with External/Internal Pullup Resistors	
MAX1393	1.5V to 3.6V, 312.5ksps, 1-Channel True-Differential/2-Channel Single-Ended, 12-Bit, SAR ADCs	Free Samples
MAX1396	1.5V to 3.6V, 312.5ksps, 1-Channel True-Differential/2-Channel Single-Ended, 12-Bit, SAR ADCs	Free Samples
MAX1415	16-Bit, Low-Power, 2-Channel, Sigma-Delta ADCs	Free Samples
MAX1416	16-Bit, Low-Power, 2-Channel, Sigma-Delta ADCs	Free Samples
MAX1471	315MHz/434MHz Low-Power, 3V/5V ASK/FSK Superheterodyne Receiver	Free Samples
MAX1472	300MHz-to-450MHz Low-Power, Crystal-Based ASK Transmitter	Free Samples
MAX1551	SOT23, Dual-Input, USB/AC Adapter, 1-Cell Li+ Battery Chargers	Free Samples
MAX1555	SOT23, Dual-Input, USB/AC Adapter, 1-Cell Li+ Battery Chargers	Free Samples
MAX1574	180mA, 1x/2x, White LED Charge Pump in 3mm x 3mm TDFN	
MAX17043	Compact, Low-Cost 1S/2S Fuel Gauges with Low-Battery Alert	Free Samples

MAX1736	SOT23, Single-Cell Li+ Battery Charger for Current-Limited Supply	Free Samples
MAX1811	USB-Powered Li+ Charger	Free Samples
MAX1848	White LED Step-Up Converter in SOT23	Free Samples
MAX1916	Low-Dropout, Constant-Current Triple White LED Bias Supply	Free Samples
MAX3349E	USB 2.0 Full-Speed Transceiver with UART Multiplexing Mode	
MAX3453E	±15kV ESD-Protected USB Transceivers	Free Samples
MAX3456E	±15kV ESD-Protected USB Transceivers	Free Samples
MAX4194	Micropower, Single-Supply, Rail-to-Rail, Precision Instrumentation Amplifiers	Free Samples
MAX4208	Ultra-Low Offset/Drift, Precision Instrumentation Amplifiers with REF Buffer	Free Samples
MAX4209	Ultra-Low Offset/Drift, Precision Instrumentation Amplifiers with REF Buffer	Free Samples
MAX6469	300mA LDO Linear Regulators with Internal Microprocessor Reset Circuit	Free Samples
MAX6484	300mA LDO Linear Regulators with Internal Microprocessor Reset Circuit	
MAX7030	Low-Cost, 315MHz and 433.92MHz ASK Transceiver with Fractional-N PLL	Free Samples
MAX7031	Low-Cost, 308MHz, 315MHz, and 433.92MHz FSK Transceiver with Fractional-N PLL	Free Samples
MAX7032	Low-Cost, Crystal-Based, Programmable, ASK/FSK Transceiver with Fractional-N PLL	Free Samples
MAX8606	USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50m Ohm Battery Switch in TDFN	Free Samples
MAX8630	125mA 1x/1.5x Charge Pumps for 5 White LEDs in 3mm x 3mm TDFN	Free Samples
MAX8860	Low-Dropout, 300mA Linear Regulator in µMAX	Free Samples
MAX8900A	1.2A Switch-Mode Li+ Chargers with ±22V Input Rating and JEITA Battery Temperature Monitoring	
MAX8900B	1.2A Switch-Mode Li+ Chargers with ±22V Input Rating and JEITA Battery Temperature Monitoring	
MAX8902A	Low-Noise 500mA LDO Regulators in a 2mm x 2mm TDFN Package	Free Samples

MAX8902B	Low-Noise 500mA LDO Regulators in a 2mm x 2mm TDFN Package	Free Samples
MAXQ2000	Low-Power LCD Microcontroller	Free Samples
MAXQ2010	16-Bit Mixed-Signal Microcontroller with LCD Interface	Free Samples
MAXQ610	16-Bit Microcontroller with Infrared Module	Free Samples
MAXQ612	16-Bit Microcontrollers with Infrared Module and Optional USB	Free Samples
MAXQ622	16-Bit Microcontrollers with Infrared Module and Optional USB	Free Samples
MAXQ8913	16-Bit, Mixed-Signal Microcontroller with Op Amps, ADC, and DACs for All-in-One Servo Loop Control	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

Application Note 4686: http://www.maximintegrated.com/an4686
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