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CSR µEnergy®

xIDE

User Guide

Issue 9

Document History

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Contents

Tables, Figures and Equations

1. Introduction

This document provides a brief introduction to CSR's Integrated Development Environment (xIDE) supplied with CSR µEnergy Software Development Kits (SDKs).

The document is intended to provide developers with the information required to begin using xIDE to develop applications for CSR's Bluetooth Smart single-mode IC devices.

Note:

Since xIDE provides a familiar environment with the tools and utilities required to write, build, run and debug code it is not intended to detail all these features. This document concentrates on CSR µEnergy-specific aspects of developing applications using xIDE.

1.1. General

xIDE allows software engineers to build and configure the application projects provided in the SDKs and to independently develop applications to run on CSR µEnergy devices.

xIDE supports the development and debugging of applications written in ANSI C for the XAP core, and assembly language for the 8051 PIO Controller, present on the device.

Code is written in the text editor and, once complete, built and compiled along with the firmware supplied with the SDK. The resultant machine code can be downloaded to, run and debugged on a real hardware development platform such as those included in the CSR µEnergy development kits.

Example code is provided that implements the latest Bluetooth Smart Profiles and on-chip peripheral functionality and when used with firmware library functions enable developers to rapidly create their working Bluetooth Smart device applications with minimal effort.

Note:

The supplied profile code usually supports all the mandatory features and most optional features of a particular profile. See the SDK Release Note and Application Notes provided with each profile-based example application for details.

2. Installation

This section gives guidance on the installation of xIDE for CSR µEnergy.

2.1. Prerequisites

xIDE may be installed on a PC running:

- Windows XP
- Windows 7 (32-bit or 64-bit)

  or
- Windows 8 (32-bit or 64-bit).

xIDE requires a USB port or an LPT port to communicate with development boards. The LPT port is only supported when xIDE is running on 32-bit versions of Windows.

CSR recommends that 250 Mbytes of free disk space is available. A typical SDK installation requires 150 Mbytes and each application built will need approximately 5 Mbytes of additional space.

A minimum of Windows Power User privileges is required to install the software correctly. If you are unsure of your current level of privileges, please contact your system administrator.

New installations can coexist with previous releases.

Note:

Spaces in folder names of the directory path are not supported i.e. you should not try to install the software in a directory which itself has spaces in its name or is contained within a folder that has spaces in its name e.g. xIDE cannot be successfully installed in the **Program Files** directory.

2.2. Installation Procedure

CSR recommends that any applications running on the PC are closed before installing the software.

1. The software is provided on a CD-ROM but can also be downloaded from www.csrsupport.com.
2. Double-click on the `CSR_uEnergy_SDK-<Version>.exe` file to launch the Setup wizard, which guides you through the rest of the installation process.
3. Follow the on-screen instructions, clicking **Next** to continue.

   For a first time installation, CSR recommends that the default settings are used.
4. Click **Finish** to complete the installation.

   If the option to install the SPI LPT device driver was selected, the PC must be restarted to complete the installation.

2.2.1. Testing the Completed Installation

2.2.1.1. Before You Begin

Connect a suitable CSR µEnergy hardware development platform, e.g. CSR100x or CSR101x development board, to your PC using the USB to SPI Adapter and cables provided in the CSR µEnergy Development Kit.

Note:

The *Quick Start Guide* accompanying the development kit or development board gives further advice on connecting the development hardware to your PC.

2.2.1.2. Testing the Installation

Launch xIDE for CSR µEnergy SDK by double-clicking on the icon on your desktop, the icon in the Quick Launch bar or from the Windows **Start** menu:

- On Windows 8 open the Start page and click on **CSR µEnergy SDK <version> (xIDE)**.
- On Windows XP and Windows 7 open the Start menu and navigate to **CSR µEnergy SDK <version>/CSR µEnergy SDK (xIDE)**.

The xIDE application window opens:

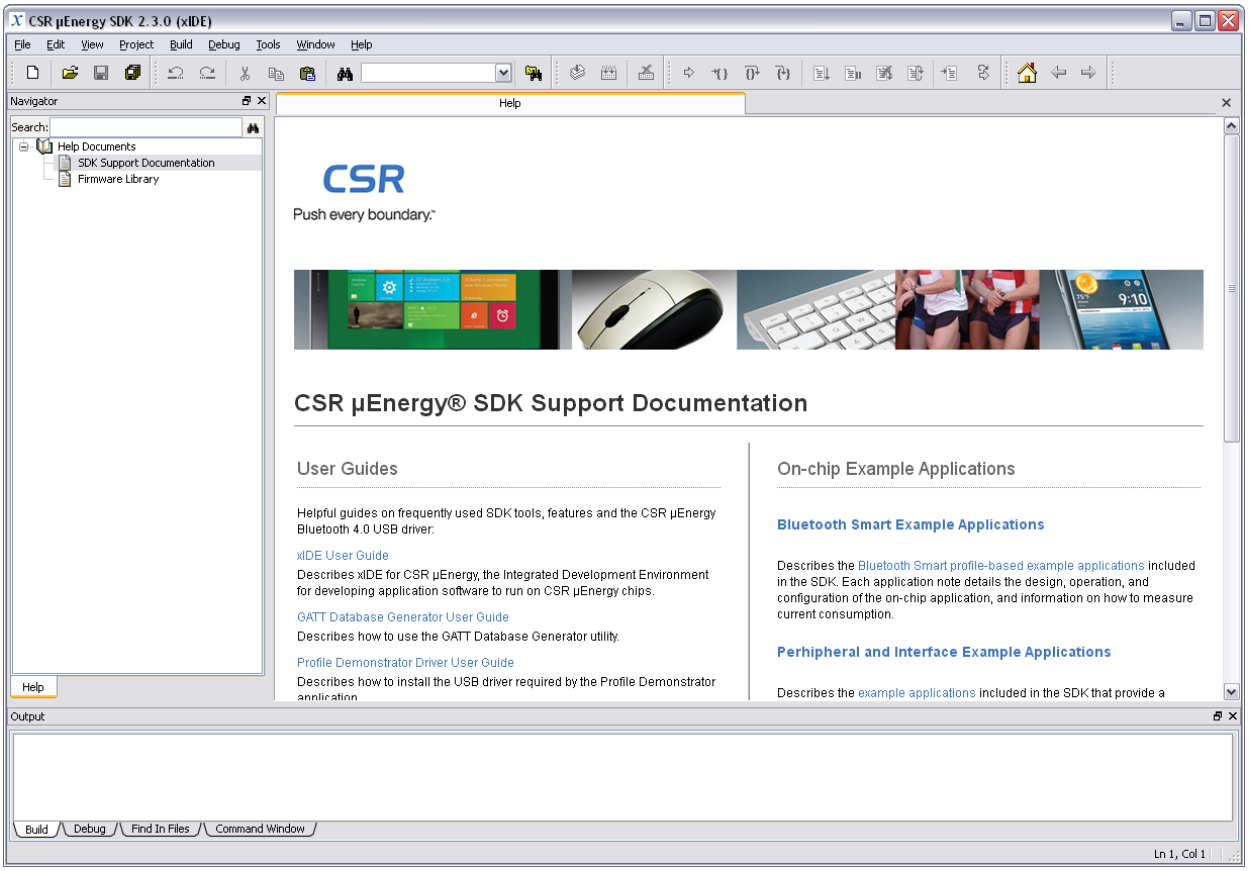


Figure 2.1: Opening Screen

To confirm the installation was successful and the software is working correctly, a new minimal project (Hello world) can be created. When built and downloaded, the on-chip application outputs the “Hello, world” text string to a virtual COM port provided by the CSR µEnergy USB to SPI Adapter.

Use a terminal client application (e.g. HyperTerminal or PuTTY) to open the COM port at 2400 bits per second, 8 data bits, no parity and one stop bit with hardware flow control:

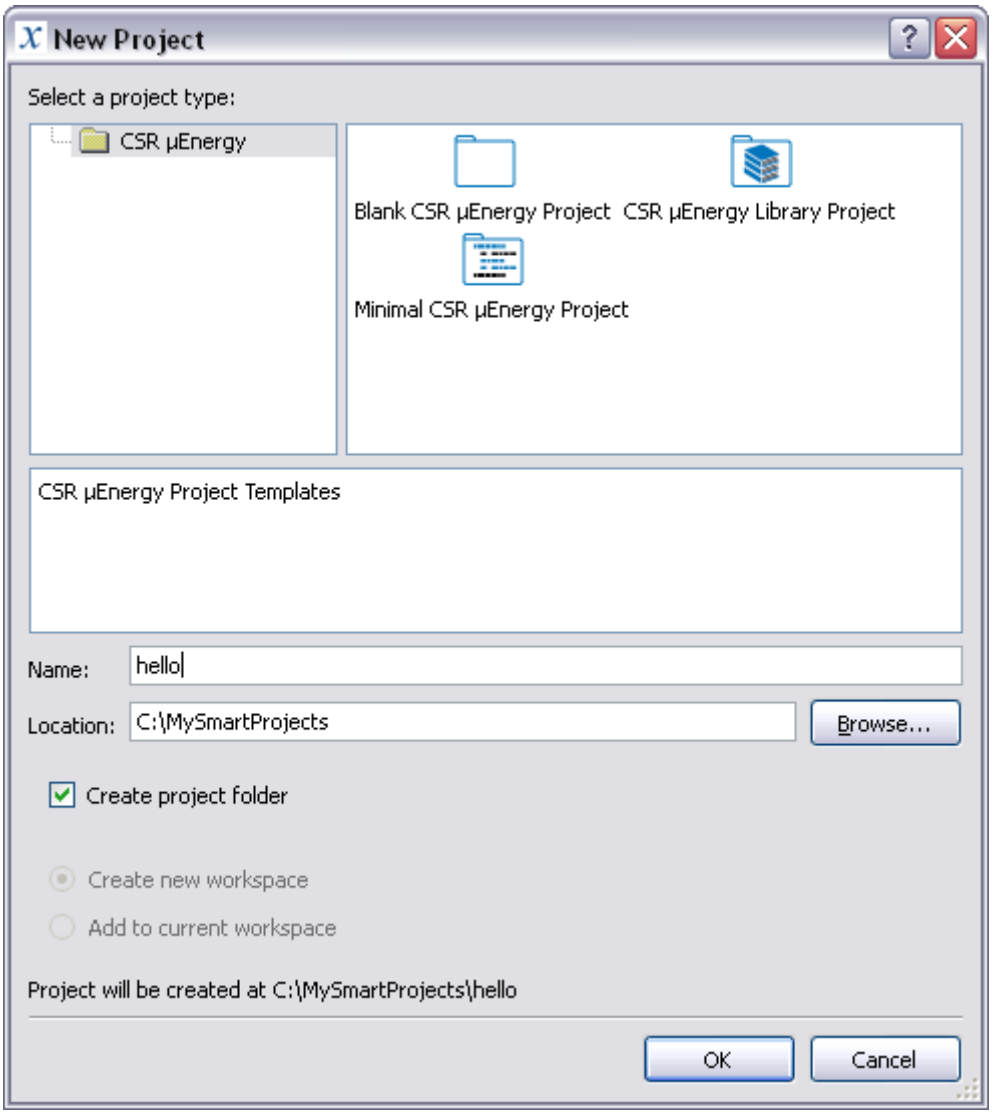
- HyperTerminal is supplied with Windows XP: open the Start menu and navigate to:

  Accessories/Communications/HyperTerminal
- Users of Windows 7 or Windows 8 need to install a terminal client application separately.

To create a minimal project:

1. Select **New** from the **Project** menu.

   The **New Project** window appears:



2. Select the **Minimal CSR µEnergy Project** and give the project a name e.g. hello.

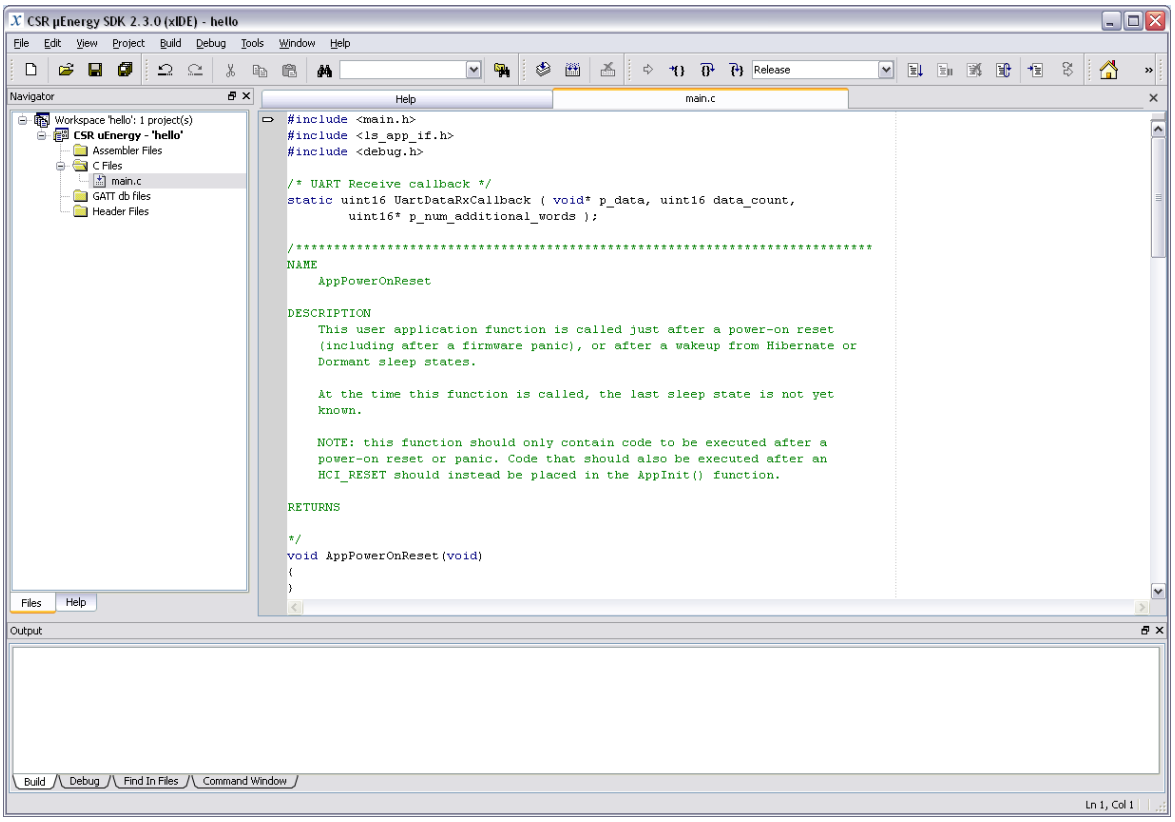
Note:

xIDE does not accept project names and location paths if they contain spaces.

3. Click **OK**.

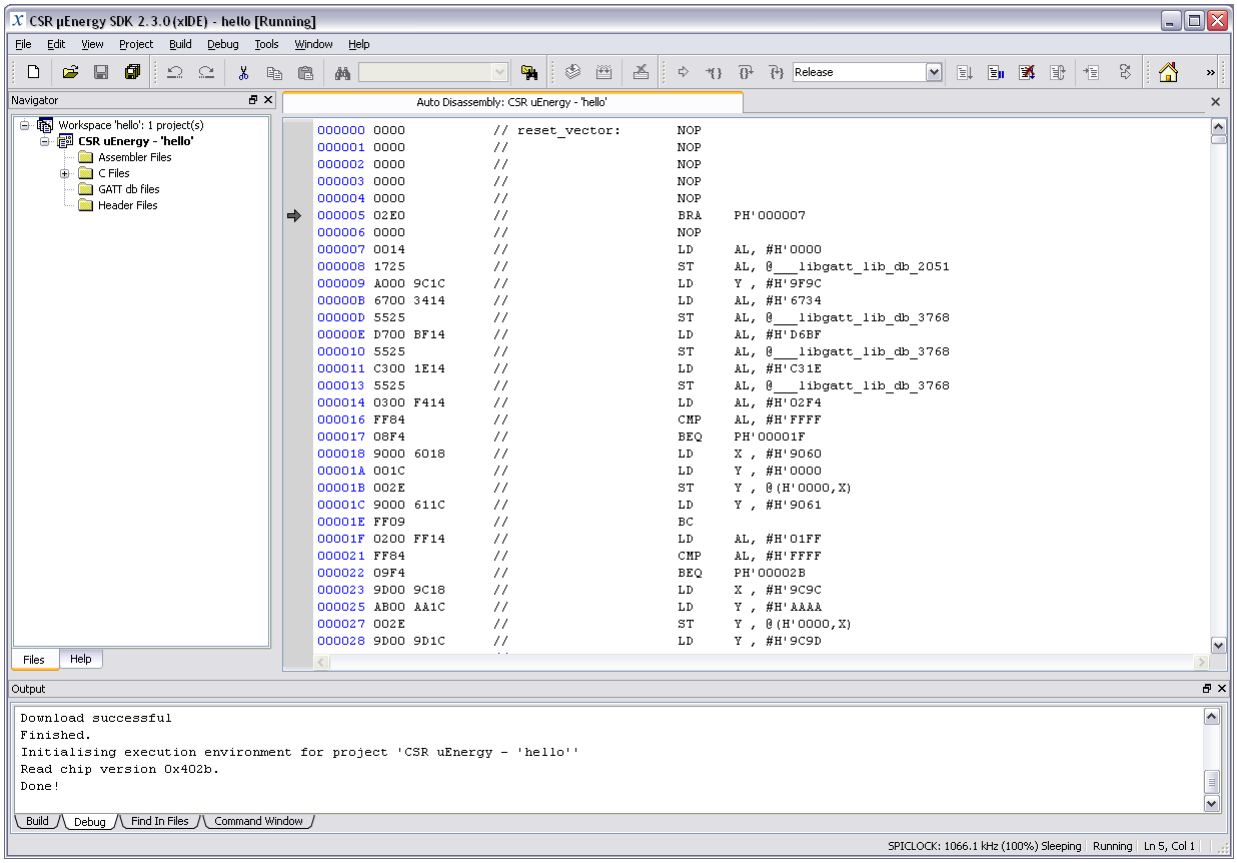
   The project is loaded into xIDE

4. Click on the **C Files** folder in the **Navigator** panel and select `main.c` to display the code in the **Text Editor** workspace:

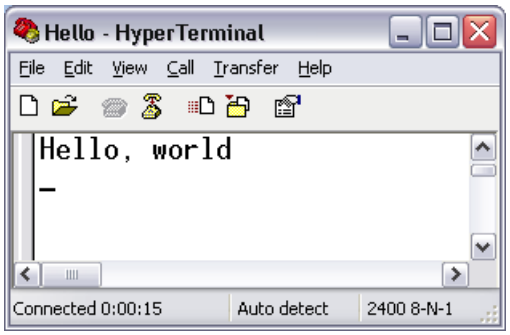


5. Ensure your target device is attached and the correct transport is selected by opening the **Debug** menu and selecting the **Transport…** menu option.
6. Select **Build Active Project** from the **Build** menu (or press the **F7** key).
7. Select **Run** from the **Debug** menu (or press the **F5** key).

   When this process is complete the application is downloaded to the attached CSR µEnergy device.



The output `Hello, world` confirms that the software has been installed and is working correctly.



3. Working with xIDE

Developers can make use of the reference applications provided as the basis for developing their own applications as these reference applications demonstrate basic functionality and conform to the relevant Bluetooth Smart Profiles.

Adopting this approach greatly reduces the effort required to develop a final product application and allows software engineers to concentrate on developing the additional functionality and Man Machine Interface (MMI) features required for their particular product.

This section describes the procedure for loading a reference application as a project in xIDE and running the code on a hardware development platform. Specific details will vary slightly depending on the application and hardware platform being used, and further information is provided in the relevant product documentation.

Note:

Guidance on the use of device peripheral and profile-based example applications is provided in readme files and application notes respectively within the application subfolders, **C:\< CSR_uEnergy_SDK-Version>\apps\...** where **C:\< CSR_uEnergy_SDK-Version>** is the installation directory.

3.1. Building a Supplied Application Project in xIDE

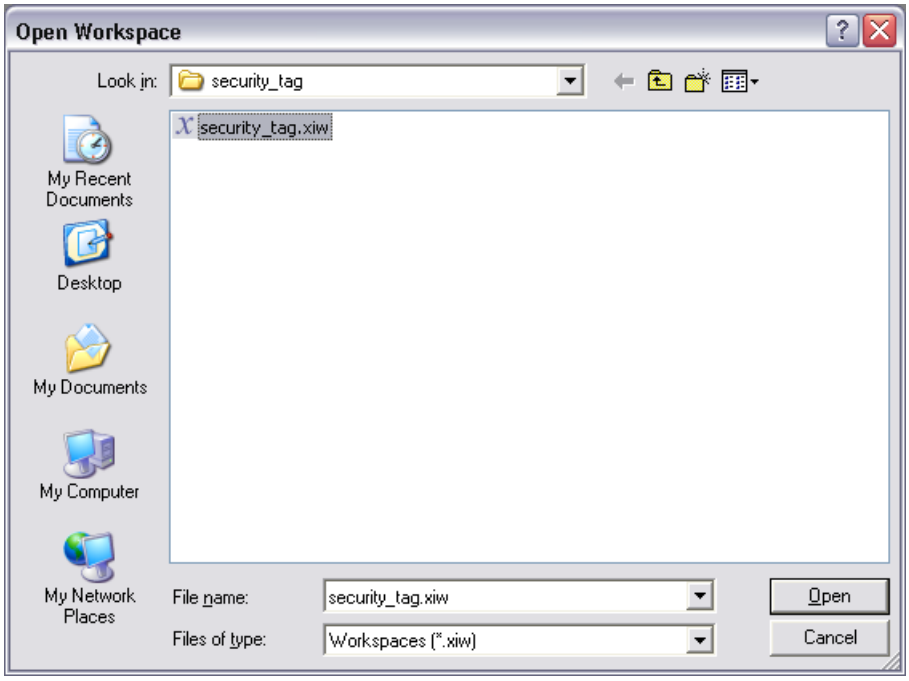
To open a project workspace for a supplied application:

1. Select **Open Workspace** in the xIDE **Project** menu.

   An **Open workspace** window appears.
2. Browse to the folder containing the example applications provided in the SDK.

   e.g. **C:\<CSR_uEnergy_SDK-Version>\apps**
3. Open the required application folder.

   Depending on the application chosen, one or more `.xiw` project files are displayed, see the example below:



3.1.1. Build Menu and Toolbar Operations

The following operations are provided on the **Build** menu and toolbar:

Compile File 

Compiles the currently selected C code, assembly language (`.asm`) or GATT database (`.db`) file.

Note:

If a master database file is present in the project it may refer to additional database files (`.db` files) and invoking the **Compile File** operation on the master file compiles the additional database files.

Build Active Project 

Builds all the files included in the Active project from the current Workspace using the selected configuration. The build is incremental, so the minimum set of builds are performed in order to reflect changes to source files and configurations.

Rebuild Active Project

Rebuilds all files included in the Active project from the current Workspace using the selected configuration. All output files are removed and re-built.

Clean Active Project

Deletes all output files created by previous build operations.

Stop Build 

Terminates the build process.

3.1.2. xIDE Build and Run Procedure

To build all the source files making up the application before downloading the machine code to the device using the **Run** facility:

3.1.2.1. Build Procedure

1. Select the required `.xiw` file in the Open Workspace window (**Project /Open Workspace**)
2. Click **Open**.

   The file is loaded into xIDE.
3. Select **Build Active Project** from the xIDE **Build** menu or press the **F7** key.

   xIDE builds all the files in the project.

3.1.2.2. Run Procedure

To download the machine code to the device:

With the project loaded in xIDE,

1. Select **Run** from the **Debug** menu or press the **F5** key.

The application should now be running on the device, see the relevant application documentation for further details.

3.1.3. Configuration Store Settings

The project folder may contain a configuration file (with `.keyr` file extension) defining the values of configuration keys for a specific type of target hardware. These configuration store settings are downloaded automatically to the target after the combined firmware and application image file has been downloaded.

Multiple CS key files can be added to the project folder but only one will be used for each type of target hardware.

3.1.3.1. Creating the Configuration Store (CS) Key File for the First Time

1. Ensure a `.keyr` is not present in the project folder, has not been added to the project, and is not configured in the **Properties…** menu option on the **Project** menu.
2. Run the application using xIDE to download the application image and to use the default firmware configuration settings.
3. Launch the **CsConfig** tool from the Windows **Start** menu:
   - On Windows 8 open the Start page and click on **CsConfig**.
   - On Windows XP or Windows 7, open the **Start** menu, and navigate to **CSR µEnergy SDK <version>/CSR µEnergy Tools/CsConfig**
4. Select the **Transport** to connect to the target device (if required).
5. Modify the individual settings before clicking **Save** to apply the settings to the target chip.
6. Select **Keys… Dump to file** from the menu.
7. Enter the filename for the `.keyr`, ensuring the file is saved to the current project folder. For example, use `CSR101x_A05.keyr` for CSR101x A05 and `CSR100x.keyr` for CSR100x hardware devices respectively.
8. Add the new configuration file to the project workspace in xIDE.
9. Using the **Properties…** menu option on the **Project** menu, specify the CS Key filename in the **CS Key File** property for each supported device type.

See the **CsConfig** on-line help for more details on its use.

3.1.3.2. Modifying Existing Configuration Store Settings

If the configuration file is already present, edit the configuration file in the **Text Editor** workspace in xIDE and save your changes.

When the application is next built and downloaded, the configuration settings contained in the saved file are used to override the default values provided in the firmware.

Note:

When using new firmware libraries, CSR recommends removing the CS Key file from the old project folder and xIDE project workspace before following the steps in section 3.1.3.1. This avoids compatibility issues between the configuration settings in use on a target device and the new firmware.

3.2. Developing Customised Applications

When the application has been downloaded and is working correctly, developers can begin to customise the example source code and add features to meet the specific requirements of the final product.

In order to work efficiently when developing an application it is important to become familiar with the library structure and functions provided. These are detailed in the Firmware Library documentation accessible from the **Help** tab on the Navigator panel, or from the Windows **Start** menu:

- On Windows 8 open the Start page and click on **Firmware Library**.
- On Windows XP and Windows 7 open the **Start** menu and navigate to **CSR µEnergy SDK <version>/Documentation/Firmware Library**.

Note:

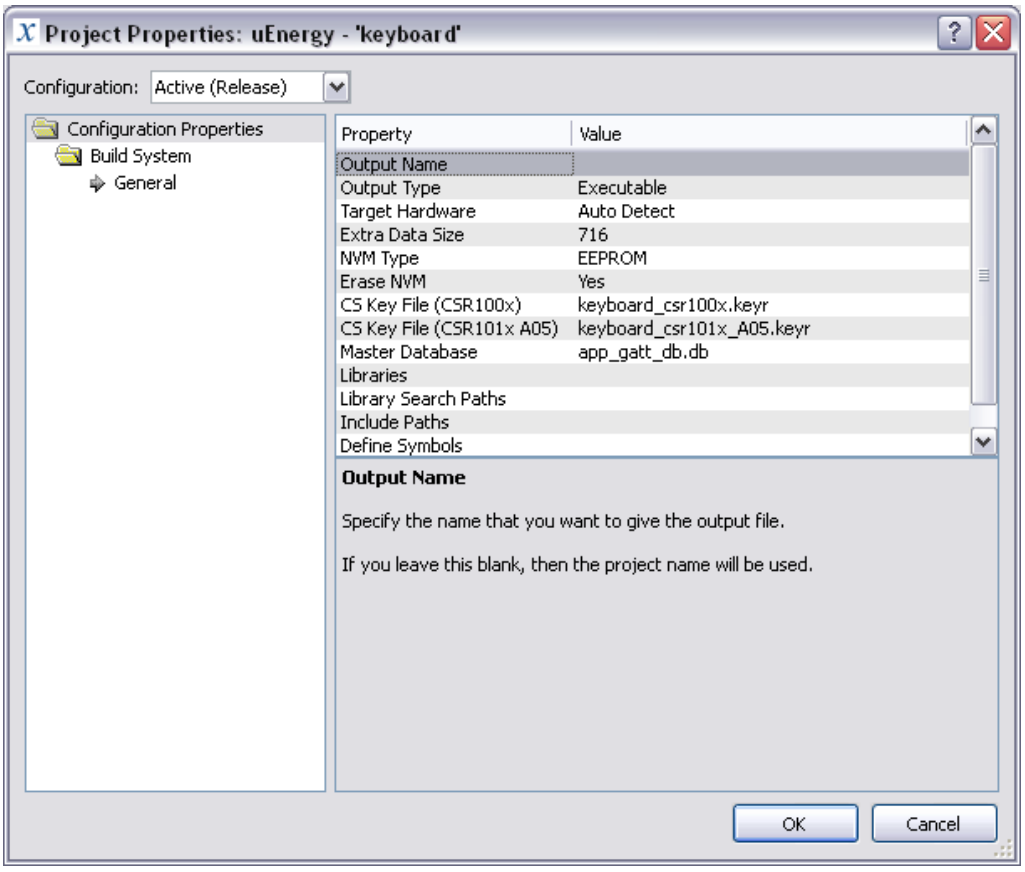
A subset of standard library C functions are available as part of the CSR µEnergy Firmware Library.

3.2.1. To Amend the Project Properties

When a project workspace has been opened:

1. Select **Properties** from the **Project** menu.

   The **Project Properties** window appears:



2. Select the **Configuration** from the drop-down list.
3. Click on a row to activate the **Value** field for the **Property** you want to amend.

   The text below the list of properties provides useful help on the selected **Property**.
4. When the required properties have been amended, click **OK** to set the properties for the project.

3.3. Debugging in xIDE

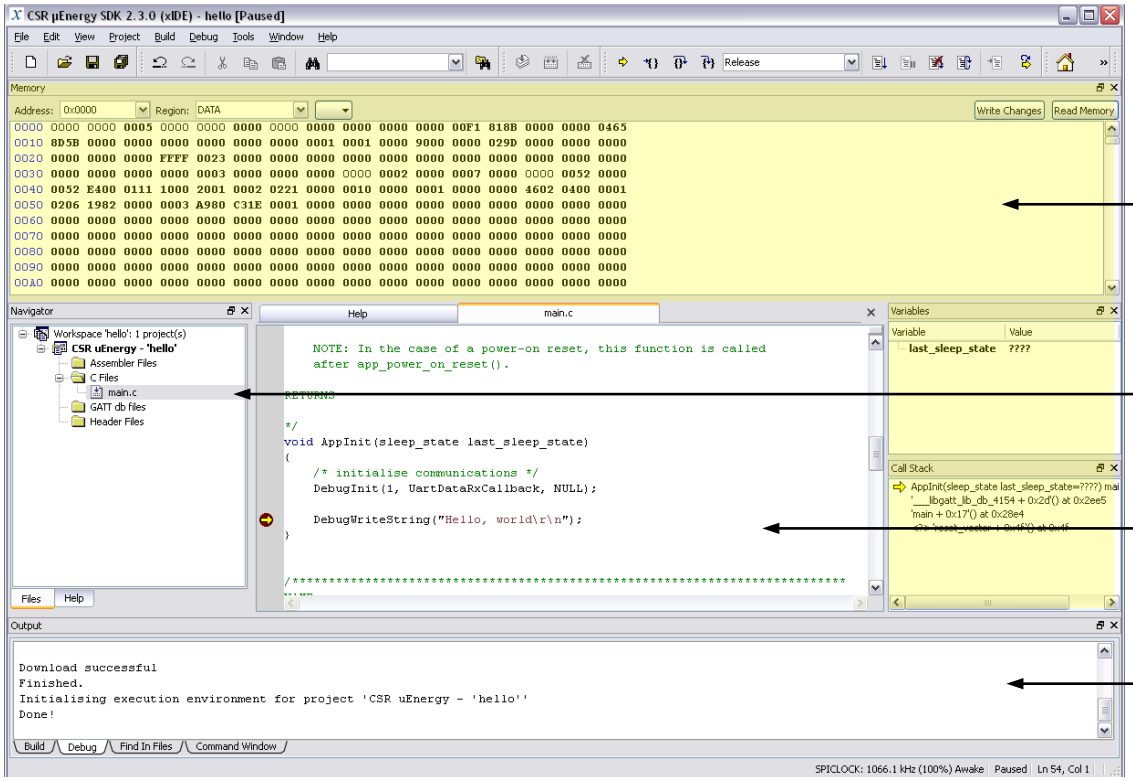
xIDE supports the debugging of the application code running on the device, excluding core firmware.

The application is run on-chip, thus ensuring the debug environment matches the final execution environment of the product as closely as is possible.

xIDE provides a familiar debugging toolset that includes facilities required to efficiently debug programs running on the device.

While many of the facilities provided in xIDE are typical debugging tools, a few are more specific to an integrated implementation such as CSR µEnergy.

3.3.1. Brief Overview of Debug Facilities



The xIDE debug view consists of four basic work areas:

- File navigation windows
- Debug monitor windows (highlighted in yellow)
- Text editor and disassembly windows
- Diagnostic windows

A brief description of each is given in this section.

3.3.1.1. Debug Menu and Toolbar Operations

The following operations are provided on the Debug menu and toolbar.

Run 

Execute the program on chip. The program pauses if a breakpoint is reached, otherwise it continues to execute until paused.

Run To Cursor 

Execute the program on chip until the cursor is reached. This is equivalent to setting a breakpoint at the cursor and selecting the Run operation.

Step Over 

Execute the next statement. If the statement contains one or more function calls, the calls are stepped over; i.e. they are executed and the processor is paused when the functions have returned.

Step Into 

Execute the next statement. If the statement contains one or more function calls, this operation steps into the first call that is executed; i.e. the processor is paused when it reaches the first statement of that function.

The equivalent **Step Out** function is not supported on CSR µEnergy devices. To step out of a function, position the cursor on its closing brace ('}') and select the **Run To Cursor** operation. When the cursor is reached and the program has paused select the **Step Over** operation.

Attach… 

Creates a debug connection to the chip without downloading the application, resetting the device, or otherwise affecting the state of the program.

Pause 

Pause execution and display the next statement that will be executed.

Restart 

Reset the device and restart the program, leaving the device in the paused state.

Stop Debugging 

Disconnect the debug connection to the device. If the processor is running, the device continues to execute the program.

Show Next Statement 

Display the next statement to be executed in the editor or disassembler.

Set Next Statement 

Set the device processor's program counter (PC).

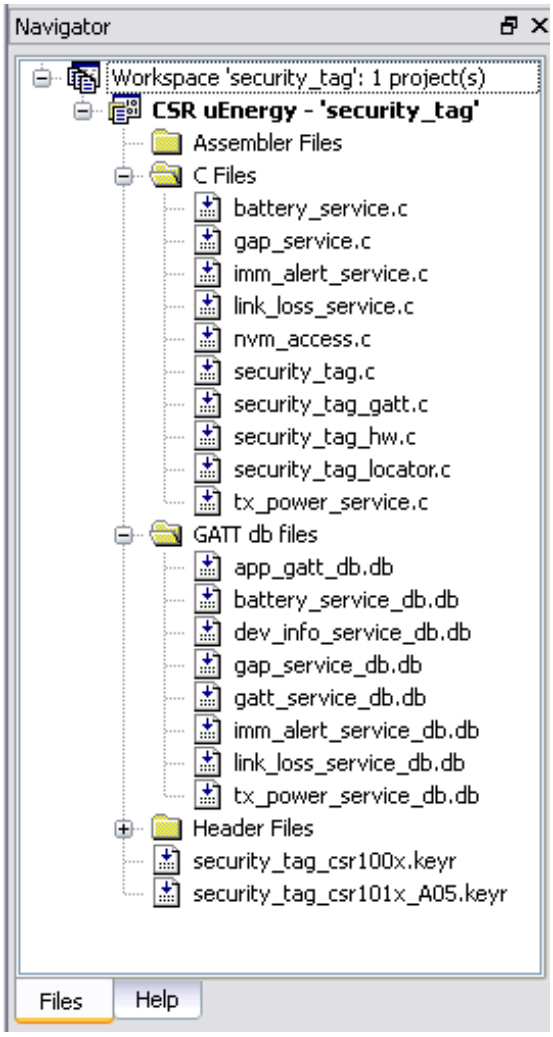
Note:

Run, **Run To Cursor**, **Step Over**, **Step Into** and **Restart** operations depend on the debugger connection status.

If the debugger is not connected to the device, these operations first build the application, download it to the device and create a debug connection to the device before carrying out the operation.

3.3.1.2. File Navigation Windows

This area displays an explorer-like view of the project workspace currently loaded in xIDE:



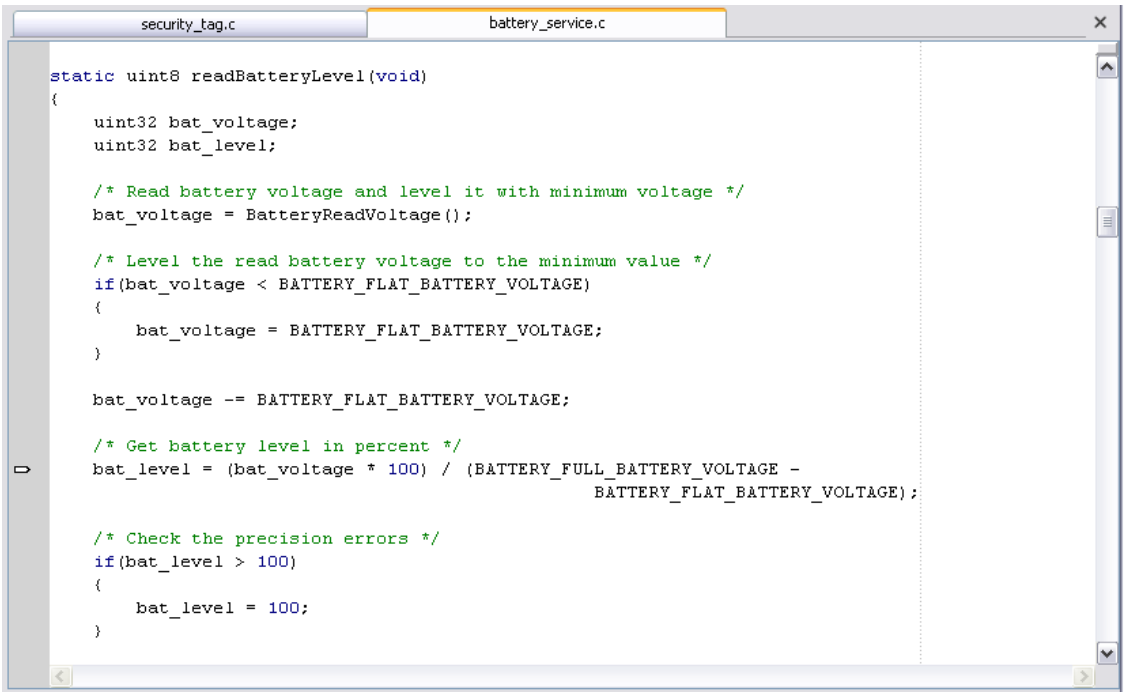
The file structure can be navigated and files opened in the text editor by double-clicking on a file.

A right-click shortcut menu can be opened for items listed in the **File Navigation** menu, the menu options depend on the item selected.

Files can also be added to the project workspace from a folder other than the project folder.

The **Help** tab displays any associated support documentation.

3.3.1.3. Text Editor and Disassembly Windows



This area displays open project files and allows:

- Text editing
- Breakpoints to be set
- Code disassembly to be viewed
- Tabs allow navigation between multiple files opened in the text editor

Note:

An * displayed after the file name on a file tab (e.g. `main.c*`) indicates that the file has been amended and has not been saved.

A right-click in the text editor window displays a shortcut menu.

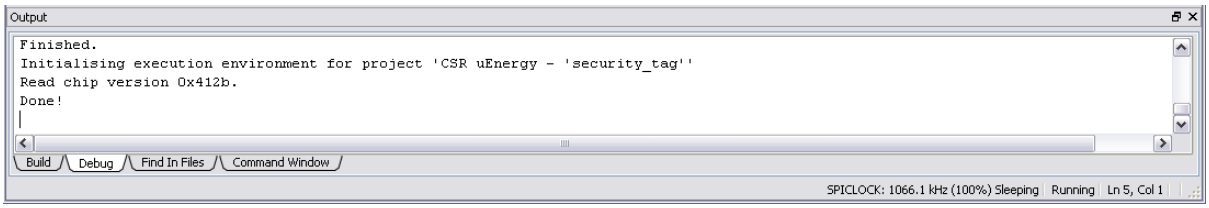
3.3.1.4. Debug Monitor Windows

Developers can select to view various windows that monitor the device state:

- **Registers**: Displays current values of registers
- **Memory**: Displays current values of selected memory addresses
- **Breakpoints**: Lists currently set program breakpoint locations
- **Watch**: Allows the user to view the current value of specific program variables
- **Source Locator**: Locates source code that has been moved since it was built
- **Call Stack**: Displays the current function call stack
- **Variables**: Displays all variables that are in-scope at the current program location
- **Statics**: As Variables, but shows only file-scope variables
- **Globals**: As Variables, but shows only global variables
- **Locals**: As Variables, but shows only function-scope variables

The views can be toggled on and off from the **View/Debug Windows** menu list.

3.3.1.5. Diagnostics Windows



This area displays various tabbed windows that display useful information when building and debugging code:

- **Build**: Displays information on the build process and status.
- **Debug**: Displays information on the debug process and status.
- **Find in Files**: Displays the results of the Find in Files facility accessed from the Edit menu or toolbar.
- **Command Window**: This window can be used to invoke Python scripts to extend xIDE.

Note:

Most developers need not concern themselves with the **Command Window**.

A right-click shortcut menu can be opened in each of the diagnostic windows, the menu options depend on the active tab.

4. SDK Build Process

The SDK's build process combines the application code, GATT database code and optional 8051 PIO Controller assembly code contained within the project, together with the firmware library to create the binary image for either EEPROM or SPI Flash external memory device.

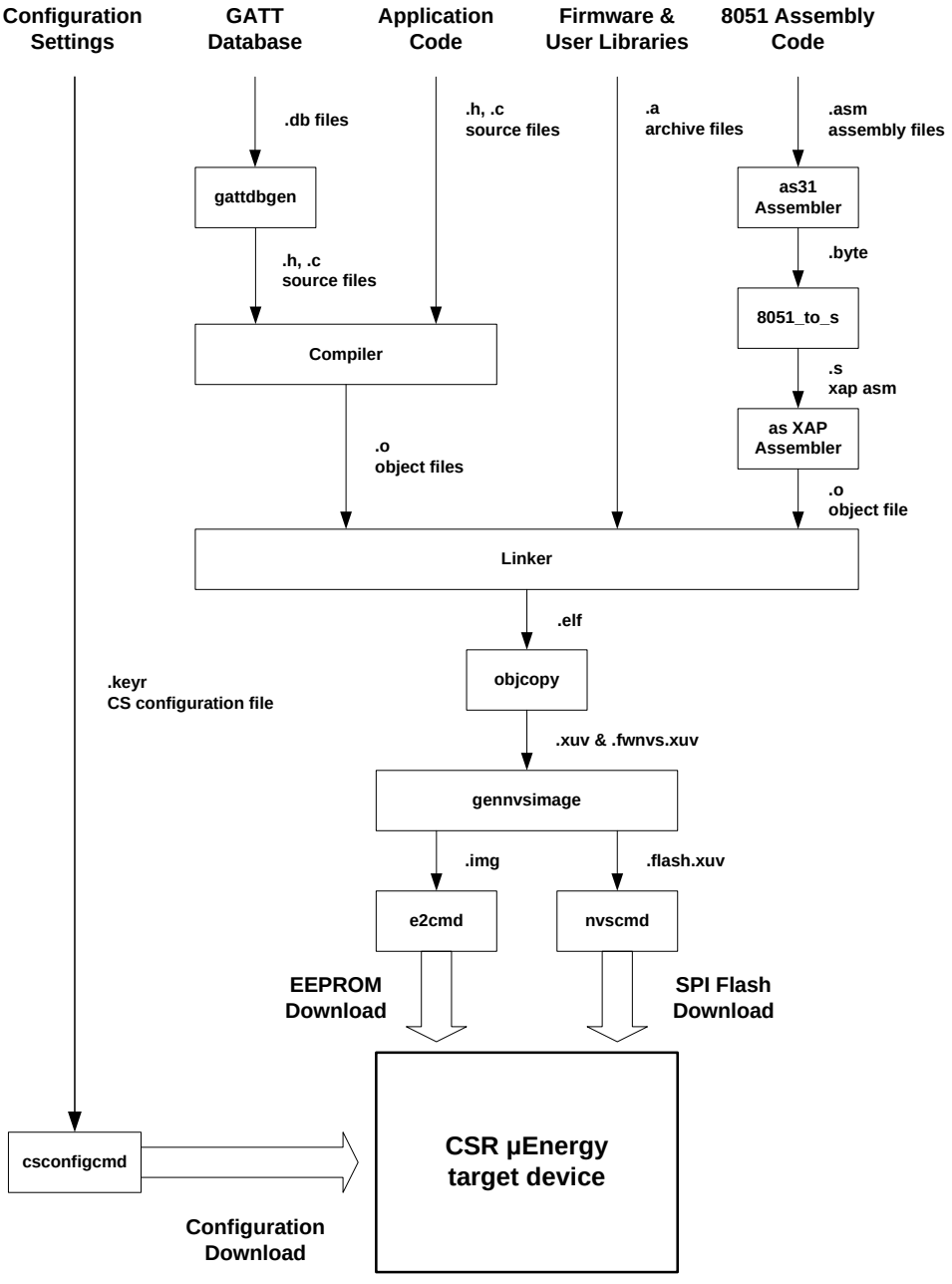


Figure 4.1: SDK Build Process

5. Frequently Asked Questions (FAQs)

1. *Can I customise the xIDE environment?*

   Yes. The **Options** menu item in the **Tools** menu allows you to select various options affecting the appearance and behaviour of xIDE.

   The **View** menu offers a number of layout options allowing you to toggle the display to show your preferred debug windows and menu items.

   Windows can be reorganised by dragging and dropping within the main xIDE window or on the desktop to create separate displays.

2. *How can I set Configuration Store values (sometimes referred as NVS Keys)?*

   Either follow the steps in section 3.1.3.1.

   Or edit the values in the `.keyr` file using xIDE before running the application.

3. *How can I restore the chip's factory settings?*

   Either use the **csconfigcmd** command line tool to load the configuration file onto the device

   Or launch the **CsConfig** tool and select **Reset All**. This assumes the configuration keys on the device are compatible with the firmware application on the PC.

4. *How can I use SPI flash instead of EEPROM?*

   The **NVM Type** can be selected from the **Properties** menu item in the **Project** menu.

5. *How can I change the SPI transport?*

   The debug transport can be configured for each project using the **Transport…** option under the **Debug** menu.

6. *How can I skip flashing the board every time I run a project?*

   If you are sure the onboard image matches the debugging target, use the **Attach** option (i.e. press **Ctrl+F5** or select **Attach** from the **Debug** menu) instead of using Run (i.e. pressing **F5** or selecting **Run** from the **Debug** menu).

7. *Where can I find the latest updates?*

   The latest updates to CSR µEnergy software can be found on our technical support website (www.csrsupport.com).

Terms and Definitions

Bluetooth SIG	Bluetooth Special Interest Group
Bluetooth®	Set of wireless technologies providing audio and data transfer over short-range radio connections
Bluetooth Smart	Formerly known as Bluetooth Low Energy
CD	Compact Disc
COM	Serial Communication Port
CS	Configuration Store (area of memory used by the firmware to store configuration values)
CSR	Cambridge Silicon Radio
DB	Database
e.g.	*exempli gratia*, for example
EEPROM	Electrically Erasable Programmable Read-Only Memory
FAQ	Frequently Asked Questions
GATT	Generic Attribute Profile
IC	Integrated Circuit
IDE	Integrated Development Environment
i.e.	*id est*, that is
LPT	Local Printer Port
MMI	Man Machine Interface
NVS	Non-Volatile Storage
NVM	Non-Volatile Memory
PIO	Programmable Input Output
ROM	Read Only Memory
SDK	Software Development Kit
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus protocol