



OVP Guide to Using Processor Models

Model specific information for renesas_RL78_RL78-S1

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Model Release Status

This model is released as part of OVP releases and is included in OVPworld packages. Please visit OVPworld.org.

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Chapter 1

Overview

This document provides the details of an OVP Fast Processor Model variant.

OVP Fast Processor Models are written in C and provide a C API for use in C based platforms. The models also provide a native interface for use in SystemC TLM2 platforms.

The models are written using the OVP VMI API that provides a Virtual Machine Interface that defines the behavior of the processor. The VMI API makes a clear line between model and simulator allowing very good optimization and world class high speed performance. Most models are provided as a binary shared object and also as source. This allows the download and use of the model binary or the use of the source to explore and modify the model.

The models are run through an extensive QA and regression testing process and most model families are validated using technology provided by the processor IP owners. There is a companion document (OVP Guide to Using Processor Models) which explains the general concepts of OVP Fast Processor Models and their use. It is downloadable from the OVPworld website documentation pages.

1.1 Description

RL78 Family Processor Model.

1.2 Licensing

Open Source Apache 2.0

1.3 Reference

RL78 User Manual: Software, Single-Chip microcontrollers,
http://documentation.renesas.com/doc/products/mpumcu/doc/rl78/r01us0015ej0220_rl78.pdf

1.4 Limitations

All instructions are supported except the MULU, MULHU, MULH, DIVHU, MACHU and MACH instructions that are not implemented.

Banked registers are not supported

The PMC (Processor Model Control) register behavior is not modeled.

This processor model requires that RAM is available at the address range of the memory mapped registers

Address ranges 0xFFEE0 to 0xFFEEFF for General purpose registers (e.g. X, A)

Address ranges 0xFFFF0 to 0xFFFFF for special function registers (e.g. SP)

This processor model should be started with a reset signal. The processor reads from the reset vector 0x0000 on reset and uses this value for the initial PC

1.5 Verification

Models have been tested by eSOL TRINITY and Imperas

1.6 Features

External exceptions are supported

The BRK instruction (internal trap) is supported

Memory mirroring is supported

Memory mapped registers is supported

Chapter 2

Configuration

2.1 Location

This model's VLVN is renesas.ovpworld.org/processor/rl78/1.0.

The model source is usually at:

`$IMPERAS_HOME/ImperasLib/source/renesas.ovpworld.org/processor/rl78/1.0`

The model binary is usually at:

`$IMPERAS_HOME/lib/$IMPERAS_ARCH/ImperasLib/renesas.ovpworld.org/processor/rl78/1.0`

2.2 GDB Path

The default GDB for this model is: `$IMPERAS_HOME/lib/$IMPERAS_ARCH/gdb/rl78-elf-gdb`.

2.3 Semi-Host Library

The default semi-host library file is renesas.ovpworld.org/semihosting/rl78Newlib/1.0

2.4 Processor Endian-ness

This is a LITTLE endian model.

2.5 QuantumLeap Support

A simulator using this processor will not be able to use QuantumLeap.

2.6 Processor ELF code

The ELF code supported by this model is: `0xc5`.

Chapter 3

All Variants in this model

This model has these variants

| Variant | Description |
|----------------|-------------|
| RL78-S1 | RL78-S1 |
| RL78-S2 | RL78-S2 |
| RL78-S3 | RL78-S3 |

Table 3.1: All Variants in this model

Chapter 4

Bus Master Ports

This model has these bus master ports.

| Name | min | max | Connect? | Description |
|-------------|-----|-----|-----------|-------------|
| INSTRUCTION | 20 | 32 | mandatory | |
| DATA | 20 | 32 | mandatory | |

Table 4.1: Bus Master Ports

Chapter 5

Bus Slave Ports

This model has these bus slave ports.

| Name | Size(bytes) | Connect? | Description |
|-------------|-------------|----------|-------------|
| GPRSP | 0x100000 | optional | |
| SFRSP | 0x100000 | optional | |

Table 5.1: Bus Slave Ports

Chapter 6

Net Ports

This model has these net ports.

| Name | Type | Connect? | Description |
|-------------|--------|----------|-------------|
| reset | input | optional | |
| extint | input | optional | |
| intAck | output | optional | |

Table 6.1: Net Ports

Chapter 7

FIFO Ports

This model has no FIFO ports.

Chapter 8

Formal Parameters

| Name | Type | Description |
|-------------------|-------------|--|
| verbose | Boolean | Verbose mode |
| variant | Enumeration | processor variant |
| sim_ac_flag | Boolean | simulate PSW.AC flag |
| exit_on_halt | Boolean | simulation will exit on HALT instruction |
| mirror_rom_addr | Uns32 | mirror rom addr |
| mirror_start_addr | Uns32 | mirror start addr |
| mirror_end_addr | Uns32 | mirror end addr |

Table 8.1: Parameters

Chapter 9

Execution Modes

| Mode | Code |
|------|------|
| RB0 | 0 |
| RB1 | 1 |
| RB2 | 2 |
| RB3 | 3 |

Table 9.1: Modes implemented in this processor

Chapter 10

Exceptions

| Exception | Code |
|-----------|-------|
| RST | 0 |
| TRP | 0 |
| IAW | 0 |
| BRK | 126 |
| IRQ | 65535 |

Table 10.1: Exceptions implemented by this processor

Chapter 11

Hierarchy of the model

A CPU core may be configured to instance many processors of a Symmetrical Multi Processor (SMP). A CPU core may also have sub elements within a processor, for example hardware threading blocks.

OVP processor models can be written to include SMP blocks and to have many levels of hierarchy. Some OVP CPU models may have a fixed hierarchy, and some may be configured by settings in a configuration register. Please see the register definitions of this model.

This model documentation shows the settings and hierarchy of the default settings for this model variant.

11.1 Level 1

This level in the model hierarchy has 2 commands.

This level in the model hierarchy has 6 register groups:

| Group name | Registers |
|-------------------|------------------|
| GPR | 8 |
| Bank1 | 8 |
| Bank2 | 8 |
| Bank3 | 8 |
| Bank4 | 8 |
| System | 7 |

Table 11.1: Register groups

This level in the model hierarchy has no children.

Chapter 12

Model Commands

A Processor model can implement one or more **Model Commands** available to be invoked from the simulator command line, from the OP API or from the Imperas Multiprocessor Debugger.

12.1 Level 1

12.1.1 isync

specify instruction address range for synchronous execution

| Argument | Type | Description |
|------------|-------|--|
| -addresshi | Uns64 | end address of synchronous execution range |
| -addresslo | Uns64 | start address of synchronous execution range |

Table 12.1: isync command arguments

12.1.2 itrace

enable or disable instruction tracing

| Argument | Type | Description |
|-------------------|---------|--|
| -after | Uns64 | apply after this many instructions |
| -enable | Boolean | enable instruction tracing |
| -instructioncount | Boolean | include the instruction number in each trace |
| -off | Boolean | disable instruction tracing |
| -on | Boolean | enable instruction tracing |
| -registerchange | Boolean | show registers changed by this instruction |
| -registers | Boolean | show registers after each trace |

Table 12.2: itrace command arguments

Chapter 13

Registers

13.1 Level 1

13.1.1 GPR

Registers at level:1, group:GPR

| Name | Bits | Initial-Hex | RW | Description |
|------|------|-------------|----|-------------|
| X | 8 | 0 | rw | X |
| A | 8 | 0 | rw | A |
| C | 8 | 0 | rw | C |
| B | 8 | 0 | rw | B |
| E | 8 | 0 | rw | E |
| D | 8 | 0 | rw | D |
| L | 8 | 0 | rw | L |
| H | 8 | 0 | rw | H |

Table 13.1: Registers at level 1, group:GPR

13.1.2 Bank1

Registers at level:1, group:Bank1

| Name | Bits | Initial-Hex | RW | Description |
|--------|------|-------------|----|-------------|
| X[RB0] | 8 | 0 | rw | R00 |
| A[RB0] | 8 | 0 | rw | R01 |
| C[RB0] | 8 | 0 | rw | R02 |
| B[RB0] | 8 | 0 | rw | R03 |
| E[RB0] | 8 | 0 | rw | R04 |
| D[RB0] | 8 | 0 | rw | R05 |
| L[RB0] | 8 | 0 | rw | R06 |
| H[RB0] | 8 | 0 | rw | R07 |

Table 13.2: Registers at level 1, group:Bank1

13.1.3 Bank2

Registers at level:1, group:Bank2

| Name | Bits | Initial-Hex | RW | Description |
|--------|------|-------------|----|-------------|
| X[RB1] | 8 | 0 | rw | R08 |

| | | | | |
|--------|---|---|----|-----|
| A[RB1] | 8 | 0 | rw | R09 |
| C[RB1] | 8 | 0 | rw | R10 |
| B[RB1] | 8 | 0 | rw | R11 |
| E[RB1] | 8 | 0 | rw | R12 |
| D[RB1] | 8 | 0 | rw | R13 |
| L[RB1] | 8 | 0 | rw | R14 |
| H[RB1] | 8 | 0 | rw | R15 |

Table 13.3: Registers at level 1, group:Bank2

13.1.4 Bank3

Registers at level:1, group:Bank3

| Name | Bits | Initial-Hex | RW | Description |
|--------|------|-------------|----|-------------|
| X[RB2] | 8 | 0 | rw | R16 |
| A[RB2] | 8 | 0 | rw | R17 |
| C[RB2] | 8 | 0 | rw | R18 |
| B[RB2] | 8 | 0 | rw | R19 |
| E[RB2] | 8 | 0 | rw | R20 |
| D[RB2] | 8 | 0 | rw | R21 |
| L[RB2] | 8 | 0 | rw | R22 |
| H[RB2] | 8 | 0 | rw | R23 |

Table 13.4: Registers at level 1, group:Bank3

13.1.5 Bank4

Registers at level:1, group:Bank4

| Name | Bits | Initial-Hex | RW | Description |
|--------|------|-------------|----|-------------|
| X[RB3] | 8 | 0 | rw | R24 |
| A[RB3] | 8 | 0 | rw | R25 |
| C[RB3] | 8 | 0 | rw | R26 |
| B[RB3] | 8 | 0 | rw | R27 |
| E[RB3] | 8 | 0 | rw | R28 |
| D[RB3] | 8 | 0 | rw | R29 |
| L[RB3] | 8 | 0 | rw | R30 |
| H[RB3] | 8 | 0 | rw | R31 |

Table 13.5: Registers at level 1, group:Bank4

13.1.6 System

Registers at level:1, group:System

| Name | Bits | Initial-Hex | RW | Description |
|------|------|-------------|----|------------------------|
| PSW | 8 | 6 | r- | status register |
| ES | 8 | f | rw | ES |
| CS | 8 | 0 | rw | CS |
| PC | 20 | 0 | rw | program counter |
| PMC | 8 | 0 | r- | processor mode control |
| MEM | 8 | 0 | r- | MEM |
| SP | 16 | 0 | rw | stack pointer |

Table 13.6: Registers at level 1, group:System