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Understanding Embedded - DSP (Digital Signal Processors)

Embedded - DSP (Digital Signal Processors) are specialized microprocessors designed to perform complex mathematical computations on digital signals in real-time. Unlike general-purpose processors, DSPs are optimized for high-speed numeric processing tasks, making them ideal for applications that require efficient and precise manipulation of digital data. These processors are fundamental in converting and processing signals in various forms, including audio, video, and communication signals, ensuring that data is accurately interpreted and utilized in embedded systems.

Applications of Embedded - DSP (Digital Signal Processors)

Details	
Product Status	Active
Type	Floating Point
Interface	CAN, EBI/EMI, Ethernet, DAI, I²C, MMC/SD/SDIO, SPI, SPORT, UART/USART, USB OTG
Clock Rate	500MHz
Non-Volatile Memory	ROM (512kB)
On-Chip RAM	640kB
Voltage - I/O	3.30V
Voltage - Core	1.10V
Operating Temperature	0°C ~ 70°C (TA)
Mounting Type	Surface Mount
Package / Case	529-LFBGA, CSPBGA
Supplier Device Package	529-CSPBGA (19x19)
Purchase URL	https://www.e-xfl.com/product-detail/analog-devices/adsp-sc587kbcz-5b

GENERAL DESCRIPTION

The ADSP-SC58x/ADSP-2158x processors are members of the SHARC® family of products. The ADSP-SC58x processor is based on the SHARC+ dual core and the ARM® Cortex®-A5 core. The ADSP-SC58x/ADSP-2158x SHARC processors are members of the SIMD SHARC family of digital signal processors (DSPs) that feature Analog Devices Super Harvard Architecture. These 32-bit/40-bit/64-bit floating-point processors are optimized for high performance audio/floating-point applications with large on-chip static random-access memory (SRAM), multiple internal buses that eliminate input/output (I/O) bottlenecks, and innovative digital audio interfaces (DAI). New additions to the SHARC+ core include cache enhancements and branch prediction, while maintaining instruction set compatibility to previous SHARC products.

By integrating a set of industry leading system peripherals and memory (see Table 1, Table 2, and Table 3), the ARM Cortex-A5 and SHARC processor is the platform of choice for applications that require programmability similar to RISC (reduced instruction set computing), multimedia support, and leading edge signal processing in one integrated package. These applications span a wide array of markets, including automotive, pro audio, and industrial-based applications that require high floating-point performance.

Table 2 provides comparison information for features that vary across the standard processors. (N/A in the table means not applicable.)

Table 3 provides comparison information for features that vary across the automotive processors. (N/A in the table means not applicable.)

Table 1. Common Product Features

Product Features	ADSP-SC58x/ADSP-2158x
DAI (includes SRU)	2
Full SPORTs	4 per DAI
S/PDIF receive/transmit	1per DAI
ASRCs	4 pair per DAI
PCGs	2 per DAI
I^2C (TWI)	3
Quad-data bit SPI	1
Dual-data bit SPI	2
CAN2.0	2
UARTs	3
Link ports	2
Enhanced PPI	1
GP timer[1]	8
GP counter	1
Enhanced PWMs[2]	3
Watchdog timers	2
ADC control module	Yes
Static memory controller	Yes
Hardware accelerators	
High performance FFT/IFFT	Yes
FIR/IIR	Yes
Harmonic analysis engine	Yes
SINC filter	Yes
Security cryptographic engine	Yes
Multichannel 12-bit ADC	8-channel

[1] Eight timers are available in the 529-BGA package only. The 349-BGA package does not include Timer 6 and 7.

[2] Three 3ePWMs are available in the 529-BGA package only. The 349-BGA package does not include PWM 2.

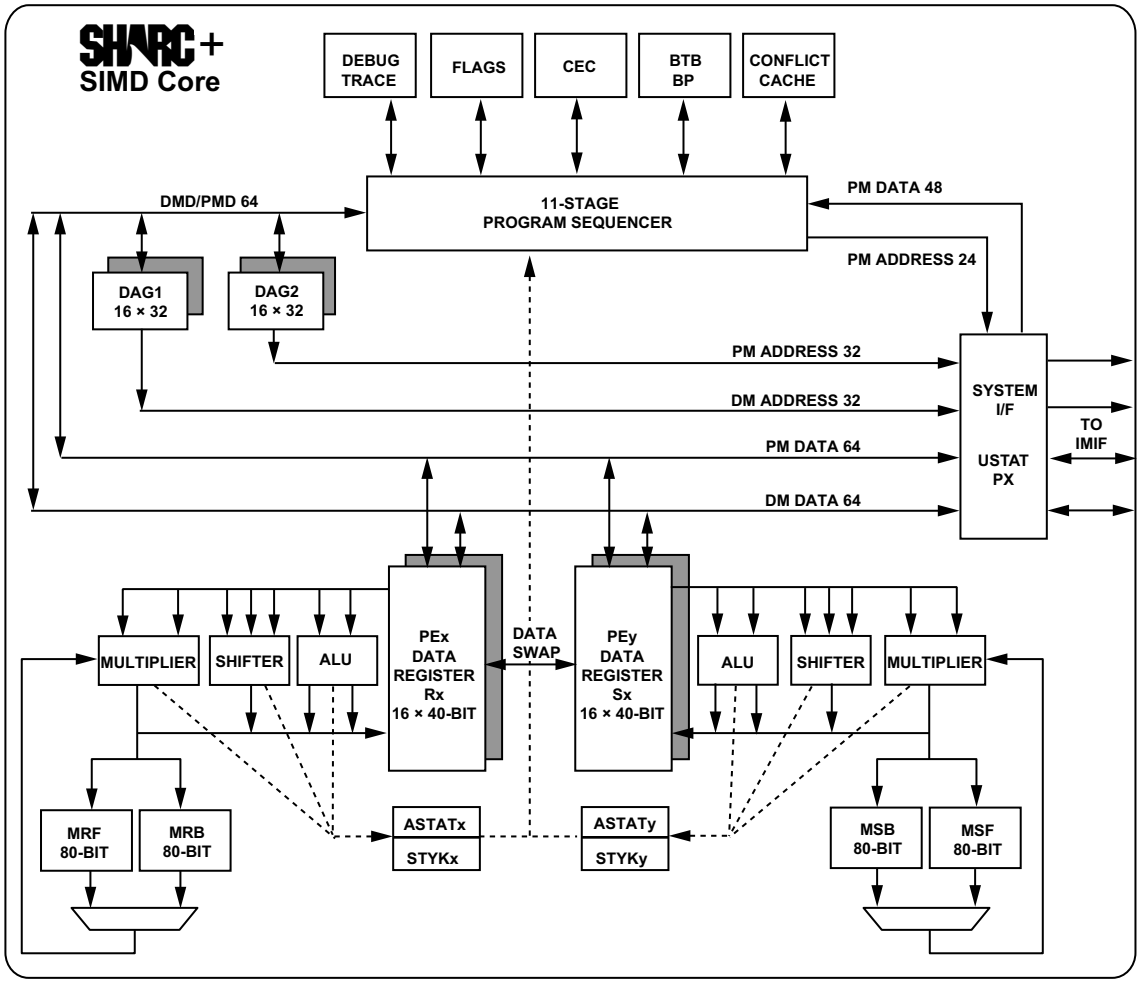

Figure 4. SHARC+ SIMD Core Block Diagram

L1 Memory

Figure 5 shows the ADSP-SC58x/ADSP-2158x memory map. Each SHARC+ core has a tightly coupled L1 SRAM of up to 5 Mb. Each SHARC+ core can access code and data in a single cycle from this memory space. The ARM Cortex-A5 core can also access this memory space with multicycle accesses.

In the SHARC+ core private address space, both cores have L1 memory.

SHARC+ core memory-mapped register (CMMR) address space is 0x 0000 0000 through 0x 0003 FFFF in Normal Word (32-bit). Each block can be configured for different combinations of code and data storage. Of the 5 Mb SRAM, up to 1024 Kb can be configured for data memory (DM), program memory (PM), and instruction cache. Each memory block supports single-cycle, independent accesses by the core processor and I/O processor. The memory architecture, in combination with its separate on-chip buses, allows two data transfers from the core and one from the DMA engine in a single cycle. The SRAM of the processor can be configured as a maximum of 160k words of 32-bit data, 320k words of 16-bit data, 106.7k words of 48-bit instructions (or 40-bit data), or combinations of different word sizes up to 5 Mb. All of the memory can be accessed as 8-bit, 16-bit, 32-bit, 48-bit, or 64-bit words. Support of a 16-bit floating-point storage format doubles the amount of data that can be stored on chip.

Conversion between the 32-bit floating-point and 16-bit floating-point formats is performed in a single instruction. While each memory block can store combinations of code and data, accesses are most efficient when one block stores data using the DM bus for transfers, and the other block stores instructions and data using the PM bus for transfers.

Using the DM and PM buses, with each bus dedicated to a memory block, assures single-cycle execution with two data transfers. In this case, the instruction must be available in the cache. The system configuration is flexible, but a typical configuration is 512 Kb DM, 128 Kb PM, and 128 Kb of instruction cache, with the remaining L1 memory configured as SRAM. Each addressable memory space outside the L1 memory can be accessed either directly or via cache.

349-BALL CSP_BGA SIGNAL DESCRIPTIONS

The processor pin definitions are shown in Table 12 for the 349-ball CSP_BGA package. The columns in this table provide the following information:

- The signal name column includes the signal name for every pin and the GPIO multiplexed pin function, where applicable.
- The description column provides a descriptive name for each signal.
- The port column shows whether or not a signal is multiplexed with other signals on a general-purpose I/O port pin.
- The pin name column 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).
- The DAI pins and their associated signal routing units (SRUs) connect inputs and outputs of the DAI peripherals (SPORT, ASRC, S/PDIF, and PCG). See the Digital Audio Interface (DAI) chapter of the ADSP-SC58x/ADSP-2158x SHARC+ Processor Hardware Reference for complete information on the use of the DAI and SRUs.

Table 12. ADSP-SC58x/ADSP-2158x 349-Ball CSP_BGA Signal Descriptions

Signal Name	Description	Port	Pin Name
ACM0_A0	ACM0 ADC Control Signals	C	PC_13
ACM0_A1	ACM0 ADC Control Signals	C	PC_14
ACM0_A2	ACM0 ADC Control Signals	C	PC_15
ACM0_A3	ACM0 ADC Control Signals	D	PD_00
ACM0_A4	ACM0 ADC Control Signals	D	PD_01
ACM0_T0	ACM0 External Trigger n	C	PC_12
C1_FLG0	SHARC Core 1 Flag Pin	E	PE_01
C1_FLG1	SHARC Core 1 Flag Pin	E	PE_03
C1_FLG2	SHARC Core 1 Flag Pin	E	PE_05
C1_FLG3	SHARC Core 1 Flag Pin	E	PE_07
C2_FLG0	SHARC Core 2 Flag Pin	E	PE_02
C2_FLG1	SHARC Core 2 Flag Pin	E	PE_04
C2_FLG2	SHARC Core 2 Flag Pin	E	PE_06
C2_FLG3	SHARC Core 2 Flag Pin	E	PE_08
CAN0_RX	CAN0 Receive	C	PC_07
CAN0_TX	CAN0 Transmit	C	PC_08
CAN1_RX	CAN1 Receive	B	PB_10
CAN1_TX	CAN1 Transmit	B	PB_09
CNT0_DG	CNT0 Count Down and Gate	B	PB_14
CNT0_UD	CNT0 Count Up and Direction	B	PB_12
CNT0_ZM	CNT0 Count Zero Marker	B	PB_11
DAI0_PIN01	DAI0 Pin 1	Not Muxed	DAI0_PIN01
DAI0_PIN02	DAI0 Pin 2	Not Muxed	DAI0_PIN02
DAI0_PIN03	DAI0 Pin 3	Not Muxed	DAI0_PIN03
DAI0_PIN04	DAI0 Pin 4	Not Muxed	DAI0_PIN04
DAI0_PIN05	DAI0 Pin 5	Not Muxed	DAI0_PIN05
DAI0_PIN06	DAI0 Pin 6	Not Muxed	DAI0_PIN06
DAI0_PIN07	DAI0 Pin 7	Not Muxed	DAI0_PIN07
DAI0_PIN08	DAI0 Pin 8	Not Muxed	DAI0_PIN08
DAI0_PIN09	DAI0 Pin 9	Not Muxed	DAI0_PIN09
DAI0_PIN10	DAI0 Pin 10	Not Muxed	DAI0_PIN10
DAI0_PIN11	DAI0 Pin 11	Not Muxed	DAI0_PIN11
DAI0_PIN12	DAI0 Pin 12	Not Muxed	DAI0_PIN12
DAI0_PIN19	DAI0 Pin 19	Not Muxed	DAI0_PIN19
DAI0_PIN20	DAI0 Pin 20	Not Muxed	DAI0_PIN20

Table 19. ADSP-SC58x/ADSP-2158x 529-Ball CSP_BGA Signal Descriptions (Continued)

Signal Name	Description	Port	Pin Name
DAI0_PIN15	DAI0 Pin 15	Not Muxed	DAI0_PIN15
DAI0_PIN16	DAI0 Pin 16	Not Muxed	DAI0_PIN16
DAI0_PIN17	DAI0 Pin 17	Not Muxed	DAI0_PIN17
DAI0_PIN18	DAI0 Pin 18	Not Muxed	DAI0_PIN18
DAI0_PIN19	DAI0 Pin 19	Not Muxed	DAI0_PIN19
DAI0_PIN20	DAI0 Pin 20	Not Muxed	DAI0_PIN20
DAI1_PIN01	DAI1 Pin 1	Not Muxed	DAI1_PIN01
DAI1_PIN02	DAI1 Pin 2	Not Muxed	DAI1_PIN02
DAI1_PIN03	DAI1 Pin 3	Not Muxed	DAI1_PIN03
DAI1_PIN04	DAI1 Pin 4	Not Muxed	DAI1_PIN04
DAI1_PIN05	DAI1 Pin 5	Not Muxed	DAI1_PIN05
DAI1_PIN06	DAI1 Pin 6	Not Muxed	DAI1_PIN06
DAI1_PIN07	DAI1 Pin 7	Not Muxed	DAI1_PIN07
DAI1_PIN08	DAI1 Pin 8	Not Muxed	DAI1_PIN08
DAI1_PIN09	DAI1 Pin 9	Not Muxed	DAI1_PIN09
DAI1_PIN10	DAI1 Pin 10	Not Muxed	DAI1_PIN10
DAI1_PIN11	DAI1 Pin 11	Not Muxed	DAI1_PIN11
DAI1_PIN12	DAI1 Pin 12	Not Muxed	DAI1_PIN12
DAI1_PIN13	DAI1 Pin 13	Not Muxed	DAI1_PIN13
DAI1_PIN14	DAI1 Pin 14	Not Muxed	DAI1_PIN14
DAI1_PIN15	DAI1 Pin 15	Not Muxed	DAI1_PIN15
DAI1_PIN16	DAI1 Pin 16	Not Muxed	DAI1_PIN16
DAI1_PIN17	DAI1 Pin 17	Not Muxed	DAI1_PIN17
DAI1_PIN18	DAI1 Pin 18	Not Muxed	DAI1_PIN18
DAI1_PIN19	DAI1 Pin 19	Not Muxed	DAI1_PIN19
DAI1_PIN20	DAI1 Pin 20	Not Muxed	DAI1_PIN20
DMC0_A00	DMC0 Address 0	Not Muxed	DMC0_A00
DMC0_A01	DMC0 Address 1	Not Muxed	DMC0_A01
DMC0_A02	DMC0 Address 2	Not Muxed	DMC0_A02
DMC0_A03	DMC0 Address 3	Not Muxed	DMC0_A03
DMC0_A04	DMC0 Address 4	Not Muxed	DMC0_A04
DMC0_A05	DMC0 Address 5	Not Muxed	DMC0_A05
DMC0_A06	DMC0 Address 6	Not Muxed	DMC0_A06
DMC0_A07	DMC0 Address 7	Not Muxed	DMC0_A07
DMC0_A08	DMC0 Address 8	Not Muxed	DMC0_A08
DMC0_A09	DMC0 Address 9	Not Muxed	DMC0_A09
DMC0_A10	DMC0 Address 10	Not Muxed	DMC0_A10
DMC0_A11	DMC0 Address 11	Not Muxed	DMC0_A11
DMC0_A12	DMC0 Address 12	Not Muxed	DMC0_A12
DMC0_A13	DMC0 Address 13	Not Muxed	DMC0_A13
DMC0_A14	DMC0 Address 14	Not Muxed	DMC0_A14
DMC0_A15	DMC0 Address 15	Not Muxed	DMC0_A15
DMC0_BA0	DMC0 Bank Address 0	Not Muxed	DMC0_BA0
DMC0_BA1	DMC0 Bank Address 1	Not Muxed	DMC0_BA1
DMC0_BA2	DMC0 Bank Address 2	Not Muxed	DMC0_BA2
$\overline{\text{DMC0\_CAS}}$	DMC0 Column Address Strobe	Not Muxed	$\overline{\text{DMC0\_CAS}}$
DMC0_CK	DMC0 Clock	Not Muxed	DMC0_CK
DMC0_CKE	DMC0 Clock enable	Not Muxed	DMC0_CKE

Table 27. ADSP-SC58x/ADSP-2158x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Int Term	Reset Term	Reset Drive	Power Domain	Description and Notes
PA_02	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 2 | EMAC0 Management Channel Clock | SMC0 Address 24 Notes: No notes
PA_03	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 3 | EMAC0 Management Channel Serial Data | SMC0 Address 23 Notes: No notes
PA_04	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 4 | EMAC0 Receive Data 0 | SMC0 Address 19 Notes: No notes
PA_05	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 5 | EMAC0 Receive Data 1 | SMC0 Address 18 Notes: No notes
PA_06	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 6 | EMAC0 RXCLK (GigE) or REFCLK (10/100) | SMC0 Address 17 Notes: No notes
PA_07	InOut	A	PullDown	none	none	VDD_EXT	Desc: EMAC0 RXCTL (GigE) or CRS (10/100) | PORTA Position 7 | EMAC0 Carrier Sense/RMII Receive Data Valid | SMC0 Address 16 Notes: No notes
PA_08	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 8 | EMAC0 Receive Data 2 | SMC0 Address 12 Notes: No notes
PA_09	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 9 | EMAC0 Receive Data 3 | SMC0 Address 11 Notes: No notes
PA_10	InOut	A	PullDown	none	none	VDD_EXT	Desc: EMAC0 TXCTL (GigE) or TXEN (10/100) | PORTA Position 10 | EMAC0 Transmit Enable | SMC0 Address 22 Notes: No notes
PA_11	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 11 | EMAC0 Transmit Clock | SMC0 Address 15 Notes: No notes
PA_12	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 12 | EMAC0 Transmit Data 2 | SMC0 Address 14 Notes: No notes
PA_13	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 13 | EMAC0 Transmit Data 3 | SMC0 Address 13 Notes: No notes
PA_14	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTA Position 14 | EMAC0 PTP Pulse-Per-Second Output 3 | SINC0 Data 0 | SMC0 Address 10 Notes: No notes

Table 27. ADSP-SC58x/ADSP-2158x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Int Term	Reset Term	Reset Drive	Power Domain	Description and Notes
PB_09	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 9 | CAN1 Transmit | LP1 Data 2 | SMC0 Data 13 Notes: No notes
PB_10	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 10 | CAN1 Receive | LP1 Data 3 | SMC0 Data 12 | TIMER0 Timer 2 | TIMER0 Alternate Capture Input 4 Notes: No notes
PB_11	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 11 | LP1 Data 4 | PWM0 Channel D High Side | SMC0 Data 11 | CNT0 Count Zero Marker Notes: No notes
PB_12	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 12 | LP1 Data 5 | PWM0 Channel D Low Side | SMC0 Data 10 | CNT0 Count Up and Direction Notes: No notes
PB_13	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 13 | LP1 Data 6 | PWM0 Channel C High Side | SMC0 Data 9 Notes: No notes
PB_14	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 14 | LP1 Data 7 | PWM0 Channel C Low Side | SMC0 Data 8 | TIMER0 Timer 5 | CNT0 Count Down and Gate Notes: No notes
PB_15	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTB Position 15 | LP1 Acknowledge | PWM0 Shutdown Input 0 | SMC0 Write Enable | TIMER0 Timer 1 Notes: No notes
PCIE0_CLKM	Input	NA	PullDown	none	none	VDD_PCIE	Desc: PCIE0 CLK - Notes: No notes
PCIE0_CLKP	Input	NA	PullDown	none	none	VDD_PCIE	Desc: PCIE0 CLK + Notes: No notes
PCIE0_REF	a	NA	PullDown	none	none	VDD_PCIE	Desc: PCIE0 Reference Notes: No notes
PCIE0_RXM	Input	NA	PullDown	none	none	VDD_PCIE_RX	Desc: PCIE0 RX - Notes: No notes
PCIE0_RXP	Input	NA	PullDown	none	none	VDD_PCIE_RX	Desc: PCIE0 RX + Notes: No notes
PCIE0_TXM	InOut	J	PullDown	none	none	VDD_PCIE_TX	Desc: PCIE0 TX - Notes: No notes
PCIE0_TXP	InOut	J	PullDown	none	none	VDD_PCIE_TX	Desc: PCIE0 TX + Notes: No notes

Table 27. ADSP-SC58x/ADSP-2158x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Int Term	Reset Term	Reset Drive	Power Domain	Description and Notes
PC_00	InOut	H	PullDown	none	none	VDD_EXT	Desc: PORTC Position 0 | LP1 Clock | PWM0 Channel B Low Side | SMC0 Read Enable | SPI0 Slave Select Output 4 Notes: No notes
PC_01	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 1 | SPI2 Clock Notes: No notes
PC_02	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 2 | SPI2 Master In, Slave Out Notes: No notes
PC_03	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 3 | SPI2 Master Out, Slave In Notes: No notes
PC_04	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 4 | SPI2 Data 2 Notes: No notes
PC_05	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 5 | SPI2 Data 3 Notes: No notes
PC_06	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 6 | SPI2 Slave Select Output 1 | SPI2 Slave Select Input Notes: No notes
PC_07	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 7 | CAN0 Receive | SMC0 Memory Select 2 | SPI0 Slave Select Output 1 | TIMER0 Alternate Capture Input 3 Notes: No notes
PC_08	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 8 | CAN0 Transmit | SMC0 Memory Select 3 Notes: No notes
PC_09	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 9 | SPI0 Clock Notes: No notes
PC_10	InOut	H	PullDown	none	none	VDD_EXT	Desc: PORTC Position 10 | SPI0 Master In, Slave Out Notes: No notes
PC_11	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 11 | SPI0 Master Out, Slave In | TIMER0 Clock Notes: No notes
PC_12	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTC Position 12 | ACM0 External Trigger n | SMC0 Address 25 | SPI0 Ready | SPI0 Slave Select Output 3 Notes: No notes

Table 27. ADSP-SC58x/ADSP-2158x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Int Term	Reset Term	Reset Drive	Power Domain	Description and Notes
PE_02	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 2 | EPPI0 Frame Sync 1 (HSYNC) | SPI0 Slave Select Output 6 | SHARC Core 2 Flag Pin | UART1 Request to Send Notes: No notes
PE_03	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 3 | EPPI0 Clock | SPI0 Slave Select Output 7 | SPI2 Slave Select Output 2 | SHARC Core 1 Flag Pin Notes: No notes
PE_04	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 4 | EPPI0 Data 8 | PWM2 Channel D High Side | SPI2 Slave Select Output 3 | SHARC Core 2 Flag Pin Notes: No notes
PE_05	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 5 | EPPI0 Data 7 | PWM2 PWMTMR Grouped | SPI2 Slave Select Output 4 | SHARC Core 1 Flag Pin Notes: No notes
PE_06	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 6 | EPPI0 Data 6 | SPI2 Slave Select Output 5 | SHARC Core 2 Flag Pin Notes: No notes
PE_07	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 7 | EPPI0 Data 5 | SPI1 Slave Select Output 2 | SHARC Core 1 Flag Pin Notes: No notes
PE_08	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 8 | EPPI0 Data 4 | SPI1 Ready | SPI1 Slave Select Output 5 | SHARC Core 2 Flag Pin Notes: No notes
PE_09	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 9 | EPPI0 Data 3 | PWM0 PWMTMR Grouped | SMC0 Data 3 | TIMER0 Timer 0 Notes: No notes
PE_10	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 10 | EPPI0 Data 2 | PWM2 Channel D Low Side | SMC0 Data 2 | UART2 Request to Send Notes: No notes
PE_11	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTE Position 11 | EPPI0 Data 1 | SMC0 Data 1 | SPI1 Slave Select Output 3 | UART2 Clear to Send | SPI1 Slave Select Input Notes: No notes

Table 27. ADSP-SC58x/ADSP-2158x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Int Term	Reset Term	Reset Drive	Power Domain	Description and Notes
PF_08	InOut	A	PullDown/ Programmable PullUp	none	none	VDD_EXT	Desc: PORTF Position 8 | MSI0 Data 6 | PWM2 Channel B Low Side Notes: No notes
PF_09	InOut	A	PullDown/ Programmable PullUp	none	none	VDD_EXT	Desc: PORTF Position 9 | MSI0 Data 7 | PWM2 Channel B High Side Notes: No notes
PF_10	InOut	A	PullDown/ Programmable PullUp	none	none	VDD_EXT	Desc: PORTF Position 10 | MSI0 Command Notes: No notes
PF_11	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTF Position 11 | MSI0 Clock Notes: No notes
PF_12	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTF Position 12 | MSI0 Card Detect Notes: No notes
PF_13	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTF Position 13 | EMAC1 Carrier Sense/RMII Receive Data Valid | MSI0 eSDIO Interrupt Input | TRACE0 Trace Data | TRACE0 Trace Data 8 Notes: No notes
PF_14	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTF Position 14 | EMAC1 Management Channel Clock | TRACE0 Trace Data | TRACE0 Trace Data 9 Notes: No notes
PF_15	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTF Position 15 | EMAC1 Management Channel Serial Data | TRACE0 Trace Data | TRACE0 Trace Data 10 Notes: No notes
PG_00	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTG Position 0 | EMAC1 Reference Clock | TRACE0 Trace Clock Notes: No notes
PG_01	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTG Position 1 | EMAC1 Transmit Enable | TRACE0 Trace Data | TRACE0 Trace Data 11 Notes: No notes
PG_02	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTG Position 2 | EMAC1 Transmit Data 0 | TRACE0 Trace Data | TRACE0 Trace Data 12 Notes: No notes
PG_03	InOut	A	PullDown	none	none	VDD_EXT	Desc: PORTG Position 3 | EMAC1 Transmit Data 1 | TRACE0 Trace Data | TRACE0 Trace Data 13 Notes: No notes

Mobile DDR SDRAM Read Cycle Timing

Table 55 and Figure 21 show mobile DDR SDRAM read cycle timing, related to the DMC.

Table 55. Mobile DDR SDRAM Read Cycle Timing, V_{DD_DMCx} Nominal 1.8 V[1]

Parameter		200 MHz[2] Min	Max	Unit
Timing Requirements				
t_{QH}	DMCx_DQ, DMCx_DQS Output Hold Time From DMCx_DQS	1.75		ns
t_{DQSQ}	DMCx_DQS to DMCx_DQ Skew for DMCx_DQS and Associated DMCx_DQ Signals		0.4	ns
t_{RPRE}	Read Preamble	0.9	1.1	t_{CK}
t_{RPST}	Read Postamble	0.4	0.6	t_{CK}

[1] Specifications apply to both DMC0 and DMC1.
[2] To ensure proper operation of LPDDR, all the LPDDR guidelines must be strictly followed. See "Interfacing DDR3/DDR2/LPDDR Memory to ADSP-SC5xx/215xx Processors" (EE-387).

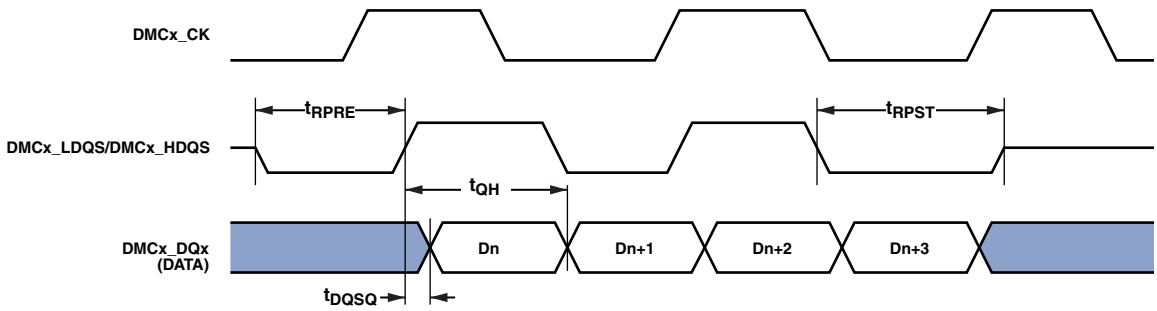

Figure 21. Mobile DDR SDRAM Controller Input AC Timing

Mobile DDR SDRAM Write Cycle Timing

Table 56 and Figure 22 show mobile DDR SDRAM write cycle timing, related to the DMC.

Table 56. Mobile DDR SDRAM Write Cycle Timing, V_{DD_DMCx} Nominal 1.8 V[1]

Parameter		200 MHz[2] Min	200 MHz[2] Max	Unit
Switching Characteristics				
t_{DQSS}[3]	DMCx_DQS Latching Rising Transitions to Associated Clock Edges	0.75	1.25	t_{CK}
t_{DS}	Last Data Valid to DMCx_DQS Delay (Slew > 1 V/ns)	0.48		ns
t_{DH}	DMCx_DQS to First Data Invalid Delay (Slew > 1 V/ns)	0.48		ns
t_{DSS}	DMCx_DQS Falling Edge to Clock Setup Time	0.2		t_{CK}
t_{DSH}	DMCx_DQS Falling Edge Hold Time From DMCx_CK	0.2		t_{CK}
t_{DQSH}	DMCx_DQS Input High Pulse Width	0.4		t_{CK}
t_{DQSL}	DMCx_DQS Input Low Pulse Width	0.4		t_{CK}
t_{WPRE}	Write Preamble	0.25		t_{CK}
t_{WPST}	Write Postamble	0.4		t_{CK}
t_{IPW}	Address and Control Output Pulse Width	2.3		ns
t_{DIPW}	DMCx_DQ and DMCx_DM Output Pulse Width	1.8		ns

[1] Specifications apply to both DMC0 and DMC1.
[2] To ensure proper operation of LPDDR, all the LPDDR guidelines must be strictly followed. See "Interfacing DDR3/DDR2/LPDDR Memory to ADSP-SC5xx/215xx Processors" (EE-387).
[3] Write command to first DMCx_DQS delay = WL × t_{CK} + t_{DQSS}.

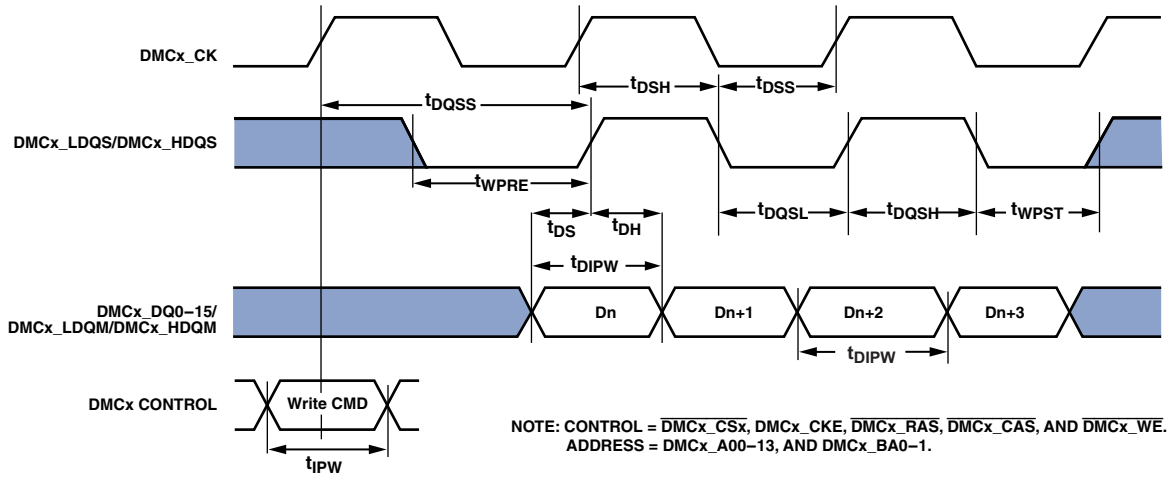

Figure 22. Mobile DDR SDRAM Controller Output AC Timing

DDR3 SDRAM Write Cycle Timing

Table 59 and Figure 25 show mobile DDR3 SDRAM output ac timing, related to the DMC.

Table 59. DDR3 SDRAM Write Cycle Timing VDD_DMCx Nominal 1.5 V[1]

Parameter		450 MHz[2] Min	450 MHz[2] Max	Unit
Switching Characteristics				
t_{DQSS}	DMCx_DQS Latching Rising Transitions to Associated Clock Edges[3]	–0.25	0.25	t_{CK}
t_{DS}	Last Data Valid to DMCx_DQS Delay (Slew > 1 V/ns)	0.125		ns
t_{DH}	DMCx_DQS to First Data Invalid Delay (Slew > 1 V/ns)	0.150		ns
t_{DSS}	DMCx_DQS Falling Edge to Clock Setup Time	0.2		t_{CK}
t_{DSH}	DMCx_DQS Falling Edge Hold Time From DMCx_CK	0.2		t_{CK}
t_{DQSH}	DMCx_DQS Input High Pulse Width	0.45	0.55	t_{CK}
t_{DQSL}	DMCx_DQS Input Low Pulse Width	0.45	0.55	t_{CK}
t_{WPRE}	Write Preamble	0.9		t_{CK}
t_{WPST}	Write Postamble	0.3		t_{CK}
t_{IPW}	Address and Control Output Pulse Width	0.840		ns
t_{DIPW}	DMCx_DQ and DMCx_DM Output Pulse Width	0.550		ns

[1] Specifications apply to both DMC0 and DMC1.
[2] To ensure proper operation of the DDR3, all the DDR3 guidelines must be strictly followed. See "Interfacing DDR3/DDR2/LPDDR Memory to ADSP-SC5xx/215xx Processors" (EE-387).
[3] Write command to first DMCx_DQS delay = WL × t_{CK} + t_{DQSS}.

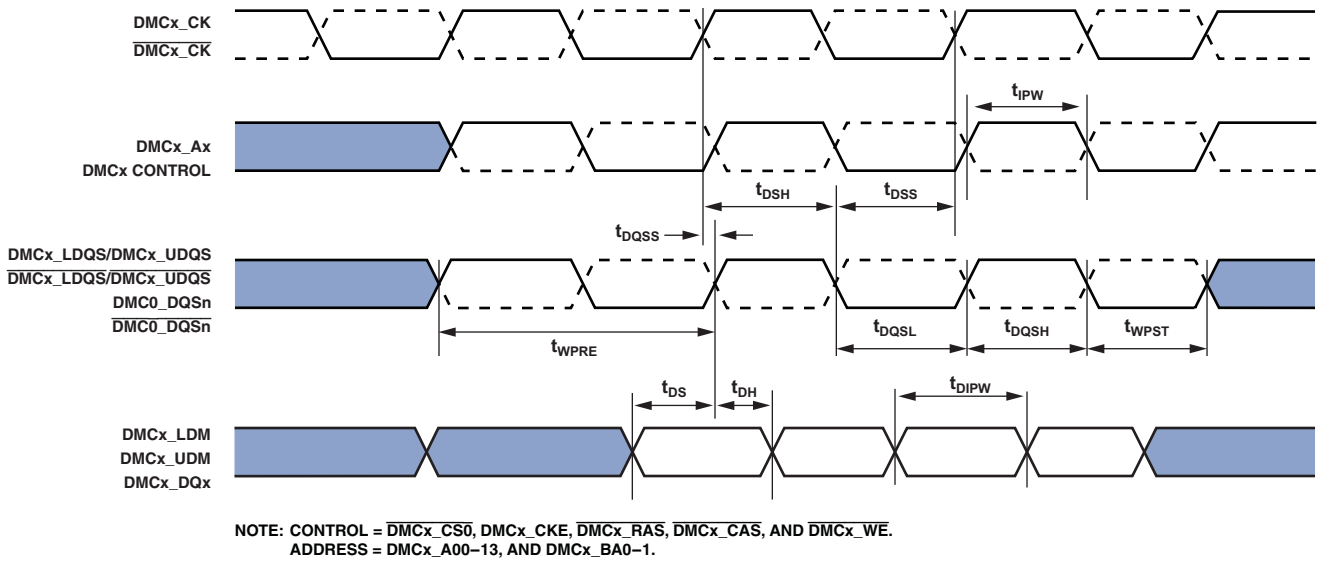

Figure 25. DDR3 SDRAM Controller Output AC Timing

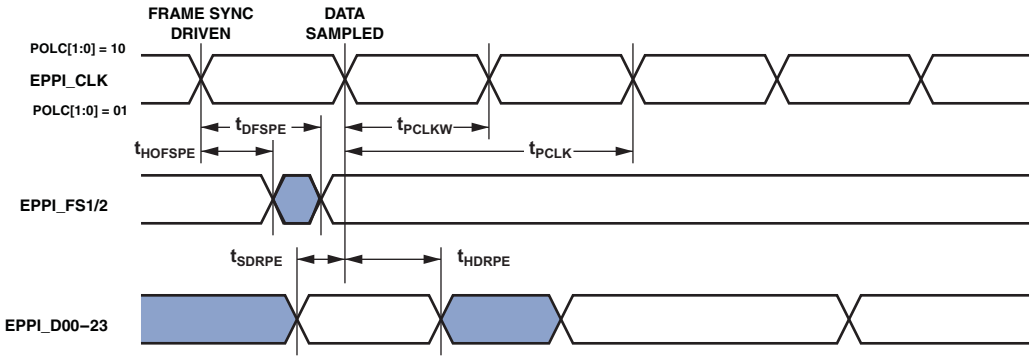

Figure 31. EPPI External Clock GP Receive Mode with Internal Frame Sync Timing

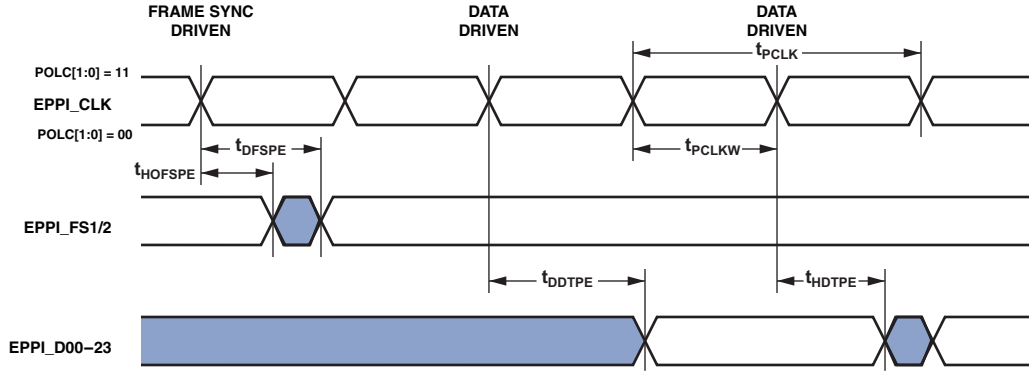

Figure 32. EPPI External Clock GP Transmit Mode with Internal Frame Sync Timing

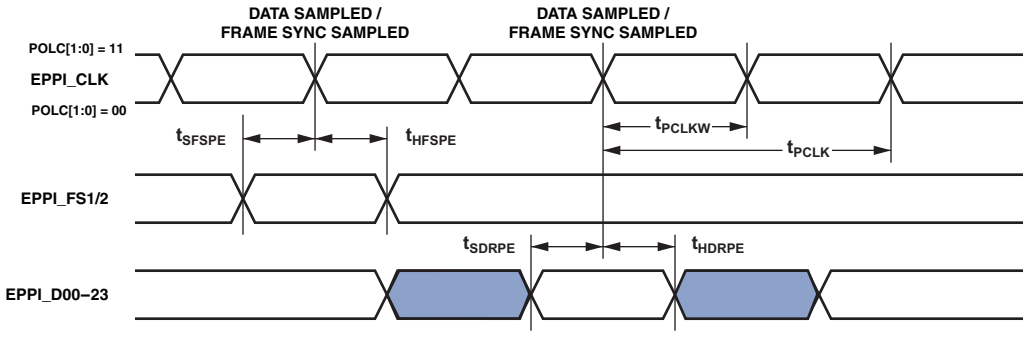

Figure 33. EPPI External Clock GP Receive Mode with External Frame Sync Timing

Link Ports (LP)

In LP receive mode, the link port clock is supplied externally and is called $f_{LCLKREXT}$, therefore the period can be represented by:

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

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:

$$f_{LCLKTPROG} = \frac{f_{CLKO8}}{(VALUE \times 2)}$$

In the case where VALUE = 0, $f_{LCLKTPROG} = f_{CLKO8}$. For all settings of VALUE, the following equation is true:

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

Calculation of the link receiver data setup and hold relative to the link clock is required to determine the maximum allowable skew that can be introduced in the transmission path length difference between LPx_Dx and LPx_CLK. Setup skew is the maximum delay that can be introduced in LPx_Dx relative to LPx_CLK (setup skew = $t_{LCLKTWH}$ min – t_{DLDCH} – t_{SLDCL}). Hold skew is the maximum delay that can be introduced in LPx_CLK relative to LPx_Dx (hold skew = $t_{LCLKTWL}$ min – t_{HLDCH} – t_{HLDCL}).

Table 62. Link Ports—Receive[1]

Parameter		Min	Max	Unit
Timing Requirements				
$f_{LCLKREXT}$	LPx_CLK Frequency		150	MHz
t_{SLDCL}	Data Setup Before LPx_CLK Low	0.9		ns
t_{HLDCL}	Data Hold After LPx_CLK Low	1.4		ns
t_{LCLKEW}	LPx_CLK Period[2]	$t_{LCLKREXT}$ – 0.42		ns
$t_{LCLKRWL}$	LPx_CLK Width Low[2]	0.5 × $t_{LCLKREXT}$		ns
$t_{LCLKRWH}$	LPx_CLK Width High[2]	0.5 × $t_{LCLKREXT}$		ns
Switching Characteristic				
t_{DLALC}	LPx_ACK Low Delay After LPx_CLK Low[3]	1.5 × t_{CLKO8} + 4	2.5 × t_{CLKO8} + 12	ns

[1] Specifications apply to LP0 and LP1.
[2] This specification indicates the minimum instantaneous width or period that can be tolerated due to duty cycle variation or jitter on the external LPx_CLK. For the external LPx_CLK ideal maximum frequency see the $f_{LCLKTEXT}$ specification in Table 29.
[3] LPx_ACK goes low with t_{DLALC} relative to rise of LPx_CLK after first byte, but does not go low if the link buffer of the receiver is not about to fill.

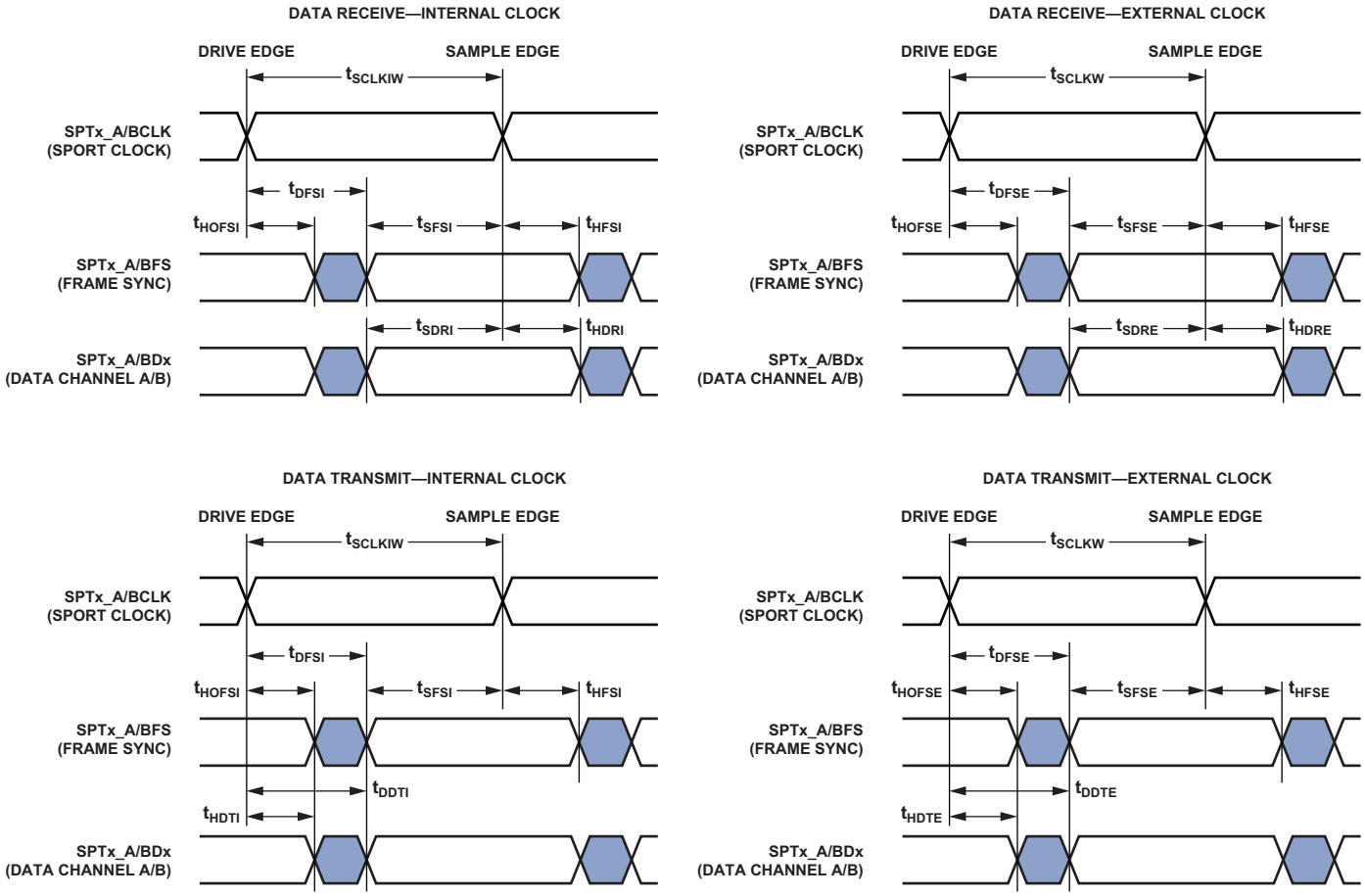

Figure 37. Serial Ports

Gigabit EMAC Timing (ETH0 Only)

Table 91 and Figure 62 describe the gigabit EMAC timing.

Table 91. Gigabit Ethernet MAC Controller (EMAC) Timing: RGMII [1]

Parameter		Min	Max	Unit
Timing Requirements				
t_{SETUPR}	Data to Clock Input Setup at Receiver	1		ns
t_{HOLDR}	Data to Clock Input Hold at Receiver	1		ns
$t_{GREFCLKF}$	RGMII Receive Clock Period	8		ns
$t_{GREFCLKW}$	RGMII Receive Clock Pulse Width	4		ns
Switching Characteristics				
t_{SKEWT}	Data to Clock Output Skew at Transmitter	–0.5	0.5	ns
t_{CYC}	Clock Cycle Duration	7.2	8.8	ns
t_{DUTY_G}	Duty Cycle for Gigabit Minimum	$t_{GREFCLKF} \times 45\%$	$t_{GREFCLKF} \times 55\%$	ns

[1] This specification is supported by ETH0 only (10/100/1000 EMAC controller).

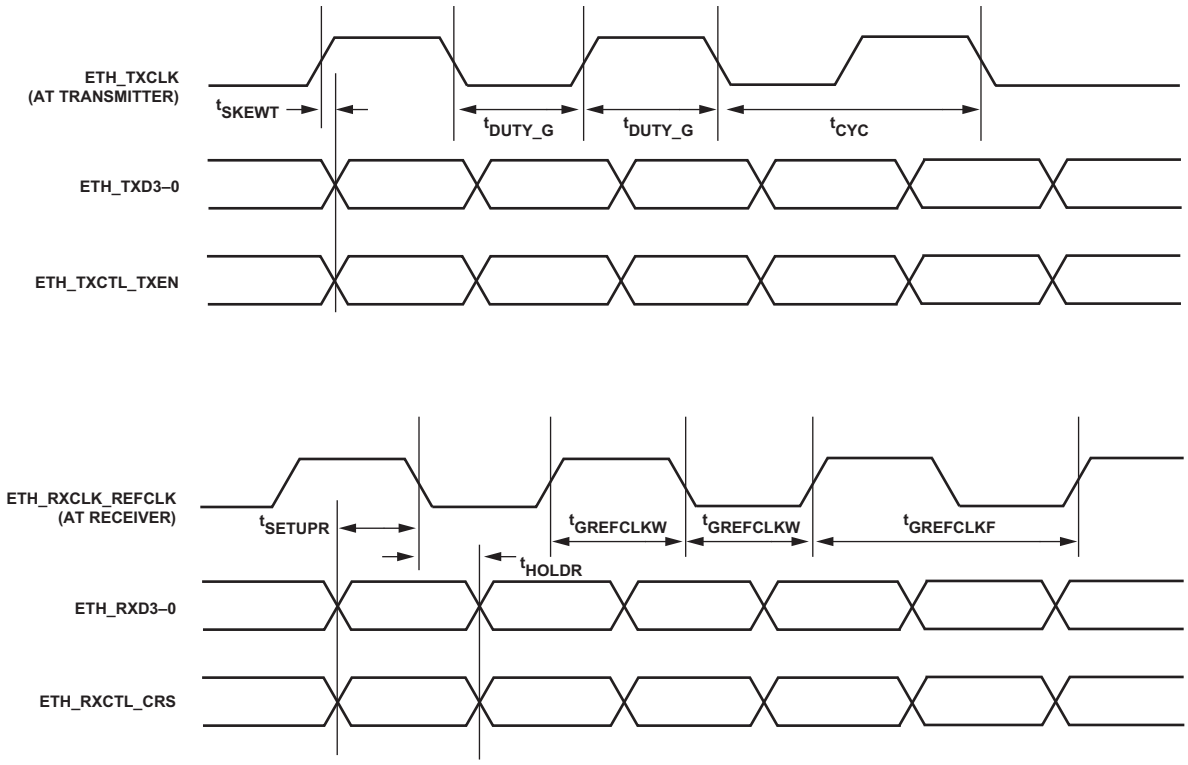

Figure 62. Gigabit EMAC Controller Timing—RGMII

S/PDIF Transmitter Input Data Timing

The timing requirements for the S/PDIF transmitter are given in Table 96. Input signals are routed to the DAIx_PINx pins using the SRU. Therefore, the timing specifications provided below are valid at the DAIx_PINx pins.

Table 96. S/PDIF Transmitter Input Data Timing

Parameter		Min	Max	Unit
Timing Requirements				
t_{SISFS}[1]	Frame Sync Setup Before Serial Clock Rising Edge	3		ns
t_{SIHFS}[1]	Frame Sync Hold After Serial Clock Rising Edge	3		ns
t_{SISD}[1]	Data Setup Before Serial Clock Rising Edge	3		ns
t_{SIHD}[1]	Data Hold After Serial Clock Rising Edge	3		ns
$t_{SITXCLKW}$	Transmit Clock Width	9		ns
$t_{SITXCLK}$	Transmit Clock Period	20		ns
$t_{SISCLKW}$	Clock Width	36		ns
t_{SISCLK}	Clock Period	80		ns

[1] The serial clock, data, and frame sync signals can come from any of the DAI pins. The serial clock and frame sync signals can also come via PCG or SPORTs. The input of the PCG can be either CLKIN or any of the DAI pins.

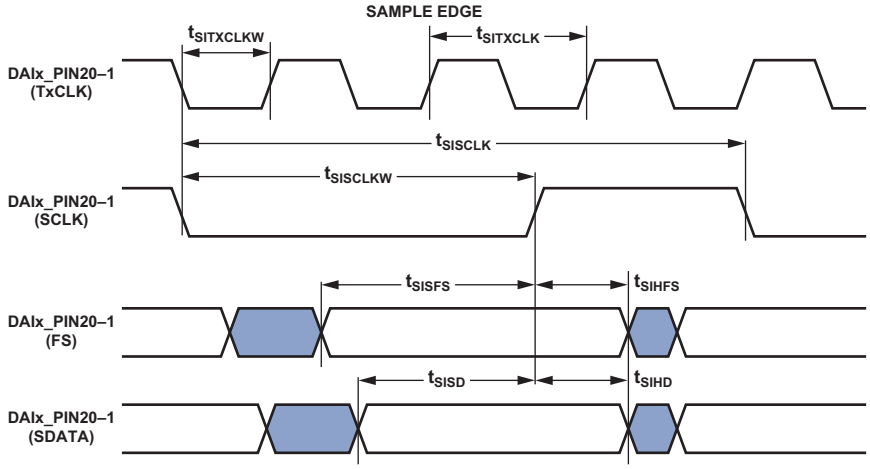

Figure 67. S/PDIF Transmitter Input Timing

Oversampling Clock (TxCLK) Switching Characteristics

The S/PDIF transmitter requires an oversampling clock input. This high frequency clock (TxCLK) input is divided down to generate the internal biphase clock.

Table 97. Oversampling Clock (TxCLK) Switching Characteristics

Parameter		Max	Unit
Switching Characteristics			
f_{TXCLK_384}	Frequency for TxCLK = 384 × Frame Sync	Oversampling ratio × frame sync ≤ $1/t_{SITXCLK}$	MHz
f_{TXCLK_256}	Frequency for TxCLK = 256 × Frame Sync	49.2	MHz
f_{FS}	Frame Rate (FS)	192.0	kHz

Media Local Bus (MLB)

All the numbers shown in Table 99 are applicable for all MLB speed modes (1024 FS, 512 FS, and 256 FS) for the 3-pin protocol, unless otherwise specified. Refer to the *Media Local Bus Specification version 4.2* for more details.

Table 99. 3-Pin MLB Interface Specifications

Parameter		Min	Typ	Max	Unit
t_{MLBCLK}	MLB Clock Period				
	1024 FS		20.3		ns
	512 FS		40		ns
	256 FS		81		ns
t_{MCKL}	MLBCLK Low Time				
	1024 FS	6.1			ns
	512 FS	14			ns
	256 FS	30			ns
t_{MCKH}	MLBCLK High Time				
	1024 FS	9.3			ns
	512 FS	14			ns
	256 FS	30			ns
t_{MCKR}	MLBCLK Rise Time (V_{IL} to V_{IH})				
	1024 FS			1	ns
	512 FS/256 FS			3	ns
t_{MCKF}	MLBCLK Fall Time (V_{IH} to V_{IL})				
	1024 FS			1	ns
	512 FS/256 FS			3	ns
t_{MPWV}[1]	MLBCLK Pulse Width Variation				
	1024 FS			0.7	nspp
	512 FS/256			2.0	nspp
t_{DSMCF}	DAT/SIG Input Setup Time	1			ns
t_{DHMCF}	DAT/SIG Input Hold Time	2			ns
t_{MCFDZ}	DAT/SIG Output Time to Three-State	0		15	ns
t_{MCDRV}	DAT/SIG Output Data Delay From MLBCLK Rising Edge			8	ns
t_{MDZH}[2]	Bus Hold Time				
	1024 FS	2			ns
	512 FS/256	4			ns
C_{MLB}	DAT/SIG Pin Load				
	1024 FS			40	pf
	512 FS/256			60	pf

[1] Pulse width variation is measured at 1.25 V by triggering on one edge of MLBCLK and measuring the spread on the other edge, measured in ns peak-to-peak.
[2] Board designs must ensure the high impedance bus does not leave the logic state of the final driven bit for this time period. Therefore, coupling must be minimized while meeting the maximum capacitive load listed.

ADSP-SC58x/ADSP-2158x 529-BALL BGA BALL ASSIGNMENTS

The ADSP-SC58x/ADSP-2158x 529-Ball BGA Ball Assignments (Numerical by Ball Number) table lists the 529-ball BGA package by ball number.

The ADSP-SC58x/ADSP-2158x 529-Ball BGA Ball Assignments (Alphabetical by Pin Name) table lists the 529-ball BGA package by pin name.

ADSP-SC58x/ADSP-2158x 529-BALL BGA BALL ASSIGNMENTS (NUMERICAL BY BALL NUMBER)

Ball No.	Pin Name	Ball No.	Pin Name	Ball No.	Pin Name	Ball No.	Pin Name
A01	GND	B19	DMC1_DQ11	D14	DMC1_BA2	F09	GND
A02	DMC0_UDQS	B20	DMC1_DQ12	D15	DMC1_CAS	F10	VDD_INT
A03	DMC0_CK	B21	DMC1_DQ14	D16	DMC1_RAS	F11	VDD_INT
A04	DMC0_CK	B22	PD_00	D17	DMC1_A09	F12	VDD_INT
A05	DMC0_DQ09	B23	PD_04	D18	DMC1_A15	F13	VDD_INT
A06	DMC0_LDQS	C01	DMC0_DQ14	D19	DMC1_A10	F14	VDD_INT
A07	DMC0_LDQS	C02	DMC0_DQ13	D20	DMC1_A11	F15	VDD_INT
A08	DMC0_DQ05	C03	DMC0_CS0	D21	PC_14	F16	GND
A09	DMC0_DQ03	C04	DMC0_CKE	D22	PD_10	F17	VDD_INT
A10	DMC0_DQ01	C05	DMC0_LDM	D23	PD_09	F18	VDD_INT
A11	DMC1_DQ03	C06	DMC1_RESET	E01	DMC0_A04	F19	VDD_INT
A12	DMC1_DQ00	C07	DMC1_A03	E02	DMC0_RAS	F20	PE_06
A13	DMC1_LDQS	C08	DMC1_A00	E03	DMC0_BA1	F21	PD_02
A14	DMC1_LDQS	C09	DMC1_A01	E04	DMC0_WE	F22	PD_13
A15	DMC1_VREF	C10	DMC1_A04	E05	DMC0_RZQ	F23	PD_12
A16	DMC1_CK	C11	DMC1_A06	E06	GND	G01	DMC0_A13
A17	DMC1_CK	C12	DMC1_BA1	E07	GND	G02	DMC0_A09
A18	DMC1_DQ09	C13	DMC1_ODT	E08	GND	G03	DMC0_A03
A19	DMC1_UDQS	C14	DMC1_CS0	E09	GND	G04	DMC0_A11
A20	DMC1_UDQS	C15	DMC1_LDM	E10	VDD_INT	G05	VDD_INT
A21	DMC1_DQ13	C16	DMC1_UDM	E11	VDD_INT	G06	VDD_DMC
A22	DMC1_DQ15	C17	DMC1_A14	E12	VDD_INT	G07	VDD_DMC
A23	GND	C18	DMC1_A12	E13	VDD_INT	G08	VDD_DMC
B01	DMC0_UDQS	C19	DMC1_A13	E14	VDD_INT	G09	VDD_DMC
B02	DMC0_DQ12	C20	PC_13	E15	VDD_INT	G10	VDD_DMC
B03	DMC0_DQ11	C21	PD_01	E16	VDD_INT	G11	VDD_DMC
B04	DMC0_DQ10	C22	PD_06	E17	VDD_INT	G12	VDD_DMC
B05	DMC0_DQ08	C23	PD_05	E18	VDD_INT	G13	VDD_DMC
B06	DMC0_DQ06	D01	DMC0_VREF	E19	DMC1_RZQ	G14	VDD_DMC
B07	DMC0_DQ07	D02	DMC0_DQ15	E20	PC_15	G15	VDD_DMC
B08	DMC0_DQ04	D03	DMC0_BA0	E21	PD_08	G16	VDD_DMC
B09	DMC0_DQ02	D04	DMC0_BA2	E22	PD_14	G17	VDD_DMC
B10	DMC0_DQ00	D05	DMC0_ODT	E23	PD_11	G18	VDD_DMC
B11	DMC1_DQ01	D06	DMC0_UDM	F01	DMC0_A01	G19	VDD_INT
B12	DMC1_DQ02	D07	DMC1_A05	F02	DMC0_A06	G20	PE_04
B13	DMC1_DQ04	D08	DMC1_WE	F03	DMC0_CAS	G21	PE_13
B14	DMC1_DQ05	D09	DMC1_A07	F04	DMC0_A02	G22	PE_01
B15	DMC1_DQ06	D10	DMC1_A02	F05	DMC0_A07	G23	PE_00
B16	DMC1_DQ07	D11	DMC1_BA0	F06	GND	H01	DMC0_A14
B17	DMC1_DQ08	D12	DMC1_A08	F07	VDD_INT	H02	DMC0_A12
B18	DMC1_DQ10	D13	DMC1_CKE	F08	VDD_INT	H03	DMC0_A05

ADSP-SC58x/ADSP-2158x 529-BALL BGA BALL ASSIGNMENTS (ALPHABETICAL BY PIN NAME)

Pin Name	Ball No.	Pin Name	Ball No.	Pin Name	Ball No.	Pin Name	Ball No.
DAI0_PIN01	AA06	DMC0_A06	F02	DMC1_A00	C08	DMC1_RZQ	E19
DAI0_PIN02	AB06	DMC0_A07	F05	DMC1_A01	C09	DMC1_UDM	C16
DAI0_PIN03	AB07	DMC0_A08	J03	DMC1_A02	D10	DMC1_UDQS	A20
DAI0_PIN04	AB05	DMC0_A09	G02	DMC1_A03	C07	$\overline{\text{DMC1\_UDQS}}$	A19
DAI0_PIN05	Y05	DMC0_A10	J02	DMC1_A04	C10	DMC1_VREF	A15
DAI0_PIN06	AA05	DMC0_A11	G04	DMC1_A05	D07	$\overline{\text{DMC1\_WE}}$	D08
DAI0_PIN07	AA04	DMC0_A12	H02	DMC1_A06	C11	GND	A01
DAI0_PIN08	Y04	DMC0_A13	G01	DMC1_A07	D09	GND	A23
DAI0_PIN09	AB03	DMC0_A14	H01	DMC1_A08	D12	GND	E06
DAI0_PIN10	Y06	DMC0_A15	J01	DMC1_A09	D17	GND	E07
DAI0_PIN11	W04	DMC0_BA0	D03	DMC1_A10	D19	GND	E08
DAI0_PIN12	V04	DMC0_BA1	E03	DMC1_A11	D20	GND	E09
DAI0_PIN13	AB04	DMC0_BA2	D04	DMC1_A12	C18	GND	F06
DAI0_PIN14	AB02	$\overline{\text{DMC0\_CAS}}$	F03	DMC1_A13	C19	GND	F09
DAI0_PIN15	AB01	DMC0_CK	A04	DMC1_A14	C17	GND	F16
DAI0_PIN16	AA03	DMC0_CKE	C04	DMC1_A15	D18	GND	J07
DAI0_PIN17	Y03	$\overline{\text{DMC0\_CK}}$	A03	DMC1_BA0	D11	GND	J08
DAI0_PIN18	W03	$\overline{\text{DMC0\_CS0}}$	C03	DMC1_BA1	C12	GND	J09
DAI0_PIN19	V03	DMC0_DQ00	B10	DMC1_BA2	D14	GND	J10
DAI0_PIN20	U04	DMC0_DQ01	A10	$\overline{\text{DMC1\_CAS}}$	D15	GND	J11
DAI1_PIN01	T23	DMC0_DQ02	B09	DMC1_CK	A16	GND	J12
DAI1_PIN02	U23	DMC0_DQ03	A09	DMC1_CKE	D13	GND	J13
DAI1_PIN03	T20	DMC0_DQ04	B08	$\overline{\text{DMC1\_CK}}$	A17	GND	J14
DAI1_PIN04	U21	DMC0_DQ05	A08	$\overline{\text{DMC1\_CS0}}$	C14	GND	J15
DAI1_PIN05	U22	DMC0_DQ06	B06	DMC1_DQ00	A12	GND	J16
DAI1_PIN06	V21	DMC0_DQ07	B07	DMC1_DQ01	B11	GND	J17
DAI1_PIN07	U20	DMC0_DQ08	B05	DMC1_DQ02	B12	GND	K07
DAI1_PIN08	U19	DMC0_DQ09	A05	DMC1_DQ03	A11	GND	K08
DAI1_PIN09	V23	DMC0_DQ10	B04	DMC1_DQ04	B13	GND	K09
DAI1_PIN10	W22	DMC0_DQ11	B03	DMC1_DQ05	B14	GND	K10
DAI1_PIN11	W21	DMC0_DQ12	B02	DMC1_DQ06	B15	GND	K11
DAI1_PIN12	V22	DMC0_DQ13	C02	DMC1_DQ07	B16	GND	K12
DAI1_PIN13	W23	DMC0_DQ14	C01	DMC1_DQ08	B17	GND	K13
DAI1_PIN14	Y21	DMC0_DQ15	D02	DMC1_DQ09	A18	GND	K14
DAI1_PIN15	Y23	DMC0_LDM	C05	DMC1_DQ10	B18	GND	K15
DAI1_PIN16	V20	DMC0_LDQS	A07	DMC1_DQ11	B19	GND	K16
DAI1_PIN17	Y22	$\overline{\text{DMC0\_LDQS}}$	A06	DMC1_DQ12	B20	GND	K17
DAI1_PIN18	AA23	DMC0_ODT	D05	DMC1_DQ13	A21	GND	L07
DAI1_PIN19	AA22	$\overline{\text{DMC0\_RAS}}$	E02	DMC1_DQ14	B21	GND	L08
DAI1_PIN20	W20	$\overline{\text{DMC0\_RESET}}$	K01	DMC1_DQ15	A22	GND	L09
DMC0_A00	H04	DMC0_RZQ	E05	DMC1_LDM	C15	GND	L10
DMC0_A01	F01	DMC0_UDM	D06	DMC1_LDQS	A13	GND	L11
DMC0_A02	F04	DMC0_UDQS	B01	$\overline{\text{DMC1\_LDQS}}$	A14	GND	L12
DMC0_A03	G03	$\overline{\text{DMC0\_UDQS}}$	A02	DMC1_ODT	C13	GND	L13
DMC0_A04	E01	DMC0_VREF	D01	$\overline{\text{DMC1\_RAS}}$	D16	GND	L14
DMC0_A05	H03	$\overline{\text{DMC0\_WE}}$	E04	$\overline{\text{DMC1\_RESET}}$	C06	GND	L15