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## REVISION HISTORY

### 2/14—Rev. 0 to Rev. A

Added the system clock output specification and additional peripheral external clocks in [Clock Related Operating Conditions on Page 53](#). These changes affect the following peripheral timing sections.

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Additional revisions include the following.

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| Corrected S0SEL and S1SEL in <a href="#">Figure 8 Clock Relationships and Divider Values</a> .....                   | 54 |
| Revised the dynamic and static current tables <a href="#">CCLK Dynamic Current per core (mA, with ASF = 1)</a> ..... | 57 |
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| Corrected the $t_{\text{WARE}}$ parameter in <a href="#">Asynchronous Page Mode Read</a> .....                       | 64 |
| Corrected the timing diagram in <a href="#">Bus Request/Bus Grant</a> .                                              | 69 |

Corrected the signal names in the following figures:

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| <a href="#">DDR2 SDRAM Clock and Control Cycle Timing</a> .....                                                                                                                                                          | 69  |
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| Corrected the $t_{\text{HSPIDM}}$ , $t_{\text{SDSCIM}}$ , $t_{\text{SPICLK}}$ , $t_{\text{HDSM}}$ , and $t_{\text{SPITDM}}$ specifications in <a href="#">Serial Peripheral Interface (SPI) Port—Master Timing</a> ..... | 86  |
| Corrected the $t_{\text{HDSPID}}$ specification in <a href="#">Serial Peripheral Interface (SPI) Port—Slave Timing</a> .....                                                                                             | 88  |
| Corrected $t_{\text{SRDYSCKM1}}$ in <a href="#">Serial Peripheral Interface (SPI) Port—SPI_RDY Timing</a> .....                                                                                                          | 92  |
| Revised all parameters in <a href="#">Timer Cycle Timing</a> .....                                                                                                                                                       | 94  |
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| Removed TWI signals in footnote 3 in <a href="#">JTAG Test And Emulation Port Timing</a> .....                                                                                                                           | 101 |
| Added models to <a href="#">Automotive Products</a> .....                                                                                                                                                                | 112 |

## GENERAL DESCRIPTION

The ADSP-BF60x processors are members of the Blackfin family of products, incorporating the Analog Devices/Intel Micro Signal Architecture (MSA). Blackfin processors combine a dual-MAC state-of-the-art signal processing engine, the advantages of a clean, orthogonal RISC-like microprocessor instruction set, and single-instruction, multiple-data (SIMD) multimedia capabilities into a single instruction-set architecture.

The processors offer performance up to 500 MHz, as well as low static power consumption. Produced with a low-power and low-voltage design methodology, they provide world-class power management and performance.

By integrating a rich set of industry-leading system peripherals and memory (shown in Table 1), Blackfin processors are the platform of choice for next-generation applications that require RISC-like programmability, multimedia support, and leading-edge signal processing in one integrated package. These applications span a wide array of markets, from automotive systems to embedded industrial, instrumentation and power/motor control applications.

**Table 1. Processor Comparison**

| Processor Feature                                              | ADSP-BF606 | ADSP-BF607 | ADSP-BF608 | ADSP-BF609 |
|----------------------------------------------------------------|------------|------------|------------|------------|
| Up/Down/Rotary Counters                                        | 1          |            |            |            |
| Timer/Counters with PWM                                        | 8          |            |            |            |
| 3-Phase PWM Units (4-pair)                                     | 2          |            |            |            |
| SPORTs                                                         | 3          |            |            |            |
| SPIs                                                           | 2          |            |            |            |
| USB OTG                                                        | 1          |            |            |            |
| Parallel Peripheral Interface                                  | 3          |            |            |            |
| Removable Storage Interface                                    | 1          |            |            |            |
| CAN                                                            | 1          |            |            |            |
| TWI                                                            | 2          |            |            |            |
| UART                                                           | 2          |            |            |            |
| ADC Control Module (ACM)                                       | 1          |            |            |            |
| Link Ports                                                     | 4          |            |            |            |
| Ethernet MAC (IEEE 1588)                                       | 2          |            |            |            |
| Pixel Compositor (PIXC)                                        | No         | 1          | 1          |            |
| Pipelined Vision Processor (PVP) Video Resolution <sup>1</sup> | No         | VGA        | HD         |            |
| Maximum PVP Line Buffer Size                                   | N/A        | 640        | 1280       |            |
| GPIOs                                                          | 112        |            |            |            |

**Table 1. Processor Comparison (Continued)**

| Processor Feature                      | ADSP-BF606                | ADSP-BF607 | ADSP-BF608 | ADSP-BF609 |     |
|----------------------------------------|---------------------------|------------|------------|------------|-----|
| Memory (bytes, per core)               | L1 Instruction SRAM       |            |            |            | 64K |
|                                        | L1 Instruction SRAM/Cache |            |            |            | 16K |
|                                        | L1 Data SRAM              |            |            |            | 32K |
|                                        | L1 Data SRAM/Cache        |            |            |            | 32K |
|                                        | L1 Scratchpad             |            |            |            | 4K  |
|                                        | L2 Data SRAM              |            | 128K       | 256K       |     |
|                                        | L2 Boot ROM               |            |            |            | 32K |
| Maximum Speed Grade (MHz) <sup>2</sup> | 400                       | 500        |            |            |     |
| Maximum SYSCLK (MHz)                   | 250                       |            |            |            |     |
| Package Options                        | 349-Ball CSP BGA          |            |            |            |     |

<sup>1</sup> VGA is 640 × 480 pixels per frame. HD is 1280 × 960 pixels per frame.

<sup>2</sup> Maximum speed grade is not available with every possible SYSCLK selection.

## BLACKFIN PROCESSOR CORE

As shown in Figure 1, the processor integrates two Blackfin processor cores. Each core, shown in Figure 2, contains two 16-bit multipliers, two 40-bit accumulators, two 40-bit ALUs, four video ALUs, and a 40-bit shifter. The computation units process 8-, 16-, or 32-bit data from the register file.

The compute register file contains eight 32-bit registers. When performing compute operations on 16-bit operand data, the register file operates as 16 independent 16-bit registers. All operands for compute operations come from the multiported register file and instruction constant fields.

Each MAC can perform a 16-bit by 16-bit multiply in each cycle, accumulating the results into the 40-bit accumulators. Signed and unsigned formats, rounding, and saturation are supported.

The ALUs perform a traditional set of arithmetic and logical operations on 16-bit or 32-bit data. In addition, many special instructions are included to accelerate various signal processing tasks. These include bit operations such as field extract and population count, modulo  $2^{32}$  multiply, divide primitives, saturation and rounding, and sign/exponent detection. The set of video instructions include byte alignment and packing operations, 16-bit and 8-bit adds with clipping, 8-bit average operations, and 8-bit subtract/absolute value/accumulate (SAA) operations. Also provided are the compare/select and vector search instructions.

For certain instructions, two 16-bit ALU operations can be performed simultaneously on register pairs (a 16-bit high half and 16-bit low half of a compute register). If the second ALU is used, quad 16-bit operations are possible.

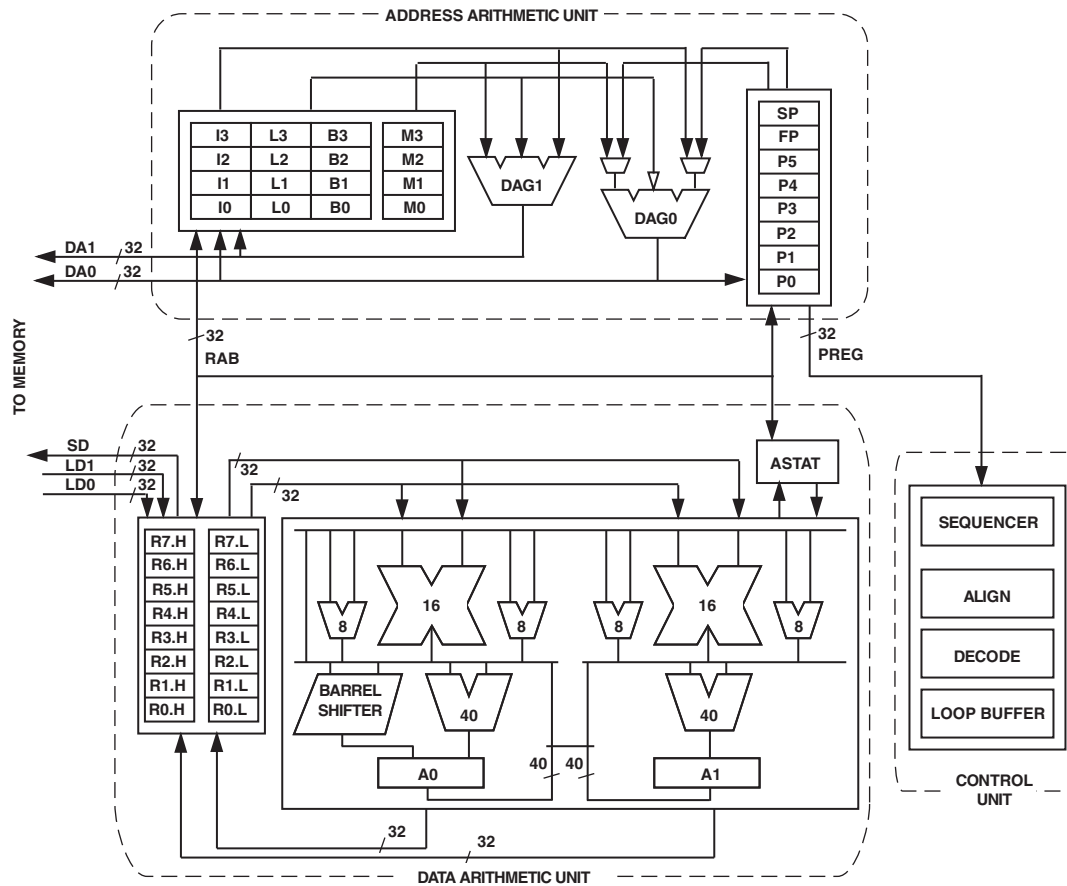


Figure 2. Blackfin Processor Core

The 40-bit shifter can perform shifts and rotates and is used to support normalization, field extract, and field deposit instructions.

The program sequencer controls the flow of instruction execution, including instruction alignment and decoding. For program flow control, the sequencer supports PC relative and indirect conditional jumps (with static branch prediction), and subroutine calls. Hardware supports zero-overhead looping. The architecture is fully interlocked, meaning that the programmer need not manage the pipeline when executing instructions with data dependencies.

The address arithmetic unit provides two addresses for simultaneous dual fetches from memory. It contains a multiported register file consisting of four sets of 32-bit index, modify, length, and base registers (for circular buffering), and eight additional 32-bit pointer registers (for C-style indexed stack manipulation).

Blackfin processors support a modified Harvard architecture in combination with a hierarchical memory structure. Level 1 (L1) memories are those that typically operate at the full processor speed with little or no latency. At the L1 level, the instruction memory holds instructions only. The data memory holds data, and a dedicated scratchpad data memory stores stack and local variable information.

In addition, multiple L1 memory blocks are provided, offering a configurable mix of SRAM and cache. The memory management unit (MMU) provides memory protection for individual tasks that may be operating on the core and can protect system registers from unintended access.

The architecture provides three modes of operation: user mode, supervisor mode, and emulation mode. User mode has restricted access to certain system resources, thus providing a protected software environment, while supervisor mode has unrestricted access to the system and core resources.

## INSTRUCTION SET DESCRIPTION

The Blackfin processor instruction set has been optimized so that 16-bit opcodes represent the most frequently used instructions, resulting in excellent compiled code density. Complex DSP instructions are encoded into 32-bit opcodes, representing fully featured multifunction instructions. Blackfin processors support a limited multi-issue capability, where a 32-bit instruction can be issued in parallel with two 16-bit instructions, allowing the programmer to use many of the core resources in a single instruction cycle.

The Blackfin processor family assembly language instruction set employs an algebraic syntax designed for ease of coding and readability. The instructions have been specifically tuned to provide a flexible, densely encoded instruction set that compiles to

a very small final memory size. The instruction set also provides fully featured multifunction instructions that allow the programmer to use many of the processor core resources in a single instruction. Coupled with many features more often seen on microcontrollers, this instruction set is very efficient when compiling C and C++ source code. In addition, the architecture supports both user (algorithm/application code) and supervisor (O/S kernel, device drivers, debuggers, ISRs) modes of operation, allowing multiple levels of access to core processor resources.

The assembly language, which takes advantage of the processor's unique architecture, offers the following advantages:

- Seamlessly integrated DSP/MCU features are optimized for both 8-bit and 16-bit operations.
- A multi-issue load/store modified-Harvard architecture, which supports two 16-bit MAC or four 8-bit ALU + two load/store + two pointer updates per cycle.
- All registers, I/O, and memory are mapped into a unified 4G byte memory space, providing a simplified programming model.
- Control of all asynchronous and synchronous events to the processor is handled by two subsystems: the Core Event Controller (CEC) and the System Event Controller (SEC).
- Microcontroller features, such as arbitrary bit and bit-field manipulation, insertion, and extraction; integer operations on 8-, 16-, and 32-bit data-types; and separate user and supervisor stack pointers.
- Code density enhancements, which include intermixing of 16-bit and 32-bit instructions (no mode switching, no code segregation). Frequently used instructions are encoded in 16 bits.

## PROCESSOR INFRASTRUCTURE

The following sections provide information on the primary infrastructure components of the ADSP-BF609 processor.

### DMA Controllers

The processor uses Direct Memory Access (DMA) to transfer data within memory spaces or between a memory space and a peripheral. The processor can specify data transfer operations and return to normal processing while the fully integrated DMA controller carries out the data transfers independent of processor activity.

DMA transfers can occur between memory and a peripheral or between one memory and another memory. Each Memory-to-memory DMA stream uses two channels, where one channel is the source channel, and the second is the destination channel.

All DMAs can transport data to and from all on-chip and off-chip memories. Programs can use two types of DMA transfers, descriptor-based or register-based. Register-based DMA allows the processor to directly program DMA control registers to initiate a DMA transfer. On completion, the control registers may be automatically updated with their original setup values for continuous transfer. Descriptor-based DMA transfers require a set of parameters stored within memory to initiate a DMA

sequence. Descriptor-based DMA transfers allow multiple DMA sequences to be chained together and a DMA channel can be programmed to automatically set up and start another DMA transfer after the current sequence completes.

The DMA controller supports the following DMA operations.

- A single linear buffer that stops on completion.
- A linear buffer with negative, positive or zero stride length.
- A circular, auto-refreshing buffer that interrupts when each buffer becomes full.
- A similar buffer that interrupts on fractional buffers (for example, 1/2, 1/4).
- 1D DMA – uses a set of identical ping-pong buffers defined by a linked ring of two-word descriptor sets, each containing a link pointer and an address.
- 1D DMA – uses a linked list of 4 word descriptor sets containing a link pointer, an address, a length, and a configuration.
- 2D DMA – uses an array of one-word descriptor sets, specifying only the base DMA address.
- 2D DMA – uses a linked list of multi-word descriptor sets, specifying everything.

### CRC Protection

The two CRC protection modules allow system software to periodically calculate the signature of code and/or data in memory, the content of memory-mapped registers, or communication message objects. Dedicated hardware circuitry compares the signature with pre calculated values and triggers appropriate fault events.

For example, every 100 ms the system software might initiate the signature calculation of the entire memory contents and compare these contents with expected, pre calculated values. If a mismatch occurs, a fault condition can be generated (via the processor core or the trigger routing unit).

The CRC is a hardware module based on a CRC32 engine that computes the CRC value of the 32-bit data words presented to it. Data is provided by the source channel of the memory-to-memory DMA (in memory scan mode) and is optionally forwarded to the destination channel (memory transfer mode).

The main features of the CRC peripheral are:

- Memory scan mode
- Memory transfer mode
- Data verify mode
- Data fill mode
- User-programmable CRC32 polynomial
- Bit/byte mirroring option (endianness)
- Fault/error interrupt mechanisms
- 1D and 2D fill block to initialize array with constants.
- 32-bit CRC signature of a block of a memory or MMR block.

## Event Handling

The processor provides event handling that supports both nesting and prioritization. Nesting allows multiple event service routines to be active simultaneously. Prioritization ensures that servicing of a higher-priority event takes precedence over servicing of a lower-priority event. The processor provides support for five different types of events:

- Emulation – An emulation event causes the processor to enter emulation mode, allowing command and control of the processor via the JTAG interface.
- Reset – This event resets the processor.
- Nonmaskable Interrupt (NMI) – The NMI event can be generated either by the software watchdog timer, by the NMI input signal to the processor, or by software. The NMI event is frequently used as a power-down indicator to initiate an orderly shutdown of the system.
- Exceptions – Events that occur synchronously to program flow (in other words, the exception is taken before the instruction is allowed to complete). Conditions such as data alignment violations and undefined instructions cause exceptions.
- Interrupts – Events that occur asynchronously to program flow. They are caused by input signals, timers, and other peripherals, as well as by an explicit software instruction.

## Core Event Controller (CEC)

The CEC supports nine general-purpose interrupts (IVG15–7), in addition to the dedicated interrupt and exception events. Of these general-purpose interrupts, the two lowest-priority interrupts (IVG15–14) are recommended to be reserved for software interrupt handlers. For more information, see the *ADSP-BF60x Processor Programmer's Reference*.

## System Event Controller (SEC)

The SEC manages the enabling, prioritization, and routing of events from each system interrupt or fault source. Additionally, it provides notification and identification of the highest priority active system interrupt request to each core and routes system fault sources to its integrated fault management unit.

## Trigger Routing Unit (TRU)

The TRU provides system-level sequence control without core intervention. The TRU maps trigger masters (generators of triggers) to trigger slaves (receivers of triggers). Slave endpoints can be configured to respond to triggers in various ways. Common applications enabled by the TRU include:

- Automatically triggering the start of a DMA sequence after a sequence from another DMA channel completes
- Software triggering
- Synchronization of concurrent activities

## Pin Interrupts

Every port pin on the processor can request interrupts in either an edge-sensitive or a level-sensitive manner with programmable polarity. Interrupt functionality is decoupled from GPIO

operation. Six system-level interrupt channels (PINT0–5) are reserved for this purpose. Each of these interrupt channels can manage up to 32 interrupt pins. The assignment from pin to interrupt is not performed on a pin-by-pin basis. Rather, groups of eight pins (half ports) can be flexibly assigned to interrupt channels.

Every pin interrupt channel features a special set of 32-bit memory-mapped registers that enable half-port assignment and interrupt management. This includes masking, identification, and clearing of requests. These registers also enable access to the respective pin states and use of the interrupt latches, regardless of whether the interrupt is masked or not. Most control registers feature multiple MMR address entries to write-one-to-set or write-one-to-clear them individually.

## General-Purpose I/O (GPIO)

Each general-purpose port pin can be individually controlled by manipulation of the port control, status, and interrupt registers:

- GPIO direction control register – Specifies the direction of each individual GPIO pin as input or output.
- GPIO control and status registers – A “write one to modify” mechanism allows any combination of individual GPIO pins to be modified in a single instruction, without affecting the level of any other GPIO pins.
- GPIO interrupt mask registers – Allow each individual GPIO pin to function as an interrupt to the processor. GPIO pins defined as inputs can be configured to generate hardware interrupts, while output pins can be triggered by software interrupts.
- GPIO interrupt sensitivity registers – Specify whether individual pins are level- or edge-sensitive and specify—if edge-sensitive—whether just the rising edge or both the rising and falling edges of the signal are significant.

## Pin Multiplexing

The processor supports a flexible multiplexing scheme that multiplexes the GPIO pins with various peripherals. A maximum of 4 peripherals plus GPIO functionality is shared by each GPIO pin. All GPIO pins have a bypass path feature – that is, when the output enable and the input enable of a GPIO pin are both active, the data signal before the pad driver is looped back to the receive path for the same GPIO pin. [For more information, see GP I/O Multiplexing for 349-Ball CSP\\_BGA on Page 33.](#)

## MEMORY ARCHITECTURE

The processor views memory as a single unified 4G byte address space, using 32-bit addresses. All resources, including internal memory, external memory, and I/O control registers, occupy separate sections of this common address space. The memory portions of this address space are arranged in a hierarchical structure to provide a good cost/performance balance of some very fast, low-latency core-accessible memory as cache or SRAM, and larger, lower-cost and performance interface-accessible memory systems. See [Figure 3](#) and [Figure 4](#).

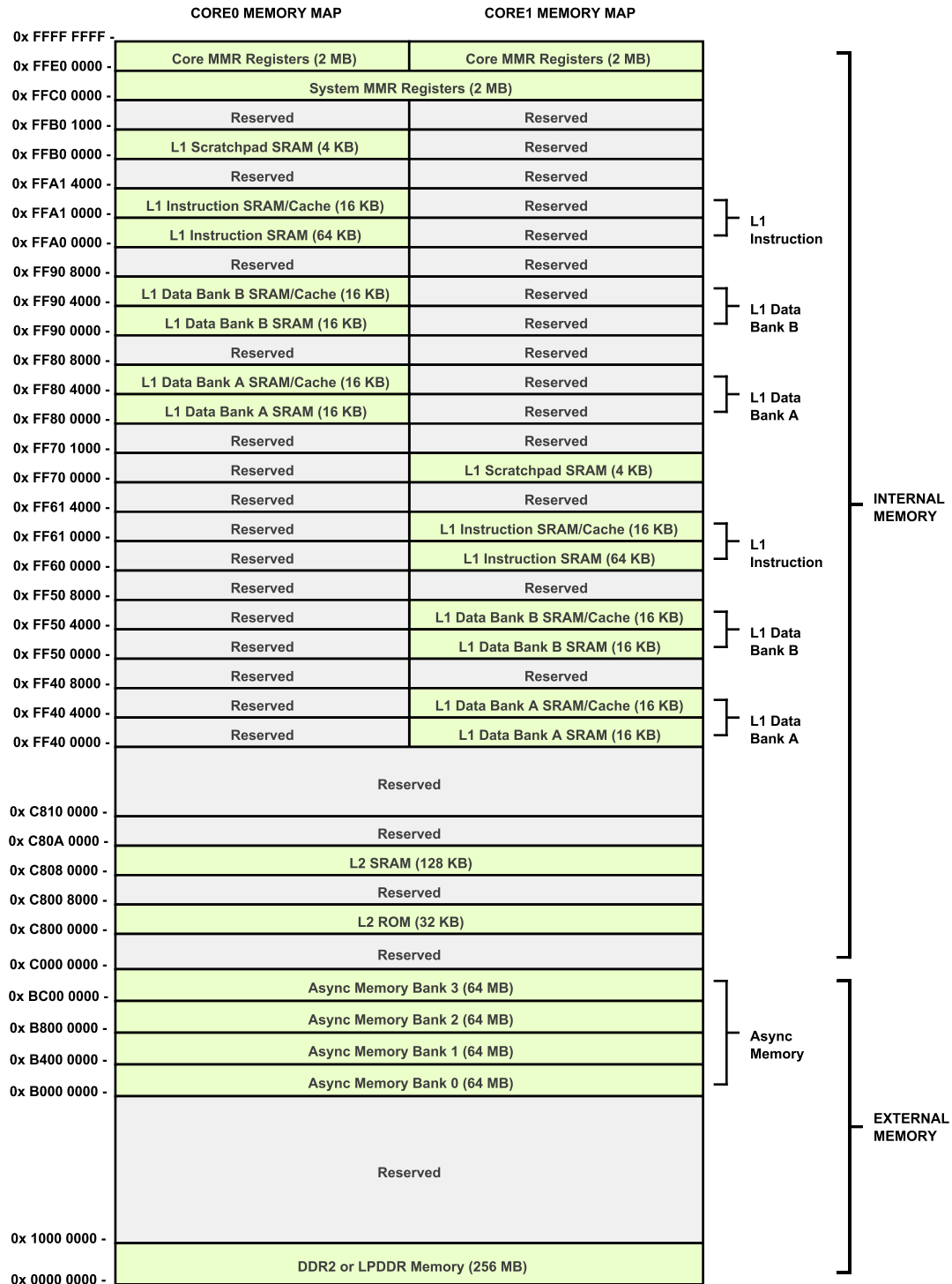


Figure 3. ADSP-BF606 Internal/External Memory Map

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

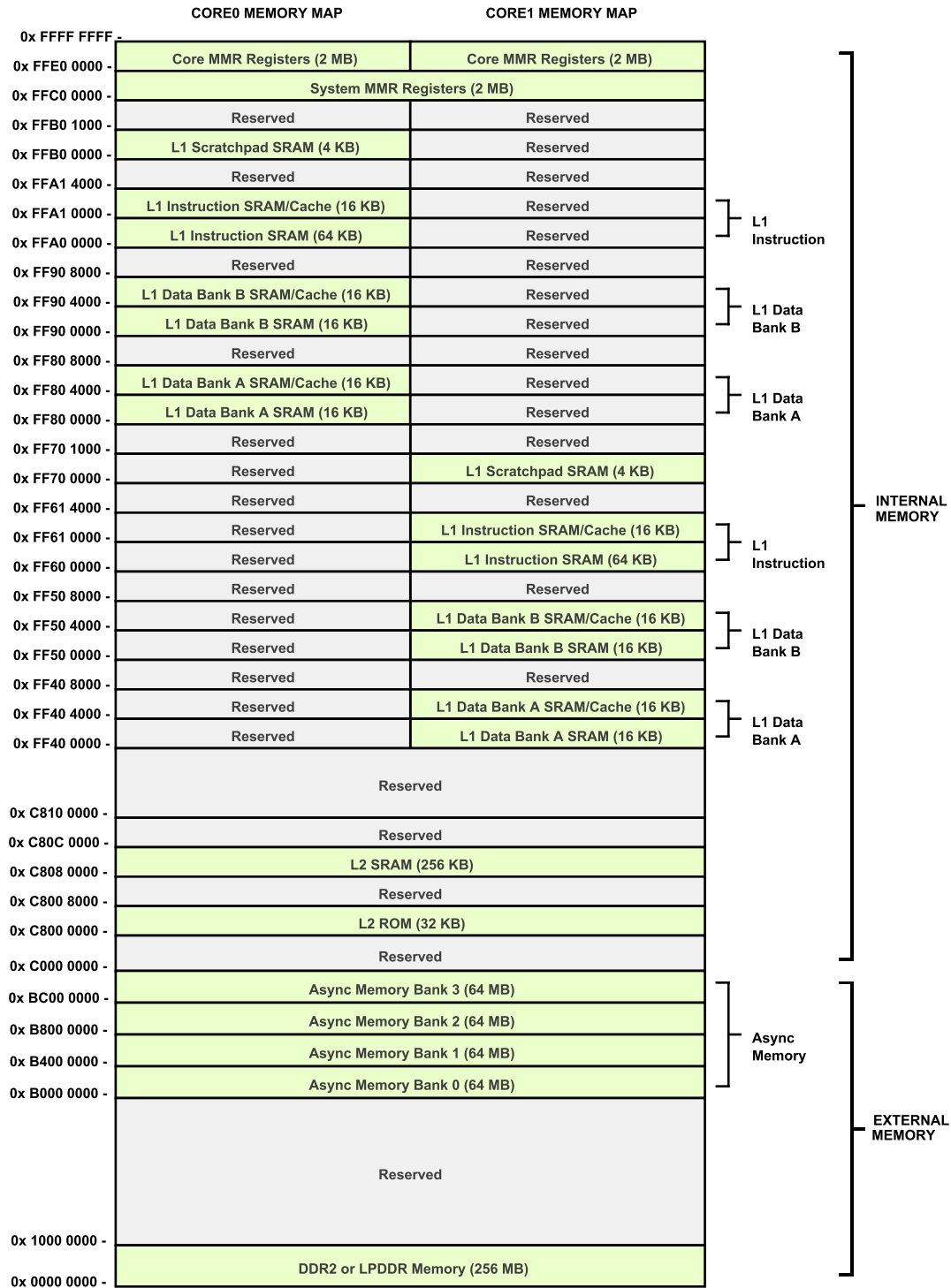


Figure 4. ADSP-BF607/ADSP-BF608/ADSP-BF609 Internal/External Memory Map

### Internal (Core-Accessible) Memory

The L1 memory system is the highest-performance memory available to the Blackfin processor cores.

Each core has its own private L1 memory. The modified Harvard architecture supports two concurrent 32-bit data accesses along with an instruction fetch at full processor speed which provides high bandwidth processor performance. In each core a 64K-byte block of data memory partners with an 80K-byte memory block for instruction storage. Each data block is multi-banked for efficient data exchange through DMA and can be configured as SRAM. Alternatively, 16K bytes of each block can be configured in L1 cache mode. The four-way set-associative instruction cache and the 2 two-way set-associative data caches greatly accelerate memory access performance, especially when accessing external memories.

The L1 memory domain also features a 4K-byte scratchpad SRAM block which is ideal for storing local variables and the software stack. All L1 memory is protected by a multi-parity bit concept, regardless of whether the memory is operating in SRAM or cache mode.

Outside of the L1 domain, L2 and L3 memories are arranged using a Von Neumann topology. The L2 memory domain is a unified instruction and data memory and can hold any mixture of code and data required by the system design. The L2 memory domain is accessible by both Blackfin cores through a dedicated 64-bit interface. It operates at SYSCLK frequency.

The processor features up to 256K bytes of L2 SRAM which is ECC-protected and organized in eight banks. Individual banks can be made private to any of the cores or the DMA subsystem. There is also a 32K-byte single-bank ROM in the L2 domain. It contains boot code and safety functions.

### Static Memory Controller (SMC)

The SMC can be programmed to control up to four banks of external memories or memory-mapped devices, with very flexible timing parameters. Each bank occupies a 64M byte segment regardless of the size of the device used, so that these banks are only contiguous if each is fully populated with 64M bytes of memory.

### Dynamic Memory Controller (DMC)

The DMC includes a controller that supports JESD79-2E compatible double data rate (DDR2) SDRAM and JESD209A low power DDR (LPDDR) SDRAM devices.

### I/O Memory Space

The processor does not define a separate I/O space. All resources are mapped through the flat 32-bit address space. On-chip I/O devices have their control registers mapped into memory-mapped registers (MMRs) at addresses near the top of the 4G byte address space. These are separated into two smaller blocks, one which contains the control MMRs for all core functions, and the other which contains the registers needed for setup and control of the on-chip peripherals outside of the core. The MMRs are accessible only in supervisor mode and appear as reserved space to on-chip peripherals.

### Bootling

The processor has several mechanisms for automatically loading internal and external memory after a reset. The boot mode is defined by the SYS\_BMODE input pins dedicated for this purpose. There are two categories of boot modes. In master boot modes, the processor actively loads data from parallel or serial memories. In slave boot modes, the processor receives data from external host devices.

The boot modes are shown in Table 2. These modes are implemented by the SYS\_BMODE bits of the reset configuration register and are sampled during power-on resets and software-initiated resets.

**Table 2. Boot Modes**

| SYS_BMODE Setting | Boot Mode    |
|-------------------|--------------|
| 000               | No boot/Idle |
| 001               | Memory       |
| 010               | RSIO Master  |
| 011               | SPI0 Master  |
| 100               | SPI0 Slave   |
| 101               | Reserved     |
| 110               | LPO Slave    |
| 111               | UART0 Slave  |

## VIDEO SUBSYSTEM

The following sections describe the components of the processor's video subsystem. These blocks are shown with blue shading in Figure 1 on Page 1.

### Video Interconnect (VID)

The Video Interconnect provides a connectivity matrix that interconnects the Video Subsystem: three PPIs, the PIXC, and the PVP. The interconnect uses a protocol to manage data transfer among these video peripherals.

### Pipelined Vision Processor (PVP)

The PVP engine provides hardware implementation of signal and image processing algorithms that are required for co-processing and pre-processing of monochrome video frames in ADAS applications, robotic systems, and other machine applications.

The PVP works in conjunction with the Blackfin cores. It is optimized for convolution and wavelet based object detection and classification, and tracking and verification algorithms. The PVP has the following processing blocks.

- Four 5 × 5 16-bit convolution blocks optionally followed by down scaling
- A 16-bit cartesian-to-polar coordinate conversion block
- A pixel edge classifier that supports 1st and 2nd derivative modes
- An arithmetic unit with 32-bit addition, multiply and divide

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- A 32-bit threshold block with 16 thresholds, a histogram, and run-length encoding
- Two 32-bit integral blocks that support regular and diagonal integrals
- An up- and down-scaling unit with independent scaling ratios for horizontal and vertical components
- Input and output formatters for compatibility with many data formats, including Bayer input format

The PVP can form a pipe of all the constituent algorithmic modules and is dynamically reconfigurable to form different pipeline structures.

The PVP supports the simultaneous processing of up to four data streams. The memory pipe stream operates on data received by DMA from any L1, L2, or L3 memory. The three camera pipe streams operate on a common input received directly from any of the three PPI inputs. Optionally, the PIXC can convert color data received by the PPI and forward luma values to the PVP's monochrome engine. Each stream has a dedicated DMA output. This preprocessing concept ensures careful use of available power and bandwidth budgets and frees up the processor cores for other tasks.

The PVP provides for direct core MMR access to all control/status registers. Two hardware interrupts interface to the system event controller. For optimal performance, the PVP allows register programming through its control DMA interface, as well as outputting selected status registers through the status DMA interface. This mechanism enables the PVP to automatically process job lists completely independent of the Blackfin cores.

### **Pixel Compositor (PIXC)**

The pixel compositor (PIXC) provides image overlays with transparent-color support, alpha blending, and color space conversion capabilities for output to TFT LCDs and NTSC/PAL video encoders. It provides all of the control to allow two data streams from two separate data buffers to be combined, blended, and converted into appropriate forms for both LCD panels and digital video outputs. The main image buffer provides the basic background image, which is presented in the data stream. The overlay image buffer allows the user to add multiple foreground text, graphics, or video objects on top of the main image or video data stream.

### **Parallel Peripheral Interface (PPI)**

The processor provides up to three parallel peripheral interfaces (PPIs), supporting data widths up to 24 bits. The PPI supports direct connection to TFT LCD panels, parallel analog-to-digital and digital-to-analog converters, video encoders and decoders, image sensor modules and other general-purpose peripherals.

The following features are supported in the PPI module:

- Programmable data length: 8 bits, 10 bits, 12 bits, 14 bits, 16 bits, 18 bits, and 24 bits per clock.
- Various framed, non-framed, and general-purpose operating modes. Frame syncs can be generated internally or can be supplied by an external device.
- ITU-656 status word error detection and correction for ITU-656 receive modes and ITU-656 preamble and status word decode.
- Optional packing and unpacking of data to/from 32 bits from/to 8 bits, 16 bits and 24 bits. If packing/unpacking is enabled, endianness can be configured to change the order of packing/unpacking of bytes/words.
- RGB888 can be converted to RGB666 or RGB565 for transmit modes.
- Various de-interleaving/interleaving modes for receiving/transmitting 4:2:2 YCrCb data.
- Configurable LCD data enable (DEN) output available on Frame Sync 3.

## **PROCESSOR SAFETY FEATURES**

The ADSP-BF60x processor has been designed for functional safety applications. While the level of safety is mainly dominated by the system concept, the following primitives are provided by the devices to build a robust safety concept.

### **Dual Core Supervision**

The processor has been implemented as dual-core devices to separate critical tasks to large independency. Software models support mutual supervision of the cores in symmetrical fashion.

### **Multi-Parity-Bit-Protected L1 Memories**

In the processor's L1 memory space, whether SRAM or cache, each word is protected by multiple parity bits to detect the single event upsets that occur in all RAMs. This applies both to L1 instruction and data memory spaces.

### **ECC-Protected L2 Memories**

Error correcting codes (ECC) are used to correct single event upsets. The L2 memory is protected with a Single Error Correct-Double Error Detect (SEC-DED) code. By default ECC is enabled, but it can be disabled on a per-bank basis. Single-bit errors are transparently corrected. Dual-bit errors can issue a system event or fault if enabled. ECC protection is fully transparent to the user, even if L2 memory is read or written by 8-bit or 16-bit entities.

### **CRC-Protected Memories**

While parity bit and ECC protection mainly protect against random soft errors in L1 and L2 memory cells, the CRC engines can be used to protect against systematic errors (pointer errors) and static content (instruction code) of L1, L2 and even L3 memories (DDR2, LPDDR). The processors feature two CRC engines which are embedded in the memory-to-memory DMA controllers. CRC check sums can be calculated or compared on the fly during memory transfers, or one or multiple memory regions can be continuously scrubbed by single DMA work unit as per DMA descriptor chain instructions. The CRC engine also protects data loaded during the boot process.

**Memory Protection**

The Blackfin cores feature a memory protection concept, which grants data and/or instruction accesses from enabled memory regions only. A supervisor mode vs. user mode programming model supports dynamically varying access rights. Increased flexibility in memory page size options supports a simple method of static memory partitioning.

**System Protection**

All system resources and L2 memory banks can be controlled by either the processor cores, memory-to-memory DMA, or the system debug unit (SDU). A system protection unit (SPU) enables write accesses to specific resources that are locked to any of four masters: Core 0, Core 1, Memory DMA, and the System Debug Unit. System protection is enabled in greater granularity for some modules (L2, SEC and GPIO controllers) through a *global lock* concept.

**Watchpoint Protection**

The primary purpose of watchpoints and hardware breakpoints is to serve emulator needs. When enabled, they signal an emulator event whenever user-defined system resources are accessed or a core executes from user-defined addresses. Watchpoint events can be configured such that they signal the events to the other Blackfin core or to the fault management unit.

**Dual Watchdog**

The two on-chip watchdog timers each may supervise one Blackfin core.

**Bandwidth Monitor**

All DMA channels that operate in memory-to-memory mode (Memory DMA, PVP Memory Pipe DMA, PIXC DMA) are equipped with a bandwidth monitor mechanism. They can signal a system event or fault when transactions tend to starve because system buses are fully loaded with higher-priority traffic.

**Signal Watchdogs**

The eight general-purpose timers feature two new modes to monitor off-chip signals. The Watchdog Period mode monitors whether external signals toggle with a period within an expected range. The Watchdog Width mode monitors whether the pulse widths of external signals are in an expected range. Both modes help to detect incorrect undesired toggling (or lack thereof) of system-level signals.

**Up/Down Count Mismatch Detection**

The up/down counter can monitor external signal pairs, such as request/grant strobes. If the edge count mismatch exceeds the expected range, the up/down counter can flag this to the processor or to the fault management unit.

**Fault Management**

The fault management unit is part of the system event controller (SEC). Any system event, whether a dual-bit uncorrectable ECC error, or any peripheral status interrupt, can be defined as being

a “fault”. Additionally, the system events can be defined as an interrupt to the cores. If defined as such, the SEC forwards the event to the fault management unit which may automatically reset the entire device for reboot, or simply toggle the SYS\_FAULT output pins to signal off-chip hardware. Optionally, the fault management unit can delay the action taken via a keyed sequence, to provide a final chance for the Blackfin cores to resolve the crisis and to prevent the fault action from being taken.

**ADDITIONAL PROCESSOR PERIPHERALS**

The processor contains a rich set of peripherals connected to the core via several high-bandwidth buses, providing flexibility in system configuration as well as excellent overall system performance (see the block diagram on [Page 1](#)). The processors contain high-speed serial and parallel ports, an interrupt controller for flexible management of interrupts from the on-chip peripherals or external sources, and power management control functions to tailor the performance and power characteristics of the processor and system to many application scenarios.

The following sections describe additional peripherals that were not described in the previous sections.

**Timers**

The processor includes several timers which are described in the following sections.

**General-Purpose Timers**

There is one GP timer unit and it provides eight general-purpose programmable timers. Each timer has an external pin that can be configured either as a pulse width modulator (PWM) or timer output, as an input to clock the timer, or as a mechanism for measuring pulse widths and periods of external events. These timers can be synchronized to an external clock input on the TMRx pins, an external clock TMRCLK input pin, or to the internal SCLK0.

The timer units can be used in conjunction with the UARTs and the CAN controller to measure the width of the pulses in the data stream to provide a software auto-baud detect function for the respective serial channels.

The timers can generate interrupts to the processor core, providing periodic events for synchronization to either the system clock or to external signals. Timer events can also trigger other peripherals via the TRU (for instance, to signal a fault).

**Core Timers**

Each processor core also has its own dedicated timer. This extra timer is clocked by the internal processor clock and is typically used as a system tick clock for generating periodic operating system interrupts.

**Watchdog Timers**

Each core includes a 32-bit timer, which may be used to implement a software watchdog function. A software watchdog can improve system availability by forcing the processor to a known state, via generation of a hardware reset, nonmaskable interrupt (NMI), or general-purpose interrupt, if the timer expires before

## ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

being reset by software. The programmer initializes the count value of the timer, enables the appropriate interrupt, then enables the timer. Thereafter, the software must reload the counter before it counts to zero from the programmed value. This protects the system from remaining in an unknown state where software, which would normally reset the timer, has stopped running due to an external noise condition or software error.

After a reset, software can determine if the watchdog was the source of the hardware reset by interrogating a status bit in the timer control register, which is set only upon a watchdog generated reset.

### 3-Phase PWM Units

The Pulse Width Modulator (PWM) module is a flexible and programmable waveform generator. With minimal CPU intervention the PWM peripheral is capable of generating complex waveforms for motor control, Pulse Coded Modulation (PCM), Digital to Analog Conversion (DAC), power switching and power conversion. The PWM module has 4 PWM pairs capable of 3-phase PWM generation for source inverters for AC induction and DC brush less motors.

The two 3-phase PWM generation units each feature:

- 16-bit center-based PWM generation unit
- Programmable PWM pulse width
- Single update mode with option for asymmetric duty
- Programmable dead time and switching frequency
- Twos-complement implementation which permits smooth transition to full ON and full OFF states
- Dedicated asynchronous PWM shutdown signal

### Link Ports

Four DMA-enabled, 8-bit-wide link ports can connect to the link ports of other DSPs or processors. Link ports are bidirectional ports having eight data lines, an acknowledge line and a clock line.

### Serial Ports (SPORTs)

Three synchronous serial ports that provide an inexpensive interface to a wide variety of digital and mixed-signal peripheral devices such as Analog Devices' AD183x family of audio codecs, ADCs, and DACs. The serial ports are made up of two data lines, a clock, and frame sync. The data lines can be programmed to either transmit or receive and each data line has a dedicated DMA channel.

Serial port data can be automatically transferred to and from on-chip memory/external memory via dedicated DMA channels. Each of the serial ports can work in conjunction with another serial port to provide TDM support. In this configuration, one SPORT provides two transmit signals while the other SPORT provides the two receive signals. The frame sync and clock are shared.

Serial ports operate in five modes:

- Standard DSP serial mode
- Multichannel (TDM) mode
- I<sup>2</sup>S mode
- Packed I<sup>2</sup>S mode
- Left-justified mode

### ACM Interface

The ADC control module (ACM) provides an interface that synchronizes the controls between the processor and an analog-to-digital converter (ADC). The analog-to-digital conversions are initiated by the processor, based on external or internal events.

The ACM allows for flexible scheduling of sampling instants and provides precise sampling signals to the ADC.

Figure 5 shows how to connect an external ADC to the ACM and one of the SPORTs.

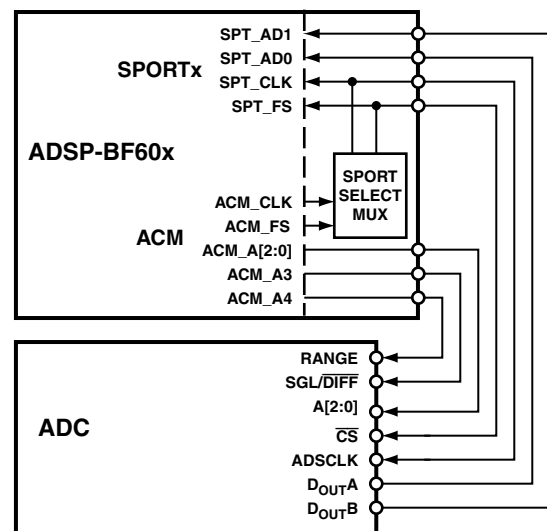


Figure 5. ADC, ACM, and SPORT Connections

The ACM synchronizes the ADC conversion process, generating the ADC controls, the ADC conversion start signal, and other signals. The actual data acquisition from the ADC is done by a peripheral such as a SPORT or a SPI.

The processor interfaces directly to many ADCs without any glue logic required.

### General-Purpose Counters

A 32-bit counter is provided that can operate in general-purpose up/down count modes and can sense 2-bit quadrature or binary codes as typically emitted by industrial drives or manual thumbwheels. Count direction is either controlled by a level-sensitive input pin or by two edge detectors.

A third counter input can provide flexible zero marker support and can alternatively be used to input the push-button signal of thumb wheels. All three pins have a programmable debouncing circuit.

Internal signals forwarded to each general-purpose timer enable these timers to measure the intervals between count events. Boundary registers enable auto-zero operation or simple system warning by interrupts when programmable count values are exceeded.

### **Serial Peripheral Interface (SPI) Ports**

The processors have two SPI-compatible ports that allow the processor to communicate with multiple SPI-compatible devices.

In its simplest mode, the SPI interface uses three pins for transferring data: two data pins (Master Output-Slave Input, MOSI, and Master Input-Slave Output, MISO) and a clock pin (serial clock, SPI\_CLK). A SPI chip select input pin (SPI\_SS) lets other SPI devices select the processor, and seven SPI chip select output pins (SPI\_SEL7-1) let the processor select other SPI devices. The SPI select pins are reconfigured general-purpose I/O pins. Using these pins, the SPI port provides a full-duplex, synchronous serial interface, which supports both master/slave modes and multimaster environments.

In a multi-master or multi-slave SPI system, the MOSI and MISO data output pins can be configured to behave as open drain outputs (using the ODM bit) to prevent contention and possible damage to pin drivers. An external pull-up resistor is required on both the MOSI and MISO pins when this option is selected.

When ODM is set and the SPI is configured as a master, the MOSI pin is three-stated when the data driven out on MOSI is a logic-high. The MOSI pin is not three-stated when the driven data is a logic-low. Similarly, when ODM is set and the SPI is configured as a slave, the MISO pin is three-stated if the data driven out on MISO is a logic-high.

The SPI port's baud rate and clock phase/polarities are programmable, and it has integrated DMA channels for both transmit and receive data streams.

### **UART Ports**

The processors provide two full-duplex universal asynchronous receiver/transmitter (UART) ports, which are fully compatible with PC-standard UARTs. Each UART port provides a simplified UART interface to other peripherals or hosts, supporting full-duplex, DMA-supported, asynchronous transfers of serial data. A UART port includes support for five to eight data bits, and none, even, or odd parity. Optionally, an additional address bit can be transferred to interrupt only addressed nodes in multi-drop bus (MDB) systems. A frame is terminated by one, one and a half, two or two and a half stop bits.

The UART ports support automatic hardware flow control through the Clear To Send (CTS) input and Request To Send (RTS) output with programmable assertion FIFO levels.

To help support the Local Interconnect Network (LIN) protocols, a special command causes the transmitter to queue a break command of programmable bit length into the transmit buffer. Similarly, the number of stop bits can be extended by a programmable inter-frame space.

The capabilities of the UARTs are further extended with support for the Infrared Data Association (IrDA®) serial infrared physical layer link specification (SIR) protocol.

### **TWI Controller Interface**

The processors include a 2-wire interface (TWI) module for providing a simple exchange method of control data between multiple devices. The TWI module is compatible with the widely used I<sup>2</sup>C bus standard. The TWI module offers the capabilities of simultaneous master and slave operation and support for both 7-bit addressing and multimedia data arbitration. The TWI interface utilizes two pins for transferring clock (TWI\_SCL) and data (TWI\_SDA) and supports the protocol at speeds up to 400k bits/sec. The TWI interface pins are compatible with 5 V logic levels.

Additionally, the TWI module is fully compatible with serial camera control bus (SCCB) functionality for easier control of various CMOS camera sensor devices.

### **Removable Storage Interface (RSI)**

The removable storage interface (RSI) controller acts as the host interface for multimedia cards (MMC), secure digital memory cards (SD), secure digital input/output cards (SDIO). The following list describes the main features of the RSI controller.

- Support for a single MMC, SD memory, SDIO card
- Support for 1-bit and 4-bit SD modes
- Support for 1-bit, 4-bit, and 8-bit MMC modes
- Support for eMMC 4.3 embedded NAND flash devices
- A ten-signal external interface with clock, command, and up to eight data lines
- Card interface clock generation from SCLK0
- SDIO interrupt and read wait features

### **Controller Area Network (CAN)**

A CAN controller implements the CAN 2.0B (active) protocol. This protocol is an asynchronous communications protocol used in both industrial and automotive control systems. The CAN protocol is well suited for control applications due to its capability to communicate reliably over a network. This is because the protocol incorporates CRC checking, message error tracking, and fault node confinement.

The CAN controller offers the following features:

- 32 mailboxes (8 receive only, 8 transmit only, 16 configurable for receive or transmit).
- Dedicated acceptance masks for each mailbox.
- Additional data filtering on first two bytes.
- Support for both the standard (11-bit) and extended (29-bit) identifier (ID) message formats.

- Support for remote frames.
- Active or passive network support.
- CAN wakeup from hibernation mode (lowest static power consumption mode).
- Interrupts, including: TX complete, RX complete, error and global.

An additional crystal is not required to supply the CAN clock, as the CAN clock is derived from a system clock through a programmable divider.

## 10/100 Ethernet MAC

The processor can directly connect to a network by way of an embedded fast Ethernet media access controller (MAC) that supports both 10-BaseT (10M bits/sec) and 100-BaseT (100M bits/sec) operation. The 10/100 Ethernet MAC peripheral on the processor is fully compliant to the IEEE 802.3-2002 standard and it provides programmable features designed to minimize supervision, bus use, or message processing by the rest of the processor system.

Some standard features are:

- Support and RMI protocols for external PHYs
- Full duplex and half duplex modes
- Media access management (in half-duplex operation)
- Flow control
- Station management: generation of MDC/MDIO frames for read-write access to PHY registers

Some advanced features are:

- Automatic checksum computation of IP header and IP payload fields of RX frames
- Independent 32-bit descriptor-driven receive and transmit DMA channels
- Frame status delivery to memory through DMA, including frame completion semaphores for efficient buffer queue management in software
- TX DMA support for separate descriptors for MAC header and payload to eliminate buffer copy operations
- Convenient frame alignment modes
- 47 MAC management statistics counters with selectable clear-on-read behavior and programmable interrupts on half maximum value
- Advanced power management
- Magic packet detection and wakeup frame filtering
- Support for 802.3Q tagged VLAN frames
- Programmable MDC clock rate and preamble suppression

## IEEE 1588 Support

The IEEE 1588 standard is a precision clock synchronization protocol for networked measurement and control systems. The processor includes hardware support for IEEE 1588 with an integrated precision time protocol synchronization engine

(PTP\_TSYNC). This engine provides hardware assisted time stamping to improve the accuracy of clock synchronization between PTP nodes. The main features of the engine are:

- Support for both IEEE 1588-2002 and IEEE 1588-2008 protocol standards
- Hardware assisted time stamping capable of up to 12.5 ns resolution
- Lock adjustment
- Automatic detection of IPv4 and IPv6 packets, as well as PTP messages
- Multiple input clock sources (SCLK0, RMI clock, external clock)
- Programmable pulse per second (PPS) output
- Auxiliary snapshot to time stamp external events

## USB 2.0 On-the-Go Dual-Role Device Controller

The USB 2.0 OTG dual-role device controller provides a low-cost connectivity solution for the growing adoption of this bus standard in industrial applications, as well as consumer mobile devices such as cell phones, digital still cameras, and MP3 players. The USB 2.0 controller allows these devices to transfer data using a point-to-point USB connection without the need for a PC host. The module can operate in a traditional USB peripheral-only mode as well as the host mode presented in the On-the-Go (OTG) supplement to the USB 2.0 specification.

The USB clock (USB\_CLKIN) is provided through a dedicated external crystal or crystal oscillator.

The USB On-the-Go dual-role device controller includes a Phase Locked Loop with programmable multipliers to generate the necessary internal clocking frequency for USB.

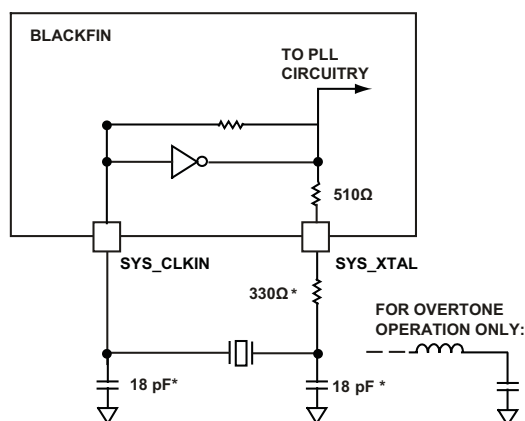
## POWER AND CLOCK MANAGEMENT

The processor provides four operating modes, each with a different performance/power profile. When configured for a 0 V internal supply voltage ( $V_{DD\_INT}$ ), the processor enters the hibernate state. Control of clocking to each of the processor peripherals also reduces power consumption. See [Table 5](#) for a summary of the power settings for each mode.

### Crystal Oscillator (SYS\_XTAL)

The processor can be clocked by an external crystal ([Figure 6](#)), a sine wave input, or a buffered, shaped clock derived from an external clock oscillator. If an external clock is used, it should be a TTL compatible signal and must not be halted, changed, or operated below the specified frequency during normal operation. This signal is connected to the processor's SYS\_CLKIN pin. When an external clock is used, the SYS\_XTAL pin must be left unconnected. Alternatively, because the processor includes an on-chip oscillator circuit, an external crystal may be used.

For fundamental frequency operation, use the circuit shown in [Figure 6](#). A parallel-resonant, fundamental frequency, micro-processor grade crystal is connected across the SYS\_CLKIN and XTAL pins. The on-chip resistance between SYS\_CLKIN and the XTAL pin is in the 500 k $\Omega$  range. Further parallel resistors are typically not recommended.



NOTE: VALUES MARKED WITH \* MUST BE CUSTOMIZED, DEPENDING ON THE CRYSTAL AND LAYOUT. PLEASE ANALYZE CAREFULLY. FOR FREQUENCIES ABOVE 33 MHz, THE SUGGESTED CAPACITOR VALUE OF 18pF SHOULD BE TREATED AS A MAXIMUM, AND THE SUGGESTED RESISTOR VALUE SHOULD BE REDUCED TO 0 Ω.

Figure 6. External Crystal Connection

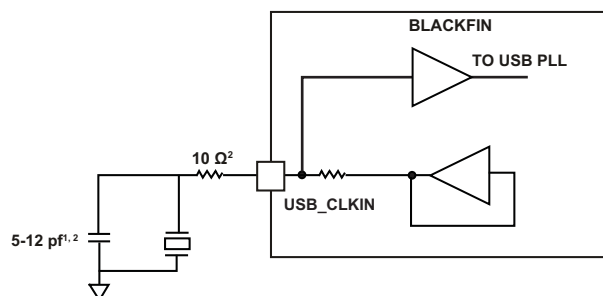
The two capacitors and the series resistor shown in Figure 6 fine tune phase and amplitude of the sine frequency. The capacitor and resistor values shown in Figure 6 are typical values only. The capacitor values are dependent upon the crystal manufacturers' load capacitance recommendations and the PCB physical layout. The resistor value depends on the drive level specified by the crystal manufacturer. The user should verify the customized values based on careful investigations on multiple devices over temperature range.

A third-overtone crystal can be used for frequencies above 25 MHz. The circuit is then modified to ensure crystal operation only at the third overtone by adding a tuned inductor circuit as shown in Figure 6. A design procedure for third-overtone operation is discussed in detail in application note (EE-168) Using Third Overtone Crystals with the ADSP-218x DSP on the Analog Devices website ([www.analog.com](http://www.analog.com))—use site search on “EE-168.”

### USB Crystal Oscillator

The USB can be clocked by an external crystal, a sine wave input, or a buffered, shaped clock derived from an external clock oscillator. If an external clock is used, it should be a TTL compatible signal and must not be halted, changed, or operated below the specified frequency during normal operation. This signal is connected to the processor's USB\_CLKIN pin. Alternatively, because the processor includes an on-chip oscillator circuit, an external crystal may be used.

For fundamental frequency operation, use the circuit shown in Figure 7. A parallel-resonant, fundamental frequency, micro-processor grade crystal is connected between the USB\_CLKIN pin and ground. A load capacitor is placed in parallel with the crystal. The combined capacitive value of the board trace parasitic, the case capacitance of the crystal (from crystal manufacturer) and the parallel capacitor in the diagram should be in the range of 8 pF to 15 pF.



NOTES:  
1. CAPACITANCE VALUE SHOWN INCLUDES BOARD PARASITICS  
2. VALUES ARE A PRELIMINARY ESTIMATE.

Figure 7. External USB Crystal Connection

The crystal should be chosen so that its rated load capacitance matches the nominal total capacitance on this node. A series resistor may be added between the USB\_CLKIN pin and the parallel crystal and capacitor combination, in order to further reduce the drive level of the crystal.

The parallel capacitor and the series resistor shown in Figure 7 fine tune phase and amplitude of the sine frequency. The capacitor and resistor values shown in Figure 7 are typical values only. The capacitor values are dependent upon the crystal manufacturers' load capacitance recommendations and the PCB physical layout. The resistor value depends on the drive level specified by the crystal manufacturer. The user should verify the customized values based on careful investigations on multiple devices over temperature range.

### Clock Generation

The clock generation unit (CGU) generates all on-chip clocks and synchronization signals. Multiplication factors are programmed to the PLL to define the PLLCLK frequency. Programmable values divide the PLLCLK frequency to generate the core clock (CCLK), the system clocks (SYSCLK, SCLK0 and SCLK1), the LPDDR or DDR2 clock (DCLK) and the output clock (OCLK). This is illustrated in Figure 8 on Page 54.

Writing to the CGU control registers does not affect the behavior of the PLL immediately. Registers are first programmed with a new value, and the PLL logic executes the changes so that it transitions smoothly from the current conditions to the new ones.

SYS\_CLKIN oscillations start when power is applied to the  $V_{DD\_EXT}$  pins. The rising edge of  $SYS\_HWRST$  can be applied after all voltage supplies are within specifications (see [Operating Conditions on Page 52](#)), and SYS\_CLKIN oscillations are stable.

### Clock Out/External Clock

The SYS\_CLKOUT output pin has programmable options to output divided-down versions of the on-chip clocks. By default, the SYS\_CLKOUT pin drives a buffered version of the SYS\_CLKIN input. Clock generation faults (for example PLL unlock) may trigger a reset by hardware. The clocks shown in Table 3 can be outputs from SYS\_CLKOUT.

**Table 3. Clock Dividers**

| Clock Source                                                       | Divider                     |
|--------------------------------------------------------------------|-----------------------------|
| CCLK (core clock)                                                  | By 4                        |
| SYSCLK (System clock)                                              | By 2                        |
| SCLK0 (system clock for PVP, all peripherals not covered by SCLK1) | None                        |
| SCLK1 (system clock for SPORTS, SPI, ACM)                          | None                        |
| DCLK (LPDDR/DDR2 clock)                                            | By 2                        |
| OCLK (output clock)                                                | Programmable                |
| CLKBUF                                                             | None, direct from SYS_CLKIN |

## Power Management

As shown in [Table 4](#), the processor supports five different power domains, which maximizes flexibility while maintaining compliance with industry standards and conventions. There are no sequencing requirements for the various power domains, but all domains must be powered according to the appropriate [Specifications](#) table for processor operating conditions; even if the feature/peripheral is not used.

**Table 4. Power Domains**

| Power Domain                                       | V <sub>DD</sub> Range |
|----------------------------------------------------|-----------------------|
| All internal logic                                 | V <sub>DD_INT</sub>   |
| DDR2/LPDDR                                         | V <sub>DD_DMC</sub>   |
| USB                                                | V <sub>DD_USB</sub>   |
| Thermal diode                                      | V <sub>DD_TD</sub>    |
| All other I/O (includes SYS, JTAG, and Ports pins) | V <sub>DD_EXT</sub>   |

The dynamic power management feature of the processor allows the processor's core clock frequency ( $f_{CCLK}$ ) to be dynamically controlled.

The power dissipated by a processor is largely a function of its clock frequency and the square of the operating voltage. For example, reducing the clock frequency by 25% results in a 25% reduction in dynamic power dissipation.

### Full-On Operating Mode—Maximum Performance

In the full-on mode, the PLL is enabled and is not bypassed, providing capability for maximum operational frequency. This is the power-up default execution state in which maximum performance can be achieved. The processor cores and all enabled peripherals run at full speed.

### Active Operating Mode—Moderate Dynamic Power Savings

In the active mode, the PLL is enabled but bypassed. Because the PLL is bypassed, the processor's core clocks and system clocks run at the input clock (SYS\_CLKIN) frequency. DMA access is available to appropriately configured L1 memories.

For more information about PLL controls, see the “Dynamic Power Management” chapter in the *ADSP-BF60x Blackfin Processor Hardware Reference*.

See [Table 5](#) for a summary of the power settings for each mode.

**Table 5. Power Settings**

| Mode/State | PLL                  | PLL Bypassed | $f_{CCLK}$ | $f_{SYSCLK}$ ,<br>$f_{DCLK}$ ,<br>$f_{SCLK0}$ ,<br>$f_{SCLK1}$ | Core Power |
|------------|----------------------|--------------|------------|----------------------------------------------------------------|------------|
| Full On    | Enabled              | No           | Enabled    | Enabled                                                        | On         |
| Active     | Enabled/<br>Disabled | Yes          | Enabled    | Enabled                                                        | On         |
| Deep Sleep | Disabled             | —            | Disabled   | Disabled                                                       | On         |
| Hibernate  | Disabled             | —            | Disabled   | Disabled                                                       | Off        |

### Deep Sleep Operating Mode—Maximum Dynamic Power Savings

The deep sleep mode maximizes dynamic power savings by disabling the clocks to the processor core and to all synchronous peripherals. Asynchronous peripherals may still be running but cannot access internal resources or external memory.

### Hibernate State—Maximum Static Power Savings

The hibernate state maximizes static power savings by disabling the voltage and clocks to the processor cores and to all of the peripherals. This setting signals the external voltage regulator supplying the V<sub>DD\_INT</sub> pins to shut off using the SYS\_EXTWAKE signal, which provides the lowest static power dissipation. Any critical information stored internally (for example, memory contents, register contents, and other information) must be written to a non-volatile storage device prior to removing power if the processor state is to be preserved.

Since the V<sub>DD\_EXT</sub> pins can still be supplied in this mode, all of the external pins three-state, unless otherwise specified. This allows other devices that may be connected to the processor to still have power applied without drawing unwanted current.

### Reset Control Unit

Reset is the initial state of the whole processor or one of the cores and is the result of a hardware or software triggered event. In this state, all control registers are set to their default values and functional units are idle. Exiting a full system reset starts with Core-0 only being ready to boot. Exiting a Core-n only reset starts with this Core-n being ready to boot.

The Reset Control Unit (RCU) controls how all the functional units enter and exit reset. Differences in functional requirements and clocking constraints define how reset signals are generated. Programs must guarantee that none of the reset functions puts the system into an undefined state or causes resources to stall. This is particularly important when only one of the cores is reset (programs must ensure that there is no pending system activity involving the core that is being reset).

From a system perspective reset is defined by both the reset target and the reset source as described below.

Target defined:

- Hardware Reset – All functional units are set to their default states without exception. History is lost.
- System Reset – All functional units except the RCU are set to their default states.
- Core-n only Reset – Affects Core-n only. The system software should guarantee that the core in reset state is not accessed by any bus master.

Source defined:

- Hardware Reset – The  $\overline{\text{SYS\_HWRST}}$  input signal is asserted active (pulled down).
- System Reset – May be triggered by software (writing to the RCU\_CTL register) or by another functional unit such as the dynamic power management (DPM) unit (Hibernate) or any of the system event controller (SEC), trigger routing unit (TRU), or emulator inputs.
- Core-n-only reset – Triggered by software.
- Trigger request (peripheral).

### **Voltage Regulation**

The processor requires an external voltage regulator to power the  $V_{DD\_INT}$  pins. To reduce standby power consumption, the external voltage regulator can be signaled through SYS\_EXTWAKE to remove power from the processor core. This signal is high-true for power-up and may be connected directly to the low-true shut-down input of many common regulators.

While in the hibernate state, all external supply pins ( $V_{DD\_EXT}$ ,  $V_{DD\_USB}$ ,  $V_{DD\_DMC}$ ) can still be powered, eliminating the need for external buffers. The external voltage regulator can be activated from this power down state by asserting the SYS\_HWRST pin, which then initiates a boot sequence. SYS\_EXTWAKE indicates a wakeup to the external voltage regulator.

## **SYSTEM DEBUG**

The processor includes various features that allow for easy system debug. These are described in the following sections.

### **System Watchpoint Unit**

The System Watchpoint Unit (SWU) is a single module which connects to a single system bus and provides for transaction monitoring. One SWU is attached to the bus going to each system slave. The SWU provides ports for all system bus address channel signals. Each SWU contains four match groups of registers with associated hardware. These four SWU match groups operate independently, but share common event (interrupt, trigger and others) outputs.

### **System Debug Unit**

The System Debug Unit (SDU) provides IEEE-1149.1 support through its JTAG interface. In addition to traditional JTAG features, present in legacy Blackfin products, the SDU adds more features for debugging the chip without halting the core processors.

## **DEVELOPMENT TOOLS**

Analog Devices supports its processors with a complete line of software and hardware development tools, including integrated development environments (which include CrossCore® Embedded Studio and/or VisualDSP++®), evaluation products, emulators, and a wide variety of software add-ins.

### **Integrated Development Environments (IDEs)**

For C/C++ software writing and editing, code generation, and debug support, Analog Devices offers two IDEs.

The newest IDE, CrossCore Embedded Studio, is based on the Eclipse™ framework. Supporting most Analog Devices processor families, it is the IDE of choice for future processors, including multicore devices. CrossCore Embedded Studio seamlessly integrates available software add-ins to support real time operating systems, file systems, TCP/IP stacks, USB stacks, algorithmic software modules, and evaluation hardware board support packages. For more information visit [www.analog.com/cces](http://www.analog.com/cces).

The other Analog Devices IDE, VisualDSP++, supports processor families introduced prior to the release of CrossCore Embedded Studio. This IDE includes the Analog Devices VDK real time operating system and an open source TCP/IP stack. For more information visit [www.analog.com/visualdsp](http://www.analog.com/visualdsp). Note that VisualDSP++ will not support future Analog Devices processors.

### **EZ-KIT Lite Evaluation Board**

For processor evaluation, Analog Devices provides wide range of EZ-KIT Lite® evaluation boards. Including the processor and key peripherals, the evaluation board also supports on-chip emulation capabilities and other evaluation and development features. Also available are various EZ-Extenders®, which are daughter cards delivering additional specialized functionality, including audio and video processing. For more information visit [www.analog.com](http://www.analog.com) and search on “ezkit” or “ezextender”.

### **EZ-KIT Lite Evaluation Kits**

For a cost-effective way to learn more about developing with Analog Devices processors, Analog Devices offer a range of EZ-KIT Lite evaluation kits. Each evaluation kit includes an EZ-KIT Lite evaluation board, directions for downloading an evaluation version of the available IDE(s), a USB cable, and a power supply. The USB controller on the EZ-KIT Lite board connects to the USB port of the user's PC, enabling the chosen IDE evaluation suite to emulate the on-board processor in-circuit. This permits the customer to download, execute, and debug programs for the EZ-KIT Lite system. It also supports in-circuit programming of the on-board Flash device to store user-specific boot code, enabling standalone operation. With the full version of

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CrossCore Embedded Studio or VisualDSP++ installed (sold separately), engineers can develop software for supported EZ-KITs or any custom system utilizing supported Analog Devices processors.

### **Software Add-Ins for CrossCore Embedded Studio**

Analog Devices offers software add-ins which seamlessly integrate with CrossCore Embedded Studio to extend its capabilities and reduce development time. Add-ins include board support packages for evaluation hardware, various middleware packages, and algorithmic modules. Documentation, help, configuration dialogs, and coding examples present in these add-ins are viewable through the CrossCore Embedded Studio IDE once the add-in is installed.

### **Board Support Packages for Evaluation Hardware**

Software support for the EZ-KIT Lite evaluation boards and EZ-Extender daughter cards is provided by software add-ins called Board Support Packages (BSPs). The BSPs contain the required drivers, pertinent release notes, and select example code for the given evaluation hardware. A download link for a specific BSP is located on the web page for the associated EZ-KIT or EZ-Extender product. The link is found in the *Product Download* area of the product web page.

### **Middleware Packages**

Analog Devices separately offers middleware add-ins such as real time operating systems, file systems, USB stacks, and TCP/IP stacks. For more information see the following web pages:

- [www.analog.com/ucos3](http://www.analog.com/ucos3)
- [www.analog.com/ucfs](http://www.analog.com/ucfs)
- [www.analog.com/ucusbdb](http://www.analog.com/ucusbdb)
- [www.analog.com/lwip](http://www.analog.com/lwip)

### **Algorithmic Modules**

To speed development, Analog Devices offers add-ins that perform popular audio and video processing algorithms. These are available for use with both CrossCore Embedded Studio and VisualDSP++. For more information visit [www.analog.com](http://www.analog.com) and search on “Blackfin software modules”.

### **Designing an Emulator-Compatible DSP Board (Target)**

For embedded system test and debug, Analog Devices provides a family of emulators. On each JTAG DSP, Analog Devices supplies an IEEE 1149.1 JTAG Test Access Port (TAP). In-circuit emulation is facilitated by use of this JTAG interface. The emulator accesses the processor’s internal features via the processor’s TAP, allowing the developer to load code, set breakpoints, and view variables, memory, and registers. The processor must be halted to send data and commands, but once an operation is completed by the emulator, the DSP system is set to run at full speed with no impact on system timing. The emulators require the target board to include a header that supports connection of the DSP’s JTAG port to the emulator.

For details on target board design issues including mechanical layout, single processor connections, signal buffering, signal termination, and emulator pod logic, see the *EE-68: Analog Devices JTAG Emulation Technical Reference* on the Analog Devices website ([www.analog.com](http://www.analog.com))—use site search on “EE-68.” This document is updated regularly to keep pace with improvements to emulator support.

### **ADDITIONAL INFORMATION**

The following publications that describe the ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609 processors (and related processors) can be ordered from any Analog Devices sales office or accessed electronically on our website:

- *Getting Started With Blackfin Processors*
- *ADSP-BF60x Blackfin Processor Hardware Reference*
- *Blackfin Processor Programming Reference*
- *ADSP-BF60x Blackfin Processor Anomaly List*

### **RELATED SIGNAL CHAINS**

A *signal chain* is a series of signal-conditioning electronic components that receive input (data acquired from sampling either real-time phenomena or from stored data) in tandem, with the output of one portion of the chain supplying input to the next. Signal chains are often used in signal processing applications to gather and process data or to apply system controls based on analysis of real-time phenomena. For more information about this term and related topics, see the “signal chain” entry in the [Glossary of EE Terms](#) on the Analog Devices website.

Analog Devices eases signal processing system development by providing signal processing components that are designed to work together well. A tool for viewing relationships between specific applications and related components is available on the [www.analog.com](http://www.analog.com) website.

The Application Signal Chains page in the Circuits from the Lab™ site (<http://www.analog.com/circuits>) provides:

- Graphical circuit block diagram presentation of signal chains for a variety of circuit types and applications
- Drill down links for components in each chain to selection guides and application information
- Reference designs applying best practice design techniques

## ADSP-BF60x DETAILED SIGNAL DESCRIPTIONS

Table 6 provides a detailed description of each signal.

Table 6. Detailed Signal Descriptions

| Signal Name        | Direction | Description                                                                                                                                                                                                                                                                   |
|--------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACM_An             | Output    | <b>ADC Control Signals</b> Function varies by mode.                                                                                                                                                                                                                           |
| ACM_CLK            | Output    | <b>Clock</b> SCLK derived clock for connecting to an ADC.                                                                                                                                                                                                                     |
| ACM_FS             | Output    | <b>Frame Sync</b> Typically used as an ADC chip select.                                                                                                                                                                                                                       |
| ACM_Tn             | Input     | <b>External Trigger n</b> Input for external trigger events.                                                                                                                                                                                                                  |
| CAN_RX             | Input     | <b>Receive</b> Typically an external CAN transceiver's RX output.                                                                                                                                                                                                             |
| CAN_TX             | Output    | <b>Transmit</b> Typically an external CAN transceiver's TX input.                                                                                                                                                                                                             |
| CNT_DG             | Input     | <b>Count Down and Gate</b> Depending on the mode of operation this input acts either as a count down signal or a gate signal.<br>Count Down: This input causes the GP counter to decrement.<br>Gate: Stops the GP counter from incrementing or decrementing.                  |
| CNT_UD             | Input     | <b>Count Up and Direction</b> Depending on the mode of operation this input acts either as a count up signal or a direction signal.<br>Count Up: This input causes the GP counter to increment.<br>Direction: Selects whether the GP counter is incrementing or decrementing. |
| CNT_ZM             | Input     | <b>Count Zero Marker</b> Input that connects to the zero marker output of a rotary device or detects the pressing of a push button.                                                                                                                                           |
| DMC_Ann            | Output    | <b>Address n</b> Address bus.                                                                                                                                                                                                                                                 |
| DMC_BAn            | Output    | <b>Bank Address Input n</b> Defines which internal bank an ACTIVATE, READ, WRITE, or PRECHARGE command is being applied to on the dynamic memory. Also defines which mode registers (MR, EMR, EMR2, and/or EMR3) are loaded during the LOAD MODE REGISTER command.            |
| DMC_CAS            | Output    | <b>Column Address Strobe</b> Defines the operation for external dynamic memory to perform in conjunction with other DMC command signals. Connect to the CAS input of dynamic memory.                                                                                          |
| DMC_CK             | Output    | <b>Clock (complement)</b> Complement of DMC_CK.                                                                                                                                                                                                                               |
| DMC_CK             | Output    | <b>Clock</b> Outputs DCLK to external dynamic memory.                                                                                                                                                                                                                         |
| DMC_CKE            | Output    | <b>Clock enable</b> Active high clock enables. Connects to the dynamic memory's CKE input.                                                                                                                                                                                    |
| DMC_CS $\bar{n}$   | Output    | <b>Chip Select n</b> Commands are recognized by the memory only when this signal is asserted.                                                                                                                                                                                 |
| DMC_DQ $\bar{n}$ n | I/O       | <b>Data n</b> Bidirectional data bus.                                                                                                                                                                                                                                         |
| DMC_LDM            | Output    | <b>Data Mask for Lower Byte</b> Mask for DMC_DQ07:DMC_DQ00 write data when driven high. Sampled on both edges of the data strobe by the dynamic memory.                                                                                                                       |
| DMC_LDQ $\bar{S}$  | I/O       | <b>Data Strobe for Lower Byte (complement)</b> Complement of LDQS. Not used in single-ended mode.                                                                                                                                                                             |
| DMC_LDQS           | I/O       | <b>Data Strobe for Lower Byte</b> DMC_DQ07:DMC_DQ00 data strobe. Output with Write Data. Input with Read Data. May be single-ended or differential depending on register settings.                                                                                            |
| DMC_ODT            | Output    | <b>On-die Termination</b> Enables dynamic memory termination resistances when driven high (assuming the memory is properly configured). ODT is enabled/disabled regardless of read or write commands.                                                                         |
| DMC_RAS            | Output    | <b>Row Address Strobe</b> Defines the operation for external dynamic memory to perform in conjunction with other DMC command signals. Connect to the RAS input of dynamic memory.                                                                                             |
| DMC_UDM            | Output    | <b>Data Mask for Upper Byte</b> Mask for DMC_DQ15:DMC_DQ08 write data when driven high. Sampled on both edges of the data strobe by the dynamic memory.                                                                                                                       |
| DMC_UDQ $\bar{S}$  | I/O       | <b>Data Strobe for Upper Byte (complement)</b> Complement of UDQS. Not used in single-ended mode.                                                                                                                                                                             |
| DMC_UDQS           | I/O       | <b>Data Strobe for Upper Byte</b> DMC_DQ15:DMC_DQ08 data strobe. Output with Write Data. Input with Read Data. May be single-ended or differential depending on register settings.                                                                                            |
| DMC_WE             | Output    | <b>Write Enable</b> Defines the operation for external dynamic memory to perform in conjunction with other DMC command signals. Connect to the $\overline{WE}$ input of dynamic memory.                                                                                       |

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Table 6. Detailed Signal Descriptions (Continued)

| Signal Name  | Direction | Description                                                                                                                                                                                                                                                          |
|--------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ETH_CRS      | Input     | <b>Carrier Sense/RMII Receive Data Valid</b> Multiplexed on alternate clock cycles.<br>CRS: Asserted by the PHY when either the transmit or receive medium is not idle. De-asserted when both are idle.<br>RXDV: Asserted by the PHY when the data on RXDn is valid. |
| ETH_MDC      | Output    | <b>Management Channel Clock</b> Clocks the MDC input of the PHY.                                                                                                                                                                                                     |
| ETH_MDIO     | I/O       | <b>Management Channel Serial Data</b> Bidirectional data bus for PHY control.                                                                                                                                                                                        |
| ETH_PTPAUXIN | Input     | <b>PTP Auxiliary Trigger Input</b> Assert this signal to take an auxiliary snapshot of the time and store it in the auxiliary time stamp FIFO.                                                                                                                       |
| ETH_PTPCLKIN | Input     | <b>PTP Clock Input</b> Optional external PTP clock input.                                                                                                                                                                                                            |
| ETH_PTPPPS   | Output    | <b>PTP Pulse-Per-Second Output</b> When the Advanced Time Stamp feature is enabled, this signal is asserted based on the PPS mode selected. Otherwise, PTPPPS is asserted every time the seconds counter is incremented.                                             |
| ETH_REFCLK   | Input     | <b>Reference Clock</b> Externally supplied Ethernet clock.                                                                                                                                                                                                           |
| ETH_RXDn     | Input     | <b>Receive Data n</b> Receive data bus.                                                                                                                                                                                                                              |
| ETH_TXDn     | Output    | <b>Transmit Data n</b> Transmit data bus.                                                                                                                                                                                                                            |
| ETH_TXEN     | I/O       | <b>Transmit Enable</b> When asserted indicates that the data on TXDn is valid.                                                                                                                                                                                       |
| JTG_EMU      | Output    | <b>Emulation Output</b> JTAG emulation flag.                                                                                                                                                                                                                         |
| JTG_TCK      | Input     | <b>Clock</b> JTAG test access port clock.                                                                                                                                                                                                                            |
| JTG_TDI      | Input     | <b>Serial Data In</b> JTAG test access port data input.                                                                                                                                                                                                              |
| JTG_TDO      | Output    | <b>Serial Data Out</b> JTAG test access port data output.                                                                                                                                                                                                            |
| JTG_TMS      | Input     | <b>Mode Select</b> JTAG test access port mode select.                                                                                                                                                                                                                |
| JTG_TRST     | Input     | <b>Reset</b> JTAG test access port reset.                                                                                                                                                                                                                            |
| LP_ACK       | I/O       | <b>Acknowledge</b> Provides handshaking. When the link port is configured as a receiver, ACK is an output. When the link port is configured as a transmitter, ACK is an input.                                                                                       |
| LP_CLK       | I/O       | <b>Clock</b> When the link port is configured as a receiver, CLK is an input. When the link port is configured as a transmitter, CLK is an output.                                                                                                                   |
| LP_Dn        | I/O       | <b>Data n</b> Data bus. Input when receiving, output when transmitting.                                                                                                                                                                                              |
| PPI_CLK      | I/O       | <b>Clock</b> Input in external clock mode, output in internal clock mode.                                                                                                                                                                                            |
| PPI_Dnn      | I/O       | <b>Data n</b> Bidirectional data bus.                                                                                                                                                                                                                                |
| PPI_FS1      | I/O       | <b>Frame Sync 1 (HSYNC)</b> Behavior depends on PPI mode. See the PPI chapter in the processor hardware reference for more details.                                                                                                                                  |
| PPI_FS2      | I/O       | <b>Frame Sync 2 (VSYNC)</b> Behavior depends on PPI mode. See the PPI chapter in the processor hardware reference for more details.                                                                                                                                  |
| PPI_FS3      | I/O       | <b>Frame Sync 3 (FIELD)</b> Behavior depends on PPI mode. See the PPI chapter in the processor hardware reference for more details.                                                                                                                                  |
| PWM_AH       | Output    | <b>Channel A High Side</b> High side drive signal.                                                                                                                                                                                                                   |
| PWM_AL       | Output    | <b>Channel A Low Side</b> Low side drive signal.                                                                                                                                                                                                                     |
| PWM_BH       | Output    | <b>Channel B High Side</b> High side drive signal.                                                                                                                                                                                                                   |
| PWM_BL       | Output    | <b>Channel B Low Side</b> Low side drive signal.                                                                                                                                                                                                                     |
| PWM_CH       | Output    | <b>Channel C High Side</b> High side drive signal.                                                                                                                                                                                                                   |
| PWM_CL       | Output    | <b>Channel C Low Side</b> Low side drive signal.                                                                                                                                                                                                                     |
| PWM_DH       | Output    | <b>Channel D High Side</b> High side drive signal.                                                                                                                                                                                                                   |
| PWM_DL       | Output    | <b>Channel D Low Side</b> Low side drive signal.                                                                                                                                                                                                                     |
| PWM_SYNC     | Input     | <b>PWM External Sync</b> This input is for an externally generated sync signal. If the sync signal is internally generated no connection is necessary.                                                                                                               |
| PWM_TRIPn    | Input     | <b>Shutdown Input n</b> When asserted the selected PWM channel outputs are shut down immediately.                                                                                                                                                                    |
| Px_nn        | I/O       | <b>Position n</b> General purpose input/output. See the GP Ports chapter in the processor hardware reference for programming information.                                                                                                                            |

**Table 6. Detailed Signal Descriptions (Continued)**

| Signal Name            | Direction | Description                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RSI_CLK                | Output    | <b>Clock</b> The clock signal applied to the connected device from the RSI.                                                                                                                                                                                                                                                                                            |
| RSI_CMD                | I/O       | <b>Command</b> Used to send commands to and receive responses from the connected device.                                                                                                                                                                                                                                                                               |
| RSI_Dn                 | I/O       | <b>Data n</b> Bidirectional data bus.                                                                                                                                                                                                                                                                                                                                  |
| SMC_ABE $\overline{n}$ | Output    | <b>Byte Enable n</b> Indicate whether the lower or upper byte of a memory is being accessed. When an asynchronous write is made to the upper byte of a 16-bit memory, $\overline{SMC\_ABE1} = 0$ and $\overline{SMC\_ABE0} = 1$ . When an asynchronous write is made to the lower byte of a 16-bit memory, $\overline{SMC\_ABE1} = 1$ and $\overline{SMC\_ABE0} = 0$ . |
| SMC_AMS $\overline{n}$ | Output    | <b>Memory Select n</b> Typically connects to the chip select of a memory device.                                                                                                                                                                                                                                                                                       |
| SMC_Ann                | Output    | <b>Address n</b> Address bus.                                                                                                                                                                                                                                                                                                                                          |
| SMC_AOE                | Output    | <b>Output Enable</b> Asserts at the beginning of the setup period of a read access.                                                                                                                                                                                                                                                                                    |
| SMC_ARDY               | Input     | <b>Asynchronous Ready</b> Flow control signal used by memory devices to indicate to the SMC when further transactions may proceed.                                                                                                                                                                                                                                     |
| SMC_ARE                | Output    | <b>Read Enable</b> Asserts at the beginning of a read access.                                                                                                                                                                                                                                                                                                          |
| SMC_AWE                | Output    | <b>Write Enable</b> Asserts for the duration of a write access period.                                                                                                                                                                                                                                                                                                 |
| SMC_BG $\overline{}$   | Output    | <b>Bus Grant</b> Output used to indicate to an external device that it has been granted control of the SMC buses.                                                                                                                                                                                                                                                      |
| SMC_BG $\overline{H}$  | Output    | <b>Bus Grant Hang</b> Output used to indicate that the SMC has a pending transaction which requires control of the bus to be restored before it can be completed.                                                                                                                                                                                                      |
| SMC_BR $\overline{}$   | Input     | <b>Bus Request</b> Input used by an external device to indicate that it is requesting control of the SMC buses.                                                                                                                                                                                                                                                        |
| SMC_Dnn                | I/O       | <b>Data n</b> Bidirectional data bus.                                                                                                                                                                                                                                                                                                                                  |
| SMC_NORCLK             | Output    | <b>NOR Clock</b> Clock for synchronous burst mode.                                                                                                                                                                                                                                                                                                                     |
| SMC_NORDV              | Output    | <b>NOR Data Valid</b> Asserts for the duration of a synchronous burst mode read setup period.                                                                                                                                                                                                                                                                          |
| SMC_NORWT              | Input     | <b>NOR Wait</b> Flow control signal used by memory devices in synchronous burst mode to indicate to the SMC when further transactions may proceed.                                                                                                                                                                                                                     |
| SPI_CLK                | I/O       | <b>Clock</b> Input in slave mode, output in master mode.                                                                                                                                                                                                                                                                                                               |
| SPI_D2                 | I/O       | <b>Data 2</b> Used to transfer serial data in quad mode. Open drain in ODM mode.                                                                                                                                                                                                                                                                                       |
| SPI_D3                 | I/O       | <b>Data 3</b> Used to transfer serial data in quad mode. Open drain in ODM mode.                                                                                                                                                                                                                                                                                       |
| SPI_MISO               | I/O       | <b>Master In, Slave Out</b> Used to transfer serial data. Operates in the same direction as SPI_MOSI in dual and quad modes. Open drain in ODM mode.                                                                                                                                                                                                                   |
| SPI_MOSI               | I/O       | <b>Master Out, Slave In</b> Used to transfer serial data. Operates in the same direction as SPI_MISO in dual and quad modes. Open drain in ODM mode.                                                                                                                                                                                                                   |
| SPI_RDY                | I/O       | <b>Ready</b> Optional flow signal. Output in slave mode, input in master mode.                                                                                                                                                                                                                                                                                         |
| SPI_SEL $\overline{n}$ | Output    | <b>Slave Select Output n</b> Used in master mode to enable the desired slave.                                                                                                                                                                                                                                                                                          |
| SPI_SS $\overline{}$   | Input     | <b>Slave Select Input</b> Slave mode: acts as the slave select input. Master mode: optionally serves as an error detection input for the SPI when there are multiple masters.                                                                                                                                                                                          |
| SPT_ACLK               | I/O       | <b>Channel A Clock</b> Data and frame sync are driven/sampled with respect to this clock. This signal can be either internally or externally generated.                                                                                                                                                                                                                |
| SPT_AD0                | I/O       | <b>Channel A Data 0</b> Primary bidirectional data I/O. This signal can be configured as an output to transmit serial data, or as an input to receive serial data.                                                                                                                                                                                                     |
| SPT_AD1                | I/O       | <b>Channel A Data 1</b> Secondary bidirectional data I/O. This signal can be configured as an output to transmit serial data, or as an input to receive serial data.                                                                                                                                                                                                   |
| SPT_AFS                | I/O       | <b>Channel A Frame Sync</b> The frame sync pulse initiates shifting of serial data. This signal is either generated internally or externally.                                                                                                                                                                                                                          |
| SPT_ATDV               | Output    | <b>Channel A Transmit Data Valid</b> This signal is optional and only active when SPORT is configured in multi-channel transmit mode. It is asserted during enabled slots.                                                                                                                                                                                             |
| SPT_BCLK               | I/O       | <b>Channel B Clock</b> Data and frame sync are driven/sampled with respect to this clock. This signal can be either internally or externally generated.                                                                                                                                                                                                                |
| SPT_BD0                | I/O       | <b>Channel B Data 0</b> Primary bidirectional data I/O. This signal can be configured as an output to transmit serial data, or as an input to receive serial data.                                                                                                                                                                                                     |

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Table 6. Detailed Signal Descriptions (Continued)

| Signal Name                     | Direction | Description                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SPT_BD1                         | I/O       | <b>Channel B Data 1</b> Secondary bidirectional data I/O. This signal can be configured as an output to transmit serial data, or as an input to receive serial data.                                                                                                                    |
| SPT_BFS                         | I/O       | <b>Channel B Frame Sync</b> The frame sync pulse initiates shifting of serial data. This signal is either generated internally or externally.                                                                                                                                           |
| SPT_BTDTV                       | Output    | <b>Channel B Transmit Data Valid</b> This signal is optional and only active when SPORT is configured in multi-channel transmit mode. It is asserted during enabled slots.                                                                                                              |
| SYS_BMODEn                      | Input     | <b>Boot Mode Control n</b> Selects the boot mode of the processor.                                                                                                                                                                                                                      |
| SYS_CLKIN                       | Input     | <b>Clock/Crystal Input</b> Connect to an external clock source or crystal.                                                                                                                                                                                                              |
| SYS_CLKOUT                      | Output    | <b>Processor Clock Output</b> Outputs internal clocks. Clocks may be divided down. See the CGU chapter in the processor hardware reference for more details.                                                                                                                            |
| SYS_EXTWAKE                     | Output    | <b>External Wake Control</b> Drives low during hibernate and high all other times. Typically connected to the enable input of the voltage regulator controlling the $V_{DD\_INT}$ supply.                                                                                               |
| $\overline{\text{SYS\_FAULT}}$  | I/O       | <b>Complementary Fault</b> Complement of SYS_FAULT.                                                                                                                                                                                                                                     |
| SYS_FAULT                       | I/O       | <b>Fault</b> Indicates internal faults or senses external faults depending on the operating mode.                                                                                                                                                                                       |
| $\overline{\text{SYS\_HWRST}}$  | Input     | <b>Processor Hardware Reset Control</b> Resets the device when asserted.                                                                                                                                                                                                                |
| $\overline{\text{SYS\_IDLEn}}$  | Output    | <b>Core n Idle Indicator</b> When low indicates that core n is in idle mode or being held in reset.                                                                                                                                                                                     |
| $\overline{\text{SYS\_NMI}}$    | Input     | <b>Non-maskable Interrupt</b> Priority depends on the core that receives the interrupt. See the processor hardware and programming references for more details.                                                                                                                         |
| SYS_PWRGD                       | Input     | <b>Power Good Indicator</b> When high it indicates to the processor that the $V_{DD\_INT}$ level is within specifications such that it is safe to begin booting upon return from hibernate.                                                                                             |
| $\overline{\text{SYS\_RESOUT}}$ | Output    | <b>Reset Output</b> Indicates that the device is in the reset state.                                                                                                                                                                                                                    |
| $\overline{\text{SYS\_SLEEP}}$  | Output    | <b>Processor Sleep Indicator</b> When low indicates that the processor is in the deep sleep power saving mode.                                                                                                                                                                          |
| SYS_TDA                         | Input     | <b>Thermal Diode Anode</b> May be used by an external temperature sensor to measure the die temperature.                                                                                                                                                                                |
| SYS_TDK                         | Input     | <b>Thermal Diode Cathode</b> May be used by an external temperature sensor to measure the die temperature.                                                                                                                                                                              |
| SYS_XTAL                        | Output    | <b>Crystal Output</b> Drives an external crystal. Must be left unconnected if an external clock is driving CLKIN.                                                                                                                                                                       |
| TMR_ACIn                        | Input     | <b>Alternate Capture Input n</b> Provides an additional input for WIDCAP, WATCHDOG, and PININT modes.                                                                                                                                                                                   |
| TMR_ACLKn                       | Input     | <b>Alternate Clock n</b> Provides an additional time base for use by an individual timer.                                                                                                                                                                                               |
| TMR_CLK                         | Input     | <b>Clock</b> Provides an additional global time base for use by all the GP timers.                                                                                                                                                                                                      |
| TMR_TMRn                        | I/O       | <b>Timer n</b> The main input/output signal for each timer.                                                                                                                                                                                                                             |
| TWI_SCL                         | I/O       | <b>Serial Clock</b> Clock output when master, clock input when slave.                                                                                                                                                                                                                   |
| TWI_SDA                         | I/O       | <b>Serial Data</b> Receives or transmits data.                                                                                                                                                                                                                                          |
| $\overline{\text{UART\_CTS}}$   | Input     | <b>Clear to Send</b> Flow control signal.                                                                                                                                                                                                                                               |
| $\overline{\text{UART\_RTS}}$   | Output    | <b>Request to Send</b> Flow control signal.                                                                                                                                                                                                                                             |
| $\overline{\text{UART\_RX}}$    | Input     | <b>Receive</b> Receive input. Typically connects to a transceiver that meets the electrical requirements of the device being communicated with.                                                                                                                                         |
| $\overline{\text{UART\_TX}}$    | Output    | <b>Transmit</b> Transmit output. Typically connects to a transceiver that meets the electrical requirements of the device being communicated with.                                                                                                                                      |
| USB_CLKIN                       | Input     | <b>Clock/Crystal Input</b> This clock input is multiplied by a PLL to form the USB clock. See Universal Serial Bus (USB) On-The-Go—Receive and Transmit Timing for frequency/tolerance information.                                                                                     |
| USB_DM                          | I/O       | <b>Data –</b> Bidirectional differential data line.                                                                                                                                                                                                                                     |
| USB_DP                          | I/O       | <b>Data +</b> Bidirectional differential data line.                                                                                                                                                                                                                                     |
| USB_ID                          | Input     | <b>OTG ID</b> Senses whether the controller is a host or device. This signal is pulled low when an A-type plug is sensed (signifying that the USB controller is the A device), but the input is high when a B-type plug is sensed (signifying that the USB controller is the B device). |
| USB_VBC                         | Output    | <b>VBUS Control</b> Controls an external voltage source to supply VBUS when in host mode. May be configured as open drain. Polarity is configurable as well.                                                                                                                            |
| USB_VBUS                        | I/O       | <b>Bus Voltage</b> Connects to bus voltage in host and device modes.                                                                                                                                                                                                                    |

## 349-BALL CSP\_BGA SIGNAL DESCRIPTIONS

The processors' pin definitions are shown in the table. The columns in this table provide the following information:

- Signal Name: The Signal Name column in the table includes the Signal Name for every pin.
- Description: The Description column in the table provides a verbose (descriptive) name for the signal.
- Port: The General-Purpose I/O Port column in the table shows whether or not the signal is multiplexed with other signals on a general-purpose I/O port pin.
- Pin Name: The Pin Name column in the table identifies the name of the package pin (at power-on reset) on which the signal is located (if a single function pin) or is multiplexed (if a general-purpose I/O pin).

Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions

| Signal Name | Description                 | Port      | Pin Name |
|-------------|-----------------------------|-----------|----------|
| ACM0_A0     | ACM0 Address 0              | F         | PF_14    |
| ACM0_A1     | ACM0 Address 1              | F         | PF_15    |
| ACM0_A2     | ACM0 Address 2              | F         | PF_12    |
| ACM0_A3     | ACM0 Address 3              | F         | PF_13    |
| ACM0_A4     | ACM0 Address 4              | F         | PF_10    |
| ACM0_CLK    | ACM0 Clock                  | E         | PE_04    |
| ACM0_FS     | ACM0 Frame Sync             | E         | PE_03    |
| ACM0_T0     | ACM0 External Trigger 0     | E         | PE_08    |
| ACM0_T1     | ACM0 External Trigger 1     | G         | PG_05    |
| CAN0_RX     | CAN0 Receive                | G         | PG_04    |
| CAN0_TX     | CAN0 Transmit               | G         | PG_01    |
| CNT0_DG     | CNT0 Count Down and Gate    | G         | PG_12    |
| CNT0_UD     | CNT0 Count Up and Direction | G         | PG_11    |
| CNT0_ZM     | CNT0 Count Zero Marker      | G         | PG_07    |
| DMC0_A00    | DMC Address 0               | Not Muxed | DMC0_A00 |
| DMC0_A01    | DMC Address 1               | Not Muxed | DMC0_A01 |
| DMC0_A02    | DMC Address 2               | Not Muxed | DMC0_A02 |
| DMC0_A03    | DMC Address 3               | Not Muxed | DMC0_A03 |
| DMC0_A04    | DMC Address 4               | Not Muxed | DMC0_A04 |
| DMC0_A05    | DMC Address 5               | Not Muxed | DMC0_A05 |
| DMC0_A06    | DMC Address 6               | Not Muxed | DMC0_A06 |
| DMC0_A07    | DMC Address 7               | Not Muxed | DMC0_A07 |
| DMC0_A08    | DMC Address 8               | Not Muxed | DMC0_A08 |
| DMC0_A09    | DMC Address 9               | Not Muxed | DMC0_A09 |
| DMC0_A10    | DMC Address 10              | Not Muxed | DMC0_A10 |
| DMC0_A11    | DMC Address 11              | Not Muxed | DMC0_A11 |
| DMC0_A12    | DMC Address 12              | Not Muxed | DMC0_A12 |
| DMC0_A13    | DMC Address 13              | Not Muxed | DMC0_A13 |
| DMC0_BA0    | DMC Bank Address Input 0    | Not Muxed | DMC0_BA0 |
| DMC0_BA1    | DMC Bank Address Input 1    | Not Muxed | DMC0_BA1 |
| DMC0_BA2    | DMC Bank Address Input 2    | Not Muxed | DMC0_BA2 |
| DMC0_CAS    | DMC Column Address Strobe   | Not Muxed | DMC0_CAS |
| DMC0_CK     | DMC Clock                   | Not Muxed | DMC0_CK  |
| DMC0_CKE    | DMC Clock Enable            | Not Muxed | DMC0_CKE |
| DMC0_CK     | DMC Clock (complement)      | Not Muxed | DMC0_CK  |
| DMC0_CS0    | DMC Chip Select 0           | Not Muxed | DMC0_CS0 |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)

| Signal Name                    | Description                                 | Port      | Pin Name                       |
|--------------------------------|---------------------------------------------|-----------|--------------------------------|
| DMC0_DQ00                      | DMC Data 0                                  | Not Muxed | DMC0_DQ00                      |
| DMC0_DQ01                      | DMC Data 1                                  | Not Muxed | DMC0_DQ01                      |
| DMC0_DQ02                      | DMC Data 2                                  | Not Muxed | DMC0_DQ02                      |
| DMC0_DQ03                      | DMC Data 3                                  | Not Muxed | DMC0_DQ03                      |
| DMC0_DQ04                      | DMC Data 4                                  | Not Muxed | DMC0_DQ04                      |
| DMC0_DQ05                      | DMC Data 5                                  | Not Muxed | DMC0_DQ05                      |
| DMC0_DQ06                      | DMC Data 6                                  | Not Muxed | DMC0_DQ06                      |
| DMC0_DQ07                      | DMC Data 7                                  | Not Muxed | DMC0_DQ07                      |
| DMC0_DQ08                      | DMC Data 8                                  | Not Muxed | DMC0_DQ08                      |
| DMC0_DQ09                      | DMC Data 9                                  | Not Muxed | DMC0_DQ09                      |
| DMC0_DQ10                      | DMC Data 10                                 | Not Muxed | DMC0_DQ10                      |
| DMC0_DQ11                      | DMC Data 11                                 | Not Muxed | DMC0_DQ11                      |
| DMC0_DQ12                      | DMC Data 12                                 | Not Muxed | DMC0_DQ12                      |
| DMC0_DQ13                      | DMC Data 13                                 | Not Muxed | DMC0_DQ13                      |
| DMC0_DQ14                      | DMC Data 14                                 | Not Muxed | DMC0_DQ14                      |
| DMC0_DQ15                      | DMC Data 15                                 | Not Muxed | DMC0_DQ15                      |
| DMC0_LDM                       | DMC Data Mask for Lower Byte                | Not Muxed | DMC0_LDM                       |
| DMC0_LDQS                      | DMC Data Strobe for Lower Byte              | Not Muxed | DMC0_LDQS                      |
| $\overline{\text{DMC0\_LDQS}}$ | DMC Data Strobe for Lower Byte (complement) | Not Muxed | $\overline{\text{DMC0\_LDQS}}$ |
| DMC0_ODT                       | DMC On-die Termination                      | Not Muxed | DMC0_ODT                       |
| $\overline{\text{DMC0\_RAS}}$  | DMC Row Address Strobe                      | Not Muxed | $\overline{\text{DMC0\_RAS}}$  |
| DMC0_UDM                       | DMC Data Mask for Upper Byte                | Not Muxed | DMC0_UDM                       |
| DMC0_UDQS                      | DMC Data Strobe for Upper Byte              | Not Muxed | DMC0_UDQS                      |
| $\overline{\text{DMC0\_UDQS}}$ | DMC Data Strobe for Upper Byte (complement) | Not Muxed | $\overline{\text{DMC0\_UDQS}}$ |
| $\overline{\text{DMC0\_WE}}$   | DMC Write Enable                            | Not Muxed | $\overline{\text{DMC0\_WE}}$   |
| ETH0_CRS                       | EMAC0 Carrier Sense/RMII Receive Data Valid | C         | PC_05                          |
| ETH0_MDC                       | EMAC0 Management Channel Clock              | C         | PC_06                          |
| ETH0_MDIO                      | EMAC0 Management Channel Serial Data        | C         | PC_07                          |
| ETH0_PTPPPS                    | EMAC0 PTP Pulse-Per-Second Output           | B         | PB_15                          |
| ETH0_REFCLK                    | EMAC0 Reference Clock                       | B         | PB_14                          |
| ETH0_RXD0                      | EMAC0 Receive Data 0                        | C         | PC_00                          |
| ETH0_RXD1                      | EMAC0 Receive Data 1                        | C         | PC_01                          |
| ETH0_TXD0                      | EMAC0 Transmit Data 0                       | C         | PC_02                          |
| ETH0_TXD1                      | EMAC0 Transmit Data 1                       | C         | PC_03                          |
| ETH0_TXEN                      | EMAC0 Transmit Enable                       | B         | PB_13                          |
| ETH1_CRS                       | EMAC1 Carrier Sense/RMII Receive Data Valid | E         | PE_13                          |
| ETH1_MDC                       | EMAC1 Management Channel Clock              | E         | PE_10                          |
| ETH1_MDIO                      | EMAC1 Management Channel Serial Data        | E         | PE_11                          |
| ETH1_PTPPPS                    | EMAC1 PTP Pulse-Per-Second Output           | C         | PC_09                          |
| ETH1_REFCLK                    | EMAC1 Reference Clock                       | G         | PG_06                          |
| ETH1_RXD0                      | EMAC1 Receive Data 0                        | G         | PG_00                          |
| ETH1_RXD1                      | EMAC1 Receive Data 1                        | E         | PE_15                          |
| ETH1_TXD0                      | EMAC1 Transmit Data 0                       | G         | PG_03                          |
| ETH1_TXD1                      | EMAC1 Transmit Data 1                       | G         | PG_02                          |
| ETH1_TXEN                      | EMAC1 Transmit Enable                       | G         | PG_05                          |
| ETH_PTPAUXIN                   | EMAC0/EMAC1 PTP Auxiliary Trigger Input     | C         | PC_11                          |

**Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)**

| Signal Name  | Description                 | Port      | Pin Name |
|--------------|-----------------------------|-----------|----------|
| ETH_PTPCLKIN | EMACO/EMAC1 PTP Clock Input | C         | PC_13    |
| GND          | Ground                      | Not Muxed | GND      |
| JTG_EMU      | Emulation Output            | Not Muxed | JTG_EMU  |
| JTG_TCK      | JTAG Clock                  | Not Muxed | JTG_TCK  |
| JTG_TDI      | JTAG Serial Data Input      | Not Muxed | JTG_TDI  |
| JTG_TDO      | JTAG Serial Data Output     | Not Muxed | JTG_TDO  |
| JTG_TMS      | JTAG Mode Select            | Not Muxed | JTG_TMS  |
| JTG_TRST     | JTAG Reset                  | Not Muxed | JTG_TRST |
| LP0_ACK      | LP0 Acknowledge             | B         | PB_01    |
| LP0_CLK      | LP0 Clock                   | B         | PB_00    |
| LP0_D0       | LP0 Data 0                  | A         | PA_00    |
| LP0_D1       | LP0 Data 1                  | A         | PA_01    |
| LP0_D2       | LP0 Data 2                  | A         | PA_02    |
| LP0_D3       | LP0 Data 3                  | A         | PA_03    |
| LP0_D4       | LP0 Data 4                  | A         | PA_04    |
| LP0_D5       | LP0 Data 5                  | A         | PA_05    |
| LP0_D6       | LP0 Data 6                  | A         | PA_06    |
| LP0_D7       | LP0 Data 7                  | A         | PA_07    |
| LP1_ACK      | LP1 Acknowledge             | B         | PB_02    |
| LP1_CLK      | LP1 Clock                   | B         | PB_03    |
| LP1_D0       | LP1 Data 0                  | A         | PA_08    |
| LP1_D1       | LP1 Data 1                  | A         | PA_09    |
| LP1_D2       | LP1 Data 2                  | A         | PA_10    |
| LP1_D3       | LP1 Data 3                  | A         | PA_11    |
| LP1_D4       | LP1 Data 4                  | A         | PA_12    |
| LP1_D5       | LP1 Data 5                  | A         | PA_13    |
| LP1_D6       | LP1 Data 6                  | A         | PA_14    |
| LP1_D7       | LP1 Data 7                  | A         | PA_15    |
| LP2_ACK      | LP2 Acknowledge             | E         | PE_08    |
| LP2_CLK      | LP2 Clock                   | E         | PE_09    |
| LP2_D0       | LP2 Data 0                  | F         | PF_00    |
| LP2_D1       | LP2 Data 1                  | F         | PF_01    |
| LP2_D2       | LP2 Data 2                  | F         | PF_02    |
| LP2_D3       | LP2 Data 3                  | F         | PF_03    |
| LP2_D4       | LP2 Data 4                  | F         | PF_04    |
| LP2_D5       | LP2 Data 5                  | F         | PF_05    |
| LP2_D6       | LP2 Data 6                  | F         | PF_06    |
| LP2_D7       | LP2 Data 7                  | F         | PF_07    |
| LP3_ACK      | LP3 Acknowledge             | E         | PE_07    |
| LP3_CLK      | LP3 Clock                   | E         | PE_06    |
| LP3_D0       | LP3 Data 0                  | F         | PF_08    |
| LP3_D1       | LP3 Data 1                  | F         | PF_09    |
| LP3_D2       | LP3 Data 2                  | F         | PF_10    |
| LP3_D3       | LP3 Data 3                  | F         | PF_11    |
| LP3_D4       | LP3 Data 4                  | F         | PF_12    |
| LP3_D5       | LP3 Data 5                  | F         | PF_13    |

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Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)

| Signal Name   | Description                                 | Port | Pin Name      |
|---------------|---------------------------------------------|------|---------------|
| LP3_D6        | LP3 Data 6                                  | F    | PF_14         |
| LP3_D7        | LP3 Data 7                                  | F    | PF_15         |
| PA_00 – PA_15 | PORTA Position 00 through PORTA Position 15 | A    | PA_00 – PA_15 |
| PB_00 – PB_15 | PORTB Position 00 through PORTB Position 15 | B    | PB_00 – PB_15 |
| PC_00 – PC_15 | PORTC Position 00 through PORTC Position 15 | C    | PC_00 – PC_15 |
| PD_00 – PD_15 | PORTD Position 00 through PORTD Position 15 | D    | PD_00 – PD_15 |
| PE_00 – PE_15 | PORTE Position 00 through PORTE Position 15 | E    | PE_00 – PE_15 |
| PF_00 – PF_15 | PORTF Position 00 through PORTF Position 15 | F    | PF_00 – PF_15 |
| PG_00 – PG_15 | PORTG Position 00 through PORTG Position 15 | G    | PG_00 – PG_15 |
| PPIO_CLK      | EPPIO Clock                                 | E    | PE_09         |
| PPIO_D00      | EPPIO Data 0                                | F    | PF_00         |
| PPIO_D01      | EPPIO Data 1                                | F    | PF_01         |
| PPIO_D02      | EPPIO Data 2                                | F    | PF_02         |
| PPIO_D03      | EPPIO Data 3                                | F    | PF_03         |
| PPIO_D04      | EPPIO Data 4                                | F    | PF_04         |
| PPIO_D05      | EPPIO Data 5                                | F    | PF_05         |
| PPIO_D06      | EPPIO Data 6                                | F    | PF_06         |
| PPIO_D07      | EPPIO Data 7                                | F    | PF_07         |
| PPIO_D08      | EPPIO Data 8                                | F    | PF_08         |
| PPIO_D09      | EPPIO Data 9                                | F    | PF_09         |
| PPIO_D10      | EPPIO Data 10                               | F    | PF_10         |
| PPIO_D11      | EPPIO Data 11                               | F    | PF_11         |
| PPIO_D12      | EPPIO Data 12                               | F    | PF_12         |
| PPIO_D13      | EPPIO Data 13                               | F    | PF_13         |
| PPIO_D14      | EPPIO Data 14                               | F    | PF_14         |
| PPIO_D15      | EPPIO Data 15                               | F    | PF_15         |
| PPIO_D16      | EPPIO Data 16                               | E    | PE_03         |
| PPIO_D17      | EPPIO Data 17                               | E    | PE_04         |
| PPIO_D18      | EPPIO Data 18                               | E    | PE_00         |
| PPIO_D19      | EPPIO Data 19                               | E    | PE_01         |
| PPIO_D20      | EPPIO Data 20                               | D    | PD_12         |
| PPIO_D21      | EPPIO Data 21                               | D    | PD_15         |
| PPIO_D22      | EPPIO Data 22                               | E    | PE_02         |
| PPIO_D23      | EPPIO Data 23                               | E    | PE_05         |
| PPIO_FS1      | EPPIO Frame Sync 1 (HSYNC)                  | E    | PE_08         |
| PPIO_FS2      | EPPIO Frame Sync 2 (VSYNC)                  | E    | PE_07         |
| PPIO_FS3      | EPPIO Frame Sync 3 (FIELD)                  | E    | PE_06         |
| PPI1_CLK      | EPPI1 Clock                                 | B    | PB_14         |
| PPI1_D00      | EPPI1 Data 0                                | C    | PC_00         |
| PPI1_D01      | EPPI1 Data 1                                | C    | PC_01         |
| PPI1_D02      | EPPI1 Data 2                                | C    | PC_02         |
| PPI1_D03      | EPPI1 Data 3                                | C    | PC_03         |
| PPI1_D04      | EPPI1 Data 4                                | C    | PC_04         |
| PPI1_D05      | EPPI1 Data 5                                | C    | PC_05         |
| PPI1_D06      | EPPI1 Data 6                                | C    | PC_06         |
| PPI1_D07      | EPPI1 Data 7                                | C    | PC_07         |

**Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)**

| Signal Name | Description                | Port | Pin Name |
|-------------|----------------------------|------|----------|
| PPI1_D08    | EPPI1 Data 8               | C    | PC_08    |
| PPI1_D09    | EPPI1 Data 9               | C    | PC_09    |
| PPI1_D10    | EPPI1 Data 10              | C    | PC_10    |
| PPI1_D11    | EPPI1 Data 11              | C    | PC_11    |
| PPI1_D12    | EPPI1 Data 12              | C    | PC_12    |
| PPI1_D13    | EPPI1 Data 13              | C    | PC_13    |
| PPI1_D14    | EPPI1 Data 14              | C    | PC_14    |
| PPI1_D15    | EPPI1 Data 15              | C    | PC_15    |
| PPI1_D16    | EPPI1 Data 16              | D    | PD_00    |
| PPI1_D17    | EPPI1 Data 17              | D    | PD_01    |
| PPI1_FS1    | EPPI1 Frame Sync 1 (HSYNC) | B    | PB_13    |
| PPI1_FS2    | EPPI1 Frame Sync 2 (VSYNC) | D    | PD_06    |
| PPI1_FS3    | EPPI1 Frame Sync 3 (FIELD) | B    | PB_15    |
| PPI2_CLK    | EPPI2 Clock                | B    | PB_00    |
| PPI2_D00    | EPPI2 Data 0               | A    | PA_00    |
| PPI2_D01    | EPPI2 Data 1               | A    | PA_01    |
| PPI2_D02    | EPPI2 Data 2               | A    | PA_02    |
| PPI2_D03    | EPPI2 Data 3               | A    | PA_03    |
| PPI2_D04    | EPPI2 Data 4               | A    | PA_04    |
| PPI2_D05    | EPPI2 Data 5               | A    | PA_05    |
| PPI2_D06    | EPPI2 Data 6               | A    | PA_06    |
| PPI2_D07    | EPPI2 Data 7               | A    | PA_07    |
| PPI2_D08    | EPPI2 Data 8               | A    | PA_08    |
| PPI2_D09    | EPPI2 Data 9               | A    | PA_09    |
| PPI2_D10    | EPPI2 Data 10              | A    | PA_10    |
| PPI2_D11    | EPPI2 Data 11              | A    | PA_11    |
| PPI2_D12    | EPPI2 Data 12              | A    | PA_12    |
| PPI2_D13    | EPPI2 Data 13              | A    | PA_13    |
| PPI2_D14    | EPPI2 Data 14              | A    | PA_14    |
| PPI2_D15    | EPPI2 Data 15              | A    | PA_15    |
| PPI2_D16    | EPPI2 Data 16              | B    | PB_07    |
| PPI2_D17    | EPPI2 Data 17              | B    | PB_08    |
| PPI2_FS1    | EPPI2 Frame Sync 1 (HSYNC) | B    | PB_01    |
| PPI2_FS2    | EPPI2 Frame Sync 2 (VSYNC) | B    | PB_02    |
| PPI2_FS3    | EPPI2 Frame Sync 3 (FIELD) | B    | PB_03    |
| PWM0_AH     | PWM0 Channel A High Side   | F    | PF_01    |
| PWM0_AL     | PWM0 Channel A Low Side    | F    | PF_00    |
| PWM0_BH     | PWM0 Channel B High Side   | F    | PF_03    |
| PWM0_BL     | PWM0 Channel B Low Side    | F    | PF_02    |
| PWM0_CH     | PWM0 Channel C High Side   | F    | PF_05    |
| PWM0_CL     | PWM0 Channel C Low Side    | F    | PF_04    |
| PWM0_DH     | PWM0 Channel D High Side   | F    | PF_07    |
| PWM0_DL     | PWM0 Channel D Low Side    | F    | PF_06    |
| PWM0_SYNC   | PWM0 Sync                  | E    | PE_08    |
| PWM0_TRIPO  | PWM0 Shutdown Input 0      | E    | PE_09    |
| PWM0_TRIPT  | PWM0 Shutdown Input 1      | F    | PF_11    |

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Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)

| Signal Name | Description              | Port      | Pin Name |
|-------------|--------------------------|-----------|----------|
| PWM1_AH     | PWM1 Channel A High Side | G         | PG_03    |
| PWM1_AL     | PWM1 Channel A Low Side  | G         | PG_02    |
| PWM1_BH     | PWM1 Channel B High Side | G         | PG_00    |
| PWM1_BL     | PWM1 Channel B Low Side  | E         | PE_15    |
| PWM1_CH     | PWM1 Channel C High Side | E         | PE_13    |
| PWM1_CL     | PWM1 Channel C Low Side  | E         | PE_12    |
| PWM1_DH     | PWM1 Channel D High Side | E         | PE_11    |
| PWM1_DL     | PWM1 Channel D Low Side  | E         | PE_10    |
| PWM1_SYNC   | PWM1 Sync                | G         | PG_05    |
| PWM1_TRIP0  | PWM1 Shutdown Input 0    | G         | PG_06    |
| PWM1_TRIP1  | PWM1 Shutdown Input 1    | G         | PG_08    |
| RSIO_CLK    | RSIO Clock               | G         | PG_06    |
| RSIO_CMD    | RSIO Command             | G         | PG_05    |
| RSIO_D0     | RSIO Data 0              | G         | PG_03    |
| RSIO_D1     | RSIO Data 1              | G         | PG_02    |
| RSIO_D2     | RSIO Data 2              | G         | PG_00    |
| RSIO_D3     | RSIO Data 3              | E         | PE_15    |
| RSIO_D4     | RSIO Data 4              | E         | PE_13    |
| RSIO_D5     | RSIO Data 5              | E         | PE_12    |
| RSIO_D6     | RSIO Data 6              | E         | PE_10    |
| RSIO_D7     | RSIO Data 7              | E         | PE_11    |
| SMC0_A01    | SMC0 Address 1           | Not Muxed | SMC0_A01 |
| SMC0_A02    | SMC0 Address 2           | Not Muxed | SMC0_A02 |
| SMC0_A03    | SMC0 Address 3           | A         | PA_00    |
| SMC0_A04    | SMC0 Address 4           | A         | PA_01    |
| SMC0_A05    | SMC0 Address 5           | A         | PA_02    |
| SMC0_A06    | SMC0 Address 6           | A         | PA_03    |
| SMC0_A07    | SMC0 Address 7           | A         | PA_04    |
| SMC0_A08    | SMC0 Address 8           | A         | PA_05    |
| SMC0_A09    | SMC0 Address 9           | A         | PA_06    |
| SMC0_A10    | SMC0 Address 10          | A         | PA_07    |
| SMC0_A11    | SMC0 Address 11          | A         | PA_08    |
| SMC0_A12    | SMC0 Address 12          | A         | PA_09    |
| SMC0_A13    | SMC0 Address 13          | B         | PB_02    |
| SMC0_A14    | SMC0 Address 14          | A         | PA_10    |
| SMC0_A15    | SMC0 Address 15          | A         | PA_11    |
| SMC0_A16    | SMC0 Address 16          | B         | PB_03    |
| SMC0_A17    | SMC0 Address 17          | A         | PA_12    |
| SMC0_A18    | SMC0 Address 18          | A         | PA_13    |
| SMC0_A19    | SMC0 Address 19          | A         | PA_14    |
| SMC0_A20    | SMC0 Address 20          | A         | PA_15    |
| SMC0_A21    | SMC0 Address 21          | B         | PB_06    |
| SMC0_A22    | SMC0 Address 22          | B         | PB_07    |
| SMC0_A23    | SMC0 Address 23          | B         | PB_08    |
| SMC0_A24    | SMC0 Address 24          | B         | PB_10    |
| SMC0_A25    | SMC0 Address 25          | B         | PB_11    |

**Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)**

| Signal Name                    | Description                | Port      | Pin Name                             |
|--------------------------------|----------------------------|-----------|--------------------------------------|
| $\overline{\text{SMC0\_ABE0}}$ | SMC0 Byte Enable 0         | B         | PB_04                                |
| $\overline{\text{SMC0\_ABE1}}$ | SMC0 Byte Enable 1         | B         | PB_05                                |
| $\overline{\text{SMC0\_AMS0}}$ | SMC0 Memory Select 0       | Not Muxed | $\overline{\text{SMC0\_AMS0}}$       |
| $\overline{\text{SMC0\_AMS1}}$ | SMC0 Memory Select 1       | B         | PB_01                                |
| $\overline{\text{SMC0\_AMS2}}$ | SMC0 Memory Select 2       | B         | PB_04                                |
| $\overline{\text{SMC0\_AMS3}}$ | SMC0 Memory Select 3       | B         | PB_05                                |
| $\overline{\text{SMC0\_AOE}}$  | SMC0 Output Enable         | Not Muxed | $\overline{\text{SMC0\_AOE\_NORDV}}$ |
| SMC0_ARDY                      | SMC0 Asynchronous Ready    | Not Muxed | SMC0_ARDY_NORWT                      |
| $\overline{\text{SMC0\_ARE}}$  | SMC0 Read Enable           | Not Muxed | $\overline{\text{SMC0\_ARE}}$        |
| $\overline{\text{SMC0\_AWE}}$  | SMC0 Write Enable          | Not Muxed | $\overline{\text{SMC0\_AWE}}$        |
| $\overline{\text{SMC0\_BGH}}$  | SMC0 Bus Grant Hang        | B         | PB_09                                |
| $\overline{\text{SMC0\_BG}}$   | SMC0 Bus Grant             | B         | PB_12                                |
| $\overline{\text{SMC0\_BR}}$   | SMC0 Bus Request           | Not Muxed | $\overline{\text{SMC0\_BR}}$         |
| SMC0_D00                       | SMC0 Data 0                | Not Muxed | SMC0_D00                             |
| SMC0_D01                       | SMC0 Data 1                | Not Muxed | SMC0_D01                             |
| SMC0_D02                       | SMC0 Data 2                | Not Muxed | SMC0_D02                             |
| SMC0_D03                       | SMC0 Data 3                | Not Muxed | SMC0_D03                             |
| SMC0_D04                       | SMC0 Data 4                | Not Muxed | SMC0_D04                             |
| SMC0_D05                       | SMC0 Data 5                | Not Muxed | SMC0_D05                             |
| SMC0_D06                       | SMC0 Data 6                | Not Muxed | SMC0_D06                             |
| SMC0_D07                       | SMC0 Data 7                | Not Muxed | SMC0_D07                             |
| SMC0_D08                       | SMC0 Data 8                | Not Muxed | SMC0_D08                             |
| SMC0_D09                       | SMC0 Data 9                | Not Muxed | SMC0_D09                             |
| SMC0_D10                       | SMC0 Data 10               | Not Muxed | SMC0_D10                             |
| SMC0_D11                       | SMC0 Data 11               | Not Muxed | SMC0_D11                             |
| SMC0_D12                       | SMC0 Data 12               | Not Muxed | SMC0_D12                             |
| SMC0_D13                       | SMC0 Data 13               | Not Muxed | SMC0_D13                             |
| SMC0_D14                       | SMC0 Data 14               | Not Muxed | SMC0_D14                             |
| SMC0_D15                       | SMC0 Data 15               | Not Muxed | SMC0_D15                             |
| SMC0_NORCLK                    | SMC0 NOR Clock             | B         | PB_00                                |
| SMC0_NORDV                     | SMC0 NOR Data Valid        | Not Muxed | $\overline{\text{SMC0\_AOE\_NORDV}}$ |
| SMC0_NORWT                     | SMC0 NOR Wait              | Not Muxed | SMC0_ARDY_NORWT                      |
| SPI0_CLK                       | SPI0 Clock                 | D         | PD_04                                |
| SPI0_D2                        | SPI0 Data 2                | D         | PD_00                                |
| SPI0_D3                        | SPI0 Data 3                | D         | PD_01                                |
| SPI0_MISO                      | SPI0 Master In, Slave Out  | D         | PD_02                                |
| SPI0_MOSI                      | SPI0 Master Out, Slave In  | D         | PD_03                                |
| SPI0_RDY                       | SPI0 Ready                 | D         | PD_10                                |
| $\overline{\text{SPI0\_SEL1}}$ | SPI0 Slave Select Output 1 | D         | PD_11                                |
| $\overline{\text{SPI0\_SEL2}}$ | SPI0 Slave Select Output 2 | D         | PD_01                                |
| $\overline{\text{SPI0\_SEL3}}$ | SPI0 Slave Select Output 3 | D         | PD_00                                |
| $\overline{\text{SPI0\_SEL4}}$ | SPI0 Slave Select Output 4 | C         | PC_15                                |
| $\overline{\text{SPI0\_SEL5}}$ | SPI0 Slave Select Output 5 | D         | PD_09                                |
| $\overline{\text{SPI0\_SEL6}}$ | SPI0 Slave Select Output 6 | C         | PC_13                                |
| $\overline{\text{SPI0\_SEL7}}$ | SPI0 Slave Select Output 7 | C         | PC_12                                |
| $\overline{\text{SPI0\_SS}}$   | SPI0 Slave Select Input    | D         | PD_11                                |

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Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)

| Signal Name                    | Description                          | Port      | Pin Name   |
|--------------------------------|--------------------------------------|-----------|------------|
| SPI1_CLK                       | SPI1 Clock                           | D         | PD_05      |
| SPI1_D2                        | SPI1 Data 2                          | E         | PE_01      |
| SPI1_D3                        | SPI1 Data 3                          | E         | PE_00      |
| SPI1_MISO                      | SPI1 Master In, Slave Out            | D         | PD_14      |
| SPI1_MOSI                      | SPI1 Master Out, Slave In            | D         | PD_13      |
| SPI1_RDY                       | SPI1 Ready                           | E         | PE_02      |
| $\overline{\text{SPI1\_SEL1}}$ | SPI1 Slave Select Output 1           | D         | PD_12      |
| $\overline{\text{SPI1\_SEL2}}$ | SPI1 Slave Select Output 2           | D         | PD_15      |
| $\overline{\text{SPI1\_SEL3}}$ | SPI1 Slave Select Output 3           | D         | PD_10      |
| $\overline{\text{SPI1\_SEL4}}$ | SPI1 Slave Select Output 4           | D         | PD_09      |
| $\overline{\text{SPI1\_SEL5}}$ | SPI1 Slave Select Output 5           | F         | PF_08      |
| $\overline{\text{SPI1\_SEL6}}$ | SPI1 Slave Select Output 6           | F         | PF_09      |
| $\overline{\text{SPI1\_SEL7}}$ | SPI1 Slave Select Output 7           | C         | PC_14      |
| $\overline{\text{SPI1\_SS}}$   | SPI1 Slave Select Input              | D         | PD_12      |
| SPT0_ACLK                      | SPORT0 Channel A Clock               | B         | PB_05      |
| SPT0_AD0                       | SPORT0 Channel A Data 0              | B         | PB_09      |
| SPT0_AD1                       | SPORT0 Channel A Data 1              | B         | PB_12      |
| SPT0_AFS                       | SPORT0 Channel A Frame Sync          | B         | PB_04      |
| SPT0_ATDV                      | SPORT0 Channel A Transmit Data Valid | B         | PB_06      |
| SPT0_BCLK                      | SPORT0 Channel B Clock               | B         | PB_08      |
| SPT0_BD0                       | SPORT0 Channel B Data 0              | B         | PB_11      |
| SPT0_BD1                       | SPORT0 Channel B Data 1              | B         | PB_10      |
| SPT0_BFS                       | SPORT0 Channel B Frame Sync          | B         | PB_07      |
| SPT0_BTDTV                     | SPORT0 Channel B Transmit Data Valid | B         | PB_12      |
| SPT1_ACLK                      | SPORT1 Channel A Clock               | E         | PE_02      |
| SPT1_AD0                       | SPORT1 Channel A Data 0              | D         | PD_15      |
| SPT1_AD1                       | SPORT1 Channel A Data 1              | D         | PD_12      |
| SPT1_AFS                       | SPORT1 Channel A Frame Sync          | E         | PE_05      |
| SPT1_ATDV                      | SPORT1 Channel A Transmit Data Valid | E         | PE_06      |
| SPT1_BCLK                      | SPORT1 Channel B Clock               | E         | PE_04      |
| SPT1_BD0                       | SPORT1 Channel B Data 0              | E         | PE_01      |
| SPT1_BD1                       | SPORT1 Channel B Data 1              | E         | PE_00      |
| SPT1_BFS                       | SPORT1 Channel B Frame Sync          | E         | PE_03      |
| SPT1_BTDTV                     | SPORT1 Channel B Transmit Data Valid | E         | PE_07      |
| SPT2_ACLK                      | SPORT2 Channel A Clock               | G         | PG_04      |
| SPT2_AD0                       | SPORT2 Channel A Data 0              | G         | PG_09      |
| SPT2_AD1                       | SPORT2 Channel A Data 1              | G         | PG_08      |
| SPT2_AFS                       | SPORT2 Channel A Frame Sync          | G         | PG_01      |
| SPT2_ATDV                      | SPORT2 Channel A Transmit Data Valid | E         | PE_14      |
| SPT2_BCLK                      | SPORT2 Channel B Clock               | G         | PG_10      |
| SPT2_BD0                       | SPORT2 Channel B Data 0              | G         | PG_12      |
| SPT2_BD1                       | SPORT2 Channel B Data 1              | G         | PG_11      |
| SPT2_BFS                       | SPORT2 Channel B Frame Sync          | G         | PG_07      |
| SPT2_BTDTV                     | SPORT2 Channel B Transmit Data Valid | G         | PG_06      |
| SYS_BMODE0                     | Boot Mode Control 0                  | Not Muxed | SYS_BMODE0 |
| SYS_BMODE1                     | Boot Mode Control 1                  | Not Muxed | SYS_BMODE1 |

**Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)**

| Signal Name                     | Description                      | Port      | Pin Name                             |
|---------------------------------|----------------------------------|-----------|--------------------------------------|
| SYS_BMODE2                      | Boot Mode Control 2              | Not Muxed | SYS_BMODE2                           |
| SYS_CLKIN                       | Clock/Crystal Input              | Not Muxed | SYS_CLKIN                            |
| SYS_CLKOUT                      | Processor Clock Output           | Not Muxed | SYS_CLKOUT                           |
| SYS_EXTWAKE                     | External Wake Control            | Not Muxed | SYS_EXTWAKE                          |
| SYS_FAULT                       | Fault Output                     | Not Muxed | SYS_FAULT                            |
| $\overline{\text{SYS\_FAULT}}$  | Complementary Fault Output       | Not Muxed | $\overline{\text{SYS\_FAULT}}$       |
| $\overline{\text{SYS\_HWRST}}$  | Processor Hardware Reset Control | Not Muxed | $\overline{\text{SYS\_HWRST}}$       |
| $\overline{\text{SYS\_IDLE0}}$  | Core 0 Idle Indicator            | G         | PG_15                                |
| $\overline{\text{SYS\_IDLE1}}$  | Core 1 Idle Indicator            | G         | PG_14                                |
| $\overline{\text{SYS\_NMI}}$    | Non-maskable Interrupt           | Not Muxed | $\overline{\text{SYS\_NMI\_RESOUT}}$ |
| SYS_PWRGD                       | Power Good Indicator             | Not Muxed | SYS_PWRGD                            |
| $\overline{\text{SYS\_RESOUT}}$ | Reset Output                     | Not Muxed | $\overline{\text{SYS\_NMI\_RESOUT}}$ |
| $\overline{\text{SYS\_SLEEP}}$  | Processor Sleep Indicator        | G         | PG_15                                |
| SYS_TDA                         | Thermal Diode Anode              | Not Muxed | SYS_TDA                              |
| SYS_TDK                         | Thermal Diode Cathode            | Not Muxed | SYS_TDK                              |
| SYS_XTAL                        | Crystal Output                   | Not Muxed | SYS_XTAL                             |
| TM0_ACIO                        | TIMER0 Alternate Capture Input 0 | D         | PD_08                                |
| TM0_AC11                        | TIMER0 Alternate Capture Input 1 | G         | PG_14                                |
| TM0_AC12                        | TIMER0 Alternate Capture Input 2 | G         | PG_04                                |
| TM0_AC13                        | TIMER0 Alternate Capture Input 3 | D         | PD_07                                |
| TM0_AC14                        | TIMER0 Alternate Capture Input 4 | G         | PG_15                                |
| TM0_AC15                        | TIMER0 Alternate Capture Input 5 | D         | PD_06                                |
| TM0_AC16                        | TIMER0 Alternate Capture Input 6 | B         | PB_13                                |
| TM0_ACLK0                       | TIMER0 Alternate Clock 0         | B         | PB_10                                |
| TM0_ACLK1                       | TIMER0 Alternate Clock 1         | B         | PB_12                                |
| TM0_ACLK2                       | TIMER0 Alternate Clock 2         | B         | PB_09                                |
| TM0_ACLK3                       | TIMER0 Alternate Clock 3         | B         | PB_11                                |
| TM0_ACLK4                       | TIMER0 Alternate Clock 4         | B         | PB_06                                |
| TM0_ACLK5                       | TIMER0 Alternate Clock 5         | D         | PD_13                                |
| TM0_ACLK6                       | TIMER0 Alternate Clock 6         | D         | PD_14                                |
| TM0_ACLK7                       | TIMER0 Alternate Clock 7         | D         | PD_05                                |
| TM0_CLK                         | TIMER0 Clock                     | G         | PG_13                                |
| TM0_TMR0                        | TIMER0 Timer 0                   | E         | PE_14                                |
| TM0_TMR1                        | TIMER0 Timer 1                   | G         | PG_04                                |
| TM0_TMR2                        | TIMER0 Timer 2                   | G         | PG_01                                |
| TM0_TMR3                        | TIMER0 Timer 3                   | G         | PG_08                                |
| TM0_TMR4                        | TIMER0 Timer 4                   | G         | PG_09                                |
| TM0_TMR5                        | TIMER0 Timer 5                   | G         | PG_07                                |
| TM0_TMR6                        | TIMER0 Timer 6                   | G         | PG_11                                |
| TM0_TMR7                        | TIMER0 Timer 7                   | G         | PG_12                                |
| TWI0_SCL                        | TWI0 Serial Clock                | Not Muxed | TWI0_SCL                             |
| TWI0_SDA                        | TWI0 Serial Data                 | Not Muxed | TWI0_SDA                             |
| TWI1_SCL                        | TWI1 Serial Clock                | Not Muxed | TWI1_SCL                             |
| TWI1_SDA                        | TWI1 Serial Data                 | Not Muxed | TWI1_SDA                             |
| $\overline{\text{UART0\_CTS}}$  | UART0 Clear to Send              | D         | PD_10                                |
| $\overline{\text{UART0\_RTS}}$  | UART0 Request to Send            | D         | PD_09                                |

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Table 7. ADSP-BF60x 349-Ball CSP\_BGA Signal Descriptions (Continued)

| Signal Name | Description              | Port      | Pin Name   |
|-------------|--------------------------|-----------|------------|
| UART0_RX    | UART0 Receive            | D         | PD_08      |
| UART0_TX    | UART0 Transmit           | D         | PD_07      |
| UART1_CTS   | UART1 Clear to Send      | G         | PG_13      |
| UART1_RTS   | UART1 Request to Send    | G         | PG_10      |
| UART1_RX    | UART1 Receive            | G         | PG_14      |
| UART1_TX    | UART1 Transmit           | G         | PG_15      |
| USB0_CLKIN  | USB0 Clock/Crystal Input | Not Muxed | USB0_CLKIN |
| USB0_DM     | USB0 Data –              | Not Muxed | USB0_DM    |
| USB0_DP     | USB0 Data +              | Not Muxed | USB0_DP    |
| USB0_ID     | USB0 OTG ID              | Not Muxed | USB0_ID    |
| USB0_VBC    | USB0 VBUS Control        | Not Muxed | USB0_VBC   |
| USB0_VBUS   | USB0 Bus Voltage         | Not Muxed | USB0_VBUS  |
| VDD_DMC     | VDD for DMC              | Not Muxed | VDD_DMC    |
| VDD_EXT     | External VDD             | Not Muxed | VDD_EXT    |
| VDD_INT     | Internal VDD             | Not Muxed | VDD_INT    |
| VDD_TD      | VDD for Thermal Diode    | Not Muxed | VDD_TD     |
| VDD_USB     | VDD for USB              | Not Muxed | VDD_USB    |
| VREF_DMC    | VREF for DMC             | Not Muxed | VREF_DMC   |

## GP I/O MULTIPLEXING FOR 349-BALL CSP\_BGA

Table 8 through Table 14 identifies the pin functions that are multiplexed on the general-purpose I/O pins of the 349-ball CSP\_BGA package.

Table 8. Signal Multiplexing for Port A

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PA_00       | SMC0_A03               | PPI2_D00               | LP0_D0                 |                                |
| PA_01       | SMC0_A04               | PPI2_D01               | LP0_D1                 |                                |
| PA_02       | SMC0_A05               | PPI2_D02               | LP0_D2                 |                                |
| PA_03       | SMC0_A06               | PPI2_D03               | LP0_D3                 |                                |
| PA_04       | SMC0_A07               | PPI2_D04               | LP0_D4                 |                                |
| PA_05       | SMC0_A08               | PPI2_D05               | LP0_D5                 |                                |
| PA_06       | SMC0_A09               | PPI2_D06               | LP0_D6                 |                                |
| PA_07       | SMC0_A10               | PPI2_D07               | LP0_D7                 |                                |
| PA_08       | SMC0_A11               | PPI2_D08               | LP1_D0                 |                                |
| PA_09       | SMC0_A12               | PPI2_D09               | LP1_D1                 |                                |
| PA_10       | SMC0_A14               | PPI2_D10               | LP1_D2                 |                                |
| PA_11       | SMC0_A15               | PPI2_D11               | LP1_D3                 |                                |
| PA_12       | SMC0_A17               | PPI2_D12               | LP1_D4                 |                                |
| PA_13       | SMC0_A18               | PPI2_D13               | LP1_D5                 |                                |
| PA_14       | SMC0_A19               | PPI2_D14               | LP1_D6                 |                                |
| PA_15       | SMC0_A20               | PPI2_D15               | LP1_D7                 |                                |

Table 9. Signal Multiplexing for Port B

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PB_00       | SMC0_NORCLK            | PPI2_CLK               | LP0_CLK                |                                |
| PB_01       | SMC0_AMS1              | PPI2_FS1               | LP0_ACK                |                                |
| PB_02       | SMC0_A13               | PPI2_FS2               | LP1_ACK                |                                |
| PB_03       | SMC0_A16               | PPI2_FS3               | LP1_CLK                |                                |
| PB_04       | SMC0_AMS2              | SMC0_ABE0              | SPT0_AFS               |                                |
| PB_05       | SMC0_AMS3              | SMC0_ABE1              | SPT0_ACLK              |                                |
| PB_06       | SMC0_A21               | SPT0_ATDV              |                        | TM0_ACLK4                      |
| PB_07       | SMC0_A22               | PPI2_D16               | SPT0_BFS               |                                |
| PB_08       | SMC0_A23               | PPI2_D17               | SPT0_BCLK              |                                |
| PB_09       | SMC0_BGH               |                        | SPT0_AD0               | TM0_ACLK2                      |
| PB_10       | SMC0_A24               |                        | SPT0_BD1               | TM0_ACLK0                      |
| PB_11       | SMC0_A25               |                        | SPT0_BD0               | TM0_ACLK3                      |
| PB_12       | SMC0_BG                | SPT0_BTDV              | SPT0_AD1               | TM0_ACLK1                      |
| PB_13       | ETH0_TXEN              | PPI1_FS1               |                        | TM0_AC16                       |
| PB_14       | ETH0_REFCLK            | PPI1_CLK               |                        |                                |
| PB_15       | ETH0_PTPPPS            | PPI1_FS3               |                        |                                |

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Table 10. Signal Multiplexing for Port C

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PC_00       | ETH0_RXD0              | PPI1_D00               |                        |                                |
| PC_01       | ETH0_RXD1              | PPI1_D01               |                        |                                |
| PC_02       | ETH0_TXD0              | PPI1_D02               |                        |                                |
| PC_03       | ETH0_TXD1              | PPI1_D03               |                        |                                |
| PC_04       |                        | PPI1_D04               |                        |                                |
| PC_05       | ETH0_CRS               | PPI1_D05               |                        |                                |
| PC_06       | ETH0_MDC               | PPI1_D06               |                        |                                |
| PC_07       | ETH0_MDIO              | PPI1_D07               |                        |                                |
| PC_08       |                        | PPI1_D08               |                        |                                |
| PC_09       | ETH1_PTPPPS            | PPI1_D09               |                        |                                |
| PC_10       |                        | PPI1_D10               |                        |                                |
| PC_11       |                        | PPI1_D11               | ETH_PTPAUXIN           |                                |
| PC_12       | <u>SPI0_SEL7</u>       | PPI1_D12               |                        |                                |
| PC_13       | <u>SPI0_SEL6</u>       | PPI1_D13               | ETH_PTPCLKIN           |                                |
| PC_14       | <u>SPI1_SEL7</u>       | PPI1_D14               |                        |                                |
| PC_15       | <u>SPI0_SEL4</u>       | PPI1_D15               |                        |                                |

Table 11. Signal Multiplexing for Port D

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PD_00       | SPI0_D2                | PPI1_D16               | <u>SPI0_SEL3</u>       |                                |
| PD_01       | SPI0_D3                | PPI1_D17               | <u>SPI0_SEL2</u>       |                                |
| PD_02       | SPI0_MISO              |                        |                        |                                |
| PD_03       | SPI0_MOSI              |                        |                        |                                |
| PD_04       | SPI0_CLK               |                        |                        |                                |
| PD_05       | SPI1_CLK               |                        |                        | TM0_ACLK7                      |
| PD_06       |                        | PPI1_FS2               |                        | TM0_AC15                       |
| PD_07       |                        | <u>UART0_TX</u>        |                        | TM0_AC13                       |
| PD_08       |                        | <u>UART0_RX</u>        |                        | TM0_AC10                       |
| PD_09       | <u>SPI0_SEL5</u>       | <u>UART0_RTS</u>       | <u>SPI1_SEL4</u>       |                                |
| PD_10       | SPI0_RDY               | <u>UART0_CTS</u>       | <u>SPI1_SEL3</u>       |                                |
| PD_11       | <u>SPI0_SEL1</u>       |                        |                        | <u>SPI0_SS</u>                 |
| PD_12       | <u>SPI1_SEL1</u>       | PPI0_D20               | SPT1_AD1               | <u>SPI1_SS</u>                 |
| PD_13       | SPI1_MOSI              |                        |                        | TM0_ACLK5                      |
| PD_14       | SPI1_MISO              |                        |                        | TM0_ACLK6                      |
| PD_15       | <u>SPI1_SEL2</u>       | PPI0_D21               | SPT1_AD0               |                                |

Table 12. Signal Multiplexing for Port E

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PE_00       | SPI1_D3                | PPIO_D18               | SPT1_BD1               | ACM0_T0<br>PWM0_TRIPO          |
| PE_01       | SPI1_D2                | PPIO_D19               | SPT1_BD0               |                                |
| PE_02       | SPI1_RDY               | PPIO_D22               | SPT1_ACLK              |                                |
| PE_03       |                        | PPIO_D16               | ACM0_FS/SPT1_BFS       |                                |
| PE_04       |                        | PPIO_D17               | ACM0_CLK/SPT1_BCLK     |                                |
| PE_05       |                        | PPIO_D23               | SPT1_AFS               |                                |
| PE_06       | SPT1_ATDV              | PPIO_FS3               | LP3_CLK                |                                |
| PE_07       | SPT1_BTDTV             | PPIO_FS2               | LP3_ACK                |                                |
| PE_08       | PWM0_SYNC              | PPIO_FS1               | LP2_ACK                |                                |
| PE_09       |                        | PPIO_CLK               | LP2_CLK                |                                |
| PE_10       | ETH1_MDC               | PWM1_DL                | RSI0_D6                |                                |
| PE_11       | ETH1_MDIO              | PWM1_DH                | RSI0_D7                |                                |
| PE_12       |                        | PWM1_CL                | RSI0_D5                |                                |
| PE_13       | ETH1_CRS               | PWM1_CH                | RSI0_D4                |                                |
| PE_14       |                        | SPT2_ATDV              | TM0_TMR0               |                                |
| PE_15       | ETH1_RXD1              | PWM1_BL                | RSI0_D3                |                                |

Table 13. Signal Multiplexing for Port F

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PF_00       | PWM0_AL                | PPIO_D00               | LP2_D0                 | PWM0_TRIPT                     |
| PF_01       | PWM0_AH                | PPIO_D01               | LP2_D1                 |                                |
| PF_02       | PWM0_BL                | PPIO_D02               | LP2_D2                 |                                |
| PF_03       | PWM0_BH                | PPIO_D03               | LP2_D3                 |                                |
| PF_04       | PWM0_CL                | PPIO_D04               | LP2_D4                 |                                |
| PF_05       | PWM0_CH                | PPIO_D05               | LP2_D5                 |                                |
| PF_06       | PWM0_DL                | PPIO_D06               | LP2_D6                 |                                |
| PF_07       | PWM0_DH                | PPIO_D07               | LP2_D7                 |                                |
| PF_08       | <u>SPI1_SEL5</u>       | PPIO_D08               | LP3_D0                 |                                |
| PF_09       | <u>SPI1_SEL6</u>       | PPIO_D09               | LP3_D1                 |                                |
| PF_10       | ACM0_A4                | PPIO_D10               | LP3_D2                 |                                |
| PF_11       |                        | PPIO_D11               | LP3_D3                 |                                |
| PF_12       | ACM0_A2                | PPIO_D12               | LP3_D4                 |                                |
| PF_13       | ACM0_A3                | PPIO_D13               | LP3_D5                 |                                |
| PF_14       | ACM0_A0                | PPIO_D14               | LP3_D6                 |                                |
| PF_15       | ACM0_A1                | PPIO_D15               | LP3_D7                 |                                |

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Table 14. Signal Multiplexing for Port G

| Signal Name | Multiplexed Function 0 | Multiplexed Function 1 | Multiplexed Function 2 | Multiplexed Function Input Tap |
|-------------|------------------------|------------------------|------------------------|--------------------------------|
| PG_00       | ETH1_RXD0              | PWM1_BH                | RSI0_D2                |                                |
| PG_01       | SPT2_AFS               | TM0_TMR2               | CAN0_TX                |                                |
| PG_02       | ETH1_TXD1              | PWM1_AL                | RSI0_D1                |                                |
| PG_03       | ETH1_TXD0              | PWM1_AH                | RSI0_D0                |                                |
| PG_04       | SPT2_ACLK              | TM0_TMR1               | CAN0_RX                | TM0_ACI2                       |
| PG_05       | ETH1_TXEN              | RSI0_CMD               | PWM1_SYNC              | ACM0_T1                        |
| PG_06       | ETH1_REFCLK            | RSI0_CLK               | SPT2_BTDTV             | PWM1_TRIP0                     |
| PG_07       | SPT2_BFS               | TM0_TMR5               |                        | CNT0_ZM                        |
| PG_08       | SPT2_AD1               | TM0_TMR3               |                        | PWM1_TRIP1                     |
| PG_09       | SPT2_AD0               | TM0_TMR4               |                        |                                |
| PG_10       | UART1_RTS              | SPT2_BCLK              |                        |                                |
| PG_11       | SPT2_BD1               | TM0_TMR6               |                        | CNT0_UD                        |
| PG_12       | SPT2_BD0               | TM0_TMR7               |                        | CNT0_DG                        |
| PG_13       | UART1_CTS              |                        |                        | TM0_CLK                        |
| PG_14       | UART1_RX               | SYS_IDLE1              |                        | TM0_ACI1                       |
| PG_15       | UART1_TX               | SYS_IDLE0              | SYS_SLEEP              | TM0_ACI4                       |

## ADSP-BF60x DESIGNER QUICK REFERENCE

The table provides a quick reference summary of pin related information for circuit board design. The columns in this table provide the following information:

- **Signal Name:** The Signal Name column in the table includes the Signal Name for every pin.
- **Type:** The Pin Type column in the table identifies the I/O type or supply type of the pin. The abbreviations used in this column are na (None), I/O (Digital input and/or output), a (Analog), s (Supply), and g (Ground).
- **Driver Type:** The Driver Type column in the table identifies the driver type used by the pin. The driver types are defined in [Output Drive Currents on Page 102](#).
- **Int Term:** The Internal Termination column in the table specifies the termination present when the processor is not in the reset or hibernate state. The abbreviations used in this column are wk (Weak Keeper, weakly retains previous value driven on the pin), pu (Pull-up resistor), or pd (Pull-down resistor).
- **Reset Term:** The Reset Termination column in the table specifies the termination present when the processor is in the reset state. The abbreviations used in this column are wk (Weak Keeper, weakly retains previous value driven on the pin), pu (Pull-up resistor), or pd (Pull-down resistor).
- **Reset Drive:** The Reset Drive column in the table specifies the active drive on the signal when the processor is in the reset state.
- **Hiber Term:** The Hibernate Termination column in the table specifies the termination present when the processor is in the hibernate state. The abbreviations used in this column are wk (Weak Keeper, weakly retains previous value driven on the pin), pu (Pull-up resistor), or pd (Pull-down resistor).
- **Hiber Drive:** The Hibernate Drive column in the table specifies the active drive on the signal when the processor is in the hibernate state.
- **Power Domain:** The Power Domain column in the table specifies the power supply domain in which the signal resides.
- **Description and Notes:** The Description and Notes column in the table identifies any special requirements or characteristics for the signal. If no special requirements are listed the signal may be left unconnected if it is not used. Also, for multiplexed general-purpose I/O pins, this column identifies the functions available on the pin.

**Table 15. ADSP-BF60x Designer Quick Reference**

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                      |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|--------------------------------------------|
| DMC0_A00    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 0.<br>Notes: No notes.  |
| DMC0_A01    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 1.<br>Notes: No notes.  |
| DMC0_A02    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 2.<br>Notes: No notes.  |
| DMC0_A03    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 3.<br>Notes: No notes.  |
| DMC0_A04    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 4.<br>Notes: No notes.  |
| DMC0_A05    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 5.<br>Notes: No notes.  |
| DMC0_A06    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 6.<br>Notes: No notes.  |
| DMC0_A07    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 7.<br>Notes: No notes.  |
| DMC0_A08    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 8.<br>Notes: No notes.  |
| DMC0_A09    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 9.<br>Notes: No notes.  |
| DMC0_A10    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 10.<br>Notes: No notes. |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                    |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|--------------------------------------------------------------------------|
| DMC0_A11    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 11.<br>Notes: No notes.                               |
| DMC0_A12    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 12.<br>Notes: No notes.                               |
| DMC0_A13    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Address 13.<br>Notes: No notes.                               |
| DMC0_BA0    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Bank Address Input 0.<br>Notes: No notes.                     |
| DMC0_BA1    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Bank Address Input 1.<br>Notes: No notes.                     |
| DMC0_BA2    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Bank Address Input 2.<br>Notes: For LPDDR, leave unconnected. |
| DMC0_CAS    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Column Address Strobe.<br>Notes: No notes.                    |
| DMC0_CK     | I/O  | C           | none     | none       | L           | none       | L           | VDD_DMC      | Desc: DMC0 Clock.<br>Notes: No notes.                                    |
| DMC0_CK     | I/O  | C           | none     | none       | L           | none       | L           | VDD_DMC      | Desc: DMC0 Clock (complement).<br>Notes: No notes.                       |
| DMC0_CKE    | I/O  | B           | none     | none       | L           | none       | L           | VDD_DMC      | Desc: DMC0 Clock enable.<br>Notes: No notes.                             |
| DMC0_CS0    | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Chip Select 0.<br>Notes: No notes.                            |
| DMC0_DQ00   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 0.<br>Notes: No notes.                                   |
| DMC0_DQ01   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 1.<br>Notes: No notes.                                   |
| DMC0_DQ02   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 2.<br>Notes: No notes.                                   |
| DMC0_DQ03   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 3.<br>Notes: No notes.                                   |
| DMC0_DQ04   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 4.<br>Notes: No notes.                                   |
| DMC0_DQ05   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 5.<br>Notes: No notes.                                   |
| DMC0_DQ06   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 6.<br>Notes: No notes.                                   |
| DMC0_DQ07   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 7.<br>Notes: No notes.                                   |
| DMC0_DQ08   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 8.<br>Notes: No notes.                                   |
| DMC0_DQ09   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 9.<br>Notes: No notes.                                   |
| DMC0_DQ10   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 10.<br>Notes: No notes.                                  |
| DMC0_DQ11   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 11.<br>Notes: No notes.                                  |
| DMC0_DQ12   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 12.<br>Notes: No notes.                                  |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name                    | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                   |
|--------------------------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| DMC0_DQ13                      | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 13.<br>Notes: No notes.                                                                                                 |
| DMC0_DQ14                      | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 14.<br>Notes: No notes.                                                                                                 |
| DMC0_DQ15                      | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data 15.<br>Notes: No notes.                                                                                                 |
| DMC0_LDM                       | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data Mask for Lower Byte.<br>Notes: No notes.                                                                                |
| DMC0_LDQS                      | I/O  | C           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data Strobe for Lower Byte.<br>Notes: For LPDDR, a 100k ohm pull-down resistor is required.                                  |
| $\overline{\text{DMC0\_LDQS}}$ | I/O  | C           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data Strobe for Lower Byte (complement).<br>Notes: For single ended DDR2, connect to VREF_DMC. For LPDDR, leave unconnected. |
| DMC0_ODT                       | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 On-die termination.<br>Notes: For LPDDR, leave unconnected.                                                                  |
| $\overline{\text{DMC0\_RAS}}$  | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Row Address Strobe.<br>Notes: No notes.                                                                                      |
| DMC0_UDM                       | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data Mask for Upper Byte.<br>Notes: No notes.                                                                                |
| DMC0_UDQS                      | I/O  | C           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data Strobe for Upper Byte.<br>Notes: For LPDDR, a 100k ohm pull-down resistor is required.                                  |
| $\overline{\text{DMC0\_UDQS}}$ | I/O  | C           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Data Strobe for Upper Byte (complement).<br>Notes: For single ended DDR2, connect to VREF_DMC. For LPDDR, leave unconnected. |
| $\overline{\text{DMC0\_WE}}$   | I/O  | B           | none     | none       | none        | none       | none        | VDD_DMC      | Desc: DMC0 Write Enable.<br>Notes: No notes.                                                                                            |
| GND                            | g    | na          | none     | none       | none        | none       | none        | na           | Desc: Ground.<br>Notes: No notes.                                                                                                       |
| JTG_EMU                        | I/O  | A           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: Emulation Output.<br>Notes: No notes.                                                                                             |
| JTG_TCK                        | I/O  | na          | pd       | none       | none        | none       | none        | VDD_EXT      | Desc: JTG Clock.<br>Notes: Functional during reset.                                                                                     |
| JTG_TDI                        | I/O  | na          | pu       | none       | none        | none       | none        | VDD_EXT      | Desc: JTG Serial Data Input.<br>Notes: Functional during reset.                                                                         |
| JTG_TDO                        | I/O  | A           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: JTG Serial Data Output.<br>Notes: Functional during reset, three-state when $\overline{\text{JTG\_TRST}}$ is asserted.            |
| JTG_TMS                        | I/O  | na          | pu       | none       | none        | none       | none        | VDD_EXT      | Desc: JTG Mode Select.<br>Notes: Functional during reset.                                                                               |
| $\overline{\text{JTG\_TRST}}$  | I/O  | na          | pd       | none       | none        | none       | none        | VDD_EXT      | Desc: JTG Reset.<br>Notes: Functional during reset.                                                                                     |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                               |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| PA_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 0   SMC0 Address 3   EPPI2 Data 0   LP0 Data 0.<br>Notes: No notes.                                                               |
| PA_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 1   SMC0 Address 4   EPPI2 Data 1   LP0 Data 1.<br>Notes: No notes.                                                               |
| PA_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 2   SMC0 Address 5   EPPI2 Data 2   LP0 Data 2.<br>Notes: No notes.                                                               |
| PA_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 3   SMC0 Address 6   EPPI2 Data 3   LP0 Data 3.<br>Notes: No notes.                                                               |
| PA_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 4   SMC0 Address 7   EPPI2 Data 4   LP0 Data 4.<br>Notes: No notes.                                                               |
| PA_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 5   SMC0 Address 8   EPPI2 Data 5   LP0 Data 5.<br>Notes: No notes.                                                               |
| PA_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 6   SMC0 Address 9   EPPI2 Data 6   LP0 Data 6.<br>Notes: No notes.                                                               |
| PA_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 7   SMC0 Address 10   EPPI2 Data 7   LP0 Data 7.<br>Notes: No notes.                                                              |
| PA_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 8   SMC0 Address 11   EPPI2 Data 8   LP1 Data 0.<br>Notes: No notes.                                                              |
| PA_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 9   SMC0 Address 12   EPPI2 Data 9   LP1 Data 1.<br>Notes: No notes.                                                              |
| PA_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 10   SMC0 Address 14   EPPI2 Data 10   LP1 Data 2.<br>Notes: No notes.                                                            |
| PA_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 11   SMC0 Address 15   EPPI2 Data 11   LP1 Data 3.<br>Notes: No notes.                                                            |
| PA_12       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 12   SMC0 Address 17   EPPI2 Data 12   LP1 Data 4.<br>Notes: No notes.                                                            |
| PA_13       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 13   SMC0 Address 18   EPPI2 Data 13   LP1 Data 5.<br>Notes: No notes.                                                            |
| PA_14       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 14   SMC0 Address 19   EPPI2 Data 14   LP1 Data 6.<br>Notes: No notes.                                                            |
| PA_15       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PA Position 15   SMC0 Address 20   EPPI2 Data 15   LP1 Data 7.<br>Notes: May be used to wake the processor from hibernate or deep sleep mode. |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                  |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| PB_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 0   SMC0 NOR Clock   EPPI2 Clock   LP0 Clock.<br>Notes: No notes.                                                                    |
| PB_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 1   SMC0 Memory Select 1   EPPI2 Frame Sync 1 (HSYNC)   LP0 Acknowledge.<br>Notes: No notes.                                         |
| PB_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 2   SMC0 Address 13   EPPI2 Frame Sync 2 (VSYNC)   LP1 Acknowledge.<br>Notes: No notes.                                              |
| PB_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 3   SMC0 Address 16   EPPI2 Frame Sync 3 (FIELD)   LP1 Clock.<br>Notes: No notes.                                                    |
| PB_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 4   SMC0 Memory Select 2   SMC0 Byte Enable 0   SPORT0 Channel A Frame Sync.<br>Notes: No notes.                                     |
| PB_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 5   SMC0 Memory Select 3   SMC0 Byte Enable 1   SPORT0 Channel A Clock.<br>Notes: No notes.                                          |
| PB_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 6   SMC0 Address 21   SPORT0 Channel A Transmit Data Valid   TIMER0 Alternate Clock 4.<br>Notes: No notes.                           |
| PB_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 7   SMC0 Address 22   EPPI2 Data 16   SPORT0 Channel B Frame Sync.<br>Notes: No notes.                                               |
| PB_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 8   SMC0 Address 23   EPPI2 Data 17   SPORT0 Channel B Clock.<br>Notes: No notes.                                                    |
| PB_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 9   SMC0 Bus Grant Hang   SPORT0 Channel A Data 0   TIMER0 Alternate Clock 2.<br>Notes: No notes.                                    |
| PB_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 10   SMC0 Address 24   SPORT0 Channel B Data 1   TIMER0 Alternate Clock 0.<br>Notes: No notes.                                       |
| PB_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 11   SMC0 Address 25   SPORT0 Channel B Data 0   TIMER0 Alternate Clock 3.<br>Notes: No notes.                                       |
| PB_12       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 12   SMC0 Bus Grant   SPORT0 Channel B Transmit Data Valid   SPORT0 Channel A Data 1   TIMER0 Alternate Clock 1.<br>Notes: No notes. |

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Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PB_13       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 13   EPPI1 Frame Sync 1 (HSYNC)   ETH0 Transmit Enable   TIMER0 Alternate Capture Input 6.<br>Notes: No notes.                                     |
| PB_14       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 14   EPPI1 Clock   ETH0 Reference Clock.<br>Notes: No notes.                                                                                       |
| PB_15       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PB Position 15   EPPI1 Frame Sync 3 (FIELD)   ETH0 PTP Pulse-Per-Second Output.<br>Notes: May be used to wake the processor from hibernate or deep sleep mode. |
| PC_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 0   EPPI1 Data 0   ETH0 Receive Data 0.<br>Notes: No notes.                                                                                        |
| PC_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 1   EPPI1 Data 1   ETH0 Receive Data 1.<br>Notes: No notes.                                                                                        |
| PC_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 2   EPPI1 Data 2   ETH0 Transmit Data 0.<br>Notes: No notes.                                                                                       |
| PC_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 3   EPPI1 Data 3   ETH0 Transmit Data 1.<br>Notes: No notes.                                                                                       |
| PC_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 4   EPPI1 Data 4   ETH0 Receive Error.<br>Notes: No notes.                                                                                         |
| PC_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 5   EPPI1 Data 5   ETH0 Carrier Sense/RMII Receive Data Valid.<br>Notes: No notes.                                                                 |
| PC_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 6   EPPI1 Data 6   ETH0 Management Channel Clock.<br>Notes: No notes.                                                                              |
| PC_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 7   EPPI1 Data 7   ETH0 Management Channel Serial Data.<br>Notes: No notes.                                                                        |
| PC_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 8   EPPI1 Data 8.<br>Notes: No notes.                                                                                                              |
| PC_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 9   EPPI1 Data 9   ETH1 PTP Pulse-Per-Second Output.<br>Notes: No notes.                                                                           |
| PC_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 10   EPPI1 Data 10.<br>Notes: No notes.                                                                                                            |
| PC_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 11   EPPI1 Data 11   ETH PTP Auxiliary Trigger Input.<br>Notes: No notes.                                                                          |
| PC_12       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 12   SPI0 Slave Select Output b   EPPI1 Data 12.<br>Notes: No notes.                                                                               |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                                                     |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PC_13       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 13   SPI0 Slave Select Output b   EPPI1 Data 13   ETH PTP Clock Input.<br>Notes: No notes.                                                                                              |
| PC_14       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 14   SPI1 Slave Select Output b   EPPI1 Data 14.<br>Notes: No notes.                                                                                                                    |
| PC_15       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PC Position 15   SPI0 Slave Select Output b   EPPI1 Data 15.<br>Notes: May be used to wake the processor from hibernate or deep sleep mode.                                                         |
| PD_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 0   SPI0 Data 2   EPPI1 Data 16   SPI0 Slave Select Output b.<br>Notes: No notes.                                                                                                       |
| PD_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 1   SPI0 Data 3   EPPI1 Data 17   SPI0 Slave Select Output b.<br>Notes: No notes.                                                                                                       |
| PD_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 2   SPI0 Master In, Slave Out.<br>Notes: No notes.                                                                                                                                      |
| PD_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 3   SPI0 Master Out, Slave In.<br>Notes: No notes.                                                                                                                                      |
| PD_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 4   SPI0 Clock.<br>Notes: No notes.                                                                                                                                                     |
| PD_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 5   SPI1 Clock   TIMER0 Alternate Clock 7.<br>Notes: No notes.                                                                                                                          |
| PD_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 6   EPPI1 Frame Sync 2 (VSYNC)   ETH0 RMII Management Data Interrupt   TIMER0 Alternate Capture Input 5.<br>Notes: May be used to wake the processor from hibernate or deep sleep mode. |
| PD_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 7   UART0 Transmit   TIMER0 Alternate Capture Input 3.<br>Notes: No notes.                                                                                                              |
| PD_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 8   UART0 Receive   TIMER0 Alternate Capture Input 0.<br>Notes: No notes.                                                                                                               |
| PD_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 9   SPI1 Slave Select Output b   UART0 Request to Send   SPI0 Slave Select Output b.<br>Notes: No notes.                                                                                |
| PD_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 10   SPI0 Ready   UART0 Clear to Send   SPI1 Slave Select Output b.<br>Notes: No notes.                                                                                                 |
| PD_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 11   SPI0 Slave Select Output b   SPI0 Slave Select Input.<br>Notes: No notes.                                                                                                          |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                      |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| PD_12       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 12   SPI1 Slave Select Output b   EPPI0 Data 20   SPORT1 Channel A Data 1   SPI1 Slave Select Input.<br>Notes: No notes. |
| PD_13       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 13   SPI1 Master Out, Slave In   TIMER0 Alternate Clock 5.<br>Notes: No notes.                                           |
| PD_14       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 14   SPI1 Master In, Slave Out   TIMER0 Alternate Clock 6.<br>Notes: No notes.                                           |
| PD_15       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PD Position 15   SPI1 Slave Select Output b   EPPI0 Data 21   SPORT1 Channel A Data 0.<br>Notes: No notes.                           |
| PE_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 0   SPI1 Data 3   EPPI0 Data 18   SPORT1 Channel B Data 1.<br>Notes: No notes.                                           |
| PE_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 1   SPI1 Data 2   EPPI0 Data 19   SPORT1 Channel B Data 0.<br>Notes: No notes.                                           |
| PE_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 2   SPI1 Ready   EPPI0 Data 22   SPORT1 Channel A Clock.<br>Notes: No notes.                                             |
| PE_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 3   EPPI0 Data 16   SPORT1 Channel B Frame Sync   ACM0 Frame Sync.<br>Notes: No notes.                                   |
| PE_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 4   EPPI0 Data 17   SPORT1 Channel B Clock   ACM0 Clock.<br>Notes: No notes.                                             |
| PE_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 5   EPPI0 Data 23   SPORT1 Channel A Frame Sync.<br>Notes: No notes.                                                     |
| PE_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 6   SPORT1 Channel A Transmit Data Valid   EPPI0 Frame Sync 3 (FIELD)   LP3 Clock.<br>Notes: No notes.                   |
| PE_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 7   SPORT1 Channel B Transmit Data Valid   EPPI0 Frame Sync 2 (VSYNC)   LP3 Acknowledge.<br>Notes: No notes.             |
| PE_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 8   PWM0 Sync   EPPI0 Frame Sync 1 (HSYNC)   LP2 Acknowledge   ACM0 External Trigger 0.<br>Notes: No notes.              |
| PE_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 9   EPPI0 Clock   LP2 Clock   PWM0 Shutdown Input.<br>Notes: No notes.                                                   |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                                                                                                                                                                    |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PE_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 10   PWM1 Channel D Low Side   RSI0 Data 6   ETH1 Management Channel Clock.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details.                                                                            |
| PE_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 11   PWM1 Channel D High Side   ETH1 Management Channel Serial Data   RSI0 Data 7.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details.                                                                     |
| PE_12       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 12   PWM1 Channel C Low Side   RSI0 Data 5   ETH1 RMII Management Data Interrupt.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details. May be used to wake the processor from hibernate or deep sleep mode. |
| PE_13       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 13   PWM1 Channel C High Side   RSI0 Data 4   ETH1 Carrier Sense/RMII Receive Data Valid.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details.                                                              |
| PE_14       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 14   SPORT2 Channel A Transmit Data Valid   TIMER0 Timer 0   ETH1 Receive Error.<br>Notes: No notes.                                                                                                                                                                                                   |
| PE_15       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PE Position 15   PWM1 Channel B Low Side   RSI0 Data 3   ETH1 Receive Data 1.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details.                                                                                      |
| PF_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 0   PWM0 Channel A Low Side   EPPI0 Data 0   LP2 Data 0.<br>Notes: No notes.                                                                                                                                                                                                                           |
| PF_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 1   PWM0 Channel A High Side   EPPI0 Data 1   LP2 Data 1.<br>Notes: No notes.                                                                                                                                                                                                                          |
| PF_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 2   PWM0 Channel B Low Side   EPPI0 Data 2   LP2 Data 2.<br>Notes: No notes.                                                                                                                                                                                                                           |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                                                                               |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PF_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 3   PWM0 Channel B High Side   EPPI0 Data 3   LP2 Data 3.<br>Notes: No notes.                                                                                                                                     |
| PF_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 4   PWM0 Channel C Low Side   EPPI0 Data 4   LP2 Data 4.<br>Notes: No notes.                                                                                                                                      |
| PF_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 5   PWM0 Channel C High Side   EPPI0 Data 5   LP2 Data 5.<br>Notes: No notes.                                                                                                                                     |
| PF_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 6   PWM0 Channel D Low Side   EPPI0 Data 6   LP2 Data 6.<br>Notes: No notes.                                                                                                                                      |
| PF_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 7   PWM0 Channel D High Side   EPPI0 Data 7   LP2 Data 7.<br>Notes: No notes.                                                                                                                                     |
| PF_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 8   SPI1 Slave Select Output b   EPPI0 Data 8   LP3 Data 0.<br>Notes: No notes.                                                                                                                                   |
| PF_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 9   SPI1 Slave Select Output b   EPPI0 Data 9   LP3 Data 1.<br>Notes: No notes.                                                                                                                                   |
| PF_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 10   ACM0 Address 4   EPPI0 Data 10   LP3 Data 2.<br>Notes: No notes.                                                                                                                                             |
| PF_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 11   EPPI0 Data 11   LP3 Data 3   PWM0 Shutdown Input.<br>Notes: No notes.                                                                                                                                        |
| PF_12       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 12   ACM0 Address 2   EPPI0 Data 12   LP3 Data 4.<br>Notes: No notes.                                                                                                                                             |
| PF_13       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 13   ACM0 Address 3   EPPI0 Data 13   LP3 Data 5.<br>Notes: No notes.                                                                                                                                             |
| PF_14       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 14   EPPI0 Data 14   ACM0 Address 0   LP3 Data 6.<br>Notes: No notes.                                                                                                                                             |
| PF_15       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PF Position 15   ACM0 Address 1   EPPI0 Data 15   LP3 Data 7.<br>Notes: No notes.                                                                                                                                             |
| PG_00       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 0   PWM1 Channel B High Side   RSI0 Data 2   ETH1 Receive Data 0.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details. |
| PG_01       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 1   SPORT2 Channel A Frame Sync   TIMER0 Timer 2   CAN0 Transmit.<br>Notes: No notes.                                                                                                                             |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                                                                                            |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PG_02       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 2   PWM1 Channel A Low Side   RSI0 Data 1   ETH1 Transmit Data 1.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details.              |
| PG_03       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 3   PWM1 Channel A High Side   RSI0 Data 0   ETH1 Transmit Data 0.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details.             |
| PG_04       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 4   SPORT2 Channel A Clock   TIMER0 Timer 1   CAN0 Receive   TIMER0 Alternate Capture Input 2.<br>Notes: May be used to wake the processor from hibernate or deep sleep mode.                                                  |
| PG_05       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 5   RSI0 Command   ETH1 Transmit Enable   PWM1 Sync   ACM0 External Trigger 1.<br>Notes: Has an optional internal pull-up resistor for use with RSI. See the RSI chapter in the processor hardware reference for more details. |
| PG_06       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 6   RSI0 Clock   SPORT2 Channel B Transmit Data Valid   ETH1 Reference Clock   PWM1 Shutdown Input.<br>Notes: No notes.                                                                                                        |
| PG_07       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 7   SPORT2 Channel B Frame Sync   TIMER0 Timer 5   CNT0 Count Zero Marker.<br>Notes: No notes.                                                                                                                                 |
| PG_08       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 8   SPORT2 Channel A Data 1   TIMER0 Timer 3   PWM1 Shutdown Input.<br>Notes: No notes.                                                                                                                                        |
| PG_09       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 9   SPORT2 Channel A Data 0   TIMER0 Timer 4.<br>Notes: No notes.                                                                                                                                                              |
| PG_10       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 10   UART1 Request to Send   SPORT2 Channel B Clock.<br>Notes: No notes.                                                                                                                                                       |
| PG_11       | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 11   SPORT2 Channel B Data 1   TIMER0 Timer 6   CNT0 Count Up and Direction.<br>Notes: No notes.                                                                                                                               |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name     | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                     |
|-----------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| PG_12           | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 12   SPORT2 Channel B Data 0   TIMER0 Timer 7   CNT0 Count Down and Gate.<br>Notes: No notes.                                           |
| PG_13           | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 13   UART1 Clear to Send   TIMER0 Clock.<br>Notes: No notes.                                                                            |
| PG_14           | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 14   UART1 Receive   SYS Core 1 Idle Indicator   TIMER0 Alternate Capture Input 1.<br>Notes: No notes.                                  |
| PG_15           | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: PG Position 15   UART1 Transmit   SYS Core 0 Idle Indicator   SYS Processor Sleep Indicator   TIMER0 Alternate Capture Input 4.<br>Notes: No notes. |
| SMC0_A01        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Address 1.<br>Notes: No notes.                                                                                                                 |
| SMC0_A02        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Address 2.<br>Notes: No notes.                                                                                                                 |
| SMC0_AMS0       | I/O  | A           | pu       | pu         | none        | pu         | none        | VDD_EXT      | Desc: SMC0 Memory Select 0.<br>Notes: No notes.                                                                                                           |
| SMC0_AOE_NORDV  | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 NOR Data Valid   SMC0 Output Enable.<br>Notes: No notes.                                                                                       |
| SMC0_ARDY_NORWT | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SMC0 NOR Wait   SMC0 Asynchronous Ready.<br>Notes: Requires an external pull-up resistor.                                                           |
| SMC0_ARE        | I/O  | A           | pu       | pu         | none        | pu         | none        | VDD_EXT      | Desc: SMC0 Read Enable.<br>Notes: No notes.                                                                                                               |
| SMC0_AWE        | I/O  | A           | pu       | pu         | none        | pu         | none        | VDD_EXT      | Desc: SMC0 Write Enable.<br>Notes: No notes.                                                                                                              |
| SMC0_BR         | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SMC0 Bus Request.<br>Notes: Requires an external pull-up resistor.                                                                                  |
| SMC0_D00        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 0.<br>Notes: No notes.                                                                                                                    |
| SMC0_D01        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 1.<br>Notes: No notes.                                                                                                                    |
| SMC0_D02        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 2.<br>Notes: No notes.                                                                                                                    |
| SMC0_D03        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 3.<br>Notes: No notes.                                                                                                                    |
| SMC0_D04        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 4.<br>Notes: No notes.                                                                                                                    |
| SMC0_D05        | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 5.<br>Notes: No notes.                                                                                                                    |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name                          | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                 |
|--------------------------------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-------------------------------------------------------------------------------------------------------|
| SMC0_D06                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 6.<br>Notes: No notes.                                                                |
| SMC0_D07                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 7.<br>Notes: No notes.                                                                |
| SMC0_D08                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 8.<br>Notes: No notes.                                                                |
| SMC0_D09                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 9.<br>Notes: No notes.                                                                |
| SMC0_D10                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 10.<br>Notes: No notes.                                                               |
| SMC0_D11                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 11.<br>Notes: No notes.                                                               |
| SMC0_D12                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 12.<br>Notes: No notes.                                                               |
| SMC0_D13                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 13.<br>Notes: No notes.                                                               |
| SMC0_D14                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 14.<br>Notes: No notes.                                                               |
| SMC0_D15                             | I/O  | A           | wk       | wk         | none        | wk         | none        | VDD_EXT      | Desc: SMC0 Data 15.<br>Notes: No notes.                                                               |
| SYS_BMODE0                           | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Boot Mode Control 0.<br>Notes: No notes.                                                    |
| SYS_BMODE1                           | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Boot Mode Control 1.<br>Notes: No notes.                                                    |
| SYS_BMODE2                           | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Boot Mode Control 2.<br>Notes: No notes.                                                    |
| SYS_CLKIN                            | a    | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Clock Input/Crystal Input.<br>Notes: Active during reset.                                   |
| SYS_CLKOUT                           | I/O  | A           | none     | none       | L           | none       | none        | VDD_EXT      | Desc: SYS Processor Clock Output.<br>Notes: No notes.                                                 |
| SYS_EXTWAKE                          | I/O  | A           | none     | none       | H           | none       | L           | VDD_EXT      | Desc: SYS External Wake Control.<br>Notes: Drives low during hibernate and high all other times.      |
| SYS_FAULT                            | I/O  | A           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Fault.<br>Notes: Open source, requires an external pull-down resistor.                      |
| $\overline{\text{SYS\_FAULT}}$       | I/O  | A           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Complementary Fault.<br>Notes: Open drain, requires an external pull-up resistor.           |
| $\overline{\text{SYS\_HWRST}}$       | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Processor Hardware Reset Control.<br>Notes: Active during reset.                            |
| $\overline{\text{SYS\_NMI\_RESOUT}}$ | I/O  | A           | none     | none       | L           | none       | none        | VDD_EXT      | Desc: SYS Reset Output   SYS Non-maskable Interrupt.<br>Notes: Requires an external pull-up resistor. |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

Table 15. ADSP-BF60x Designer Quick Reference (Continued)

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                                                            |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYS_PWRGD   | I/O  | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Power Good Indicator.<br>Notes: If hibernate is not used or the internal Power Good Counter is used, connect to VDD_EXT.                                                                               |
| SYS_TDA     | a    | na          | none     | none       | none        | none       | none        | VDD_TD       | Desc: SYS Thermal Diode Anode.<br>Notes: Active during reset and hibernate. If the thermal diode is not used, connect to ground.                                                                                 |
| SYS_TDK     | a    | na          | none     | none       | none        | none       | none        | VDD_TD       | Desc: SYS Thermal Diode Cathode.<br>Notes: Active during reset and hibernate. If the thermal diode is not used, connect to ground.                                                                               |
| SYS_XTAL    | a    | na          | none     | none       | none        | none       | none        | VDD_EXT      | Desc: SYS Crystal Output.<br>Notes: Leave unconnected if an oscillator is used to provide SYS_CLKIN. Active during reset. State during hibernate is controlled by DPM_HIB_DIS.                                   |
| TWI0_SCL    | I/O  | D           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: TWI0 Serial Clock.<br>Notes: Open drain, requires external pull-up resistor. Consult Version 2.1 of the I2C specification for the proper resistor value. If TWI is not used, connect to ground.            |
| TWI0_SDA    | I/O  | D           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: TWI0 Serial Data.<br>Notes: Open drain, requires external pull-up resistor. Consult Version 2.1 of the I2C specification for the proper resistor value. If TWI is not used, connect to ground.             |
| TWI1_SCL    | I/O  | D           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: TWI1 Serial Clock.<br>Notes: Open drain, requires external pull-up resistor. Consult Version 2.1 of the I2C specification for the proper resistor value. If TWI is not used, connect to ground.            |
| TWI1_SDA    | I/O  | D           | none     | none       | none        | none       | none        | VDD_EXT      | Desc: TWI1 Serial Data.<br>Notes: Open drain, requires external pull-up resistor. See the I2C-Bus Specification, Version 2.1, January 2000 for the proper resistor value. If TWI is not used, connect to ground. |
| USB0_CLKIN  | a    | na          | none     | none       | none        | none       | none        | VDD_USB      | Desc: USB0 Clock/Crystal Input.<br>Notes: If USB is not used, connect to ground. Active during reset.                                                                                                            |
| USB0_DM     | I/O  | F           | none     | none       | none        | none       | none        | VDD_USB      | Desc: USB0 Data –.<br>Notes: Pull low if not using USB. For complete documentation of hibernate behavior when USB is used, see the USB chapter in the processor hardware reference.                              |

**Table 15. ADSP-BF60x Designer Quick Reference (Continued)**

| Signal Name | Type | Driver Type | Int Term | Reset Term | Reset Drive | Hiber Term | Hiber Drive | Power Domain | Description and Notes                                                                                                                                                                                                                                     |
|-------------|------|-------------|----------|------------|-------------|------------|-------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| USB0_DP     | I/O  | F           | none     | none       | none        | none       | none        | VDD_USB      | Desc: USB0 Data +.<br>Notes: Pull low if not using USB. For complete documentation of hibernate behavior when USB is used, see the USB chapter in the processor hardware reference.                                                                       |
| USB0_ID     | I/O  | na          | none     | none       | none        | pu         | none        | VDD_USB      | Desc: USB0 OTG ID.<br>Notes: If USB is not used, connect to ground. When USB is being used, the internal pull-up resistor that is present during hibernate is programmable. See the USB chapter in the processor hardware reference. Active during reset. |
| USB0_VBC    | I/O  | E           | none     | none       | none        | wk         | none        | VDD_USB      | Desc: USB0 VBUS Control.<br>Notes: If USB is not used, pull low.                                                                                                                                                                                          |
| USB0_VBUS   | I/O  | G           | none     | none       | none        | none       | none        | VDD_USB      | Desc: USB0 Bus Voltage.<br>Notes: If USB is not used, connect to ground.                                                                                                                                                                                  |
| VDD_DMC     | s    | na          | none     | none       | none        | none       | none        | na           | Desc: VDD for DMC.<br>Notes: If the DMC is not used, connect to VDD_INT.                                                                                                                                                                                  |
| VDD_EXT     | s    | na          | none     | none       | none        | none       | none        | na           | Desc: External VDD.<br>Notes: Must be powered.                                                                                                                                                                                                            |
| VDD_INT     | s    | na          | none     | none       | none        | none       | none        | na           | Desc: Internal VDD.<br>Notes: Must be powered.                                                                                                                                                                                                            |
| VDD_TD      | s    | na          | none     | none       | none        | none       | none        | na           | Desc: VDD for Thermal Diode.<br>Notes: If the thermal diode is not used, connect to ground.                                                                                                                                                               |
| VDD_USB     | s    | na          | none     | none       | none        | none       | none        | na           | Desc: VDD for USB.<br>Notes: If USB is not used, connect to VDD_EXT.                                                                                                                                                                                      |
| VREF_DMC    | s    | na          | none     | none       | none        | none       | none        | na           | Desc: VREF for DMC.<br>Notes: If the DMC is not used, connect to VDD_INT.                                                                                                                                                                                 |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## SPECIFICATIONS

For information about product specifications please contact your ADI representative.

### OPERATING CONDITIONS

| Parameter                            |                              | Conditions                             | Min                         | Nominal | Max                         | Unit |
|--------------------------------------|------------------------------|----------------------------------------|-----------------------------|---------|-----------------------------|------|
| V <sub>DD_INT</sub>                  | Internal Supply Voltage      | CCLK ≤ 500 MHz                         | 1.19                        | 1.25    | 1.32                        | V    |
| V <sub>DD_EXT</sub> <sup>1</sup>     | External Supply Voltage      | 1.8 V I/O                              | 1.7                         | 1.8     | 1.9                         | V    |
| V <sub>DD_EXT</sub> <sup>1</sup>     | External Supply Voltage      | 3.3 V I/O                              | 3.13                        | 3.3     | 3.47                        | V    |
| V <sub>DD_DMC</sub>                  | DDR2/LPDDR Supply Voltage    |                                        | 1.7                         | 1.8     | 1.9                         | V    |
| V <sub>DD_USB</sub> <sup>2</sup>     | USB Supply Voltage           |                                        | 3.13                        | 3.3     | 3.47                        | V    |
| V <sub>DD_TD</sub>                   | Thermal Diode Supply Voltage |                                        | 3.13                        | 3.3     | 3.47                        | V    |
| V <sub>IH</sub> <sup>3</sup>         | High Level Input Voltage     | V <sub>DD_EXT</sub> = 3.47 V           | 2.1                         |         |                             | V    |
| V <sub>IH</sub> <sup>3</sup>         | High Level Input Voltage     | V <sub>DD_EXT</sub> = 1.9 V            | 0.7 × V <sub>DD_EXT</sub>   |         |                             | V    |
| V <sub>IHTWI</sub> <sup>4, 5</sup>   | High Level Input Voltage     | V <sub>DD_EXT</sub> = Maximum          | 0.7 × V <sub>VBUSTWI</sub>  |         | V <sub>VBUSTWI</sub>        | V    |
| V <sub>IH_DDR2</sub> <sup>6, 7</sup> |                              | V <sub>DD_DMC</sub> = 1.9 V            | V <sub>DDR_REF</sub> + 0.25 |         |                             | V    |
| V <sub>IH_LPDDR</sub> <sup>8</sup>   |                              | V <sub>DD_DMC</sub> = 1.9 V            | 0.8 × V <sub>DD_DMC</sub>   |         |                             | V    |
| V <sub>ID_DDR2</sub> <sup>9</sup>    | Differential Input Voltage   | V <sub>IX</sub> = 1.075 V              | 0.50                        |         |                             | V    |
| V <sub>ID_DDR2</sub> <sup>9</sup>    | Differential Input Voltage   | V <sub>IX</sub> = 0.725 V              | 0.55                        |         |                             | V    |
| V <sub>IL</sub> <sup>3</sup>         | Low Level Input Voltage      | V <sub>DD_EXT</sub> = 3.13 V           |                             |         | 0.8                         | V    |
| V <sub>IL</sub> <sup>3</sup>         | Low Level Input Voltage      | V <sub>DD_EXT</sub> = 1.7 V            |                             |         | 0.3 × V <sub>DD_EXT</sub>   | V    |
| V <sub>ILTWI</sub> <sup>4, 5</sup>   | Low Level Input Voltage      | V <sub>DD_EXT</sub> = Minimum          |                             |         | 0.3 × V <sub>VBUSTWI</sub>  | V    |
| V <sub>IL_DDR2</sub> <sup>6, 7</sup> |                              | V <sub>DD_DMC</sub> = 1.7 V            |                             |         | V <sub>DDR_REF</sub> − 0.25 | V    |
| V <sub>IL_LPDDR</sub> <sup>8</sup>   |                              | V <sub>DD_DMC</sub> = 1.7 V            |                             |         | 0.2 × V <sub>DD_DMC</sub>   | V    |
| T <sub>J</sub>                       | Junction Temperature         | T <sub>AMBIENT</sub> = 0°C to +70°C    | 0                           |         | +105                        | °C   |
| T <sub>J</sub>                       | Junction Temperature         | T <sub>AMBIENT</sub> = −40°C to +85°C  | −40                         |         | +105                        | °C   |
| T <sub>J</sub>                       | Junction Temperature         | T <sub>AMBIENT</sub> = −40°C to +105°C | −40                         |         | +125                        | °C   |

<sup>1</sup> Must remain powered (even if the associated function is not used).

<sup>2</sup> If not used, connect to 1.8 V or 3.3 V.

<sup>3</sup> Parameter value applies to all input and bidirectional signals except TWI signals, DMC0 signals and USB0 signals.

<sup>4</sup> Parameter applies to TWI signals.

<sup>5</sup> TWI signals are pulled up to V<sub>BUSTWI</sub>. See Table 16.

<sup>6</sup> Parameter applies to DMC0 signals in DDR2 mode.

<sup>7</sup> V<sub>DDR\_REF</sub> is the voltage applied to pin V<sub>REF\_DMC</sub>, nominally V<sub>DD\_DMC</sub>/2.

<sup>8</sup> Parameter applies to DMC0 signals in LPDDR mode.

<sup>9</sup> Parameter applies to signals DMC0\_CK, DMC0\_CK, DMC0\_LDQS, DMC0\_LDQS, DMC0\_UDQS, DMC0\_UDQS when used in DDR2 differential input mode.

**Table 16. TWI\_VSEL Selections and V<sub>DD\_EXT</sub>/V<sub>BUSTWI</sub>**

|                     | V <sub>DD_EXT</sub> Nominal | V <sub>BUSTWI</sub> Min | V <sub>BUSTWI</sub> Nom | V <sub>BUSTWI</sub> Max | Unit |
|---------------------|-----------------------------|-------------------------|-------------------------|-------------------------|------|
| TWI000 <sup>1</sup> | 3.30                        | 3.13                    | 3.30                    | 3.47                    | V    |
| TWI001              | 1.80                        | 1.70                    | 1.80                    | 1.90                    | V    |
| TWI011              | 1.80                        | 3.13                    | 3.30                    | 3.47                    | V    |
| TWI100              | 3.30                        | 4.75                    | 5.00                    | 5.25                    | V    |

<sup>1</sup> Designs must comply with the V<sub>DD\_EXT</sub> and V<sub>BUSTWI</sub> voltages specified for the default TWI\_DT setting for correct JTAG boundary scan operation during reset.

### Clock Related Operating Conditions

Table 17 describes the core clock, system clock, and peripheral clock timing requirements. The data presented in the tables applies to all speed grades (found in [Automotive Products on](#)

Page 112 and [Ordering Guide on Page 112](#)) except where expressly noted. Figure 8 provides a graphical representation of the various clocks and their available divider values.

**Table 17. Clock Operating Conditions**

| Parameter                                                                                    | Restriction                                  | Min | Typ | Max   | Unit |
|----------------------------------------------------------------------------------------------|----------------------------------------------|-----|-----|-------|------|
| $f_{\text{CLK}}$ Core Clock Frequency                                                        | $f_{\text{CLK}} \geq f_{\text{SYSCLK}}$      |     |     | 500   | MHz  |
| $f_{\text{SYSCLK}}$ SYSCLK Frequency                                                         |                                              |     |     | 250   | MHz  |
| $f_{\text{SCLK0}}$ SCLK0 Frequency <sup>1</sup>                                              | $f_{\text{SYSCLK}} \geq f_{\text{SCLK0}}$    | 30  |     | 125   | MHz  |
| $f_{\text{SCLK1}}$ SCLK1 Frequency                                                           | $f_{\text{SYSCLK}} \geq f_{\text{SCLK1}}$    |     |     | 125   | MHz  |
| $f_{\text{DCLK}}$ DDR2/LPDDR Clock Frequency                                                 | $f_{\text{SYSCLK}} \geq f_{\text{DCLK}}$     |     |     | 250   | MHz  |
| $f_{\text{OCLK}}$ Output Clock Frequency                                                     |                                              |     |     | 125   | MHz  |
| $f_{\text{SYS\_CLKOUTJ}}$ SYS_CLKOUT Period Jitter <sup>2, 3</sup>                           |                                              |     | ±1  |       | %    |
| $f_{\text{PVPCLK}}$ PVP Clock Frequency                                                      |                                              |     |     | 83.3  | MHz  |
| $f_{\text{NRCLKPROG}}$ Programmed NOR Burst Clock                                            |                                              |     |     | 66.67 | MHz  |
| $f_{\text{PCLKPROG}}$ Programmed PPI Clock When Transmitting Data and Frame Sync             |                                              |     |     | 83.3  | MHz  |
| $f_{\text{PCLKPROG}}$ Programmed PPI Clock When Receiving Data or Frame Sync                 |                                              |     |     | 62.5  | MHz  |
| $f_{\text{PCLKEXT}}$ External PPI Clock When Receiving Data and Frame Sync <sup>4, 5</sup>   | $f_{\text{PCLKEXT}} \leq f_{\text{SCLK0}}$   |     |     | 83.3  | MHz  |
| $f_{\text{PCLKEXT}}$ External PPI Clock Transmitting Data or Frame Sync <sup>4, 5</sup>      | $f_{\text{PCLKEXT}} \leq f_{\text{SCLK0}}$   |     |     | 58.8  | MHz  |
| $f_{\text{LCLKTPROG}}$ Programmed Link Port Transmit Clock                                   |                                              |     |     | 83.3  | MHz  |
| $f_{\text{LCLKREXT}}$ External Link Port Receive Clock <sup>4, 5</sup>                       | $f_{\text{LCLKREXT}} \leq f_{\text{SCLK0}}$  |     |     | 83.3  | MHz  |
| $f_{\text{SPTCLKPROG}}$ Programmed SPT Clock When Transmitting Data and Frame Sync           |                                              |     |     | 83.3  | MHz  |
| $f_{\text{SPTCLKPROG}}$ Programmed SPT Clock When Receiving Data or Frame Sync               |                                              |     |     | 62.5  | MHz  |
| $f_{\text{SPTCLKEXT}}$ External SPT Clock When Receiving Data and Frame Sync <sup>4, 5</sup> | $f_{\text{SPTCLKEXT}} \leq f_{\text{SCLK1}}$ |     |     | 83.3  | MHz  |
| $f_{\text{SPTCLKEXT}}$ External SPT Clock Transmitting Data or Frame Sync <sup>4, 5</sup>    | $f_{\text{SPTCLKEXT}} \leq f_{\text{SCLK1}}$ |     |     | 58.8  | MHz  |
| $f_{\text{SPICLKPROG}}$ Programmed SPI Clock When Transmitting Data                          |                                              |     |     | 83.3  | MHz  |
| $f_{\text{SPICLKPROG}}$ Programmed SPI Clock When Receiving Data                             |                                              |     |     | 75    | MHz  |
| $f_{\text{SPICLKEXT}}$ External SPI Clock When Receiving Data <sup>4, 5</sup>                | $f_{\text{SPICLKEXT}} \leq f_{\text{SCLK1}}$ |     |     | 83.3  | MHz  |
| $f_{\text{SPICLKEXT}}$ External SPI Clock When Transmitting Data <sup>4, 5</sup>             | $f_{\text{SPICLKEXT}} \leq f_{\text{SCLK1}}$ |     |     | 58.8  | MHz  |
| $f_{\text{ACLKPROG}}$ Programmed ACM Clock                                                   |                                              |     |     | 62.5  | MHz  |

<sup>1</sup> The minimum frequency for SCLK0 applies only when the USB is used.

<sup>2</sup> SYS\_CLKOUT jitter is dependent on the application system design including pin switching activity, board layout, and the jitter characteristics of the SYS\_CLKIN source. Due to the dependency on these factors the measured jitter may be higher or lower than this typical specification for each end application.

<sup>3</sup> The value in the Typ field is the percentage of the SYS\_CLKOUT period.

<sup>4</sup> The maximum achievable frequency for any peripheral in external clock mode is dependent on being able to meet the setup and hold times in the AC timing specifications section for that peripheral. Pay particular attention to setup and hold times for VDD\_EXT = 1.8 V which may preclude the maximum frequency listed here.

<sup>5</sup> The peripheral external clock frequency must also be less than or equal to the  $f_{\text{SCLK}}$  ( $f_{\text{SCLK0}}$  or  $f_{\text{SCLK1}}$ ) that clocks the peripheral.

**Table 18. Phase-Locked Loop Operating Conditions**

| Parameter                               | Min | Max  | Unit |
|-----------------------------------------|-----|------|------|
| $f_{\text{PLLCLK}}$ PLL Clock Frequency | 250 | 1000 | MHz  |

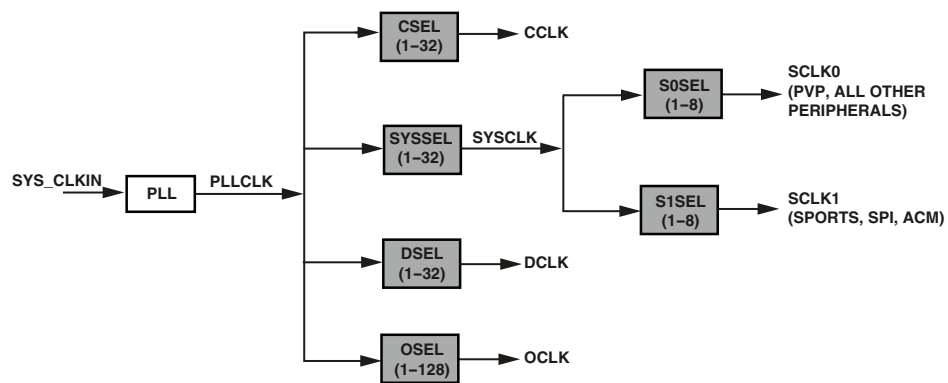


Figure 8. Clock Relationships and Divider Values

## ELECTRICAL CHARACTERISTICS

| Parameter                    |                                                   | Test Conditions                                                                                                            | Min                  | Typical                | Max   | Unit          |
|------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------|-------|---------------|
| $V_{OH}^1$                   | High Level Output Voltage                         | $V_{DD\_EXT} = 1.7\text{ V}$ , $I_{OH} = -0.5\text{ mA}$                                                                   | $V_{DD\_EXT} - 0.40$ |                        |       | V             |
| $V_{OH}^1$                   | High Level Output Voltage                         | $V_{DD\_EXT} = 3.13\text{ V}$ , $I_{OH} = -0.5\text{ mA}$                                                                  | $V_{DD\_EXT} - 0.40$ |                        |       | V             |
| $V_{OH\_DDR2}^2$             | High Level Output Voltage, $ds = 00$              | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OH} = -13.4\text{ mA}$                                                                 | 1.388                |                        |       | V             |
| $V_{OH\_DDR2}^3$             | High Level Output Voltage, $ds = 10$              | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OH} = -6.70\text{ mA}$                                                                 | 1.311                |                        |       | V             |
| $V_{OH\_LPDDR}^4$            | High Level Output Voltage, $ds = 00$              | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OH} = -11.2\text{ mA}$                                                                 | 1.300                |                        |       | V             |
| $V_{OH\_LPDDR}^5$            | High Level Output Voltage, $ds = 01$              | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OH} = -7.85\text{ mA}$                                                                 | 1.300                |                        |       | V             |
| $V_{OH\_LPDDR}^6$            | High Level Output Voltage, $ds = 10$              | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OH} = -5.10\text{ mA}$                                                                 | 1.300                |                        |       | V             |
| $V_{OH\_LPDDR}^7$            | High Level Output Voltage, $ds = 11$              | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OH} = -2.55\text{ mA}$                                                                 | 1.300                |                        |       | V             |
| $V_{OL}^8$                   | Low Level Output Voltage                          | $V_{DD\_EXT} = 1.7\text{ V}$ , $I_{OL} = 2.0\text{ mA}$                                                                    |                      |                        | 0.400 | V             |
| $V_{OL}^8$                   | Low Level Output Voltage                          | $V_{DD\_EXT} = 3.13\text{ V}$ , $I_{OL} = 2.0\text{ mA}$                                                                   |                      |                        | 0.400 | V             |
| $V_{OL\_DDR2}^2$             | Low Level Output Voltage, $ds = 00$               | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OL} = 13.4\text{ mA}$                                                                  |                      |                        | 0.312 | V             |
| $V_{OL\_DDR2}^3$             | Low Level Output Voltage, $ds = 10$               | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OL} = 6.70\text{ mA}$                                                                  |                      |                        | 0.390 | V             |
| $V_{OL\_LPDDR}^4$            | Low Level Output Voltage, $ds = 00$               | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OL} = 11.2\text{ mA}$                                                                  |                      |                        | 0.400 | V             |
| $V_{OL\_LPDDR}^5$            | Low Level Output Voltage, $ds = 01$               | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OL} = 7.85\text{ mA}$                                                                  |                      |                        | 0.400 | V             |
| $V_{OL\_LPDDR}^6$            | Low Level Output Voltage, $ds = 10$               | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OL} = 5.10\text{ mA}$                                                                  |                      |                        | 0.400 | V             |
| $V_{OL\_LPDDR}^7$            | Low Level Output Voltage, $ds = 11$               | $V_{DD\_DMC} = 1.70\text{ V}$ , $I_{OL} = 2.55\text{ mA}$                                                                  |                      |                        | 0.400 | V             |
| $I_{IH}^9$                   | High Level Input Current                          | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 3.47\text{ V}$ |                      |                        | 10    | $\mu\text{A}$ |
| $I_{IH\_PD}^{10}$            | High Level Input Current with Pull-down Resistor  | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 3.47\text{ V}$ |                      |                        | 110   | $\mu\text{A}$ |
| $I_{IL}^{11}$                | Low Level Input Current                           | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 0\text{ V}$    |                      |                        | 10    | $\mu\text{A}$ |
| $I_{IL\_PU}^{12}$            | Low Level Input Current with Pull-up Resistor     | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 0\text{ V}$    |                      |                        | 100   | $\mu\text{A}$ |
| $I_{IH\_USB0}^{13}$          | High Level Input Current                          | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 3.47\text{ V}$ |                      |                        | 240   | $\mu\text{A}$ |
| $I_{IL\_USB0}^{13}$          | Low Level Input Current                           | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 0\text{ V}$    |                      |                        | 100   | $\mu\text{A}$ |
| $I_{OZH}^{14}$               | Three-State Leakage Current                       | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 3.47\text{ V}$ |                      |                        | 10    | $\mu\text{A}$ |
| $I_{OZH}^{15}$               | Three-State Leakage Current                       | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 1.9\text{ V}$  |                      |                        | 10    | $\mu\text{A}$ |
| $I_{OZL}^{16}$               | Three-State Leakage Current                       | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 0\text{ V}$    |                      |                        | 10    | $\mu\text{A}$ |
| $I_{OZL\_PU}^{17}$           | Three-State Leakage Current with Pull-up Resistor | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 0\text{ V}$    |                      |                        | 100   | $\mu\text{A}$ |
| $I_{OZH\_TWI}^{18}$          | Three-State Leakage Current                       | $V_{DD\_EXT} = 3.47\text{ V}$ , $V_{DD\_DMC} = 1.9\text{ V}$ ,<br>$V_{DD\_USB} = 3.47\text{ V}$ , $V_{IN} = 5.5\text{ V}$  |                      |                        | 10    | $\mu\text{A}$ |
| $C_{IN}^{19, 20}$            | Input Capacitance                                 | $T_{AMBIENT} = 25^\circ\text{C}$                                                                                           |                      | 4.9                    | 6.7   | pF            |
| $C_{IN\_TWI}^{18, 20}$       | Input Capacitance                                 | $T_{AMBIENT} = 25^\circ\text{C}$                                                                                           |                      | 8.9                    | 9.9   | pF            |
| $C_{IN\_DDR}^{20, 21}$       | Input Capacitance                                 | $T_{AMBIENT} = 25^\circ\text{C}$                                                                                           |                      | 5.8                    | 6.6   | pF            |
| $I_{DD\_TD}$                 | $V_{DD\_TD}$ Current                              | $V_{DD\_TD} = 3.3\text{ V}$                                                                                                |                      |                        | 1     | $\mu\text{A}$ |
| $I_{DD\_DEEPSLEEP}^{22, 23}$ | $V_{DD\_INT}$ Current in Deep Sleep Mode          | $f_{CLK} = 0\text{ MHz}$<br>$f_{SCLK0/1} = 0\text{ MHz}$                                                                   |                      | Table 21 on<br>Page 58 |       | mA            |

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| Parameter                                                        | Test Conditions                                                                                                                                                                                                                                                              | Min | Typical | Max                                        | Unit          |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------|--------------------------------------------|---------------|
| $I_{DD\_IDLE}^{23}$ $V_{DD\_INT}$ Current in Idle                | $f_{CCLK} = 500$ MHz<br>ASFC0 = 0.14 (Idle)<br>ASFC1 = 0 (Disabled)<br>$f_{SYSCLK} = 250$ MHz, $f_{SCLK0/1} = 125$ MHz<br>$f_{DCLK} = 0$ MHz (DDR Disabled)<br>$f_{USBCLK} = 0$ MHz (USB Disabled)<br>No PVP or DMA activity<br>$T_J = 25^\circ\text{C}$                     |     | 137     |                                            | mA            |
| $I_{DD\_TYP}^{23}$ $V_{DD\_INT}$ Current                         | $f_{CCLK} = 500$ MHz<br>ASFC0 = 1.0 (Full-on Typical)<br>ASFC1 = 0.86 (App)<br>$f_{SYSCLK} = 250$ MHz, $f_{SCLK0/1} = 125$ MHz<br>$f_{DCLK} = 250$ MHz<br>$f_{USBCLK} = 0$ MHz (USB Disabled)<br>DMA Data Rate = 124 MB/s<br>Medium PVP Activity<br>$T_J = 25^\circ\text{C}$ |     | 357     |                                            | mA            |
| $I_{DD\_HIBERNATE}^{22, 24}$ Hibernate State Current             | $V_{DD\_INT} = 0$ V,<br>$V_{DD\_EXT} = V_{DD\_TD} = V_{DD\_USB} = 3.3$ V,<br>$V_{DD\_DMC} = 1.8$ V, $V_{REF\_DMC} = 0.9$ V,<br>$T_J = 25^\circ\text{C}$ , $f_{CLKIN} = 0$ MHz                                                                                                |     | 40      |                                            | $\mu\text{A}$ |
| $I_{DD\_HIBERNATE}^{22, 24}$ Hibernate State Current Without USB | $V_{DD\_INT} = 0$ V,<br>$V_{DD\_EXT} = V_{DD\_TD} = V_{DD\_USB} = 3.3$ V,<br>$V_{DD\_DMC} = 1.8$ V, $V_{REF\_DMC} = 0.9$ V,<br>$T_J = 25^\circ\text{C}$ ,<br>$f_{CLKIN} = 0$ MHz, USB protection disabled (USB0_PHY_CTL.DIS=1)                                               |     | 10      |                                            | $\mu\text{A}$ |
| $I_{DD\_INT}^{23}$ $V_{DD\_INT}$ Current                         | $f_{CCLK} > 0$ MHz<br>$f_{SCLK0/1} \geq 0$ MHz                                                                                                                                                                                                                               |     |         | See $I_{DD\_INT\_TOT}$ equation on Page 57 | mA            |

<sup>1</sup> Applies to all output and bidirectional signals except DMC0 signals, TWI signals and USB0 signals.

<sup>2</sup> Applies to all DMC0 output and bidirectional signals in DDR2 full drive strength mode.

<sup>3</sup> Applies to all DMC0 output and bidirectional signals in DDR2 half drive strength mode.

<sup>4</sup> Applies to all DMC0 output and bidirectional signals in LPDDR full drive strength mode.

<sup>5</sup> Applies to all DMC0 output and bidirectional signals in LPDDR three-quarter drive strength mode.

<sup>6</sup> Applies to all DMC0 output and bidirectional signals in LPDDR half drive strength mode.

<sup>7</sup> Applies to all DMC0 output and bidirectional signals in LPDDR one-quarter drive strength mode.

<sup>8</sup> Applies to all output and bidirectional signals except DMC0 signals and USB0 signals.

<sup>9</sup> Applies to signals SMC0\_ARDY, SMC0\_BR, SYS\_BMODE0-2, SYS\_CLKIN, SYS\_HWRST, SYS\_PWRGD, JTG\_TDI, and JTG\_TMS.

<sup>10</sup> Applies to signals JTG\_TCK and JTG\_TRST.

<sup>11</sup> Applies to signals SMC0\_ARDY, SMC0\_BR, SYS\_BMODE0-2, SYS\_CLKIN, SYS\_HWRST, SYS\_PWRGD, JTG\_TCK, and JTG\_TRST.

<sup>12</sup> Applies to signals JTG\_TDI, JTG\_TMS.

<sup>13</sup> Applies to signal USB0\_CLKIN.

<sup>14</sup> Applies to signals PA0-15, PB0-15, PC0-15, PD0-15, PE0-15, PF0-15, PG0-15, SMC0\_AMS0, SMC0\_ARE, SMC0\_AWE, SMC0\_A0E, SMC0\_A01-02, SMC0\_D00-15, SYS\_FAULT, SYS\_FAULT, JTG\_EMU, JTG\_TDO, USB0\_DM, USB0\_DP, USB0\_ID, USB0\_VBC, USB0\_VBUS.

<sup>15</sup> Applies to DMC0\_A[00:13], DMC0\_BA[0:2], DMC0\_CAS, DMC0\_CS0, DMC0\_DQ[00:15], DMC0\_LQDS, DMC0\_LDQS, DMC0\_UDQS, DMC0\_UDQS, DMC0\_LDM, DMC0\_UDM, DMC0\_ODT, DMC0\_RAS, and DMC0\_WE.

<sup>16</sup> Applies to signals PA0-15, PB0-15, PC0-15, PD0-15, PE0-15, PF0-15, PG0-15, SMC0\_A0E, SMC0\_A01-02, SMC0\_D00-15, SYS\_FAULT, SYS\_FAULT, JTG\_EMU, JTG\_TDO, USB0\_DM, USB0\_DP, USB0\_ID, USB0\_VBC, USB0\_VBUS, DMC0\_A00-13, DMC0\_BA0-2, DMC0\_CAS, DMC0\_CS0, DMC0\_DQ00-15, DMC0\_LQDS, DMC0\_LDQS, DMC0\_UDQS, DMC0\_UDQS, DMC0\_LDM, DMC0\_UDM, DMC0\_ODT, DMC0\_RAS, DMC0\_WE, and TWI signals.

<sup>17</sup> Applies to signals SMC0\_AMS0, SMC0\_ARE, SMC0\_AWE, and when RSI pull-up resistors are enabled, PE10-13, 15 and PG00, 02, 03, 05.

<sup>18</sup> Applies to all TWI signals.

<sup>19</sup> Applies to all signals, except DMC0 and TWI signals.

<sup>20</sup> Guaranteed, but not tested.

<sup>21</sup> Applies to all DMC0 signals.

<sup>22</sup> See the ADSP-BF60x Blackfin Processor Hardware Reference Manual for definition of deep sleep and hibernate operating modes.

<sup>23</sup> Additional information can be found at [Total Internal Power Dissipation on Page 57](#).

<sup>24</sup> Applies to  $V_{DD\_EXT}$ ,  $V_{DD\_DMC}$ ,  $V_{DD\_USB}$  and  $V_{DD\_TD}$  supply signals only. Clock inputs are tied high or low.

## Total Internal Power Dissipation

Total power dissipation has two components:

1. Static, including leakage current (deep sleep)
2. Dynamic, due to transistor switching characteristics for each clock domain

Many operating conditions can also affect power dissipation, including temperature, voltage, operating frequency, and processor activity. The following equation describes the internal current consumption.

$$I_{DDINT\_TOT} = I_{DDINT\_CCLK\_DYN} + I_{DDINT\_SYSCLK\_DYN} + I_{DDINT\_SCLK0\_DYN} + I_{DDINT\_SCLK1\_DYN} + I_{DDINT\_DCLK\_DYN} + I_{DDINT\_USCLK\_DYN} + I_{DDINT\_DMA\_DR\_DYN} + I_{DDINT\_DEEPSLEEP} + I_{DDINT\_PVP\_DYN}$$

$I_{DDINT\_DEEPSLEEP}$  is the only item present that is part of the static power dissipation component.  $I_{DDINT\_DEEPSLEEP}$  is specified as a function of voltage ( $V_{DD\_INT}$ ) and temperature (see [Table 21](#)).

There are eight different items that contribute to the dynamic power dissipation. These components fall into three broad categories: application-dependent currents, clock currents and data transmission currents.

### Application-Dependent Current

The application-dependent currents include the dynamic current in the core clock domain and the dynamic current of the PVP.

Core clock (CCLK) use is subject to an activity scaling factor (ASF) that represents application code running on the processor cores and L1/L2 memories ([Table 20](#)). The ASF is combined with the CCLK frequency and  $V_{DD\_INT}$  dependent data in [Table 19](#) to calculate this portion.

$$I_{DDINT\_CCLK\_DYN} \text{ (mA)} = \text{Table 19} \times (\text{ASFC0} + \text{ASFC1})$$

The dynamic current of the PVP is determined by selecting the appropriate use case from [Table 22](#).

$$I_{DDINT\_PVP\_DYN} \text{ (mA)} = \text{Table 22}$$

### Clock Current

The dynamic clock currents provide the total power dissipated by all transistors switching in the clock paths. The power dissipated by each clock domain is dependent on voltage ( $V_{DD\_INT}$ ), operating frequency and a unique scaling factor.

$$I_{DDINT\_SYSCLK\_DYN} \text{ (mA)} = 0.187 \times f_{\text{SYSCLK}} \text{ (MHz)} \times V_{DD\_INT} \text{ (V)}$$

$$I_{DDINT\_SCLK0\_DYN} \text{ (mA)} = 0.217 \times f_{\text{SCLK0}} \text{ (MHz)} \times V_{DD\_INT} \text{ (V)}$$

$$I_{DDINT\_SCLK1\_DYN} \text{ (mA)} = 0.042 \times f_{\text{SCLK1}} \text{ (MHz)} \times V_{DD\_INT} \text{ (V)}$$

$$I_{DDINT\_DCLK\_DYN} \text{ (mA)} = 0.024 \times f_{\text{DCLK}} \text{ (MHz)} \times V_{DD\_INT} \text{ (V)}$$

The dynamic component of the USB clock is a unique case. The USB clock contributes a near constant current value when used.

$$I_{DDINT\_USCLK\_DYN} \text{ (mA)} = 5 \text{ mA (if USB enabled)}$$

### Data Transmission Current

The data transmission current represents the power dissipated when transmitting data. This current is expressed in terms of data rate. The calculation is performed by adding the data rate (MB/s) of each DMA and core driven access to peripherals and L2/external memory. This number is then multiplied by a coefficient and  $V_{DD\_INT}$ . The following equation provides an estimate of all data transmission current.

$$I_{DDINT\_DMA\_DR\_DYN} \text{ (mA)} = 0.0578 \times \text{data rate (MB/s)} \times V_{DD\_INT} \text{ (V)}$$

For details on using this equation see the related [Engineer Zone](#) material.

**Table 19. CCLK Dynamic Current per core (mA, with ASF = 1)**

| $f_{\text{CCLK}}$ (MHz) | Voltage ( $V_{DD\_INT}$ ) |       |       |       |       |       |       |
|-------------------------|---------------------------|-------|-------|-------|-------|-------|-------|
|                         | 1.190                     | 1.200 | 1.225 | 1.250 | 1.275 | 1.300 | 1.320 |
| 500                     | 97.9                      | 98.8  | 101.5 | 103.9 | 106.7 | 109.3 | 110.8 |
| 450                     | 88.6                      | 89.5  | 91.9  | 94.1  | 96.7  | 98.9  | 100.6 |
| 400                     | 79.3                      | 80.1  | 82.2  | 84.3  | 86.5  | 88.6  | 90.1  |
| 350                     | 70.0                      | 70.7  | 72.5  | 74.4  | 76.3  | 78.3  | 79.4  |
| 300                     | 60.6                      | 61.2  | 63.0  | 64.6  | 66.3  | 68.0  | 69.1  |
| 250                     | 51.3                      | 51.8  | 53.2  | 54.7  | 56.3  | 57.6  | 58.5  |
| 200                     | 42.0                      | 42.4  | 43.6  | 44.8  | 46.0  | 47.2  | 48.2  |
| 150                     | 32.5                      | 32.9  | 34.0  | 34.8  | 35.9  | 37.0  | 37.4  |
| 100                     | 23.2                      | 23.5  | 24.2  | 25.0  | 25.7  | 26.5  | 26.9  |

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**Table 20. Activity Scaling Factors (ASF)**

| <b>I<sub>DDINT</sub> Power Vector</b> | <b>ASF</b> |
|---------------------------------------|------------|
| I <sub>DD-PEAK</sub>                  | 1.34       |
| I <sub>DD-HIGH</sub>                  | 1.25       |
| I <sub>DD-FULL-ON-TYP</sub>           | 1.00       |
| I <sub>DD-APP</sub>                   | 0.86       |
| I <sub>DD-NOP</sub>                   | 0.72       |
| I <sub>DD-IDLE</sub>                  | 0.14       |

**Table 21. Static Current—I<sub>DD\_DEEPSLEEP</sub> (mA)**

| <b>T<sub>J</sub> (°C)</b> | <b>Voltage (V<sub>DD_INT</sub>)</b> |              |              |              |              |              |              |
|---------------------------|-------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                           | <b>1.190</b>                        | <b>1.200</b> | <b>1.225</b> | <b>1.250</b> | <b>1.275</b> | <b>1.300</b> | <b>1.320</b> |
| –40                       | 1.7                                 | 1.8          | 2.2          | 2.5          | 2.7          | 3.1          | 3.4          |
| –20                       | 4.0                                 | 4.2          | 4.6          | 5.1          | 5.6          | 6.2          | 6.8          |
| 0                         | 8.4                                 | 9.0          | 9.6          | 10.6         | 11.5         | 12.5         | 13.4         |
| 25                        | 19.0                                | 19.8         | 21.5         | 23.2         | 25.3         | 27.2         | 29.0         |
| 40                        | 29.9                                | 31.7         | 34.4         | 36.8         | 40.0         | 42.8         | 45.4         |
| 55                        | 46.6                                | 48.9         | 52.4         | 56.4         | 60.6         | 65.0         | 68.1         |
| 70                        | 66.4                                | 70.4         | 75.5         | 80.6         | 86.2         | 92.4         | 97.9         |
| 85                        | 93.9                                | 99.3         | 105.9        | 113.0        | 120.7        | 128.9        | 136.4        |
| 100                       | 137.2                               | 144.2        | 153.6        | 163.4        | 173.9        | 185.1        | 194.1        |
| 105                       | 153.8                               | 162.4        | 172.5        | 183.4        | 195.2        | 207.5        | 217.5        |
| 115                       | 193.3                               | 203.7        | 216.2        | 229.5        | 243.9        | 258.6        | 271.1        |
| 125                       | 236.1                               | 247.2        | 261.8        | 277.3        | 294.0        | 311.9        | 326.4        |

**Table 22. I<sub>DDINT\_PVP\_DYN</sub> (mA)**

| <b>PVP Activity Level</b> | <b>PVPSF (PVP Scaling Factor)</b> |
|---------------------------|-----------------------------------|
| High                      | 42.4                              |
| Medium                    | 20                                |
| Low                       | 0                                 |

## PROCESSOR — ABSOLUTE MAXIMUM RATINGS

Stresses greater than those listed in Table 23 may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions greater than those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 23. Absolute Maximum Ratings

| Parameter                                        | Rating                           |
|--------------------------------------------------|----------------------------------|
| Internal Supply Voltage ( $V_{DD\_INT}$ )        | –0.33 V to 1.32 V                |
| External (I/O) Supply Voltage ( $V_{DD\_EXT}$ )  | –0.33 V to 3.63 V                |
| Thermal Diode Supply Voltage ( $V_{DD\_TD}$ )    | –0.33 V to 3.63 V                |
| DDR2 Controller Supply Voltage ( $V_{DD\_DMC}$ ) | –0.33 V to 1.90 V                |
| USB PHY Supply Voltage ( $V_{DD\_USB}$ )         | –0.33 V to 3.63 V                |
| Input Voltage <sup>1, 2, 3</sup>                 | –0.33 V to 3.63 V                |
| TWI Input Voltage <sup>2, 4</sup>                | –0.33 V to 5.50 V                |
| USB0_Dx Input Voltage <sup>5</sup>               | –0.33 V to 5.25 V                |
| USB0_VBUS Input Voltage <sup>5</sup>             | –0.33 V to 6.00 V                |
| DDR2 Input Voltage <sup>6</sup>                  | –0.33 V to 1.90 V                |
| Output Voltage Swing                             | –0.33 V to $V_{DD\_EXT} + 0.5$ V |
| $I_{OH}/I_{OL}$ Current per Signal <sup>1</sup>  | 12.5 mA (max)                    |
| Storage Temperature Range                        | –65°C to +150°C                  |
| Junction Temperature Under Bias                  | +125°C                           |

<sup>1</sup> Applies to 100% transient duty cycle.

<sup>2</sup> Applies only when  $V_{DD\_EXT}$  is within specifications. When  $V_{DD\_EXT}$  is outside specifications, the range is  $V_{DD\_EXT} \pm 0.2$  V.

<sup>3</sup> For other duty cycles see Table 24.

<sup>4</sup> Applies to balls TWI\_SCL and TWI\_SDA.

<sup>5</sup> If the USB is not used, connect USB0\_Dx and USB0\_VBUS according to Table 15 on Page 37.

<sup>6</sup> Applies only when  $V_{DD\_DMC}$  is within specifications. When  $V_{DD\_DMC}$  is outside specifications, the range is  $V_{DD\_DMC} \pm 0.2$  V.

Table 24. Maximum Duty Cycle for Input Transient Voltage<sup>1, 2</sup>

| Maximum Duty Cycle (%) <sup>2</sup> | $V_{IN}$ Min (V) <sup>3</sup> | $V_{IN}$ Max (V) <sup>3</sup> |
|-------------------------------------|-------------------------------|-------------------------------|
| 100                                 | –0.33                         | 3.63                          |
| 50                                  | –0.50                         | 3.80                          |
| 40                                  | –0.56                         | 3.86                          |
| 25                                  | –0.67                         | 3.97                          |
| 20                                  | –0.73                         | 4.03                          |
| 15                                  | –0.80                         | 4.10                          |
| 10                                  | –0.90                         | 4.20                          |

<sup>1</sup> Applies to all signal balls with the exception of SYS\_CLKIN, SYS\_XTAL, SYS\_EXT\_WAKE, USB0\_DP, USB0\_DM, USB0\_VBUS, TWI signals, and DMC0 signals.

<sup>2</sup> Applies only when  $V_{DD\_EXT}$  is within specifications. When  $V_{DD\_EXT}$  is outside specifications, the range is  $V_{DD\_EXT} \pm 0.2$  V.

<sup>3</sup> The individual values cannot be combined for analysis of a single instance of overshoot or undershoot. The worst case observed value must fall within one of the specified voltages, and the total duration of the overshoot or undershoot (exceeding the 100% case) must be less than or equal to the corresponding duty cycle.

## ESD SENSITIVITY



### ESD (electrostatic discharge) sensitive device.

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PROCESSOR — PACKAGE INFORMATION

The information presented in Figure 9 and Table 25 provides details about package branding. For a complete listing of product availability, see Automotive Products on Page 112.



Figure 9. Product Information on Package

Table 25. Package Brand Information

| Brand Key  | Field Description          |
|------------|----------------------------|
| ADSP-BF609 | Product Model              |
| t          | Temperature Range          |
| pp         | Package Type               |
| Z          | RoHS Compliant Designation |
| ccc        | See Ordering Guide         |
| vvvvvv.x   | Assembly Lot Code          |
| n.n        | Silicon Revision           |
| yyww       | Date Code                  |

TIMING SPECIFICATIONS

Specifications are subject to change without notice.

Clock and Reset Timing

Table 26 and Figure 10 describe clock and reset operations. Per the CCLK, SYSCLK, SCLK0, SCLK1, DCLK, and OCLK timing specifications in Table 17 on Page 53, combinations of SYS\_CLKIN and clock multipliers must not select clock rates in excess of the processor’s maximum instruction rate.

Table 26. Clock and Reset Timing

| Parameter           |                                                                      | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal |     | Unit |
|---------------------|----------------------------------------------------------------------|--------------------------------------------|-----|------|
|                     |                                                                      | Min                                        | Max |      |
| Timing Requirements |                                                                      |                                            |     |      |
| f <sub>CKIN</sub>   | SYS_CLKIN Frequency (using a crystal) <sup>1, 2, 3</sup>             | 20                                         | 50  | MHz  |
| f <sub>CKIN</sub>   | SYS_CLKIN Frequency (using a crystal oscillator) <sup>1, 2, 3</sup>  | 20                                         | 60  | MHz  |
| t <sub>CKINL</sub>  | SYS_CLKIN Low Pulse <sup>1</sup>                                     | 6.67                                       |     | ns   |
| t <sub>CKINH</sub>  | SYS_CLKIN High Pulse <sup>1</sup>                                    | 6.67                                       |     | ns   |
| t <sub>WRST</sub>   | $\overline{\text{SYS\_HWRST}}$ Asserted Pulse Width Low <sup>4</sup> | 11 × t <sub>CKIN</sub>                     |     | ns   |

<sup>1</sup> Applies to PLL bypass mode and PLL non bypass mode.  
<sup>2</sup> The t<sub>CKIN</sub> period (see Figure 10) equals 1/f<sub>CKIN</sub>.  
<sup>3</sup> If the CGU\_CTL.DF bit is set, the minimum f<sub>CKIN</sub> specification is 40 MHz.  
<sup>4</sup> Applies after power-up sequence is complete. See Table 27 and Figure 11 for power-up reset timing.

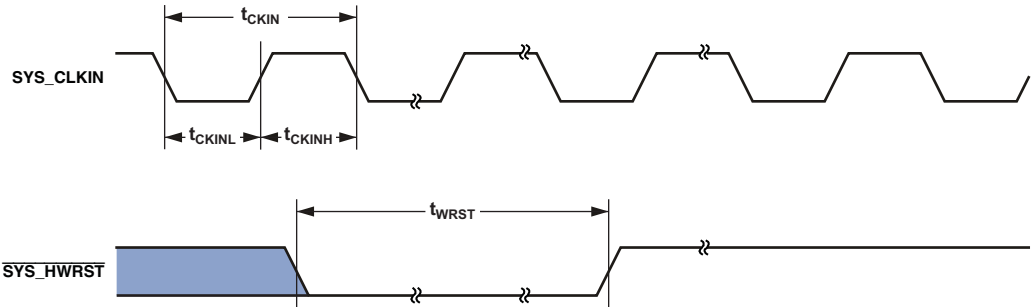


Figure 10. Clock and Reset Timing

Power-Up Reset Timing

In Figure 11,  $V_{DD\_SUPPLIES}$  are  $V_{DD\_INT}$ ,  $V_{DD\_EXT}$ ,  $V_{DD\_DMC}$ ,  $V_{DD\_USB}$ , and  $V_{DD\_TD}$ .

Table 27. Power-Up Reset Timing

| Parameter                                                                                                                                                                                       | Min                  | Max | Unit |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----|------|
| Timing Requirement                                                                                                                                                                              |                      |     |      |
| $t_{RST\_IN\_PWR}$ $\overline{SYS\_HWRST}$ Deasserted after $V_{DD\_INT}$ , $V_{DD\_EXT}$ , $V_{DD\_DMC}$ , $V_{DD\_USB}$ , $V_{DD\_TD}$ , and $SYS\_CLKIN$ are Stable and Within Specification | $11 \times t_{CKIN}$ |     | ns   |

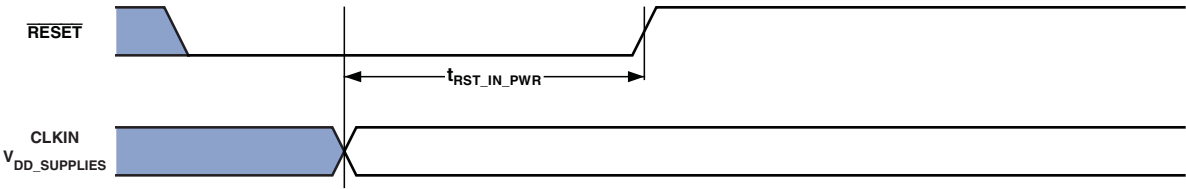


Figure 11. Power-Up Reset Timing

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## Asynchronous Read

Table 28. Asynchronous Memory Read (BxMODE = b#00)

| Parameter                 | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal                                                |                                                          | Unit |
|---------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------|------|
|                           | Min                                                                                       | Max                                                      |      |
| Timing Requirements       |                                                                                           |                                                          |      |
| t <sub>SDATARE</sub>      | DATA in Setup Before $\overline{SMC0\_ARE}$ High                                          | 8.2                                                      | ns   |
| t <sub>HDATARE</sub>      | DATA in Hold After $\overline{SMC0\_ARE}$ High                                            | 0                                                        | ns   |
| t <sub>DARDYARE</sub>     | SMC0_ARDY Valid After $\overline{SMC0\_ARE}$ Low <sup>1, 2</sup>                          | (RAT – 2.5) × t <sub>SCLK0</sub> – 17.5                  | ns   |
| Switching Characteristics |                                                                                           |                                                          |      |
| t <sub>ADDRARE</sub>      | SMC0_Ax/ $\overline{SMC0\_AMSx}$ Assertion Before $\overline{SMC0\_ARE}$ Low <sup>3</sup> | (PREST + RST + PREAT) × t <sub>SCLK0</sub> – 2           | ns   |
| t <sub>AOEARE</sub>       | $\overline{SMC0\_AOE}$ Assertion Before $\overline{SMC0\_ARE}$ Low                        | (RST + PREAT) × t <sub>SCLK0</sub> – 2                   | ns   |
| t <sub>HARE</sub>         | Output <sup>4</sup> Hold After $\overline{SMC0\_ARE}$ High <sup>5</sup>                   | RHT × t <sub>SCLK0</sub> – 2                             | ns   |
| t <sub>WARE</sub>         | $\overline{SMC0\_ARE}$ Active Low Width <sup>6</sup>                                      | RAT × t <sub>SCLK0</sub> – 2                             | ns   |
| t <sub>DAREARDY</sub>     | $\overline{SMC0\_ARE}$ High Delay After SMC0_ARDY Assertion <sup>1</sup>                  | 2.5 × t <sub>SCLK0</sub> 3.5 × t <sub>SCLK0</sub> + 17.5 | ns   |

<sup>1</sup>  $\overline{SMC0\_BxCTL.ARDYEN}$  bit = 1.

<sup>2</sup> RAT value set using the  $\overline{SMC\_BxTIM.RAT}$  bits.

<sup>3</sup> PREST, RST, and PREAT values set using the  $\overline{SMC\_BxETIM.PREST}$  bits,  $\overline{SMC\_BxTIM.RST}$  bits, and the  $\overline{SMC\_BxETIM.PREAT}$  bits.

<sup>4</sup> Output signals are  $\overline{SMC0\_Ax}$ ,  $\overline{SMC0\_AMS}$ ,  $\overline{SMC0\_AOE}$ ,  $\overline{SMC0\_ABEx}$ .

<sup>5</sup> RHT value set using the  $\overline{SMC\_BxTIM.RHT}$  bits.

<sup>6</sup>  $\overline{SMC0\_BxCTL.ARDYEN}$  bit = 0.

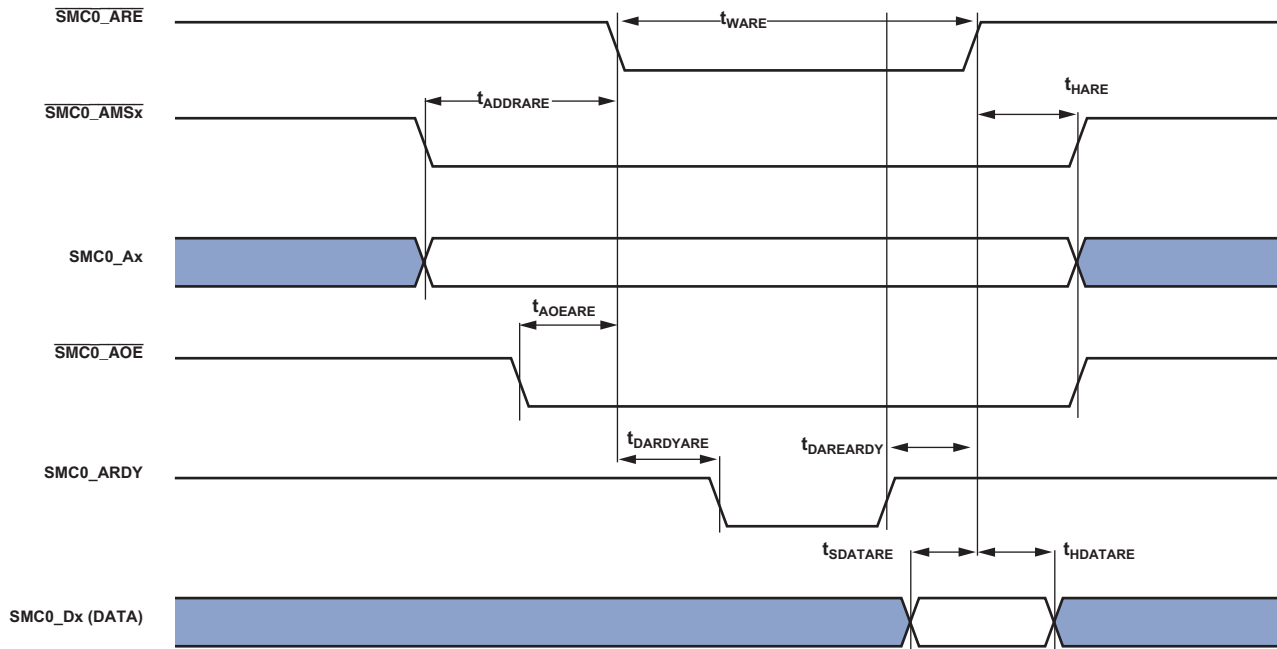


Figure 12. Asynchronous Read

## Asynchronous Flash Read

Table 29. Asynchronous Flash Read

| Parameter                      |                                                                                  | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal |     | Unit |
|--------------------------------|----------------------------------------------------------------------------------|--------------------------------------------|-----|------|
|                                |                                                                                  | Min                                        | Max |      |
| Switching Characteristics      |                                                                                  |                                            |     |      |
| t <sub>AMSADV</sub>            | SMC0_Ax (Address)/ <u>SMC0_AMSx</u> Assertion Before SMC0_NORDV Low <sup>1</sup> | PREST × t <sub>SCLK0</sub> − 2             |     | ns   |
| t <sub>WADV</sub>              | SMC0_NORDV Active Low Width <sup>2</sup>                                         | RST × t <sub>SCLK0</sub> − 2               |     | ns   |
| t <sub>DADVARE</sub>           | <u>SMC0_ARE</u> Low Delay From SMC0_NORDV High <sup>3</sup>                      | PREAT × t <sub>SCLK0</sub> − 2             |     | ns   |
| t <sub>HARE</sub>              | Output <sup>4</sup> Hold After <u>SMC0_ARE</u> High <sup>5</sup>                 | RHT × t <sub>SCLK0</sub> − 2               |     | ns   |
| t <sub>WARE</sub> <sup>6</sup> | <u>SMC0_ARE</u> Active Low Width <sup>7</sup>                                    | RAT × t <sub>SCLK0</sub> − 2               |     | ns   |

<sup>1</sup> PREST value set using the SMC\_BxETIM.PREST bits.

<sup>2</sup> RST value set using the SMC\_BxTIM.RST bits.

<sup>3</sup> PREAT value set using the SMC\_BxETIM.PREAT bits.

<sup>4</sup> Output signals are SMC0\_Ax, SMC0\_AMS, SMC0\_AOE.

<sup>5</sup> RHT value set using the SMC\_BxTIM.RHT bits.

<sup>6</sup> SMC0\_BxCTL.ARDYEN bit = 0.

<sup>7</sup> RAT value set using the SMC\_BxTIM.RAT bits.

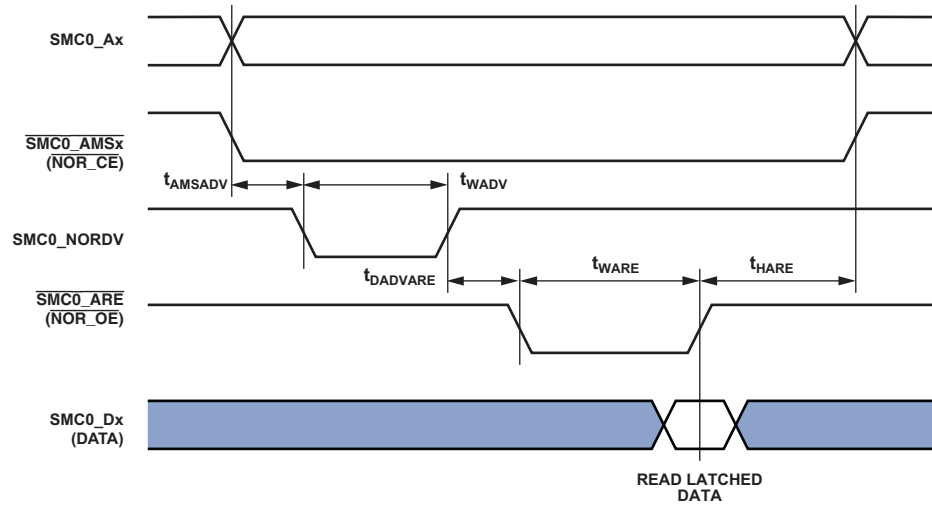


Figure 13. Asynchronous Flash Read

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Asynchronous Page Mode Read

Table 30. Asynchronous Page Mode Read

|                           |                                                                         | $V_{DD\_EXT}$<br>1.8V / 3.3V Nominal                |     |      |
|---------------------------|-------------------------------------------------------------------------|-----------------------------------------------------|-----|------|
| Parameter                 |                                                                         | Min                                                 | Max | Unit |
| Switching Characteristics |                                                                         |                                                     |     |      |
| $t_{AV}$                  | SMC0_Ax (Address) Valid for First Address Min Width <sup>1</sup>        | $(PREST + RST + PREAT + RAT) \times t_{SCLK0} - 2$  |     | ns   |
| $t_{AV1}$                 | SMC0_Ax (Address) Valid for Subsequent SMC0_Ax (Address) Min Width      | $PGWS \times t_{SCLK0} - 2$                         |     | ns   |
| $t_{WADV}$                | SMC0_NORDV Active Low Width <sup>2</sup>                                | $RST \times t_{SCLK0} - 2$                          |     | ns   |
| $t_{HARE}$                | Output <sup>3</sup> Hold After $\overline{SMC0\_ARE}$ High <sup>4</sup> | $RHT \times t_{SCLK0} - 2$                          |     | ns   |
| $t_{WARE}^5$              | $\overline{SMC0\_ARE}$ Active Low Width <sup>6, 7</sup>                 | $(RAT + (Nw - 1) \times PGWS) \times t_{SCLK0} - 2$ |     | ns   |

<sup>1</sup> PREST, RST, PREAT and RAT values set using the SMC\_BxETIM.PREST bits, SMC\_BxTIM.RST bits, SMC\_BxETIM.PREAT bits, and the SMC\_BxTIM.RAT bits.

<sup>2</sup> RST value set using the SMC\_BxTIM.RST bits.

<sup>3</sup> Output signals are SMC0\_Ax, SMC0\_AMSx, SMC0\_AOE.

<sup>4</sup> RHT value set using the SMC\_BxTIM.RHT bits.

<sup>5</sup> SMC\_BxCTL.ARDYEN bit = 0.

<sup>6</sup> RAT value set using the SMC\_BxTIM.RAT bits.

<sup>7</sup> Nw = Number of 16-bit data words read.

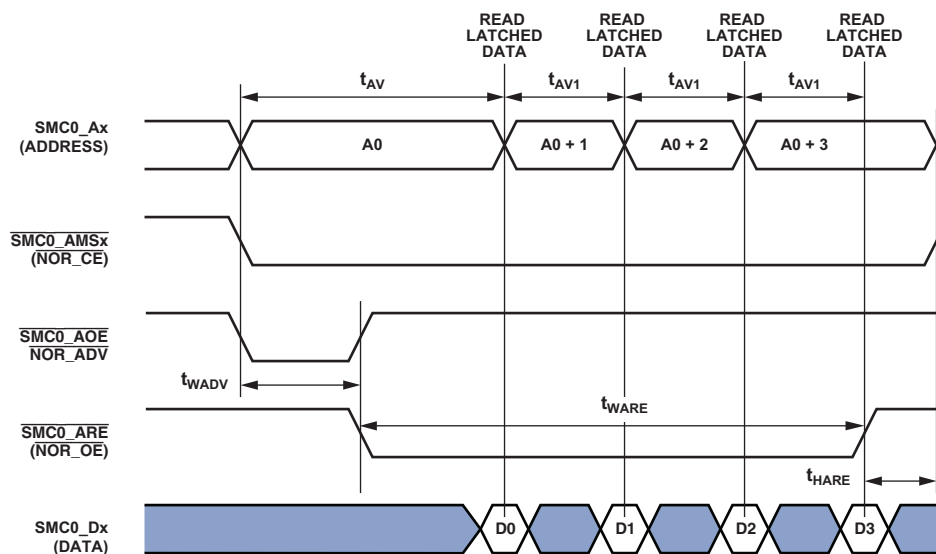


Figure 14. Asynchronous Page Mode Read

## Synchronous Burst Flash Read

In synchronous burst mode the programmed NOR burst clock ( $f_{NRCLKPROG}$ ) frequency in MHz is set by the following equation where BCLK is a field in the SMC\_BxCTL register that can be set from 0 to 3:

$$f_{NRCLKPROG} = \frac{f_{SCLK0}}{(BCLK + 1)}$$

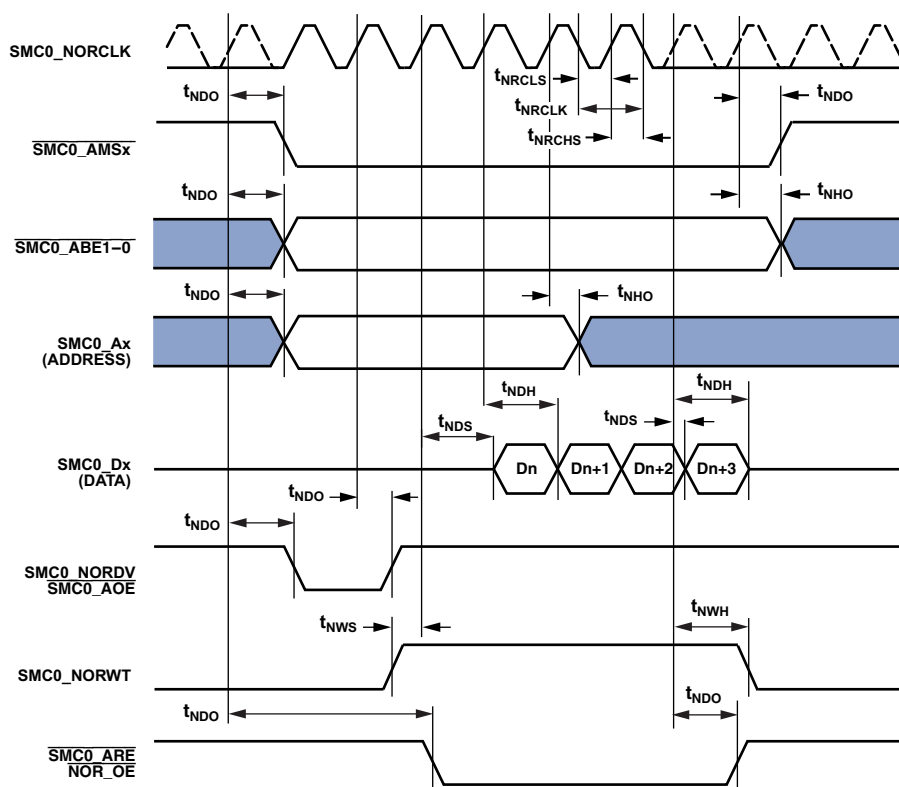
$$t_{NRCLKPROG} = \frac{1}{f_{NRCLKPROG}}$$

**Table 31. Synchronous Burst AC Timing (BxMODE = b#11)**

| Parameter                 |                                                  | V <sub>DD_EXT</sub><br>1.8V/3.3V Nominal |     | Unit |
|---------------------------|--------------------------------------------------|------------------------------------------|-----|------|
|                           |                                                  | Min                                      | Max |      |
| Timing Requirements       |                                                  |                                          |     |      |
| t <sub>NDS</sub>          | DATA-In Setup Before SMC0_NORCLK High            | 3                                        |     | ns   |
| t <sub>NDH</sub>          | DATA-In Hold After SMC0_NORCLK High              | 1.5                                      |     | ns   |
| t <sub>NWS</sub>          | WAIT-In Setup Before SMC0_NORCLK High            | 3                                        |     | ns   |
| t <sub>NWH</sub>          | WAIT-In Hold After SMC0_NORCLK High              | 1.5                                      |     | ns   |
| Switching Characteristics |                                                  |                                          |     |      |
| t <sub>NRCLS</sub>        | NOR_CLK Low Period <sup>1</sup>                  | 0.5 × t <sub>NRCLKPROG</sub> – 1         |     | ns   |
| t <sub>NRCHS</sub>        | NOR_CLK High Period <sup>1</sup>                 | 0.5 × t <sub>NRCLKPROG</sub> – 1         |     | ns   |
| t <sub>NRCLK</sub>        | NOR_CLK Period <sup>1</sup>                      | t <sub>NRCLKPROG</sub> – 1               |     | ns   |
| t <sub>NDO</sub>          | Output Delay After SMC0_NORCLK High <sup>2</sup> |                                          | 6   | ns   |
| t <sub>NHO</sub>          | Output Hold After SMC0_NORCLK High <sup>2</sup>  | 0.8                                      |     | ns   |

<sup>1</sup> See Table 17 on Page 53 in [Clock Related Operating Conditions](#) for details on the minimum period that may be programmed for t<sub>NRCLKPROG</sub>.

<sup>2</sup> Output = SMC0\_Ax (address), SMC0\_NORDV, SMC0\_ARE, SMC0\_AMSx (N0R\_CE).



NOTE: SMC0\_NORCLK dotted line represents a free running version of SMC0\_NORCLK that is not visible on the SMC0\_NORCLK pin.

Figure 15. Synchronous Burst AC Interface Timing

## Asynchronous Write

Table 32. Asynchronous Memory Write (BxMODE = b#00)

| Parameter                                                                                              | $V_{DD\_EXT}$<br>1.8V/3.3V Nominal           |                                       | Unit |
|--------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------|------|
|                                                                                                        | Min                                          | Max                                   |      |
| Timing Requirement                                                                                     |                                              |                                       |      |
| $t_{DARDYAW}^1$ SMC0_ARDY Valid After $\overline{SMC0\_AWE}$ Low <sup>2</sup>                          |                                              | $(WAT - 2.5) \times t_{SCLK0} - 17.5$ | ns   |
| Switching Characteristics                                                                              |                                              |                                       |      |
| $t_{ENDAT}$ DATA Enable After $\overline{SMC0\_AMSx}$ Assertion                                        | -3                                           |                                       | ns   |
| $t_{DDAT}$ DATA Disable After $\overline{SMC0\_AMSx}$ Deassertion                                      |                                              | 3                                     | ns   |
| $t_{AMSAWE}$ SMC0_Ax/ $\overline{SMC0\_AMSx}$ Assertion Before $\overline{SMC0\_AWE}$ Low <sup>3</sup> | $(PREST + WST + PREAT) \times t_{SCLK0} - 2$ |                                       | ns   |
| $t_{HAW}$ Output <sup>4</sup> Hold After $\overline{SMC0\_AWE}$ High <sup>5</sup>                      | $WHT \times t_{SCLK0} - 2$                   |                                       | ns   |
| $t_{WAVE}^6$ $\overline{SMC0\_AWE}$ Active Low Width <sup>2</sup>                                      | $WAT \times t_{SCLK0} - 2$                   |                                       | ns   |
| $t_{DAWEARDY}^1$ $\overline{SMC0\_AWE}$ High Delay After SMC0_ARDY Assertion                           | $2.5 \times t_{SCLK0}$                       | $3.5 \times t_{SCLK0} + 17.5$         | ns   |

<sup>1</sup> SMC\_BxCTL.ARDYEN bit = 1.

<sup>2</sup> WAT value set using the SMC\_BxTIM.WAT bits.

<sup>3</sup> PREST, WST, PREAT values set using the SMC\_BxETIM.PREST bits, SMC\_BxTIM.WST bits, SMC\_BxETIM.PREAT bits, and the SMC\_BxTIM.RAT bits.

<sup>4</sup> Output signals are DATA, SMC0\_Ax, SMC0\_AMSx, SMC0\_ABEx.

<sup>5</sup> WHT value set using the SMC\_BxTIM.WHT bits.

<sup>6</sup> SMC\_BxCTL.ARDYEN bit = 0.

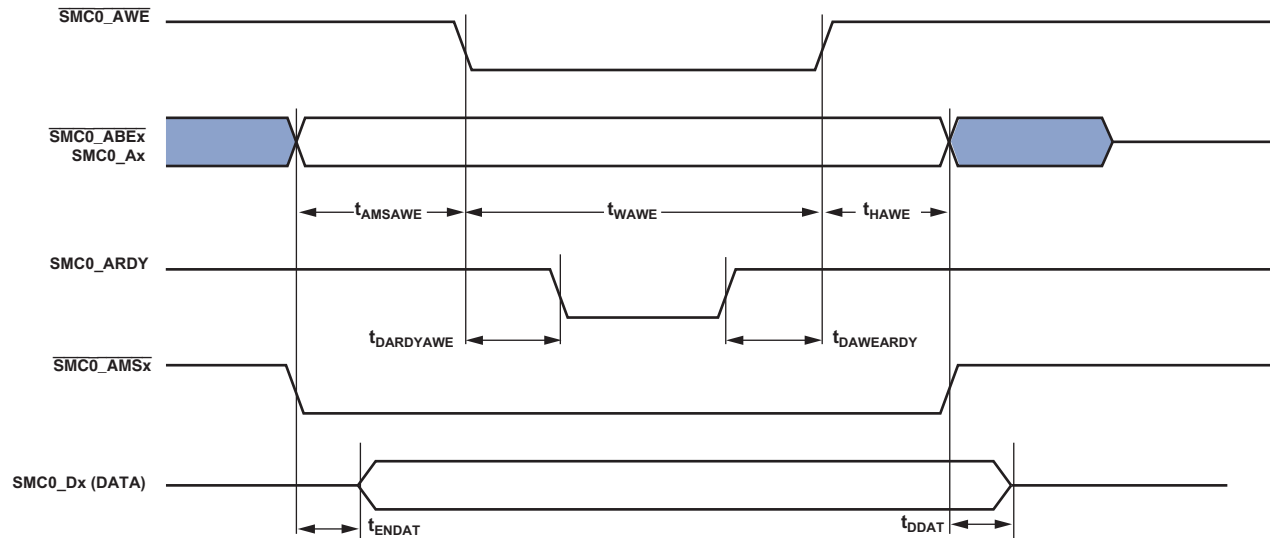


Figure 16. Asynchronous Write

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Asynchronous Flash Write

Table 33. Asynchronous Flash Write

|                           |                                                                                   | $V_{DD\_EXT}$<br>1.8V/3.3V Nominal |     |      |
|---------------------------|-----------------------------------------------------------------------------------|------------------------------------|-----|------|
| Parameter                 |                                                                                   | Min                                | Max | Unit |
| Switching Characteristics |                                                                                   |                                    |     |      |
| $t_{AMSADV}$              | $\overline{SMC0\_Ax}/\overline{SMC0\_AMSx}$ Assertion Before ADV Low <sup>1</sup> | $PREST \times t_{SCLK0} - 2$       |     | ns   |
| $t_{DADVAWE}$             | $\overline{SMC0\_AWE}$ Low Delay From ADV High <sup>2</sup>                       | $PREAT \times t_{SCLK0} - 2$       |     | ns   |
| $t_{WADV}$                | NR_ADV Active Low Width <sup>3</sup>                                              | $WST \times t_{SCLK0} - 2$         |     | ns   |
| $t_{HAWE}$                | Output <sup>4</sup> Hold After $\overline{SMC0\_AWE}$ High <sup>5</sup>           | $WHT \times t_{SCLK0} - 2$         |     | ns   |
| $t_{WAVE}$ <sup>6</sup>   | $\overline{SMC0\_AWE}$ Active Low Width <sup>7</sup>                              | $WAT \times t_{SCLK0} - 2$         |     | ns   |

<sup>1</sup> PREST value set using the SMC\_BxETIM.PREST bits.

<sup>2</sup> PREAT value set using the SMC\_BxETIM.PREAT bits.

<sup>3</sup> WST value set using the SMC\_BxTIM.WST bits.

<sup>4</sup> Output signals are DATA, SMC0\_Ax, SMC0\_AMSx, SMC0\_ABEx.

<sup>5</sup> WHT value set using the SMC\_BxTIM.WHT bits.

<sup>6</sup> SMC\_BxCTL.ARDYEN bit = 0.

<sup>7</sup> WAT value set using the SMC\_BxTIM.WAT bits.

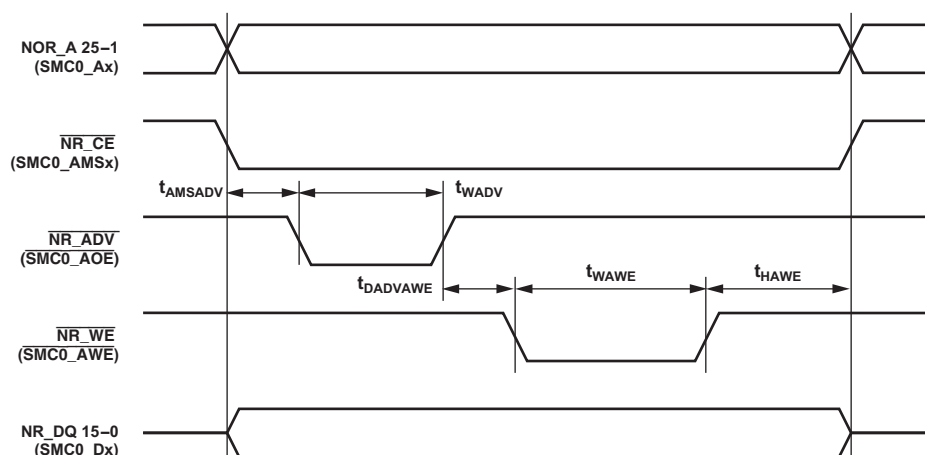


Figure 17. Asynchronous Flash Write

## All Accesses

Table 34. All Accesses

| Parameter                                         | $V_{DD\_EXT}$<br>1.8V/3.3V Nominal |     | Unit |
|---------------------------------------------------|------------------------------------|-----|------|
|                                                   | Min                                | Max |      |
| Switching Characteristic                          |                                    |     |      |
| $t_{TURN}$ $\overline{SMC0\_AMSx}$ Inactive Width | $(IT + TT) \times t_{SCLK0} - 2$   |     | ns   |

## Bus Request/Bus Grant

Table 35. Bus Request/Bus Grant

| Parameter                 |                                       | V <sub>DD_EXT</sub><br>1.8V/3.3V Nominal |                                 | Unit |
|---------------------------|---------------------------------------|------------------------------------------|---------------------------------|------|
|                           |                                       | Min                                      | Max                             |      |
| Switching Characteristics |                                       |                                          |                                 |      |
| t <sub>DBGBR</sub>        | SMC0_BG Delay After SMC0_BR           | 2.5 × t <sub>SCLK0</sub>                 | 3.5 × t <sub>SCLK0</sub> + 17.5 | ns   |
| t <sub>ENGDAT</sub>       | DATA Enable After SMC0_BG Deassertion | −3                                       |                                 | ns   |
| t <sub>DBGDAT</sub>       | DATA Disable After SMC0_BG Assertion  |                                          | 3                               | ns   |

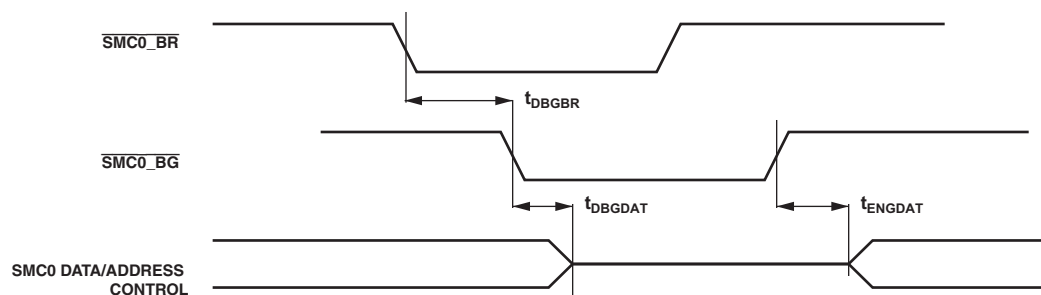
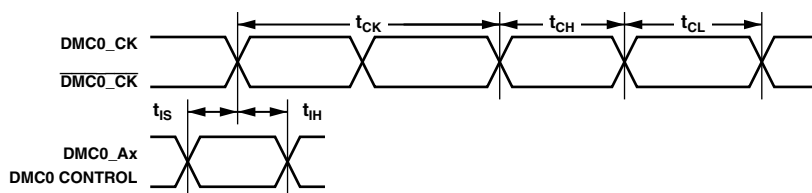


Figure 18. Bus Request/Bus Grant

## DDR2 SDRAM Clock and Control Cycle Timing

Table 36. DDR2 SDRAM Read Cycle Timing,  $V_{DD\_DMC}$  Nominal 1.8 V

| Parameter                 |                                                | 250 MHz |      | Unit            |
|---------------------------|------------------------------------------------|---------|------|-----------------|
|                           |                                                | Min     | Max  |                 |
| Switching Characteristics |                                                |         |      |                 |
| t <sub>CK</sub>           | Clock Cycle Time (CL = 2 Not Supported)        | 4       |      | ns              |
| t <sub>CH</sub>           | Minimum Clock Pulse Width                      | 0.45    | 0.55 | t <sub>CK</sub> |
| t <sub>CL</sub>           | Maximum Clock Pulse Width                      | 0.45    | 0.55 | t <sub>CK</sub> |
| t <sub>IS</sub>           | Control/Address Setup Relative to DMC0_CK Rise | 350     |      | ps              |
| t <sub>IH</sub>           | Control/Address Hold Relative to DMC0_CK Rise  | 475     |      | ps              |



NOTE: CONTROL = DMC0\_CS0, DMC0\_CKE, DMC0\_RAS, DMC0\_CAS, AND DMC0\_WE.  
ADDRESS = DMC0\_A00-13, AND DMC0\_BA0-1.

Figure 19. DDR2 SDRAM Clock and Control Cycle Timing

## DDR2 SDRAM Read Cycle Timing

Table 37. DDR2 SDRAM Read Cycle Timing,  $V_{DD\_DMC}$  Nominal 1.8 V

| Parameter           |                                                                   | 250 MHz <sup>1</sup> |      | Unit            |
|---------------------|-------------------------------------------------------------------|----------------------|------|-----------------|
|                     |                                                                   | Min                  | Max  |                 |
| Timing Requirements |                                                                   |                      |      |                 |
| t <sub>DQSQ</sub>   | DMC0_DQS-DMC0_DQ Skew for DMC0_DQS and Associated DMC0_DQ Signals |                      | 0.35 | ns              |
| t <sub>QH</sub>     | DMC0_DQ, DMC0_DQS Output Hold Time From DMC0_DQS                  | 1.6                  |      | ns              |
| t <sub>RPRE</sub>   | Read Preamble                                                     | 0.9                  |      | t <sub>CK</sub> |
| t <sub>RPST</sub>   | Read Postamble                                                    | 0.4                  |      | t <sub>CK</sub> |

<sup>1</sup> In order to ensure proper operation of the DDR2, all the DDR2 guidelines have to be strictly followed.

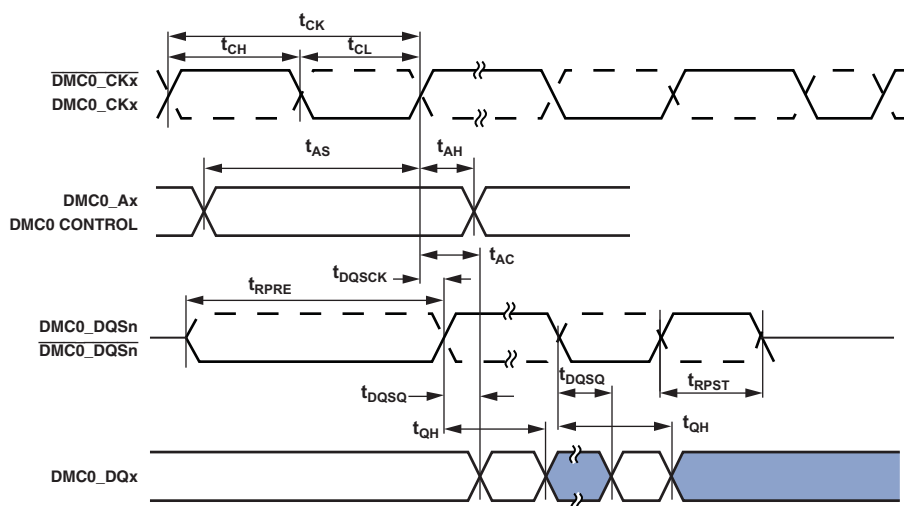


Figure 20. DDR2 SDRAM Controller Input AC Timing

## DDR2 SDRAM Write Cycle Timing

Table 38. DDR2 SDRAM Write Cycle Timing,  $V_{DD\_DMC}$  Nominal 1.8 V

| Parameter                      |                                                                | 250 MHz <sup>1</sup> |      | Unit            |
|--------------------------------|----------------------------------------------------------------|----------------------|------|-----------------|
|                                |                                                                | Min                  | Max  |                 |
| Switching Characteristics      |                                                                |                      |      |                 |
| t <sub>DQSS</sub> <sup>2</sup> | DMC0_DQS Latching Rising Transitions to Associated Clock Edges | −0.15                | 0.15 | t <sub>CK</sub> |
| t <sub>DS</sub>                | Last Data Valid to DMC0_DQS Delay                              | 0.15                 |      | ns              |
| t <sub>DH</sub>                | DMC0_DQS to First Data Invalid Delay                           | 0.3                  |      | ns              |
| t <sub>DSS</sub>               | DMC0_DQS Falling Edge to Clock Setup Time                      | 0.25                 |      | t <sub>CK</sub> |
| t <sub>DSH</sub>               | DMC0_DQS Falling Edge Hold Time From DMC0_CK                   | 0.25                 |      | t <sub>CK</sub> |
| t <sub>DQSH</sub>              | DMC0_DQS Input High Pulse Width                                | 0.35                 |      | t <sub>CK</sub> |
| t <sub>DQSL</sub>              | DMC0_DQS Input Low Pulse Width                                 | 0.35                 |      | t <sub>CK</sub> |
| t <sub>WPRE</sub>              | Write Preamble                                                 | 0.35                 |      | t <sub>CK</sub> |
| t <sub>WPST</sub>              | Write Postamble                                                | 0.4                  |      | t <sub>CK</sub> |
| t <sub>IPW</sub>               | Address and Control Output Pulse Width                         | 0.6                  |      | t <sub>CK</sub> |
| t <sub>DIPW</sub>              | DMC0_DQ and DMC0_DM Output Pulse Width                         | 0.35                 |      | t <sub>CK</sub> |

<sup>1</sup> In order to ensure proper operation of the DDR2, all the DDR2 guidelines have to be strictly followed.

<sup>2</sup> Write command to first DMC0\_DQS delay =  $WL \times t_{CK} + t_{DQSS}$ .

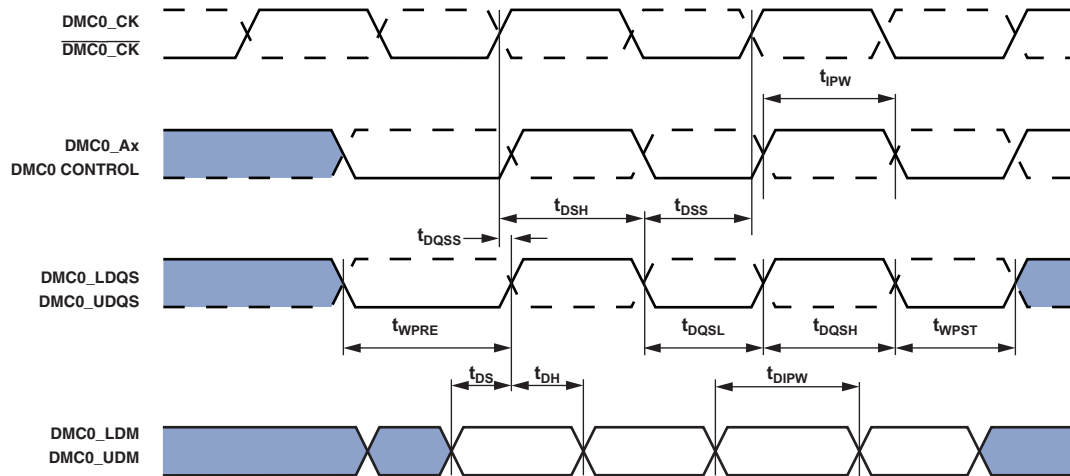


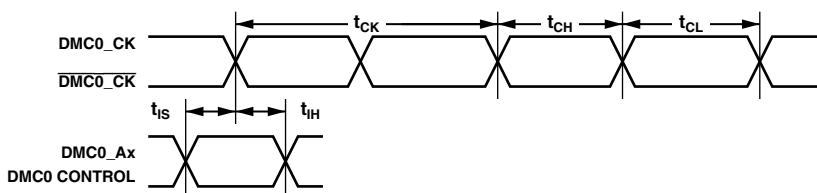
Figure 21. DDR2 SDRAM Controller Output AC Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Mobile DDR SDRAM Clock and Control Cycle Timing

Table 39. Mobile DDR SDRAM Read Cycle Timing,  $V_{DD\_DMC}$  Nominal 1.8 V

| Parameter                 |                                                | 200 MHz |      | Unit            |
|---------------------------|------------------------------------------------|---------|------|-----------------|
|                           |                                                | Min     | Max  |                 |
| Switching Characteristics |                                                |         |      |                 |
| t <sub>CK</sub>           | Clock Cycle Time (CL = 2 Not Supported)        | 5       |      | ns              |
| t <sub>CH</sub>           | Minimum Clock Pulse Width                      | 0.45    | 0.55 | t <sub>CK</sub> |
| t <sub>CL</sub>           | Maximum Clock Pulse Width                      | 0.45    | 0.55 | t <sub>CK</sub> |
| t <sub>IS</sub>           | Control/Address Setup Relative to DMC0_CK Rise | 1       |      | ns              |
| t <sub>IH</sub>           | Control/Address Hold Relative to DMC0_CK Rise  | 1       |      | ns              |



NOTE: CONTROL = DMC0\_CS0, DMC0\_CKE, DMC0\_RAS, DMC0\_CAS, AND DMC0\_WE.  
ADDRESS = DMC0\_A00-13, AND DMC0\_BA0-1.

Figure 22. Mobile DDR SDRAM Clock and Control Cycle Timing

## Mobile DDR SDRAM Read Cycle Timing

Table 40. Mobile DDR SDRAM Read Cycle Timing,  $V_{DD\_DMC}$  Nominal 1.8 V

| Parameter           |                                                                   | 200 MHz |     | Unit            |
|---------------------|-------------------------------------------------------------------|---------|-----|-----------------|
|                     |                                                                   | Min     | Max |                 |
| Timing Requirements |                                                                   |         |     |                 |
| t <sub>QH</sub>     | DMC0_DQ, DMC0_DQS Output Hold Time From DMC0_DQS                  | 1.75    |     | ns              |
| t <sub>DQSQ</sub>   | DMC0_DQS-DMC0_DQ Skew for DMC0_DQS and Associated DMC0_DQ Signals |         | 0.4 | ns              |
| t <sub>RPRE</sub>   | Read Preamble                                                     | 0.9     | 1.1 | t <sub>CK</sub> |
| t <sub>RPST</sub>   | Read Postamble                                                    | 0.4     | 0.6 | t <sub>CK</sub> |

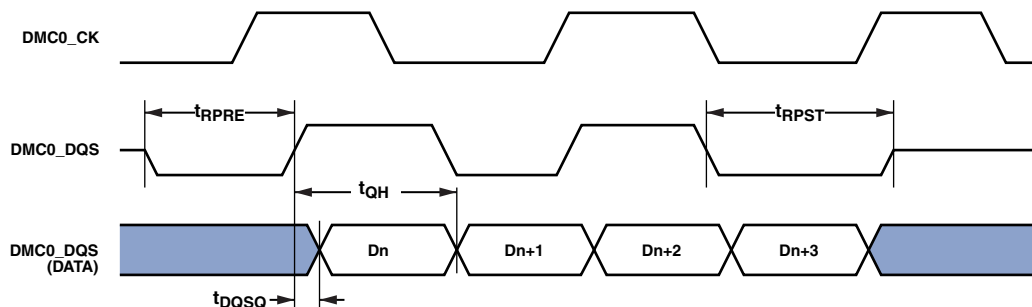


Figure 23. Mobile DDR SDRAM Controller Input AC Timing

## Mobile DDR SDRAM Write Cycle Timing

Table 41. Mobile DDR SDRAM Write Cycle Timing,  $V_{DD\_DMC}$  Nominal 1.8 V

| Parameter                      |                                                                | 200 MHz |      | Unit            |
|--------------------------------|----------------------------------------------------------------|---------|------|-----------------|
|                                |                                                                | Min     | Max  |                 |
| Switching Characteristics      |                                                                |         |      |                 |
| t <sub>DQSS</sub> <sup>1</sup> | DMC0_DQS Latching Rising Transitions to Associated Clock Edges | 0.75    | 1.25 | t <sub>CK</sub> |
| t <sub>DS</sub>                | Last Data Valid to DMC0_DQS Delay (Slew > 1 V/ns)              | 0.48    |      | ns              |
| t <sub>DH</sub>                | DMC0_DQS to First Data Invalid Delay (Slew > 1 V/ns)           | 0.48    |      | ns              |
| t <sub>DSS</sub>               | DMC0_DQS Falling Edge to Clock Setup Time                      | 0.2     |      | t <sub>CK</sub> |
| t <sub>DSH</sub>               | DMC0_DQS Falling Edge Hold Time From DMC0_CK                   | 0.2     |      | t <sub>CK</sub> |
| t <sub>DQSH</sub>              | DMC0_DQS Input High Pulse Width                                | 0.4     |      | t <sub>CK</sub> |
| t <sub>DQSL</sub>              | DMC0_DQS Input Low Pulse Width                                 | 0.4     |      | t <sub>CK</sub> |
| t <sub>WPRE</sub>              | Write Preamble                                                 | 0.25    |      | t <sub>CK</sub> |
| t <sub>WPST</sub>              | Write Postamble                                                | 0.4     |      | t <sub>CK</sub> |
| t <sub>IPW</sub>               | Address and Control Output Pulse Width                         | 2.3     |      | ns              |
| t <sub>DIPW</sub>              | DMC0_DQ and DMC0_DM Output Pulse Width                         | 1.8     |      | ns              |

<sup>1</sup> Write command to first DMC0\_QQS delay =  $WL \times t_{CK} + t_{DQSS}$ .

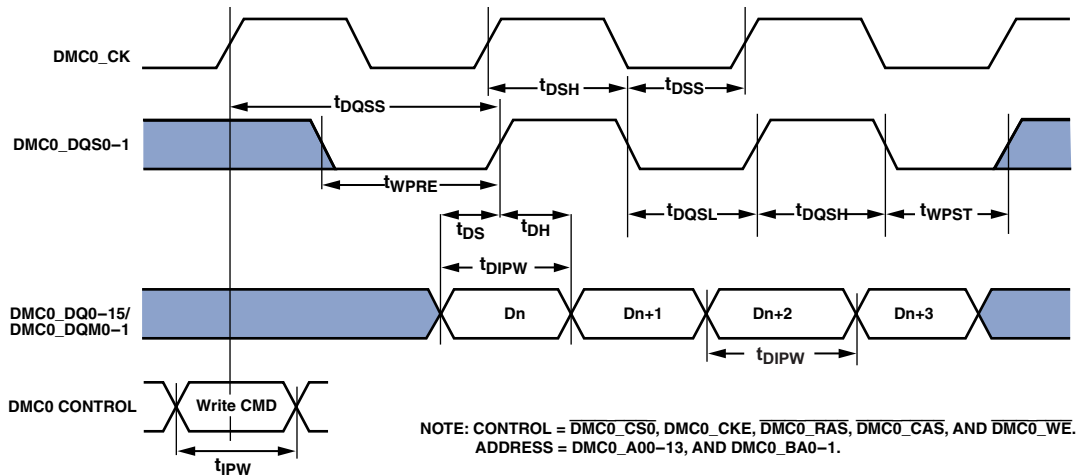


Figure 24. Mobile DDR SDRAM Controller Output AC Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Enhanced Parallel Peripheral Interface Timing

The following tables and figures describe enhanced parallel peripheral interface timing operations. The POLC bits in the EPPI\_CTL register may be used to set the sampling/driving edges of the EPPI clock.

When internally generated, the programmed PPI clock ( $f_{PCLKPROG}$ ) frequency in MHz is set by the following equation where VALUE is a field in the EPPI\_CLKDIV register that can be set from 0 to 65535:

$$f_{PCLKPROG} = \frac{f_{SCLK0}}{(VALUE + 1)}$$

$$t_{PCLKPROG} = \frac{1}{f_{PCLKPROG}}$$

When externally generated the EPPI\_CLK is called  $f_{PCLKEXT}$ :

$$t_{PCLKEXT} = \frac{1}{f_{PCLKEXT}}$$

**Table 42. Enhanced Parallel Peripheral Interface—Internal Clock**

| Parameter                                                                                      | V <sub>DD_EXT</sub><br>1.8V Nominal |     | V <sub>DD_EXT</sub><br>3.3V Nominal |     | Unit |
|------------------------------------------------------------------------------------------------|-------------------------------------|-----|-------------------------------------|-----|------|
|                                                                                                | Min                                 | Max | Min                                 | Max |      |
| Timing Requirements                                                                            |                                     |     |                                     |     |      |
| t <sub>SFSPI</sub> External FS Setup Before EPPI_CLK                                           | 7.9                                 |     | 6.5                                 |     | ns   |
| t <sub>HFSPI</sub> External FS Hold After EPPI_CLK                                             | 0                                   |     | 0                                   |     | ns   |
| t <sub>SDRPI</sub> Receive Data Setup Before EPPI_CLK                                          | 7.9                                 |     | 6.5                                 |     | ns   |
| t <sub>HDRPI</sub> Receive Data Hold After EPPI_CLK                                            | 0                                   |     | 0                                   |     | ns   |
| t <sub>SFS3GI</sub> External FS3 Input Setup Before EPPI_CLK<br>Fall Edge in Clock Gating Mode | 15.4                                |     | 14                                  |     | ns   |
| t <sub>HFS3GI</sub> External FS3 Input Hold Before EPPI_CLK<br>Fall Edge in Clock Gating Mode  | 0                                   |     | 0                                   |     | ns   |
| Switching Characteristics                                                                      |                                     |     |                                     |     |      |
| t <sub>PCLKW</sub> EPPI_CLK Width <sup>1</sup>                                                 | 0.5 × t <sub>PCLKPROG</sub> – 1     |     | 0.5 × t <sub>PCLKPROG</sub> – 1     |     | ns   |
| t <sub>PCLK</sub> EPPI_CLK Period <sup>1</sup>                                                 | t <sub>PCLKPROG</sub> – 1           |     | t <sub>PCLKPROG</sub> – 1           |     | ns   |
| t <sub>DFSPI</sub> Internal FS Delay After EPPI_CLK                                            |                                     | 3.5 |                                     | 3.5 | ns   |
| t <sub>HOFSPI</sub> Internal FS Hold After EPPI_CLK                                            | –0.5                                |     | –0.5                                |     | ns   |
| t <sub>DDTPI</sub> Transmit Data Delay After EPPI_CLK                                          |                                     | 3.5 |                                     | 3.5 | ns   |
| t <sub>HDTPI</sub> Transmit Data Hold After EPPI_CLK                                           | –0.5                                |     | –0.5                                |     | ns   |

<sup>1</sup> See Table 17 on Page 53 in [Clock Related Operating Conditions](#) for details on the minimum period that may be programmed for  $t_{PCLKPROG}$ .

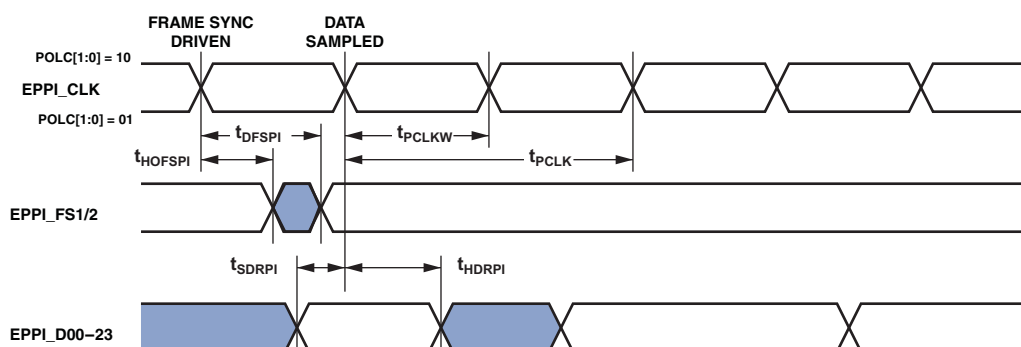


Figure 25. PPI Internal Clock GP Receive Mode with Internal Frame Sync Timing

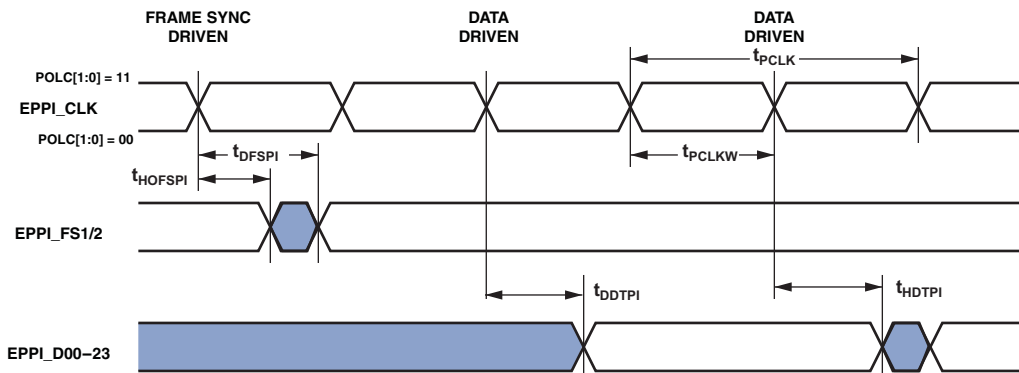


Figure 26. PPI Internal Clock GP Transmit Mode with Internal Frame Sync Timing

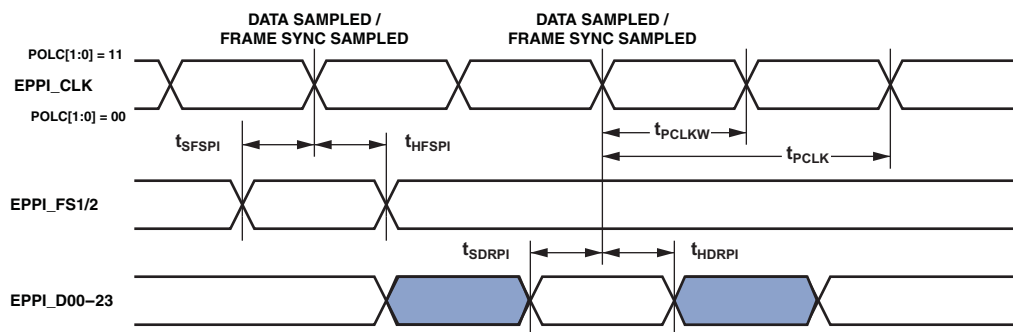


Figure 27. PPI Internal Clock GP Receive Mode with External Frame Sync Timing

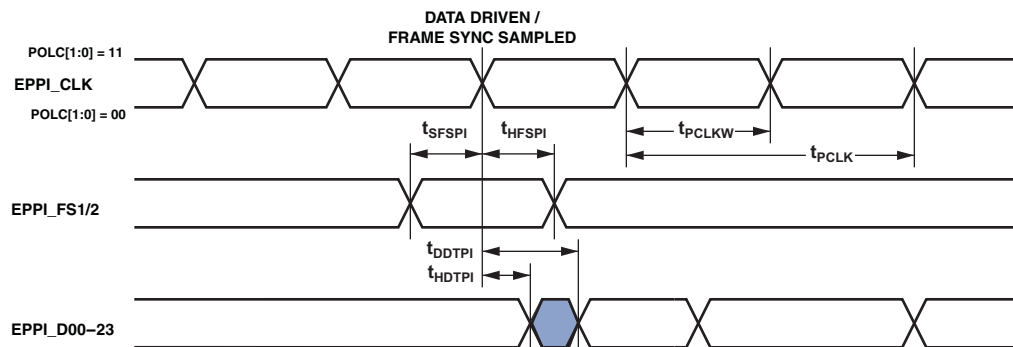


Figure 28. PPI Internal Clock GP Transmit Mode with External Frame Sync Timing

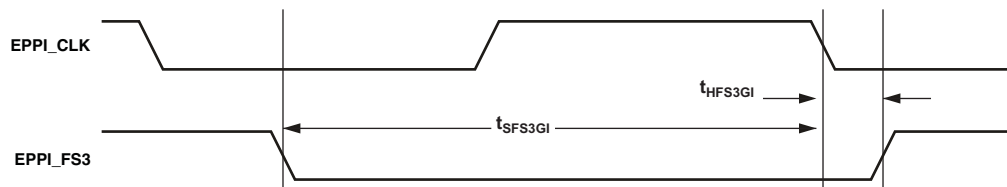


Figure 29. Clock Gating Mode with Internal Clock and External Frame Sync Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

**Table 43. Enhanced Parallel Peripheral Interface—External Clock**

| Parameter                                      | $V_{DD\_EXT}$<br>1.8 V Nominal    |     | $V_{DD\_EXT}$<br>3.3 V Nominal    |     | Unit |
|------------------------------------------------|-----------------------------------|-----|-----------------------------------|-----|------|
|                                                | Min                               | Max | Min                               | Max |      |
| Timing Requirements                            |                                   |     |                                   |     |      |
| $t_{PCLKW}$ EPPI_CLK Width <sup>1</sup>        | $(0.5 \times t_{PCLKEXT}) - 1.25$ |     | $(0.5 \times t_{PCLKEXT}) - 1.25$ |     | ns   |
| $t_{PCLK}$ EPPI_CLK Period <sup>1</sup>        | $t_{PCLKEXT} - 1.25$              |     | $t_{PCLKEXT} - 1.25$              |     | ns   |
| $t_{SFSPE}$ External FS Setup Before EPPI_CLK  | 2                                 |     | 2                                 |     | ns   |
| $t_{HFSPE}$ External FS Hold After EPPI_CLK    | 3.7                               |     | 3.7                               |     | ns   |
| $t_{SDRPE}$ Receive Data Setup Before EPPI_CLK | 2                                 |     | 2                                 |     | ns   |
| $t_{HDRPE}$ Receive Data Hold After EPPI_CLK   | 3.7                               |     | 3.7                               |     | ns   |
| Switching Characteristics                      |                                   |     |                                   |     |      |
| $t_{DFSPE}$ Internal FS Delay After EPPI_CLK   | 20.1                              |     | 15.3                              |     | ns   |
| $t_{HOFSPPE}$ Internal FS Hold After EPPI_CLK  | 2.4                               |     | 2.4                               |     | ns   |
| $t_{DDTPE}$ Transmit Data Delay After EPPI_CLK | 20.1                              |     | 15.3                              |     | ns   |
| $t_{HDTPE}$ Transmit Data Hold After EPPI_CLK  | 2.4                               |     | 2.4                               |     | ns   |

<sup>1</sup> This specification indicates the minimum instantaneous width or period that can be tolerated due to duty cycle variation or jitter on the external EPPI\_CLK. For the external EPPI\_CLK ideal maximum frequency see the  $f_{PCLKEXT}$  specification in [Table 17 on Page 53](#).

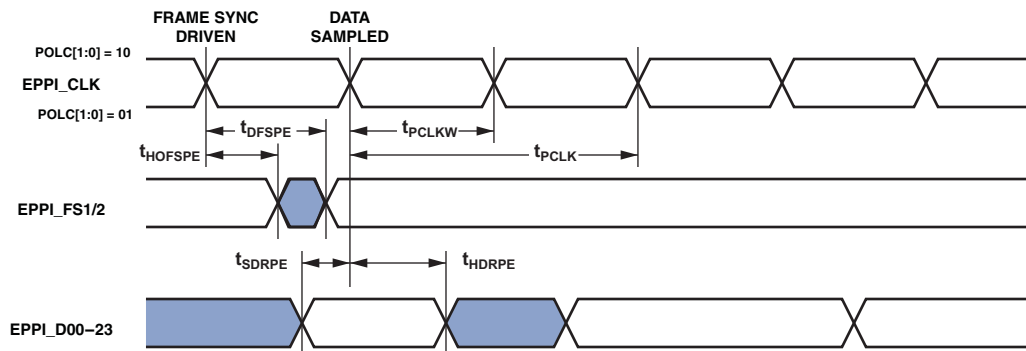


Figure 30. PPI External Clock GP Receive Mode with Internal Frame Sync Timing

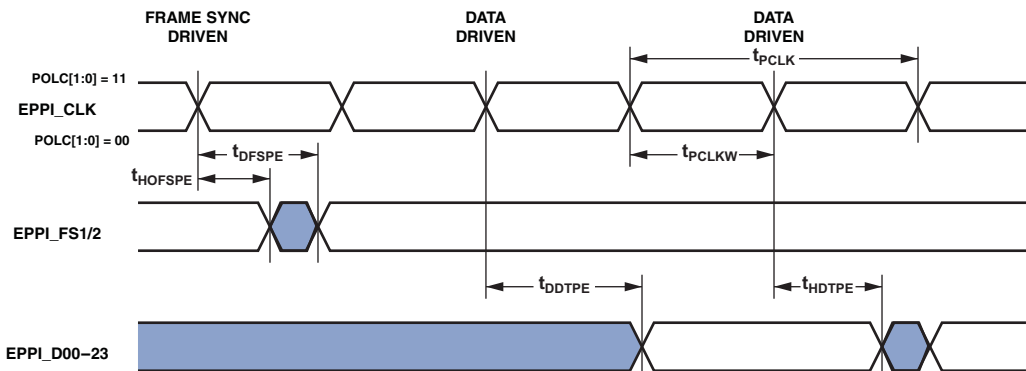


Figure 31. PPI External Clock GP Transmit Mode with Internal Frame Sync Timing

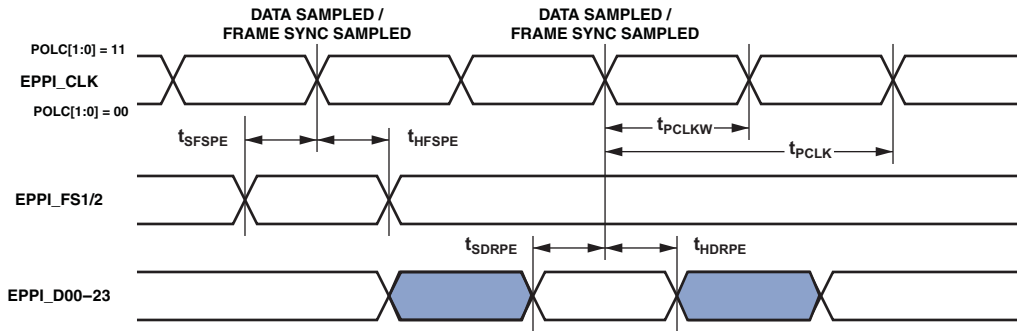


Figure 32. PPI External Clock GP Receive Mode with External Frame Sync Timing

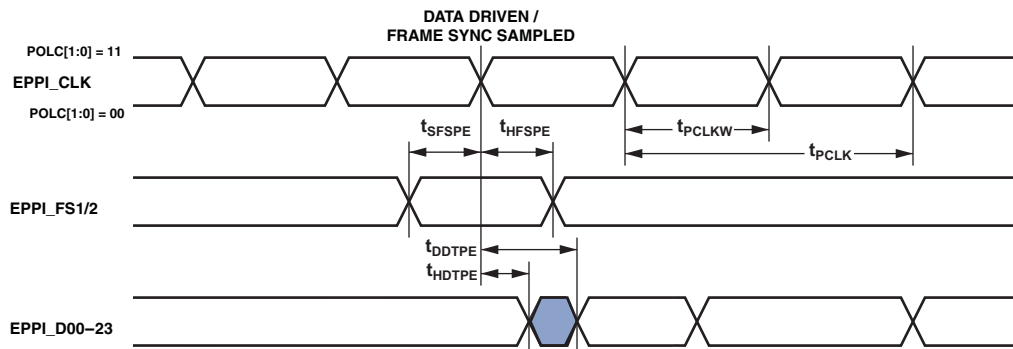


Figure 33. PPI External Clock GP Transmit Mode with External Frame Sync Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Link Ports

In link port receive mode the link port clock is supplied externally and is called  $f_{LCLKREXT}$ :

$$t_{LCLKREXT} = \frac{1}{f_{LCLKREXT}}$$

In link port transmit mode the programmed link port clock ( $f_{LCLKTPROG}$ ) frequency in MHz is set by the following equation where VALUE is a field in the LP\_DIV register that can be set from 1 to 255:

$$f_{LCLKTPROG} = \frac{f_{SCLK0}}{(VALUE \times 2)}$$

In the case where VALUE = 0,  $f_{LCLKTPROG} = f_{SCLK0}$ . For all settings of VALUE the following equation also holds:

$$t_{LCLKTPROG} = \frac{1}{f_{LCLKTPROG}}$$

Calculation of link receiver data setup and hold relative to link clock is required to determine the maximum allowable skew that can be introduced in the transmission path length difference between LP\_Dx (data) and LP\_CLK. Setup skew is the maximum delay that can be introduced in LP\_Dx relative to LP\_CLK:

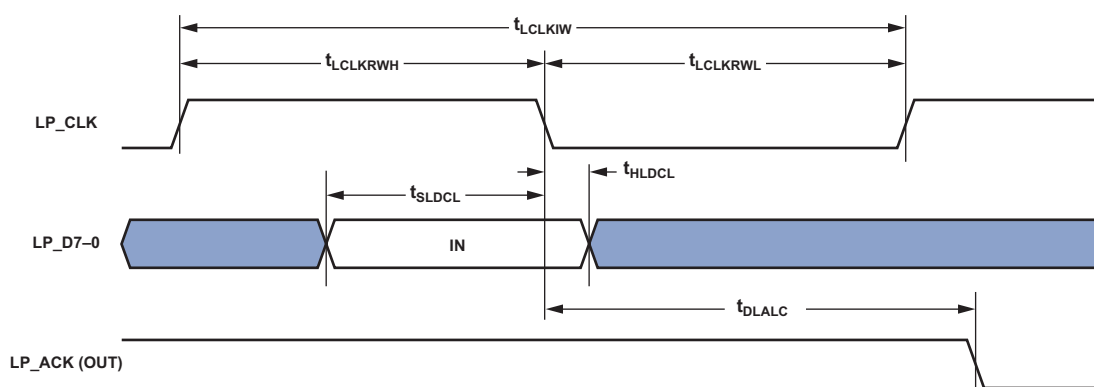
(setup skew =  $t_{LCLKTWH} \text{ min} - t_{DLDCH} - t_{SLDCL}$ ). Hold skew is the maximum delay that can be introduced in LP\_CLK relative to LP\_Dx: (hold skew =  $t_{LCLKTWL} \text{ min} - t_{HLDCH} - t_{HLDCL}$ ).

**Table 44. Link Ports—Receive**

| Parameter                | V <sub>DD_EXT</sub><br>1.8V Nominal/3.3V Nominal |                                      | Unit                          |    |
|--------------------------|--------------------------------------------------|--------------------------------------|-------------------------------|----|
|                          | Min                                              | Max                                  |                               |    |
| Timing Requirements      |                                                  |                                      |                               |    |
| t <sub>SLDCL</sub>       | Data Setup Before LP_CLK Low                     | 2                                    | ns                            |    |
| t <sub>HLDCL</sub>       | Data Hold After LP_CLK Low                       | 3                                    | ns                            |    |
| t <sub>LCLKIW</sub>      | LP_CLK Period <sup>1</sup>                       | t <sub>LCLKREXT</sub> – 1.5          | ns                            |    |
| t <sub>LCLKRWL</sub>     | LP_CLK Width Low <sup>1</sup>                    | (0.5 × t <sub>LCLKREXT</sub> ) – 1.5 | ns                            |    |
| t <sub>LCLKRWH</sub>     | LP_CLK Width High <sup>1</sup>                   | (0.5 × t <sub>LCLKREXT</sub> ) – 1.5 | ns                            |    |
| Switching Characteristic |                                                  |                                      |                               |    |
| t <sub>DIALC</sub>       | LP_ACK Low Delay After LP_CLK Low <sup>2</sup>   | 1.5 × t <sub>SC1K0</sub> + 4         | 2.5 × t <sub>SC1K0</sub> + 12 | ns |

<sup>1</sup> This specification indicates the minimum instantaneous width or period that can be tolerated due to duty cycle variation or jitter on the external LP\_CLK. For the external LP\_CLK ideal maximum frequency see the  $f_{LCLKREXT}$  specification in [Table 17 on Page 53](#) in [Clock Related Operating Conditions](#).

<sup>2</sup> LP\_ACK goes low with  $t_{DLALC}$  relative to rise of LP\_CLK after first byte, but does not go low if the receiver's link buffer is not about to fill.

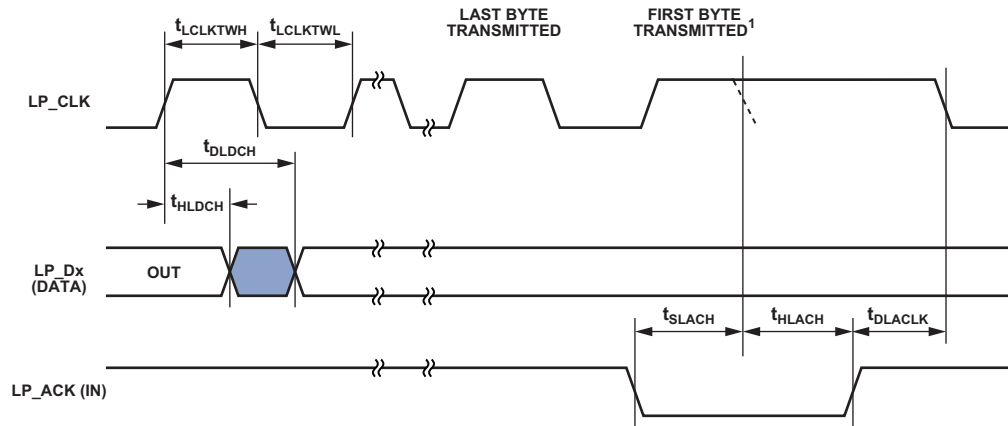


**Figure 34. Link Ports—Receive**

Table 45. Link Ports—Transmit

| Parameter                                             | V <sub>DD_EXT</sub><br>1.8 V Nominal |                                                    | V <sub>DD_EXT</sub><br>3.3 V Nominal |                                                    | Unit |
|-------------------------------------------------------|--------------------------------------|----------------------------------------------------|--------------------------------------|----------------------------------------------------|------|
|                                                       | Min                                  | Max                                                | Min                                  | Max                                                |      |
| Timing Requirements                                   |                                      |                                                    |                                      |                                                    |      |
| t <sub>SLACH</sub> LP_ACK Setup Before LP_CLK Low     | 2 × t <sub>SCLK0</sub> + 17.5        |                                                    | 2 × t <sub>SCLK0</sub> + 13.5        |                                                    | ns   |
| t <sub>HLACH</sub> LP_ACK Hold After LP_CLK Low       | 0                                    |                                                    | 0                                    |                                                    | ns   |
| Switching Characteristics                             |                                      |                                                    |                                      |                                                    |      |
| t <sub>DLDCH</sub> Data Delay After LP_CLK High       | 2.5                                  |                                                    | 2.5                                  |                                                    | ns   |
| t <sub>HLDCH</sub> Data Hold After LP_CLK High        | −1.5                                 |                                                    | −1.5                                 |                                                    | ns   |
| t <sub>LCLKTWL</sub> <sup>1</sup> LP_CLK Width Low    | 0.4 × t <sub>LCLKTPROG</sub>         | 0.6 × t <sub>LCLKTPROG</sub>                       | 0.4 × t <sub>LCLKTPROG</sub>         | 0.6 × t <sub>LCLKTPROG</sub>                       | ns   |
| t <sub>LCLKTWH</sub> <sup>1</sup> LP_CLK Width High   | 0.4 × t <sub>LCLKTPROG</sub>         | 0.6 × t <sub>LCLKTPROG</sub>                       | 0.4 × t <sub>LCLKTPROG</sub>         | 0.6 × t <sub>LCLKTPROG</sub>                       | ns   |
| t <sub>LCLKTW</sub> <sup>1</sup> LP_CLK Period        | t <sub>LCLKTPROG</sub> − 1.2         |                                                    | t <sub>LCLKTPROG</sub> − 1.2         |                                                    | ns   |
| t <sub>DLACK</sub> LP_CLK Low Delay After LP_ACK High | t <sub>SCLK0</sub> + 4               | (2 × t <sub>SCLK0</sub> ) + t <sub>LCLK</sub> + 10 | t <sub>SCLK0</sub> + 4               | (2 × t <sub>SCLK0</sub> ) + t <sub>LCLK</sub> + 10 | ns   |

<sup>1</sup> See Table 17 on Page 53 in Clock Related Operating Conditions for details on the minimum period that may be programmed for  $t_{LCLKTPROG}$ .



#### NOTES

The  $t_{SLACH}$  and  $t_{HLACH}$  specifications apply only to the LP\_ACK falling edge. If these specifications are met, LP\_CLK would extend and the dotted LP\_CLK falling edge would not occur as shown. The position of the dotted falling edge can be calculated using the  $t_{LCLKTWH}$  specification.  $t_{LCLKTWH}$  Min should be used for  $t_{SLACH}$  and  $t_{LCLKTWL}$  Max for  $t_{HLACH}$ .

Figure 35. Link Ports—Transmit

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Serial Ports

To determine whether communication is possible between two devices at clock speed  $n$ , the following specifications must be confirmed: 1) frame sync delay and frame sync setup and hold, 2) data delay and data setup and hold, and 3) serial clock (SPT\_CLK) width. In [Figure 36](#) either the rising edge or the falling edge of SPT\_CLK (external or internal) can be used as the active sampling edge.

When externally generated the SPORT clock is called  $f_{SPTCLKEXT}$ :

$$t_{SPTCLKEXT} = \frac{1}{f_{SPTCLKEXT}}$$

When internally generated, the programmed SPORT clock ( $f_{SPTCLKPROG}$ ) frequency in MHz is set by the following equation where CLKDIV is a field in the SPORT\_DIV register that can be set from 0 to 65535:

$$f_{SPTCLKPROG} = \frac{f_{SCLK1}}{(CLKDIV + 1)}$$

$$t_{SPTCLKPROG} = \frac{1}{f_{SPTCLKPROG}}$$

**Table 46. Serial Ports—External Clock**

| Parameter                 |                                                                                                                      | V <sub>DD_EXT</sub><br>1.8V Nominal   |      | V <sub>DD_EXT</sub><br>3.3V Nominal   |      | Unit |
|---------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------|------|---------------------------------------|------|------|
|                           |                                                                                                                      | Min                                   | Max  | Min                                   | Max  |      |
| Timing Requirements       |                                                                                                                      |                                       |      |                                       |      |      |
| t <sub>SFSE</sub>         | Frame Sync Setup Before SPT_CLK<br>(Externally Generated Frame Sync in either Transmit or Receive Mode) <sup>1</sup> | 2                                     |      | 2                                     |      | ns   |
| t <sub>HFSE</sub>         | Frame Sync Hold After SPT_CLK<br>(Externally Generated Frame Sync in either Transmit or Receive Mode) <sup>1</sup>   | 2.7                                   |      | 2.7                                   |      | ns   |
| t <sub>SDRE</sub>         | Receive Data Setup Before Receive SPT_CLK <sup>1</sup>                                                               | 2                                     |      | 2                                     |      | ns   |
| t <sub>HDRE</sub>         | Receive Data Hold After SPT_CLK <sup>1</sup>                                                                         | 2.7                                   |      | 2.7                                   |      | ns   |
| t <sub>SCLKW</sub>        | SPT_CLK Width <sup>2</sup>                                                                                           | (0.5 × t <sub>SPTCLKEXT</sub> ) – 1.5 |      | (0.5 × t <sub>SPTCLKEXT</sub> ) – 1.5 |      | ns   |
| t <sub>SPTCLK</sub>       | SPT_CLK Period <sup>2</sup>                                                                                          | t <sub>SPTCLKEXT</sub> – 1.5          |      | t <sub>SPTCLKEXT</sub> – 1.5          |      | ns   |
| Switching Characteristics |                                                                                                                      |                                       |      |                                       |      |      |
| t <sub>DFSE</sub>         | Frame Sync Delay After SPT_CLK<br>(Internally Generated Frame Sync in either Transmit or Receive Mode) <sup>3</sup>  |                                       | 19.3 |                                       | 14.5 | ns   |
| t <sub>HOFSE</sub>        | Frame Sync Hold After SPT_CLK<br>(Internally Generated Frame Sync in either Transmit or Receive Mode) <sup>3</sup>   | 2                                     |      | 2                                     |      | ns   |
| t <sub>DDTE</sub>         | Transmit Data Delay After Transmit SPT_CLK <sup>3</sup>                                                              |                                       | 18.8 |                                       | 14   | ns   |
| t <sub>HDTE</sub>         | Transmit Data Hold After Transmit SPT_CLK <sup>3</sup>                                                               | 2                                     |      | 2                                     |      | ns   |

<sup>1</sup> Referenced to sample edge.

<sup>2</sup> This specification indicates the minimum instantaneous width or period that can be tolerated due to duty cycle variation or jitter on the external SPT\_CLK. For the external SPT\_CLK ideal maximum frequency see the  $f_{SPTCLKEXT}$  specification in [Table 17 on Page 53](#) in [Clock Related Operating Conditions](#).

<sup>3</sup> Referenced to drive edge.

Table 47. Serial Ports—Internal Clock

| Parameter                 |                                                                                                                   | V <sub>DD_EXT</sub><br>1.8V Nominal |     | V <sub>DD_EXT</sub><br>3.3V Nominal |     | Unit |
|---------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----|-------------------------------------|-----|------|
|                           |                                                                                                                   | Min                                 | Max | Min                                 | Max |      |
| Timing Requirements       |                                                                                                                   |                                     |     |                                     |     |      |
| t <sub>SFSI</sub>         | Frame Sync Setup Before SPT_CLK (Externally Generated Frame Sync in either Transmit or Receive Mode) <sup>1</sup> | 16.8                                |     | 12                                  |     | ns   |
| t <sub>HFSI</sub>         | Frame Sync Hold After SPT_CLK (Externally Generated Frame Sync in either Transmit or Receive Mode) <sup>1</sup>   | 0                                   |     | −0.5                                |     | ns   |
| t <sub>SDRI</sub>         | Receive Data Setup Before SPT_CLK <sup>1</sup>                                                                    | 4.8                                 |     | 3.4                                 |     | ns   |
| t <sub>HDRI</sub>         | Receive Data Hold After SPT_CLK <sup>1</sup>                                                                      | 1.5                                 |     | 1.5                                 |     | ns   |
| Switching Characteristics |                                                                                                                   |                                     |     |                                     |     |      |
| t <sub>DFSI</sub>         | Frame Sync Delay After SPT_CLK (Internally Generated Frame Sync in Transmit or Receive Mode) <sup>2</sup>         |                                     | 3.5 |                                     | 3.5 | ns   |
| t <sub>HOFSI</sub>        | Frame Sync Hold After SPT_CLK (Internally Generated Frame Sync in Transmit or Receive Mode) <sup>2</sup>          | −1                                  |     | −1                                  |     | ns   |
| t <sub>DDTI</sub>         | Transmit Data Delay After SPT_CLK <sup>2</sup>                                                                    |                                     | 3.5 |                                     | 3.5 | ns   |
| t <sub>HDTI</sub>         | Transmit Data Hold After SPT_CLK <sup>2</sup>                                                                     | −1                                  |     | −1                                  |     | ns   |
| t <sub>SCLKIW</sub>       | SPT_CLK Width <sup>3</sup>                                                                                        | 0.5 × t <sub>SPTCLKPROG</sub> − 1.5 |     | 0.5 × t <sub>SPTCLKPROG</sub> − 1.5 |     | ns   |
| t <sub>SPTCLK</sub>       | SPT_CLK Period <sup>3</sup>                                                                                       | t <sub>SPTCLKPROG</sub> − 1.5       |     | t <sub>SPTCLKPROG</sub> − 1.5       |     | ns   |

<sup>1</sup> Referenced to the sample edge.<sup>2</sup> Referenced to drive edge.<sup>3</sup> See Table 17 on Page 53 in [Clock Related Operating Conditions](#) for details on the minimum period that may be programmed for  $t_{SPTCLKPROG}$ .

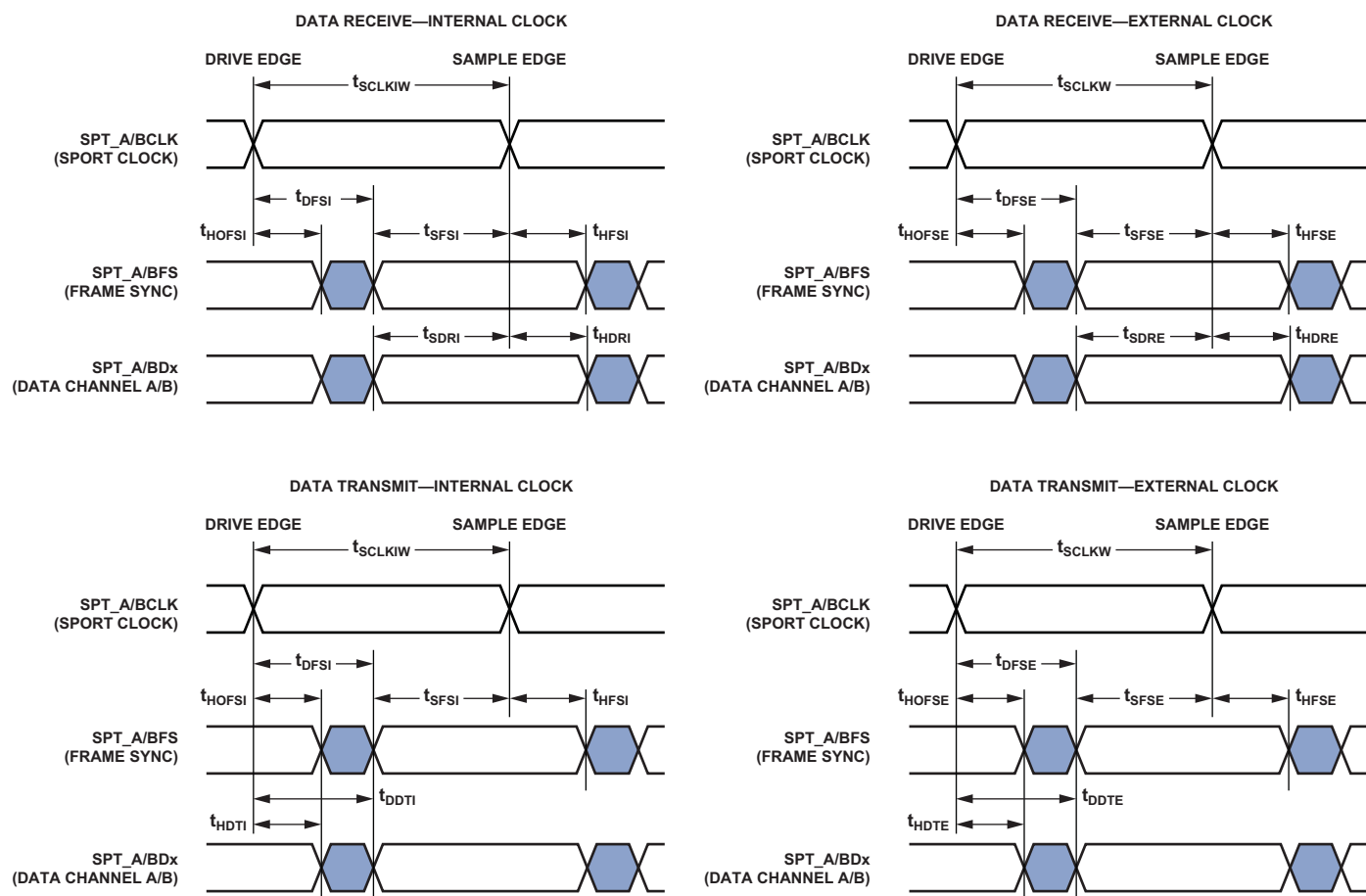


Figure 36. Serial Ports

**Table 48. Serial Ports—Enable and Three-State**

| Parameter                 |                                                          | V <sub>DD_EXT</sub><br>1.8V Nominal |      | V <sub>DD_EXT</sub><br>3.3V Nominal |     | Unit |
|---------------------------|----------------------------------------------------------|-------------------------------------|------|-------------------------------------|-----|------|
|                           |                                                          | Min                                 | Max  | Min                                 | Max |      |
| Switching Characteristics |                                                          |                                     |      |                                     |     |      |
| t <sub>DDTEN</sub>        | Data Enable from External Transmit SPT_CLK <sup>1</sup>  | 1                                   |      | 1                                   |     | ns   |
| t <sub>DDTTE</sub>        | Data Disable from External Transmit SPT_CLK <sup>1</sup> |                                     | 18.8 |                                     | 14  | ns   |
| t <sub>DDTIN</sub>        | Data Enable from Internal Transmit SPT_CLK <sup>1</sup>  | −1                                  |      | −1                                  |     | ns   |
| t <sub>DDTTI</sub>        | Data Disable from Internal Transmit SPT_CLK <sup>1</sup> |                                     | 2.8  |                                     | 2.8 | ns   |

<sup>1</sup> Referenced to drive edge.

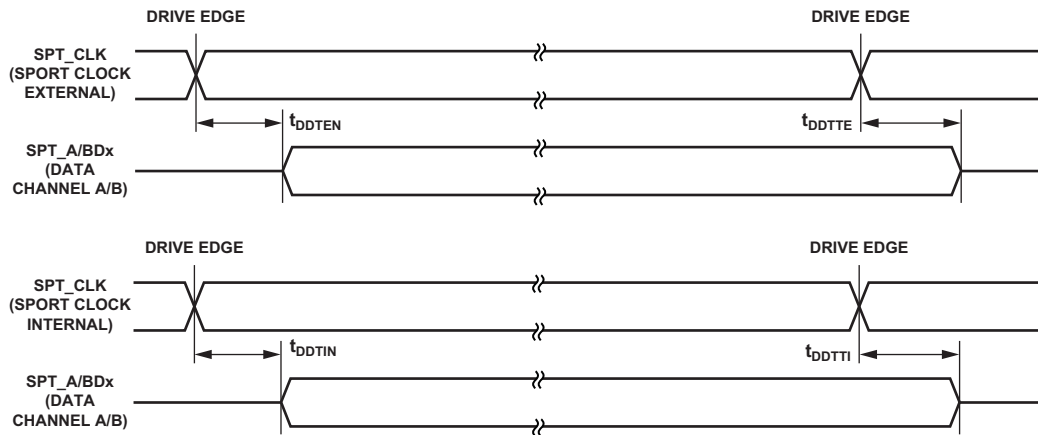


Figure 37. Serial Ports—Enable and Three-State

The SPT\_TDV output signal becomes active in SPORT multi-channel mode. During transmit slots (enabled with active channel selection registers) the SPT\_TDV is asserted for communication with external devices.

Table 49. Serial Ports—TDV (Transmit Data Valid)

| Parameter                 |                                                                         | V <sub>DD_EXT</sub><br>1.8V Nominal |      | V <sub>DD_EXT</sub><br>3.3V Nominal |     | Unit |
|---------------------------|-------------------------------------------------------------------------|-------------------------------------|------|-------------------------------------|-----|------|
|                           |                                                                         | Min                                 | Max  | Min                                 | Max |      |
| Switching Characteristics |                                                                         |                                     |      |                                     |     |      |
| t <sub>DRDVEN</sub>       | Data-Valid Enable Delay from Drive Edge of External Clock <sup>1</sup>  | 2                                   |      | 2                                   |     | ns   |
| t <sub>DFDVEN</sub>       | Data-Valid Disable Delay from Drive Edge of External Clock <sup>1</sup> |                                     | 18.8 |                                     | 14  | ns   |
| t <sub>DRDVIN</sub>       | Data-Valid Enable Delay from Drive Edge of Internal Clock <sup>1</sup>  | –1                                  |      | –1                                  |     | ns   |
| t <sub>DFDVIN</sub>       | Data-Valid Disable Delay from Drive Edge of Internal Clock <sup>1</sup> |                                     | 3.5  |                                     | 3.5 | ns   |

<sup>1</sup> Referenced to drive edge.

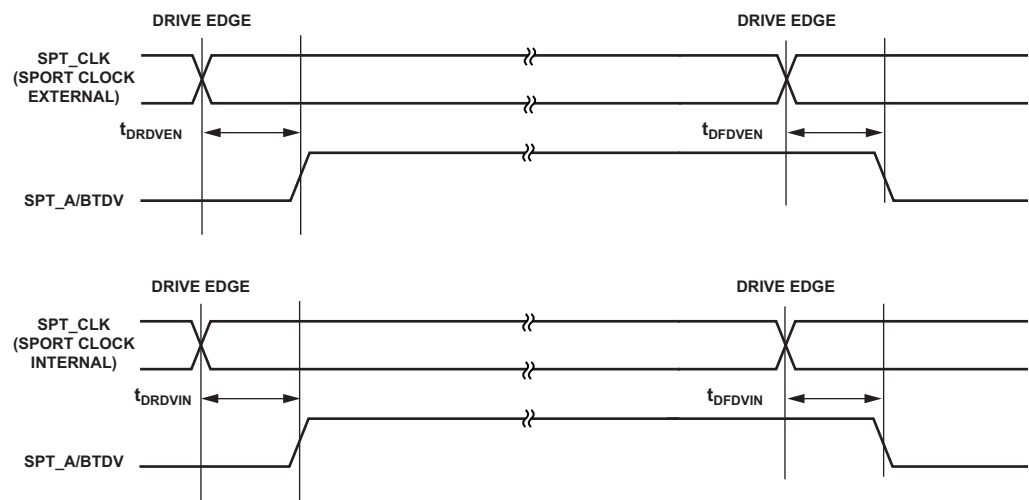


Figure 38. Serial Ports—Transmit Data Valid Internal and External Clock

**Table 50. Serial Ports—External Late Frame Sync**

| Parameter                 |                                                                                                                     | V <sub>DD_EXT</sub><br>1.8V Nominal |      | V <sub>DD_EXT</sub><br>3.3V Nominal |     | Unit |
|---------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------|------|-------------------------------------|-----|------|
|                           |                                                                                                                     | Min                                 | Max  | Min                                 | Max |      |
| Switching Characteristics |                                                                                                                     |                                     |      |                                     |     |      |
| t <sub>DDTLFSE</sub>      | Data Delay from Late External Transmit Frame Sync or External Receive Frame Sync with MCE = 1, MFD = 0 <sup>1</sup> |                                     | 18.8 |                                     | 14  | ns   |
| t <sub>DDTENFS</sub>      | Data Enable for MCE = 1, MFD = 0 <sup>1</sup>                                                                       | 0.5                                 |      | 0.5                                 |     | ns   |

<sup>1</sup> The t<sub>DDTLFSE</sub> and t<sub>DDTENFS</sub> parameters apply to left-justified as well as standard serial mode, and MCE = 1, MFD = 0.

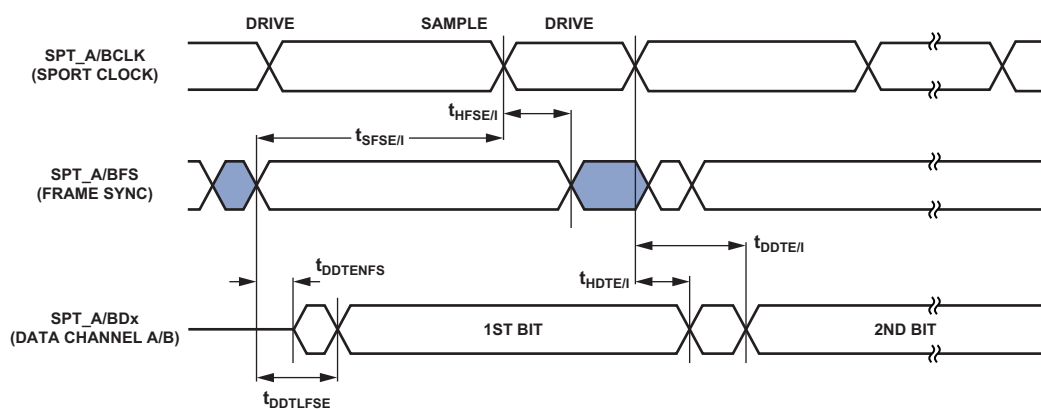


Figure 39. External Late Frame Sync

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Serial Peripheral Interface (SPI) Port—Master Timing

Table 51 and Figure 40 describe SPI port master operations.

When internally generated, the programmed SPI clock ( $f_{SPICLKPROG}$ ) frequency in MHz is set by the following equation where BAUD is a field in the SPI\_CLK register that can be set from 0 to 65535:

$$f_{SPICLKPROG} = \frac{f_{SCLK1}}{(BAUD + 1)}$$

$$t_{SPICLKPROG} = \frac{1}{f_{SPICLKPROG}}$$

Note that:

- In dual mode data transmit the SPI\_MISO signal is also an output.
- In quad mode data transmit the SPI\_MISO, SPI\_D2, and SPI\_D3 signals are also outputs.
- In dual mode data receive the SPI\_MOSI signal is also an input.
- In quad mode data receive the SPI\_MOSI, SPI\_D2, and SPI\_D3 signals are also inputs.
- To add additional frame delays see the documentation for the SPI\_DLY register in the hardware reference manual.

**Table 51. Serial Peripheral Interface (SPI) Port—Master Timing**

| Parameter                 | V <sub>DD_EXT</sub><br>1.8V Nominal                    |                                          | V <sub>DD_EXT</sub><br>3.3V Nominal      |     | Unit |
|---------------------------|--------------------------------------------------------|------------------------------------------|------------------------------------------|-----|------|
|                           | Min                                                    | Max                                      | Min                                      | Max |      |
| Timing Requirements       |                                                        |                                          |                                          |     |      |
| t <sub>SSPIDM</sub>       | Data Input Valid to SPI_CLK Edge (Data Input Setup)    | 4.6                                      | 3.2                                      |     | ns   |
| t <sub>HSPIDM</sub>       | SPI_CLK Sampling Edge to Data Input Invalid            | 1.3                                      | 1.3                                      |     | ns   |
| Switching Characteristics |                                                        |                                          |                                          |     |      |
| t <sub>SDSCIM</sub>       | $\overline{\text{SPI\_SEL}}$ low to First SPI_CLK Edge | $0.5 \times t_{\text{SCLK1}} - 2$        | $0.5 \times t_{\text{SCLK1}} - 2$        |     | ns   |
| t <sub>SPICHM</sub>       | SPI_CLK High Period <sup>1</sup>                       | $0.5 \times t_{\text{SPICLKPROG}} - 1.5$ | $0.5 \times t_{\text{SPICLKPROG}} - 1.5$ |     | ns   |
| t <sub>SPICLM</sub>       | SPI_CLK Low Period <sup>1</sup>                        | $0.5 \times t_{\text{SPICLKPROG}} - 1.5$ | $0.5 \times t_{\text{SPICLKPROG}} - 1.5$ |     | ns   |
| t <sub>SPICLK</sub>       | SPI_CLK Period <sup>1</sup>                            | $t_{\text{SPICLKPROG}} - 1.5$            | $t_{\text{SPICLKPROG}} - 1.5$            |     | ns   |
| t <sub>HDSM</sub>         | Last SPI_CLK Edge to $\overline{\text{SPI\_SEL}}$ High | $(0.5 \times t_{\text{SCLK1}}) - 1.5$    | $(0.5 \times t_{\text{SCLK1}}) - 1.5$    |     | ns   |
| t <sub>SPITDM</sub>       | Sequential Transfer Delay                              | $t_{\text{SCLK1}} - 1.5$                 | $t_{\text{SCLK1}} - 1.5$                 |     | ns   |
| t <sub>DDSPIDM</sub>      | SPI_CLK Edge to Data Out Valid (Data Out Delay)        | 2.6                                      |                                          | 2.6 | ns   |
| t <sub>HDDSPIDM</sub>     | SPI_CLK Edge to Data Out Invalid (Data Out Hold)       | −1                                       | −1                                       |     | ns   |

<sup>1</sup> See Table 17 on Page 53 in [Clock Related Operating Conditions](#) for details on the minimum period that may be programmed for t<sub>SPICLKPROG</sub>.

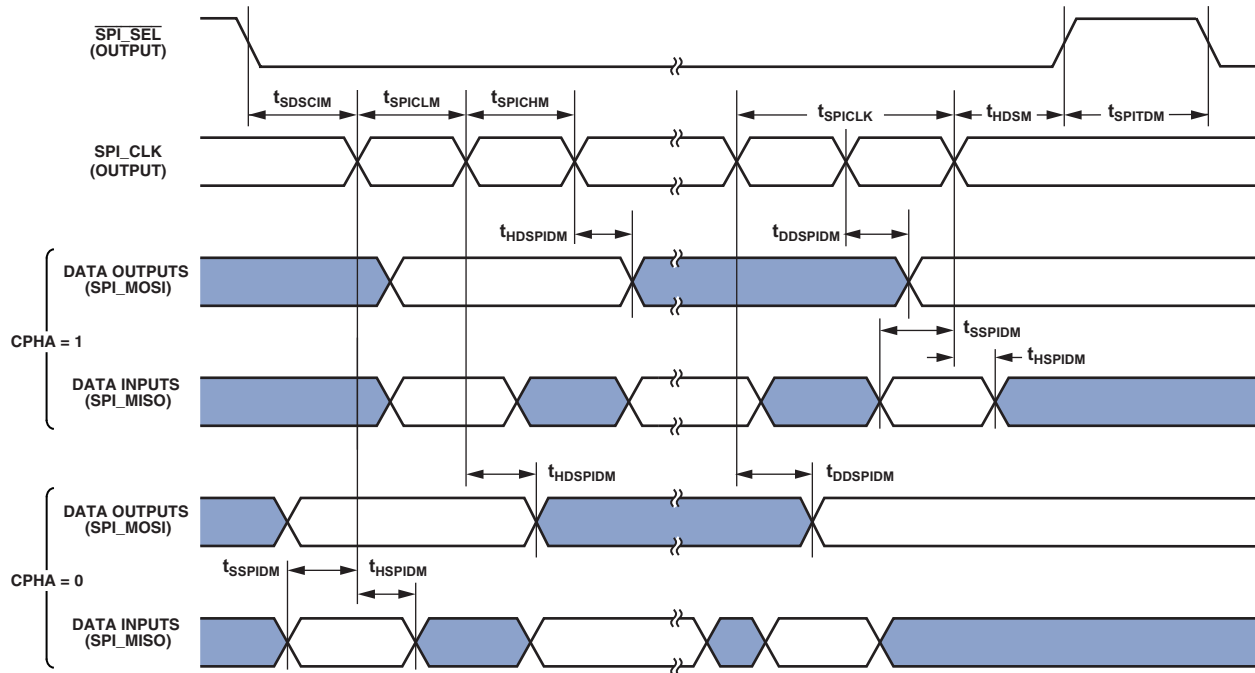


Figure 40. Serial Peripheral Interface (SPI) Port—Master Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Serial Peripheral Interface (SPI) Port—Slave Timing

Table 52 and Figure 41 describe SPI port slave operations. Note that:

- In dual mode data transmit the SPI\_MOSI signal is also an output.
- In quad mode data transmit the SPI\_MOSI, SPI\_D2, and SPI\_D3 signals are also outputs.
- In dual mode data receive the SPI\_MISO signal is also an input.

- In quad mode data receive the SPI\_MISO, SPI\_D2, and SPI\_D3 signals are also inputs.
- In SPI slave mode the SPI clock is supplied externally and is called  $f_{SPICLKEXT}$ :

$$t_{SPICLKEXT} = \frac{1}{f_{SPICLKEXT}}$$

Table 52. Serial Peripheral Interface (SPI) Port—Slave Timing

| Parameter                 | $V_{DD\_EXT}$<br>1.8V Nominal                           |     | $V_{DD\_EXT}$<br>3.3V Nominal         |      | Unit |
|---------------------------|---------------------------------------------------------|-----|---------------------------------------|------|------|
|                           | Min                                                     | Max | Min                                   | Max  |      |
| Timing Requirements       |                                                         |     |                                       |      |      |
| t <sub>SPICHS</sub>       | SPI_CLK High Period <sup>1</sup>                        |     | (0.5 × t <sub>SPICLKEXT</sub> ) – 1.5 |      | ns   |
| t <sub>SPICLS</sub>       | SPI_CLK Low Period <sup>1</sup>                         |     | (0.5 × t <sub>SPICLKEXT</sub> ) – 1.5 |      | ns   |
| t <sub>SPICLK</sub>       | SPI_CLK Period <sup>1</sup>                             |     | t <sub>SPICLKEXT</sub> – 1.5          |      | ns   |
| t <sub>HDS</sub>          | Last SPI_CLK Edge to $\overline{SPI\_SS}$ Not Asserted  |     | 5                                     |      | ns   |
| t <sub>SPITDS</sub>       | Sequential Transfer Delay                               |     | 0.5 × t <sub>SPICLK</sub> – 1.5       |      | ns   |
| t <sub>SDSCI</sub>        | $\overline{SPI\_SS}$ Assertion to First SPI_CLK Edge    |     | 10.5                                  |      | ns   |
| t <sub>SSPID</sub>        | Data Input Valid to SPI_CLK Edge (Data Input Setup)     |     | 2.0                                   |      | ns   |
| t <sub>HSPID</sub>        | SPI_CLK Sampling Edge to Data Input Invalid             |     | 1.6                                   |      | ns   |
| Switching Characteristics |                                                         |     |                                       |      |      |
| t <sub>DSOE</sub>         | $\overline{SPI\_SS}$ Assertion to Data Out Active       |     | 0                                     | 18.8 | ns   |
| t <sub>DSDHI</sub>        | $\overline{SPI\_SS}$ Deassertion to Data High Impedance |     | 0                                     | 16.3 | ns   |
| t <sub>DDSPID</sub>       | SPI_CLK Edge to Data Out Valid (Data Out Delay)         |     |                                       | 18.8 | ns   |
| t <sub>HDSPID</sub>       | SPI_CLK Edge to Data Out Invalid (Data Out Hold)        |     | 1.5                                   |      | ns   |

<sup>1</sup> This specification indicates the minimum instantaneous width or period that can be tolerated due to duty cycle variation or jitter on the external SPI\_CLK. For the external SPI\_CLK ideal maximum frequency see the  $f_{SPICLKEXT}$  specification in the [Clock Related Operating Conditions](#) table on [Page 53](#).

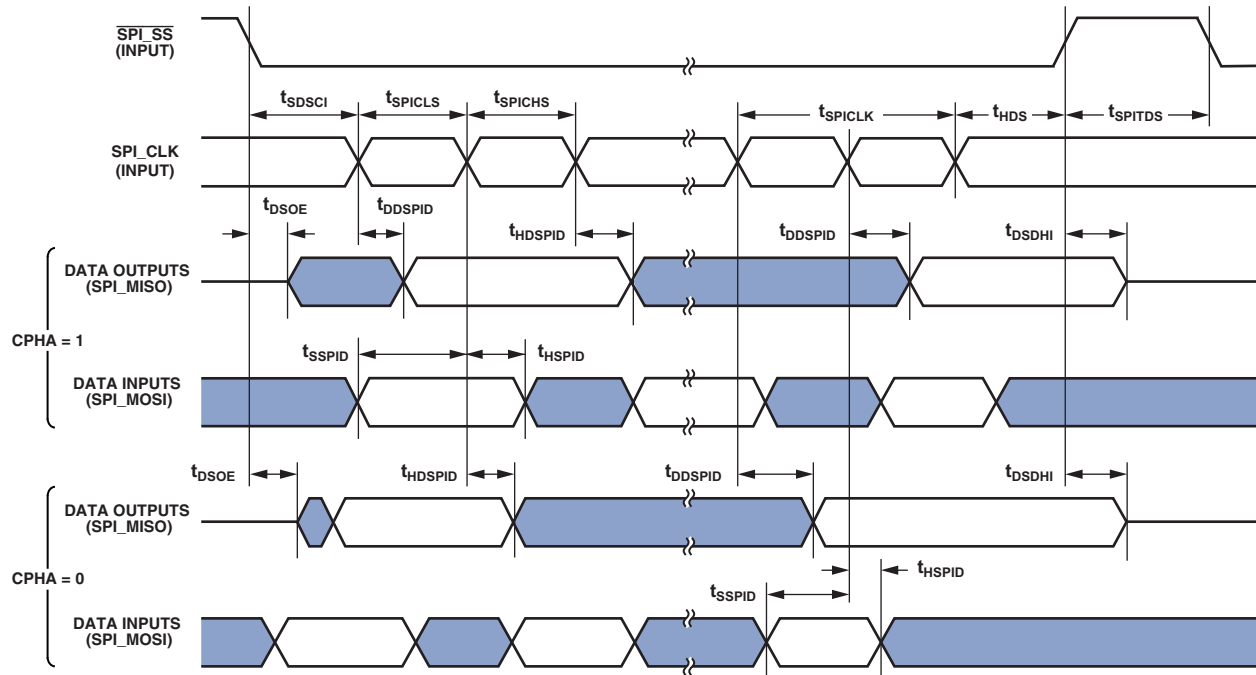


Figure 41. Serial Peripheral Interface (SPI) Port—Slave Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## Serial Peripheral Interface (SPI) Port—SPI\_RDY Slave Timing

Table 53. SPI Port—SPI\_RDY Slave Timing

| Parameter                 | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal                                |                          | Unit                            |    |
|---------------------------|---------------------------------------------------------------------------|--------------------------|---------------------------------|----|
|                           | Min                                                                       | Max                      |                                 |    |
| Switching Characteristics |                                                                           |                          |                                 |    |
| t <sub>DSPISCKRDYSR</sub> | SPI_RDY De-assertion from Valid Input SPI_CLK Edge in Slave Mode Receive  | 2.5 × t <sub>SCLK1</sub> | 3.5 × t <sub>SCLK1</sub> + 17.5 | ns |
| t <sub>DSPISCKRDYST</sub> | SPI_RDY De-assertion from Valid Input SPI_CLK Edge in Slave Mode Transmit | 3.5 × t <sub>SCLK1</sub> | 4.5 × t <sub>SCLK1</sub> + 17.5 | ns |

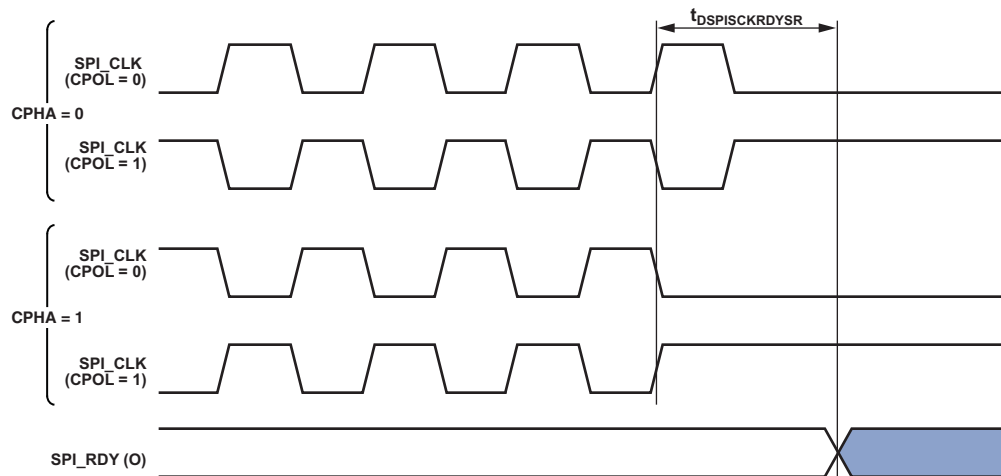


Figure 42. SPI\_RDY De-assertion from Valid Input SPI\_CLK Edge in Slave Mode Receive (FCCH = 0)

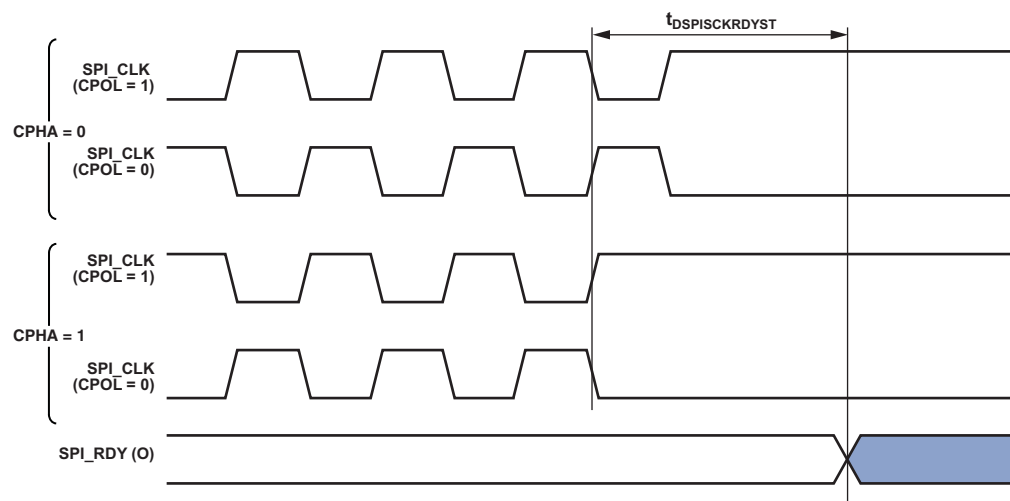


Figure 43. SPI\_RDY De-assertion from Valid Input SPI\_CLK Edge in Slave Mode Transmit (FCCH = 1)

## Serial Peripheral Interface (SPI) Port—Open Drain Mode

### Timing

In Figure 44 and Figure 45, the outputs can be SPI\_MOSI, SPI\_MISO, SPI\_D2, and/or SPI\_D3 depending on the mode of operation.

Table 54. SPI Port ODM Master Mode Timing

| Parameter                                                                 | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal |     | Unit |
|---------------------------------------------------------------------------|--------------------------------------------|-----|------|
|                                                                           | Min                                        | Max |      |
| Switching Characteristics                                                 |                                            |     |      |
| t <sub>HDSPIODMM</sub> SPI_CLK Edge to High Impedance from Data Out Valid | −1                                         |     | ns   |
| t <sub>DDSPIODMM</sub> SPI_CLK Edge to Data Out Valid from High Impedance | 0                                          | 6   | ns   |

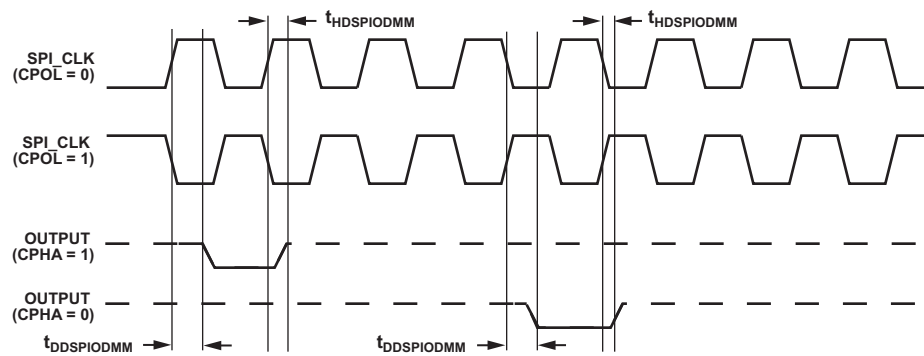


Figure 44. ODM Master

Table 55. SPI Port—ODM Slave Mode

| Parameter                                                                 | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal |      | Unit |
|---------------------------------------------------------------------------|--------------------------------------------|------|------|
|                                                                           | Min                                        | Max  |      |
| Timing Requirements                                                       |                                            |      |      |
| t <sub>HDSPIODMS</sub> SPI_CLK Edge to High Impedance from Data Out Valid | 0                                          |      | ns   |
| t <sub>DDSPIODMS</sub> SPI_CLK Edge to Data Out Valid from High Impedance |                                            | 11.5 | ns   |

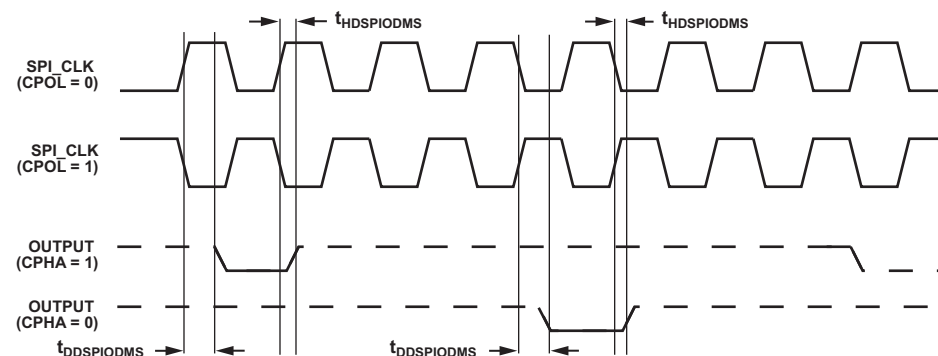


Figure 45. ODM Slave

## Serial Peripheral Interface (SPI) Port—SPI\_RDY Timing

SPI\_RDY is used to provide flow control. The CPOL and CPHA bits are set in SPI\_CTL, while LEADX, LAGX, and STOP are in SPI\_DLY.

**Table 56. SPI Port—SPI\_RDY Timing**

| Parameter                | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal                                                                                                            |                                                     | Unit                                                       |    |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------|----|
|                          | Min                                                                                                                                                   | Max                                                 |                                                            |    |
| Timing Requirements      |                                                                                                                                                       |                                                     |                                                            |    |
| t <sub>SRDYSCKM0</sub>   | Minimum Setup Time for SPI_RDY De-assertion in Master Mode Before Last SPI_CLK Edge of Valid Data Transfer to Block Subsequent Transfer with CPHA = 0 |                                                     | ns                                                         |    |
| t <sub>SRDYSCKM1</sub>   | Minimum Setup Time for SPI_RDY De-assertion in Master Mode Before Last SPI_CLK Edge of Valid Data Transfer to Block Subsequent Transfer with CPHA = 1 |                                                     | ns                                                         |    |
| Switching Characteristic |                                                                                                                                                       |                                                     |                                                            |    |
| t <sub>SRDYSCKM</sub>    | Time Between Assertion of SPI_RDY by Slave and First Edge of SPI_CLK for New SPI Transfer with CPHA = 0 and BAUD = 0 (STOP, LEADX, LAGX = 0)          | 3 × t <sub>SCLK1</sub>                              | 4 × t <sub>SCLK1</sub> + 17.5                              | ns |
|                          | Time Between Assertion of SPI_RDY by Slave and First Edge of SPI_CLK for New SPI Transfer with CPHA = 0 and BAUD ≥ 1 (STOP, LEADX, LAGX = 0)          | (4 + 1.5 × BAUD <sup>1</sup> ) × t <sub>SCLK1</sub> | (5 + 1.5 × BAUD <sup>1</sup> ) × t <sub>SCLK1</sub> + 17.5 | ns |
|                          | Time Between Assertion of SPI_RDY by Slave and First Edge of SPI_CLK for New SPI Transfer with CPHA = 1 (STOP, LEADX, LAGX = 0)                       | (3 + 0.5 × BAUD <sup>1</sup> ) × t <sub>SCLK1</sub> | (4 + 0.5 × BAUD <sup>1</sup> ) × t <sub>SCLK1</sub> + 17.5 | ns |

<sup>1</sup> BAUD value set using the SPI\_CLK.BAUD bits.

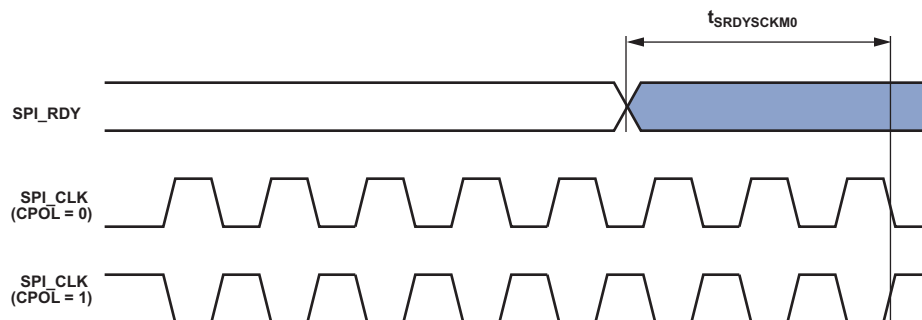


Figure 46. SPI\_RDY Setup Before SPI\_CLK with CPHA = 0

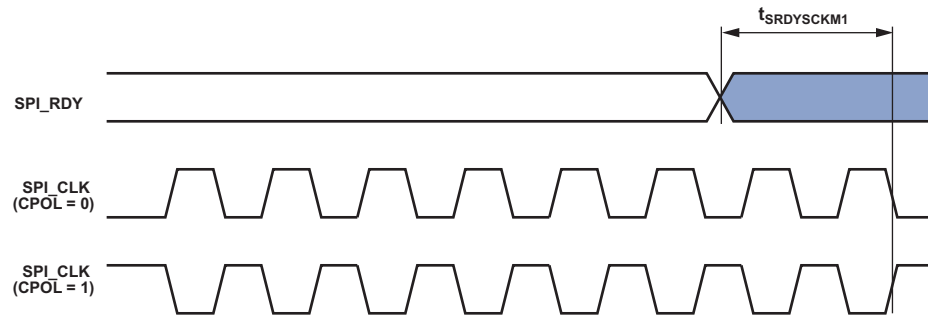


Figure 47. SPI\_RDY Setup Before SPI\_CLK with CPHA = 1

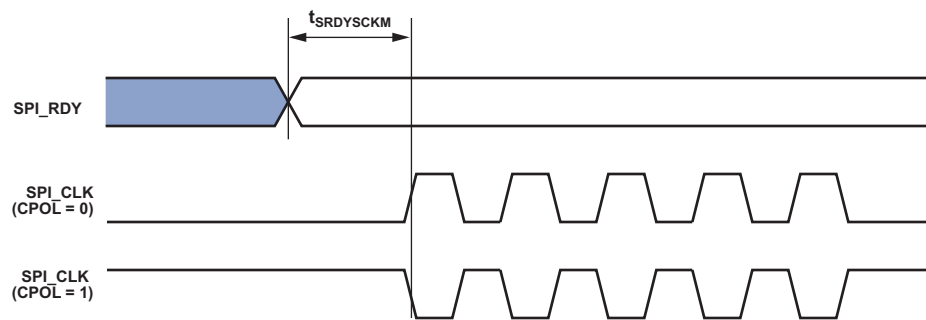


Figure 48. SPI\_CLK Switching Diagram after SPI\_RDY Assertion, CPHA = x

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## General-Purpose Port Timing

Table 57 and Figure 49 describe general-purpose port operations.

Table 57. General-Purpose Port Timing

| Parameter                                            | $V_{DD\_EXT}$<br>1.8 V/3.3 V Nominal |     | Unit |
|------------------------------------------------------|--------------------------------------|-----|------|
|                                                      | Min                                  | Max |      |
| Timing Requirement                                   |                                      |     |      |
| $t_{WFI}$ General-Purpose Port Pin Input Pulse Width | $2 \times t_{SCLK0} - 1.5$           |     | ns   |

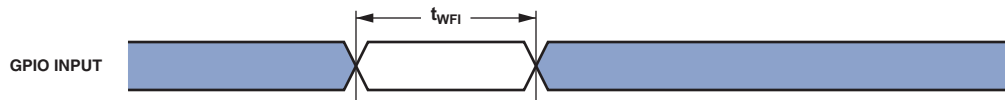


Figure 49. General-Purpose Port Timing

## Timer Cycle Timing

Table 58 and Figure 50 describe timer expired operations. The input signal is asynchronous in “width capture mode” and “external clock mode” and has an ideal maximum input fre-

quency of  $(f_{SCLK0}/4)$  MHz. The Period Value (VALUE) is the timer period assigned in the TMx\_TMRn\_PER register and can range from 2 to  $2^{32} - 1$ .

Table 58. Timer Cycle Timing

|                                                           | $V_{DD\_EXT}$<br>1.8V Nominal    |     | $V_{DD\_EXT}$<br>3.3V Nominal    |     |      |
|-----------------------------------------------------------|----------------------------------|-----|----------------------------------|-----|------|
| Parameter                                                 | Min                              | Max | Min                              | Max | Unit |
| Timing Requirements                                       |                                  |     |                                  |     |      |
| t <sub>WL</sub> Timer Pulse Width Input Low <sup>1</sup>  | 2 × t <sub>SCLK0</sub> – 1.5     |     | 2 × t <sub>SCLK0</sub> – 1.5     |     | ns   |
| t <sub>WH</sub> Timer Pulse Width Input High <sup>1</sup> | 2 × t <sub>SCLK0</sub> – 1.5     |     | 2 × t <sub>SCLK0</sub> – 1.5     |     | ns   |
| Switching Characteristics                                 |                                  |     |                                  |     |      |
| t <sub>HTO</sub> Timer Pulse Width Output                 | t <sub>SCLK0</sub> × VALUE – 1.5 |     | t <sub>SCLK0</sub> × VALUE – 1.5 |     | ns   |

<sup>1</sup> This specification indicates the minimum instantaneous width that can be tolerated due to duty cycle variation or jitter for TMx signals in width capture and external clock modes. The ideal maximum frequency for TMx signals is listed in [Timer Cycle Timing](#) on this page.

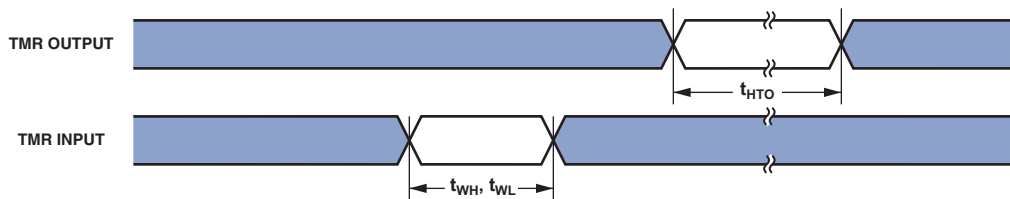


Figure 50. Timer Cycle Timing

## Up/Down Counter/Rotary Encoder Timing

Table 59. Up/Down Counter/Rotary Encoder Timing

| Parameter          | $V_{DD\_EXT}$<br>1.8 V Nominal                   |     | $V_{DD\_EXT}$<br>3.3 V Nominal |                      | Unit |
|--------------------|--------------------------------------------------|-----|--------------------------------|----------------------|------|
|                    | Min                                              | Max | Min                            | Max                  |      |
| Timing Requirement |                                                  |     |                                |                      |      |
| $t_{WCOUNT}$       | Up/Down Counter/Rotary Encoder Input Pulse Width |     | $2 \times t_{SCLK0}$           | $2 \times t_{SCLK0}$ | ns   |

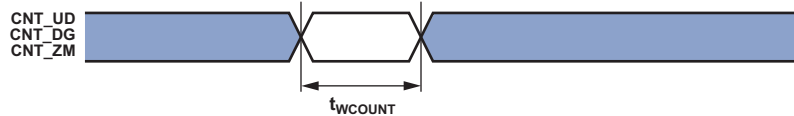


Figure 51. Up/Down Counter/Rotary Encoder Timing

## Pulse Width Modulator (PWM) Timing

Table 60 and Figure 52 describe PWM operations.

Table 60. PWM Timing

|                                                                        | $V_{DD\_EXT}$<br>1.8V Nominal |     | $V_{DD\_EXT}$<br>3.3V Nominal |                             |      |
|------------------------------------------------------------------------|-------------------------------|-----|-------------------------------|-----------------------------|------|
| Parameter                                                              | Min                           | Max | Min                           | Max                         | Unit |
| Timing Requirement                                                     |                               |     |                               |                             |      |
| t <sub>ES</sub> External Sync Pulse Width                              |                               |     | 2 × t <sub>SCLK0</sub>        |                             | ns   |
| Switching Characteristics                                              |                               |     |                               |                             |      |
| t <sub>DODIS</sub> Output Inactive (OFF) After Trip Input <sup>1</sup> |                               |     |                               | 15                          | ns   |
| t <sub>DOE</sub> Output Delay After External Sync <sup>1, 2</sup>      |                               |     | 2 × t <sub>SCLK0</sub> + 5.5  | 5 × t <sub>SCLK0</sub> + 14 | ns   |

<sup>1</sup> PWM outputs are: PWMx\_AH, PWMx\_AL, PWMx\_BH, PWMx\_BL, PWMx\_CH, and PWMx\_CL.

<sup>2</sup> When the external sync signal is synchronous to the peripheral clock, it takes fewer clock cycles for the output to appear compared to when the external sync signal is asynchronous to the peripheral clock. For more information, see the *ADSP-BF60x Blackfin Processor Hardware Reference*.

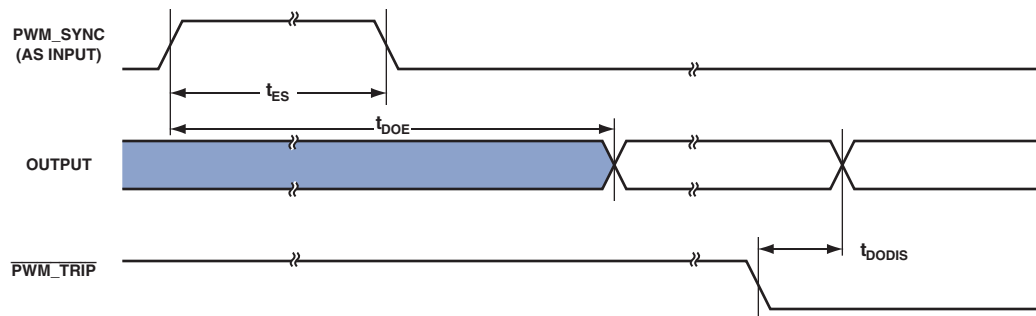


Figure 52. PWM Timing

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## ADC Controller Module (ACM) Timing

Table 61 and Figure 53 describe ACM operations.

When internally generated, the programmed ACM clock ( $f_{\text{ACLKPROG}}$ ) frequency in MHz is set by the following equation where CKDIV is a field in the ACM\_TC0 register and ranges from 1 to 255:

$$f_{\text{ACLKPROG}} = \frac{f_{\text{SCLK1}}}{\text{CKDIV} + 1}$$

$$t_{\text{ACLKPROG}} = \frac{1}{f_{\text{ACLKPROG}}}$$

Setup cycles (SC) in Table 61 is also a field in the ACM\_TC0 register and ranges from 0 to 4095. Hold Cycles (HC) is a field in the ACM\_TC1 register that ranges from 0 to 15.

Table 61. ACM Timing

|                           |                                                                             | V <sub>DD_EXT</sub><br>1.8 V/3.3 V Nominal |     |      |
|---------------------------|-----------------------------------------------------------------------------|--------------------------------------------|-----|------|
| Parameter                 |                                                                             | Min                                        | Max | Unit |
| Timing Requirements       |                                                                             |                                            |     |      |
| t <sub>SDR</sub>          | SPORT DRxPRI/DRxSEC Setup Before ACMx_CLK                                   | 3                                          |     | ns   |
| t <sub>HDR</sub>          | SPORT DRxPRI/DRxSEC Hold After ACMx_CLK                                     | 1.5                                        |     | ns   |
| Switching Characteristics |                                                                             |                                            |     |      |
| t <sub>SCTLCS</sub>       | ACM Controls (ACMx_A[4:0]) Setup Before Assertion of $\overline{\text{CS}}$ | (SC + 1) × t <sub>SCLK1</sub> – 3          |     | ns   |
| t <sub>HCTLCS</sub>       | ACM Control (ACMx_A[4:0]) Hold After De-assertion of $\overline{\text{CS}}$ | HC × t <sub>ACLK</sub> + 0.1               |     | ns   |
| t <sub>ACLKW</sub>        | ACM Clock Pulse Width <sup>1</sup>                                          | (0.5 × t <sub>ACLKPROG</sub> ) – 1.5       |     | ns   |
| t <sub>ACLK</sub>         | ACM Clock Period <sup>1</sup>                                               | t <sub>ACLKPROG</sub> – 1.5                |     | ns   |
| t <sub>HCSACLK</sub>      | $\overline{\text{CS}}$ Hold to ACMx_CLK Edge                                | –0.1                                       |     | ns   |
| t <sub>SCSACLK</sub>      | $\overline{\text{CS}}$ Setup to ACMx_CLK Edge                               | t <sub>ACLK</sub> – 3.5                    |     | ns   |

<sup>1</sup> See Table 17 on Page 53 in Clock Related Operating Conditions for details on the minimum period that may be programmed for  $t_{\text{ACLKPROG}}$ .

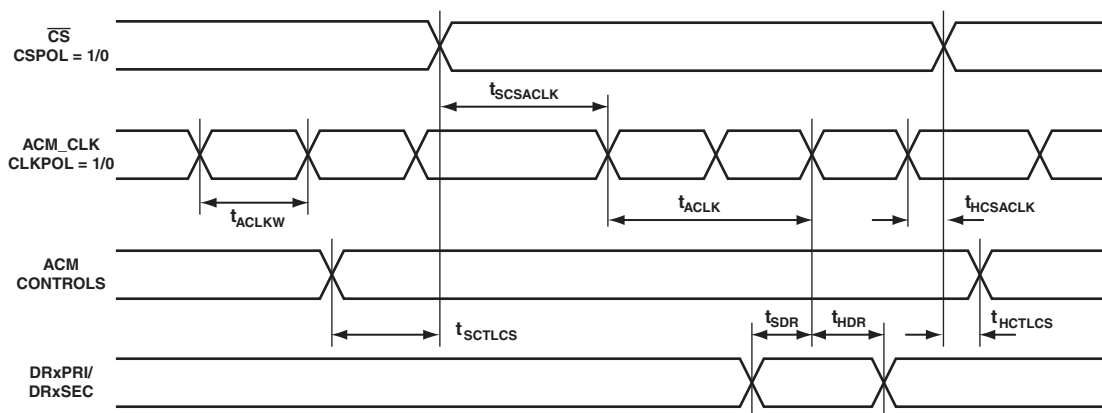


Figure 53. ACM Timing

## Universal Asynchronous Receiver-Transmitter (UART) Ports—Receive and Transmit Timing

The UART ports receive and transmit operations are described in the *ADSP-BF60x Blackfin Processor Hardware Reference Manual*.

## CAN Interface

The CAN interface timing is described in the *ADSP-BF60x Blackfin Processor Hardware Reference Manual*.

## Universal Serial Bus (USB) On-The-Go—Receive and Transmit Timing

[Table 62](#) describes the USB On-The-Go receive and transmit operations.

**Table 62. USB On-The-Go—Receive and Transmit Timing**

| Parameter           |                                  | V <sub>DD_USB</sub><br>3.3 V Nominal |     | Unit |
|---------------------|----------------------------------|--------------------------------------|-----|------|
|                     |                                  | Min                                  | Max |      |
| Timing Requirements |                                  |                                      |     |      |
| f <sub>USBS</sub>   | USB_XI Frequency                 | 48                                   | 48  | MHz  |
| fs <sub>USB</sub>   | USB_XI Clock Frequency Stability | −50                                  | +50 | ppm  |



## 10/100 Ethernet MAC Controller Timing

Table 64 through Table 66 and Figure 55 through Figure 57 describe the 10/100 Ethernet MAC Controller operations.

**Table 64. 10/100 Ethernet MAC Controller Timing: RMII Receive Signal**

| Parameter <sup>1</sup>                                                         | <b>V<sub>DD_EXT</sub><br/>1.8V/3.3V Nominal</b> |                          | Unit |
|--------------------------------------------------------------------------------|-------------------------------------------------|--------------------------|------|
|                                                                                | Min                                             | Max                      |      |
| <b>Timing Requirements</b>                                                     |                                                 |                          |      |
| $t_{REFCLKF}$ ETHx_REFCLK Frequency ( $f_{SCLK0}$ = SCLK0 Frequency)           | None                                            | 50 + 1%                  | MHz  |
| $t_{REFCLKW}$ ETHx_REFCLK Width ( $t_{REFCLK}$ = ETHx_REFCLK Period)           | $t_{REFCLK} \times 35\%$                        | $t_{REFCLK} \times 65\%$ | ns   |
| $t_{REFCLKIS}$ Rx Input Valid to RMII ETHx_REFCLK Rising Edge (Data In Setup)  | 4                                               |                          | ns   |
| $t_{REFCLKIH}$ RMII ETHx_REFCLK Rising Edge to Rx Input Invalid (Data In Hold) | 2.2                                             |                          | ns   |

<sup>1</sup> RMII inputs synchronous to RMII REF\_CLK are ERxD1-0, RMII CRS\_DV, and ERxER.

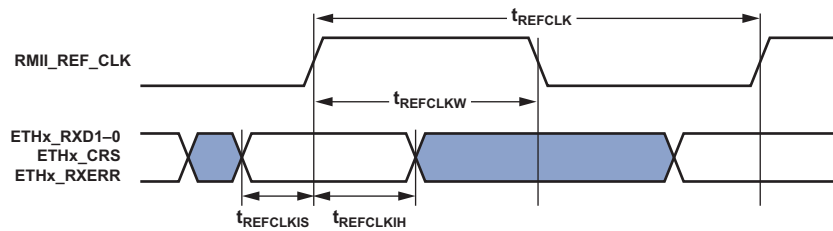


Figure 55. 10/100 Ethernet MAC Controller Timing: RMII Receive Signal

**Table 65. 10/100 Ethernet MAC Controller Timing: RMII Transmit Signal**

| Parameter <sup>1</sup>                                                                 | <b>V<sub>DD_EXT</sub><br/>1.8V/3.3V Nominal</b> |     | Unit |
|----------------------------------------------------------------------------------------|-------------------------------------------------|-----|------|
|                                                                                        | Min                                             | Max |      |
| <b>Switching Characteristics</b>                                                       |                                                 |     |      |
| $t_{REFCLKOV}$ RMII ETHx_REFCLK Rising Edge to Transmit Output Valid (Data Out Valid)  |                                                 | 14  | ns   |
| $t_{REFCLKOH}$ RMII ETHx_REFCLK Rising Edge to Transmit Output Invalid (Data Out Hold) | 2                                               |     | ns   |

<sup>1</sup> RMII outputs synchronous to RMII REF\_CLK are ETxD1-0.

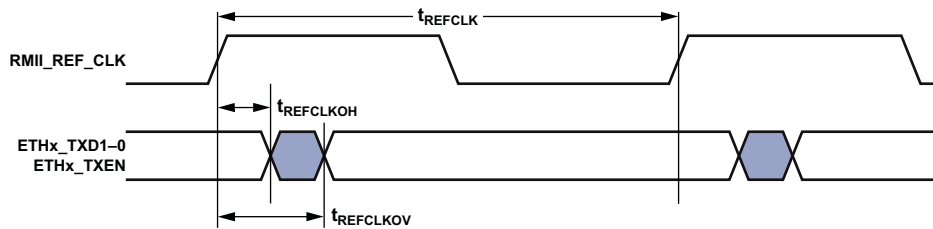


Figure 56. 10/100 Ethernet MAC Controller Timing: RMII Transmit Signal

Table 66. 10/100 Ethernet MAC Controller Timing: RMII Station Management

| Parameter <sup>1</sup>                                                      | V <sub>DD_EXT</sub><br>1.8V/3.3V Nominal |                        | Unit |
|-----------------------------------------------------------------------------|------------------------------------------|------------------------|------|
|                                                                             | Min                                      | Max                    |      |
| Timing Requirements                                                         |                                          |                        |      |
| t <sub>MDIOS</sub> ETHx_MDIO Input Valid to ETHx_MDC Rising Edge (Setup)    | 14                                       |                        | ns   |
| t <sub>MDCIH</sub> ETHx_MDC Rising Edge to ETHx_MDIO Input Invalid (Hold)   | 0                                        |                        | ns   |
| Switching Characteristics                                                   |                                          |                        |      |
| t <sub>MDCOV</sub> ETHx_MDC Falling Edge to ETHx_MDIO Output Valid          |                                          | t <sub>SCLK0</sub> + 5 | ns   |
| t <sub>MDCOH</sub> ETHx_MDC Falling Edge to ETHx_MDIO Output Invalid (Hold) | t <sub>SCLK0</sub> – 1                   |                        | ns   |

<sup>1</sup> ETHx\_MDC/ETHx\_MDIO is a 2-wire serial bidirectional port for controlling one or more external PHYs. ETHx\_MDC is an output clock whose minimum period is programmable as a multiple of the system clock SCLK0. ETHx\_MDIO is a bidirectional data line.

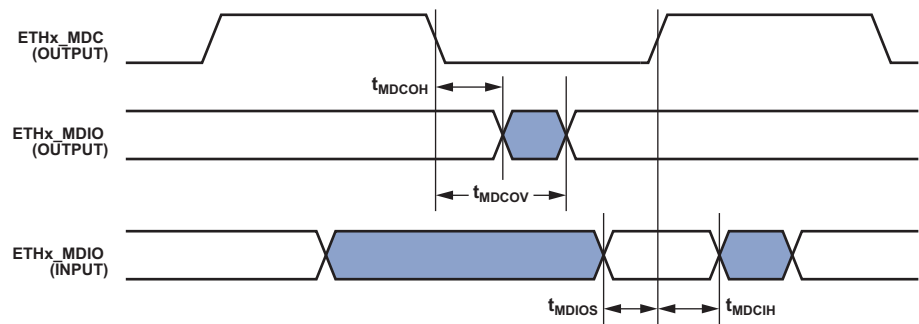


Figure 57. 10/100 Ethernet MAC Controller Timing: RMII Station Management

## JTAG Test And Emulation Port Timing

Table 67 and Figure 58 describe JTAG port operations.

**Table 67. JTAG Port Timing**

| Parameter                 |                                                                | V <sub>DD_EXT</sub><br>1.8V Nominal |     | V <sub>DD_EXT</sub><br>3.3V Nominal |      | Unit            |
|---------------------------|----------------------------------------------------------------|-------------------------------------|-----|-------------------------------------|------|-----------------|
|                           |                                                                | Min                                 | Max | Min                                 | Max  |                 |
| Timing Requirements       |                                                                |                                     |     |                                     |      |                 |
| t <sub>TCK</sub>          | JTG_TCK Period                                                 | 20                                  |     | 20                                  |      | ns              |
| t <sub>STAP</sub>         | JTG_TDI, JTG_TMS Setup Before JTG_TCK High                     | 4                                   |     | 4                                   |      | ns              |
| t <sub>HTAP</sub>         | JTG_TDI, JTG_TMS Hold After JTG_TCK High                       | 4                                   |     | 4                                   |      | ns              |
| t <sub>SSYS</sub>         | System Inputs Setup Before JTG_TCK High <sup>1</sup>           | 12                                  |     | 12                                  |      | ns              |
| t <sub>HSYS</sub>         | System Inputs Hold After JTG_TCK High <sup>1</sup>             | 5                                   |     | 5                                   |      | ns              |
| t <sub>TRSTW</sub>        | JTG_TRST Pulse Width (measured in JTG_TCK cycles) <sup>2</sup> | 4                                   |     | 4                                   |      | T <sub>CK</sub> |
| Switching Characteristics |                                                                |                                     |     |                                     |      |                 |
| t <sub>DTDO</sub>         | JTG_TDO Delay from JTG_TCK Low                                 |                                     | 18  |                                     | 13.5 | ns              |
| t <sub>DSYS</sub>         | System Outputs Delay After JTG_TCK Low <sup>3</sup>            |                                     | 22  |                                     | 17   | ns              |

<sup>1</sup> System Inputs = DMC0\_DQ00-15, DMC0\_LDQS, DMC0\_LDQS, DMC0\_UDQS, DMC0\_UDQS, PA\_15-0, PB\_15-0, PC\_15-0, PD\_15-0, PE\_15-0, PF\_15-0, PG\_15-0, SMC0\_ARDY\_NORWT, SMC0\_BR, SMC0\_D15-0, SYS\_BMODE0-2, SYS\_HWRST, SYS\_FAULT, SYS\_FAULT, SYS\_NMI\_RESOUT, SYS\_PWRGD, TWI0\_SCL, TWI0\_SDA, TWI1\_SCL, TWI1\_SDA.

<sup>2</sup> 50 MHz Maximum.

<sup>3</sup> System Outputs = DMC0\_A00-13, DMC0\_BA0-2, DMC0\_CAS, DMC0\_CK, DMC0\_CK, DMC0\_CKE, DMC0\_CS0, DMC0\_DQ00-15, DMC0\_LDM, DMC0\_LDQS, DMC0\_LDQS, DMC0\_ODT, DMC0\_RAS, DMC0\_UDM, DMC0\_UDQS, DMC0\_UDQS, DMC0\_WE, JTG\_EMU, PA\_15-0, PB\_15-0, PC\_15-0, PD\_15-0, PE\_15-0, PF\_15-0, PG\_15-0, SMC0\_AMS0, SMC0\_AOE\_NORDV, SMC0\_ARE, SMC0\_AWE, SMC0\_A01, SMC0\_A02, SMC0\_D15-0, SYS\_CLKOUT, SYS\_FAULT, SYS\_FAULT, SYS\_NMI\_RESOUT.

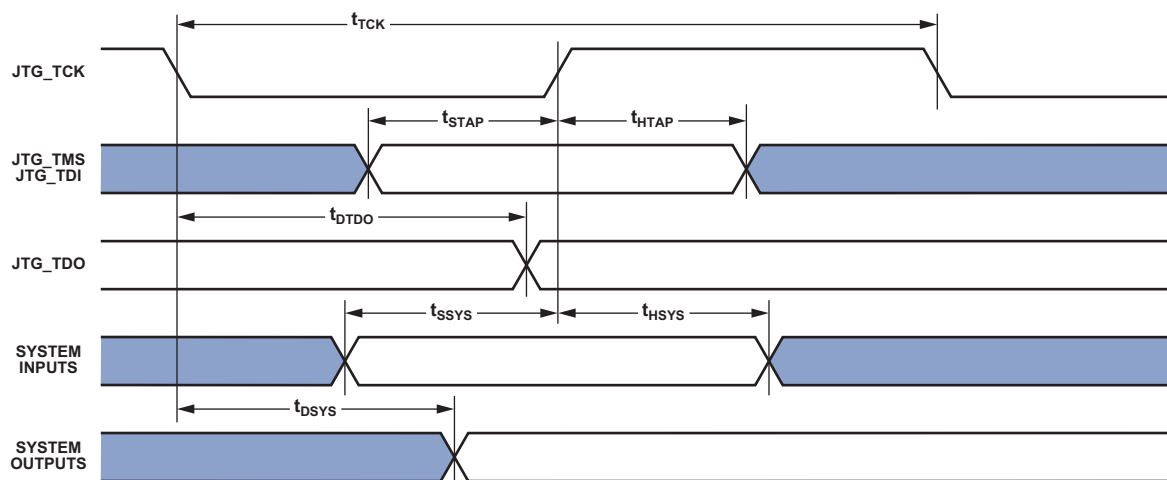


Figure 58. JTAG Port Timing

## OUTPUT DRIVE CURRENTS

Figure 59 through Figure 64 show typical current-voltage characteristics for the output drivers of the ADSP-BF60x Blackfin processors. The curves represent the current drive capability of the output drivers as a function of output voltage.

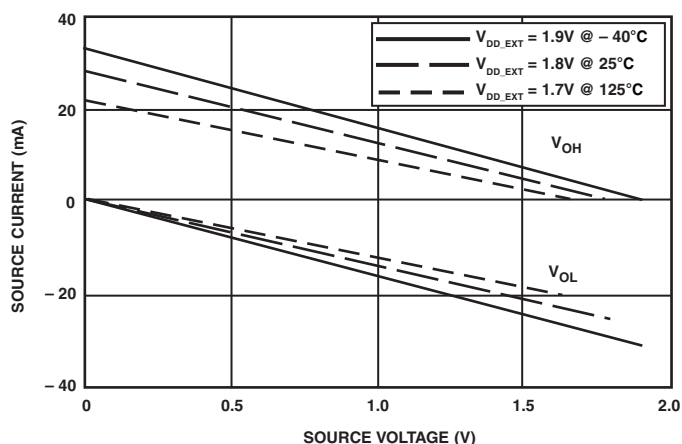


Figure 59. Driver Type A Current (1.8 V  $V_{DD\_EXT}$ )

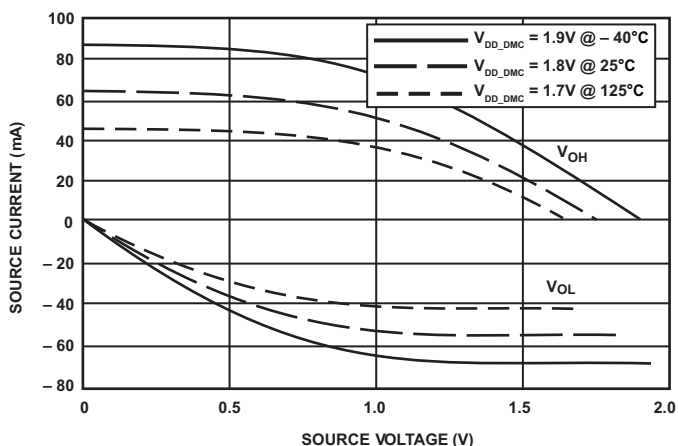


Figure 61. Driver Type B Current (1.8 V  $V_{DD\_DMC}$ )

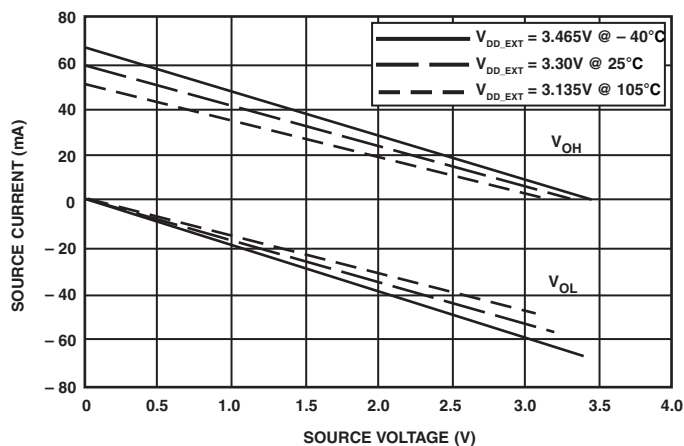


Figure 60. Driver Type A Current (3.3 V  $V_{DD\_EXT}$ )

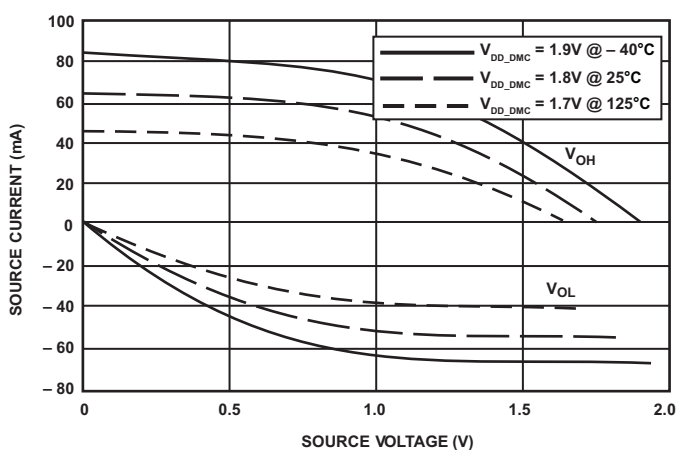
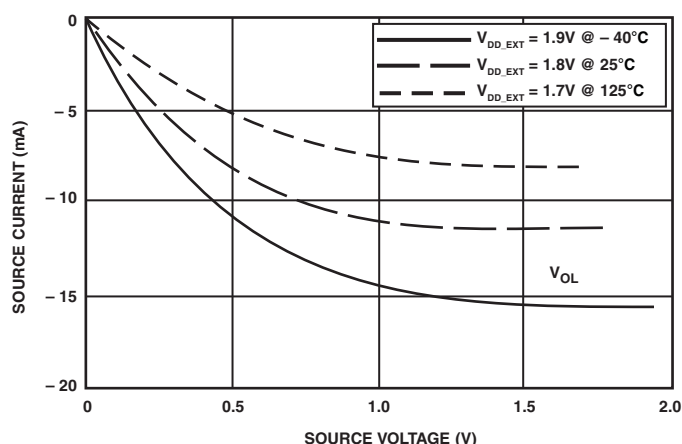
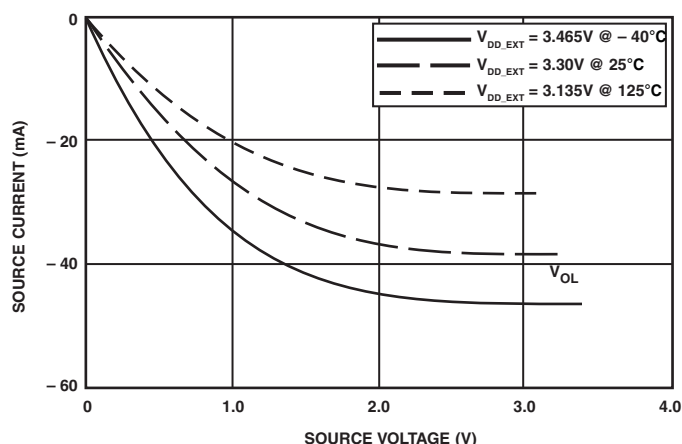


Figure 62. Driver Type C Current (1.8 V  $V_{DD\_DMC}$ )


Figure 63. Driver Type D Current (1.8 V  $V_{DD\_EXT}$ )

Figure 64. Driver Type D Current (3.3 V  $V_{DD\_EXT}$ )

## TEST CONDITIONS

All Timing Requirements appearing in this data sheet were measured under the conditions described in this section. Figure 65 shows the measurement point for AC measurements (except output enable/disable). The measurement point  $V_{MEAS}$  is  $V_{DDEXT}/2$  or  $V_{DDMEM}/2$  for  $V_{DDEXT}/V_{DDMEM}$  (nominal) = 1.8 V/2.5 V/3.3 V.

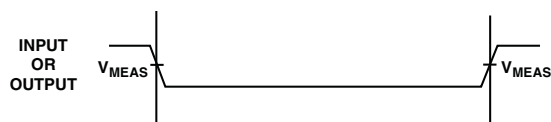


Figure 65. Voltage Reference Levels for AC Measurements (Except Output Enable/Disable)

## Output Enable Time Measurement

Output balls are considered to be enabled when they have made a transition from a high impedance state to the point when they start driving.

The output enable time  $t_{ENA}$  is the interval from the point when a reference signal reaches a high or low voltage level to the point when the output starts driving as shown on the right side of Figure 66.

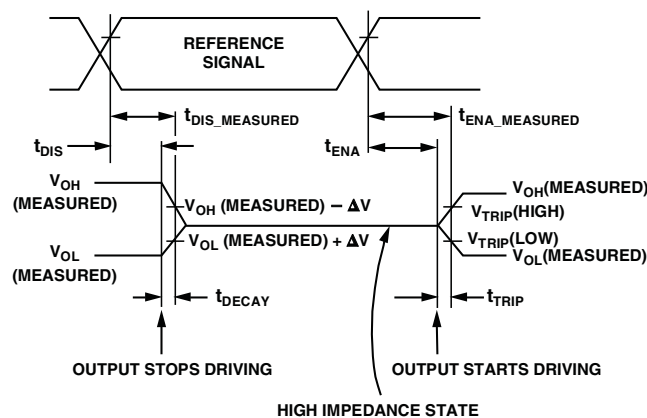


Figure 66. Output Enable/Disable

The time  $t_{ENA\_MEASURED}$  is the interval from when the reference signal switches to when the output voltage reaches  $V_{TRIP}(high)$  or  $V_{TRIP}(low)$ . For  $V_{DDEXT}/V_{DDMEM}$  (nominal) = 1.8 V,  $V_{TRIP}(high)$  is 1.05 V, and  $V_{TRIP}(low)$  is 0.75 V. For  $V_{DDEXT}/V_{DDMEM}$  (nominal) = 2.5 V,  $V_{TRIP}(high)$  is 1.5 V and  $V_{TRIP}(low)$  is 1.0 V. For  $V_{DDEXT}/V_{DDMEM}$  (nominal) = 3.3 V,  $V_{TRIP}(high)$  is 1.9 V, and  $V_{TRIP}(low)$  is 1.4 V. Time  $t_{TRIP}$  is the interval from when the output starts driving to when the output reaches the  $V_{TRIP}(high)$  or  $V_{TRIP}(low)$  trip voltage.

Time  $t_{ENA}$  is calculated as shown in the equation:

$$t_{ENA} = t_{ENA\_MEASURED} - t_{TRIP}$$

If multiple balls (such as the data bus) are enabled, the measurement value is that of the first ball to start driving.

## Output Disable Time Measurement

Output balls are considered to be disabled when they stop driving, go into a high impedance state, and start to decay from their output high or low voltage. The output disable time  $t_{DIS}$  is the difference between  $t_{DIS\_MEASURED}$  and  $t_{DECAY}$  as shown on the left side of Figure 66.

$$t_{DIS} = t_{DIS\_MEASURED} - t_{DECAY}$$

The time for the voltage on the bus to decay by  $\Delta V$  is dependent on the capacitive load  $C_L$  and the load current  $I_L$ . This decay time can be approximated by the equation:

$$t_{DECAY} = (C_L \Delta V) / I_L$$

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The time  $t_{\text{DECAY}}$  is calculated with test loads  $C_L$  and  $I_L$ , and with  $\Delta V$  equal to 0.25 V for  $V_{\text{DDEXT}}/V_{\text{DDMEM}}$  (nominal) = 2.5 V/3.3 V and 0.15 V for  $V_{\text{DDEXT}}/V_{\text{DDMEM}}$  (nominal) = 1.8 V.

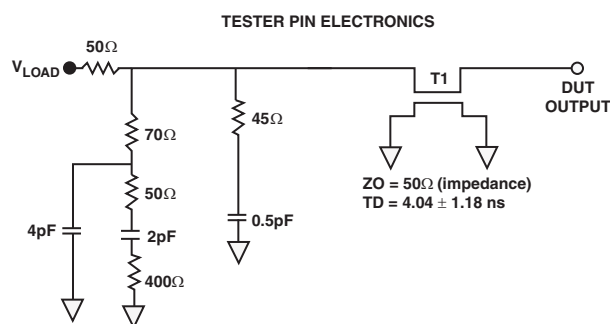
The time  $t_{\text{DIS\_MEASURED}}$  is the interval from when the reference signal switches, to when the output voltage decays  $\Delta V$  from the measured output high or output low voltage.

## Example System Hold Time Calculation

To determine the data output hold time in a particular system, first calculate  $t_{\text{DECAY}}$  using the equation given above. Choose  $\Delta V$  to be the difference between the processor's output voltage and the input threshold for the device requiring the hold time.  $C_L$  is the total bus capacitance (per data line), and  $I_L$  is the total leakage or three-state current (per data line). The hold time is  $t_{\text{DECAY}}$  plus the various output disable times as specified in the [Timing Specifications on Page 60](#).

## Capacitive Loading

Output delays and holds are based on standard capacitive loads of an average of 6 pF on all pins (see [Figure 67](#)).  $V_{\text{LOAD}}$  is equal to  $(V_{\text{DD\_EXT}})/2$ .



NOTES:  
THE WORST CASE TRANSMISSION LINE DELAY IS SHOWN AND CAN BE USED FOR THE OUTPUT TIMING ANALYSIS TO REFLECT THE TRANSMISSION LINE EFFECT AND MUST BE CONSIDERED. THE TRANSMISSION LINE (TD) IS FOR LOAD ONLY AND DOES NOT AFFECT THE DATA SHEET TIMING SPECIFICATIONS.

ANALOG DEVICES RECOMMENDS USING THE IBIS MODEL TIMING FOR A GIVEN SYSTEM REQUIREMENT. IF NECESSARY, A SYSTEM MAY INCORPORATE EXTERNAL DRIVERS TO COMPENSATE FOR ANY TIMING DIFFERENCES.

Figure 67. Equivalent Device Loading for AC Measurements  
(Includes All Fixtures)

The graphs of [Figure 68](#) through [Figure 70](#) show how output rise and fall times vary with capacitance. The delay and hold specifications given should be derated by a factor derived from these figures. The graphs in these figures may not be linear outside the ranges shown.

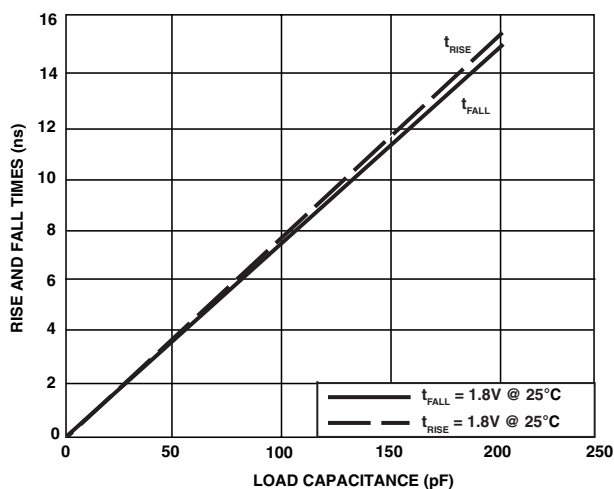


Figure 68. Driver Type A Typical Rise and Fall Times (10%-90%) vs. Load Capacitance ( $V_{\text{DD\_EXT}} = 1.8 \text{ V}$ )

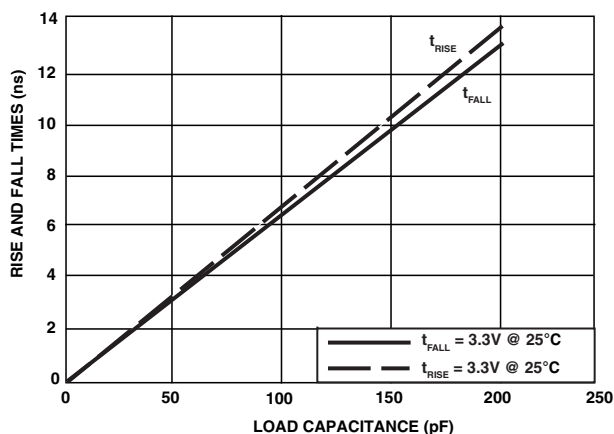


Figure 69. Driver Type A Typical Rise and Fall Times (10%-90%) vs. Load Capacitance ( $V_{\text{DD\_EXT}} = 3.3 \text{ V}$ )

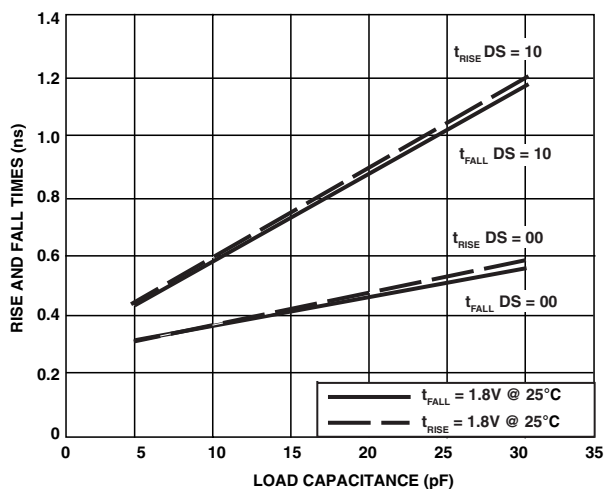


Figure 70. Driver Type B & C Typical Rise and Fall Times (10%-90%) vs. Load Capacitance ( $V_{\text{DD\_DMC}} = 1.8 \text{ V}$ )

## ENVIRONMENTAL CONDITIONS

To determine the junction temperature on the application printed circuit board use:

$$T_J = T_{CASE} + (\Psi_{JT} \times P_D)$$

where:

$T_J$  = Junction temperature (°C)

$T_{CASE}$  = Case temperature (°C) measured by customer at top center of package.

$\Psi_{JT}$  = From [Table 68](#)

$P_D$  = Power dissipation (see [Total Internal Power Dissipation on Page 57](#) for the method to calculate  $P_D$ )

**Table 68. Thermal Characteristics**

| Parameter      | Condition             | Typical | Unit |
|----------------|-----------------------|---------|------|
| $\theta_{JA}$  | 0 linear m/s air flow | 16.7    | °C/W |
| $\theta_{JMA}$ | 1 linear m/s air flow | 14.6    | °C/W |
| $\theta_{JMA}$ | 2 linear m/s air flow | 13.9    | °C/W |
| $\theta_{JC}$  |                       | 4.41    | °C/W |
| $\Psi_{JT}$    | 0 linear m/s air flow | 0.11    | °C/W |
| $\Psi_{JT}$    | 1 linear m/s air flow | 0.24    | °C/W |
| $\Psi_{JT}$    | 2 linear m/s air flow | 0.25    | °C/W |

Values of  $\theta_{JA}$  are provided for package comparison and printed circuit board design considerations.  $\theta_{JA}$  can be used for a first order approximation of  $T_J$  by the equation:

$$T_J = T_A + (\theta_{JA} \times P_D)$$

where:

$T_A$  = Ambient temperature (°C)

Values of  $\theta_{JC}$  are provided for package comparison and printed circuit board design considerations when an external heat sink is required.

**Table 69. Thermal Diode Parameters—Transistor Model**

| Symbol                | Parameter            | Min | Typ   | Max | Unit |
|-----------------------|----------------------|-----|-------|-----|------|
| $I_{FW}$ <sup>1</sup> | Forward Bias Current | 10  |       | 300 | μA   |
| $I_E$                 | Emitter Current      | 10  |       | 300 | μA   |
| $n_Q$ <sup>2, 3</sup> | Transistor Ideality  |     | 1.006 |     |      |
| $R_T$ <sup>2, 4</sup> | Series Resistance    |     | 2.8   |     | Ω    |

<sup>1</sup> Analog Devices does not recommend operation of the thermal diode under reverse bias.

<sup>2</sup> Not 100% tested. Specified by design characterization.

<sup>3</sup> The ideality factor,  $n_Q$ , represents the deviation from ideal diode behavior as exemplified by the diode equation:  $I_C = I_S \times (\exp(qV_{BE}/n_QkT) - 1)$ , where  $I_S$  = saturation current,  $q$  = electrical charge,  $V_{BE}$  = voltage across the diode,  $k$  = Boltzmann Constant, and  $T$  = absolute temperature (Kelvin).

<sup>4</sup> The series resistance ( $R_T$ ) can be used for more accurate readings as needed.

In [Table 68](#), airflow measurements comply with JEDEC standards JESD51-2 and JESD51-6. The junction-to-case measurement complies with MIL-STD-883 (Method 1012.1). All measurements use a 2S2P JEDEC test board.

## Thermal Diode

The processor incorporates a thermal diode to monitor the die temperature. The thermal diode is a grounded collector, PNP Bipolar Junction Transistor (BJT). The SYS\_TDA ball is connected to the emitter and the SYS\_TDK ball is connected to the base of the transistor. These balls can be used by an external temperature sensor (such as the ADM 1021A or the LM86 or others) to read the die temperature of the chip.

The technique used by the external temperature sensor is to measure the change in  $V_{BE}$  when the thermal diode is operated at two different currents. This is shown in the following equation:

$$\Delta V_{BE} = n_Q \times \frac{kT}{q} \times \ln(N)$$

where:

$n_Q$  = multiplication factor close to 1, depending on process variations

$k$  = Boltzmann's constant

$T$  = temperature (°Kelvin)

$q$  = charge of the electron

$N$  = ratio of the two currents

The two currents are usually in the range of 10 micro Amperes to 300 micro Amperes for the common temperature sensor chips available.

[Table 69](#) contains the thermal diode specifications using the transistor model. Note that Measured Ideality Factor already takes into effect variations in beta (B).

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## ADSP-BF60x 349-BALL CSP\_BGA BALL ASSIGNMENTS

The 349-Ball CSP\_BGA Ball Assignment (Numerical by Ball Number) table lists the CSP\_BGA package by ball number for the ADSP-BF609.

The 349-Ball CSP\_BGA Ball Assignment (Alphabetical by Pin Name) table lists the CSP\_BGA package by signal.

### 349-BALL CSP\_BGA BALL ASSIGNMENT (NUMERICAL BY BALL NUMBER)

| Ball No. | Pin Name  | Ball No. | Pin Name            | Ball No. | Pin Name            | Ball No. | Pin Name            |
|----------|-----------|----------|---------------------|----------|---------------------|----------|---------------------|
| A01      | GND       | B21      | GND                 | F06      | V <sub>DD_EXT</sub> | H22      | DMC0_DQ14           |
| A02      | USB0_DM   | B22      | SMC0_AOE_NORDV      | F07      | V <sub>DD_INT</sub> | J01      | GND                 |
| A03      | USB0_DP   | C01      | USB0_CLKIN          | F08      | V <sub>DD_INT</sub> | J02      | SYS_PWRGD           |
| A04      | PB_10     | C02      | USB0_VBC            | F09      | V <sub>DD_INT</sub> | J03      | SYS_BMODE0          |
| A05      | PB_07     | C03      | GND                 | F10      | V <sub>DD_INT</sub> | J06      | V <sub>DD_EXT</sub> |
| A06      | PA_14     | C04      | PB_12               | F11      | V <sub>DD_EXT</sub> | J09      | GND                 |
| A07      | PA_12     | C05      | PB_09               | F12      | V <sub>DD_EXT</sub> | J10      | GND                 |
| A08      | PA_10     | C06      | PB_06               | F13      | V <sub>DD_INT</sub> | J11      | GND                 |
| A09      | PA_08     | C07      | PB_05               | F14      | V <sub>DD_INT</sub> | J12      | GND                 |
| A10      | PA_06     | C08      | PB_04               | F15      | V <sub>DD_INT</sub> | J13      | GND                 |
| A11      | PA_04     | C09      | PB_03               | F16      | V <sub>DD_INT</sub> | J14      | GND                 |
| A12      | PA_02     | C10      | PB_02               | F17      | V <sub>DD_DMC</sub> | J17      | V <sub>DD_DMC</sub> |
| A13      | PA_00     | C11      | PB_01               | F20      | DMC0_CS0            | J20      | DMC0_ODT            |
| A14      | SMC0_A01  | C12      | PB_00               | F21      | DMC0_DQ15           | J21      | DMC0_DQ12           |
| A15      | SMC0_D00  | C13      | SMC0_BR             | F22      | DMC0_DQ08           | J22      | DMC0_DQ11           |
| A16      | SMC0_AMS0 | C14      | SMC0_D06            | G01      | GND                 | K01      | PC_00               |
| A17      | SMC0_D03  | C15      | SMC0_D12            | G02      | SYS_HWRST           | K02      | SYS_EXTWAKE         |
| A18      | SMC0_D04  | C16      | SMC0_ARE            | G03      | SYS_BMODE2          | K03      | PB_13               |
| A19      | SMC0_D07  | C17      | SMC0_D08            | G06      | V <sub>DD_EXT</sub> | K06      | V <sub>DD_EXT</sub> |
| A20      | SMC0_D10  | C18      | SMC0_D11            | G07      | V <sub>DD_EXT</sub> | K08      | GND                 |
| A21      | SMC0_AWE  | C19      | SMC0_D14            | G08      | V <sub>DD_INT</sub> | K09      | GND                 |
| A22      | GND       | C20      | GND                 | G09      | V <sub>DD_INT</sub> | K10      | GND                 |
| B01      | USB0_VBUS | C21      | TWI1_SCL            | G10      | V <sub>DD_EXT</sub> | K11      | GND                 |
| B02      | GND       | C22      | TWI0_SCL            | G11      | V <sub>DD_EXT</sub> | K12      | GND                 |
| B03      | USB0_ID   | D01      | JTG_TDI             | G12      | V <sub>DD_EXT</sub> | K13      | GND                 |
| B04      | PB_11     | D02      | JTG_TDO             | G13      | V <sub>DD_EXT</sub> | K14      | GND                 |
| B05      | PB_08     | D03      | JTG_TCK             | G14      | V <sub>DD_INT</sub> | K15      | GND                 |
| B06      | PA_15     | D11      | V <sub>DD_EXT</sub> | G15      | V <sub>DD_INT</sub> | K17      | V <sub>DD_DMC</sub> |
| B07      | PA_13     | D12      | GND                 | G16      | V <sub>DD_DMC</sub> | K20      | DMC0_LDM            |
| B08      | PA_11     | D20      | SMC0_ARDY_NORWT     | G17      | V <sub>DD_DMC</sub> | K21      | DMC0_LDQS           |
| B09      | PA_09     | D21      | TWI1_SDA            | G20      | DMC0_UDM            | K22      | DMC0_LDQS           |
| B10      | PA_07     | D22      | TWI0_SDA            | G21      | DMC0_UDQS           | L01      | PC_02               |
| B11      | PA_05     | E01      | JTG_TRST            | G22      | DMC0_UDQS           | L02      | PC_01               |
| B12      | PA_03     | E02      | JTG_EMU             | H01      | SYS_CLKIN           | L03      | PB_14               |
| B13      | PA_01     | E03      | JTG_TMS             | H02      | SYS_XTAL            | L04      | V <sub>DD_EXT</sub> |
| B14      | SMC0_A02  | E05      | V <sub>DD_USB</sub> | H03      | SYS_BMODE1          | L06      | V <sub>DD_EXT</sub> |
| B15      | SMC0_D01  | E20      | DMC0_CAS            | H06      | V <sub>DD_EXT</sub> | L08      | GND                 |
| B16      | SMC0_D15  | E21      | DMC0_DQ10           | H07      | V <sub>DD_EXT</sub> | L09      | GND                 |
| B17      | SMC0_D09  | E22      | DMC0_DQ13           | H16      | V <sub>DD_DMC</sub> | L10      | GND                 |
| B18      | SMC0_D02  | F01      | SYS_FAULT           | H17      | V <sub>DD_DMC</sub> | L11      | GND                 |
| B19      | SMC0_D13  | F02      | SYS_FAULT           | H20      | DMC0_RAS            | L12      | GND                 |
| B20      | SMC0_D05  | F03      | SYS_NMI_RESOUT      | H21      | DMC0_DQ09           | L13      | GND                 |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

| Ball No. | Pin Name            | Ball No. | Pin Name            | Ball No. | Pin Name            | Ball No. | Pin Name |
|----------|---------------------|----------|---------------------|----------|---------------------|----------|----------|
| L14      | GND                 | P11      | GND                 | U14      | V <sub>DD_INT</sub> | AA05     | PE_03    |
| L15      | GND                 | P12      | GND                 | U15      | V <sub>DD_INT</sub> | AA06     | PF_14    |
| L17      | V <sub>DD_DMC</sub> | P13      | GND                 | U16      | V <sub>DD_INT</sub> | AA07     | PF_12    |
| L19      | VREF_DMC            | P14      | GND                 | U17      | V <sub>DD_DMC</sub> | AA08     | PF_10    |
| L20      | DMC0_CK             | P17      | V <sub>DD_DMC</sub> | U20      | DMC0_A09            | AA09     | PF_08    |
| L21      | DMC0_DQ06           | P20      | DMC0_CKE            | U21      | DMC0_A05            | AA10     | PF_06    |
| L22      | DMC0_DQ07           | P21      | DMC0_DQ02           | U22      | DMC0_A01            | AA11     | PF_04    |
| M01      | PC_04               | P22      | DMC0_DQ05           | V01      | PD_00               | AA12     | PF_02    |
| M02      | PC_03               | R01      | PC_10               | V02      | PC_15               | AA13     | PF_00    |
| M03      | PB_15               | R02      | PC_09               | V03      | PD_10               | AA14     | PG_00    |
| M04      | GND                 | R03      | PD_07               | V20      | DMC0_BA1            | AA15     | PE_15    |
| M06      | V <sub>DD_EXT</sub> | R06      | V <sub>DD_EXT</sub> | V21      | DMC0_A13            | AA16     | PE_14    |
| M08      | GND                 | R07      | V <sub>DD_EXT</sub> | V22      | DMC0_A11            | AA17     | PG_05    |
| M09      | GND                 | R16      | V <sub>DD_DMC</sub> | W01      | PD_04               | AA18     | PG_08    |
| M10      | GND                 | R17      | V <sub>DD_DMC</sub> | W02      | PD_01               | AA19     | PG_07    |
| M11      | GND                 | R20      | DMC0_BA2            | W03      | PD_12               | AA20     | PG_13    |
| M12      | GND                 | R21      | DMC0_BA0            | W11      | GND                 | AA21     | GND      |
| M13      | GND                 | R22      | DMC0_A10            | W12      | V <sub>DD_TD</sub>  | AA22     | GND      |
| M14      | GND                 | T01      | PC_12               | W20      | DMC0_A04            | AB01     | GND      |
| M15      | GND                 | T02      | PC_11               | W21      | DMC0_A06            | AB02     | PD_05    |
| M17      | V <sub>DD_DMC</sub> | T03      | PD_08               | W22      | DMC0_A08            | AB03     | PD_14    |
| M19      | GND                 | T06      | V <sub>DD_EXT</sub> | Y01      | PD_03               | AB04     | PE_01    |
| M20      | DMC0_CK             | T07      | V <sub>DD_EXT</sub> | Y02      | PD_02               | AB05     | PE_04    |
| M21      | DMC0_DQ00           | T08      | V <sub>DD_INT</sub> | Y03      | GND                 | AB06     | PF_15    |
| M22      | DMC0_DQ01           | T09      | V <sub>DD_INT</sub> | Y04      | PD_15               | AB07     | PF_13    |
| N01      | PC_06               | T10      | V <sub>DD_EXT</sub> | Y05      | PE_02               | AB08     | PF_11    |
| N02      | PC_05               | T11      | V <sub>DD_EXT</sub> | Y06      | PE_05               | AB09     | PF_09    |
| N03      | SYS_CLKOUT          | T12      | V <sub>DD_EXT</sub> | Y07      | PE_06               | AB10     | PF_07    |
| N06      | V <sub>DD_EXT</sub> | T13      | V <sub>DD_EXT</sub> | Y08      | PE_07               | AB11     | PF_05    |
| N08      | GND                 | T14      | V <sub>DD_INT</sub> | Y09      | PE_08               | AB12     | PF_03    |
| N09      | GND                 | T15      | V <sub>DD_INT</sub> | Y10      | PE_09               | AB13     | PF_01    |
| N10      | GND                 | T16      | V <sub>DD_DMC</sub> | Y11      | SYS_TDK             | AB14     | PE_13    |
| N11      | GND                 | T17      | V <sub>DD_DMC</sub> | Y12      | SYS_TDA             | AB15     | PG_03    |
| N12      | GND                 | T20      | DMC0_A03            | Y13      | PE_12               | AB16     | PG_06    |
| N13      | GND                 | T21      | DMC0_A07            | Y14      | PE_10               | AB17     | PG_02    |
| N14      | GND                 | T22      | DMC0_A12            | Y15      | PE_11               | AB18     | PG_12    |
| N15      | GND                 | U01      | PC_14               | Y16      | PG_09               | AB19     | PG_14    |
| N17      | V <sub>DD_DMC</sub> | U02      | PC_13               | Y17      | PG_01               | AB20     | PG_15    |
| N20      | DMC0_WE             | U03      | PD_09               | Y18      | PG_04               | AB21     | PG_10    |
| N21      | DMC0_DQ04           | U06      | V <sub>DD_EXT</sub> | Y19      | PG_11               | AB22     | GND      |
| N22      | DMC0_DQ03           | U07      | V <sub>DD_INT</sub> | Y20      | GND                 |          |          |
| P01      | PC_08               | U08      | V <sub>DD_INT</sub> | Y21      | DMC0_A00            |          |          |
| P02      | PC_07               | U09      | V <sub>DD_INT</sub> | Y22      | DMC0_A02            |          |          |
| P03      | PD_06               | U10      | V <sub>DD_INT</sub> | AA01     | PD_11               |          |          |
| P06      | V <sub>DD_EXT</sub> | U11      | V <sub>DD_EXT</sub> | AA02     | GND                 |          |          |
| P09      | GND                 | U12      | V <sub>DD_EXT</sub> | AA03     | PD_13               |          |          |
| P10      | GND                 | U13      | V <sub>DD_INT</sub> | AA04     | PE_00               |          |          |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## 349-BALL CSP\_BGA BALL ASSIGNMENT (ALPHABETICAL BY PIN NAME)

| Pin Name  | Ball No. | Pin Name | Ball No. | Pin Name | Ball No. | Pin Name | Ball No. |
|-----------|----------|----------|----------|----------|----------|----------|----------|
| DMC0_A00  | Y21      | GND      | A01      | GND      | N11      | PB_09    | C05      |
| DMC0_A01  | U22      | GND      | A22      | GND      | N12      | PB_10    | A04      |
| DMC0_A02  | Y22      | GND      | AA02     | GND      | N13      | PB_11    | B04      |
| DMC0_A03  | T20      | GND      | AA21     | GND      | N14      | PB_12    | C04      |
| DMC0_A04  | W20      | GND      | AA22     | GND      | N15      | PB_13    | K03      |
| DMC0_A05  | U21      | GND      | AB01     | GND      | P09      | PB_14    | L03      |
| DMC0_A06  | W21      | GND      | AB22     | GND      | P10      | PB_15    | M03      |
| DMC0_A07  | T21      | GND      | B21      | GND      | P11      | PC_00    | K01      |
| DMC0_A08  | W22      | GND      | C20      | GND      | P12      | PC_01    | L02      |
| DMC0_A09  | U20      | GND      | D12      | GND      | P13      | PC_02    | L01      |
| DMC0_A10  | R22      | GND      | G01      | GND      | P14      | PC_03    | M02      |
| DMC0_A11  | V22      | GND      | J01      | GND      | W11      | PC_04    | M01      |
| DMC0_A12  | T22      | GND      | J09      | GND      | Y03      | PC_05    | N02      |
| DMC0_A13  | V21      | GND      | J10      | GND      | Y20      | PC_06    | N01      |
| DMC0_BA0  | R21      | GND      | J11      | GND      | C03      | PC_07    | P02      |
| DMC0_BA1  | V20      | GND      | J12      | GND      | B02      | PC_08    | P01      |
| DMC0_BA2  | R20      | GND      | J13      | JTG_EMU  | E02      | PC_09    | R02      |
| DMC0_CAS  | E20      | GND      | J14      | JTG_TCK  | D03      | PC_10    | R01      |
| DMC0_CK   | M20      | GND      | K08      | JTG_TDI  | D01      | PC_11    | T02      |
| DMC0_CKE  | P20      | GND      | K09      | JTG_TDO  | D02      | PC_12    | T01      |
| DMC0_CK   | L20      | GND      | K10      | JTG_TMS  | E03      | PC_13    | U02      |
| DMC0_CS0  | F20      | GND      | K11      | JTG_TRST | E01      | PC_14    | U01      |
| DMC0_DQ00 | M21      | GND      | K12      | PA_00    | A13      | PC_15    | V02      |
| DMC0_DQ01 | M22      | GND      | K13      | PA_01    | B13      | PD_00    | V01      |
| DMC0_DQ02 | P21      | GND      | K14      | PA_02    | A12      | PD_01    | W02      |
| DMC0_DQ03 | N22      | GND      | K15      | PA_03    | B12      | PD_02    | Y02      |
| DMC0_DQ04 | N21      | GND      | L08      | PA_04    | A11      | PD_03    | Y01      |
| DMC0_DQ05 | P22      | GND      | L09      | PA_05    | B11      | PD_04    | W01      |
| DMC0_DQ06 | L21      | GND      | L10      | PA_06    | A10      | PD_05    | AB02     |
| DMC0_DQ07 | L22      | GND      | L11      | PA_07    | B10      | PD_06    | P03      |
| DMC0_DQ08 | F22      | GND      | L12      | PA_08    | A09      | PD_07    | R03      |
| DMC0_DQ09 | H21      | GND      | L13      | PA_09    | B09      | PD_08    | T03      |
| DMC0_DQ10 | E21      | GND      | L14      | PA_10    | A08      | PD_09    | U03      |
| DMC0_DQ11 | J22      | GND      | L15      | PA_11    | B08      | PD_10    | V03      |
| DMC0_DQ12 | J21      | GND      | M04      | PA_12    | A07      | PD_11    | AA01     |
| DMC0_DQ13 | E22      | GND      | M08      | PA_13    | B07      | PD_12    | W03      |
| DMC0_DQ14 | H22      | GND      | M09      | PA_14    | A06      | PD_13    | AA03     |
| DMC0_DQ15 | F21      | GND      | M10      | PA_15    | B06      | PD_14    | AB03     |
| DMC0_LDM  | K20      | GND      | M11      | PB_00    | C12      | PD_15    | Y04      |
| DMC0_LDQS | K22      | GND      | M12      | PB_01    | C11      | PE_00    | AA04     |
| DMC0_LDQS | K21      | GND      | M13      | PB_02    | C10      | PE_01    | AB04     |
| DMC0_ODT  | J20      | GND      | M14      | PB_03    | C09      | PE_02    | Y05      |
| DMC0_RAS  | H20      | GND      | M15      | PB_04    | C08      | PE_03    | AA05     |
| DMC0_UDM  | G20      | GND      | M19      | PB_05    | C07      | PE_04    | AB05     |
| DMC0_UDQS | G21      | GND      | N08      | PB_06    | C06      | PE_05    | Y06      |
| DMC0_UDQS | G22      | GND      | N09      | PB_07    | A05      | PE_06    | Y07      |
| DMC0_WE   | N20      | GND      | N10      | PB_08    | B05      | PE_07    | Y08      |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

| Pin Name        | Ball No. | Pin Name            | Ball No. | Pin Name            | Ball No. | Pin Name            | Ball No. |
|-----------------|----------|---------------------|----------|---------------------|----------|---------------------|----------|
| PE_08           | Y09      | SMC0_BR             | C13      | V <sub>DD_DMC</sub> | K17      | V <sub>DD_INT</sub> | F16      |
| PE_09           | Y10      | SMC0_D00            | A15      | V <sub>DD_DMC</sub> | L17      | V <sub>DD_INT</sub> | G08      |
| PE_10           | Y14      | SMC0_D01            | B15      | V <sub>DD_DMC</sub> | M17      | V <sub>DD_INT</sub> | G09      |
| PE_11           | Y15      | SMC0_D02            | B18      | V <sub>DD_DMC</sub> | N17      | V <sub>DD_INT</sub> | G14      |
| PE_12           | Y13      | SMC0_D03            | A17      | V <sub>DD_DMC</sub> | P17      | V <sub>DD_INT</sub> | G15      |
| PE_13           | AB14     | SMC0_D04            | A18      | V <sub>DD_DMC</sub> | R16      | V <sub>DD_INT</sub> | T08      |
| PE_14           | AA16     | SMC0_D05            | B20      | V <sub>DD_DMC</sub> | R17      | V <sub>DD_INT</sub> | T09      |
| PE_15           | AA15     | SMC0_D06            | C14      | V <sub>DD_DMC</sub> | T16      | V <sub>DD_INT</sub> | T14      |
| PF_00           | AA13     | SMC0_D07            | A19      | V <sub>DD_DMC</sub> | T17      | V <sub>DD_INT</sub> | T15      |
| PF_01           | AB13     | SMC0_D08            | C17      | V <sub>DD_DMC</sub> | U17      | V <sub>DD_INT</sub> | U07      |
| PF_02           | AA12     | SMC0_D09            | B17      | V <sub>DD_EXT</sub> | D11      | V <sub>DD_INT</sub> | U08      |
| PF_03           | AB12     | SMC0_D10            | A20      | V <sub>DD_EXT</sub> | F06      | V <sub>DD_INT</sub> | U09      |
| PF_04           | AA11     | SMC0_D11            | C18      | V <sub>DD_EXT</sub> | F11      | V <sub>DD_INT</sub> | U10      |
| PF_05           | AB11     | SMC0_D12            | C15      | V <sub>DD_EXT</sub> | F12      | V <sub>DD_INT</sub> | U13      |
| PF_06           | AA10     | SMC0_D13            | B19      | V <sub>DD_EXT</sub> | G06      | V <sub>DD_INT</sub> | U14      |
| PF_07           | AB10     | SMC0_D14            | C19      | V <sub>DD_EXT</sub> | G07      | V <sub>DD_INT</sub> | U15      |
| PF_08           | AA09     | SMC0_D15            | B16      | V <sub>DD_EXT</sub> | G10      | V <sub>DD_INT</sub> | U16      |
| PF_09           | AB09     | SYS_BMODE0          | J03      | V <sub>DD_EXT</sub> | G11      | V <sub>DD_TD</sub>  | W12      |
| PF_10           | AA08     | SYS_BMODE1          | H03      | V <sub>DD_EXT</sub> | G12      | V <sub>DD_USB</sub> | E05      |
| PF_11           | AB08     | SYS_BMODE2          | G03      | V <sub>DD_EXT</sub> | G13      | VREF_DMC            | L19      |
| PF_12           | AA07     | SYS_CLKIN           | H01      | V <sub>DD_EXT</sub> | H06      |                     |          |
| PF_13           | AB07     | SYS_CLKOUT          | N03      | V <sub>DD_EXT</sub> | H07      |                     |          |
| PF_14           | AA06     | SYS_EXTWAKE         | K02      | V <sub>DD_EXT</sub> | J06      |                     |          |
| PF_15           | AB06     | SYS_FAULT           | F02      | V <sub>DD_EXT</sub> | K06      |                     |          |
| PG_00           | AA14     | SYS_FAULT           | F01      | V <sub>DD_EXT</sub> | L04      |                     |          |
| PG_01           | Y17      | SYS_NMI_RESOUT      | F03      | V <sub>DD_EXT</sub> | L06      |                     |          |
| PG_02           | AB17     | SYS_PWRGD           | J02      | V <sub>DD_EXT</sub> | M06      |                     |          |
| PG_03           | AB15     | SYS_HWRST           | G02      | V <sub>DD_EXT</sub> | N06      |                     |          |
| PG_04           | Y18      | SYS_TDA             | Y12      | V <sub>DD_EXT</sub> | P06      |                     |          |
| PG_05           | AA17     | SYS_TDK             | Y11      | V <sub>DD_EXT</sub> | R06      |                     |          |
| PG_06           | AB16     | SYS_XTAL            | H02      | V <sub>DD_EXT</sub> | R07      |                     |          |
| PG_07           | AA19     | TWI0_SCL            | C22      | V <sub>DD_EXT</sub> | T06      |                     |          |
| PG_08           | AA18     | TWI0_SDA            | D22      | V <sub>DD_EXT</sub> | T07      |                     |          |
| PG_09           | Y16      | TWI1_SCL            | C21      | V <sub>DD_EXT</sub> | T10      |                     |          |
| PG_10           | AB21     | TWI1_SDA            | D21      | V <sub>DD_EXT</sub> | T11      |                     |          |
| PG_11           | Y19      | USB0_CLKIN          | C01      | V <sub>DD_EXT</sub> | T12      |                     |          |
| PG_12           | AB18     | USB0_DM             | A02      | V <sub>DD_EXT</sub> | T13      |                     |          |
| PG_13           | AA20     | USB0_DP             | A03      | V <sub>DD_EXT</sub> | U06      |                     |          |
| PG_14           | AB19     | USB0_ID             | B03      | V <sub>DD_EXT</sub> | U11      |                     |          |
| PG_15           | AB20     | USB0_VBC            | C02      | V <sub>DD_EXT</sub> | U12      |                     |          |
| SMC0_A01        | A14      | USB0_VBUS           | B01      | V <sub>DD_INT</sub> | F07      |                     |          |
| SMC0_A02        | B14      | V <sub>DD_DMC</sub> | F17      | V <sub>DD_INT</sub> | F08      |                     |          |
| SMC0_AMS0       | A16      | V <sub>DD_DMC</sub> | G16      | V <sub>DD_INT</sub> | F09      |                     |          |
| SMC0_AOE_NORDV  | B22      | V <sub>DD_DMC</sub> | G17      | V <sub>DD_INT</sub> | F10      |                     |          |
| SMC0_ARDY_NORWT | D20      | V <sub>DD_DMC</sub> | H16      | V <sub>DD_INT</sub> | F13      |                     |          |
| SMC0_ARE        | C16      | V <sub>DD_DMC</sub> | H17      | V <sub>DD_INT</sub> | F14      |                     |          |
| SMC0_AWE        | A21      | V <sub>DD_DMC</sub> | J17      | V <sub>DD_INT</sub> | F15      |                     |          |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## 349-BALL CSP\_BGA BALL CONFIGURATION

Figure 71 shows an overview of signal placement on the 349-ball CSP\_BGA package.

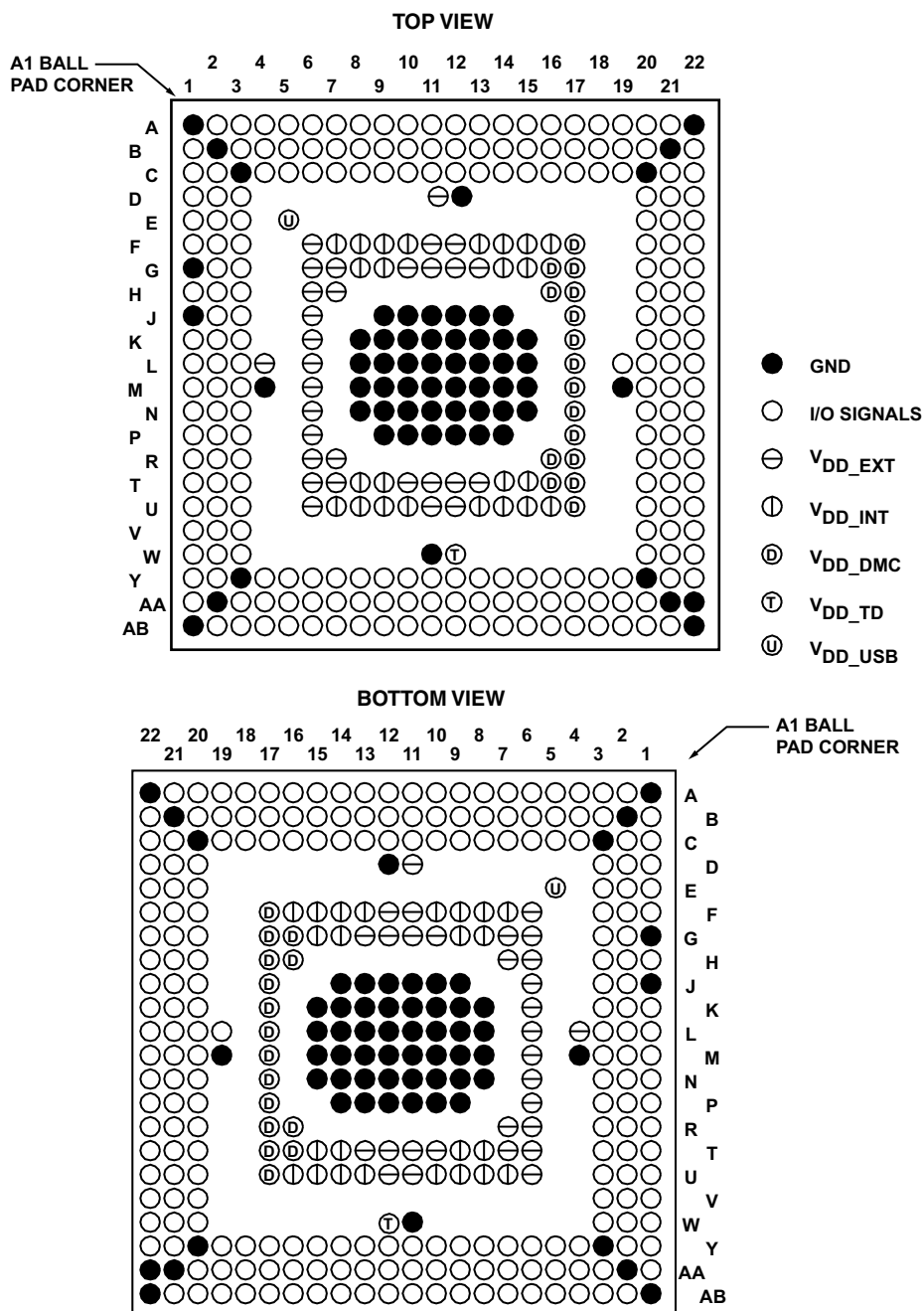
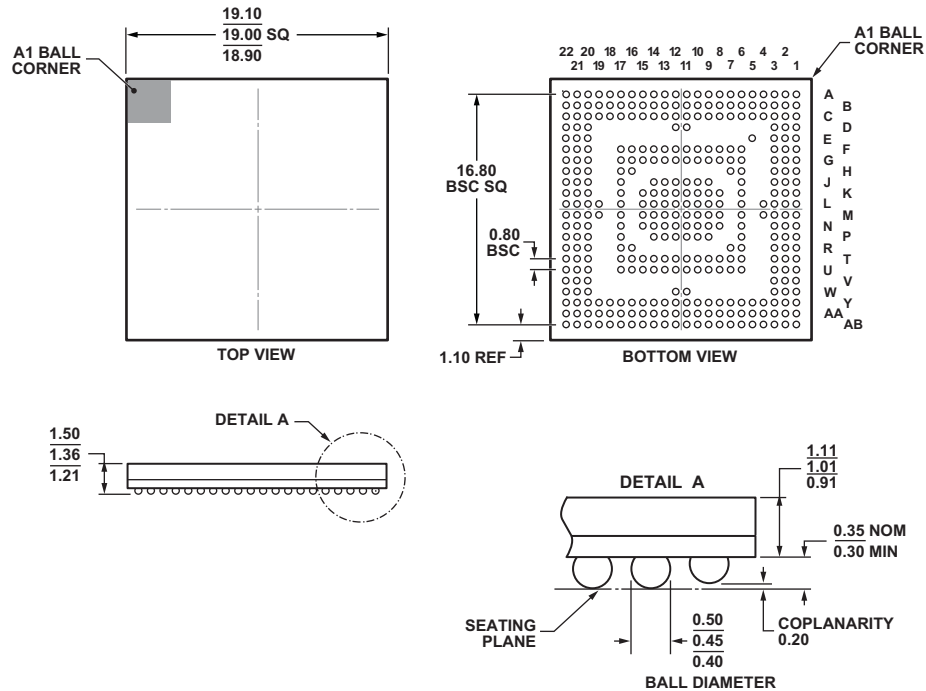


Figure 71. 349-Ball CSP\_BGA Ball Configuration

## OUTLINE DIMENSIONS

Dimensions for the 19 mm × 19 mm CSP\_BGA package in Figure 72 are shown in millimeters.



COMPLIANT TO JEDEC STANDARDS MO-275-PPAB-2.

Figure 72. 349-Ball Chip Scale Package Ball Grid Array [CSP\_BGA]  
(BC-349-1)

Dimensions shown in millimeters

## SURFACE-MOUNT DESIGN

Table 70 is provided as an aid to PCB design. For industry-standard design recommendations, refer to IPC-7351, *Generic Requirements for Surface-Mount Design and Land Pattern Standard*.

Table 70. BGA Data for Use with Surface-Mount Design

| Package  | Package Ball Attach Type | Package Solder Mask Opening | Package Ball Pad Size |
|----------|--------------------------|-----------------------------|-----------------------|
| BC-349-1 | Solder Mask Defined      | 0.4 mm Diameter             | 0.5 mm Diameter       |

# ADSP-BF606/ADSP-BF607/ADSP-BF608/ADSP-BF609

## AUTOMOTIVE PRODUCTS

The models in the following table are available with controlled manufacturing to support the quality and reliability requirements of automotive applications. Note that these automotive models may have specifications that differ from the commercial models and designers should review the product specifications section of this data sheet carefully. Contact your local ADI account representative for specific product ordering information and to obtain the specific Automotive Reliability reports for these models.

| Model <sup>1</sup> | Max. Core Clock | Temperature Range <sup>2</sup> | Package Description | Package Option |
|--------------------|-----------------|--------------------------------|---------------------|----------------|
| ADBF606WCBCZ4xx    | 400 MHz         | –40°C to +105°C                | 349-Ball CSP_BGA    | BC-349-1       |
| ADBF607WCBCZ5xx    | 500 MHz         | –40°C to +105°C                | 349-Ball CSP_BGA    | BC-349-1       |
| ADBF608WCBCZ5xx    | 500 MHz         | –40°C to +105°C                | 349-Ball CSP_BGA    | BC-349-1       |
| ADBF609WCBCZ5xx    | 500 MHz         | –40°C to +105°C                | 349-Ball CSP_BGA    | BC-349-1       |

<sup>1</sup> Z =RoHS compliant part.

<sup>2</sup> Referenced temperature is ambient temperature. The ambient temperature is not a specification. Please see [Operating Conditions on Page 52](#) for the junction temperature (T<sub>j</sub>) specification which is the only temperature specification.

## ORDERING GUIDE

| Model <sup>1</sup> | Max. Core Clock | Temperature Range <sup>2</sup> | Package Description | Package Option |
|--------------------|-----------------|--------------------------------|---------------------|----------------|
| ADSP-BF606KBCZ-4   | 400 MHz         | 0°C to +70°C                   | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF606BBCZ-4   | 400 MHz         | –40°C to +85°C                 | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF607KBCZ-5   | 500 MHz         | 0°C to +70°C                   | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF607BBCZ-5   | 500 MHz         | –40°C to +85°C                 | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF608KBCZ-5   | 500 MHz         | 0°C to +70°C                   | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF608BBCZ-5   | 500 MHz         | –40°C to +85°C                 | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF609KBCZ-5   | 500 MHz         | 0°C to +70°C                   | 349-Ball CSP_BGA    | BC-349-1       |
| ADSP-BF609BBCZ-5   | 500 MHz         | –40°C to +85°C                 | 349-Ball CSP_BGA    | BC-349-1       |

<sup>1</sup> Z =RoHS compliant part.

<sup>2</sup> Referenced temperature is ambient temperature. The ambient temperature is not a specification. Please see [Operating Conditions on Page 52](#) for the junction temperature (T<sub>j</sub>) specification which is the only temperature specification.