

System Interface 9

9.1

OVERVIEW

This chapter describes the basic system interface features of the ADSP-2100 family processors. The system interface includes various hardware and software features used to control the DSP processor.

Processor control pins include a RESET signal, clock signals, flag inputs and outputs, and interrupt requests. This chapter describes only the logical relationships of control signals; consult individual processor data sheets for actual timing specifications.

9.2

CLOCK SIGNALS

The ADSP-2100 family processors may be operated with a TTL-compatible clock signal input to the CLKIN pin or with a crystal connected between the CLKIN and XTAL pins. If an external clock is used, XTAL must be left unconnected. The CLKIN signal may not be halted or changed in frequency during operation.

The ADSP-2101, ADSP-2105, ADSP-2115, and ADSP-2111 processors operate with an input clock frequency equal to the instruction cycle rate. The ADSP-2171, ADSP-2181, and ADSP-21msp58/59 processors operate with an input clock frequency equal to half the instruction rate; for example, a 16.67 MHz input clock produces a 33 MHz instruction rate (30 ns cycle time). Device timing is relative to the internal clock rate which is indicated by the CLKOUT signal.

Because these processors include an on-chip oscillator circuit, an external crystal can be used. The crystal should be connected between the CLKIN and XTAL pins, with two capacitors connected as shown in Figure 9.1, which can be found on the following page. A parallel-resonant, fundamental frequency, microprocessor-grade crystal should be used. The frequency value selected for the crystal should be equal to the desired instruction rate for the processor (for the ADSP-2101, ADSP-2105, ADSP-2115, and ADSP-2111) or half the desired instruction rate (for the ADSP-2171, ADSP-2181, and ADSP-21msp58/59).

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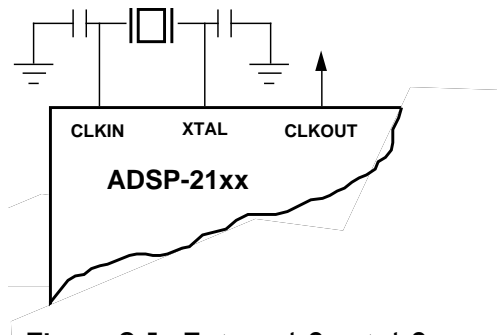


Figure 9.1 External Crystal Connections

The internal phased lock loop of the processors generates an internal clock which is four times the instruction rate.

The processors also generate a CLKOUT signal which is synchronized to the processors' internal cycles and operates at the instruction cycle rate. A phase-locked loop is used to generate CLKOUT and to divide each instruction cycle into a sequence of internal time periods called processor states. The relationship between the phases of CLKIN, CLKOUT, and the processor states is shown in Figure 9.2 for the ADSP-2101, ADSP-2105, ADSP-2115, and ADSP-2111 processors. Figure 9.3 shows the same information for the ADSP-2171, ADSP-2181, and ADSP-21msp58/59 processors. The phases of the internal processor clock are dependent upon the period of the external clock.

The CLKOUT output can be disabled on the ADSP-2171, ADSP-2181, and ADSP-21msp58/59 processors. This is controlled by the CLKODIS bit in the SPORT0 Autobuffer Control Register.

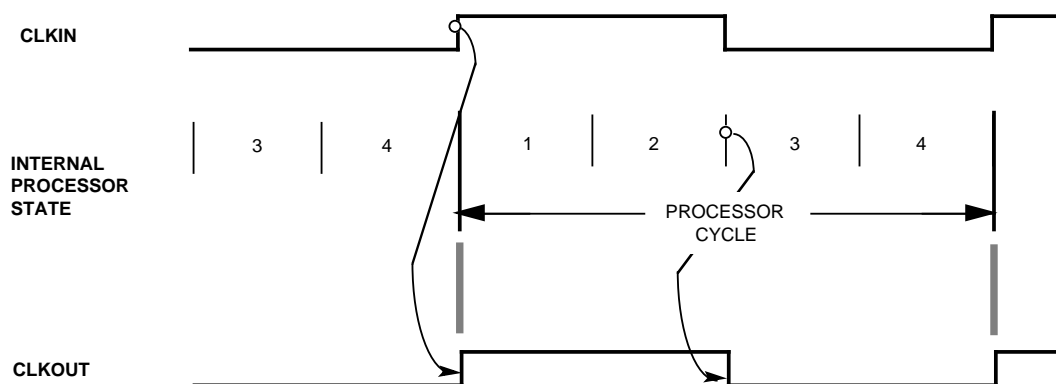


Figure 9.2 Clock Signals & Processor States (ADSP-2101, ADSP-2105, ADSP-2115, ADSP-2111)

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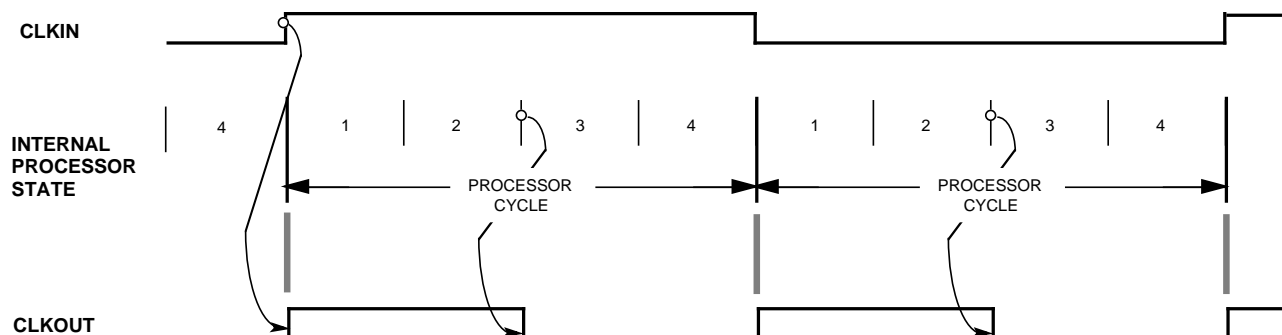


Figure 9.3 Clock Signals & Processor States (ADSP-2171, ADSP-2181, ADSP-21msp58/59)

9.2.1 Synchronization Delay

Each processor has several asynchronous inputs (interrupt requests, for example), which can be asserted in arbitrary phase to the processor clock. The processor synchronizes such signals before recognizing them. The delay associated with signal recognition is called synchronization delay.

Different asynchronous inputs are recognized at different points in the processor cycle. Any asynchronous input must be valid prior to the recognition point to be recognized in a particular cycle. If an input does not meet the setup time on a given cycle, it is recognized either in the current cycle or during the next cycle if it remains valid.

Edge-sensitive interrupt requests are latched internally so that the request signal only has to meet the pulse width requirement. To ensure the recognition of any asynchronous input, however, the input must be asserted for at least one full processor cycle plus setup and hold time. Setup and hold times are specified in the data sheet for each individual device.

9.2.2 1x & 1/2x Clock Considerations

Each processor requires only a 1X or 1/2X frequency clock signal. They use what is effectively an on-chip phase-locked loop to generate the higher frequency internal clock signals and CLKOUT. Because these clocks are generated based on the rising edge of CLKIN, there is no ambiguity about the phase relationship of two processors sharing the same input clock. Multiple processor synchronization is simplified as a result.

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Using a 1X or 1/2X frequency input clock with the phase-locked loop to generate the various internal clocks imposes certain restrictions. The CLKIN signal must be valid long enough to achieve phase lock before RESET can be deasserted. Also, the clock frequency cannot be changed unless the processor is in RESET. Refer to the processor data sheets for details.

9.3

RESET

RESET halts execution and causes a hardware reset of the processor. The RESET signal must be asserted when the processor is powered up to assure proper initialization.

Tables 9.2–9.7 show the RESET state of various registers, including the processors' on-chip memory-mapped status/control registers. The values of any registers not listed are undefined at reset. The contents of on-chip memory are unchanged after RESET, except as shown in Tables 9.2–9.7 for the data-memory-mapped control/status registers. The CLKOUT signal continues to be generated by the processor during RESET, except when disabled on the ADSP-2171, ADSP-2181, or ADSP-21msp58/59.

The contents of the computation unit (ALU, MAC, Shifter) and data address generator (DAG1, DAG2) registers are undefined following RESET.

When RESET is released, the processor's booting operation takes place, depending on the state of the processor's MMAP pin. Program booting is described in Chapter 10, "Memory Interface."

For the ADSP-2111, ADSP-2171, and ADSP-21msp58/59 processors, which include a host interface port, setting the software reset bit in the HSR7 register has the same affect as asserting RESET. This allows either the host processor or the ADSP-21xx to initiate a reset under software control.

In a multiprocessing system with several processors, a synchronous RESET is required.

9.4

SOFTWARE-

FORCED REBOOTING

Software-forced reboots can be accomplished in several ways. A software-forced reboot clears the context of the processor and initializes some registers. A *context clear* clears the processor stacks and restart execution at address 0x0000. Table 9.1 shows the different ways each processor can perform a software reboot.

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<i>Processor</i>	<i>Reboot Method</i>	<i>Description</i>
ADSP-2101 ADSP-2105 ADSP-2111 ADSP-2115	Boot Force	Setting the BFORCE bit in the System Control Register causes a reboot
ADSP-2171	Boot Force	Setting the BFORCE bit in the System Control Register causes a reboot
	Powerup Context Reset	Setting the PUCR bit in the SPORT1 Autobuffer & Powerdown Control Register causes a reboot on recovery from powerdown
ADSP-2181	BDMA Context Reset	Setting the BCR bit in the BDMA Control Register <i>before</i> writing to the BDMA Word Count Register (BWCOUNT) causes a reboot. Execution starts after the BDMA reboot is completed.
	Powerup Context Reset	Setting the PUCR bit in the SPORT1 Autobuffer & Powerdown Control Register causes a reboot on recovery from powerdown

Table 9.1 Software-Forced Rebooting

Tables 9.2–9.7 show the state of the processor registers after a software-forced reboot. The values of any registers not listed are unchanged by a reboot.

During booting (and rebooting), all interrupts including serial port interrupts are masked and autobuffering is disabled. The serial port(s) remain active; one transfer—from internal shift register to data register—can occur for each serial port before there are overrun problems.

The timer runs during a reboot. If a timer interrupt occurs during the reboot, it is masked. Thus, if more than one timer interrupt occurs during the reboot, the processor latches only the first. A timer overrun can occur.

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<i>Control Field</i>	<i>Description</i>	<i>Reset</i>	<i>Reboot</i>
<i>Bus Exchange Register</i>			
PX	PX register	undefined	undefined
<i>Status Registers</i>			
IMASK	Interrupt service enables	0	0
ASTAT	Arithmetic status	0	0
MSTAT	Mode status	0	unchanged
SSTAT	Stack status	0x55	0x55
ICNTL	Interrupt control	undefined	unchanged
IFC	Interrupt force/clear	0	0
<i>Control Registers (memory-mapped)</i>			
BWAIT	Boot memory wait states	3	unchanged
BPAGE	Boot page	0	unchanged
SPORT1 configure	Configuration	1	unchanged
SPE0	SPORT0 enable	0	unchanged
SPE1	SPORT1 enable	0	unchanged
DWAIT0–4	Data memory wait states	7	unchanged
PWAIT	Program memory wait	7	unchanged
TCOUNT	Timer count register	undefined	operates during reboot
TPERIOD	Timer period register	undefined	unchanged
TSCALE	Timer scale register	undefined	unchanged
<i>Serial Port Control Registers (memory-mapped, one set per SPORT)</i>			
ISCLK	Internal serial clock	0	unchanged
RFSR, TFSR	Frame sync required	0	unchanged
RFSW, TFSW	Frame sync width	0	unchanged
IRFS, ITFS	Internal frame sync	0	unchanged
INVRFS, INVTFS	Invert frame sense	0	unchanged
DTYPE	Companding type, format	0	unchanged
SLEN	Serial word length	0	unchanged
SCLKDIV	Serial clock divide	undefined	unchanged
RFSDIV	RFS divide	undefined	unchanged
Multichannel word enable bits		undefined	unchanged
MCE	Multichannel enable	0	unchanged
MCL	Multichannel length	0	unchanged
MFD	Multichannel frame delay	0	unchanged
INVTDV	Invert transmit data valid	0	unchanged
RBUF, TBUF	Autobuffering enable	0	0
TIREG, RIREG	Autobuffer I index	undefined	unchanged
TMREG, RMREG	Autobuffer M index	undefined	unchanged
FO (<i>SPORT1 only</i>)	Flag Out value	undefined	unchanged

Table 9.2 ADSP-2101/ADSP-2115 State After Reset Or Software Reboot

System Interface 9

<i>Control Field</i>	<i>Description</i>	<i>Reset</i>	<i>Reboot</i>
<i>Bus Exchange Register</i>			
PX	PX register	undefined	undefined
<i>Status Registers</i>			
IMASK	Interrupt service enables	0	0
ASTAT	Arithmetic status	0	0
MSTAT	Mode status	0	unchanged
SSTAT	Stack status	0x55	0x55
ICNTL	Interrupt control	undefined	unchanged
IFC	Interrupt force/clear	0	0
<i>Control Registers (memory-mapped)</i>			
BWAIT	Boot memory wait states	3	unchanged
BPAGE	Boot page	0	unchanged
SPORT1 configure	Configuration	1	unchanged
SPE1	SPORT1 enable	0	unchanged
DWAIT0–4	Data memory wait states	7	unchanged
PWAIT	Program memory wait	7	unchanged
TCOUNT	Timer count register	undefined	operates during reboot
TPERIOD	Timer period register	undefined	unchanged
TSCALE	Timer scale register	undefined	unchanged
<i>Serial Port 1 Control Registers (memory-mapped)</i>			
ISCLK	Internal serial clock	0	unchanged
RFSR, TFSR	Frame sync required	0	unchanged
RFSW, TFSW	Frame sync width	0	unchanged
IRFS, ITFS	Internal frame sync	0	unchanged
INVRFS, INVTFS	Invert frame sense	0	unchanged
DTYPE	Companding type, format	0	unchanged
SLEN	Serial word length	0	unchanged
SCLKDIV	Serial clock divide	undefined	unchanged
RFSDIV	RFS divide	undefined	unchanged
RBUF, TBUF	Autobuffering enable	0	0
TIREG, RIREG	Autobuffer I index	undefined	unchanged
TMREG, RMREG	Autobuffer M index	undefined	unchanged
FO	Flag Out value	undefined	unchanged

Table 9.3 ADSP-2105 State After Reset Or Software Reboot

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<i>Control Field</i>	<i>Description</i>	<i>Reset</i>	<i>Reboot</i>
<i>Bus Exchange Register</i>			
PX	PX register	undefined	undefined
<i>Status Registers</i>			
IMASK	Interrupt service enables	0	0
ASTAT	Arithmetic status	0	0
MSTAT	Mode status	0	unchanged
SSTAT	Stack status	0x55	0x55
ICNTL	Interrupt control	undefined	unchanged
IFC	Interrupt force/clear	0	0
<i>Control Registers (memory-mapped)</i>			
BWAIT	Boot memory wait states	3	unchanged
BPAGE	Boot page	0	unchanged
SPORT1 configure	Configuration	1	unchanged
SPE0	SPORT0 enable	0	unchanged
SPE1	SPORT1 enable	0	unchanged
DWAIT0–4	Data memory wait states	7	unchanged
PWAIT	Program memory wait	7	unchanged
TCOUNT	Timer count register	undefined	operates during reboot
TPERIOD	Timer period register	undefined	unchanged
TSCALE	Timer scale register	undefined	unchanged
<i>Serial Port Control Registers (memory-mapped, one set per SPORT)</i>			
ISCLK	Internal serial clock	0	unchanged
RFSR, TFSR	Frame sync required	0	unchanged
RFSW, TFSW	Frame sync width	0	unchanged
IRFS, ITFS	Internal frame sync	0	unchanged
INVRFS, INVTFSS	Invert frame sense	0	unchanged
DTYPE	Companding type, format	0	unchanged
SLEN	Serial word length	0	unchanged
SCLKDIV	Serial clock divide	undefined	unchanged
RFSDIV	RFS divide	undefined	unchanged
Multichannel word enable bits		undefined	unchanged
MCE	Multichannel enable	0	unchanged
MCL	Multichannel length	0	unchanged
MFD	Multichannel frame delay	0	unchanged
INVTDV	Invert transmit data valid	0	unchanged
RBUF, TBUF	Autobuffering enable	0	0
TIREG, RIREG	Autobuffer I index	undefined	unchanged
TMREG, RMREG	Autobuffer M index	undefined	unchanged
FO (<i>SPORT1 only</i>)	Flag Out value	undefined	unchanged
<i>Host Interface Port Registers (memory-mapped)</i>			
HDR0-5	HIP data registers	undefined	used during HIP reboot
HSR6	HIP status register	0x0000	used during HIP reboot
HSR7	HIP status register	0x0080	unchanged
HMASK	HIP interrupt enables	0	unchanged

Table 9.4 ADSP-2111 State After Reset Or Software Reboot

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<i>Control Field</i>	<i>Description</i>	<i>Reset</i>	<i>Reboot</i>
<i>Bus Exchange Register</i>			
PX	PX register	undefined	undefined
<i>Status Registers</i>			
IMASK	Interrupt service enables	0	0
ASTAT	Arithmetic status	0	0
MSTAT	Mode status	0	unchanged
SSTAT	Stack status	0x55	0x55
ICNTL	Interrupt control	undefined	unchanged
IFC	Interrupt force / clear	0	0
<i>Control Registers (memory-mapped)</i>			
BWAIT	Boot memory wait states	3	unchanged
BPAGE	Boot page	0	unchanged
SPORT1 configure	Configuration	1	unchanged
SPE0	SPORT0 enable	0	unchanged
SPE1	SPORT1 enable	0	unchanged
DWAIT0–4	Data memory wait states	7	unchanged
PWAIT	Program memory wait	7	unchanged
TCOUNT	Timer count register	undefined	operates during reboot
TPERIOD	Timer period register	undefined	unchanged
TSCALE	Timer scale register	undefined	unchanged
ROMENABLE	Program memory ROM enable	0	unchanged
PDFORCE	Powerdown force	0	unchanged
PUCR	Powerup context reset	0	unchanged
XTALDIS	XTAL pindrive disable	0	unchanged
	during powerdown		
XTALDELAY	Delay startup from powerdown (4096 cycles)	0	unchanged
<i>Serial Port Control Registers (memory-mapped, one set per SPORT)</i>			
ISCLK	Internal serial clock	0	unchanged
RFSR, TFSR	Frame sync required	0	unchanged
RFSW, TFSW	Frame sync width	0	unchanged
IRFS, ITFS	Internal frame sync	0	unchanged
INVRFS, INVTFS	Invert frame sense	0	unchanged
DTYPE	Companding type, format	0	unchanged
SLEN	Serial word length	0	unchanged
SCLKDIV	Serial clock divide	undefined	unchanged
RFSDIV	RFS divide	undefined	unchanged
Multichannel word enable bits		undefined	unchanged
MCE	Multichannel enable	0	unchanged
MCL	Multichannel length	0	unchanged
MFD	Multichannel frame delay	0	unchanged
INVTDV	Invert transmit data valid	0	unchanged
RBUF, TBUF	Autobuffering enable	0	0
TIREG, RIREG	Autobuffer I index	undefined	unchanged
TMREG, RMREG	Autobuffer M index	undefined	unchanged

Table 9.5 ADSP-2171 State After Reset Or Software Reboot (cont. on next page)

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FO (<i>SPORT1 only</i>)	Flag Out value	undefined	unchanged
CLKODIS	CLKOUT disable	0	unchanged
BIASRND	MAC biased rounding	0	unchanged
<i>Host Interface Port Registers (memory-mapped)</i>			
HDR0-5	HIP data registers	undefined	used during HIP reboot
HSR6	HIP status register	0x0000	used during HIP reboot
HSR7	HIP status register	0x0080	unchanged
HMASK	HIP interrupt enables	0	unchanged

Table 9.5 ADSP-2171 State After Reset Or Software Reboot

<i>Control Field</i>	<i>Description</i>	<i>Reset</i>	<i>Reboot</i>
<i>Bus Exchange Register</i>			
PX	PX register	undefined	undefined
<i>Status Registers</i>			
IMASK	Interrupt service enables	0	0
ASTAT	Arithmetic status	0	0
MSTAT	Mode status	0	unchanged
SSTAT	Stack status	0x55	0x55
ICNTL	Interrupt control	undefined	unchanged
IFC	Interrupt force/clear	0	0
<i>Control Registers (memory-mapped)</i>			
BWAIT	Boot memory wait states	3	unchanged
BPAGE	Boot page	0	unchanged
SPORT1 configure	Configuration	1	unchanged
SPE0	SPORT0 enable	0	unchanged
SPE1	SPORT1 enable	0	unchanged
DWAIT0-4	Data memory wait states	7	unchanged
PWAIT	Program memory wait	7	unchanged
TCOUNT	Timer count register	undefined	operates during reboot
TPERIOD	Timer period register	undefined	unchanged
TSCALE	Timer scale register	undefined	unchanged
PDFORCE	Powerdown force	0	unchanged
PUCR	Powerup context reset	0	unchanged
XTALDIS	XTAL pindrive disable	0	unchanged
	during powerdown		
XTALDELAY	Delay startup from powerdown (4096 cycles)	0	unchanged

Table 9.6 ADSP-2181 State After Reset Or Software Reboot (cont. on next page)

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Serial Port Control Registers (memory-mapped, one set per SPORT)

ISCLK	Internal serial clock	0	unchanged
RFSR, TFSR	Frame sync required	0	unchanged
RFSW, TFSW	Frame sync width	0	unchanged
IRFS, ITFS	Internal frame sync	0	unchanged
INVRFS, INVTFS	Invert frame sense	0	unchanged
DTYPE	Companding type, format	0	unchanged
SLEN	Serial word length	0	unchanged
SCLKDIV	Serial clock divide	undefined	unchanged
RFSDIV	RFS divide	undefined	unchanged
Multichannel word enable bits		undefined	unchanged
MCE	Multichannel enable	0	unchanged
MCL	Multichannel length	0	unchanged
MFD	Multichannel frame delay	0	unchanged
INVTDV	Invert transmit data valid	0	unchanged
RBUF, TBUF	Autobuffering enable	0	0
TIREG, RIREG	Autobuffer I index	undefined	unchanged
TMREG, RMREG	Autobuffer M index	undefined	unchanged
FO (<i>SPORT1 only</i>)	Flag Out value	undefined	unchanged
CLKODIS	CLKOUT disable	0	unchanged
BIASRND	MAC biased rounding	0	unchanged

External Memory Control Registers (non-memory-mapped)

DMOVLAY	Data memory overlay select	0	unchanged
PMOVLAY	Program memory overlay select	0	unchanged
<i>(memory-mapped)</i>			
DWAIT	Data memory overlay wait states	0x7	unchanged
PWAIT	Program memory overlay wait states	0x7	unchanged
BMWAIT	Byte memory wait states	0x7	unchanged
IOWAIT0-3	I/O memory wait states	0x7	unchanged
CMSSEL	Composite memory select	0xB	unchanged

Programmable Flag Data & Control Registers (memory-mapped)

PFDATA	Programmable flag data	undefined	unchanged
PFTYPE	Programmable flag direction	0	unchanged

DMA Control Registers (memory-mapped)

IDMAA	IDMA Internal Memory Address	0x00	unchanged
IDMAD	IDMA Destination Memory Type	0	unchanged
BIAD	BDMA Internal Memory Address	0	0x20*
BEAD	BDMA External Memory Address	0	0x60*
BTYPE	BDMA Transfer Word Type	0	unchanged
BDIR	BDMA Transfer Direction	0	unchanged
BCR	BDMA Context Reset	1	unchanged
BWCOUNT	BDMA Word Count	0x20	0*
BMPAGE	External Byte Memory Page	0	0*

Table 9.6 ADSP-2181 State After Reset Or Software Reboot

* These values assume that you have just completed an initial BDMA boot load of the ADSP-2181 (MMAP=0 & BMODE=0). For more information on BDMA register contents during the boot loading process see Table 9.8. These values will vary with a processor reboot (other than initial load), since they depend on the previous values.

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<i>Control Field</i>	<i>Description</i>	<i>Reset</i>	<i>Reboot</i>
<i>Bus Exchange Register</i>			
PX	PX register	undefined	undefined
<i>Status Registers</i>			
IMASK	Interrupt service enables	0	0
ASTAT	Arithmetic status	0	0
MSTAT	Mode status	0	unchanged
SSTAT	Stack status	0x55	0x55
ICNTL	Interrupt control	undefined	unchanged
IFC	Interrupt force/clear	0	0
<i>Control Registers (memory-mapped)</i>			
BWAIT	Boot memory wait states	3	unchanged
BPAGE	Boot page	0	unchanged
SPORT1 configure	Configuration	1	unchanged
SPE0	SPORT0 enable	0	unchanged
SPE1	SPORT1 enable	0	unchanged
DWAIT0–4	Data memory wait states	7	unchanged
PWAIT	Program memory wait	7	unchanged
TCOUNT	Timer count register	undefined	operates during reboot
TPERIOD	Timer period register	undefined	unchanged
TSCALE	Timer scale register	undefined	unchanged
ROMENABLE	Program memory ROM enable	0	unchanged
PDFORCE	Powerdown force	0	unchanged
PUCR	Powerup context reset	0	unchanged
XTALDIS	XTAL pindrive disable	0	unchanged
	during powerdown		
XTALDELAY	Delay startup from powerdown (4096 cycles)	0	unchanged
<i>Serial Port Control Registers (memory-mapped, one set per SPORT)</i>			
ISCLK	Internal serial clock	0	unchanged
RFSR, TFSR	Frame sync required	0	unchanged
RFSW, TFSW	Frame sync width	0	unchanged
IRFS, ITFS	Internal frame sync	0	unchanged
INVRFS, INVTFS	Invert frame sense	0	unchanged
DTYPE	Companding type, format	0	unchanged
SLEN	Serial word length	0	unchanged
SCLKDIV	Serial clock divide	undefined	unchanged
RFSDIV	RFS divide	undefined	unchanged
	Multichannel word enable bits	undefined	unchanged
MCE	Multichannel enable	0	unchanged
MCL	Multichannel length	0	unchanged
MFD	Multichannel frame delay	0	unchanged
INVTDV	Invert transmit data valid	0	unchanged
RBUF, TBUF	Autobuffering enable	0	0
TIREG, RIREG	Autobuffer I index	undefined	unchanged
TMREG, RMREG	Autobuffer M index	undefined	unchanged

Table 9.7 ADSP-21msp58/59 State After Reset Or Software Reboot (cont. on next page)

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FO (<i>SPORT1</i> only)	Flag Out value	undefined	unchanged
CLKODIS	CLKOUT disable	0	unchanged
BIASRND	MAC biased rounding	0	unchanged
<i>Host Interface Port Registers (memory-mapped)</i>			
HDR0-5	HIP data registers	undefined	used during HIP reboot
HSR6	HIP status register	0x0000	used during HIP reboot
HSR7	HIP status register	0x0080	unchanged
HMASK	HIP interrupt enables	0	unchanged
<i>Analog Autobuffer/Powerdown Registers</i>			
ARBUF	Receive autobuffer enable	0	0
ATBUF	Transmit autobuffer enable	0	0
control bits	Analog autobuffer control bits	0	unchanged

Table 9.7 ADSP-21msp58/59 State After Reset Or Software Reboot

9.4.1 ADSP-2181 Register Values for BDMA Booting

The state of some ADSP-2181 registers during reset and rebooting is influenced by the MMAP and BMODE pins. If these pins are set for a BDMA boot, the values in the BDMA registers change as shown in Table 9.8.

Register	Process Description*	Value Before Boot	Value After Boot
BIAD	BDMA Internal Memory Address. Set for internal address 0.	0	0x20
BEAD	BDMA External Memory Address. Set for external address 0.	0	0x60
BTYPE	BDMA Transfer Word Type. Set for 24-bit program memory words.	0	0
BDIR	BDMA Transfer Direction. Set to transfer data from byte memory.	0	0
BMPAGE	BDMA Page Selection. Set to byte memory page 0.	0	0
BWCOUNT	BDMA Word Count. Set to transfer 32 words.	0x20	0
BMWAIT	BDMA Port Wait States. Set to 7 waits per transfer.	0x7	0x7
BCR	BDMA Context Reset. **	1	1

Table 9.8 BDMA Registers Before And After Initial Boot Loading

* Assuming MMAP=0 and BMODE=0 for a BDMA boot.

** Set to 1 to (a) holdoff instruction execution during BDMA transfer, (b) start execution at address PM(0x0000) after BDMA transfer, and (c) leave a BDMA interrupt pending. This sequence of events occurs if BCR is set before BWCOUNT is written, or after the initial boot.

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9.5 INTERRUPTS

EXTERNAL

Each ADSP-2100 family processor has a number of prioritized, individually maskable external interrupts which can be either level- or edge-triggered. These interrupt request pins are named IRQ0, IRQ1, and IRQ2. The IRQ0 and IRQ1 pins are only available as the (optional) alternate configuration of SPORT1. The configuration of SPORT1 as either a serial port or as interrupts (and flags) is determined by bit 10 of the processor's system control register.

The ADSP-2181 processor additionally has two dedicated level-triggered interrupt request pins and one dedicated edge-triggered interrupt request pin; these are IRQL0, IRQL1, and IRQE.

Internal interrupts, including serial port, timer, host interface port, DMA and analog interface interrupts, are discussed in other chapters. Additional information about interrupt masking, set up, and operation can be found in Chapter 3, "Program Control."

9.5.1 Interrupt Sensitivity

Individual external interrupts can be configured in the ICNTL register as either level-sensitive or edge-sensitive.

Level-sensitive interrupts operate by asserting the interrupt request line (IRQx) until the request is recognized by the processor. Once recognized, the request must be deasserted before unmasking the interrupt so that the DSP does not continually respond to the interrupt.

In contrast, edge-triggered interrupt requests are latched when any high-to-low transition occurs on the interrupt line. The processor latches the interrupt so that the request line may be held at any level for an arbitrarily long period between interrupts. This latch is automatically cleared when the interrupt is serviced. Edge-triggered interrupts require less external hardware than level-sensitive requests since there is never a need to hold or negate the request. With level-sensitive interrupts, however, many interrupting devices can share a single request input; this allows easy system expansion.

An interrupt request will be serviced if it is not masked (in the IMASK register) and a higher priority request is not pending. Valid requests initiate an interrupt servicing sequence that vectors the processor to the appropriate interrupt vector address. The interrupt vector addresses for each family processor are given in Appendix D. There is a synchronization delay

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associated with both external interrupt request lines and internal interrupts.

If an interrupt occurs during a waitstated external memory access or during the extra cycles required to execute an instruction that accesses external memory more than once, it is not recognized between the cycles, only before or after. Edge-sensitive interrupts are latched, but not serviced, during bus grant (BG) unless the GO mode is enabled.

In order to service an interrupt, the processor must be running and executing instructions. The IDLE instruction can be used to effectively halt processor operations while waiting for an interrupt.

Edge-sensitive and level-sensitive interrupt requests are serviced similarly. Edge-sensitive interrupts may remain active (low) indefinitely, while level-sensitive interrupts must be deasserted before the RTI instruction is executed; otherwise, the same interrupt immediately recurs.

Care must be taken with the serial port (SPORT1) that can be configured for alternate functions (IRQ0 and IRQ1). If the RFS1 or TFS1 input is held low when SPORT1 is configured as the serial port and then is reconfigured as IRQ0 and IRQ1, an interrupt request can be generated. This interrupt request can be cleared with the use of the IFC register.

9.6

FLAG PINS

All ADSP-21xx processors provide flag pins. The alternate configuration of SPORT1 includes a Flag In (FI) pin and a Flag Out (FO) pin. The configuration of SPORT1 as either a serial port or as flags and interrupts is selected by bit 10 of the processor's system control register.

FI can be used to control program branching, using the IF FLAG_IN and IF NOT FLAG_IN conditions of the JUMP and CALL instructions. These conditions are evaluated based on the last state of the FI pin; FLAG_IN is true if FI was last sampled as a 1 and false if last sampled as a 0. FO can be used as a general purpose external signal. The state of FO is also available as a read-only bit of the SPORT1 control register.

The ADSP-2111, ADSP-2171, ADSP-2181, and ADSP-21msp58/59 processors have three additional flag output pins: FL0, FL1 and FL2. These flags (and FO) can be controlled in software to signal events or conditions to any external device such as a host processor. The Modify Flag Out instruction, which is conditional, can perform SET, RESET and TOGGLE actions—this instruction allows programs executing on the DSP processor to control the state of its flag output pins. Note that if the condition in the Modify Flag Out instruction is CE

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(counter expired), the counter is not decremented as in other IF CE instructions.

Flag outputs FL0, FL1 and FL2 are set to 1 at RESET. The Flag Out (F0) is not affected by RESET.

The ADSP-2181 has eight additional general-purpose flag pins, PF7-0. These flags can be programmed as either inputs or outputs; they default to inputs following reset. The PFx pins are programmed with the use of two memory-mapped registers. The Programmable Flag & Composite Select Control Register determines the flag direction: 1=output and 0=input. The Programmable Flag Data Register is used to read and write the values on the pins. Data being read from a pin configured as an input is synchronized to the processor's clock. Pins configured as outputs drive the appropriate output value. When the PFDATA register is read, any pins configured as outputs will read back the value being driven out.

Programmable Flag & Composite Select Control

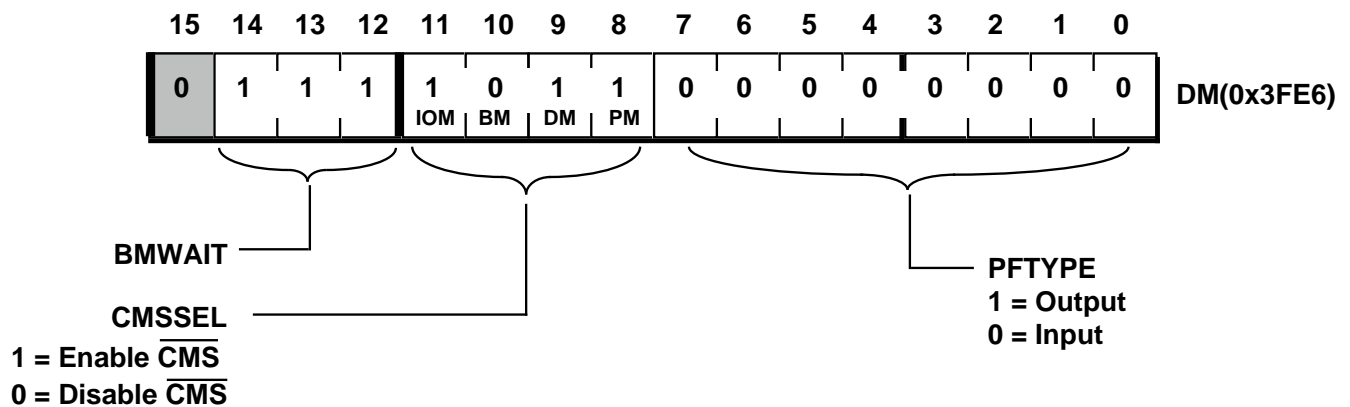


Figure 9.4 Programmable Flag & Composite Select Control Register (ADSP-2181)

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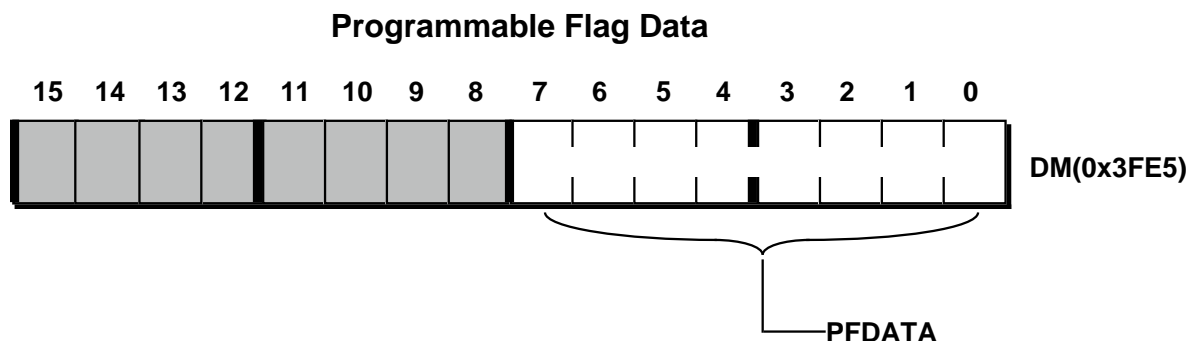


Figure 9.5 Programmable Flag Data Register (ADSP-2181)

9.7 POWERDOWN

The ADSP-2171, ADSP-2181, and ADSP-21msp58/59 provide a powerdown feature that allows the processor to enter a very low power dormant state through hardware or software control. In this CMOS standby state, power consumption is less than 1 mW (approximate). (Refer to the processor data sheet for exact power consumption specifications.)

The powerdown feature is useful for applications where power conservation is necessary, for example in battery-powered operation. Features of powerdown include:

- Internal clocks are disabled
- Processor registers and memory contents are maintained
- Ability to recover from powerdown in less than 100 CLKIN cycles
- Ability to disable internal oscillator when using crystal
- No need to shut down clock for lowest power when using external oscillator
- Interrupt support for executing “housekeeping” code before entering powerdown and after recovering from powerdown
- User selectable powerup context

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Even though the processor is put into the powerdown mode, the lowest level of power consumption still might not be achieved if certain guidelines are not followed. Lowest possible power consumption requires no additional current flow through processor output pins and no switching activity on active input pins. Therefore, a careful analysis of pin loading in your circuit is required. The following sections detail the proper powerdown procedure as well as provide guidelines for clock and output pin connections required for optimum low-power performance.

9.7.1 Powerdown Control

You can control several parameters of powerdown operation through control bits in the SPORT1 Autobuffer / Powerdown Control Register (or Analog Autobuffer / Powerdown Control Register on the ADSP-21msp58/59). This control register is memory-mapped at location 0x3FEF and is shown in Figure 9.6.

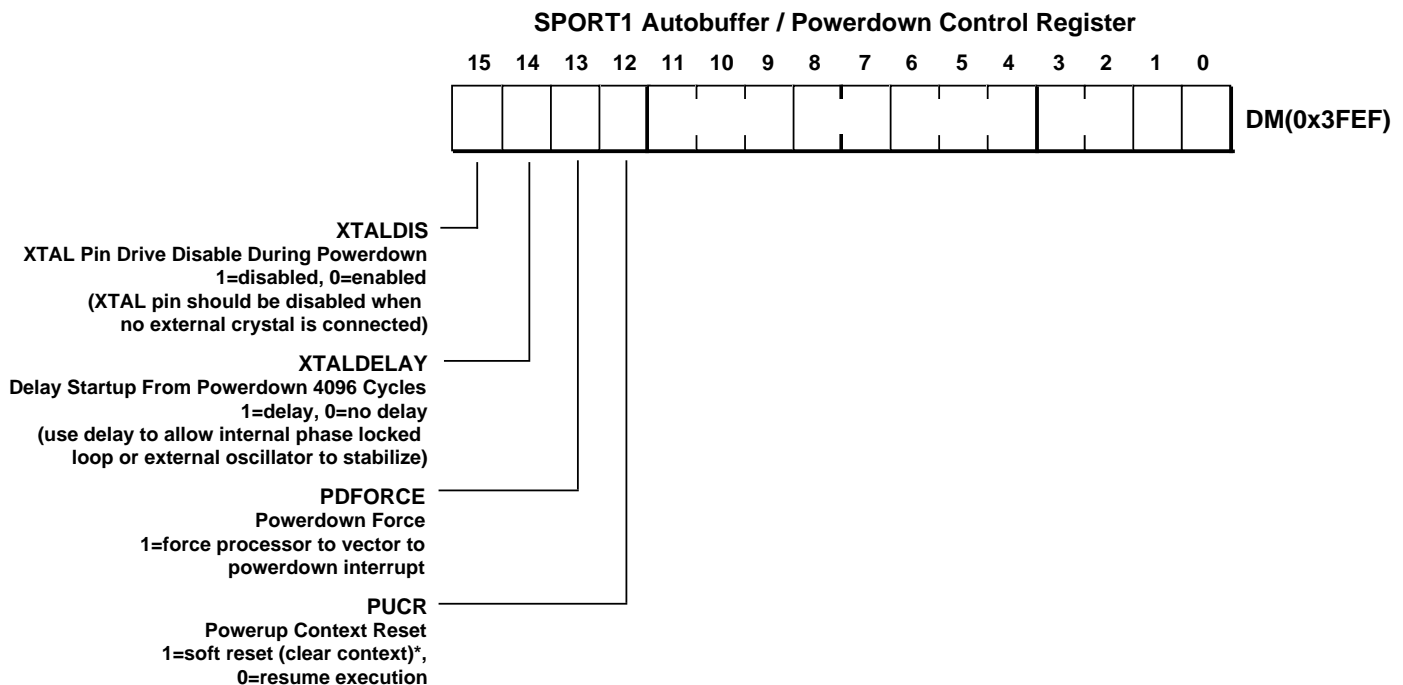


Figure 9.6 SPORT1 Autobuffer / Powerdown Control Register

* PUCR=1: Clears the PC, STATUS, LOOP and CNTR stacks. IMASK and ASTAT registers are cleared to 0 and SSTAT is set to 0x55. The processor will start executing instructions from address 0x0000.

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9.7.2 Entering Powerdown

The powerdown sequence is defined as follows.

- 1.) Initiate the powerdown sequence by applying a high-to-low transition to the PWD pin or by setting the powerdown force control bit (PDFORCE) in the SPORT1 Autobuffer/Powerdown Control Register.
- 2.) The processor vectors to the non-maskable powerdown interrupt vector at address 0x002C. (Note: The powerdown interrupt is never masked. You must be careful not to cause multiple powerdown interrupts to occur or stack overflow may result. Multiple powerdown interrupts can occur if the PWD input is pulsed while the processor is already servicing the powerdown interrupt.)
- 3.) Any number of housekeeping instructions, starting at location 0x002C, can be executed prior to the processor entering the powerdown mode. Typically, this section of code is used to configure the powerdown state, disable on-chip peripherals and clear pending interrupts.
- 4.) The processor now enters powerdown mode when it executes an IDLE instruction (while PWD is asserted). The processor may take either one or two cycles to power down depending upon internal clock states during the execution of the IDLE instruction. All register and memory contents are maintained while in powerdown. Also, all active outputs are held in whatever state they are in before going into powerdown.

If an RTI is executed before the IDLE instruction, then the processor returns from the powerdown interrupt and the powerdown sequence is aborted.

While the processor is in the powerdown mode, the processor is in CMOS standby. This allows the lowest level of power consumption where most input pins are ignored. Active inputs need to be held at CMOS levels to achieve lowest power. More information can be found in the section “Operation During Powerdown” later in this chapter.

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9.7.3 Exiting Powerdown

The powerdown mode can be exited with the use of the PWD pin or with RESET. There are also several user-selectable modes for start-up from powerdown which specify a start-up delay as well as specify the program flow after start-up. This allows the program to resume from where it left off before powerdown or for the program context to be cleared.

9.7.3.1 Ending Powerdown With The PWD Pin

Applying a low-to-high transition to the PWD pin will take the processor out of powerdown mode. You have the option of selecting the amount of time the processor takes to come out of the powerdown mode with the “delay start-up from powerdown” control bit (XTALDELAY, bit 14 in the Powerdown Control Register.) If this bit is cleared to 0, no additional delay over the quick start-up (100 cycles) is introduced. If this bit is set to 1, a delay of 4096 cycles is introduced. The delay feature is used depending upon the state of an external clock oscillator at the time of powerup or if the internal clock is disabled. This is further discussed in the sections “Systems Using an External TTL/CMOS Clock” and “Systems Using a Crystal and The Internal Oscillator.”

You can also program one of two options directing the processor how to resume operation. The context for exiting powerdown is set by bit 12 (PUCR, powerup context reset) of the Powerdown Control Register.

If the PUCR control bit is cleared to 0, the processor will continue to execute instructions following the IDLE instruction. For example, a high-to-low transition is applied to the PWD pin which causes the processor to vector to the powerdown interrupt routine. In this routine, a few housekeeping tasks are performed and the IDLE instruction is executed. The processor powers down. Some time later a low-to-high transition is applied to the PWD pin, causing the processor to exit powerdown mode. Since the PUCR bit is 0, the processor resumes executing instructions in the powerdown interrupt routine, starting at the instruction following the IDLE instruction. When an RTI instruction is encountered, control then passes back to the main routine.

If the PUCR bit is set to 1 for a clear context, the processor resumes operation from powerdown by clearing the PC, STATUS, LOOP and CNTR stacks. The IMASK and ASTAT registers are set to 0 and the SSTAT goes to 0x55. The processor will start executing instructions from address 0x0000.

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9.7.3.2 Ending Powerdown With The RESET Pin

If RESET is asserted while the processor is in the powerdown mode, the processor is reset and instructions are executed from address 0x0000. A boot is performed if the MMAP pin is set to 0. If the RESET pin is used to exit powerdown, then it must be held low for the appropriate number of cycles. If the clock is stopped at powerup or operating at a different frequency at powerup than it was before powerdown, RESET must be held long enough for the oscillator to stabilize plus an additional 1000 CLKIN cycles for the phase locked loop to lock. The time required for the oscillator to stabilize depends upon the type of crystal used and capacitance of the external crystal circuit. Typically 2000 CLKIN cycles is adequate for clock stabilization time.

If the clock was not stopped at powerup and is at a stable frequency at powerup (same as before powerdown), only 5 cycles of RESET are required.

When ending powerdown with RESET, the XTALDELAY (delay start-up from powerdown) control bit is ignored.

9.7.4 Startup Time After Powerdown

The time required to exit the powerdown state depends on whether an internal or external oscillator is used, and the method used to exit powerdown.

9.7.4.1 Systems Using An External TTL/CMOS Clock

When the processor is in powerdown, the external clock signal is ignored if the XTALDIS bit (XTAL pin disable) of the Powerdown Control Register is set to 1. It is therefore not necessary to stop the external clock since no power is wasted while the external clock is running. If the external clock is to be stopped anyway, it must be kept running for (at least) one additional cycle after the IDLE instruction is executed.

The XTALDIS bit should always be set before entering powerdown. This specifies that the XTAL pin is not to be driven by the processor. During powerdown there is no need to drive the XTAL pin when an external oscillator is used. Disabling the XTAL pin drive during powerdown lets the input clock run without wasting power.

After the processor is taken out of the powerdown mode by either the PWD pin or RESET, it will begin executing instructions after a maximum start-up time of 100 CLKIN cycles as long as the clock oscillator is stable and at the same frequency as before powerdown.

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If the external clock is unstable when the processor exits powerdown, then the XTALDELAY control bit can be used. This allows time for the external clock to stabilize by inserting an additional 4096-cycle delay before the processor starts to execute instructions. The start-up delay can only be used when the processor is taken out of powerdown mode with the PWD pin.

If the processor is taken out of powerdown by RESET and the clock is stable and at the same frequency as before powerdown, RESET needs to be held for only 5 cycles.

9.7.4.2 Systems Using A Crystal And The Internal Oscillator

A trade-off can be made so that a fast start-up is possible, but power is consumed by leaving the oscillator running during powerdown. If a fast start-up is desired, then you must clear bits 14 (XTALDELAY) and 15 (XTALDIS) of the Powerdown Control Register to 0 before entering powerdown. This selects no additional delay after start-up from powerdown and drives the external crystal during powerdown. In this configuration, the oscillator will continue to operate and the processor will start executing instructions in less than 100 cycles after the low to high signal transition at the PWD pin. The XTAL pin will also be driven and the powerdown power consumption will be higher than the 1 mW specification. The following code example shows the powerdown interrupt routine.

```
{ Sample Powerdown Code                                }
{ Located at interrupt vector address 0x002C            }
  pwd_int: ax0 = 0x0000; { enable crystal, no delay }
             dm(0x3FEF) = ax0;
             idle;
             rti;
```

If lowest possible power consumption is required, then you must set the XTALDELAY and XTALDIS bits to 1 before entering powerdown. This selects the additional 4096 cycle delay to allow the oscillator to start and the phase locked loop to lock after start-up and disables the drive to the XTAL pin during powerdown. The following code example shows the powerdown interrupt routine.

```
{ Sample Powerdown Code                                }
{ Located at interrupt vector address 0x002C            }
  pwd_int: ax0 = 0xC000; { disable crystal, delay }
             dm(0x3FEF) = ax0;
             idle;
             rti;
```

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Depending on the particular situation and external system conditions, the powerdown modes shown above could be set conditionally. If you want to powerdown for a long time you may want to set the mode for lowest power consumption. If you want to powerdown for a short time, lowest power consumption may not be that important.

If the RESET pin is used to exit powerdown and the clock has been stopped, then RESET must be held low for 1000 CLKIN cycles plus the time required for the phase locked loop to lock and the crystal oscillator to stabilize (typically 2000 CLKIN cycles.) If the clock is running during powerdown, a RESET signal of only 5 cycles is required.

9.7.5 Processor Operation During Powerdown

Some processor circuitry may still be active during powerdown mode. Also, some output pins remain active. A good understanding of these states will allow you to determine the best low-power configuration for your system. By keeping output loading and input switching to a minimum the lowest possible power consumption can be achieved.

9.7.5.1 Interrupts And Flags

Interrupts are latched and can be serviced if the processor exits powerdown without a context reset (PUCR=1). Any activity on the interrupt or flag input pins during powerdown will increase the power consumption. There should also be no resistive load on the flag output pins (as with any active output pin) if lowest power is desired.

9.7.5.2 SPORTS

The circuitry of the serial ports is not directly affected by powerdown. The SPORTs are indirectly affected if an internally generated SCLK or frame sync is required. SPORT circuitry continues to operate during powerdown.

It is possible to clock data into or out of the serial ports during powerdown. You must supply an external serial clock to support operation during powerdown. No interrupts or autobuffer operations will be serviced during powerdown. Instead, the SPORT interrupts are latched and can be serviced if the processor exits powerdown without resetting the processor. Data clocked into the processor will remain in the receive (RX) registers. Autobuffer transfers will occur after the device exits powerdown if the processor is not powered up with RESET. Note that any SPORT activity will increase the power consumption above the 1 mW specification.

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If an external serial clock and an external frame sync signal are supplied, data can be clocked into the RX register or out of the TX register during powerdown. Since the TX register can not be updated while the processor is in powerdown, the same value is repeatedly clocked out the serial port. Also, data in the RX register is continually overwritten since the RX register can not be read by the processor during powerdown.

If an external serial clock is used with an internal frame sync, frame sync signals continue to be generated during powerdown since they are derived from the serial clock. Data bits continue to be received with the RX register being overwritten. Since data is only transmitted when the TX register is written, data bits are only transferred out of the processor if the processor is put in powerdown during a serial port transfer. While the processor is being put into powerdown, the serial port transfer in progress is allowed to complete. Since an internally generated transmit frame sync is used, no subsequent frame syncs are generated while in powerdown.

If internal serial clock is used, there is no SPORT activity during powerdown; the serial clock stops.

Lowest power dissipation is achieved when active SPORT pins are not changing during powerdown and are held at CMOS levels.

9.7.5.3 HIP During Powerdown

The circuitry of the Host Interface Port (HIP) is not directly affected by powerdown on the ADSP-2171 and ADSP-21msp58/59. The HIP is indirectly affected since the processor, when in powerdown, is unable to service interrupts or read and write HIP data registers. HIP circuitry continues to operate during powerdown.

The host can write to the HIP register during powerdown but the processor is disabled and cannot service interrupts. Instead, HIP interrupts are latched and can be serviced if the processor exits powerdown without a context reset (PUCR=1).

If the HDR overwrite bit (bit 7 in HSR7) is cleared, a host acknowledge signal will not be asserted until the processor has read data written by the host. During powerdown, the processor is unable to read the data register and the host acknowledge signal will not be asserted. Care must be taken in a system where the host waits for a host acknowledge. In this case, it is possible that the host will “hang” waiting for the acknowledge while the DSP processor is in powerdown.

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While in powerdown, the processor can be reset by writing the HSR software reset bit. This will produce the same results as asserting the RESET pin for five cycles (minimum RESET pulse) on the processor. If an external crystal is used and the clock has been stopped, this reset duration is too short; therefore software reset cannot be used in this mode. Note that any HIP activity will increase the power consumption above the 1 mW specification.

Two mode pins, HMD0 and HMD1, are used to put the processor's HIP into one of four possible modes. When HMD0 = 1, the HIP data bus is multiplexed for both address and data. In this case, the HIP data bus inputs are active during powerdown and any bus activity will result in higher power dissipation. Also, inputs must be at CMOS levels. If this host mode is used and there is potential for the bus to be floating, pull-up resistors should be used on the data lines. If you desire the host to communicate with other devices on the bus while the DSP processor is in powerdown, HMD0 should be held low to avoid extra power to be dissipated. When the HIP is put in other modes where data inputs are not active this is not a problem.

Lowest power dissipation is achieved when the HIP pins are not changing during powerdown and are held at CMOS levels.

9.7.5.4 IDMA Port During Powerdown (ADSP-2181)

The IDMA port can receive data during powerdown, but it can not respond with an acknowledge (IACK) signal or increment the IDMA internal address. If you are using a short read or short write and are in the middle of an IDMA transfer, you can complete a single read or write while the processor is in powerdown. If you are using the long read or long write method and are in the middle of an IDMA transfer, your host must be able to handle a "timeout" condition, as the DSP will not return an acknowledge to the transfer in process.

Note that IDMA activity while the DSP is in powerdown uses power and should be avoided to conserve power. For more information on lowest power use, see "Conditions For Lowest Power Consumption."

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9.7.5.5 BDMA Port During Powerdown (ADSP-2181)

Do not powerdown the ADSP-2181 during a BDMA transfer. If you do, the DSP will not be able to recover correctly from powerdown and the contents of memory accessed by the ADSP-2181's BDMA port will be corrupted.

If you need to go into powerdown mode, either:

- Verify that the BWCOUNT register contains a zero. If a BDMA transfer is in process, poll the BWCOUNT register to determine when the transfer is done.
or
- Abort any BDMA transfer in progress by writing 1 to the BWCOUNT register and go into powerdown when the BWCOUNT register contains a zero. (Note that the BDMA transfer is not properly completed in this case.)

9.7.5.6 Analog Interface (ADSP-21msp5x)

You must powerdown the ADSP-21msp58/59's analog interface separately from the processor, as described in the Analog Interface chapter of this manual. The analog interface does not work during powerdown and causes additional power to be dissipated if it is not disabled. The following code example shows a powerdown interrupt routine for the ADSP-21msp58/59:

```
{ Sample Powerdown Code          }  
{ located at address 0x002C      }  
  
pwd_int: ax0 = 0x0000;           {powerdown analog interface}  
        dm(0x3FEE) = ax0;  
        ax0 = 0x0000;           {enable crystal, no delay}  
        dm(0x3FEF) = ax0;  
        NOP;  
        idle;  
        rti;
```

It takes three cycles for the analog interface to powerdown. The IDLE instruction should not be executed before these three cycles have elapsed.

9.7.6 Conditions For Lowest Power Consumption

The state of all processor pins during powerdown is shown in Table 9.9.

To assure the lowest power consumption, all active input pins should be held at a CMOS level. All active output pins should be free of resistive load since

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load current will increase power dissipation. Some pins will be in one of several states depending upon the connection of mode pins. For example, the ADSP-2171's HIP data bus pins may be either active or inactive depending whether a host write is in progress or how the host mode pins are connected. You must perform a careful analysis of each input and output pin in order to insure lowest power dissipation.

Some inputs are active but ignored. The state of these inputs does not matter as long as they are at a CMOS level.

<u>Pin</u>	<u>Direction</u>	<u>State During Powerdown</u>
<u>RESET</u>	I	Active
<u>PWD</u>	I	Active
<u>IRQ2</u>	I	Active, latched but not serviced
<u>IRQE</u>	I	(ADSP-2181) Active, latched but not serviced
<u>IRQL0</u>	I	(ADSP-2181) Active, latched but not serviced
<u>IRQL1</u>	I	(ADSP-2181) Active, latched but not serviced
<u>MMAP</u>	I	Active
<u>BR</u>	I	Active, no response until after powerdown
<u>BG</u>	O	Driven HIGH unless bus is granted
<u>CLKIN</u>	I	Input buffer inactive, but XTAL oscillator is active unless XTALDIS bit is set
<u>CLKOUT</u>	O	Driven HIGH
<u>XTAL</u>	O	Driven HIGH if XTALDIS set, inversion of CLKIN otherwise
<u>PWDACK</u>	O	Driven HIGH
<u>PMS</u>	O	Driven HIGH, high impedance if bus granted
<u>DMS</u>	O	Driven HIGH, high impedance if bus granted
<u>BMS</u>	O	Driven HIGH, high impedance if bus granted
<u>IOMS</u>	O	(ADSP-2181) Driven HIGH, high impedance if bus granted
<u>CMS</u>	O	(ADSP-2181) Driven HIGH, high impedance if bus granted
<u>RD</u>	O	Driven HIGH, high impedance if bus granted
<u>WR</u>	O	Driven HIGH, high impedance if bus granted
<u>ADDR<13:0></u>	O	High impedance
<u>DATA<23:0></u>	I	Inactive
<u>DATA<23:0></u>	O	High impedance
<u>SCLK0</u>	I	Active
<u>SCLK0</u>	O	Driven to static level if internal, high impedance otherwise
<u>TFS0</u>	I	Active if SPORT 0 is enabled
<u>TFS0</u>	O	Driven if configured internal or in multichannel mode and SPORT 0 enabled, high impedance otherwise
<u>RFS0</u>	I	Active if SPORT 0 is enabled
<u>RFS0</u>	O	Driven if configured internal and SPORT 0 enabled, high impedance otherwise
<u>DR0</u>	I	Active if SPORT 0 is enabled
<u>DT0</u>	O	Driven if serial port operating. Output may be static or changing depending upon serial clock, high impedance otherwise

Table 9.9 Pin States During Powerdown (cont. on next page)

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<u>Pin</u>	<u>Direction</u>	<u>State During Powerdown</u>
SCLK1	I	Active
SCLK1	O	Driven to a static level if internal, high impedance otherwise
TFS1 / <u>IRQ1</u>	I	Active if SPORT 1 is enabled or configured alternate (<u>IRQ1</u>)
TFS1	O	Driven if SPORT 1 is enabled and configured for internal transmit framing, high impedance otherwise
RFS1 / <u>IRQ0</u>	I	Active if SPORT 1 is enabled or configured alternate (<u>IRQ0</u>)
RFS1	O	Driven if SPORT 1 is enabled and configured for internal receive framing, high impedance otherwise
DR1 / FLAGIN	I	Active if SPORT 1 is enabled or configured alternate (FLAGIN)
DT1 / FLAGOUT	O	Driven if serial port operating. Output may be static or changing depending upon serial clock. Driven if SPORT 1 is enabled or configured alternate (FLAGOUT)
FL<2:0>	O	Driven to previous value
PF<7:0>	I/O	(ADSP-2181) Active
BMODE	I	Active
<u>IRD</u>	I	(ADSP-2181) Active, if <u>IS</u> asserted
<u>IWR</u>	I	(ADSP-2181) Active, if <u>IS</u> asserted
<u>IS</u>	I	(ADSP-2181) Active
IAL	I	(ADSP-2181) Active, if <u>IS</u> asserted
IAD	I/O	(ADSP-2181) Active, if an operation in progress
<u>IACK</u>	O	(ADSP-2181) Active
HSIZE	I	(ADSP-2171, ADSP-21msp5x) Active
HMD0	I	(ADSP-2171, ADSP-21msp5x) Active
HMD1	I	(ADSP-2171, ADSP-21msp5x) Active
HSEL	I	(ADSP-2171, ADSP-21msp5x) Active
HRD	I	(ADSP-2171, ADSP-21msp5x) Active
HWR	I	(ADSP-2171, ADSP-21msp5x) Active
HADR<2:0>	I	(ADSP-2171, ADSP-21msp5x) Active
HDATA<15:0>	I	(ADSP-2171, ADSP-21msp5x) Active if host writing or HMD1 and HA2/HALE HIGH, inactive otherwise
HDATA<15:0>	O	(ADSP-2171, ADSP-21msp5x) Driven if host reading, high impedance otherwise
HACK	O	(ADSP-2171, ADSP-21msp5x) Driven
VIN (NORM)	I	(ADSP-21msp5x) Inactive, set analog powerdown bit
VIN (AUX)	I	(ADSP-21msp5x) Inactive, set analog powerdown bit
VFB (NORM)	O	(ADSP-21msp5x) Inactive, set analog powerdown bit
VFB (AUX)	O	(ADSP-21msp5x) Inactive, set analog powerdown bit
VOUTP	O	(ADSP-21msp5x) Driven low in powerdown
VOUTN	O	(ADSP-21msp5x) Driven low in powerdown
VREF	O	(ADSP-21msp5x) Reference turned off

Table 9.9 Pin States During Powerdown

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9.7.7 PWDACK Pin

The powerdown acknowledge pin (PWDACK) is an output that indicates when the processor is powered down. This pin is driven high by the processor when it has powered down and is driven low when the processor has completed its powerup sequence. A low level on the PWDACK pin also indicates that there is a valid CLKOUT signal and that instruction execution has begun. Figure 9.7 shows an example of timing for the powerdown and restart sequence.

The processor is executing code when the PWD pin is brought low. The processor vectors to the powerdown interrupt vector and an IDLE instruction is executed causing the processor to go into powerdown. The CLKOUT and PWDACK signals are driven high by the processor. At this point, the input clock pin is ignored. If the processor is put into the powerdown mode via the powerdown force bit in the powerdown control register, the result is the same as described above.

The input clock is started and the PWD pin is brought high. After the necessary start-up cycles the processor brings the PWDACK output low, begins driving the CLKOUT pin with a clock signal and begins to fetch the instruction after the IDLE instruction. The processor then resumes normal operation.

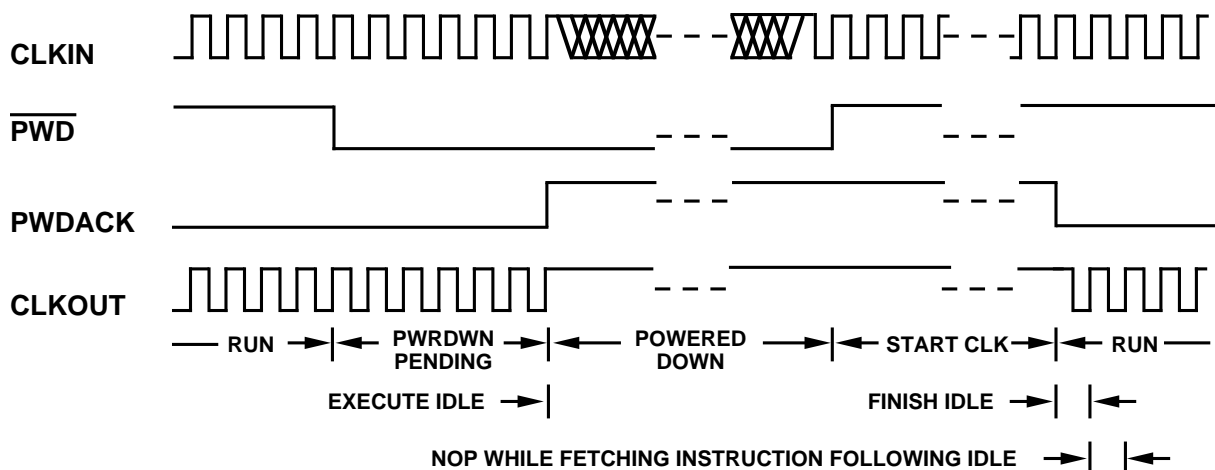


Figure 9.7 Powerdown Timing Example

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When powerdown is terminated with the RESET pin or if a start-up delay is selected, a low level on the PWDACK pin only indicates the start of oscillations on the CLKOUT pin. It will not necessarily indicate the start of instruction execution.

The state of PWDACK and also the CLKOUT signal is undefined during the first 100 cycles of initial reset.

9.7.8 Using Powerdown As A Non-Maskable Interrupt

The powerdown interrupt is never masked. It is possible to use this interrupt for other purposes if desired. The processor will not go into powerdown until an IDLE instruction is executed. If an RTI is executed before the IDLE instruction, then the processor returns from the powerdown interrupt and the powerdown sequence is aborted.

It is possible to place a series of instructions at the powerdown interrupt vector location 0x002C. This routine should end with an RTI instruction and not contain an IDLE instruction if the interrupt is to be used for purposes other than powerdown.