



Imperas Peripheral Model Guide

Model Specific Information for freescale.ovpworld.org / KinetisUSBHS

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Author	Imperas Software Limited
Version	20211118.0
Filename	OVP_Peripheral_Specific_Information_KinetisUSBHS.pdf
Created	31 December 2021
Status	OVP Standard Release

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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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1.0 Model Specific Information

This document provides usage information for an Imperas OVP peripheral behavioral model.

The document is split into sections providing specific information for this peripheral, including any ports for connecting into a platform, registers, other component parts, and configuration options and general information for peripheral modeling with Imperas OVP.

1.1 Description

Model of the USBHS peripheral used on the Freescale Kinetis platform

1.2 Limitations

Provides the base behaviour for the OVP Freescale Kinetis platforms

1.3 Reference

www.freescale.com/Kinetis

1.4 Licensing

Open Source Apache 2.0

1.5 Location

The KinetisUSBHS peripheral model is located in an Imperas/OVP installation at the VLVN:
[freescale.ovpworld.org / peripheral / KinetisUSBHS / 1.0](http://freescale.ovpworld.org/peripheral/KinetisUSBHS/1.0).

2.0 Net Ports

This model has the following net ports:

Table 1. Net Ports

Name	Type	Must Be Connected	Description
Reset	input	F (False)	

3.0 Bus Slave Ports

This model has the following bus slave ports:

3.1 Bus Slave Port: *bport1*

Table 2. Bus Slave Port: *bport1*

Name	Size (bytes)	Must Be Connected	Description
<i>bport1</i>	0x1000	F (False)	

Table 3. Bus Slave Port: *bport1* Registers:

Name	Offset	Width (bits)	Description	R/W	is Volatile
ab_ID	0x0	32	Identification Register, offset: 0x0		

ab_HWGENERAL	0x4	32	General Hardware Parameters Register, offset: 0x4		
ab_HWHOST	0x8	32	Host Hardware Parameters Register, offset: 0x8		
ab_HWDEVICE	0xc	32	Device Hardware Parameters Register, offset: 0xC		
ab_HWTXBUF	0x10	32	Transmit Buffer Hardware Parameters Register, offset: 0x10		
ab_HWRXBUF	0x14	32	Receive Buffer Hardware Parameters Register, offset: 0x14		
ab_GPTIMER0LD	0x80	32	General Purpose Timer n Load Register, offset: 0x80		
ab_GPTIMER0CTL	0x84	32	General Purpose Timer n Control Register, offset: 0x84		
ab_GPTIMER1LD	0x88	32	General Purpose Timer n Load Register, offset: 0x88		
ab_GPTIMER1CTL	0x8c	32	General Purpose Timer n Control Register, offset: 0x8C		
ab_SBUSCFG	0x90	32	System Bus Interface Configuration Register, offset: 0x90		
ab_HCIVERSION	0x100	32	Host Controller Interface Version Register, offset: 0x100		
ab_HCSPARAMS	0x104	32	Host Controller Structural Parameters Register, offset: 0x104		
ab_HCCPARAMS	0x108	32	Host Controller Capability Parameters Register, offset: 0x108		
ab_DCIVERSION	0x120	32	Device Controller Interface Version, offset: 0x122, 16bit		
ab_DCCPARAMS	0x124	32	Device Controller Capability Parameters, offset: 0x124		
ab_USBCMD	0x140	32	USB Command Register, offset: 0x140		
ab_USBSTS	0x144	32	USB Status Register, offset: 0x144		
ab_USBINTR	0x148	32	USB Interrupt Enable Register, offset: 0x148		
ab_FRINDEX	0x14c	32	Frame Index Register, offset: 0x14C		
ab_DEVICEADDR	0x154	32	Device Address Register, offset: 0x154		
ab_ASYNCLISTADDR	0x158	32	Current Asynchronous List Address Register,		

			offset: 0x158		
ab_TTCTRL	0x15c	32	Host TT Asynchronous Buffer Control, offset: 0x15C		
ab_BURSTSIZE	0x160	32	Master Interface Data Burst Size Register, offset: 0x160		
ab_TXFILLTUNING	0x164	32	Transmit FIFO Tuning Control Register, offset: 0x164		
ab_ULPI_VIEWPORT	0x170	32	ULPI Register Access, offset: 0x170		
ab_ENDPTNAK	0x178	32	ULPI Register Access, offset: 0x170		
ab_ENDPTNAKEN	0x17c	32	ULPI Register Access, offset: 0x170		
ab_CONFIGFLAG	0x180	32	Configure Flag Register, offset: 0x180		
ab_PORTSC1	0x184	32	Port Status and Control Registers, offset: 0x184		
ab_OTGSC	0x1a4	32	On-the-Go Status and Control Register, offset: 0x1A4		
ab_USBMODE	0x1a8	32	USB Mode Register, offset: 0x1A8		
ab_EPSETUPSR	0x1ac	32	Endpoint Setup Status Register, offset: 0x1AC		
ab_EPPRIME	0x1b0	32	Endpoint Initialization Register, offset: 0x1B0		
ab_EPFLUSH	0x1b4	32	Endpoint Flush Register, offset: 0x1B4		
ab_EPSR	0x1b8	32	Endpoint Status Register, offset: 0x1B8		
ab_EPCOMPLETE	0x1bc	32	Endpoint Complete Register, offset: 0x1BC		
ab_EPCR0	0x1c0	32	Endpoint Control Register 0, offset: 0x1C0		
ab_EPCR1	0x1c4	32	Endpoint Control Register n, array offset: 0x1C4, array step: 0x4		
ab_EPCR2	0x1c8	32	Endpoint Control Register n, array offset: 0x1C4, array step: 0x4		
ab_EPCR3	0x1cc	32	Endpoint Control Register n, array offset: 0x1C4, array step: 0x4		
ab_USBGENTRL	0x200	32	General Control Register, offset: 0x20		

4.0 Platforms that use this peripheral component

Peripheral components can be used in many different platforms, including those developed by Imperas or by other users of OVP. You can use this peripheral in your own platforms.

Table 4. Publicly available platforms using peripheral 'KinetisUSBHS'

Platform Name	Vendor
FreescaleKinetis60	freescale.ovpworld.org
FreescaleKinetis64	freescale.ovpworld.org

5.0 Peripheral components in the library

Table 5. Publicly available Imperas/OVP peripheral models (227 models)

Peripheral	Peripheral	Peripheral
freescale.ovpworld.org/KinetisVREF	freescale.ovpworld.org/KinetisWDOG	freescale.ovpworld.org/Uart
freescale.ovpworld.org/VybridADC	freescale.ovpworld.org/VybridANADIG	freescale.ovpworld.org/VybridCCM
freescale.ovpworld.org/VybridDMA	freescale.ovpworld.org/VybridGPIO	freescale.ovpworld.org/VybridI2C
freescale.ovpworld.org/VybridLCD	freescale.ovpworld.org/VybridQUADSPI	freescale.ovpworld.org/VybridSDHC
freescale.ovpworld.org/VybridSPI	freescale.ovpworld.org/VybridUART	freescale.ovpworld.org/VybridUSB
imperas.ovpworld.org/frameBuffer	imperas.ovpworld.org/uart	imperas.ovpworld.org/usecCounter
intel.ovpworld.org/82077AA	intel.ovpworld.org/82371EB	intel.ovpworld.org/8253
intel.ovpworld.org/8259A	intel.ovpworld.org/NorFlash48F4400	intel.ovpworld.org/PciIDE
intel.ovpworld.org/PciPM	intel.ovpworld.org/PciUSB	intel.ovpworld.org/Ps2Control
marvell.ovpworld.org/GT6412x	maxim.ovpworld.org/max673x	microsemi.ovpworld.org/CoreUARTapb
mips.ovpworld.org/16450C	mips.ovpworld.org/MaltaFPGA	mips.ovpworld.org/SmartLoaderLinux
motorola.ovpworld.org/MC146818	national.ovpworld.org/16450	national.ovpworld.org/16550
national.ovpworld.org/16550_4bytes	nxp.ovpworld.org/iMX6_Analog	nxp.ovpworld.org/iMX6_CCM
nxp.ovpworld.org/iMX6_GPC	nxp.ovpworld.org/iMX6_GPIO	nxp.ovpworld.org/iMX6_GPT
nxp.ovpworld.org/iMX6_MMDC	nxp.ovpworld.org/iMX6_SDHC	nxp.ovpworld.org/iMX6_SRC
nxp.ovpworld.org/iMX6_UART	nxp.ovpworld.org/iMX6_WDOG	ovpworld.org/Alpha2x16Display
ovpworld.org/DynamicBridge	ovpworld.org/FlashDevice	ovpworld.org/ledRegister
ovpworld.org/SerInt	ovpworld.org/SimpleDma	ovpworld.org/switchRegister
ovpworld.org/temperatureSensor	ovpworld.org/trap	ovpworld.org/trap4K
ovpworld.org/vEthernet_Bridge	ovpworld.org/VirtioBlkMMIO	ovpworld.org/VirtioNetMMIO
philips.ovpworld.org/ISP1761	renesas.ovpworld.org/adc	renesas.ovpworld.org/bcu
renesas.ovpworld.org/brg	renesas.ovpworld.org/can	renesas.ovpworld.org/can
renesas.ovpworld.org/clkgen	renesas.ovpworld.org/crc	renesas.ovpworld.org/csib
renesas.ovpworld.org/csie	renesas.ovpworld.org/dma	renesas.ovpworld.org/intc
renesas.ovpworld.org/memc	renesas.ovpworld.org/rng	renesas.ovpworld.org/taa
renesas.ovpworld.org/tms	renesas.ovpworld.org/tmt	renesas.ovpworld.org/uartc
renesas.ovpworld.org/UPD70F3441Logic	riscv.ovpworld.org/CLINT	riscv.ovpworld.org/PLIC
riscv.ovpworld.org/SmartLoaderRV64Linux	safepower.ovpworld.org/node	safepower.ovpworld.org/NostrumNode
safepower.ovpworld.org/ring_oscillator	safepower.ovpworld.org/TTELNode	sifive.ovpworld.org/artyIO
sifive.ovpworld.org/DDRCTL	sifive.ovpworld.org/gpio	sifive.ovpworld.org/MSEL
sifive.ovpworld.org/PLIC	sifive.ovpworld.org/PRCI	sifive.ovpworld.org/pwm
sifive.ovpworld.org/spi	sifive.ovpworld.org/teststatus	sifive.ovpworld.org/UART
smc.ovpworld.org/LAN9118	smc.ovpworld.org/LAN91C111	ti.ovpworld.org/tca6416a
ti.ovpworld.org/UartInterface	ti.ovpworld.org/ucd9012a	ti.ovpworld.org/ucd9248
vendor.com/fifo	xilinx.ovpworld.org/axi-gpio	xilinx.ovpworld.org/axi-intc
xilinx.ovpworld.org/axi-pcie	xilinx.ovpworld.org/axi-timer	xilinx.ovpworld.org/logiccore-fit
xilinx.ovpworld.org/mdm	xilinx.ovpworld.org/mpmc	xilinx.ovpworld.org/xps-gpio
xilinx.ovpworld.org/xps-iic	xilinx.ovpworld.org/xps-intc	xilinx.ovpworld.org/xps-ll-temac
xilinx.ovpworld.org/xps-mch-emc	xilinx.ovpworld.org/xps-sysace	xilinx.ovpworld.org/xps-timer
xilinx.ovpworld.org/xps-uartlite	xilinx.ovpworld.org/zynq_7000-can	xilinx.ovpworld.org/zynq_7000-ddrc
xilinx.ovpworld.org/zynq_7000-devcfg	xilinx.ovpworld.org/zynq_7000-dmac	xilinx.ovpworld.org/zynq_7000-gpio
xilinx.ovpworld.org/zynq_7000-iic	xilinx.ovpworld.org/zynq_7000-ocm	xilinx.ovpworld.org/zynq_7000-qos301
xilinx.ovpworld.org/zynq_7000-qspi	xilinx.ovpworld.org/zynq_7000-sdio	xilinx.ovpworld.org/zynq_7000-slcr

xilinx.ovpworld.org/zynq_7000-spi	xilinx.ovpworld.org/zynq_7000-swdt	xilinx.ovpworld.org/zynq_7000-ttc
xilinx.ovpworld.org/zynq_7000-tz_GPVsecurity	xilinx.ovpworld.org/zynq_7000-tz_security	xilinx.ovpworld.org/zynq_7000-usb
altera.ovpworld.org/dw-apb-timer	altera.ovpworld.org/dw-apb-uart	altera.ovpworld.org/IntervalTimer32Core
altera.ovpworld.org/IntervalTimer64Core	altera.ovpworld.org/JtagUart	altera.ovpworld.org/PerformanceCounterCore
altera.ovpworld.org/RSTMGR	altera.ovpworld.org/SystemIDCore	altera.ovpworld.org/Uart
amd.ovpworld.org/79C970	andes.ovpworld.org/ATCUART100	andes.ovpworld.org/NCEPLIC100
andes.ovpworld.org/NCEPLMT100	arm.ovpworld.org/AaciPL041	arm.ovpworld.org/CompactFlashRegs
arm.ovpworld.org/CoreModule9x6	arm.ovpworld.org/DebugLedAndDipSwitch	arm.ovpworld.org/DMemCtrlPL341
arm.ovpworld.org/IcpControl	arm.ovpworld.org/IcpCounterTimer	arm.ovpworld.org/IntICP
arm.ovpworld.org/IntICP	arm.ovpworld.org/KbPL050	arm.ovpworld.org/L2CachePL310
arm.ovpworld.org/LcdPL110	arm.ovpworld.org/MmcPL181	arm.ovpworld.org/RtcPL031
arm.ovpworld.org/SerBusDviRegs	arm.ovpworld.org/SmartLoaderArm64Linux	arm.ovpworld.org/SmartLoaderArmLinux
arm.ovpworld.org/SMemCtrlPL354	arm.ovpworld.org/SysCtrlSP810	arm.ovpworld.org/TimerSP804
arm.ovpworld.org/TzpcBP147	arm.ovpworld.org/UartPL011	arm.ovpworld.org/VexpressSysRegs
arm.ovpworld.org/WdtSP805	atmel.ovpworld.org/AdvancedInterruptController	atmel.ovpworld.org/ParallelIOController
atmel.ovpworld.org/PowerSaving	atmel.ovpworld.org/SpecialFunction	atmel.ovpworld.org/TimerCounter
atmel.ovpworld.org/UsartInterface	atmel.ovpworld.org/WatchdogTimer	cadence.ovpworld.org/gem
cadence.ovpworld.org/uart	cirrus.ovpworld.org/GD5446	freescale.ovpworld.org/KinetisADC
freescale.ovpworld.org/KinetisAIPS	freescale.ovpworld.org/KinetisAXBBS	freescale.ovpworld.org/KinetisCAN
freescale.ovpworld.org/KinetisCMP	freescale.ovpworld.org/KinetisCMT	freescale.ovpworld.org/KinetisCRC
freescale.ovpworld.org/KinetisDAC	freescale.ovpworld.org/KinetisDDR	freescale.ovpworld.org/KinetisDMA
freescale.ovpworld.org/KinetisDMAC	freescale.ovpworld.org/KinetisDMAMUX	freescale.ovpworld.org/KinetisENET
freescale.ovpworld.org/KinetisEWM	freescale.ovpworld.org/KinetisFB	freescale.ovpworld.org/KinetisFMC
freescale.ovpworld.org/KinetisFTFE	freescale.ovpworld.org/KinetisFTM	freescale.ovpworld.org/KinetisGPIO
freescale.ovpworld.org/KinetisI2C	freescale.ovpworld.org/KinetisI2S	freescale.ovpworld.org/KinetisLLWU
freescale.ovpworld.org/KinetisLPTMR	freescale.ovpworld.org/KinetisMCG	freescale.ovpworld.org/KinetisMPU
freescale.ovpworld.org/KinetisNFC	freescale.ovpworld.org/KinetisOSC	freescale.ovpworld.org/KinetisPDB
freescale.ovpworld.org/KinetisPIT	freescale.ovpworld.org/KinetisPMC	freescale.ovpworld.org/KinetisPORT
freescale.ovpworld.org/KinetisRCM	freescale.ovpworld.org/KinetisRFSYS	freescale.ovpworld.org/KinetisRFVBAT
freescale.ovpworld.org/KinetisRNG	freescale.ovpworld.org/KinetisRTC	freescale.ovpworld.org/KinetisSDHC
freescale.ovpworld.org/KinetisSIM	freescale.ovpworld.org/KinetisSMC	freescale.ovpworld.org/KinetisSPI
freescale.ovpworld.org/KinetisTSI	freescale.ovpworld.org/KinetisUART	freescale.ovpworld.org/KinetisUSB
freescale.ovpworld.org/KinetisUSBDCD	freescale.ovpworld.org/KinetisUSBHS	

6.0 General Information on Peripheral Models

This document provides usage information for an Imperas OVP peripheral behavioral model.

The document is split into sections providing specific information for this peripheral, including any ports for connecting into a platform, registers etc. and configuration options and general information for peripheral modeling with Imperas OVP.

6.1 Background

Imperas OVP simulation technology enables very high performance simulation, debug and analysis of platforms containing multiple processors and peripheral models. The technology is designed to be extensible: you can create new models of processors, peripherals and other platform components using interfaces and libraries defined by OVP.

The peripheral models created using the OVP APIs run on the Peripheral Simulation Engine (PSE).

The model is typically written in C and compiled into an executable for the PSE processor architecture. The model is compiled for speed of execution and to protect IP. It is dynamically loaded by the simulator at run time.

7.0 Building peripherals easily with Imperas iGen

To aid with model creation, Imperas products include iGen, a model generation tool. iGen takes the laborious and error-prone task of constructing the various hardware model and software element files required for a typical model, and automates this process. iGen creates the needed C files. iGen also creates the C++ SystemC TLM2 interface files needed to run peripheral models in SystemC simulations.

iGen takes as input a simple script specification that includes device internals such as registers and memories, port information, component descriptors, and other elements. iGen then builds the C code model files and user editable templates. These include model frameworks with registers, function calls, memory map, and other items. It ensures that all component parts of the model are well-structured using best practices, and are consistent throughout the files, thus eliminating a common source of errors.

More information on iGen can be found: imperas.com/products.

8.0 Peripheral model internals

Each instance of a peripheral model runs on its own virtual machine with an address space large enough for the model. This processor (the PSE) and its memory are separate from any processors, memories and buses in the platform being simulated; they exist only to execute the code of the peripheral model.

Interception of functions defined in the peripheral model allows the use of features of the host system in the

implementation of the behavior of a peripheral. As an example, a real platform might contain a video display device. When simulating this system, it is generally more convenient not to simulate the complete video display device but to use a video package available on the host machine, such as SDL, and to use this to render to the host display. Also models of uarts, ethernet devices and USB components can make use of the host PC resources during simulation, to allow, for example, a simulation to browse the real internet, or the simulation to connect to a real USB device.

9.0 Parts of peripheral models

9.1 *Configuring the Peripheral Instance with Parameters*

A peripheral can include the behaviour of several configurations. These are controlled when the peripheral is instanced in the platform by setting parameters defined on the peripheral.

9.2 *Net Ports*

Peripherals may be connected to other peripherals or processors with signal wires (nets). These can be used to act as interrupt signals or used to control behavior between peripherals.

The wires are created in the platform as nets and this net is connected into the peripheral using a net port.

9.3 *Bus master ports*

A bus master port initiates (and controls the address of) a bus cycle. Bus cycles are generated by behavioral code within the peripheral model.

9.4 *Bus slave ports*

A peripheral can be defined as having several bus slave ports. The bus slave ports can be split into several address blocks. Each address block be either local memory or memory mapped registers. Both of these can have associated callback functions. A memory mapped register can also be defined as specific read/write access, whether it is volatile, and also whether it is associated with a reset pin and mask. A memory mapped register can also have specific bit fields defined.

9.5 *Packetnets*

A peripheral can be defined as being connected to packetnet ports. A packetnet is used to model packet based communication such as Ethernet, CAN bus or GSM. A packetnet is created in a platform, then connected to packetnet ports on model instances. A packetnet can have many connections, each able to send or receive packets. A packetnet is used as an efficient method of communication within OVP models.

For more information on modeling with packetnets, please see the peripheral modeling documentation: [OVP_Peripheral_Modeling_Guide.pdf](#), [OVPSim_and_CpuManager_User_Guide.pdf](#) and the example: [\\$IMPERAS_HOME/Examples/Models/Peripherals/packetnet](#).

10.0 More information (documentation) on peripheral models and modeling

More information on modeling and APIs can be found at: OVPworld.org/technology_apis.

Specifics on modeling peripherals can be found: [OVP_Peripheral_Modeling_Guide.pdf](#).

A full list of the currently available OVP documentation is available: [OVPworld.org/documentation](#).

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