Pulse Oximetry

Medical Solutions from Texas Instruments

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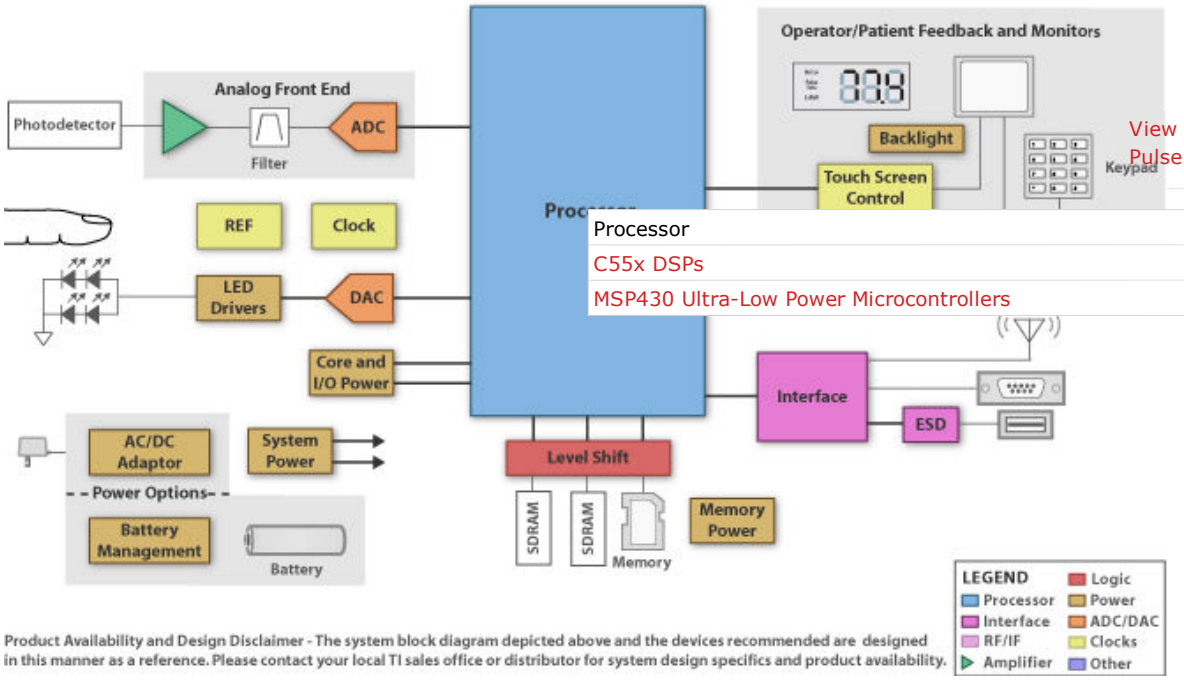
Block Diagram



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Processor
C55x DSPs
MSP430 Ultra-Low Power Microcontrollers

eases - 13 Nov 2007
truments Introduces

Product Availability and Design Disclaimer - The system block diagram depicted above and the devices recommended are designed in this manner as a reference. Please contact your local TI sales office or distributor for system design specifics and product availability.

Design Considerations

Overview

Pulse oximeters measure arterial blood oxygen saturation by sensing absorption properties of deoxygenated and oxygenated hemoglobin using various wavelengths of light. A basic meter is comprised of a sensing probe attached to a patient's earlobe, toe, finger, or other body locations, and data acquisition system for the calculation and display of oxygen saturation level, heart rate, and blood flow.

Low-End Portable Pulse Oximeter

For low-end designs, TI's family of highly integrated MSP430 Ultra-Low-Power microcontrollers (MCUs) reduces the number of external components needed in the design. Since elements of the signal chain, power management and display driver are integrated into the MCU.

Signal Acquisition Challenges: An inverting resistor-feedback configuration is commonly used with the gain amplifier in the signal chain. However, large feedback resistor values may drive extreme output swings with small changes in light intensity due to the sensitivity level of the circuit. Some designs may benefit from driving the

output swing down to or below ground. Dual supply Auto-zero trans-impedance amplifiers allow the output swing to ground and single supply devices swing very close to ground. A pull-down resistor tied to –5V allows the output to swing slightly below ground, minimize errors as the output gets very close to 0V. TI offers a family of transimpedance amplifiers that provide extremely high precision, excellent long-term stability, and very low 1/f noise.

Mid-Range and High-End Portable Pulse Oximeters

For mid and high-end implementations, higher performance processors and higher precision analog components with low supply current could be required. TI's low power DSP technology can eliminate signal distortion caused by other light sources or motion occurring while readings are taken, extracting only the signal of interest. DSP technology allows accurate readings of very low level signals through sophisticated algorithms. This additional processing capability is very useful in pulse oximeters measuring the absorption of additional wavelengths to detect the saturation of other species of hemoglobin.

Signal Acquisition Challenges: TI's precision switched integrator transimpedance amplifiers do not have the thermal noise of feedback resistors and do not suffer from stability problems commonly found in transimpedance amps using large feedback resistor. Using one photodiode with two integrator transimpedance amplifiers eliminates dark current and ambient light errors, since errors common to both can be subtracted. Additionally, these amplifiers allow for synchronized sampling at an integer multiple of the AC line frequency, providing extremely high noise rejection. Transimpedance gain can be easily changed by manipulating on-chip settings. Also, TI's high precision ADCs offer small packaging, excellent AC/DC performance, and single-chip solution for measuring photodiodes.

In general, Pulse Oximeters require ultra-low power consumption, and low noise power rails; in order to support extended battery life and precision measurements. TI's buck-boost converters provide support for Li-ion battery technologies, and 96% efficiency. For additional low noise power rails, high PSRR LDOs are also available. Requirements for wall-plug and USB-port charging can be addressed with the TI's linear lithium low single-cell charger family. Innovative next-generation gas gauge solutions are offered with "Impedance Track" to automatically learn/detect battery characteristics, extending both battery life and system run time.

Application Notes

Advanced Linker Techniques for Convenient and Efficient Memory Usage (Rev. A)
(spraa46a.htm, 8 KB)
18 Dec 2008 Abstract

Board and System Design Considerations for the TMS320VC5503/06/07/09A DSPs
(sprab14.htm, 8 KB)
19 Nov 2008 Abstract

Flash Programming Solutions for the TMS320F28xxx DSCs (spraal3.htm, 8 KB)
19 Aug 2008 Abstract

Interfacing SD/MMC Cards With TMS320F28xxx DSCs (spraao7.htm, 9 KB)
26 Jul 2007 Abstract

A Single-Chip Pulsoximeter Design Using the MSP430 (slaa274.htm, 8 KB)
02 Nov 2005 Abstract

Selection and Solution Guides

Selection Guides

Amplifier and Data Converter Selection Guide (Rev. C) (slyb115c.pdf, 8.72 MB)
21 Sep 2008 Download

Solution Guides

Medical Applications Guide (Rev. D) (slyb108d.pdf, 8.24 MB)
09 Dec 2008 Download

Tools and Software

Name	Part #	Company	Software/Tool Type
Code Composer Studio IDE	CCSTUDIO	Texas Instruments	Code Composer Studio(TM) IDE
MSP430FG43X Flash Emulation Tool	MSP-FET430P430	Texas Instruments	Development Boards/EVMs

Product Bulletin & White Papers

Product Bulletin

TMS320C55x DSK Product Bulletin (sprt388.pdf, 84 KB)
21 Apr 2006 Download

News Releases & Authored Articles

News Releases

Date	Headline
13 Nov 2007	Texas Instruments Introduces Low-Power Microcontroller with Complete Signal Chain for Portable Medical Diagnostic Equipments
07 Jun 2007	Attendees Receive Free MSP430 Collector's Kit and Capacitive Touch Boards At TI's 430 Day
14 Feb 2007	MSP430FG461x MCUs Bring SoC Benefits to Portable Medical And Industrial Sensing Applications

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