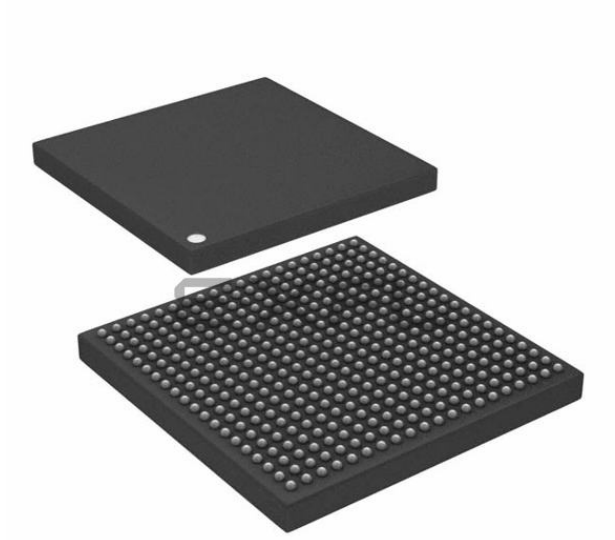

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Understanding Embedded - DSP (Digital Signal Processors)

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	Fixed/Floating Point
Interface	CAN, EBI/EMI, Ethernet, DAI, I²C, MMC/SD/SDIO, SPI, SPORT, UART/USART, USB OTG
Clock Rate	300MHz, 300MHz
Non-Volatile Memory	External
On-Chip RAM	2MB
Voltage - I/O	3.30V
Voltage - Core	1.10V
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	400-LFBGA, CSPBGA
Supplier Device Package	400-CSPBGA (17x17)
Purchase URL	https://www.e-xfl.com/product-detail/analog-devices/adsp-sc573bbcz-3

ARM CORTEX-A5 PROCESSOR

The ARM Cortex-A5 processor (see Figure 2) is a high performance processor with the following features:

- Instruction cache unit (32 Kb) and data Level 1 (L1) cache unit (32 Kb)
- In order pipeline with dynamic branch prediction
- ARM, Thumb, and ThumbEE instruction set support
- ARM TrustZone® security extensions
- Harvard L1 memory system with a memory management unit (MMU)
- ARM v7 debug architecture
- Trace support through an embedded trace macrocell (ETM) interface
- Extension—vector floating-point unit (IEEE754) with trapless execution
- Extension—media processing engine (MPE) with NEON™ technology
- Extension—Jazelle® hardware acceleration

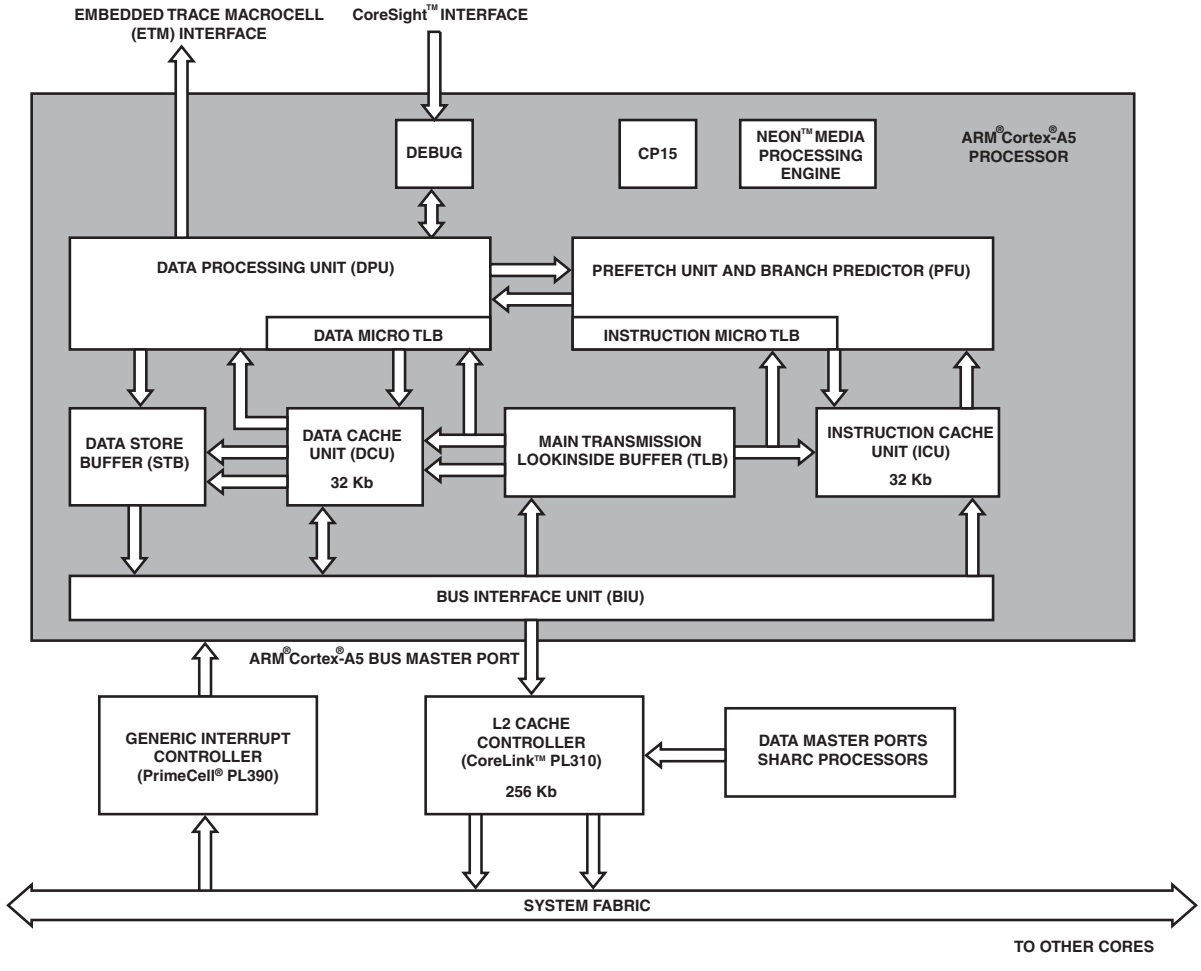

Figure 2. ARM Cortex-A5 Processor Block Diagram

periodic communication message objects. Dedicated hardware circuitry compares the signature with precalculated values and triggers appropriate fault events.

For example, every 100 ms the system software initiates the signature calculation of the entire memory contents and compares these contents with expected, precalculated values. If a mismatch occurs, a fault condition is generated through the processor core or the trigger routing unit.

The CRC is a hardware module based on a CRC32 engine that computes the CRC value of the 32-bit data-words presented to it. The source channel of the memory to memory DMA (in memory scan mode) provides data. The data can be optionally forwarded to the destination channel (memory transfer mode). The main features of the CRC peripheral are as follows:

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

Event Handling

The processors provide event handling that supports both nesting and prioritization. Nesting allows multiple event service routines to be active simultaneously. Prioritization ensures that servicing a higher priority event takes precedence over servicing a lower priority event.

The processors provide support for four different types of events:

- An emulation event causes the processors to enter emulation mode, allowing command and control of the processors through the JTAG interface.
- A reset event resets the processors.
- An exceptions event occurs synchronously to program flow (in other words, the exception is taken before the instruction is allowed to complete). Conditions triggered on the one side by the SHARC+ core, such as data alignment (SIMD or long word) or compute violations (fixed or floating point), and illegal instructions cause core exceptions. Conditions triggered on the other side by the SEC, such as error correcting codes (ECC), parity, watchdog, or system clock, cause system exceptions.
- An interrupts event occurs asynchronously to program flow. They are caused by input signals, timers, and other peripherals, as well as by an explicit software instruction.

System Event Controller (SEC)

Both SHARC+ cores feature a system event controller. The SEC features include the following:

- Comprehensive system event source management, including interrupt enable, fault enable, priority, core mapping, and source grouping
- A distributed programming model where each system event source control and all status fields are independent of each other
- Determinism where all system events have the same propagation delay and provide unique identification of a specific system event source
- A slave control port that provides access to all SEC registers for configuration, status, and interrupt and fault services
- Global locking that supports a register level protection model to prevent writes to locked registers
- Fault management including fault action configuration, time out, external indication, and system reset

Trigger Routing Unit (TRU)

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

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

SECURITY FEATURES

The following sections describe the security features of the ADSP-SC57x/ADSP-2157x processors.

ARM TrustZone

The ADSP-SC57x processors provide TrustZone technology that is integrated into the ARM Cortex-A5 processors. The TrustZone technology enables a secure state that is extended throughout the system fabric.

Cryptographic Hardware Accelerators

The ADSP-SC57x/ADSP-2157x processors support standards-based hardware accelerated encryption, decryption, authentication, and true random number generation.

Support for the hardware accelerated cryptographic ciphers includes the following:

- AES in ECB, CBC, ICM, and CTR modes with 128-bit, 192-bit, and 256-bit keys
- DES in ECB and CBC mode with 56-bit key
- 3DES in ECB and CBC mode with 3x 56-bit key
- ARC4 in stateful, stateless mode, up to 128-bit key

Table 12. ADSP-SC57x/ADSP-2157x 400-Ball CSP_BGA Signal Descriptions (Continued)

Signal Name	Description	Port	Pin Name
TRACE0_D03	TRACE0 Trace Data 3	F	PF_03
TRACE0_D04	TRACE0 Trace Data 4	D	PD_10
TRACE0_D05	TRACE0 Trace Data 5	D	PD_11
TRACE0_D06	TRACE0 Trace Data 6	D	PD_12
TRACE0_D07	TRACE0 Trace Data 7	D	PD_13
TWI0_SCL	TWI0 Serial Clock	Not Muxed	TWI0_SCL
TWI0_SDA	TWI0 Serial Data	Not Muxed	TWI0_SDA
TWI1_SCL	TWI1 Serial Clock	Not Muxed	TWI1_SCL
TWI1_SDA	TWI1 Serial Data	Not Muxed	TWI1_SDA
TWI2_SCL	TWI2 Serial Clock	Not Muxed	TWI2_SCL
TWI2_SDA	TWI2 Serial Data	Not Muxed	TWI2_SDA
$\overline{\text{UART0\_CTS}}$	UART0 Clear to Send	D	PD_06
$\overline{\text{UART0\_RTS}}$	UART0 Request to Send	D	PD_05
$\overline{\text{UART0\_RX}}$	UART0 Receive	F	PF_09
$\overline{\text{UART0\_TX}}$	UART0 Transmit	F	PF_08
$\overline{\text{UART1\_CTS}}$	UART1 Clear to Send	E	PE_14
$\overline{\text{UART1\_RTS}}$	UART1 Request to Send	E	PE_00
$\overline{\text{UART1\_RX}}$	UART1 Receive	F	PF_11
$\overline{\text{UART1\_TX}}$	UART1 Transmit	F	PF_10
$\overline{\text{UART2\_CTS}}$	UART2 Clear to Send	A	PA_11
$\overline{\text{UART2\_RTS}}$	UART2 Request to Send	A	PA_10
$\overline{\text{UART2\_RX}}$	UART2 Receive	C	PC_13
$\overline{\text{UART2\_TX}}$	UART2 Transmit	C	PC_12
USB0_CLKIN	USB0 Clock/Crystal Input	Not Muxed	USB_CLKIN
USB0_DM	USB0 Data –	Not Muxed	USB0_DM
USB0_DP	USB0 Data +	Not Muxed	USB0_DP
USB0_ID	USB0 OTG ID	Not Muxed	USB0_ID
USB0_VBC	USB0 VBUS Control	Not Muxed	USB0_VBC
USB0_VBUS	USB0 Bus Voltage	Not Muxed	USB0_VBUS
USB0_XTAL	USB0 Crystal	Not Muxed	USB_XTAL
VDD_EXT	External Voltage Domain	Not Muxed	VDD_EXT
VDD_INT	Internal Voltage Domain	Not Muxed	VDD_INT
VDD_DMC	DMC VDD	Not Muxed	VDD_DMC
VDD_HADC	HADC/TMU VDD	Not Muxed	VDD_HADC
VDD_USB	USB VDD	Not Muxed	VDD_USB

[1] Signal is routed to the DAI0_PINnn pin through the DAI0_PBnn pin buffers using the SRU.

Table 25. ADSP-SC57x/ADSP-2157x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Internal Termination	Reset Drive	Power Domain	Description and Notes
DMC0_LDQS	InOut	C	none	none	VDD_DMC	Desc: DMC0 Data Strobe for Lower Byte (complement) Notes: No notes
DMC0_ODT	Output	B	none	L	VDD_DMC	Desc: DMC0 On-die termination Notes: No notes
DMC0_RAS	Output	B	none	L	VDD_DMC	Desc: DMC0 Row Address Strobe Notes: No notes
DMC0_RESET	Output	B	none	L	VDD_DMC	Desc: DMC0 Reset (DDR3 only) Notes: No notes
DMC0_RZQ	a	B	none	none	VDD_DMC	Desc: DMC0 External calibration resistor connection Notes: Applicable for DDR2 and DDR3 only. Pull down using a 34 Ohm resistor.
DMC0_UDM	Output	B	none	L	VDD_DMC	Desc: DMC0 Data Mask for Upper Byte Notes: No notes
DMC0_UDQS	InOut	C	none	none	VDD_DMC	Desc: DMC0 Data Strobe for Upper Byte Notes: External weak pull-down required in LPDDR mode
DMC0_UDQS	InOut	C	none	none	VDD_DMC	Desc: DMC0 Data Strobe for Upper Byte (complement) Notes: No notes
DMC0_VREF	a		none	none	VDD_DMC	Desc: DMC0 Voltage Reference Notes: No notes
DMC0_WE	Output	B	none	L	VDD_DMC	Desc: DMC0 Write Enable Notes: No notes
GND	g		none	none		Desc: Ground Notes: No notes
HADC0_VIN0	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 0 Notes: Connect to GND through a resistor if not used[4]
HADC0_VIN1	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 1 Notes: Connect to GND through a resistor if not used[4]
HADC0_VIN2	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 2 Notes: Connect to GND through a resistor if not used[4]
HADC0_VIN3	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 3 Notes: Connect to GND through a resistor if not used[4]
HADC0_VIN4	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 4 Notes: Connect to GND through a resistor if not used[4]
HADC0_VIN5	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 5 Notes: Connect to GND through a resistor if not used[4]
HADC0_VIN6	a	NA	none	none	VDD_HADC	Desc: HADC0 Analog Input at channel 6 Notes: Connect to GND through a resistor if not used[4]

Table 25. ADSP-SC57x/ADSP-2157x Designer Quick Reference (Continued)

Signal Name	Type	Driver Type	Internal Termination	Reset Drive	Power Domain	Description and Notes
PB_10	InOut	H	none	none	VDD_EXT	Desc: PORTB Position 10 Notes: Connect to VDD_EXT or GND if not used
PB_11	InOut	H	none	none	VDD_EXT	Desc: PORTB Position 11 Notes: Connect to VDD_EXT or GND if not used
PB_12	InOut	H	none	none	VDD_EXT	Desc: PORTB Position 12 Notes: Connect to VDD_EXT or GND if not used
PB_13	InOut	H	none	none	VDD_EXT	Desc: PORTB Position 13 Notes: Connect to VDD_EXT or GND if not used
PB_14	InOut	H	none	none	VDD_EXT	Desc: PORTB Position 14 Notes: Connect to VDD_EXT or GND if not used
PB_15	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTB Position 15 Notes: See note[2]
PC_00	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 0 Notes: See note[2]
PC_01	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 1 Notes: See note[2]
PC_02	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 2 Notes: See note[2]
PC_03	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 3 Notes: See note[2]
PC_04	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 4 Notes: See note[2]
PC_05	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 5 Notes: See note[2]
PC_06	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 6 Notes: See note[2]
PC_07	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 7 Notes: See note[2]
PC_08	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 8 Notes: See note[2]
PC_09	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 9 Notes: See note[2]
PC_10	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 10 Notes: See note[2]
PC_11	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 11 Notes: See note[2]
PC_12	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 12 Notes: See note[2]
PC_13	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 13 Notes: See note[2]
PC_14	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 14 Notes: See note[2]
PC_15	InOut	A	Programmable PullUp[1]	none	VDD_EXT	Desc: PORTC Position 15 Notes: See note[2]

SPECIFICATIONS

For information about product specifications, contact your Analog Devices representative.

OPERATING CONDITIONS

Parameter		Conditions	Min	Nominal	Max	Unit
V_{DD_INT}	Internal (Core) Supply Voltage	CCLK ≤ 450 MHz	1.05	1.10	1.15	V
		CCLK ≤ 500 MHz	1.10	1.15	1.20	V
V_{DD_EXT}	External (I/O) Supply Voltage		3.13	3.3	3.47	V
V_{DD_HADC}	Analog Power Supply Voltage		3.13	3.3	3.47	V
V_{DD_DMC}[1]	DDR2/LPDDR Controller Supply Voltage		1.7	1.8	1.9	V
	DDR3 Controller Supply Voltage		1.425	1.5	1.575	V
V_{DD_USB}[2]	USB Supply Voltage		3.13	3.3	3.47	V
V_{DDR_VREF}	DDR2 Reference Voltage Applies to the DMC0_VREF pin		0.49 × V_{DD_DMC}	0.50 × V_{DD_DMC}	0.51 × V_{DD_DMC}	V
V_{HADC_REF}[3]	HADC Reference Voltage		2.5	3.30	V_{DD_HADC}	V
V_{HADC0_VINx}	HADC Input Voltage		0		V_{HADC_REF} + 0.2	V
V_{IH}[4]	High Level Input Voltage	V_{DD_EXT} = 3.47 V	2.0			V
V_{IHTWI}[5, 6]	High Level Input Voltage	V_{DD_EXT} = 3.47 V	0.7 × $V_{VBUSTWI}$		$V_{VBUSTWI}$	V
V_{IL}[4]	Low Level Input Voltage	V_{DD_EXT} = 3.13 V			0.8	V
V_{ILTWI}[5, 6]	Low Level Input Voltage	V_{DD_EXT} = 3.13 V			0.3 × $V_{VBUSTWI}$	V
V_{IL_DDR2}[7]	Low Level Input Voltage	V_{DD_DMC} = 1.7 V			V_{REF} – 0.25	V
V_{IL_DDR3}[7]	Low Level Input Voltage	V_{DD_DMC} = 1.425 V			V_{REF} – 0.175	V
V_{IH_DDR2}[7]	High Level Input Voltage	V_{DD_DMC} = 1.9 V	V_{REF} + 0.25			V
V_{IH_DDR3}[7]	High Level Input Voltage	V_{DD_DMC} = 1.575 V	V_{REF} + 0.175			V
V_{IL_LPDDR}[8]	Low Level Input Voltage	V_{DD_DMC} = 1.7 V			0.2 × V_{DD_DMC}	V
V_{IH_LPDDR}[8]	High Level Input Voltage	V_{DD_DMC} = 1.9 V	0.8 × V_{DD_DMC}			V
T_J	Junction Temperature 400-Ball CSP_BGA	$T_{AMBIENT}$ = 0°C to +70°C CCLK ≤ 450 MHz	0		95	°C
T_J	Junction Temperature 400-Ball CSP_BGA	$T_{AMBIENT}$ = –40°C to +100°C CCLK ≤ 450 MHz	–40		+125	°C
T_J	Junction Temperature 176-Lead LQFP-EP	$T_{AMBIENT}$ = 0°C to +70°C CCLK ≤ 450 MHz	0		90	°C
T_J	Junction Temperature 176-Lead LQFP-EP	$T_{AMBIENT}$ = –40°C to +105°C CCLK ≤ 450 MHz	–40		+125	°C
T_J	Junction Temperature 400-Ball CSP_BGA	$T_{AMBIENT}$ = 0°C to +70°C CCLK ≤ 500 MHz	0		100	°C
T_J	Junction Temperature 400-Ball CSP_BGA	$T_{AMBIENT}$ = –40°C to +95°C CCLK ≤ 500 MHz	–40		+125	°C
T_J	Junction Temperature 176-Lead LQFP-EP	$T_{AMBIENT}$ = 0°C to +70°C CCLK ≤ 500 MHz	0		95	°C
T_J	Junction Temperature 176-Lead LQFP-EP	$T_{AMBIENT}$ = –40°C to +100°C CCLK ≤ 500 MHz	–40		+125	°C

Parameter		Conditions	Min	Nominal	Max	Unit
AUTOMOTIVE USE ONLY						
T_J	Junction Temperature 400-Ball CSP_BGA (Automotive Grade)	$T_{AMBIENT}$ = –40°C to +105°C CCLK ≤ 450 MHz	–40		+130[9]	°C
T_J	Junction Temperature 176-Lead LQFP-EP (Automotive Grade)	$T_{AMBIENT}$ = –40°C to +105°C CCLK ≤ 450 MHz	–40		+125[9]	°C
T_J	Junction Temperature 400-Ball CSP_BGA (Automotive Grade)	$T_{AMBIENT}$ = –40°C to +105°C CCLK ≤ 500 MHz	–40		+133[9]	°C
T_J	Junction Temperature 176-Lead LQFP-EP (Automotive Grade)	$T_{AMBIENT}$ = –40°C to +105°C CCLK ≤ 500 MHz	–40		+130[9]	°C

[1] Applies to DDR2/DDR3/LPDDR signals.
[2] If not used, V_{DD_USB} must be connected to 3.3 V.
[3] V_{HADC_VREF} must always be less than V_{DD_HADC}.
[4] Parameter value applies to all input and bidirectional pins except the TWI, DMC, USB, and MLB pins.
[5] Parameter applies to TWI signals.
[6] TWI signals are pulled up to V_{BUSTWI}. See Table 26.
[7] This parameter applies to all DMC0 signals in DDR2/DDR3 mode. V_{REF} is the voltage applied to the V_{REF_DMC} pin, nominally $V_{DD\_DMC}/2$.
[8] This parameter applies to DMC0 signals in LPDDR mode.
[9] Automotive application use profile only. Not supported for nonautomotive use. Contact Analog Devices for more information.

Table 26. TWI_VSEL Selections and V_{DD_EXT}/V_{BUSTWI}

TWI_VSEL Selections	V_{DD_EXT} Nominal	V_{BUSTWI}			Unit
		Min	Nominal	Max	
TWI000[1]	3.30	3.13	3.30	3.47	V
TWI100	3.30	4.75	5.00	5.25	V

[1] Designs must comply with the V_{DD_EXT} and V_{BUSTWI} voltages specified for the default TWI_DT setting for correct JTAG boundary scan operation during reset.

Table 28. PLL Operating Conditions

Parameter		Min	Max	Unit
f_{PLLCLK}	PLL Clock Frequency	200	1000	MHz

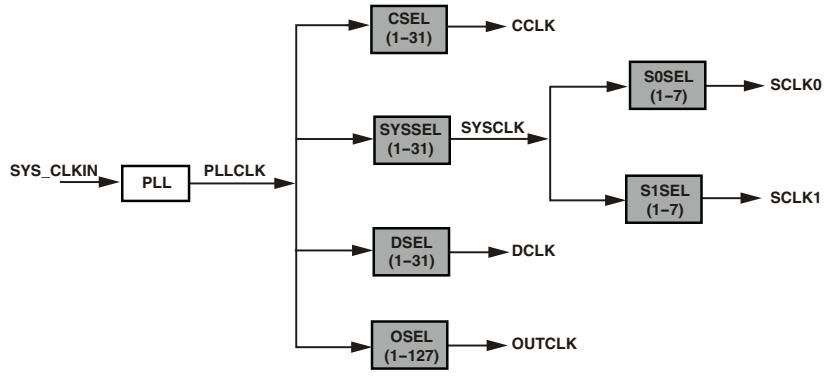

Figure 7. Clock Relationships and Divider Values

Clock and Reset Timing

Table 42 and Figure 9 describe clock and reset operations related to the CGU and RCU. Per the CCLK, SYSCLK, SCLK, DCLK, and OCLK timing specifications in Table 27, combinations of SYS_CLKIN and clock multipliers must not select clock rates in excess of the maximum instruction rate of the processor.

Table 42. Clock and Reset Timing

Parameter		Min	Max	Unit
Timing Requirements				
f_{CKIN}	SYS_CLKINx Frequency (Crystal)[1, 2, 3]	20	50	MHz
	SYS_CLKINx Frequency (External CLKIN)[1, 2, 3]	20	50	MHz
t_{CKINL}	CLKIN Low Pulse[1]	10		ns
t_{CKINH}	CLKIN High Pulse[1]	10		ns
t_{WRST}	$\overline{\text{RESET}}$ Asserted Pulse Width Low[4]	11 × t_{CKIN}		ns

[1] Applies to PLL bypass mode and PLL nonbypass mode.
[2] The t_{CKIN} period (see Figure 9) equals $1/f_{CKIN}$.
[3] If the CGU_CTL.DF bit is set, the minimum f_{CKIN} specification is 40 MHz.
[4] Applies after power-up sequence is complete. See Table 41 and Figure 8 for power-up reset timing.

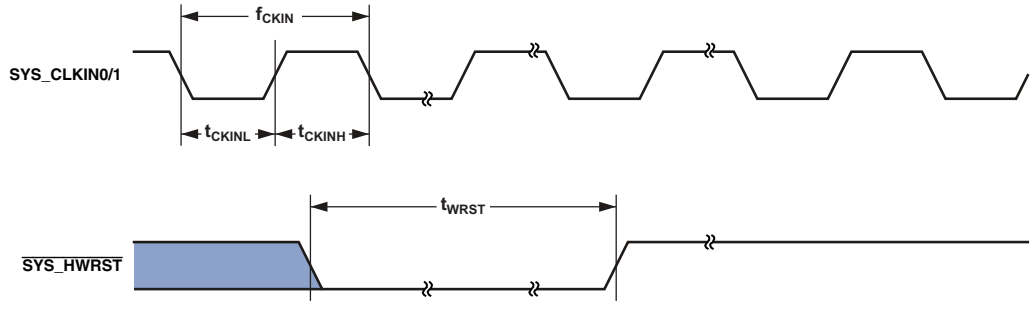

Figure 9. Clock and Reset Timing

Enhanced Parallel Peripheral Interface (EPPI) Timing

Table 52 and Table 53 and Figure 19 through Figure 27 describe enhanced parallel peripheral interface (EPPI) timing operations. In Figure 19 through Figure 27, POLC[1:0] represents the setting of the EPPI_CTL register, which sets the sampling/driving edges of the EPPI clock.

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

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

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

When externally generated, the EPPI_CLK is called $f_{PCLKEXT}$:

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

Table 52. Enhanced Parallel Peripheral Interface (EPPI)—Internal Clock

Parameter		Min	Max	Unit
Timing Requirements				
t_{SFSPI}	External FS Setup Before EPPI_CLK	6.5		ns
t_{HFSPI}	External FS Hold After EPPI_CLK	0		ns
t_{SDRPI}	Receive Data Setup Before EPPI_CLK	6.5		ns
t_{HDRPI}	Receive Data Hold After EPPI_CLK	0		ns
t_{SFS3GI}	External FS3 Input Setup Before EPPI_CLK Fall Edge in Clock Gating Mode	14		ns
t_{HFS3GI}	External FS3 Input Hold Before EPPI_CLK Fall Edge in Clock Gating Mode	0		ns
Switching Characteristics				
t_{PCLKW}	EPPI_CLK Width[1]	$0.5 \times t_{PCLKPROG} - 1.5$		ns
t_{PCLK}	EPPI_CLK Period[1]	$t_{PCLKPROG} - 1.5$		ns
t_{DFSPI}	Internal FS Delay After EPPI_CLK		3.6	ns
t_{HOFSPI}	Internal FS Hold After EPPI_CLK	–0.72		ns
t_{DDTPI}	Transmit Data Delay After EPPI_CLK		3.5	ns
t_{HDTPI}	Transmit Data Hold After EPPI_CLK	–0.5		ns

[1] See Table 27 for details on the minimum period that can be programmed for $t_{PCLKPROG}$.

Table 64. SPI2 Port—Master Timing[1]

Parameter		Min	Max	Unit
Timing Requirements				
t_{SSPIDM}	Data Input Valid to SPIx_CLK Edge (Data Input Setup)	2.7		ns
t_{HSPIDM}	SPIx_CLK Sampling Edge to Data Input Invalid	0.75		ns
Switching Characteristics				
t_{SDSCIM}	$\overline{\text{SPIx\_SEL}}$ low to First SPI_CLK Edge for CPHA = 1[2]	$t_{SPICLKPROG} - 5$		ns
	$\overline{\text{SPIx\_SEL}}$ low to First SPI_CLK Edge for CPHA = 0[2]	$1.5 \times t_{SPICLKPROG} - 5$		ns
t_{SPICHM}	SPIx_CLK High Period[3]	$0.5 \times t_{SPICLKPROG} - 1.5$		ns
t_{SPICLM}	SPIx_CLK Low Period[3]	$0.5 \times t_{SPICLKPROG} - 1.5$		ns
t_{SPICLK}	SPIx_CLK Period[3]	$t_{SPICLKPROG} - 1.5$		ns
t_{HDSM}	Last SPIx_CLK Edge to $\overline{\text{SPIx\_SEL}}$ High for CPHA = 1[2]	$1.5 \times t_{SPICLKPROG} - 5$		ns
	Last SPIx_CLK Edge to $\overline{\text{SPIx\_SEL}}$ High for CPHA = 0[2]	$t_{SPICLKPROG} - 5$		ns
t_{SPITDM}	Sequential Transfer Delay[2, 4]	$t_{SPICLKPROG} - 1.5$		ns
$t_{DDSPIDM}$	SPIx_CLK Edge to Data Out Valid (Data Out Delay)		3.17	ns
$t_{HDSPIDM}$	SPIx_CLK Edge to Data Out Invalid (Data Out Hold)	–2.4		ns

[1] All specifications apply to SPI2 only.
[2] Specification assumes the LEADX and LAGX bits in the SPI_DLY register are 1.
[3] See Table 27 for details on the minimum period that may be programmed for $t_{SPICLKPROG}$.
[4] Applies to sequential mode with STOP ≥ 1.

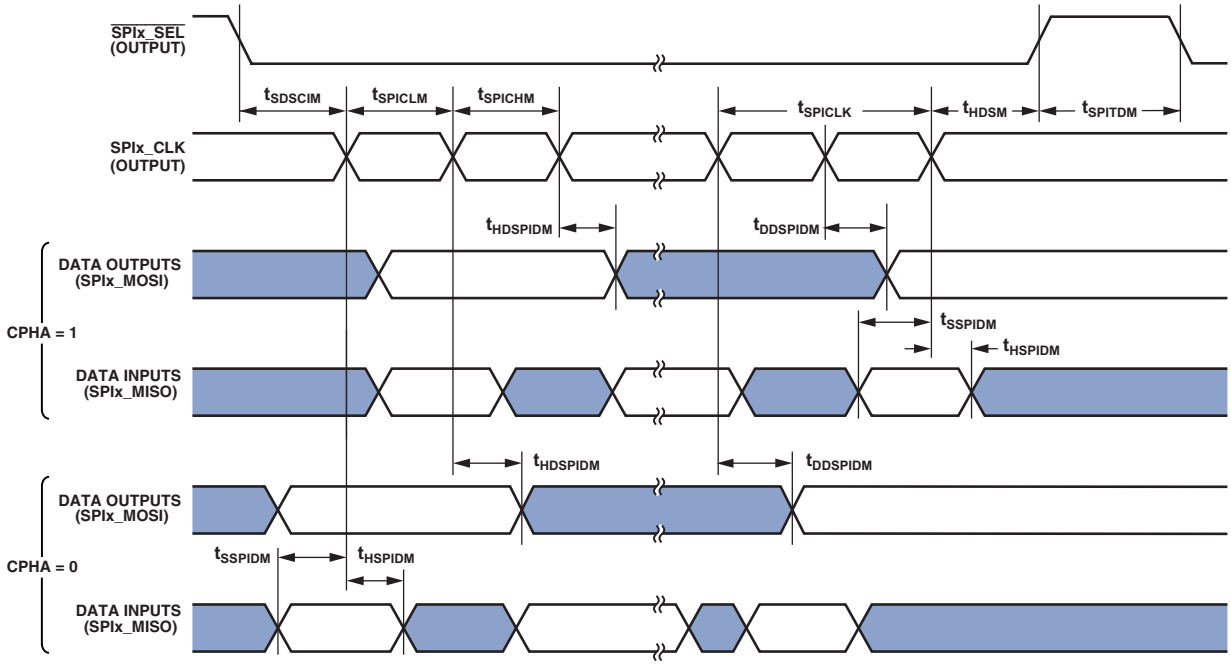

Figure 36. SPI Port—Master Timing

Table 66. SPI2 Port—Slave Timing[1]

Parameter		Min	Max	Unit
Timing Requirements				
t_{SPICHS}	SPIx_CLK High Period[2]	$0.5 \times t_{SPICLKEXT} - 1.5$		ns
t_{SPICLS}	SPIx_CLK Low Period[2]	$0.5 \times t_{SPICLKEXT} - 1.5$		ns
t_{SPICLK}	SPIx_CLK Period[2]	$t_{SPICLKEXT} - 1.5$		ns
t_{HDS}	Last SPIx_CLK Edge to $\overline{SPIx\_SS}$ Not Asserted	5		ns
t_{SPITDS}	Sequential Transfer Delay	$t_{SPICLKEXT} - 1.5$		ns
t_{SDSCI}	$\overline{SPIx\_SS}$ Assertion to First SPIx_CLK Edge	10.5		ns
t_{SSPID}	Data Input Valid to SPIx_CLK Edge (Data Input Setup)	2		ns
t_{HSPID}	SPIx_CLK Sampling Edge to Data Input Invalid	1.6		ns
Switching Characteristics				
t_{DSOE}	$\overline{SPIx\_SS}$ Assertion to Data Out Active	0	14	ns
t_{DSDHI}	$\overline{SPIx\_SS}$ Deassertion to Data High Impedance	0	11.5	ns
t_{DDSPID}	SPIx_CLK Edge to Data Out Valid (Data Out Delay)		14	ns
t_{HDSPID}	SPIx_CLK Edge to Data Out Invalid (Data Out Hold)	1.5		ns

[1] All specifications apply to SPI2 only.
[2] This specification indicates the minimum instantaneous width or period that can be tolerated due to duty cycle variation or jitter on the external SPIx_CLK. For the external SPIx_CLK ideal maximum frequency, see the $f_{SPICLKTEXT}$ specification in Table 27.

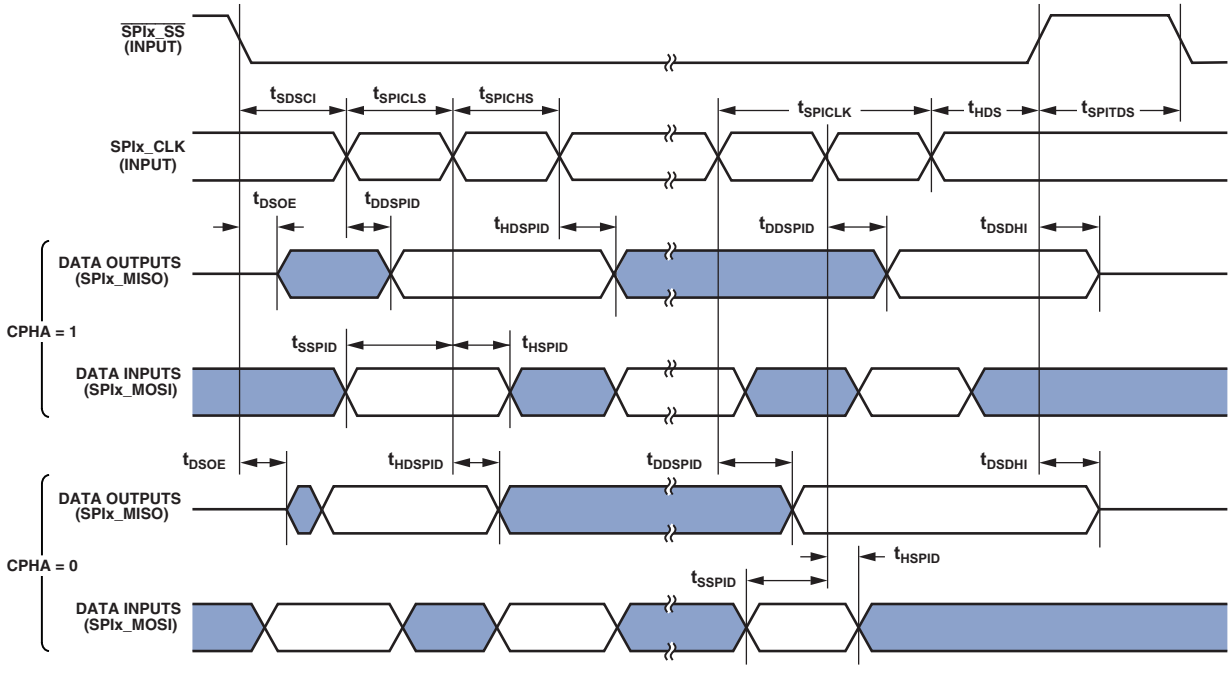

Figure 37. SPI Port—Slave Timing

SPI Port—Open Drain Mode (ODM) Timing

In Figure 39 and Figure 40, the outputs can be SPIx_MOSI, SPIx_MISO, SPIx_D2, and/or SPIx_D3, depending on the mode of operation. CPOL and CPHA are configuration bits in the SPI_CTL register.

Table 68. SPI Port—ODM Master Mode Timing[1]

Parameter		Min	Max	Unit
Switching Characteristics				
$t_{HDSPIODMM}$	SPIx_CLK Edge to High Impedance from Data Out Valid	–1.1		ns
$t_{DDSPIODMM}$	SPIx_CLK Edge to Data Out Valid from High Impedance	–1	6	ns

[1] All specifications apply to all three SPIs.

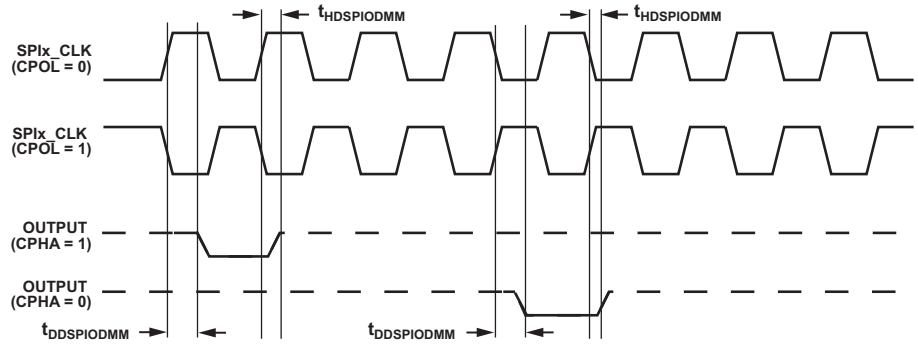

Figure 39. ODM Master Mode

Table 69. SPI Port—ODM Slave Mode[1]

Parameter		Min	Max	Unit
Timing Requirements				
$t_{HDSPIODMS}$	SPIx_CLK Edge to High Impedance from Data Out Valid	0		ns
$t_{DDSPIODMS}$	SPIx_CLK Edge to Data Out Valid from High Impedance		11	ns

[1] All specifications apply to all three SPIs.

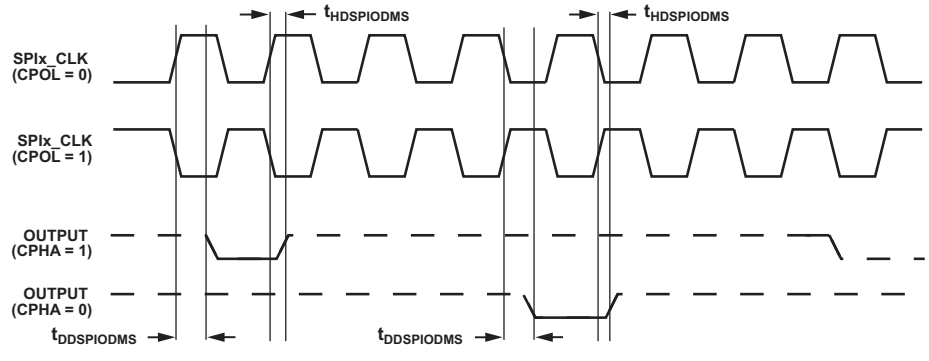

Figure 40. ODM Slave Mode

10/100 EMAC Timing

Table 79 through Table 83 and Figure 49 through Figure 53 describe the MII and RMII EMAC operations.

Table 79. 10/100 EMAC Timing: MII Receive Signal

Parameter[1]		V_{DDEXT} 3.3 V Nominal		Unit
		Min	Max	
Timing Requirements				
$t_{ERXCLKF}$	ETH0_RXCLK_REFCLK Frequency (f_{SCLK} = SCLK Frequency)	None	25 + 1%	MHz
$t_{ERXCLKW}$	ETH0_RXCLK_REFCLK Width (t_{ERxCLK} = ETH0_RXCLK_REFCLK Period)	t_{ERxCLK} × 35%	t_{ERxCLK} × 65%	ns
$t_{ERXCLKIS}$	Rx Input Valid to ETH0_RXCLK_REFCLK Rising Edge (Data In Setup)	1.75		ns
$t_{ERXCLKIH}$	ETH0_RXCLK_REFCLK Rising Edge to Rx Input Invalid (Data In Hold)	1.5		ns

[1] MII inputs synchronous to ETH0_RXCLK_REFCLK are ETH0_RXD3-0, ETH0_RXCTL_RXDV, and ETH0_RXERR.

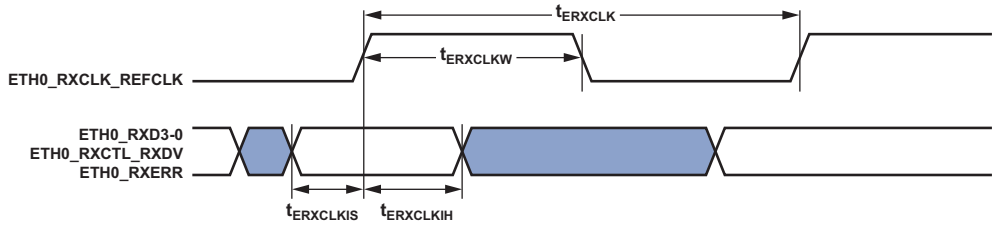

Figure 49. 10/100 EMAC Timing: MII Receive Signal

Table 80. 10/100 EMAC Timing: MII Transmit Signal

Parameter[1]		V_{DDEXT} 3.3 V Nominal		Unit
		Min	Max	
Timing Requirements				
$t_{ETXCLKF}$	ETH0_TXCLK Frequency (f_{SCLK} = SCLK Frequency)	None	25 + 1%	MHz
$t_{ETXCLKW}$	ETH0_TXCLK Width (t_{ETxCLK} = ETH0_TXCLK Period)	t_{ETxCLK} × 35%	t_{ETxCLK} × 65%	ns
Switching Characteristics				
$t_{ETXCLKOV}$	ETH0_TXCLK Rising Edge to Tx Output Valid (Data Out Valid)		11.4	ns
$t_{ETXCLKOH}$	ETH0_TXCLK Rising Edge to Tx Output Invalid (Data Out Hold)	2		ns

[1] MII outputs synchronous to ETH0_TXCLK are ETH0_TXD3-0.

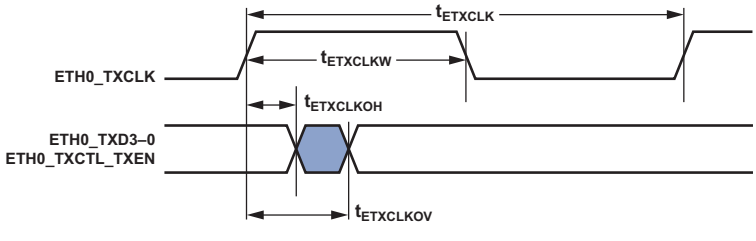

Figure 50. 10/100 EMAC Timing: MII Transmit Signal

Table 83. 10/100/1000 EMAC Timing—RMII and RGMII Station Management

Parameter[1]		Min	Max	Unit
Timing Requirements				
t_{MDIOS}	ETH0_MDIO Input Valid to ETH0_MDC Rising Edge (Setup)	12.6		ns
t_{MDCIH}	ETH0_MDC Rising Edge to ETH0_MDIO Input Invalid (Hold)	0		ns
Switching Characteristics				
t_{MDCOV}	ETH0_MDC Falling Edge to ETH0_MDIO Output Valid		t_{SCLK0} + 2	ns
t_{MDCOH}	ETH0_MDC Falling Edge to ETH0_MDIO Output Invalid (Hold)	t_{SCLK0} –2.9		ns

[1] ETH0_MDC/ETH0_MDIO is a 2-wire serial bidirectional port for controlling one or more external PHYs. ETH0_MDC is an output clock with a minimum period that is programmable as a multiple of the system clock SCLK0. ETH0_MDIO is a bidirectional data line.

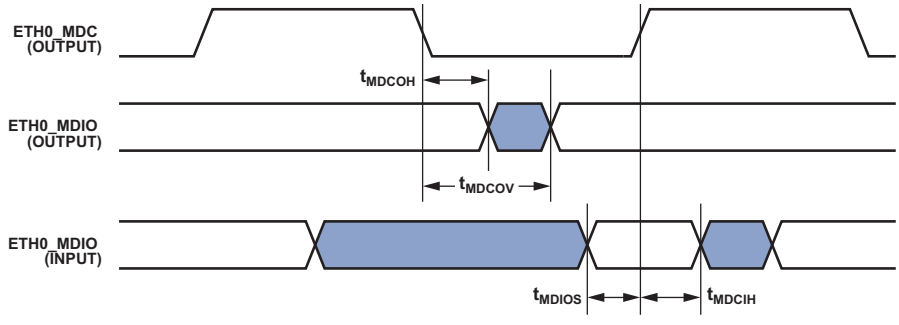

Figure 53. 10/100 /1000 Ethernet MAC Controller Timing—RMII and RGMII Station Management

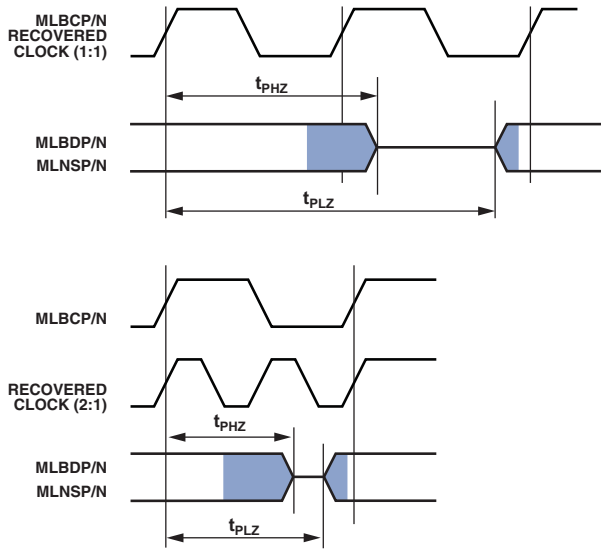

Figure 64. MLB 6-Pin Disable and Enable Turnaround Times

Program Trace Macrocell (PTM) Timing

Table 94 and Figure 66 provide I/O timing related to the PTM.

Table 94. Trace Timing

Parameter		Min	Max	Unit
Switching Characteristics				
t_{DTRD}	TRACE Data Delay From Trace Clock Maximum		$0.5 \times t_{SCLK0} + 4$	ns
t_{HTRD}	TRACE Data Hold From Trace Clock Minimum	$0.5 \times t_{SCLK0} - 2.2$		ns
t_{PTRCK}	TRACE Clock Period Minimum	$2 \times t_{SCLK0} - 1$		ns

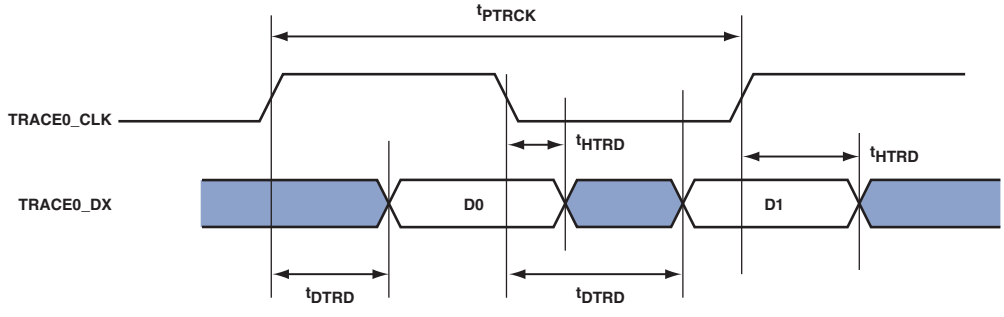

Figure 66. Trace Timing

ADSP-SC57X/ADSP-2157X 176-LEAD LQFP LEAD ASSIGNMENTS (ALPHABETICAL BY PIN NAME)

Pin Name	Lead No.	Pin Name	Lead No.	Pin Name	Lead No.	Pin Name	Lead No.
DAI0_PIN01	123	PA_01	79	PC_15	12	VDD_EXT	149
DAI0_PIN02	127	PA_02	77	PD_00	67	VDD_EXT	152
DAI0_PIN03	121	PA_03	76	PD_01	64	VDD_EXT	158
DAI0_PIN04	122	PA_04	75	PD_02	63	VDD_EXT	160
DAI0_PIN05	120	PA_05	74	PD_03	62	VDD_EXT	164
DAI0_PIN06	118	PA_06	70	PD_04	61	VDD_EXT	167
DAI0_PIN07	119	PA_07	69	PD_05	51	VDD_EXT	171
DAI0_PIN08	117	PA_08	68	PD_06	50	VDD_HADC	90
DAI0_PIN09	116	PA_09	13	PD_07	49	VDD_INT	01
DAI0_PIN10	113	PA_10	10	PD_08	48	VDD_INT	03
DAI0_PIN11	112	PA_11	11	PD_09	43	VDD_INT	07
DAI0_PIN12	111	PA_12	08	PD_10	42	VDD_INT	14
DAI0_PIN13	110	PA_13	06	PD_11	41	VDD_INT	16
DAI0_PIN14	108	PA_14	05	PD_12	40	VDD_INT	30
DAI0_PIN15	107	PA_15	04	PD_13	37	VDD_INT	39
DAI0_PIN16	106	PB_00	174	PD_14	36	VDD_INT	47
DAI0_PIN17	105	PB_01	173	PD_15	35	VDD_INT	52
DAI0_PIN18	102	PB_02	172	SYS_BMODE0	86	VDD_INT	59
DAI0_PIN19	101	PB_03	169	SYS_BMODE1	87	VDD_INT	66
DAI0_PIN20	100	PB_04	168	SYS_CLKIN0	154	VDD_INT	72
GND	02	PB_05	166	SYS_CLKOUT	157	VDD_INT	73
GND	15	PB_06	165	$\overline{\text{SYS\_FAULT}}$	85	VDD_INT	82
GND	44	PB_07	162	$\overline{\text{SYS\_HWRST}}$	151	VDD_INT	88
GND	45	PB_08	161	$\overline{\text{SYS\_RESOUT}}$	81	VDD_INT	98
GND	65	PB_09	159	SYS_XTAL0	155	VDD_INT	103
GND	83	PB_10	148	TWI0_SCL	54	VDD_INT	109
GND	89	PB_11	146	TWI0_SDA	53	VDD_INT	114
GND	97	PB_12	144	TWI1_SCL	56	VDD_INT	124
GND	99	PB_13	142	TWI1_SDA	55	VDD_INT	129
GND	125	PB_14	141	TWI2_SCL	58	VDD_INT	130
GND	131	PB_15	128	TWI2_SDA	57	VDD_INT	132
GND	133	PC_00	34	VDD_EXT	09	VDD_INT	134
GND	176	PC_01	33	VDD_EXT	21	VDD_INT	139
GND	177[1]	PC_02	32	VDD_EXT	31	VDD_INT	145
HADC0_VIN0	91	PC_03	29	VDD_EXT	38	VDD_INT	150
HADC0_VIN1	92	PC_04	28	VDD_EXT	46	VDD_INT	156
HADC0_VIN2	94	PC_05	27	VDD_EXT	60	VDD_INT	163
HADC0_VIN3	95	PC_06	26	VDD_EXT	71	VDD_INT	170
HADC0_VREFN	93	PC_07	25	VDD_EXT	78	VDD_INT	175
HADC0_VREFP	96	PC_08	24	VDD_EXT	84		
JTG_TCK	135	PC_09	23	VDD_EXT	104		
JTG_TDI	137	PC_10	22	VDD_EXT	115		
JTG_TDO	136	PC_11	20	VDD_EXT	126		
JTG_TMS	138	PC_12	19	VDD_EXT	140		
$\overline{\text{JTG\_TRST}}$	153	PC_13	18	VDD_EXT	143		
PA_00	80	PC_14	17	VDD_EXT	147		

[1] Pin 177 is the GND supply (see Figure 91) for the processor; this pad must connect to GND.

AUTOMOTIVE PRODUCTS

The following models are available with controlled manufacturing to support the quality and reliability requirements of automotive applications. Note that these automotive models may have specifications that differ from the commercial models; therefore, designers should review the Specifications section of this data sheet carefully. Only the automotive grade products shown in Table 99 are available for use in automotive applications. Contact your local Analog Devices account representative for specific product ordering information and to obtain the specific Automotive Reliability reports for these models.

Table 99. Automotive Products

Model [1, 2, 3]	Processor Instruction Rate (Max)	ARM Instruction Rate (Max)[4]	Temperature Range[5]	ARM Cores[4]	SHARC+ Cores	External Memory Ports	Package Description	Package Option
AD21571WCSWZ4xx	450 MHz	N/A	–40°C to +105°C	N/A	2	0	176-Lead LQFP_EP	SW-176-5
AD21571WCSWZ5xx	500 MHz	N/A	–40°C to +105°C	N/A	2	0	176-Lead LQFP_EP	SW-176-5
AD21573WCBCZ4xx	450 MHz	N/A	–40°C to +105°C	N/A	2	1	Pad 400-Ball CSP_BGA	BC-400-2
AD21573WCBCZ5xx	500 MHz	N/A	–40°C to +105°C	N/A	2	1	Pad 400-Ball CSP_BGA	BC-400-2
ADSC570WCSWZ42xx	450 MHz	225 MHz	–40°C to +105°C	1	1	0	176-Lead LQFP_EP	SW-176-5
ADSC570WCSWZ4xx	450 MHz	450 MHz	–40°C to +105°C	1	1	0	176-Lead LQFP_EP	SW-176-5
ADSC571WCSWZ3xx	300 MHz	300 MHz	–40°C to +105°C	1	2	0	176-Lead LQFP_EP	SW-176-5
ADSC571WCSWZ4xx	450 MHz	450 MHz	–40°C to +105°C	1	2	0	176-Lead LQFP_EP	SW-176-5
ADSC571WCSWZ5xx	500 MHz	500 MHz	–40°C to +105°C	1	2	0	176-Lead LQFP_EP	SW-176-5
ADSC572WCBCZ42xx	450 MHz	225 MHz	–40°C to +105°C	1	1	1	Pad 400-Ball CSP_BGA	BC-400-2
ADSC572WCBCZ4xx	450 MHz	450 MHz	–40°C to +105°C	1	1	1	Pad 400-Ball CSP_BGA	BC-400-2
ADSC573WCBCZ3xx	300 MHz	300 MHz	–40°C to +105°C	1	2	1	Pad 400-Ball CSP_BGA	BC-400-2
ADSC573WCBCZ4xx	450 MHz	450 MHz	–40°C to +105°C	1	2	1	Pad 400-Ball CSP_BGA	BC-400-2
ADSC573WCBCZ5xx	500 MHz	500 MHz	–40°C to +105°C	1	2	1	Pad 400-Ball CSP_BGA	BC-400-2

[1] Z = RoHS Compliant Part.
[2] xx denotes the current die revision.
[3] For evaluation of all models, order the ADZS-SC573-EZLITE evaluation board.
[4] N/A means not applicable.
[5] Referenced temperature is ambient temperature. The ambient temperature is not a specification. Please see the Operating Conditions section for the junction temperature (T_J) specification which is the only temperature specification.

I^{2}C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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