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

Adrian Valenzuela
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www.ti.com/chronoswiki
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
Chronos | Advanced Integration

- CC430F6137 MCU
- 3-Axis VTI Accelerometer
- <1GHz RF
  - 433, 868 & 915 MHz
- VTI Pressure & Altitude Sensor
- Temperature Sensor
- Voltage & Battery Sensor
- CR2032 Battery
- 2-Wire JTAG Access
- 96 segment LCD
- Buzzer
- eZ430 Programmer
- RF Access Point
- Chronos Disassembly Tool
Chronos | Teardown
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-ksp
- 96 segment LCD controller
- 128-bit AES security encryption/decryption coprocessor

64QFN Pin Package
- 9.1 mm x 9.1 mm area
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
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
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
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
Endless possibilities | Chronos serves as a central hub for nearby wireless sensors

- Control ceiling fan
- Raise & lower blinds
- Adjust thermostat
- Display GPS data
- Adjust entertainment system settings
- Pair with pedometer
- Pair with heart rate monitor
- Map Chronos buttons for PC Automation, motion-based control and more
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
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
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
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:**
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)
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
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
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.

Enjoy the Chronos.