eZ430-Chronos™ Development Tool

User's Guide

Literature Number: SLAU292G
November 2009–Revised July 2015

Contents

Preface **8**

1 eZ430-Chronos™ Overview **9**

1.1 Overview 9

1.2 eZ430-Chronos Features 9

1.3 Kit Contents 10

2 Getting Started **11**

2.1 Using the eZ430-Chronos Wrist Module Stand Alone 11

2.1.1 Setting the Time 11

2.1.2 Setting the Date 12

2.1.3 Feature Overview and Menu Structure 13

2.2 Install Demo Application, Drivers and Firmware 14

2.2.1 Windows® Installation 14

2.2.2 Linux® Installation 14

2.3 Using the eZ430-Chronos Wrist Module With a PC 15

2.3.1 Transmission of Acceleration Data and Button Pushes 15

3 eZ430-Chronos Software **19**

3.1 Overview 19

3.2 eZ430-Chronos Demo Software 19

3.2.1 Detailed Feature Overview - Modes Using the Top LCD Line 21

3.2.2 Detailed Feature Overview - Modes Using the Bottom LCD Line 24

3.3 eZ430-Chronos Control Center PC Software 27

3.3.1 SimpliciTI™ Acc/PPT Tab (Mouse and PowerPoint Control) 28

3.3.2 Key Configuration Tab 31

3.3.3 SimpliciTI™ Sync 32

3.3.4 BlueRobin™ Heart Rate Simulator 33

3.3.5 Wireless Update 34

3.4 eZ430-Chronos Data Logger 36

3.4.1 Detailed Feature Overview 37

3.5 Data Logger PC Software 37

3.5.1 SimpliciTI Data Logger 38

3.5.2 Wireless Update 40

3.6 eZ430-Chronos Software Projects 41

3.6.1 IDE Installation 41

3.6.2 eZ430-Chronos Software Flow 42

3.6.3 eZ430-Chronos Wireless Update Feature 44

3.6.4 eZ430-Chronos Firmware 50

3.6.5 eZ430-Chronos GUI Sources 51

4 eZ430-Chronos Hardware **57**

4.1 Programming the eZ430-Chronos Wrist Module: Disassembly and Assembly of the Housing 57

4.1.1 Disassembly of eZ430-Chronos Wrist Module 57

4.1.2 Assembly of eZ430-Chronos Wrist Module 59

4.2 Functional Description of the eZ430-Chronos Wrist Module 61

4.3 Functional Description of the eZ430-Chronos RF Access Point 63

4.3.1 Access Point With Black PCB 63

Copyright © 2009–2015, Texas Instruments Incorporated

4.3.2 Access Point With White PCB 64
4.4 Functional Description of the eZ430-Chronos Debug Interface 65
4.4.1 MSP430 Application UART 65
4.5 Schematics, Layout, BOM, and LCD 66
4.5.1 eZ430-Chronos-433 Wrist Module With Black PCB 66
4.5.2 eZ430-Chronos-433 Wrist Module With White PCB 74
4.5.3 eZ430-Chronos-868 and -915 Wrist Modules With Black PCB 82
4.5.4 eZ430-Chronos-868 and -915 Wrist Modules With White PCB 90
4.5.5 LCD 94
4.6 Access Point Schematics, Layout, and BOM 96
4.6.1 eZ430-Chronos-433 With Black PCB RF Access Point 96
4.6.2 eZ430-Chronos-433 With White PCB RF Access Point 101
4.6.3 eZ430-Chronos-868 and -915 With Black PCB RF Access Point 106
4.6.4 eZ430-Chronos-868 and -915 With White PCB RF Access Point 112
4.6.5 Debugging Interface Schematics and Layout 121
A Frequently Asked Questions 125
A.1 FAQs 125
B Detailed Hardware Driver Installation Guide 129
B.1 Overview 129
B.2 eZ430-Chronos RF Access Point 129
B.3 eZ430-RF Debug Interface 133
Revision History 135

Copyright © 2009–2015, Texas Instruments Incorporated

List of Figures

1 eZ430-Chronos With Black PCB 10
2 eZ430-Chronos With White PCB 10
2-1. eZ430-Chronos Wrist Module Push Buttons 11
2-2. Overview eZ430-Chronos LCD 11
2-3. eZ430-Chronos Feature Overview and Menu Structure 13
2-4. eZ430-Chronos Control Center 15
2-5. eZ430-Chronos Control Center With Acceleration Data 16
3-1. eZ430-Chronos Feature Overview and Menu Structure 20
3-2. eZ430-Chronos Control Center 28
3-3. eZ430-Chronos Control Center With Acceleration Data 29
3-4. eZ430-Chronos Control Center With PPT Control 30
3-5. eZ430-Chronos Control Center Key Configuration 31
3-6. eZ430-Chronos Control Center Sync 32
3-7. eZ430-Chronos Control Center Heart Rate Simulator 33
3-8. eZ430-Chronos Control Center Wireless Update 35
3-9. eZ430-Chronos Data Logger Feature Overview and Menu Structure 36
3-10. eZ430-Chronos Data Logger 39
3-11. eZ430-Chronos Control Center Wireless Update 41
3-12. eZ430-Chronos Software Flowchart 43
3-13. Flow Chart of Wireless Update Software on Access Point 45
3-14. Flow Chart of Flash Based Wireless Update Software on eZ430-Chronos Wrist Module 46
3-15. Upgrade AP Firmware 47
3-16. eZ430-Chronos RF Access Point Connection to CC Debugger 48
3-17. SmartRF Flash Programmer 49
4-1. Remove Chronos Module From Housing 57
4-2. Remove Chronos Module Battery 58
4-3. eZ430-Chronos Module Attached to eZ430-RF Debug Interface 59
4-4. eZ430-Chronos Module Insertion Into Housing 60
4-5. Metal Strips of Chronos Module Housing and Buttons of Housing 60
4-6. Push Metal Strips Inward 61
4-7. eZ430-Chronos Wrist Module Block Diagram 61
4-8. eZ430-Chronos Module Front 62
4-9. eZ430-Chronos Module Back 62
4-10. eZ430-Chronos RF Access Point 63
4-11. eZ430-Chronos RF Access Point Connection to CC Debugger 63
4-12. Access Point With White PCB 64
4-13. Access Point With Connector 64
4-14. eZ430-Chronos Debug Interface 65
4-15. eZ430-Chronos-433 Wrist Module With Black PCB, Schematics 66
4-16. eZ430-Chronos-433 Wrist Module With Black PCB, PCB Components on Top Layer 67
4-17. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Top Layer (LCD Side) 68
4-18. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Second Layer 69
4-19. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Third Layer 70
4-20. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Bottom Layer (Battery Side) 71
4-21. eZ430-Chronos-433 Wrist Module With White PCB, Schematics 74
4-22. eZ430-Chronos-433 Wrist Module With White PCB, PCB Components on Top Layer 75
4-23. eZ430-Chronos-433 Wrist Module With White PCB, Layout Top Layer (LCD Side) 76

Copyright © 2009–2015, Texas Instruments Incorporated

4-24. eZ430-Chronos-433 Wrist Module With White PCB, Layout Second Layer 77
4-25. eZ430-Chronos-433 Wrist Module With White PCB, Layout Third Layer 78
4-26. eZ430-Chronos-433 Wrist Module With White PCB, Layout Bottom Layer (Battery Side) 79
4-27. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Schematics 82
4-28. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, PCB Components on Top Layer 83
4-29. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Top Layer (LCD Side) 84
4-30. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Second Layer 85
4-31. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Third Layer 86
4-32. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Bottom Layer (Battery Side) 87
4-33. eZ430-Chronos-868 Wrist Modules With White PCBs, Schematics 90
4-34. eZ430-Chronos-915 Wrist Modules With White PCBs, Schematics 91
4-35. LCD Segment Map 94
4-36. LCD Pinout 95
4-37. eZ430-Chronos-433 RF Access Point With Black PCB, Schematics 96
4-38. eZ430-Chronos-433 RF Access Point With Black PCB, PCB Components on Top Layer 97
4-39. eZ430-Chronos-433 RF Access Point With Black PCB, Layout Top Layer 98
4-40. eZ430-Chronos-433 RF Access Point With Black PCB, Layout Bottom Layer 99
4-41. eZ430-Chronos-433 RF Access Point With White PCB, Schematics 101
4-42. eZ430-Chronos-433 RF Access Point With White PCB, PCB Components on Top Layer 102
4-43. eZ430-Chronos-433 RF Access Point With White PCB, Layout Top Layer 103
4-44. eZ430-Chronos-433 RF Access Point With White PCB, Layout Bottom Layer 104
4-45. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, Schematics 106
4-46. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, PCB Components on Top Layer 107
4-47. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, Layout Top Layer 108
4-48. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, Layout Bottom Layer 109
4-49. eZ430-Chronos-868 RF Access Point With White PCB, Schematics 112
4-50. eZ430-Chronos-915 RF Access Point With White PCB, Schematics 113
4-51. eZ430-Chronos-868 and -915 RF Access Point With White PCB, PCB Components on Top Layer 114
4-52. eZ430-Chronos-868 RF Access Point With White PCB, Layout Top Layer 115
4-53. eZ430-Chronos-915 RF Access Point With White PCB, Layout Top Layer 116
4-54. eZ430-Chronos-868 RF Access Point With White PCB, Layout Bottom Layer 117
4-55. eZ430-Chronos-915 RF Access Point With White PCB, Layout Bottom Layer 118
4-56. USB Debug Interface, Schematic 121
4-57. USB Debug Interface, Schematic 122
4-58. USB Debug Interface, PCB Components on Top Layer 123
4-59. USB Debug Interface, PCB Components on Bottom Layer 123
4-60. USB Debug Interface, Layout Top Layer 123
4-61. USB Debug Interface, Layout Bottom Layer 123
B-1. Device Driver installation Wizard for the Access Point 129
B-2. Successful Driver Installation for Access Point 130
3 Access Point Detection for eZ430-Chronos With Black PCB 130
4 Access Point Detection for eZ430-Chronos With White PCB 130
B-5. Windows Found New Hardware Wizard 131
B-6. Automatic Driver installation 131
B-7. Windows Uncertified Driver Installation Warning 132
8 Access Point in Windows Device Manager for eZ430-Chronos With Black PCB 132
9 Access Point in Windows Device Manager for eZ430-Chronos With White PCB 132
10 Port Settings for eZ430-Chronos With Black PCB 132
11 Port Settings for eZ430-Chronos With White PCB 132

Copyright © 2009–2015, Texas Instruments Incorporated

B-12. eZ430-RF Windows Driver Installation 133
B-13. eZ430-RF in Windows Device Manager as HID and COM Port Devices 134

Copyright © 2009–2015, Texas Instruments Incorporated

List of Tables

4-1. Estimated Battery Life (Demo Software) 62
4-2. eZ430-Chronos-433 Wrist Module With Black PCB, BOM List 72
4-3. eZ430-Chronos-433 Wrist Module With White PCB, BOM List 80
4-4. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, BOM List 88
4-5. eZ430-Chronos-868 and -915 PCB Cross Reference 92
4-6. eZ430-Chronos-868 Wrist Module With White PCB, BOM List 92
4-7. eZ430-Chronos-433 Access Point With Black PCB, BOM List 100
4-8. eZ430-Chronos-433 Access Point With White PCB, BOM List 105
4-9. eZ430-Chronos-868 Access Point With Black PCB, BOM List 110
4-10. eZ430-Chronos-915 Access Point With Black PCB, BOM List 111
4-11. eZ430-Chronos-868 Access Point With White PCB, BOM List 119
4-12. eZ430-Chronos-915 Access Point With White PCB, BOM List 120

Copyright © 2009–2015, Texas Instruments Incorporated

Read This First

The eZ430-Chronos software development tool is a highly integrated, wearable, wireless development system that is based on the CC430F6137. It may be used as a reference platform for watch systems, a personal display for personal area networks, or as a wireless sensor node for remote data collection.

If You Need Assistance

If you have any feedback or questions, support for the MSP430™ microcontrollers and the eZ430-Chronos™ software development tool is provided by the Texas Instruments Product Information Center (PIC) (support.ti.com), the TI E2E Forum (http://e2e.ti.com/support/microcontrollers/msp430/default.aspx), and the eZ430-Chronos wiki (www.ti.com/chronoswiki). Additional device-specific information can be found on the MSP430 website (www.ti.com/msp430).

Related Documentation from Texas Instruments

The primary sources of MSP430 information are the device-specific data sheets and user's guides. The most up-to-date versions of the user's guide documents available at the time of production have been provided on the CD-ROM included with this tool. However, the most current information is found at www.ti.com/msp430.

Information specific to the eZ430-Chronos development tool can be found at www.ti.com/chronos.

MSP430 device and IDE user's guides may be accessed on the included CD-ROM under the user's guides section. The IDE user's guides include detailed information on setting up a project for the MSP430 using Code Composer Studio™ integrated development environment (IDE) (SLAU157) and the IAR Embedded Workbench™ IDE (SLAU138).

FCC, IC, and Other Geographical Radio Use Restrictions

eZ430-Chronos-433 and eZ430-Chronos-868 are restricted from use in the USA and Canada due to frequency conflicts.

eZ430-Chronos-915 is restricted from the use in Europe due to frequency conflicts.

It is the user's responsibility to assure this evaluation module is not operated in any other geographical regions that may be restricted.

Environmental Operating Conditions

Operating temperature 0°C to 40°C (32°F to 104°F)

Storage temperature -20°C to 60°C (-4°F to 140°F)

Export Control Regulations

This development kit is subject to the export and import control regulations of the United States per the harmonization code: ECCN 5A002A1A TSPA. Note that it may also be subject to export control policies of local authorities.

Patents

German utility model and patent pending.

Copyright © 2009–2015, Texas Instruments Incorporated

Trademarks

SimpliciTI, MSP430, eZ430-Chronos, Code Composer Studio are trademarks of Texas Instruments.
BlueRobin is a trademark of BM innovations GmbH.
IAR Embedded Workbench, KickStart are trademarks of IAR Systems.
Linux is a registered trademark of Linus Torvalds.
Windows, PowerPoint are registered trademarks of Microsoft Corporation.
All other trademarks are the property of their respective owners.

eZ430-Chronos™ Overview

1.1 Overview

Based on the CC430F6137 sub-1-GHz RF SoC, the eZ430-Chronos is a complete development system featuring a 96-segment LCD display, an integrated pressure sensor, and a three-axis accelerometer for motion sensitive control. The integrated wireless interface allows the eZ430-Chronos to act as a central hub for nearby wireless sensors such as pedometers and heart-rate monitors. The eZ430-Chronos offers temperature and battery voltage measurement and is complete with a USB-based MSP430F5509 + CC1101 (part of the new eZ430-Chronos kit with white PCBs) or CC1111 (part of the initial eZ430-Chronos kit with black PCBs) wireless interface to a PC.

The eZ430-Chronos wrist module may be disassembled to be programmed with custom applications and includes an eZ430 USB programming interface.

NOTE: The information provided in this document applies equally to all of the kits that are available, unless otherwise noted.

There are several different eZ430-Chronos kit versions available. In addition to the different frequency versions, there are two generations of kits:

- First generation eZ430-Chronos with black PCBs (legacy), sometimes referred to as "Chronos BLACK"
  - Chronos module based on VIT accelerometer and pressure sensor
  - Chronos module based on discrete RF matching
  - Access Point based on CC1111 (8051 based SoC with USB and <1GHz transceiver)
- Second generation eZ430-Chronos with white PCBs, sometimes referred to as "Chronos WHITE"
  - Chronos module based on Bosch Sensortec accelerometer and pressure sensor
  - Model number engraved in metal back of wrist housing
  - Chronos module based on Johanson Technology Filter baluns
  - Access Point based on MSP430F5509 microcontroller with USB and CC1101 <1GHz transceiver

1.2 eZ430-Chronos Features

- Sports watch development kit based on the CC430F6137, an MSP430™ microcontroller with integrated sub-1-GHz wireless transceiver
- Wrist module can be programmed for custom wireless applications
- Highly integrated wrist module includes on-board three-axis accelerometer, pressure sensor,

Copyright © 2009–2015, Texas Instruments Incorporated

temperature sensor, and battery voltage sensor

- 96-segment LCD display driven directly by the CC430 microcontroller
- Can be paired wirelessly with heart-rate monitors, pedometers, or other devices based on RF transceivers such as the CC430 or CC11xx devices
- Includes an eZ430-RF USB emulator that connects the eZ430-Chronos to a PC for real-time in-system programming and debugging.



Figure 1. eZ430-Chronos With Black PCB



Figure 2. eZ430-Chronos With White PCB

1.3 Kit Contents

- One eZ430-Chronos module with wrist housing (battery included)
- One eZ430-RF USB debugging interface
- One CC1111 USB RF access point (Chronos BLACK only)
- One MSP430F5509 + CC1101 USB RF access point (Chronos WHITE only)
- One 4-pin solder-on debug connector for the USB RF access point (Chronos WHITE only)
- One mini Phillips screwdriver
- Two spare screws
- One MSP430 development tool CD containing documentation and development software (Chronos BLACK only)
  - *eZ430-Chronos™ Windows® PC-Software and Source Code* SLAC341
  - *eZ430-Chronos™ Linux® PC-Software and Source Code* SLAC388
  - *eZ430-Chronos™ Development Tool User's Guide* SLAU292
  - *CC430 Family User's Guide* SLAU259
  - *Code Composer Studio™ v5* CCS Mediawiki
  - *Code Composer Studio™ v5 User's Guide for MSP430* SLAU157
  - *IAR Embedded Workbench™ KickStart™* SLAC050
  - *IAR Embedded Workbench™ User's Guide for MSP430* SLAU138

NOTE: For the latest software and documentation, go to www.ti.com/chronos or www.ti.com/chronoswiki.

Copyright © 2009–2015, Texas Instruments Incorporated

2.1 Using the eZ430-Chronos Wrist Module Stand Alone

For first time use, remove the eZ430-Chronos from box and press any button twice to wake the Chronos module from sleep mode. After the first button press, the LCD displays the same content as shown on the box of the kit, and after the second button press, the Chronos module starts full operation.

NOTE: For the next steps it is important to understand the eZ430-Chronos user concept. The top and bottom LCD lines can be controlled individually by pushing the buttons on the left side. The buttons on the right side are used to select or activate secondary functions. Detailed instructions are available in Section 3.2.



Figure 2-1. eZ430-Chronos Wrist Module Push Buttons

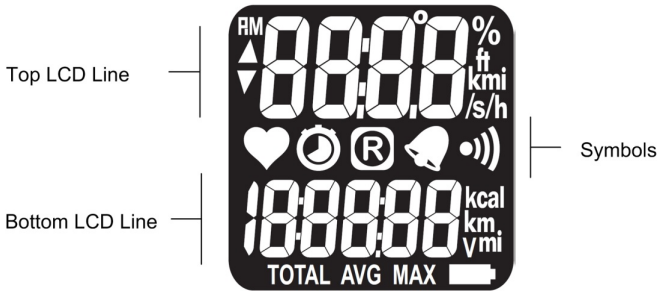


Figure 2-2. Overview eZ430-Chronos LCD

2.1.1 Setting the Time

1. Push the * button until the time is displayed in the top LCD line.
2. Hold * for three seconds until the time disappears and 12H or 24H is shown on the LCD.
3. Select 12H or 24H mode by pushing the UP or DOWN buttons.
4. Press # to continue with the time adjustment.
5. Set the hours by pushing the UP or DOWN button.
6. Press # to continue with the minute adjustment.
7. Set the minutes by pushing the UP or DOWN button.
8. Press # to continue with the second adjustment.
9. Set the seconds by pushing the UP or DOWN button.
10. Press * to confirm the settings and go back to normal operation, or press # to start over with step 2.

Copyright © 2009–2015, Texas Instruments Incorporated

NOTE: If no button is pushed for more than 30 seconds, the previous settings are restored.

Alternatively, the time and date may be set wirelessly using the eZ430-Chronos Control Center (see Section 3.3.3).

2.1.2 Setting the Date

1. Push the # button until the date is displayed in the bottom LCD line.
2. Hold # for three seconds until the year flashes on the bottom LCD line.
3. Set the year by pushing the UP or DOWN button.
4. Press # to continue with the month adjustment.
5. Set the month by pushing the UP or DOWN button.
6. Press # to continue with the day adjustment.
7. Set the day by pushing the UP or DOWN button.
8. Press * to confirm the settings and go back to normal operation, or press # to start over with step 3.

NOTE: If no button is pushed for more than 30 seconds, the previous settings are being restored.

Copyright © 2009–2015, Texas Instruments Incorporated

2.1.3 Feature Overview and Menu Structure

Figure 2-3 shows all modes and secondary functions. A detailed description of the features can be found in Section 3.2.

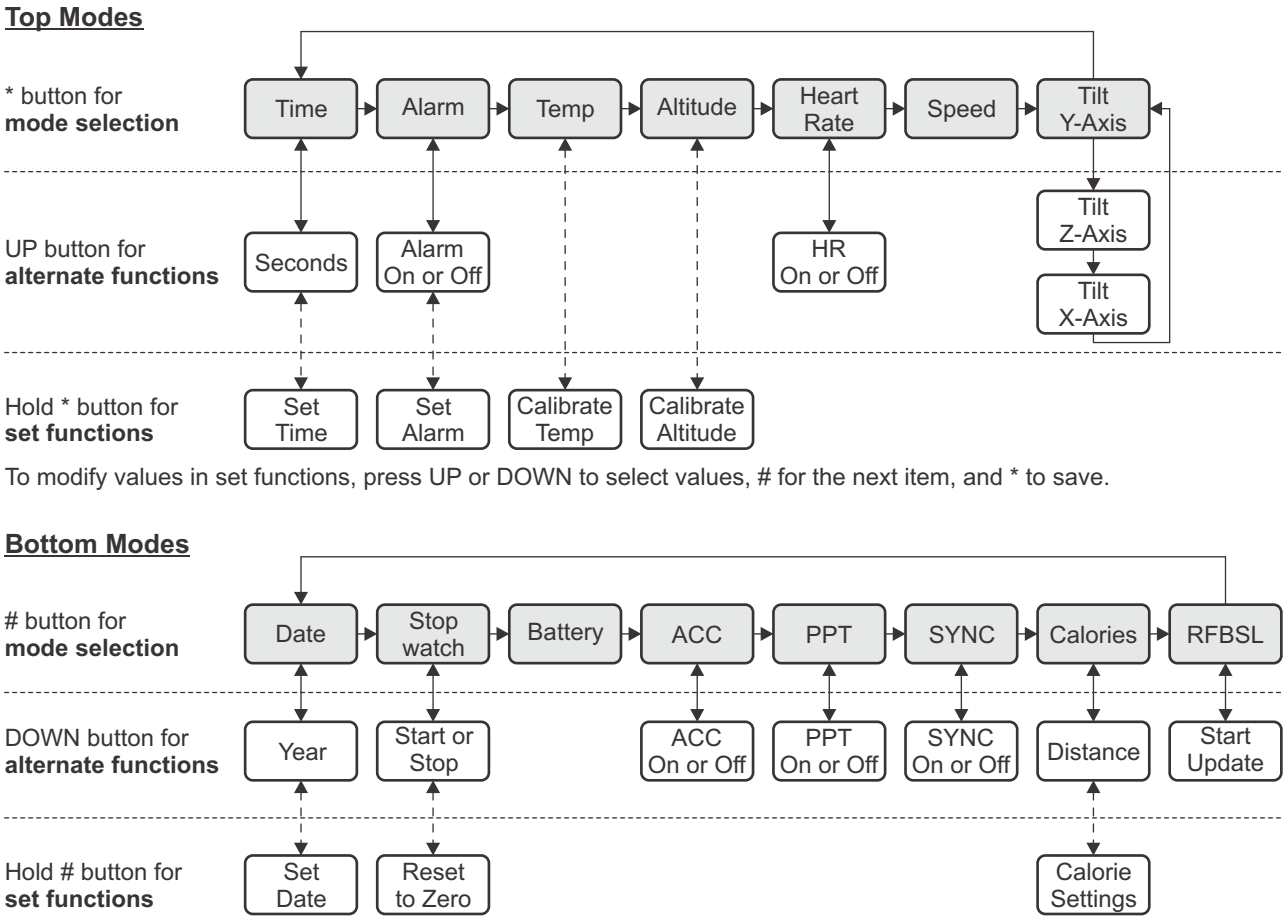


Figure 2-3. eZ430-Chronos Feature Overview and Menu Structure

Copyright © 2009–2015, Texas Instruments Incorporated

2.2 Install Demo Application, Drivers and Firmware

The eZ430-Chronos PC software supports Windows® and Linux® (Ubuntu 12.04) operating systems. Download the latest eZ430-Chronos Software and Source Code Installer for Windows (SLAC341) or for Linux (SLAC388) from the eZ430-Chronos web page at www.ti.com/chronos.

2.2.1 Windows® Installation

1. Unzip the archive and run Chronos-Setup.exe.
2. Respond to the prompts to install the software. During the installation a separate window opens for the Windows driver installation. Accept the driver installation.

NOTE: The eZ430-Chronos access point driver may not be certified by Microsoft. Therefore, Windows may generate a warning. Allow the driver installation to continue.

3. When installation finishes, connect the eZ430-Chronos RF USB access point to the PC and follow the Windows driver installation (see Section 2.3).
4. If prompted for the driver for the TI CC1111 Low-Power RF to USB CDC Serial Port (legacy software), or eZ430-ChronosAP (current software) allow Windows to 'Install the software automatically'. This can be done only if the eZ430-Chronos PC Software package has already been installed.
5. Open the eZ430-Chronos Control Center program. A shortcut is available on the Desktop and the Start Menu under Programs > Texas Instruments > eZ430-Chronos > eZ430-Chronos Control Center.

For a detailed driver installation, see Appendix B.

2.2.2 Linux® Installation

The eZ430-Chronos PC software for Linux requires TCL/Tk. If the Linux distribution does not already include TCL/Tk yet, install both with the apt-get command:

```
sudo apt-get install tcl8.5-dev
sudo apt-get install tk8.5-dev
```

To generate keyboard events and mouse clicks through the Chronos module buttons, xdotool is required. Install with the apt-get command:

```
sudo apt-get install xdotool
```

The PC now has the infrastructure for the eZ430-Chronos PC Software. Continue with the eZ430-Chronos installation:

1. Extract the archive and run Chronos-Setup.
2. Respond to the prompts to install the software.
3. Insert the eZ430-Chronos RF USB access point to the PC.
4. Check the /dev directory for new entry /dev/ttyACMx, where *x* specifies the number of the port.
5. Set the COM variable in eZ430-Chronos_CC_1_2.tcl and eZ430-Chronos_Datalogger_1_2.tcl if the USB RF access point is not mounted as /dev/ttyACM0
6. Set script files to executable:
   chmod u+x ./eZ430-Chronos_CC_1_2.tcl
   chmod u+x ./eZ430-Chronos_Datalogger_1_2.tcl
7. Launch the script (./eZ430-Chronos_CC_1_2.tcl) from terminal as root user.

NOTE: Linux is supported by the eZ430-Chronos Control Center and eZ430-Chronos Data Logger PC applications. The eZ430-Chronos software package also contains all source code for the Chronos module and access point, which are provided for Code Composer Studio IDE (Windows and Linux) and the IAR Embedded Workbench IDE (Windows only). CrossWorks from Rowley Associates supports Linux and MacOS in addition to Windows OS but requires manual project setup. MSPGCC may also be used.

Copyright © 2009–2015, Texas Instruments Incorporated

2.3 Using the eZ430-Chronos Wrist Module With a PC

1. The Control Center provides a variety of demos. A detailed description can be found in Section 3.3. The following sections describe only how to use the eZ430-Chronos module to control the mouse pointer on the PC and to use it to control PowerPoint® presentation software.

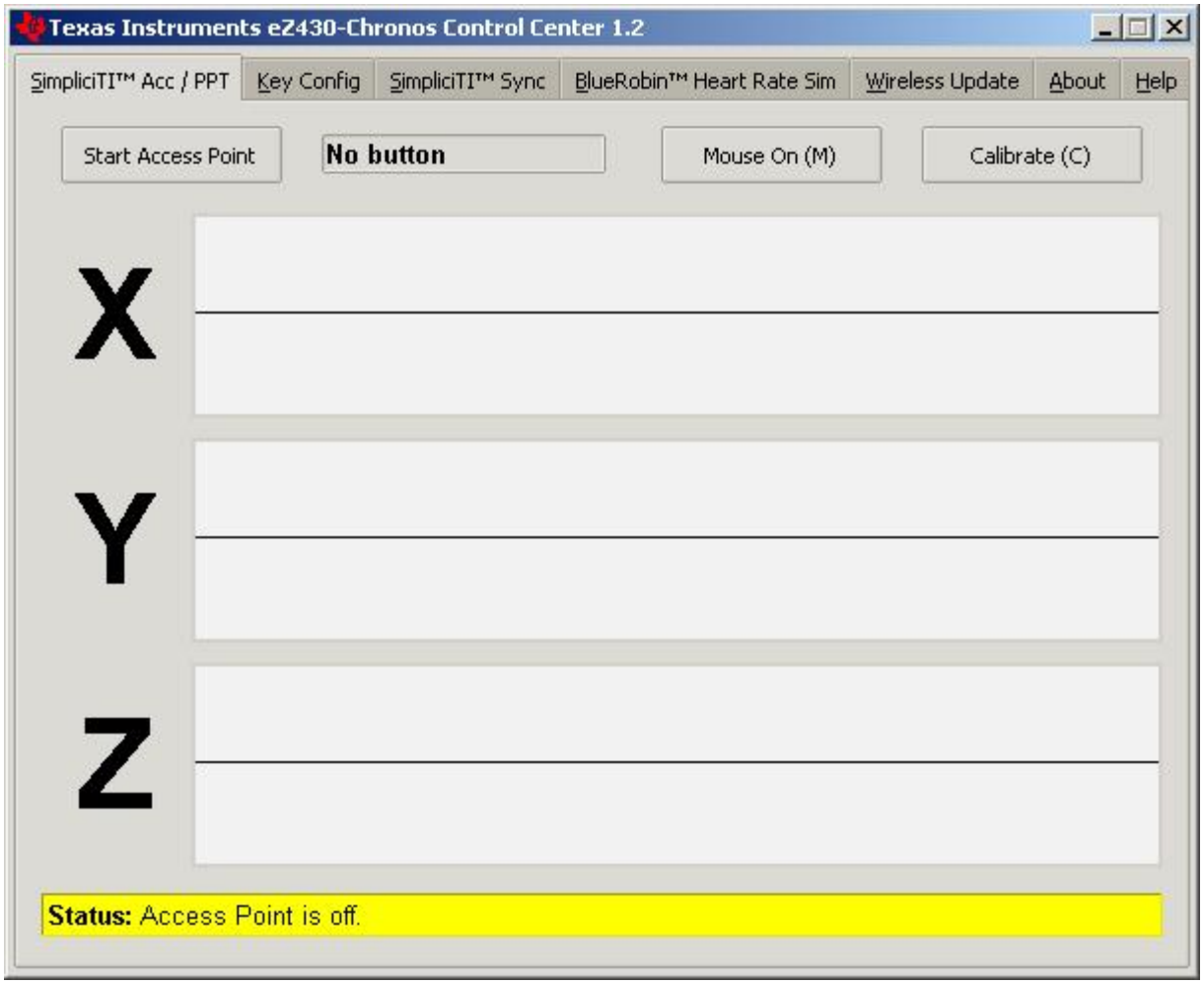


Figure 2-4. eZ430-Chronos Control Center

2.3.1 Transmission of Acceleration Data and Button Pushes

1. Select the SimpliciTI Acc/PPT tab.
2. Click Start Access Point to start PC. When the PC is ready, the control center status line displays "Access point started. Now start watch in ACC, PPT or synch mode".
3. Select the ACC mode in the bottom LCD line of the eZ430-Chronos module and active the data transmission by pressing the DOWN button. The Chronos module connects to the PC (this may take a few seconds) and starts transmitting 3-Axis acceleration values
4. After connection, the Control Center status bar reports "Receiving data from acceleration sensor" and the values according to the axis. The graphs display the acceleration data of the Chronos module for each axis.

Copyright © 2009–2015, Texas Instruments Incorporated

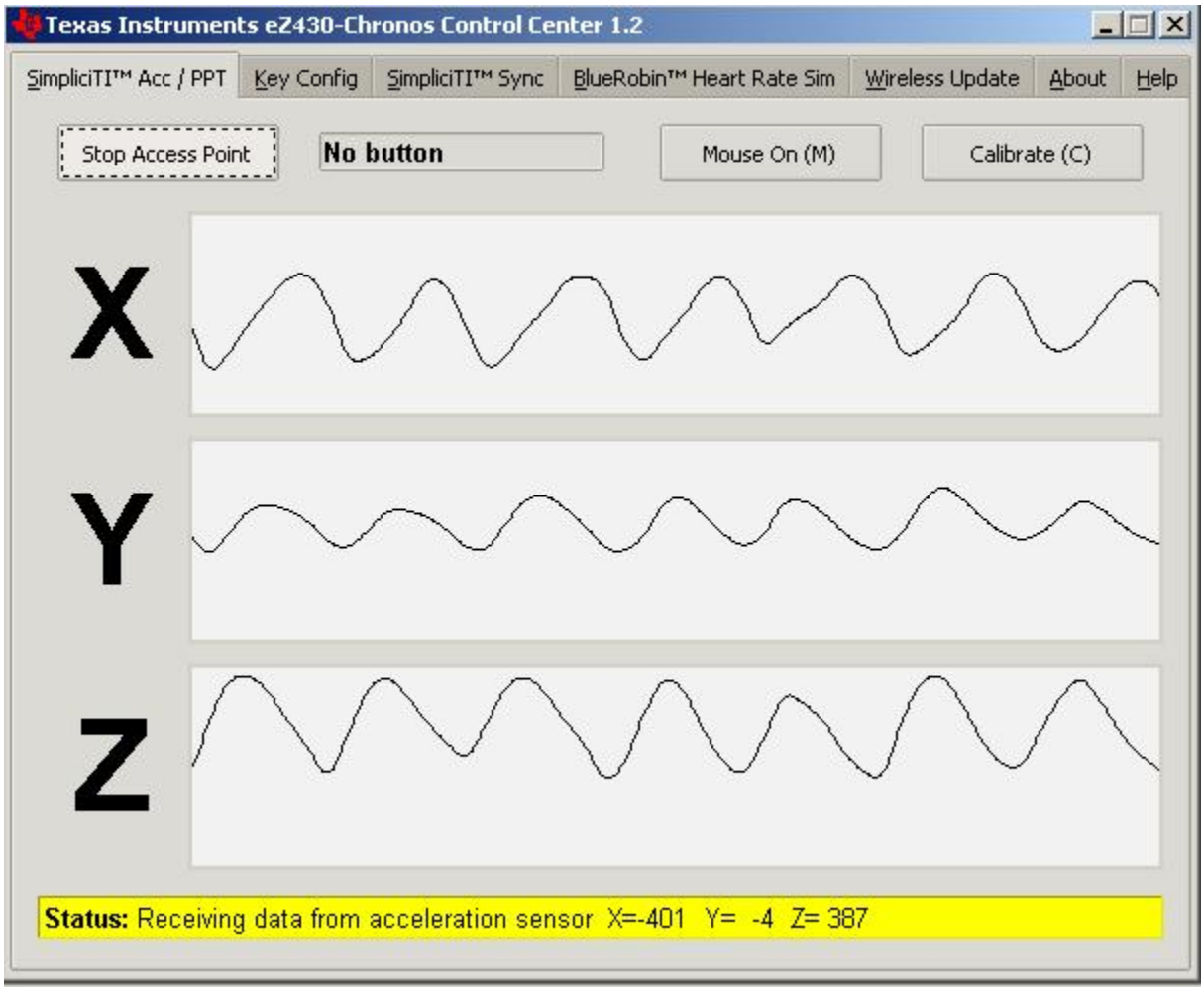


Figure 2-5. eZ430-Chronos Control Center With Acceleration Data

2.3.1.1 PC Mouse Control

1. Click Mouse On (M) to control the PC mouse pointer with the eZ430-Chronos module. Hold the Chronos module with its display facing up. The mouse pointer moves vertically (x-axis in Control Center) when tilting the Chronos module forward/backward and moves vertically (y-axis in Control Center) when tilting the Chronos module left/right. Mouse clicks are possible as well:
   - Left single click: * button
   - Left double click: # button
   - Right click: UP button
2. Mouse control can be calibrated to set a point of zero acceleration (that is, no pointer movement) by selecting Calibration (C). It may be disabled by clicking Mouse Off (M) or by typing M on the PC keyboard.

NOTE: Holding buttons (for example, for drag and drop) is not supported.

3. Turn the demo off by pushing the DOWN button on the eZ430-Chronos module and clicking Stop Access Point in the PC application

Copyright © 2009–2015, Texas Instruments Incorporated

2.3.1.2 PowerPoint Control

The Control Center allows the user to map button pushes on the wrist module into keystrokes on the PC. The default setting is PowerPoint control, which allows switching slides forward/backward and to start the slide show.

1. Select the SimpliciTI Acc/PPT tab.
2. Click Start Access Point to start linking. The control center status line displays "Access point started".
3. Select PPt mode in the bottom LCD line of the eZ430-Chronos module and activate the RF link by pressing the DOWN button. The wrist module connects to the PC, this may take a moment.
4. Once connected, the Control Center status bar show when a button is pushed.
5. Open a PowerPoint presentation. Press # to go to presentation mode (slide show - F5), UP to switch to next slide (right arrow key), and * (left arrow key) to switch to previous slide.

NOTE: To avoid bouncing of the Chronos buttons, a delay of 0.6 seconds between transmissions is implemented; that is, if a button is pressed twice in less than 0.6 seconds, it is translated into one keystroke only.

The eZ430-Chronos Control Center allows to the user to define other short cuts; for example, to control a music or video player. See Section 3.3.2 for details.

For troubleshooting tips, see Appendix A, Frequently Asked Questions.

Copyright © 2009–2015, Texas Instruments Incorporated

Copyright © 2009–2015, Texas Instruments Incorporated

eZ430-Chronos Software

3.1 Overview

This chapter describes the software that is included in the eZ430-Chronos kit. Different projects and PC user interfaces are available:

- eZ430-Chronos module demo software
- Control Center PC software for Windows and Linux
- eZ430-Chronos module data logger
- Data logger PC software for Windows and Linux

Many features of the eZ430-Chronos kit are based on TI's SimpliciTI protocol stack. However, the Chronos module can also be used as a heart-rate monitor. For this purpose, the BlueRobin™ ultralow-power protocol stack can be used. (1) is implemented on the wrist module and USB access point. The protocol stacks are selected automatically, depending on which feature is used.

3.2 eZ430-Chronos Demo Software

The sports firmware (default) of the Chronos module provides a broad set of features. In addition to basic Chronos module functions such as time, date, alarm, and stopwatch, other advanced features such as an altimeter, heart-rate monitor, calorie, vertical speed, and distance information (2) are available. The internal accelerometer provides acceleration data on the wrist module LCD and allows control of a PC by transferring the sensor's measurements. The Chronos module can also be used to control PowerPoint or other PC software with its buttons.

User concept:

The different features are either available in the top or bottom LCD line.

There are three user modes available: Modes such as Time or Date, Secondary Functions that allow activation and deactivation of features (for example, to start or stop the stopwatch or to enable or disable the alarm), and Set Functions that allow changing settings (for example, setting the time or date or resetting the stopwatch) (see Figure 3-1).

- **Modes:** The different modes can be selected by using the button left of the corresponding LCD line.

  Examples:

  The * button allows selecting the top line mode

  The # button allows changing the bottom line modes
- **Secondary Functions:** Secondary functions provide an extension to the selected mode and are available through the button to the right of the corresponding LCD line.

  Examples:

  Toggling between time (HH:MM) and seconds (.SS) in time mode: push UP button to toggle between modes.

  Start or Stop in stopwatch mode: push DOWN to start or stop stopwatch
- **Set Functions:** Time, date, and other options can be set by holding the button to the left of the corresponding LCD line.

  Examples:

  To set the time (shown in top LCD line): hold the * button to enter the time set menu.

(1) BlueRobin is available from BM wireless at www.bmwireless.com.

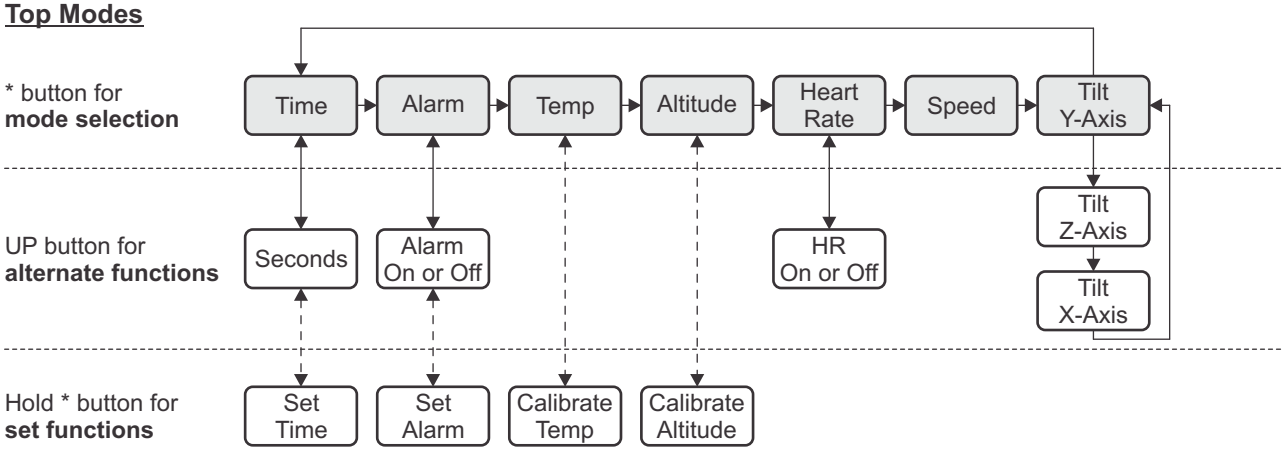
(2) For heart-rate monitor, calorie, vertical speed, and distance information, additional accessories or the eZ430-Chronos Control Center heart rate simulation required.

Copyright © 2009–2015, Texas Instruments Incorporated

To reset the stopwatch (shown in bottom LCD line): hold the # button to reset.

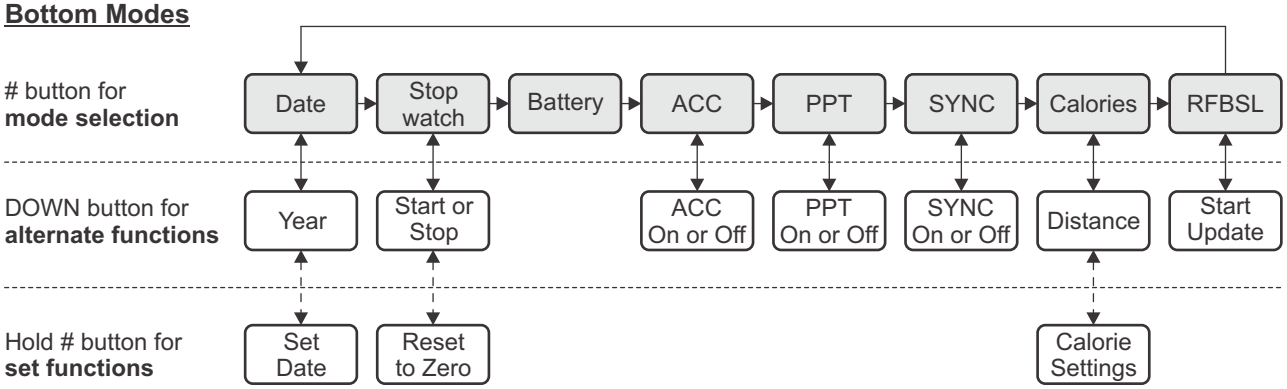
An exception to the above modes is the Keylock. It allows locking the buttons to avoid accidental change or activation of modes (for example, when the Chronos module is carried in a suitcase or bag). The keylock may be enabled or disabled by holding # and DOWN simultaneously for three seconds. The LCD shows "Loct" when the keylock is active and "oPEn" when it is inactive.

Top Modes



To modify values in set functions, press UP or DOWN to select values, # for the next item, and * to save.

Bottom Modes



To modify values in set functions, press UP or DOWN to select values, # for the next item, and * to save.

Note: Heart rate can be generated by eZ430-Chronos Control Center. Optional heart-rate monitor is available from BM innovations at www.bm-innovations.com/chronos.

Figure 3-1. eZ430-Chronos Feature Overview and Menu Structure

Copyright © 2009–2015, Texas Instruments Incorporated

3.2.1 Detailed Feature Overview - Modes Using the Top LCD Line

3.2.1.1 Time Mode

Press * until the time mode is active (see Figure 3-1 for details).

Secondary function: Seconds. Press UP to activate the alternative display. To return to the HH:MM mode, push the UP button again.

Set function: Setting the time.

1. Hold * for three seconds until the time disappears and 12H or 24H is shown on the LCD.
2. Select 12H or 24H mode by pushing the UP or DOWN buttons.
3. Press # to continue with the time adjustment.
4. Set the hours by pushing the UP or DOWN button.
5. Press # to continue with the minutes adjustment.
6. Set the minutes by pushing the UP or DOWN button.
7. Press # to continue with the second adjustment.
8. Set the seconds by pushing the UP or DOWN button.
9. Press * to confirm the settings and go back to normal operation, or press # to start over with step 2.

NOTE: If no button is pressed for more than 30 seconds, the previous settings are restored.

3.2.1.2 Alarm Mode

Press * until the alarm mode is active (see Figure 3-1 for details). The alarm mode can be distinguished from time mode by an alarm symbol (bell) that flashes when the alarm time is displayed.

Secondary function: Alarm on or off. Press UP to enable or disable the alarm. The settings are confirmed by "on" and "off" in the top LCD line. The bell icon stays on in all other modes when the alarm is enabled and does not appear when the alarm is disabled.

Set function: Setting the alarm time.

1. Hold * for three seconds until the alarm time hour starts to flash.
2. Set the hours by pushing the UP or DOWN button.
3. Press # to continue with the minutes adjustment.
4. Set the minutes by pushing the UP or DOWN button.
5. Press * to confirm the settings and go back to normal operation, or press # to start over with step 2.

NOTE: If no button is pressed for more than 30 seconds, the previous settings are restored.

Copyright © 2009–2015, Texas Instruments Incorporated

3.2.1.3 Temperature Mode

Press * until the temperature mode is active (see Figure 3-1 for details). The temperature can be shown in degree Celsius or Fahrenheit. The selection depends on the time mode setting. In 12H mode, the temperature is shown in degrees Fahrenheit, in 24H mode in degrees Celsius. The temperature is measured in 1-second intervals. Positive temperatures are marked with a small arrow pointing up in the upper LCD line, left of the temperature. An arrow pointing down indicated temperatures below zero.

Secondary function: None

Set function: Temperature calibration (can also calibrated from PC software in Sync mode, see Section 3.3).

1. Hold * for three seconds until the temperature starts to flash.
2. Set the temperatures by pushing the UP or DOWN button.
3. Press * to confirm the settings.

NOTE: The temperature is measured inside the wrist module by the CC430 device. When the wrist module is worn, its temperature may be different from the surrounding temperature due to body heat. For accurate temperature measurements, do not wear the wrist module and allow a sufficient amount of time for the wrist module to adapt to the surrounding temperature.

3.2.1.4 Altimeter Mode

Press * until the altimeter alarm mode is active (see Figure 3-1 for details). The altitude can be shown in metric or imperial units. In 12H time mode, the altitude is shown in imperial units. In 24H time mode, the altitude is shown in metric units. The altitude is measured only when the altimeter mode is active, and measurement are made in intervals of 1 second.

The implementation of the altitude algorithm is done according to the VTI's application report AN33 without any additional low-power optimizations. Therefore, the altimeter is active only in altimeter mode. In addition, a timeout deactivates the measurements after 60 minutes. Altitudes above sea level are indicated with a small arrow pointing up in the upper LCD line, left of the altitude. Altitudes below sea level are indicated with a small arrow pointing down.

The altimeter algorithm is based on the air pressure and the ambient temperature. Therefore, changes in air pressure affect the altitude accuracy. For precise measurements, the altimeter must be calibrated manually for weather changes.

NOTE: For most accurate altitude measurement, the wrist module must be fully exposed to the ambient temperature (that is, the wrist module should not be worn directly on the arm), because temperature is part of the altitude measurement (see Section 3.2.1.3).

Secondary function: Re-activate altimeter after timeout

Set function: Altitude calibration

1. Hold * for three seconds until the altitude starts to flash.
2. Set the altitude by pushing the UP or DOWN button.
3. Press * to confirm the settings.

Copyright © 2009–2015, Texas Instruments Incorporated

3.2.1.5 Heart Rate Mode - RF [3]

Press * until the heart icon appears on the display that is heart rate mode is active (see Figure 3-1 for details). When this mode is active, heart rate is shown and burned calories are determined (additional settings must be made for first time use, see Section 3.2.2.7). For information on how to use the chest belt, see to the documentation included with the heart-rate monitor device.

NOTE: This mode requires a heart-rate monitor (chest belt) that is not included in this kit, but available from BM innovations, Germany (see www.bm-innovations.com/chronos). However, a heart rate can be simulated without a chest belt by the eZ430-Chronos Control Center, see Section 3.3 for details.

While almost all other eZ430-Chronos functions are based on TI's SimpliciTI protocol, the heart-rate monitoring uses BlueRobin, an ultralow-power low-data-rate wireless communication protocol from BM innovations.

Secondary function: Heart rate display on/off. Press UP to enable or disable the heart-rate monitoring. Once a connection is established, the heart rate is shown on the top LCD line

Set function: None

3.2.1.6 Speed Mode - RF [4]

Press * until the "mi/h" or "km/h" icon is shown on the display; that is, the speed mode is active (see Figure 3-1). Your running speed is shown on the LCD top line.

NOTE: This mode requires a heart-rate monitor (chest belt) which includes an accelerometer to determine running speed. Visit BM innovations at www.bm-innovations.com/chronos for available additions. However, speed can be simulated without a chest belt by the eZ430-Chronos Control Center, see Section 3.3.4 for details.

While almost all other eZ430-Chronos functions are based on TI's SimpliciTI protocol, the speed mode uses BlueRobin, an ultralow-power low-data-rate wireless communication protocol from BM innovations.

Secondary function: None

Set function: None

3.2.1.7 Tilt Mode

Press * until the tilt mode is active (see Figure 3-1). The acceleration is shown in G (9.81 m/s^2) for all three axes. After entering the tilt mode, the y-axis acceleration is shown by default, and the z-axis or x-axis can be selected. Positive acceleration values are marked with a small arrow pointing up in the top LCD line, left of the acceleration. Negative acceleration values are marked with a small arrow pointing down. After 60 minutes, a timeout deactivates the measurements.

Secondary function: Select axis. The default is y-axis, followed by z-axis and x-axis.

Set function: None

[3] Additional accessory or eZ430-Chronos Control Center heart rate simulation required.
[4] Additional accessory or eZ430-Chronos Control Center heart rate simulation required.

Copyright © 2009–2015, Texas Instruments Incorporated

3.2.2 Detailed Feature Overview - Modes Using the Bottom LCD Line

3.2.2.1 Date Mode

Press # until the date mode is active (see Figure 3-1).

Secondary function: Year. Press DOWN to activate the alternative display. To return to day and month, push the DOWN button again.

Set function: Setting the date

1. Push the # button until the date is displayed in the bottom LCD line.
2. Hold # for three seconds until the year flashes on the bottom LCD line.
3. Set the year by pushing the UP or DOWN button.
4. Press # to continue with the month adjustment.
5. Set the month by pushing the UP or DOWN button.
6. Press # to continue with the day adjustment.
7. Set the day by pushing the UP or DOWN button. Press * to confirm the settings and go back to normal operation, or press # to start over with step 3.

NOTE: If no key is pressed for more than 30 seconds, the previous settings are restored.

3.2.2.2 Stopwatch Mode

Press # until the stopwatch mode is active (see Figure 3-1). It supports up time intervals up to 19 hours, 59 minutes and 59 seconds. For the first 20 minutes, the resolution is 1/100 second, after 20 minutes the resolution changes to 1 second.

Secondary function: Start and stop. Press DOWN to start or stop the stopwatch

Set function: Reset stopwatch.

Hold the # button until the stopwatch is set to zero.

3.2.2.3 Battery Voltage Mode

Press # until the battery voltage is shown (see Figure 3-1). It is updated once per minute.

Secondary function: None

Set function: None

3.2.2.4 Acceleration Mode - RF

This mode requires the eZ430-Chronos Control Center PC software.

Press # until "ACC" is shown on the LCD (see Figure 3-1). This mode provide a continuous transmission of 3D acceleration from the Chronos module using TI's SimpliciTI protocol stack. In addition, the Chronos module transmits a signal when the #, *, or UP buttons are pushed.

Secondary function: Start or stop transmission of acceleration data. Pushing DOWN starts/stops the pairing process or stop the transmission (the access point on the PC must be started first from the eZ430-Chronos Control Center (see Section 3.3.1). The RF icon on the LCD flashes when the radio is active. If the pairing fails, it disappears. The top LCD line shows the time during the pairing and until the data transmission is disabled.

Set function: None

Copyright © 2009–2015, Texas Instruments Incorporated

3.2.2.5 PowerPoint Mode - RF

This mode requires the eZ430-Chronos Control Center PC software.

Press # until PPt is shown (see Figure 3-1). This mode allows control of a PowerPoint presentation by translating button pushes on the Chronos module into keystrokes of the PC keyboard. No acceleration or other data is transmitted. The default settings are:

- # : Go to presentation mode (F5)
- * : Previous slide (Left)
- UP : Next slide (Right)

The Control Center allows user defined key settings (including combinations) (see Section 3.3.2).

Secondary function: Start or stop transmission of button pushes. Pushing DOWN starts/stops the pairing process or stops the transmission (the access point on the PC must be started from the eZ430-Chronos Control Center (see Section 3.3.1). The RF icon on the LCD flashes when the radio is active; if pairing fails, the icon disappears. The top LCD line shows the time during the pairing until the data transmission is disabled.

Set function: None

3.2.2.6 Sync Mode - RF

This mode requires the eZ430-Chronos Control Center PC software.

Press # until "SYnC" is shown (see Figure 3-1). This mode allows doing a variety of settings for the wrist module conveniently from the eZ430-Chronos Control Center PC software over the air (see Section 3.3.3).

- Time settings
- Date settings
- Altitude calibration
- Temperature calibration

Secondary function: Start or stop link for Sync Mode. Pushing DOWN starts/stops the pairing process or stop the link (the access point on the PC must be started first from the eZ430-Chronos Control Center (see Section 3.3.3). The RF icon on the LCD flashes when the radio is active. If the pairing fails, it disappears. After a successfully received message, the LCD shows "DONE". The top LCD line is off during the pairing and until the Sync Mode is disabled.

Set function: None

Copyright © 2009–2015, Texas Instruments Incorporated

3.2.2.7 Calorie/Distance Mode - RF [5]

Press # until the "kcal" icon appears (see Figure 3-1). This mode shows the amount of calories that were burned while exercising, if the optional chest belt is used and heart rate mode is active. This mode also provides the distance (for example, when running) if a chest belt with build-in accelerometer is used. For accurate calorie determination, users need to set their sex and weight.

Secondary function: Distance. Press DOWN to activate the alternative display. To return to Calorie Mode, push the DOWN button again.

Set function: (Re-)setting calories and setting user weight and sex.

1. Push the # button until the calories is displayed in the bottom LCD line
2. Hold # for three seconds until the calorie value flashes on the bottom LCD line
3. (Re-)set the calories by pushing UP or DOWN
4. Press # to continue with the user sex adjustment
5. Set the user sex by pushing UP or DOWN
6. Press # to continue with user weight adjustment
7. Set the user weight (lb in 12H time mode, kg in 24H time mode) by pushing UP or DOWN
8. Press * to confirm the settings and go back to normal operation, or press # to start over with step 3

NOTE: If no key is pressed for more than 30 seconds, the previous settings are restored.

3.2.2.8 Wireless Update - RF

This mode requires the eZ430-Chronos Control Center PC software.

Press # until the "rFbSL" is shown (see Figure 3-1). This mode allows updating the firmware of the eZ430-Chronos module wirelessly.

Secondary function: Start or restart the update process. Push DOWN once to switch to the confirmation menu "CONF". Pushing DOWN again starts or restarts the update process (the wireless update on the PC must be started from the eZ430-Chronos Control Center first (see Section 3.3.1)). At the beginning of the update the LCD shows "rAM" for a few seconds. During this time, the update software is downloaded from the PC to the RAM of the CC430 on the Chronos module. This program contains all memory write and LCD routines. After this transfer is finished, the code is executed from RAM, and the download of the actual firmware file is started. The LCD shows the progress in percent on the upper LCD line. After the transfer is complete, a reset starts the software on the Chronos module. See Section 3.6.3 for details.

NOTE: When the wireless update is activated on the Chronos module, it returns to the main application only with a reset, whether or not an update was performed. Time, data, alarm, and other RAM-based data are lost.

[5] Additional accessory or eZ430-Chronos Control Center heart rate simulation required.

Copyright © 2009–2015, Texas Instruments Incorporated

3.3 eZ430-Chronos Control Center PC Software

The eZ430-Chronos Control Center software provides several features demonstrating the wireless capabilities of the kit on Windows and Linux operating systems. Different RF protocol stacks are automatically selected for use, depending on the function. Available features:

- 3D acceleration graph with PC mouse control
- Wireless remote control / PowerPoint control
- Time, date, and calibration data synchronization tool
- Heart rate and speed simulator
- Wireless firmware update

NOTE: Connect the USB RF access point to the PC before launching the Control Center software. For first time use, wait until Windows has finished the access point driver installation.

In case of problems on Windows PCs, check if the settings for the RF access point are correct in the Windows Device Manager Start > Control Panel > System > Hardware > Device Manager. The RF access point is listed under *Ports (COM & LPT)* as TI CC1111 Low-Power RF to USB CDC Serial Port (Chronos BLACK) or eZ430-ChronosAP (Chronos WHITE). The port settings should be:

- Baud Rate: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

In case of problems on Linux PCs, ensure that the correct tty setting is specified. Check /dev for the new tty device after plugging in the RF access point. If the RF access point is assigned to a device other than ttyACM0, either remove the serial device that occupies this slot (for example, a modem), or change the script file variable "com" in eZ430-Chronos_CC_1_2.tcl located in /home/<user name>/Texas Instruments/eZ430-Chronos/Control Center/eZ430-Chronos Control Center.

To launch the Control Center software on a Windows PC, shortcuts are available on the Desktop and in the Start Menu under Programs > Texas Instruments > eZ430-Chronos > eZ430-Chronos Control Center.

To launch the Control Center software on a Linux PC, browse to /home/<user name>/Texas Instruments/eZ430-Chronos/Control Center/eZ430-Chronos Control Center and run eZ430-Chronos_CC_1_2.tcl as root user.

The different features are grouped onto tabs of the Control Center window. The tabs also indicate which radio protocol is used.

Copyright © 2009–2015, Texas Instruments Incorporated

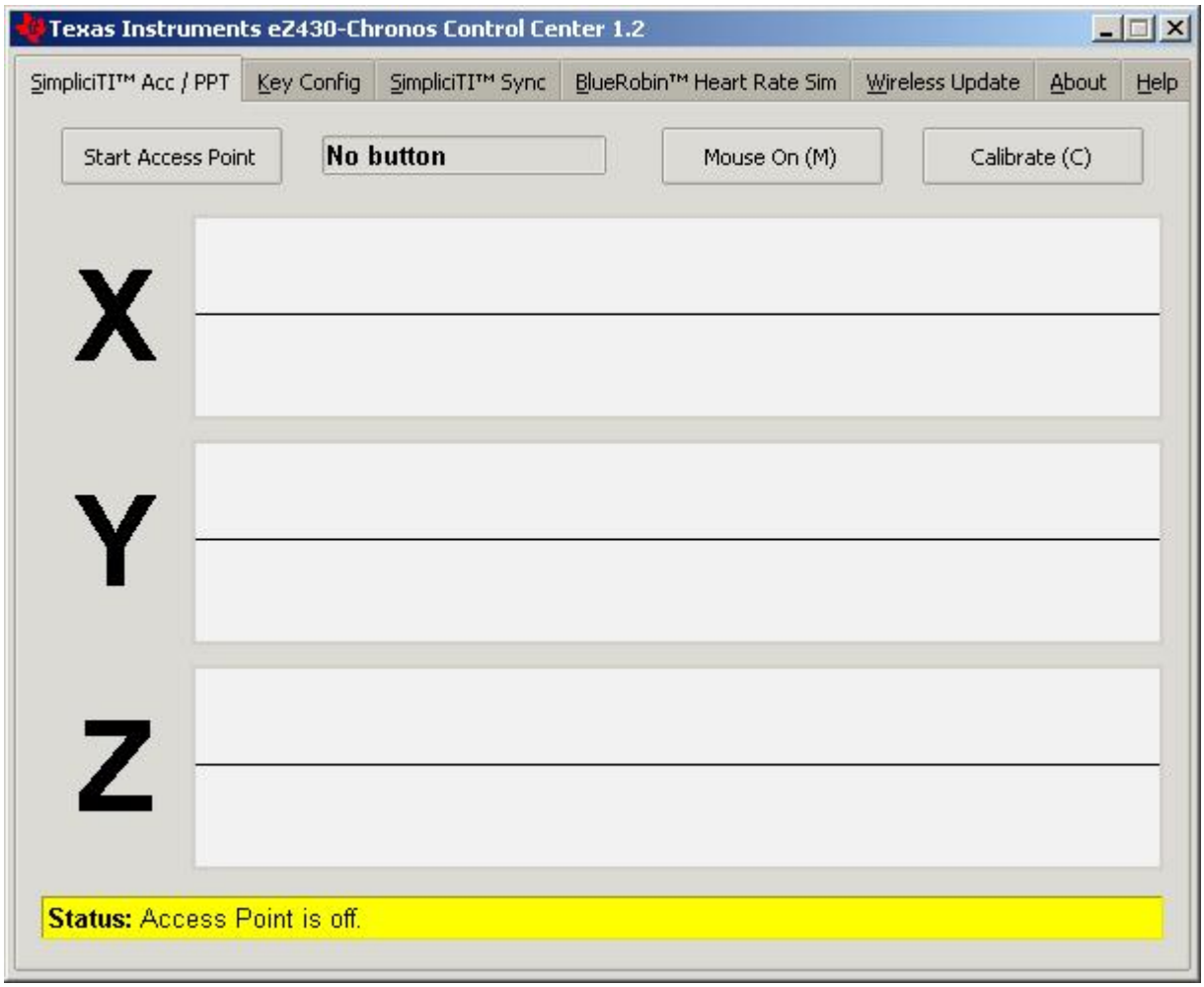


Figure 3-2. eZ430-Chronos Control Center

3.3.1 SimpliciTI™ Acc/PPT Tab (Mouse and PowerPoint Control)

The SimpliciTI Acc / PPT tab support two different features. It may be used to display the acceleration data transmitted by the Chronos module, which can also be used to control the mouse pointer. It may also be used to remotely control the PC with user-definable shortcuts such as PowerPoint control.

Pairing Chronos module and PC:

1. Activate the pairing on the PC by clicking Start Access Point. The control center status line displays "Access point started. Now start watch in acc, ppt or sync mode" when the PC is ready
2. Select "ACC" or "PPt" on the eZ430-Chronos module by pushing the # button, depending on the desired function - see detailed description in Section 3.3.1.1 or in Section 3.2.2.4.
3. Initiate pairing on the Chronos module by pushing the DOWN button to activate the selected mode

   After a short time, the link is established.

   In "ACC" mode, the Control Center status bar shows:
   "Receiving data from acceleration sensor X=... Y=... Z=...".

   In PPt mode, the Control Center status bar reports which button is pushed (#, *, or UP).

Copyright © 2009–2015, Texas Instruments Incorporated

3.3.1.1 Acc Mode

In this mode, the Chronos module constantly transmits acceleration data to the PC. In addition, #, *, and UP button pushes are transferred. The Control Center software shows the 3D acceleration in graphs. Optionally, mouse control can be activated by clicking on Mouse On (M) or by typing M on the keyboard.

Once active, the PC mouse pointer can be controlled by tilting the Chronos module. Hold the Chronos module with its display facing up. The mouse pointer moves vertically (X-axis in Control Center) when tilting the wrist module forward or backward and move vertically (Y-axis in Control Center) when tilting it left or right. Mouse clicks are also possible–see the following description. Mouse control can be calibrated (to set a point of zero acceleration or no pointer movement) by selecting Calibration (C). It may be disabled by clicking Mouse Off (M) or by typing M on the PC keyboard.

- Left single click: * button
- Left double click: # button
- Right click: UP button

NOTE: Holding buttons (for example, to drag and drop) is not supported.

Turn the demo off by pushing the DOWN button on the eZ430-Chronos module and clicking "Stop Access Point" in the PC application.

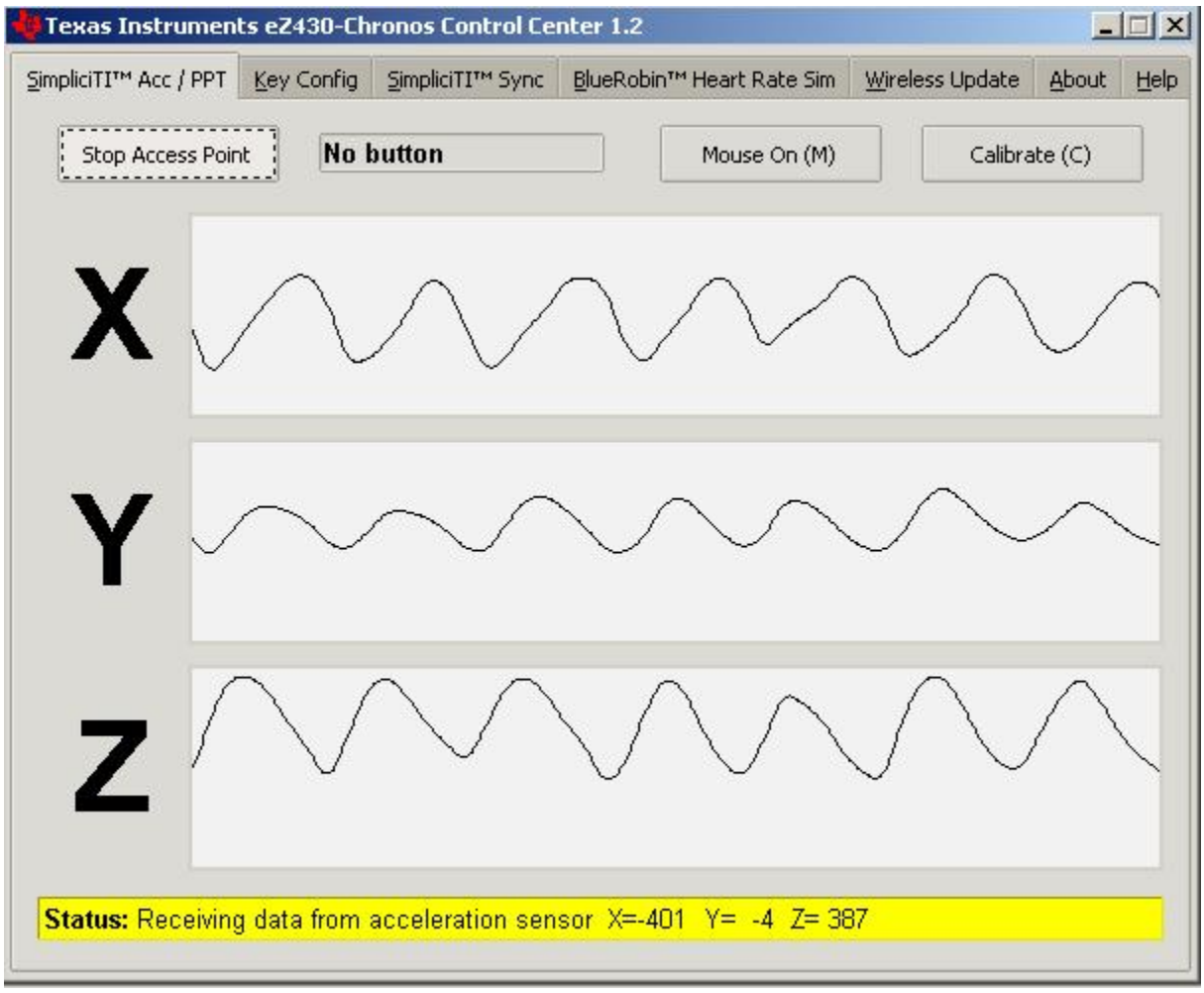


Figure 3-3. eZ430-Chronos Control Center With Acceleration Data

Copyright © 2009–2015, Texas Instruments Incorporated

3.3.1.2 PPT Mode

This mode allows using the eZ430-Chronos module as a simple PC remote control. Data is transmitted only when either the #, *, or UP button is pushed. This information is mapped into keystrokes on the PC. The default setting is PowerPoint control, and the buttons are mapped to:

- # to go to presentation mode (slide show - F5)
- UP to switch to next slide (right arrow key)
- * (left arrow key) to switch to previous slide

These settings can be changed to many other combinations; for example, such as controlling music players or standard Windows functions (see Section 3.3.2 for details).

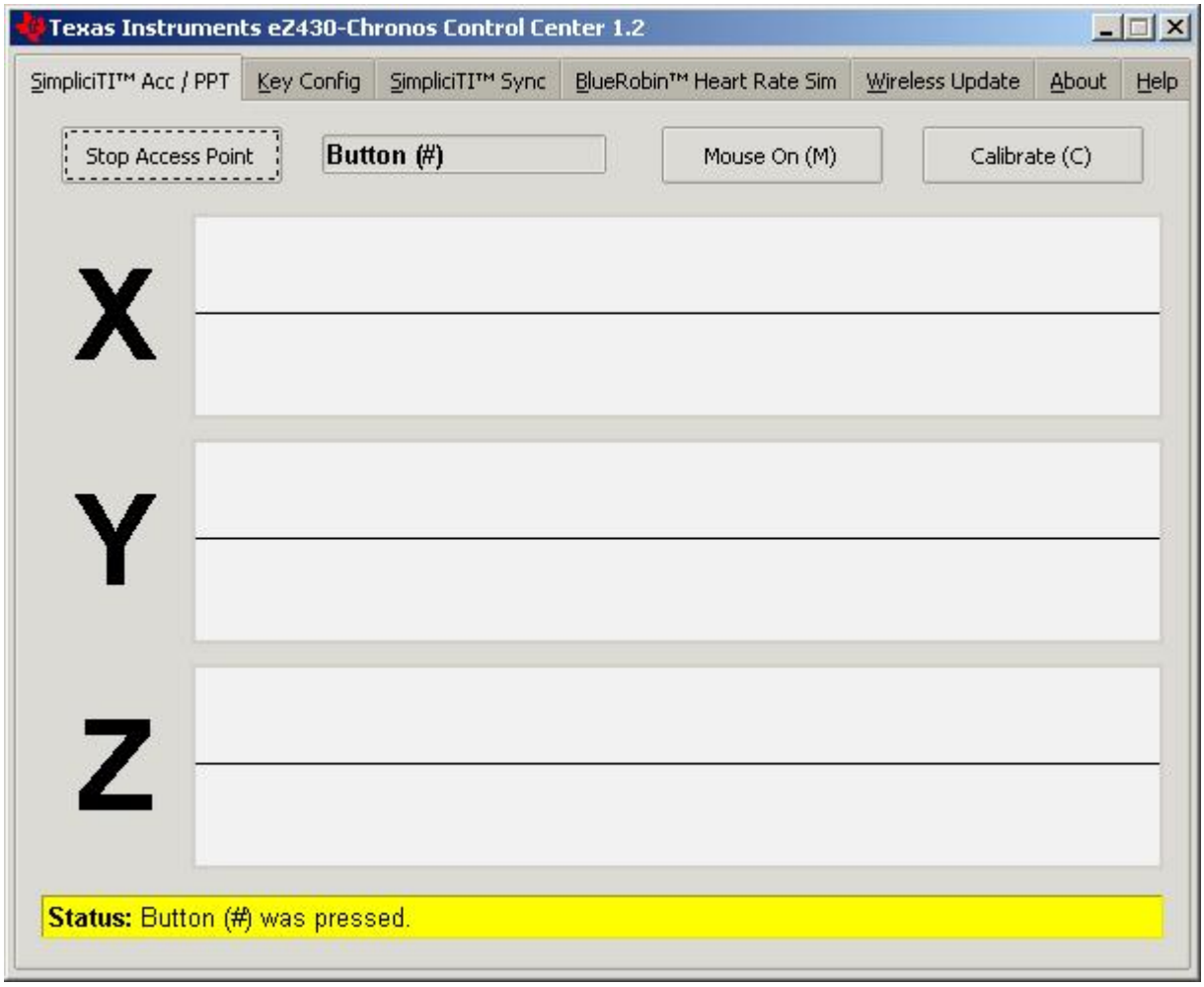


Figure 3-4. eZ430-Chronos Control Center With PPT Control

Copyright © 2009–2015, Texas Instruments Incorporated

3.3.2 Key Configuration Tab

This tab contains the key mapping for the eZ430-Chronos module buttons #, * and UP. Besides a single key selection (pulldown menu for each button), also full combinations including the Shift, Ctrl, Alt, and Windows keys can be user defined by selecting the corresponding option. Changes can be made while the PPT mode is active. Configurations can be saved by clicking the Save button.

Predefined configurations are available in a pull down menu on top of the menu. Select configuration from menu and click Load to activate them.

Predefined key configurations:

- PowerPoint Control (eZ430-Chronos-CC.ini)
  * = previous slide
  UP = next slide
  # = start presentation (F5)
- Windows Media Player (Media Player Control.ini)
  * = previous song
  UP = next song
  # = start/pause
- iTunes (iTunes Control.ini)
  * = previous song
  UP = next song
  # = start/pause

The key mapping may be changes while PPT mode is active.

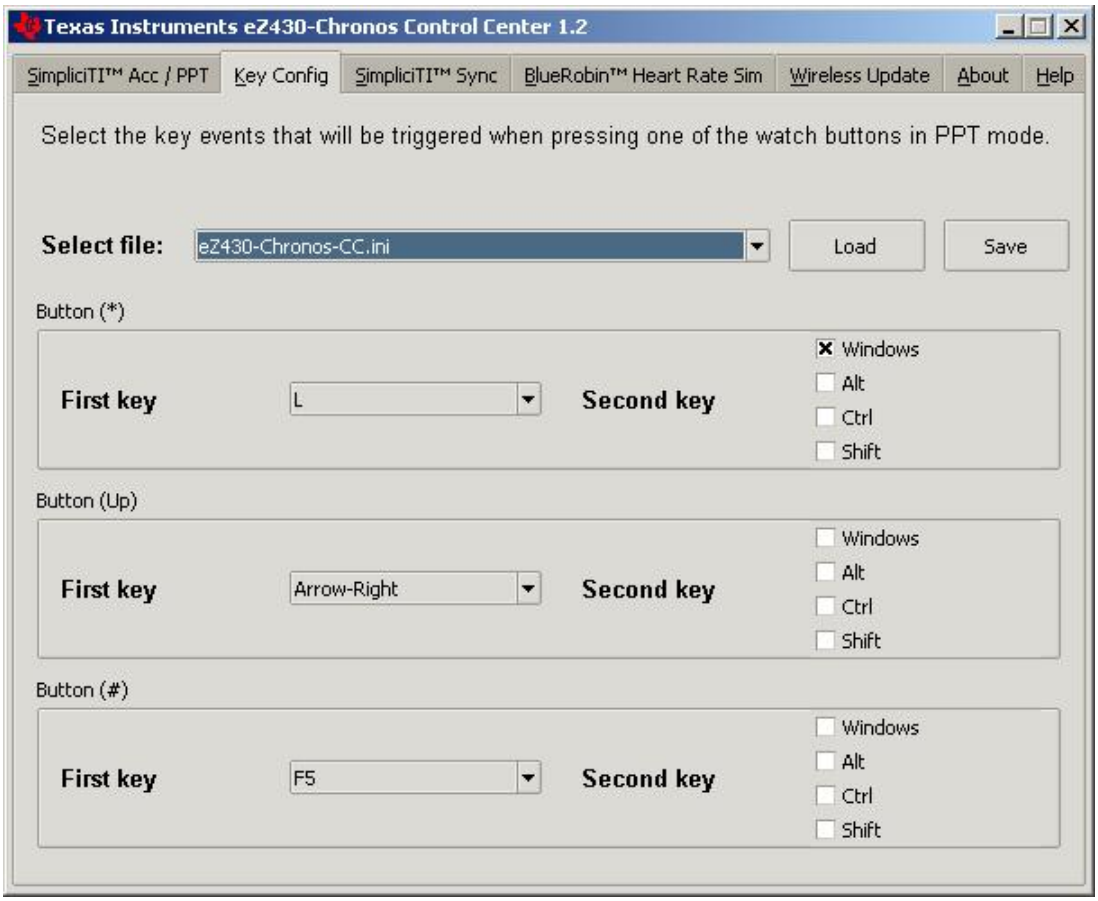


Figure 3-5. eZ430-Chronos Control Center Key Configuration

Copyright © 2009–2015, Texas Instruments Incorporated

3.3.3 SimpliciTI™ Sync

The SimpliciTI Sync tab offers the possibility setting time/date of the Chronos module including calibration data conveniently.

Pairing Chronos module and PC:

1. Activate the pairing on the PC by clicking Start Access Point. The Control Center status line displays "Access point started. Now start watch in ACC, PPT or synch mode" when the PC is ready
2. Select "SYnC" on the eZ430-Chronos module by pushing the # button.
3. Initiate pairing on the Chronos module by pushing the DOWN button to activate the selected mode. After a short time, the link is established.

Setting the Chronos module:

1. Select metric or imperial units
2. Enter calibration data for the temperature and altitude OR read back the data from the Chronos module by clicking Read Watch.
3. Click Copy System Time to set the Chronos module according to read the PC system time.
4. Click Set Watch to transfer data to the Chronos module.
5. The Chronos module shows DONE.
6. Push the DOWN button on the Chronos module to end connection.

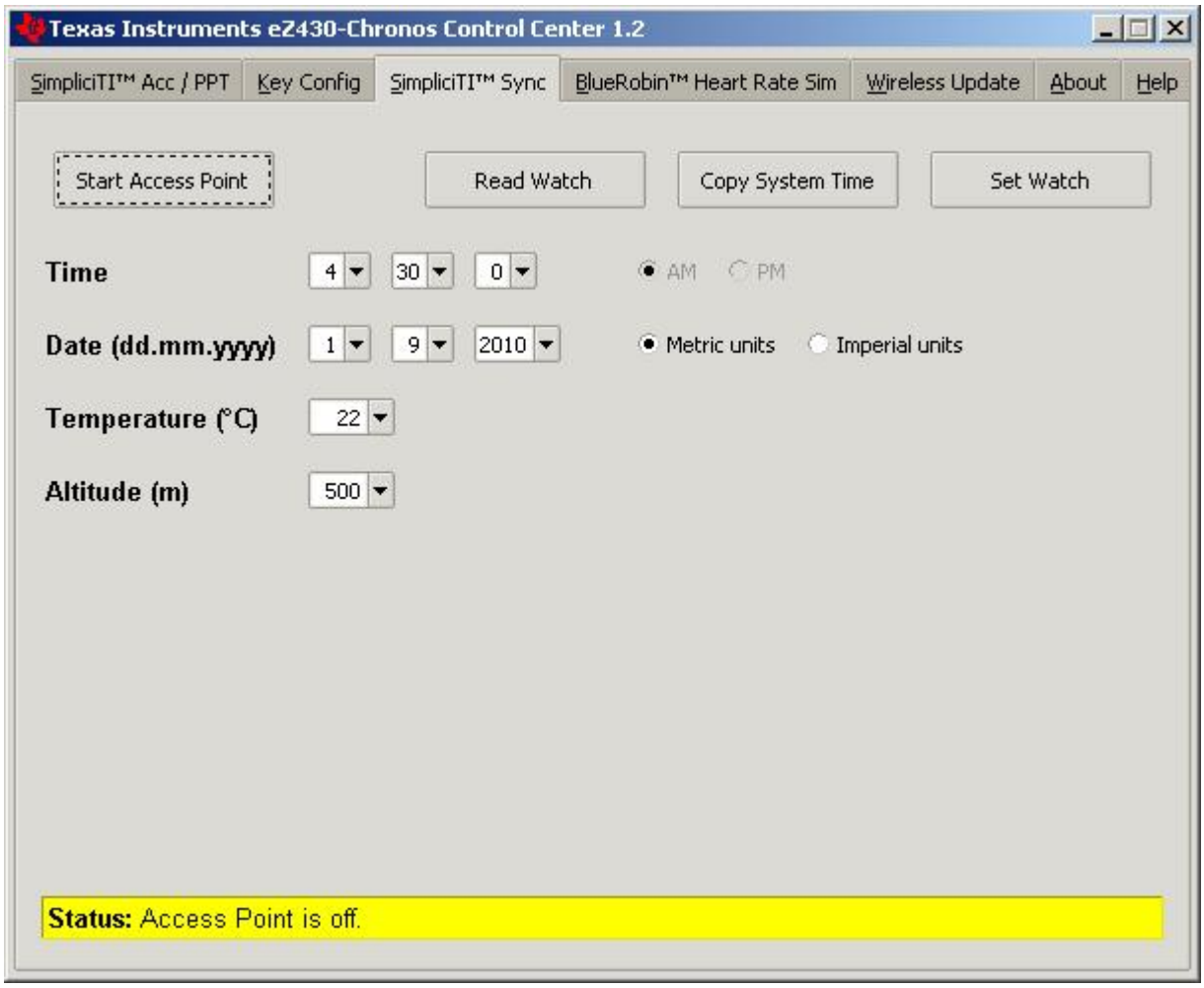


Figure 3-6. eZ430-Chronos Control Center Sync

Copyright © 2009–2015, Texas Instruments Incorporated

3.3.4 BlueRobin™ Heart Rate Simulator

This mode simulates an active heart rate chest belt. Besides the heart rate it may also be used to transfer speed and distance data from the PC to the eZ430-Chronos wrist module.

Pairing Chronos module and PC:

1. Activate link on the PC by clicking Start Transmitter. The Control Center status line displays "Transmitting heart rate (...bpm), speed (...km/h) and distance (...m)" when the PC is transmitting data. The heart rate may be changed by the heart rate and speed sliders or by selecting "sweep" for automatic heart rate and speed sweeping
2. Select heart rate mode (heart symbol is shown) by pushing the * button (see detailed description in Section 3.2.1.5).
3. Start receiver on wrist module by pushing the UP button
4. After a short moment, the current heart rate is displayed

   Speed can be selected by pushing the * button

   Calories can be selected by pushing the # button

   Distance can be selected by pushing the DOWN button in Calorie Mode (see Section 3.2.2.7).
5. The reception may be stopped by pushing UP while the heart rate is shown

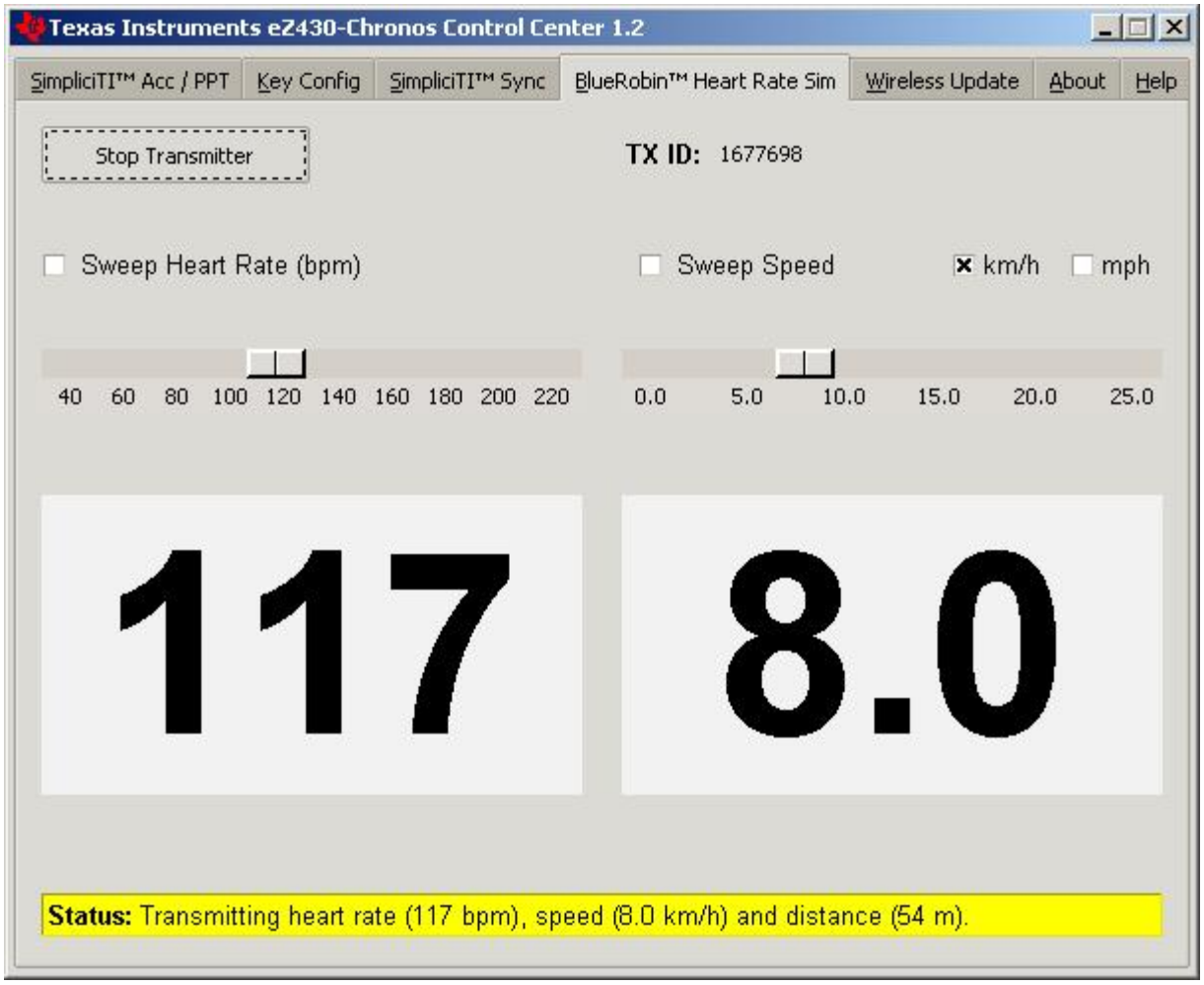


Figure 3-7. eZ430-Chronos Control Center Heart Rate Simulator

Copyright © 2009–2015, Texas Instruments Incorporated

3.3.5 Wireless Update

This mode allows updating the firmware of the eZ430-Chronos wrist module wirelessly, without disassembling it.

Update procedure:

1. Select CC430 flash image (.txt file) by clicking Browse.... Example images for the demo software and the data logger application are located for Windows in C:\Program Files\Texas Instruments\eZ430-Chronos\Recovery\Chronos Watch\Applications and for Linux in /home/<user name>/Texas Instruments/eZ430-Chronos/Recovery/Chronos Watch/Applications.

   NOTE: Ensure selecting the correct version of the flash images. If the wrong frequency is selected, no wireless communication is possible anymore. In that case, the Chronos module must be updated using the eZ430 debug interface.

   Only transfer flash images to the Chronos module, which allow invoking the update software on the Chronos module.

   The file to be downloaded to the Chronos module must be in TI-TXT format to work with this update procedure. This new firmware must reside within the main memory flash (0x8000 to 0xFFFF), otherwise the update procedure fails due to boundary checks on the Chronos module side.

2. Activate the update mechanism on the PC by clicking Update eZ430-Chronos Watch. The Control Center status line displays "Access point started. Now start watch in rFbSL mode" when the PC is ready.
3. Select "rFbSL" on the eZ430-Chronos module by pushing the # button
4. Initiate update by pushing the DOWN button
5. After a short moment, the update is started

   At the beginning of the update the LCD shows "rAM" for a few seconds. During this time, the actual update software is downloaded from the PC to the RAM of the CC430 on the Chronos module. This program contains all memory write and LCD routines. After this transfer is finished, the code is executed from RAM, and the download of the firmware file is started. The LCD shows the progress in percent on the upper LCD line. After the transfer is complete, a reset starts the software on the Chronos module (see Section 3.6.3).

   NOTE: If the update fails, it can be activated again by pushing the DOWN button again on the eZ430-Chronos wrist module, given that the wireless update is active in the eZ430-Chronos Control Center.

Copyright © 2009–2015, Texas Instruments Incorporated

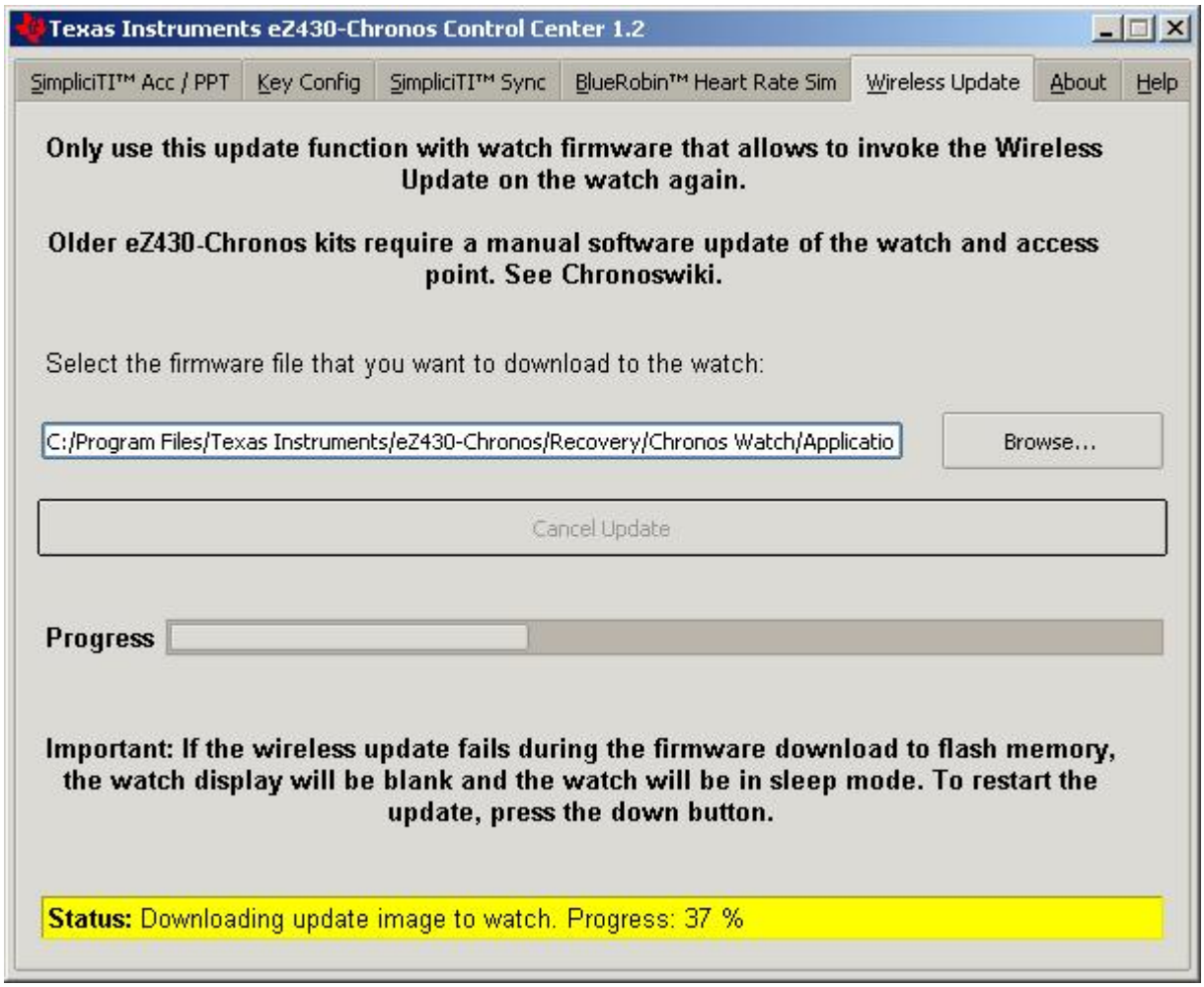


Figure 3-8. eZ430-Chronos Control Center Wireless Update

Copyright © 2009–2015, Texas Instruments Incorporated

3.4 eZ430-Chronos Data Logger

Besides the demo software, the eZ430-Chronos kit comes with an additional software project that turns the Chronos module into a data logger. Heart rate [6], temperature, and altitude can be logged in user definable intervals of 1 to 255 seconds. 8KB of flash memory is reserved for logging several hours up to days, depending on the settings. The stored data can be transferred to a PC (in CSV format) and used for further analysis. The data logger provides fewer features compared to the demo software as memory is freed for data storage. Most importantly, no Set Functions are available (that is, the Chronos module cannot be set or calibrated standalone); however, calibration can be done conveniently by using the eZ430-Chronos Data Logger PC software. The software project for CCS can be found in C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\Chronos Watch\CCS\Data Logger and for IAR in C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\Chronos Watch\IAR\Data Logger.

Available features:

- Time and Date
- Temperature
- Altitude
- Heart rate
- Sync
- Wireless firmware update
- Data logger
- Battery monitoring

NOTE: No Set Functions are available in this software. All settings can be done using the eZ430-Chronos Data Logger PC software.

User concept:

The user concept and the modes remain the same as in the demo software except for the Set Functions (see Section 2.1).

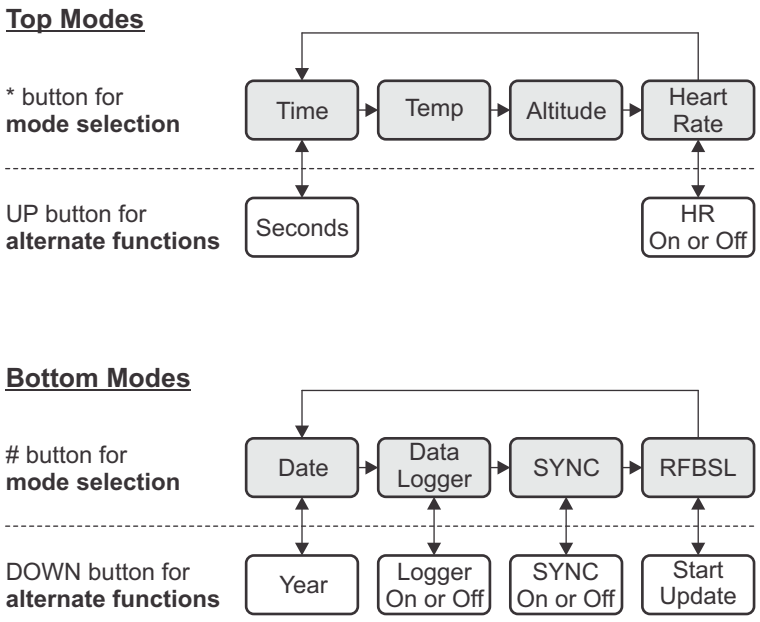


Figure 3-9. eZ430-Chronos Data Logger Feature Overview and Menu Structure

[6] Heart rate can be generated by eZ430-Chronos Control Center. Optional heart-rate monitor is available from BM innovations at www.bm-innovations.com/chronos.

Copyright © 2009–2015, Texas Instruments Incorporated

3.4.1 Detailed Feature Overview

As all available modes remain the same in the Data Logger software, only the additions are described in this section.

3.4.1.1 Data Logger Mode

The data logger mode can be selected by pushing the # button until the bottom LCD line shows "dLog". It may be enabled or disabled by pushing the DOWN button. If the heart rate data logging is selected (see Section 3.5) in data logger PC software, the heart-rate monitor is automatically enabled (the RF icon flashes until linked to a heart-rate monitor). When active, the record icon on the LCD is on (see Figure 1).

NOTE: Connect the USB RF access point to the PC before launching the Control Center software. For first time use, wait until Windows has finished the access point driver installation.

In case of problems on Windows PCs, check if the settings for the RF access point are correct in the Windows Device Manager Start > Control Panel > System > Hardware > Device Manager. The RF access point is listed under Ports (COM & LPT) as TI CC1111 Low-Power RF to USB CDC Serial Port (Chronos BLACK) or eZ430-ChronosAP (Chronos WHITE). The port settings should be:

- Baud Rate: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

In case of problems on Linux PCs, ensure that the correct tty setting is specified. Check /dev for the new tty device after plugging in the RF access point. If the RF access point is assigned to a device other than ttyACM0, either remove the serial device that occupies this slot (for example, a modem), or change the script file variable "com" in *eZ430-Chronos_Datalogger_1_2.tcl* located in /home/<user name>/Texas Instruments/eZ430-Chronos/Control Center/eZ430-Chronos Data Logger.

To launch the Control Center software, shortcuts are available in the Start Menu under Programs > Texas Instruments > eZ430-Chronos > eZ430-Chronos Data Logger.

3.5 Data Logger PC Software

The eZ430-Chronos data logger PC software allows reading out logged data from the Chronos module. It can also be used to set and calibrate the Chronos module, as its set modes were removed to free up as much memory as possible for data logging. Available features:

- Time, date, and calibration data synchronization tool
- Read out of logged data
- Wireless firmware update

To launch the eZ430-Chronos Data Logger software on a Windows PC, shortcuts are available on the Desktop and in the Start Menu under Programs > Texas Instruments > eZ430-Chronos > eZ430-Chronos Data Logger.

To launch the eZ430-Chronos Data Logger software on a Linux PC, browse to /home/<user name>/Texas Instruments/eZ430-Chronos/Control Center/eZ430-Chronos Data Logger and run eZ430-Chronos_Datalogger_1_2.tcl as root user.

Copyright © 2009–2015, Texas Instruments Incorporated

3.5.1 SimpliciTI Data Logger

The SimpliciTI Sync tab offers the possibility setting time/date of the wrist module including calibration data besides reading out logged data.

Pairing Chronos module and PC:

1. Activate the pairing on the PC by clicking Start Access Point. When the PC is ready, the eZ430-Chronos Data Logger status line displays *Access point started. Now start watch in acc, ppt or sync mode.*
2. Select SYnC on the eZ430-Chronos module by pushing the # button (see detailed description in Section 3.3.3).
3. Initiate pairing on the wrist module by pushing the DOWN button to activate the selected mode. After a short time, the link is established

Setting the Chronos module:

1. Select metric or imperial units.
2. Enter calibration data for the temperature and altitude or read back the data from the Chronos module by clicking Read Watch.
3. Specify the data that should be logged.
4. Define logging time interval (1 to 255 seconds) in which data is stored.
5. Click Copy System Time to set the Chronos module according to read the PC's system time.
6. Click Set Watch to transfer data to the Chronos module.
7. The Chronos module shows DONE.
8. Push the DOWN button on the Chronos module to end connection

Reading out logged data:

1. Pair the wrist module with PC in case not linked yet (see the previous section, *Pairing Chronos module and PC*)
2. Specify file name and location of log file
3. Click Download to start data transfer
4. Push the DOWN button to stop connection when the transfer has finished.

The log file is stored in CSV format. Its content appears as one line per log. Each line starts with date, time, heart rate, temperature, and altitude. Parameters which were not logged are set to zero (according to settings in eZ430-Chronos Data Logger PC software).

Copyright © 2009–2015, Texas Instruments Incorporated

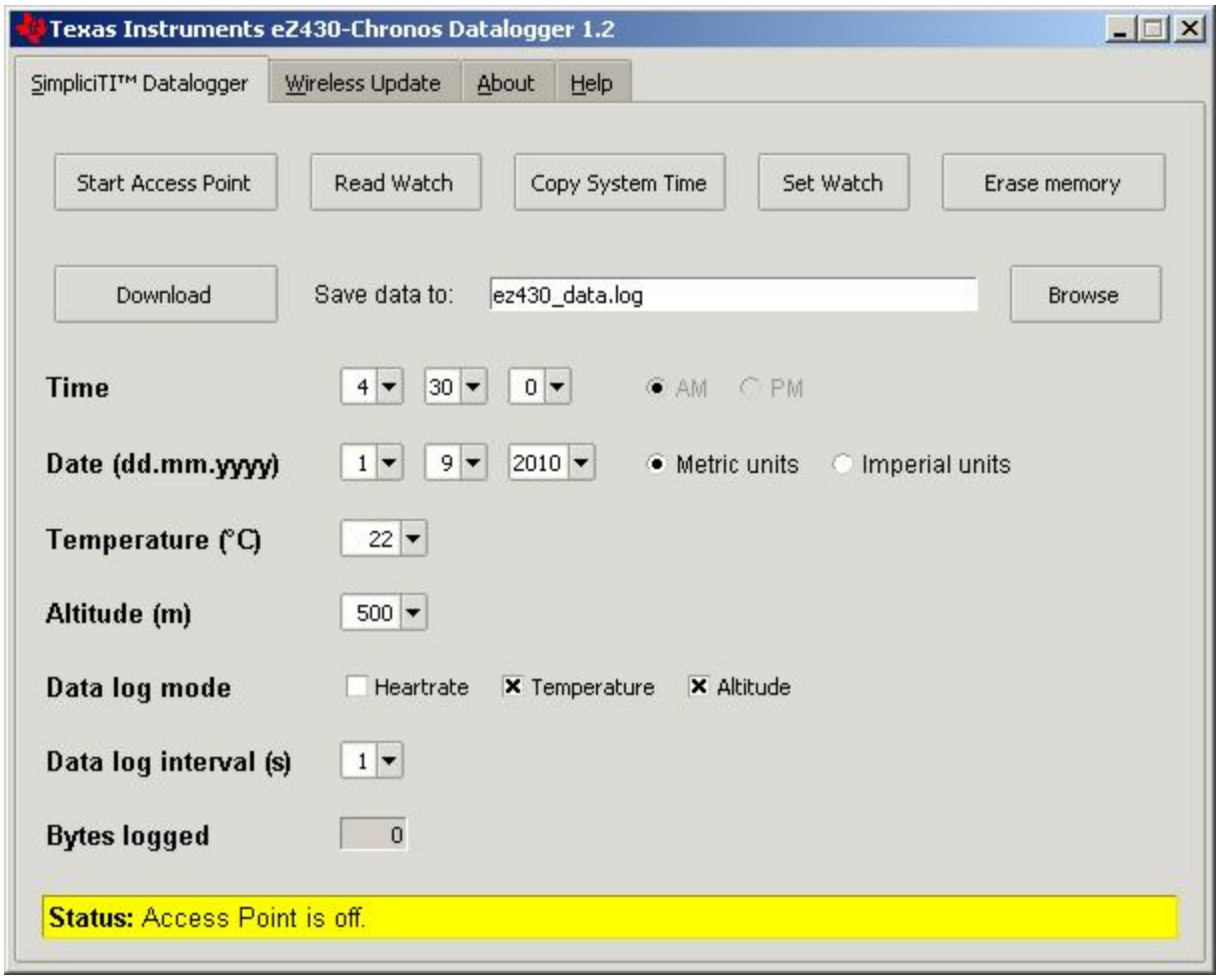


Figure 3-10. eZ430-Chronos Data Logger

Copyright © 2009–2015, Texas Instruments Incorporated

3.5.2 Wireless Update

This mode allows updating the firmware of the eZ430-Chronos wrist module wirelessly, without disassembling it.

Update procedure:

1. Select CC430 flash image (.txt file) by clicking Browse.... Example images for the demo software and the data logger application are located for Windows in *C:\Program Files\Texas Instruments\eZ430-Chronos\Recovery\Chronos Watch\Applications* and for Linux in */home/<user name>/Texas Instruments/eZ430-Chronos/Recovery/Chronos Watch/Applications*.

   NOTE: Ensure selecting the correct version of the flash images. If the wrong frequency is selected, no wireless communication is possible anymore. In that case, the wrist module must be updated using the eZ430 debug interface.

   Only transfer flash images to the Chronos module, which allow invoking the update software on the Chronos module.

   The file to be downloaded to the Chronos module must be in TI-TXT format to work with this update procedure. This new firmware must reside within the main memory flash (0x8000 to 0xFFFF), otherwise the update procedure fails due to boundary checks on the Chronos module side.

2. Activate the update mechanism on the PC by clicking Update eZ430-Chronos Watch. The Control Center status line displays "Access point started. Now start watch in rFbSL mode" when the PC is ready.
3. Select "rFbSL" on the eZ430-Chronos wrist module by pushing the # button
4. Push once DOWN button to switch to confirmation menu
5. Push DOWN again to initiate update
6. After a short moment, the update is started

   At the beginning of the update the LCD shows "rAM" for a few seconds. During this time, the actual update software is downloaded from the PC to the RAM of the CC430 on the Chronos module. This program contains all memory write and LCD routines. After this transfer is finished, the code is executed from RAM, and the download of the firmware file is started. The LCD shows the progress in percent on the upper LCD line. After the transfer is complete, a reset starts the software on the Chronos module. See Section 3.6.3 for details.

   NOTE: If the update fails, it can be activated again by pushing the DOWN button again on the eZ430-Chronos wrist module, given that the wireless update is active in the eZ430-Chronos Control Center.

Copyright © 2009–2015, Texas Instruments Incorporated

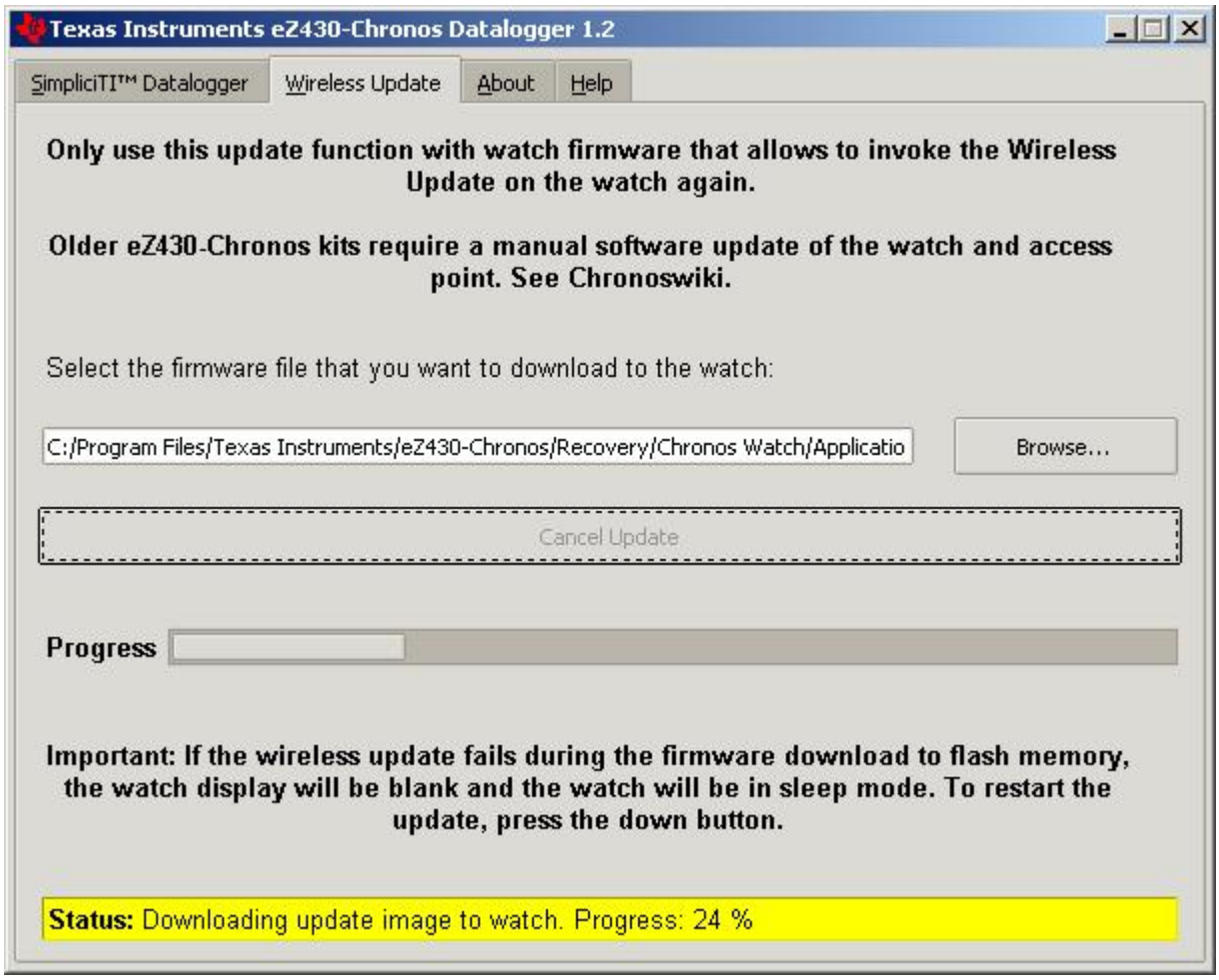


Figure 3-11. eZ430-Chronos Control Center Wireless Update

3.6 eZ430-Chronos Software Projects

3.6.1 IDE Installation

To edit and download code to the CC430 device used inside the eZ430-Chronos module, Code Composer Studio v5.5 Core Edition or the IAR Embedded Workbench KickStart 5.60.2 must be installed.

1. Download Code Composer Studio v5.5 Core Edition from www.ti.com/ccs, IAR Embedded Workbench KickStart from www.ti.com/iarkickstart or from the included CD
2. Extract the zip file and run the installation program
3. Respond to the prompts to install the IDE

NOTE: The eZ430-Chronos firmware projects are provided for both Code Composer Studio and IAR Embedded Workbench, the user has the option to select the IDE of their choice.

Currently IAR Embedded Workbench is only available for Windows. CrossWorks from Rowley Associates supports Linux and MacOS, but requires manual project setup. MSPGCC may be used for Linux as well.

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.2 eZ430-Chronos Software Flow

The Chronos module software is structured according to the menu items. The source for each menu item is stored in a separate source file (for example, "temperate.c" for the temperature menu and its functions). Details can be found in the flow chart in Figure 3-12. The data logger application works in a very similar way and, therefore, is not described separately.

Each menu item has at least the following functions:

- UP or DOWN button pushed
- * or # button is pressed for more than three seconds

The source code file "menu.c" contains two linked lists with menu items, one for the upper LCD line (Line1), one for the lower LCD line (Line2). Each list entry contains the following pointers:

- Pointer to next menu item
- UP or DOWN button is pressed
- * or # button is pressed for more than three seconds

To support the various RF frequencies and compiler licenses, the following configurations are available:

RF Frequencies

- 915 MHz (USA)
- 868 MHz (Europe)
- 433 MHz (Other regions)

IDE Versions (CCS, IAR)

- Unrestricted IDE versions
- Free IDE versions (CCS Core Edition, IAR KickStart). To allow recompilation of the source code, parts of the source code files have been embedded in libraries; for example, the SimpliciTI stack and most of the hardware drivers.

Figure 3-12 shows the basic software flow of the demo application.

Copyright © 2009–2015, Texas Instruments Incorporated

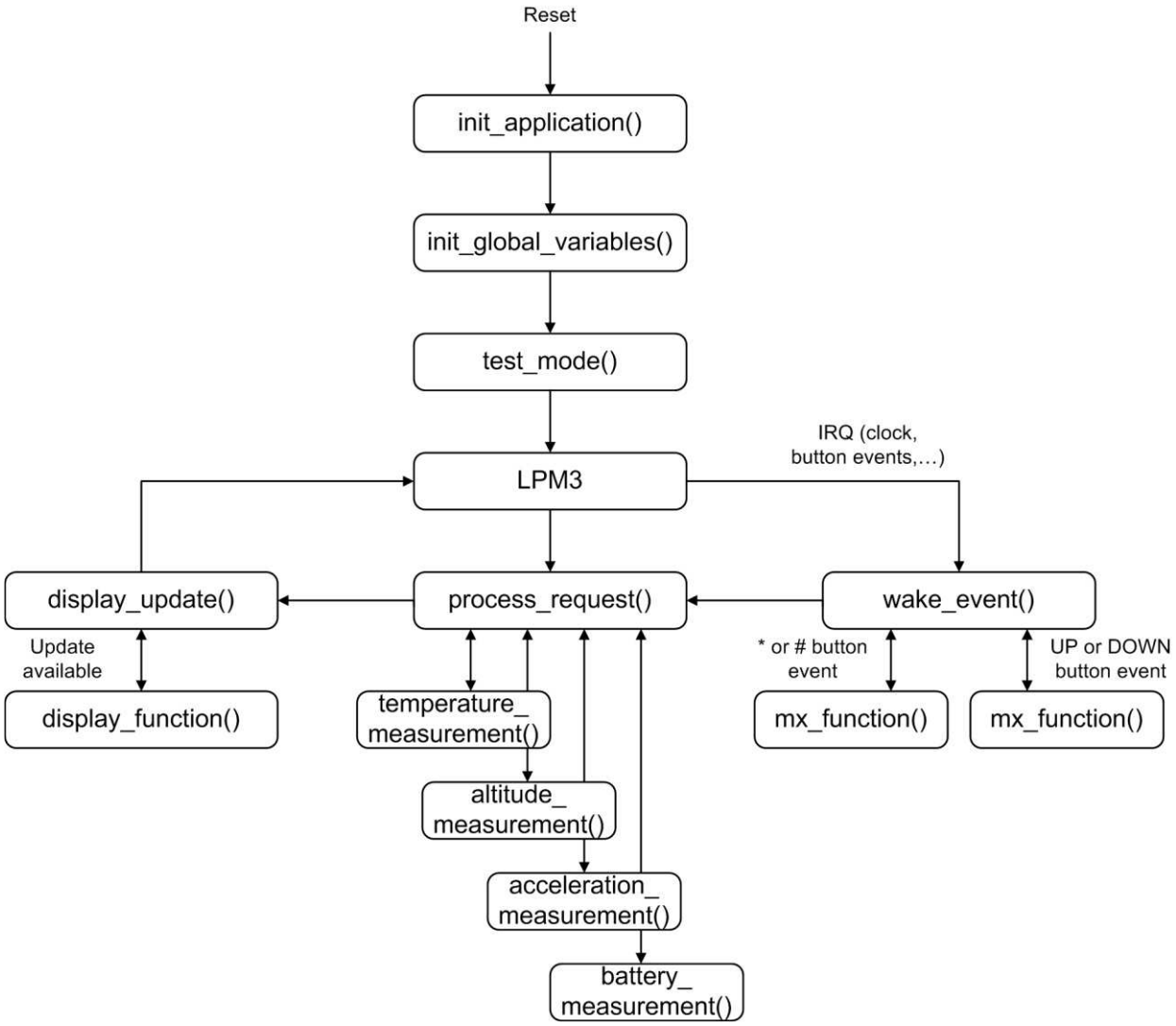


Figure 3-12. eZ430-Chronos Software Flowchart

After a power-up reset, the hardware is initialized, the display memory is cleared and the radio is set to sleep mode. The main loop waits for wake-up events, which can be either a scheduled event such as a clock interrupt, or a button event.

Button events lead to the execution of either mx_functions or sx_functions.

If the LCD is updated with new data, the modules set a display flag, and LCD Line1, Line2, or both are updated by calling the menu-specific display functions. Display updates have been reduced as much as possible; for example, when the time changes from 10:22 to 10:23, only the last digit is updated.

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.3 eZ430-Chronos Wireless Update Feature

The wireless update feature allows to perform a firmware update of the eZ430-Chronos wrist module wirelessly, that is the Chronos module does not need to be opened. The wireless update software should be seen as an application and not as an universal BSL. It can only be invoked by the main application, which needs to be created in a certain way (see Section 3.6.3.2). In addition it may must be modified to comply local RF regulatory. The current consumption during the update process may be significant. Considering the small battery capacity, the update software is intended to be used only occasionally.

NOTE: References in the software projects and the menu items of the Chronos module refer to it as "RF BSL" and "WBSL" for simplicity reasons.

Whenever the wireless update is activated on the Chronos module, it returns to the main application with a reset, wether or not an update was performed. Time, data, alarm, and other RAM-based data are lost.

3.6.3.1 Overview and Components of the Wireless Update Feature

As described in Section 3.6.3, the wireless update feature allows wireless updates of the eZ430-Chronos firmware. One of the requirements for the wireless update implementation is to use as little flash memory as possible. Therefore, a lightweight radio protocol was developed, which resides in the BSL flash area of the CC430. The software that handles the LCD progress information and the flash memory programming is downloaded over the air and executed in RAM. Components of the wireless update software include:

- Radio protocol in BSL memory area of the CC430 (eZ430-Chronos wrist module)
- The "RAM-based update software" contains LCD and flash write routines (transferred from PC to RAM of the wrist module)
- Radio protocol stack of the wireless update on RF access point (CC1111 or MSP430F5509 + CC1101)
- PC application supporting the update functionality

The update procedure works as follows:

1. Wireless update functionality is activated in the PC application, after a valid flash image is selected
2. RF access point is ready and awaits a request from a Chronos module
3. Wireless update is activated on the Chronos module
4. Chronos module downloads LCD and flash write routines (RAM-based update software) from the PC into the RAM of the CC430. The Chronos module displays "rAN" (=RAM).
5. Chronos module executes the RAM-based update software. This starts the actual code (flash image) download process. The LCD shows the progress.
6. A reset starts the new application on the Chronos module when the update is finished.

The FAQ in Appendix A also list common questions on the wireless update feature.

3.6.3.2 Detailed Description of the Wireless Update Feature

To invoke the wireless update procedure, the main application must call the start of the wireless update software, which is located at address 0x1000. Therefore, the demo and data logger projects contain an extra menu item called "rFbSL". When activated, it determines if the battery level of the Chronos module is sufficient to start a wireless update and then calls address 0x1000. At this time, the user application is no longer running.

NOTE: Whenever the wireless update is activated on the Chronos module, it returns to the main application with a reset, whether or not an update was performed. Time, data, alarm, and other RAM-based data is lost.

Copyright © 2009–2015, Texas Instruments Incorporated

After invoking the wireless update (rFbSL), the Chronos module tries to link to a listening RF access point and start the update procedure. If the link is successful, the Chronos module downloads the RAM-based update software into the RAM of the CC430. Once finished, this software then tries to link again with the RF access point to download the actual update image. If this link is successful, a mass flash erase is performed, which erases all the main memory flash (0x8000 to 0xFFFF). The Chronos module then starts to receive all of the data packets and writes them to flash, checking if each word was written successfully. If the link is not successful, the Chronos module generates a reset to restart the user application. During the download of the update image, a percentage indicator appears on the Chronos module. When download is complete, "dOnE" is shown on the LCD, and a reset is generated to start the new user application that has just been written to flash.

A detailed flow of the update software on the Chronos module and the USB access point can be found in Figure 3-13 and Figure 3-14.

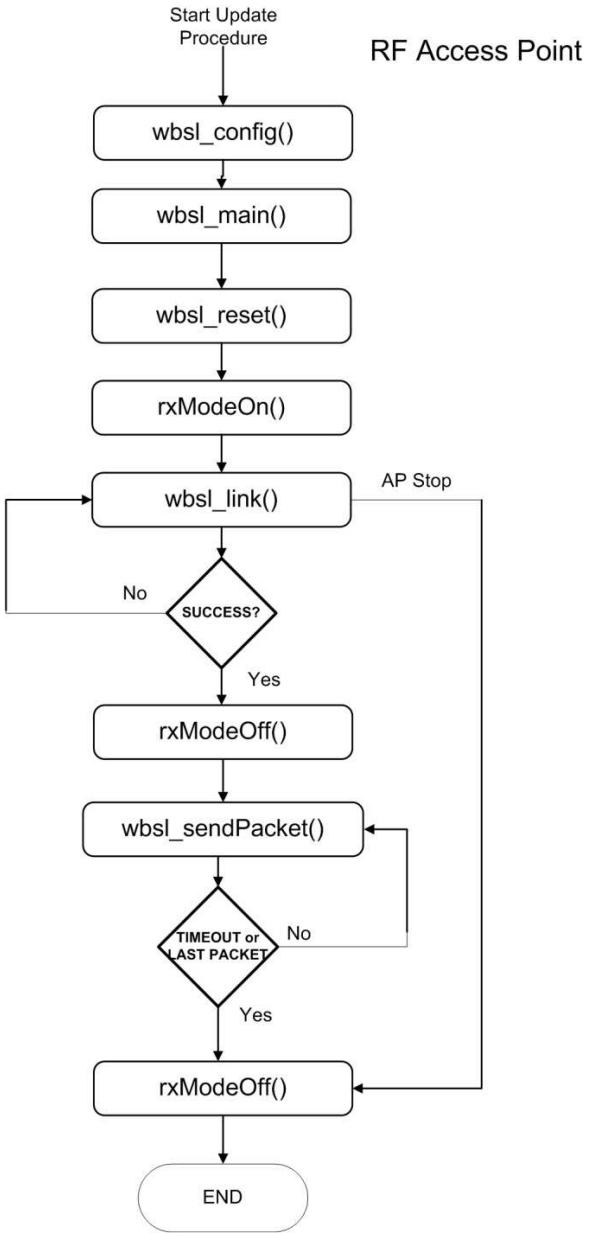


Figure 3-13. Flow Chart of Wireless Update Software on Access Point

Copyright © 2009–2015, Texas Instruments Incorporated

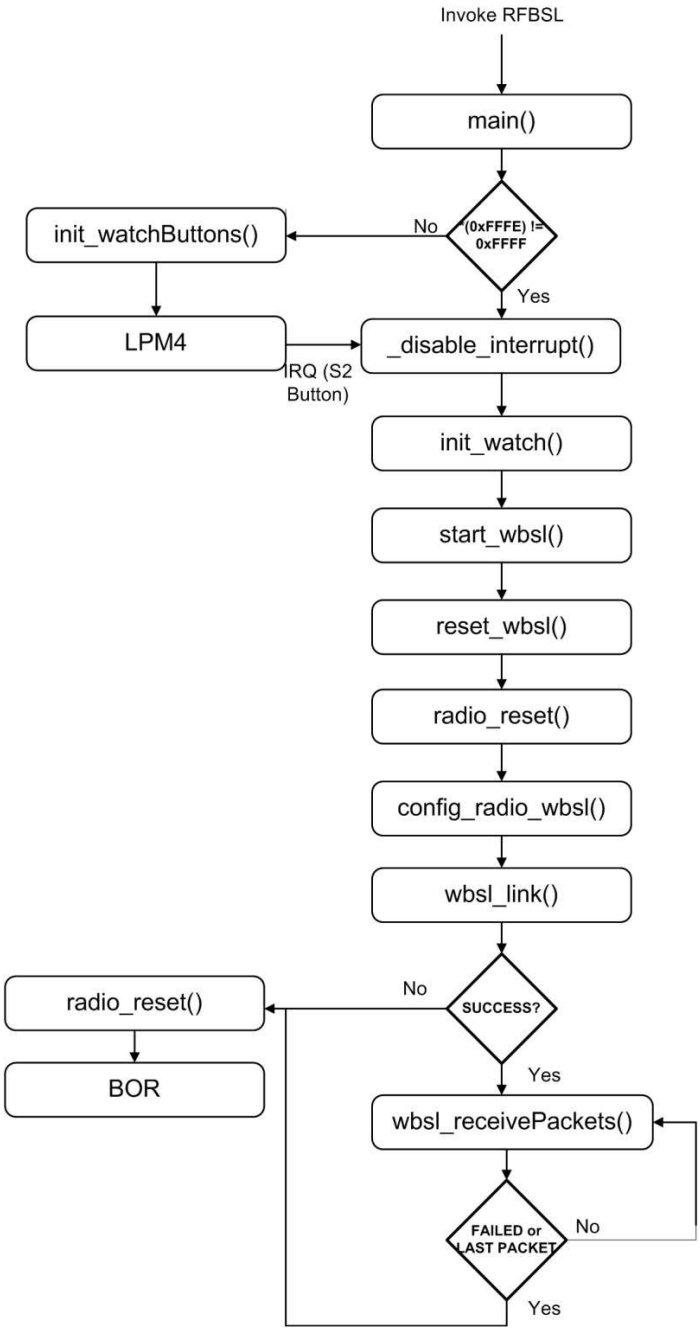


Figure 3-14. Flow Chart of Flash Based Wireless Update Software on eZ430-Chronos Wrist Module

3.6.3.3 Error Handling

The wireless update software is designed to be fail safe. The radio protocol contains limited error handling due to its small footprint, but the update software provides recovery if the update process fails. Upon communication failures, the Chronos module is put in low-power mode (LPM4) and the LCD is turned off. The update process can be restarted by pushing the DOWN button after the update process is restarted on the PC.

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.3.4 Upgrading Existing eZ430-Chronos Kits

Earlier eZ430-Chronos kits (production date prior to 04/2010; the production date may be found on bottom of eZ430-Chronos box) do not support the wireless update feature. Therefore, the kits must be updated manually. In addition to a new version of the PC software, firmware updates of the RF access point and the eZ430-Chronos wrist module are required.

3.6.3.4.1 RF Access Point Update

3.6.3.4.1.1 Access Point Based on MSP430F5509 Microcontroller and CC1101 Transceiver

The eZ430 USB emulator provided with the Chronos WHITE kit can be used to reprogram the access point.

1. As shown in Figure 3-15, solder the 4-pin debugger connector (provided with the kit) onto the access point.

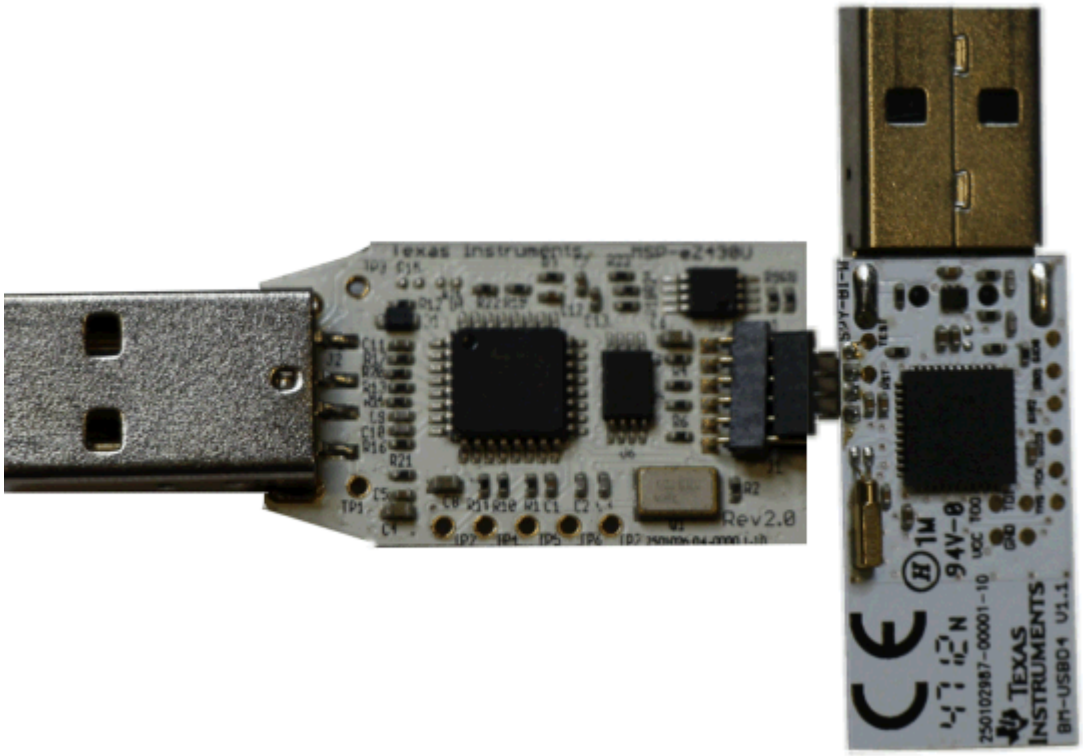


Figure 3-15. Upgrade AP Firmware

2. Connect the eZ430 USB emulator to the access point and then to a PC.
3. Launch an IDE (Code Composer Studio or IAR Embedded Workbench).
4. Select and download the corresponding firmware (default directory: *C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\RF Access Point\MSP430 v1.1 - white PCB\CCS*) as described in Section 3.6.4 .

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.3.4.1.2 Access Point Based on CC1111

The CC Debugger is required to program the CC1111 based RF access point. To perform the update, the SmartRF Flash Programmer software is used to on the PC.

1. Solder a debug interface connector cable onto the CC1111 access point as shown in Figure 3-16.



Figure 3-16. eZ430-Chronos RF Access Point Connection to CC Debugger

CC-Debugger	RF Access Point
Pin 1	GND
Pin 2	Vcc
Pin 3	P2.2 (DC)
Pin 4	P2.1 (DD)
Pin 7	RST
Pin 9	Vcc

2. Connect RF access point to CC Debugger and press the "Reset". The LED on the CC Debugger should become green.
3. Launch the SmartRF Programmer software
4. Open .hex file according to frequency in *C:\Program Files\Texas Instruments\eZ430-Chronos\Recovery\RF Access Point*
5. Select "Erase, program and verify"
6. Clock "Perform actions"

Copyright © 2009–2015, Texas Instruments Incorporated

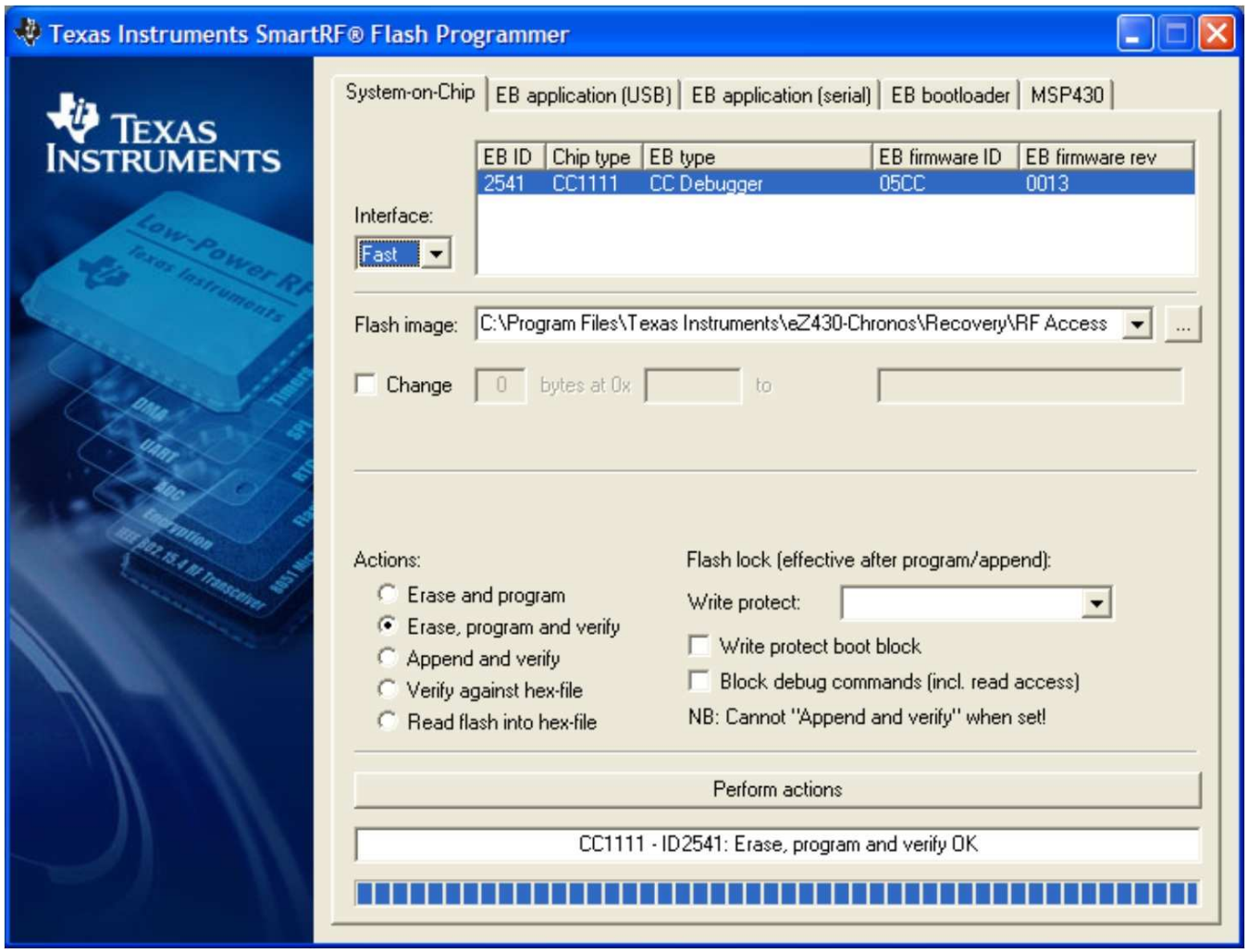


Figure 3-17. SmartRF Flash Programmer

3.6.3.4.2 eZ430-Chronos Wrist Module Update

The update of the eZ430-Chronos wrist module needs to be done in two stages. First, the wireless update software needs to be written to the BSL area of the flash memory of the CC430. Afterwards, the main application must be loaded onto the wrist module. The easiest and fasted way is using BM innovations' Firmware Update Tool. It writes the wireless update software into the BSL memory of the wrist module and programs the corresponding demo firmware according to the latest eZ430-Chronos software release (recommended).

Alternatively, the wireless update software may be loaded onto the wrist module using the included IAR Embedded Workbench (free KickStart version is sufficient). Moreover, the .txt image may be written to the device by using 3rd party tools such as the free FET-Pro430 Lite software from Elprotronic.

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.3.4.2.1 eZ430-Chronos Wrist Module Update Using IAR

The project is available in *C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\Chronos Watch\IAR\Wireless Update*. The eZ430-Chronos module needs to be connected to the emulator which must be connected to the PC.

1. Open project by double clicking "Wireless Updater.eww"
2. Select build configuration according to frequency in *Project > Edit Configurations...*
3. Click *Project > Download and Debug*
4. Close the Embedded Workbench after code was written
5. Program the wrist module main application as described in Section 3.6.4.

3.6.4 eZ430-Chronos Firmware

To restore or modify the original Chronos module projects, the source code must be installed. This happens during the installation of the demo software package (SLAC341), which contains two different sets of examples. Code Composer Studio v5.5 or the IAR Workbench can be used, regardless if code limited or not.

3.6.4.1 Using Code Composer Studio™ v5.5

1. Launch Code Composer Studio v5.5: *Start > All Programs > Texas Instruments > Code Composer Studio 5.5.0 > Code Composer Studio 5.5.0*
2. Create new Workspace or open existing Workspace that does not yet contain eZ430-Chronos projects

   NOTE: Workspaces should not be located in a long path of directories as Windows only supports path names up to 255 characters. Keep in mind that the projects contain subdirectories as well.
3. Import eZ430-Chronos Projects by clicking: *Project > Import Existing CCS Eclipse Project*
4. Click Browse and browse to eZ430-Chronos Projects (*C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\Chronos Watch\CCS*). Confirm directory by clicking OK
5. The eZ430-Chronos demo project appears as *ez430_chronos*, the eZ430-Chronos data logger appears as *ez430_chronos_datalogger*. Check the boxes *Copy projects into workspace* and *Automatically import referenced projects* to create a new copy of the projects
6. Click Finish to finalize the project import. The projects appear in the *C/C++ Projects view of CCS*
7. Select the right version of the project. Each project comes with six different project settings (build configurations), which can be selected in *Project > Properties > C/C++ Build > Active Configuration > Configuration*:

   915 MHz – Limited CCS Core Edition (USA)

   868 MHz – Limited CCS Core Edition (Europe)

   433 MHz – Limited CCS Core Edition (Other regions)

   915 MHz – Unrestricted CCS Platinum (USA)

   868 MHz – Unrestricted CCS Platinum (Europe)

   433 MHz – Unrestricted CCS Platinum (Other regions)
8. Go to *Run > Debug* to launch the debugger

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.4.2 Using IAR Embedded Workbench™

1. Launch the Embedded Workbench:*Start > All Programs > IAR Systems > IAR Embedded Workbench KickStart for MSP430 5.60 > IAR Embedded Workbench*
2. Open eZ430-Chronos Workspace by: *File > Open > Workspace...*
3. Browse to eZ430-Chronos Projects (*C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\Chronos Watch\IAR\Sports Watch* or *C:\Program Files\Texas Instruments\eZ430-Chronos\Software Projects\Chronos Watch\IAR\Data Logger*)
4. Select **.eww* file and click *Open*
5. Select the right version of the project. Each project comes with four different project settings (build configurations), which can be selected on top of the Workspace window:

   915 MHz – Limited IAR KickStart (USA)

   868 MHz – Limited IAR KickStart (Europe)

   433 MHz – Limited IAR KickStart (Other regions)

   915 MHz – Unrestricted IAR Workbench (USA)

   868 MHz – Unrestricted IAR Workbench (Europe)

   433 MHz – Unrestricted IAR Workbench (Other regions)
6. Go to *Project > Download and Debug* to launch the debugger

3.6.5 eZ430-Chronos GUI Sources

Full sources of the eZ430-Chronos Control Center and eZ430-Chronos Data Logger are available in the eZ430-Chronos software packages for Windows SLAC341 and Linux SLAC388. The sources are copied to the PC during the software installation. The graphical user interfaces are based on TCL/Tk.

3.6.5.1 eZ430-Chronos GUI for Windows

The eZ430-Chronos PC software consists of a TCL/Tk executable and a DLL, which handles the communication with the RF access Point. Download TCL/Tk for Windows for free from http://www.activestate.com/activetcl. Once TCL/Tk was installed on the computer, a double-click on a TCL script (*.tcl) starts the interpreter and executes the script. Alternatively, start the TCL interpreter *wish.exe* and execute the script with the "source" command. If the script filename contains blanks, put it into quotes. The sources files are located in *C:\Program Files\Texas Instruments\eZ430-Chronos\Control Center\GUI Sources*

3.6.5.1.1 TCL/TK Handling

A wrapping tool is needed to compile all TCL/Tk components into standalone applications. The freeware tool Freewrap http://freewrap.sourceforge.net may be used for that purpose.

1. Open Command Prompt
2. Navigate to the Freewrap directory; for example, *C:\Tcl\freewrap*
3. Start Freewrap with the complete path to the TCL script to be wrapped; for example, *freewrap.exe C:\Program Files\Texas Instruments\eZ430-Chronos\Control Center\eZ430-Chronos Control Center\eZ430-Chronos CC 1_2.tcl*

A standalone application, which only requires the corresponding Windows DLL is generated. It can be used on every PC, TCL/Tk must not be installed.

Copyright © 2009–2015, Texas Instruments Incorporated

3.6.5.1.2 Control Center DLL

The sources for the DLL are available in the eZ430-Chronos Windows package and can be found in *C:\Program Files\Texas Instruments\eZ430-Chronos\Control Center\GUI Sources\DLL*.

The eZ430-Chronos Windows DLL has been developed using Microsoft Visual C++ 2008 Express Edition. In order to rebuild the DLL file the Microsoft Visual Studio must be installed, since the registry enumeration code uses MFC functions. If Microsoft Visual Studio is not present, it is still possible to rebuild the DLL, but the "enumser" source code part needs to be removed from the project. Therefore, the BM_GetCOM() function won't work anymore.

The DLL has two interface sections, one that exports standard C functions, and a second one exporting TCL-compliant functions. These TCL-compliant functions are used by the graphical user interface. Hence, when compiling the DLL, TCL needs to be present in the default directory (*C:\Tcl*); otherwise, the reference to the TCL libraries (tcl85.lib, tclstub85.lib) is invalid. If the DLL is compiled without the TCL interface, the respective source code file and the references to the TCL libraries must be deleted.

COM Port Management

1. Opening the COM port

   Prior to any communication, the COM port where the RF access point is connected must be opened. The hardware is powered up immediately after the unit is connected. Some parts of the hardware require a startup time of several hundred milliseconds. As a result, any access to the hardware should not be done within one second after connecting the device.

   NOTE: To address COM ports higher than COM9 in Windows, precede the "COMxx" string with the sequence "\\.\".

   The COM port is opened with the following function:

```
bool BM_OpenCOM(    char * strPortName,
     DWORD dwBaudrate = 115200,
     WORD wTimeout = 30,
     bool bRTS = false,
     bool bDTR = false);
```

   Parameters

   strPortName

   Name of the COM port (for example, "\\.\COM11").

   wTimeout

   Time in milliseconds a reply to a command is expected; default value is 30 ms, should not be changed

   dwBaudrate

   Baudrate for the serial interface; default is 115200 Baud, should not be changed

   bRTS

   State of RTS line during normal operation; default is false (=GND), should not be changed

   bDTR

   State of DTR line during normal operation; default is false (=GND), should not be changed

   Return Value

   Returns true if COM port could be opened, otherwise returns false.

2. Closing the COM port

   A successfully opened COM port must be closed when quitting the application to release all allocated memory and the port itself.

   The COM port is closed with the following function:

```
void BM_CloseCOM(void);
```


Copyright © 2009–2015, Texas Instruments Incorporated

3. Locating the RF access point

   This function checks the Windows registry for the friendly name "TI CC1111 Low-Power RF to USB CDC Serial Port" or "eZ430-ChronosAP" and returns the COM port number if the device was found.

   ```
   bool BM_GetCOM(unsigned char& bPortNb);
   ```

   Parameters

   bPortNb

   Number of the COM port (for example, „11")

   Return Value

   Returns true if device was found, otherwise returns false.

4. Resetting the RF access point

   After power-up, the hardware is not automatically reset. Use the following function to initialize the RF access point hardware. This function can also be used during normal operation if an error condition was detected.

   ```
   bool BM_Reset(void);
   ```

   Return Value

   Returns true if RF access point could be initialized successfully and false if the reset failed.

5. Read status from RF access point

   This command returns the current RF access point status.

   ```
   bool BM_GetStatus(WORD& wStatus);
   ```

   Parameters

   wStatus

   Current status of RF access point HW_IDLE, HW_SIMPLICITI_STOPPED, HW_SIMPLICITI_TRYING_TO_LINK, HW_SIMPLICITI_LINKED, HW_BLUEROBIN_STOPPED, HW_BLUEROBIN_TRANSMITTING, HW_ERROR, HW_NO_ERROR, HW_NOT_CONNECTED

   Return Value

   Returns true if command could be executed and false if the command execution failed.

BlueRobin Functions

1. Set BlueRobin Heart Rate

   This command sets the heart rate value that is transmitted in each BlueRobin packet.

   ```
   bool BM_BR_SetHeartrate(WORD wHeartrate);
   ```

   Parameters

   wHeartrate

   Heart rate in bpm

   Return Value

   Returns true if command could be executed and false if the command execution failed.

2. Set BlueRobin ID

   This command sets the transmitter ID for BlueRobin transmission.

   ```
   bool BM_BR_SetID(DWORD dwID);
   ```

   Parameters

   dwID

   24-bit transmitter ID

   Return Value

   Returns true if command could be executed and false if the command execution failed.

Copyright © 2009–2015, Texas Instruments Incorporated

3. Read BlueRobin ID

   This command reads the transmitter ID for BlueRobin transmission.

   ```
   bool BM_BR_GetID(DWORD& dwID);
   ```

   Parameters

   dwID

   24-bit transmitter ID

   Return Value

   Returns true if command could be executed and false if the command execution failed.

4. Start BlueRobin transmission

   This command starts the BlueRobin transmission.

   ```
   bool BM_BR_Start(void);
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

5. Stop BlueRobin transmission

   This command stops the BlueRobin transmission.

   ```
   bool BM_BR_Stop(void);
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

SimpliciTI Functions

1. Start SimpliciTI in acc/ppt mode

   This command starts SimpliciTI in acc/ppt mode.

   ```
   bool BM_SPL_Start(void);
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

2. Start SimpliciTI in sync mode

   This command starts SimpliciTI in sync mode.

   ```
   bool BM_SYNC_Start(void);
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

3. Stop SimpliciTI

   This command exits the SimpliciTI stack.

   ```
   bool BM_SPL_Stop(void);
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

Copyright © 2009–2015, Texas Instruments Incorporated

4. Read SimpliciTI acc/ppt data

   This command reads the received data from the RF access point buffer.

   ```
   bool BM_SPL_GetData(DWORD& wData);
   ```

   Parameters

   wData

   4 byte data (byte3, byte2, byte1, byte0)
   byte3 = Acceleration value Z-axis
   byte2 = Acceleration value Y-axis
   byte1 = Acceleration value X-axis
   byte0 = 0x11 → Left mouse click (acc mode)
   byte0 = 0x21 → Left mouse double-click (acc mode)
   byte0 = 0x31 → Right mouse click (acc mode)
   byte0 = 0x12 → Button * (ppt mode)
   byte0 = 0x22 → Button # (ppt mode)
   byte0 = 0x32 → Button ↑ (ppt mode)
   byte0 = 0xFF → Data has been read before

   Return Value

   Returns true if command could be executed and false if the command execution failed.

5. Read SimpliciTI sync buffer status

   This command reads the buffer status during sync mode from the RF access point buffer.

   ```
   bool BM_SYNC_GetBufferStatus(WORD& wStatus);
   ```

   Parameters

   wStatus

   Buffer status

   0 = Buffer empty
   1 = Data available for download

   Return Value

   Returns true if command could be executed and false if the command execution failed.

6. Read SimpliciTI sync buffer

   This command reads the buffer content during sync mode.

   ```
   bool BM_SYNC_ReadBuffer(BYTE * bData);
   ```

   Parameters

   bData

   19-byte SimpliciTI data Packet content defined Chronos module sending routine

   Return Value

   Returns true if command could be executed and false if the command execution failed.

Wireless Update Functions

1. Start wireless update

   This command starts SimpliciTI in acc/ppt mode.

   ```
   BR_COMM_API bool BM_WBSL_Start(void)
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

2. Stop wireless update

   This command exits the SimpliciTI stack.

   ```
   BR_COMM_API bool BM_WBSL_Stop(void)
   ```

   Return Value

   Returns true if command could be executed and false if the command execution failed.

Copyright © 2009–2015, Texas Instruments Incorporated

3. Get status of update

   This command reads the buffer status during sync mode from the RF access point buffer.

   ```
   BR_COMM_API bool BM_WBSL_GetStatus(DWORD& wData)
   ```

   Parameters

   dwData

   Status

   1 = linking
   2 = linked
   4 = error

   Return Value

   Returns true if command could be executed and false if the command execution failed.

4. Send Data (Text File parts) to the End Device

   This command reads the buffer status during sync mode from the RF access point buffer.

   ```
   BR_COMM_API bool BM_WBSL_Send_Data(BYTE * data, int len, DWORD& dwData)
   ```

   Parameters

   data

   Pointer to byte array

   len

   Array length

   dwData

   Return value

   Return Value

   dwData = Length of last transmitted package.

5. Get status of packet (checks if a new packet needs to be sent from the GUI)

   This command reads the buffer status during sync mode from the RF access point buffer.

   ```
   BR_COMM_API bool BM_WBSL_GetPacketStatus(DWORD& wData)
   ```

   Return Value

   dwData

   0x80 = error
   0x01 = disabled
   0x02 = processing packet
   0x04 = send info packet
   0x08 = send new data packet

3.6.5.2 eZ430-Chronos GUI for Linux

The eZ430-Chronos PC software for Linux consists of a TCL/Tk scrips, similar to its Windows equivalent. The scripts are available in*/home/<user name>/Texas Instruments/eZ430-Chronos/Control Center/eZ430-Chronos Control Center*.

See Section 3.3 for instructions on how to run these scripts on Linux machines.

Copyright © 2009–2015, Texas Instruments Incorporated

eZ430-Chronos Hardware

4.1 Programming the eZ430-Chronos Wrist Module: Disassembly and Assembly of the Housing

To program and debug code on the CC430, it needs to be connected to a PC with a JTAG interface. The eZ430-Chronos kit includes the eZ430-RF JTAG interface for that purpose. It can only be connected to the eZ430-Chronos module after the electronic module is removed from its housing. This chapter describes how to remove the electronic module from the housing and how to assemble the wrist module again.

NOTE: Videos with detailed instructions can be found on www.ti.com/chronos and the CD that is included in the kits.

4.1.1 Disassembly of eZ430-Chronos Wrist Module

1. Open screws on back of the wrist module. Use the included Phillips screwdriver.
2. Remove the metal back of the wrist housing. Be careful not to damage the gasket between the wrist module and the metal back.
3. Lift out the Chronos module. Use the screwdriver as shown in Figure 4-1.



Figure 4-1. Remove Chronos Module From Housing

Copyright © 2009–2015, Texas Instruments Incorporated

4. Remove the battery before connecting the module to the emulator. Place the screwdriver tip between the battery and the battery holder (small metal tab) and push the tab away from battery (see Figure 4-2). Detailed instructions are shown in the eZ430-Chronos Disassembly and Assembly video on www.ti.com/chronoswiki.



Figure 4-2. Remove Chronos Module Battery

CAUTION

To prevent the battery from being charged, always remove the battery from the enclosure before connecting the Chronos module to an emulator.

WARNING

Properly dispose of the battery. Keep the battery out of the reach of children. If the battery is swallowed, contact a physician immediately.

Copyright © 2009–2015, Texas Instruments Incorporated

5. Connect the Chronos module to the emulator. The Chronos module and the USB connector must be on the same side of the PCB as shown in Figure 4-3. Be careful when connecting the Chronos module, because its small plastic strips can get stuck at components on the emulator.

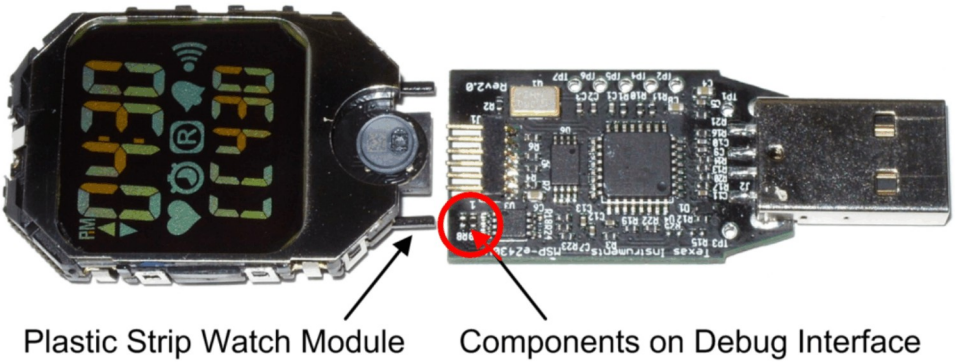


Figure 4-3. eZ430-Chronos Module Attached to eZ430-RF Debug Interface

NOTE:

- Never disassemble the Chronos module itself.
- Do not bend the metal strips that are used as contacts for the buttons.
- Be careful when connecting the Chronos module to the debug interface; its small plastic strips can get stuck at components on the emulator.

4.1.2 Assembly of eZ430-Chronos Wrist Module

1. Insert the battery ("+" facing up) into Chronos module and close battery holder clip by pushing the open end towards the module. If the small clip at the end of the holder does not snap into the plastic frame, it may need to be bent inwards slightly

NOTE: Only insert Q-LITE Lithium battery type CR2032 or equivalent.

2. Gently insert Chronos module into the housing. Insert it in parallel to the housing. Do not try to insert one side first (see Figure 4-4). Ensure that the small metal strips of the buttons on Chronos module slide over buttons of the housing (see Figure 4-5).

Copyright © 2009–2015, Texas Instruments Incorporated

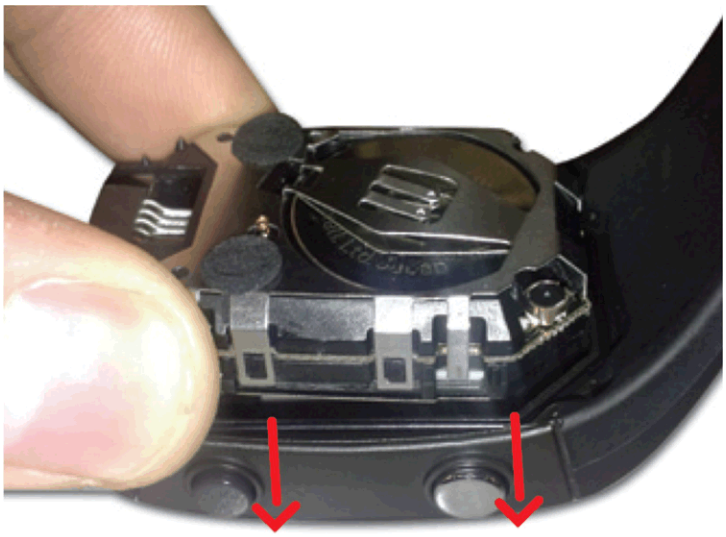


Figure 4-4. eZ430-Chronos Module Insertion Into Housing



Figure 4-5. Metal Strips of Chronos Module Housing and Buttons of Housing

Copyright © 2009–2015, Texas Instruments Incorporated

CAUTION

Be careful when inserting the Chronos module. Do not push in the Chronos module or tighten the screws without checking if the module is in position. The metal strips of the buttons may get stuck at the buttons of the Chronos module housing. If this happens, gently push the strips towards the module with the screwdriver until they slide over the buttons (see Figure 4-6).

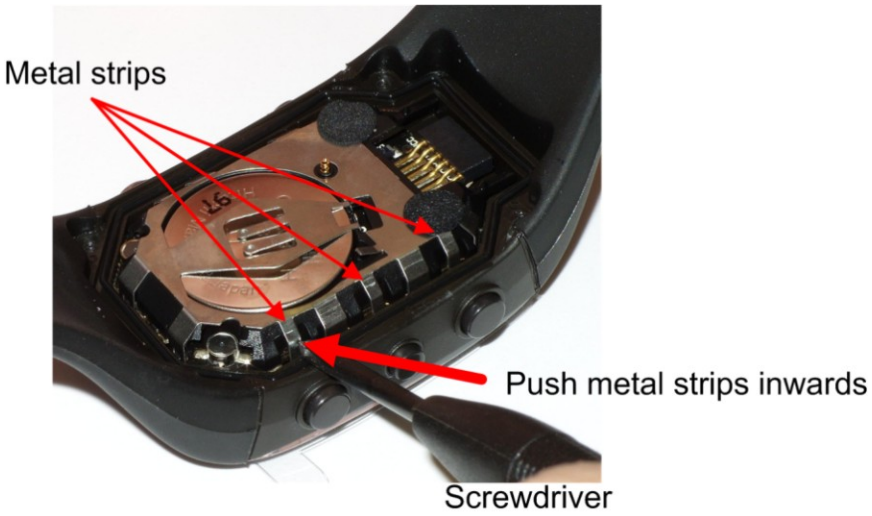


Figure 4-6. Push Metal Strips Inward

3. Make sure that the gasket is in position and replace the back with the screws. Try to use the existing threads in the plastic housing and do not over tighten the screws.

4.2 Functional Description of the eZ430-Chronos Wrist Module

The core technology behind the eZ430-Chronos wrist module is the CC430F6137 microcontroller with its integrated <1-GHz radio. The CC430 also controls the LCD and its temperature sensor is used for temperature measurement. The only other ICs on the Chronos module PCB are pressure and acceleration sensors and the LCD backlight driver.

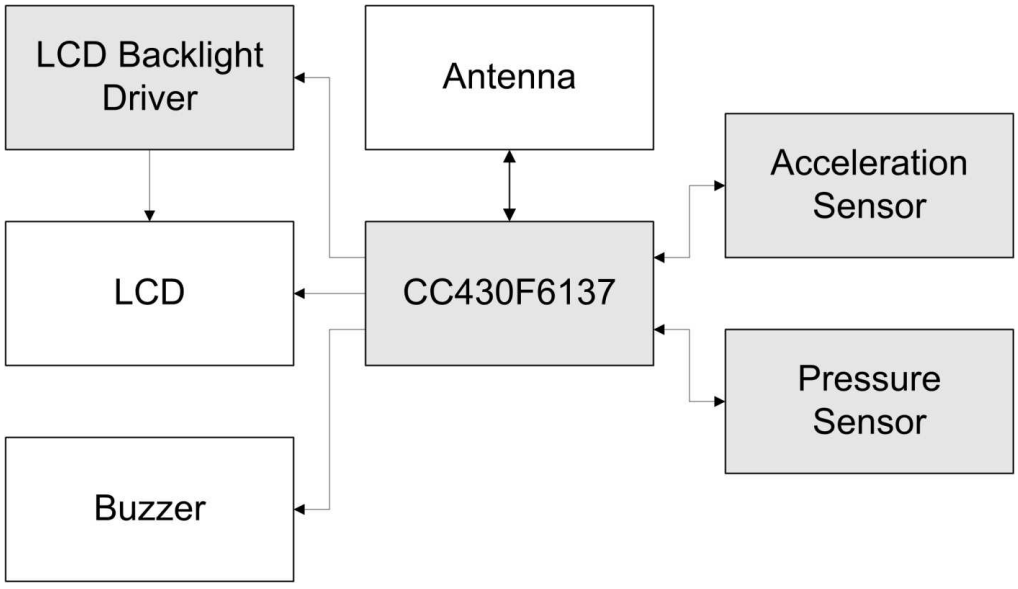


Figure 4-7. eZ430-Chronos Wrist Module Block Diagram

Copyright © 2009–2015, Texas Instruments Incorporated

The PCB does not include an antenna; the metal frame of the Chronos module that surrounds the LCD is used as antenna. The antenna is tuned for best performance when the Chronos module is worn or held in hands.

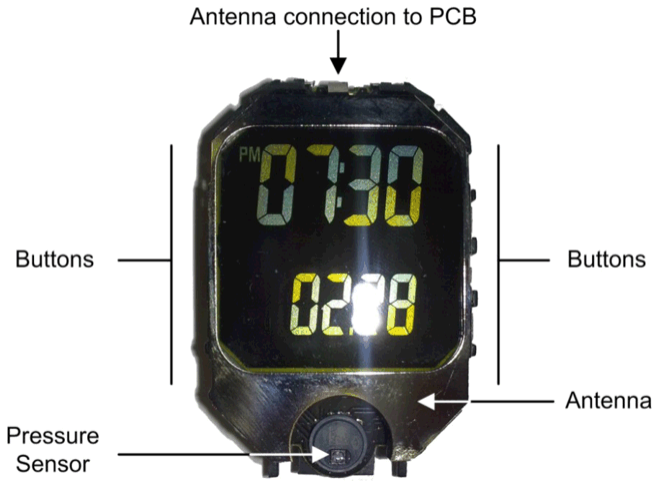


Figure 4-8. eZ430-Chronos Module Front

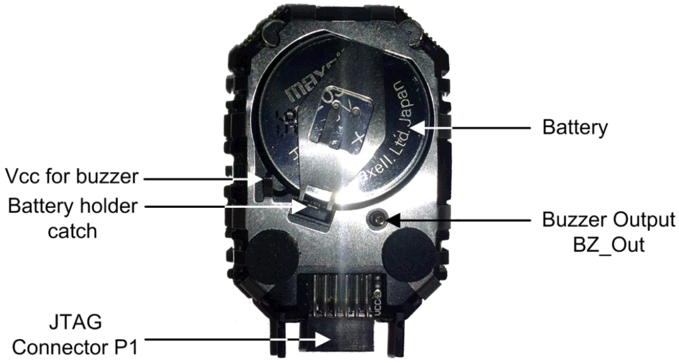


Figure 4-9. eZ430-Chronos Module Back

Table 4-1. Estimated Battery Life (Demo Software)

Mode	Average Current	Battery Life
Shelf mode (LPM4)	2.7 µA	92.6 months
Welcome screen (LPM3)	8.9 µA	28.0 months
Time and date	9.0 µA	27.7 months
Continuous temperature measurement	10.0 µA	25.0 months
Continuous altitude measurement	18.0 µA	13.8 months
Continuous acceleration measurement	166.0 µA	1.5 months
Continuous BlueRobin RX	40.0 µA	6.2 months
Continuous SimpliciTI PPT (no button pressed)	10.0 µA	25.0 months
Continuous SimpliciTI SYNC	0.9 mA	8 days
Continuous SimpliciTI ACC	3.7 mA	2 days
1 hour per day BlueRobin RX	10.3 µA	24.2 months
1 hour per day SimpliciTI PPT (no button pressed)	9.1 µA	25.4 months
1 hour per day SimpliciTI SYNC	46.1 µA	5.4 months
1 hour per day SimpliciTI ACC	169.9 µA	1.4 months

Copyright © 2009–2015, Texas Instruments Incorporated

4.3 Functional Description of the eZ430-Chronos RF Access Point

The RF access point allows wireless communication with the eZ430-Chronos directly from the PC to download data, sync information, or control programs running on the PC (see Figure 4-10).

4.3.1 Access Point With Black PCB

This access point is based on the CC1111F32 controller, which features an integrated USB controller in addition to a <1-GHz radio.

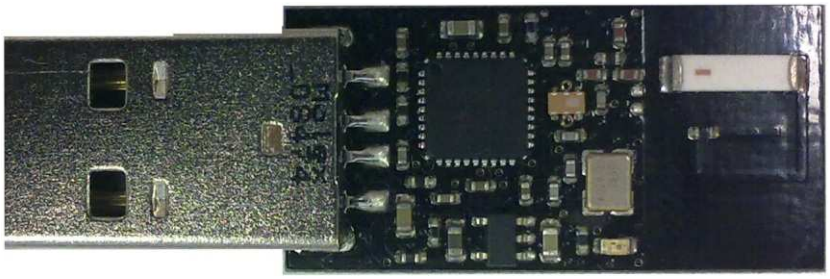


Figure 4-10. eZ430-Chronos RF Access Point

NOTE: The access point is this kit comes in a small production-ready design. Therefore, it does not include a JTAG connector. However, the bottom side provides pads that allow soldering cables to connect the CC1111 to the CC Debugger. TI also offers the professional CC1111EMK868-915 development kit including connectors and a push button.

To program the RF access point, a debug interface connector cable must be soldered to the CC1111 access point as shown in Figure 4-11.



Figure 4-11. eZ430-Chronos RF Access Point Connection to CC Debugger

CC-Debugger	RF Access Point
Pin 1	GND
Pin 2	Vcc
Pin 3	P2.2 (DC)
Pin 4	P2.1 (DD)
Pin 7	RST
Pin 9	Vcc

Copyright © 2009–2015, Texas Instruments Incorporated

4.3.2 Access Point With White PCB

This access point consists of an MSP430F5509 microcontroller connected to a <1-GHz transceiver (CC1101) (see Figure 4-12).

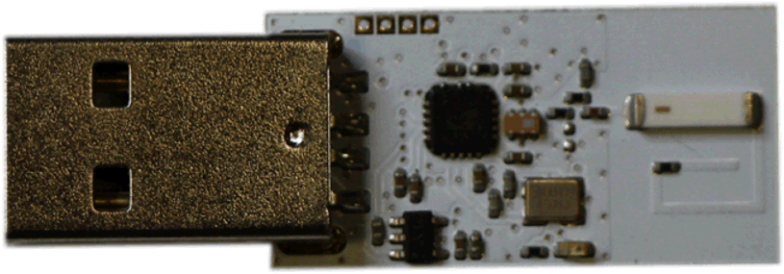


Figure 4-12. Access Point With White PCB

As shown in Figure 3-15, the RF access point can be reprogrammed by connecting the eZ430 USB emulator to the access point. First of all, solder the 4-pin debugger connector (provided with the kit) onto the access point.

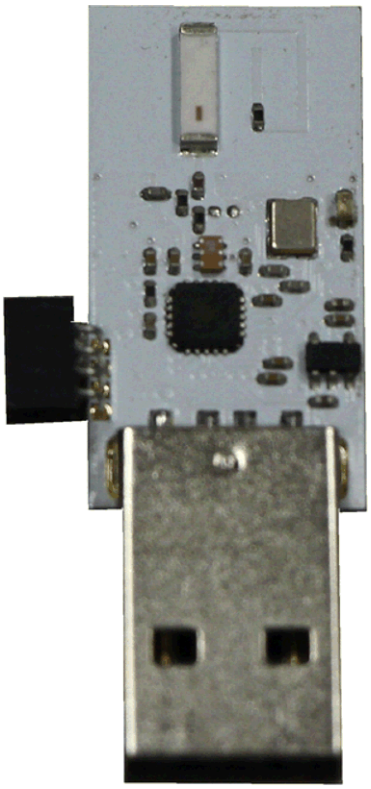


Figure 4-13. Access Point With Connector

Copyright © 2009–2015, Texas Instruments Incorporated

4.4 Functional Description of the eZ430-Chronos Debug Interface

The eZ430-Chronos kit includes an USB emulator that provides full programming and debugging features using its Spy-Bi-Wire (2-wire) interface. It features a back channel MSP430 application UART that may be used independently of a debug session.

NOTE: The eZ430 USB emulator with white or black PCB are identical from a hardware perspective.

Despite the fact that the Chronos module is equipped with a 6-pin connector, there is no UART connection from the Chronos module to the emulator as all pins of the CC430 are already used for other purposes.

Supported devices:

- CC430F51xx
- CC430F61xx
- MSP430F20xx
- MSP430F21x2
- MSP430F22xx
- MSP430F41x2
- MSP430F54xx
- MSP430F54xxA
- MSP430F55xx

Connector J1 on the emulator (starting on top with pin 1) (see Figure 4-14).

- UART TX (from emulator to target)
- 3.6-V supply for target
- TEST/SBWTCK
- RST/SBWTDIO
- GND
- UART RX (from target to emulator)

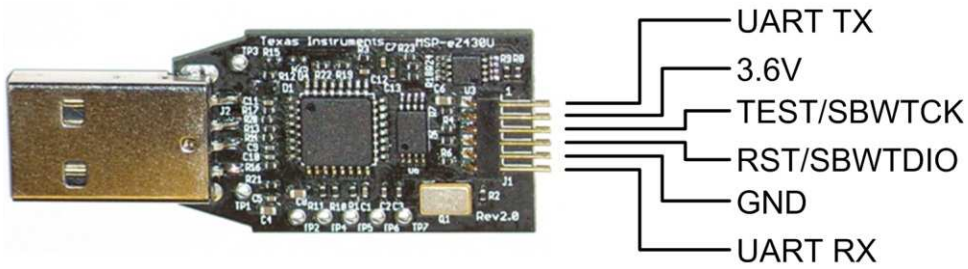


Figure 4-14. eZ430-Chronos Debug Interface

4.4.1 MSP430 Application UART

The eZ430-Chronos emulator includes a back channel MSP430 Application UART that may be used independently of a debug session. This allows the user to transfer serial data to a terminal window at a fixed rate of 9600 bps with no flow control. Check the Device Manager for COM port assignment of the MSP430 Application UART (for more details, see Section B.3).

Copyright © 2009–2015, Texas Instruments Incorporated

4.5 Schematics, Layout, BOM, and LCD

Gerber files for the eZ430-Chronos wrist module are part of the eZ430-Chronos software packages for Windows SLAC341 and Linux SLAC388.

4.5.1 eZ430-Chronos-433 Wrist Module With Black PCB

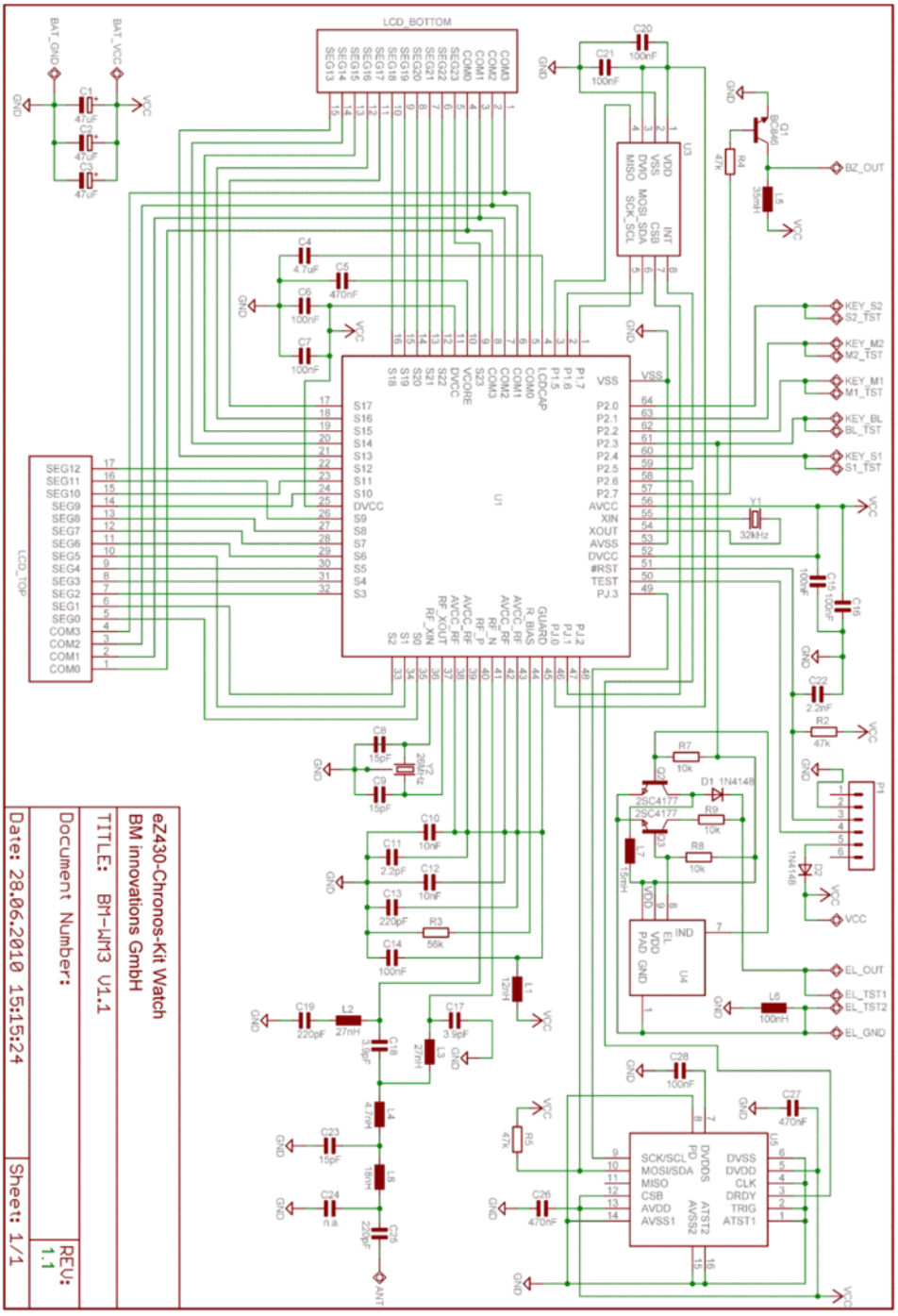


Figure 4-15. eZ430-Chronos-433 Wrist Module With Black PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

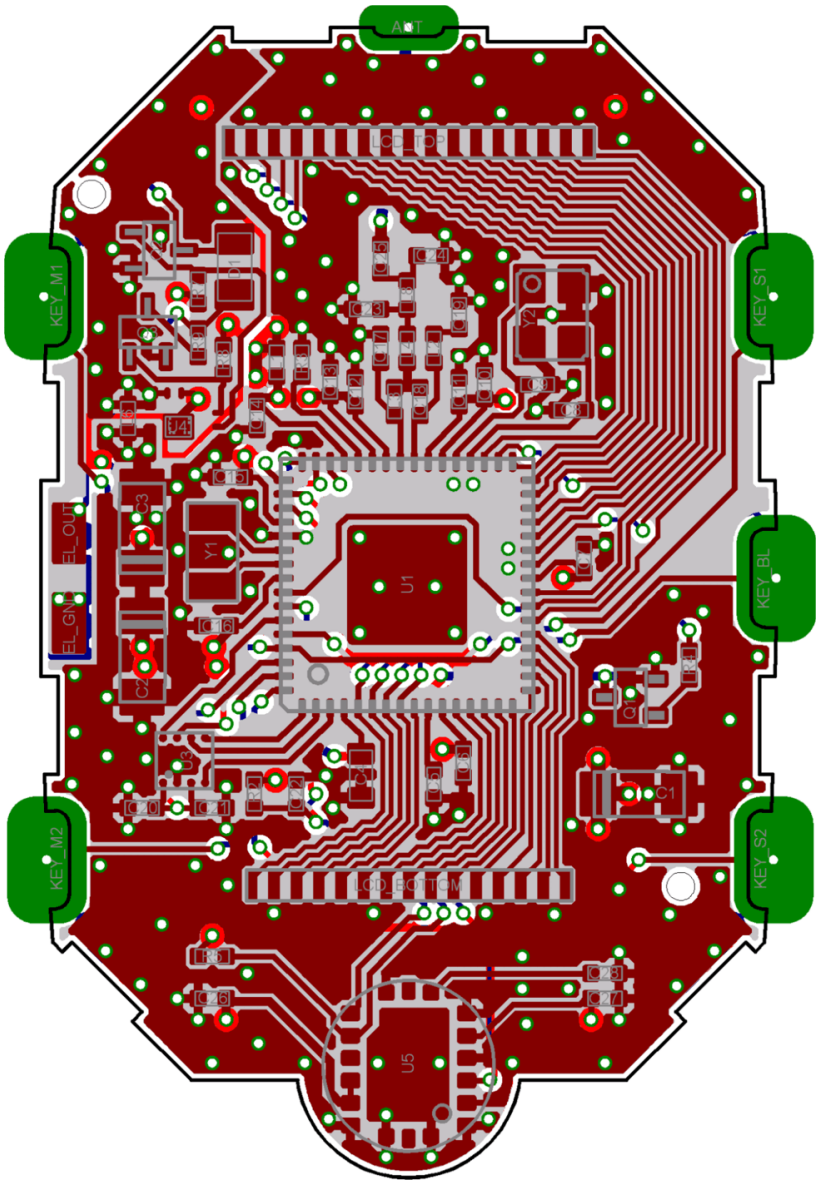


Figure 4-16. eZ430-Chronos-433 Wrist Module With Black PCB, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

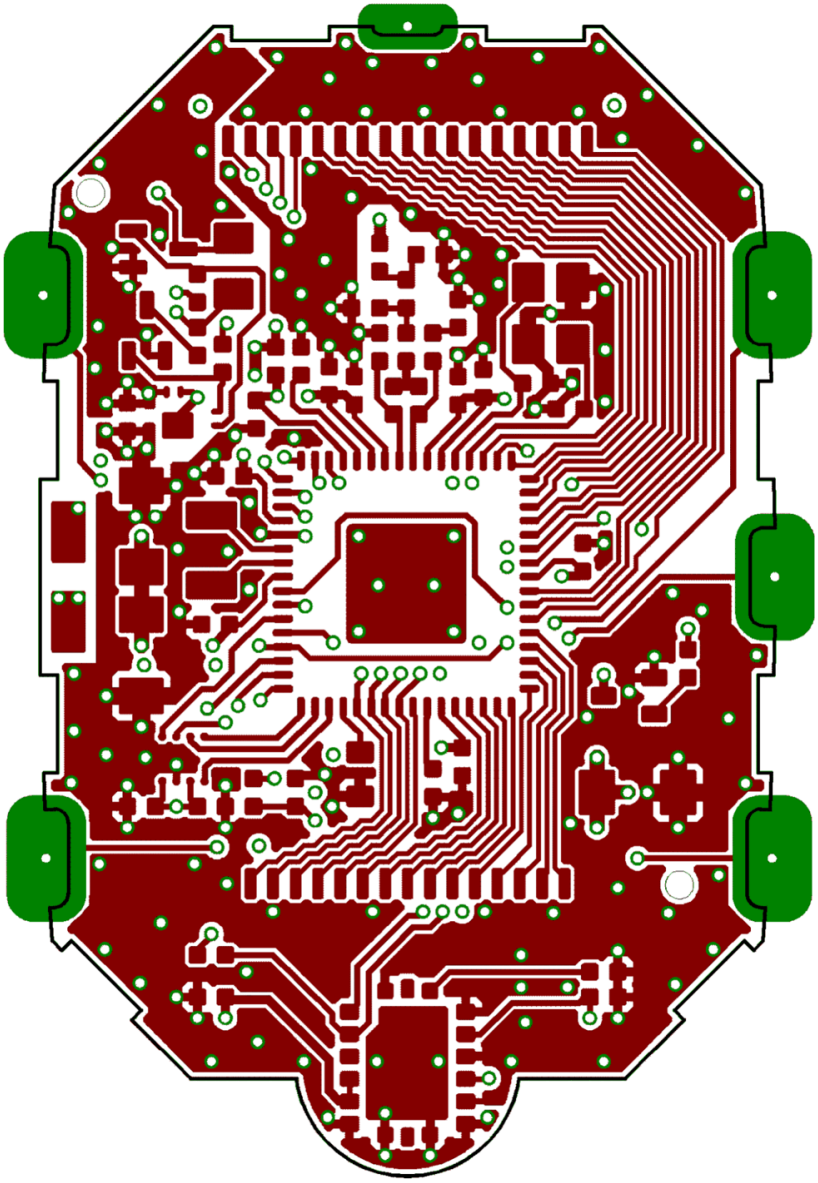


Figure 4-17. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Top Layer (LCD Side)

Copyright © 2009–2015, Texas Instruments Incorporated

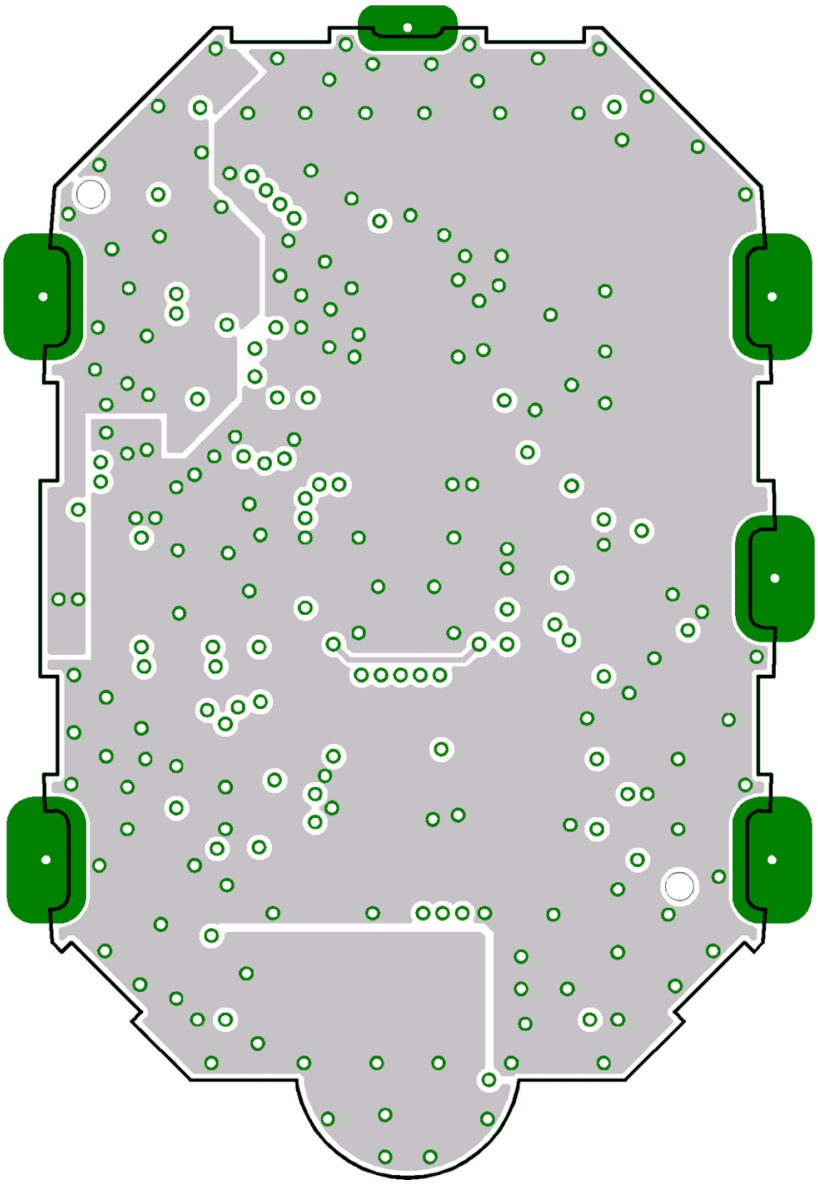


Figure 4-18. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Second Layer

Copyright © 2009–2015, Texas Instruments Incorporated

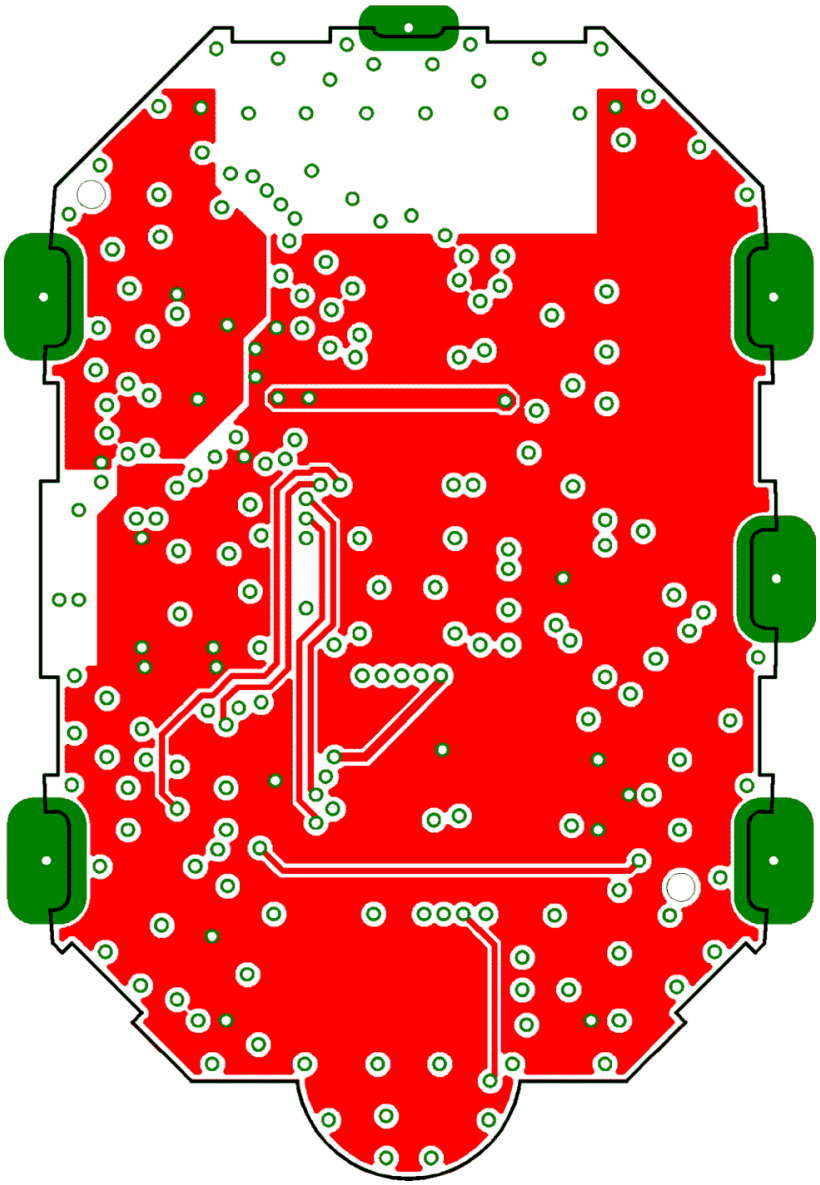


Figure 4-19. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Third Layer

Copyright © 2009–2015, Texas Instruments Incorporated

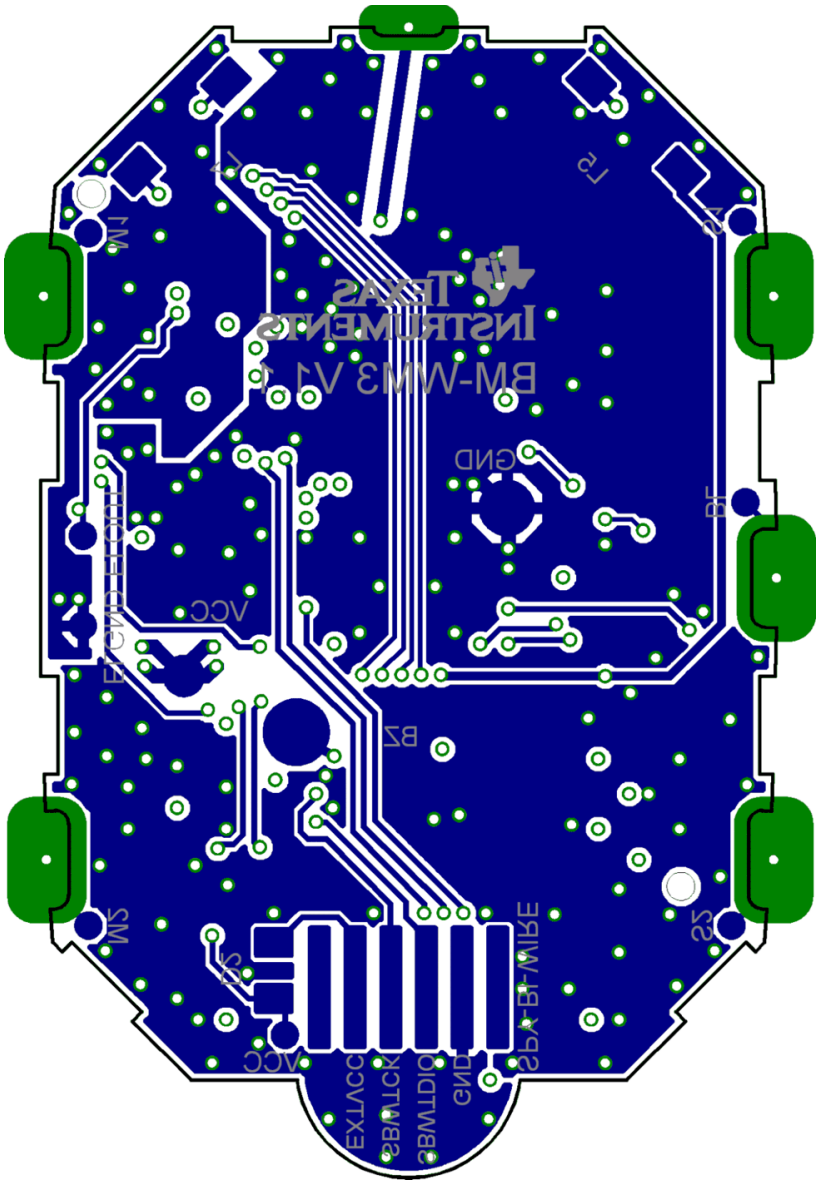


Figure 4-20. eZ430-Chronos-433 Wrist Module With Black PCB, Layout Bottom Layer (Battery Side)

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-2. eZ430-Chronos-433 Wrist Module With Black PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C2	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C3	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C4	4.7 µF	±20%, X5R	603	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	100 nF	±10%, X7R	402	Capacitor SMD	
C7	100 nF	±10%, X7R	402	Capacitor SMD	
C8	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C9	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25 pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	100 nF	±10%, X7R	402	Capacitor SMD	
C15	100 nF	±10%, X7R	402	Capacitor SMD	
C16	100 nF	±10%, X7R	402	Capacitor SMD	
C17	3.9 pF	±0.1 pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S3R9BV4
C18	3.9 pF	±0.1 pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S3R9BV4
C19	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C20	100 nF	±10%, X7R	402	Capacitor SMD	
C21	100 nF	±10%, X7R	402	Capacitor SMD	
C22	2.2 nF	±10%, X7R	402	Capacitor SMD	
C26	470 nF	±10%, X5R	402	Capacitor SMD	
C27	470 nF	±10%, X5R	402	Capacitor SMD	
C28	100 nF	±10%, X7R	402	Capacitor SMD	
D1	1N4148		805	Diode SMD	
D2	1N4148		805	Diode SMD	
L1	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV4
L2	27 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C27NJV4
L3	27 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C27NJV4
L4	4.7 nH	±0.3nH	402	Inductor Monolithic SMD	Johanson L-07C4N7SV4
L5	35 mH, RDC≤250Ω, IDC≥1mA	±10%		Inductor Coil	
L6	100 nH	±10%	402	Inductor Monolithic SMD	
L7	4mH, RDC≤100Ω, IDC≥10mA	±10%		Inductor Coil	
L8	18 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C18NJV4
P1	Female Header 1.27mm			Connector SMD	for example, MPE-Garry BL SMD 91-06
PCB1	CUSTOM, solder stop black			PCB, 4 layers, 0.6 mm thick	
Q1	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q2	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q3	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
R2	47k	±5%	402	Resistor SMD	
R3	56k	±1%	402	Resistor SMD	
R4	47k	±5%	402	Resistor SMD	
R5	47k	±5%	402	Resistor SMD	
R7	10k	±5%	402	Resistor SMD	
R8	10k	±5%	402	Resistor SMD	
R9	10k	±5%	402	Resistor SMD	

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-2. eZ430-Chronos-433 Wrist Module With Black PCB, BOM List (continued)

Designator	Value	Tolerance	Footprint	Description	Manufacturer
U1	CC430F6137IRGC		QFN64	MCU with ISM Transceiver	TI
U3	CMA3000-D01		WLP	Acceleration Sensor SPI	VTI
U4	HKA5403Q-30		DIE	EL Driver	
U5	SCP1000-D11			Pressure Sensor I2C	VTI
Y1	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	3.2 x 1.5 mm^2	Crystal SMD	Microcrystal CC7V-T1A
Y2	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021014300

Copyright © 2009–2015, Texas Instruments Incorporated

4.5.2 eZ430-Chronos-433 Wrist Module With White PCB

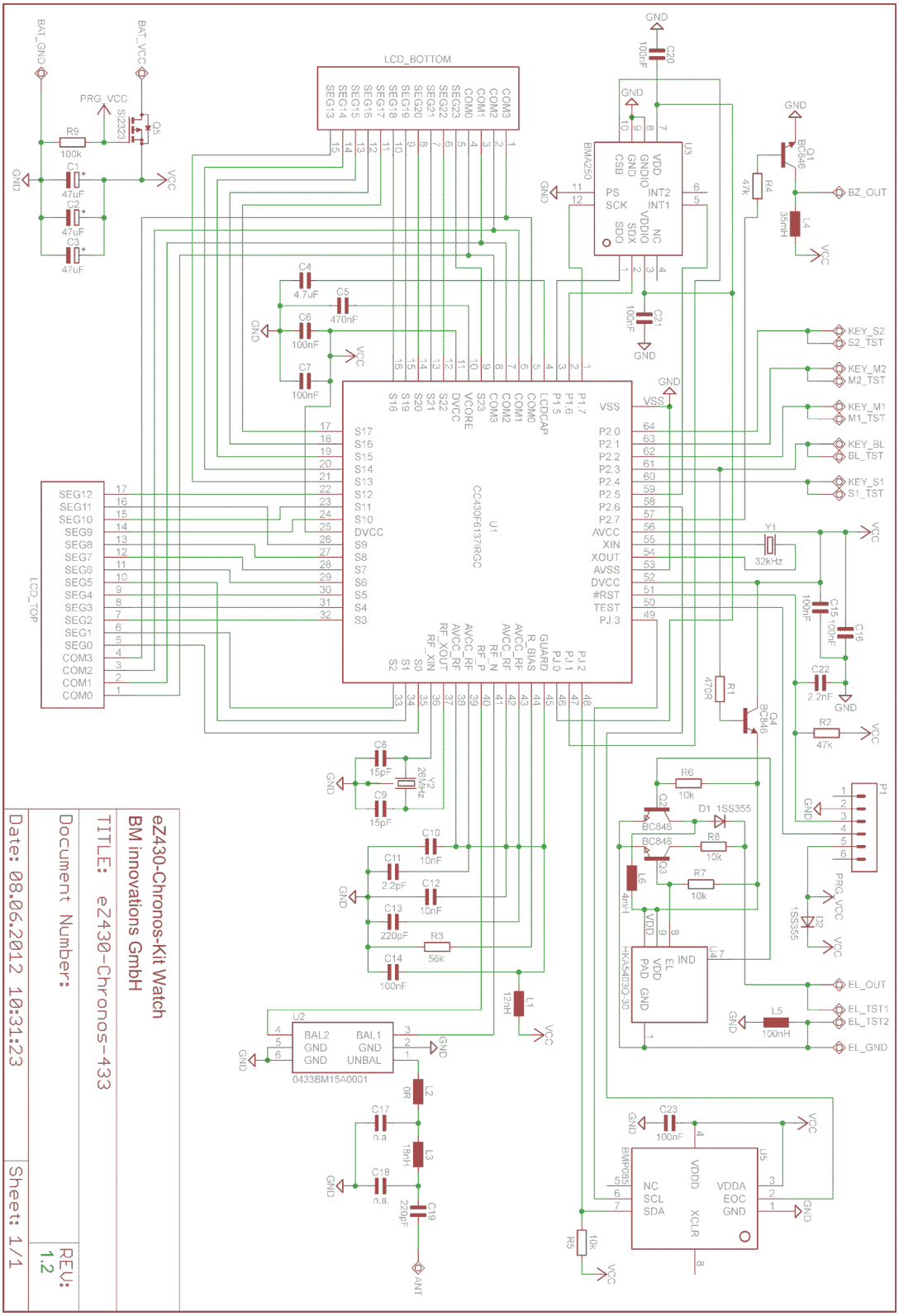


Figure 4-21. eZ430-Chronos-433 Wrist Module With White PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

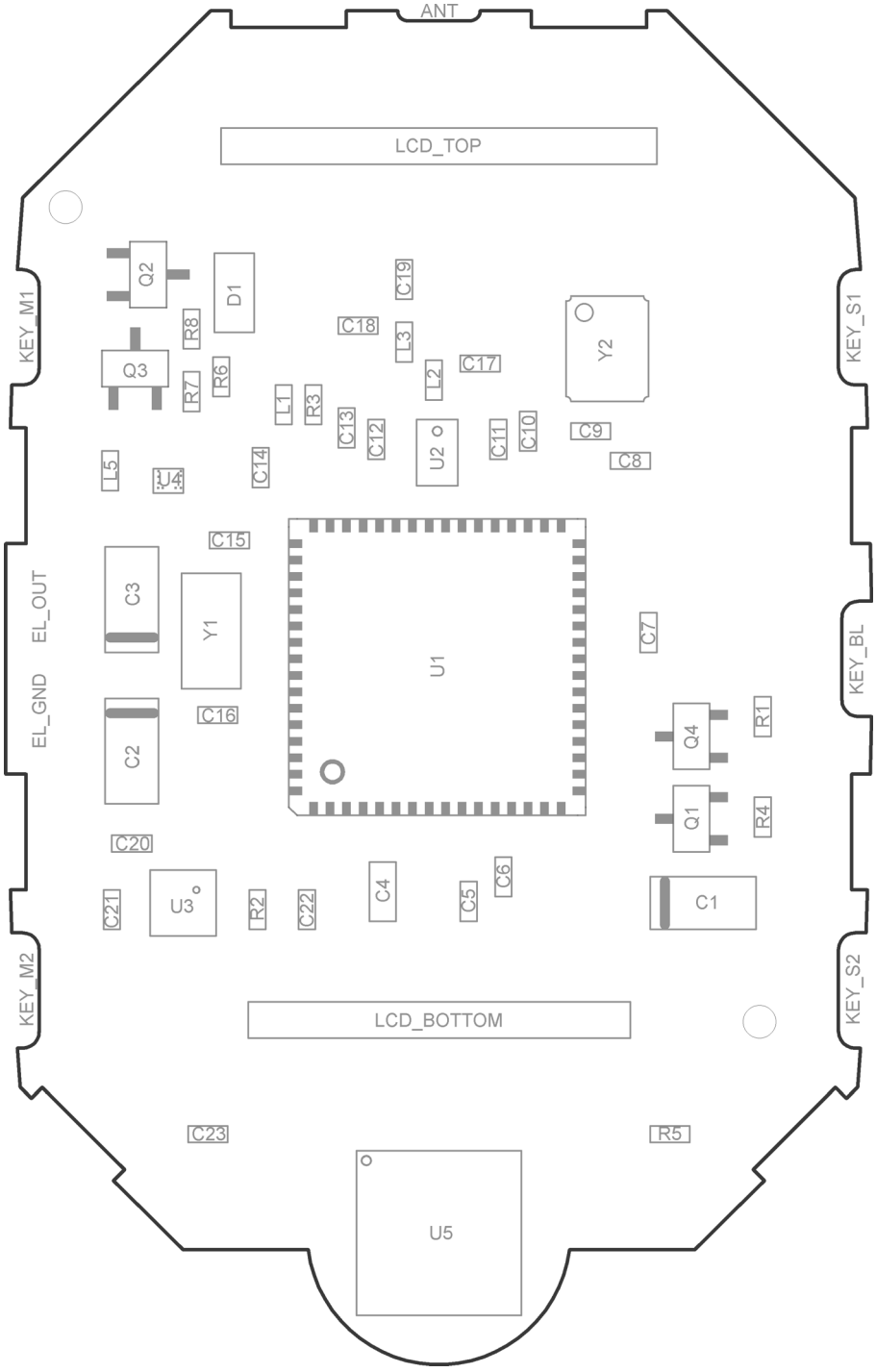


Figure 4-22. eZ430-Chronos-433 Wrist Module With White PCB, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

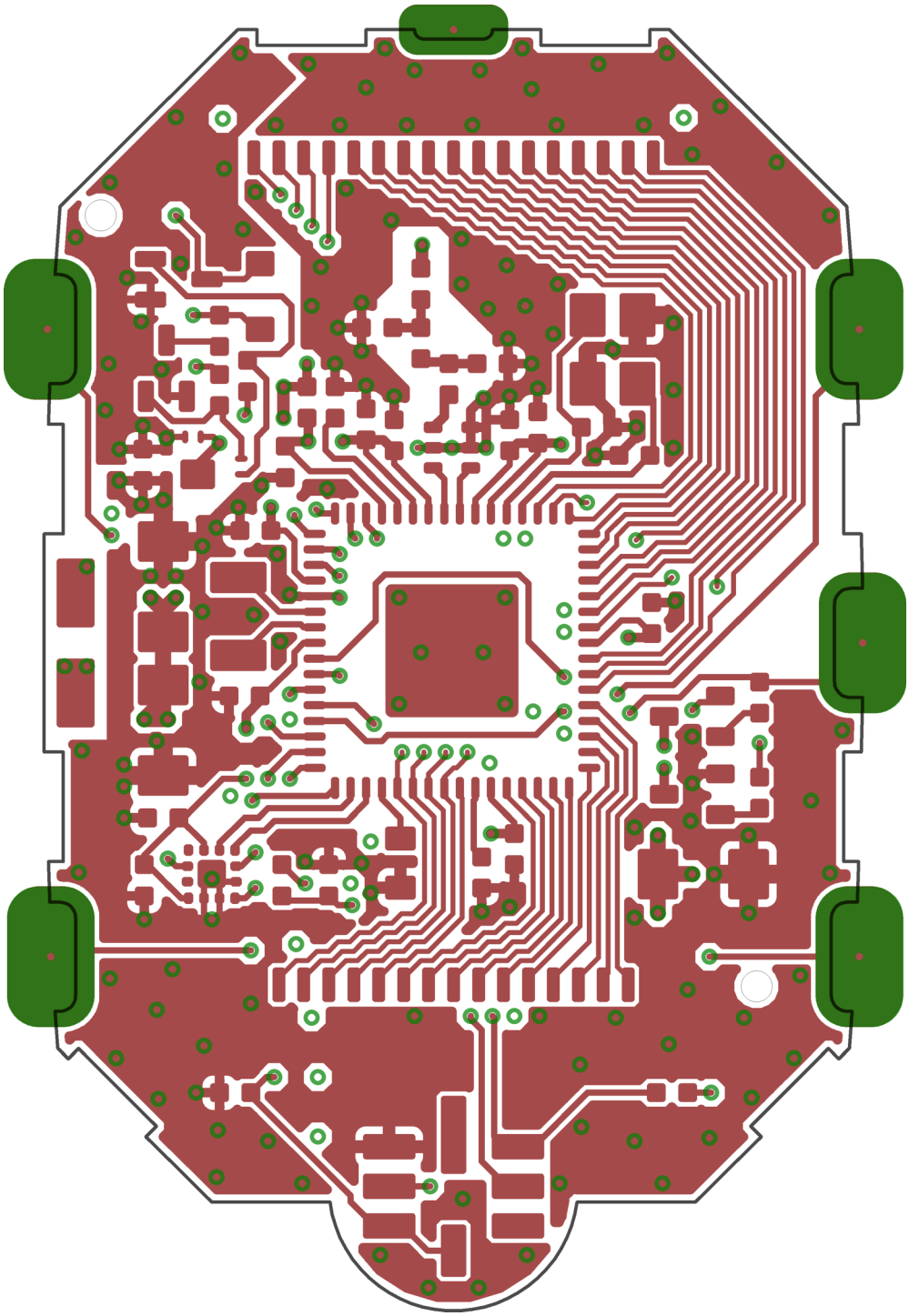


Figure 4-23. eZ430-Chronos-433 Wrist Module With White PCB, Layout Top Layer (LCD Side)

Copyright © 2009–2015, Texas Instruments Incorporated

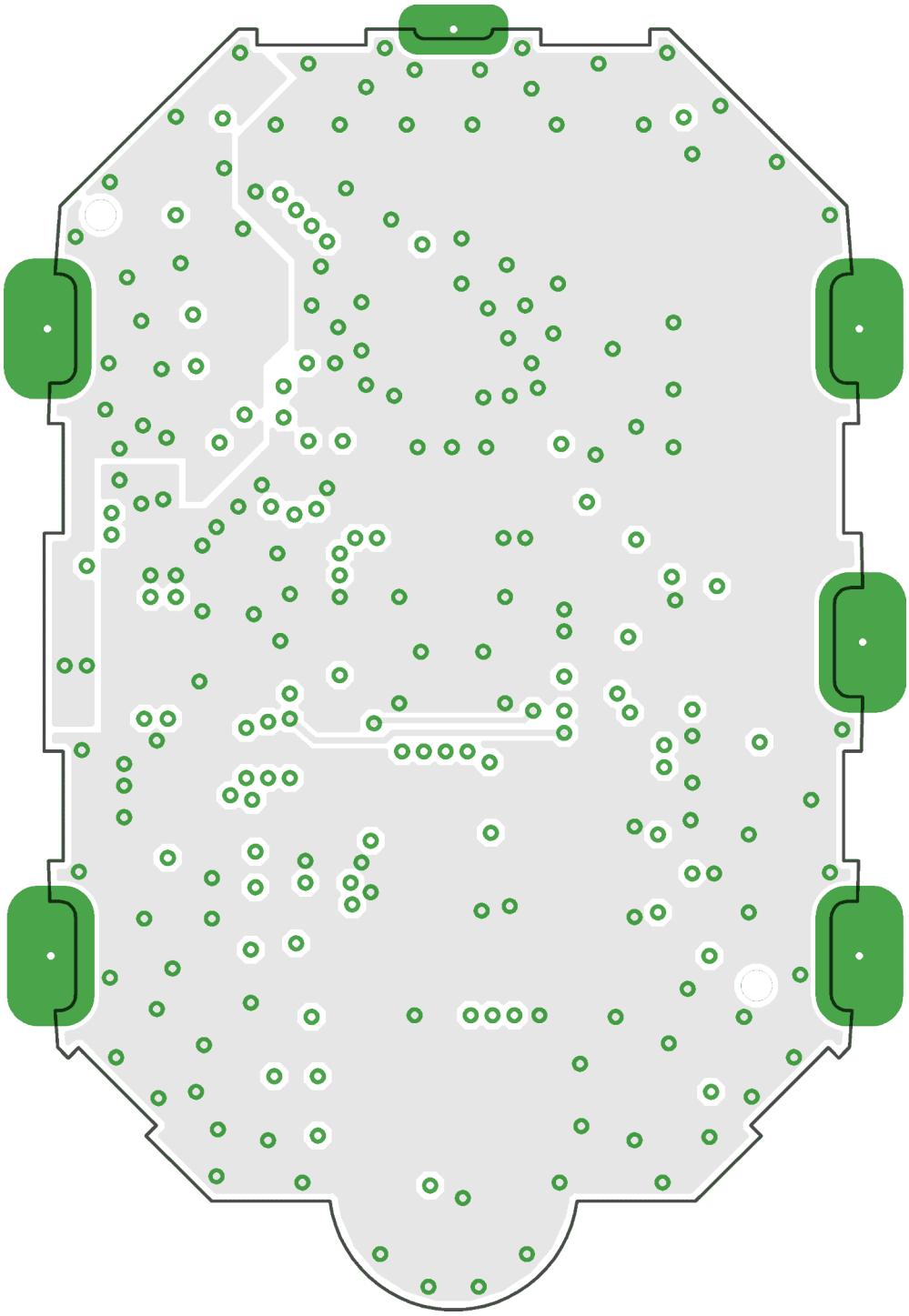


Figure 4-24. eZ430-Chronos-433 Wrist Module With White PCB, Layout Second Layer

Copyright © 2009–2015, Texas Instruments Incorporated

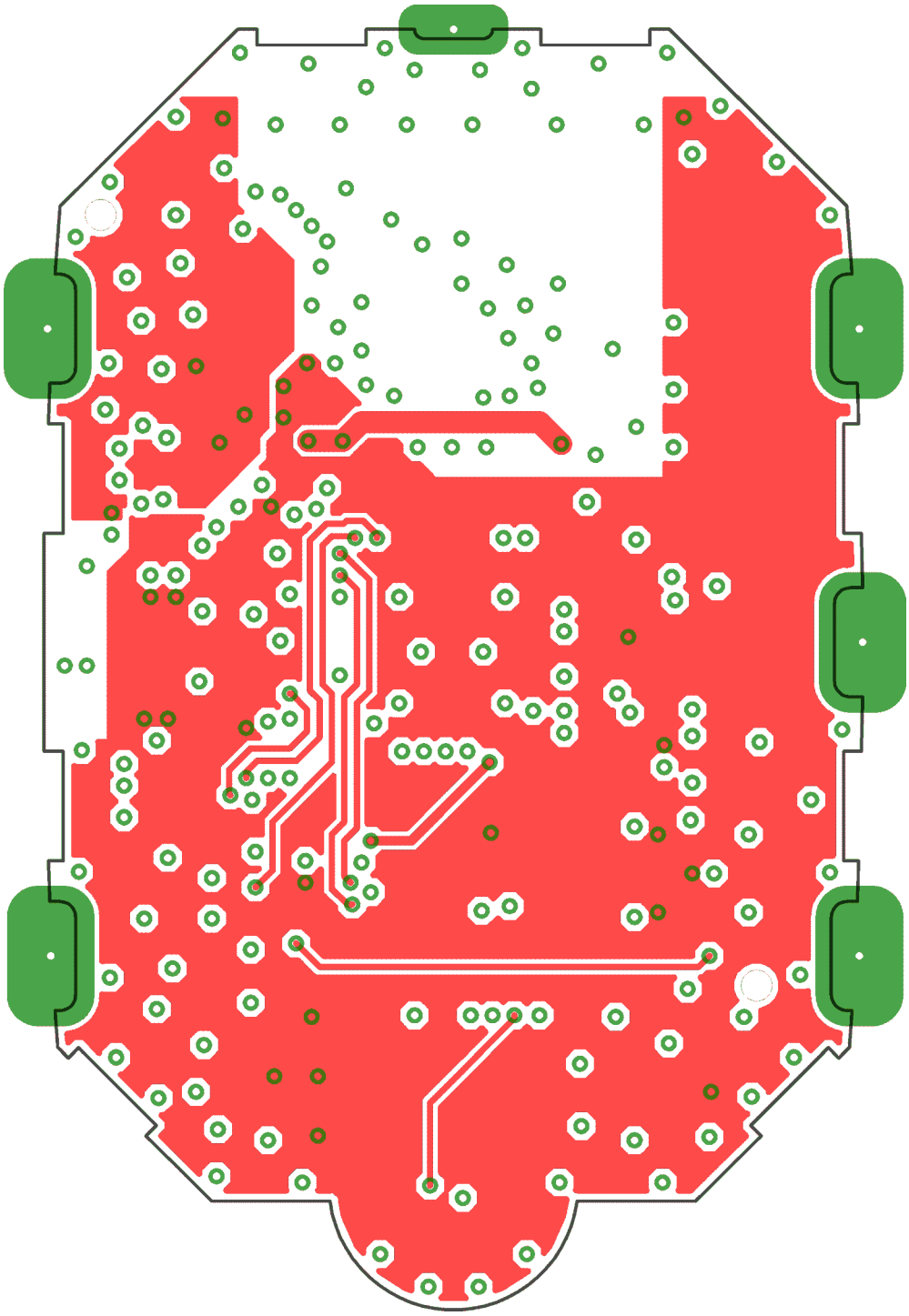


Figure 4-25. eZ430-Chronos-433 Wrist Module With White PCB, Layout Third Layer

Copyright © 2009–2015, Texas Instruments Incorporated

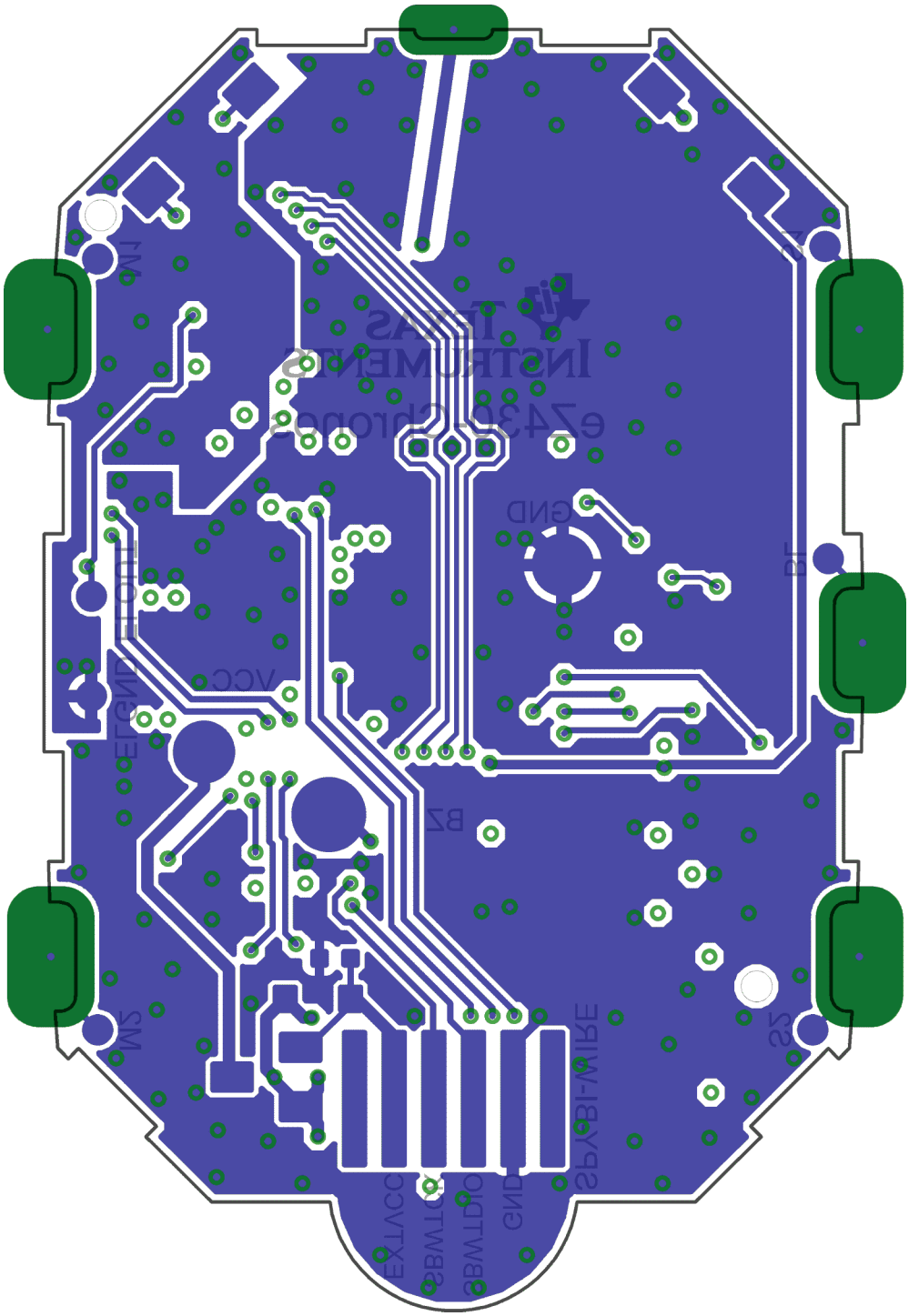


Figure 4-26. eZ430-Chronos-433 Wrist Module With White PCB, Layout Bottom Layer (Battery Side)

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-3. eZ430-Chronos-433 Wrist Module With White PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C2	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C3	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C4	4.7 µF	±20%, X5R	603	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C7	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C8	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C9	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25 pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C15	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C16	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C17	N.A.				
C18	N.A.				
C19	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C20	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C21	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C22	2.2 nF	±10%, X7R	402	Capacitor SMD	
C23	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
D1	1SS355		SOD323	Diode SMD	
D2	1SS355		SOD323	Diode SMD	
L1	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV4
L2(R)	0R	±5%	402	Resistor SMD	
L3	18 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C18NJV4
L4	35mH, RDC≤250Ω, IDC≥1mA	±10%		Inductor Coil	
L5	100 nH	±10%	402	Inductor Monolithic SMD	
L6	4 mH, RDC≤100Ω, IDC≥10mA	±10%		Inductor Coil	
P1	Female Header 1.27mm			Connector SMD	e.g. MPE-Garry BL SMD 91-06
PCB1	CUSTOM, solder stop white			PCB, 4 layers, 0.6 mm thick	
Q1	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q2	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q3	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q4	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q5	NTR4101P		SOT23	P-Channel MOSFET SMD	
R1	470R	±5%	402	Resistor SMD	
R2	47k	±5%	402	Resistor SMD	
R3	56k	±1%	402	Resistor SMD	
R4	47k	±5%	402	Resistor SMD	
R5	10k	±5%	402	Resistor SMD	
R6	10k	±5%	402	Resistor SMD	
R7	10k	±5%	402	Resistor SMD	
R8	10k	±5%	402	Resistor SMD	
R9	100k	±5%	402	Resistor SMD	

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-3. eZ430-Chronos-433 Wrist Module With White PCB, BOM List (continued)

Designator	Value	Tolerance	Footprint	Description	Manufacturer
U1	CC430F6137IRGC		QFN64	MCU with ISM Transceiver	TI
U2	0433BM15A0001			Balun 433MHz	Johanson
U3	BMA250		LGA12	Acceleration Sensor SPI	Bosch Sensortec
U4	HKA5403Q-30		DIE	EL Driver	
U5	BMP085			Pressure Sensor I2C	Bosch Sensortec
Y1	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	3.2 x 1.5mm^2	Crystal SMD	Microcrystal CM7V-T1A
Y2	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021014300

Copyright © 2009–2015, Texas Instruments Incorporated

4.5.3 eZ430-Chronos-868 and -915 Wrist Modules With Black PCB

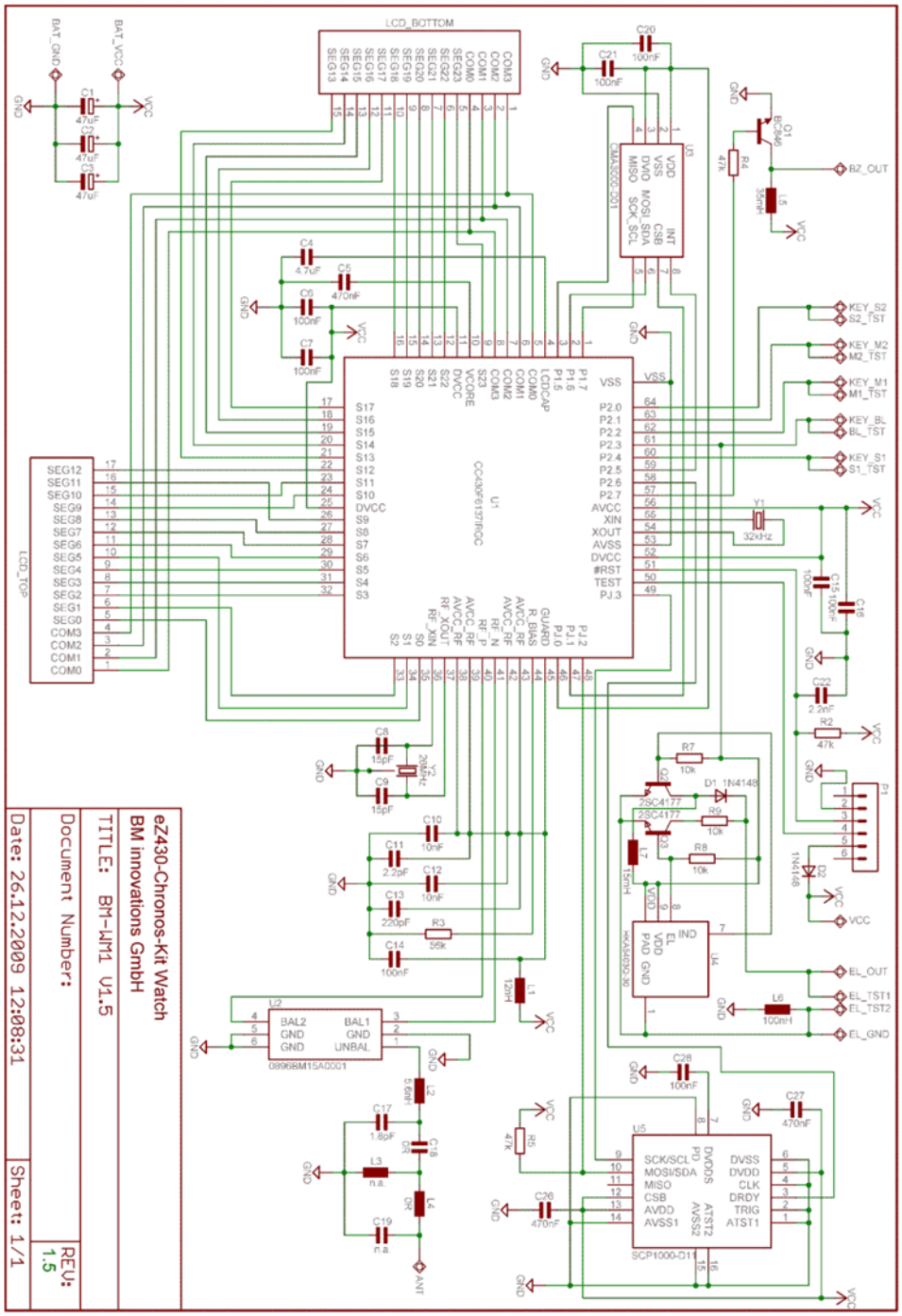


Figure 4-27. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

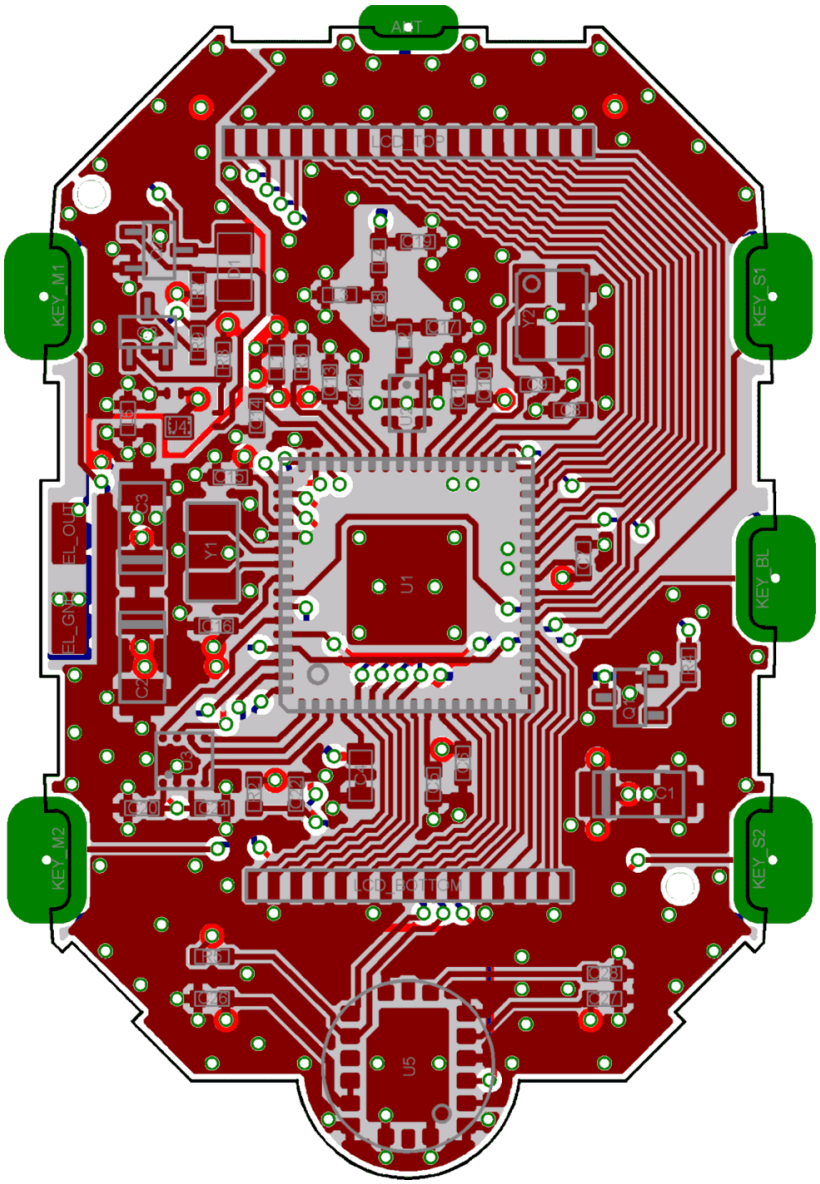


Figure 4-28. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

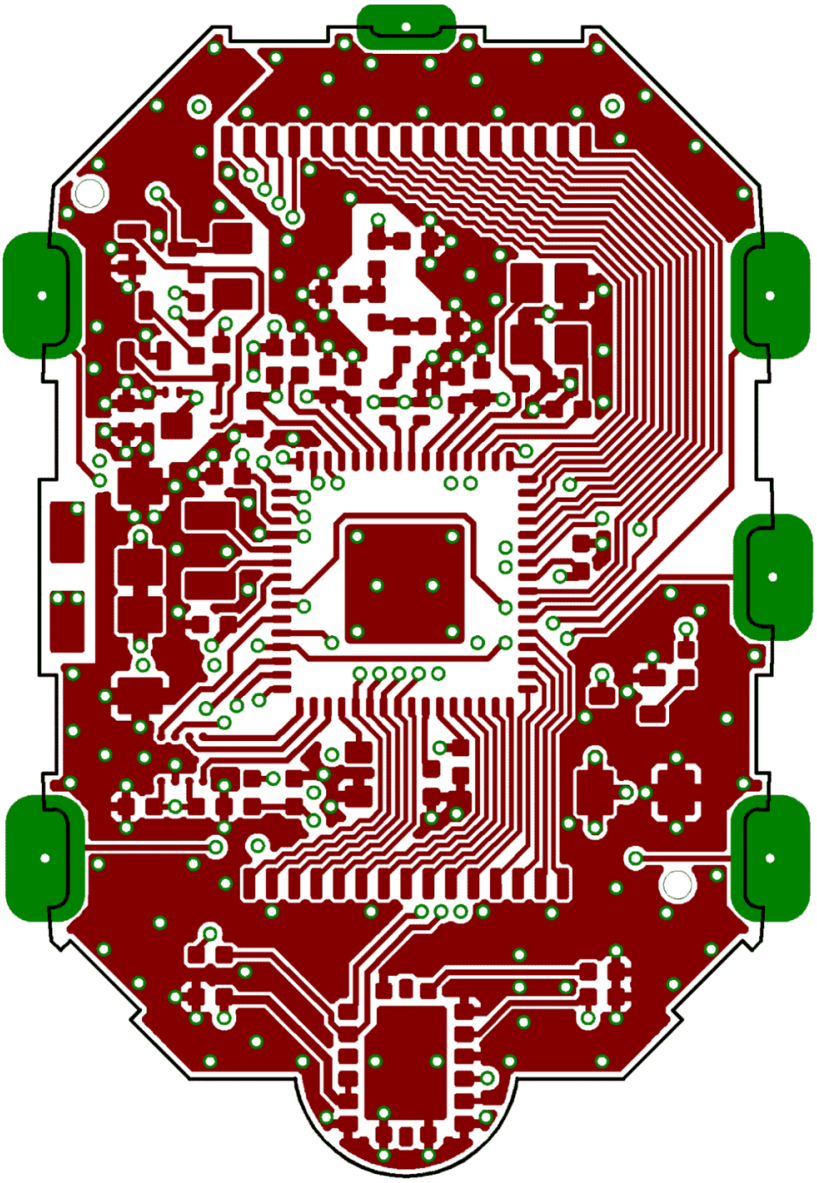


Figure 4-29. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Top Layer (LCD Side)

Copyright © 2009–2015, Texas Instruments Incorporated

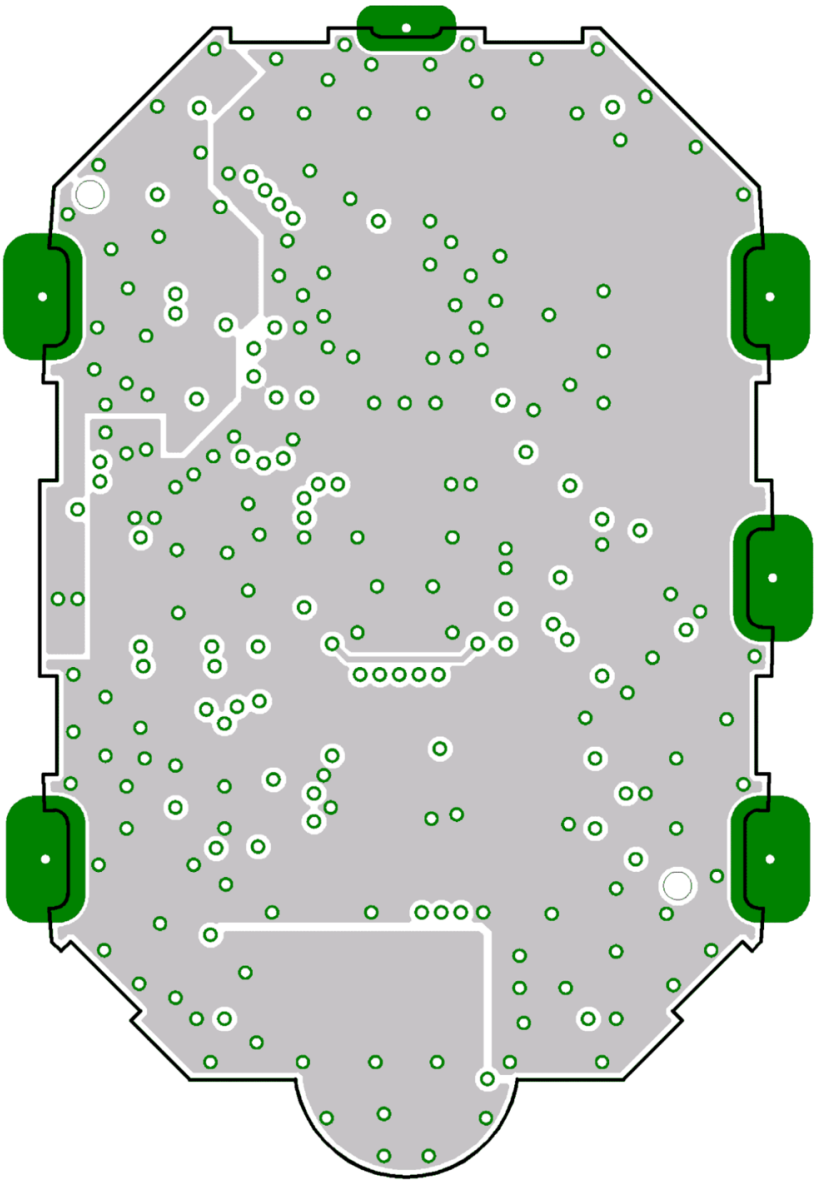


Figure 4-30. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Second Layer

Copyright © 2009–2015, Texas Instruments Incorporated

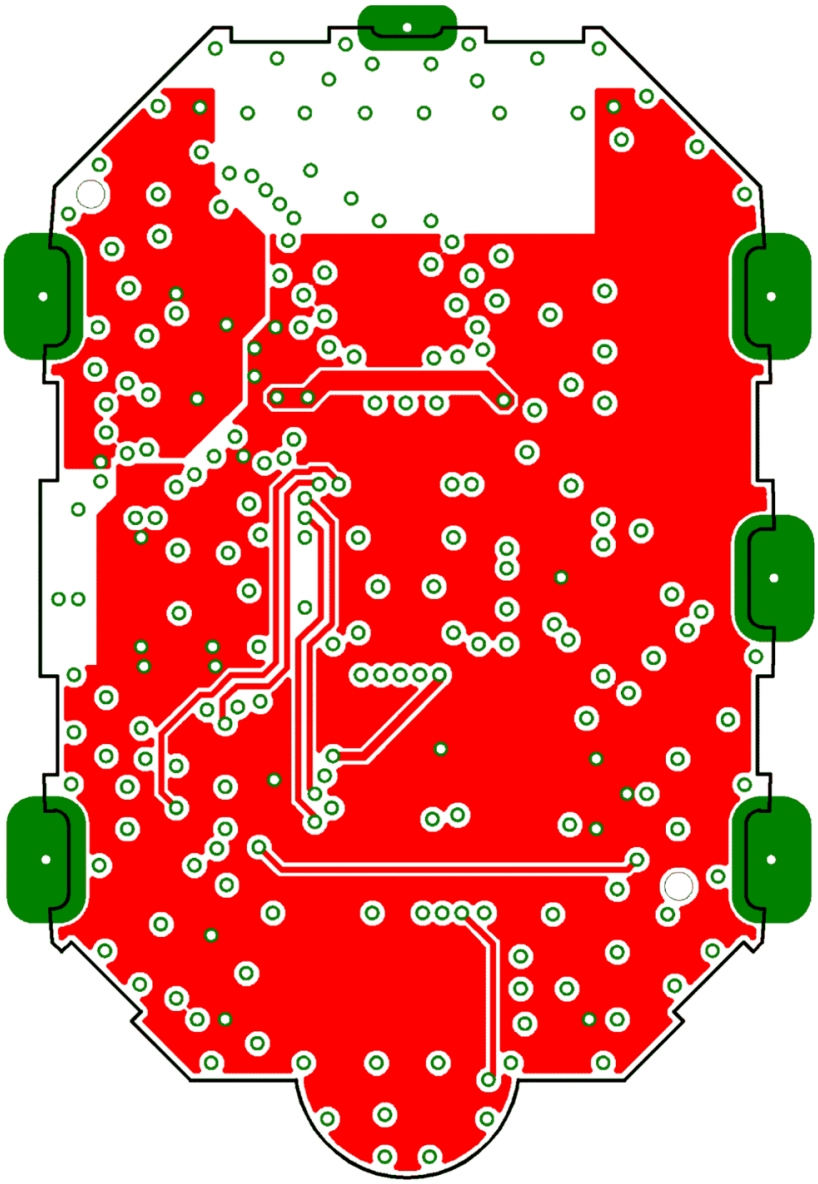


Figure 4-31. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Third Layer

Copyright © 2009–2015, Texas Instruments Incorporated

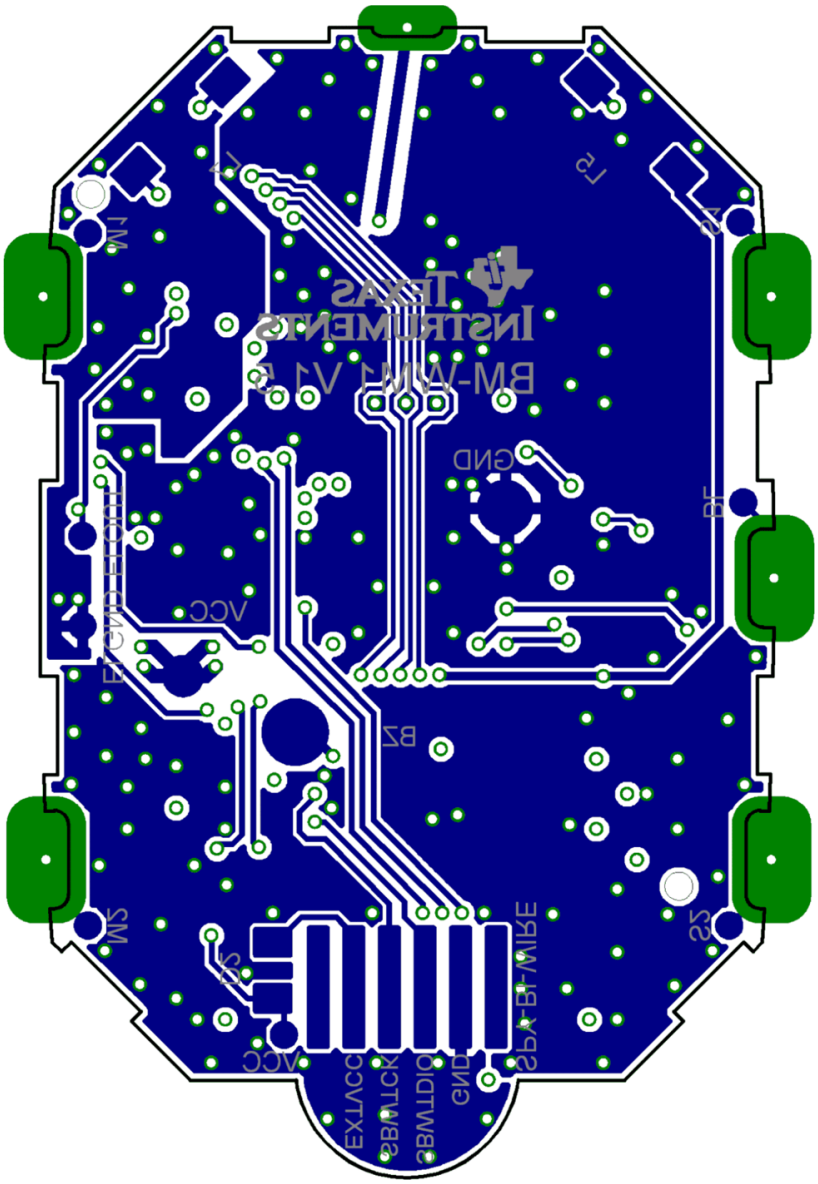


Figure 4-32. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, Layout Bottom Layer (Battery Side)

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-4. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6mm
C2	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6mm
C3	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6mm
C4	4.7 µF	±20%, X5R	603	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	100 nF	±10%, X7R	402	Capacitor SMD	
C7	100 nF	±10%, X7R	402	Capacitor SMD	
C8	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C9	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	100 nF	±10%, X7R	402	Capacitor SMD	
C15	100 nF	±10%, X7R	402	Capacitor SMD	
C16	100 nF	±10%, X7R	402	Capacitor SMD	
C17	1.8 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S1R8BV4
C18	0R	±5%	402	Resistor SMD	
C19	N.A.				
C20	100 nF	±10%, X7R	402	Capacitor SMD	
C21	100 nF	±10%, X7R	402	Capacitor SMD	
C22	2.2 nF	±10%, X7R	402	Capacitor SMD	
C26	470 nF	±10%, X5R	402	Capacitor SMD	
C27	470 nF	±10%, X5R	402	Capacitor SMD	
C28	100 nF	±10%, X7R	402	Capacitor SMD	
D1	1N4148		805	Diode SMD	
D2	1N4148		805	Diode SMD	
L1	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV4
L2	5.6 nH	±0.3nH	402	Inductor Monolithic SMD	Johanson L-07C5N6SV4
L3	N.A.				
L4	0R	±5%	402	Resistor SMD	
L5	35 mH, RDC≤250Ω, IDC≥1mA	±10%		Inductor Coil	
L6	100nH	±10%	402	Inductor Monolithic SMD	
L7	4mH, RDC≤100Ω, IDC≥10mA	±10%		Inductor Coil	
P1	Female Header 1.27mm			Connector SMD	for example, MPE-Garry BL SMD 91-06
PCB1	CUSTOM, solder stop black			PCB, 4 layers, 0.6 mm thick	
Q1	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q2	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q3	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
R2	47k	±5%	402	Resistor SMD	
R3	56k	±1%	402	Resistor SMD	
R4	47k	±5%	402	Resistor SMD	
R5	47k	±5%	402	Resistor SMD	
R7	10k	±5%	402	Resistor SMD	
R8	10k	±5%	402	Resistor SMD	
R9	10k	±5%	402	Resistor SMD	
U1	CC430F6137IRGC		QFN64	MCU with ISM Transceiver	TI

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-4. eZ430-Chronos-868 and -915 Wrist Modules With Black PCBs, BOM List (continued)

Designator	Value	Tolerance	Footprint	Description	Manufacturer
U2	0896BM15A0001			896MHz Balun	Johanson
U3	CMA3000-D01		WLP	Acceleration Sensor SPI	VTI
U4	HKA5403Q-30		DIE	EL Driver	
U5	SCP1000-D11			Pressure Sensor I2C	VTI
Y1	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	3.2 x 1.5 mm^2	Crystal SMD	Microcrystal CC7V-T1A
Y2	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021014300

Copyright © 2009–2015, Texas Instruments Incorporated

4.5.4 eZ430-Chronos-868 and -915 Wrist Modules With White PCB

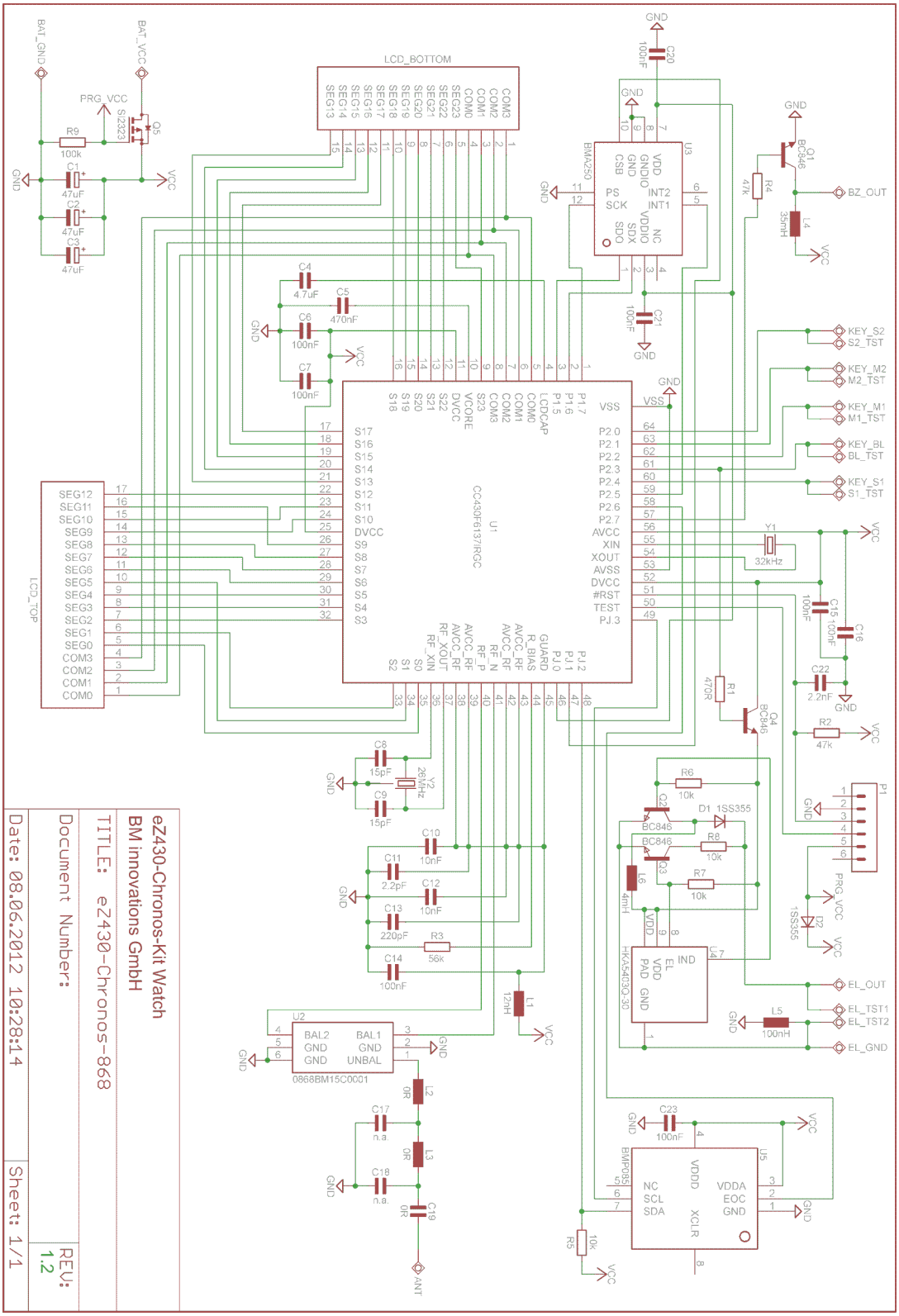


Figure 4-33. eZ430-Chronos-868 Wrist Modules With White PCBs, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

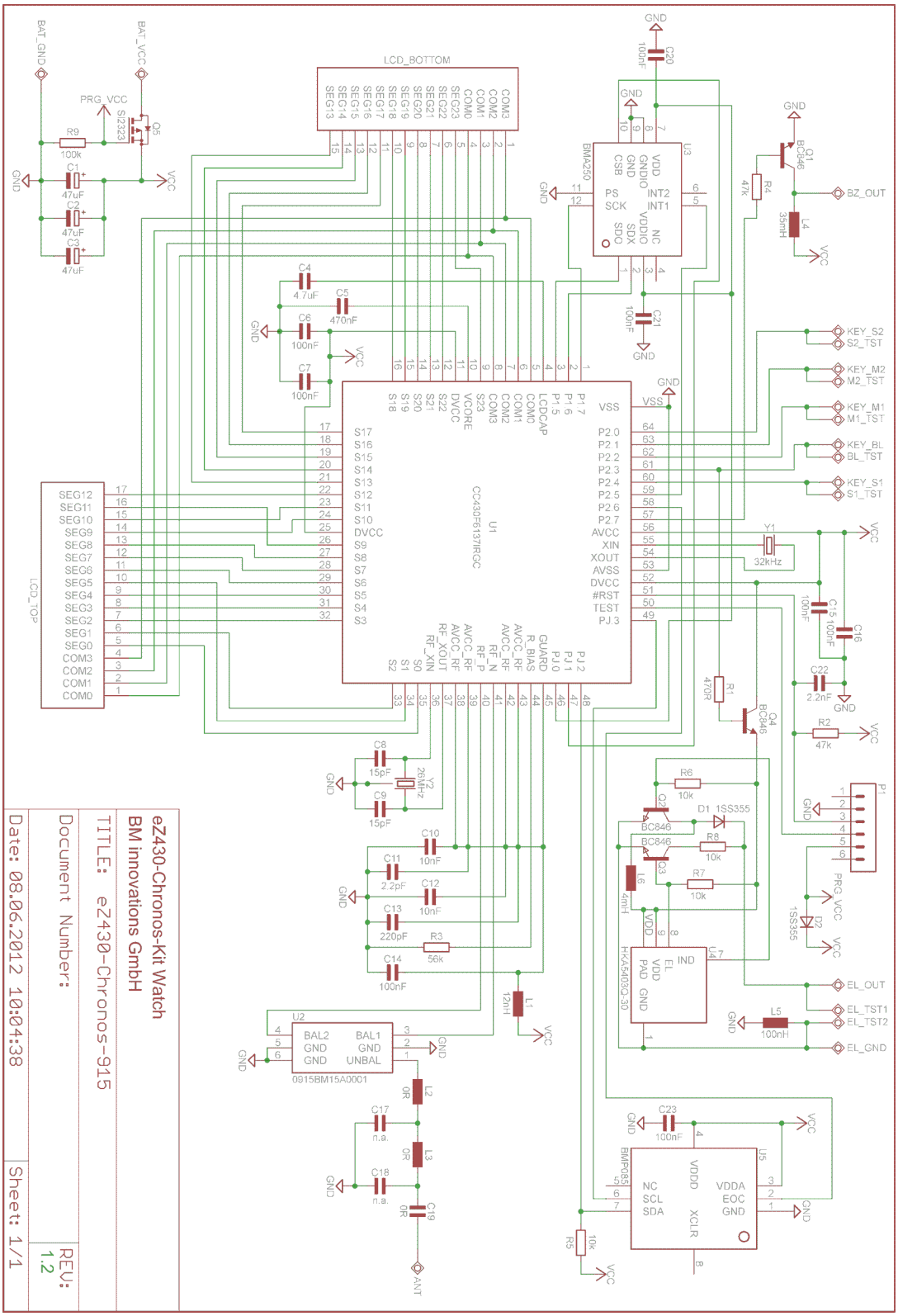


Figure 4-34. eZ430-Chronos-915 Wrist Modules With White PCBs, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

NOTE: The layers for the eZ430-Chronos-433 wrist module with White PCB also apply to the following layers. Table 4-5 shows the applicable images.

Table 4-5. eZ430-Chronos-868 and -915 PCB Cross Reference

PCB Layer	Figure Reference
eZ430-Chronos-868 and -915 Wrist Modules With White PCBs, PCB Components on Top Layer	Figure 4-22
eZ430-Chronos-868 and -915 Wrist Modules With White PCBs, Layout Top Layer (LCD Side)	Figure 4-23
eZ430-Chronos-868 and -915 Wrist Modules With White PCBs, Layout Second Layer	Figure 4-24
eZ430-Chronos-868 and -915 Wrist Modules With White PCBs, Layout Third Layer	Figure 4-25
eZ430-Chronos-868 and -915 Wrist Modules With White PCBs, Layout Bottom Layer (Battery Side)	Figure 4-26

Table 4-6. eZ430-Chronos-868 Wrist Module With White PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C2	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C3	47 µF	±20%	TAJ-A	Capacitor SMD	Tantalum, height max. 1.6 mm
C4	4.7 µF	±20%, X5R	603	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C7	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C8	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C9	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C15	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C16	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C17	N.A.				
C18	N.A.				
C19 (R)	0R	±5%	402	Capacitor SMD	
C20	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C21	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C22	2.2 nF	±10%, X7R	402	Capacitor SMD	
C23	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
D1	1SS355		SOD323	Diode SMD	
D2	1SS355		SOD323	Diode SMD	
L1	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV4
L2 (R)	0R	±5%	402	Resistor SMD	
L3 (R)	0R	±5%	402	Resistor SMD	
L4	35 mH, RDC≤250 Ω, IDC≥1 mA	±10%		Inductor Coil	
L5	100 nH	±10%	402	Inductor Monolithic SMD	
L6	4 mH, RDC≤100 Ω, IDC≥10 mA	±10%		Inductor Coil	
P1	Female Header 1.27mm			Connector SMD	e.g. MPE-Garry BL SMD 91-06
PCB1	CUSTOM, solder stop white			PCB, 4 layers, 0.6 mm thick	

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-6. eZ430-Chronos-868 Wrist Module With White PCB, BOM List (continued)

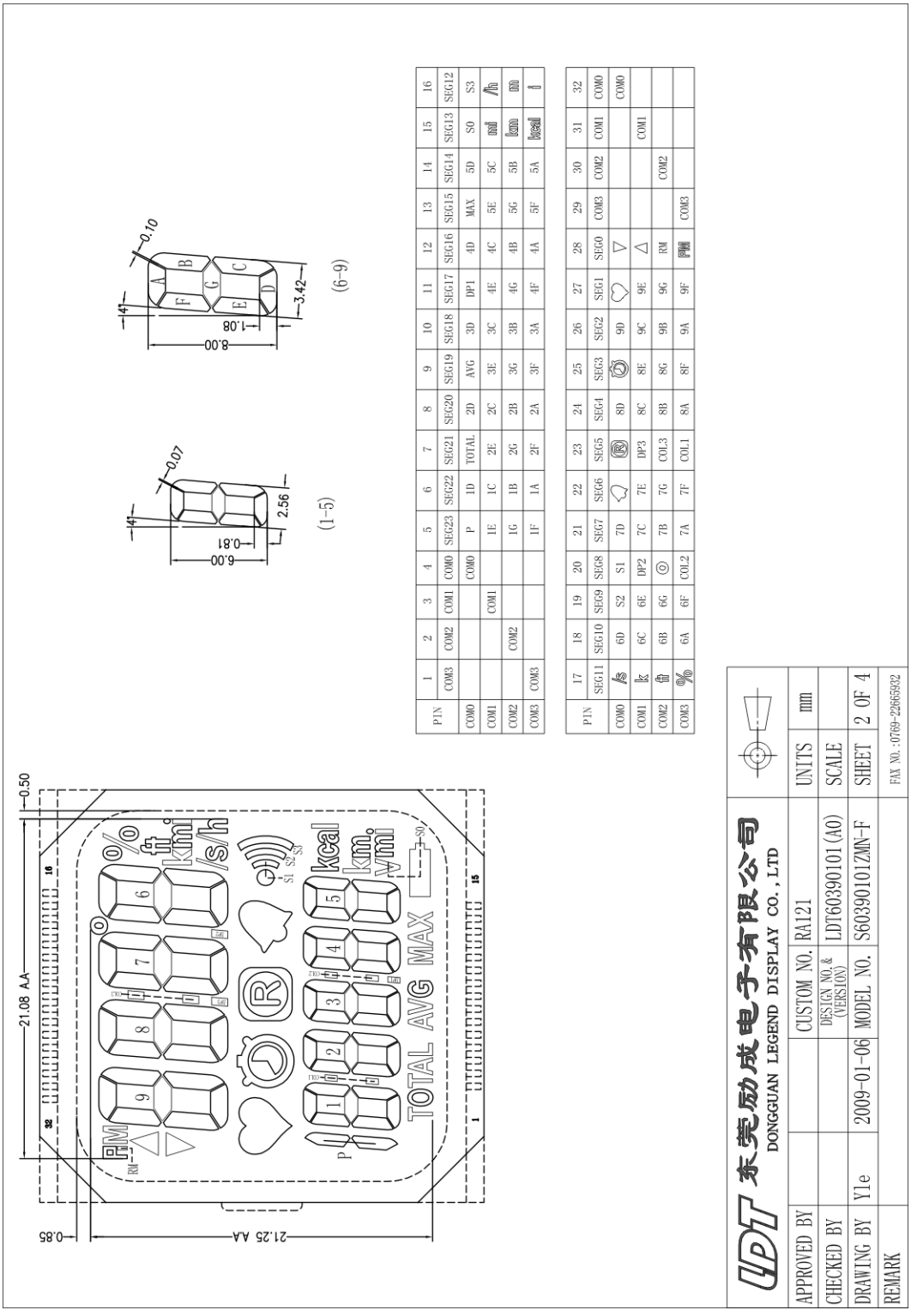
Designator	Value	Tolerance	Footprint	Description	Manufacturer
Q1	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q2	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q3	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q4	BC846BW or BC847BW		SOT323	Bipolar Transistor NPN SMD	
Q5	NTR4101P		SOT23	P-Channel MOSFET SMD	
R1	470R	±5%	402	Resistor SMD	
R2	47k	±5%	402	Resistor SMD	
R3	56k	±1%	402	Resistor SMD	
R4	47k	±5%	402	Resistor SMD	
R5	10k	±5%	402	Resistor SMD	
R6	10k	±5%	402	Resistor SMD	
R7	10k	±5%	402	Resistor SMD	
R8	10k	±5%	402	Resistor SMD	
R9	100k	±5%	402	Resistor SMD	
U1	CC430F6137IRGC		QFN64	MCU with ISM Transceiver	TI
U2	0868BM15C0001			Balun 868MHz	Johanson
U3	BMA250		LGA12	Acceleration Sensor SPI	Bosch Sensortec
U4	HKA5403Q-30		DIE	EL Driver	
U5	BMP085			Pressure Sensor I2C	Bosch Sensortec
Y1	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	3.2 x 1.5 mm^2	Crystal SMD	Microcrystal CM7V-T1A
Y2	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021014300

NOTE: The BOM in Table 4-6 also applies to the eZ430-Chronos-915 wrist module with White PCB except as shown in the following table.

Designator	Value	Tolerance	Footprint	Description	Manufacturer
U2	0915BM15A0001			Balun 915MHz	Johanson

Copyright © 2009–2015, Texas Instruments Incorporated

4.5.5 LCD



PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
COM0	COM3	COM2	COM1	COM0	SEG23	SEG22	SEG21	SEG20	SEG19	SEG18	SEG17	SEG16	SEG15	SEG14	SEG13	SEG12
COM0				COM0	P	1D	TOTAL	2D	AVG	3D	DP1	4D	MAX	5D	S0	S3
COM1			COM1		1E	1C	2E	2C	3E	3C	4E	4C	5E	5C		
COM2		COM2			1G	1B	2G	2B	3G	3B	4G	4B	5G	5B		
COM3	COM3				1F	1A	2F	2A	3F	3A	4F	4A	5F	5A		

PIN	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	SEG11	SEG10	SEG9	SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	SEG0	COM3	COM2	COM1	COM0
COM0		6D	S2	S1	7D			8D		9D						COM0
COM1		6C	6E	DP2	7C	7E	DP3	8C	8E	9C	9E				COM1	
COM2		6B	6G		7B	7G	COL3	8B	8G	9B	9G	RM	COM2			
COM3		6A	6F	COL2	7A	7F	COL1	8A	8F	9A	9F		COM3			

Figure 4-35. LCD Segment Map

Copyright © 2009–2015, Texas Instruments Incorporated

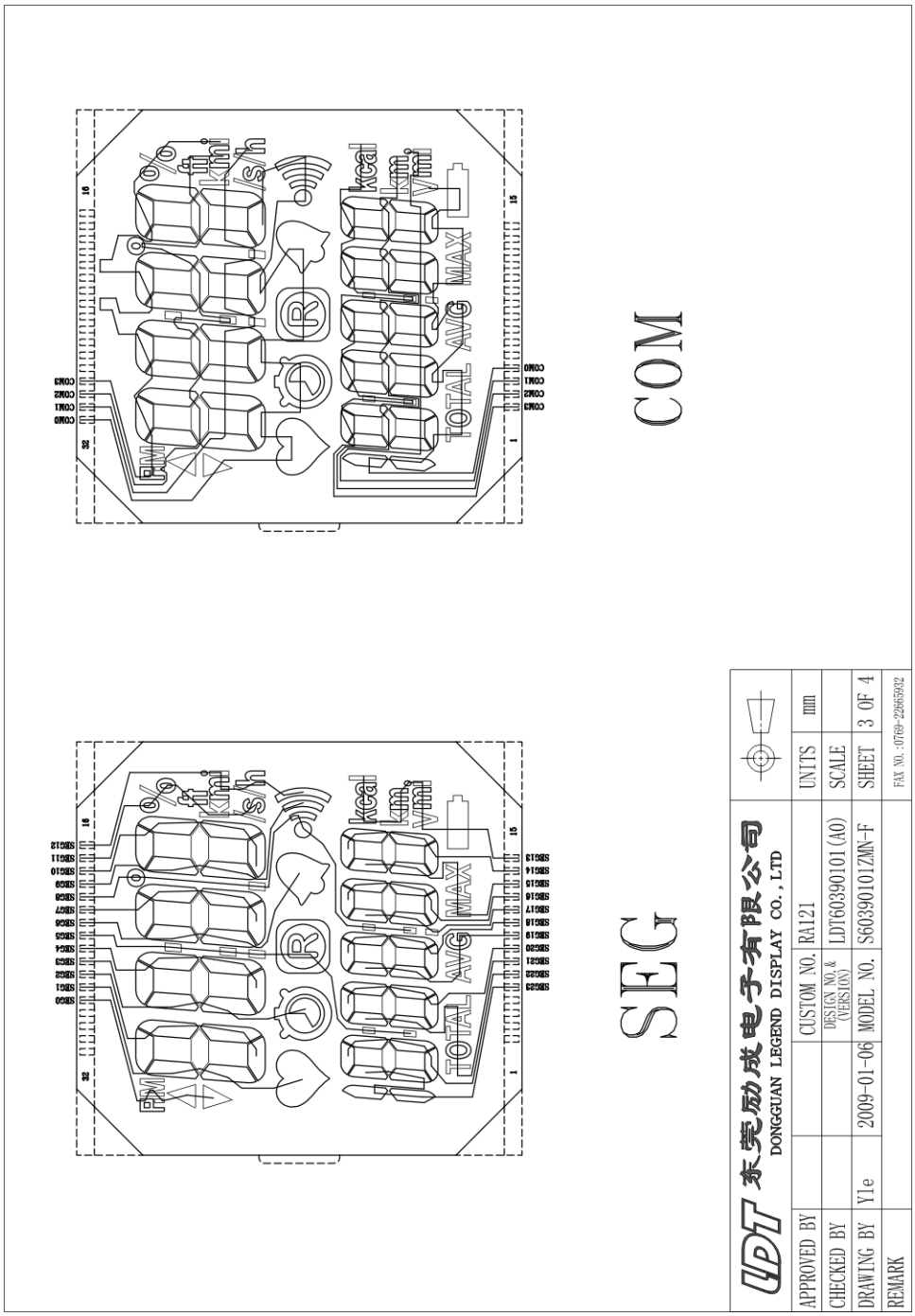


Figure 4-36. LCD Pinout

Copyright © 2009–2015, Texas Instruments Incorporated

4.6 Access Point Schematics, Layout, and BOM

Gerber files for the eZ430-Chronos access point are part of the eZ430-Chronos software packages for Windows SLAC341 and Linux SLAC388.

4.6.1 eZ430-Chronos-433 With Black PCB RF Access Point

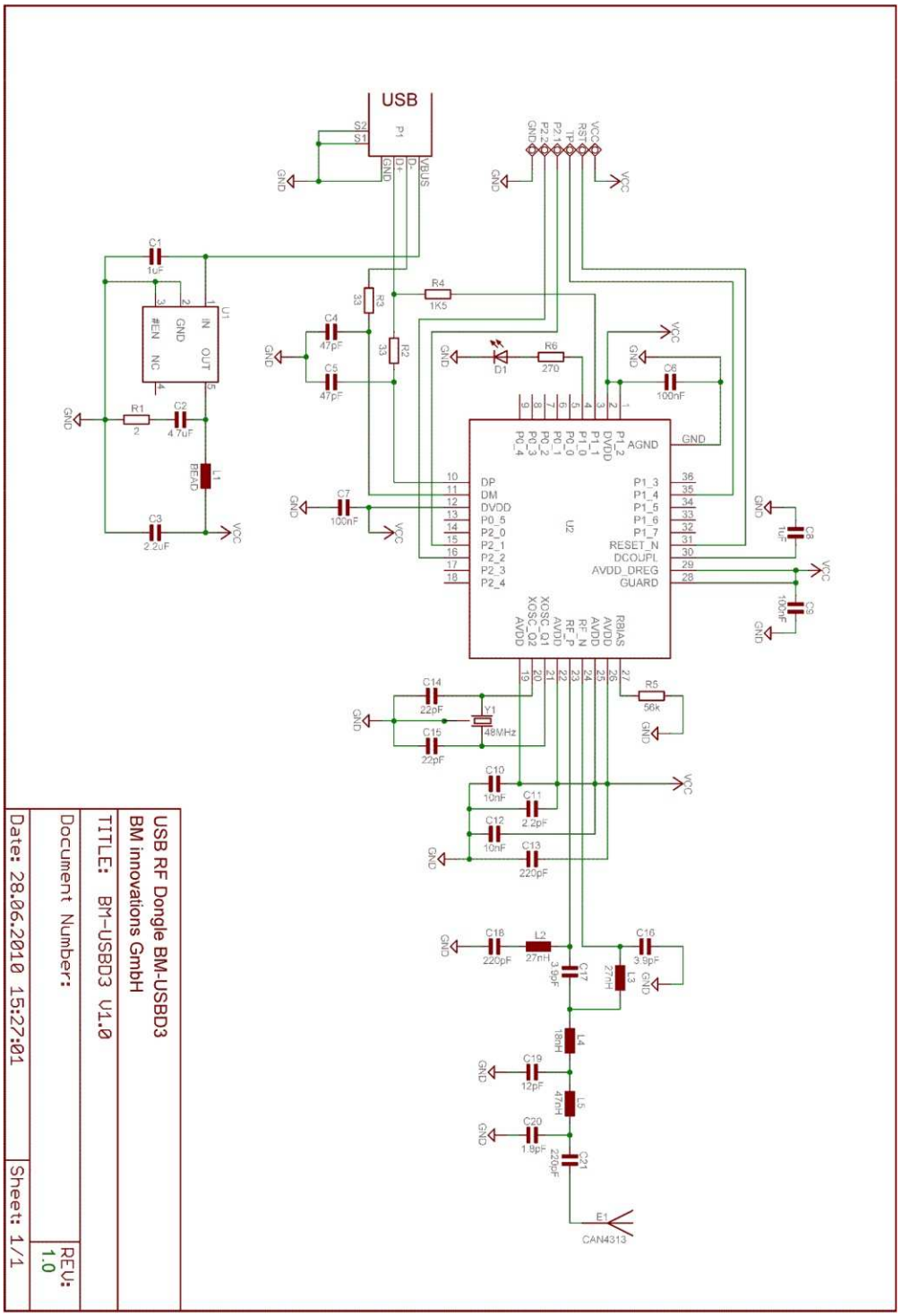


Figure 4-37. eZ430-Chronos-433 RF Access Point With Black PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

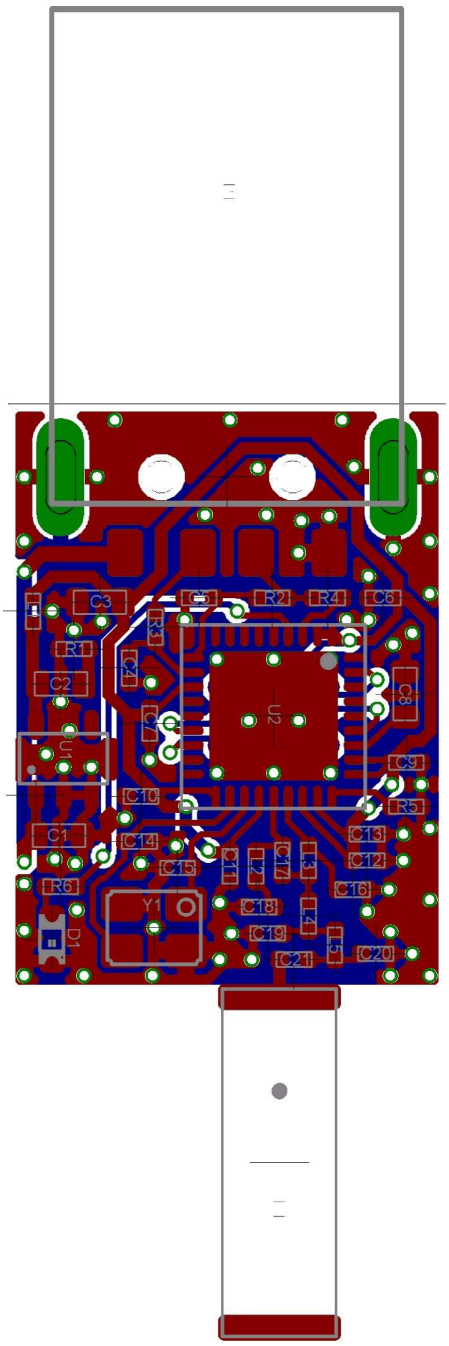


Figure 4-38. eZ430-Chronos-433 RF Access Point With Black PCB, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

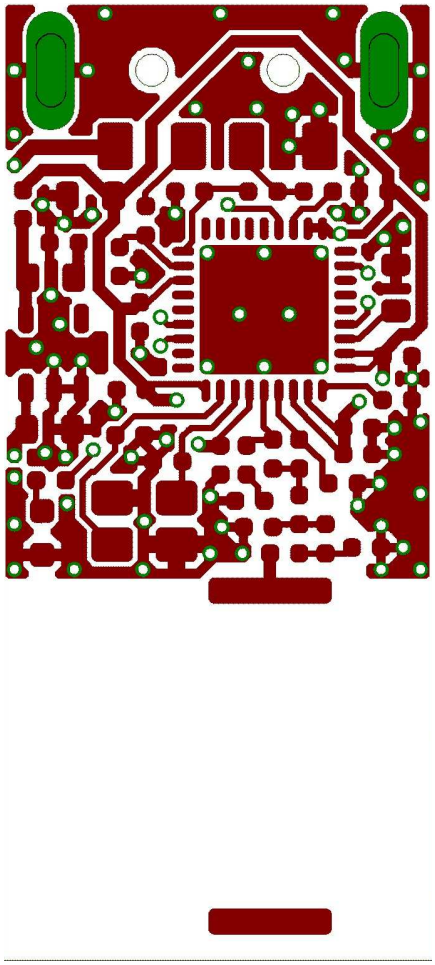


Figure 4-39. eZ430-Chronos-433 RF Access Point With Black PCB, Layout Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

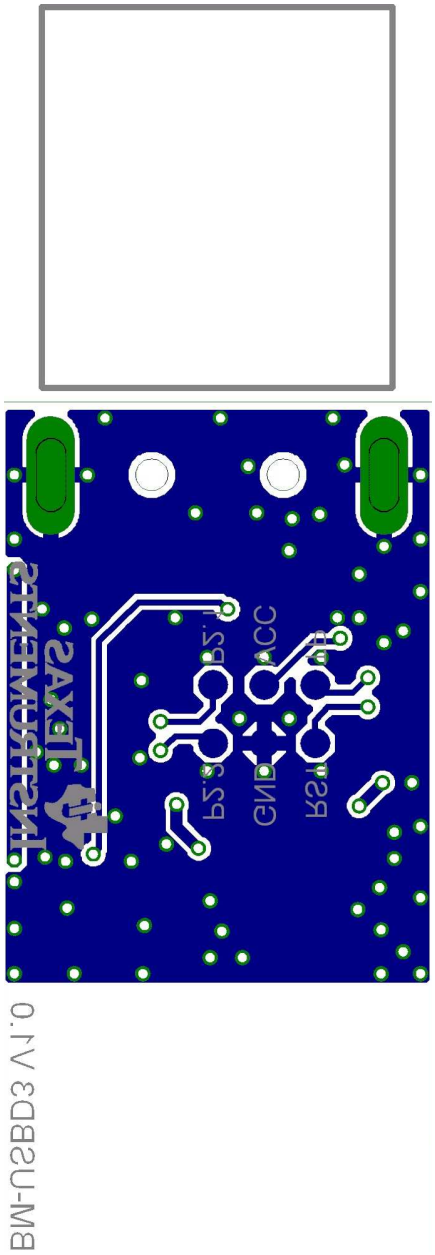


Figure 4-40. eZ430-Chronos-433 RF Access Point With Black PCB, Layout Bottom Layer

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-7. eZ430-Chronos-433 Access Point With Black PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	1 µF	±10%, X5R	603	Capacitor SMD	
C2	4.7 µF	±10%, X5R	603	Capacitor SMD	
C3	2.2 µF	±10%, X5R	603	Capacitor SMD	
C4	47 pF	±10%, COG/NP0	402	Capacitor SMD	
C5	47 pF	±10%, COG/NP0	402	Capacitor SMD	
C6	100 nF	±10%, X7R	402	Capacitor SMD	
C7	100 nF	±10%, X7R	402	Capacitor SMD	
C8	1 µF	±10%, X5R	603	Capacitor SMD	
C9	100 nF	±10%, X7R	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	22 pF	±5%, COG/NP0	402	Capacitor SMD	
C15	22 pF	±5%, COG/NP0	402	Capacitor SMD	
C16	3.9 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S3R9BV4
C17	3.9 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S3R9BV4
C18	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C18	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C19	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C20	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C21	220 pF	±10%, COG/NP0	402	Capacitor SMD	
D1	green		603	LED SMD	
E1	0868AT43A0020			Chip Antenna	Johanson
L1	Ferrite Bead 1k, 1R, min. 100mA		402	EMI Filter SMD	for example, TDK MMZ1005S102C
L2	27 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C27NJV4
L3	27 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C27NJV4
L4	18 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C18NJV4
L5	47nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C47NJV4
P1	USB Type A			USB Plug	for example, Lumberg 241007
PCB1	CUSTOM, solder stop black			PCB, 2 layers, 0.8 mm thick	
R1	2R	±5%	402	Resistor SMD	
R2	33R	±5%	402	Resistor SMD	
R3	33R	±5%	402	Resistor SMD	
R4	1.5k	±5%	402	Resistor SMD	
R5	56k	±1%	402	Resistor SMD	
R6	270R	±5%	402	Resistor SMD	
U1	TPS76933DBV		SOT-23	Linear Regulator	TI
U2	CC1111F32RSP		QFN36	ISM Transceiver	TI
Y1	48MHz, CL=16pF, ESR≤40Ω	±10ppm	23.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021040300

Copyright © 2009–2015, Texas Instruments Incorporated

4.6.2 eZ430-Chronos-433 With White PCB RF Access Point

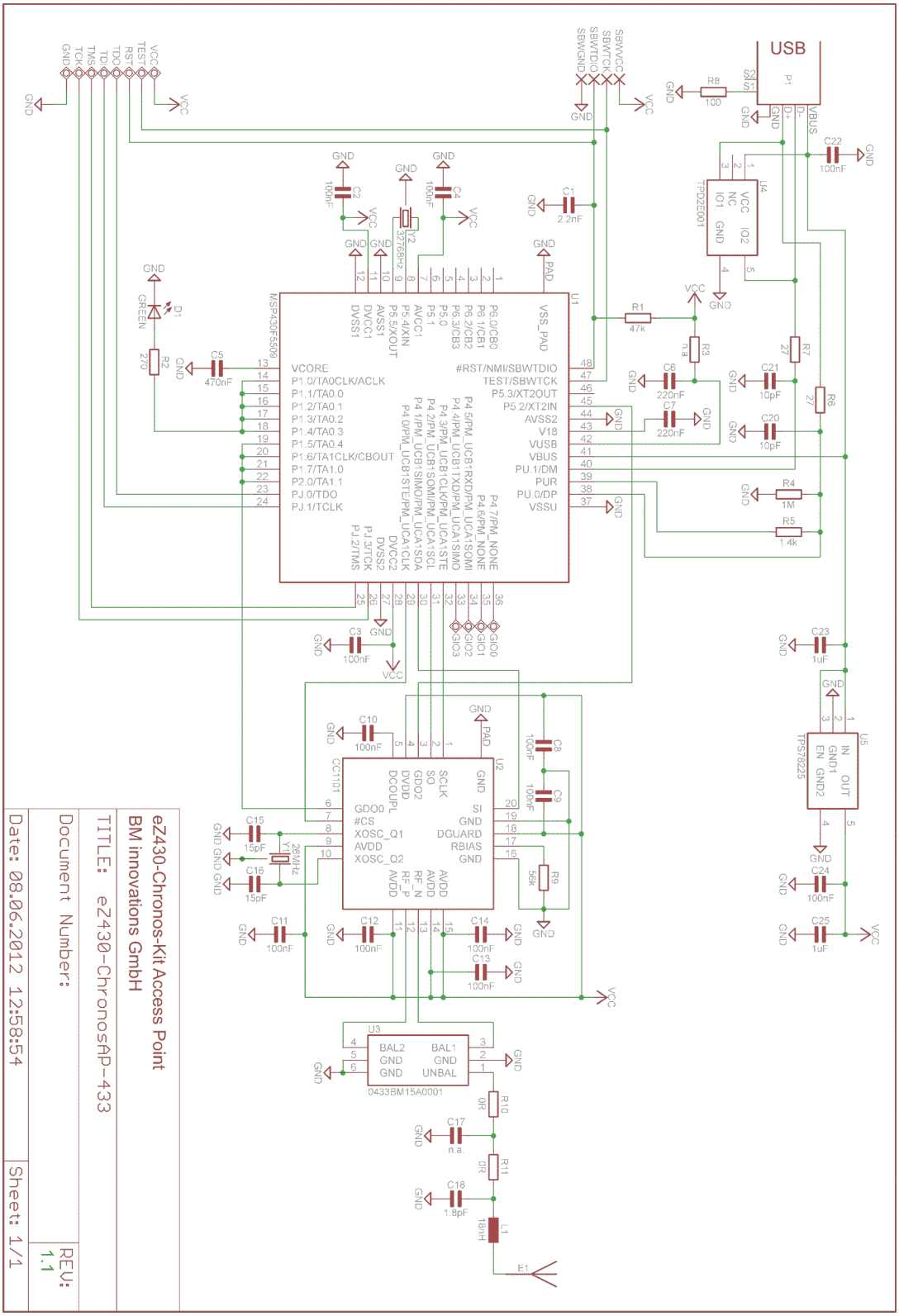


Figure 4-41. eZ430-Chronos-433 RF Access Point With White PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

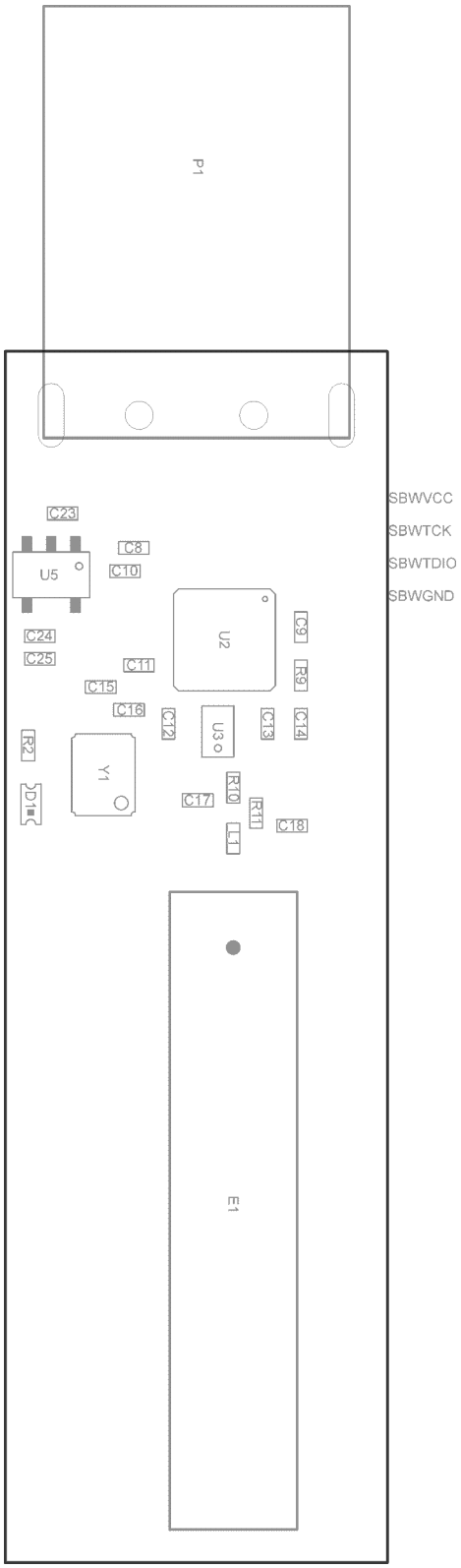


Figure 4-42. eZ430-Chronos-433 RF Access Point With White PCB, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

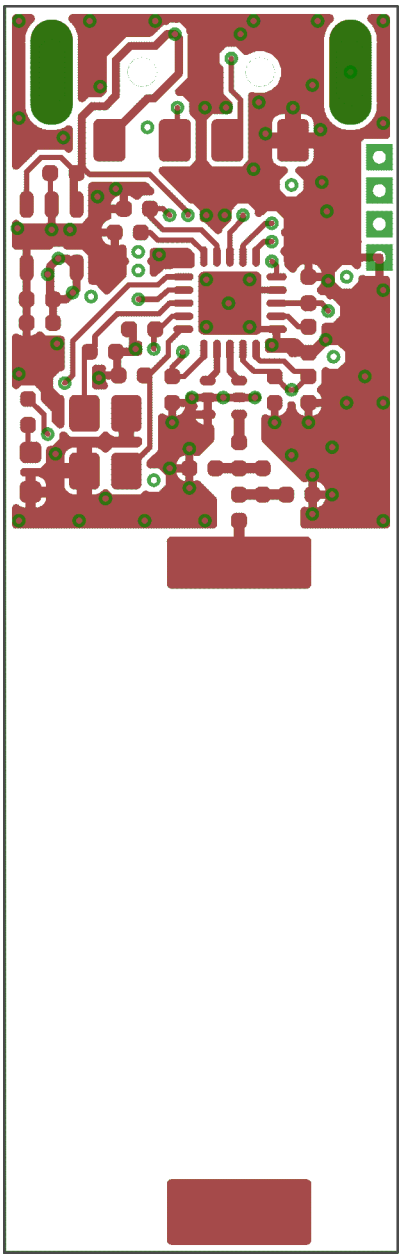


Figure 4-43. eZ430-Chronos-433 RF Access Point With White PCB, Layout Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

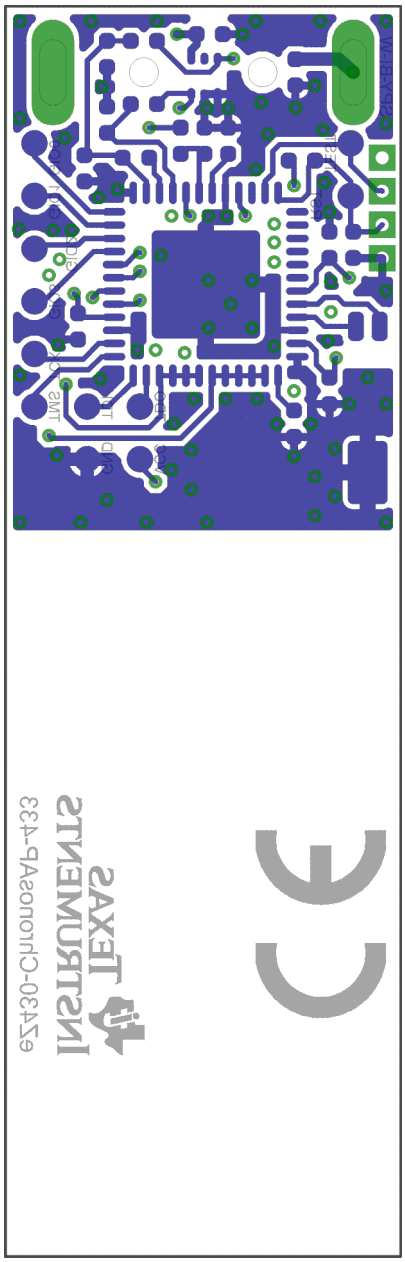


Figure 4-44. eZ430-Chronos-433 RF Access Point With White PCB, Layout Bottom Layer

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-8. eZ430-Chronos-433 Access Point With White PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	2.2 nF	±10%, X7R	402	Capacitor SMD	
C2	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C3	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C4	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	220 nF	±10%, X5R	402	Capacitor SMD	
C7	220 nF	±10%, X5R	402	Capacitor SMD	
C8	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C9	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C10	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C11	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C12	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C13	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C14	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C15	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C16	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C17	N.A.				
C18	1.8 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S1R8BV4
C20	10 pF	±5%, COG/NP0	402	Capacitor SMD	
C21	10 pF	±5%, COG/NP0	402	Capacitor SMD	
C22	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C23	1.0 µF	±10%, X5R	402	Capacitor SMD	
C24	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C25	1.0 µF	±10%, X5R	402	Capacitor SMD	
D1	green		603	LED SMD	
E1	0433AT62A0020			Chip Antenna 433MHz	Johanson
L1	18 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C18NJV6
P1	USB Type A			USB Plug	e.g. Lumberg 241007
PCB1	CUSTOM, solder stop white			PCB, 4 layers, 0.8 mm thick	
R1	47k	±5%	402	Resistor SMD	
R2	270R	±5%	402	Resistor SMD	
R3	N.A.				
R4	1M	±5%	402	Resistor SMD	
R5	1.4k	±5%	402	Resistor SMD	
R6	27R	±5%	402	Resistor SMD	
R7	27R	±5%	402	Resistor SMD	
R8	100R	±5%	402	Resistor SMD	
R9	56k	±1%	402	Resistor SMD	
R10	0R	±5%	402	Resistor SMD	
R11	0R	±5%	402	Resistor SMD	
U1	MSP430F5509IRGZR		QFN48	MCU	TI
U2	CC1101RTKR		QLP20	ISM Transceiver	TI
U3	0433BM15A0001			Balun 433MHz	Johanson
U4	TPD2E001DRLR		DRL5	ESD Protection	TI
U5	TPS78225DDCR		TSOT23-5	Linear Regulator	TI
Y1	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021014300
Y2	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	1.5x1.5x6.7mm	Crystal SMD	MicroCrystal MS3V-T1R

Copyright © 2009–2015, Texas Instruments Incorporated

4.6.3 eZ430-Chronos-868 and -915 With Black PCB RF Access Point

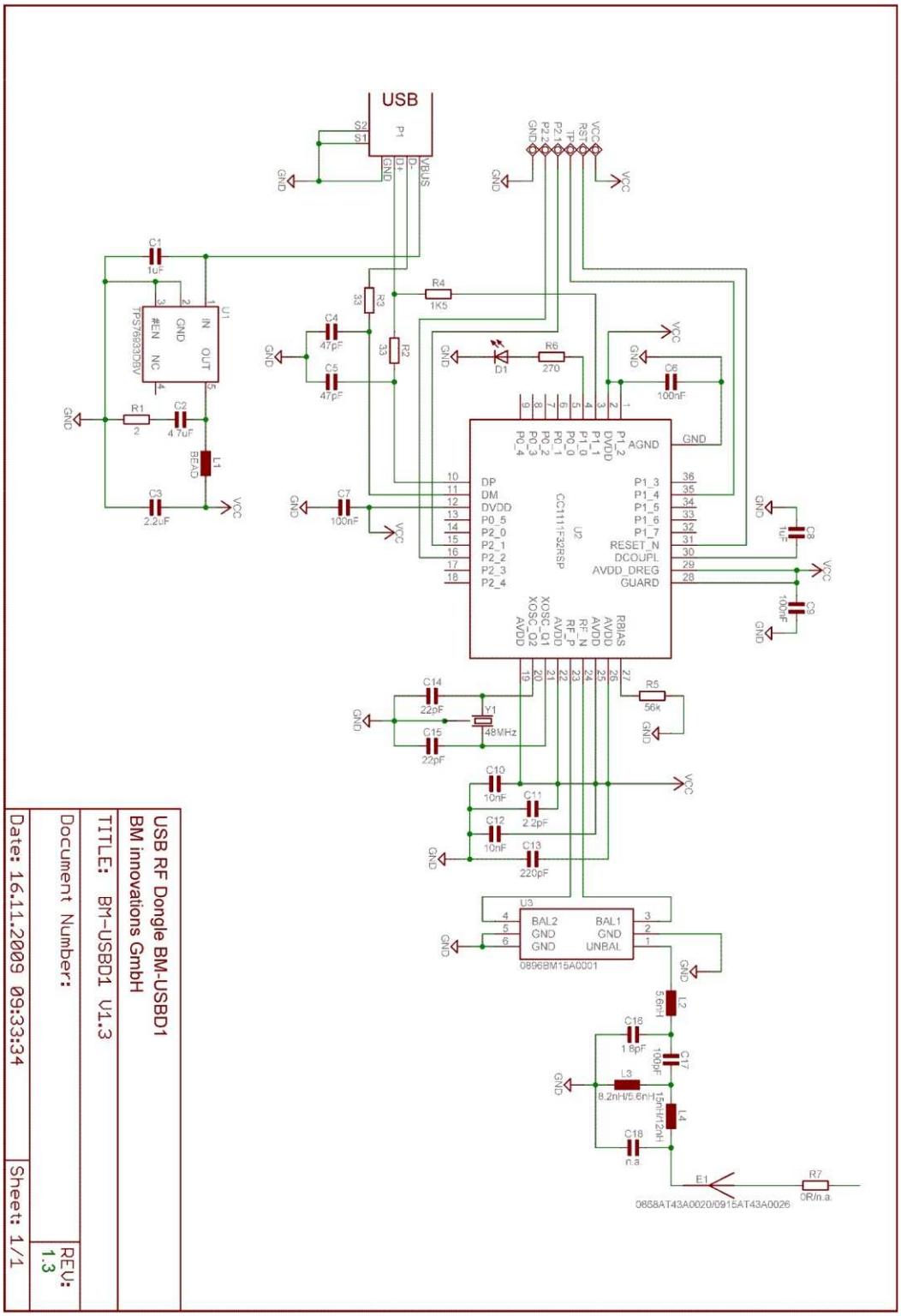


Figure 4-45. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

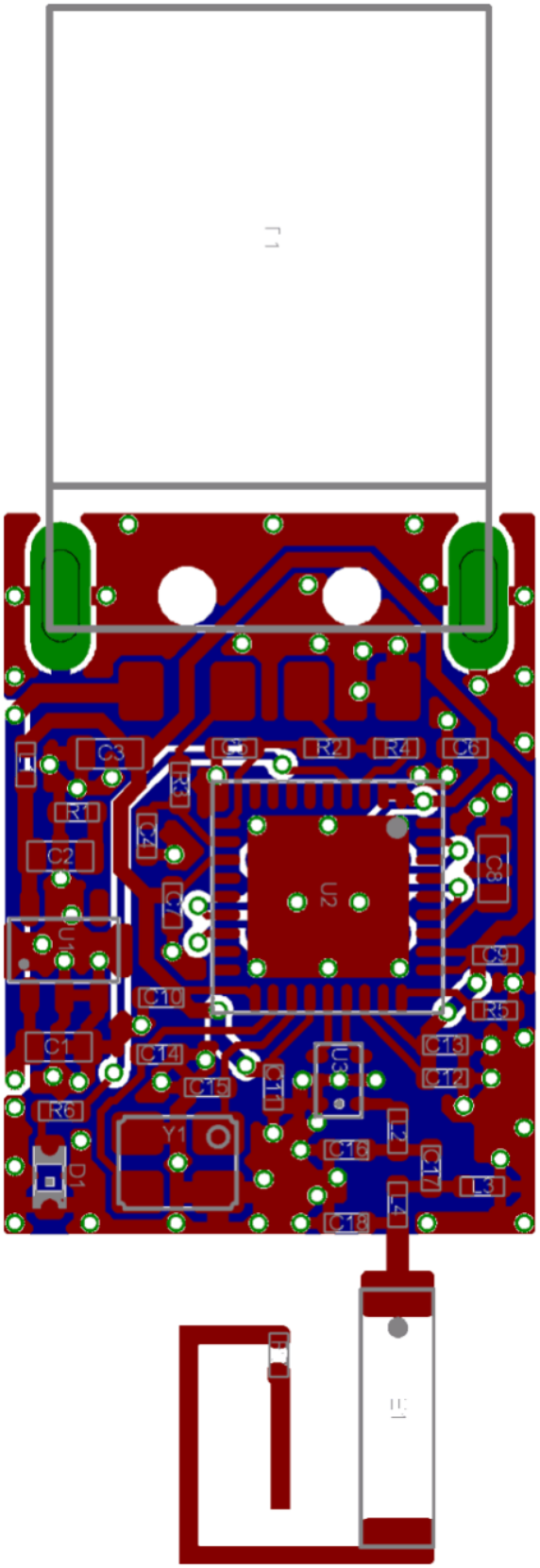


Figure 4-46. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

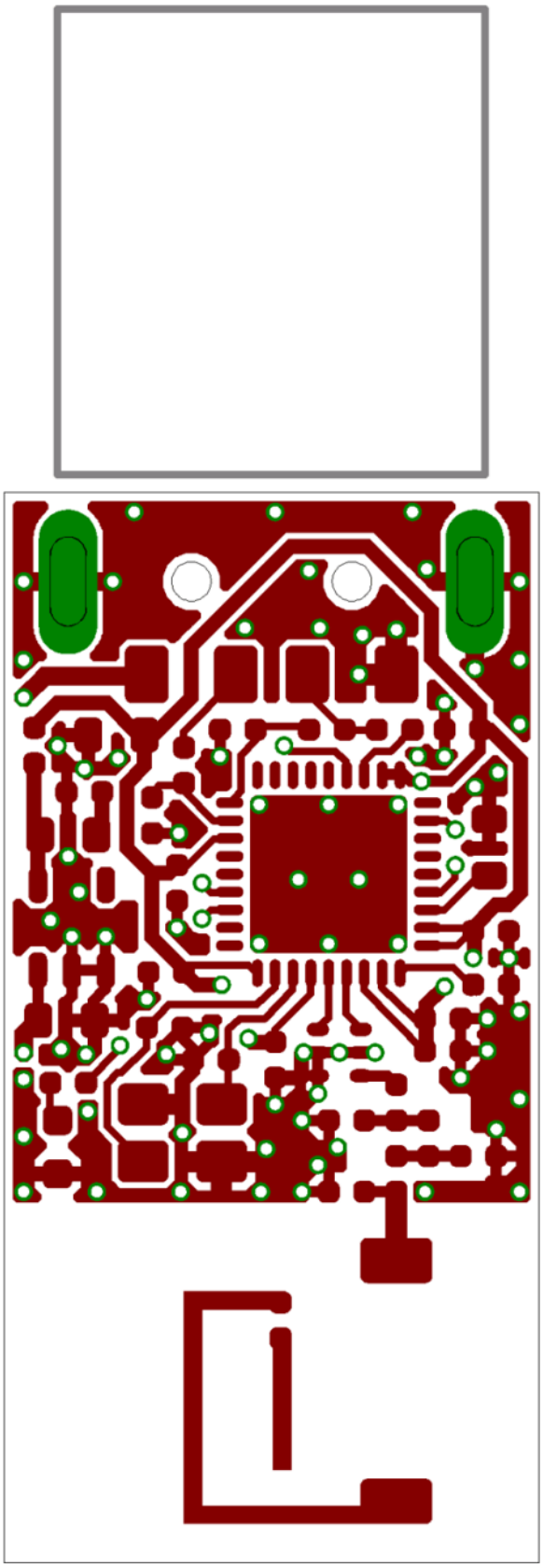


Figure 4-47. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, Layout Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

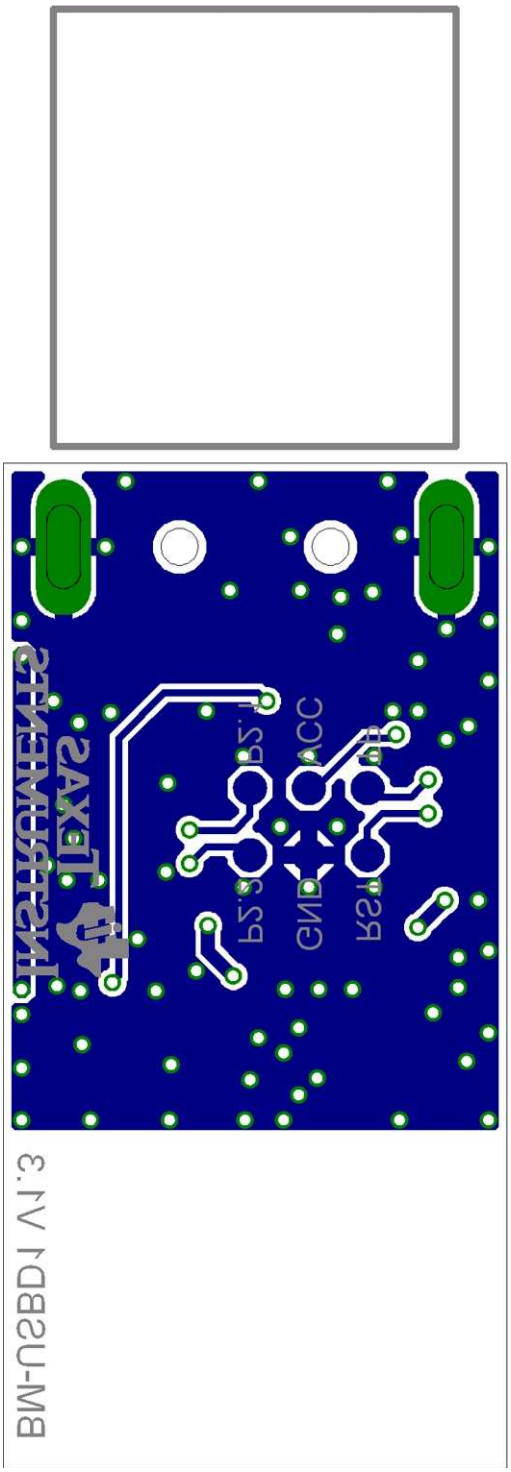


Figure 4-48. eZ430-Chronos-868 and -915 RF Access Point With Black PCB, Layout Bottom Layer

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-9. eZ430-Chronos-868 Access Point With Black PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	1 µF	±10%, X5R	603	Capacitor SMD	
C2	4.7 µF	±10%, X5R	603	Capacitor SMD	
C3	2.2 µF	±10%, X5R	603	Capacitor SMD	
C4	47 pF	±10%, COG/NP0	402	Capacitor SMD	
C5	47 pF	±10%, COG/NP0	402	Capacitor SMD	
C6	100 nF	±10%, X7R	402	Capacitor SMD	
C7	100 nF	±10%, X7R	402	Capacitor SMD	
C8	1 µF	±10%, X5R	603	Capacitor SMD	
C9	100 nF	±10%, X7R	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	22 pF	±5%, COG/NP0	402	Capacitor SMD	
C15	22 pF	±5%, COG/NP0	402	Capacitor SMD	
C16	1.8 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S1R8BV4
C17	100 pF	±10%, COG/NP0	402	Capacitor SMD	
C18	N.A.				
D1	green		603	LED SMD	
E1	0915AT43A0026			Chip Antenna	Johanson
L1	Ferrite Bead 1k, 1R, min. 100mA		402	EMI Filter SMD	for example, TDK MMZ1005S102C
L2	5.6 nH	±0.3nH	402	Inductor Monolithic SMD	Johanson L-07C5N6SV4
L3	5.6 nH	±0.3nH	402	Inductor Monolithic SMD	Johanson L-07C5N6SV4
L4	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV4
P1	USB Type A			USB Plug	for example, Lumberg 241007
PCB1	CUSTOM, solder stop black			PCB, 2 layers, 0.8 mm thick	
R1	2R	±5%	402	Resistor SMD	
R2	33R	±5%	402	Resistor SMD	
R3	33R	±5%	402	Resistor SMD	
R4	1.5k	±5%	402	Resistor SMD	
R5	56k	±1%	402	Resistor SMD	
R6	270R	±5%	402	Resistor SMD	
R7	0R	±5%	402	Resistor SMD	
U1	TPS76933DBV		SOT-23	Linear Regulator	TI
U2	CC1111F32RSP		QFN36	ISM Transceiver	TI
U3	0896BM15A0001			896MHz Balun	Johanson
Y1	48MHz, CL=16pF, ESR≤40Ω	±10ppm	23.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021040300

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-10. eZ430-Chronos-915 Access Point With Black PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	1 µF	±10%, X5R	603	Capacitor SMD	
C2	4.7 µF	±10%, X5R	603	Capacitor SMD	
C3	2.2 µF	±10%, X5R	603	Capacitor SMD	
C4	47 pF	±10%, COG/NP0	402	Capacitor SMD	
C5	47 pF	±10%, COG/NP0	402	Capacitor SMD	
C6	100 nF	±10%, X7R	402	Capacitor SMD	
C7	100 nF	±10%, X7R	402	Capacitor SMD	
C8	1 µF	±10%, X5R	603	Capacitor SMD	
C9	100 nF	±10%, X7R	402	Capacitor SMD	
C10	10 nF	±10%, X7R	402	Capacitor SMD	
C11	2.2 pF	±0.25pF, COG/NP0	402	Capacitor SMD	
C12	10 nF	±10%, X7R	402	Capacitor SMD	
C13	220 pF	±10%, COG/NP0	402	Capacitor SMD	
C14	22 pF	±5%, COG/NP0	402	Capacitor SMD	
C15	22 pF	±5%, COG/NP0	402	Capacitor SMD	
C16	1.8 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S1R8BV4
C17	100 pF	±10%, COG/NP0	402	Capacitor SMD	
C18	N.A.				
D1	green		603	LED SMD	
E1	0915AT43A0026			Chip Antenna	Johanson
L1	Ferrite Bead 1k, 1R, min. 100mA		402	EMI Filter SMD	for example, TDK MMZ1005S102C
L2	5.6 nH	±0.3nH	402	Inductor Monolithic SMD	Johanson L-07C5N6SV4
L3	5.6 nH	±0.3nH	402	Inductor Monolithic SMD	Johanson L-07C5N6SV4
L4	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV4
P1	USB Type A			USB Plug	for example, Lumberg 241007
PCB1	CUSTOM, solder stop black			PCB, 2 layers, 0.8 mm thick	
R1	2R	±5%	402	Resistor SMD	
R2	33R	±5%	402	Resistor SMD	
R3	33R	±5%	402	Resistor SMD	
R4	1.5k	±5%	402	Resistor SMD	
R5	56k	±1%	402	Resistor SMD	
R6	270R	±5%	402	Resistor SMD	
R7	N.A.				
U1	TPS76933DBV		SOT-23	Linear Regulator	TI
U2	CC1111F32RSP		QFN36	ISM Transceiver	TI
U3	0896BM15A0001			896MHz Balun	Johanson
Y1	48MHz, CL=16pF, ESR≤40Ω	±10ppm	23.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021040300

Copyright © 2009–2015, Texas Instruments Incorporated

4.6.4 eZ430-Chronos-868 and -915 With White PCB RF Access Point

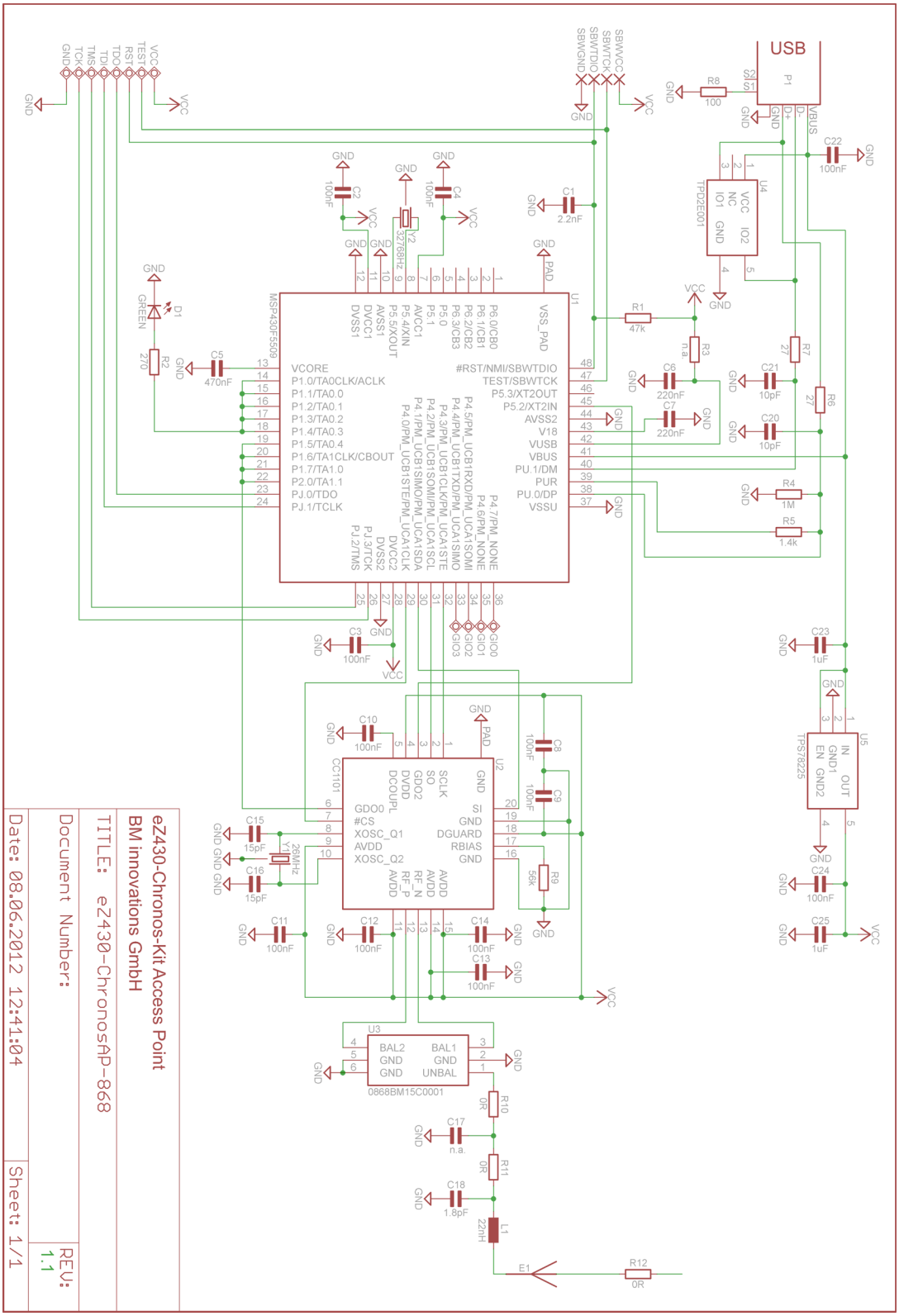


Figure 4-49. eZ430-Chronos-868 RF Access Point With White PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

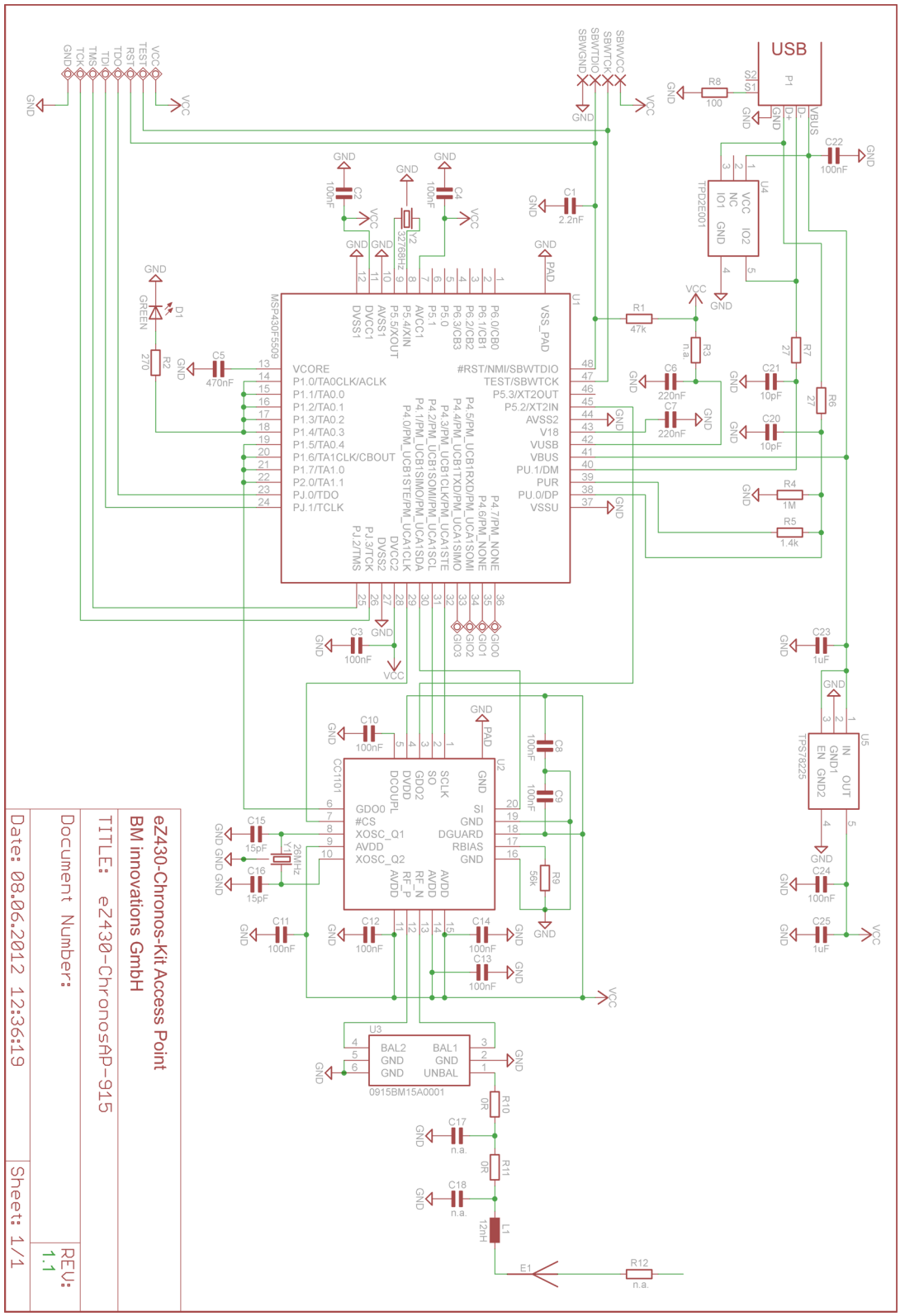


Figure 4-50. eZ430-Chronos-915 RF Access Point With White PCB, Schematics

Copyright © 2009–2015, Texas Instruments Incorporated

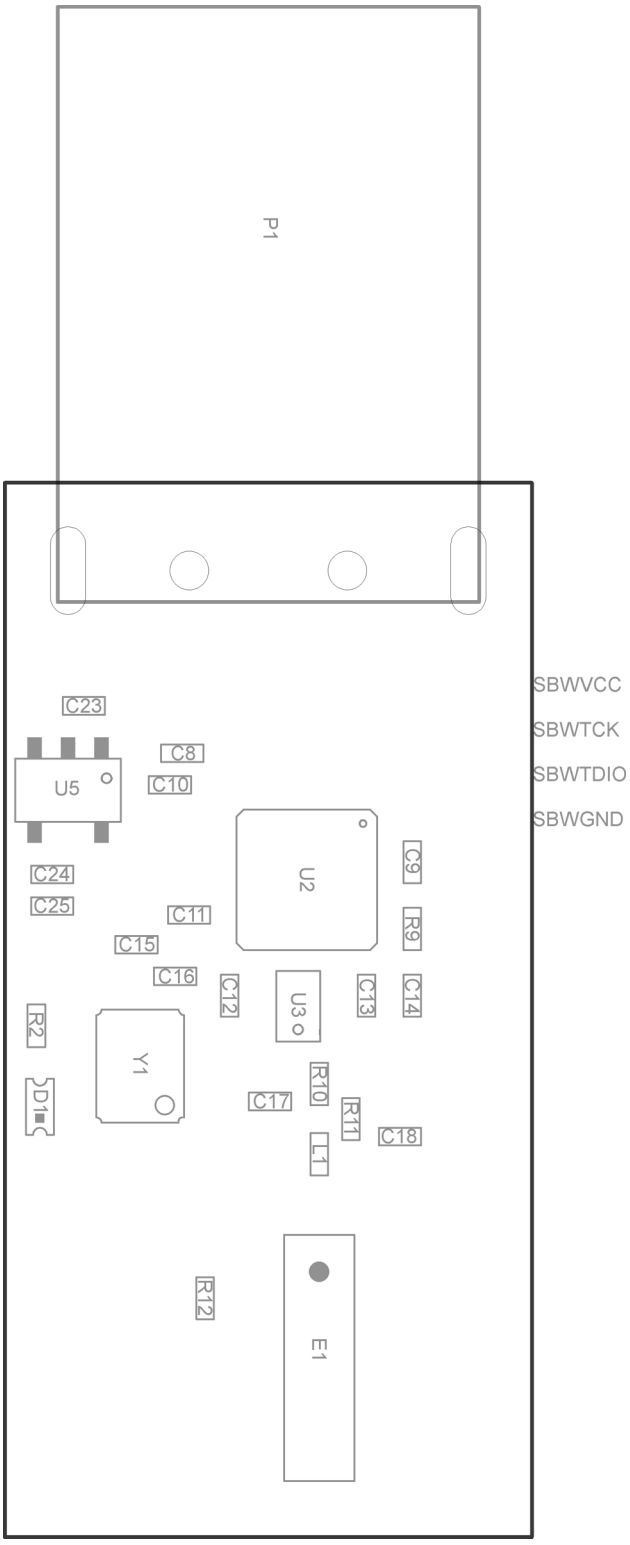


Figure 4-51. eZ430-Chronos-868 and -915 RF Access Point With White PCB, PCB Components on Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

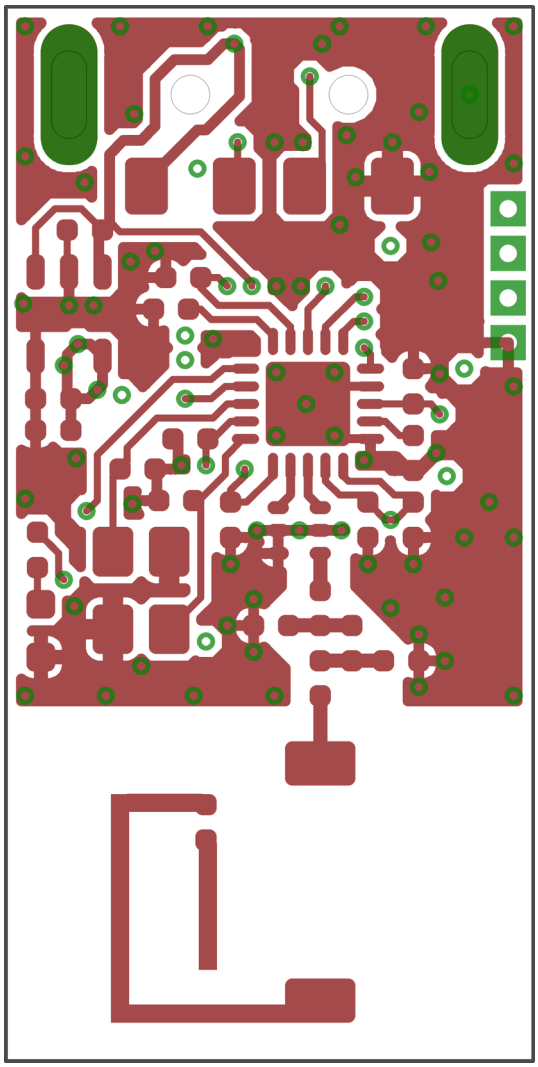


Figure 4-52. eZ430-Chronos-868 RF Access Point With White PCB, Layout Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

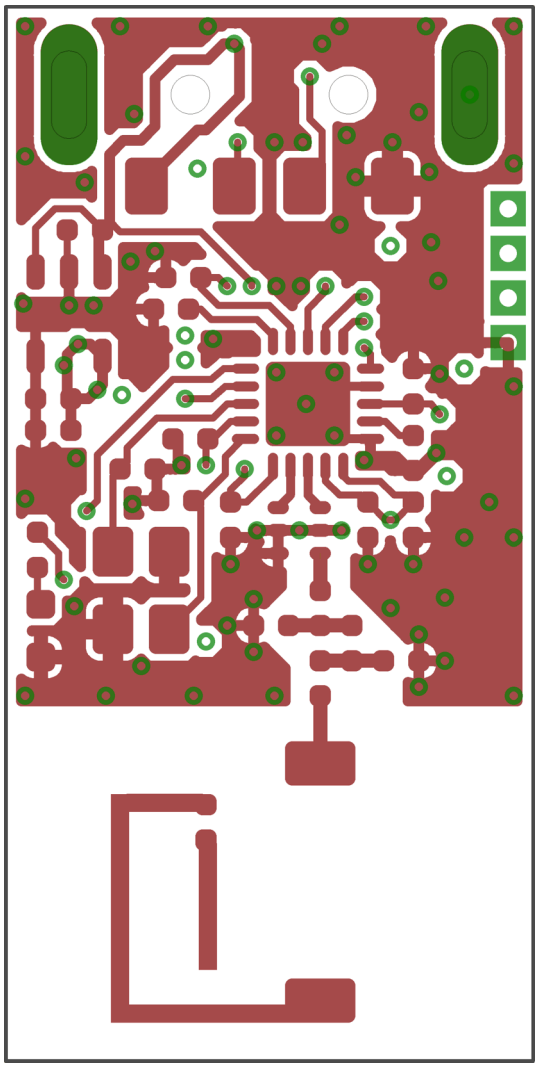


Figure 4-53. eZ430-Chronos-915 RF Access Point With White PCB, Layout Top Layer

Copyright © 2009–2015, Texas Instruments Incorporated

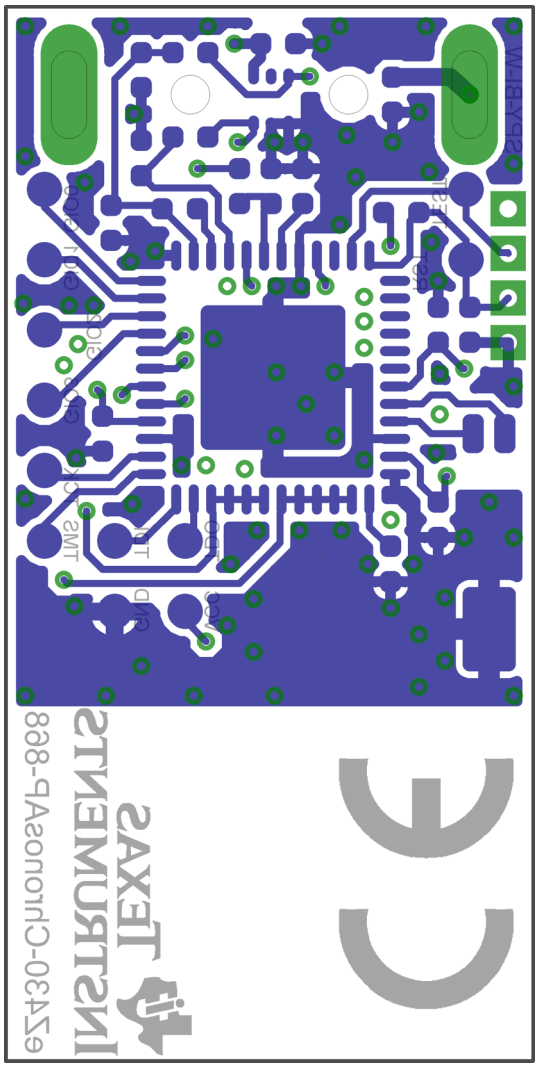


Figure 4-54. eZ430-Chronos-868 RF Access Point With White PCB, Layout Bottom Layer

Copyright © 2009–2015, Texas Instruments Incorporated

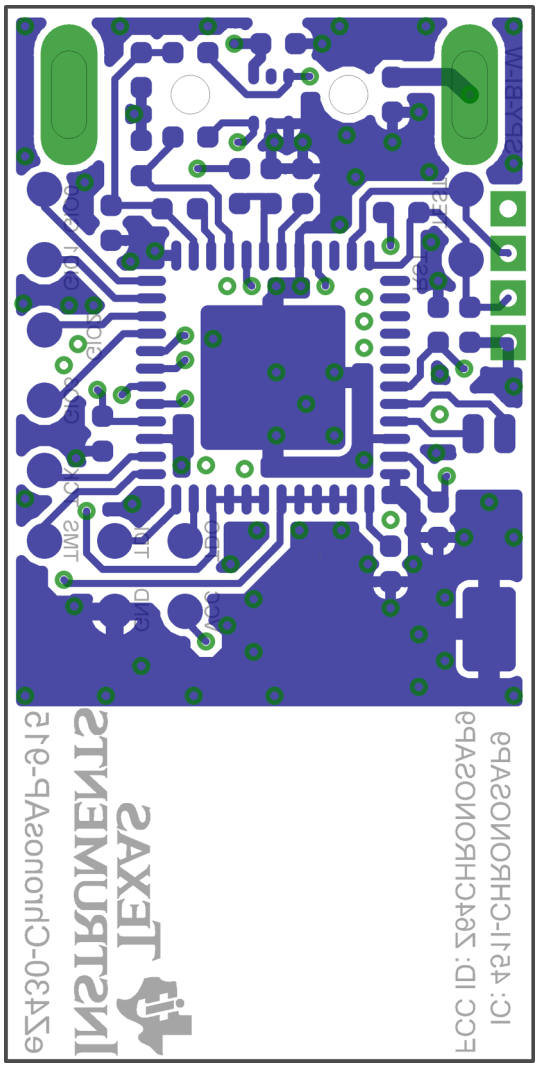


Figure 4-55. eZ430-Chronos-915 RF Access Point With White PCB, Layout Bottom Layer

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-11. eZ430-Chronos-868 Access Point With White PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	2.2 nF	±10%, X7R	402	Capacitor SMD	
C2	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C3	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C4	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	220 nF	±10%, X5R	402	Capacitor SMD	
C7	220 nF	±10%, X5R	402	Capacitor SMD	
C8	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C9	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C10	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C11	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C12	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C13	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C14	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C15	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C16	15 pF	±5%, COG/NP0	402	Capacitor SMD	
C17	N.A.				
C18	1.8 pF	±0.1pF, COG/NP0	402	Capacitor SMD	Johanson 500R07S1R8BV4
C20	10 pF	±5%, COG/NP0	402	Capacitor SMD	
C21	10 pF	±5%, COG/NP0	402	Capacitor SMD	
C22	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C23	1.0 µF	±10%, X5R	402	Capacitor SMD	
C24	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C25	1.0 µF	±10%, X5R	402	Capacitor SMD	
D1	green		603	LED SMD	
E1	0868AT43A0020			Chip Antenna 868MHz	Johanson
L1	22 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C22NJV6
P1	USB Type A			USB Plug	e.g. Lumberg 241007
PCB1	CUSTOM, solder stop white			PCB, 4 layers, 0.8 mm thick	
R1	47k	±5%	402	Resistor SMD	
R2	270R	±5%	402	Resistor SMD	
R3	N.A.				
R4	1M	±5%	402	Resistor SMD	
R5	1.4k	±5%	402	Resistor SMD	
R6	27R	±5%	402	Resistor SMD	
R7	27R	±5%	402	Resistor SMD	
R8	100R	±5%	402	Resistor SMD	
R9	56k	±1%	402	Resistor SMD	
R10	0R	±5%	402	Resistor SMD	
R11	0R	±5%	402	Resistor SMD	
R12	0R	±5%	402	Resistor SMD	
U1	MSP430F5509IRGZR		QFN48	MCU	TI
U2	CC1101RTKR		QLP20	ISM Transceiver	TI
U3	0868BM15C0001			Balun 868MHz	Johanson
U4	TPD2E001DRLR		DRL5	ESD Protection	TI
U5	TPS78225DDCR		TSOT23-5	Linear Regulator	TI
Y1	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm	Crystal SMD	Epson TSX3225-X1E000021014300
Y2	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	1.5 x 1.5 x 6.7 mm	Crystal SMD	MicroCrystal MS3V-T1R

Copyright © 2009–2015, Texas Instruments Incorporated

Table 4-12. eZ430-Chronos-915 Access Point With White PCB, BOM List

Designator	Value	Tolerance	Footprint	Description	Manufacturer
C1	2.2 nF	±10%, X7R	402	Capacitor SMD	
C2	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C3	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C4	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C5	470 nF	±10%, X5R	402	Capacitor SMD	
C6	220 nF	±10%, X5R	402	Capacitor SMD	
C7	220 nF	±10%, X5R	402	Capacitor SMD	
C8	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C9	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C10	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C11	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C12	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C13	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C14	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C15	15pF	±5%, COG/NP0	402	Capacitor SMD	
C16	15pF	±5%, COG/NP0	402	Capacitor SMD	
C17	N.A.				
C18	N.A.				
C20	10 pF	±5%, COG/NP0	402	Capacitor SMD	
C21	10 pF	±5%, COG/NP0	402	Capacitor SMD	
C22	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C23	1.0 µF	±10%, X5R	402	Capacitor SMD	
C24	100 nF	±10%, X5R or X7R	402	Capacitor SMD	
C25	1.0 µF	±10%, X5R	402	Capacitor SMD	
D1	green		603	LED SMD	
E1	0915AT43A0026			Chip Antenna 915MHz	Johanson
L1	12 nH	±5%	402	Inductor Monolithic SMD	Johanson L-07C12NJV6
P1	USB Type A			USB Plug	e.g. Lumberg 241007
PCB1	CUSTOM, solder stop white			PCB, 4 layers, 0.8 mm thick	
R1	47k	±5%	402	Resistor SMD	
R2	270R	±5%	402	Resistor SMD	
R3	N.A.				
R4	1M	±5%	402	Resistor SMD	
R5	1.4k	±5%	402	Resistor SMD	
R6	27R	±5%	402	Resistor SMD	
R7	27R	±5%	402	Resistor SMD	
R8	100R	±5%	402	Resistor SMD	
R9	56k	±1%	402	Resistor SMD	
R10	0R	±5%	402	Resistor SMD	
R11	0R	±5%	402	Resistor SMD	
R12	N.A.				
U1	MSP430F5509IRGZR		QFN48	MCU	TI
U2	CC1101RTKR		QLP20	ISM Transceiver	TI
U3	0915BM15A0001			Balun 915MHz	Johanson
U4	TPD2E001DRLR		DRL5	ESD Protection	TI
U5	TPS78225DDCR		TSOT23-5	Linear Regulator	TI
Y1	26MHz, CL=10pF, ESR≤40Ω	±10ppm	3.2 x 2.5 mm^2	Crystal SMD	Epson TSX3225-X1E000021014300
Y2	32.768kHz, CL=12.5pF, ESR≤80kΩ	±20ppm	1.5x1.5x6.7 mm	Crystal SMD	MicroCrystal MS3V-T1R

Copyright © 2009–2015, Texas Instruments Incorporated

4.6.5 Debugging Interface Schematics and Layout

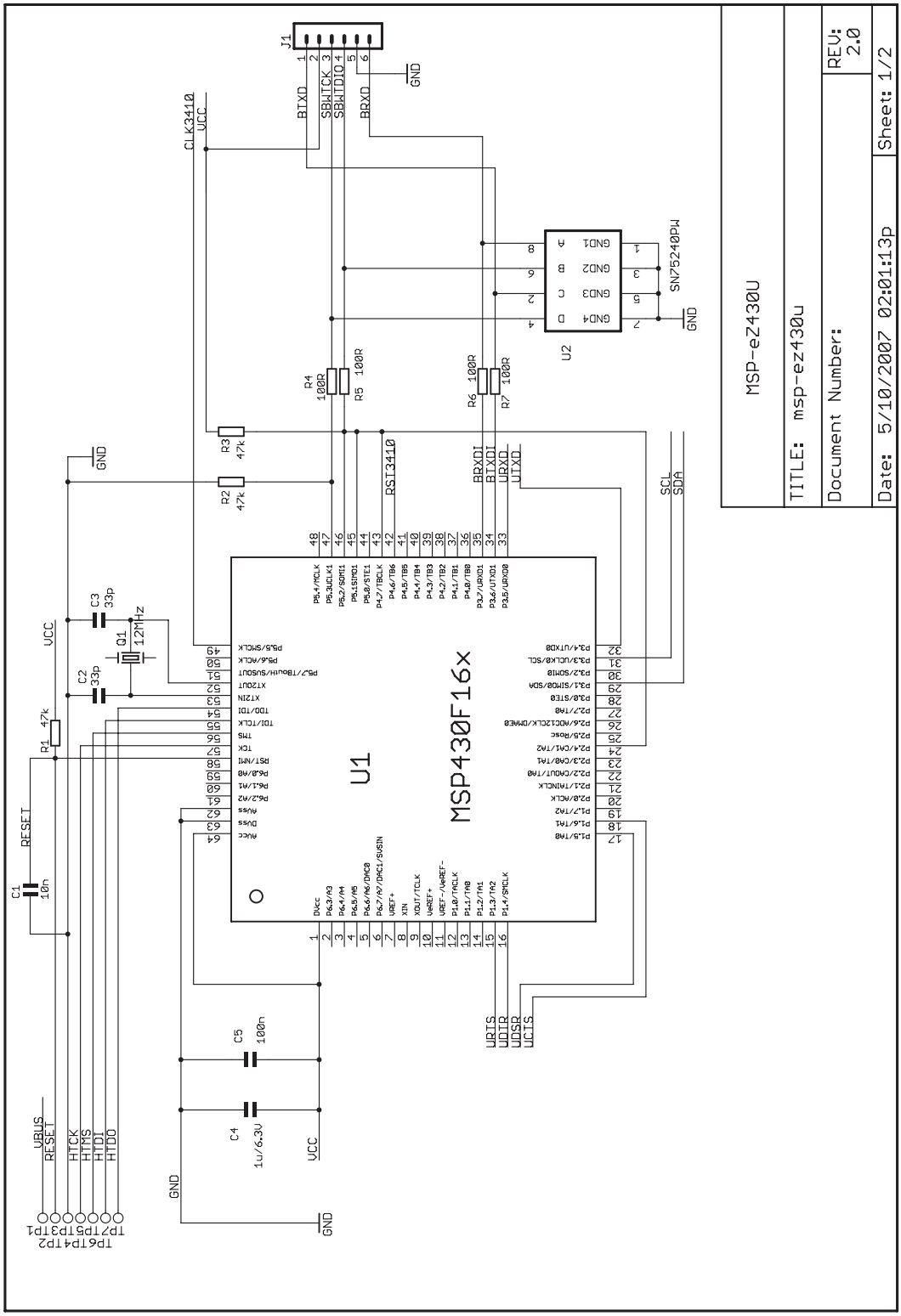


Figure 4-56. USB Debug Interface, Schematic

Copyright © 2009–2015, Texas Instruments Incorporated

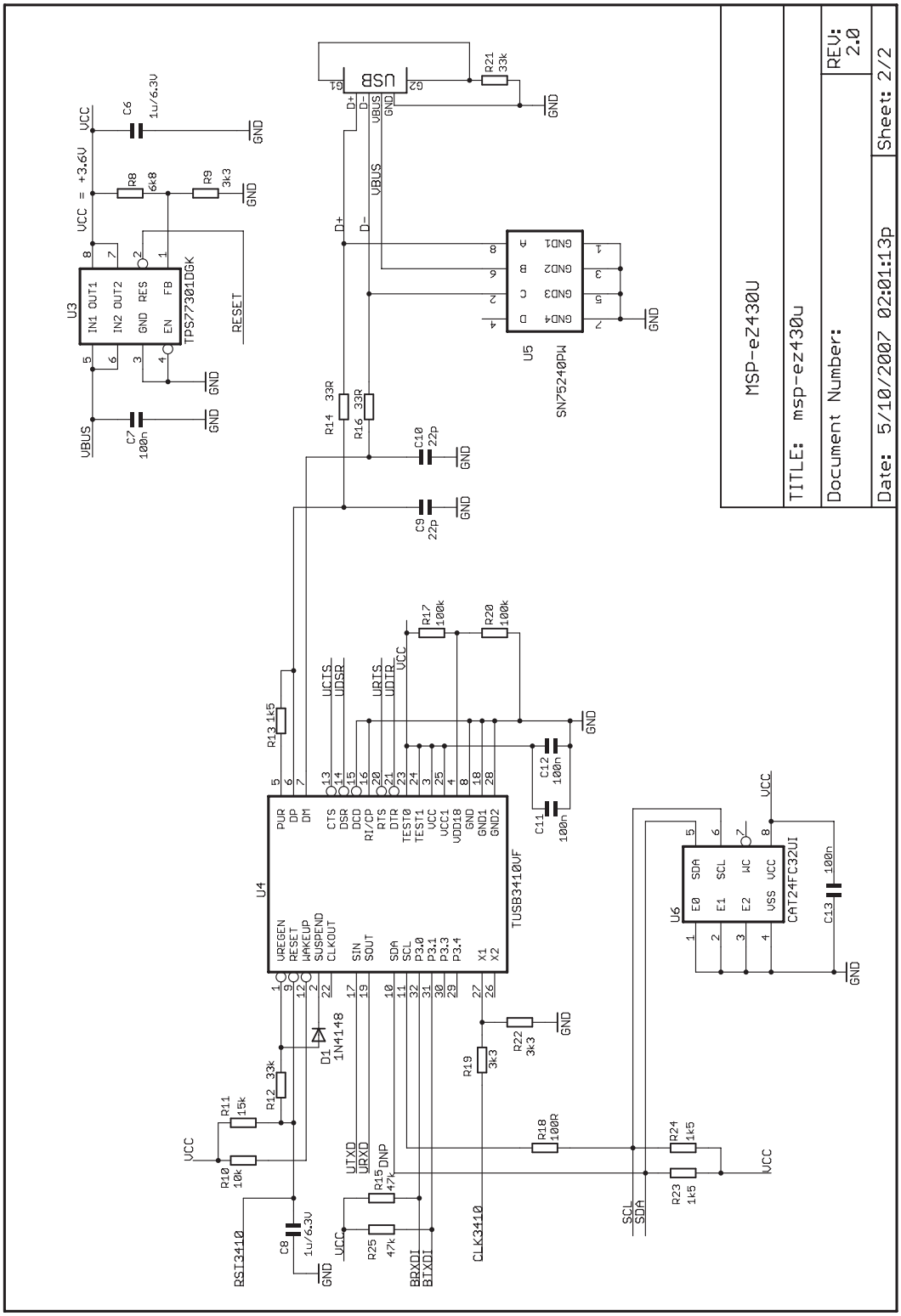


Figure 4-57. USB Debug Interface, Schematic

Copyright © 2009–2015, Texas Instruments Incorporated

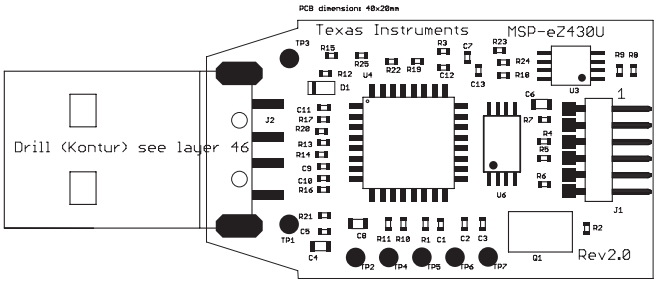


Figure 4-58. USB Debug Interface, PCB Components on Top Layer

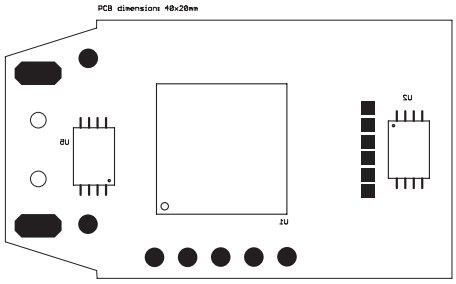


Figure 4-59. USB Debug Interface, PCB Components on Bottom Layer

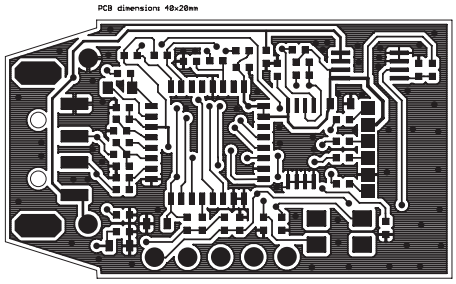


Figure 4-60. USB Debug Interface, Layout Top Layer

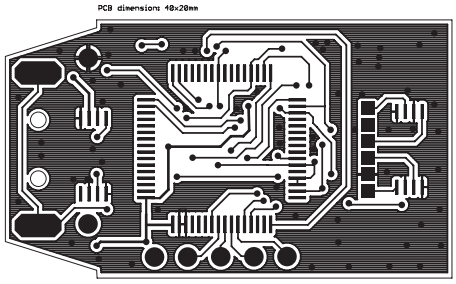


Figure 4-61. USB Debug Interface, Layout Bottom Layer

Copyright © 2009–2015, Texas Instruments Incorporated

Copyright © 2009–2015, Texas Instruments Incorporated

Frequently Asked Questions

A.1 FAQs

1. **How Do I visually identify the wrist module's PCB version?**

   To identify the PCB version, remove the enclosure from the wrist housing and check the PCB color around the pressure sensor or the area around the JTAG connector P1.

2. **My eZ430-Chronos wrist module doesn't respond when I push buttons, instead it shows "Loct" in the LCD?**

   "Loct" on the 7-segment LCD stands for "Lock" and indicates that the keylock is active. By holding # and DOWN for three seconds simultaneously unlocks or locks the buttons. The LCDs shows "oPEn" when the keylock is disabled.

3. **Why doesn't my eZ430-Chronos wrist module always respond when buttons are pushed?**

   If buttons are pushed slowly (that is, held down too long), button pushes are ignored.

4. **Why doesn't my eZ430-Chronos wrist module respond when I try to push buttons in short intervals in PPT or ACC mode?**

   Especially in PPT mode it is important to avoid bouncing of the buttons. Therefore, an artificial delay on the receiver side is implemented. Button pushes are translated into keystrokes or mouse clicks only if there is at least 0.5 seconds between two of them.

5. **Is my eZ430-Chronos waterproof?**

   Yes, it is 30-m waterproof. This indicates that it resists splashes and rain. However, it cannot be used while taking a shower, swimming, diving, surfing, snorkeling or any other water sports. Set the Chronos module before exposing it to excessive water. Pressing the buttons in water or heavy rainstorms may cause water to enter the Chronos module.

6. **The reported temperature is incorrect, how can I calibrate the sensor?**

   A temperature offset is stored in Flash, which is calibrated at production. If the offset is erased or is incorrect, it can be changed to an appropriate level; see Section 3.2.1.3 for details.

7. **The reported altitude is incorrect, why is that and how can I calibrate the sensor?**

   The altitude is determined from barometric pressure. Therefore, the altimeter needs to be recalibrated as the pressure changes with the weather. See Section 3.2.1.4 for details on how to calibrate the altimeter. Moreover, the altitude is a function of the temperature in addition to the barometric pressure. Therefore, the Chronos module needs to have ambient temperature, wearing it on the arm or close to the body may cause inaccurate measurements.

8. **Why is there a timeout for the altimeter?**

   The altimeter algorithm is implemented according to an application report from VTI. It is not optimized for ultra-low current consumption. For enhanced battery life, the altimeter stops operation after one hour. It can be reactivated by pushing the UP button.

9. **Why are the backchannel pins not connected on the eZ430-Chronos PCB despite the fact that the eZ430-Chronos debug interface supports the backchannel?**

   All pins of the CC430 were used for the LCD, buttons, or sensors.

10. **Why is there no JTAG connector on the RF access point with black PCB?**

    The access point is designed to be production ready and as small as possible. Therefore, no debug connector is added. However, it may be programmed by attaching a TI low-power wireless debug interface to the corresponding pads on the bottom of the PCB or by using TI's CC1111EMK868-915.

Copyright © 2009–2015, Texas Instruments Incorporated

11. **When I try to compile the source code with IAR KickStart, I get the following error: Fatal Error[e89]: Too much object code produced (more than 0x4000 bytes) for this package**

    IAR KickStart currently has a 16KB code size limitation, and the project being compiled is larger than 16KB (0x4000 = 16384). Select the limited project version in the Workspace pulldown menu of the IDE or use a full license version IAR Embedded Workbench. A 30-day evaluation version of IAR is available from http://supp.iar.com/Download/SW/?item=EW430-EVAL.

12. **When I try to compile the source code with Code Composer Studio v5.5, I get the following error: error: output file "eZ430_chronos_ISM_xxx.out exceeds code size limit**

    Code Composer Studio v5.5 Core Edition is limited to 16KB of code size, and the project being compiled is larger than 16KB. Select the limited project version in the Build Property Configuration pulldown menu of the IDE or use the Platinum Edition of CCS. A 30-day evaluation version is available from http://tiexpressdsp.com/index.php/Category:Code_Composer_Studio_v5

13. **What is the range of the eZ430-Chronos kit?**

    In free field, distances of up to 100 m (328 ft) have been measured. The range in other conditions, especially within buildings, is difficult to predict and also depends on the protocol stack that is used.

14. **A button fell of the eZ430-Chronos housing after I reassembled it.**

    The buttons of the eZ430-Chronos module housing are held by small C-clips. If the metal strips for the buttons of the Chronos module bent and stuck at the wrist housing buttons, they could have removed the C-clip. Open the wrist housing, locate the C-clip, and reassemble the button.

15. **How do I know whether I have a 915-MHz, 868-MHz, or 433-MHz kit?**

    Each eZ430-Chronos kit has a sticker on the box that includes the part number and frequency. The 915-MHz and 868-MHz wrist modules are the same for both frequencies from a hardware perspective. The USB access points are slightly different. The 868-MHz version has a 0-Ω resistor next to the antenna, and the 915-MHz version does not. The 433-MHz wrist modules and access points (with blue antenna and larger than the 915-MHz and 868-MHz versions) are different from a hardware and software perspective and cannot be used for other frequencies.

16. **How do I restore the original software on my eZ430-Chronos wrist module?**

    The eZ430-Chronos software on the PC contains source code projects as well as flash images, which may be used to restore the original software state of the wrist module. The .txt files are located in C:\Program Files\Texas Instruments\eZ430-Chronos\Recovery. To program the .txt flash images tool such as the Flash Pro Lite software from Elprotronic (www.elprotronic.com) can be used. Ensure that the information memory block D is not erased, as it contains calibration data and the ID of the Chronos module.

17. **I have erased the Chronos module ID and calibration data. What happens now?**

    If information memory block D was erased, default values for the calibration data and ID are used. See function read_calibration_values() in main.c for details.

18. **I have more than one eZ430-Chronos wrist module connecting to one access point at the same time. How can I prevent this?**

    Each eZ430-Chronos kit has a unique ID stored in information memory block D. If this block was erased, the ID is equal on all Chronos modules. See FAQ item 17 about restoring the ID value.

19. **Can I purchase the eZ430-Chronos kit or components of it in quantities? Can I get a customized version?**

    Yes, our partner BM innovations (http://www.bm-innovations.com) provides all components of the eZ430-Chronos kit in volume as well as a range of other products.

20. **Which version of SimpliciTI is used with eZ430-Chronos?**

    The current software release used SimpliciTI 1.1.1.

Copyright © 2009–2015, Texas Instruments Incorporated

21. **The LCD of my eZ430-Chronos remains blank after a wireless update. What can I do?**

    In case of an error during the wireless update, the Chronos module does not go back to the previous software version as its Flash memory was deleted. To reduce current consumption, the Chronos module is put in low-power mode (LPM4) and the LCD is turned off. As the wireless update software is still active, the update procedure can be started again despite the fact that the LCD remains blank. This can be done, by selecting a flash image (.txt file) on the wireless update tabs of the eZ430-Chronos Control Center PC software and clicking Update eZ430-Chronos Watch. To start the update on the Chronos module, press the DOWN button. The update is started. For details, see Section 3.6.3.

22. **The wireless update procedure always returns an error while downloading to flash.**

    Make sure that the file you are trying to download does not include data outside the main flash boundaries, which are 0x8000 to 0xFFFF. This protection mechanism avoids writing of data to non-existent or restricted addresses. Try to download one of the original example project's .txt files, which are available for Windows in C:\Program Files\Texas Instruments\eZ430-Chronos\Recovery\Chronos Watch\Applications and for Linux in /home/<user name>/Texas Instruments/eZ430-Chronos/Recovery/Chronos Watch/Applications. If the update still does not work, the RAM-based update software may be corrupted; see the next question.

23. **The wireless update always returns an error while downloading to RAM.**

    Make sure that the file named ram_based_updater.txt, which is located on the working directory of your Control Center or Data Logger GUI has not been changed. If so, reinstall the eZ430-Chronos Software to restore the original file.

24. **I get an error message right after I start the wireless update on the PC. Failed to start Wireless Update.**

    Check if the RF access point contains right software version. Kits older than 04/2010 (date code can be found on bottom of the eZ430-Chronos box) require a manual update as described in Section 3.6.3.

25. **Activating the rFbSL mode on the Chronos module always results in a rest.**

    This is normal. Whenever the wireless update was activated on the Chronos module, it returns to the main application with a reset, regardless if an update was performed or not. Time, data, alarm, and other RAM-based data is lost. For details, see Section 3.6.3.

26. **The buzzer doesn't work when the Chronos module is not inside the housing. What's wrong?**

    This is normal as the buzzer is located on the metal back of the wrist housing. It is only connected to the Chronos module when the metal back is mounted.

Copyright © 2009–2015, Texas Instruments Incorporated

Copyright © 2009–2015, Texas Instruments Incorporated

Detailed Hardware Driver Installation Guide

B.1 Overview

Detailed instructions for the Windows driver installation of the access point and the Debug Interface. The instructions are shown for Windows XP, but are similar in Windows Vista and Windows 7.

B.2 eZ430-Chronos RF Access Point

1. The eZ430-Chronos access point USB drivers are included in the eZ430-Chronos installer package. A separate driver wizard window opens during installation as shown in Figure B-1. Continue by clicking next. A Windows warning may appear as the driver is not certified. Accept the driver installation.



Figure B-1. Device Driver installation Wizard for the Access Point

Copyright © 2009–2015, Texas Instruments Incorporated

2. The driver installation wizard shows if the driver is successfully installed (see Figure B-2)



Figure B-2. Successful Driver Installation for Access Point

3. Insert the access point.
4. Windows detects the new hardware as *TI CC1111 Low-Power RF to USB CDC Serial Port or eZ430-ChronosAP* (see Figure 3).



Figure 3. Access Point Detection for eZ430-Chronos With Black PCB

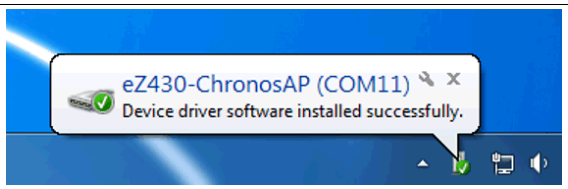


Figure 4. Access Point Detection for eZ430-Chronos With White PCB

Copyright © 2009–2015, Texas Instruments Incorporated

5. Windows may open the *Found New Hardware Wizard*. If so, select *No, not this time* (see Figure B-5).



Figure B-5. Windows Found New Hardware Wizard

6. Select *Install the software automatically* in next dialog (see Figure B-6).

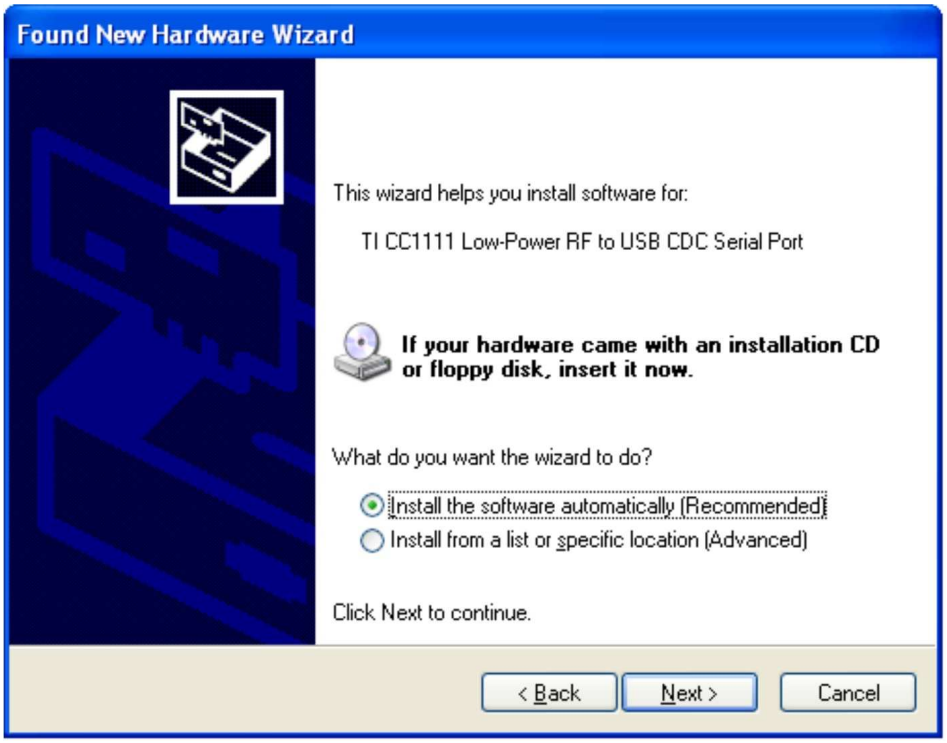


Figure B-6. Automatic Driver installation

Copyright © 2009–2015, Texas Instruments Incorporated

7. A Windows warning appears as the driver is not certified. Click *Continue Anyway* (see Figure B-7). The drivers are installed.



Figure B-7. Windows Uncertified Driver Installation Warning

8. The Windows Device Manager lists the device *TI CC1111 Low-Power RF to USB CDC Serial Port (COMx) or eZ430-ChronosAP (COMx)* in *Ports (COM & LPT)* (see Figure 8).

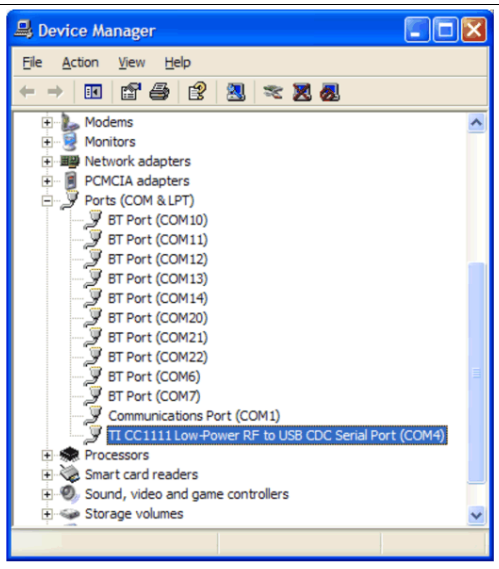


Figure 8. Access Point in Windows Device Manager for eZ430-Chronos With Black PCB

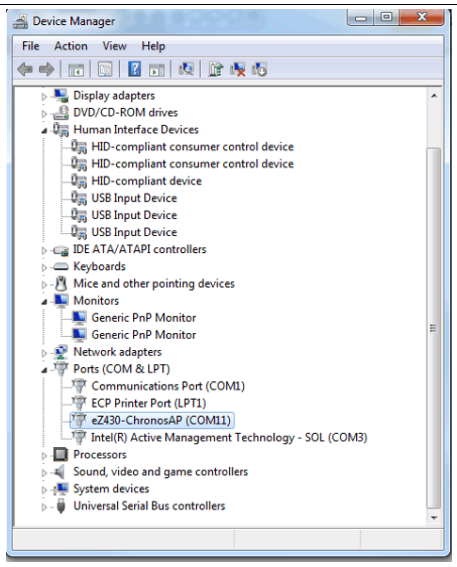


Figure 9. Access Point in Windows Device Manager for eZ430-Chronos With White PCB

9. Verify correct properties of the port settings (see Figure 10 and Figure 11).

Copyright © 2009–2015, Texas Instruments Incorporated

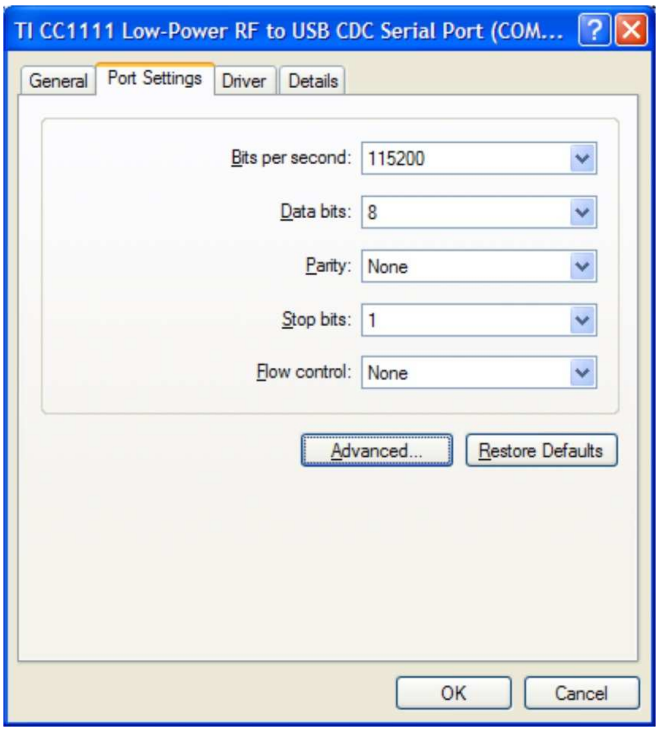


Figure 10. Port Settings for eZ430-Chronos With Black PCB

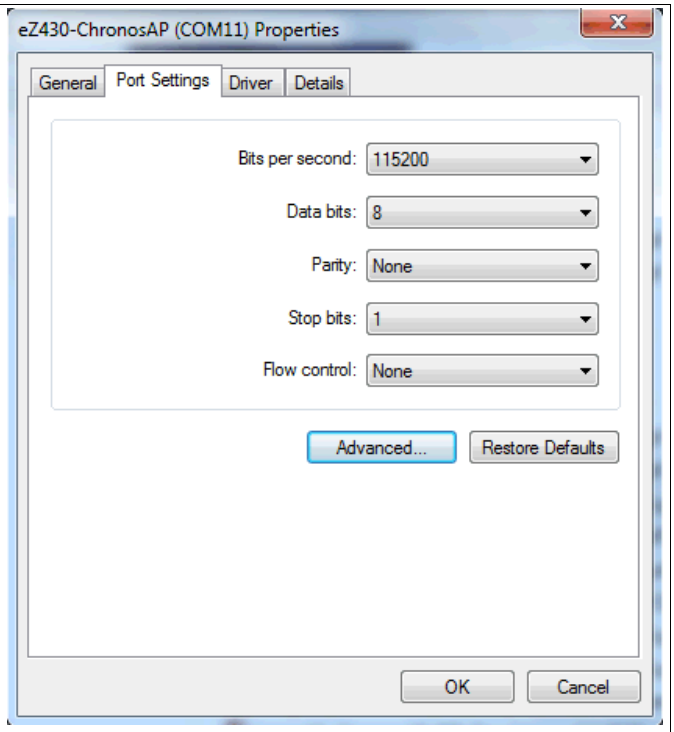


Figure 11. Port Settings for eZ430-Chronos With White PCB

B.3 eZ430-RF Debug Interface

1. Install an IDE of your choice (see Section 3.6), it contains the drivers for the debug interfaces
2. Connect the eZ430-RF USB Debug Interface to an USB port of the PC
3. Windows should now recognize the new hardware as an "MSP430 XXX x.xx.xx" (see Figure B-12). The device name may be different from the one shown here.



Figure B-12. eZ430-RF Windows Driver Installation

4. The drivers are installed automatically without any user interaction.
5. The USB debug interface is installed and ready to use. The Windows Device Manager lists a new entries for a Human Interface Device and the MSP430 Application UART (COMx) (see Figure B-13).

Copyright © 2009–2015, Texas Instruments Incorporated

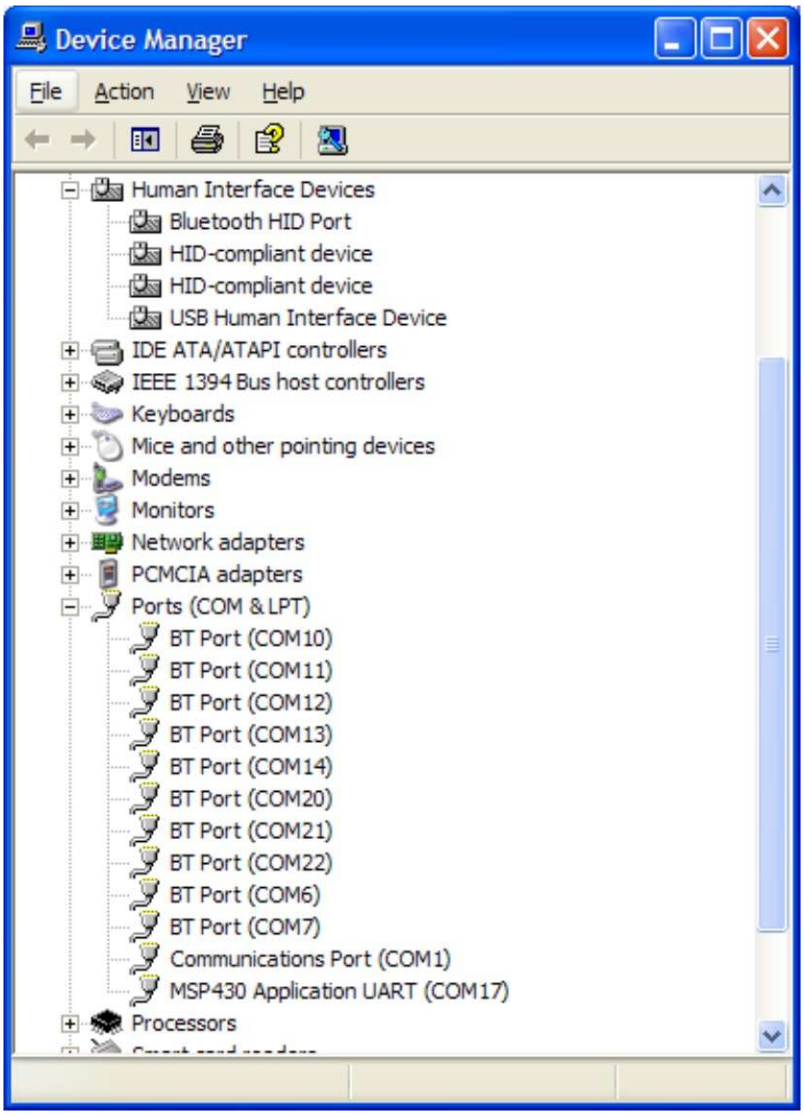


Figure B-13. eZ430-RF in Windows Device Manager as HID and COM Port Devices

Copyright © 2009–2015, Texas Instruments Incorporated

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from F Revision (October 2013) to G Revision	Page
• Removed former FAQ 9 "How can TI sell the eZ430-Chronos for only..."	125

Copyright © 2009–2015, Texas Instruments Incorporated

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ('TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products http://www.ti.com/sc/docs/stdterms.htm), evaluation modules, and samples (http://www.ti.com/sc/docs/sampterms.htm).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2018, Texas Instruments Incorporated