

Product Overview

Introduction

This design guide describes the design of a low power consumption optical mouse using the new Avago Technologies ADNB-3532 low power small form factor optical mouse sensor, Texas Instruments MSP430F1222 micro-controller and Nordic Semiconductor nRF2402 2.4GHz RF transmitter. The receiver dongle is implemented with a Nordic Semiconductor nRF2401A 2.4GHz RF transceiver in conjunction with a Cypress CY7C63231A enCoRe™ USB controller. This reference design kit provides a power efficient and feature-rich solution in one small and slim package.

The design guide discusses the reference design hardware and firmware implementation. The document starts with the basic operations of a computer mouse peripheral followed by an introduction to the Avago ADNS-3530 low power optical mouse sensor, the Nordic Semiconductor nRF2402 transmitter and nRF2401A transceiver, Texas Instruments MSP430F1222 micro-controller. The software section of this application note describes the architecture of the firmware required to implement the mouse and the USB dongle functions. Included in Appendix A is the schematic for this reference design mouse and USB dongle.

The ADNK-3533-TN24 low power slim optical mouse utilizes the ADNB-3532 low power Light Emitting Diode (LED) slim mouse sensor bundle. The LED mouse bundle is a small form factor (SFF) LED illuminated navigation system. The bundle consists of an integrated chip-on-board (COB) LED mouse sensor ADNS-3530 and a SFF lens ADNS-3150-001.

The ADNS-3530 is a low-power optical navigation sensor. It has a new, low-power architecture and automatic power management modes, making it ideal for battery- and power-sensitive applications such as cordless input devices.

The ADNS-3530 is capable of high-speed motion detection – up to 20ips and 8G. In addition, it has an on-chip oscillator and integrated LED to minimize external components.

The ADNS-3530 along with the ADNS-3150-001 lens form a complete and compact mouse tracking system. There are no moving parts which means high reliability and less maintenance for the end user. In addition, precision optical alignment is not required, facilitating high volume assembly.

The bundle sensor is programmed via registers through a four-wire serial port. It is packaged in a 16 I/O surface mountable package.

Introduction to ADNS-3530 Optical Mouse Sensor

The ADNS-3530 is based on Optical Navigation Technology, which measures changes in position by optically acquiring sequential surface images (frames) and mathematically determining the direction and magnitude of movement.

The ADNS-3530 contains an Image Acquisition System (IAS), a Digital Signal Processor (DSP), and a four wire serial port.

The IAS acquires microscopic surface images via the lens and illumination system. These images are processed by the DSP to determine the direction and distance of motion. The DSP calculates the Δx and Δy relative displacement values.

An external microcontroller reads the Δx and Δy information from the sensor serial port. The microcontroller then translates the data into PS2, USB, or RF signals before sending them to the host PC or game console.

To learn more about sensor's technical information, please visit the Avago web site at <http://www.avagotech.com/>

Texas Instrument MSP430F1222 Microcontroller

The Texas Instruments MSP430 family of ultra-low power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low-power modes, is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that attribute to maximum code efficiency. The Digitally Controlled Oscillator (DCO) allows wake-up from low-power modes to active mode in less than 6 μ sec.

The specific device used in this reference design is the MSP430F1222 with 28 pin to accommodate ample amount of I/O. It is an ultra-low power mixed-signal microcontrollers with a built-in 16-bit timer, 10-bit A/D converter with integrated reference and Data Transfer Controller (DTC), and 14 (20 pin package) or 22 (28 pin package) general purpose I/O pins. The MSP430x12x2 series microcontrollers have built-in communication capability using asynchronous (UART) and synchronous (SPI) protocols. The architecture, combined with five low power modes is optimized to achieve extended battery life on wireless application.

Features

- Low Supply Voltage Range 1.8 V to 3.6 V
- Ultra Low-Power Consumption:
 - Active Mode: 200 μ A at 1 MHz, 2.2 V
 - Standby Mode: 0.7 μ A
 - Off Mode (RAM Retention): 0.1 μ A
- Five Power Saving Modes
- Wake-Up From Standby Mode in less than 6 μ s
- 16-Bit RISC Architecture, 125 ns Instruction Cycle Time
- Basic Clock Module Configurations:
 - Various Internal Resistors
 - Single External Resistor
 - 32-kHz Crystal
 - High Frequency Crystal
 - Resonator
 - External Clock Source
- 16-Bit Timer_A With Three Capture/Compare Registers
- 10-Bit, 200-kbps A/D Converter With Internal Reference, Sample-and-Hold, Autoscan, and Data Transfer Controller
- Serial Communication Interface (USART0) With Software-Selectable Asynchronous UART or Synchronous SPI
- Serial Onboard Programming, No External Programming Voltage Needed Programmable Code Protection by Security Fuse
- Supply Voltage Brownout Protection
- 4KB + 256B Flash Memory 256B RAM
- Available in 28-Pin Plastic SOWB, 28-Pin Plastic TSSOP, and 32-Pin QFN Packages

For Complete Module Descriptions, See the TI MSP430x1xx Family User's Guide, Literature Number SLAU049

Nordic Semiconductor nRF2402 2.4GHz Transmitter and nRF2401A 2.4GHz Transceiver

The Nordic nRF2402 and nRF2401A are the low-power, single-chip radio transmitter and transceiver for the world wide 2.4 - 2.5 GHz ISM band. The entire transmitter and transceiver including all inductors and filters are integrated in each single chip respectively which gives the lowest cost solution to the end user. All configurations of the nRF2402 transmitter and nRF2401A transceiver are done via a standard serial interface. The nRF devices include the ShockBurst engine which allow for high data rates on air using low data rates between the microcontroller and the nRF device, it will also automatically validate the packets address and CRC, further reducing the microcontrollers processing tasks.

Features for nRF2402 2.4GHz Transmitter

- True single chip GFSK transmitter in a
- small 16-pin package (QFN16 4x4)
- Adjustable output power up to 0dBm
- Data rate 0 to 1Mbps
- Low Bill of Material
- Multi Channel operation
- 128 channels
- Support frequency hopping
- Channel switching time <200ms.
- Power supply range: 1.9 to 3.6 V
- CRC computation
- ShockBurst™ mode for ultra-low power operation
- Low supply current, typical 10mA peak @ -5dBm output power
- 100% RF tested

Features for nRF2401A 2.4GHz Transceiver

- True single chip GFSK transceiver in a small 24-pin package (QFN24 5x5mm)
- Data rate 0 to 1Mbps
- Only 2 external components
- Multi channel operation
- 125 channels
- Channel switching time <200ms.
- Support frequency hopping
- Data slicer / clock recovery of data
- Address and CRC computation
- DuoCeiver™ for simultaneous dual receiver topology
- ShockBurst™ mode for ultra-low power operation and relaxed MCU performance
- Power supply range: 1.9 to 3.6 V
- Low supply current (TX), typical 10.5mA peak @ -5dBm output power
- Low supply current (RX), typical 18mA peak in receive mode
- 100 % RF tested
- No need for external SAW filter

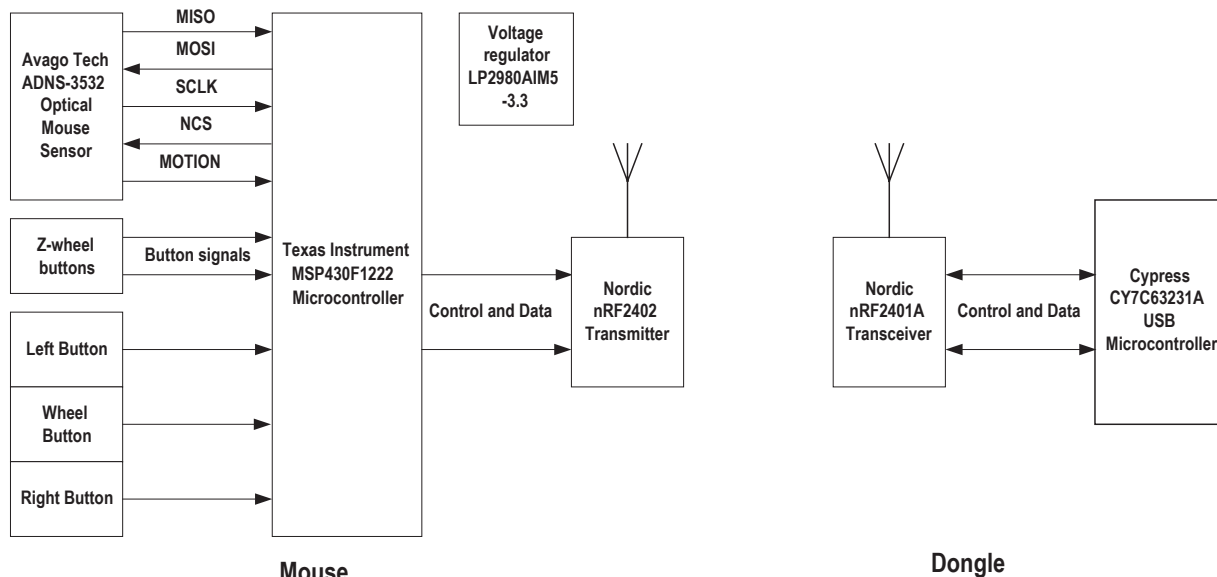


Figure 1. ADNK-3533-TN24 Reference Design Mouse Functional Block Diagram

Kit Components

The designer's kit contains components as follows:

Part Number	Description	Name	Quantity
ADNK-3533-TN24 Mouse	Reference Design Mouse	Reference Design Unit	1
ADNS-3530	Solid-State Optical Mouse Sensor	Sensor	5
ADNS-3150-001	Lens Plate	Lens	5
ADNK-3533-TN24 CD	Includes Documentation and Support Files for ADNK-3533-TN24 Documentation a. ADNB-3532 Data Sheet Hardware Support Files a. ADNK-3533-TN24 BOM List b. ADNK-3533-TN24 Schematic c. IGES Base Plate Feature File d. Gerber File Software Support Files a. Microcontroller Firmware		1

Ordering Information

For ordering information, please contact your local Avago Technologies sales representative.

At Avago Technologies call (800)235-0312, visit the website at <http://www.avagotech.com/>

At Sunplus call +886-3-5786005 ext. 3288 or visit the web site at www.sunplus.com

For product information and a complete list of distributors, please go to our web site: www.avagotech.com

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