



V350EPC Rev. A0

LOCAL BUS TO PCI BRIDGE FOR MULTIPLEXED A/D PROCESSORS

- Glueless i960Jx/Sx processors interface
- Large, 640-byte FIFOs using V3's unique *DYNAMIC BANDWIDTH ALLOCATION™* architecture
- Increased 64-byte Read FIFO per aperture
- Both target and master (primary or secondary) modes supported on the PCI and local buses
- Dual bi-directional address space remapping
- On-the-fly byte order (endian) conversion
- Fully compliant with PCI 2.1 specification
- I₂O ready hardware messaging unit
- 2 channel DMA controller plus Multiprocessor DMA chaining and demand mode DMA
- Hot Swapping Capability
- Bi-directional mailboxes w/doorbell interrupts
- Flexible PCI and local interrupt management
- Serial EEPROM configuration interface
- 33MHz and 40MHz local bus versions
- Low cost 160-pin EIAJ PQFP package

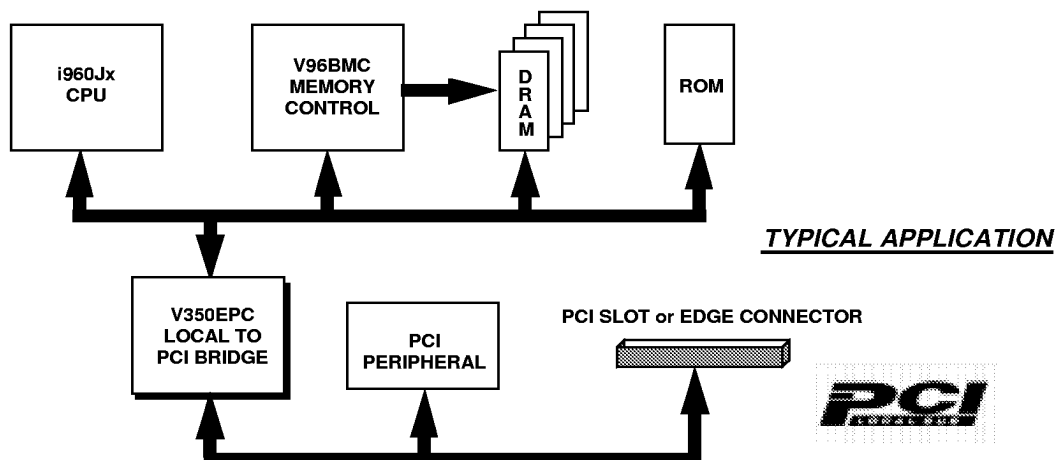
V350EPC is a high-performance and low-cost generic solution for interfacing both 32-bit and 16-bit multiplexed local bus applications to the PCI bus. V350EPC directly connects to i960Jx or i960Sx processors without any glue logic. Minimal glue logic is required for high-performance interfacing to other multiplexed processors like Motorola ColdFire™.

V350EPC is a second generation of V3's I₂O ready PCI bridges - fully backward compatible with both V961PBC and V960PBC Rev B2 devices - and is supporting powerful features like Hot Swapping and DMA chaining. The PCI bus can be run at the full 33MHz frequency, regardless of processor clock rate. The overall throughput of the system is dramatically improved by increasing the FIFO depths and

utilizing the unique *DYNAMIC BANDWIDTH ALLOCATION™* architecture.

Access to the PCI bus can be performed through two programmable address apertures. Two more apertures are provided for PCI-to-local bus accesses. There are 64-bytes of read FIFOs dedicated for each aperture in each direction.

Two high-performance DMA channels with chaining and demand mode capabilities provide a powerful data transfer engine for bulk data transfers. Mailbox registers and flexible PCI interrupt controllers are also included to provide a simple mechanism to emulate PCI device control ports. The part is available in 160-pin low cost PQFP packages in 33MHz and 40MHz versions.



V350EPC

This document contains the product codes, pinouts, package mechanical information, DC characteristics, and AC characteristics for the V350EPC. Detailed functional information is contained in the User's Manual.

V3 Semiconductor retains the rights to change documentation, specifications, or device functionality at any time without notice. Please verify that you have the latest copy of all documents before finalizing a design.

1.0 Product Codes

Table 1: Product Codes

Product Code	Processors	Bus Type	Package	Frequency
V350EPC-33 REV A0	i960Jx/Sx	32/16-bit multiplexed	160-pin EIAJ PQFP	33MHz
V350EPC-40 REV A0	i960Jx/Sx	32/16-bit multiplexed	160-pin EIAJ PQFP	40MHz

2.0 Pin Description and Pinout

Table 2 below lists the pin types found on the V350EPC. Table 3 describes the function of each pin on the V350EPC. Table 5 lists the pins by pin number. Figure 1 shows the pinout for the 160-pin EIAJ PQFP package and Figure 2 shows the mechanical dimensions of the package.

Table 2: Pin Types

Pin Type	Description
PCI I	PCI input only pin.
PCI O	PCI output only pin.
PCI I/O	PCI tri-state I/O pin.
PCI I/OD	PCI input with open drain output.
I/O ₄	TTL I/O pin with 4mA output drive.
I	TTL input only pin.
O ₄	TTL output pin with 4mA output drive.

Table 3: Signal Descriptions

PCI Bus Interface			
Signal	Type	R ^a	Description
AD[31:0]	PCI I/O	Z	Address and data, multiplexed on the same pins.
C/BE[3:0]	PCI I/O	Z	Bus Command and Byte Enables, multiplexed on the same pins.
PAR	PCI I/O	Z	Parity represents even parity across AD[31:0] and C/BE[3:0].
FRAME	PCI I/O	Z	Cycle Frame indicates the beginning and burst length of an access.
IRDY	PCI I/O	Z	Initiator Ready indicates the initiating agent's (bus master's) ability to complete the current data phase of the transaction.
TRDY	PCI I/O	Z	Target Ready indicates the target agent's (selected device's) ability to complete the current data phase of the transaction.
STOP	PCI I/O	Z	Stop indicates the current target is requesting the master to stop the current transaction (retry or disconnect).
DEVSEL	PCI I/O	Z	Device Select, when actively driven by a target, indicates the driving device has decoded its address as the target of the current access. As an input to the initiator, DEVSEL indicates whether any device on the bus has been selected.
IDSEL	PCI I		Initialization Device Select is used as a chip select during configuration read and write transactions. It must be driven high in order to access the chip's internal configuration space.
REQ	PCI O	Z	Request indicates to the arbiter that this agent requests use of the bus.
GNT	PCI I		Grant indicates to the agent that access to the bus has been granted.
PCLK	PCI I		PCLK provides timing for all transactions on the PCI bus.
PRST	PCI I/O	Z/L	Acts as an input when RDIR is high, an output when RDIR is low. As an input it is asserted low to bring all internal PBC operation to a reset state.
PERR	PCI I/O	Z	Parity Error is used to report data parity errors during all PCI transactions except a Special Cycle.
SERR	PCI I/OD	Z	System Error is used to report address parity errors, data parity errors on the Special Cycle command, or any other system error where the result will be catastrophic.
INT[A:D]	PCI I/OD	Z	Level-sensitive interrupt requests may be received or generated.

Table 3: Signal Descriptions (cont'd)

Local Bus Interface			
Signal	Type	R	Description
LAD[31:0] LAD[15:0] ^b	I/O4	Z	Local multiplexed address and data bus.
LA[31:16] ^b	I/O4	Z	Local address bus.
LA[5:2]	O4		Lower local address bus (non-multiplexed version).
$\overline{\text{BE}}[3:0]$ $\overline{\text{BE}}[1:0]$ ^b	I/O4	Z	Local bus byte enables.
W/ $\overline{\text{R}}$	I/O4	Z	Write/ $\overline{\text{Read}}$.
$\overline{\text{ADS}}$ $\overline{\text{AS}}$ ^b	I/O4	Z	Asserted low to indicate the beginning of a bus cycle.
$\overline{\text{RDYRCV}}$ $\overline{\text{READY}}$ ^b	I/O4	Z	Local Bus data ready
HOLD	O4	L	Local bus hold request: asserted by the chip to initiate a local bus master cycle.
HOLDA	I		Local bus hold acknowledge.
LPAR[3:0] LPAR[1:0] ^b	I/O4	Z	Local bus parity.
$\overline{\text{BLAST}}$	I/O4	Z	Burst last.
$\overline{\text{BTERM}}$ ^c	I/O4	Z	Bus Time-out. Burst terminate.
$\overline{\text{LINT}}$	O4	H	Local interrupt request.
$\overline{\text{LRST}}$	I/O4	L/Z	Local bus RESET signal.
LCLK	I		Local bus clock.

Serial EEPROM Interface			
Signal	Type	R	Description
SCL/ $\overline{\text{LPERR}}$	O4	X	EEPROM clock. Local parity error.
SDA	I/O4	X	EEPROM data.

Configuration

Table 3: Signal Descriptions (cont'd)

Signal	Type	R	Description
RDIR	I		Reset direction. Tie low to drive PRST out and LRST in, high to drive LRST out and PRST in.
EN5V	I		Selects 5V (EN5V driven low) or 3.3V (EN5V driven high) device operation modes.
Power and Ground Signals			
Signal	Type	R	Description
V _{CC}	-		POWER leads intended for external connection to a V _{CC} board plane.
GND	-		GROUND leads intended for external connection to a GND board plane.

- a. R indicates state during reset.
b. Applies to i960Sx mode.
c. Applies to i960Jx mode.

2.1 Test Mode Pins

Several device pins are used during manufacturing test to put the V350EPC device into various test modes. ***These pins must be maintained at proper levels during reset to insure proper operation.*** This is typically handled through pull-up or pull-down resistors (typically 1K to 10K) on the signal pins if they are not guaranteed to be at the proper level during reset. Table 4 below shows the reset states for test mode pins:

Table 4: RESET State for Test Mode Pins

Mode	Pin 134	Pin 135	Pin 153
i960Jx	Pull-Down	Pull-Up	Pull-Down
i960Sx	Pull-Down	Pull-Down	Pull-Down

Table 5: Pin Assignments

PIN #	Signal	PIN #	Signal	PIN #	Signal	PIN #	Signal
1	V _{CC}	41	V _{CC}	81	V _{CC}	121	V _{CC}
2	INTD	42	AD14	82	NC	122	NC

Table 5: Pin Assignments (cont'd)

PIN #	Signal	PIN #	Signal	PIN #	Signal	PIN #	Signal
3	PRST	43	AD13	83	LAD8	123	LA(D ^a)25
4	PCLK	44	AD12	84	NC	124	LA5
5	$\overline{\text{GNT}}$	45	AD11	85	LAD9	125	LA(D ^a)26
6	REQ	46	AD10	86	NC	126	LA4
7	AD31	47	AD9	87	LAD10	127	LA(D ^a)27
8	AD30	48	AD8	88	NC	128	LA3
9	AD29	49	C/BE $\overline{0}$	89	LAD11	129	LA(D ^a)28
10	AD28	50	V _{CC}	90	NC	130	LA2
11	GND	51	GND	91	LAD12	131	LA(D ^a)29
12	AD27	52	AD7	92	NC	132	LA(D ^a)30
13	AD26	53	AD6	93	LAD13	133	LA(D ^a)31
14	AD25	54	AD5	94	NC	134	ALE
15	AD24	55	AD4	95	LAD14	135	'0' BTERM ^a
16	C/BE $\overline{3}$	56	AD3	96	NC	136	$\overline{\text{READY}}$ RDYRCV ^a
17	IDSEL	57	AD2	97	LAD15	137	HOLD
18	AD23	58	AD1	98	NC	138	HOLDA
19	AD22	59	AD0	99	LA(D ^a)16	139	$\overline{\text{AS}}$ ADS ^a
20	V _{CC}	60	V _{CC}	100	V _{CC}	140	V _{CC}
21	GND	61	GND	101	GND	141	GND
22	AD21	62	LAD0	102	NC	142	LCLK
23	AD20	63	NC	103	LA(D ^a)17	143	EN5V
24	AD19	64	LAD1	104	NC	144	V _{CC}
25	AD18	65	NC	105	LA(D ^a)18	145	NC BE $\overline{3}$ ^a
26	AD17	66	LAD2	106	NC	146	NC BE $\overline{2}$ ^a

Table 5: Pin Assignments (cont'd)

PIN #	Signal	PIN #	Signal	PIN #	Signal	PIN #	Signal
27	AD16	67	NC	107	LA(D ^a)19	147	BE $\overline{1}$
28	C/BE $\overline{2}$	68	LAD3	108	NC	148	BE $\overline{0}$
29	FRAME	69	NC	109	LA(D ^a)20	149	BLAST
30	GND	70	LAD4	110	NC	150	W/R
31	TRDY	71	NC	111	LA(D ^a)21	151	RDIR
32	TRDY	72	LAD5	112	NC	152	LRST
33	DEVSEL	73	NC	113	LA(D ^a)22	153	'0'
34	STOP	74	LAD6	114	NC	154	LINT
35	PERR	75	NC	115	LA(D ^a)23	155	SDA
36	SERR	76	LAD7	116	NC	156	SCL/LPERR
37	PAR	77	NC	117	NC LPAR2 ^a	157	INTA
38	C/BE $\overline{1}$	78	LPAR0	118	NC LPAR3 ^a	158	INTB
39	AD15	79	LPAR1	119	LA(D ^a)24	159	INTC
40	GND	80	GND	120	GND	160	GND

a. Applies to i960Jx mode.

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V350EPC Data Sheet Rev 1.0x

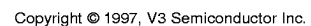
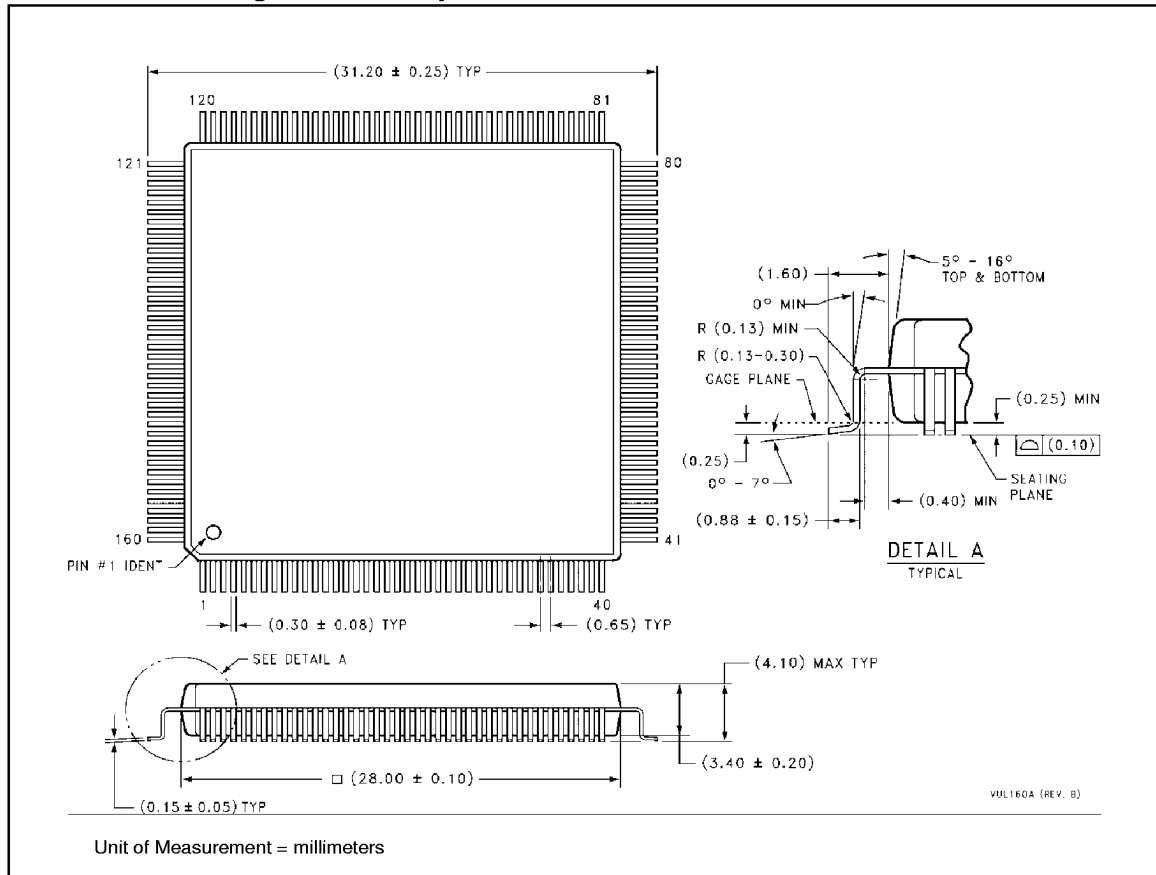


Figure 2: 160-pin EIAJ PQFP mechanical details



3.0 DC Specifications

The DC specifications for the PCI bus signals match exactly those given in the PCI Specification, Rev. 2.1, Section 4.2.1.1. For more information on the PCI DC specifications, see the PCI Specification.

Table 6: Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{CC}	Supply voltage	-0.3 to +7	V
V_{IN}	DC input voltage	-0.3 to $V_{CC}+0.3$	V
I_{IN}	DC input current	± 10	mA
T_{STG}	Storage temperature range	-40 to +125	°C

Table 7: Guaranteed Operating Conditions

Symbol	Parameter	Value	Units
V_{CC}	Supply voltage	4.50 to 5.50	V
T_A	Ambient temperature range	-40 to 85	°C

3.1 PCI Bus DC Specifications

Table 8: PCI Bus Signals DC Operating Specifications

Symbol	Parameter	Condition	Min	Max	Units	Notes
V_{IH}	Input high voltage		2.0	$V_{CC}+0.5$	V	
V_{IL}	Input low voltage		-0.5	0.8	V	
I_{IH}	Input high leakage current	$V_{IN} = 2.7V$		70	μA	1
I_{IL}	Input low leakage current	$V_{IN} = 0.5V$		-70	μA	1
V_{OH}	Output high voltage	$I_{OUT} = -2mA$	2.4		V	
V_{OL}	Output low voltage	$I_{OUT} = 3mA, 6mA$		0.55	V	2
C_{IN}	Input pin capacitance			10	pF	3
C_{CLK}	PCLK pin capacitance		5	12	pF	
C_{IDSEL}	IDSEL pin capacitance			8	pF	4
L_{PIN}	Pin inductance			20	nH	

Notes:

1. Input leakage currents include high impedance output leakage for all bi-directional buffers with tri-state outputs.
2. Signals without pullup resistors have greater than 3mA low output current. Signals requiring pull resistors have greater than 6mA output current. The latter include `FRAME`, `TRDY`, `TRDY`, `STOP`, `SERR`, `PERR`.
3. Absolute maximum pin capacitance for a PCI unit is 10pF (except for CLK).
4. Lower capacitance on this input-only pin allows for non-resistive coupling to AD[xx].

3.2 Local Bus DC Specifications

Table 9: Local Bus Signals DC Operating Specifications

Symbol	Description	Conditions	Min	Max	Units
V_{IL}	Low level input voltage	$V_{CC} = 4.75V$		0.8	V
V_{IH}	High level input voltage	$V_{CC} = 5.25V$	2.0		V
I_{IL}	Low level input current	$V_{IN}=GND, V_{CC}=5.25V$	-10		μA
I_{IH}	High level input current	$V_{IN} = V_{CC} = 5.25V$		10	μA
V_{OL4}	Low level output voltage for 4 mA outputs and I/O pins	$I_{OL} = -4 \text{ mA}$		0.4	V
V_{OH4}	High level output voltage for 4 mA outputs and I/O pins	$I_{OH} = 4 \text{ mA}$	2.4		V
I_{OZL}	Low level float input leakage	$V_{IN} = GND$	-10		μA
I_{OZH}	High level float input leakage	$V_{IN} = V_{CC}$		10	μA
$I_{CC} \text{ (max)}$	Maximum supply current	$V_{CC} = 5.25V$ $PCLK = LCLK = 33MHz$		150	mA
$I_{CC} \text{ (typ)}$	Typical supply current	$V_{CC} = 5.0V$ $PCLK = LCLK = 33MHz$		120	mA
C_{IO}	Input and output capacitance			10	pF

4.0 AC Specifications

The AC specifications for the PCI bus signals match exactly those given in the PCI Specification, Rev. 2.1, Section 4.2.1.2. For more information on the PCI AC specifications, including the V/I curves for 5V signalling, see section 4.2.1.2 of Rev 2.1 PCI Specification.

4.1 PCI Bus Timings

Table 10: PCI Bus Signals AC Operating Specifications

Symbol	Parameter	Condition	Min	Max	Units	Notes
$I_{OH(AC)}$	Switching current high	$0V < V_{OUT} \leq 1.4V$	-44		mA	1
		$1.4V < V_{OUT} < 2.4V$	$-44 + (V_{OUT} - 1.4)/0.024$	Equation A	mA	1, 2, 3
	(Test point)	$V_{OUT} = 3.1V$		-142	mA	3
$I_{OL(AC)}$	Switching current low	$V_{OUT} \geq 2.2V$	95		mA	1
		$2.2V > V_{OUT} > 0.55V$	$V_{OUT}/0.023$	Equation B	mA	1, 3
	(Test point)	$V_{OUT} = 0.71V$		206	mA	3
I_{CL}	Low clamp current	$-5 < V_{IN} \leq -1$	$-25 + (V_{IN} + 1)/0.015$		mA	
t_R	Unloaded output rise time	0.4V to 2.4V	1	5	V/ns	4
t_F	Unloaded output fall time	2.4V to 0.4V	1	5	V/ns	4

Notes:

1. Refer to the V/I curves in Section 4.2.1 of the PCI Specification. This specification does not apply to CLK and RST which are system outputs. "Switching Current High" specifications are not relevant to open drain outputs such as SERR and INTA-INTD.
2. Note that this segment of the minimum current curve is drawn from the AC drive point directly to the DC drive point rather than toward the voltage rail (as it does in the pull-down curve). This difference is intended to allow for an optional N-channel pullup.
3. Maximum current requirements are met as drivers pull beyond the first step voltage (AC drive point). Equations defining these maximums (A and B) are provided with the respective V/I curves given in the PCI Spec. The equation defined maxima is met by design.
4. The minimum slew rate (slowest signal edge) is met by the PCI drivers. The maximum slew rate (fastest signal edge) is a guideline. Motherboard designers must bear in mind that rise and fall times faster than this maximum guideline could occur, and should ensure that signal integrity modeling accounts for this.

$$\text{Equation A: } I_{OH} = 11.9 \cdot (V_{OUT} - 5.25V) \cdot (V_{OUT} + 2.45V) \text{ for } V_{CC} > V_{OUT} > 3.1V$$

$$\text{Equation B: } I_{OL} = 78.5 \cdot V_{OUT}(4.4V - V_{OUT}) \text{ for } 0V < V_{OUT} < 0.71V$$

4.2 Local Bus Timings

Table 11: Local Bus AC Test Conditions

Symbol	Parameter	Limits	Units
V _{CC}	Supply voltage	4.50 to 5.50	V
V _{IN}	Input low and high voltages	0.4 and 2.0	V
C _{OUT}	Capacitive load on output and I/O pins	50	pF

Table 12: Capacitive Derating for Output and I/O Pins

Output Drive Limit	Derating
4mA	0.058 ns/pF for loads > 50pF

Figure 3: Clock and Synchronous Signals

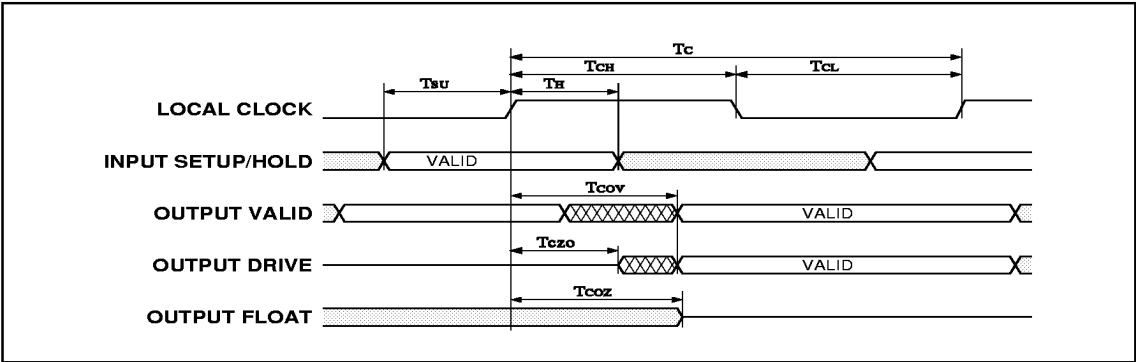


Table 13: Local Bus Timing Parameters for Vcc = 5 Volts +/- 5%

					33MHz	40MHz		
#	Symbol	Description	Notes	Min	Max	Min	Max	Units
1	T _C	LCLK period		30		25		ns
2	T _{CH}	LCLK high time	1	12		11		ns
3	T _{CL}	LCLK low time	1	12		11		ns
4	T _{SU}	Synchronous input setup	2	7		6		ns
4a	T _{SU}	Synchronous input setup (BLAST)		8		7		ns
4b	T _{SU}	Synchronous input setup (W/R, BTERM)		4		4		ns
4c	T _{SU}	Synchronous input setup (ADS/AS)		6		5		ns
4d	T _{SU}	Synchronous input setup (address, data, byte enables)		9		8		ns
4e	T _{SU}	Synchronous input setup for read data when in local bus master mode		5		5		ns
5	T _H	Synchronous input hold			2		2	ns
6	T _{COV}	LCLK to output valid delay	3	3	14	3	12	ns
6a	T _{COV}	LCLK to output valid delay (address, data, byte enable, parity)		3	15	3	14	ns
7	T _{CZO}	LCLK to output driving delay		3	15	3	14	ns
8	T _{COZ}	LCLK to high impedance delay	4	3	15	3	14	ns
9	T _{RST}	Reset period when LRST used as input		16·T _C		16·T _C		ns

Notes:

1. Measured at 1.5V.
2. All local bus signals except those in 4a, 4b, 4c, 4d and 4e.
3. All local bus signals except those in 6a.
4. READY, BLAST, ADS are driven to high impedance at the falling edge of LCLK.

Table 14: PCI Bus Timing Parameters for Vcc = 5 Volts +/- 10%

#	Symbol	Description	Notes	Min	Max	Units
1	T _C	PCLK period		30		ns
2	T _{SU}	Synchronous input setup to PCLK	1	7		ns
2a	T _{SU}	Synchronous input setup to PCLK (GNT)		10		ns
3	T _H	Synchronous input hold from PCLK		0		ns

Table 14: PCI Bus Timing Parameters for Vcc = 5 Volts +/- 10%

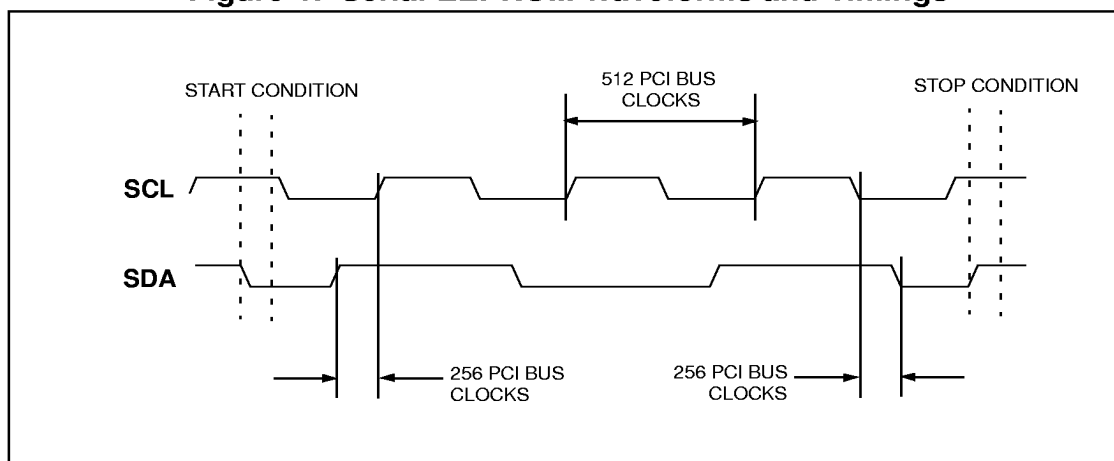
4	T _{COV}	PCLK to output valid delay	2	3	11	ns
4a	T _{COV}	PCLK to output valid delay (REQ)		4	12	ns
5	T _{CZO}	PCLK to output driving delay		4	11	ns
6	T _{COZ}	PCLK to high impedance delay		5	18	ns
7	T _{RST}	Reset period when PRST used as input		16·T _C		

Notes:

1. All PCI bus signals except those in 2a.
2. All PCI bus signals except those in 4a.

4.3 Serial EEPROM Port Timings

The clock for the serial EEPROM interface is derived by dividing the PCI bus clock. The waveforms generated are shown in Figure 4.

Figure 4: Serial EEPROM Waveforms and Timings

5.0 Revision History

Table 15: Revision History

Revision Number	Date	Comments and Changes
1.0	8/97	First revision of preliminary data sheet.



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