



Enabling the Smart Society

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Advanced Debugging on the RX600

Renesas Electronics America Inc.

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Renesas Technology & Solution Portfolio









Microcontroller and Microprocessor Line-up



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Feature	Full ICE	On Chip
Address Breakpoints	V	
Data Breakpoints	V	
Trace		
Time Measurement		

DEV

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Agenda

Debugging features of the RX600

- Complex Breakpoints
- Branch & Data Trace
- Performance Counters (HEW)
- RAM Monitor (E20)
- E1 & E20
- RX Simulator
- E100
- Lab





Debugging Features of the RX600





Debugging Features – Complex Breakpoints

- Breakpoints can monitor either:
 - Execution Address
 - Data Access
- Execution Address is used for standard 'Before PC' breaks
- Data Access breakpoints can monitor reads and writes

Flash	n Address	Assembly Code		
FFFF	8B15	MOV.L	#00001144H,[R14]	





Debugging Features – Breakpoint Extras

Other features that are used along with breakpoints

- Masking
 - Look for a range of values
- Combine Breakpoints

- AND



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Debugging Features – Trace

Branch Trace

Tracks branch sources and destinations

Flash Address	Instruction		
FFFF0000	BRANCH #FFFF0008		
FFFF0004	ADD R1, R2, R3		
FFFF0008	MOV R4, R5		
FFFF000C	SUB R3, R2, R1	-	
FFFF0010	BRANCH #FFFF0200		

- Can fill in instructions in between destination and next branch
- Data Access Trace
- Where to store the data?
 - Internal buffer
 - Stream to PC





Debugging Features – Performance Counters

RX600 has two dedicated 32-bit counters

- Used to measure CPU cycles between triggers
- Can filter cycles
 - All cycles
 - Cycles spent in interrupt
 - Number of interrupts
- Can cascade counters for 64-bit operation









Debugging Features – Real-Time Memory

- Expression view/Real-time memory What is the difference?
- Uses Debug DMAC to remove burden from MCU
 - Same as RAM Monitor in HEW

💷 Console 🤕 Tasks 🔝 Problems 🚺 Executables 🔗 Search 😫		Panes	•]	~ - 8)
0x1400		Endian	•	Go	New Tab
0x1400 null 🖾 0x1930 null		Text	►		
0x00001400 05 0A 36 AC 2C F9 83 F7 D4 0C 77 F2 D4 73		Cell Size	►		<u> </u>
0x00001410 32 26 00 D0 8D A8 06 CB F5 29 DA 4C 99 10		Radix	×	•	Hex
0x00001420 4E 48 24 1B 7B 75 8D 90 40 31 70 21 50 AE		Columns	►	_	Decimal Signed
0x00001430 5B A9 32 2C 42 42 7B 99 BE CD 67 05 9C A0		Update Mode	•		Decimal Unsigned
0x00001440 96 27 16 A6 02 17 1B EE 08 7B D4 30 7D EF	L (Octal
0x00001450 98 1B 61 3C AA E1 C5 89 D2 88 BD 90 17 13		Copy To Clipboard			D'
0x00001460 BA ED 3D C3 6B 6B 95 68 E4 7E 49 59 7D C6	51	Copy Address			Binary
0x00001470 67 4D 3A 05 1E 74 A9 77 4D 94 32 A2 E3 15	i -	Reset To Base Address			
0x00001480 03 00 00 00 00 00 00 00 00 00 00 00 00		Refresh			
0x00001490 00 00 00 00 00 00 00 00 00 00 00 00 0					
0x000014A0 00 00 00 00 00 00 00 00 00 00 00 00 0) (Refresh Interval			
				_	.



E1 & E20





E1 & E20

Supports the RX family

- E1 supports V850, RL78, R8C, 78K
- The features do not come from the debuggers!
- E1 has 14 pin JTAG connection
- E20 has 38 pin JTAG + Trace connection









The E20 Debugger Allows any Renesas MCU to use Data Access Breakpoints.

DE

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1. True







RX Simulator





RX Simulator

- GDB simulator in e²studio
- **RX600 simulator in HEW**
 - Software algorithm development
 - Cycle accurate simulation
 - Has performance analysis built in
 - Can trigger interrupts
 - Great for testing software routines S/W Algorithm Testing





E100





How many of you know what Code Coverage is?









How many of you know the Difference Between CO, C1, and C2 Code Coverage?

```
if(x) { function1(); } else { function2(); }
if(y) {
   function3();
} else {
   function4();
}
```





E100

- Above and beyond E1 & E20
- Full trace
- Code coverage and profiling
- Stack overflow detection







Questions?





Lab Exercises





Start the Lab

- There are 6 lab sections
- Please complete them in sequence
- Please answer the questions in the lab
 - We will cover them at the end
- Let us know if you have any questions during the lab
- Please refer to the Lab Handout and let's get started!

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LAB PROCEDURE

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ID 3L05I: Advanced Debugging with the RX600 Series RX600 Series

Description: The purpose of this lab is to get the user accustomed to using some of the advanced debugging features available on RX600 Series devices. The features covered are the expression window, complex breakpoints, and branch trace.

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Lab Objectives

- Learn to generate and view preprocessed source files.
- Understand and use complex breakpoints.
- 3. Demonstrate trace functionality.
- 4. Setup and use multiple eventpoints.

Skill Level:

- 1. Programming in C
- Basic operations in e2Studio.
 Basic debugging to the bright operation.
- 3. Basic debugging techniques.

Lab Materials Please verify you have the following materials at

- your lab station. • RDKRX63N
- USB debugger cable
- USB debugger cable
 e2Studio Version 1.0.1.14
- RX Toolchain Version 1.02.00
- RX_Advanced_Debug lab workspace

Time to Complete Lab 100 Minutes

Lab Questions





Lab Question 1

Question:

Why does the linker give an error while building the project when the compiler is configured to output preprocessed source files (*.p files)?







Lab Question 2

Question:

Which data block was being processed when the error occurred?







Lab Question 3 and 4

Question:

What is the address of the CurrentState?

Answer:

Question:

What is the value of the CurrentState?







Lab Question 5

Question:

If you wanted to break when a variable is set to a value between 0x80 and 0x87 or 0x90 and 0x97 (break on 0x80 <= $x \le 0x87$ or 0x90 <= $x \le 0x97$) what would your Compare and Mask Value fields be in the Add Eventpoint window?





Lab Question 6

Question:

Why data compare value is set to 0x80?







Questions?





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