

PC87200 PCI to ISA Bridge

1.0 General Description

The PC87200 Enhanced Integrated PCI-to-ISA bridge works with an LPC chipset to provide ISA slot support. It is a complement to the National Semiconductor PC8736x Super I/O family.

2.0 Features

2.1 General

- Functionally compatible with Intel 82380AB
- 5.0 V tolerant PCI and ISA interfaces
- Slave mode serialized IRQ support for both quiet and continuous modes
- PC/PCI DMA support
- 32-bit address decode for the 1MB BIOS ROM
- Supports ISA bus mastering
- 160-pin PQFP package

2.2 PCI-to-ISA Bridge

- PCI 2.1 compliant 33 MHz bus
- Supports PCI initiator-to-ISA and ISA master-to-PCI cycle translations
- Subtractive agent for unclaimed transactions (see the PROHIBIT signal description for exceptions)
- Parallel to Serial IRQ conversion including IRQ3,4,5,6,7,9,10,11,12,14,15
- Supports 4 ISA slots directly without buffering
- Programmable ISA clock (8.33 to 11 MHz)
- Slow slew rate on edges

2.3 "PROHIBIT" functional support

- Disables PCI bus subtractive decoding when PROHIBIT is asserted

Block Diagram

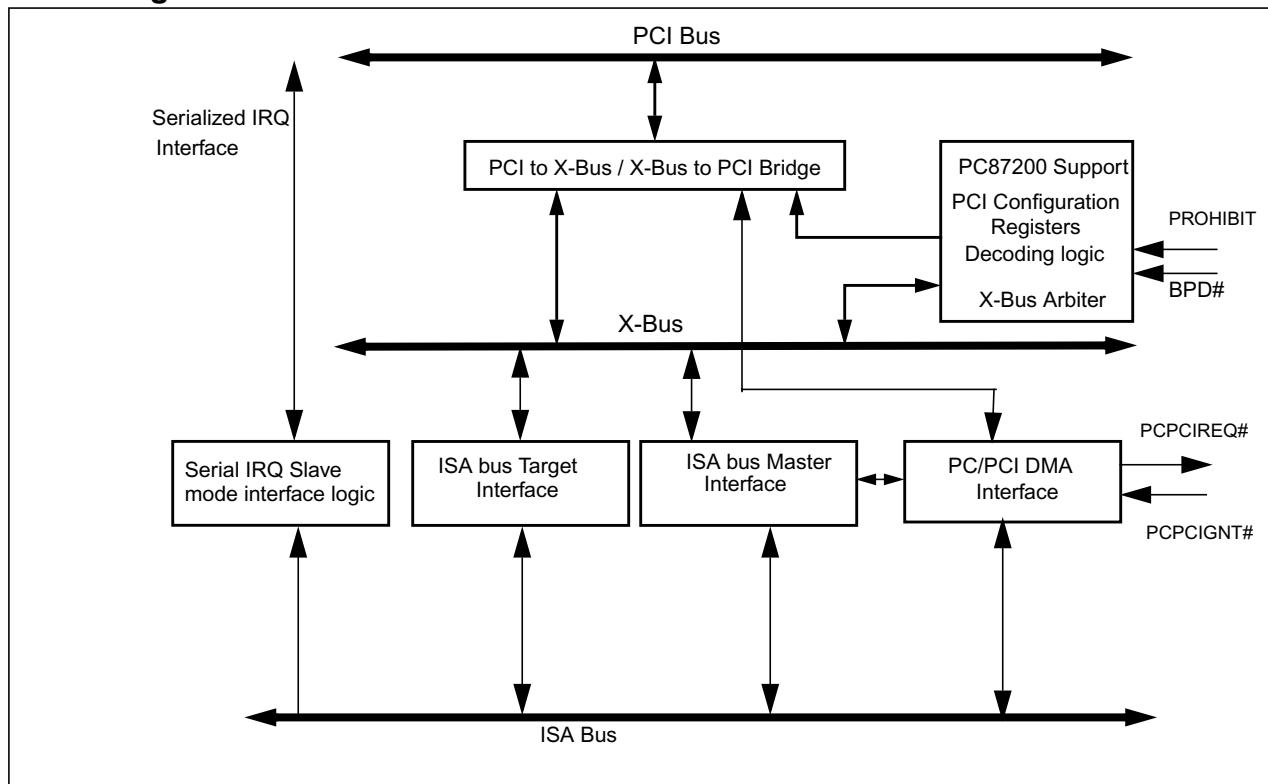


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3.0 Device Overview

The PC87200 can be described as providing the functional blocks shown in Figure 1.

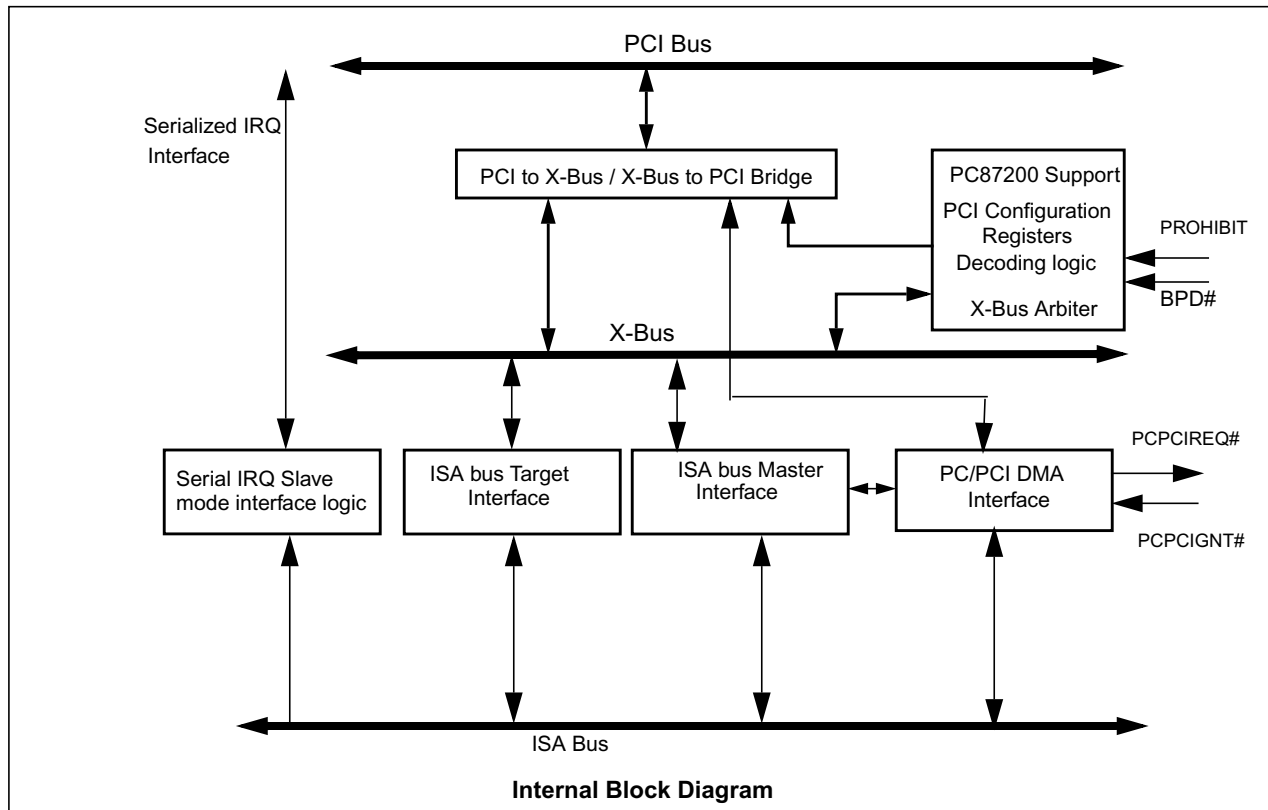
- PCI bus master/slave interface
- ISA bus master/slave interface
- Serial IRQ slave mode interface
- PROHIBIT signal support
- PC/PCI DMA interface

3.1 PCI Bus Interface

The PC87200 provides a PCI bus interface that is both a slave for PCI cycles initiated by the CPU or other PCI mas-

ter devices, and a PC/PCI DMA master for DMA transfer cycles. The PC87200 supports positive decode for the BIOS ROM in the special test mode and implements subtractive decode for unclaimed PCI accesses when the PROHIBIT signal is low. The PC87200 also generates address and data parity and performs parity checking.

Configuration registers are accessed through the PCI interface using the PCI Bus Type 1 configuration mechanism as described in the PCI 2.1 Specification.



3.2 ISA Bus Interface

The PC87200 provides an ISA bus interface for subtractive-decoded memory and I/O cycles on PCI. The PC87200 is the default subtractive decoding agent and will forward all unclaimed memory and I/O cycles to the ISA interface; however, the PC87200 may be configured to ignore either I/O, memory or all unclaimed cycles (subtractive decode disabled) by asserting the PROHIBIT signal.

ISA master cycles will only be passed to the PCI bus if they access memory. I/O accesses are left to complete on the ISA bus.

ISA master cycles that access memory on ISA bus are not supported by the PC87200.

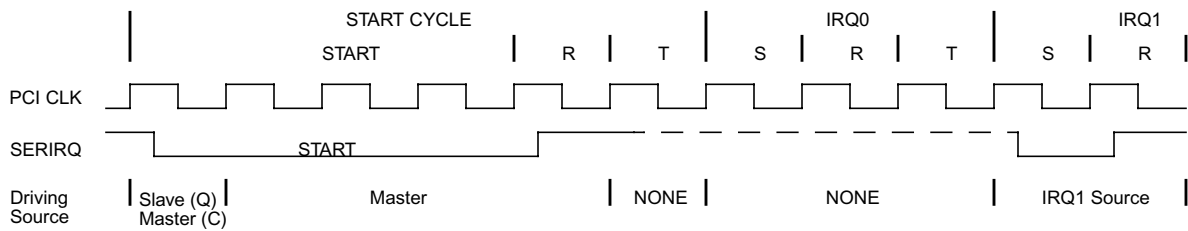
3.3 Serialized IRQ support

The PC87200's Serial Interrupt interface uses a serial interrupt bus to transmit ISA Bus legacy interrupt requests. The bus is a one pin bus (SERIRQ) and uses the PCI clock as its timing reference. The serial interrupt bus is a multi-drop bus that is shared by all PCI devices that have legacy interrupts. The serial interrupt logic conforms to the serial-

ized IRQ defined in the Serialized IRQ on the "PCI way" - Version 6.0 specification. Programming of the serial interrupt controller when the controller is currently running can produce unexpected results.

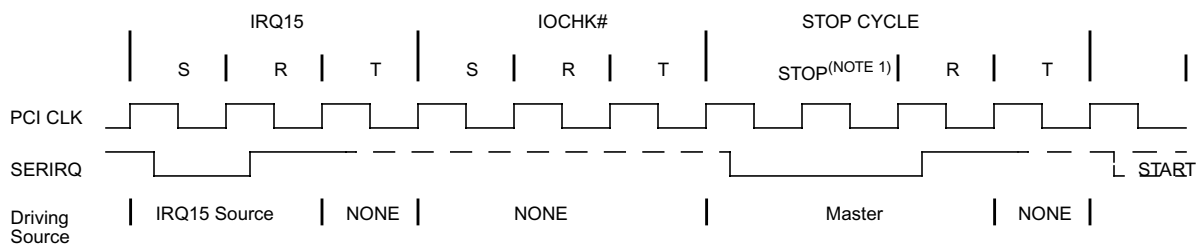
3.0 Device Overview (Continued)

Timing of the serialized IRQ is illustrated as follows.



R = Recovery; T= Turn-around; S = Sample

Start Cycle Timing



R = Recovery; T= Turn-around; S = Sample

NOTE 1: The Stop pulse is 2 clocks wide for Quiet mode, 3 clocks wide for Continuous mode

Stop Cycle Timing

3.3.1 Serial Interrupts (Slave Mode)

There are two types of Serial Interrupt transfer modes; the following describes the operation of the PC87200's Serial Interrupt Interface as a Slave:

1. Quiet Mode: Any Serial Interrupt device may initiate a Start Cycle, while the Serial Interrupt interface is Idle, by driving SERIRQ low for one PCI clock period. After driving low for one clock the device should immediately TRI-STATE[®] SERIRQ, without ever driving this signal high. A Start Cycle may not be initiated in the middle of an active Serial Interrupt transfer. Between Stop and Start Cycles the SERIRQ signal will be pulled high and the Serial Interrupt interface will be Idle.

When the PC87200 Serial Interrupt interface must initiate a Start Cycle in order to transfer any pending interrupt request to the Master. The only exception to this requirement is when a Serial Interrupt transfer sequence is already in progress and the PC87200 can transfer the request during this present Serial Interrupt transfer sequence, then the Serial Interrupt device is not required to generate another Start Cycle.

2. Continuous Mode: The PC87200 tracks both the Start and Stop Frames and is responsible for inserting its interrupt requests on the appropriate IRQ frames.

3.3.2 IRQ Sampling Periods

Once a Start Cycle has been initiated all Serial Interrupt devices watch for the rising edge of the Start Pulse and start counting IRQ Sample periods from that point. Each

IRQ Sample Period is three clocks long, with the first clock being the Sampled phase, the second clock being the Recovery phase, and the third clock being the Turn-around phase. During the Sample phase the Serial Interrupt device drives SERIRQ low if its associated IRQ signal/data is presently low. If its IRQ signal/data is high the Serial Interrupt device must TRI-STATE SERIRQ. During the Recovery phase, the Serial Interrupt device that drove SERIRQ low (if any Serial Interface device does) is required to drive back high. During the Turn-around phase all Serial Interface devices will TRI-STATE SERIRQ. All Serial Interface devices will drive SERIRQ low at the appropriate sample point regardless of which device initiated the sample activity, if its associated IRQ signal/data is low.

Slave

The PC87200 will support the interrupt request frames listed in the following table.

The Generation clock for each IRQ follows the low to high edge of the Start Pulse by the number of PCI Clocks listed in Table 1.

Note: : The number of clocks equals: $(3 \times (\text{IRQ number} + 1)) - 1$

3.3.3 Stop Cycle Control

The PC87200 will monitor SERIRQ for a Stop Cycle, so that it may initiate a Start Cycle for a pending transition in any of its IRQs (Quiet Mode). For Continuous Mode, the PC87200 will not initiate any Start Cycle, but will track the Start and Stop Cycles and insert its IRQs appropriately.

3.0 Device Overview (Continued)

Table 1. SERIRQ Slave Generation Periods

SERIRQ Period	Signal Generated	# of clocks past Start
1	Reserved.	2
2	Reserved.	5
3	Reserved.	8
4	IRQ3	11
5	IRQ4	14
6	IRQ5	17
7	IRQ6	20
8	IRQ7	23
9	Reserved.	26
10	IRQ9	29
11	IRQ10	32
12	IRQ11	35
13	IRQ12	38
14	Reserved.	41
15	IRQ14	44
16	IRQ15	47
17	IOCHK#	50
21:18	Reserved.	62,59,56, 53

3.4 PROHIBIT signal support

The chipset will use this signal to claim the BIOS first and then deassert the "PROHIBIT" signal to configure the PCI to ISA bridge to continue the boot sequence.

Special test mode support is provided by means of the BPD# pin. When this test mode is active, the PC87200 will enable positive memory decode during boot up to enable the host to look for boot ROM on ISA card.

PROHIBIT will be a don't care in this test mode at boot up for the ROM BIOS range, but should function normally after booting

3.5 PC/PCI DMA Interface Support

The PC87200 operates as a PC/PCI DMA Secondary Arbitration Bridge. The PC87200 can pass all seven legacy ISA bus DMA channel requests to the PC/PCI DMA Primary Bus Arbiter using the channel passing protocol defined in the Mobile PC/PCI DMA Arbitration and Protocol Specification (Revision 2.2). Figure 1 shows the topology of the PC87200 PC/PCI DMA requests and grants:

The PC87200 converts the seven legacy ISA bus DMA requests (DREQ0, 1, 2, 3, 5, 6 and 7) into a serial PC/PCI DMA compliant REQ# sequence and converts the corresponding PC/PCI DMA GNT# sequence into the appropriate DMA acknowledge (DACK0-3, 5-7#). This PC/PCI DMA expansion Channel Passing Protocol is illustrated Figure 2.

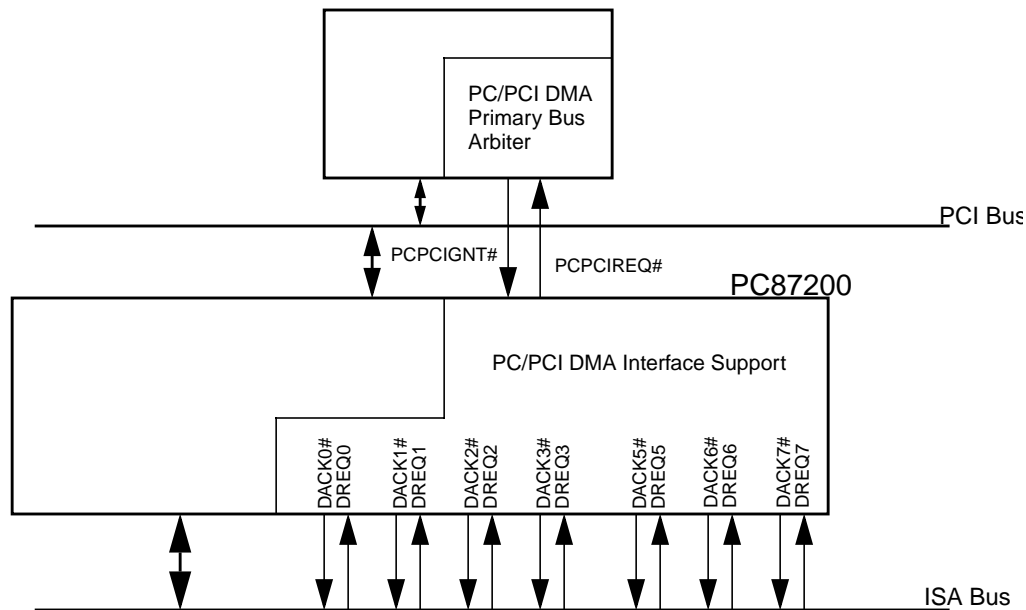


Figure 1. PC87200 PC/PCI DMA Topology

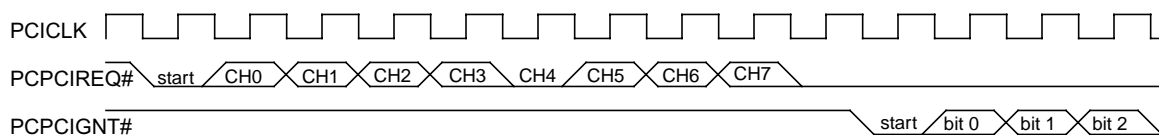


Figure 2. Channel Passing Protocol

3.0 Device Overview (Continued)

When a legacy ISA bus DMA request is asserted, the PC87200 will transmit that request to the PC/PCI Primary Bus Arbiter by encoding it and driving it out the PC87200's PCPCIREQ# according to the above; first PCPCIREQ# will be driven low for one PCICLK period to indicate that the serial encoded request transfer is starting. Then the PC87200 will drive each of the next eight bits with the value of its corresponding DREQ. (NOTE: Channel 4 will always be driven low.) At the end of the request sequence, the PC87200 will continue to drive its PCPCIREQ# signal active, indicating that the request is still being maintained.

In response to the request sequence, the PC/PCI Primary Bus Arbiter will respond with a PC/PCI DMA encoded grant transfer when it is granting the PCI bus for a PC/PCI DMA transfer cycle. The PC/PCI encoded grant transfer will begin when the PC/PCI Primary Bus Arbiter drives PCPCIGNT# low for one PCICLK period to indicate the start of the grant sequence; then the next three PCPCIGNT# signal PCICLK periods will then contain the encoded grant value, indicating which legacy ISA DMA channel is being granted the PC Bus.

bit 2	bit 1	bit 0	Channel Granted
0	0	0	DMA Channel 0 (DACK0#)
0	0	1	DMA Channel 0 (DACK1#)
0	1	0	DMA Channel 0 (DACK2#)
0	1	1	DMA Channel 0 (DACK3#)
1	0	0	RESERVED
1	0	1	DMA Channel 0 (DACK5#)
1	1	0	DMA Channel 0 (DACK6#)
1	1	1	DMA Channel 0 (DACK7#)

After receiving a valid grant from the PC/PCI DMA Arbiter, the PC87200 will recognize the following I/O accesses as DMA I/O Reads(Writes) from (to) the granted legacy ISA DMA channel.

DMA Cycle Type	DMA I/O Address	TC (A2)	PCI Cycle Type
Normal	0000_0000h	0	I/O Read/Write
Normal TC	0000_0004h	1	I/O Read/Write
Verify	0000_00C0h	0	I/O Read
Verify TC	0000_00C4h	1	I/O Read.

PCI bus address bit 2 (A2) indicates if the cycle is to be a Terminal Count cycle or not.

For Normal DMA Cycles, PCI bus I/O Reads and Writes will be translated to legacy ISA DMA Reads and Writes respectively. For Verify DMA Cycles, only PCI bus I/O Reads will be translated to legacy ISA DMA Verify cycles.

3.5.1 Clock Generation

The PC87200 generates the ISA clock using PCI clock signal (typically 33 MHz).

A PCICLK divisor (3,4) is programmable through PCI configuration register to generate the ISA clock signal. This provides support for the generation of ISACK frequencies 8.33 MHz and 11 MHz off of a 33MHz PCICLK.

Figure 3. shows a block diagram for clock generation within the PC87200.

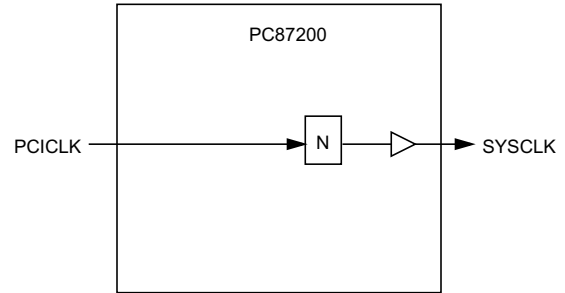
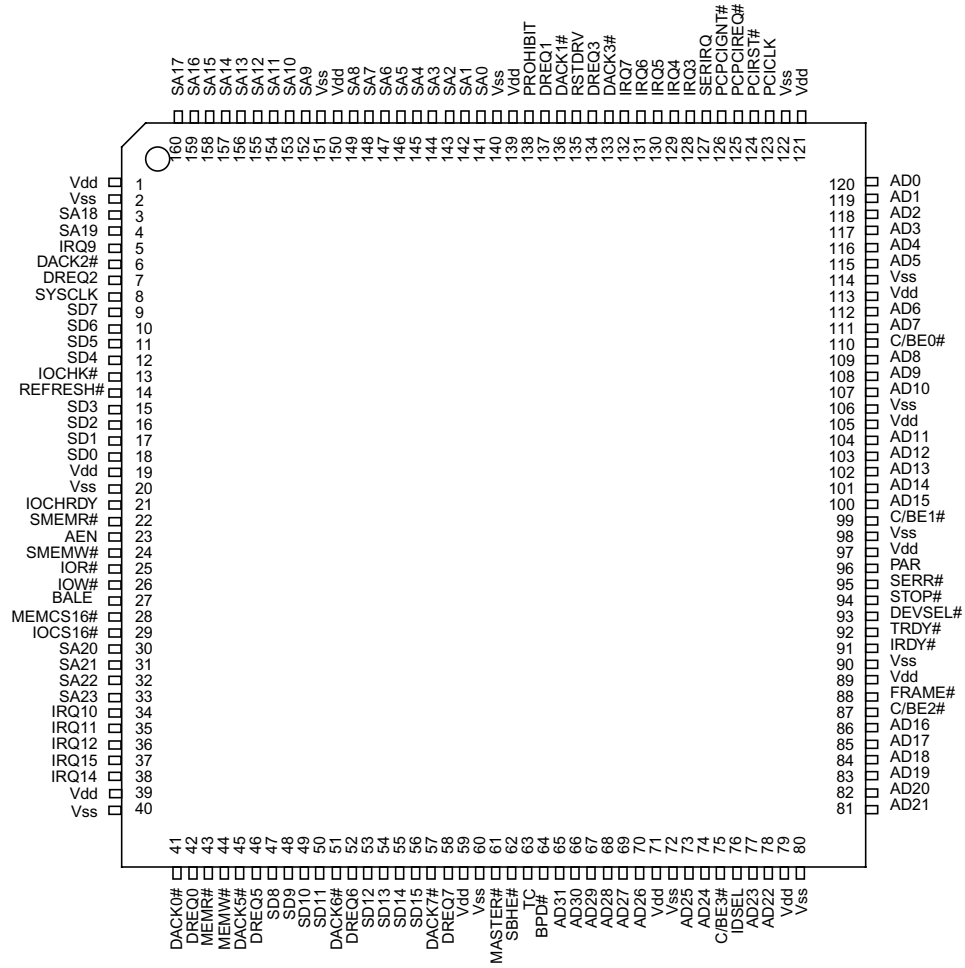


Figure 3. PC87200 Clock Generation

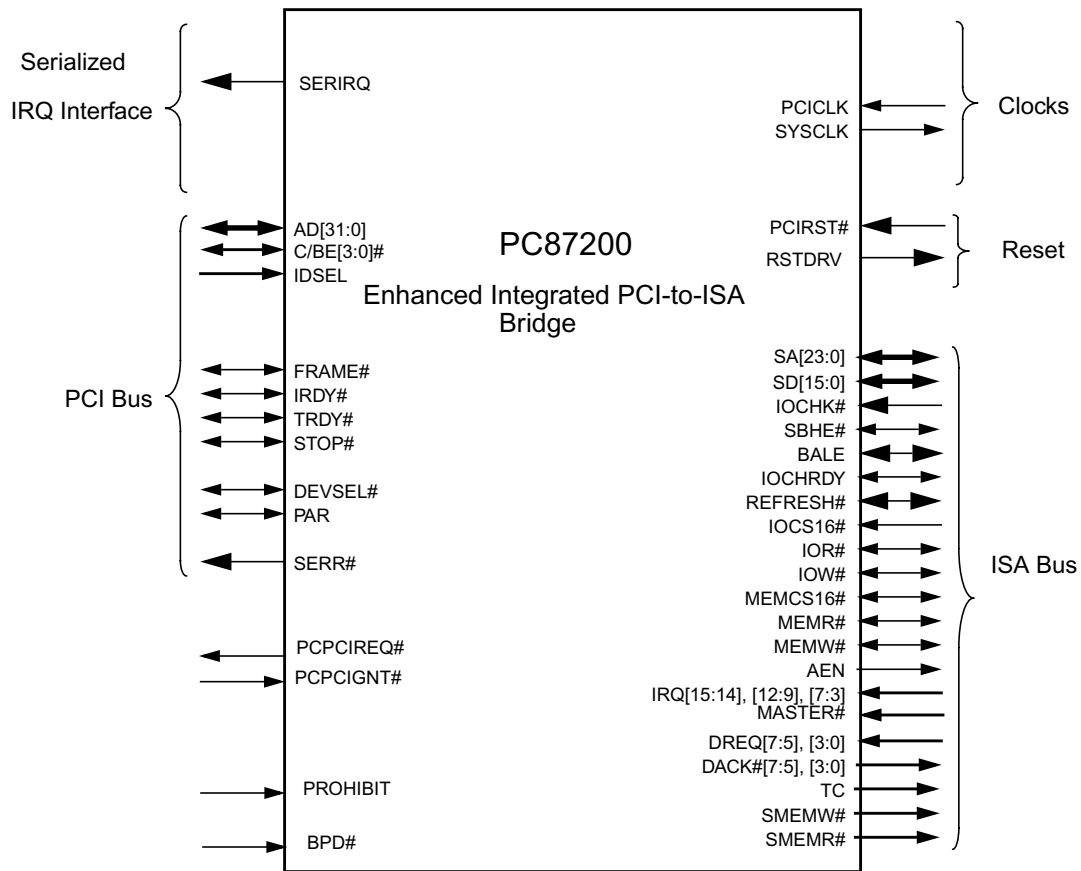
4.0 Device Pinout



5.0 Pin Descriptions

5.1 Signal Definitions

This section defines the signals and describes the external interface of the PC87200. The following diagram shows the pins organized by their functional groupings. Internal test and electrical pins are not shown.



PC87200 Signal Groups

5.0 Pin Descriptions (Continued)

5.2 Pin Assignments

The tables in this section use several common abbreviations. Table 2. lists the mnemonics and their meanings.

In the next section, description of each signal within its associated functional group is provided.

Table 2. Pin Type Definitions

Mnemonic	Definition
I	Standard input pin.
I/O	Bidirectional pin.
O	Totem-pole output.
OD	Open-drain output structure that allows multiple devices to share the pin in a wired-OR configuration.
PU	Pull-up resistor.
PD	Pull-down resistor.
smt	Schmitt Trigger.
s/t/s	Sustained TRI-STATE, an active-low TRI-STATE signal owned and driven by one and only one agent at a time. The agent that drives an s/t/s pin low must drive it high for at least one clock before letting it float. A new agent cannot start driving an s/t/s signal any sooner than one clock after the previous owner lets it float. A pull-up resistor is required to sustain the inactive state until another agent drives it and must be provided by the central resource.
t/s	TRI-STATE signal.
VDD (PWR)	Power pin.
VSS (GND)	Ground pin.
#	The "#" symbol at the end of a signal name indicates that the active, or asserted state occurs when the signal is at a low voltage level. When "#" is not present after the signal name, the signal is asserted when at a high voltage level.

5.3 Signal Descriptions

5.3.1 Reset Signals

Signal Name	Pin No.	Type	Description
PCIRST#	124	I	PCI Reset PCIRST# is the reset signal for the PCI bus.
RSTDRV	135	O	Reset Drive This signal is asserted to reset devices that reside on the ISA bus. It will be driven by the inverse of the PCIRST# input signal.

5.3.2 Clock Interface Signals

Signal Name	Pin No.	Type	Description
PCICLK	123	I	PCI Clock This clock runs at the PCI clock frequency and is used to drive most of the PC87200 circuitry.
SYSCLK	8	O	ISA Bus Clock ISACLK is derived from PCICLK and is typically programmed for 8.33MHz. F0 Index 50h[2:0] is used to program the ISA clock divisor. These bits determine the divisor of the PCI clock used to generate the ISA bus clock. If F0 Index 50h[2:0] is set to: 010 = Divide by three (sysclk=11MHz) 011 = Divide by four (sysclk = 8.33MHz) All other values are invalid and can produce unexpected results.

5.0 Pin Descriptions (Continued)

5.3.3 PCI Interface Signals

Signal Name	Pin No.	Type	Description
AD[31:0]	65,66, 67,68, 69,70, 73,74, 77,78, 81,82, 83,84, 85,86, 100,101, 102,103, 104,107, 108,109, 111,112, 115,116, 117,118, 119,120	I/O t/s	<p>PCI Address/Data</p> <p>AD[31:0] is a physical address during the first clock of a PCI transaction; it is the data during subsequent clocks.</p> <p>When the PC87200 is a PCI master, AD[31:0] are outputs during the address and write data phases, and are inputs during the read data phase of a transaction.</p> <p>When the PC87200 is a PCI slave, AD[31:0] are inputs during the address and write data phases, and are outputs during the read data phase of a transaction.</p>
C/BE[3:0]#	75,87, 99,110	I/O t/s	<p>PCI Bus Command and Byte Enables</p> <p>During the address phase of a PCI transaction, C/BE[3:0]# defines the bus command. During the data phase of a transaction, C/BE[3:0]# are the data byte enables.</p> <p>C/BE[3:0]# are outputs when the PC87200 is a PCI master and are inputs when it is a PCI slave.</p>
IDSEL	76	I	<p>Initialization Device Select</p> <p>It is used as a chip select during configuration read and write transactions.</p>
FRAME#	88	I/O t/s	<p>PCI Cycle Frame</p> <p>FRAME# is asserted to indicate the start and duration of a transaction. It is deasserted on the final data phase.</p> <p>FRAME# is an input when the PC87200 is a PCI slave.</p>
IRDY#	91	I/O t/s	<p>PCI Initiator Ready</p> <p>IRDY# is driven by the master to indicate valid data on a write transaction, or that it is ready to receive data on a read transaction.</p> <p>When the PC87200 is a PCI slave, IRDY# is an input that can delay the beginning of a write transaction or the completion of a read transaction.</p> <p>Wait cycles are inserted until both IRDY# and TRDY# are asserted together.</p>
TRDY#	92	I/O t/s	<p>PCI Target Ready</p> <p>TRDY# is asserted by a PCI slave to indicate it is ready to complete the current data transfer.</p> <p>TRDY# is an input that indicates a PCI slave has driven valid data on a read or a PCI slave is ready to accept data from the PC87200 on a write.</p> <p>TRDY# is an output that indicates the PC87200 has placed valid data on AD[31:0] during a read or is ready to accept the data from a PCI master on a write.</p> <p>Wait cycles are inserted until both IRDY# and TRDY# are asserted together.</p>
STOP#	94	I/O t/s	<p>PCI Stop</p> <p>As an input, STOP# indicates that a PCI slave wants to terminate the current transfer. The transfer will be aborted, retried, or disconnected.</p> <p>As an output, STOP# is asserted with TRDY# to indicate a target disconnect, or without TRDY# to indicate a target retry.</p>

5.0 Pin Descriptions (Continued)

Signal Name	Pin No.	Type	Description
DEVSEL#	93	I/O t/s	<p>PCI Device Select</p> <p>DEVSEL# is asserted by a PCI slave, to indicate to a PCI master and subtractive decoder that it is the target of the current transaction.</p> <p>As an input, DEVSEL# indicates a PCI slave has responded to the current address.</p> <p>As an output, DEVSEL# is asserted one cycle after the assertion of FRAME# and remains asserted to the end of a transaction as the result of a positive decode. DEVSEL# is asserted four cycles after the assertion of FRAME# if the PC87200 is selected as the result of a subtractive decode. The subtractive decode sample point can be configured in F0 Index 41h[2:1]. These cycles are passed to the ISA bus.</p>
PAR	96	I/O t/s	<p>PCI Parity</p> <p>PAR is the parity signal driven to maintain even parity across AD[31:0] and C/BE[3:0]#.</p> <p>The PC87200 drives PAR one clock after the address phase and one clock after each completed data phase of write transactions as a PCI master. It also drives PAR one clock after each completed data phase of read transactions as a PCI slave.</p>
SERR#	95	O OD	<p>PCI System Error</p> <p>SERR# is pulsed by a PCI device to indicate an address parity error.</p>

5.0 Pin Descriptions (Continued)

5.3.4 ISA Bus Interface Signals

Signal Name	Pin No.	Type	Description
MASTER#	61	I	ISA Master Mode: Master The MASTER# input asserted indicates an ISA bus master is driving the ISA bus and that it may access any device on the system board.
SA[23:0]	33,32, 31,30, 4,3,160, 159,158, 157,156, 155,154, 153,152, 149,148, 147,146, 145,144, 143,142, 141	I/O	System Address Bus This bus carries the addresses for all ISA cycles.
SD[15:0]	56,55, 54,53, 50,49, 48,47, 9,10, 11,12, 15,16, 17,18	I/O	System Data Bus This bus carries the data for all ISA cycles.
SMEMW#	24	O	System Memory Write SMEMW# is output on this pin. SMEMW# is asserted for any memory write accesses below 1MB. It enables 8-bit memory slaves to decode the memory address on SA[19:0].
SMEMR#	22	O	System Memory Read SMEMR# is output on this pin. SMEMR# is asserted for memory read accesses below 1MB. It enables 8-bit memory slaves to decode the memory address on SA[19:0].
SBHE#	62	I/O	System Bus High Enable The PC87200 or ISA master asserts SBHE# to indicate that SD[15:8] will be used to transfer a byte at an odd address. SBHE# is an output during non-ISA master DMA operations. It is driven as the inversion of AD0 during 8-bit DMA cycles. It is forced low for all 16-bit DMA cycles. SBHE# is an input during ISA master operations.
BALE	27	I/O	Buffered Address Latch Enable/Special Test mode BALE indicates when SA[23:0] and SBHE# are valid and may be latched. This pin will be used as strap for special test mode with the PROHIBIT signal by checking its input level during reset.
IOCHRDY	21	I/O OD	I/O Channel Ready IOCHRDY deasserted indicates that an ISA slave requires additional wait states. When the PC87200 is an ISA slave, IOCHRDY is an output indicating additional wait states are required.
REFRESH#	14	I/O OD	Refresh Cycle indicator The PC87200 supports the standard ISA refresh function. When the ISA bus is not in use by the ISA bus controller, the DMA controller, or an ISA bus master, the refresh control logic will generate an ISA refresh cycle. The 87200 also supports refresh requests initiated by ISA masters.

5.0 Pin Descriptions (Continued)

Signal Name	Pin No.	Type	Description
IOCS16#	29	I	I/O Chip Select 16 IOCS16# is asserted by 16-bit ISA I/O devices based on an asynchronous decode of SA[15:0] to indicate that SD[15:0] may be used to transfer data (8-bit ISA I/O devices use SD[7:0]).
IOR#	25	I/O	I/O Read IOR# is asserted to request an ISA I/O slave to drive data onto the data bus.
IOW#	26	I/O	I/O Write IOW# is asserted to request an ISA I/O slave to accept data from the data bus.
MEMCS16#	28	I/O OD	Memory Chip Select 16 MEMCS# is asserted by 16-bit ISA memory devices based on an asynchronous decode of SA[23:17] to indicate that SD[15:0] may be used to transfer data (8-bit ISA memory devices use SD[7:0]).
MEMR#	43	I/O	Memory Read MEMR# is asserted for all memory read accesses (including those above 1MB). It enables 16-bit memory slaves to decode the memory address on SA[23:0].
MEMW#	44	I/O	Memory Write MEMW# is asserted for all memory write accesses (including those above 1MB). It enables 16-bit memory slaves to decode the memory address on SA[23:0].
AEN	23	O	Address Enable AEN asserted indicates to ISA memory devices that a valid address for a DMA transfer is present on SA[23:0], and for I/O devices to ignore this address and any data on the ISA bus.
IRQ[15:14], [12:9], [7:3]	37,38, 36,35, 34,5, 132,131, 130,129, 128	I	ISA Bus Interrupt Request IRQ inputs are interrupts that indicate ISA devices or other devices requesting a CPU interrupt service.
DREQ[7:5], DREQ[3:0]	58, 52, 46,134, 7,137,42	I	DMA Request - Channels [7:5], [3:0] DREQ inputs are asserted by ISA DMA devices to request a DMA transfer. The request must remain asserted until the corresponding DACK# is asserted.
DACK[7:5]#, DACK[3:0]#	57,51, 45,133, 6,136,41	O	DMA Acknowledge- Channels [7:5], [3:0] DACK# outputs are asserted to indicate when a DREQ is granted and the start of a DMA cycle.
TC	63	O	Terminal Count TC signals the final data transfer of a DMA transfer.
IOCHK#	13	I	I/O channel check Asserted by an ISA device indicating an error condition.

5.3.5 Miscellaneous Signals (Continued)

Signal Name	Pin No.	Type	Description
SERIRQ	127	I/O s/t/s	Serial IRQ This is a one pin bus that conveys interrupt source information to the chipset.
PROHIBIT	138	I	PROHIBIT An active high signal from the chipset indicating that the PC87200 should not act as the subtractive decode agent on the PCI bus.
BPD#	64	I	BIOS Positive Decode (active low) When this pin is asserted low after BALE is detected high after reset, the PROHIBIT signal will be a don't care. The BIOS memory range will be positively decoded and claimed as such. All other cycles are still subtractively decoded.

5.0 Pin Descriptions (Continued)

5.3.6 PC/PCI signals

PCPCIREQ#	125	O	PC/PCI Bus Request The PC87200 asserts PCPCIREQ# using the PC/PCI DMA request protocol in response to a DMA request or ISA master request to gain ownership of the PCI bus. The PCPCIREQ# and PCPCIGNT# signals are used to arbitrate for the PCI bus.
PCPCIGNT#	126	I	PC/PCI Bus Grant PCPCIGNT# is asserted using the PC/PCI DMA grant protocol by an arbiter that indicates to the PC87200 that access to the PCI bus has been granted.

5.3.7 Power, Ground, and Reserved Terminals

Signal Name	Pin No.	Type	Description
VDD	1,19,39, 59,71, 79,89, 97,105, 113,121, 139,150	PWR	3.3V (nominal) Power Connection
VSS	2,20,40, 60,72, 80,90, 98,106, 114,122, 140,151	GND	Ground Connection

6.0 Configuration

a. Connect the NOGO signal of the south bridge to Prohibit pin of PC87200, SERIRQ to SERIRQ, REQ[A] to PCPCIREQ#, GNT[A] to PCPCIGNT# (other PC/PCI REQ, GNT pair may also be used). If BPD# is not being used, it should be pulled high.

cards with option ROM (e.g.,VGA cards, SCSI cards) to work properly.

b. On power-up reset (i.e., cold boot), the NOGO signal is high on reset and therefore disables the subtractive decoding capability of PC87200. The rationale for doing this is as follows: on the PCI bus, only one subtractive decoding agent can exist. Since the south bridge will normally power up as the subtractive decoding agent, the PC87200 must be "prohibited" from doing so. Any other GPO pin which is high on reset can also be used.

c. After PCI bus enumeration, when the device ID and vendor ID of PC87200 is found, do the following:

d. Enable serial IRQ in continuous mode, 21 frames and 4 clock start frame by setting register 64h of south bridge to d0h. (In the old south bridge, the serial IRQ pin is multiplexed with a GPIO and need to be selected as serial IRQ. In the latest industry standard south bridge, however, the serial IRQ is a dedicated pin and does not require initialization.)

e. Enable PC/PCI DMA by setting the PC/PCI request and grant pins to PC/PCI DMA mode, instead of using them as GPIOs. Any PC/PCI request and grant pair can be used, but on the south bridge, GNT[B] is multiplexed with GNT[5], so PC/PCI request and grant pair A is more preferable to use.

Set all channels of DMA to PC/PCI DMA except for channels 4 and 2 (channel 4 is for cascading the DMAC and channel 2 is for FDC). The value to be put in register 91:90 is 5475_{16} for the latest south bridge and 5455_{16} for older south bridges. The difference is due to the use of "11" for LPC DMA, and the value of 00_{16} (ISA DMA) being put into reserved instead.

f. Enable positive decode for the devices under the new south bridge: program the value of $3C0F_{16}$ into reg. E7:E6 will enable positive decode for most devices except sound and gameport. Changing it to enable/disable other devices will be straightforward for the new south bridge. (For old south bridges, it will be harder, and requires one to find all the bits to set/reset.)

g. Enable the new south bridge to do positive decode by setting bit 1 of reg. B0₁₆ to 1.

h. Set the NOGO signal to low.

i. Program register 42₁₆ of PC87200 to 20₁₆. This is a required initialization step.

j. Program a value of 03_{16} into register D3₁₆ of device 1F₁₆ in function 0 of the new south bridge. This will prevent the PC87200 from responding to configuration accesses afterwards. The rationale for doing this is to prevent Windows from detecting two ISA bridges, the other one being the PCI-to-LPC bridge, and thus creating a conflict. NOTE that you must connect AD22 to IDSEL of PC87200 for this to work.

After this, proceed in normal BIOS flow. Note that step d to j must be performed before ISA bus enumeration, and therefore before ISA plug and play initialization and option ROM checking. This is needed for plug and play cards and

7.0 Register Descriptions

The 87200 is a single function device. Its register space is called the Bridge Configuration Registers Space (F0) which is accessed through the PCI interface using the PCI Type One Configuration Mechanism.

The PCI header is a 256-byte region used for configuring a PCI device or function. The first 64 bytes are the same for all PCI devices and are predefined by the PCI specification. These registers are used to configure the PCI for the device. The rest of the 256-byte region is used to configure the device or function itself.

The remaining subsections of this chapter is as follows:

- A brief discussion on how to access the registers located in the PCI Configuration Space.
- Register summary.
- Detailed bit formats of all registers.

7.1 Register Summary

The tables in this subsection summarize all the registers of the PC87200. Included in the tables are the register's reset values.

Table 3. Function 0: Bridge Configuration Registers Summary

F0 Index	Width (Bits)	Type	Name	Reset Value
00h-01h	16	RO	Vendor Identification Register	100Bh
02h-03h	16	RO	Device Identification Register	0021h
04h-05h	16	R/W	PCI Command Register	0107h
06h-07h	16	R/W	PCI Status Register	0280h
08h	8	RO	Device Revision ID Register	00h
09h-0Bh	24	RO	PCI Class Code Register	060100h
0Ch	8	R/W	PCI Cache Line Size Register	00h
0Dh	8	R/W	PCI Latency Timer Register	00h
0Eh	8	RO	PCI Header Type Register	00h
0Fh	8	RO	PCI BIST Register	00h
10h-3Fh	--	--	Reserved	00h
40h	8	R/W	PCI Function Control Register 1	79h
41h	8	R/W	PCI Function Control Register 2	10h
42h	8	R/W	PCI Function Control Register 3	28h
43h	8	R/W	PCI Function Control Register 4	46h
44h	8	R/W	Reset Control Register	00h
45h-4Fh	--	--	Internal use, do not overwrite	--
50h	8	R/W	ISA CLK Divider	43h
51h	8	R/W	ISA I/O Recovery Control Register	43h
52h	8	R/W	ROM/AT Logic Control Register	04h
53h-5Ah	--	--	Internal use, do not overwrite	--
5Bh	8	R/W	Decode Control Register 2	00h
5Ch-FFh	--	--	Internal use, do not overwrite	--

7.0 Register Descriptions (Continued)

7.2 Chipset Register Space

The Chipset Register Space of the PC87200 is comprised of one function with PCI header registers. There is no memory or I/O mapped register.

unique to the PC87200. All registers in Function 0 are directly accessed (i.e., there are no memory or I/O mapped registers in F0). Table 4 gives the bit formats for these registers.

7.2.1 Bridge Configuration Registers - Function 0

The register space designated as Function 0 (F0) contains registers used to configure features and functionality

IMPORTANT: Register bits marked internal use should not be overwritten, else error will occur.

Table 4. Bridge Configuration Registers

Bit	Description
Index 00h-01h	Vendor Identification Register (RO) Reset Value = 100Bh
Index 02h-03h	Device Identification Register (RO) Reset Value = 0021h
Index 04h-05h	PCI Command Register (R/W) Reset Value = 0107h
15:10	Reserved — Set to 0.
9	Fast Back-to-Back Enable (Read Only) — This function is not supported when PC87200 is a master. It is always disabled (must always be set to 0).
8	SERR# — Allow SERR# assertion on detection of special errors: 0 = Disable; 1 = Enable.
7	Wait Cycle Control (Read Only) — This function is not supported in PC87200. It is always disabled (bit is set to 0).
6	Parity Error — Allow PC87200 to check for parity errors on PCI cycles for which it is a target, and to assert PERR# when a parity error is detected: 0 = Disable; 1 = Enable.
5	VGA Palette Snoop Enable (Read Only) — This function is not supported in PC87200. It is always disabled (bit is set to 0).
4	Memory Write and Invalidate — Allow PC87200 to do memory write and invalidate cycles, if the PCI cache line register is set to 16 bytes (04h). 0=Disable, 1=Enable.
3	Special Cycles — This function is not supported. It must always be set to 0.
2	Bus Master — Allow PC87200 bus mastering capabilities: 0 = Disable; 1 = Enable. Set this bit to 1.
1	Memory Space — Allow PC87200 to respond to memory cycles from the PCI bus: 0 = Disable; 1 = Enable. PC87200 will only respond to memory cycles destined for the ISA bus as none of its internal functions are memory-mapped.
0	I/O Space — Allow PC87200 to respond to I/O cycles from the PCI bus: 0 = Disable; 1 = Enable.
Index 06h-07h	PCI Status Register (R/W) Reset Value = 0280h
15	Detected Parity Error — This bit is set whenever a parity error is detected. Write 1 to clear.
14	Signaled System Error — This bit is set whenever PC87200 asserts SERR# active. Write 1 to clear.
13	Received Master Abort — This bit is set whenever a master abort cycle occurs. A master abort will occur when a PCI cycle is not claimed, except for special cycles. Write 1 to clear. Register is cleared after RMA is read.
12	Received Target Abort — This bit is set whenever a target abort is received while the PC87200 is the master for the PCI cycle. Write 1 to clear.
11	Signaled Target Abort — This bit is set whenever the PC87200 signals a target abort. This occurs when an address parity error occurs for an address that hits in the active address decode space of the PC87200. Write 1 to clear.
10:9	DEVSEL# Timing — These bits are always 01, as the PC87200 will always respond to cycles for which it is an active target with medium DEVSEL# timing. 00 = Fast 01 = Medium 10 = Slow 11 = Reserved

7.0 Register Descriptions (Continued)

Table 4. Bridge Configuration Registers (Continued)

Bit	Description
8	Data Parity Detected — This bit is set when: 1) The PC87200 asserted PERR# or observed PERR# asserted. 2) PC87200 is the master for the cycle in which the PERR# occurred, and PE is set (F0 Index 04h[6] = 1). Write 1 to clear.
7	Fast Back-to-Back Capable — As a target, PC87200 is capable of accepting fast back-to-back transactions: 0 = Disable; 1 = Enable. This bit is always set to 1.
6:0	Reserved — Set to 0.
Index 08h Device Revision ID Register (RO) Reset Value = 00h	
Index 09h-0Bh PCI Class Code Register (RO) Reset Value = 060100h	
Index 0Ch PCI Cache Line Size Register (R/W) Reset Value = 00h	
7:0	PCI Cache Line Size Register — reserved.
Index 0Dh PCI Latency Timer Register (R/W) Reset Value = 00h	
7:4	Reserved — Set to 0.
3:0	PCI Latency Timer Value — The PCI Latency Timer Register prevents system lockup when a slave does not respond to a cycle that the PC87200 masters. If the value is set to 00h (default), the timer is disabled. If the timer is written with any other value, bits [3:0] become the four most significant bytes in a timer that counts PCI clocks for slave response. The timer is reset on each valid data transfer. If the counter expires before the next assertion of TRDY# is received, the PC87200 stops the transaction with a master abort and asserts SERR#, if enabled to do so.
Index 0Eh PCI Header Type (RO) Reset Value = 00h	
7:0	PCI Header Type Register — This register defines the format of this header. This header is of type format 0. Additionally, bit 7 defines whether this PCI device is a multifunction device (bit 7 = 1) or not (bit 7 = 0).
Index 0Fh PCI BIST Register (RO) Reset Value = 00h	
7:0	Reserved. Set to 0.
Index 10h-3Fh Reserved Reset Value = 00h	
Index 40h PCI Function Control Register 1 (R/W) Reset Value = 79h	
7	Internal use, do not overwrite.
6	Single Write Mode — PC87200 accepts only single cycle write transfers as a slave on the PCI bus and performs a target disconnect with the first data transferred: 0 = Disable (accepts burst write cycles); 1 = Enable.
5	Single Read Mode — PC87200 accepts only single cycle read transfers as a slave on the PCI bus and performs a target disconnect with the first data transferred. 0 = Disable (accepts burst read cycles); 1 = Enable.
4	Retry PCI Cycles — Retry inbound PCI cycles if data is buffered and waiting to go outbound on PCI: 0 = No Retry; 1 = Retry.
3	Write Buffer — PCI slave write buffer: 0 = Disable; 1 = Enable.
2:1	Reserved- set to 0.
0	BS8/16 — This bit can not be written. Always = 1.

Note: Bits 6 and 5 emulate the behavior of first generation devices developed for PCI.

7.0 Register Descriptions (Continued)

Table 4. Bridge Configuration Registers (Continued)

Bit	Description
Index 41h PCI Function Control Register 2 (R/W) Reset Value = 10h	
7	Burst to Beat — Bursts are converted to single beats for X-Bus to PCI bus reads: 0 = Disable; 1 = Enable.
6	Internal use, do not overwrite.
5	PERR# Signals SERR# — Assert SERR# any time that PERR# is asserted or detected active by the PC87200 (allows PERR# assertion to be cascaded to NMI (SMI) generation in the system): 0 = Disable; 1 = Enable.
4	Write Buffer Enable — Allow 16-byte buffering for X-Bus to PCI bus writes: 0 = Disable; 1 = Enable.
3	Internal use, do not overwrite.
2:1	Subtractive Decode — These bits determine the point at which the PC87200 accepts cycles that are not claimed by another device. The PC87200 defaults to taking subtractive decode cycles in the default cycle clock, but can be moved up to the Slow Decode cycle point if all other PCI devices decode in the fast or medium clocks. Disabling subtractive decode must be done with care, as all ISA and ROM cycles are decoded subtractively. 00 = Default sample (4th clock from FRAME# active) 01 = Slow sample (3rd clock from FRAME# active) 1x = No subtractive decode
0	Internal use, do not overwrite.
Index 42h PCI Function Control Register 3 (R/W) Reset Value = 28h	
7	Internal use, do not overwrite.
6	Internal use, do not overwrite.
5	Delayed Transactions — Allow delayed transactions on the PCI bus: 0 = Disable; 1 = Enable.
4	Internal use, do not overwrite.
3	No X-Bus ARB, Buffer Enable — When PC87200 is a PCI target, allow buffer PCI transactions without X-Bus arbitration: 0 = Disable; 1 = Enable.
2	Internal use, do not overwrite.
1	Internal use, do not overwrite.
0	Internal use, do not overwrite.
Index 43h PCI Function Control Register 4 Reset Value = 46h	
7	Reserved — Set to 0.
6	Internal use, do not overwrite.
5	Internal use, do not overwrite.
4	Internal use, do not overwrite.
3	Internal use, do not overwrite.
2	Internal use, do not overwrite.
1	PCI Retry Cycles — When PC87200 is a PCI target and the PCI buffer is not empty, allow PCI bus to retry cycles: 0 = Disable; 1 = Enable. This bit works in conjunction with PCI bus delayed transactions bit. F0 Index 42h[5] must = 1 for this bit to be valid.
0	Internal use, do not overwrite.
Index 44h Reset Control Register (R/W) Reset Value = 0000000b	
7	Internal use, do not overwrite.

7.0 Register Descriptions (Continued)

Table 4. Bridge Configuration Registers (Continued)

Bit	Description
6	Internal use, do not overwrite.
5	Internal use, do not overwrite.
4	Internal use, do not overwrite.
3	Internal use, do not overwrite.
2	Internal use, do not overwrite.
1	Internal use, do not overwrite.
0	X-Bus Warm Start Write only: 0 = NOP; 1 = Execute system wide reset (used only for clock configuration at power-up)
Index 45h-4Fh Internal use, do not overwrite	
Index 50h ISA CLK Divider (R/W) Reset Value = 43h	
7	Internal use, do not overwrite.
6	Internal use, do not overwrite.
5	Internal use, do not overwrite.
4	Internal use, do not overwrite.
3	Internal use, do not overwrite.
2:0	ISA Clock Divisor — Determines the divisor of the PCI clock used to generate the ISA bus clock: 010 = Divide by three (ISA clock = 11MHz) 011 = Divide by four (ISA clock = 8.33 MHz) All other values are invalid and can produce unexpected results.
Index 51h ISA I/O Recovery Control Register (R/W) Reset Value = 43h	
7:4	8-Bit I/O Recovery — These bits determine the number of ISA bus clocks between back-to-back 8-bit I/O read cycles. This count is in addition to a preset one-clock delay built into the controller. 0000 = 1 PCI clock 1101 = 14 PCI clocks 0001 = 2 PCI clocks 1110 = 15 PCI clocks :::1111 = 16 PCI clocks
3:0	16-Bit I/O Recovery — These bits determine the number of ISA bus clocks between back-to-back 16-bit I/O cycles. This count is in addition to a preset one-clock delay built into the controller. 0000 = 1 PCI clock 1101 = 14 PCI clocks 0001 = 2 PCI clocks 1110 = 15 PCI clocks :::1111 = 16 PCI clocks
Index 52h ROM Control Register (R/W) Reset Value = 04h	
7	Internal use, do not overwrite.
6	Internal use, do not overwrite.
5	Internal use, do not overwrite.
4	Internal use, do not overwrite.
3	Internal use, do not overwrite.
2	ROM 1MB Enable — Allow addressing to 512K or 1MB ROM (FFF0000h-FFFFFFFFh): 0 = Disable; 1 = Enable.
1	Internal use, do not overwrite.
0	Internal use, do not overwrite.

7.0 Register Descriptions (Continued)

Table 4. Bridge Configuration Registers (Continued)

Bit	Description
Index 53h-5Ah	
Internal use, do not overwrite	
Index 5Bh	
Decode Control Register 2 (R/W)	
Reset Value = 00h	
7	Internal use, do not overwrite.
6	Reserved — Set to 0.
5	BIOS ROM Positive Decode — Selects positive or subtractive decoding for accesses to the configured ROM space: 0 = Subtractive; 1 = Positive.
4	Internal use, do not overwrite.
3	Internal use, do not overwrite.
2	Internal use, do not overwrite.
1	Internal use, do not overwrite.
0	Internal use, do not overwrite.
Note: Positive decoding by the PC87200 speeds up the I/O cycle time.	
Index 5Ch-FFh	
Internal use, do not overwrite	

8.0 Electrical Characteristics

8.1 Electrical Specifications

This section provides information on testing modes, electrical connections, absolute maximum ratings, recommended operating conditions, and DC/AC characteristics. All voltage values in Electrical Specifications are with respect to V_{SS} unless otherwise noted.

For detailed information on the PCI bus electrical specification refer to Chapter 4 of the PCI Bus Specification, Revision 2.1.

8.2 PC87200 Test Modes

The PC87200 can be forced into different test modes. The following table summarizes the test mode selection process.

Table 5. Test mode selection

Mode	Signal Name						
	PCIRST#	BALE during reset	IRQ3	IRQ4	IRQ5	IRQ6	IRQ7
Reserved	x	0	0	1	0	0	1
NAND tree test	x	0	x	x	x	x	0
Reserved	x	0	1	0	0	0	1
Reserved	x	0	1	1	0	0	1
Reserved	x	0	1	1	1	0	1
Reserved	x	0	0	0	0	1	1
SCAN_MODE = 1, SCAN_ENABLE = 0,	x	0	1	0	0	1	1
SCAN_MODE = 1, SCAN_ENABLE = 1, X-BUS_DISABLE = 1	x	0	1	0	1	1	1

Note: x = Don't Care

8.0 Electrical Characteristics (Continued)

8.2.1 Test Mode Logic

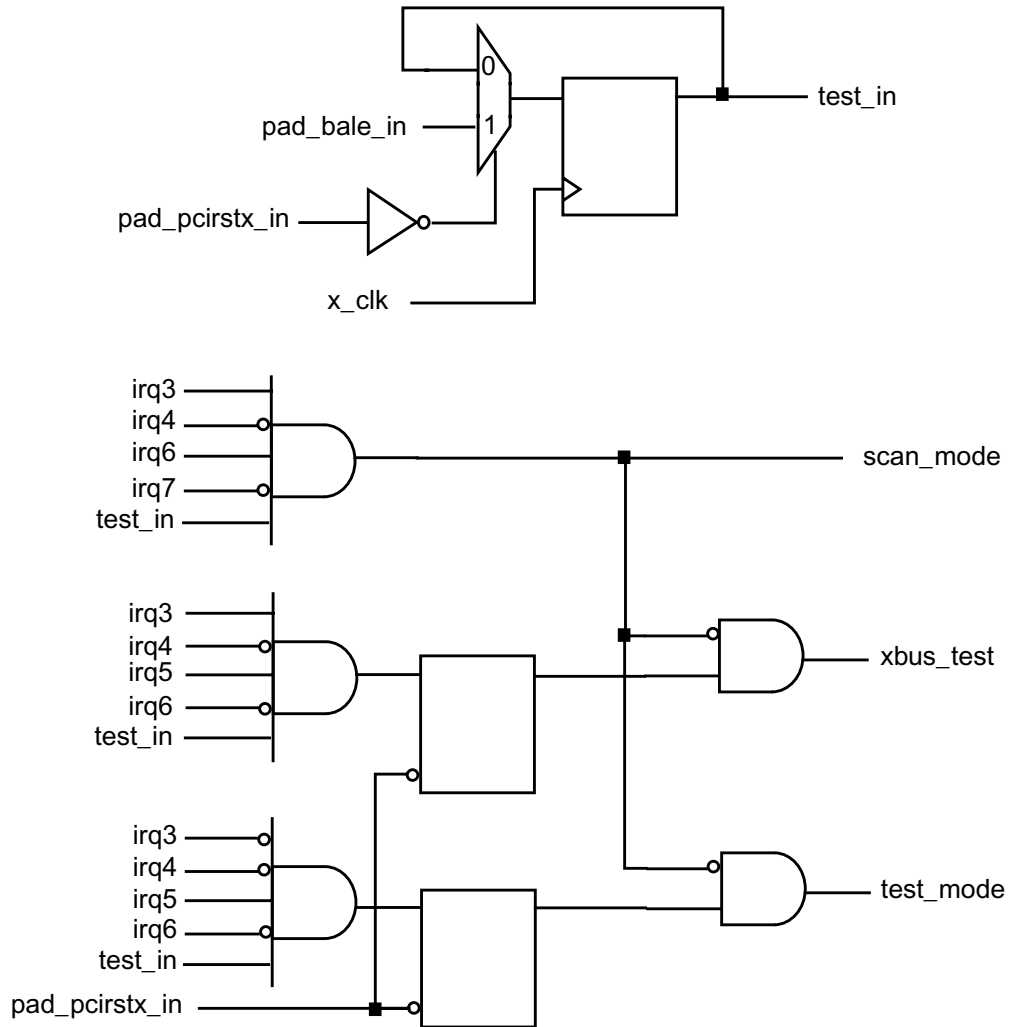
This block will produce various test mode signals for different test modes :

— NAND test signal

— XBus test signal

— Test mode signal

— Scan mode signal



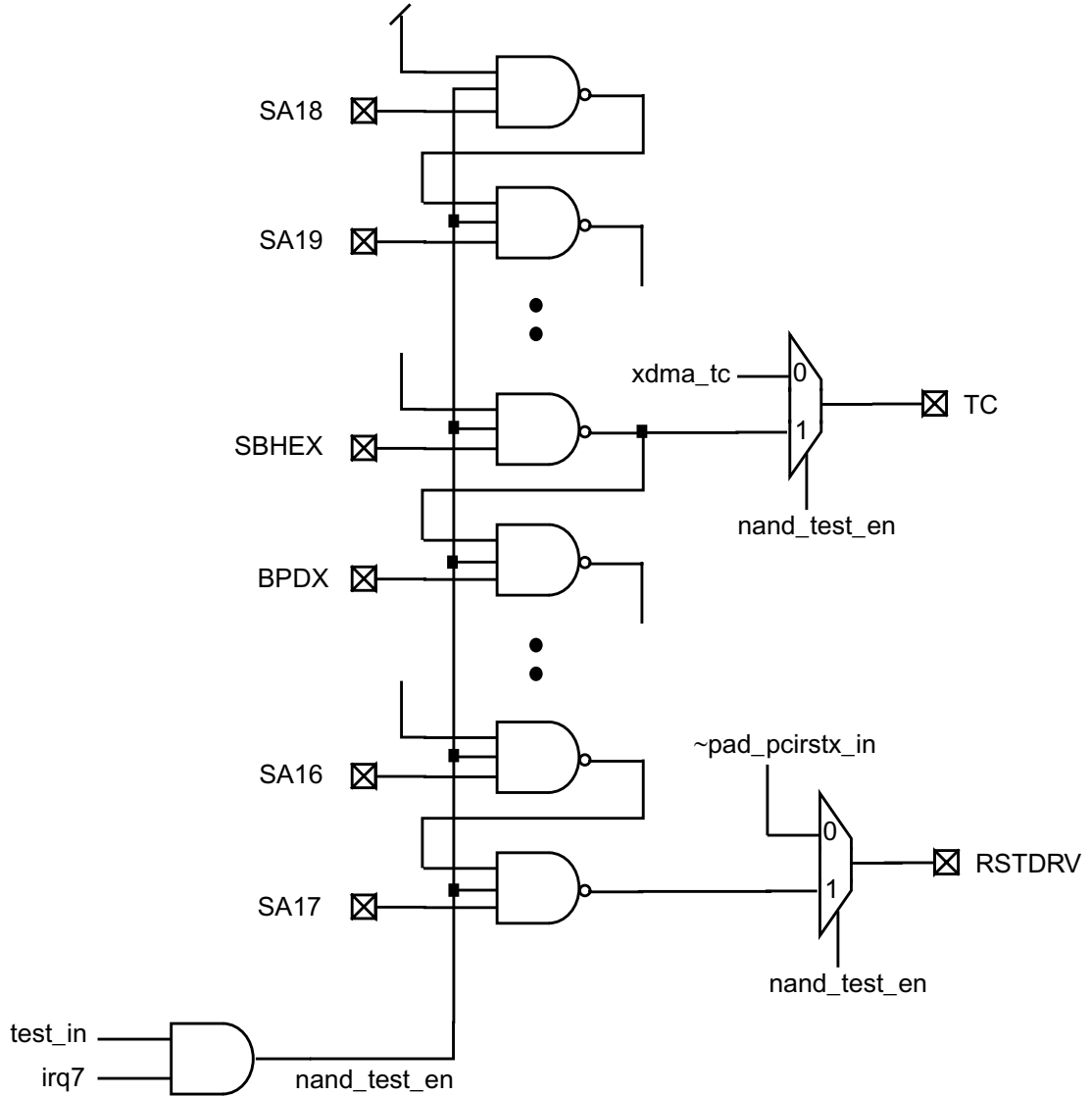
Test signal generation logic

8.0 Electrical Characteristics (Continued)

8.2.2 NAND Tree Connections

During NAND tree testing, all outputs and bi-directional pins will be tri-stated except BALE and RSTDRV pins. The first input of the NAND chain is SA18. The NAND chain is routed counter-clockwise around the chip (eg. SA18, SA19, IRQ9, ...). TC is the intermediate output and RST-

DRV is the final output. BALE, PCIRSTX and IRQ7 are not included in the NAND chain because they are required to put the chip to NAND test mode. The NAND tree connection is as shown below.



NAND Tree Diagram

8.0 Electrical Characteristics (Continued)

8.2.3 NAND Tree Order

Pin #	Pin Name	Note
1	VDD	
2	VSS	
3	SA18	first input in NAND chain
4	SA19	
5	IRQ9	
6	DACK2#	
7	DREQ2	
8	SYSCLK	
9	SD7	
10	SD6	
11	SD5	
12	SD4	
13	IOCHK#	
14	REFRESH#	
15	SD3	
16	SD2	
17	SD1	
18	SD0	
19	VDD	
20	VSS	
21	IOCHRDY	
22	SMEMR#	
23	AEN	
24	SMEMW#	
25	IOR#	
26	IOW#	
27	BALE	not in NAND chain (see Timing Diagram)
28	MEMCS16#	
29	IOCS16#	
30	SA20	
31	SA21	
32	SA22	
33	SA23	
43	IRQ10	
35	IRQ11	
36	IRQ12	

Pin #	Pin Name	Note
37	IRQ15	
38	IRQ14	
39	VDD	
40	VSS	
41	DACK0#	
42	DREQ0	
43	MEMR#	
44	MEMW#	
45	DACK5#	
46	DREQ5	
47	SD8	
48	SD9	
49	SD10	
50	SD11	
51	DACK6#	
52	DREQ6	
53	SD12	
54	SD13	
55	SD14	
56	SD15	
57	DACK7#	
58	DREQ7	
59	VDD	
60	VSS	
61	MASTER#	
62	SBHE#	
63	TC	intermediate NAND chain output
64	BPD#	
65	AD31	
66	AD30	
67	AD29	
68	AD28	
69	AD27	
70	AD26	
71	VDD	
72	VSS	
73	AD25	

8.0 Electrical Characteristics (Continued)

Pin #	Pin Name	Note
74	AD24	
75	C/BE3#	
76	IDSEL	
77	AD23	
78	AD22	
79	VDD	
80	VSS	
81	AD21	
82	AD20	
83	AD19	
84	AD18	
85	AD17	
86	AD16	
87	C/BE2#	
88	FRAME#	
89	VDD	
90	VSS	
91	IRDY#	
92	TRDY#	
93	DEVSEL#	
94	STOP#	
95	SERR#	
96	PAR	
97	VDD	
98	VSS	
99	C/BE1#	
100	AD15	
101	AD14	
102	AD13	
103	AD12	
104	AD11	
105	VDD	
106	VSS	
107	AD10	
108	AD9	
109	AD8	
110	C/BE0#	

Pin #	Pin Name	Note
111	AD7	
112	AD6	
113	VDD	
114	VSS	
115	AD5	
116	AD4	
117	AD3	
118	AD2	
119	AD1	
120	AD0	
121	VDD	
122	VSS	
123	PCICLK	(see Timing Diagram)
124	PCIRST#	not in NAND chain (see Timing Diagram)
125	PCPCIREQ#	floating, not in NAND chain
126	PCPCIGNT#	
127	SERIRQ	
128	IRQ3	
129	IRQ4	
130	IRQ5	
131	IRQ6	
132	IRQ7	not in NAND chain (see Timing Diagram)
133	DACK3#	
143	DREQ3	
135	RSTDRV	NAND chain output
136	DACK1#	
137	DREQ1	
138	PROHIBIT	
139	VDD	
140	VSS	
141	SA0	
142	SA1	
143	SA2	
144	SA3	
145	SA4	
146	SA5	

8.0 Electrical Characteristics (Continued)

Pin #	Pin Name	Note
147	SA6	
148	SA7	
149	SA8	
150	VDD	
151	VSS	
152	SA9	
153	SA10	
154	SA11	
155	SA12	
156	SA13	
157	SA14	
158	SA15	
159	SA16	
160	SA17	end of NAND chain

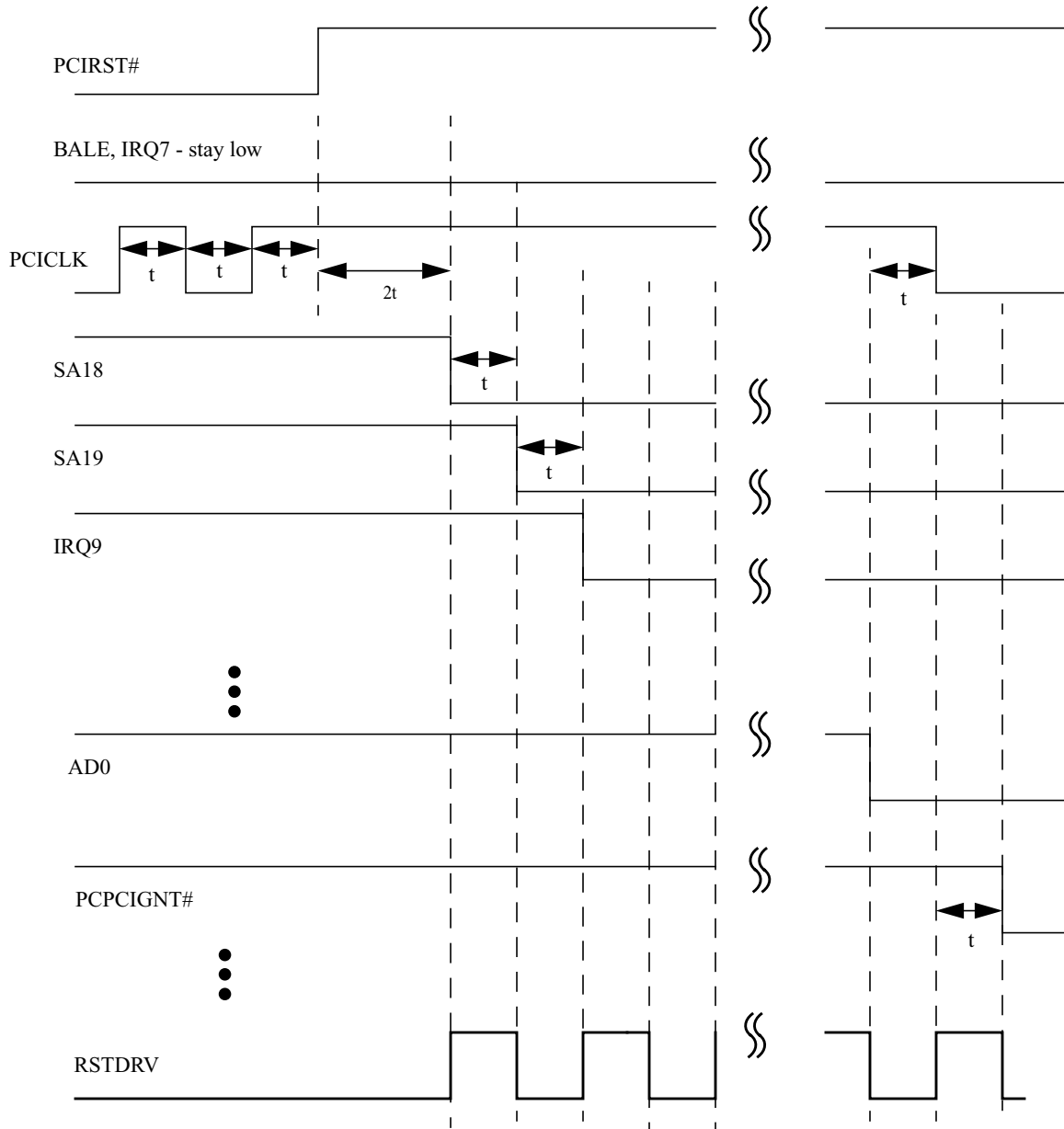
Note 1: All Vdd and Vss are not in the NAND chain.

8.0 Electrical Characteristics (Continued)

8.2.4 Timing Diagram for NAND test

Set PCIRST#, BALE and IRQ7 to low (PCPCIREQ# should be left floating), toggle PCICLK (provide a low-to-high transition) at least once (recommended to provide two edges as show in the diagram below). All other pins

in the NAND chain should be pulled high. Then release PCIRST#. After PCIRST# goes inactive, starting with SA18 going counter-clockwise, switch each pin in the NAND chain low at a rate of at least about 100ns apart.



Note : $t \geq 100\text{ns}$

8.2.5 Scan chain description

There are eight scan chains in the PC87200 chip. During scan mode, the PCICLK is the scan clock and IRQ5 is the scan enable which will enable the shifting of scan patterns.

Scan inputs are DREQ[0:3],[7:5], and IRQ15 and scan outputs are DACK[0:3],[7:5] and TC.

8.0 Electrical Characteristics (Continued)

8.3 Electrical Connections

8.3.1 Unused Input Pins

All inputs not used by the system designer should be kept at either ground or V_{DD} . To prevent possible spurious operation, connect active-high inputs to ground through a 20-kohm (10%) pull-down resistor and active-low inputs to V_{DD} through a 20-kohm (10%) pull-up resistor

8.3.2 NC-Designated Pins

Pins designated NC should be left disconnected. Connecting an NC pin to a pull-up resistor, pull-down resistor, or an active signal could cause unexpected results and possible circuit malfunctions.

8.3.3 Power and Ground Connections and Decoupling

Testing and operating the PC87200 requires the use of standard high frequency techniques to reduce parasitic

effects. These effects can be minimized by filtering the DC power leads with low-inductance decoupling capacitors, using low-impedance wiring, and by utilizing all of the V_{DD} and GND pins.

8.4 Absolute Maximum Ratings

Table 6. lists absolute maximum ratings for the PC87200. Stresses beyond the listed ratings may cause permanent damage to the device. Exposure to conditions beyond these limits may (1) reduce device reliability and (2) result in premature failure even when there is no immediately apparent sign of failure. Prolonged exposure to conditions at or near the absolute maximum ratings may also result in reduced useful life and reliability. These are stress ratings only and do not imply that operation under any conditions other than those listed under Table 7. is possible.

Table 6. Absolute Maximum Ratings

Parameter	Min	Max	Units	Comment
Operating Case Temperature		110	°C	
Storage Temperature	-65	150	°C	No Bias
Supply Voltage		4.0	V	
Voltage On Any Pin:	-0.5	5.5	V	

8.5 Recommended Operating Conditions

Table 7. lists the recommended operating conditions for the PC87200.

Table 7. Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units	Comment
T_A	Ambient Temperature	0	70	°C	
V_{DD}	Supply Voltage	3.0	3.6	V	3.3 V nominal

8.0 Electrical Characteristics (Continued)

8.6 DC Characteristics

Table 8. DC Characteristics (at Recommended Operating Conditions)

Symbol	Parameter	Min	Typ	Max	Units	Comment
ISA bus (including PROHIBIT, BPD#)						
V _{IL}	Input Low Voltage			0.8	V	TTL Level Inputs
V _{IH}	Input High Voltage	2.0			V	TTL Level Inputs
V _{OL}	Output Low Voltage			0.5	V	I _{ol} =12 mA
V _{OH}	Output High Voltage	2.4			V	I _{oh} =-3mA
I _{OHL}	Output High Leakage			200	uA	V _o =V _{cc} , for OD driver
PCI bus (including PCPCIREQ#, PCPCIGNT#, SERIRQ)						
V _{ILC}	Input Low Voltage			0.3V _{DD}	V	CMOS Level Inputs
V _{IHC}	Input High Voltage	0.5V _{DD}			V	CMOS Level Inputs
V _{OLC}	Output Low Voltage			0.1V _{DD}	V	I _{out} =1500uA
V _{OHC}	Output High Voltage	0.9V _{DD}			V	I _{out} =-500uA
All pins						
I _I	Input Leakage Current for each input pin			15	A	0 < V _{IN} < V _{DD} ,
C _{IN}	Input Capacitance			10	pF	f = 1MHz
C _{OUT}	Output or I/O Capacitance			10	pF	f = 1MHz
C _{CLK}	CLK Input Capacitance			10	pF	f = 1MHz
Current Consumption						
I _{CC}	Active I _{CC} : PCICLK @ 33 MHz		30	160	mA	
I _{CCSS}	Standby I _{CC} (PCICLK Stopped)		10		uA	f _{PCICLK} = 0MHz

8.0 Electrical Characteristics (Continued)

8.7 AC Characteristics

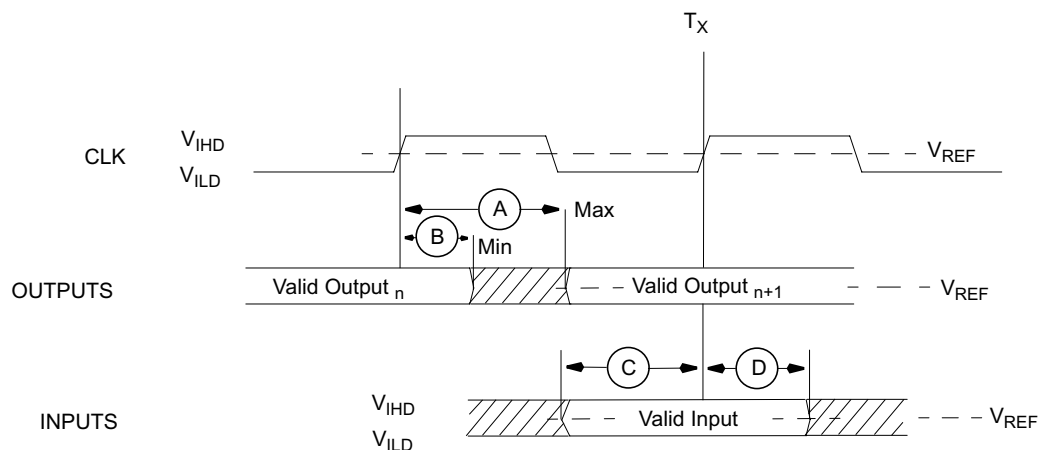
The following tables list the AC characteristics including output delays, input setup requirements, input hold requirements and output float delays. The rising-clock-edge reference level V_{REF} and other reference levels are shown in Table 9. Input or output signals must cross these levels during testing.

Input setup and hold times are specified minimums that define the smallest acceptable sampling window for which a synchronous input signal must be stable for correct operation.

Note: All AC tests are at $V_{DD} = 3.0V$ to $3.6V$,
 $T_A = 0^{\circ}C$ to $70^{\circ}C$, $C_L = 50pF$ unless otherwise specified.

Table 9. Drive Level and Measurement Points for Switching Characteristics

Symbol	Voltage (V)
V_{REF}	1.5
V_{IHD}	2.3
V_{ILD}	0.3



Legend: A = Maximum Output Delay Specification
 B = Minimum Output Delay Specification
 C = Minimum Input Setup Specification
 D = Minimum Input Hold Specification

Figure 4. Drive Level and Measurement Points for Switching Characteristics

Table 10. AC Characteristics of Specification Compliant Interface Signals

Interface Signal Group	Specification Name
PCI Bus Interface Signals	PCI Bus Specification, Revision 2.1
ISA Bus Interface Signals	Abides industry standards

The interface signal groups listed in Table 11. adhere to the timing parameters given in the corresponding specification. For details, refer to those specifications.

8.0 Electrical Characteristics (Continued)

Table 11. Clock Characteristics

Symbol	Parameter	Min	Max	Duty Cycle	Unit	Comment
Input Signal						
t_{cyc}	PCICLK Cycle Time	30	∞		ns	
t_{HIGH}	PCICLK High Time	11			ns	
t_{LOW}	PCICLK Low Time	11			ns	
--	PCICLK Slew Time	1	4		V/ns	Note 1

Note 1: Rise and fall times are specified in terms of the edge rate measured in V/ns. This slew rate must be met across the minimum peak-to-peak portion of the clock waveform as shown in Figure 5..

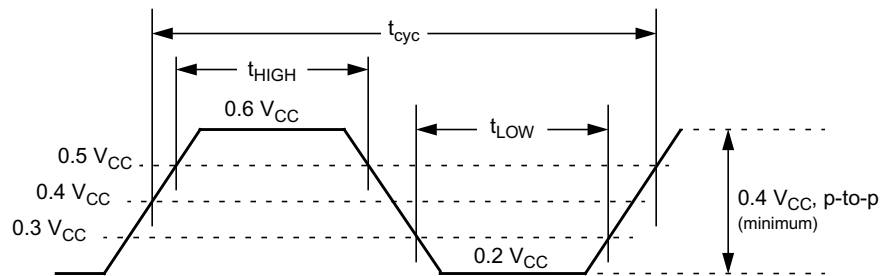
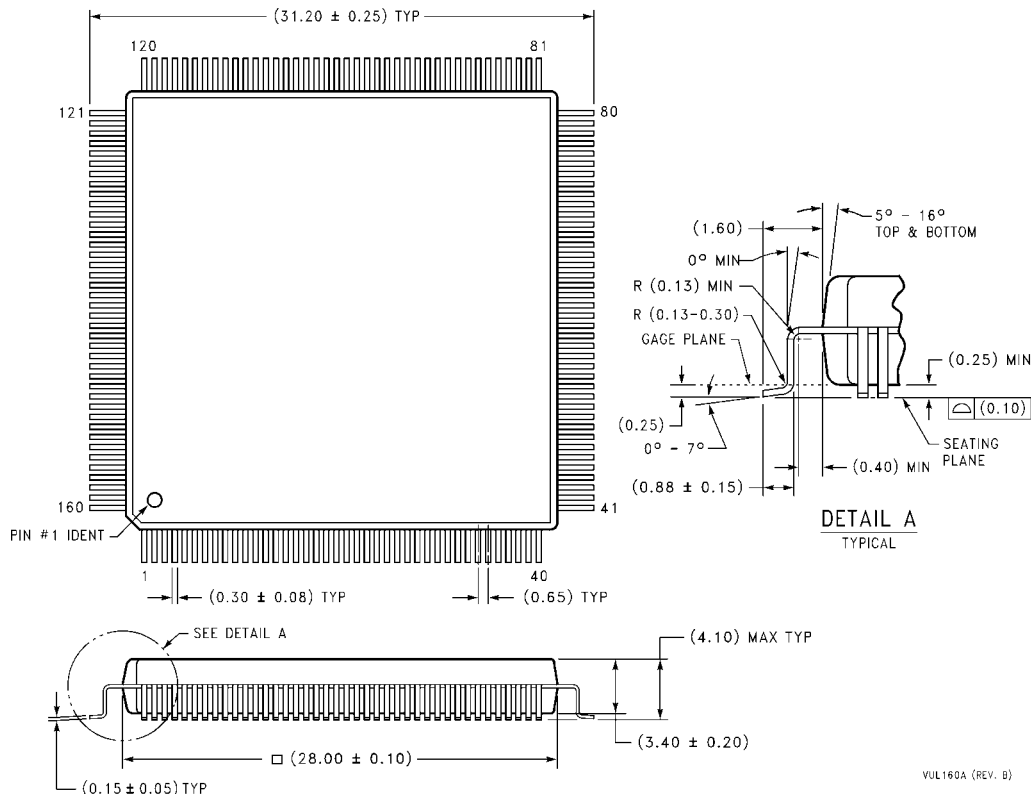


Figure 5. PCICLK Waveform

9.0 Physical Dimensions inches (millimeters) unless otherwise noted



160 Lead Molded Plastic Quad Flat Package (JEDEC)
 Order Number PC87200VUL
 NS Package Number VUL160A

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