eZ430-Chronos Wireless Watch Development Tool: Teardown & Getting Started

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www.ti.com/chronoswiki

TEXAS INSTRUMENTS

eZ430-Chronos for wireless networking applications

Complete hardware, software and support community

Simplify & inspire development with world's first customizable tool within an intelligent sports watch

Unparalleled system integration and ultra-low power

Easily enable wireless connectivity, longer battery life, improved ergonomics
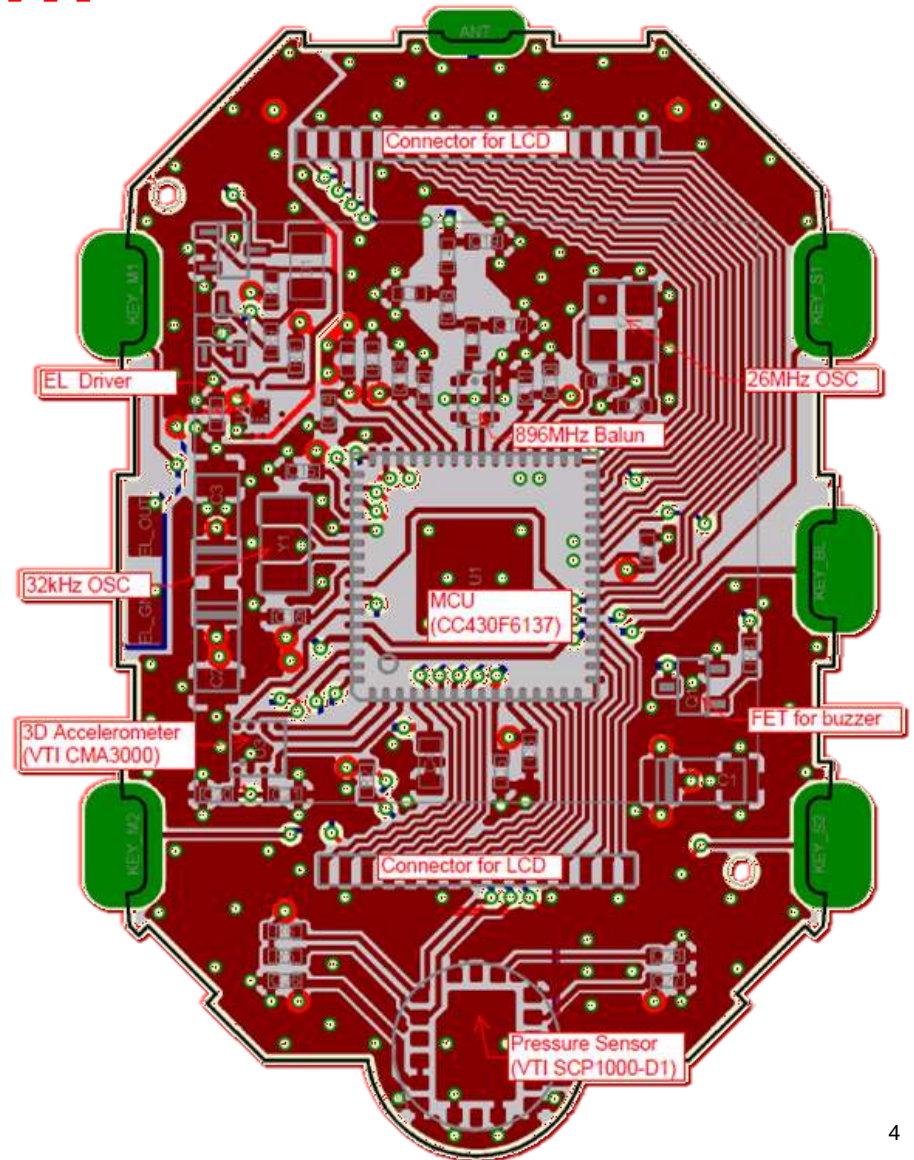
Low cost development kit at $49

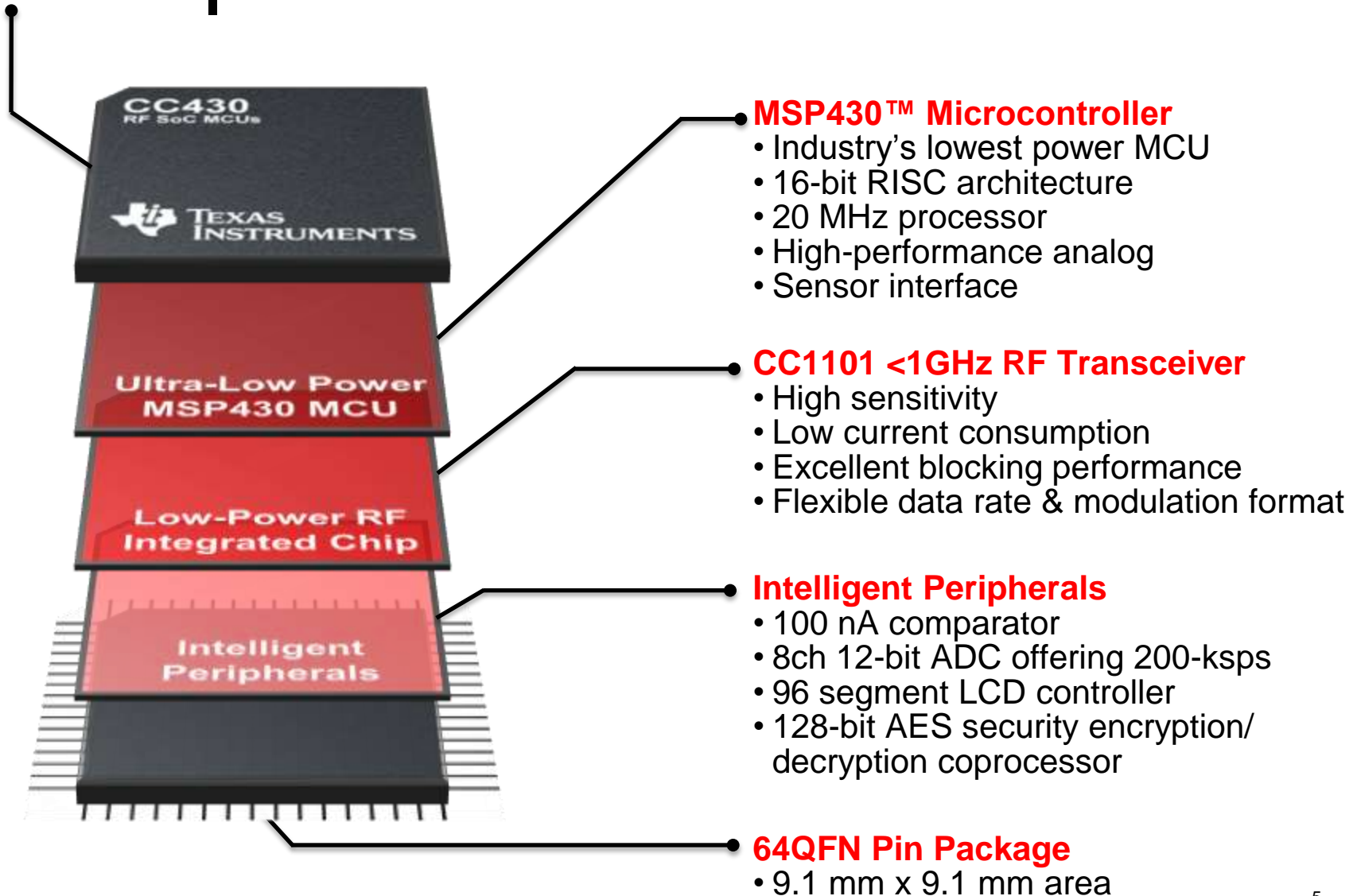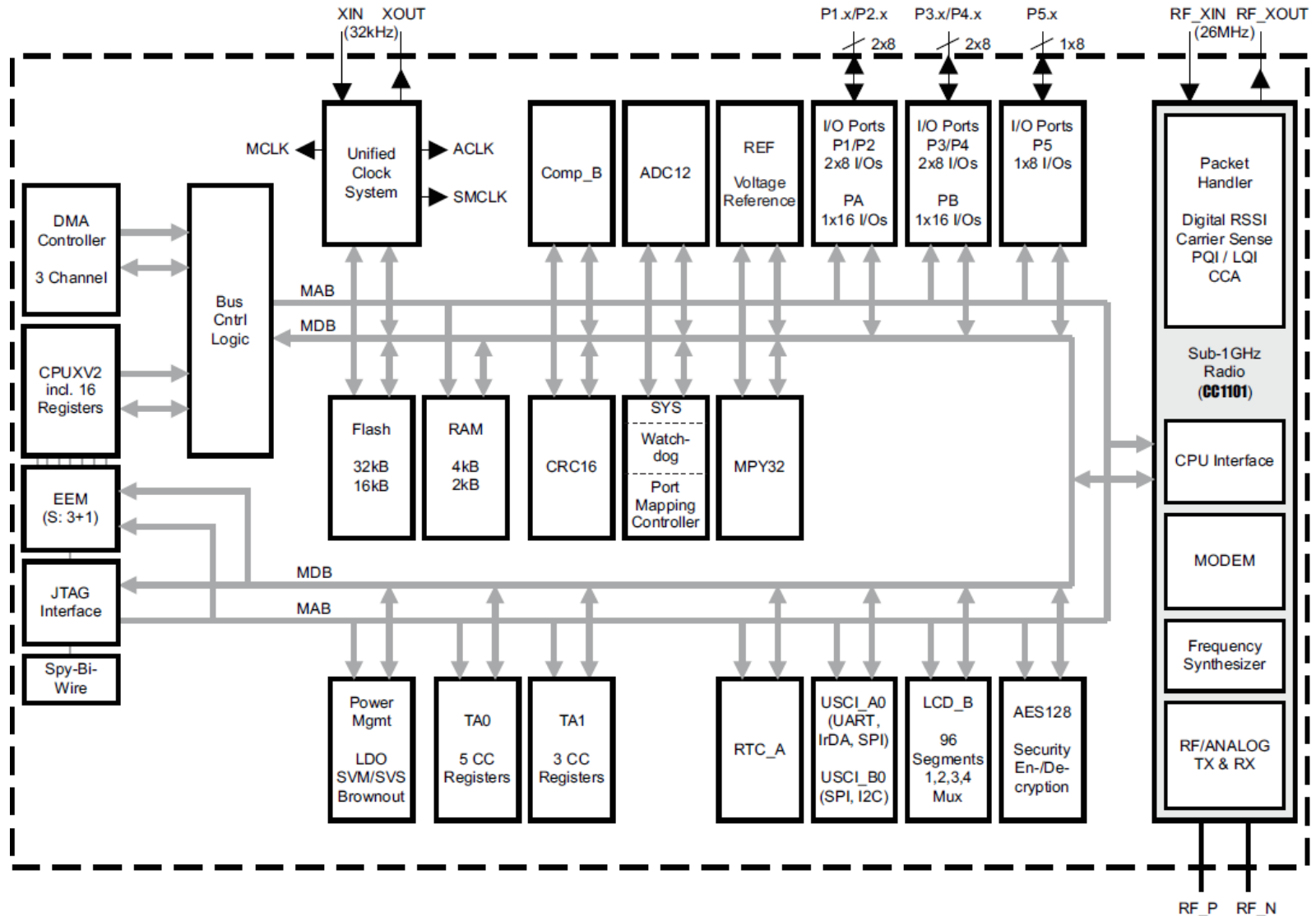**Increase accessibility and reduce development cost**

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Chronos | Advanced Integration

CC430F6137 MCU

<1GHz RF
 • 433, 868 & 915 MHz

2-Wire JTAG Access

96 segment LCD

Buzzer

3-Axis VTI Accelerometer

VTI Pressure & Altitude Sensor

Temperature Sensor

Voltage & Battery Sensor

CR2032 Battery

eZ430 Programmer

RF Access Point

Chronos Disassembly Tool

3

Chronos | Teardown

4

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CC430 | RF + Ultra-Low Power MCU

MSP430™ Microcontroller
- Industry's lowest power MCU
- 16-bit RISC architecture
- 20 MHz processor
- High-performance analog
- Sensor interface

CC1101 <1GHz RF Transceiver
- High sensitivity
- Low current consumption
- Excellent blocking performance
- Flexible data rate & modulation format

Intelligent Peripherals
- 100 nA comparator
- 8ch 12-bit ADC offering 200-ksps
- 96 segment LCD controller
- 128-bit AES security encryption/ decryption coprocessor
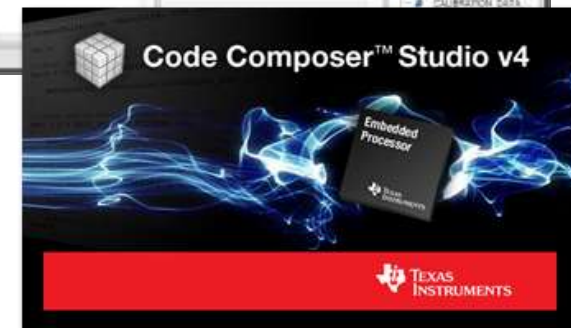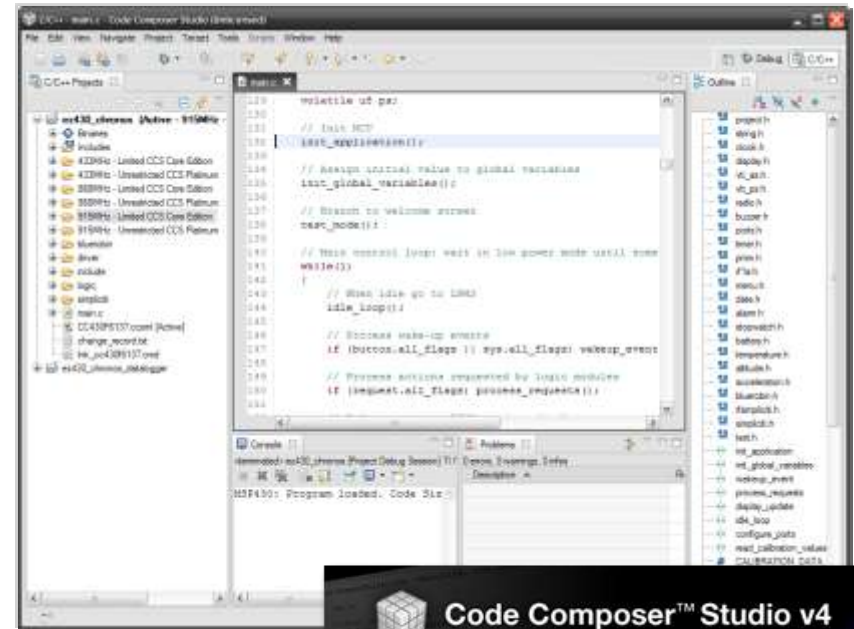
**64QFN Pin Package**
- 9.1 mm x 9.1 mm area

CC430 Block Diagram

Chronos | The Software

- Free development software
  - Code Composer Studio
  - IAR Embedded Workbench
  - MSPGCC*
- Production-ready, open-source projects
- RF stacks available
  - SimpliciTI
  - BlueRobin
  - W-Mbus
  - 6LoWPAN
  - More coming…
- User generated apps and support on www.ti.com/chronoswiki

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SimpliciTI

- TI proprietary low-power RF network protocol
- Low Cost:
  - < 8K FLASH
  - <1K RAM
- Flexible:
  - simple star w/ extendor
  - p2p communication
- Simple: Utilizes a very basic core API
- Low Power: Supports sleeping devices

8
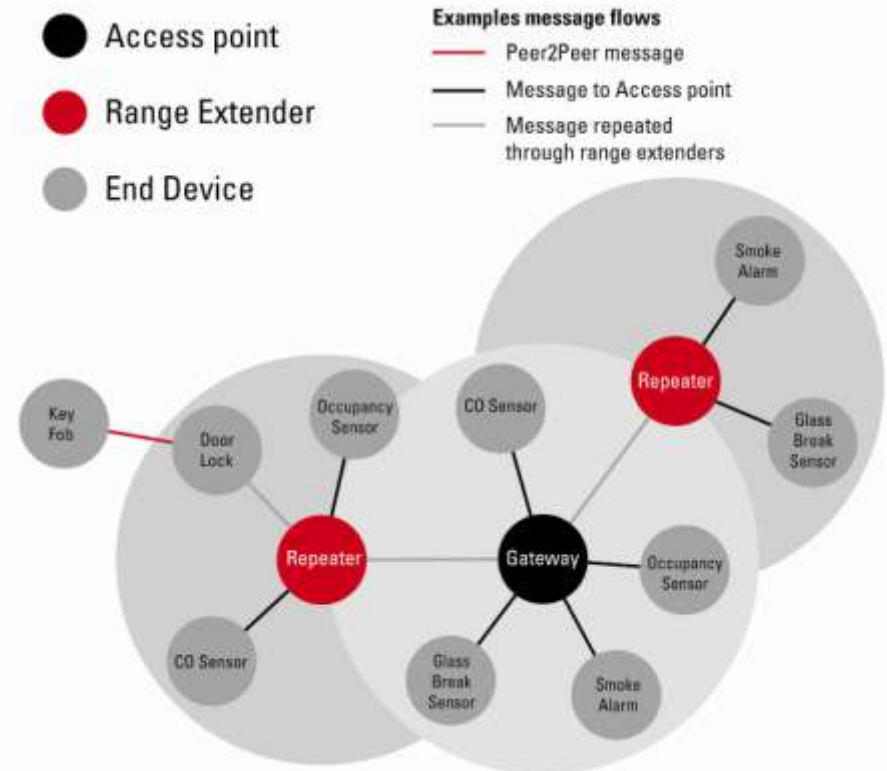
BM Wireless' BlueRobin Key Facts

- *BlueRobin*™ targets at
  - body area networks
  - long range monitoring systems

- *BlueRobin* provides
  - ultra-low power operation in TX and RX mode
  - multi-user support with patented collision avoidance
  - bi-directional and long range communication
  - remote data storage with automatic data download
  - built-in data encryption

- *BlueRobin* offers flexibility through
  - hardware independent implementation
  - small memory footprint and low resource requirements
  - support of all ISM bands (433MHz to 2.4GHz)

- *BlueRobin* key apps
  - Heart Rate, Speed, Distance, Steps, GPS, Temperature,
  - Altitude, Rotations, Weight, Blood Pressure, Blood Glucose

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Chronos | **Projects**

- Watch functions: time, date, alarm, stopwatch
- Fitness function: running speed, distance, heart rate, calories burned
- Sensor data logging w/ wireless PC download
- PowerPoint Control
- Media Remote
- Motion-based mouse/PC game control
- Wireless App Updating
- Wireless door lock
- Virtual Theremin
- Robotics control

More apps to come…
www.ti.com/chronoswiki

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Endless possibilities | Chronos serves as a central hub for nearby wireless sensors
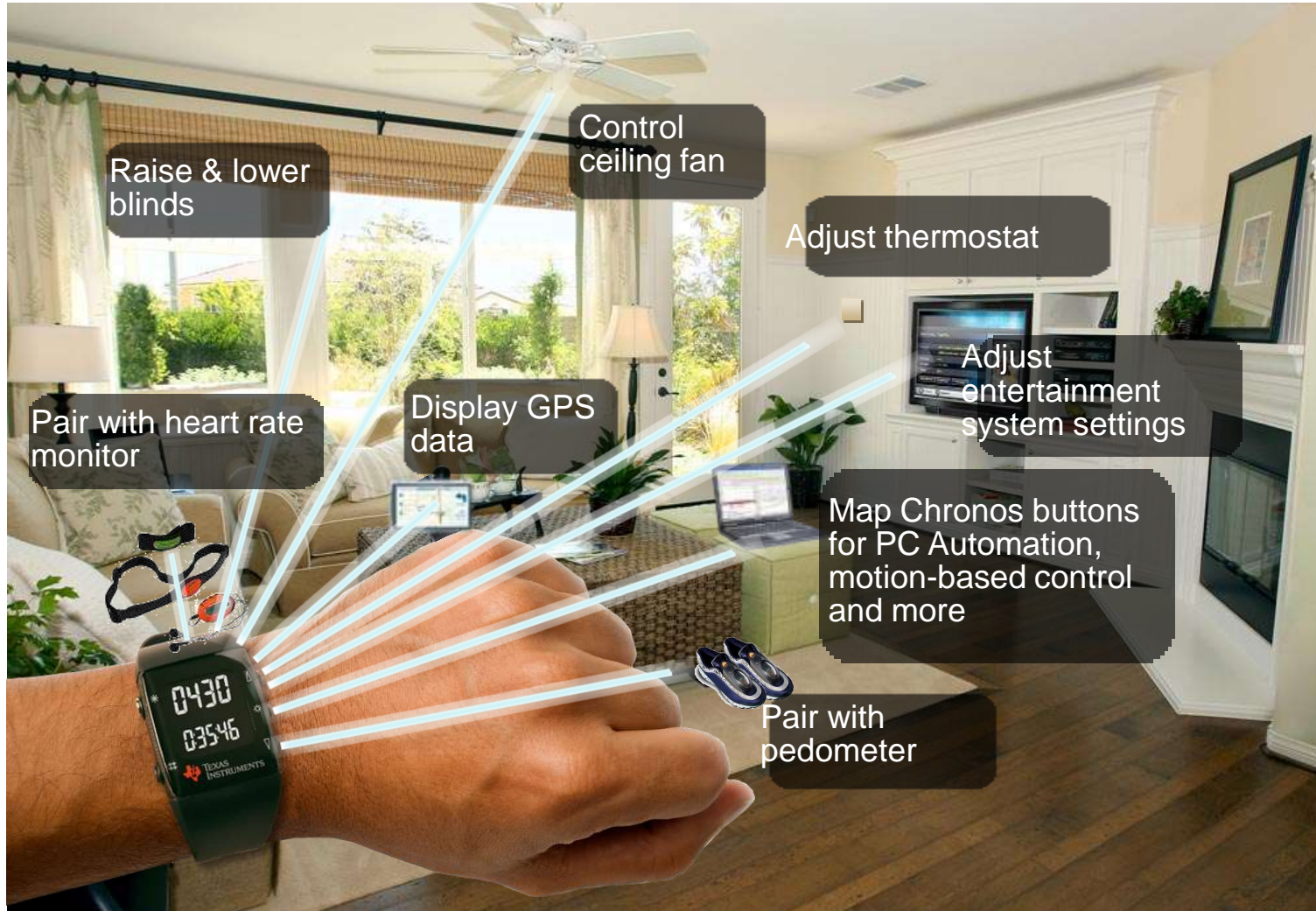
Chronos | Frequency Differences

- Available in 3 different frequencies
  - 433 MHz : Japan, India, WW
  - 868 MHz : Europe
  - 915 MHz : N. & S. America
- 868 & 915
  - Use identical watch hardware
  - Frequency is software selectable
  - 868 MHz RF Access Point has extra 0Ω R
- 433 MHz
  - Still in R&D
  - Available in June (estimated)
  - RF Range predicted to be *worse* than 868/915

Chronos | RF Access Point

- Based on CC1111
  w/ integrated USB + <1GHz RF
- "Fixed function" to communicate with Chronos & PC
- Can be manually reprogrammed with CC Debugger
- Supports wireless updating of Chronos firmware via RF BSL
  - RF BSL not included on first production batch
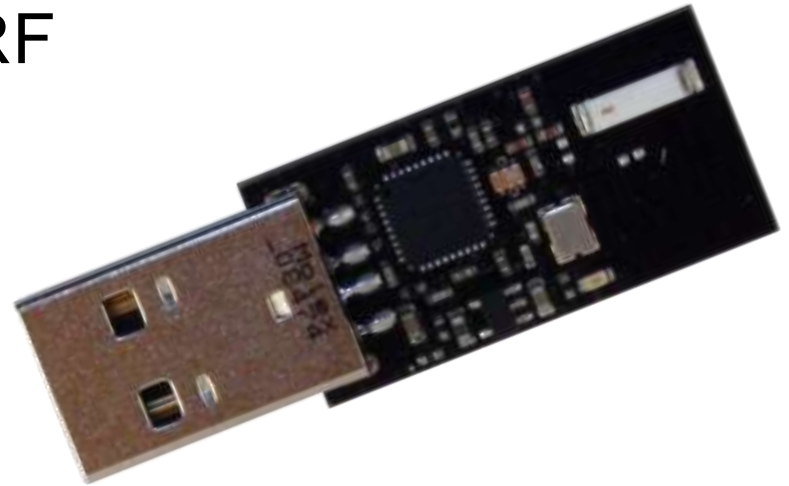
Header to JTAG signals
has to be manually added

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RF BSL | Wireless Updating

- Wireless update of watch firmware
- Small RF Stack resides in BSL memory
- Application must include function to invoke BSL

- Pros:
  - ~10x faster than downloading code via SBW
  - No need to open enclosure
- Cons:
  - No debug capability
  - Power hog
  - Not supported out-of-the-box on early units (before 4/2010)
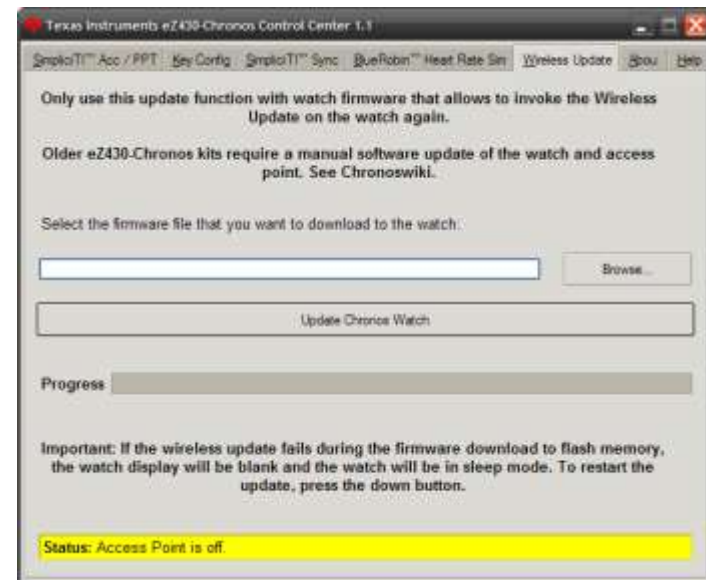
Chronos | Data Logger

- Chronos can be used as a data logger for:
  - Heart rate
  - Temperature
  - Altitude

- User definable intervals
  - 1 to 255 seconds

- 8kB of Flash memory reserved

- The stored data can be transferred to a PC

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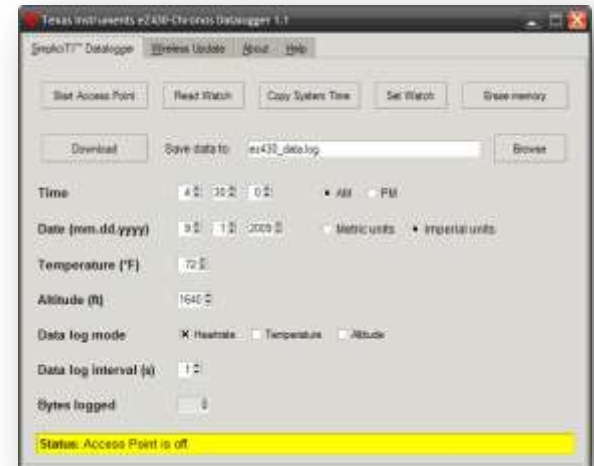
PC/Chronos Communication

- RF Access Point open Virtual COM Port over USB
  - bps   115200
  - Data bits   8
  - Parity   None
  - Stop Bits   1
  - Flow Control   None
- Control Center automatically
  - Opens COM port
  - Transfers data
  - Decodes packets
  - Displays info

- API available for manual data transfer
- Scripts available for:
  - Python
  - Processing
  - Ruby
  - .net

- All community developed, supported

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Chronos | Extra Hardware

- Heart Rate Monitors
  - BM-CS5 (800m)
  - BM-CS5SR (10m): 49€
- **Bike Sensors**
  - Speed and distance (according to BMi Q4 2010)
- **Compatible RF Development Boards**
  - AMB8423
  - EM430F6137RF900
  - CC1101EMK433
  - CC1111EMK868-915

Getting Started: What you need

- **Hardware**:   www.ti.com/chronoswiki
  1. eZ430-Chronos
  2. Computer: Windows / Linux

- **Software**:
  1. eZ430-Chronos Software Package:
     Windows (SLAC341), Linux (SLAC388)
  2. IDE: IAR or CCS
  3. Firmware Update tool (adds rfBSL)

- **Documentation**
  1. eZ430-Chronos User Guide (SLAU292): Technical details and instructions for Chronos
  2. CC430 User Guide: Technical user manual for CC430
  3. CC430F613x Datasheet: Electrical specs for CC430F613x

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Chronos Software Package

- All files copied to C:\Program Files\Texas Instruments\eZ430-Chronos
- What's included:
  - Control Center
    - Control Center GUI binary
    - Data logger GUI binary
    - GUI source code
  - Documentation
    - Chronos User Guide
    - Schematics, Layout (Gerbers) & BOM
      - RF Access Point
      - eZ430 Debug Interface
      - Watch

- RF Access Point Driver
- Binary images (Recovery)
  - Sports watch/Chronos
  - Datalogger app
  - rfBSL
  - RF Access Point
- Software projects
  - Sports watch (CCS/IAR)
  - Datalogger (CCS/IAR)
  - RF Access Point (IAR)

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Working with the Chronos Project (CCS)

- Open CCS
  - Pick any workspace
  - Close welcome screen
- Import Project
  - Project > Import existing…
  - Browse to C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects
  - Select 'Copy Projects into workspace'
- Select 'Active Project'
  - Right Click on project name
- Select 'Active Build'
  - Select correct frequency & IDE version (core vs. full)
- Debug

TEXAS INSTRUMENTS
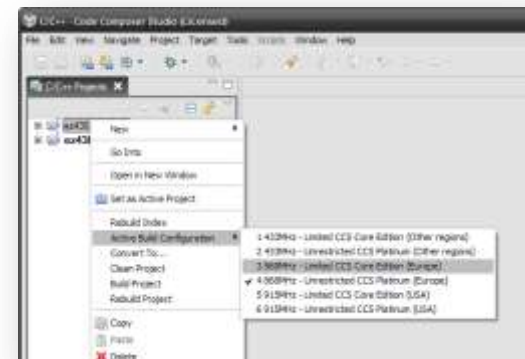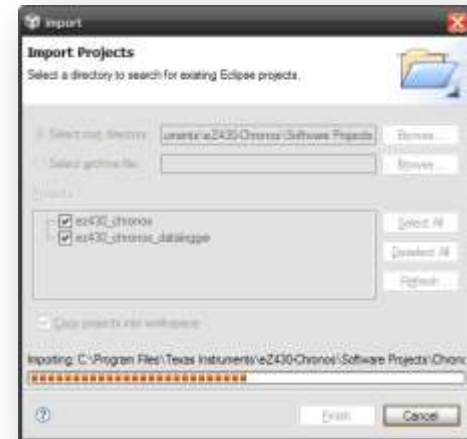
Adding RFBSL to RF Access Point

- Hardware You'll need
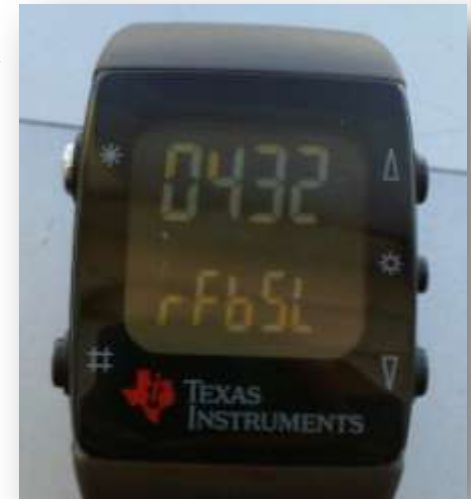 - RF Access Point
  - CC Debugger
- Add connector to RF AP

- Run "Smart RF Flash Programmer"
- Load RF Access Point Recovery image
- Erase, Program, & Verify

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Adding RF BSL to Chronos Watch

- RF BSL includes a small RF protocol stack with error recovery

- Resides within reserved BSL memory

    - Accessing via IAR/CCS is *tricky*

- Easiest update method

    - Use Firmware Update Tool

    - Select correct script for watch frequency

    - Automatically updates BSL + User Application

- User App needs to be modified to invoke BSL from menus

Thank you.

Texas Instruments

Enjoy the Chronos.