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# Uses of Breakpoints

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## Introduction

The concept of a Breakpoint is that it only interrupts the execution of a program prior to a specified instruction. The implementation can be in hardware or software, but this will not be discussed in this document. Being simple doesn't mean that a Breakpoint can't be used in complex combinations that can solve a bug in an easy way. The fact is that software and firmware developers cannot live without breakpoints. How do we make the best use of them? This document provides the best hints on how to debug your application faster and make use of each one of the available breakpoints.

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## 1. Uses of Breakpoints

In the IAR Embedded Workbench® for Renesas Synergy™ (IAR EW for Synergy), you have the possibility to use the following breakpoints:

### 1.1 Code Breakpoints

This is the simplest use of a breakpoint. You only need to choose the C line or the ASM instruction in the disassembly windows and toggle the breakpoint. Once the breakpoint is hit, your application will stop. At this time, you can check the values of variables, flags and registers. In other words, you have full control.

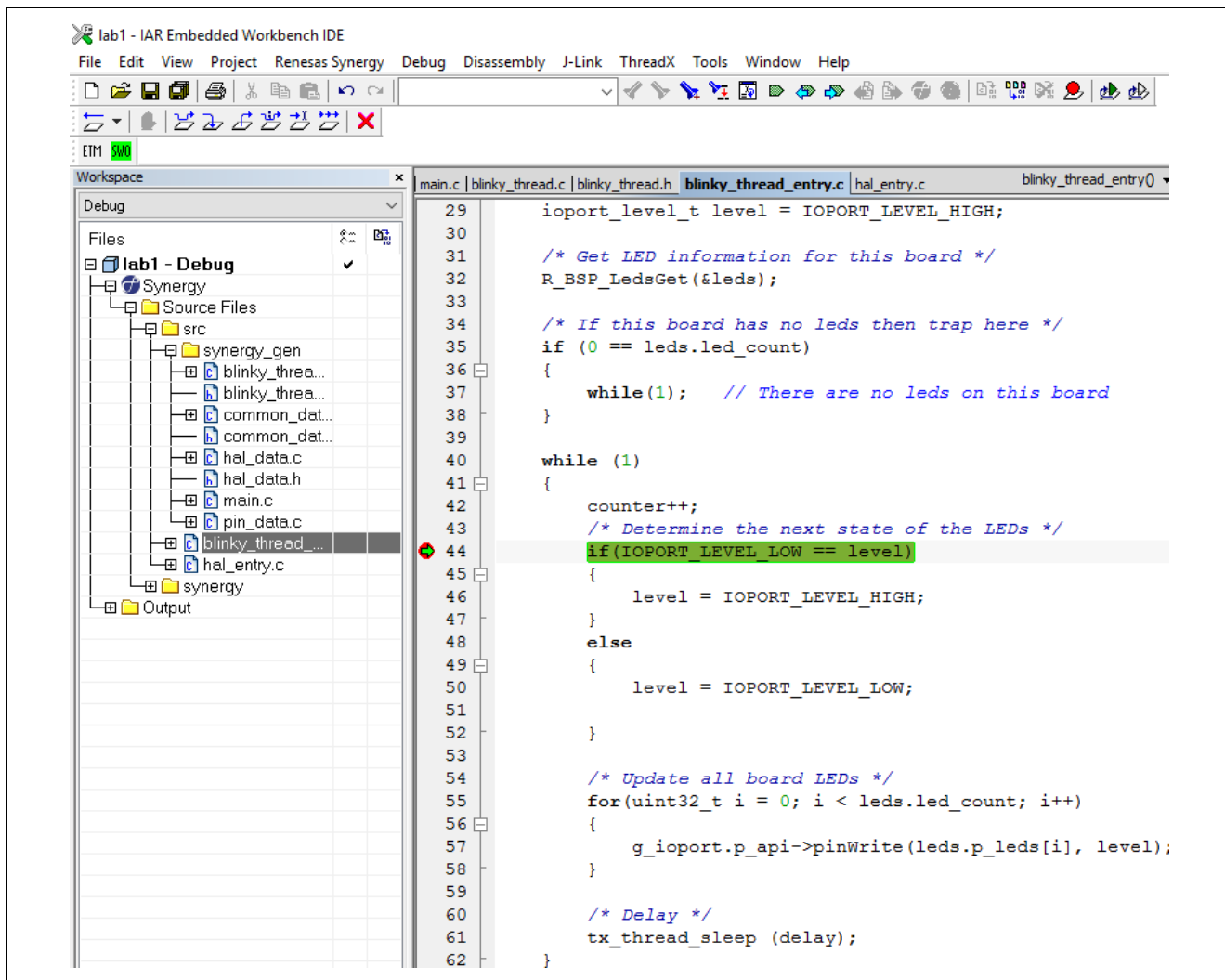


Figure 1. Code Breakpoints

The number of code breakpoints is limited to the number of hardware breakpoints but can be unlimited if you make use of software breakpoints or run the application in RAM. Even with a limited number, for example for Renesas Synergy devices that have six breakpoints, you could save the location and disable and enable the breakpoint when needed. Just choose to show the **View -> Breakpoints window** and you will be able to **set/clear** the box; this means **enabling** or **disabling** the breakpoint.

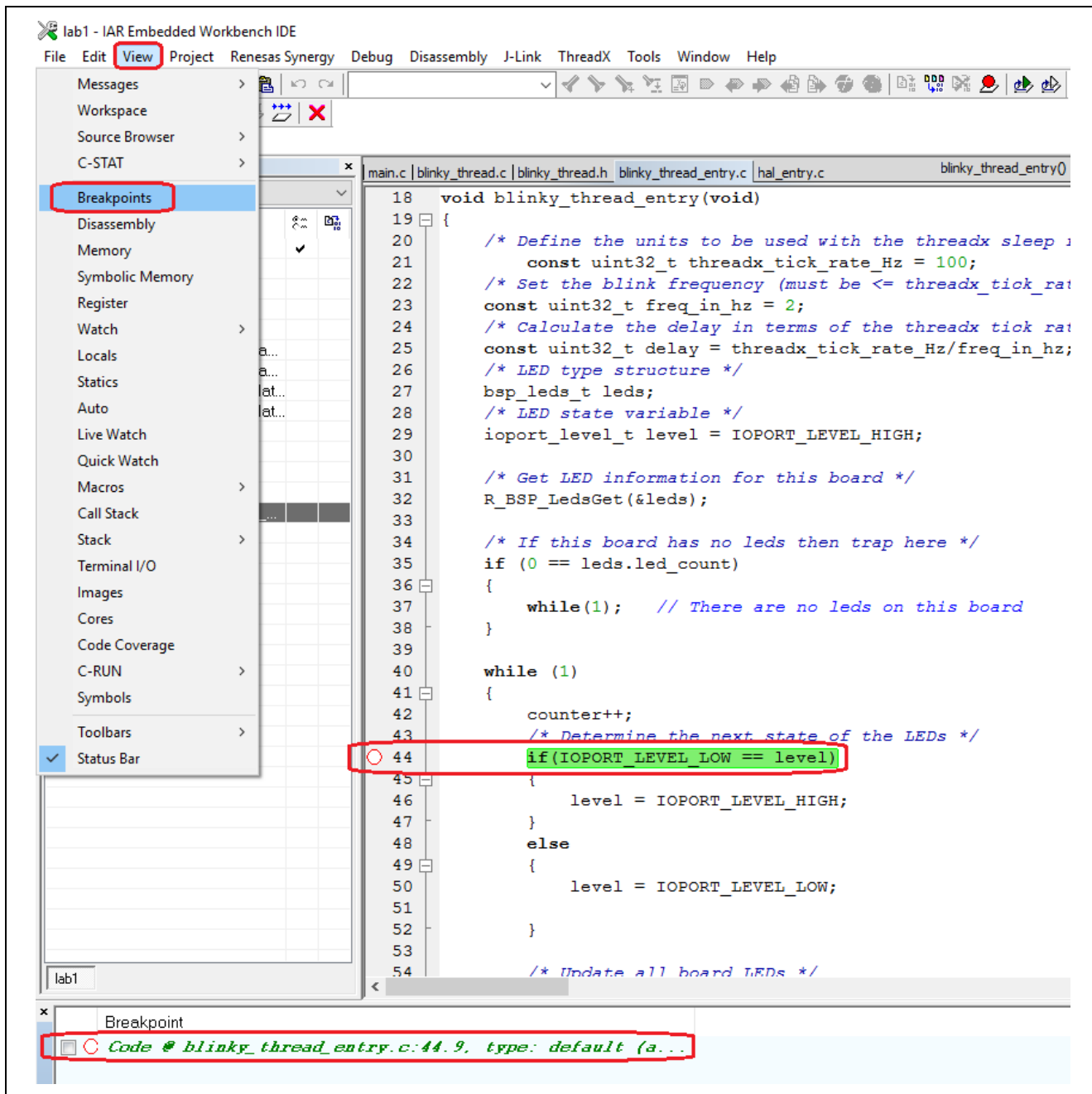


Figure 2. View Breakpoints

In this case, you can have more than six breakpoints but not all active at the same time. Notice that J-Link™ and I-Jet™ also offer you the capability of Software breakpoints. This will give you an unlimited number of breakpoints in Flash but with the cost of reprogramming a few blocks of memory with the downside of making the debug slower.

### 1.2 Conditional Code Breakpoints

A conditional breakpoint is the combination of a code breakpoint with some flag or variable as a condition. Once a breakpoint is set, you can use the **View ->Breakpoints window** to see all breakpoints, but also set extra parameters by right-clicking and select **Edit option**.

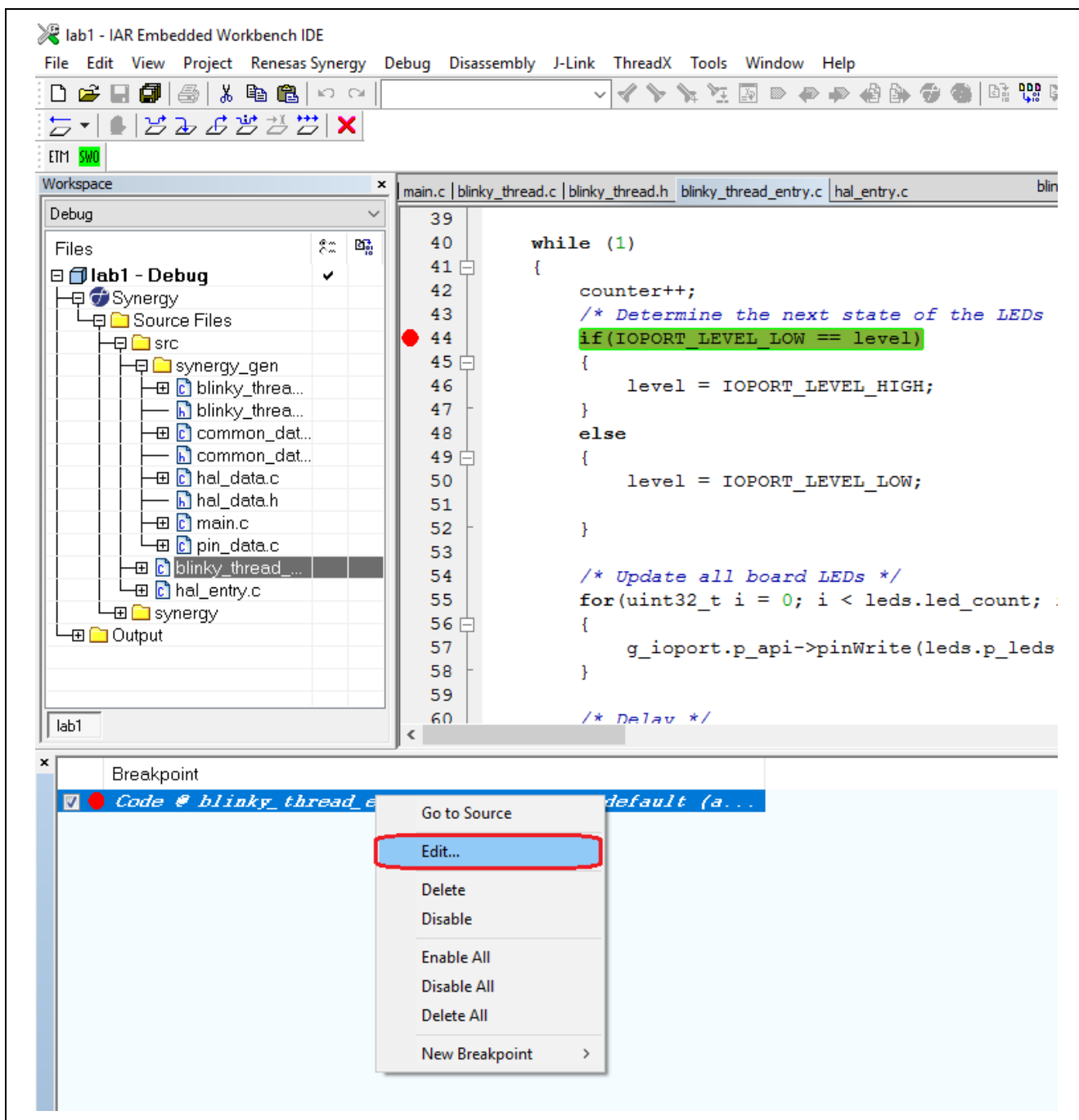


Figure 3. Conditional Code Breakpoints

The syntax to be used is similar to the C syntax and you can use ==, >= and <=. For example, if we want our application to halt at the breakpoint when the counter is equal to 10 we use `counter==10`.

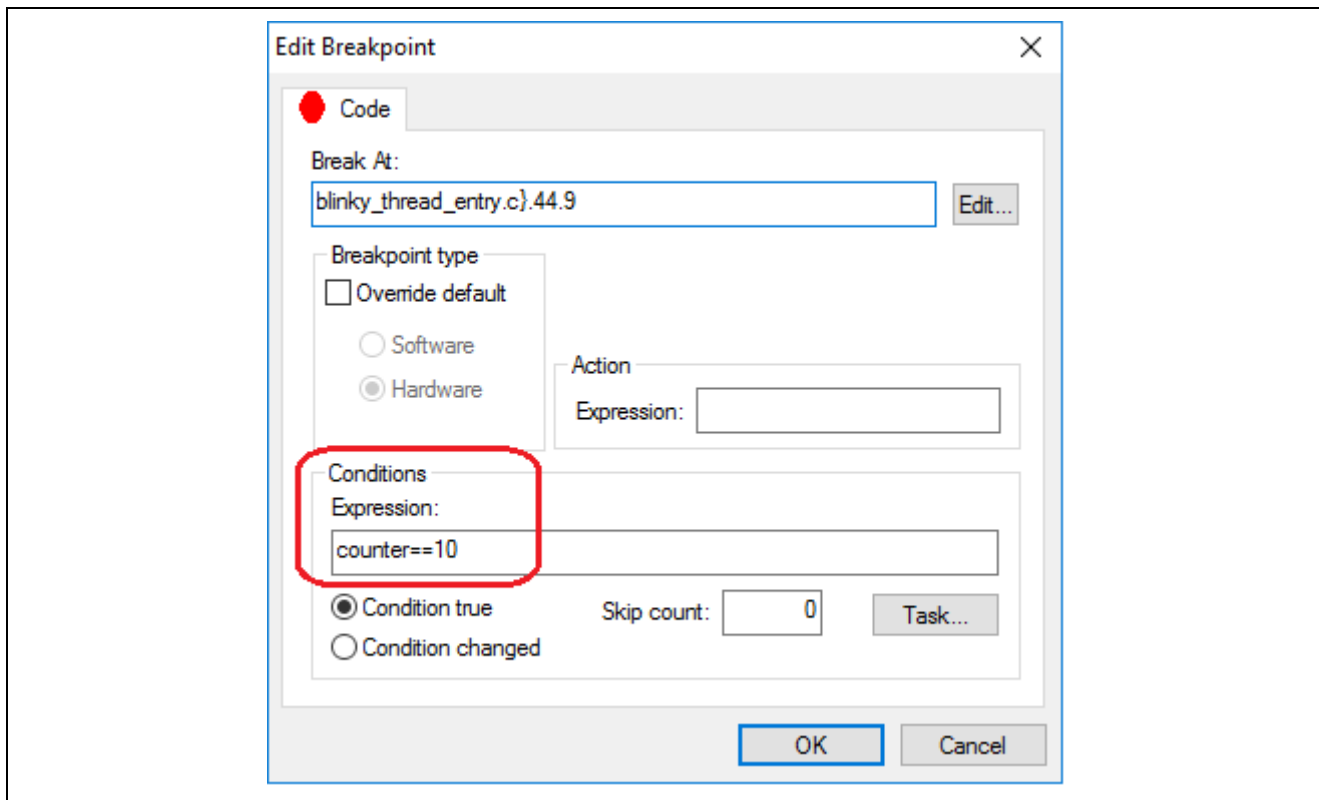


Figure 4. Edit Code Breakpoint

This is very useful when a breakpoint is needed inside an interrupt routine. Without a condition, it would be impossible to debug your application since it would halt all the time. Using a flag or variable as a condition makes things much easier. You can also go a bit further using the **skip counter** and a **condition check** like **true** or **changed**.

### 1.3 Data Breakpoints with Read and Write Access

Data Breakpoints are a bit different since they monitor the read and write access to a specific memory address, flag, variable or register. Using this breakpoint is very straightforward. Simply **right-click** the **flag** or **variable** and select the option **Set Data Breakpoint**. By default, the read and write accesses will be monitored. If you want to add some extra setting you can do it through the **View->Breakpoints window** and **Edit option**. Aside from the accesses, it is possible to monitor if the data matches. This means that the write or read access would only trigger the halt if the data matches. Choosing the **Edit** button opens an extra window that makes it possible to select **absolute addresses** or even a **source line**. In case of a variable or flag it is recommended to use the auto size but if a bigger range needs to be monitored the manual size should be used with the desired size.

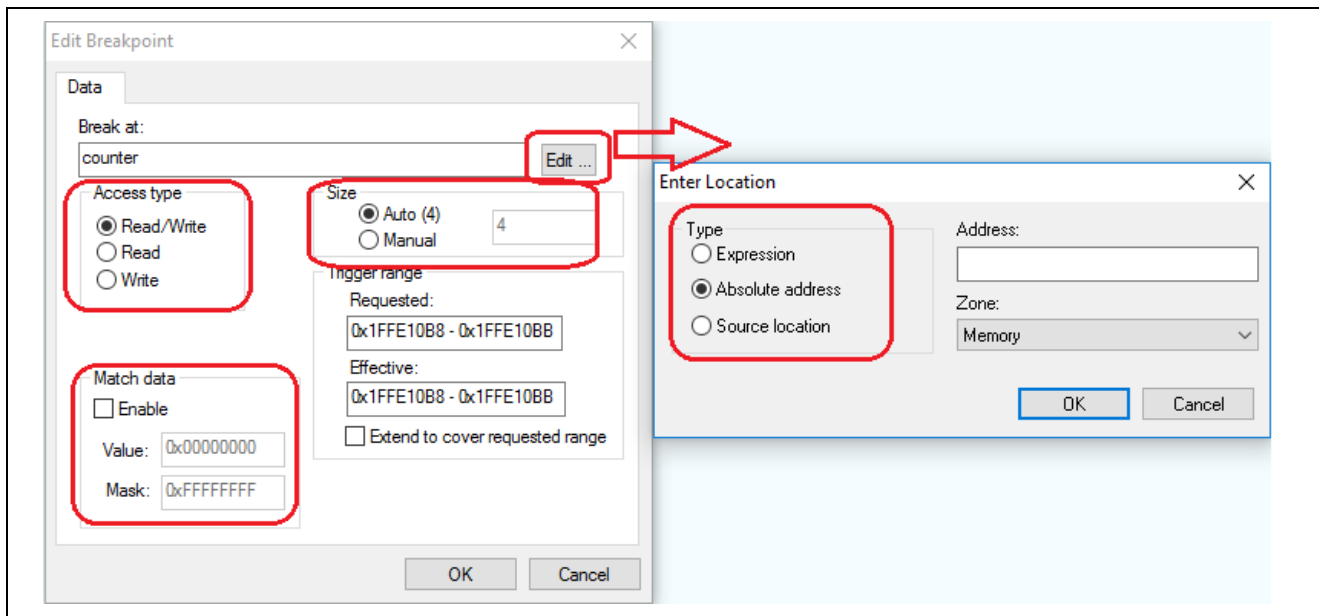


Figure 5. Data Breakpoints

The data breakpoint is very useful to debug flags and variables that are being corrupted by the application. Once there is some access the application halts. Another approach is the stack overflow investigation. Just set a data breakpoint at 80-90% of the stack size and when the overflow is near, you can halt the application and go step-by-step to find the root of the problem.

### 1.4 Log Breakpoints

Aside from the **code** and **data breakpoints** you also have the **log breakpoints**. This is a special breakpoint since it will only temporarily halt the application to print a message. It will only show the selected message once the breakpoint is hit.

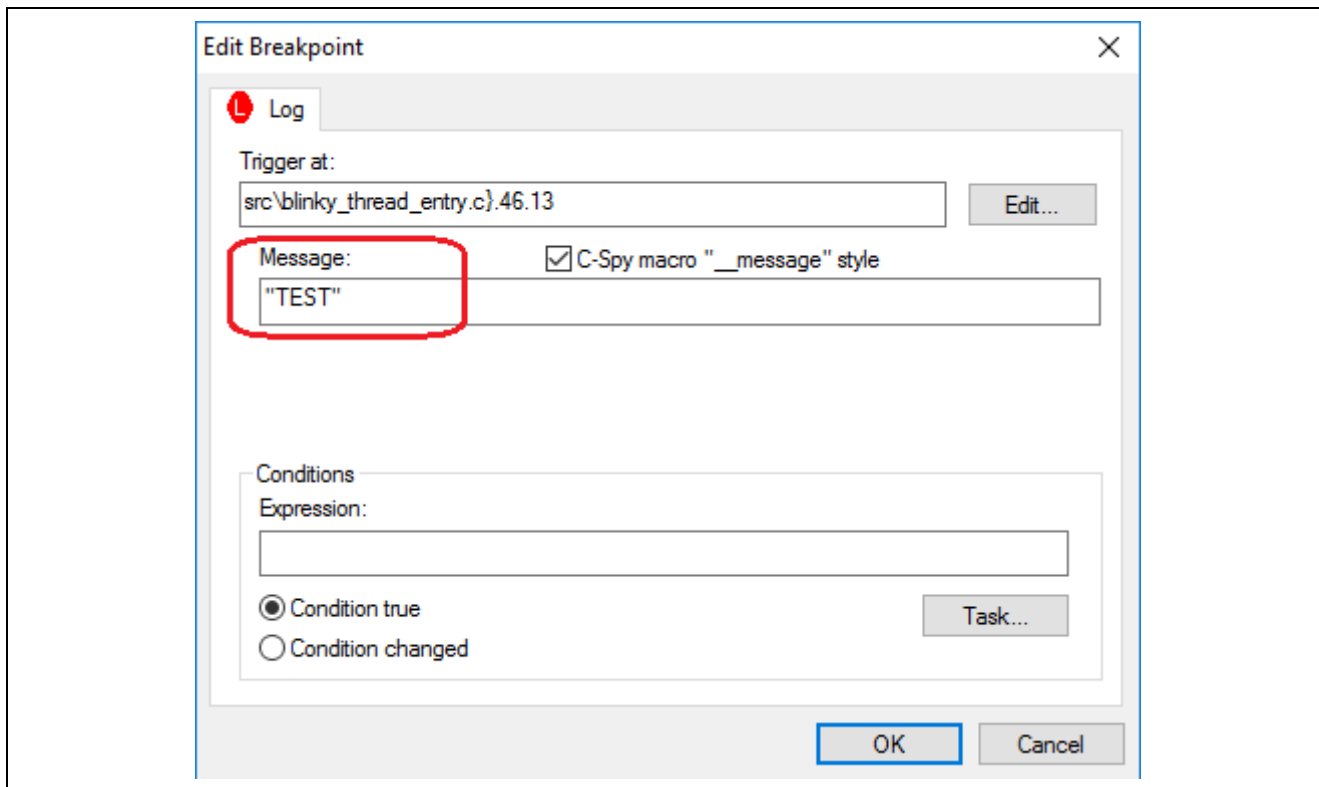


Figure 6. Log Breakpoints

Every time that the breakpoint is hit, a message will be displayed in the debug log window. An added counter makes it possible to know how many times the application passed that part of the source code.

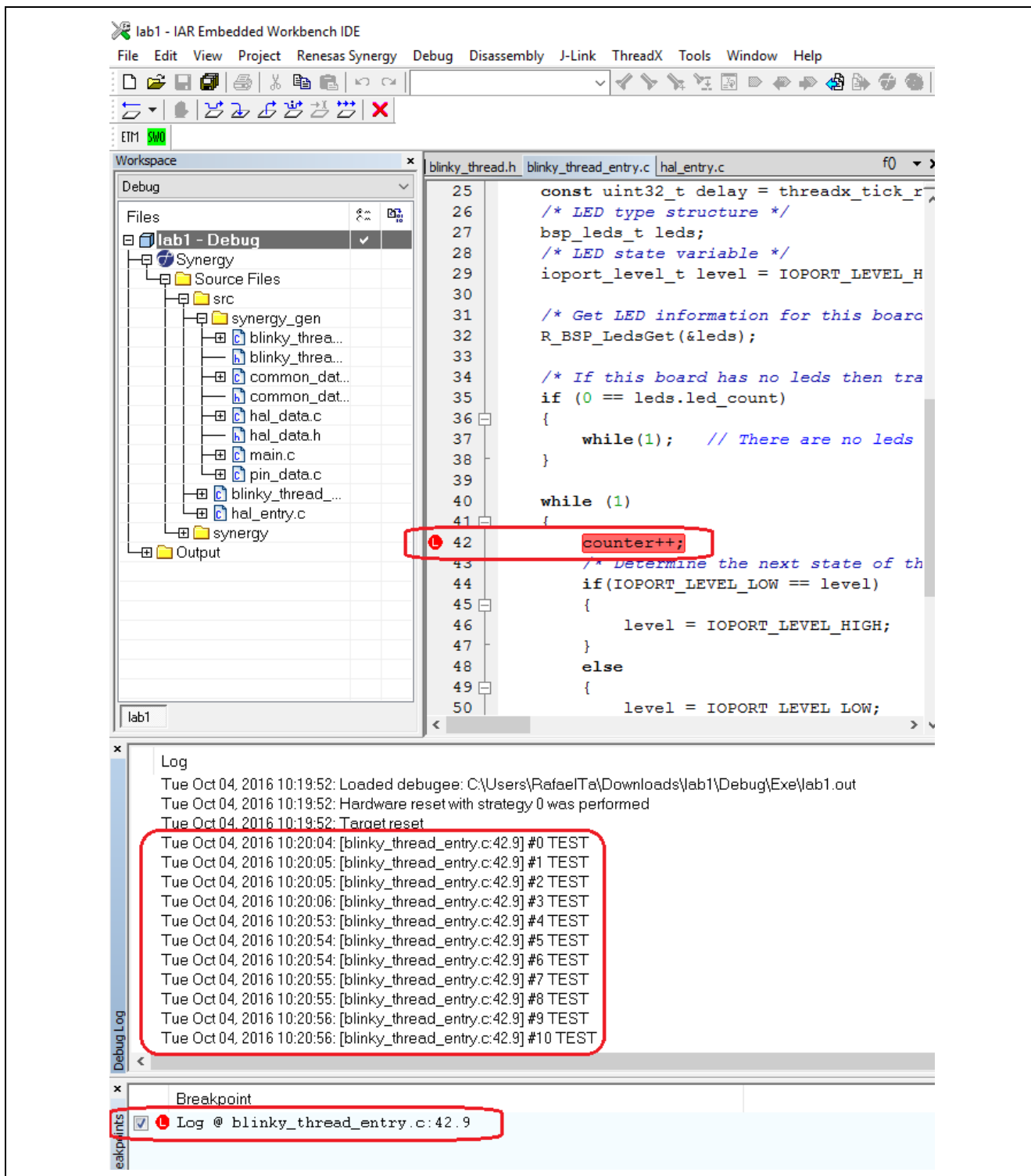
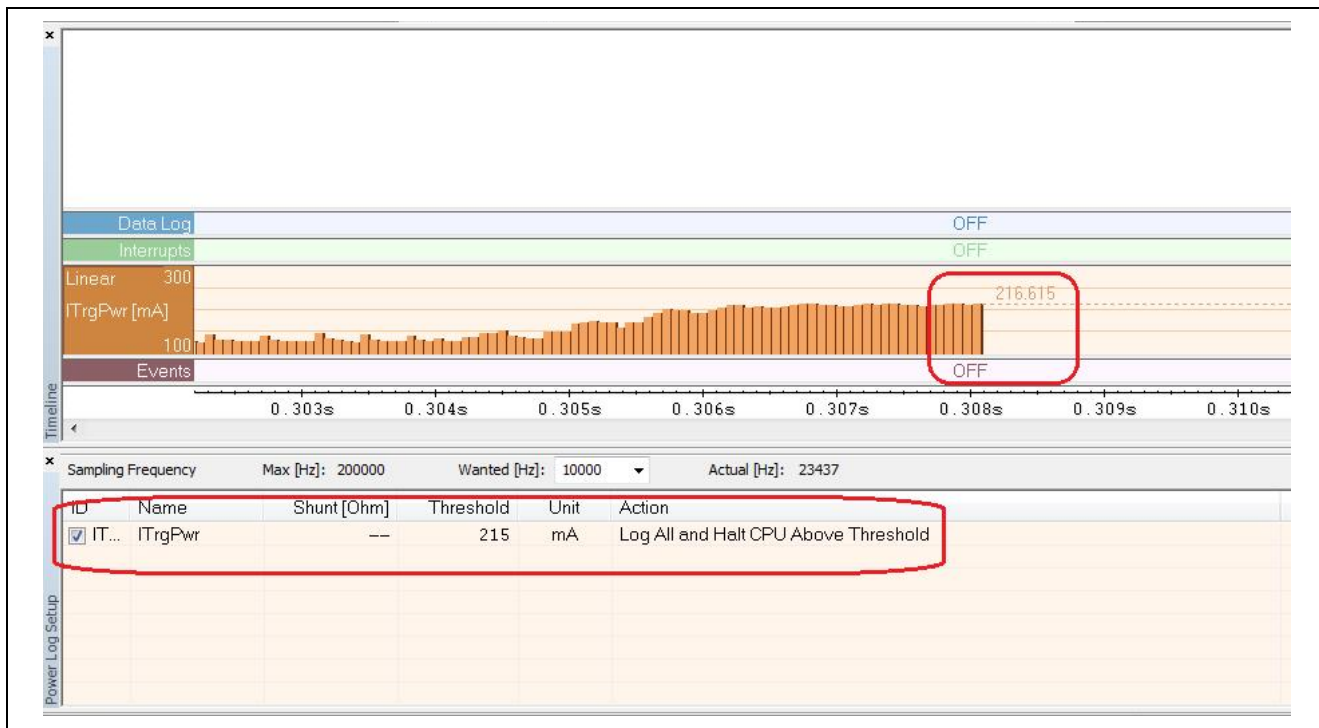


Figure 7. Debug Log window

### 1.5 Power Breakpoints

IAR EW for Synergy and others have introduced the concept of **Power Debugging** that lets you monitor the energy consumption and correlate it with the source code. This makes it possible to know the energy consumption of the entire application. This concept makes it possible to add **power breakpoints**. It is possible to set a threshold, like 215 mA, and the debugger will halt once the energy is above this value.



**Figure 8. Power Breakpoints**

Setting the threshold is very simple. You only need to open the **J-Link** or **I-JET/JTAGJet->Power Log Setup window** in order to set the value and desired option like above or below the value. Notice that this feature is not available on the J-Link board that is available in most of the Synergy SK and DK Kits. The **I-Scope** is recommended for external power supply in conjunction with the **I-Jet** since the probe supply to the target would be limited to 450 mA.



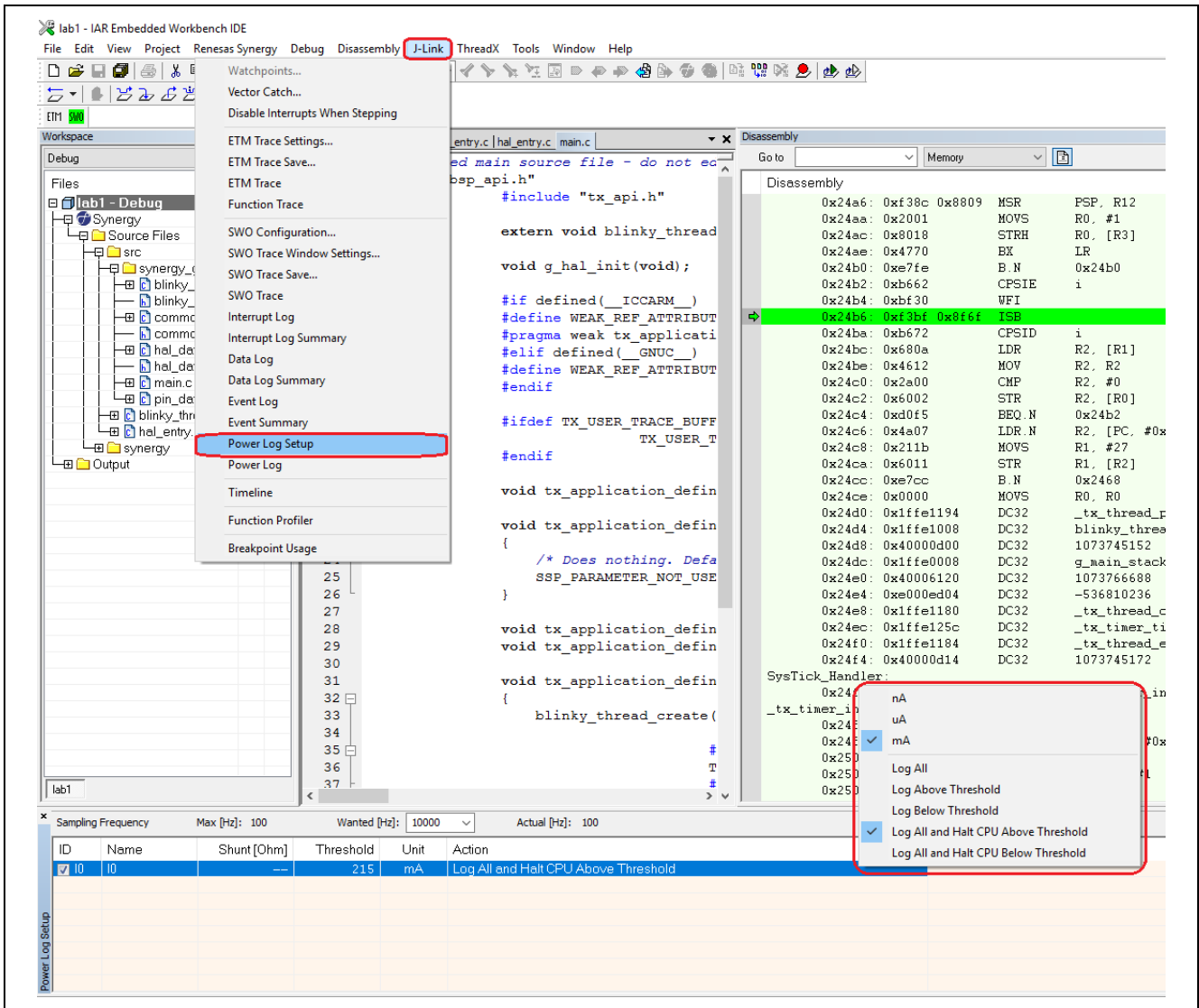


Figure 9. Power Log Setup

The feature is useful to guarantee that you will not have peaks of power consumption or higher values than specified and the battery will last longer with this kind of analysis. You can leave your application running for a long period of time. The timeline is not necessary but it gives you the complete information about the energy that is being used.

The different types of breakpoints are available in the IAR EW for Synergy with J-Link and I-Jet. Now that you know the different combinations and uses of breakpoints, you should be able to make the best use of them while debugging your application.

## Website and Support

Support: <https://synergygallery.renesas.com/support>

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**Revision History**

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		<b>Page</b>	<b>Summary</b>
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