

TMS320DM647/DM648 DSP Host Port Interface (HPI)

User's Guide



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Read This First

About This Manual

This document describes the features and operation of the host port interface (HPI) in the TMS320DM647/DM648 Digital Signal Processor (DSP).

Notational Conventions

This document uses the following conventions.

- Hexadecimal numbers are shown with the suffix h. For example, the following number is 40 hexadecimal (decimal 64): 40h.
- Registers in this document are shown in figures and described in tables.
 - Each register figure shows a rectangle divided into fields that represent the fields of the register. Each field is labeled with its bit name, its beginning and ending bit numbers above, and its read/write properties below. A legend explains the notation used for the properties.
 - Reserved bits in a register figure designate a bit that is used for future device expansion.

Note: Acronyms 3PSW, CPSW, CPSW_3G, and 3pGSw are interchangeable and all refer to the 3 port gigabit switch.

Related Documentation From Texas Instruments

The following documents describe the TMS320DM647/DM648 Digital Signal Processor (DSP). Copies of these documents are available on the Internet at www.ti.com. *Tip:* Enter the literature number in the search box provided at www.ti.com.

[SPRS372](#) — *TMS320DM647/DM648 Digital Media Processor Data Manual* describes the signals, specifications and electrical characteristics of the device.

[SPRU732](#) — *TMS320C64x/C64x+ DSP CPU and Instruction Set Reference Guide* describes the CPU architecture, pipeline, instruction set, and interrupts for the TMS320C64x and TMS320C64x+ digital signal processors (DSPs) of the TMS320C6000 DSP family. The C64x/C64x+ DSP generation comprises fixed-point devices in the C6000 DSP platform. The C64x+ DSP is an enhancement of the C64x DSP with added functionality and an expanded instruction set.

[SPRUEK5](#) — *TMS320DM647/DM648 DSP DDR2 Memory Controller User's Guide* describes the DDR2 memory controller in the TMS320DM647/DM648 Digital Signal Processor (DSP). The DDR2/mDDR memory controller is used to interface with JESD79D-2A standard compliant DDR2 SDRAM devices and standard Mobile DDR SDRAM devices.

[SPRUEK6](#) — *TMS320DM647/DM648 DSP External Memory Interface (EMIF) User's Guide* describes the operation of the asynchronous external memory interface (EMIF) in the TMS320DM647/DM648 Digital Signal Processor (DSP). The EMIF supports a glueless interface to a variety of external devices.

[SPRUEK7](#) — *TMS320DM647/DM648 DSP General-Purpose Input/Output (GPIO) User's Guide* describes the general-purpose input/output (GPIO) peripheral in the TMS320DM647/DM648 Digital Signal Processor (DSP). The GPIO peripheral provides dedicated general-purpose pins that can be configured as either inputs or outputs. When configured as an input, you can detect the state of the input by reading the state of an internal register. When configured as an output, you can write to an internal register to control the state driven on the output pin.

[SPRUJEK8](#) — TMS320DM647/DM648 DSP Inter-Integrated Circuit (I2C) Module User's Guide

describes the inter-integrated circuit (I2C) peripheral in the TMS320DM647/DM648 Digital Signal Processor (DSP). The I2C peripheral provides an interface between the DSP and other devices compliant with the I2C-bus specification and connected by way of an I2C-bus. External components attached to this 2-wire serial bus can transmit and receive up to 8-bit wide data to and from the DSP through the I2C peripheral. This document assumes the reader is familiar with the I2C-bus specification.

[SPRUJEL0](#) — TMS320DM647/DM648 DSP 64-Bit Timer User's Guide describes the operation of the 64-bit timer in the TMS320DM647/DM648 Digital Signal Processor (DSP). The timer can be configured as a general-purpose 64-bit timer, dual general-purpose 32-bit timers, or a watchdog timer.

[SPRUJEL1](#) — TMS320DM647/DM648 DSP Multichannel Audio Serial Port (McASP) User's Guide describes the multichannel audio serial port (McASP) in the TMS320DM647/DM648 Digital Signal Processor (DSP). The McASP functions as a general-purpose audio serial port optimized for the needs of multichannel audio applications. The McASP is useful for time-division multiplexed (TDM) stream, Inter-Integrated Sound (I2S) protocols, and intercomponent digital audio interface transmission (DIT).

[SPRUJEL2](#) — TMS320DM647/DM648 DSP Enhanced DMA (EDMA) Controller User's Guide describes the operation of the enhanced direct memory access (EDMA3) controller in the TMS320DM647/DM648 Digital Signal Processor (DSP). The EDMA3 controller's primary purpose is to service user-programmed data transfers between two memory-mapped slave endpoints on the DSP.

[SPRUJEL4](#) — TMS320DM647/DM648 DSP Peripheral Component Interconnect (PCI) User's Guide describes the peripheral component interconnect (PCI) port in the TMS320DM647/DM648 Digital Signal Processor (DSP). The PCI port supports connection of the C642x DSP to a PCI host via the integrated PCI master/slave bus interface. The PCI port interfaces to the DSP via the enhanced DMA (EDMA) controller. This architecture allows for both PCI master and slave transactions, while keeping the EDMA channel resources available for other applications.

[SPRUJEL5](#) — TMS320DM647/DM648 DSP Host Port Interface (UHPI) User's Guide describes the host port interface (HPI) in the TMS320DM647/DM648 Digital Signal Processor (DSP). The HPI is a parallel port through which a host processor can directly access the CPU memory space. The host device functions as a master to the interface, which increases ease of access. The host and CPU can exchange information via internal or external memory. The host also has direct access to memory-mapped peripherals. Connectivity to the CPU memory space is provided through the enhanced direct memory access (EDMA) controller.

[SPRUJEL8](#) — TMS320DM647/DM648 DSP Universal Asynchronous Receiver/Transmitter (UART) User's Guide describes the universal asynchronous receiver/transmitter (UART) peripheral in the TMS320DM647/DM648 Digital Signal Processor (DSP). The UART peripheral performs serial-to-parallel conversion on data received from a peripheral device, and parallel-to-serial conversion on data received from the CPU.

[SPRUJEL9](#) — TMS320DM647/DM648 DSP VLYNQ Port User's Guide describes the VLYNQ port in the TMS320DM647/DM648 Digital Signal Processor (DSP). The VLYNQ port is a high-speed point-to-point serial interface for connecting to host processors and other VLYNQ compatible devices. It is a full-duplex serial bus where transmit and receive operations occur separately and simultaneously without interference.

[SPRUJEM1](#) — TMS320DM647/DM648 DSP Video Port/VCXO Interpolated Control (VIC) Port User's Guide discusses the video port and VCXO interpolated control (VIC) port in the TMS320DM647/DM648 Digital Signal Processor (DSP). The video port can operate as a video capture port, video display port, or transport channel interface (TCI) capture port. The VIC port provides single-bit interpolated VCXO control with resolution from 9 bits to up to 16 bits. When the video port is used in TCI mode, the VIC port is used to control the system clock, VCXO, for MPEG transport channel.

[SPRUEM2](#) — **TMS320DM647/DM648 DSP Serial Port Interface (SPI) User's Guide** discusses the Serial Port Interface (SPI) in the TMS320DM647/DM648 Digital Signal Processor (DSP). This reference guide provides the specifications for a 16-bit configurable, synchronous serial peripheral interface. The SPI is a programmable-length shift register, used for high speed communication between external peripherals or other DSPs.

[SPRUEU6](#) — **TMS320DM647/DM648 DSP Subsystem User's Guide** describes the subsystem in the TMS320DM647/DM648 Digital Signal Processor (DSP). The subsystem is responsible for performing digital signal processing for digital media applications. The subsystem acts as the overall system controller, responsible for handling many system functions such as system-level initialization, configuration, user interface, user command execution, connectivity functions, and overall system control.

[SPRUF57](#) — **TMS320DM647/DM648 DSP 3 Port Switch (3PSW) Ethernet Subsystem User's Guide** describes the operation of the 3 port switch (3PSW) ethernet subsystem in the TMS320DM647/DM648 Digital Signal Processor (DSP). The 3 port switch gigabit ethernet subsystem provides ethernet packet communication and can be configured as an ethernet switch (DM648 only). It provides the serial gigabit media independent interface (SGMII), the management data input output (MDIO) for physical layer device (PHY) management.

Host Port Interface (HPI)

1 Introduction

The host port interface (HPI) provides a parallel port interface through which an external host processor can directly access the TMS320DM647/DM648 processor's resources (configuration and program/data memories). The external host device is asynchronous to the CPU clock and functions as a master to the HPI interface. The HPI enables a host device and the DM647/DM648 processor to exchange information via internal or external memory. Dedicated address (HPIA) and data (HPID) registers within the HPI provide the data path between the external host interface and the processor resources. An HPI control register (HPIC) is available to the host and the CPU for various configuration and interrupt functions.

1.1 Purpose of the Peripheral

The HPI enables an external host processor (host) to directly access program/data memory on the processor using a parallel interface. The primary purpose is to provide a mechanism to move data to and from the processor. In addition to data transfer, the host can also use the HPI to bootload the processor by downloading program and data information to the processor's memory after power-up.

1.2 Features

The HPI supports the following features:

- Multiplexed address/data
- Dual 16-bit halfword cycle access (internal data word is 32-bits wide)
- 32-bit-wide host data bus interface
- Internal data bursting using 8-word read and write, first-in first-out (FIFO) buffers
- HPI control register (HPIC) accessible by both the DSP CPU and the external host
- HPI address register (HPIA) accessible by both the DSP CPU and the external host
- Separate HPI address registers for read (HPIAR) and write (HPIAW) with configurable option for operating as a single HPI address register
- HPI data register (HPID)/FIFOs providing data-path between external host interface and CPU resources
- Multiple strobes and control signals to allow flexible host connection
- Asynchronous HRDY output to allow the HPI to insert wait states to the host
- Software control of data prefetching to the HPID/FIFOs
- Processor-to-Host interrupt output signal controlled by HPIC accesses
- Host-to-Processor interrupt controlled by HPIC accesses
- Memory-mapped peripheral identification register (PID)
- Bus holders on host data and address buses (these are actually external to HPI module)

1.3 Functional Block Diagram

Figure 1 is a high-level block diagram showing how the HPI connects a host (left side of figure) and the processor internal memory (right side of figure). Host activity is asynchronous to the internal processor clock that drives the HPI. The host functions as a master to the HPI. When HPI resources are temporarily busy or unavailable, the HPI communicates this to the host by de-asserting the HPI ready (HRDY) output signal.

The HPI uses multiplexed operation, meaning the data bus carries both address and data. When the host drives an address on the bus, the address is stored in the address register (HPIA) in the HPI, so that the bus can then be used for data.

The HPI supports two interface modes: HPI16 and HPI32 mode. DSP selects either HPI16 or HPI32 mode with the help of HPI_WIDTH device configuration pin at reset.

-16-bit multiplexed mode (HPI16): The HPI is called HPI16 when operating as a 16-bit wide host port. This mode is selected if the HPI_WIDTH configuration pin of the DSP is sampled low at reset. In this mode, a 16-bit data bus (HD[15:0]) carries both addresses and data. HPI16 combines successive 16-bit transfers to provide 32-bit data to the CPU. The halfword identification line (HHWIL) input is used on the HPI16 to identify the first or second half word of a word transfer.

-32-bit multiplexed mode (HPI32): HPI operates in this mode as a 32-bit wide host port. This mode is selected if the HPI_WIDTH configuration pin of the DSP is sampled high at reset. In this mode, a 32-bit data bus (HD[31:0]) carries both addresses and data. HHWIL is not applicable for HPI32 mode.

The HPI contains two HPIAs (HPIAR and HPIAW), which can be used as separate address registers for read accesses and write accesses (for details, see [Section 2.7.1](#)).

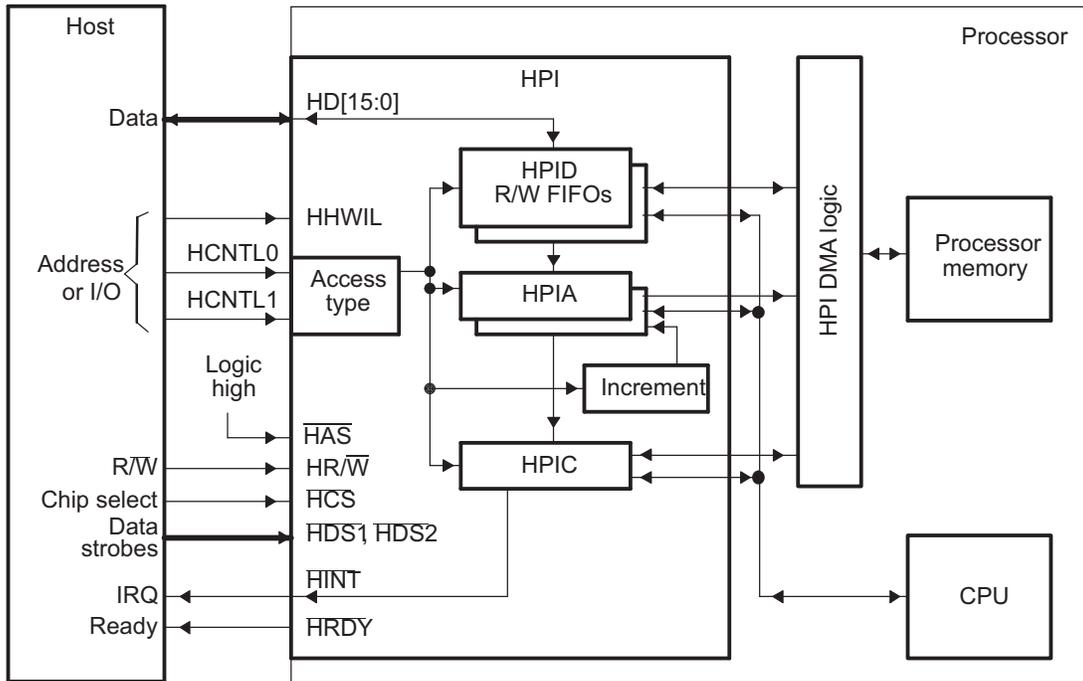
A control register (HPIC) is accessible by the CPU and the host. The CPU uses HPIC to send an interrupt request to the host, to clear an interrupt request from the host, and to configure and monitor the HPI.

Data flow between the host and the HPI uses a temporary storage register, the 32-bit data register (HPID). Data arriving from the host is held in HPID until the data can be stored elsewhere in the processor. Data to be sent to the host is held in HPID until the HPI is ready to perform the transfer. When address auto-incrementing is used, read and write FIFOs are used to store burst data. If auto-incrementing is not used, the FIFO memory acts as a single register (only one location is used).

Note: To manage data transfers between HPID and the internal memory, the DSP contains dedicated HPI DMA logic. The HPI DMA logic is not programmable. It automatically stores or fetches data using the address provided by the host. The HPI DMA logic is independent of the EDMA3 controller included in the DSP.

In the DSP system, master and slave peripherals communicate with each other via the Switched Central Resource (SCR). By definition, master peripherals are capable of initiating read and write transfers in the system and may not solely rely on the EDMA3 controller for their data transfers. Slave peripherals rely on the EDMA3 controller to perform transfers. The HPI is a master peripheral; it uses its DMA logic to directly communicate with the rest of the system via the SCR and does not rely on the EDMA3 controller for its data transfers. Note that the HPI cannot access all DSP resources or peripherals; see the device-specific data manual for a list of resources accessible through the HPI.

Figure 1. HPI Block Diagram



1.4 Industry Standard(s) Compliance Statement

The HPI is not an industry standard interface that is developed and monitored by an international organization. It is a generic parallel interface that can be configured to gluelessly interface, a variety of parallel devices.

1.5 Terminology Used in This Document

The following is a brief explanation of some terms used in this document:

Term	Meaning
CPU	DSP CPU
host	External host device
HPI DMA logic	Logic used to communicate between the HPI and the DMA system that moves data to and from memory. This is independent of the EDMA system on the processor
processor	the entire digital media system-on-chip

2 Peripheral Architecture

2.1 Clock Control

The HPI clock is derived from SYSCLK2, which is the PLL1 clock divided by 6. For detailed information on the PLLs and clock distribution on the processor, see the Subsystem User's Guide.

2.2 Memory Map

The HPI can be used by the host to access the following processor resources:

- HPI configuration registers
- Most on-chip device memory, peripherals, and memory-mapped registers (see Section 4, *System Interconnect*, in the device-specific data manual for more detailed information)
- DDR2 Memory Controller configuration register file and memory address ranges
- Power and Sleep Controller (PSC) registers
- PLL1 and PLL2 registers

Consult the device-specific data manual for the memory address ranges of the above resources.

2.3 Signal Descriptions

[Table 1](#) shows the a description of the HPI signals.

2.4 Pin Multiplexing

On the DM648 extensive pin multiplexing is used to accommodate the largest number of peripheral functions in the smallest possible package. Pin multiplexing is controlled using a combination of hardware configuration at device reset and software programmable register settings. UHPI pins are multiplexed with PCI pins' functionality. The configuration pin UHPIEN is to be set to 1 to enable UHPI. Refer to the device-specific data manual to determine how pin multiplexing affects the HPI.

2.5 Protocol Description

The HPI does not conform to any industry standard protocol. Details on the nature of address, data and control transactions are found in the following sections.

2.6 Endianness Considerations

The HPI operation is independent of the DM648 endianness mode; therefore, there are no endianness considerations for the HPI.

Table 1. HPI Pins

Pin	Type	Host Connection	Function
HCNTL[1:0]	I	Address or control pins	HPI access control inputs. The HPI latches the logic levels of these pins on the falling edge of internal HSTRB (for details about internal HSTRB, see Section 2.7.4). The four binary states of these pins determine the access type of the current transfer (HPIC, HPIA, HPID with and without auto-incrementing).
$\overline{\text{HCS}}$	I	Chip select pin	HPI chip select. $\overline{\text{HCS}}$ must be low for the HPI to be selected by the host. $\overline{\text{HCS}}$ can be kept low between accesses. $\overline{\text{HCS}}$ normally precedes an active HDS (data strobe) signal, but can be connected to an HDS pin for simultaneous select and strobe activity.
HR $\overline{\text{W}}$	I	R/W strobe pin	HPI read/write. On the falling edge of internal $\overline{\text{HSTRB}}$, HR $\overline{\text{W}}$ indicates whether the current access is to be a read or write operation. Driving HR $\overline{\text{W}}$ high indicates the transfer is a read from the HPI, while driving HR $\overline{\text{W}}$ low indicates a write to the HPI.
HHWIL	I	Address or control pins	Halfword identification line. The host uses HHWIL to identify the first and second halfwords of the host cycle. HHWIL must be driven low for the first halfword and high for the second halfword.
$\overline{\text{HAS}}$	I	None	Address strobe. Connect to logic high.
$\overline{\text{HINT}}$	O/Z	Interrupt pin	Host Interrupt. The CPU can interrupt the host processor by writing a 1 to the HINT bit of HPIC. Before subsequent $\overline{\text{HINT}}$ interrupts can occur, the host must acknowledge interrupts by writing a 1 to the HINT bit. This pin is active-low (that is, when an interrupt is asserted from the host, the state of this signal is low) and inverted from the HINT bit value in HPIC.
$\overline{\text{HDS1}}$ and $\overline{\text{HDS2}}$	I	Read strobe and write strobe pins or any data strobe pin	HPI data strobe pins. These pins are used for strobing data in and out of the HPI (for data strobing details, see Section 2.7.4). The direction of the data transfer depends on the logic level of the HR $\overline{\text{W}}$ signal. The HDS signals are also used to latch control information on the falling edge. During an HPID write access, data is latched into the HPID register on the rising edge of HDS. During read operations, these pins act as output-enable pins of the host data bus.
HD[31:0] HD[15:0]	I/O/Z	Data bus	HPI data bus. The HPI data bus carries the address and data to/from the HPI. HD[31:0] applies to HPI32 and HD[15:0] applies to HPI16.
$\overline{\text{HRDY}}$	O/Z	Asynchronous ready pin	HPI-ready signal. When the HPI drives $\overline{\text{HRDY}}$ low, the host has permission to complete the current host cycle. When the HPI drives $\overline{\text{HRDY}}$ high, the HPI is not ready for the current host cycle to complete.
HINT	O/Z	Interrupt pin	The DSP can interrupt the host processor by writing a 1 to the HINT bit of HPIC. Before subsequent HINT interrupts can occur, the host must clear previous interrupts by writing a 1 to the HINT bit. This pin is active-low and inverted from the HINT bit value in HPIC.

2.7 Architecture and Operation

2.7.1 Using the Address Registers

The HPI contains two 32-bit address registers: one for read operations (HPIAR) and one for write operations (HPIAW). These roles are unchanging from the viewpoint of the HPI logic. The HPI DMA logic gets the address from HPIAR when reading from processor resources (see [Section 2.2](#)) and gets the address from HPIAW when writing to processor resources (see [Section 2.2](#)).

However, unlike the HPI logic, the host can choose how to interact with the two HPI address registers. Using the DUALHPIA bit in the HPI control register (HPIC), the host determines whether HPIAR and HPIAW act as a single 32-bit register (single-HPIA mode) or as two independent 32-bit registers (dual-HPIA mode).

Note: The addresses loaded into the HPI address registers must be word addresses, and must be 32-bit word aligned (with the least-significant two bits equal to zero), for use in addressing memory space within the DM648. For example, to access L2 SRAM at 0x00A0_0000, HPIA should be loaded with 0x0028_0000 (0x00A0_0000 divided by 4).

2.7.1.1 Single-HPIA Mode

When DUALHPIA = 0 in HPIC, HPIAR and HPIAW become a single HPI address register (HPIA) from the perspective of the host. In this mode:

- A host HPIA write cycle (HCNTL[1:0] = 10b, $HR\overline{W}$ = 0) updates HPIAR and HPIAW with the same value.
- Both HPI address registers are incremented during auto-increment read/write cycles (HCNTL[1:0] = 01b).
- An HPIA read cycle (HCNTL[1:0] = 10b, $HR\overline{W}$ = 1) returns the content of HPIAR, which should be identical to the content of HPIAW.

To maintain consistency between the contents of HPIAR and HPIAW, the host should always reinitialize the HPI address registers after changing the state of the DUALHPIA bit. In addition, when DUALHPIA = 0, the host must always reinitialize the HPI address registers when it changes the data direction (from an HPID read cycle to an HPID write cycle, or conversely). Otherwise, the memory location accessed by the HPI DMA logic might not be the location intended by the host.

2.7.1.2 Dual-HPIA Mode

When DUALHPIA = 1 in HPIC, HPIAR and HPIAW are two independent HPI address registers from the perspective of the host. In this mode:

- A host HPIA access (HCNTL[1:0] = 10b) reads/updates either HPIAR or HPIAW, depending on the value of the HPIA read/write select (HPIASEL) bit in HPIC. This bit is programmed by the host. While HPIASEL = 1, only HPIAR is read or updated by the host. While HPIASEL = 0, only HPIAW is read or updated by the host. The HPIASEL bit is only meaningful in the dual-HPIA mode.

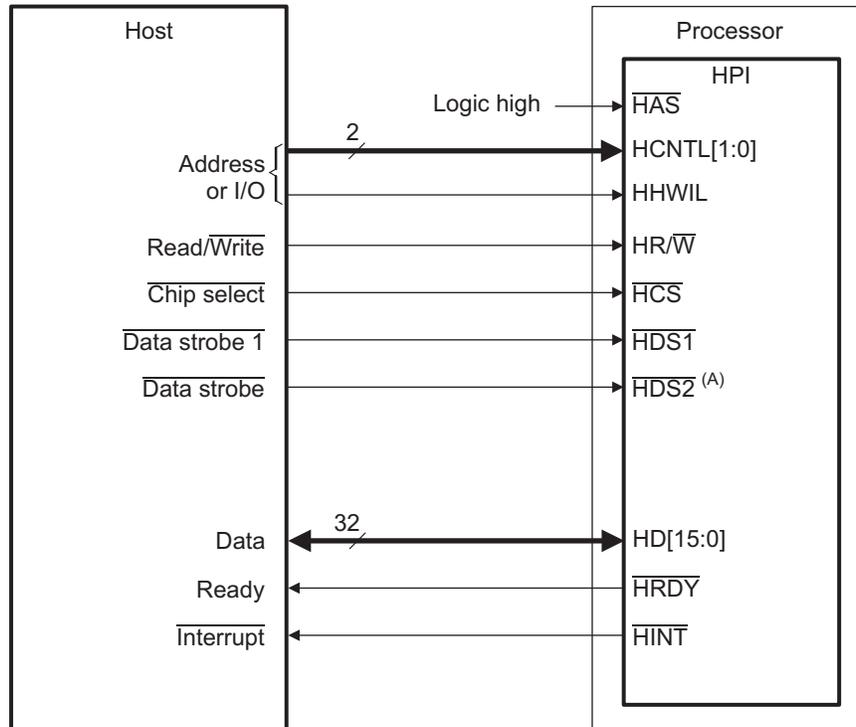
Note: The HPIASEL bit does not affect the HPI DMA logic. Regardless of the value of HPIASEL, the HPI DMA logic uses HPIAR when reading from memory and HPIAW when writing to memory.

- A host HPID access with auto-incrementing (HCNTL[1:0] = 01b) causes only the relevant HPIA value to be incremented to the next consecutive memory address. In an auto-increment read cycle, HPIAR is incremented after it has been used to perform the current read from memory. In an auto-increment write cycle, HPIAW is incremented after it has been used for the write operation.

2.7.2 Host-HPI Signal Connections

Figure 2 shows an example of a signal connection between the HPI and a host.

Figure 2. Example of Host-Processor Signal Connections



A Data strobing options are given in [Section 2.7.4](#)

2.7.3 HPI Configuration and Data Flow

The host accomplishes a multiplexed access in the following manner:

1. The host writes to the HPI control register (HPIC) to properly configure the HPI. Typically, this means programming the halfword order bit (HWOB) and the HPIA-related bits (DUALHPIA and HPIASEL). This step is normally performed once before the initial data access.
2. The host writes the desired internal processor memory address to an address register (HPIAR and/or HPIAW). For an introduction to the two HPI address registers and the two ways the host can interact with them, see [Section 2.7.1](#).
3. The host reads from or writes to the data register (HPID). Data transfers between HPID and the internal memory of the processor are handled by the HPI DMA logic and are transparent to the CPU.

Each step of the access uses the same bus. Therefore, the host must drive the appropriate levels on the HCNTL1 and HCNTL0 signals to indicate which register is to be accessed. The host must also drive the appropriate level on the HR/W signal to indicate the data direction (read or write) and must drive other control signals as appropriate. When HPI resources are temporarily busy or unavailable, the HPI can communicate this to the host by de-asserting the HPI-ready (HRDY) output signal.

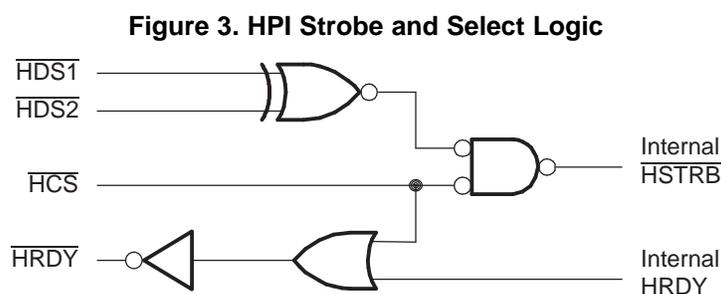
When performing an access, the HPI first latches the levels on HCNTL[1:0], HR/W, and other control signals. This latching can occur on the falling edge of the internal strobe signal (for details, see [Section 2.7.4](#)). After the control information is latched, the HPI initiates an access based on the control signals.

If the host wants to read data from processor resources (see [Section 2.2](#)), the HPI DMA logic reads the resource address from HPIAR and retrieves the data from the addressed memory location. When the data has been placed in HPID, the HPI drives the data onto its HD bus. The $\overline{\text{HRDY}}$ signal informs the host whether the data on the HD bus is valid ($\overline{\text{HRDY}}$ low) or not valid yet ($\overline{\text{HRDY}}$ high). When the data is valid, the host should latch the data and drive the connected data strobe ($\overline{\text{HDS1}}$ or $\overline{\text{HDS2}}$) inactive, which, in turn, will cause the internal strobe (internal $\overline{\text{HSTRB}}$) signal to transition from low to high.

If the host wants to write data to processor resources (see [Section 2.2](#)), the operation is similar. After the host determines that the HPI is ready to latch the data ($\overline{\text{HRDY}}$ is low), it must cause internal $\overline{\text{HSTRB}}$ to transition from low to high, which causes the data to be latched into HPID. Once the data is in HPID, the HPI DMA logic reads the memory address from HPIAW and transfers the data from HPID to the addressed memory location.

2.7.4 $\overline{\text{HDS2}}$, $\overline{\text{HDS1}}$, and $\overline{\text{HCS}}$: Data Strobing and Chip Selection

As shown in [Figure 3](#), the strobing logic is a function of three key inputs: the chip select pin ($\overline{\text{HCS}}$) and two data strobe signals ($\overline{\text{HDS1}}$ and $\overline{\text{HDS2}}$). The internal strobe signal, which is referred to as internal $\overline{\text{HSTRB}}$ throughout this document, functions as the actual strobe signal inside the HPI. $\overline{\text{HCS}}$ must be low (HPI selected) during strobe activity on the $\overline{\text{HDS}}$ pins. If $\overline{\text{HCS}}$ remains high (HPI not selected), activity on the $\overline{\text{HDS}}$ pins is ignored.



Strobe connections between the host and the HPI depend in part on the number and types of strobe pins available on the host. [Table 2](#) describes some options for connecting to the $\overline{\text{HDS}}$ pins.

Notice in [Figure 3](#) that $\overline{\text{HRDY}}$ is also gated by $\overline{\text{HCS}}$. If $\overline{\text{HCS}}$ goes high (HPI not selected), $\overline{\text{HRDY}}$ goes low, regardless of whether the current internal transfer is completed in the processor.

Note: The $\overline{\text{HCS}}$ input and one $\overline{\text{HDS}}$ strobe input can be tied together and driven with a single strobe signal from the host. This technique selects the HPI and provides the strobe, simultaneously. When using this method, be aware that $\overline{\text{HRDY}}$ is gated by $\overline{\text{HCS}}$ as previously described.

It is not recommended to tie both $\overline{\text{HDS1}}$ and $\overline{\text{HDS2}}$ to static logic levels and use $\overline{\text{HCS}}$ as a strobe.

Table 2. Options for Connecting Host and HPI Data Strobe Pins

Available Host Data Strobe Pins	Connections to HPI Data Strobe Pins
Host has separate read and write strobe pins, both active-low	Connect one strobe pin to $\overline{\text{HDS1}}$ and the other to $\overline{\text{HDS2}}$ ⁽¹⁾ . Since such a host might not provide a R/W line, take care to satisfy HR/W timings as stated in the device data manual. This could possibly be done using a host address line.
Host has separate read and write strobe pins, both active-high	Connect one strobe pin to $\overline{\text{HDS1}}$ and the other to $\overline{\text{HDS2}}$ ⁽¹⁾ . Since such a host might not provide a R/W line, take care to satisfy HR/W timings as stated in the device data manual. This could possibly be done using a host address line.
Host has one active-low strobe pin	Connect the strobe pin to $\overline{\text{HDS1}}$ or $\overline{\text{HDS2}}$, and connect the other pin to logic-level 1.
Host has one active-high strobe pin	Connect the strobe pin to $\overline{\text{HDS1}}$ or $\overline{\text{HDS2}}$, and connect the other strobe pin to logic-level 0.

⁽¹⁾ The HR/W signal could be driven by a host address line in this case.

2.7.5 HCNTL[1:0] and HR/W: Indicating the Cycle Type

The cycle type consists of:

- The access type that the host selects by driving the appropriate levels on the HCNTL[1:0] pins of the HPI. [Table 3](#) describes the four available access types.
- The transfer direction that the host selects with the HR/W pin. The host must drive the HR/W signal high (read) or low (write).

A summary of cycle types is in [Table 4](#). The HPI samples the HCNTL levels at the falling edge of the internal strobe signal HSTRB.

Table 3. Access Types Selectable With the HCNTL Signals

HCNTL1 ⁽¹⁾	HCNTL0 ⁽¹⁾	Access Type
0	0	HPIC access. The host requests to access the HPI control register (HPIC).
0	1	HPID access with auto-incrementing. The host requests to access the HPI data register (HPID) and to have the appropriate HPI address register (HPIAR and/or HPIAW) automatically incremented by 1 after the access.
1	0	HPIA access. The host requests to access the appropriate HPI address register (HPIAR and/or HPIAW).
1	1	HPID access without auto-incrementing. The host requests to access the HPI data register (HPID) but requests no automatic post-increment of the HPI address register.

⁽¹⁾ Note that the encoding of HCNTL0 and HCNTL1 for the different types of HPI accesses varies on many TI DSPs; therefore, you should use caution to ensure that the correct encoding of these inputs is used for your device. The encoding of these signals as described in this document applies only to the DM648.

Table 4. Cycle Types Selectable With the HCNTL and HR \overline{W} Signals

HCNTL1 ⁽¹⁾	HCNTL0 ⁽¹⁾	HR \overline{W}	Cycle Type
0	0	0	HPIC write cycle
0	0	1	HPIC read cycle
0	1	0	HPID write cycle with auto-incrementing
0	1	1	HPID read cycle with auto-incrementing
1	0	0	HPIA write cycle
1	0	1	HPIA read cycle
1	1	0	HPID write cycle without auto-incrementing
1	1	1	HPID read cycle without auto-incrementing

⁽¹⁾ Note that the encoding of HCNTL0 and HCNTL1 for the different types of HPI accesses varies on many TI DSPs; therefore, you should use caution to ensure that the correct encoding of these inputs is used for your device. The encoding of these signals as described in this document applies only to the DM648.

2.7.6 HHWIL: Identifying the First and Second Halfwords in Multiplexed Mode Transfers

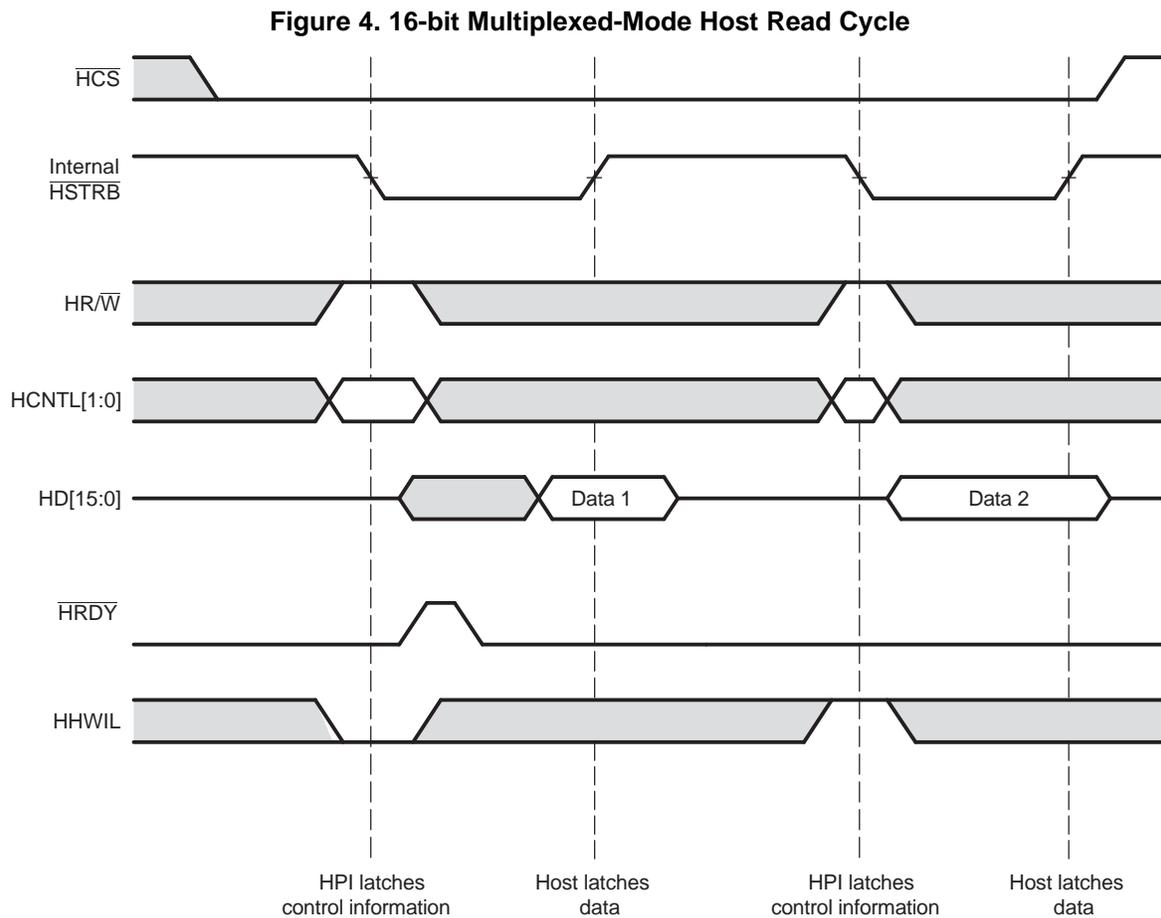
Each host cycle consists of two consecutive halfword transfers. For each transfer, the host must specify the cycle type with HCNTL[1:0] and HR \overline{W} , and the host must use HHWIL to indicate whether the first or second halfword is being transferred. For HPID and HPIA accesses, HHWIL must always be driven low for the first halfword transfer and high for the second halfword transfer. Results are undefined if the sequence is broken. For examples of using HHWIL, see [Section 2.7.7](#).

When the host sends the two halfwords of a 32-bit word in this manner, the host can send the most-significant and the least-significant halfwords of the word in either order (most-significant halfword first or most-significant halfword second). However, the host must inform the HPI of the selected order before beginning the host cycle. This is done by programming the halfword order (HWOB) bit in HPIC. Although HWOB is written at bit 0 in HPIC, its current value is readable at both bit 0 and bit 8 (HWOBSTAT). Thus, the host can determine the current halfword order configuration by checking the least-significant bit of either half of HPIC.

There is one case when the HPI does not require a dual halfword access with HHWIL low for the first halfword and HHWIL high for the second halfword. This is the case when accessing the HPIC register. When accessing HPIC, the state of HHWIL is ignored and the same 16-bit HPIC register is accessed regardless of whether the host performs a single or dual access. For an example timing diagram of this case, see [Section 2.7.8](#).

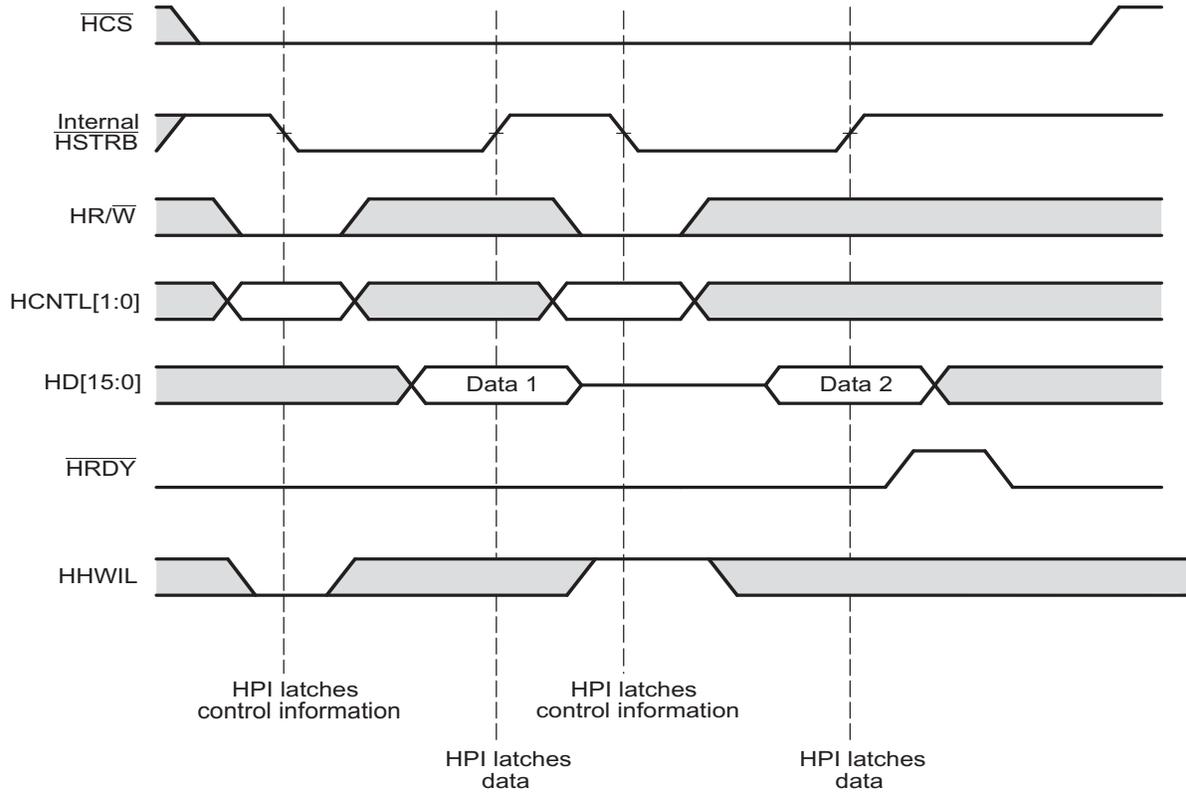
2.7.7 Performing a Multiplexed Access

Figure 2 shows an example of signal connections for multiplexed transfers. Figure 4 and Figure 5 show typical HPI signal activity when performing a read and write transfer, respectively. In these cases, the falling edge of internal HSTRB is used to latch the HCNTL[1:0], HR/W, and HHWIL states into the HPI. Internal HSTRB is derived from HCS, HDS1, and HDS2 as described in Section 2.7.4.



NOTE: Depending on the type of write operation (HPID without auto-incrementing, HPIA, HPIC, or HPID with auto-incrementing) and the state of the FIFO, transitions on $\overline{\text{HRDY}}$ may or may not occur. For more information, see Section 2.7.9.

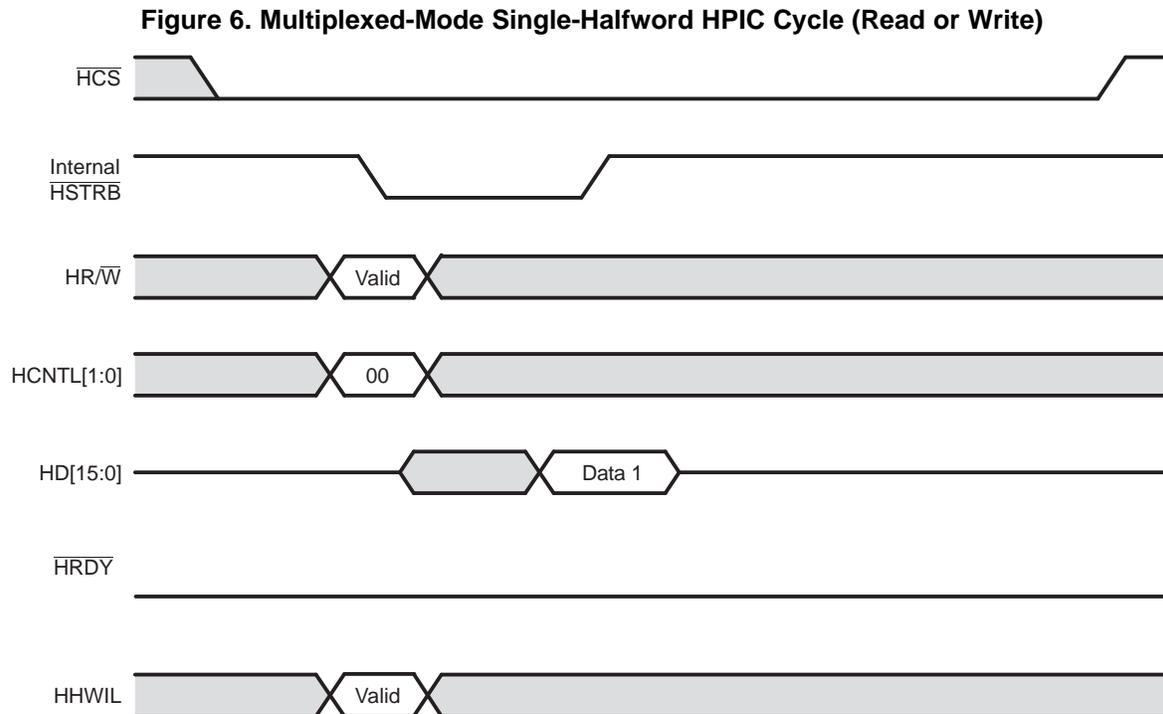
Figure 5. 16-bit Multiplexed-Mode Host Write Cycle



NOTE: Depending on the type of write operation (HPID without auto-incrementing, HPIA, HPIC, or HPID with auto-incrementing) and the state of the FIFO, transitions on $\overline{\text{HRDY}}$ may or may not occur. For more information, see [Section 2.7.9](#).

2.7.8 Single-Halfword HPIC Cycle in 16-bit Multiplexed Mode

Figure 6 shows the special case (see Section 2.7.6) when the host performs a single-halfword cycle to access the HPIC. The state of HHWIL is ignored and if a dual-halfword access is performed, then the same HPIC register is accessed twice.



2.7.9 Hardware Handshaking Using the HPI-Ready ($\overline{\text{HRDY}}$) Signal

The HPI uses its ready signal, $\overline{\text{HRDY}}$, to tell the host whether it is ready to complete an access. During a read cycle, the HPI is ready (drives $\overline{\text{HRDY}}$ high) when it has data available for the host. During a write cycle, the HPI is ready (drives $\overline{\text{HRDY}}$ high) when it is ready to latch data from the host. If the HPI is not ready, it can drive $\overline{\text{HRDY}}$ low to insert wait states. These wait states indicate to the host that read data is not yet valid (read cycle) or that the HPI is not ready to latch write data (write cycle). The number of wait states that must be inserted by the HPI is dependent upon the state of the resource that is being accessed.

When the HPI is not ready to complete the current cycle ($\overline{\text{HRDY}}$ low), the host can begin a new host cycle by forcing the HPI to latch new control information. However, once the cycle has been initiated, the host must wait until $\overline{\text{HRDY}}$ goes high before causing a rising edge on the internal strobe signal (internal HSTRB) to complete the cycle. If internal HSTRB goes high when the HPI is not ready, the cycle will be terminated with invalid data being returned (read cycle) or written (write cycle).

One reason the HPI may drive $\overline{\text{HRDY}}$ low is a not-ready condition in one of its first-in, first-out buffers (FIFOs). For example, any HPID access that occurs while the write FIFO is full or the read FIFO is empty may result in some number of wait states being inserted by the HPI. The FIFOs are explained in Section 2.7.10.

The following sections describe the behavior of $\overline{\text{HRDY}}$ during HPI register accesses. In all cases, the chip select signal, HCS , must be asserted for $\overline{\text{HRDY}}$ to go low.

2.7.9.1 $\overline{\text{HRDY}}$ Behavior During 16-bit Multiplexed-Mode Read Operations

Figure 7 shows an HPIC (HCNTL[1:0] = 00b) or HPIA (HCNTL[1:0] = 10b) read cycle. Neither an HPIC read cycle nor an HPIA read cycle causes $\overline{\text{HRDY}}$ to go low. For this type of access, the state of HHWIL is ignored, so if a dual halfword access is performed, the same register will be accessed twice.

Figure 7. $\overline{\text{HRDY}}$ Behavior During an HPIC or HPIA Read Cycle in the 16-bit Multiplexed Mode

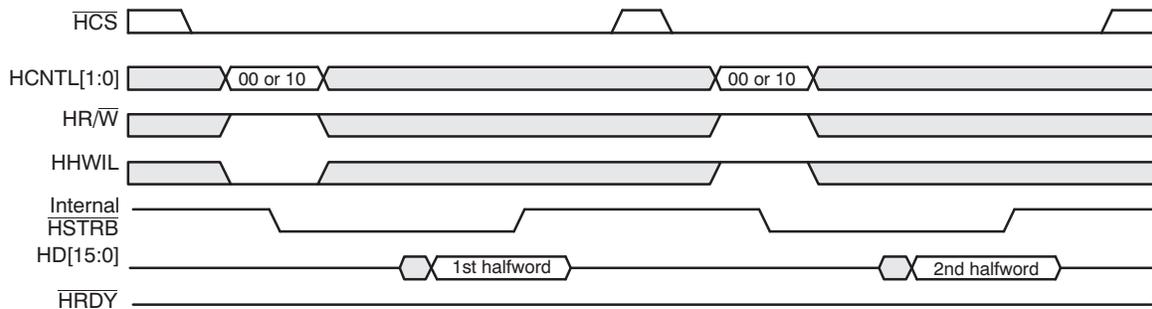


Figure 8 includes an HPID read cycle without auto-incrementing. The host writes the memory address during the HPIA (HCNTL[1:0] = 10b) write cycle, and the host reads the data during the HPID (HCNTL[1:0] = 11b) read cycle. $\overline{\text{HRDY}}$ goes low for each HPIA halfword access, but $\overline{\text{HRDY}}$ goes low for only the first halfword access in each HPID read cycle.

Figure 8. $\overline{\text{HRDY}}$ Behavior During a Data Read Operation in the 16-bit Multiplexed Mode (Case 1: HPIA Write Cycle Followed by Nonauto-increment HPID Read Cycle)

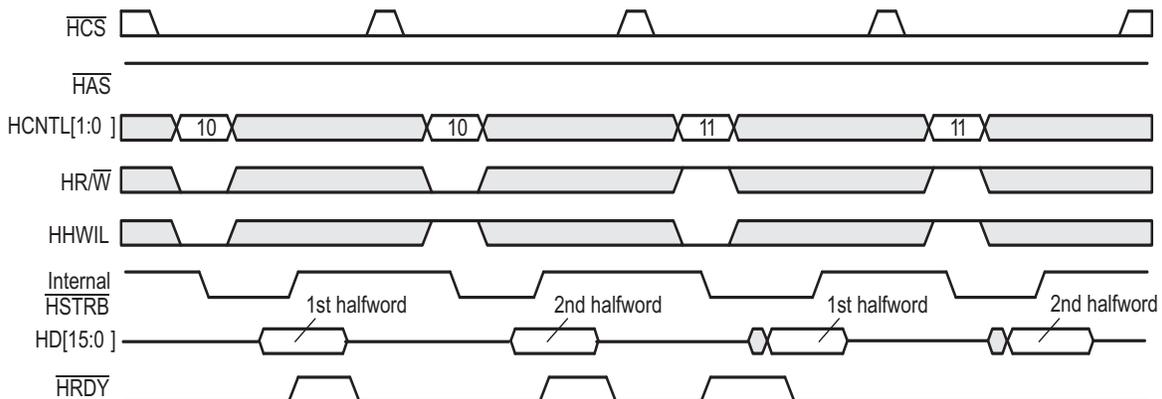
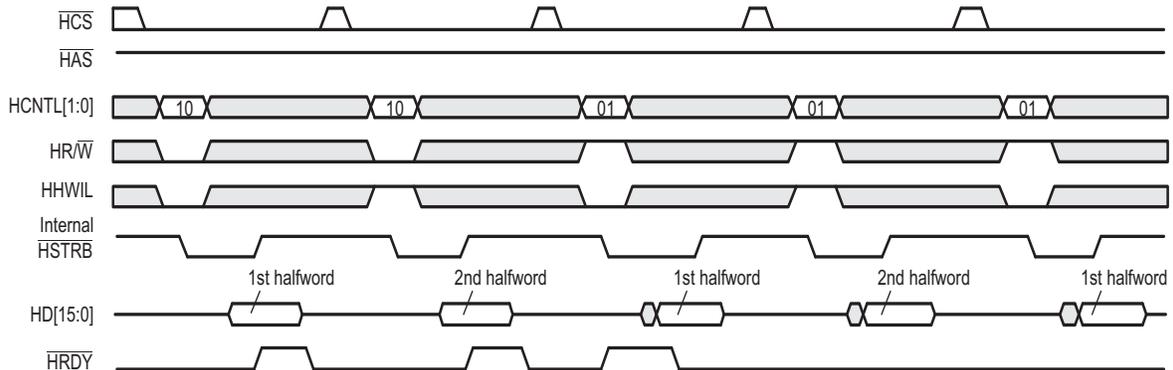


Figure 9 includes an auto-increment HPID read cycle. The host writes the memory address while asserting HCNTL[1:0] = 10b and reads the data while asserting HCNTL[1:0] = 01b. During the first HPID read cycle, $\overline{\text{HRDY}}$ goes low for only the first halfword access, and subsequent HPID read cycles do not cause $\overline{\text{HRDY}}$ to go low.

Figure 9. $\overline{\text{HRDY}}$ Behavior During a Data Read Operation in the 16-bit Multiplexed Mode (Case 2: HPIA Write Cycle Followed by Auto-increment HPID Read Cycles)



2.7.9.2 $\overline{\text{HRDY}}$ Behavior During 16-bit Multiplexed-Mode Write Operations

Figure 10 shows an HPIC (HCNTL[1:0] = 00b) write cycle operation. An HPIC write cycle does not cause $\overline{\text{HRDY}}$ to go low and the state of HHWIL is ignored. Firmware is not required to perform a dual access to access HPIC.

Figure 10. $\overline{\text{HRDY}}$ Behavior During an HPIC Write Cycle in the 16-bit Multiplexed Mode

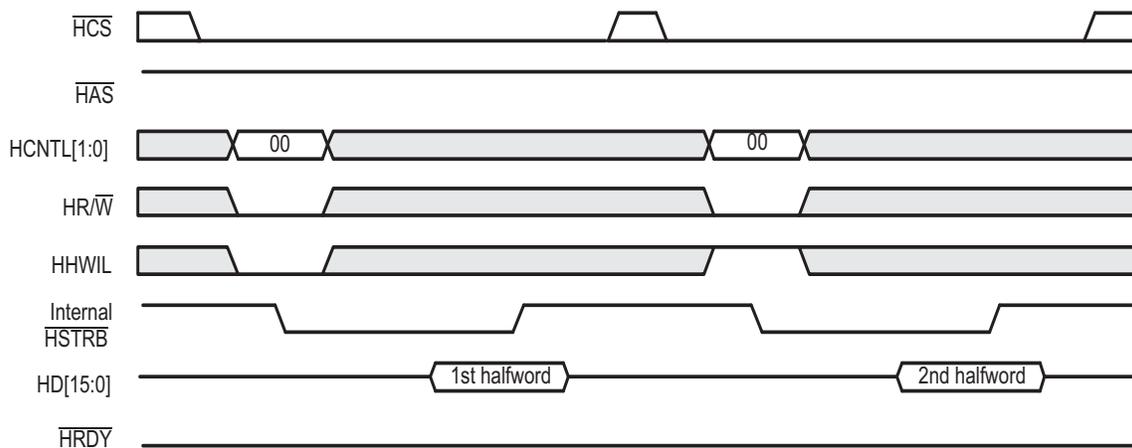


Figure 11 includes a HPID write cycle without auto-incrementing. The host writes the memory address while HCNTL[1:0] = 10b and writes the data while HCNTL[1:0] = 11b. During the HPID write cycle, $\overline{\text{HRDY}}$ goes low only for the second halfword access.

Figure 11. $\overline{\text{HRDY}}$ Behavior During a Data Write Operation in the 16-bit Multiplexed Mode (Case 1: No Auto-incrementing)

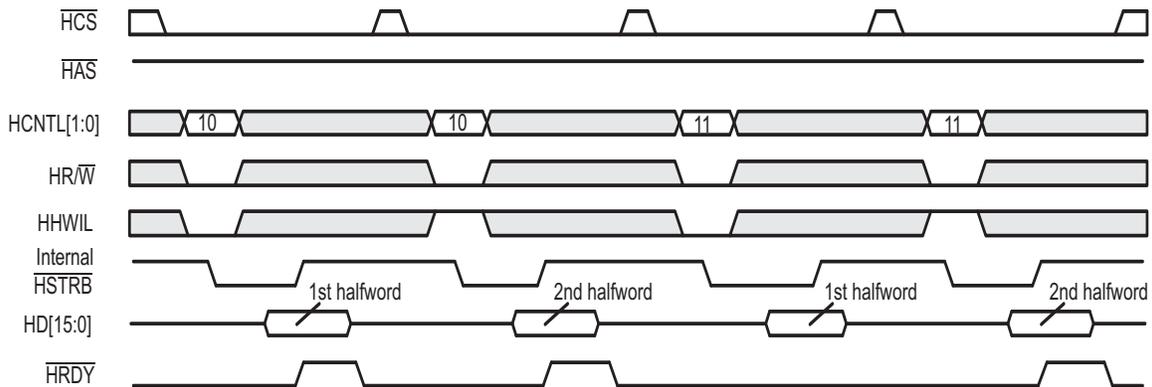


Figure 12 shows auto-increment HPID write cycles when the write FIFO is empty prior to the HPIA write. The host writes the memory address while $\text{HCNTL}[1:0] = 10\text{b}$ and writes the data while $\text{HCNTL}[1:0] = 01\text{b}$. $\overline{\text{HRDY}}$ does not go low during any of the HPID write cycles until the FIFO is full.

Figure 12. $\overline{\text{HRDY}}$ Behavior During a Data Write Operation in the 16-bit Multiplexed Mode (Case 2: Auto-incrementing Selected, FIFO Empty Before Write)

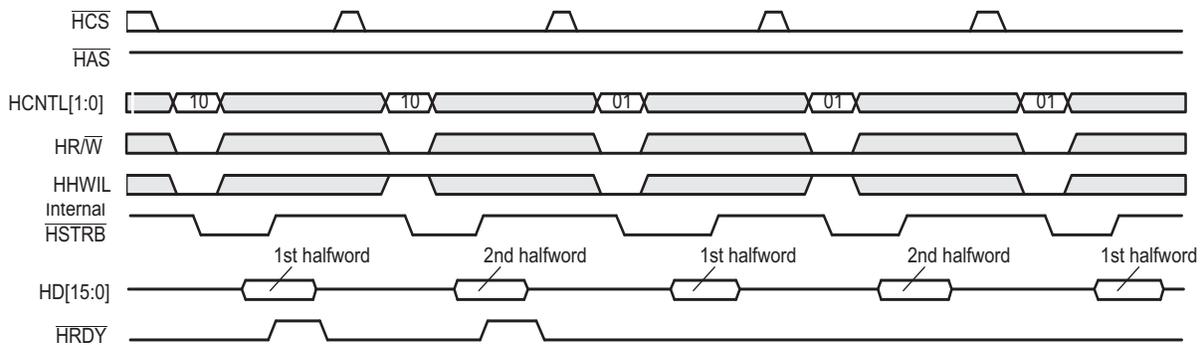
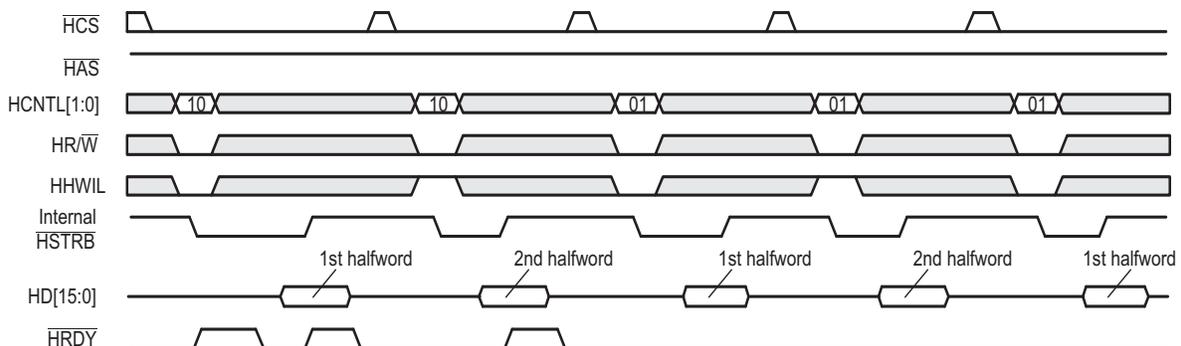


Figure 13 shows a case similar to that of Figure 12. However, in the case of Figure 13, the write FIFO is not empty when the HPIA access is made. $\overline{\text{HRDY}}$ goes low twice for the first halfword access of the HPIA write cycle. The first $\overline{\text{HRDY}}$ low period is due to the nonempty FIFO. The data currently in the FIFO must first be written to the memory. This results in $\overline{\text{HRDY}}$ going low immediately after the falling edge of the data strobe (HSTRB). The second and third $\overline{\text{HRDY}}$ low periods occur for the writes to the HPIA. $\overline{\text{HRDY}}$ remains high for the HPID accesses.

Figure 13. $\overline{\text{HRDY}}$ Behavior During a Data Write Operation in the 16-bit Multiplexed Mode (Case 3: Auto-incrementing Selected, FIFO Not Empty Before Write)



2.7.9.3 $\overline{\text{HRDY}}$ Behavior During 32-bit Multiplexed-Mode Read Operations

Figure 14 shows an HPIC (HCNTL[1:0] = 00b) read or an HPIA (HCNTL[1:0] = 01b) read access for 32-bit multiplexed HPI operation. Note that neither an HPIC nor an HPIA read access causes HRDY to become active.

Figure 14. $\overline{\text{HRDY}}$ Behavior During an HPIC or HPIA Read Cycle in the 32-Bit Multiplexed Mode

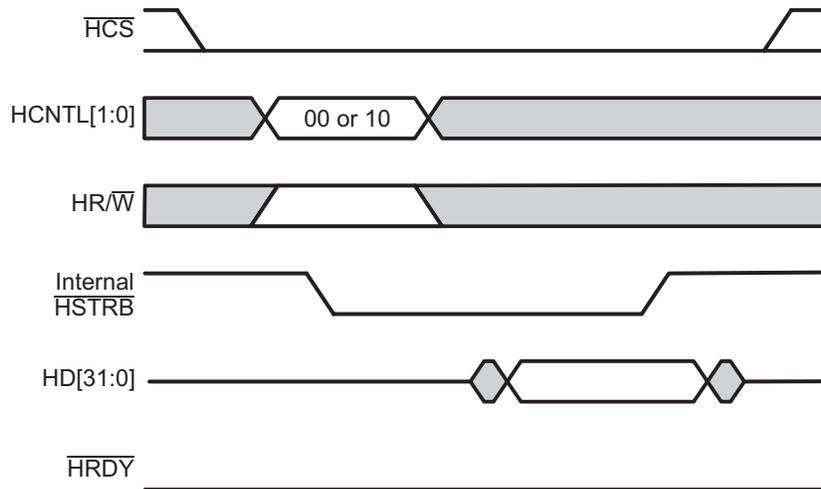


Figure 15 shows an HPIA (HCNTL[1:0] = 10b) write access followed by an HPID (HCNTL[1:0] = 11b) read access for 32-bit multiplexed HPI operation.

Figure 15. $\overline{\text{HRDY}}$ Behavior During a Data Read Operation in the 16-Bit Multiplexed Mode (Case 1: HPIA Write Cycle Followed by Non-auto-increment HPID Read Cycle)

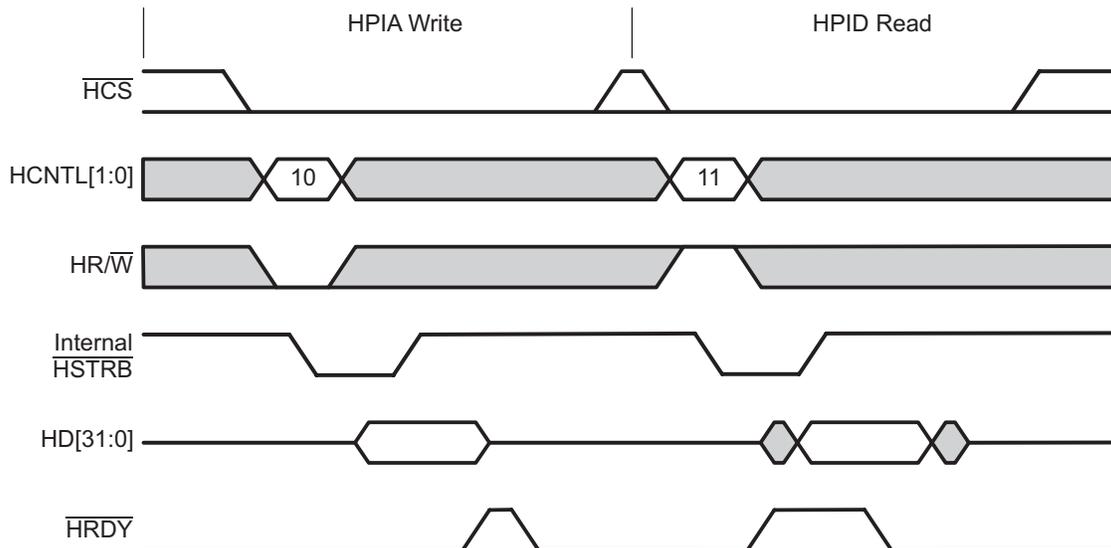
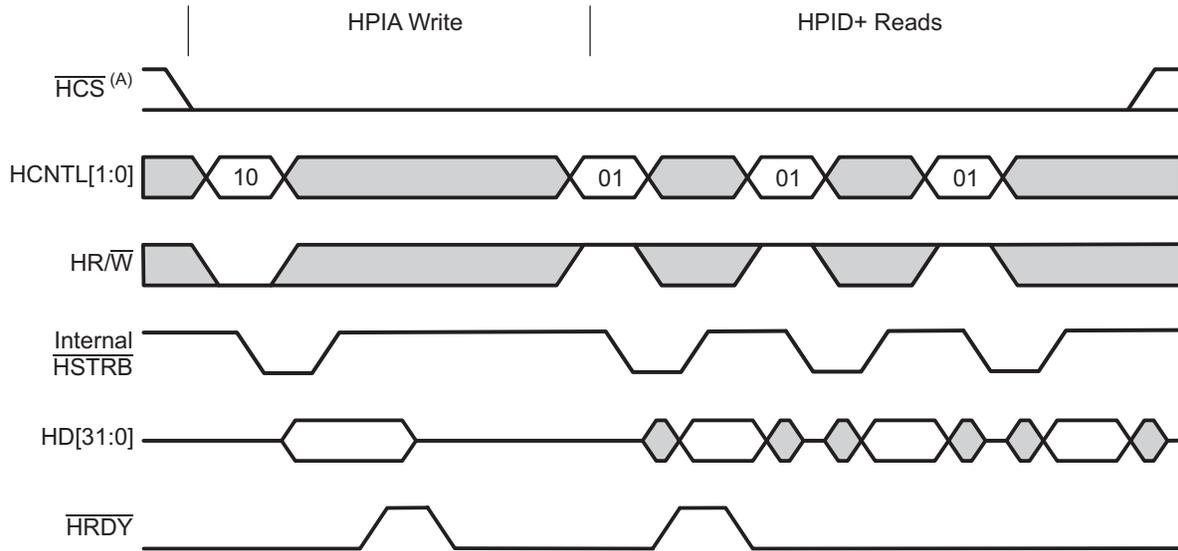


Figure 16 shows an HPIA (HCNTL[1:0] = 10b) write access followed by several auto-increment HPID (HCNTL[1:0] = 01b) read accesses. Note that HRDY is active for the HPIA access. HRDY is also active for the first HPID read access, but not for subsequent read accesses.

Figure 16. $\overline{\text{HRDY}}$ Behavior During a Data Read Operation in the 32-Bit Multiplexed Mode (Case 2: HPIA Write Cycle Followed by Auto-increment HPID Read Cycles)



2.7.9.4 $\overline{\text{HRDY}}$ Behavior During 32-bit Multiplexed-Mode Write Operations

Figure 17 shows an HPIC ($\text{HCNTL}[1:0] = 00\text{b}$) write access for 32-bit multiplexed HPI operation. Note that an HPIC write access does not cause $\overline{\text{HRDY}}$ to become active.

Figure 17. $\overline{\text{HRDY}}$ Behavior During an HPIC Write Cycle in the 32-Bit Multiplexed Mode

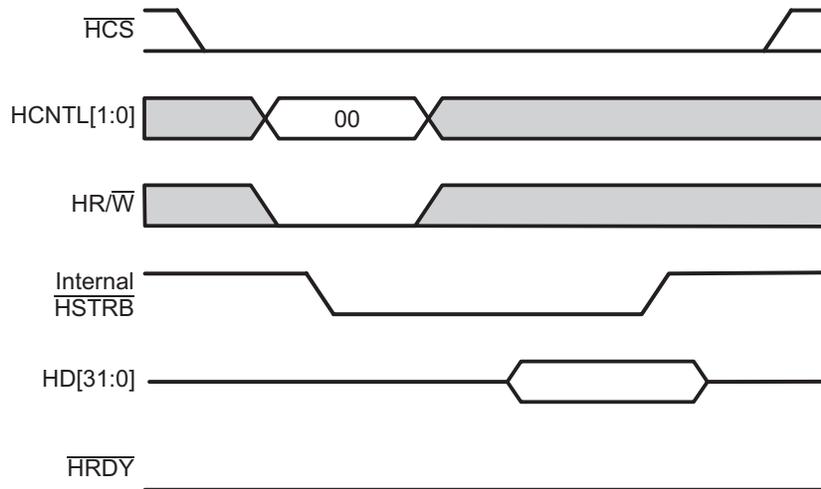


Figure 18 shows an HPIA ($\text{HCNTL}[1:0] = 10\text{b}$) write access followed by an HPID ($\text{HCNTL}[1:0] = 11\text{b}$) write access for 32-bit multiplexed HPI operation.

Figure 18. $\overline{\text{HRDY}}$ Behavior During a Data Write Operation in the 32-Bit Multiplexed Mode (Case 1: No Auto-incrementing)

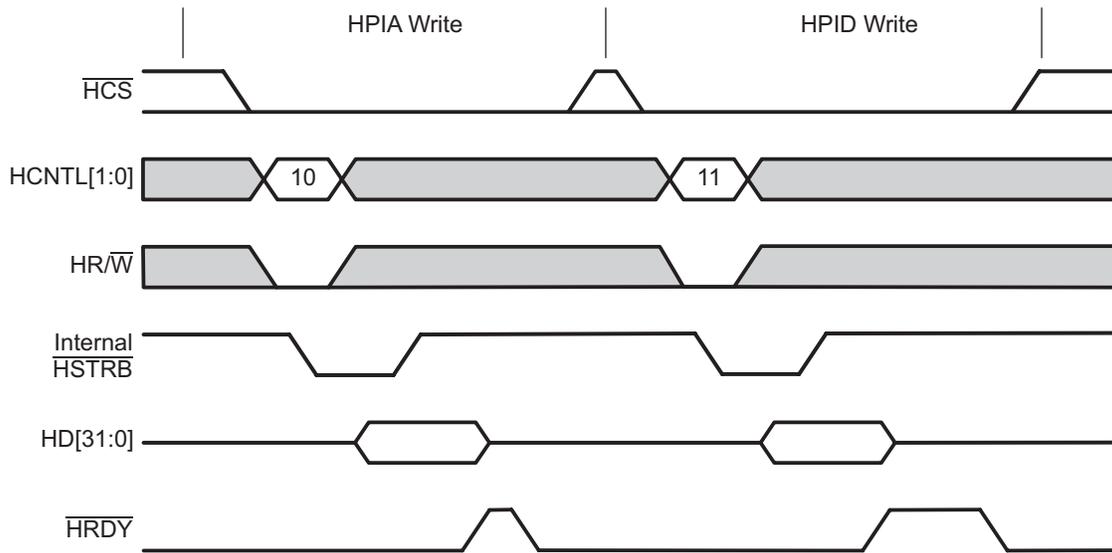


Figure 19 shows an HPIA ($\text{HCNTL}[1:0] = 10\text{b}$) write access followed by several auto-incrementing HPID ($\text{HCNTL}[1:0] = 01\text{b}$) write accesses when the write FIFO is empty. Note that $\overline{\text{HRDY}}$ is active during the HPIA access but not active during any of the HPID accesses.

Figure 19. $\overline{\text{HRDY}}$ Behavior During a Data Write Operation in the 32-Bit Multiplexed Mode (Case 2: Auto-incrementing Selected, FIFO Empty Before Write)

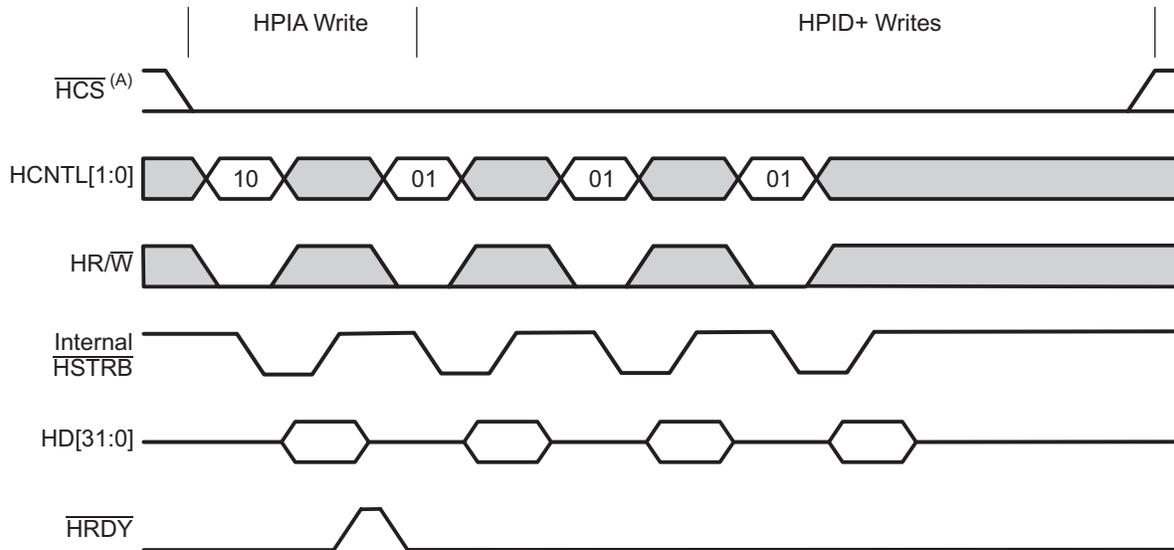
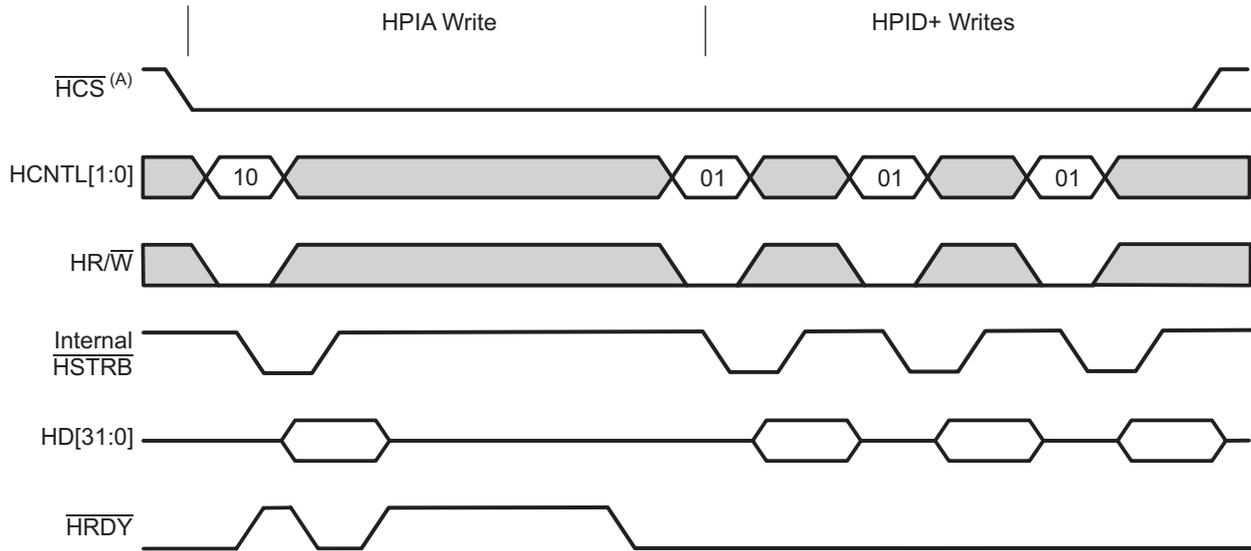


Figure 20 shows an HPIA ($\text{HCNTL}[1:0] = 10\text{b}$) write access when the write FIFO is not empty, followed by several auto-incrementing HPID ($\text{HCNTL}[1:0] = 01\text{b}$) write accesses. Note that $\overline{\text{HRDY}}$ is active twice for the HPIA access. This occurs because the FIFO is not empty and the data in the FIFO must first be written to memory. This results in an $\overline{\text{HRDY}}$ assertion immediately after the falling edge of the data-strobe (HSTRB). When a write request to memory has been made that will empty the internal FIFO, the HPIA write operation can complete with the rising edge of HSTRB . The second $\overline{\text{HRDY}}$ assertion is for the write to the HPIA register. $\overline{\text{HRDY}}$ is not active for the HPID accesses.

Figure 20. $\overline{\text{HRDY}}$ Behavior During a Data Write Operation in the 32-Bit Multiplexed Mode (Case 3: Auto-incrementing Selected, FIFO Not Empty Before Write)

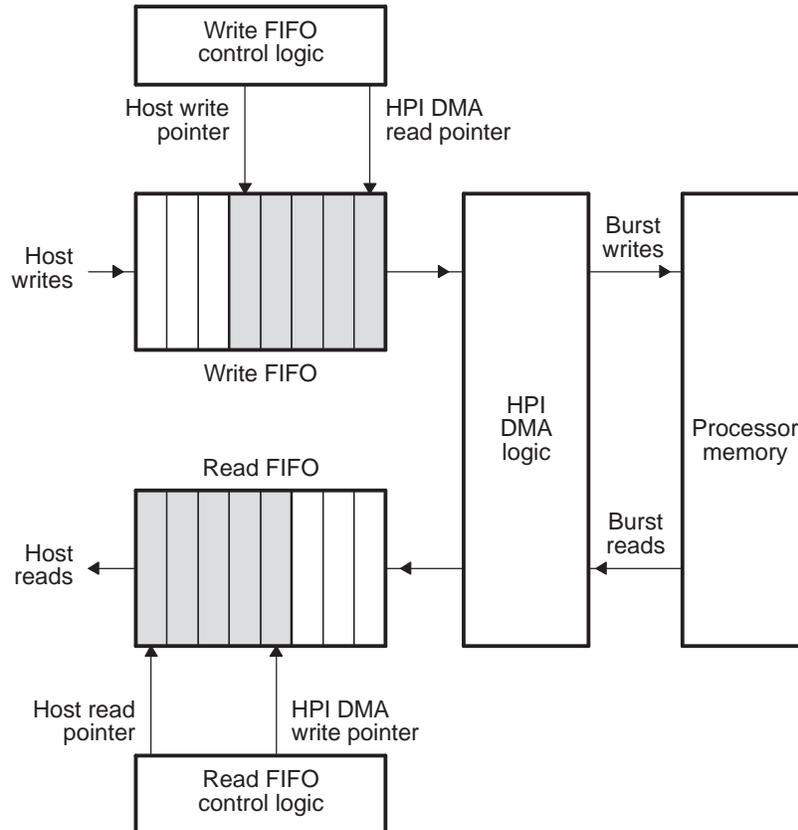


2.7.10 FIFOs and Bursting

The HPI data register (HPID) is a port through which the host accesses two first-in, first-out buffers (FIFOs). As shown in [Figure 21](#), a read FIFO supports host read cycles, and a write FIFO supports host write cycles. Both read and write FIFOs are 8-words deep (each word is 32 bits). If the host is performing multiple reads or writes to consecutive memory addresses (auto-increment HPID cycles), the FIFOs are used for bursting. The HPI DMA logic reads or writes a burst of four words at a time when accessing one of the FIFOs.

Bursting is essentially invisible to the host because the host interface signaling is not affected. Its benefit to the host is that the $\overline{\text{HRDY}}$ signal is de-asserted less often when there are multiple reads or writes to consecutive addresses.

Figure 21. FIFOs in the HPI



2.7.10.1 Read Bursting

When the host writes to the read address register (HPIAR), the read FIFO is flushed. Any host read data that was in the read FIFO is discarded (the read FIFO pointers are reset). If an HPI DMA write to the read FIFO is in progress at the time of a flush request, the HPI allows this write to complete and then performs the flush.

Read bursting can begin in one of two ways: the host initiates an HPID read cycle with auto-incrementing, or the host initiates issues a FETCH command (writes 1 to the FETCH bit in HPIC).

If the host initiates an HPID read cycle with auto-incrementing, the HPI DMA logic performs two 4-word burst operations to fill the read FIFO. The host is initially held off by the de-assertion of the $\overline{\text{HRDY}}$ signal until data is available to be read from the read FIFO. Once data is available in the read FIFO, the host can read data from the read FIFO by performing subsequent reads of HPID with auto-incrementing. Once the initial read has been performed, the HPI DMA logic continues to perform 4-word burst operations to consecutive memory addresses every time there are four empty word locations in the read FIFO. The HPI DMA logic continues to prefetch data to keep the read FIFO full, until the occurrence of an event that causes a read FIFO flush (see [Section 2.7.10.3](#)).

As mentioned, the second way that read bursting may begin is with a FETCH command. The host should always precede the FETCH command with the initialization of the HPIAR register or a nonauto-increment access, so that the read FIFO is flushed beforehand. When the host initiates a FETCH command, the HPI DMA logic begins to prefetch data to keep the read FIFO full, as described in the previous paragraph. The FETCH bit in HPIC does not actually store the value that is written to it; rather, the decoding of a host write of 1 to this bit is considered a FETCH command.

The FETCH command can be helpful if the host wants to minimize a stall condition on the interface. The host can initiate prefetching by writing 1 to the FETCH bit and later perform a read. The host can make use of the time it takes to load the read FIFO with read data, during which the HPI was not ready, by using the CPU to service other tasks.

Both types of continuous or burst reads described in the previous paragraphs begin with a write to the HPI address register, which causes a read FIFO flush. This is the typical way of initiating read cycles, because the initial read address needs to be specified.

Note: An HPID read cycle without auto-incrementing does not initiate any prefetching activity. Instead, it causes the read FIFO to be flushed and causes the HPI DMA logic to perform a single-word read from the processor memory. As soon as the host activates a read cycle without auto-incrementing, prefetching activity ceases until the occurrence of a FETCH command or an auto-increment read cycle.

2.7.10.2 Write Bursting

A write to the write address register (HPIAW) causes the write FIFO to be flushed. This means that any write data in the write FIFO is forced to its destination in the processor memory (the HPI DMA logic performs burst operations until the write FIFO is empty). When the FIFO has been flushed, the only action that will cause the HPI DMA logic to perform burst writes is a host write to HPID with auto-incrementing. The initial host-write data is stored in the write FIFO. An HPI DMA write is not requested until there are four words in the write FIFO. As soon as four words have been written to the FIFO via HPID write cycles with auto-incrementing, the HPI DMA logic performs a 4-word burst operation to the processor memory. The burst operations continue as long as there are at least four words in the FIFO. If the FIFO becomes full (eight words are waiting in the FIFO), the HPI holds off the host by de-asserting $\overline{\text{HRDY}}$ until at least one empty word location is available in the FIFO.

Because excessive time might pass between consecutive burst operations, the HPI has a time-out counter. If there are fewer than four words in the write FIFO and the time-out counter expires, the HPI DMA logic empties the FIFO immediately by performing a 2-word or 3-word burst, or a single-word write, as necessary. Every time new data is written to the write FIFO, the time-out counter is automatically reset to begin its count again. The time-out period is programmable and is configured by writing to the TIMOUT bits in the HPI configuration register (HPI_CTL). Note that you should only modify the TIMOUT bits once during device initialization. When modifying the TIMOUT bits, you must ensure that the HPI FIFOs are empty and there are no on-going HPI transactions.

In an actual system environment, the TIMOUT value should generally be set considerably larger than the typical time expected for the host to fill half of the FIFO. If the TIMOUT value is set less than this, HPI throughput performance can be significantly reduced due to excessive FIFO flushing that will result in more frequent not-ready conditions on the host interface, and decrease the overall effectiveness of the FIFO.

A practical worst-case value would be to set the timeout to the maximum latency that can be tolerated after the last word is written from the host before the HPI initiates a transfer to memory. Note that calculation of the value for worst-case latency should take into account the time required to perform the data transfer to memory, so that the overall system latency requirements are met.

Note: An HPID write cycle without auto-incrementing does not initiate any bursting activity. Instead, it causes the write FIFO to be flushed and causes the HPI DMA logic to perform a single-word write to the processor memory. As soon as the host activates a write cycle without auto-incrementing, bursting activity ceases until the occurrence of an auto-increment write cycle. A nonauto-increment write cycle always should be preceded by the initialization of HPIAW or by another nonauto-increment access, so that the write FIFO is flushed beforehand.

2.7.10.3 FIFO Flush Conditions

When specific conditions occur within the HPI, the read or write FIFO must be flushed to prevent the reading of stale data from the FIFOs. When a read FIFO flush condition occurs, all current host accesses and direct memory accesses (DMAs) to the read FIFO are allowed to complete. This includes DMAs that have been requested but not yet initiated. The read FIFO pointers are then reset, causing any read data to be discarded.

Similarly, when a write FIFO flush condition occurs, all current host accesses and DMAs to the write FIFO are allowed to complete. This includes DMAs that have been requested but not yet initiated. All posted writes in the FIFO are then forced to completion with a final burst or single-word write, as necessary.

If the host initiates an HPID host cycle during a FIFO flush, the cycle is held off with the de-assertion of $\overline{\text{HRDY}}$ until the flush is complete and the FIFO is ready to be accessed.

The following conditions cause the read and write FIFOs to be flushed:

- Read FIFO flush conditions:
 - A value from the host is written to the read address register (HPIAR).
 - The host performs an HPID read cycle without auto-incrementing.
- Write FIFO flush conditions:
 - A value from the host is written to the write address register (HPIAW).
 - The host performs an HPID write cycle without auto-incrementing.
 - The write-burst time-out counter expires.

When operating with $\text{DUALHPIA} = 0$, any read or write flush condition causes both read and write FIFOs to be flushed. In addition, the following scenarios cause both FIFOs to be flushed when $\text{DUALHPIA} = 0$:

- The host performs a write to the HPIA register.
- The host performs an HPID write cycle with auto-incrementing while the read FIFO is not empty (the read FIFO still contains data from prefetching or an HPID read cycle with auto-incrementing).
- The host performs an HPID read cycle with auto-incrementing while the write FIFO is not empty (there is still posted write data in the write FIFO).

This is useful in providing protection against reading stale data by reading a memory address when a previous write cycle has not been completed at the same address. Similarly, this protects against overwriting data at a memory address when a previous read cycle has not been completed at the same address.

When operating with $\text{DUALHPIA} = 1$ (HPIAR and HPIAW are independent), there is no such protection. However, when $\text{DUALHPIA} = 1$, data flow can occur in both directions without flushing both FIFOs simultaneously, thereby improving HPI bandwidth.

2.7.10.4 FIFO Behavior When a Hardware Reset Occurs

A hardware reset (RESET pin driven low) causes the FIFOs to be reset. The FIFO pointers are cleared, so that all data in the FIFOs are discarded. In addition, all associated FIFO logic is reset.

If a host cycle is active when a hardware or HPI software reset occurs, the $\overline{\text{HRDY}}$ signal is asserted (driven low), allowing the host to complete the cycle. When the cycle is complete, $\overline{\text{HRDY}}$ is de-asserted (driven high). Any access interrupted by a reset may result in corrupted read data or a lost write data (if the write does not actually update the intended memory or register). Although data may be lost, the host interface protocol is not violated. While either of reset condition is true, and the host is idle (internal $\overline{\text{HSTRB}}$ is held high), the FIFOs are held in reset, and host transactions are held off with an inactive $\overline{\text{HRDY}}$ signal.

2.8 Reset Considerations

The HPI has two reset sources: software reset and hardware reset.

2.8.1 Software Reset Considerations

The HPI is not affected by a software reset issued by the emulator.

2.8.2 Hardware Reset Considerations

When the entire processor is reset with the RESET pin:

- If the internal strobe signal, internal $\overline{\text{HSTRB}}$, is high (host is inactive), $\overline{\text{HRDY}}$ is driven low and remains low until the reset condition is over.

- If internal $\overline{\text{HSTRB}}$ is low (host cycle is active), $\overline{\text{HRDY}}$ is driven high, allowing the host to complete the cycle. When internal $\overline{\text{HSTRB}}$ goes high (cycle is complete), $\overline{\text{HRDY}}$ is driven low and remains low until the reset condition is over. If the active cycle was a write cycle, the memory or register may not have been correctly updated. If the active cycle was a read cycle, the fetched value may not be valid.
- The HPI registers are reset to their default values (see [Section 3](#)).
- The read and write FIFOs and the associated FIFO logic are reset (this includes a flush of the FIFOs).
- Host-to-CPU and CPU-to-host interrupts are cleared.

2.9 Initialization

The following steps are required to configure the HPI after a hardware reset:

1. Perform the necessary device pin multiplexing setup (see the device-specific data manual).
2. Choose how HPIAR and HPIAW will be controlled by configuring the DUALHPIA bit in HPIC.
3. Choose how halfword ordering will be handled by configuring the HWOB bit in HPIC.
4. Choose how the HPI will respond to emulation suspend events by configuring the FREE and SOFT bits in PWREMU_MGMT.
5. Choose the desired initial addresses and write the addresses to HPIAW and HPIAR, appropriately.

The HPI is now ready to perform data transactions.

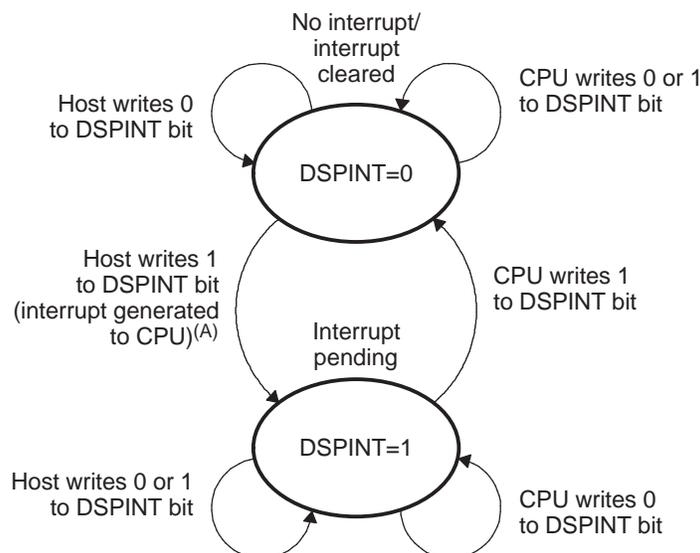
2.10 Interrupt Support

The host can interrupt the CPU via the DSPINT bit in HPIC, as described in [Section 2.10.1](#). The CPU can send an interrupt to the host by using the HINT bit in HPIC, as described in [Section 2.10.2](#).

2.10.1 DSPINT Bit: Host-to-CPU Interrupts

The DSPINT bit in HPIC allows the host to send an interrupt request to the CPU. The use of the DSPINT bit is summarized in [Figure 22](#).

Figure 22. Host-to-CPU Interrupt State Diagram



A When the DSPINT bit transitions from 0 to 1, an interrupt is generated to the CPU. No new interrupt can be generated until the CPU has cleared the bit (DSPINT = 0).

To interrupt the CPU, the host must:

1. Drive both HCNTL1 and HCNTL0 low to request a write to HPIC.

2. Write 1 to the DSPINT bit in HPIC.

When the host sets the DSPINT bit, the HPI generates an interrupt pulse to the CPU. If this maskable interrupt is properly enabled in the CPU, the CPU executes the corresponding interrupt service routine (ISR).

Before the host can use DSPINT to generate a subsequent interrupt to the CPU, the CPU must acknowledge the current interrupt by writing a 1 to the DSPINT bit. When the CPU writes 1, DSPINT is forced to 0. The host should verify that DSPINT = 0 before generating subsequent interrupts. While DSPINT = 1, host writes to the DSPINT bit do not generate an interrupt pulse.

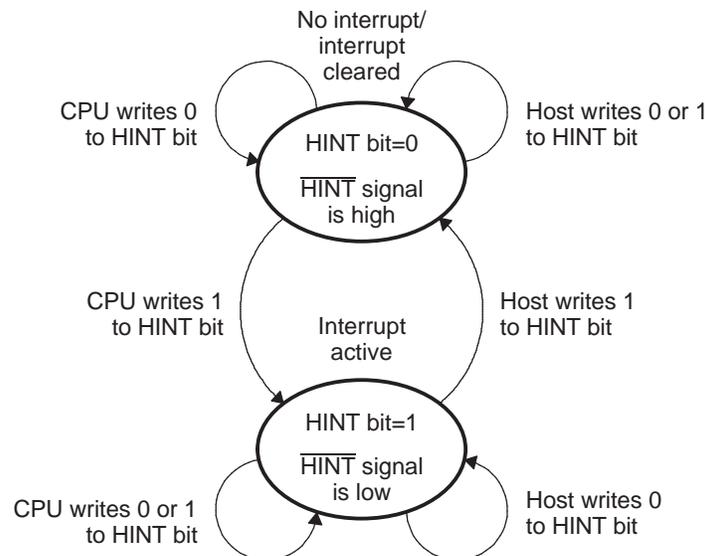
Writes of 0 have no effect. A hardware reset immediately clears DSPINT and thus clears an active host-to-CPU interrupt.

Note: When the HPIC is owned by the processor (not the host), the host is allowed to write into the interrupt fields in the HPIC register.

2.10.2 HINT Bit: CPU-to-Host Interrupts

The HINT bit in HPIC allows the CPU to send an interrupt request to the host. The use of the HINT bit is summarized in [Figure 23](#).

Figure 23. CPU-to-Host Interrupt State Diagram



If the CPU writes 1 to the HINT bit of HPIC, the HPI drives the $\overline{\text{HINT}}$ signal low, indicating an interrupt condition to the host. Before the CPU can use the HINT bit generate a subsequent interrupt to host, the host must acknowledge the current interrupt by writing 1 to the HINT bit. When the host does this, the HPI clears the HINT bit (HINT = 0), and this drives the $\overline{\text{HINT}}$ signal high. The CPU should read HPIC and make sure HINT = 0 before generating subsequent interrupts.

Writes of 0 have no effect. A hardware reset immediately clears the HINT bit and thus clears an active CPU-to-host interrupt.

Note: When the HPIC is owned by the processor (not the host), the host is allowed to write into the interrupt fields in the HPIC register.

2.10.3 Interrupt Multiplexing

The HPI has a single interrupt source to the DSP CPU. This interrupt source is not multiplexed with any other interrupt source on the CPU.

2.11 EDMA Event Support

The HPI does not provide synchronization events to the EDMA system. Memory accesses from the HPI are handled automatically, independent of the EDMA controller. The HPI controller has its own dedicated DMA and its operation and configuration are transparent.

2.12 Power Management

The HPI peripheral can be placed in reduced-power modes to conserve power during periods of low activity. The power management of the HPI peripheral is controlled by the processor Power and Sleep Controller (PSC). The PSC acts as a master controller for power management for all of the peripherals on the device. For detailed information on power management procedures using the PSC, see the Subsystem User's Guide.

2.13 Emulation Considerations

The FREE and SOFT bits in the power and emulation management register (PWREMU_MGMT) determine the response of the HPI to an emulation suspend condition. If FREE = 1, the HPI is not affected, and the SOFT bit has no effect. If FREE = 0 and SOFT = 0, the HPI is not affected. If FREE = 0 and SOFT = 1:

- The HPI DMA logic halts after the current host and HPI DMA operations are completed.
- The external host interface functions as normal throughout the emulation suspend condition. The host may access the control register (HPIC). The host may also access the HPIA registers and may perform data reads until the read FIFO is empty or data writes until the write FIFO is full. As in normal operation, $\overline{\text{HRDY}}$ is driven low during a host cycle that cannot be completed due to the write FIFO being full or the read FIFO being empty. If this occurs, $\overline{\text{HRDY}}$ continues to be driven low, holding off the host, until the emulation suspend condition is over, and the FIFOs are serviced by the HPI DMA logic, allowing the host cycle to complete.
- When the emulation suspend condition is over, the appropriate requests by the HPI DMA logic are made to process any posted host writes in the write FIFO or to fill the read FIFO as necessary. HPI operation then continues as normal.

3 Registers

[Table 5](#) lists the memory-mapped registers for the HPI. See the device-specific data manual for the memory addresses of these registers.

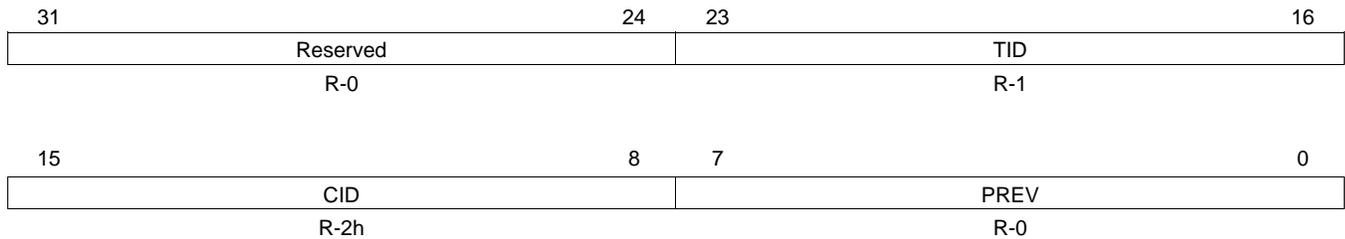
Table 5. HPI Registers Relative to Base Address 0200 0030h

Offset	Acronym	Register Description	Section
0h	PID	Peripheral Identification Register	Section 3.1
4h	PWREMU_MGMT	Power and Emulation Management Register	Section 3.2
30h	HPIC	Host Port Interface Control Register	Section 3.3
34h	HPIAW	Host Port Interface Write Address Register	Section 3.4
38h	HPIAR	Host Port Interface Read Address Register	Section 3.5

3.1 Peripheral Identification Register (PID)

The peripheral identification register (PID) contains identification data (class, revision, and type) for the peripheral. PID is shown in [Figure 24](#) and described in [Table 6](#).

Figure 24. Peripheral Identification Register (PID)



LEGEND: R = Read only; -n = value after reset

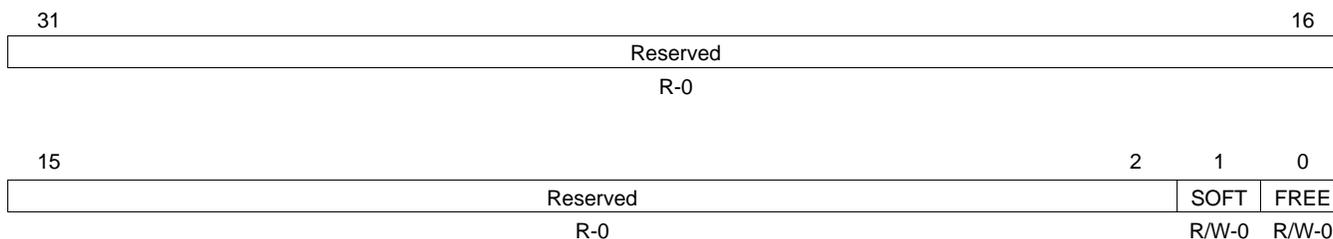
Table 6. Peripheral Identification Register (PID) Field Descriptions

Bit	Field	Value	Description
31-24	Reserved	0	Reserved
23-16	TID	0-Fh 1	Identifies type of peripheral. HPI module
15-8	CID	0-Fh 2h	Identifies class of peripheral. Host port.
7-0	PREV	0-Fh 2h	Identifies revision of peripheral. Current revision of peripheral.

3.2 Power and Emulation Management Register (PWREMU_MGMT)

The power and emulation management register (PWREMU_MGMT) determines the emulation mode of the HPI. PWREMU_MGMT is shown in [Figure 25](#) and described in [Table 7](#).

Figure 25. Power and Emulation Management Register (PWREMU_MGMT)



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 7. Power and Emulation Management Register (PWREMU_MGMT) Field Descriptions

Bit	Field	Value	Description
31-2	Reserved	0	Reserved
1	SOFT	0	Determines emulation mode functionality of the HPI. When the FREE bit is cleared to 0, the SOFT bit selects the HPI mode. Upon emulation suspend, the HPI operation is not affected.
		1	In response to an emulation suspend event, the HPI logic halts after the current HPI transaction is completed.
0	FREE	0	Free run emulation control. Determines emulation mode functionality of the HPI. When the FREE bit is cleared to 0, the SOFT bit selects the HPI mode. The SOFT bit selects the HPI mode.
		1	The HPI runs free regardless of the SOFT bit.

3.3 Host Port Interface Control Register (HPIC)

The host port interface control register (HPIC) stores configuration and control information for the HPI. As shown in [Figure 26](#) and [Figure 27](#) and described in [Table 8](#), the owner (Host) and non-owner (DSP) do not have the same access permissions. The owner (Host) of HPIC has full read/write access; the non-owner (DSP) of HPIC has primarily read-only access, but the exceptions are:

- the non-owner (DSP) can write 1 to the HINT bit to generate an interrupt to the host.
- the non-owner (DSP) can write 1 to HPI_RST bit to cause an HPI software reset.

Figure 26. Host Port Interface Control Register (HPIC) – Owner (Host) Access Permissions

31							16								
Reserved															
R-0															
15					12			11		10		9		8	
Reserved					HPIASEL			Reserved		DUALHPIA		HWOBSTAT			
R-0					R/W-0			R/W-0		R/W-0		R-0			
7		6		5		4		3		2		1		0	
HPI_RST		Reserved		FETCH		Reserved		HINT		DSPINT		HWOB			
(1)		R/W-0		R/W-0		R-1		R/W1C-0		R/W-0		R/W-0			

LEGEND: R/W = Read/Write; R = Read only; W1C = Write 1 to clear (writing 0 has no effect); -n = value after reset

(1) Default value after reset = 0, when HPI boot used. See [Table 8](#) for details.

Figure 27. Host Port Interface Control Register (HPIC)–Non-owner (DSP) Access Permissions

31							16								
Reserved															
R-0															
15					12			11		10		9		8	
Reserved					HPIASEL			Reserved		DUALHPIA		HWOBSTAT			
R-0					R-0			R-0		R-0		R-0			
7		6		5		4		3		2		1		0	
HPI_RST		Reserved		FETCH		Reserved		HINT		DSPINT		HWOB			
(1)		R-0		R-0		R-1		R/W-0		R/W1C-0		R-0			

LEGEND: R/W = Read/Write; R = Read only; W1C = Write 1 to clear (writing 0 has no effect); -n = value after reset

(1) Default value after reset = 0, when HPI boot used. See [Table 8](#) for details.

Table 8. Host Port Interface Control Register (HPIC) Field Descriptions

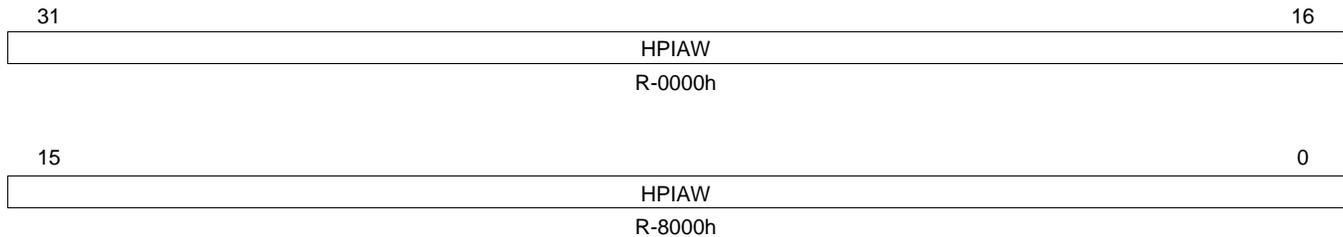
Bit	Field	Value	Description
31-12	Reserved	0	Reserved
11	HPIASEL	0 1	HPI address register select bit. When DUALHPIA = 1, the HPIASEL bit is used to select the HPI address register to be accessed. Selects the HPI write address register (HPIAW). Selects the HPI read address register (HPIAR).
10	Reserved	0	Reserved. Always write 0 to this bit.
9	DUALHPIA	0 1	Dual HPIA mode configuration bit. The CPU can access both HPI address registers separately, regardless of the DUALHPIA setting. (Regardless of this bit, dual HPIA mode is implied when the CPU has ownership of the HPI address registers). The two HPI address registers (HPIAW and HPIAR) operate as a single HPI address register in terms of host accesses. Dual HPIA mode operation is enabled.
8	HWOBSTAT	0 1	HWOB status. The value of the HWOB bit is also stored in this bit position. A write to the HWOB bit also updates HWOBSTAT. HWOB bit is logic 0. HWOB bit is logic 1.
7	HPI_RST	0 1	HPI reset Default value after reset, when HPI boot used Default value after reset, when boot other than HPI is used. The DSP must clear this bit before making any host access through HPI.
6-5	Reserved		Reserved. Always write 0 to this bit.
4	FETCH		Host data fetch request bit. Only the host may write to FETCH. When a host writes a 1 to FETCH, a request is posted in the HPI to prefetch data into the read FIFO. Host and CPU reads of FETCH return a 0.
3	Reserved	1	Reserved
2	HINT	0 1	Processor-to-host interrupt. The CPU writes a 1 to HINT to generate a host interrupt. HINT has an inverted logic level to the $\overline{\text{HINT}}$ pin. The host must write a 1 to HINT to clear the $\overline{\text{HINT}}$ pin; writing a 0 to HINT by the host or processor has no effect. No effect. A CPU write generates a host interrupt ($\overline{\text{HINT}}$ signal goes low). A host write sets the $\overline{\text{HINT}}$ signal high (clears the interrupt).
1	DSPINT	0 1	Host-to-processor interrupt. The host writes a 1 to DSPINT to generate a processor interrupt; writing a 0 to DSPINT by the host or processor has no effect. No effect A host write generates a processor interrupt. A DSP write clears the interrupt/bit.
0	HWOB	0 1	Halfword ordering bit. HWOB affects both data and address transfers. HWOB must be initialized before the first data or address register access. First halfword is most significant. First halfword is least significant.

3.4 Host Port Interface Write Address Register (HPIAW)

The HPI contains two 32-bit address registers: one for read operations (HPIAR) and one for write operations (HPIAW). The host port interface write address register (HPIAW) is shown in [Figure 28](#) and described in [Table 9](#). The HPI can be configured such that HPIAR and HPIAW act as a single 32-bit HPIA (single-HPIA mode) or as two separate 32-bit HPIAs (dual-HPIA mode) from the perspective of the host. For details about these HPIA modes, see [Section 2.7.1](#).

Note that the addresses loaded into the HPI address registers must be word addresses, and must be 32-bit word aligned (with the least-significant two bits equal to zero), for use in addressing memory space within the DM648.

Figure 28. Host Port Interface Write Address Register (HPIAW)



LEGEND: R = Read only; -n = value after reset

Table 9. Host Port Interface Write Address Register (HPIAW) Field Descriptions

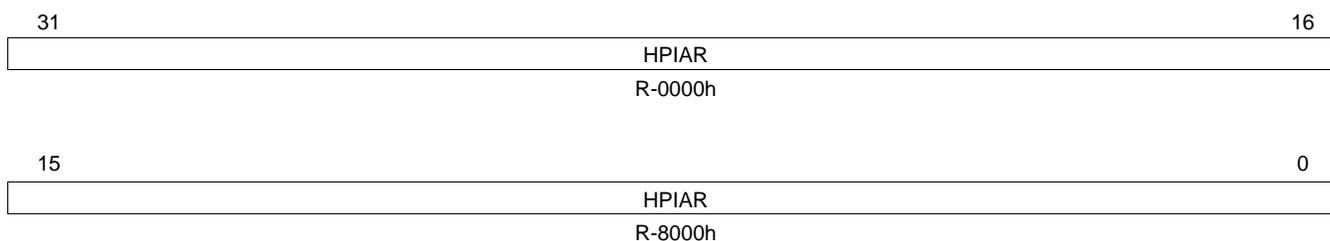
Bit	Field	Value	Description
31-0	HPIAW	0-FFFF FFFFh	Host port interface write address.

3.5 Host Port Interface Read Address Register (HPIAR)

The HPI contains two 32-bit address registers: one for read operations (HPIAR) and one for write operations (HPIAW). The host port interface read address register (HPIAR) is shown in Figure 29 and described in Table 10. The HPI can be configured such that HPIAR and HPIAW act as a single 32-bit HPIA (single-HPIA mode) or as two separate 32-bit HPIAs (dual-HPIA mode) from the perspective of the host. For details about these HPIA modes, see Section 2.7.1.

Note that the addresses loaded into the HPI address registers must be word addresses, and must be 32-bit word aligned (with the least-significant two bits equal to zero), for use in addressing memory space within the DM648.

Figure 29. Host Port Interface Read Address Register (HPIAR)



LEGEND: R = Read only; -n = value after reset

Table 10. Host Port Interface Read Address Register (HPIAR) Field Descriptions

Bit	Field	Value	Description
31-0	HPIAR	0-FFFF FFFFh	Host port interface read address.

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