Getting Started with RSL10

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CHAPTER 1

Introduction

1.1 OVERVIEW

RSL10 is a multi-protocol, Bluetooth[®] 5 certified, radio System on Chip (SoC), with the lowest power consumption in the industry. It is designed to be used in devices that require high performance and advanced wireless features, with minimal system size and maximized battery life. The RSL10 Software Development Kit (SDK) includes firmware, software, example projects, documentation, and development tools. The Eclipse-based ON Semiconductor Integrated Development Environment (IDE) is offered as a free download with optional support for Arm[®] Keil[®] μ Vision[®] and IAR Embedded Workbench[®].

Software components, device and board support information are delivered using the CMSIS-Pack standard. Standard CMSIS-Drivers for peripheral interfaces and FreeRTOS sample applications are supported. With the CMSIS-Pack standard, you can easily go beyond what is included in our software package and have access to a variety of generic Cortex-M software components. If you have existing RSL10 projects and have not used the RSL10 CMSIS-Pack before, see Appendix A, "Migrating to CMSIS-Pack" on page 48 for more information.

The RSL10 SDK allows for rapid development of ultra-low power Bluetooth Low Energy applications. Convenient abstraction decouples user application code from system code, allowing for simple modular code design. Features such as FOTA (Firmware Over-the-Air) can easily be added to any application. Advanced debugging features such as support for SEGGER® RTT help developers monitor and debug code. Sample applications, from Blinky to ble_peripheral_server_bond and everything in between, help get software development moving quickly. An optional Bluetooth mesh networking CMSIS-Pack quickly enables mesh networking for any application.

This document helps you to get started with the RSL10 SDK. It guides you through the process of connecting your RSL10 Evaluation and Development Board, installing an IDE and the CMSIS-Pack, configuring your environment, and building and debugging your first RSL10 application.

NOTE: RSL10 contains a low power DSP processor core; see *RSL10 LPDSP32 Software Package.zip* for more information.

1.2 INTENDED AUDIENCE

This manual is for people who intend to develop applications for RSL10. It assumes that you are familiar with software development activities.

1.3 CONVENTIONS

The following conventions are used in this manual to signify particular types of information:

| monospace | Commands and their options, file and path names, error messages, code samples and code snippets. |
|-----------|---|
| mono bold | A placeholder for the specified information. For example, replace filename with the actual name of the file. |
| bold | Graphical user interface labels, such as those for menus, menu items and buttons. |
| italics | File names and path names, or any portion of them. |

CHAPTER 2

Setting Up the Hardware and Software

2.1 Prerequisite Hardware

The following items are needed before you can make connections:

- RSL10 Evaluation and Development Board and a micro USB cable
- A computer running Windows

2.2 CONNECTING THE HARDWARE

To connect the Evaluation and Development Board to a computer:

1. Check the jumper positions:

Ensure that the jumper CURRENT is connected and POWER OPTIONS is selected for USB. Also, connect the jumpers TMS, TCK and SWD. Finally, connect the headers P7, P8, P9 and P10 to 3.3 V, as highlighted in Figure 1.

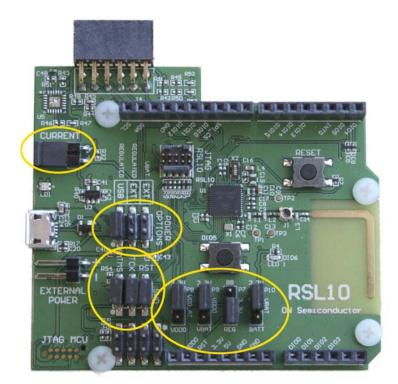


Figure 1. Evaluation and Development Board with Pins and Jumpers for Connection Highlighted

2. Once the jumpers are in the right positions, you can plug the micro USB cable into the socket on the board. The LED close to the USB connector flashes green during the first time plugging in, then turns a steady green once the process is finished.

2.2.1 Preloaded Sample

The Evaluation and Development Boards come with one of the following preloaded sample applications:

- "Peripheral Device with Sleep Mode" is on boards with a serial number lower than 1741xxxxx.
- "Peripheral Device with Server" is on boards with a serial number higher than 1741xxxxx.

For more information about sample applications, refer to the RSL10 Sample Code User's Guide.

2.3 PREREQUISITE SOFTWARE

Install the latest version of J-Link. It is available from the <u>SEGGER website</u>. Make sure to run the J-Link DLL updater, as shown in Figure 2, to update the J-Link DLL inside your IDE and confirm that the version used by the IDE has been updated.

| R SEGGER J-Link DLL Updater V6.34h | | × |
|--|-----------|-----------------|
| 2 applications found that can be updated to V6.34h of the J-Link software: | | |
| ✓ SEGGER Embedded Studio ARM 3.20 (x86) (DLL V6.40 in "C\Program Files (x86)\SEGGER\ ✓ Keil MDK-ARM (DLL V6.40 in "C\Keil_v5\ARM\Segger") | SEGGER Em | bedded Studio : |
| | | |
| | | |
| | | |
| Select All Select None | | |
| Select the ones you would like to replace by this version. The previous version will be renamed and kept in the same folder, allowing manual "undo". | | |
| la construit de la seconte de contrata en la factoria (n. 1977). | Ok | Cancel |

Figure 2. J-Link DLL Updater

CHAPTER 3

Getting Started with the Eclipse-Based ON Semiconductor IDE

3.1 ON SEMICONDUCTOR IDE AND RSL10 CMSIS-PACK INSTALLATION PROCEDURES

If you have a previous version of the ON Semiconductor IDE (formerly known as the RSL10 Software Development Kit (SDK)) installed:

- 1. Uninstall RSL10 Development Tools using Windows Control Panel.
- 2. Check if the RSL10 SDK folder is still there; if it is, delete it.

Install your new ON Semiconductor IDE by running *ON_Semiconductor_IDE.msi*. The ON Semiconductor IDE is installed in this location by default: *C:\Program Files (x86)\ON Semiconductor\IDE*.

The release version and build number are stored in the *REVISION* text file at the root of the installed ON Semiconductor IDE.

To install the RSL10 CMSIS-Pack:

- 1. Download the RSL10 CMSIS-Pack from <u>www.onsemi.com/RSL10</u> and save it in any temporary folder.
- 2. Open the ON Semiconductor IDE and choose the desired location for your new workspace for example, *c:\workspace* — and click **OK**.
- 3. On the top right corner, click on the **Open Perspective** icon, select **CMSIS Pack Manager**, and click **OK** (see Figure 3).

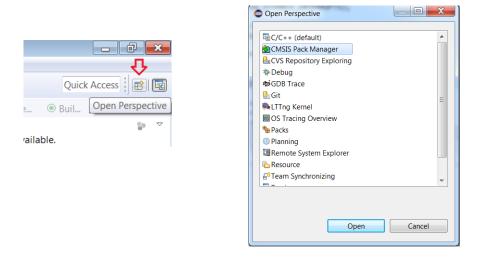


Figure 3. Opening the CMSIS Pack Manager Perspective

4. Click on the **Import existing packs** icon, select your pack file *ONSemiconductor.RSL10.version.pack*, where **version** is a number such as 2.3.27, and click **Open** (see Figure 4).

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| | | Op | en 👻 Cancel |
| | | | |

Figure 4. Installing the RSL10 CMSIS-Pack

- 5. The IDE prompts you to read and accept our license agreement, and then installs the RSL10 CMSIS-Pack in the specified pack root folder.
- 6. The RSL10 CMSIS-Pack now appears in the list of installed packs. In the Devices tab, if you expand All Devices > ONSemiconductor > RSL10 Series you can see RSL10 listed there. You can manage your installed packs in the Packs tab. Expanding ONSemiconductor.RSL10 makes the Pack Properties tab display the details of the RSL10 CMSIS-Pack. Figure 5 on page 9 illustrates what the Pack Manager perspective looks like after installation.

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| RSL10 Series | 1 Device | # 1.2.0 | | Release 1.2.0 | Pevice | |
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Figure 5. Pack Manager Perspective after RSL10 CMSIS-Pack is Installed

3.2 BUILDING YOUR FIRST SAMPLE APPLICATION WITH THE ON SEMICONDUCTOR IDE

This section guides you through importing and building your first sample application, named *blinky*. This application makes the LED (DIO6) blink on the Evaluation and Development Board.

For more information about the sample applications, see the RSL10 Sample Code User's Guide.

3.2.1 Launching the ON Semiconductor IDE

To use the IDE for the first time, follow the steps below:

- 1. To start the IDE, go to the Windows Start menu, and select ON Semiconductor > ON Semiconductor IDE.
- 2. When you open the IDE for the first time, you are prompted to select a workspace for the session. The workspace is the work area for all your IDE projects.

IMPORTANT: Create a new workspace for your version of the ON Semiconductor IDE. Re-using an existing workspace originally created with another Eclipse-based IDE might not be compatible.

3.2.2 Importing the Sample Code

Import the sample code as follows:

- 1. In the Pack Manager perspective, click on the **Examples** tab to list all the example projects included in the RSL10 CMSIS-Pack.
- 2. Choose the example project called *blinky*, and click the **Copy** button to import it into your workspace (see Figure 6 on page 10).

| Frampla | Action | Description |
|--|------------|---|
| Example | | |
| blinky (RSL10 Evaluation Board) | Copy | Blinky GPIO I/O Sample Code |
| central_client (RSL10 Evaluation Board) | 🈻 Сору | Central Device with Client Sample Code |
| central_client_double (RSL10 Evaluation | в 🕸 Сору | Central Device with Client Sample Code - Double |
| central_peripheral (RSL10 Evaluation Bo | oar 🧇 Copy | Central Peripheral Device Sample Code |
| custom_protocol_trx (RSL10 Evaluation | Вс ጳ Сору | Low Latency Audio Sample Application with Custom Prot |
| default_MANU_INFO_INIT (RSL10 Evaluation | ati 🕸 Copy | Default System Initialization Function |
| hci_app (RSL10 Evaluation Board) | 🚸 Copy | Host Controller Interface Application |
| pair_bond (RSL10 Evaluation Board) | 🚸 Сору | Pairing and Bonding with Peripheral Device Sample Code |
| pair_bond_master (RSL10 Evaluation Bo | ar ጳ Copy | Pairing and Bonding with Central Device Sample Code |
| peripheral_server (RSL10 Evaluation Boa | arc ጳ Copy | Peripheral Device with Server Sample Code |
| peripheral_server_FOTA (RSL10 Evaluati | or ጳ Copy | Peripheral Device with Server for Sending Firmware Over |
| peripheral_server_hrp (RSL10 Evaluation | n B 🇇 Copy | Heart Rate Peripheral Device with Server Sample Code |
| peripheral_server_sleep (RSL10 Evaluati | on ጳ Copy | Sleep Mode Sample Code for Peripheral Device with Serv |
| sleep_ble_advertisements (RSL10 Evalua | ati 🎨 Copy | Sleep and Wakeup with Bluetooth Low Energy Technolog |
| sleep_RAM_retention (RSL10 Evaluation | В 🏶 Сору | Sleep and Wakeup Sample Code |
| standby_power_mode (RSL10 Evaluatio | n 🐶 Copy | Standby Power Mode Sample Code |
| supplemental calibrate (RSL10 Evaluati | on 🄄 Copy | Supplemental Calibration Sample Code |

Figure 6. Pack Manager Perspective: Examples Tab

- 3. The C/C++ perspective opens and displays your newly copied project. In the **Project Explorer** panel, you can expand your project folder and explore the files inside your project. On the right side, the blinky.rteconfig file displays software components. If you expand Device > Libraries, you can see the System library (*libsyslib*) and the Startup (libcmsis) components selected for blinky (see Figure 7 on page 11).
- NOTE: Sample projects are preconfigured with *Release* versions of RSL10 libraries, which are distributed as object files. In the RTE configuration, you can switch to the Source variant to include the source code of the library directly into your project (see Figure 7 on page 11).

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| M Includes M RTE | | Software Components | Sel. | Variant | Vendor | Version | Description | |
| Ric Main.c | | RSL10 | | | ONSemicondu | | ARM Cortex-M3 48 MHz, 32 kB RAM, 384 kB ROM | |
| blinky.rteconfig | | A Device | | | | | | |
| readme_blinky.txt | | Bluetooth Profile | n - | | | | | |
| sections.ld | | Libraries | | | | | | |
| | | ♀ BLE | | release | ONSemicondu | 1.0.0 | Bluetooth Stack (libblelib) | |
| · 續 - cmais (watvcs) - 節 - measure_r_cosc (watvcs) - 値 remote_mic_pr_aw - 値 remote_mic_b_raw | Calibrate | | release | ONSemicondu | | Calibration Library (libcalibratelib) | | |
| | Custom Proto | c 🗆 | release | ONSemicondu | | Low Latency Audio Streaming Custom Protocol Library (libc | | |
| | Flash | | release | ONSemicondu | | Flash Library (libflashlib) | | |
| | Kernel | | release | ONSemicondu | 1.0.0 | Event Kernel Library (libkelib) | | |
| | Math | | release | ONSemicondu | 1.0.0 | Math Library (libmathlib) | | |
| | Remote_Mic | | release | ONSemicondu | 1.0.0 | Remote Microphone Library (libremote_micLib) | | |
| | System | | release | ONSemicondu | 1.0.0 | System Macros and Library (libsyslib) | | |
| | Weak_PRF | | release | ONSemicondu | 1.0.0 | Weak Profile Library (weak_prf) | | |
| | | Startup | | release | ONSemicondu | 1.0.0 | RSL10-CMSIS Startup Library and Include Folders (libcmsis) | |
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Figure 7. RTE Configuration for the Blinky Example Project in the ON Semiconductor IDE

3.2.3 Build the Sample Code

Follow these steps to build the sample code:

1. Right click on the folder for *blinky* and click **Build Project**. Alternatively, you can select the project and click the hammer icon shown in Figure 8.

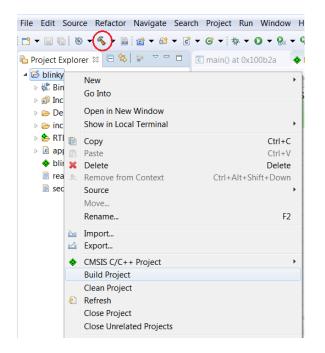


Figure 8. Starting to Build a Project in the ON Semiconductor IDE

When the build is running, the output of the build is shown in the ON Semiconductor IDE C/C++2. Development Tooling (CDT) Build Console, as illustrated in Figure 9.



Figure 9. Example of Build Output

- The key resulting output in Project Explorer includes: 3.
 - blinky.hex: HEX file for loading into Flash memory
 - *blinky.elf*: Arm[®] executable file, run from RAM, used for debugging •
 - blinky.map: map file of the sections and memory usage .

These files are shown in Figure 10 on page 13.

NOTE: You might need to refresh the project to see the three built output files. To do so, right-click on the project name *blinky* and choose **Refresh** from the menu.

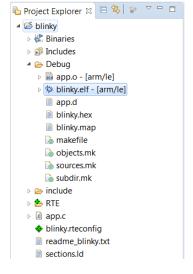


Figure 10. Output Files from Building a Sample Project

NOTE: If the ON Semiconductor IDE has trouble finding the GNU toolchain, it might be caused by having other GNU toolchains installed. See Appendix B, "Arm Toolchain Support" on page 50 for more information.

3.3 DEBUGGING THE SAMPLE CODE

3.3.1 Debugging with the .elf File

Debug the application using the .*elf* file as follows:

- 1. Within the **Project Explore**r, right-click on the *blinky.elf* file and select **Debug As > Debug Configurations...**
- 2. When the **Debug Configurations** dialog appears, right-click on **GDB SEGGER J-Link Debugging** and select **New**. A new configuration for *blinky* appears under the **GDB SEGGER** heading, with new configuration details in the right side panel.
- 3. Change to the **Debugger** tab, and enter RSL10 in the **Device** field. Ensure that **SWD** is selected as the target interface (as shown in Figure 11 on page 14).

| 1 🗈 🗶 😑 🐡 🕶 | Name: blinky | | | |
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Figure 11. Setting Up a GDB Launch Configuration, Debugger Tab

- NOTE: If you want to debug an application that does not start at the first address of flash memory, see Chapter 6, "Advanced Debugging" on page 32.
- 4. Once the updates to the configuration are completed, make sure the Evaluation and Development Board is connected to the PC via a micro USB cable, and click Debug. J-Link automatically downloads the blinky sample code to RSL10's flash memory.
- NOTE: If J-Link does not automatically write your program to RSL10's flash memory, make sure you are using the J-Link version specified in Section 2.3, "Prerequisite Software" on page 6.

If you are having trouble downloading firmware because an application with Sleep Mode is on the Evaluation and Development Board, see Section 6.4.1, "Downloading Firmware in Sleep Mode" on page 40.

- The ON Semiconductor IDE asks if you would like to open the Debug perspective. Answer Yes, and click on 5. Remember my decision so that the question is not asked again.
- 6. The Debug perspective opens and the application runs up to the first breakpoint in main, as shown in Figure 12 on page 15. You can press F6 multiple times to step through the code and observe that the LED changes its state when the application executes the function Sys GPIO Toggle (LED DIO).

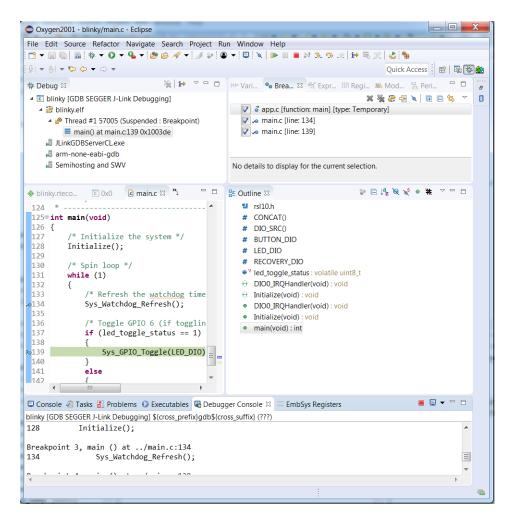


Figure 12. Debug Perspective

3.3.2 Peripheral Registers View with the ON Semiconductor IDE

The ON Semiconductor IDE includes a peripheral register view plugin that enables you to visualize and modify all of the RSL10 registers during a debug session. It can be configured by setting the path to the SVD file in the Debug session.

The following steps demonstrate how to configure and use the Peripheral Registers View with the *Blinky* application:

- 1. Right click on the *blinky.elf* file, select **Debug As** > **Debug Configurations**, and open your configuration details set, as described in Section 3.3.1, "Debugging with the .elf File" on page 13.
- Change to the SVD Path tab, and set the path to the *rsl10.svd* file as C:\Users\<user_id>\ON_Semiconductor\PACK\ONSemiconductor\RSL10\<pack_version>svd (see Figure 13). Click Debug.

| Create, manage, and run configurat | ions 🔅 |
|--|--|
| Image: Second Secon | Name: blinky Debug Main * Debugger * Startup * Source Common * SVD Path SVD file (used by the peripheral registers viewer) File path: C:\Users_\ON_Semiconductor\PACK\ONSemiconductor\RSL10\3.0.503\svd\rs10.svd File path: C:\User_id> |
| Filter matched 18 of 104 items | Revert Apply Debug Close |

Figure 13. SVD Path Tab Perspective

- 3. In the **Debug** perspective, when the application runs up to the first breakpoint in *main*, open the **Peripherals** window view, by navigating to Window > Show View > Other > Debug > Peripherals and clicking Open. Now you can see all the RSL10 peripherals displayed.
- 4. Select the peripheral that you need to monitor, and open the Memory window to show the RSL10 peripheral registers. The read only registers are highlighted in green. If you wish, you can drag your Memory window and place it side-by-side with your source code view (see Figure 15 on page 18).
- 5. Select DIO and CLK in the peripherals window. Now you can monitor the selected peripherals from the Monitors tab and switch between them. To see or change the **DIO** register status, choose **DIO** and expand the **DIO** > **DIO DATA** register in the Memory window.
- Press F6 to step through the code. You can observe that this register's bit 6 toggles its state when 6. Sys_GPIO_Toggle (LED_DIO) is executed. The register turns yellow to indicate that you have activated real-time monitoring for it. (see Figure 14).

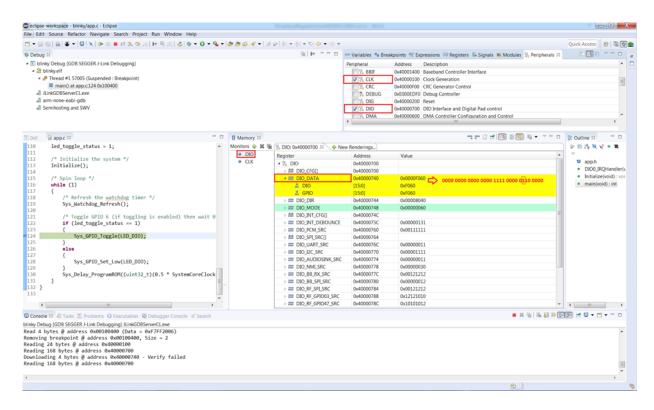


Figure 14. Peripheral Registers View Perspective in Debug Session After Setting SVD Path

7. Click on the **Value** tab of the **GPIO** register to change the (**HIGH/LOW**) state of GPIO6, as shown in Figure 15. You can observe that the LED (DIO6) on your board changes its state.

| | 🌋 🛃 DIO: 0x40000700 🛛 🗍 🕂 Nev | v Renderings | | |
|-----|-------------------------------|--------------|--|----|
| DIO | Register | Address | Value | |
| CLK | A 🚡 DIO | 0x40000700 | | |
| | ▷ # DIO_CFG[] | 0x40000700 | | |
| | ▲ IIII DIO_DATA | 0x40000740 | 0x0000F060 | |
| | 🔐 DIO | [15:0] | 0xF060 | |
| | SPIO . | [15:0] | 0x0: GPIO0_LOW | Ψ. |
| | ▷ 👯 DIO_DIR | 0x40000744 | 0x0: GPIO12_LOW | • |
| | ▷ 🚻 DIO_MODE | 0x40000748 | 0x0: GPIO13_LOW | |
| | ▷ INT_CFG[] | 0x4000074C | 0x0: GPIO14_LOW | |
| | ▷ IIII DIO_INT_DEBOUNCE | 0x4000075C | 0x0: GPIO15_LOW | |
| | ▷ 🔐 DIO_PCM_SRC | 0x40000760 | 0x1: GPIO0_HIGH 0x2: GPIO1_HIGH | |
| | ▷ # DIO_SPI_SRC[] | 0x40000764 | 0x4: GPIO2 HIGH | |
| | ▷ 🗤 DIO_UART_SRC | 0x4000076C | 0x8: GPIO3_HIGH | |
| | ▷ IIII DIO_I2C_SRC | 0x40000770 | 0x10: GPIO4_HIGH | |
| | ▷ ## DIO_AUDIOSINK_SRC | 0x40000774 | 0x20: GPIO5_HIGH | |
| | ▷ 🗤 DIO_NMI_SRC | 0x40000778 | 0x40: GPIO6_HIGH | |
| | ▷ ## DIO BB RX SRC | 0x4000077C | 0x80: GPIO7_HIGH | |
| | ▷ ## DIO BB SPI SRC | 0x40000780 | 0x100: GPIO8_HIGH 0x200: GPIO9 HIGH | = |
| | ▷ ## DIO_RF_SPI_SRC | 0x40000784 | 0x400: GPIO10 HIGH | |
| | ▷ ## DIO_RF_GPIO03_SRC | 0x40000788 | 0x800: GPIO11 HIGH | |
| | ▷ ## DIO RF GPIO47 SRC | 0x4000078C | 0x1000: GPIO12_HIGH | |
| | ▷ ### DIO RF GPIO89 SRC | 0x40000790 | 0x2000: GPIO13_HIGH | |

Figure 15. Toggling RSL10 DIO Using the Peripheral Registers View

CHAPTER 4

Getting Started with Keil

4.1 PREREQUISITE SOFTWARE

Download and install the Keil µVision IDE from the Keil website, using the vendor's instructions.

4.2 RSL10 CMSIS-PACK INSTALLATION PROCEDURE

To install the RSL10 CMSIS-Pack:

1. Open the Keil µVision IDE and navigate to **Project > Manage > Pack** installer or click on the icon shown in Figure 16.

| File | Edit | View | Project | Flash | Debug | Peripherals | Tools | SVCS | Wine |
|------|------|-------|---------|-------|-------|-------------|-------|-------|------------|
| | 🞽 🖬 | | 3 h 🕻 | 9 | • ا | ⇒ 🧖 🖄 | 内内 | * | ۰ ₽ |
| ٢ | |) 🗳 🗸 | | Targ | et 1 | - 🔊 | 📥 🗟 | 6 🔶 👌 | › 💑 |

Figure 16. Pack Installer Icon

2. Click on File > Import, select your pack file ONSemiconductor.RSL10.version.pack, and click Open (see Figure 17). version is the RSL10 version, such as 2.2.347.

| | 🛃 Import Packs |
|--|--|
| | Good and the second |
| | Organize 🔻 New folder 🔠 💌 🗍 😧 |
| | Favorites Ame Date modified Type |
| | Desktop ONSemiconductor.RSL10.2.2.347 10/31/2018 4:29 PM uVis |
| Pack Installer - C:\Keil_v5\ARM\PACK File Packs Window Help Refresh Import Import from Folder Mapage Local Dependitories Pack | Downloads Recent Places Libraries Documents Music |
| Manage Local Repositories Summary Pack Exit Summary Devices T = 2 All Devices 5734 Devices # | S Pictures Videos Computer |
| | 📲 SYSTEM (C:) 🗸 🖌 🔢 |
| | File name: ONSemiconductor.RSL10.2.2.347 Software Pack - PACK (*.zip; •) Open • Cancel |

Figure 17. Installing the RSL10 CMSIS-Pack for the Keil $\mu\text{Vision IDE}$

- 3. The IDE prompts you to read and accept our license agreement, then installs the RSL10 CMSIS-Pack in the C:\Keil_v5 folder.
- 4. After installation, use File > Refresh as shown in Figure 18 to update your pack proprieties.

| 🛞 Pa | ack Installer - C:\Keil_v5\ARM\PACK | |
|------|---|------------|
| File | Packs Window Help | |
| | Refresh | |
| I | Import Import from Folder Manage Local Repositories | Pack |
| | Fxit | Summary De |

Figure 18. Refresh Pack after installation

5. The RSL10 CMSIS-Pack now appears in the list of installed packs. In the Devices tab, if you expand All Devices > ONSemiconductor > RSL10 Series, you can see RSL10 listed there. You can manage your installed packs in the Packs tab. Expanding ONSemiconductor.RSL10 makes the Pack Properties tab display the details of the RSL10 CMSIS-Pack. Figure 19 on page 20 illustrates what the Pack Installer perspective looks like after installation.

| File Packs Window Help Device: ONSemiconductor - RSL10 | | | | | |
|---|--------------------------------------|----------|---------------------------------------|--------|------------------|
| Devices Boards | · | ⊳ | 4 Packs Examples | | |
| Search: • X 🖻 |] | | Show examples from installed Packs or | nly | |
| Device | / Summary | | Example | Action | Description |
| 🗄 🔗 Maxim | 9 Devices | | ADC_UART (RSL10 Evaluation Board) | 🔶 Сору | ADC with UART |
| 🗉 🔗 MediaTek | 2 Devices | | ble_central_client_bond (RSL10 Eval | 🔶 Сору | BLE Central Clie |
| 🗉 🔗 Microchip | 345 Devices | | ble_central_client_scan (RSL10 Eval | 🔶 Сору | Pairing and Bor |
| 🗉 📍 Microsemi | 6 Devices | | ble_peripheral_server_bond (RSL10 | 🔶 Сору | BLE Peripheral S |
| MindMotion | 2 Devices | | ble_peripheral_server_hrp (RSL10 Ev | 🔶 Сору | Pairing and Bor |
| Nordic Semiconductor | 13 Devices | | blinky (RSL10 Evaluation Board) | 🔶 Сору | Blinky GPIO I/O |
| 🗉 🔗 Nuvoton | 487 Devices | | default_MANU_INFO_INIT (RSL10 E | 🔶 Сору | Default System |
| I VXP | 1223 Devices | | hci_app (RSL10 Evaluation Board) | 🔶 Сору | Host Controller |
| ONSemiconductor | 1 Device | | | 🔶 Сору | I2C CMSIS-Driv |
| 🖻 🍄 RSL10 Series | 1 Device | | kernel_timer (RSL10 Evaluation Boa | 🔶 Сору | Kernel Timer Sa |
| RSL10 | ARM Cortex-M3, 48 MHz | | measure_rc_osc (RSL10 Evaluation | 🔶 Сору | Measure 32 kHz |
| Redpine Signals | 2 Devices | | peripheral_server_standby (RSL10 E | 🔶 Сору | Peripheral Devi |
| 🗉 📍 Renesas | 4 Devices | | spi_cmsis_driver (RSL10 Evaluation | 🔶 Сору | SPI CMSIS-Drive |
| Silicon Labs | 783 Devices | | supplemental_calibrate (RSL10 Eval | 🔶 Сору | Default System |
| Sinowealth | 1 Device | | uart_cmsis_driver (RSL10 Evaluation | 🔶 Сору | UART CMSIS-D |
| 🗉 🔮 SONIX | 50 Devices | | | | |
| STMicroelectronics | 1061 Devices | | | | |
| 🗉 💡 Texas Instruments | 350 Devices | _ | • | | |
| Dutput | | | , With | | |
| pdate available for Keil::ARM_Compiler (in: | stalled: 1.3.3, available: 1.4.0) | | | | |
| pdate available for Keil::MDK-Middleware | (installed: 7.5.0, available: 7.6.0) | | | | |

Figure 19. Pack Installer after RSL10 CMSIS-Pack is Installed in the Keil $\mu\text{V}\textsc{ision}$ IDE

4.3 BUILDING YOUR FIRST SAMPLE APPLICATION WITH THE KEIL UVISION IDE

This section guides you through importing and building your first sample application, named *blinky*. This application makes the LED (DIO6) blink on the Evaluation and Development Board.

For more information about the sample applications, see the RSL10 Sample Code User's Guide.

4.3.1 Import the Sample Code

To import the sample code:

- 1. In the Pack installer, click on the **Examples** tab to list all the example projects included in the RSL10 CMSIS-Pack.
- 2. Choose the example project called *blinky*, and click the **Copy** button to import it into your workspace (see Figure 20 on page 21). Choose a destination folder for a copy of the sample code.

| Search Example | | |
|---|-------------|---|
| Search Example | | |
| Example | Action | Description |
| blinky (RSL10 Evaluation Board) | 🕸 Copy | Blinky GPIO I/O Sample Code |
| central_client (RSL10 Evaluation Board) | 🚸 Сору | Central Device with Client Sample Code |
| central_client_double (RSL10 Evaluation | n B 🇇 Copy | Central Device with Client Sample Code - Double |
| central_peripheral (RSL10 Evaluation B | oar ጳ Copy | Central Peripheral Device Sample Code |
| custom_protocol_trx (RSL10 Evaluation | Вс 🇇 Сору | Low Latency Audio Sample Application with Custom Prot |
| default_MANU_INFO_INIT (RSL10 Evalu | iati ጳ Copy | Default System Initialization Function |
| hci_app (RSL10 Evaluation Board) | 🚸 Сору | Host Controller Interface Application |
| pair_bond (RSL10 Evaluation Board) | 🚸 Сору | Pairing and Bonding with Peripheral Device Sample Code |
| pair_bond_master (RSL10 Evaluation Bo | oar 🄄 Copy | Pairing and Bonding with Central Device Sample Code |
| peripheral_server (RSL10 Evaluation Bo | arc ጳ Copy | Peripheral Device with Server Sample Code |
| peripheral_server_FOTA (RSL10 Evaluat | ior ጳ Copy | Peripheral Device with Server for Sending Firmware Over . |
| peripheral_server_hrp (RSL10 Evaluatio | n B 🧇 Copy | Heart Rate Peripheral Device with Server Sample Code |
| peripheral_server_sleep (RSL10 Evaluat | ion 🇇 Copy | Sleep Mode Sample Code for Peripheral Device with Serv. |
| sleep_ble_advertisements (RSL10 Evalu | ati 🧇 Copy | Sleep and Wakeup with Bluetooth Low Energy Technolog. |
| sleep_RAM_retention (RSL10 Evaluation | n B 🧇 Copy | Sleep and Wakeup Sample Code |
| standby_power_mode (RSL10 Evaluation | on I 🇇 Copy | Standby Power Mode Sample Code |
| supplemental calibrate (RSL10 Evaluat | ion 🏵 Copy | Supplemental Calibration Sample Code |

Figure 20. Pack Manager Perspective: Examples Tab

Sample projects are preconfigured with *Release* versions of RSL10 libraries, which are distributed as object files. For Keil, **System library** (*libsyslib*) and **Startup** (*libcmsis*) are preconfigured with the Source variant, so the source code of those libraries is included directly (see Figure 21 on page 22).

| ct 🗣 🔝 | Manage Run-Time Environment | | | | - |
|--|--|------|---|--|--|
| Project: blinky | Software Component | Sel. | Variant | Version | Description |
| Source app.c include | Device Startup B- Bluetooth Profiles Libraries | V | source | 1.0.0 | Startup, System Setup System Startup for ON Semiconductor RSL10 |
| Device Device Trillo_protocolc (LibrariesSystem) Trillo_romvectc (LibrariesSystem) Trillo_sys_asrcc (LibrariesSystem) Trillo_sys_audioc (LibrariesSystem) Trillo_sys_colockc (LibrariesSystem) Trillo_sys_crockc (LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_power (LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_fact(LibrariesSystem) Trillo_sys_tfmec (LibrariesSystem) Trillo_sys_tfmesc (LibrariesSystem) Trillo_sys_tfmesc (LibrariesSystem) | | | release source source release source source source release MDK-Plus MDK-Plus MDK-Plus | ▼ 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 5.0.1 ▼ 7.9.0 ▼ 6.12.8 | Weak Profile Library (likeak, prf) System Macros and Library (likesystiib) Remote Microphone Library (libremote micLib) Math Library (library) (libremote micLib) Event Kernel Library (librelib) Flash Library (libralibratelib) Cow Latency Audio Streaming Custom Protocol Library (libcustom protoc Calibration Library (libralibratelib) Biuetocoth Stack (libbelib) File Access on various storage devices User Interface on graphical LCD displays IPv4 Networking using Ethernet or Serial protocols USB Communication with various device classes |
| T rsl10_sys_version.c (LibrariesSystem) startup_rsl10.s (Startup) system_rsl10.c (Startup) | Validation Output | | Descrip | tion | |

Figure 21. RTE Configuration for the Blinky Example Project in the Keil μ Vision IDE

4.3.2 Build the Sample Code

Build the sample code as follows:

1. Right click on **Target 1** and choose **Rebuild all target files**. Alternatively, you can use the icon shown in the Figure 22.

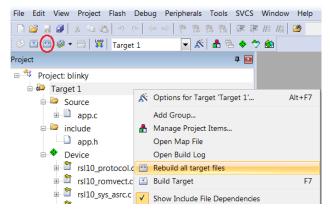


Figure 22. Starting to Build a Project in the Keil $\mu\text{Vision IDE}$

2. When the build is running, the output of the build is shown in the **Build Output** view in the IDE, as illustrated in Figure 23.

```
Build Output

*** Using Compiler 'V5.06 update 6 (build 750)', folder: 'C:\Keil_v5\ARM\ARMCC\Bin'

Build target 'Target 1'

compiling app.c...

linking...

Program Size: Code=1508 RO-data=32 RW-data=4 ZI-data=3076

FromELF: creating hex file...

".\Objects\blinky.axf" - 0 Error(s), 0 Warning(s).

Build Time Elapsed: 00:00:02
```

Figure 23. Example of Build Output

- 3. The key resulting output in Project Explorer in the IDE includes:
 - *blinky.hex*: HEX file for loading into Flash memory
 - *blinky.axf*: Arm[®] executable file, run from RAM, used for debugging
 - *blinky.map*: map file of the sections and memory usage

4.3.3 Debugging the Sample Code

4.3.3.1 Preparing J-Link for Debugging

Before debugging with J-Link, go to C:\Keil_v5\ARM\Segger and make sure that the folder contains a JL2CM3.dll file. As well, make sure that you have installed the latest version of J-Link and have run the J-Link DLL Updater, as shown in Section 2.3, "Prerequisite Software" on page 6.

4.3.3.2 Debugging Applications

The IDE's debug configurations are already set in the CMSIS-Pack. To debug an application:

- 1. Make sure the Evaluation and Development Board is connected to the PC via a micro USB cable.
- 2. Select Debug > Start/Stop Debug Session or click the icon shown in Figure 24.

| File Edit View Project Flash (| Debug Peripherals Tools SVCS Window He | lp |
|--------------------------------|--|------------------------------|
| 🗋 🗃 😹 🎒 👗 🛍 🛍 🔊 | Start/Stop Debug Session Ctrl+F5 | const union gapc_d 🔻 🔜 🥐 🔍 🔿 |
| 🔗 🕮 🕮 🧼 🕶 🤐 🗱 🛛 Targe | Energy Measurement without Debug | \sim |
| | Reset CPU | |

Figure 24. Start/Stop Debug Session Icon

If you are having trouble downloading firmware because an application with Sleep Mode is on the Evaluation and Development Board, see Section 6.4.1, "Downloading Firmware in Sleep Mode" on page 40.

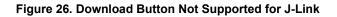
3. The application runs up to the first breakpoint in *main*, as shown in Figure 25. You can press F11 multiple times to step through the code and observe that the LED changes its state when the application executes the function Sys_GPIO_Toggle (LED_DIO).

| File Edit View Project Flash Debug Peripherals Tools | | | anc d 💌 🗟 🥐 🔘 · | | 2 | |
|--|--|---|---|--|-----------------|---|
| | | - | | | | |
| roject 🗸 🖉 | Disassembly | | | | | ņ |
| Project: blinky Target 1 Source p.c include app.h Device | 80: | 801 CM 0116 BN Sys } else { 0006 MO if((uint8_ | P r0, #0x01 E 0x00100574 _GPIO_Toggle (LED_D) VS r0, #0x06 t) DIO->CFG[gpio_pir | - | 10_Mask) == 0) | |
| 👜 🎬 rsl10_protocol.c (Libraries:System) | 0∞00100548_0 | INR1 TS | TS 91 90 #2 | | | 4 |
| e→ [©] rsl10_romvect.c (Libraries:System) e→ [©] rsl10_sys_asrc.c (Libraries:System) | app.c | startup_r | sl10.s | | | - |
| rsl10_sys_audio.c (Libraries:System) rsl10_sys_clocks.c (Libraries:System) rsl10_sys_crc.c (Libraries:System) rsl10_sys_dma.c (Libraries:System) rsl10_sys_power.c (Libraries:System) rsl10_sys_power.c (Libraries:System) rsl10_sys_timers.c (Libraries:System) startup_rsl10.s (Startup) system_rsl10.c (Startup) | 108 = { 109 = 1 109 = 1 109 = 1 110 = 1 111 = 1 112 = 1 113 = 1 114 = 1 115 = 1 116 = 1 117 = 1 118 = 1 120 = 1 121 = 1 122 = 1 123 = 1 124 = 1 125 = 1 126 = 1 127 = 1 4 | <pre>led_tog /* Init Initial /* Spin while ({ /* Sys /* if { els { // //</pre> | <pre>clop */ l) Refresh the wat _Watchdog_Refre Toggle GPI0 6 (led_toggle_sta Sys_GPI0_Toggl e</pre> | <pre>cchdog timer */ sch(); if toggling is end tus == 1)</pre> | abled) then wa | Þ |
| ommand | | | Call Stack + Locals | | | Ļ |
| evice: RSL10 Target = 3.300V tate of Pins: TCK: 0, TDI: 1, TDO: 1, TMS: 1, TRES ardware-Breakpoints: 2 oftware-Breakpoints: 8192 | : 1, TRST: 1 | • | Name — 🌳 main | Location/Value 0x00000000 | Type int f() | |
| atchpoints: 1 IAG speed: 2667 kHz ad "C:\\Users\\zbhn3b\\Desktop\\cmsisp\\Files\\so JLink Info: J-Link: Flash download: Bank 0 @ 0x00 JLink Info: Executing RSL10 reset type: 0x0000000 S \\blinky\app.cl24 III | 100000: Skipped. | | | | | |
| IAG speed: 2667 kHz Dad "C:\\Users\\zbhn3b\\Desktop\\cmsisp\\Files\\so Jink Info: J-Link: Flash download: Bank 0 @ 0x00 Jink Info: Executing RSL10 reset type: 0x0000000 S \\blinky\app.c\124 | 100000: Skipped. 0 | Content E | - Call Stack + Locals | Memory 1 | | |

Figure 25. Debug Session in the Keil $\mu\text{Vision IDE}$

NOTE: Debug configurations are preconfigured for the sample applications in the IDE's CMSIS-Pack. Flash downloading through the Download icon (Figure 26) or F8 is not supported for J-Link in the IDE at this point. The IDE may add support for this feature in future releases.

| File Edit | View | Project | Flash | Debug | Peripherals |
|-----------|-------|---------|-------|-------|-------------|
| 🗋 💕 (| 3 🥥 | X 16 (B | 19 | € ← | ⇒ p p |
| 0 🖾 🖉 | 🖆 🗳 🕶 | | Targ | et 1 | - * |
| Project | | | | | |



CHAPTER 5

Getting Started with IAR

5.1 PREREQUISITE SOFTWARE

Download and install the IAR Embedded Workbench from the IAR Website, using the vendor's instructions.

5.2 RSL10 CMSIS-PACK INSTALLATION PROCEDURE

To install the RSL10 CMSIS-Pack:

- Open the IAR Embedded Workbench and expand File > New Workspace to open a new workspace, then go to File > Save Workspace As and choose the location for your workspace.
- 2. Navigate to **Project > CMSIS Pack Manager**, or click on the icon shown in Figure 27.



Figure 27. Pack Installer Icon

 Click on CMSIS Manager > Import Existing Packs, select your pack file ONSemiconductor.RSL10.version.pack, and click Open (see Figure 28). version is the RSL10 version, such as 2.3.27.

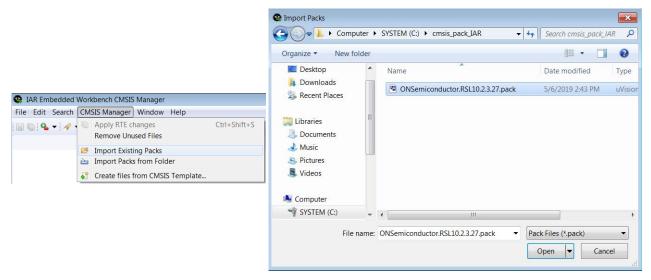


Figure 28. Installing the RSL10 CMSIS-Pack for the IAR Embedded Workbench IDE

- 4. The IDE prompts you to read and accept the license agreement, then installs the RSL10 CMSIS-Pack in the CMSIS-Pack root folder.
- 5. After installation, click on the refresh icon with yellow arrows, which shows the text **Reload Packs in the CMSIS Pack root folder** when you hover over it with your cursor, in the Packs tab (as shown in Figure 29), to update your pack proprieties.

| 🖄 Packs 🛛 | Devices | Boards | 📑 Examples | E Console 😑 Pack Properties 👘 🗖 |
|-------------|---------|--------|------------|---------------------------------|
| | | | | ⊞ ⊟ �� ≥ 🗠 Ø 🔻 |
| Search Pack | | | | |
| Pack | | | Action | Description |

Figure 29. Refresh Pack after installation

6. In the **Devices** tab, expand **All Devices** > **ONSemiconductor** > **RSL10** Series, and select **RSL10** from the list. The RSL10 CMSIS-Pack now appears in the list of installed packs in the Packs tab. Expanding ONSemiconductor.RSL10 makes the Pack Properties tab display the details of the RSL10 CMSIS-Pack. Figure 30 on page 26 illustrates what the Pack Manager perspective looks like after installation.

| IAR Embedded Workbench CMSIS | Manager | | | |
|--------------------------------|------------------------------|--------------|--|--------------------|
| File Edit Search CMSIS Manager | Window Help | | | |
| i 🛄 🔞 i 💁 🕶 i 🔗 🕶 i 🖗 💌 🖏 🕶 😂 | ⇔ • ⇔ • | | | Quick Access 🗄 📑 💽 |
| | 🚵 Packs 🛛 🔳 Devices 📓 Boards | E Pack Prope | rties 📑 Examples 📮 Console | 🗄 🖂 🤣 🍣 🐸 🗎 🔍 🔻 🗖 |
| | Search Pack | | | |
| | Pack | Action | Description | |
| | Device Specific | 1 Pack | RSL10 selected | |
| | ONSemiconductor.RSL10 | 😻 Up to dat | ON Semiconductor RSL10 Device Family Pack | |
| | # 2.4.450 | 🔀 Remove | www.onsemi.com | |
| | Generic | | Software Packs with generic content not specific to a devi | |
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Figure 30. The IAR Embedded Workbench CMSIS Manager after RSL10 CMSIS-Pack is Installed

5.3 BUILDING YOUR FIRST SAMPLE APPLICATION WITH THE IAR EMBEDDED WORKBENCH

This section guides you through importing and building your first sample application, named blinky. This application makes the LED (DIO6) blink on the Evaluation and Development Board. The procedure described in this section assumes that you have installed the SDK.

For more information about the sample applications, see the RSL10 Sample Code User's Guide.

5.3.1 Import the Sample Code

Import the sample code to your workspace as follows:

1. In the IDE's CMSIS Manager, click on the **Examples** tab to list all the example projects included in the RSL10 CMSIS-Pack.

Choose the example project called *blinky*, and click the Copy button to import it into your workspace (see 2. Figure 31 on page 27). Choose a destination folder for a copy of the sample code.

| 🕸 Packs 🔳 Devices 📓 Boards 📑 Example | | sole | 🗆 Only show examples from installed packs 🛛 🖑 🏞 🐸 🔯 💿 🚿 |
|--|----------|--|---|
| Search Example | | | |
| Example | Action | Description | |
| ADC_UART (RSL10 Evaluation Board) | 🗇 Сору | ADC with UART Sample Code | |
| ble_central_client_bond (RSL10 Evaluation | 🗇 Сору | BLE Central Client Bonding Sample Code | |
| ble_central_client_scan (RSL10 Evaluation | 🔶 Сору | Central Device with Client Scanner Sample Code | |
| ble_peripheral_server_bond (RSL10 Evaluation | 🔶 Сору | BLE Peripheral Server Bonding Sample Code | |
| ble_peripheral_server_hrp (RSL10 Evaluati | 🔶 Сору 👘 | Heart Rate Peripheral Device with Server Sample Code | |
| blinky (RSL10 Evaluation Board) | 💠 Сору | Blinky GPIO I/O Sample Code | |
| default_MANU_INFO_INIT (RSL10 Evaluati | 💠 Сору | Default System Initialization Function | |
| hci_app (RSL10 Evaluation Board) | 🔶 Сору | Host Controller Interface Application | |
| i2c_cmsis_driver (RSL10 Evaluation Board | 🔶 Сору | I2C CMSIS-Driver Sample Code | |
| kernel_timer (RSL10 Evaluation Board) | 💠 Сору | Kernel Timer Sample Code | |
| measure_rc_osc (RSL10 Evaluation Board) | 💠 Сору | Measure 32 kHz RC Oscillator | |
| peripheral_server_sleep (RSL10 Evaluation | 🔶 Сору | Sleep Mode Sample Code for Peripheral Device with Serv | |
| peripheral_server_standby (RSL10 Evaluat | і� Сору | Peripheral Device with Server and Standby Power Mode S | |
| spi_cmsis_driver (RSL10 Evaluation Board | 🔶 Copy | SPI CMSIS-Driver Sample Code | |
| supplemental_calibrate (RSL10 Evaluation | 🔶 Сору | Default System Initialization Function | |
| uart_cmsis_driver (RSL10 Evaluation Board | 💠 Сору | UART CMSIS-Driver Sample Code | |

Figure 31. IAR Embedded Workbench CMSIS Manager: Examples Tab

Sample projects are preconfigured with Release versions of RSL10 libraries, which are distributed as object files. For the IDE, System library (libsyslib) and Startup (libcmsis) are preconfigured with the Source variant, so the source code of those libraries is included directly in both CMSIS Manager and IDE windows (see Figure 32 on page 27 and Figure 33 on page 28).

| ile Edit Source Refactor Navigate Search Projec | t CMSIS Manager Run W | indow Help | | | | | |
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| 🔺 🗁 blinky | | The Components I Re | solve | | | | |
| 🖻 🗁 Debug | | | | | | | |
| 🕨 🗁 include | | Software Components | Sel | . Variant | Vendor | Version | Description |
| 🔺 🏂 RTE | | RSL10 | | | ONSemiconduc | | ARM Cortex-M3 48 MHz, 24 kB |
| 🔺 🗁 Device | | Device | | | | | |
| 🔺 🗁 RSL10 | | Bluetooth Profile | 95 | | | | |
| R rsl10_protocol.c [ONSemiconductor::Dev | ice.Libraries.System.source] | Libraries | | | | | |
| ronvect.c [ONSemiconductor::Device.Libraries.System.source] ronvect.c [ONSemiconductor::Device.Libraries.System.source] | BLE | Ц | release | ONSemiconduc | 2.4.450 | Bluetooth Stack (libblelib) | |
| | ce.Libraries.System.source] | Calibrate | | source | ONSemiconduc | 2.4.450 | Calibration Library (libcalibrate |
| R rsl10_sys_audio.c [ONSemiconductor::De | | Custom Proto | cΩ | source | ONSemiconduc | 2.4.450 | Low Latency Audio Streaming |
| R rsl10_sys_clocks.c [ONSemiconductor::De | | Flash | | source | ONSemiconduc | 2.4.450 | Flash Library (libflashlib) |
| R rsl10_sys_crc.c [ONSemiconductor::Devic | | 📍 Fota | | release | ONSemiconduc | 2.4.450 | Fota Library (libfota) |
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| R rsl10 sys version.c [ONSemiconductor::D | | Validation Output | | | Dec | cription | |
| startup_rsl10.s [ONSemiconductor::Devic | | valuation Output | | | Des | cripuon | |
| system_rsl10.c [ONSemiconductor::Devic | | | | | | | |
| RTE_Components.h | ere cal colore er e e l | | | | | | |

Figure 32. RTE Configuration for the Blinky Example Project in the IAR Embedded Workbench CMSIS Manager window

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Figure 33. RTE Configuration for the Blinky Example Project in the IAR Embedded Workbench window

5.3.2 Building the Sample Code

To build the sample code:

1. Right click on the folder for blinky and choose **Rebuild all**. Alternatively, you can use the icon shown in Figure 34.

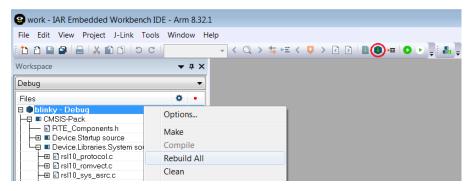


Figure 34. Starting to Build a Project in the IAR Embedded Workbench

2. When the build is running, the output of the build is displayed in the **Build Output** view in the IDE, as illustrated in Figure 35.

| | Files | • |
|--|----------------------------|---|
| | 🗆 🌒 blinky - Debug | ~ |
| uild | — ⊞ 🛋 include | |
| ana | 🖃 🖬 app.c | |
| Messages | - 🗎 readme_blinky.txt | |
| 5 | - 🖽 🔳 CMSIS-Pack | |
| Building configuration: blinky - Debug | 🖵 📮 🛑 Output | |
| Updating build tree | - B blinky.map | |
| startup_rsl10.s | 🖵 🖸 blinky.out | |
| rsl10_protocol.c | - 🛱 💼 Output | |
| rsl10_romvect.c | blinky.hex | |
| rsl10_sys_asrc.c | blinky.map | |
| app.c | - D app.o | |
| rsl10_sys_audio.c | - dl7M tln.a. | |
| rsl10_sys_clocks.c | - 1 m7M tl.a | |
| rsl10_sys_crc.c | | |
| rsl10_sys_dma.c | - I rsl10 romvect.o | |
| rsl10_sys_flash.c rsl10_sys_power.c rsl10_sys_ffe.c rsl10_sys_power_modes.c rsl10_sys_timers.c | - I rsl10_sys_asrc.o | |
| | - Instructions | |
| | - Institution sys clocks.o | |
| | rsi10_sys_crc.o | |
| | isino_sys_cic.o | |
| rsl10_sys_uart.c | rsi10_sys_dila.0 | |
| rsl10_sys_version.c | rsi10 sys power.o | |
| system_rsl10.c | rsi10_sys_power.o | |
| Linking | rsi10 sys_power_modes.o | |
| blinky.out | rsi10_sys_timers.o | |
| Converting | rsi10_sys_unters.0 | |
| | rsi10_sys_uarto | |
| Total number of errors: 0 | | |
| Total number of warnings: 0 | C rt7M_tl.a. | |
| - | | |
| Build Debug Log | shb_l.a | |
| | Startup_rsl10.o | |
| | 🖵 🗋 system_rsl10.o | |

Figure 35. Example of Build Output

- 3. The key resulting output shown in **Project Explorer** in the IDE includes:
 - *blinky.hex*: HEX file for loading into flash memory
 - *blinky.out*: Arm executable file, used for debugging
 - *blinky.map*: map file of the sections and memory usage

5.3.3 Debugging the Sample Code

5.3.3.1 Debugging Applications

IDE debug configurations are already set in the CMSIS pack. To debug an application:

- 1. Make sure the Evaluation and Development Board is connected to the PC via a micro USB cable.
- 2. Select **Project > Download and Debug,** or click the icon shown in Figure 36, then accept the J-Link pop-up dialog in order to use the flash breakpoints (as shown in Figure 37).



Figure 36. Start/Stop Debug Session Icon

| 🔝 J-Li | ink V6.34h Out of breakpoints |
|---------|--|
| | The debugger is trying to set a breakpoint in flash memory at address 0x001003E8. The target CPU has run out of hardware breakpoints. In order to set the requested breakpoint a software breakpoint in flash memory can be set. Unlimited breakpoints in flash memory (Flash Breakpoints) is an enhanced feature of J-Link which requires an additional license. Some members of the J-Link family (such as J-Link PRO and J-Link PLUS) already come with a built-in license for unlimited breakpoints in flash memory. In order to buy a license for unlimited breakpoints in flash memory for the connected emulator, please get in touch with sales@segger.com. For more information regarding this feature, please refer to http://www.segger.com/jlink_buy_flashbps.html. However, using this feature without the additional license is possible and permitted if used for evaluation only. |
| | Evaluate unlimited breakpoints in flash memory now? |
| | J-Link S/N: 483035975 |
| | 🖾 Do not show this message again fi |
| | Yes No Install existing license |

Figure 37. J-link "Out of breakpoints" pop-up dialog

If you are having trouble downloading firmware because an application with Sleep Mode is on the Evaluation and Development Board, see Section 6.4.1, "Downloading Firmware in Sleep Mode" on page 40.

3. The application runs up to the first breakpoint in *main*. You can press F5 or the Run icon (as shown in Figure 38) multiple times to step through the code and observe that the LED changes its state when the application executes the function Sys GPIO Toggle (LED DIO). To stop the debug session, press the Stop icon.

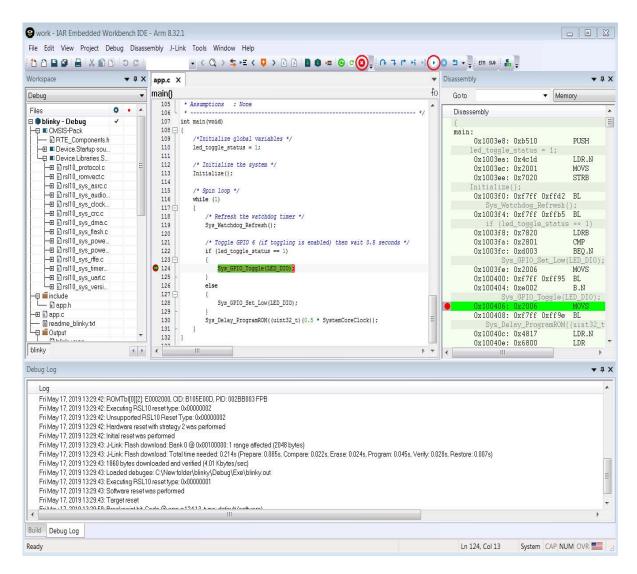


Figure 38. Debug Session in the IAR Embedded Workbench

CHAPTER 6

Advanced Debugging

6.1 PRINTF DEBUG CAPABILITIES

The PRINTF() macro is used to provide printf() debug capability in RSL10 applications. The implementation of the PRINTF () macro is user selectable to allow for different types of debug interfaces. The functionality is accessed via the tracing API.

The tracing API supports two debug interfaces: UART and RTT. The implementation of the tracing functions can be found in the *app_trace.c* file. The developer can select the debug interface during the compilation process by setting the RSL10 DEBUG macro in the *app_trace.h* file. If the macro is set to DBG NO, tracing is disabled. This is the default behavior in all sample applications.

NOTE: The files *app_trace.c* and *app_trace.h* need to be present in your sample application, and initialized using TRACE INIT(), in order to for you use the PRINTF() feature. You can find these two required files in most Bluetooth Low Energy sample applications, such as ble_peripheral_server_bond.

To debug time critical applications, we recommend setting the tracing option to DBG RTT option. With SEGGER RTT (Real Time Transfer), you can output information from the target MCU to the RTT Viewer application at a very high speed without compromising the target's real time behavior. More information about SEGGER RTT can be found in JLINK user manual, at www.segger.com.

6.1.1 Adding Printf Debug Capabilities

To add printf debug capabilities over UART, change the define in the app trace.h file to #define RSL10 DEBUG DBG UART, and set the RSL10 DEBUG macro to DBG UART. A standard terminal program on a PC can be used to view the debug output.

To add RTT printf debug capabilities, change the define in the *app trace*.h file to #define RSL10 DEBUG DBG RTT and add the SEGGER RTT files to the application. The Segger RTT Viewer application on a PC can be used to view the debug output.

Samples for RTT are under C:\Program Files (x86)\SEGGER\JLink V640b\Samples\RTT.

More information about the RTT API can be found in the JLINK manual, under C:\Program Files (x86)\SEGGER\JLink V640b\Doc\Manuals.

NOTE: Note that these RTT sample and information files are for SEGGER JLink version 640b.

6.2 DEBUGGING APPLICATIONS THAT DO NOT START AT THE BASE ADDRESS OF FLASH

If you want to debug an application that does not start at the first address of the flash memory (0x00100000), read on. For example, you might be debugging an application in RAM, or a flash memory application that has been placed in a different address.

This procedure assumes you have performed the steps in Section 3.3.1, "Debugging with the .elf File" on page 13, and you are using the ON Semiconductor IDE:

- 1. In your Debug configuration, change to the **Startup** tab
- 2. Enter the following in the **Run/Restart Commands** field as illustrated in Figure 39:

| Main 🕸 Debugger 🕨 | Startup 🛛 🦆 Sc | ource 🗖 Comn | non | | | | |
|--|------------------|-----------------------|------------|----------------|-------|-------------|--|
| Initialization Commands | | | | | | | |
| Initial Reset and Halt | Type: | Low s | peed: 1000 | kHz | | | |
| JTAG/SWD Speed: 💿 A | uto 🔘 Adaptive | e 🔘 Fixed | kHz | | | | |
| 🔽 Enable flash breakpo | ints | | | | | | |
| Enable semihosting | | to: V Telnet 🛽 | GDB client | | | | |
| Enable SWO CPU free | q: 10000000 | Hz. SWO free | ą: O | Hz. Port mask | : 0x1 | | |
| | | | | | | ^ | |
| | | | | | | - | |
| and Sumbols and Sussi | tabla | | | | | | |
| Load Symbols and Execu Load symbols | lable | | | | | | |
| Use project binary: | blinky.elf | | | | | | |
| O Use file: | | | | Works | pace | File System | |
| Symbols offset (hex): | | | | | | | |
| Load executable | | | | | | | |
| Our State of Use project binary: | blinky.elf | | | | | | |
| O Use file: | | | | Works | pace | File System | |
| Executable offset (hex): | | | | | | | |
| | | | | | | | |
| Runtime Options | oad after each n | eset/restart) | | | | | |
| | | use y restarty | | | | | |
| Run/Restart Commands | Turner | | (a) | | | | |
| Pre-run/Restart reset | | | (always ex | ecuted at Rest | art) | | |
| <pre>set {int} &VTOR = ISF set \$sp = *((int *) &ISR</pre> | | | | | | ^ | |
| | | | | | | - | |
| | | | | | | | |
| Set program counter | at (hex): | | | | | | |
| Set program counter Set breakpoint at: | at (hex): | | | | | | |

Figure 39. Setting Up a GDB Launch Configuration, Startup Tab

6.3 Arm Cortex-M3 Core Breakpoints

A maximum of two hardware breakpoints can be set at a given time. If you need more than two breakpoints, you can use the Unlimited Flash Breakpoints feature available through J-Link.

IMPORTANT: You can use hardware breakpoints when using the debugger with the Arm Cortex-M3 core, but software breakpoints cannot be used with the flash overlay. Writing to flash memory does not place breakpoints within the overlay, so any attempt to use software breakpoints would be ineffective.

6.4 DEBUGGING WITH LOW POWER SLEEP MODE

Debugging applications that use sleep mode is a challenging task because the hardware debug logic and system clocks are powered down when the device goes to sleep. Therefore, the debug session cannot be kept alive between sleep cycles.

Besides using GPIOs, UART, and other peripherals as tools to help debug your application, you can reattach the debugger after the device wakes up from sleep. To do so, you need to make sure that the device stays awake, and start a new debug session to connect to the running target, making sure a reset is not performed. The following instructions show an example of how to perform this on the *peripheral_server_sleep* sample application in the ON Semiconductor IDE, but you can also adapt it for other applications that use sleep mode, and for other IDEs.

- 1. Copy the *peripheral_server_sleep* application into your workspace and navigate to the *app_process.c* source file under the *code* folder.
- 2. Modify the function void Continue_Application (void) by adding a while loop before the Main_Loop(); call, to make sure that the device stays awake in the infinite loop after waking up (see Figure 40). Save and compile your application.

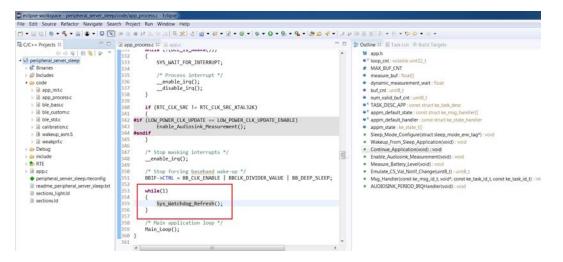


Figure 40. Continue_Application Function Perspective After Adding While Loop

- 3. Within the Project Explorer, right-click on the *.elf* file and select **Debug As > Debug Configurations**.
- 4. When the **Debug Configurations** dialog appears, create two debug sessions:
 - a. Debug session that initiates restart and halts the target:
 - i. Right-click on **GDB SEGGER J-Link Debugging** and select **New**. A new configuration appears under the **GDB SEGGER** heading, with new configuration details in the right panel.
 - ii. Adjust the displayed values for your configuration and click on **Apply** (see Figure 41 and Figure 42 on page 35).
- NOTE: If you are having trouble downloading firmware to the device, in addition to using DIO12, you can also perform the software recovery by setting the **Reset Type** to 1 in the **Debug** session configuration (see Figure 41). The default Reset Type is 0, which only resets the Arm Cortex-M3 core while leaving the device/peripherals in a state where J-Link can't reconnect. Setting the Reset Type to 1 ensures that not only is the Arm Cortex-M3 core reset, but so are all the peripherals. If this does not work, see Section 6.4.1, "Downloading Firmware in Sleep Mode" on page 40.

| eate, manage, and run configurati | ions 🕺 |
|--|--|
| 🔞 🗶 🖶 🕈 🕈 | Name: peripheral_server_sleep Debug |
| ype filter text C/C++ Application C/C++ Attach to Application C/C++ Attach to Application C/C++ Remote Application C/C++ Remote Application C/DE Hardware Debugging C/DE Application C/DE SEGGER J-Link Debugging C/DE peripheral_server_sleep Debug C/DE peripheral_server_sleep.pud, att | Main & Debugger Startup & Source Common & SVD Path Initialization Commands Source Common & SVD Path Initialization Commands Initialization Initialization Commands Initialization Init |
| Isva Applet Java Applet Java Applet Java Applet Java Javia Javia Java Sourd Sourd Sourd Sourd Remote Java Application | Load Symbols and Executable C Load Symbols Use project binary: peripheral_server_sleep.elf Use file: Use project binary: peripheral_server_sleep.elf Use file: Executable offset (hex): Executable offset (hex): Executable o |
| ter matched 19 of 100 items | Revert Apply |

Figure 41. Setting Reset Type in the Debug Configuration Session

| reate, manage, and run configurations | 3 | | | | | | |
|--|---|--|--|--|--|--|--|
| 🗎 🗶 🖶 🖶 💌 | Name: peripheral_server_sleep Debug | | | | | | |
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| C/C++ Application | Initialization Commands | | | | | | |
| C/C++ Attach to Application C/C++ Postmortem Debugger | ☑ Initial Reset and Halt Type: Low speed: 1000 kHz | | | | | | |
| C/C++ Postmortem Debugger | JTAG/SWD Speed: | | | | | | |
| Eclipse Application | | | | | | | |
| C GDB Hardware Debugging | | | | | | | |
| GDB OpenOCD Debugging | Enable SWO CPU freq: 0 Hz. SWO freq: 0 Hz. Port mask: 0x1 | | | | | | |
| C GDB SEGGER J-Link Debugging c peripheral_server_sleep Debug | | | | | | | |
| I Java Applet | | | | | | | |
| Java Application | • | | | | | | |
| Ju JUnit jt JUnit Plug-in Test & Launch Group | Load Symbols and Executable | | | | | | |
| | ✓ Load symbols | | | | | | |
| Launch Group (Deprecated) | Use project binary: peripheral_server_sleep.elf | | | | | | |
| Mwe2 Launch | O Use file: Workspace File System | | | | | | |
| OSGi Framework Remote Java Application | Symbols offset (hex): | | | | | | |
| | Coad executable | | | | | | |
| | Use project binary: peripheral_server_sleep.elf | | | | | | |
| | O Use file: Workspace File System | | | | | | |
| | Executable offset (hex): | | | | | | |
| | Runtime Options | | | | | | |
| | RAM application (reload after each reset/restart) | | | | | | |
| | Run/Restart Commands | | | | | | |
| | Pre-run/Restart reset Type: (always executed at Restart) | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | · | | | | | | |
| | Set program counter at (hex): | | | | | | |
| | Set breakpoint at: main | | | | | | |
| | Continue | | | | | | |
| | | | | | | | |
| Iter matched 18 of 107 items | Revert Apply | | | | | | |

Figure 42. Startup Tab: Debug Session that Initiates Restart

- b. Debug session that connects to the running target:
 - Create another new debug configuration under the GDB SEGGER heading, with new configuration i. details in the right panel.
 - ii. Adjust the displayed values for your configuration then click on Apply (see Figure 43 and Figure 44 on page 37).

| reate, manage, and run configurations |) C | | | | | | | | |
|---|---|--|--|--|--|--|--|--|--|
| 1 R X 8 3 · | Name: peripheral_server_sleep Debug_swd_att | | | | | | | | |
| type filter text | Main Debugger Startup Source Common 5 SVD Path | | | | | | | | |
| yge hiter text © (C++ Application © (C++ Attach to Application © (C++ Attach to Application © (C++ Remote Application © GBB Verbacks Debugging © GBB Verbacks I-Hink Debugging © DeB SEGER3-Hink Debugging © peripheral_server_siese Debug © peripheral_server_siese Debug © Java Application Jr. Nuht © Java Application Jr. Nuht © Java Application Jr. Muht © Java Application © GGB Framework © Remote Java Application | Main © Debuger & Startue] & Source C Common & SVD Path - Luk COB Server Statu Startue + Luk COB server locally Connection: Splink.gbb/sEGGER/Luk V634h/Luk CDBServerCLess to change tus we global or workspace preferences pages of the proceed properties page) Device name: SSL0 Endiamesis & Uittle Big Connection: USB [] USB servia of P name/address) Interface: USB [] USB servia of P name/address I tele topt: 2333 I Uscal host only] Silert I Log file: USB server I Recorder for semihosting and SWO COB Cleft Setup Executable: arm-one-rabigdb Command: eff memory in arm-one-rabigdb Command: eff memory in accessible-by-default off I Remote Target Host name of P address Iocalhost Port number: 233 I Cord memory II address Iocalhost Port number: 233 I Cord device de | | | | | | | | |
| ilter matched 19 of 107 items | Revert Apply | | | | | | | | |

Figure 43. Debugger Tab: Debug Session that Connects to the Running Target

| Image: Sever_sleep Debug Type filter text Image: Debugger Image | ~~ |
|---|-----------------------|
| Eclipse Application IV Enable flash breakpoints GDB Hardware Debugging IV Enable semihosting Console routed to: IV Telnet □ GDB client GDB OpenOCD Debugging V Enable SWO CPU freq: 0 Hz. SWO freq: 0 Hz. Por | t mask 0x1 |
| C GDB SEGGER J-Link Debugging peripheral_server_sleep_Debug Java Applet Java Applet Java Application Jr JUnit Julit Julit Load symbols and Executable Julit Load symbols Use project binary: peripheral_server_sleep.elf Luce file: | Workspace File System |
| Launch Group (Deprecated) Mwe2 Launch OSGi Framework OSGi Framework Cload executable Use project binary: peripheral_server_sleep.elf Use file: Executable offset (hex): | Workspace File System |
| ilter matched 19 of 100 items | Revert Apply |

Figure 44. Startup Tab: Debug Session that Connects to the Running Target

- NOTE: If you are having trouble connecting to the running target, you can perform a software recovery by setting the Reset Type to 1 in the Debug session configuration as shown in Figure 44. The default Reset type is set to 0, which only resets the Arm Cortex-M3 core and leaves the device/ peripherals in a state where the J-Link cannot reconnect. By setting it to 1, you ensure that not only the Arm Cortex-M3 core is reset, but also all the peripherals. If this does not work, see Section 6.4.1, "Downloading Firmware in Sleep Mode" on page 40 for more ideas.
- 5. Start the first debug session (which initiates target restart). Once the target is halted at main, resume the execution (see Figure 45).

Getting Started with RSL10

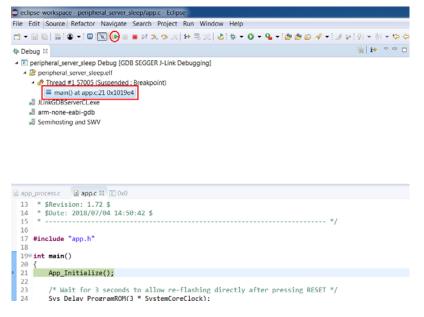


Figure 45. First Debug Session Perspective Before Starting Execution

Wait until the target enters Deep Sleep Mode. At this point the debug connection is lost; and even when the 6. target is awake, it cannot establish a connection with JTAG. The following output is generated on the console (see Figure 46).

| 🗳 Console 🛱 🔄 Tasks 🖹 Problems 🕥 Executables 📓 Debugger Console 🔋 Memory 🛷 Search |
|---|
| peripheral_server_sleep Debug [GDB SEGGER J-Link Debugging] JLinkGDBServerCL.exe |
| ERROR: Can not read register 2 (R2) while CPU is running |
| ERROR: Can not read register 3 (R3) while CPU is running |
| ERROR: Can not read register 4 (R4) while CPU is running |
| ERROR: Can not read register 5 (R5) while CPU is running |
| ERROR: Can not read register 6 (R6) while CPU is running |
| ERROR: Can not read register 7 (R7) while CPU is running |
| ERROR: Can not read register 8 (R8) while CPU is running |
| ERROR: Can not read register 9 (R9) while CPU is running |
| ERROR: Can not read register 10 (R10) while CPU is running |
| ERROR: Can not read register 11 (R11) while CPU is running |
| ERROR: Can not read register 12 (R12) while CPU is running |
| ERROR: Can not read register 13 (R13) while CPU is running |
| ERROR: Can not read register 14 (R14) while CPU is running |
| ERROR: Can not read register 15 (R15) while CPU is running |
| ERROR: Can not read register 16 (XPSR) while CPU is running |
| ERROR: Can not read register 17 (MSP) while CPU is running |
| ERROR: Can not read register 18 (PSP) while CPU is running |
| ERROR: Can not read register 24 (PRIMASK) while CPU is running |
| ERROR: Can not read register 25 (BASEPRI) while CPU is running |
| ERROR: Can not read register 26 (FAULTMASK) while CPU is running |
| ERROR: Can not read register 27 (CONTROL) while CPU is running |
| WARNING: Failed to read memory @ address 0xDEADBEEE |
| Starting target CPU |
| ERROR: CPU is not halted |
| ERROR: Can not read register 15 (R15) while CPU is running |
| Reading all registers |
| |
| |

Figure 46. Debug Session Perspective when Debug Connection is Lost

7. Stop the debug session and click on the **Terminate** icon to remove all terminated targets (see Figure 47).

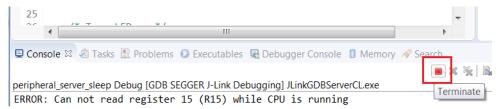


Figure 47. Terminate Targets Icon

8. After the target exits Deep Sleep Mode, it is running in the infinite loop (step 1), and we can connect to the running target by starting the second debug session (see Figure 48). Note that the debugger is able to reattach to the running target and halt the processor after waking up from sleep.

| e Edit Source Refactor Navigate Search Project | Run Window Help | | | | | | |
|---|--|-----------------------------------|--|---|---|------|--|
| • © © K • 0 💌 • 10 • 1 • 1 × 2 • 1 | 14 K + K & C + Q + Q + B & K + I + V - A + B & K + K + V + V + V + V + V + V + V + V + | N+N+00+0+ | | | Quick Access | | |
| Debug II | 2 4 T T D | 🗠 Variables 🍬 Breakpoints 🐔 Expre | ssions 12 III Registers 🗄 Signals 🛤 Modules 5 | Peripherals | 의 🔟 원 🖉 위 🖄 (1) 년 🔻 | | |
| Deripheral server_sleep_swd_att (GDB SEGGER J-Link Debugging) #B peripheral_server_sleep_eff # Thread # 157005 (Suppended : Signal: SIGINT/Interrupt) | | Expression Type | | | Value | | |
| | | № _stack | <text debug="" info="" no="" variable,=""></text> | | { <text debug="" info="" no="" variable,="">} 0x20005fe8</text> | | |
| | | Add new expression | | | | | |
| Continue_Application() at app_process.c354 (Wakeup From Sleep Application() at app_pro | | | | | | | |
| waxeup_rom_seep_Application() at app_pri Ovtfffffe | ocess.cz81 042000008 | | | | | | |
| a vomme √II JinkGD8serverCLexe ↓I arm-none-eabi-gdb | | | | | | | |
| | | | | | | | |
| J Semihosting and SWV | | | | | | | |
| | | | | | | - | |
| | | 4 | | | y | | |
| app_process.c 22 @ app.c Ovffffffe 18 rs10_s | vs watchdog.h | | - 0 | BE Outline 11 | PB588.** | | |
| 49 | | | | app.h | | | |
| 59 /* Stop forcing baseband wake-up */ 51 BBIF-SCTRL = BB_CLK_DIVIDER_VALUE BB_DEEP_SLEEP; | | | | Voop_ont:volatile uint32_t MAX_BUF_CNT | | | |
| | | | # MAX B | | | | |
| 2 while(1) | | | | | re_buf : float[] | | |
| Sys_Watchdog_Refresh(); | | | | | ic_measurement_wait : float | | |
| 55 } | | | | buf_cnt | | - | |
| 0* Main application loop */ 7 Main_Loop(); 558 559 | | | | num_valid_buf_ont : uint8_t * TASK_DESC_APP : const struct ke_task_desc | | | |
| | | | • appm_default_state : const struct ke_msg_handler[] | | | | |
| | | | | default_handler : const struct ke_state_handler | | | |
| 60 61#/* | | | | · appm_s | state : ke_state_t[] | | |
| 52 * Function : void Enable Audiosin | | | | | Mode_Configure(struct sleep_mode_erv_tag*) :: | void | |
| | | | | | p_From_Sleep_Application(void) : void | | |
| | tely RC_OSC_MEASUREMENT_INTERVAL seconds | | | | ue_Application(void) : void | | |
| 365 * before enabling audiosink interrupt. * | | | | _Audiosink_Measurement(void) : void | - | | |
| | | | | | | | |

Figure 48. Second Debug Session Perspective After Connecting to the Running Target

6.4.1 Downloading Firmware in Sleep Mode

If an application with Sleep Mode is currently on your board, and changing the Reset Type to 1 as described in Section 6.4, "Debugging with Low Power Sleep Mode" is not working, try the following:

- 1. Connect DIO12 to ground.
- 2. Press the RESET button (this restarts the application, which pauses at the start of its initialization routine).
- 3. Repeat step 2 above. After successfully downloading *blinky* to flash memory, disconnect DIO12 from ground, and press the RESET button so that the application works properly.

Alternatively, use the Stand-Alone Flash Loader (available with its own manual in the *RSL10_Utility_Apps.zip* file) to erase the application with Sleep Mode from the board's flash memory.

CHAPTER 7

More Information

7.1 FOLDER STRUCTURE OF THE RSL10 CMSIS-PACK INSTALLATION

By default, your files are installed in the following location:

- If you are using the Eclipse-based ON Semiconductor IDE: C:\Users\<user_id>\ON_Semiconductor\PACK.
- If you are using the Keil IDE: C:\Keil_v5\ARM\PACK
- If you are using the IAR IDE: C:\Users\<user_name>\IAR-CMSIS-Packs

Subfolders are described in Table 1, below, and Table 2 on page 41.

Table 1. Installed Folders - CMSIS-Pack

| Folder | Contents | | |
|---------------|---|---|--|
| configuration | J-Link flash loader files. | | |
| documentation | Hardware, firmware and software documentation in PDF format. Also 3rd-party documentation from other companies besides ON Semiconductor. Available from the books tab in the IDE. | | |
| images | Contains evaluation board pictures. | | |
| include | Include files for the firmware components and libraries. Projects can point to this directory and sub-directories when including firmware header files. | | |
| lib | Pre-built libraries which can be linked to by sample code or other source code. Project linker settings must point to this directory when linking with firmware libraries. | | |
| source | firmware | The source of the provided support libraries. | |
| | samples/rslx (for ON Semiconductor IDE) samples/uv (for Keil IDE) samples/iar (for IAR IDE) | Sample code sources as ready-to-build projects. | |
| svd | Contains the System View Description file used in the registers view during debugging. | | |

Table 2. Installed Folders - ON Semiconductor IDE

| Folder | Contents |
|----------------------|--|
| arm_tools | The Arm Toolchain is installed here. |
| eclipse | Pre-built libraries which can be linked to by sample code or other source code. Project linker settings must point to this directory when linking with firmware libraries. |
| jre* | The included JAVA runtime environment. |
| ON Semiconductor IDE | ON Semiconductor license agreement, revision file and pack description file. |

7.2 DOCUMENTATION

7.2.1 Documentation Included with the CMSIS-Pack

A set of documents is included with the CMSIS-Pack installation in C:\Users\<user_id>\ON_Semiconductor\PACK\ONSemiconductor\RSL10\<pack_version>\documentation (where <user_id is your profile name, and <pack_version> is the version number, e.g., 3.0.521).

These documents are also accessible via any of the three IDEs:

Getting Started with RSL10

- ON Semiconductor IDE: documentation is accessible through the C/C++ perspective by opening any RTE • configuration file, such as *blinky.rteconfig*, and selecting the tab **Device** (see Figure 49 on page 42).
- Keil µVision IDE: documentation is available in the **Books** tab, as shown in Figure 50 on page 43. ٠
- IAR Embedded Workbench: documentation is accessible through the IAR Embedded Workbench CMSIS • Manager window, as shown in Figure 51 on page 44.

| - 🔜 🐘 🥹 - 🧞 - 📾 🕍 - 63 - 67 - 67 - | \$ • 0 • 9, • 9, • 12 @ @ # • 10 0 0 0 0 • 10 1 × 1 = 11 × 1 = 11 × 1 = 11 × 1 | 御 * 御 * 🌣 🗢 * 🔶 * |
|--|---|---|
| Project Explorer 🛛 📄 😘 | Image: Start.c ◆ blinky.rteconfig Image: Ox0 @ main.c | |
| 🛎 blinky | I Device | 0 |
| Binaries | Device: RSL10 | |
| 2 Includes | | hange |
| Debug | Family: RSL10 Series | CPU: ARM Cortex-M3 |
| blinky.elf - [arm/le] | SubFamily: | Max. Clock: 48 MHz |
| Immanuo - (armyle) blinky,hex | Vendor: ONSemiconductor | Memory: 32 kB RAM, 384 kB ROM |
| iii blinky.map | Pack ONSemiconductor.RSL10.1.2.0 | FPU: none |
| main.d | URL: http://www.keil.com/dd2/onsemiconductor/rsl10 | Endian: Little-endian |
| a makefile | Device data books: | Description: |
| lo objects.mk | ARM and Thumb-2 Instruction Set Quick Reference Card | RSL10 is an ultra-low-power, multi-protocol 2.4 |
| la sources.mk | Sap Interface Specification | GHz radio designed for use in wireless devices |
| li subdir.mk | SATT Interface Specification | that demand low power consumption and a |
| s RTE | L2C Interface Specification | restricted size. |
| i main.c | RSL10 Firmware Reference | |
| blinky.rteconfig | RSL10 Hardware Reference | |
| readme_blinky.txt | RSL10 Sample Code User's Guide | |
| sections.ld | RW BLE Alert Notification Profile Interface Specification | |
| | RW BLE Battery Service Interface Specification | |
| | RW BLE Blood Pressure Profile (BLP) Interface Specification | |
| | RW BLE Cycling Power Profile Interface Specification | |
| | RW BLE Cycling Speed and Cadence Profile Interface Specification | |
| | RW BLE Device Information Service Interface Specification | |
| | RW BLE Find Me Profile Interface Specification | |
| | RW BLE Glucose Profile (GLP) Interface Specification | |
| | RW BLE Health Thermometer Profile Interface Specification | |
| | RW BLE Heart Rate Profile (HRP) Interface Specification | |
| | RW BLE HID Over GATT Profile Interface Specification | |
| | RW BLE Host Error Code Interface Specification | |
| | RW BLE Location and Navigation Profile Interface Specification | |
| | RW BLE Phone Alert Status Profile Interface Specification Interface Specification | |
| | RW BLE Proximity Profile Interface Specification | |
| | RW BLE Running Speed and Cadence Profile Interface Specification | |
| | RW BLE Scan Parameters Profile Interface Specification | |

Figure 49. Accessing RSL10 Documentation from the ON Semiconductor IDE

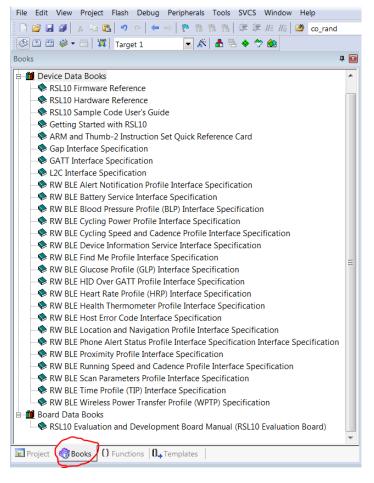


Figure 50. Accessing RSL10 Documentation from the Keil $\mu\text{Vision IDE}$

| | | | | | concerning all sound | |
|---|-----|------------------------------|------------------|--|----------------------|--|
| © 1 • 1 ≠ • 1 9) • 81 • © • • • • | | | | | Quick Access | |
| blinky.rteconfig 🖽 | - C | 🙆 Packs 🕮 🔳 Devices 🛢 Boards | C* Examples | Console | @ @] 🖗 V 😅 🖮 🛞 🔻 🕾 | |
| Device 0 | | Search Pack | | | | |
| blinky.rteconfig 🗉 | 0 🖬 | En actives in province | Action 1 Pack | Console Description RSLD selected ON Semiconductor RSL10 Device Family Pack Software Packs with generic content not specific to a device | | |
| WW BLE Running Speed and Cadence Profile Interface Specification WW BLE Scan Parameters Profile Interface Specification WW BLE Miles Proven Transfer Profile (WPTI) Specification WW BLE Wireless Power Transfer Profile (WPTI) Specification | | | | | | |
| ompatible boards: | | | | | | |

Figure 51. Accessing RSL10 documentation from the IAR Embedded Workbench

For more information, see the following:

Arm and Thumb®-2 Instruction Set Quick Reference Card

From the Arm company, this quick reference card provides a short-hand list of instructions for the Arm Cortex-M3 processor.

RSL10 Evaluation and Development Board Manual

This document actually contains a link to the manual that is stored elsewhere on the website. It is a reference manual that provides detailed information on the configuration and use of the RSL10 Evaluation and Development Board. When you use this board with the software development tools, you can test and measure the performance and capabilities of the RSL10 radio SoC.

RSL10 Firmware Reference

The system firmware provides functionality that isolates you from the hardware, and implements complex but common tasks, making it easier to support and maintain your code. The Bluetooth firmware provides an implementation of the Bluetooth host, controller, and profiles, supporting the standards-compliant use of these components within your application. This manual provides a reference to both sets of firmware features, and explains how they can assist with the development of your applications.

RSL10 Hardware Reference

Describes all the functional features provided by the RSL10 SoC, including how these features are configured and how they can be used. This manual is a good place to start when you are designing real-time implementations of your algorithms, or planning a product based on the RSL10 SoC.

RSL10 Sample Code User's Guide

Explains how to use the sample applications provided with the RSL10 software development tools. You learn about setting up your system, accessing code files, and how the sample applications work, using the Peripheral Device with Server sample code as the prime example.

RivieraWaves Interface Specifications (files in the ceva folder)

Interface Specifications from RivieraWaves provide a description of the API for the specified library:

- GAP Interface Specification
- GATT Interface Specification
- Host Error Code Interface Specification
- L2C Interface Specification
- RW BLE Alert Notification Profile Interface Specification
- RW BLE Battery Service Interface Specification
- RW BLE Blood Pressure Profile (BLP) Interface Specification
- RW BLE Cycling Power Profile Interface Specification
- RW BLE Cycling Speed and Cadence Profile Interface Specification
- RW BLE Device Information Service Interface Specification
- RW BLE Find Me Profile Interface Specification
- RW BLE Glucose Profile (GLP) Interface Specification
- RW BLE HID Over GATT Profile Interface Specification
- RW BLE Heart Rate Profile (HRP) Interface Specification
- RW BLE Health Thermometer Profile Interface Specification
- RW BLE Location and Navigation Profile Interface Specification
- RW BLE Phone Alert Status Profile Interface Specification
- RW BLE Proximity Profile Interface Specification
- RW BLE Running Speed and Cadence Profile Interface Specification
- RW BLE Scan Parameters Profile Interface Specification
- RW BLE Time Profile (TIP) Interface Specification
- RW BLE Wireless Power Transfer System Profile Interface Specification

LPDSP32 Documentation

The following documents are available in the RSL10_LPDSP32_Support.zip file:

- RSL10 Getting Started with the LPDSP32 Processor, which provides an overview of the techniques involved when writing and integrating code for the LPDSP32 processor that is on **RSL10**.
- LPDSP32-V3 Block Diagram, which provides a drawing of all the inputs, outputs, components and process blocks
- LPDSP32-V3 Hardware Reference Manual, which describes the hardware aspects of the LPDSP32-V3 core and its operations to provide an understanding of the core architecture and various kinds of supported operations.
- LPDSP32-V3 Interrupt Support Manual, which describes how interrupts are supported.

• User Guide IP Programmers for LPDSP32-V3, which describes the C application layer, the flow generally followed when any application is ported to LPDSP32, various tips for optimization to make the best use of the processor and compiler resources, and certain things the programmers should be aware of when porting applications. It also provides a few examples to show the usage of LPDSP32 intrinsic functions and to give an idea of how certain DSP functions can be ported to and optimized for LPDSP32.

RSL10 Release Notes

Lists new features in the latest release and known issues. This file is downloaded with the installer in a zip file, and is not in the *documentation* folder.

7.2.2 Documentation in the documentation.zip File

You can access documentation through the *documentation.zip* file available with this release of RSL10. It contains all of the documents included with the CMSIS-Pack as well as the following:

Getting Started with RSL10 Bluetooth Low Energy Mesh

Helps you to get started with the RSL10 mesh package. It guides you through the process of installing the mesh package alongside the RSL10 SDK, configuring your environment, and building and debugging your first RSL10 mesh network.

RSL10 Bluetooth Low Energy Mesh Sample Code User's Guide

Shows you what the mesh sample application (*ble_mesh*) demonstrates, how to configure the project to set up different mesh network scenarios, and how to experiment with them to verify their features and operations.

Files in the mindtree folder (related to Bluetooth Low Energy Mesh networking)

- EtherMind_Mesh_API.chm
- EtherMind_Mesh_Application_Developer's_Guide_Generic.pdf
- *EtherMind_Mesh_CLI_User_Guide.pdf*

RSL10 Bootloader Guide

The RSL10 bootloader provides means of performing firmware updates using the UART interface, and is a required component for Firmware Over the Air (FOTA). The bootloader enables firmware updates without the use of the JTAG interface. Firmware can be loaded from a host microcontroller over UART or over the air from another wireless device using FOTA. The bootloader copies the firmware image to the designated location in flash memory. This document describes the bootloader firmware application and development tools.

RSL10 Firmware Over-The-Air User's Guide

This manual describes Firmware Over-The-Air (FOTA) with RSL10. It provides the prerequisites and instructions necessary to develop FOTA-ready firmware applications and to perform FOTA updates in the field.

RSL10 LPDSP32 Support Manual

Provides an overview of the techniques involved when writing and integrating code for the LPDSP32 processor included with the RSL10 radio System-on-Chip (SoC).

RSL10 Getting Started with the LPDSP32 Processor

Provides an overview of the techniques involved when writing and integrating code for the LPDSP32 processor that is on RSL10.

Manuals in the lpdsp32 folder:

- *LPDSP32-V3 Block Diagram*: provides a drawing of all the inputs, outputs, components and process blocks
- *LPDSP32-V3 Hardware Reference Manual*: Describes the hardware aspects of the LPDSP32-V3 core and its operations to provide an understanding of the core architecture and various kinds of supported operations
- LPDSP32-V3 Interrupt Support Manual: Describes how interrupts are supported
- User Guide IP Programmers for LPDSP32-V3: Describes the C application layer, the flow generally followed when any application is ported to LPDSP32, various tips for optimization to make the best use of the processor and compiler resources, and certain things the programmers should be aware of when porting applications. It also provides a few examples to show the usage of LPDSP32 intrinsic functions and to give an idea of how certain DSP functions can be ported to and optimized for LPDSP32.

RSL10 Stand Alone Flash Loader Manual

Provides the information that you need to use the stand-alone flash loader. It describes the operations that the flash loader can perform, and explains how to configure the flash loader to connect to an RSL10 radio IC. The stand-alone flash loader is used to program, erase and read flash memory in RSL10.

RSL10 Release Notes History

A zip file containing the release notes for previous releases.

APPENDIX A

Migrating to CMSIS-Pack

If you have an existing project and have not used the RSL10 CMSIS-Pack before, this section is for you. Starting from SDK 3.0, the RSL10 firmware is no longer bundled with the Eclipse IDE. The RSL10 Eclipse IDE has been optimized and rebranded as the ON Semiconductor IDE, and the RSL10-specific firmware is now delivered exclusively as a separate CMSIS-Pack that can be imported into the IDE. For future RSL10 releases, you only need to download and import the updated CMSIS-Pack. There is no need to re-install the Eclipse IDE if it has not been updated.

Existing Eclipse project files from previous SDK releases are not compatible with the new ON Semiconductor IDE. Fortunately, migrating your existing project into the new IDE to take advantage of the CMSIS-Pack standard is a straightforward process, as shown in the next section.

A.1 MIGRATING AN EXISTING ECLIPSE PROJECT TO THE CMSIS-PACK METHOD

In order to tell whether your project is managed by CMSIS-Packs, check that a file with the *.rteconfig* extension is present in the project folder. If not, your project is not managed by CMSIS-Packs and needs to be migrated. The easiest way to migrate your existing Eclipse project to the new IDE is to start from one of the CMSIS-Pack RSL10 sample projects, and follow these steps:

- NOTE: This section assumes you know how to import the CMSIS-Pack and a sample application, as shown in Chapter 3, "Getting Started with the Eclipse-Based ON Semiconductor IDE" on page 7.
- 1. Decide on which CMSIS-Pack sample project to import. It is best to import a CMSIS-Pack project that looks similar (in terms of libraries used) to the existing project you would like to migrate. For example, if your existing application uses the Heart Rate Profile, you might want to import the *ble_peripheral_server_hrp* sample application as a reference.
- 2. Right-click the project and rename it as you wish.
- 3. Remove the source code from the sample project.
- 4. Copy over the source and header files from your existing project into the new one.
- 5. Open the RTE Configuration Wizard by double-clicking the *.rteconfig* file, and make sure all the software components (libraries) required for your project are selected.
 - Pay special attention to the Bluetooth components, such as the Bluetooth Low Energy Stack, Kernel, and Profiles. Ensure that these components have the correct variants selected (such as *release_light*, or *release_hci*).
 - Some libraries might have been removed, such as the *weakprf.a*. This library has been replaced by the *stubprf.c* file that is automatically added together with the Bluetooth Low Energy Stack component, so you no longer need to explicitly reference it.
 - You can also remove (deselect) the software components that you do not need in your existing application.
 - If you change the *.rteconfig* file, make sure to save it, so that it can update your project settings automatically (such as the library paths, includes, etc.) to reflect the newly added or removed software components.
- 6. Navigate to your project settings and add or remove the preprocessor *symbol* or *include* folders from your existing project.
- 7. Build your application and make sure it builds correctly.
 - In case of build errors related to missing components, files, or preprocessor symbols, go back to steps 5 and 6 and review your configuration carefully.
 - If you encounter errors related to duplicated code, review the *RTE* folder in your application. Some files that were common to multiple sample applications have been transformed into software components, such as the BLE Abstraction, CMSIS-Drivers, etc.

For errors related to deprecated code or API changes, review the latest RSL10 CMSIS-Pack release notes ٠ and check to see if there are any feature changes that could affect your project.

A.2 USING THE LATEST RSL10 FIRMWARE IN A PREVIOUS VERSION OF THE ECLIPSE-BASED IDE

We recommend always updating your installation to the latest version of the Eclipse-based ON Semiconductor IDE. However, if your circumstances are such that this is impractical, you can manually update the RSL10 firmware files in a previous version of the Eclipse-based IDE. If this is your case, try the following steps:

- 1. Download the RSL10 SDK CMSIS-Pack from www.onsemi.com/RSL10 and save it in any temporary folder.
- 2. Use a compressing tool, such as 7-Zip, and extract the contents of the ONSemiconductor.RSL10.version.pack file.
- 3. Copy and replace the *lib* and *include* folders from the CMSIS-Pack into your existing RSL10 SDK Installation folder.
- 4. Clean and build your application. If the build has been successful, you can see that it now references the updated libraries and include files.

In case of build errors, make sure to review the latest release notes from the CMSIS-Pack and check to see if there are any features or bug fixes that affect your application.

APPENDIX B

Arm Toolchain Support

There are several ways in which the ON Semiconductor IDE determines which Arm GNU toolchain to use when building. Understanding how this works can help prevent confusion and frustration, when the development machine has several versions of GNU toolchains installed.

B.1 BASIC INSTALLATION

The ON Semiconductor IDE supports the Arm toolchain by installing it in the *arm_tools* directory within the installed RSL10 software tools location. The build tools RM and Make are also included with the toolchain, to allow for an easier building experience out of the box.

When the user starts the ON Semiconductor IDE with the *IDE.exe* program (whose shortcut is located in Windows menu items), the *arm_tools\bin* directory is added to the path, to give the ON Semiconductor IDE access to the toolchain installed with the RSL10 software tools.

Conflicts with toolchain versions can occur in the ON Semiconductor IDE, if an Arm-based toolchain has been installed elsewhere or already exists on the path, and the IDE selects that toolchain rather than the one included in *arm_tools*.

B.2 CONFIGURING THE ARM TOOLCHAIN IN THE ON SEMICONDUCTOR IDE

All toolchain location options can be accessed by right clicking on the project in the **Project Explorer** view, selecting **Properties** at the bottom of the pop-up menu, and choosing the **Toolchains** tab. The scope of the toolchain path support is described below.

| Global Path: | This is the path used by all workspaces/projects. The global path can be set in the Toolchains tab of the project. |
|-----------------|---|
| Workspace Path: | This is the path used by all projects in the current workspace. |
| Project Path: | This is the path used by the current project for its toolchain. |

B.3 ADDITIONAL SETTINGS

Additional settings (other than the toolchain paths) are located within the MCU preference. These are:

- The Build Tools path (global, workspace, project-based) for tools such as Make and RM
- The Segger JLink path (global, workspace, project-based) for the location of the Segger JLink executables. This replaces the Run/Debug string substitutions for JLink previously used.

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