

## CC85xx External Host Interface: Examples and Library

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### Keywords

- CC85xx
- Source Library
- External Host Interface
- MSP430
- EHIF
- CC85XXDK-HEADSET
- MSP430F5438

## 1 Introduction

The CC85xx EHIF Library implements a generic framework for using the External Host Interface (EHIF), based on a 4-wire SPI interface and 2 optional GPIO pins. This allows external microcontroller or DSP, also referred to as the host processor, to implement flash programming and production tests, operate the CC85xx in host-controlled operation and check performance in autonomous operation:

- Autonomous operation
  - Device information
  - RF and audio statistics
  - Non-volatile storage read/write
- Host controlled operation
  - Device information
  - RF and audio statistics
  - Network management
  - Power management
  - Audio related operations
  - Data side-channel
  - Remote control functionality (mouse, keyboard, remote control)
  - Non-volatile storage read/write
- USB operation
  - Device information
  - RF and audio statistics
  - Non-volatile storage read/write
- Production test
  - RF tests (Rx, Tx, Packet Error Rate)
  - IO tests
  - Audio tests

This help system should not be read without also understanding the [CC85XX Family User's Guide](#) and especially its Appendix B.

The library code is documented in \ehif\_lib\doc\cc85xx\_ehif\_lib.chm while the examples source code is documented extensively in the code itself. Project collateral discussed in this design note can be downloaded from the following URL: <http://www.ti.com/lit/zip/SWRA369>.

**Note** that for simple testing and extracting device information and statistics, the [PurePath Wireless Commander](#) PC tool may be favored over the EHIF Library. This tool supports scripted command execution (using Java-script), and uses the CCDebugger (included in the development kits) to interface with CC85xx devices.

## Table of Contents

<b>1</b>	<b>INTRODUCTION</b> .....	<b>1</b>
<b>2</b>	<b>EHIF LIBRARY SOURCE CODE</b> .....	<b>3</b>
2.1	PORTABILITY.....	3
2.2	FILE HIERARCHY.....	3
<b>3</b>	<b>APPLICATION EXAMPLES</b> .....	<b>4</b>
3.1	FLASH PROGRAMMING.....	4
3.2	MASTER.....	4
3.3	SLAVE.....	4
3.4	PRODUCTION TEST .....	5
<b>4</b>	<b>EXAMPLE HARDWARE CONFIGURATION</b> .....	<b>5</b>
<b>5</b>	<b>REFERENCES</b> .....	<b>6</b>
<b>6</b>	<b>GENERAL INFORMATION</b> .....	<b>7</b>
6.1	DOCUMENT HISTORY.....	7

## Abbreviations

API	Application Programming Interface
EHIF	External Host Interface
DUT	Device Under Test
LCD	Liquid Crystal Display
PER	Packet Error Rate
SPI	Serial Peripheral Interface
USB	Universal Serial Bus

## 2 EHIF Library Source Code

The EHIF library source code is divided into the modules listed below. Click on the different modules' hyperlinks to view their documentation:

- Interfacing the host processor application:
  - **Command Execution Framework**
    - Used by the host processor to execute commands from the EHIF command set (except bootloader)
    - Application interface is based on the data structures defined by the **External Host Interface Definitions**
    - Automates endianness conversion when using little-endian microcontroller/compiler
  - **Basic Operations**
    - Implements basic SPI operations, pin and SPI-based reset routines and waiting/timeout utilities
  - **Bootloader Commands**
    - Provides access to bootloader specific EHIF commands and defines relevant EHIF status words
- Low-level microcontroller and board hardware abstraction:
  - **HAL: Board Specific Definitions and Routines**
    - Defines board specific constants, macros and functions.
  - **HAL: Microcontroller Specific Definitions and Routines**
    - Defines microcontroller specific constants, macros and functions.
- Internal functionality:
  - **Utilities**
  - **Basic Operations with Automatic Field Endianness Conversion**

### 2.1 Portability

The EHIF library and examples have been written and tested for MSP430 and 8051, using the IAR toolchain.

To support conversion from the big-endian nature of the EHIF commands to the microcontroller's and compiler's endianness, the **Basic Operations with Automatic Field Endianness Conversion** submodule (used by the **Command Execution Framework**) comes in two versions:

- The little-endian version swaps byte order for all 16- and 32-bit fields, using micro-scripts defined for each data structure
- The big-endian version is a simple byte-oriented wrapper around **Basic Operations**

Bit-fields in data structures have been used to maximize ease-of-use and application code readability while maintaining a low memory footprint. The understanding of bit-fields is compiler specific, and must be understood when selecting the appropriate version of the **External Host Interface Definitions** header file:

- The little-endian version has all bit-fields within a container (e.g. uint32\_t) reversed
- The big-endian version has all bit-fields in normal order as listed in the User's Guide

### 2.2 File Hierarchy

The library source code is found under the source directory:

- source: Endianness- and hardware-independent source files
  - little\_endian: Little-endian versions of **External Host Interface Definitions** and **Basic Operations with Automatic Field Endianness Conversion**
  - big\_endian: Big-endian versions of **External Host Interface Definitions** and **Basic Operations with Automatic Field Endianness Conversion**
  - hal: Low-level hardware abstraction

- \*mcu\*: One directory per MCU type, containing MCU-specific definitions
  - \*board\*: One directory per board type, containing board-specific definitions

## 3 Application Examples

Code examples are provided for the MSP-EXP430F5438 board, with project files and support libraries for IAR Embedded Workbench for MSP430 version 5.40.2. All applications utilize the board's LCD display for usage instructions and status output.

### 3.1 Flash Programming

Shows how to perform flash programming of CC85XX devices:

Uses the **Programming Algorithm** without modifications

- Two flash images have been converted from the hex-file format output by the PurePath Wireless Configurator to C byte-arrays, using the supplied HEX2C conversion tool. These CC85xx flash images are then compiled into the MSP430 flash image, so that the MSP430 can operate standalone:
  - Image 0 - Master network role from the CC85XXDK Preloaded Demo (autonomous operation), generated by running:

```
hex2c -p10 -ippweb_preloaded_demo_master.hex -oppweb_preloaded_demo_master.c -npMasterImage
```

- Image 1 - Slave network role from the CC85XXDK Preloaded Demo (autonomous operation), generated by running:

```
hex2c -p10 -ippweb_preloaded_demo_slave.hex -oppweb_preloaded_demo_slave.c -npSlaveImage
```

### 3.2 Master

Shows how to operate a CC85xx host-controlled protocol master:

- Implements local CC85xx power control
- Implements button-based network pairing
- Implements remote volume control of the protocol slave

### 3.3 Slave

Shows how to operate a CC85xx host-controlled protocol slave:

- Implements local CC85xx power control
- Implements button-based network pairing
- Uses remote volume control
- Implements two different versions of the remote control user interface:
  - Play control: Volume up/down (affecting own volume through remote volume control) and play/pause and skip next/previous (for use with USB-based or other advanced protocol master)
    - Include *uif\_play\_control.c* in the build
  - Mouse (supported by FW 1.3.1 and later): Implements simple mouse functionality using the joystick (for use with USB-based protocol master)
    - Include *uif\_mouse.c* in the build

## 3.4 Production Test

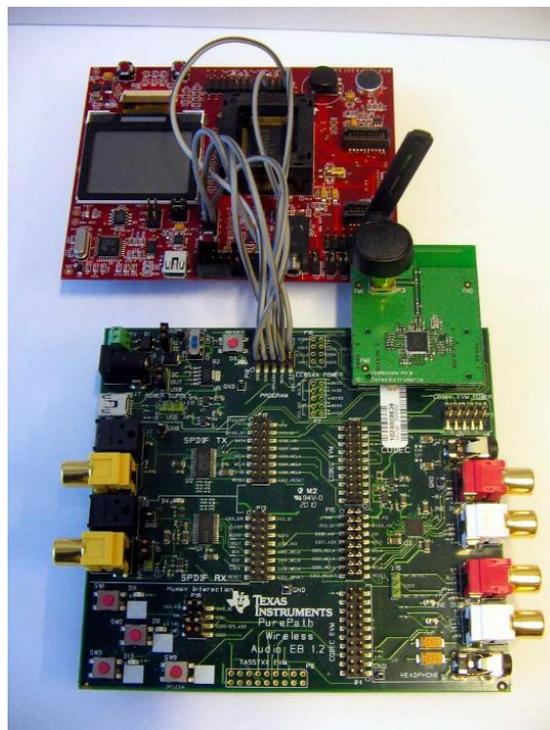
Shows how a production test can be implemented for the CC85xx Headset reference design.

- The test procedure checks I/O, audio and RF. Depending on customer priorities, a real production test can be more or less complex than this example
- A production test can also include flash programming, using the functionality demonstrated by the flash programming code example. When using the default MSP430 hardware configuration (with SPI at 4 MHz), the entire procedure (including erasing, programming and verification) can be completed approximately 350 ms.

## 4 Example Hardware Configuration

The example code is written for the [MSP430F5438 Experimenter Board](#). Running an example requires one such board connected to a PurePath Wireless EB in the following manner: Note that the production test example with the CC85XXDK-HEADSET is connected in a similar fashion.

Function	PurePath Wireless EB	MSP-EXP430F5438
Ground	P10.1	GND
GIO3 (EHIF interrupt)	P10.4	P5.1
SPI CSn	P10.5	P10.3
SPI SCLK	P10.6	P10.0
RSTn	P10.7	P5.0
SPI MOSI	P10.8	P10.4
SPI MISO	P10.10	P10.5



## **5 References**

- [1] PurePath Wireless Headset Development Kit  
<http://focus.ti.com/docs/toolsw/folders/print/cc85xxdk-headset.html>
- [2] PurePath Wireless Configurator\_  
<http://www.ti.com/tool/purepath-wl-cfg>
- [3] CC Debugger Product Page  
<http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html>
- [4] MSP-EXP430F5438 Experimenter Board Product Page  
<http://focus.ti.com/docs/toolsw/folders/print/msp-exp430f5438.html>
- [5] SmartRF Flash Programmer Product Page  
<http://focus.ti.com/docs/toolsw/folders/print/flash-programmer.html>
- [6] MSP430 USB Debugging Interface Product Page  
<http://focus.ti.com/docs/toolsw/folders/print/msp-fet430uif.html>
- [7] CC85xx Family User's Guide  
<http://www.ti.com/lit/swru250>
- [8] PurePath Wireless Commander\_  
<http://www.ti.com/tool/purepath-wl-cmd>
- [9] PurePath Wireless Audio landing page.  
<http://www.ti.com/purepathwireless>

## **6 General Information**

### **6.1 Document History**

<b>Revision</b>	<b>Date</b>	<b>Description/Changes</b>
SWRA269A	2012.08.08	Renamed and completely re-written to include more examples and full EHIF source code compliant with FW1.4.0
SWRA369	2011.06.16	Initial release.

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