



## OVP Guide to Using Processor Models

### Model Specific Information for variant ARM\_ARMv7-M

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## Table of Contents

1.0 Overview.....	4
1.1 Description.....	4
1.2 Licensing.....	4
1.3 Limitations.....	5
1.4 Verification.....	5
1.5 Features.....	5
2.0 Configuration.....	5
2.1 Location.....	5
2.2 GDB Path.....	5
2.3 Semi-Host Library.....	5
2.4 Processor Endian-ness.....	5
2.5 QuantumLeap Support.....	5
2.6 Processor ELF Code.....	5
3.0 Other Variants in this Model.....	5
4.0 Bus Ports.....	6
5.0 Net Ports.....	6
6.0 FIFO Ports.....	6
7.0 Parameters.....	6
8.0 Execution Modes.....	7
9.0 Exceptions.....	7
10.0 Hierarchy of the model.....	9
10.1 Level 1:.....	9
11.0 Model Commands.....	10
11.1 Level 1:.....	10
12.0 Registers.....	10
12.1 Level 1:.....	10
12.1.1 Core.....	10
12.1.2 Control.....	10
12.1.3 System.....	11
12.1.4 Integration_support.....	12

## 1.0 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

ARMM Processor Model

### 1.2 Licensing

Usage of binary model under license governing simulator usage.

Note that for models of ARM CPUs the license includes the following terms:

Licensee is granted a non-exclusive, worldwide, non-transferable, revocable licence to:

If no source is being provided to the Licensee: use and copy only (no modifications rights are granted) the model for the sole purpose of designing, developing, analyzing, debugging, testing, verifying, validating and optimizing software which: (a) (i) is for ARM based systems; and (ii) does not incorporate the ARM Models or any part thereof; and (b) such ARM Models may not be used to emulate an ARM based system to run application software in a production or live environment.

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Except to the extent that such activity is permitted by applicable law, Licensee shall not reverse engineer, decompile, or disassemble this model. If this model was provided to Licensee in Europe, Licensee shall not reverse engineer, decompile or disassemble the Model for the purposes of error correction.

The License agreement does not entitle Licensee to manufacture in silicon any product based on this model.

The License agreement does not entitle Licensee to use this model for evaluating the validity of any ARM patent.

The License agreement does not entitle Licensee to use the model to emulate an ARM based system to run application software in a production or live environment.

Source of model available under separate Imperas Software License Agreement.

### **1.3 Limitations**

Performance Monitors are not implemented.

Debug Extension and related blocks are not implemented.

### **1.4 Verification**

Models have been extensively tested by Imperas. ARM Cortex-M models have been successfully used by customers to simulate the Micrium uC/OS-II kernel and FreeRTOS.

### **1.5 Features**

The model is configured with 0 interrupts and 3 priority bits (use `override_numInterrupts` and `override_priorityBits` parameters to change these).

Thumb-2 instructions are supported.

MPU is not implemented. Use parameter `override_MPU_TYPE` to enable it if required.

SysTick timer is implemented. Use parameter `SysTickPresent` to disable it if required.

FPU extension is not implemented. Use parameter `override_MVFR0` to enable it if required.

DSP extension is not implemented. Use parameter `override_InstructionAttributes3` to enable it if required.

Bit-band region is not implemented. Use parameter `BitBandPresent` to enable it if required.

## **2.0 Configuration**

### **2.1 Location**

The model source and object file is found in the VLNV tree at:

[arm.ovpworld.org/processor/armm/1.0](http://arm.ovpworld.org/processor/armm/1.0)

### **2.2 GDB Path**

The default GDB for this model is found at:

`$IMPERAS_HOME/lib/$IMPERAS_ARCH/gdb/arm-none-eabi-gdb`

### **2.3 Semi-Host Library**

The default semi-host library file is found in the VLNV tree at :

[arm.ovpworld.org/semihosting/armNewlib/1.0](http://arm.ovpworld.org/semihosting/armNewlib/1.0)

### **2.4 Processor Endian-ness**

This model can be set to either endian-ness (normally by a pin, or the ELF code).

### **2.5 QuantumLeap Support**

This processor is qualified to run in a QuantumLeap enabled simulator.

### **2.6 Processor ELF Code**

The ELF code supported by this model is: 0x28

## **3.0 Other Variants in this Model**

Table 1.

Variant
ARMv6-M

ARMv7-M
Cortex-M0
Cortex-M0plus
Cortex-M1
Cortex-M3
Cortex-M4
Cortex-M4F

## 4.0 Bus Ports

Table 2.

Type	Name	Bits
master (initiator)	INSTRUCTION	32
master (initiator)	DATA	32

## 5.0 Net Ports

Table 3.

Name	Type
sysResetReq	output
intISS	output
eventOut	output
lockup	output
int	input
reset	input
nmi	input
eventIn	input

## 6.0 FIFO Ports

No FIFO Ports in this model.

## 7.0 Parameters

Table 4.

Name	Type	Description
verbose	Boolean	Specify verbosity of output
showHiddenRegs	Boolean	Show hidden registers during register tracing
UAL	Boolean	Disassemble using UAL syntax
enableVFPAAtReset	Boolean	Enable vector floating point (SIMD and VFP) instructions at reset. (Enables cp10/11 in CPACR and sets FPEXC.EN)

compatibility	Enumeration	Specify compatibility mode ISA=0 gdb=1 nopBKPT=2
override_debugMask	Uns32	Specifies debug mask, enabling debug output for model components
instructionEndian	Endian	The architecture specifies that instruction fetch is always little endian; this attribute allows the defined instruction endianness to be overridden if required
resetAtTime0	Boolean	Reset the model at time=0 (default=1)
SysTickPresent	Boolean	Specify presence of SysTick timer
BitBandPresent	Boolean	Specify presence of bit-band region
override_CPUID	Uns32	Override system CPUID register
override_MPU_TYPE	Uns32	Override system MPU_TYPE register
override_VTOR	Uns32	Override VTOR register reset value
override_InstructionAttributes0	Uns32	Override InstructionAttributes0 register
override_InstructionAttributes1	Uns32	Override InstructionAttributes1 register
override_InstructionAttributes2	Uns32	Override InstructionAttributes2 register
override_InstructionAttributes3	Uns32	Override InstructionAttributes3 register
override_InstructionAttributes4	Uns32	Override InstructionAttributes4 register
override_InstructionAttributes5	Uns32	Override InstructionAttributes5 register
override_MVFR0	Uns32	Override MVFR0 register
override_MVFR1	Uns32	Override MVFR1 register
override_STROffsetPC12	Uns32	Specifies that STR/STR of PC should do so with 12:byte offset from the current instruction (if 1), otherwise an 8:byte offset is used
override_ERG	Uns32	Specifies exclusive reservation granule
override_priorityBits	Uns32	Specifies number of priority bits in BASEPRI etc (1-8, default is 3)
override_numInterrupts	Uns32	Specifies number of external interrupt lines (default is 16)

## 8.0 Execution Modes

Table 5.

Name	Code
Thread	0
Handler	1

## 9.0 Exceptions

Table 6.

Name	Code
None	0
Reset	1

NMI	2
HardFault	3
MemManage	4
BusFault	5
UsageFault	6
SVCall	11
DebugMonitor	12
PendSV	14
SysTick	15



## 10.0 Hierarchy of the model

A CPU core may allow the user to configure it 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.

### 10.1 Level 1:

This level in the model hierarchy has 2 commands.

This level in the model hierarchy has 4 register groups:

Table 7.

Group name	Registers
Core	16
Control	7
System	44
Integration_support	2

This level in the model hierarchy has no children.

## 11.0 Model Commands

### 11.1 Level 1:

Table 8.

Name	Arguments
isync	specify instruction address range for synchronous execution
itrace	enable or disable instruction tracing

## 12.0 Registers

### 12.1 Level 1:

#### 12.1.1 Core

Table 9.

Name	Bits	Initial value (Hex)		Description
r0	32	0	rw	
r1	32	0	rw	
r2	32	0	rw	
r3	32	0	rw	
r4	32	0	rw	
r5	32	0	rw	
r6	32	0	rw	
r7	32	0	rw	
r8	32	0	rw	
r9	32	0	rw	
r10	32	0	rw	
r11	32	0	rw	frame pointer
r12	32	0	rw	
sp	32	0	rw	stack pointer
lr	32	0	rw	
pc	32	0	rw	program counter

#### 12.1.2 Control

Table 10.

Name	Bits	Initial value (Hex)		Description
cpsr	32	0	rw	
control	32	0	rw	

primask	32	0	rw	
faultmask	32	0	rw	
basepri	32	0	rw	
sp_process	32	0	rw	stack pointer
sp_main	32	0	rw	stack pointer

### 12.1.3 System

Table 11.

Name	Bits	Initial value (Hex)		Description
ICTR	32	0	rw	Address 0xe000e004
ACTLR	32	0	rw	Address 0xe000e008
SYST_CSR	32	0	rw	Address 0xe000e010
SYST_RVR	32	0	rw	Address 0xe000e014
SYST_CVR	32	0	rw	Address 0xe000e018
SYST_CALIB	32	0	rw	Address 0xe000e01c
NVIC_ISER0	32	0	rw	Address 0xe000e100
NVIC_ICER0	32	0	rw	Address 0xe000e180
NVIC_ISPR0	32	0	rw	Address 0xe000e200
NVIC_ICPR0	32	0	rw	Address 0xe000e280
NVIC_IABR0	32	0	r-	Address 0xe000e300
CPUID	32	0	r-	Address 0xe000ed00
ICSR	32	1000	rw	Address 0xe000ed04
VTOR	32	0	rw	Address 0xe000ed08
AIRCR	32	fa050000	rw	Address 0xe000ed0c
SCR	32	0	rw	Address 0xe000ed10
CCR	32	200	rw	Address 0xe000ed14
SHPR1	32	0	rw	Address 0xe000ed18
SHPR2	32	0	rw	Address 0xe000ed1c
SHPR3	32	0	rw	Address 0xe000ed20
SHCSR	32	0	rw	Address 0xe000ed24
CFSR	32	0	rw	Address 0xe000ed28
HFSR	32	0	rw	Address 0xe000ed2c
MMAR	32	0	rw	Address 0xe000ed34
BFAR	32	0	rw	Address 0xe000ed38
AFSR	32	0	rw	Address 0xe000ed3c
ID_PFR0	32	0	rw	Address 0xe000ed40
ID_PFR1	32	0	rw	Address 0xe000ed44
ID_DFR0	32	0	rw	Address 0xe000ed48
ID_AFR0	32	0	rw	Address 0xe000ed4c
ID_MMFR0	32	0	rw	Address 0xe000ed50
ID_MMFR1	32	0	rw	Address 0xe000ed54

ID_MMFR2	32	0	rw	Address 0xe000ed58
ID_MMFR3	32	0	rw	Address 0xe000ed5c
ID_ISAR0	32	0	rw	Address 0xe000ed60
ID_ISAR1	32	0	rw	Address 0xe000ed64
ID_ISAR2	32	0	rw	Address 0xe000ed68
ID_ISAR3	32	0	rw	Address 0xe000ed6c
ID_ISAR4	32	0	rw	Address 0xe000ed70
ID_ISAR5	32	0	rw	Address 0xe000ed74
CPACR	32	0	rw	Address 0xe000ed88
MPU_TYPE	32	0	rw	Address 0xe000ed90
MPU_CONTROL	32	0	rw	Address 0xe000ed94
STIR	32	-	-w	Address 0xe000ef00 (User mode access:-w)

#### *12.1.4 Integration\_support*

Table 12.

Name	Bits	Initial value (Hex)		Description
executionPri	32	7fffffff	r-	current execution priority level
stackDomain	32	82ae5e8	r-	stack domain for current execution level

#