



Pentium/P54C PCI/ISA Chipset

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SiS 85C501/502/503

Preliminary

Rev. 2.0

January 9, 1995

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1 85C501/502/503 Overview

| | |
|-----------|---|
| SiS85C501 | PCI/ISA Cache Memory Controller (PCMC) |
| SiS85C502 | PCI Local Data Buffer (PLDB) |
| SiS85C503 | PCI System I/O (PSIO) |

A whole set of the SiS85C501, 85C502, and 85C503 provides fully integrated support for the Pentium/P54C PCI/ISA system. The chipset is developed by using a very high level of function integration and system partitioning. With the SiS85C501, SiS85C502, and SiS85C503 chipset, only 13 TTLs (include 3 DRAM address buffer) are required to implement a low cost, high performance, Pentium/P54C PCI/ISA system. Figure 1 shows the system block diagram.

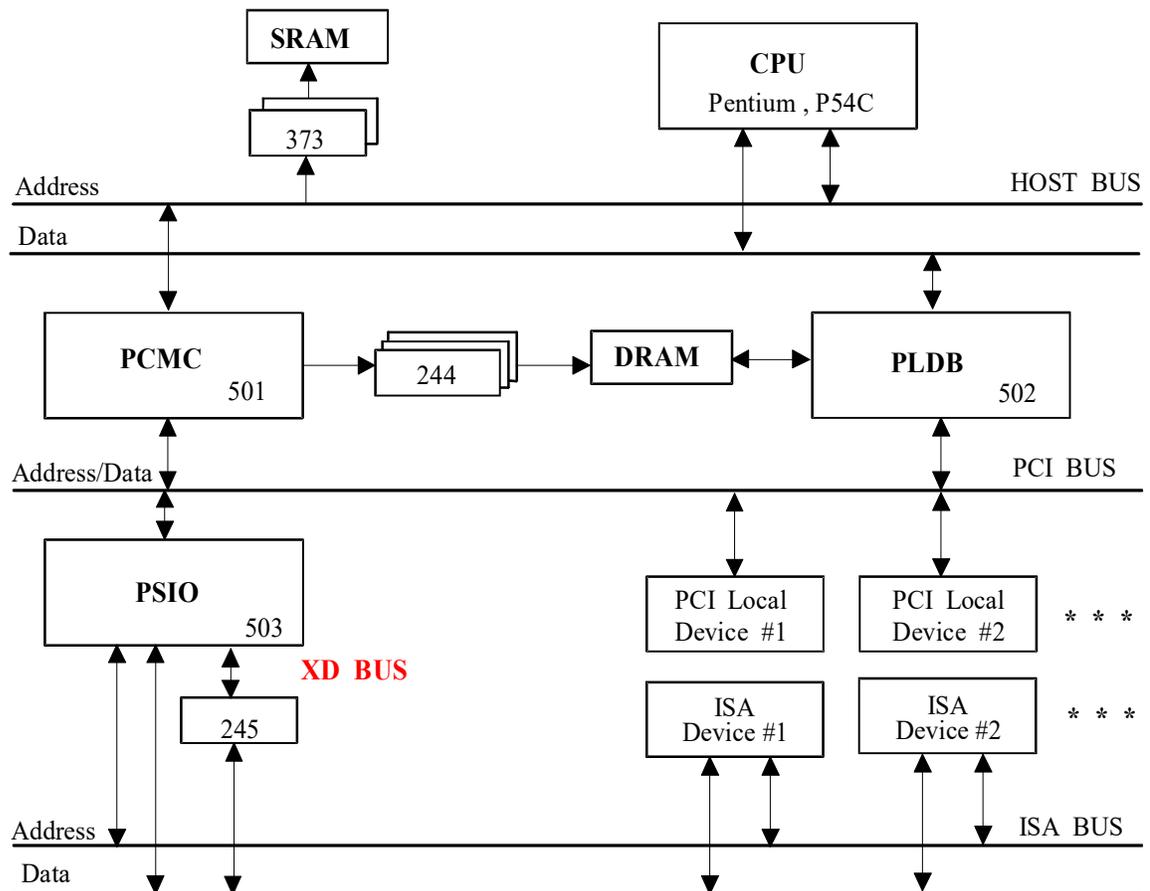


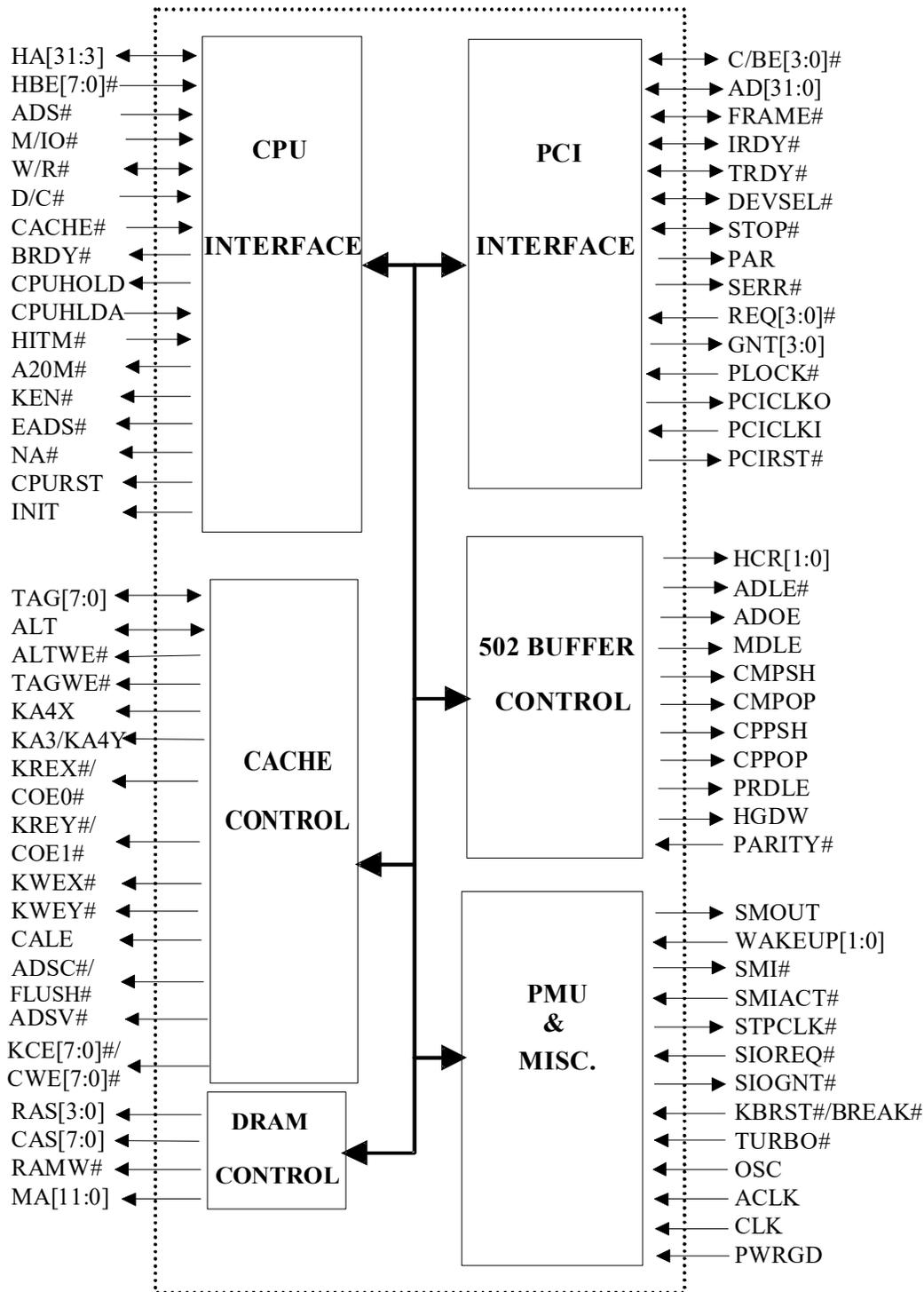
Figure 1.1 System Block Diagram

2. SiS85C501

2.1 Features

- **Supports the Pentium Processor at 60 MHz or 66 MHz Bus Speed**
- **Supports the P54C Processor at 50 MHz, 60 MHz or 66 MHz Bus Speed**
- **Supports the Pipelined Address Mode of the Pentium or the P54C Processor**
- **Integrated Second Level (L2) Cache Controller**
 - Write Through and Write Back Cache Modes
 - **8 bits or 7 bits Tag with** Direct Mapped Organization
 - Supports Standard and Burst SRAMs
 - Supports **64** KBytes to 2 MBytes Cache Sizes
 - Cache Read/Write Cycle of 3-2-2-2 or 4-2-2-2 Using Standard SRAMs at 66 MHz
 - Cache Read/Write Cycle of 3-1-1-1 Using Burst SRAMs at 66 MHz
- **Integrated DRAM Controller**
 - Supports 2 MBytes to 128 MBytes of Cacheable Main Memory
 - Concurrent Write Back
 - CAS#-before-RAS# Transparent DRAM Refresh
 - 256K/1M/4M/16M xN 70ns Fast Page Mode DRAM Support
 - Programmable DRAM Speed
 - **Programmable CAS# driving Current**
- **Two Programmable Non-Cacheable Regions**
- **Option to Disable Local Memory in Non-Cacheable Regions**
- **Shadow RAM in Increments of 16 KBytes**
- **Supports Pentium/P54C SMM Mode**
- **Supports CPU Stop Clock**
- **Provides High Performance PCI Arbiter**
 - Supports Four PCI Masters
 - Supports Rotating Priority Mechanism
 - Hidden Arbitration Scheme Minimizes Arbitration Overhead
- **Integrated PCI Bridge**
 - Translates the CPU Cycles into the PCI Bus Cycles
 - Provides CPU-to-PCI Read Assembly and Write Disassembly Mechanism
 - Translates Sequential CPU-to-PCI Memory Write Cycles into PCI Burst Cycles
 - PCI Burst Write in the Pace of X-2-2-2-....
 - PCI Burst Read L2 Cache in X-2-2-2-....
 - PCI Burst Read DRAM in X-3-2-3-2-....
 - Cache Snoop Filters Ensure Data Coherency and Minimize Snoop Frequency
- **208-Pin PQFP Package**
- **0.6µm CMOS Technology**

2.2 Functional Block Diagram



SiS85C501 Functional Block Diagram

2.3 General Description

The SiS85C501(PCMC) bridges between the host bus and the PCI local bus. The SiS85C501 (PCMC) monitors each cycle initiated by the CPU, and forwards it to the PCI bus if the CPU cycle does not target the local memory. For the CPU or the PCI bus to the local memory cycles, the built-in Cache and DRAM Controller assume control to the secondary cache, DRAMs, and the SiS85C502 (PLDB). The SiS85C501 (PCMC) also guides the SiS85C502 (PLDB) for correct data flow. All of the Green PC functions are provided.

2.4 CPU Interface

The SiS85C501 is designed to support Pentium/P54C CPU host interface at 66.667/60/50MHz. The host data bus and the DRAM bus are 64-bit wide.

The SiS85C501 supports the pipelined addressing mode of the Pentium/P54C CPU by issuing the next address signal, NA#. NA# is only generated in two cases:a) burst read L2 cache or DRAM, and b) single read DRAM.

The PCMC supports the CPU L1 write back(WB) or write through(WT) cache and the PCMC L2 WB or WT cache. The L1 cache is snooped by the assertion of EADS# when the CPU is put in the HOLD state.

The PCMC issues CPUHOLD to the Pentium/P54C CPU in response to the assertion of PCI master requests(REQ[3:0]#, and SIOREQ#). Upon receiving the CPUHLDA from the CPU, it does not immediately assert GNT[3:0]# or SIOGNT# until both the CPU to PCI posted write buffer and the Memory write buffer are empty. During inquire cycles, the CPUHOLD may be negated temporarily to allow the CPU to write back the inquired hit modified line to L2 or DRAM.

2.5 Cache Controller

The built-in L2 Cache Controller uses a direct-mapped, bank-interleaved/non-interleaved scheme, which can be configured as either in the write through or write back mode. Both standard and burst SRAMs are supported.

Table 1 shows the cache sizes that are supported by the SiS85C501, with the corresponding TAG RAM sizes, data RAM sizes, and cacheable memory sizes. Tables 2 and 3 summarize the performance and options when either the standard SRAMs or the Burst SRAMs are used.

**Table 1**

| Cache Size | Data RAM | Tag RAM | Alter RAM | Cacheable Size | Interleaved |
|-------------|-----------------|--------------|--------------|----------------|-------------|
| 64K | 8Kx8x8 | 2Kx8 | 2Kx1 | 16M | No |
| 128K | 8Kx8x16 | 4Kx8 | 4Kx1 | 32M | Yes |
| 256K | 32Kx8x8 | 8Kx8 | 8Kx1 | 64M | No |
| 512K | 32Kx8x16 | 16Kx8 | 16Kx1 | 128M | Yes |
| 512K | 64Kx8x8 | 16Kx8 | 16Kx1 | 128M | No |
| 1M | 128Kx8x8 | 32Kx8 | 32Kx1 | 128M | No |
| 1M | 64Kx8x16 | 32Kx8 | 32Kx1 | 128M | Yes |
| 2M | 128Kx8x16 | 64Kx8 | 64Kx1 | 128M | Yes |

The PCMC also provides an alternative to save the dirty SRAM chip. This is accomplished by sharing the alter bit with tag address bits in the same 8-bit wide TAG RAM. System uses this implementation supports 7 tag address bits and 1 dirty bit. By doing so, the cacheable local memory sizes are reduced to half of the original sizes as indicated in Table 1.

In reality, the L2 Cacheable DRAM Size is determined by:

- 1) Max. L2 Cacheable Size as described in table 1.
- 2) Noncacheable Area defined in register 57h, 58h, 59h and 5Ah and
- 3) C, D, E, F Segment Cachability defined in register 53h, 54h, 55h, and 56h.

But, the L1 Cacheable size is only determined by 2), 3), and the maximum DRAM size, i.e., 128 M bytes. Thus, the cycles with address ranging over the L2 Cacheable Size but within the 128M bytes can also be cacheable to L1. The behavior of KEN# is ruled by the L1 Cacheability. Note that only code of C, D, E, F segment is cacheable to L1/L2, and the data portion of C, D, E, F segment is not cacheable to L1/L2.

Table 2 Standard SRAM

| Cycle Type | 66,60 MHz | 50MHz |
|--------------|----------------------|---------------------|
| Burst read | 3/ <u>4</u> /5-2-2-2 | <u>3</u> /4/5-2-2-2 |
| | 3/4/5-3-3-3 | 3/4/5-3-3-3 |
| Burst write | 3/ <u>4</u> /5-2-2-2 | <u>3</u> /4/5-2-2-2 |
| | 3/4/5-3-3-3 | 3/4/5-3-3-3 |
| Single read | 3/ <u>4</u> /5 | <u>3</u> /4/5 |
| Single write | 3/ <u>4</u> /5 | <u>3</u> /4/5 |

Note :

- 1: The standard SRAM speed for 66/60MHz is 15ns. For 50MHz, it is 20ns.
- 2: X-Y-Y-Y is the recommended setting. For example, 4-2-2-2 is the recommended cycle setting for 66MHz burst read.

**Table 3** Burst SRAM

| Cycle type | 66,60 MHz | 50MHz |
|--------------|---------------------------------|---------------------------------|
| Burst read | 3/ <u>4</u> -1-1-1 3/4-2-2-2 | 3/ <u>4</u> -1-1-1 3/4-2-2-2 |
| Burst write | 3/ <u>4</u> -1-1-1 3/4-2-2-2 | 3/ <u>4</u> -1-1-1 3/4-2-2-2 |
| Single read | 3/ <u>4</u> | 3/ <u>4</u> |
| Single write | 3/ <u>4</u> | 3/ <u>4</u> |

Note :

- 1: The burst SRAM speed for 66/60MHz is 9 ns. For 50MHz, it is 12ns.
- 2: X-Y-Y-Y is the recommended setting.

Table 4 Asynchronous SRAM speed setting (apply to read and write cycle)

| cache configuration | 66MHz | | 60MHz | | 50MHz | |
|------------------------|-------|------|-------|------|-------|------|
| | Tag | Data | Tag | Data | Tag | Data |
| 3-1-1-1 interleave | --- | --- | --- | --- | 15ns | 15ns |
| 3-1-1-1 non-interleave | --- | --- | --- | --- | --- | --- |
| 3-2-2-2 interleave | --- | --- | --- | --- | 20ns | 20ns |
| 3-2-2-2 non-interleave | --- | --- | --- | --- | 20ns | 20ns |
| 3-3-3-3 interleave | --- | --- | --- | --- | 20ns | 20ns |
| 3-3-3-3 non-interleave | --- | --- | --- | --- | 20ns | 20ns |
| 4-1-1-1 interleave | 15ns | 12ns | 15ns | 12ns | 20ns | 15ns |
| 4-1-1-1 non-interleave | --- | --- | --- | --- | --- | --- |
| 4-2-2-2 interleave | 15ns | 15ns | 20ns | 20ns | 20ns | 20ns |
| 4-2-2-2 non-interleave | 15ns | 15ns | 20ns | 20ns | 20ns | 20ns |
| 4-3-3-3 interleave | 15ns | 20ns | 20ns | 20ns | 20ns | 20ns |
| 4-3-3-3 non-interleave | 15ns | 20ns | 20ns | 20ns | 20ns | 20ns |
| 5-1-1-1 interleave | 20ns | 12ns | 20ns | 12ns | 20ns | 15ns |
| 5-1-1-1 non-interleave | --- | --- | --- | --- | --- | --- |
| 5-2-2-2 interleave | 20ns | 15ns | 20ns | 20ns | 20ns | 20ns |
| 5-2-2-2 non-interleave | 20ns | 15ns | 20ns | 20ns | 20ns | 20ns |
| 5-3-3-3 interleave | 20ns | 20ns | 20ns | 20ns | 20ns | 20ns |
| 5-3-3-3 non-interleave | 20ns | 20ns | 20ns | 20ns | 20ns | 20ns |

2.6 DRAM Controller

The SiS85C501 supports a 64-bit memory array ranging in size from 2 MBytes up to 128 MBytes.

Both single-sided and double-sided 9/36-bit wide SIMM modules are supported. **The DRAM controller of 85C501 can support up to 4 banks (8 SIMMS) of single-sided SIMM module, or 2 banks (4 SIMMS) of double-sided SIMM module.** The 12-bit multiplexed row/column



address MA[11:0] allows the PCMC to support 256K, 1M, 4M, and 16M 70ns fast page mode DRAMs.

Table 5. shows the corresponding request address bits used in column address and row address for the DRAM.

Table 5. MA Generation Table

| Body Type | 256K | | 1M | | 4M | | 16M | |
|-----------|------|-----|-----|-----|-----|-----|-----|-----|
| MA | CAS | RAS | CAS | RAS | CAS | RAS | CAS | RAS |
| MA0 | A3 | A12 | A3 | A22 | A3 | A22 | A3 | A22 |
| MA1 | A4 | A13 | A4 | A13 | A4 | A24 | A4 | A24 |
| MA2 | A5 | A14 | A5 | A14 | A5 | A14 | A5 | A26 |
| MA3 | A6 | A15 | A6 | A15 | A6 | A15 | A6 | A15 |
| MA4 | A7 | A16 | A7 | A16 | A7 | A16 | A7 | A16 |
| MA5 | A8 | A17 | A8 | A17 | A8 | A17 | A8 | A17 |
| MA6 | A9 | A18 | A9 | A18 | A9 | A18 | A9 | A18 |
| MA7 | A10 | A19 | A10 | A19 | A10 | A19 | A10 | A19 |
| MA8 | A11 | A20 | A11 | A20 | A11 | A20 | A11 | A20 |
| MA9 | NA | NA | A12 | A21 | A12 | A21 | A12 | A21 |
| MA10 | NA | NA | NA | NA | A13 | A23 | A13 | A23 |
| MA11 | NA | NA | NA | NA | NA | NA | A14 | A25 |

To improve the CPU write DRAMs performance, there is a one level built-in CPU-to-Memory posted write buffer with 4 QWs deep (CTMPB). All the single writes and the burst writes are buffered. In the CPU read miss/line fill cycle, the write-back data from the L2 cache are also buffered into the CTMPB. At the same time, the PCMC starts reading from the DRAMs. The buffered data are written to the DRAMs when the read cycle completes. With this concurrent write back policy, many wait states are eliminated. However, any other cycle targeting the DRAMs will be suspended until the CTMPB is empty.

Typically, it takes about 30 CPUCLK to complete a read miss/line fill cycle in 60/66 MHz system, and about 25 CPUCLK for 50 MHz system.

Table 6 outlines the read and write DRAM cycle performance based on 70ns DRAMs.

Table 6 DRAM Performance

| Cycle type | 66,60 MHz | 50MHz |
|------------------------------------|--|--|
| read (page hit/row miss/page miss) | <u>7/11/14-4-4-4</u> 8/12/15-5-5-5 9/13/16-6-6-6 | <u>7/11/14-4-4-4</u> 8/12/15-5-5-5 9/13/16-6-6-6 |
| posted write | <u>3/4/5-1-1-1</u> 3/4/5-2-2-2 3/4/5-3-3-3 | <u>3/4/5-1-1-1</u> 3/4/5-2-2-2 3/4/5-3-3-3 |
| write retire rate | <u>3/4/5</u> | <u>3/4/5</u> |

**Note:**1: **X-Y-Y-Y** is the recommended setting.

2: In read cycles, the CAS# precharge time is 2T.

Table 7 DRAM speed setting based on 70ns DRAM (apply to read and write cycle)

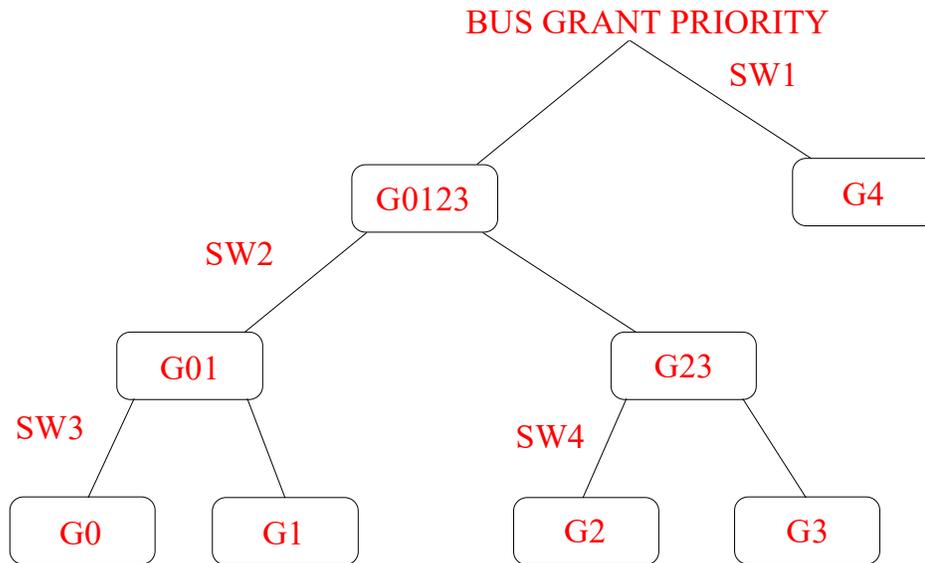
| | register | 66MHz | 60MHz | 50MHz |
|------------------------------|-------------|-------|-------|-------|
| read CAS pulse width | 50h bit 7-6 | 2T | 2T | 2T |
| write CAS pulse width | 50h bit 5 | 2T | 2T | 2T |
| CAS precharge time | 53h bit 7 | 2T | 2T | 1T |
| RAS precharge time | 53h bit 1 | 4T | 4T | 4T |
| RAS to CAS delay time | 53h bit 2 | 4T | 4T | 3T |
| refresh RAS active time | 52h bit 0 | 5T | 5T | 4T |
| DRAM write push to CAS delay | 5Bh bit 3 | 2T | 2T | 2T |

2.7 PCI Arbiter

The SiS85C501 contains a high performance hidden arbitration scheme that allows efficient bus sharing among five PCI Masters and the CPU. Note that one PCI master is reserved for the PSIO chip.

The SiS85C501 employs the priority rotation scheme that is done at two different layers. The first layer is shared between PSIO and four PCI Masters as a group. The second layer consists of four PCI masters with equal priority. Arbitration is done at both layers. The winner of arbitration among the four PCI masters arbitrates the PCI bus against PSIO. Fair rotation scheme applies only at layer level. The arbitration scheme assures that ISA master or DMA channels (represented by PSIO) access the bus with minimal latency. The PSIO is given a high level of priority to assure compatibility with traditional ISA expansion boards that require short bus latency. This implementation together with PCI Programmable Bursting Address Counter guarantees ISA device will not be starved during PCI master long bursting cycle. For example, When the maximum bursting length is 512 bytes, the maximum arbitration latency for PSIO, and PCI master is about 12us, and 40us respectively. The following two figures detail the rotation arbitration structure and its corresponding timing diagram.

Rotation Arbitration Scheme:



Notation:

SW1: is the switch for path from node G4 or G0123 to BUS GRANT PRIORITY

SW2: is the switch for path from node G01 or G23 to node G0123

SW3: is the switch for path from node G0 or G1 to node G01

SW4: is the switch for path from node G2 or G3 to node G23

G01, G23, G0123: are intermediate nodes

G4: is the bus request from PSIO

G0, G1, G2, G3: are the bus requests from PCI device 0, device 1, device 2, device 3 respectively.

Initial Path Parking:

SW1 : BUS GRANT PRIORITY-G4

SW2 : G0123-G01

SW3 : G01-G0

SW4 : G23-G2

Rule of Rotating Priority for Bus Arbitration:

- BUS GRANT PRIORITY will choose a path whenever it encounters an optional path.
- PCI bus will be granted as Daisy Chain
- Path switches will be toggled from BUS GRANT PRIORITY to any request node (G4, G0, G1, G2, G3) if any of them have been utilized

Example:

Initial Priority:G4, G01, G0, G2

1. PSIO(G4) Request Bus

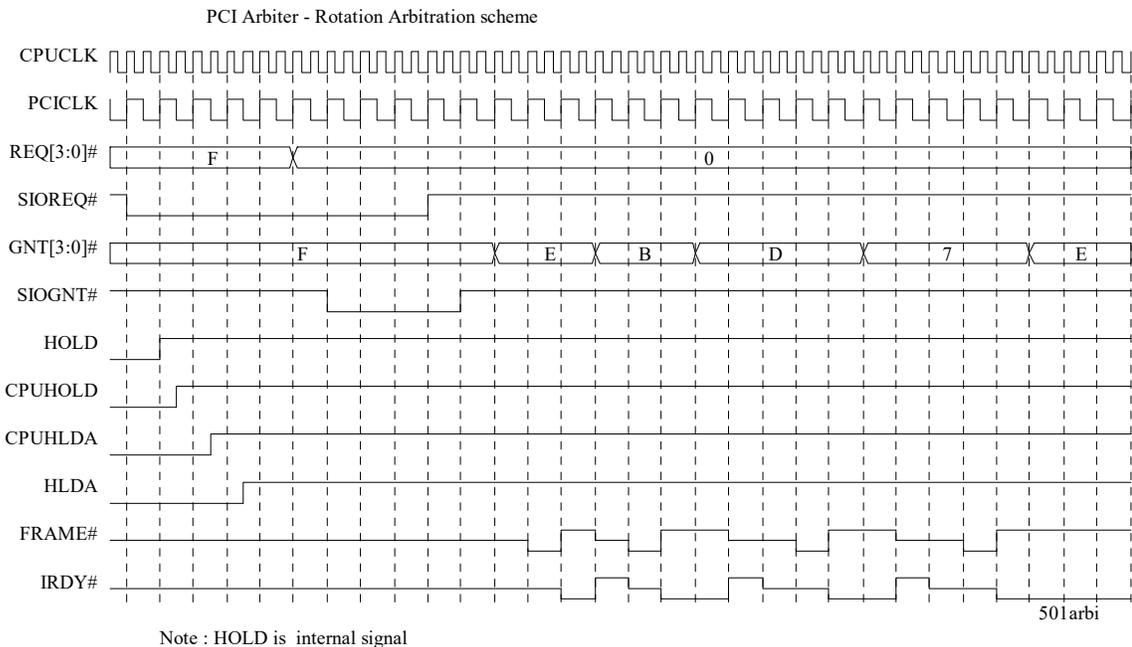
SIOGNT# is asserted

SW1 is toggled to G0123 (since it has been utilized)

Priority change to G0, G1, G2, G3, G4



2. PSIO, REQ3, REQ2, REQ1, REQ0 are requesting bus
 GNT0# is asserted
 SW1, SW2 and SW3 are toggled to G4, G23 and G1 respectively (since they have been utilized)
 Priority change to G4, G2, G3, G1, G0
3. REQ3, REQ2, REQ1, REQ0 are active
 GNT2# is asserted
 SW2, SW4 are toggled to G01 and G3 respectively (since they have been utilized)
 Priority change to G4, G1, G0, G3, G2
4. REQ3, REQ2, REQ1, REQ0 are active
 GNT1# is asserted
 SW2, SW3 are toggled to G23 and G0 respectively (since they have been utilized)
 Priority change to G4, G3, G2, G0, G1
5. REQ3, REQ2, REQ1, REQ0 are active
 GNT3# is asserted
 SW2, SW4 are toggled to G01 and G2 respectively (since they have been utilized)
 Priority change to G4, G0, G1, G2, G3
6. During 3-5 if there is a request comes from PSIO, the Arbiter will grant bus to PSIO.



A PCI master can burst so long as the target can source/sink the data, and no other agent requests the bus. However, PCI specifies two mechanisms that cap a master's tenure in the presence of other requests, so that predictable bus acquisition latency can be achieved. One is

the Master Latency Timer(LT) that is not implemented into the PCMC, the other is the Target Initiated Termination. In the SiS85C501, a Programmable Bursting Address Counter(PBAC) is implemented to disconnect the PCI master during the long bursting cycle. In this way, high throughput is maintained, and the bus latency is still kept reasonably small. Note that the bursting length is naturally applied to PCI master to local memory accessing. When PCI master accesses non-local memory target, the master and target should together have the responsibility of maintaining reasonable latency, but not the system arbiter does.

The PCI arbiter asserts only one GNT# at any time. The 85C501 has also implemented a time-out counter to prevent faulty device hugging the bus. If the PCI bus is granted to a PCI device and the bus is currently idle, 16 PCI clocks is the limitation that device should assert FRAME# during the period of time. If time-out occurs, the arbiter will mask request line, therefore deasserts GNT#. When this happens, all PCI devices start arbitration again. Note that PSIO is free to this constraint.

The 85C501 PCI master will also mask the PSIO request to the arbiter if the PCI LOCK# is asserted to keep ISA master or DMA channels target latency within specification. The 85C501 PCI arbiter is also allowed to force system back to CPU each time after SIOREQ# is serviced. This function is disabled by default, and can be enabled by set bit 7 of register 6F in the PCMC Configuration space.

2.8 PCI Bridge

2.8.1 PCI Master Controller

The PCI Master Controller forwards the CPU cycles not targeting the local memory to the PCI bus. In the case of a 64-bit CPU request or a misaligned 32-bit CPU request, the PCMC assumes the read assembly and write disassembly control. A 4 level posted write buffer (CTPPB) is implemented to improve the CPU to PCI memory write performance. Except for on-board memory write cycles, any cycles forwarded to the PCI bus will be suspended until the CTPPB is empty. For PCI bus memory write cycles, the CPU data are pushed into the CTPPB if it is not full. The pushed data are, at later time, written to the PCI bus. If the consecutive written data are in DW incremental sequence, they will be transferred to the PCI bus in a burst manner. The burst transfer rate is always X-2-2-2-... until 128 DWs are exhausted.

The PCI master interface can read data from or write data to the PCI bus at the utmost speed of 1 wait state. This is due to the fact that the PCMC drives the PCI bus address and the PLDB drives the PCI bus data. That necessitates a turn around cycle between the address and the data phases.

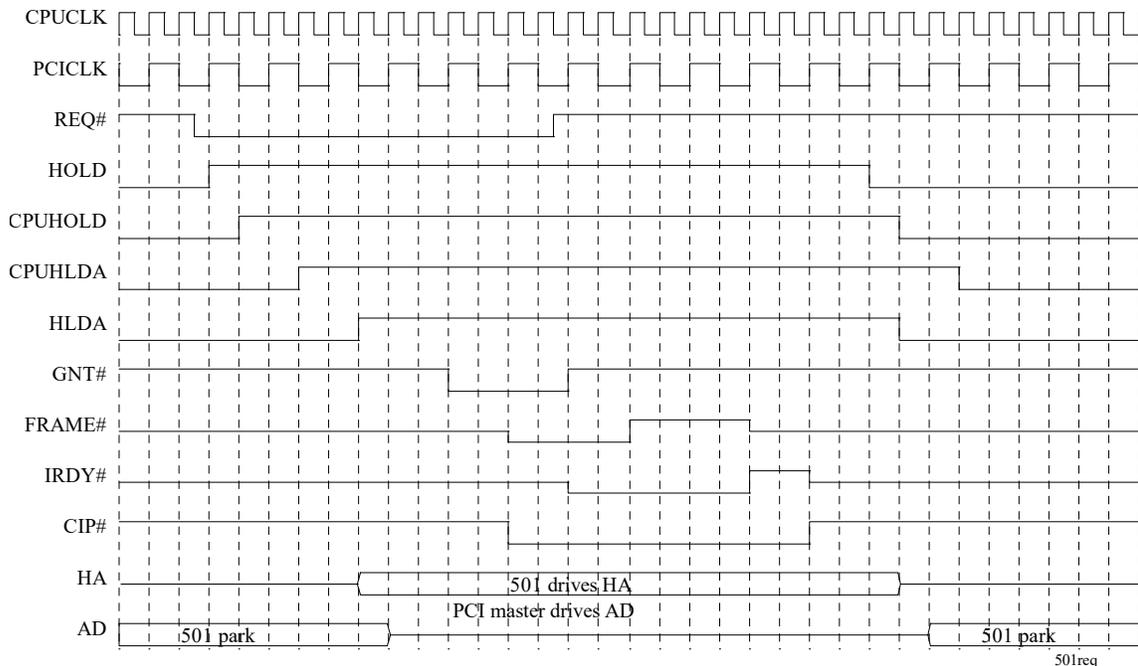
The PCMC provides a mechanism for converting standard I/O cycles on the CPU bus to Configuration cycles on the PCI bus. Configuration Mechanism #1 in PCI Specification 2.0 page 61 is used to do the cycle conversion.

The PCMC always intercepts the first interrupt acknowledge cycle from CPU bus, and forwards the second interrupt acknowledge cycle onto the PCI bus.



2.8.2 PCI Slave Controller

The SiS85C501 operates as a slave on the PCI bus whenever a PCI master requests an access to the SiS85C501 resource such as Cache, DRAM and the SiS85C501 Internal registers. Note that the internal registers can only be accessed by the SiS85C501 itself when in CPU cycle. In the SiS85C500 PCI/ISA system, the CPU is placed in HOLD state before granting the PCI bus to a PCI master. The following figure shows the behavior of CPUHOLD/CPUHLDA in response to PCI masters requests. Only linear ordered PCI cycles are supported by the PCMC PCI slave interface.



Note : HOLD,CIP# (current in progress) are internal signal

A PCI master to the local memory access is not conducted until the snoop cycle has completed. The snoop cycle is used to inquire the first level cache to maintain coherency between first level and second level caches and main memory. Snoop cycles are performed by driving the PCI master address onto the CPU bus and asserting EADS#. Depending on the status of HITM# two clocks after the assertion of EADS#, PCMC conducts the PCI master cycles as table 8 outlines.

Table 8

| PCI Master Read Cycle | | |
|------------------------|-----------------------|--|
| L1 | L2 | Data Transfer |
| Miss (or Unmodified) | Miss | Data transfer from DRAM to PCI |
| Miss (or Unmodified) | Hit (Dirty or !Dirty) | Data transfer from L2 to PCI |
| HitM | Miss | Data is first written back from L1 to DRAM. Then, PCI master gets data from DRAM. |
| HitM | Hit (Dirty or !Dirty) | Data is first written back from L1 to L2. Then, PCI master gets data from L2. The line is marked dirty in the L2. |
| PCI Master write Cycle | | |
| L1 | L2 | Data Transfer |
| Miss (or Unmodified) | Miss | Data transfer from PCI to DRAM |
| Miss (or Unmodified) | Hit (Dirty or !Dirty) | Data transfer from PCI to DRAM and L2. The Dirty bit is not changed. |
| HitM | Miss | Data is first written back from L1 to DRAM. Then, PCI master writes data to DRAM. |
| HitM | Hit (Dirty or !Dirty) | Data is first written back from L1 to L2. Then, PCI master writes data to L2 and DRAM. The Line is marked dirty in the L2. |

A snoop filter is implemented to prevent the need of multiple inquires to the same line if the line was inquired previously. To support snoop filter, a Snoop Address Latch (SAL) and a Line Comparator are implemented. The line comparator is used to determine if the New Address (NA) is the same as the content of the SAL. If it is not, the NA is loaded into the SAL, and a snoop cycle is issued. In addition, a Valid bit in association with the SAL is used to ensure the snoop filtering is effective only when HLDA is asserted. The simplified filter algorithm is:

1) Write Back Mode

- a) if $NA=SAL$ in a PCI master write cycle, the PCMC only issues EADS#. It does not wait for the status of HITM#.
- b) if $NA=SAL$ in a PCI master read cycle, no snoop cycle nor EADS# is issued.
- c) if $NA \neq SAL$ in a PCI master cycle, the PCMC issues a snoop cycle by EADS#, and then monitors the status of HITM#.
- d) During a burst transaction, the PCMC automatically generates a snoop cycle when the address advances across a new line.

2) Write Through Mode

In the following two cases, the PCMC only generates EADS#. It ignores the logic of HITM#.

- a) if $NA=SAL$ in a PCI master write cycle, and
- b) During a burst transaction, the address advances across a new line.

In the SiS85C500, the INV signal of P54C should be connected to W/R# that is driven by the SiS85C501 in the PCI master cycle. In this way, the SiS85C501 can invalidate the line that is currently inquired via the assertion of EADS# in the PCI master write cycles.

The PCMC slave interface supports PCI burst transfers. A burst transfer will be disconnected (retry) if the transfer goes across the 512 bytes (or 1 KBytes selected by Register 5Dh, bit 5) address boundary. This is due to the fact that the address generator, to support the burst transfer, can only address 512 or 1K bytes. In this way, at most 32 cache lines can be uninterruptedly transferred if they are in I, S, or E state in the L1 cache.

Another reason for the constraint is that page miss may occur only once during the entire bursting transaction since the maximum bursting length is always within the page size in any of the used DRAM.

The PCI master writes are buffered in the one QW deep PCI to Memory posted write buffer (PTMPB). The PCMC always packs an aligned QW PCI write data into the write buffer, and then retires it into the DRAM array or the L2 cache. The PCI master write performance, to the utmost, is X-2-2-2- ...

The PCI master reads are through a QW read buffer with which the burst transfers can perform in the pace of X-2-2-2-... (from the L2 cache), or X-3-2-3-2-... (from the DRAMs).

Concurrent refresh will still be performed when CPU is put into Hold state. If the DRAM is idle, refresh can be conducted at any time. If refresh request occurs at the same time that a PCI master wants to access DRAM, an arbitration scheme is employed to resolve the conflict. The refresh request may thus get service while the PCI master accessing is suspended until refresh cycle is completed. Although refresh may win the DRAM bus, at most one refresh cycle may be conducted for each individual PCI transaction, i.e. for each Frame# initiating. On the other hand, refresh may be also deferred until the DRAM is idle. In SiS85C500 system, the refresh may be postponed for no more than 24 us in the worst case when a PCI master is reading the whole 32 lines through one burst transaction.

2.8.3 PCI Bus Speed Setting

The following settings apply to all system environment, even though the system is running at 66MHz while the PCI bus is running at 33MHz.

**Table 9** PCI bus setting

| | Register | Setting | Unit |
|---|-----------|---------|--------|
| latency from ADS# to monitor local memory status | 5Ch bit 7 | 2T | CPUCLK |
| CAS# pulse width in PCI master write cycle | 5Ch bit 4 | 1T | PCICLK |
| latency from the disarming of "full" to the assertion of BRDY# for the pending CPU to PCI write cycle | 5Ch bit 3 | 1T | CPUCLK |
| latency from reading L2/DRAM to the assertion of TRDY# in PCI master read cycles | 5Dh bit 4 | 1T | PCICLK |
| latency from packing one Qword into PTMPB to the assertion of CAS#(or KWE#) | 5Dh bit 3 | 1T | PCICLK |
| latency from TRDY# to BRDY# in CPU read/write PCI slave cycles | 5Dh bit 2 | 2T | CPUCLK |

2.9 Green PC Function

The following paragraphs are the PMU (Power Management Unit) features description:

2.9.1 Power States

The PMU provides different power management states, which are described in the following sections.

(i) Monitor Standby State

The Monitor will be blanked and the external devices are turned off through SMOUT when the Monitor standby timer expires.

Monitor Standby monitors the following events:

- IRQ 1-15
- HOLD
- NMI

Each IRQ has two sets of mask bits, one for wake up mask, and the other for standby mask. The HOLD includes the PCI local masters and the ISA master request. Each event is maskable. If no event happens during the monitored period and the timer expires, an SMI is generated and the monitor enters the standby state.

Once the Monitor is in the standby state, any event from IRQ1-15, NMI or HOLD will cause an SMI which brings the Monitor back to the normal state.

The time slot of the Monitor standby timer is programmable to 6.6sec, 0.84sec, 13.3ms, 1.6ms.

(ii) System Standby State

If the system standby timer expires, an SMI is generated for the system to enter the system standby state. The following events happen:



STPCLK# is asserted to stop the CPU clock
The hard disk drives spindle motors can be turned off
The serial, parallel ports or the programmable I/O port can be turned off

Once the STPCLK# is asserted, any events from IRQ1-15, NMI, HOLD, INIT will cause the STPCLK# be de-asserted. If any of the Hard disk motors, serial, parallel or programmable I/O ports were turned off, they will be back to the normal state only when they are accessed.

System Standby monitored events (each event is maskable)
Programmable I/O ports (one is a 10-bit I/O port, another is a 16-bit I/O port)
IRQ 1-15 (each has 2 sets of mask bits as for Monitor Standby State)
HOLD
NMI
Hard Disk ports (1F0-1F7h, 3F6-3F7h, 170-17Fh, 320-32Fh)
Serial ports (2F8-2FFh, 3F8-3FFh, 2E8-2EFh, 3E8-3EFh)
Parallel ports (278-27Fh, 378-37Fh, 3BC-3BEh)
A0000-AFFFFh or B0000-BFFFFh Address trap (Video RAM)
C0000-C7FFFh Address trap (Video BIOS)
3Bx-3Dxh (Video I/O port)

The time slot of the System standby timer is programmable to 9 sec, 1.1 sec, 70ms, and 8.85ms.

(iii) Throttling state

In throttling state, STPCLK# is asserted and de-asserted periodically. This function is maskable. The throttling timer (Registers 61h and 62h) is programmable and the time slot is 35us.

2.9.2 Break Switch SMI

If the break switch is pressed, it will cause an SMI. The SMI can not be used to wake up any standby state. Instead, it is used to enter the standby state. The signal from the break switch is a level trigger signal which lasts for more than 3 CPU clocks.

2.9.3 Software SMI

If the software SMI enable bit is set and a '1' is written to bit 1 of Register 60h, an SMI# is generated and the software SMI service routine is invoked. The bit 1 of Register 60h should be cleared at the end of the SMI handler.

2.10 Configuration Registers

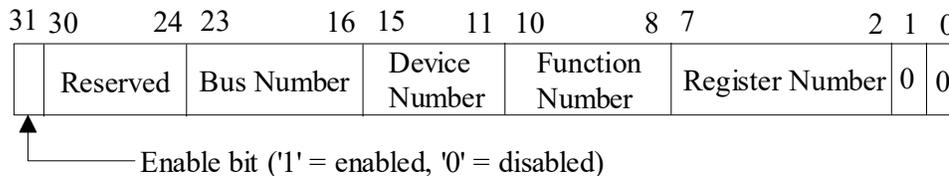
The PCMC contains two sets of registers: the I/O mapped registers and the PCI configuration space mapped registers.

2.10.1 I/O Mapped Registers

The SiS85C501 uses PCI configuration space access mechanism #1. This mechanism defines two DWORD registers. The first register(CF8h) references a read/write register that is named CONFIG_ADDRESS. The second register (CFCh) references a register named CONFIG_DATA. The mechanism in accessing configuration space is to write a value into CONFIG_ADDRESS that specifies the PCI bus, device on that bus, and the configuration register in that device being accessed. A read or write to CONFIG_DATA will then cause the bridge to translate that CONFIG_ADDRESS value to the requested configuration cycle on the PCI bus.

The definition of CONFIG_ADDRESS register is described below:

Register 0CF8h CONFIG_ADDRESS Register



Bit 31 is an enable flag for determining if the accesses to CONFIG_DATA should be translated to configuration cycles on the PCI bus.

Bits 30:24 Reserved, read only, and must return 0's when read.

Bits 23:16 Choose a specific PCI bus in the system.

Bits 15:11 Choose a specific device on the bus.

Bits 10:8 Choose a specific function in a device.

Bits 7:2 Choose a DWORD in the device's configuration space.

Bits 1:0 read only and must return 0's when read.

A full Dword I/O writes to 0CF8h address will load the CONFIG_ADDRESS register . Also, a full DWord I/O Read to 0CF8h gets the data from CONFIG_ADDRESS register . Writes or Reads to any other length other than a DWORD are passed to PCI I/O cycles. When the SiS85C501 sees an I/O access that falls inside the Dword beginning at CONFIG_DATA address, it checks the enable bit in the CONFIG_ADDRESS register. If the bit is 0, the I/O cycle is passed to PCI unchanged. If the bit is 1, the I/O cycle is translated into a configuration cycle.



If the Bus Number field of the CONFIG_ADDRESS register is zero, the I/O cycle is translated into a Type 0 configuration cycle; if the Bus Number field is non-zero, the I/O cycle is translated into a Type 1 configuration cycle.

The PCMC is considered device 0 on bus 0. Thus, a configuration cycle to device 0 on bus 0 is translated as a PCI configuration cycle that is responded by PCMC via the assertion of DEVSEL#.

A type 0 configuration cycle is indicated on the PCI bus by driving AD[1:0]=00 during the address phase of the cycle. The device number in CONFIG_ADDRESS is decoded and ensures one of the AD[31:11] to be driven high during the address phase of the configuration cycle. For instance, AD11 is high when the device number is 0. The AD[31:12] lines is used as the IDSEL signal of the target service. Never use AD11 as the IDSEL line for any other PCI target device since it is reserved for PCMC. CONFIG_ADDRESS bit 10 to 2 are copied directly to AD[10:2].

A type 1 configuration cycle is translated on the PCI bus by driving AD[1:0]=01 during the address phase of the cycle. CONFIG_ADDRESS bits 31 to 2 are copied directly to AD[31:2] during the address phase of the cycle. The byte-enables for the data phase of the either types of configuration cycle are copied from the HBE[7:4]#. The following programming sequences is an example of writing register 51h in PCMC and of reading register 5Ch, 5Dh, 5Eh and 5Fh in PCMC.

```
write 51h:
MOV EAX, 80000050h
OUT 0CF8h, EAX
MOV AL, DATA
OUT 0CFDh, AL

read 5Ch, 5Dh, 5Eh and 5Fh:
MOV EAX, 8000005Ch
OUT 0CF8h, EAX
IN 0CFCh
```

Register 0CF9h Turbo and Reset Control Register .

Bits 7:5 Reserved

Bit 4 INIT Enable

When this bit is set to 1 ,the PCMC drives INIT during software reset. When this bit is cleared to 0, the PCMC drives CPURST during software reset, and INIT is inactive.

Bit 3 CPU BIST Enable.

When this bit is set to 1 and bit 4 as well as bit 1 are enabled, a subsequent initiation of the CPU hard reset through bit 2 of this register enables the Built In



Self Test(BIST) mode of the CPU. **The PCMC also drives the INIT during the hard reset.**

Bit 2 Reset CPU.

There are two types of resets to the CPU: a hard reset using the CPURST signal and a soft reset using the INIT signal. If bit 1 of this register is set to 1 and bit 2 transitions from 0 to 1, the PCMC initiates a hard reset. A hard reset through this register thus requires two write operations to this register: the first write operation writes a 1 to bit 1 and a 0 to bit 2. The second write operation writes **a 1 to bit 1 and** a 1 to bit 2. When bit 1 of this register is 0 and bit 2 transitions from 0 to 1, the PCMC initiates a soft reset. The sequence to initiate a soft reset through this register is identical to that of a hard reset except a 0 is written to bit 1 in the first write operation.

Bit 1 Enable System Hard Reset.

When this bit is set to 1 and bit 2 transitions from 0 to 1, the PCMC initiates a hard reset to the CPU . When this bit is 0 and bit 2 transitions from 0 to 1, the PCMC initiates a soft reset to the CPU.

Bit 0 Select Turbo /DeTurbo Mode.

There are two ways to enter Deturbo mode. One is through software; another is hardware.

- **Software Deturbo: Set Reg. 5Bh bit 1 to 1, and Reg. 65h bit 3 to 1, then set Reg. CF9h bit 0 to 1.**
- **Hardware Deturbo: Set Reg. 5Bh bit 1 to 1, and Reg. 65h bit 3 to 1, then press deturbo switch.**

2.10.2 PCI Configuration Space Mapped Registers

Register 00h Vendor ID - low byte

Bits 7:0 39h

Register 01h Vendor ID - high byte

Bits 7:0 10h

Register 02h Device ID - low byte

Bits 7:0 06h

Register 03h Device ID - high byte

Bits 7:0 04h

Register 04h Command - low byte

Bit 7 Reserved

Bit 6 Respond to parity.

This bit is always 0 since the PCMC does not support parity checking on the PCI bus



- Bits 5:4** **Reserved**
- Bit 3** **Enable special cycle.**
This bit is always 0 since the PCMC does not issue special cycle.
- Bit 2** **Enable bus master.**
This bit is always 1, allowing the PCMC to serve as a PCI bus master.
- Bit 1** **Enable response to memory access.**
0: Disables PCI master's accesses to local memory
1: Enables PCI master's accesses to local memory
- Bit 0** **Enable response to I/O access.**
This bit is always 0 since the PCMC does not respond to any PCI I/O cycles.
The PCMC only responds to CPU initiated I/O cycles.
- Register 05h** **Command - high byte**
- Bits 7:0** **Reserved**
- Register 06h** **Status - low byte**
- Bits 7:0** **Reserved**
- Register 07h** **Status - high byte**
- Bit 7** **Detected parity error.**
This bit is always 0 since the PCMC does not support parity checking on the PCI bus.
- Bit 6** **Signaled system error.**
This bit is set when the PCMC asserts SERR#. This bit is cleared by writing a 1 to it.
- Bit 5** **Received master abort.**
This bit is set by the PCMC whenever it terminates a transaction with master abort. This bit is cleared by writing a 1 to it.
- Bit 4** **Received target abort.**
This bit is set when a CPU to PCI transaction is terminated with target abort. This bit is cleared by writing a 1 to it.
- Bit 3** **Signaled target abort.**
This bit is always 0 since the PCMC will not terminate a transaction with target abort.

**Bits 2:1 DEVSEL# Timing DEVT.**

The two bits define the timing to assert DEVSEL#. The PCMC asserts the DEVSEL# signal within three clocks after the assertion of FRAME#. The default value is DEVT=10. In fact, the PCMC always asserts DEVSEL# in medium timing except in CPU writes to I/O port 64h or 60h.

Bit 0 Reserved**Register 08h Revision Identification.****Bits 7:0 00h.****Register 0B~09h Class Code****Bits 23:0 060000h****Register 50h****Bits 7:6 DRAM Read CAS Pulse Width**

00 : 4T

01 : 3T

10 : 2T

11 : Reserved

Bit 5 DRAM Write CAS Pulse Width

0 : 3T

1 : 2T

Bits 4:0 DRAM configuration

| | SIMM 1 | SIMM 2 | SIMM3 | SIMM 4 | SIMM 5 | SIMM 6 | SIMM 7 | SIMM 8 | Total |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 00000 | 256K-S | 256K-S | | | | | | | 2MB |
| 00001 | 256K-S | 256K-S | 256K-S | 256K-S | | | | | 4MB |
| 00010 | 256K-S | 256K-S | 256K-S | 256K-S | 1M-S | 1M-S | | | 12MB |
| | 512K-D | 512K-D | 1M-S | 1M-S | | | | | 12MB |
| 00011 | 256K-S | 256K-S | 256K-S | 256K-S | 1M-S | 1M-S | 1M-S | 1M-S | 20MB |
| 00100 | 256K-S | 256K-S | 256K-S | 256K-S | 4M-S | 4M-S | | | 36MB |
| 00101 | 512K-D | 512K-D | | | | | | | 4MB |
| 00110 | 512K-D | 512K-D | 512K-D | 512K-D | | | | | 8MB |
| 00111 | 512K-D | 512K-D | 2M-D | 2M-D | | | | | 20MB |
| 01000 | 512K-D | 512K-D | 4M-S | 4M-S | | | | | 36MB |
| 01001 | 1M-S | 1M-S | | | | | | | 8MB |
| 01010 | 1M-S | 1M-S | 1M-S | 1M-S | | | | | 16MB |
| 01011 | 1M-S | 1M-S | 1M-S | 1M-S | 1M-S | 1M-S | | | 24MB |
| | 1M-S | 1M-S | 2M-D | 2M-D | | | | | 24MB |
| 01100 | 1M-S | 32MB |
| | 1M-S | 1M-S | 1M-S | 1M-S | 2M-D | 2M-D | | | |
| | 1M-S | 1M-S | 2M-D | 2M-D | 1M-S | 1M-S | | | |
| 01101 | 1M-S | 1M-S | 4M-S | 4M-S | | | | | 40MB |
| 01110 | 1M-S | 1M-S | 1M-S | 1M-S | 4M-S | 4M-S | | | 48MB |
| 01111 | 1M-S | 1M-S | 4M-S | 4M-S | 4M-S | 4M-S | | | 72MB |



| | | | | | | | | | |
|-------|-------|-------|------|------|------|------|------|------|-------|
| | 1M-S | 1M-S | 8M-D | 8M-D | | | | | 72MB |
| 10000 | 1M-S | 1M-S | 1M-S | 1M-S | 4M-S | 4M-S | 4M-S | 4M-S | 80MB |
| | 1M-S | 1M-S | 1M-S | 1M-S | 2M-D | 8M-D | | | |
| 10001 | 2M-D | 2M-D | | | | | | | 16MB |
| 10010 | 2M-D | 2M-D | 2M-D | 2M-D | | | | | 32MB |
| 10011 | 2M-D | 2M-D | 4M-S | 4M-S | | | | | 48MB |
| 10100 | 2M-D | 2M-D | 4M-S | 4M-S | 4M-S | 4M-S | | | 80MB |
| 10101 | 2M-D | 2M-D | 8M-D | 8M-D | | | | | 80MB |
| 10110 | 4M-S | 4M-S | | | | | | | 32MB |
| 10111 | 4M-S | 4M-S | 4M-S | 4M-S | | | | | 64MB |
| 11000 | 4M-S | 4M-S | 4M-S | 4M-S | 4M-S | 4M-S | | | 96MB |
| | 4M-S | 4M-S | 8M-D | 8M-D | | | | | 96MB |
| 11001 | 4M-S | 4M-S | 4M-S | 4M-S | 4M-S | 4M-S | 4M-S | 4M-S | 128MB |
| 11010 | 8M-D | 8M-D | | | | | | | 64MB |
| 11011 | 8M-D | 8M-D | 8M-D | 8M-D | | | | | 128MB |
| 11100 | 16M-S | 16M-S | | | | | | | 128MB |

Register 51h

| | |
|-----------------|--|
| Bit 7 | L2 Cache Exist or not |
| | 0 : Not Exist |
| | 1 : Exist |
| Bit 6 | L2 Cache Enable |
| | 0 : Disable |
| | 1 : Enable |
| Bit 5 | SRAM type (Standard or Burst) |
| | 0 : Standard SRAM |
| | 1 : Burst SRAM |
| Bit 4 | L2 Cache WT/WB Policy |
| | 0 : Write-Through mode |
| | 1 : Write-Back mode |
| Bits 3:1 | L2 Cache Size |
| | 000 : 64KB |
| | 001 : 128KB |
| | 010 : 256KB |
| | 011 : 512KB |
| | 100 : 1MB |
| | 101 : 2MB |
| | 11x : Reserved |
| Bit 0 | CPU L1 Cache Write-Back Enable |



0 : Disable

1 : Enable

Register 52h

Bits 7:6 Standard SRAM Cache speed (Read/Write)

00 : 5-x-x-x Slower

01 : 4-x-x-x Faster

10 : 3-x-x-x Fastest

11 : Reserved

Bits 5:4 Standard/Burst SRAM x Setting (Burst Read/Write cycle)

00 : 3T

x1 : 1T

10 : 2T

Bit 3 Cache Interleave Enable

0 : Disable

1 : Enable

Bit 2 Burst SRAM Cache Burst Cycle

0 : 4-x-x-x

1 : 3-x-x-x

Bit 1 Cache Sizing Enable

0: Normal Operation

1: Always Cache hit to enable Cache Sizing for BIOS

Bit 0 Refresh RAS Active time

0 : 6T

1 : 5T

Register 53h

Bit 7 DRAM CAS precharge time

0 : 2T

1 : 1T

Bit 6 Shadow RAM Read Enable

0 : Disable

1 : Enable

When this bit is enabled, the F segment is shadowed by default.



Before shadowing, BIOS should not turn on the bit so that reading F segment is always forwarded to PCI bus.

Bit 5 Shadow RAM Write Protection Enable

0 : Disable

1 : Enable

After porting the shadowed segment into DRAM, this bit can be set so that the corresponding shadowed segment is not writable. Under such circumstances, the cycle which intends to write the segment is treated as non-local memory cycle, and is forwarded to PCI bus.

Bit 4 Shadow RAM Enable for PCI Master Accesses

0 : Disable

1 : Enable

Bit 3 F0000h - FFFFFh Shadow RAM Cacheable

0 : Non-Cacheable

1 : Cacheable

Note that only code is cacheable to L2/L1 when this bit is set.

Bit 2 RAS to CAS delay time

0 : 4T

1 : 3T

Bit 1 RAS precharge time

0 : 5T

1 : 4T

Bit 0 Enable host to CTMPB push rate to be X-1-1-1

0 : Enable

1 : Disable.

When this bit is disabled, the push rate is defined by bit [5:4] of register 52h.

Register 54h E Segment Setting

Bit 7 E0000h - E3FFFh Shadow RAM Enable

Bit 6 E4000h - E7FFFh Shadow RAM Enable

Bit 5 E8000h - EBFFFh Shadow RAM Enable

Bit 4 EC000h - EFFFFh Shadow RAM Enable

Bit 3 E0000h - E3FFFh Shadow RAM Cacheable



- Bit 2** **E4000h - E7FFFh Shadow RAM Cacheable**
- Bit 1** **E8000h - EBFFFh Shadow RAM Cacheable**
- Bit 0** **EC000h - EFFFFh Shadow RAM Cacheable**

Register 55h D Segment Setting

- Bit 7** **D0000h - D3FFFh Shadow RAM Enable**
- Bit 6** **D4000h - D7FFFh Shadow RAM Enable**
- Bit 5** **D8000h - DBFFFh Shadow RAM Enable**
- Bit 4** **DC000h - DFFFFh Shadow RAM Enable**
- Bit 3** **D0000h - D3FFFh Shadow RAM Cacheable**
- Bit 2** **D4000h - D7FFFh Shadow RAM Cacheable**
- Bit 1** **D8000h - DBFFFh Shadow RAM Cacheable**
- Bit 0** **DC000h - DFFFFh Shadow RAM Cacheable**

Register 56h C Segment Setting

- Bit 7** **C0000h - C3FFFh Shadow RAM Enable**
- Bit 6** **C4000h - C7FFFh Shadow RAM Enable**
- Bit 5** **C8000h - CBFFFh Shadow RAM Enable**
- Bit 4** **CC000h - CFFFFh Shadow RAM Enable**
- Bit 3** **C0000h - C3FFFh Shadow RAM Cacheable**
- Bit 2** **C4000h - C7FFFh Shadow RAM Cacheable**
- Bit 1** **C8000h - CBFFFh Shadow RAM Cacheable**
- Bit 0** **CC000h - CFFFFh Shadow RAM Cacheable**

Register 57h

- Bit 7** **Allocation of Non-cacheable Area #1**
 - 0 : Local DRAM
 - 1 : AT Bus. The local DRAM is disabled.
- Bit 6** **Non-cacheable Area #1 Enable**
 - 0 : Disable
 - 1 : Enable



- Bits 5:3** **Size of Non-Cacheable Area #1 (within 128 MBytes)**
- 000 : 64KB
 - 001 : 128KB
 - 010 : 256KB
 - 011 : 512KB
 - 100 : 1MB
 - 101 : 2MB
 - 110 : 4MB
 - 111 : 8MB
- Bits 2:0** **A26 ~ A24 of Non-Cacheable Area #1 (within 128MBytes)**
- Register 58h**
- Bits 7~0** **A23 ~ A16 of Non-Cacheable Area #1 (within 128MBytes)**
- Register 59h**
- Bit 7** **Allocation of Non-cacheable Area #2**
- 0 : Local DRAM
 - 1 : AT Bus. The local DRAM is disabled.
- Bit 6** **Non-cacheable Area #2 Enable**
- 0 : Disable
 - 1 : Enable
- Bits 5:3** **Size of Non-Cacheable Area #2 (within 128MBytes)**
- 000 : 64KB
 - 001 : 128KB
 - 010 : 256KB
 - 011 : 512KB
 - 100 : 1MB
 - 101 : 2MB
 - 110 : 4MB
 - 111 : 8MB
- Bits 2:0** **A26 ~ A24 of Non-Cacheable Area #2 (within 128MBytes)**

**Register 5Ah****Bits 7:0** **A23 ~ A16 of Non-Cacheable Area #2 (within 128MBytes)****Register 5Bh****Bit 7** **Fast Gate A20 Emulation Enable**

0 : Disable

1 : Enable

The sequence to generate A20M# is: write D1h to I/O port 64h followed by I/O write to port 60h with data 00h. When this bit is enabled, the SiS85C501 responds the cycle by asserting DEVSEL# in slowest timing. Otherwise, the cycle is subtractively decoded by SiS 85C503, and then is passed to 8042 on the ISA bus.

Bit 6 **Fast Reset Emulation Enable**

0 : Disable

1 : Enable

The Fast reset command is I/O write to port 64h with data 1111XXX0b.

After the command is issued, the assertion of INIT or CPURST is delayed by 2us or 6us which can be programmed in bit 5, and is held for 25 CPUCLK.

Bit 5 **Fast Reset Latency Control**

0 : 2us

1 : 6us

Bit 4 **Slow Refresh Enable (1:4)**

0 : Normal Refresh

1 : Slow Refresh

Bit 3 **DRAM Write Push to CAS delay**

0 : 2T

1 : 1T

Bit 2 **De-turbo Hold time**

0 : Hold 4 us

1 : Hold 8 us (Every 12 us)

Bit 1 **De-turbo Switch Enable**

0 : Always turbo, ignore the status of De-turbo Switch

1 : De-turbo Switch Enable

Bit 0 **CAS Driving Current Control Bit 0 (Please refer to Reg. 5Eh Bit 0 for details)**

Register 5Ch

- Bit 7 Latency from ADS# to Monitor Local Memory Status**
0 : 3T
1 : 2T
Depending on the setting of this bit, the PCI master bridge in the SiS85C501 may monitor the local memory status from the inside local memory decoder either by the end of T2 or T3. If the CPU initiates a PCI cycle, it is determined to be converted to PCI side from this point. Specifically, BRDY# is always returned to CPU one CPUCLK later if the CTPPB is not full, for post memory write cycles. Thus, this bit also affects the CPU to PCI Post write speed. When it is set to 0, the Post write rate is 5T for each double word. When it is set to 1, the rate is 4T per double word. For a Qword PCI memory write, the post write rate is 7T(bit7=1), or 8T(bit7=0).
- Bit 6 Enable Refresh Cycle when CPU is hold**
0 : Disable
1 : Enable
- Bit 5 Enable Snoop Filter**
0 : Disable
1 : Enable
- Bit 4 CAS# Pulse Width in PCI master write cycle**
0 : 1T
1 : 2T
- Bit 3 Latency from the disarming of "Full" to the assertion of BRDY# for the pending CPU to PCI write cycle**
0 : 1T
1 : 2T
- Bit 2 Selection of KWE# synchronization**
0 : KWE# is synchronized with ACLK (Recommended)
1 : KWE# is synchronized with CPUCLK
- Bit 1 L2 Tag Length**
0 : 8 bits
1 : 7 bits
- Bit 0 Memory Parity Enable/Disable**
0: Enable parity error detection (default value)
1: Disable parity error detection



Register 5Dh PCI Control Register

Bits 7:6 PCI Clock Frequency Selection

- 00 : PCICLK=CPUCLK/2
- 01 : PCICLK=CPUCLK/1.5
- 10 : Reserved
- 11 : PCICLK=14MHz

Bit 5 Maximum Burstable Address Range in PCI master cycles

- 0 : 512 Bytes
 - 1 : 1 KBytes
- This bit defines the maximum bursting length for each FRAME# asserting.

Bit 4 Latency from Reading L2/DRAM to the assertion of TRDY# in PCI master read cycles

- 0 : 1T
- 1 : 2T

Bit 3 Latency from Packing one Qword into PTMPB to the assertion of CAS#(or KWE#)

- 0 : 1T
- 1 : 2T

This latency is reserved for the Post write data propagating onto MD bus, and also for the parity generation so that minimum set up time for MD data to CAS# will not be violated.

Bit 2 Latency from TRDY# to BRDY# in CPU read/write PCI slave cycles

- 0 : 2 CPUCLKs
- 1 : 3 CPUCLKs

Bit 1 CPU-to-PCI burst memory write Enable

- 0 : Disable
- 1 : Enable

Bit 0 CPU-to-PCI post memory write Enable

- 0 : Disable
- 1 : Enable

**Register 5Eh**

This register mainly defines the enable bits for the events monitored by System Standby timer. If any monitored event occurs during the programmed time, the System standby timer will be reloaded and starts to count down again.

Bit 7 Programmable 10-bit I/O port

When set, any I/O access to the address will cause the timer be reloaded. The address is defined in Registers 66h and 67h.

Bit 6 Programmable 16-bit I/O port

When set, any I/O access to the address will cause the timer be reloaded. The address is defined in Registers 6Dh and 6Eh.

Bit 5 Hard Disk port

When set, any I/O access to the Hard Disk ports (1F0-1F7h or 3F6h) will cause the timer be reloaded.

Bit 4 Serial port

When set, any I/O access to the Serial Ports (2F8-2FFh, 3F8-3FFh, 2E8-2EFh or 3E8-3EFh) will cause the timer be reloaded.

Bit 3 Parallel port

When set, any I/O access to the Parallel ports (278-27Fh, 378-37Fh or 3BC-3BEh) will cause the timer be reloaded.

Bit 2 HOLD

When set, any event from the ISA master or the PCI Local Master will cause the timer be reloaded.

Bit 1 IRQ1-15, NMI

When set, any event from the IRQ1-15 or NMI will cause the timer be reloaded.

Bit 0 CAS Driving Current Control Bit 1

Register 5B bit 0 and 5E bit 0 are used to control CAS driving current.

| Register 5B bit 0 | Register 5E bit 0 | Minimum Current |
|-------------------|-------------------|-----------------|
| 0 | 0 | 8mA (default) |
| 1 | 0 | 4mA |
| 0 | 1 | 12mA |
| 1 | 1 | 8mA |

Register 5Fh

Bits 7:6 Define the events monitored by the Monitor standby timer

Bits 5:0 Define the events to break the Monitor and System standby state.

Bit 7 IRQ 1-15, NMI

When set, any event from the IRQ1-15 or NMI will cause the Monitor standby timer be reloaded.



- Bit 6** **HOLD**
- When set, any event from the ISA master or the PCI local master will cause the Monitor standby timer be reloaded.
- Bit 5** **IRQ 1-15, NMI**
- When enabled, any event from the IRQ1-15 or NMI will bring the Monitor back to the Normal state from the Standby state.
- Bit 4** **HOLD**
- When enabled, any event from the ISA master or the PCI local master will bring the Monitor back to the Normal state from the Standby state.
- Bit 3** **IRQ 1-15, NMI**
- When enabled, any event from the IRQ1-15 or NMI will de-assert the STPCLK#.
- Bit 2** **HOLD**
- When enabled, any event from the ISA master or the PCI local master will de-assert the STPCLK#.
- Bit 1** **INIT**
- When enabled, an event from the INIT will de-assert the STPCLK#.
- Bit 0** **Reserved (must be '0')**

Register 60h

- Bit 7** **Reserved. It should be written with 0.**
- Bit 6** **Reserved. It should be written with 0.**
- Bit 5** **STPCLK# Enable**
- When set, writing a '1' to bit 3 of Register 60h will cause the STPCLK# to become active. This bit can be cleared.
- Bit 4** **Throttling Enable**
- When set, writing a '1' to bit 3 of Register 60h will cause the STPCLK# throttling state to become active. The throttling function can be disabled by clearing this bit.
- Bit 3** **STPCLK# Control**
- When this bit is set, the STPCLK# will be asserted or the Throttling function will be enabled depending on bits 5 and 4. If both bits 5 and 4 are enabled, the system will do the throttling function.



Bit 2 Break Switch Enable

When set, the break switch can be used to force the system to enter the Standby state.

Bit 1 APM SMI

When Register 68h bit 0 is enabled, and a '1' is written to this bit, an SMI is generated. It is used by the software controlled SMI function like APM. This bit should be cleared at the end of the SMI handler.

Bit 0 Reserved.

Register 61h STPCLK# Assertion Timer

Bits 7:0

Bits 7-0 define the period of the STPCLK# assertion time when the STPCLK# enable bit is set. The timer will not start to count until the Stop Grant Special Cycle is received. The timer slot is 35 us.

Register 62h STPCLK# De-assertion Timer

Bits 7:0

Bits 7-0 define the period of the STPCLK# de-assertion time when the STPCLK# enable bit is set. The timer starts to count when the STPCLK# assertion timer expires. When these two registers are read, the current values are returned.

Register 63h System Standby Timer

Bits 7:0 The register defines the duration of the System Standby Timer.

When the System Standby Timer expires, the system enters System Standby State. If any non-masked event occurs before the timer expires, the timer is reloaded with programmed number and the timer starts counting down again.

Register 64h SMRAM mapping address.

Bits 7:0 Correspond to Host address A[27:20].

This register together with register 65h define SMRAM location. SMRAM location can either be set to a non-shadow, non-cacheable location by selecting E segment as defined in register 65h or be implemented through logical address remap scheme. Logical address remap is done through comparing the upper 11 bits of access address with the address bits defined in register 64h and 65h. If addresses are compared equal and SRAM area selection has been set to either A



or B segment, then access is remapped into an A or B segment access. The SMRAM mapping address should be set up by BIOS during the POST process and the SMI service routine is also moved into the SMRAM area during this process. When the system is in the SMM mode or the SMRAM access control bit is enabled, any access to SMRAM area will be redirected as defined by these two registers.

Note: The SMRAM mapping address defines 1MB granularity and the logical address must not set to the first 1MB memory area.

Register 65h

Bits 7:5 SMRAM area selection

000 : E0000h-E7FFFh

100 : A0000h-A7FFFh

010 : A0000h-AFFFFh

110 : B0000h-B7FFFh

001 : B0000h-BFFFFh

others : reserved

The SMRAM area is non-cacheable, and non-shadowed.

E0000h-E7FFFh is a physical and logical address space. The other selections can be used to relocate the SMRAM from the pre-defined area (as defined in registers 64h and 65h) during SMM.

Bit 4 SMRAM access control

1: When set, the SMRAM area can be used. This bit can be set whenever it is necessary to access the SMRAM area. It is cleared after the access is finished.

0: The SMRAM area can only be accessed during the SMI handler.

Bit 3 FLUSH# (De-turbo mode), ADSC# selection (pin 13)

0: ADSC#

1: FLUSH# (De-turbo mode)

Bits 2:0 Bits 2-0 correspond to Host Address A[30:28].

Register 66h

Bit 7 Reserved (must be '0')

Bits 6:5 Define the time slot of the Monitor Standby timer

00 : 6.6 seconds

01 : 0.84 seconds

10 : 13.3 milli-seconds

11 : 1.6 milli-seconds



Bits 4:2 Programmable 10-bit I/O port address mask bits

- 000 : No mask
- 001 : A0 masked
- 010 : A1-A0 masked
- 011 : A2-A0 masked
- 100 : A3-A0 masked
- 101 : A4-A0 masked
- 110 : A5-A0 masked
- 111 : A6-A0 masked

Bits 1:0 Programmable 10-bit I/O port address bits A1, A0.

Bits 1:0 correspond to the address bits A1 and A0.

Register 67h

Bits 7:0

Bits 7:0 define the programmable 10-bit I/O port address bits A[9:2].

Register 68h

This register defines the enable status of the devices in SMM. The bits 6:2 are set when the devices are in standby state and cleared when the respective devices are in normal state.

Bit 7 System Standby SMI enable

When no non-masked event occurs during the programmed duration of the system standby timer, the timer expires. If this bit is enabled, the SMI# is generated and the system enters the System Standby state.

Bit 6 Programmable 10-bit I/O port wake up SMI enable

When set, any I/O access to this port will be monitored to generate the SMI# to wake up this I/O port from the standby state to the Normal state. This bit is enabled only when the I/O port is in the Standby state.

Bit 5 Programmable 16-bit I/O port wake up SMI enable

When set, any I/O access to this port will be monitored to generate the SMI# to wake up this I/O port from the standby state to the Normal state. This bit is enabled only when the I/O port is in the Standby state.



- Bit 4 Serial ports wake up SMI enable**
- When set, any I/O access to the serial ports will be monitored to generate the SMI# to wake up the serial ports from the standby state to the Normal state. This bit is enabled only when the serial ports are in the Standby state.
- Bit 3 Parallel ports wake up SMI enable**
- When set, any I/O access to the parallel ports will be monitored to generate the SMI# to wake up the parallel ports from the standby state to the Normal state. This bit is enabled only when the parallel ports are in the Standby state.
- Bit 2 Hard Disk port SMI enable**
- When set, any I/O access to the hard disk port will be monitored to generate the SMI# to wake up the hard disk from the standby state to the Normal state. This bit is enabled only when the hard disk port is in the Standby state.
- Bit 1 Break Switch SMI enable**
- When set, the break switch can be pressed to generate the SMI# for the system to enter the Standby state.
- Bit 0 Software SMI enable**
- When set, an I/O write to register 60h bit 1 will generate an SMI.

Register 69h

This register defines the SMI request status. If the respective SMI enable bit is set, each specific event will cause the respective bit to be set. The asserted bit should be cleared at the end of the SMI handler.

- Bit 7 System standby SMI request**
- This bit is set when the system standby timer expires.
- Bit 6 Programmable 10-bit I/O port wake up request**
- This bit is set when there is an I/O access to the port.
- Bit 5 Programmable 16-bit I/O port wake up request**
- This bit is set when there is an I/O access to the port.
- Bit 4 Serial ports wake up request**
- This bit is set when the serial ports are accessed.
- Bit 3 Parallel ports wake up request**
- This bit is set when the parallel ports are accessed.
- Bit 2 Hard Disk port wake up request**
- This bit is set when the hard disk port is accessed.
- Bit 1 Break Switch SMI request**



This bit is set when the break switch is pressed.

Bit 0 Software SMI request

This bit is set when an I/O write to the bit 1 of register 60h.

Register 6Ah

Bit 7 Monitor Standby SMI enable

0 : Disable

1 : Enable

When there is no access from the **IRQ1-15, HOLD and NMI** during the programmed time of the Monitor Standby Timer, the timer expires. If this bit is set, an SMI is generated to bring the Monitor to the standby state.

Bit 6 Monitor Standby SMI request

This bit is set when the Monitor Standby Timer expires. This bit should be cleared at the end of the SMI handler.

Bit 5 Monitor wake up SMI enable

When set, any event from the **IRQ1-15, HOLD or NMI** will be monitored to generate the SMI# to wake up the monitor from the standby state to the normal state.

Bit 4 Monitor wake up request

This bit is set when there is an event from the **IRQ1-15, HOLD or NMI**, and the Monitor is in the standby state.

Bit 3 Throttling wake up SMI request

This bit is set when there is any unmasked event from the NMI, INIT, IRQ1-15, or HOLD when the system is in the throttling state.

Bit 2 Throttling wake up SMI enable

When set, any unmasked event from the NMI, INIT, IRQ1-15, or HOLD will cause an SMI to be generated to bring the system back to the Normal state from the throttling state.

Bit 1 System wake up SMI enable

When set, any unmasked event from the NMI, INIT, IRQ1-15, or HOLD will cause an SMI to be generated to bring the system back to the Normal state from the standby state.



Bit 0 System wake up SMI request

This bit is set when there is any unmasked event from the NMI, INIT, IRQ1-15, or HOLD when the system is in the standby state.

Register 6Bh Monitor Standby timer - Low byte

Bits 7:0 Bits 7:0 define the low byte of the Monitor standby timer.

It is a count-down timer and the time slot is **programmable for 6.6s, 0.84s, 13.3 ms or 1.6ms**. The value programmed to this register is loaded when the timer is enabled and the timer starts counting down. The timer is reloaded when an event from the **IRQ1-15, HOLD or NMI** occurs before the timer expires. When this register is read, the current value is returned.

Register 6Ch Monitor Standby timer - High byte

Bits 7:0 Bits 7:0 define the high byte of the Monitor standby timer.

Register 6Dh Programmable 16-bit I/O port - Low byte

Bits 7:0 Bits 7:0 define the low byte of the Programmable 16-bit I/O port.

Register 6Eh Programmable 16-bit I/O port - High byte

Bits 7:0 Bits 7:0 define the high byte of the Programmable 16-bit I/O port.

Register 6Fh

This register except bit 7 mainly defines the events monitored by the System Standby timer. If any unmasked event occurs before the timer expires, the System Standby Timer will be reloaded and the timer starts to count down again.

Bit 7 Return Bus to CPU after SIOREQ# is Serviced

0 : Disable

1 : Enable

Bit 6 SMOUT

It is reserved for the application circuit.

Bit 5 A0000h - AFFFFh or B0000 - BFFFFh Address trap

When set, any memory access to the address range will cause the timer to be reloaded.

Bit 4 C0000h - C7FFFh Address trap

When set, any memory access to the address range will cause the timer to be reloaded.

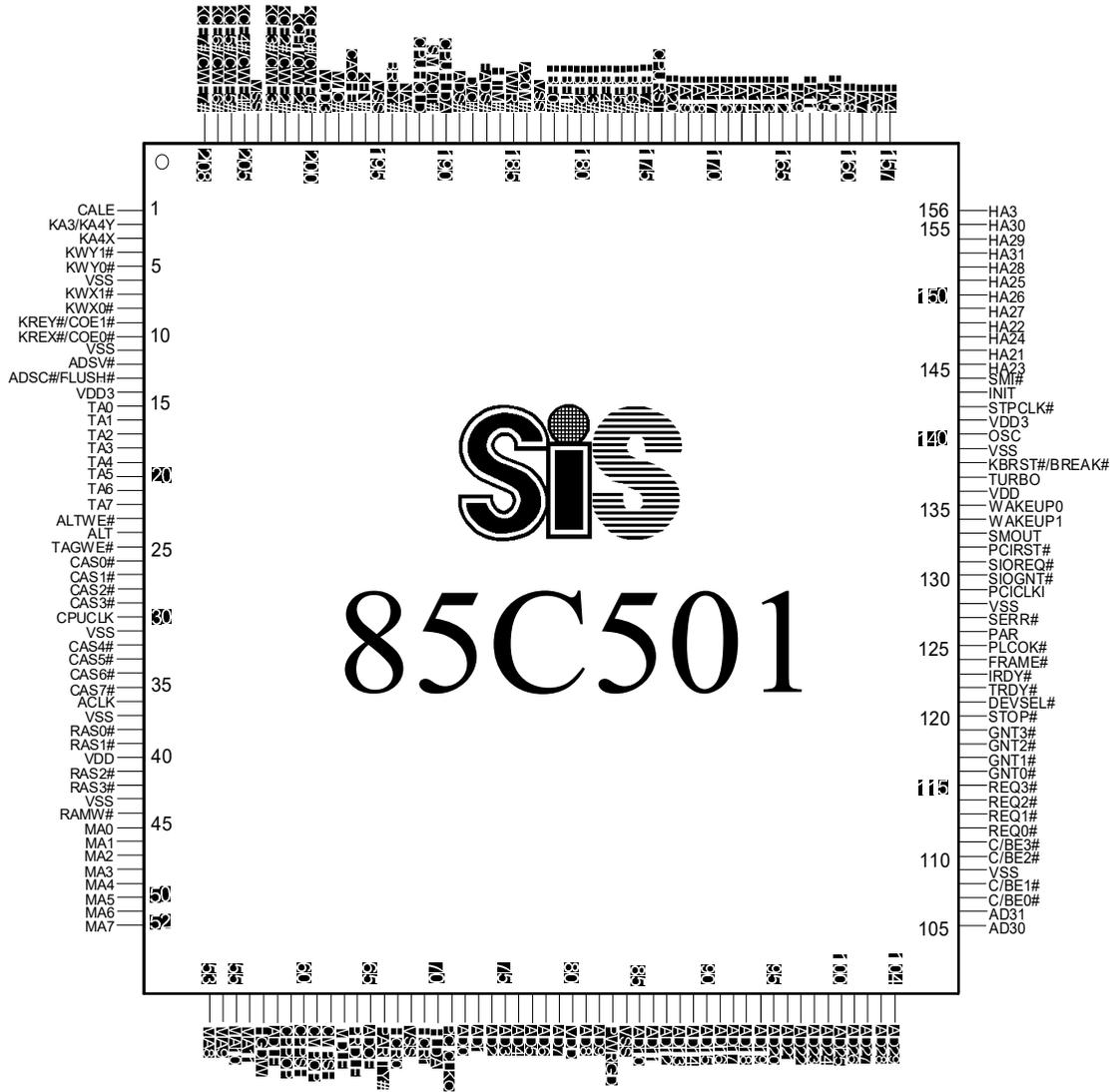


- Bit 3** **3B0-3BFh, 3C0-3CFh, 3D0-3DFh Address trap**
- When set, any I/O access to the I/O addresses will cause the timer to be reloaded.
- Bit 2** **Secondary Drive port**
- When set, any I/O access to the secondary drive port (170-17Fh, 320-32Fh, 3F7h) will reload the system standby timer.
- Bits 1:0** **System Standby Timer Slot**
- 11 : 8.85 milli seconds
- 10 : 70 milli seconds
- 01 : 1.1 seconds
- 00 : 9 seconds



2.11 Pin Assignment and Description

2.11.1 Pin Assignment





2.11.2 Pin Listing (# means active low)

| | | | | | |
|-----------------|---------|------------|----|-------------------|---------|
| 1=CALE | 5V/3.3V | 48=MA3 | 5V | 95=AD20 | 5V |
| 2=KA3/KA4Y | 5V/3.3V | 49=MA4 | 5V | 96=AD21 | 5V |
| 3=KA4X | 5V/3.3V | 50=MA5 | 5V | 97=AD22 | 5V |
| 4=KWY1# | 5V/3.3V | 51=MA6 | 5V | 98=AD23 | 5V |
| 5=KWY0# | 5V/3.3V | 52=MA7 | 5V | 99=AD24 | 5V |
| 6=VSS | | 53=MA8 | 5V | 100=AD25 | 5V |
| 7=KWX1# | 5V/3.3V | 54=MA9 | 5V | 101=AD26 | 5V |
| 8=KWX0# | 5V/3.3V | 55=MA10 | 5V | 102=AD27 | 5V |
| 9=KREY#/COE1# | 5V/3.3V | 56=MA11 | 5V | 103=AD28 | 5V |
| 10=KREX#/COE0# | 5V/3.3V | 57=HGDW | 5V | 104=AD29 | 5V |
| 11=VSS | | 58=ADLE# | 5V | 105=AD30 | 5V |
| 12=ADSV# | 5V/3.3V | 59=CPPOP | 5V | 106=AD31 | 5V |
| 13=ADSC#/FLUSH# | 5V/3.3V | 60=CPPSH | 5V | 107=C/BE0# | 5V |
| 14=VDD3 | 5V/3.3V | 61=CMPOP | 5V | 108=C/BE1# | 5V |
| 15=TA0 | 5V | 62=CMPSH | 5V | 109=VSS | |
| 16=TA1 | 5V | 63=MDLE | 5V | 110=C/BE2# | 5V |
| 17=TA2 | 5V | 64=PRDLE | 5V | 111=C/BE3# | 5V |
| 18=TA3 | 5V | 65=ADOE | 5V | 112=REQ0# | 5V |
| 19=TA4 | 5V | 66=PARITY# | 5V | 113=REQ1# | 5V |
| 20=TA5 | 5V | 67=HCR0 | 5V | 114=REQ2# | 5V |
| 21=TA6 | 5V | 68=VSS | | 115=REQ3# | 5V |
| 22=TA7 | 5V | 69=HCR1 | 5V | 116=GNT0# | 5V |
| 23=ALTWE# | 5V | 70=HLDA | 5V | 117=GNT1# | 5V |
| 24=ALT | 5V | 71=PCICLK0 | 5V | 118=GNT2# | 5V |
| 25=TAGWE# | 5V | 72=AD0 | 5V | 119=GNT3# | 5V |
| 26=CAS0# | 5V | 73=AD1 | 5V | 120=STOP# | 5V |
| 27=CAS1# | 5V | 74=AD2 | 5V | 121=DEVSEL# | 5V |
| 28=CAS2# | 5V | 75=AD3 | 5V | 122=TRDY# | 5V |
| 29=CAS3# | 5V | 76=AD4 | 5V | 123=IRDY# | 5V |
| 30=CPUCLK | 5V | 77=AD5 | 5V | 124=FRAME# | 5V |
| 31=VSS | | 78=AD6 | 5V | 125=PLOCK# | 5V |
| 32=CAS4# | 5V | 79=AD7 | 5V | 126=PAR | 5V |
| 33=CAS5# | 5V | 80=VDD | 5V | 127=SERR# | 5V |
| 34=CAS6# | 5V | 81=AD8 | 5V | 128=VSS | |
| 35=CAS7# | 5V | 82=AD9 | 5V | 129=PCICLKI | 5V |
| 36=ACLK | 5V | 83=PWRGD | 5V | 130=SIOGNT# | 5V |
| 37=VSS | | 84=VSS | | 131=SIORREQ# | 5V |
| 38=RAS0# | 5V | 85=AD10 | 5V | 132=PCIRST# | 5V |
| 39=RAS1# | 5V | 86=AD11 | 5V | 133=SMOUT | 5V |
| 40=VDD | 5V | 87=AD12 | 5V | 134=WAKEUP1 | 5V |
| 41=RAS2# | 5V | 88=AD13 | 5V | 135=WAKEUP0 | 5V |
| 42=RAS3# | 5V | 89=AD14 | 5V | 136=VDD | 5V |
| 43=VSS | | 90=AD15 | 5V | 137=TURBO | 5V |
| 44=RAMW# | 5V | 91=AD16 | 5V | 138=KBRST#/BREAK# | 5V |
| 45=MA0 | 5V | 92=AD17 | 5V | 139=VSS | |
| 46=MA1 | 5V | 93=AD18 | 5V | 140=OSC | 5V |
| 47=MA2 | 5V | 94=AD19 | 5V | 141=VDD3 | 5V/3.3V |



| | | | |
|-------------|---------|-----------------|---------|
| 142=STPCLK# | 5V/3.3V | 176=HBE6# | 5V/3.3V |
| 143=INIT | 5V/3.3V | 177=HBE5# | 5V/3.3V |
| 144=SMI# | 5V/3.3V | 178=HBE4# | 5V/3.3V |
| 145=HA23 | 5V/3.3V | 179=HBE3# | 5V/3.3V |
| 146=HA21 | 5V/3.3V | 180=HBE2# | 5V/3.3V |
| 147=HA24 | 5V/3.3V | 181=HBE1# | 5V/3.3V |
| 148=HA22 | 5V/3.3V | 182=HBE0# | 5V/3.3V |
| 149=HA27 | 5V/3.3V | 183=VSS | |
| 150=HA26 | 5V/3.3V | 184=A20M# | 5V/3.3V |
| 151=HA25 | 5V/3.3V | 185=W/R# | 5V/3.3V |
| 152=HA28 | 5V/3.3V | 186=HITM# | 5V/3.3V |
| 153=HA31 | 5V/3.3V | 187=EADS# | 5V/3.3V |
| 154=HA29 | 5V/3.3V | 188=D/C# | 5V/3.3V |
| 155=HA30 | 5V/3.3V | 189=ADS# | 5V/3.3V |
| 156=HA3 | 5V/3.3V | 190=CPUHLDA | 5V/3.3V |
| 157=HA4 | 5V/3.3V | 191=SMIACT# | 5V/3.3V |
| 158=HA6 | 5V/3.3V | 192=CPUHOLD | 5V/3.3V |
| 159=HA7 | 5V/3.3V | 193=NA# | 5V/3.3V |
| 160=HA8 | 5V/3.3V | 194=BRDY# | 5V/3.3V |
| 161=HA10 | 5V/3.3V | 195=VSS | |
| 162=HA5 | 5V/3.3V | 196=KEN# | 5V/3.3V |
| 163=HA11 | 5V/3.3V | 197=CACHE# | 5V/3.3V |
| 164=HA9 | 5V/3.3V | 198=M/IO# | 5V/3.3V |
| 165=HA12 | 5V/3.3V | 199=VDD3 | 5V/3.3V |
| 166=HA13 | 5V/3.3V | 200=KCE0#/CWE0# | 5V/3.3V |
| 167=HA14 | 5V/3.3V | 201=KCE1#/CWE1# | 5V/3.3V |
| 168=HA15 | 5V/3.3V | 202=KCE2#/CWE2# | 5V/3.3V |
| 169=HA16 | 5V/3.3V | 203=KCE3#/CWE3# | 5V/3.3V |
| 170=HA17 | 5V/3.3V | 204=VSS | |
| 171=HA18 | 5V/3.3V | 205=KCE4#/CWE4# | 5V/3.3V |
| 172=HA19 | 5V/3.3V | 206=KCE5#/CWE5# | 5V/3.3V |
| 173=HA20 | 5V/3.3V | 207=KCE6#/CWE6# | 5V/3.3V |
| 174=CPURST | 5V/3.3V | 208=KCE7#/CWE7# | 5V/3.3V |
| 175=HBE7# | 5V/3.3V | | |



2.11.3 Pin Description

Host Interface

| Pin No. | Symbol | Type | Function |
|---------|-----------|------|--|
| 145-173 | HA[31:3] | I/O | The CPU Address is driven by the CPU during CPU bus cycles. The 85C501 forwards it to either the DRAM or the PCI bus depending on the address range. The address bus is driven by the 85C501 during bus master cycles. |
| 175-182 | HBE[7:0]# | I | CPU Byte Enables indicate which byte lanes on the CPU data bus carry valid data during the current bus cycle. HBE7# indicates that the most significant byte of the data bus is valid while HBE0# indicates that the least significant byte of the data bus is valid. |
| 189 | ADS# | I | Address Status is driven by the CPU to indicate the start of a CPU bus cycle. |
| 198 | M/IO# | I | Memory I/O definition is an input to indicate an I/O cycle when low, or a memory cycle when high. |
| 185 | W/R# | I/O | Write/Read from the CPU indicates whether the current cycle is a write or read access. It is an output during the PCI master cycles. |
| 188 | D/C# | I | Data/Code is used to indicate whether the current cycle is a data or code access. |
| 194 | BRDY# | O | Burst Ready indicates that data presented are valid during a burst cycle. |
| 192 | CPUHOLD | O | CPU Hold Request is used to request the control of the CPU bus. CPUHLDA will be asserted by the CPU after completing the current bus cycle. |
| 190 | CPUHLDA | I | CPU Hold Acknowledge comes from the CPU in response to a CPUHOLD request. It is active high and remains driven during bus hold period. CPUHLDA indicates that the CPU has given the bus to another bus master. |
| 186 | HITM# | I | Hit Modified indicates the snoop cycle hits a modified line in the L1 cache of the CPU. |
| 184 | A20M# | O | A20 Mask is the fast A20GATE output to the CPU. It remains high during power up and CPU reset period. It forces A20 to go low when active. |



| | | | |
|-----|---------|---|--|
| 196 | KEN# | O | The CPU Cache Enable pin is used when the current cycle is cacheable to the L1 cache of the CPU. It is an active low signal asserted by the 85C501 during cacheable cycles. |
| 197 | CACHE# | I | The Cache pin indicates an internally cacheable read cycle or a burst write-back cycle. If this pin is driven inactive during a read cycle, the CPU will not cache the returned data, regardless of the state of the KEN# pin. |
| 187 | EADS# | O | The EADS# is driven to indicate that a valid external address has been driven to the CPU address pins to be used for an inquire cycle. |
| 193 | NA# | O | Next Address is driven for one clock to the CPU to indicate that the memory system is ready to accept a new bus cycle. Although the data transfer for the current cycle has not yet completed, the CPU may drive a internally pending cycle out to the address bus two clocks after NA# is asserted. |
| 174 | CPURST | O | Reset CPU is an active high output to reset the CPU. |
| 143 | INIT | O | The Initialization output forces the CPU to begin execution in a known state. The CPU state after INIT is the same as the state after CPURST except that the internal caches, model specific registers, and floating point registers retain the values they had prior to INIT. |
| 144 | SMI# | O | System Management Interrupt is used to indicate the occurrence of system management events. It is connected directly to the CPU SMI# input. |
| 191 | SMIACK# | I | The SMIACK# pin is used as the SMI acknowledgment input from the CPU to indicate that the SMI is being acknowledged and the processor is operating in System Management Mode(SMM). |
| 142 | STPCLK# | O | Stop Clock indicates a stop clock request to the CPU. |

Cache & DRAM Interface



| Pin No. | Symbol | Type | Function |
|--------------------|--------------------------|------|--|
| 22-15 | TA[7:0] | I/O | TAG RAM data bus lines. |
| 24 | ALT | I/O | The ALT bit indicates the particular line in the 2nd level cache contains modified data. |
| 3 | KA4X | O | Cache address bit 4 for even bank in an interleaved cache configuration.. |
| 2 | KA3/KA4Y | O | Cache address bit 4 for odd bank, or Cache address bit 3 in non-interleaved mode. |
| 10 | KREX#/COE0# | O | Cache Read Enable for even bank of standard SRAM, or Cache Output Enable for burst SRAM. |
| 9 | KREY#/COE1# | O | Cache Read Enable for odd bank of standard SRAM, or Cache Output Enable for burst SRAM. When used as COE1#, it is a copy of COE0# for loading consideration. |
| 8,7 | KWX0/1# | O | Cache Write Enable for standard SRAM, even bank. |
| 5,4 | KWY0/1# | O | Cache Write Enable for standard SRAM, odd bank. |
| 23 | ALTWE# | O | The ALTWE# is the write strobe to the ALT RAM. This signal is active low when cache read miss or cache write hit occurs. It is used to update the ALT bit. |
| 25 | TAGWE# | O | TAG RAM write enable output. |
| 208-205 203-200 | KCE[7:0]# / CWE[7:0]# | O | Cache Enable pins for standard SRAM indicate that the corresponding byte is accessed. Cache Write Enable pins for burst SRAM to allow cache data RAM update on a byte-by-byte basis. |
| 1 | CALE | O | The CALE controls the external latch between the host address lines and the cache address lines. When high, it allows the CPU address lines to propagate through external latches and onto cache address lines. When low, it is used to latch cache address lines. |
| 13 | ADSC#/FLUSH# | O | This pin that can be used as ADSC#, or FLUSH# depends on the BIOS programming. Cache Address Strobe Control causes the burst SRAM to latch the cache address. FLUSH# is asserted during deturbo mode. It is used to force CPU to writeback all modified lines in the data cache and invalidate CPU internal cache. |



| | | | |
|----------------|-----------|---|--|
| 12 | ADSV# | O | Cache Advance is driven to burst SRAM to advance the internal two-bit address counter to the next address of burst sequence. |
| 42,41 39,38 | RAS[3:0]# | O | The RAS[3:0]# are used to latch the row address on the MA bus. Each RAS[3:0]# corresponds to one DRAM row. |
| 35-32 29-26 | CAS[7:0]# | O | The CAS[7:0]# are used to latch the column address on the MA bus. Each CAS[7:0]# corresponds to one byte of the eight-byte wide array. |
| 44 | RAMW# | O | RAM Write is an active low output signal to enable local DRAM writes. |
| 56-45 | MA[11:0] | O | The MA[11:0] provide the row and column address to the DRAM. |

PCI Interface

| Pin No. | Symbol | Type | Function |
|--------------------------|------------|------|---|
| 111,110 108,107 | C/BE[3:0]# | I/O | PCI Bus Command and Byte Enables define the PCI command during the address phase of a PCI cycle, and the PCI byte enables during the data phases. C/BE[3:0]# are outputs when the 85C501 is a PCI bus master and inputs when it is a PCI slave. |
| 106-85 82,81 79-72 | AD[31:0] | I/O | PCI Address /Data Bus <i>In address phase:</i> 1. When the 85C501 is a PCI bus master, AD[31:0] are output signals. 2. When the 85C501 is a PCI target, AD[31:0] are input signals. <i>In data phase:</i> 1. When the 85C501 is a bus master of a memory read/write cycle, AD[31:0] are floating. 2. When the 85C501 is a bus master of a configuration or an I/O cycle, AD[31:0] are input signals in a read cycle, and output signals in a write cycle. 3. When the 85C501 is a target of a memory read/write cycle, AD[31:0] are floating. 4. When the 85C501 is a target of a configuration or an I/O cycle, AD[31:0] are output signals in a read cycle, and input signals in a write cycle. |



| | | | |
|---------|-----------|-----|---|
| 124 | FRAME# | I/O | FRAME# is an output when the 85C501 is a PCI bus master. The 85C501 drives FRAME# to indicate the beginning and duration of an access. When the 85C501 is a PCI slave, FRAME# is an input signal. |
| 123 | IRDY# | I/O | IRDY# is an output when the 85C501 is a PCI bus master. The assertion of IRDY# indicates the current PCI bus master's ability to complete the current data phase of the transaction. For a read cycle, IRDY# indicates that the PCI bus master is prepared to accept the read data on the following rising edge of the PCI clock. For a write cycle, IRDY# indicates that the bus master has driven valid data on the PCI bus. When the 85C501 is a PCI slave, IRDY# is an input. |
| 122 | TRDY# | I/O | TRDY# is an output when the 85C501 is a PCI slave. The assertion of TRDY# indicates the target agent's ability to complete the current data phase of the transaction. For a read cycle, TRDY# indicates that the target has driven valid data onto the PCI bus. For a write cycle, TRDY# indicates that the target is prepared to accept data from the PCI bus. When the 85C501 is a PCI master, it is an input. |
| 121 | DEVSEL# | I/O | The 85C501 drives DEVSEL# based on the DRAM address range being accessed by a PCI bus master or if the current configuration cycle is to the 85C501. As an input it indicates if any device has responded to current PCI bus cycle initiated by the 85C501. |
| 120 | STOP# | I/O | STOP# indicates that the bus master must start terminating its current PCI bus cycle at the next clock edge and release control of the PCI bus. STOP# is used for disconnect, retry, and target-abort sequences on the PCI bus. |
| 126 | PAR | O | Parity is an even parity generated across AD[31:0] and C/BE[3:0]#. |
| 127 | SERR# | O | System error is an open drain output for reporting errors. |
| 115-112 | REQ[3:0]# | I | PCI Bus Request is used to indicate to the PCI bus arbiter that an agent requires use of the PCI bus. |
| 119-116 | GNT[3:0]# | O | PCI Bus Grant indicates to an agent that access to the PCI bus has been granted. |



| | | | |
|-----|---------|---|--|
| 125 | PLOCK# | I | PCI Lock indicates an exclusive bus operation that may require multiple transactions to complete. When PLOCK# is sampled asserted at the beginning of a PCI cycle, the 85C501 considers itself a locked resource and remains in the locked state until PLOCK# is sampled negated on a new PCI cycle. |
| 71 | PCICLK0 | O | The PCICLK0 provides the clock for the 85C501/502/503 and PCI devices of the system. |
| 129 | PCICLK1 | I | The PCICLK1 input provides the fundamental timing and the internal operating frequency for the 85C501. It runs at the same frequency and skew of the PCI local bus. It should be generated from the PCICLK0 signal through a clock distribution buffer. |
| 132 | PCIRST# | O | The PCI Reset forces the PCI devices to a known state. |

Data Buffer Control Interface

| Pin No. | Symbol | Type | Function |
|---------|----------|------|--|
| 69,67 | HCR[1:0] | O | Host Data Bus Controls. These signals are driven by the 85C501 and are used to control the 85C502 HD[63:0] bus. They are defined as: 00: 502 floats HD bus 01: 502 drives FFFFFFFF to HD bus 10: 502 drives data from AD bus to HD bus 11: 502 drives data from MD bus to HD bus |
| 58 | ADLE# | O | AD Bus Data Latch Enable. This signal has the following functions: 1. Latch HD or MD data into the PCI read buffer (PRMB) 2. Latch AD data into CPU read PCI buffer on the rising edge of PCICLK1. 3. Latch AD data into PCI posted write buffer (PTMPB) on the rising edge of PCICLK1. |
| 65 | ADOE | O | AD Bus Output Enable. This signal is used to enable the 85C502 to drive PCI AD bus. It is asserted in CPU writes PCI or PCI master reads local memory cycles. |
| 63 | MDLE | O | Memory Data Read Latch Enable. This signal latches the data on the MD bus when negated. |



| | | | |
|----|---------|---|--|
| 60 | CPPSH | O | Push CPU to PCI Posted Write Data into the 85C502. The data on the HD bus is latched into the 85C502 CPU to PCI Posted Write Buffer on CPPSH rising edge. The edge also increases the write pointer to the next available loading entry in the buffer. |
| 59 | CPPOP | O | On the rising edge of CPPPOP, the read pointer is changed to address the next available reading location. |
| 62 | CMPSH | O | When this signal is asserted, the data on the HD bus is written into the CPU to memory posted write buffer (CTMPB) on the rising edge of CPUCLK, and the write pointer is also changed to address the next available location. |
| 61 | CMPOP | O | Pop CPU to Memory Posted Write Buffer Data. When this signal is asserted, the read pointer of the CPU to Memory Posted Write Buffer is increased on the rising edge of CPUCLK. |
| 64 | PRDLE | O | This signal latches the current output entry in the CPU to PCI Posted Write Buffer into the prelatck in the 85C502. The output of the prelatck is driven onto the PCI AD bus. In a PCI master cycle, PRDLE is asserted when PCI master is reading data from the secondary cache, or when PCI master is writing data to the local memory. |
| 57 | HGDW | O | High Double Word Indicator. The signal is driven high when: (1) a high DW from the HD bus is written into CPU to PCI Posted Write Buffer, (2) the CPU reads a high DW from PCI bus, (3) PCI master writes a high DW to local memory, (4) PCI master reads a high DW from local memory. |
| 66 | PARITY# | I | Parity Bit, from the 85C502. |

Others

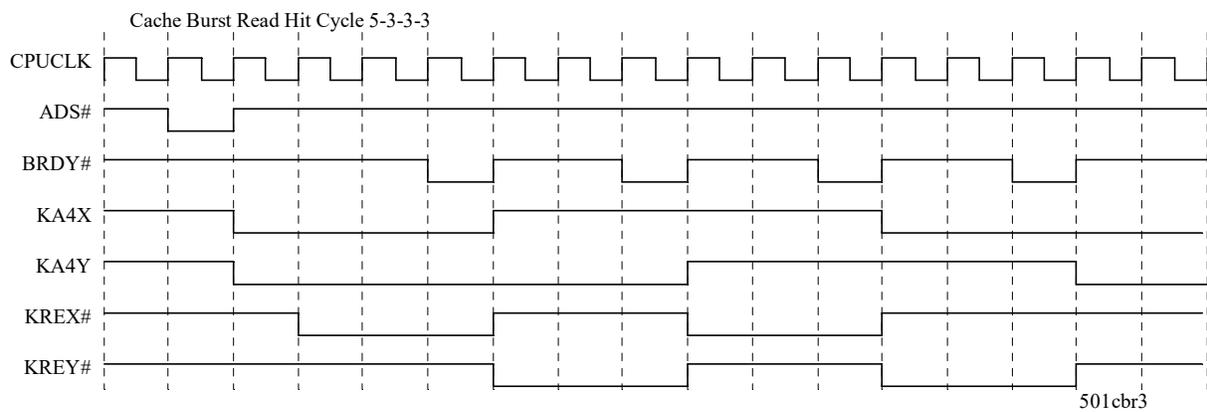
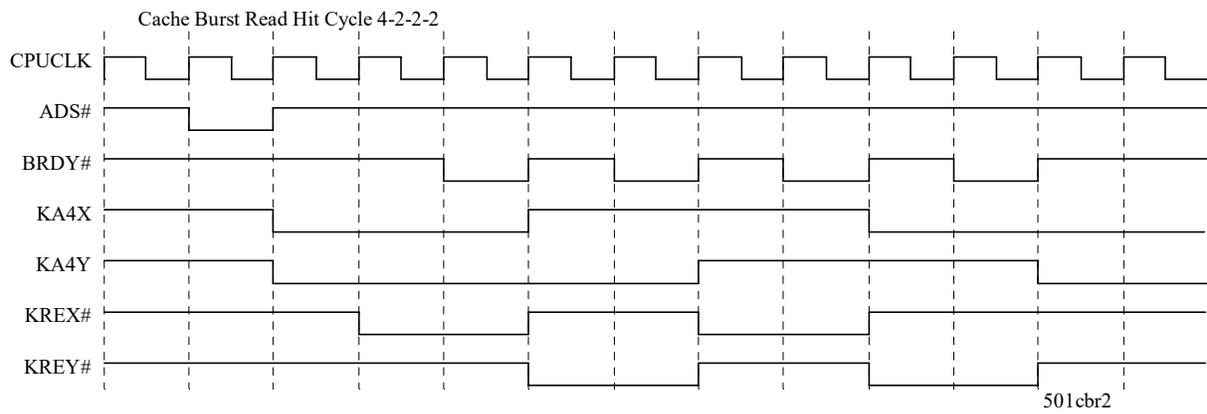
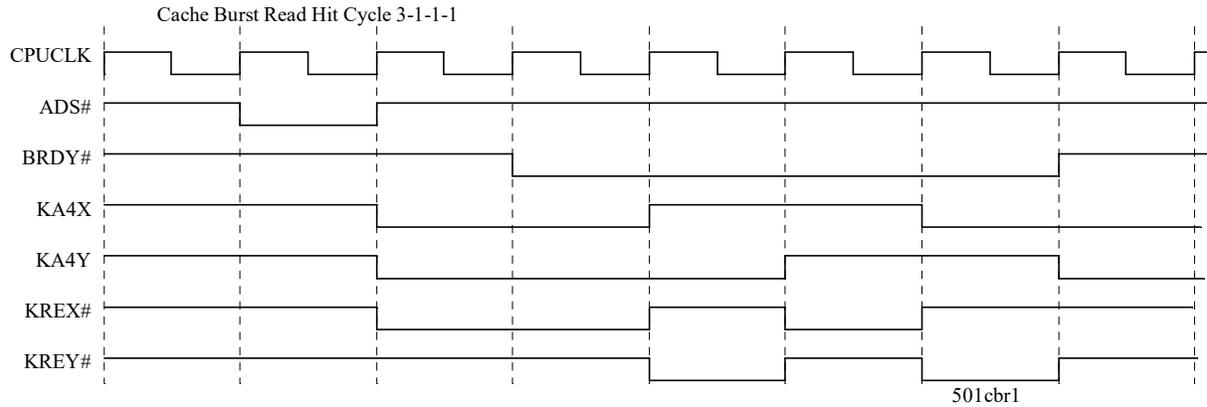
| Pin No. | Symbol | Type | Function |
|---------|----------|------|--|
| 70 | HLDA | O | Hold Acknowledge. |
| 133 | SMOUT | O | System Management Output control pin. It is used to control peripheral's power, clock...etc. |
| 131 | SIORREQ# | I | SIO Request from the 85C503 to request the PCI bus. |

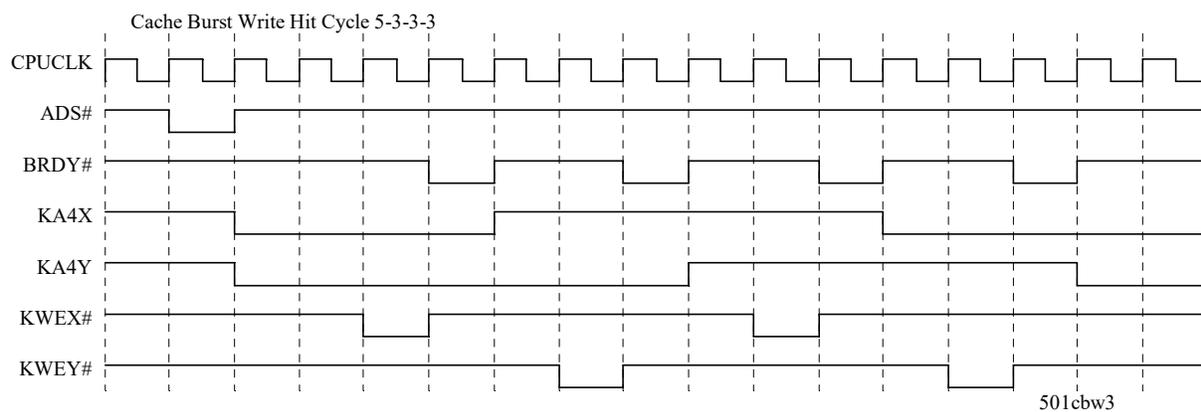
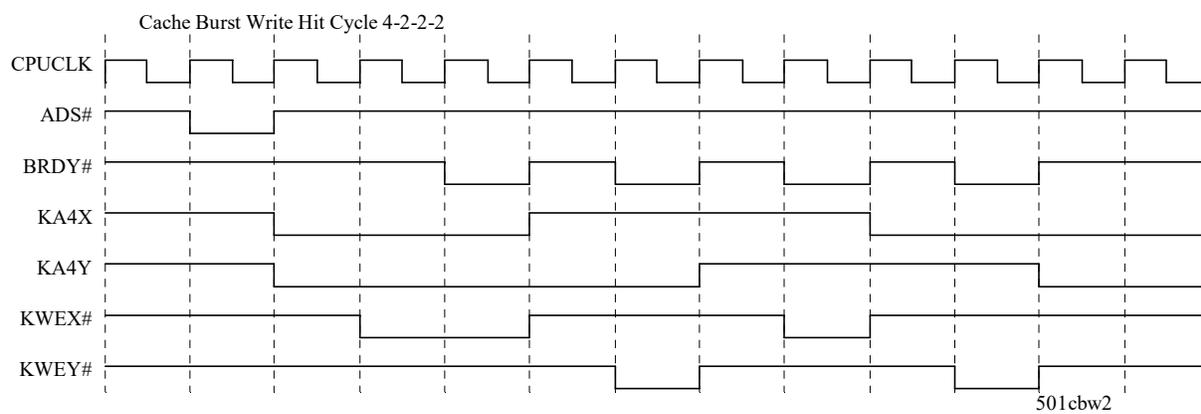
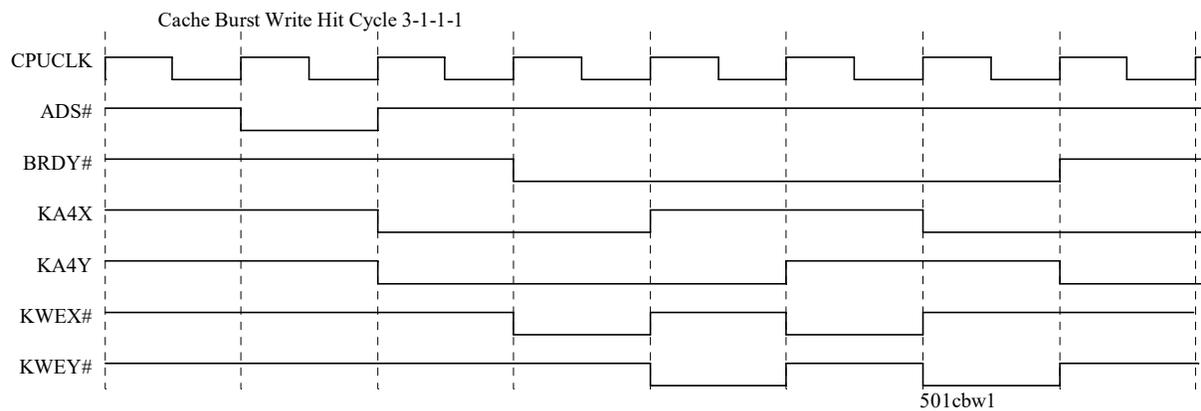


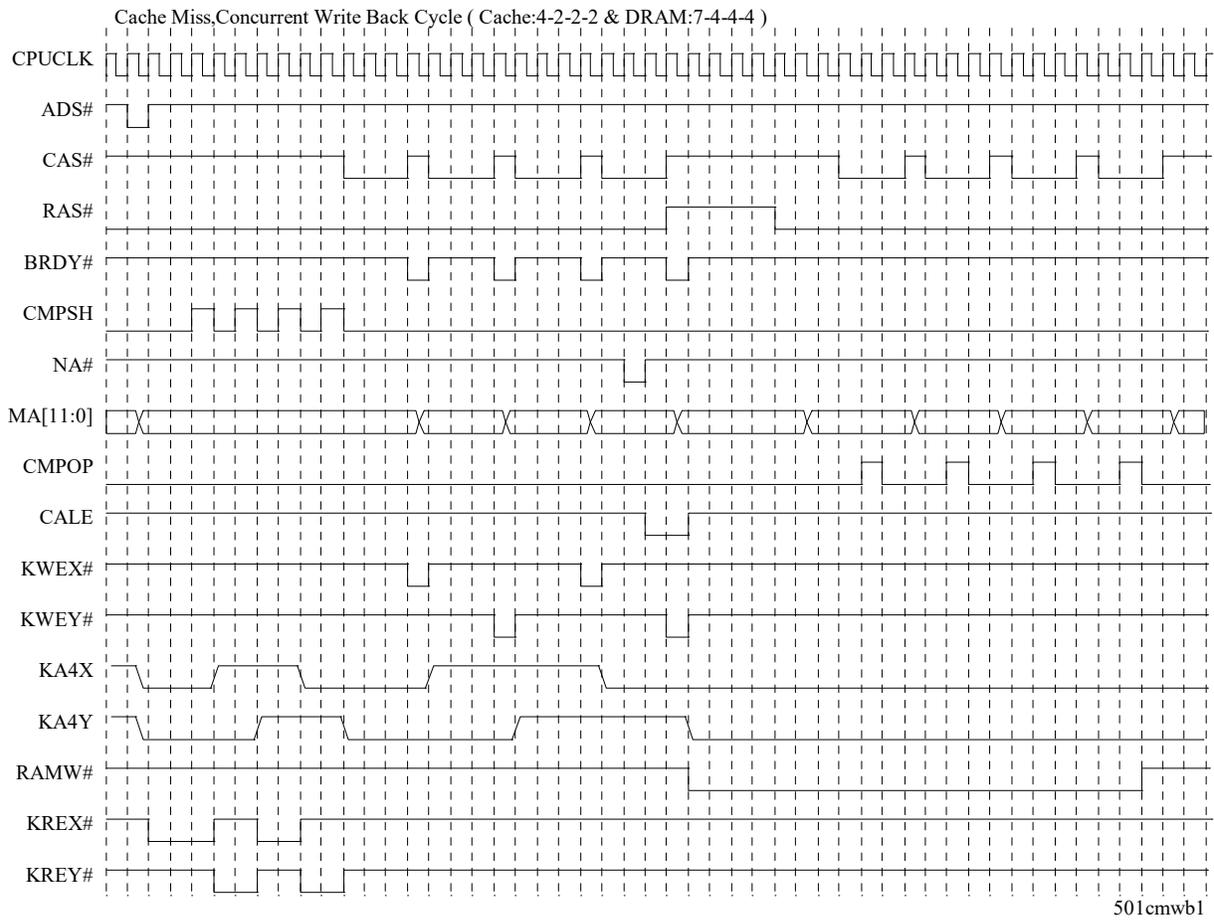
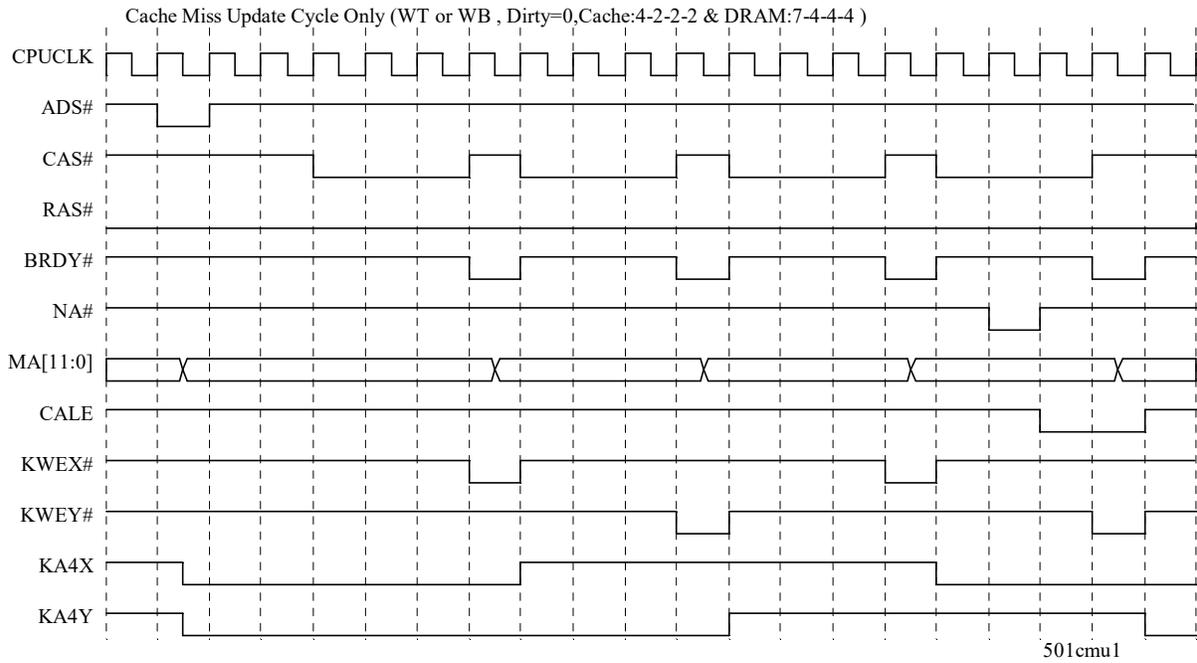
| | | | |
|---|---------------|---|---|
| 130 | SIOGNT# | O | SIO Grant. When asserted, SIOGNT# indicates that the PCI arbiter has granted use of the bus to the 85C503. |
| 138 | KBRST#/BREAK# | I | When the break switch enable bit is set, the KBRST# will be disabled. A signal from the break switch will cause the system enters the standby state. The pulse width of the BREAK# must greater than 4 CPUCLK. |
| 137 | TURBO | I | Turbo input pin. The system is in De-turbo mode when this pin is low. |
| 134 | WAKEUP1 | I | When this input is activated, the 85C501 will reload the system standby timer. If it is inactive and the system standby timer expires, the system will enter system standby state. During the system standby state, if this input becomes active, the system will wake up from standby state and return back to normal state. |
| 135 | WAKEUP0 | I | When this input is activated, the 85C501 will reload the monitor standby timer. If it is inactive and the monitor standby timer expires, the system will enter monitor standby state. During the monitor standby state, if this input becomes active, the system will wake up from standby state and return back to normal state. |
| 140 | OSC | I | OSC is a clock input for the timer and the DMA controller. It is 14.318MHz and is generated by an external oscillator. |
| 36 | ACLK | I | Advanced CPU clock should lead the CPUCLK by 3 to 7 ns to provide the clock for the 85C501 internal cache control logic. |
| 30 | CPUCLK | I | CPU clock input runs at the frequency and skew equal to those of the CPU clock. |
| 83 | PWRGD | I | Power Good is a power on reset and push button reset input. |
| 40,80,136 | VDD | | +5V DC power |
| 14,141 199 | VDD3 | | +3.3V DC power in 3V system +5V DC power in 5V system |
| 6,11,31,3 743,68,84 109,128 139,183 195,204 | VSS | | Ground |

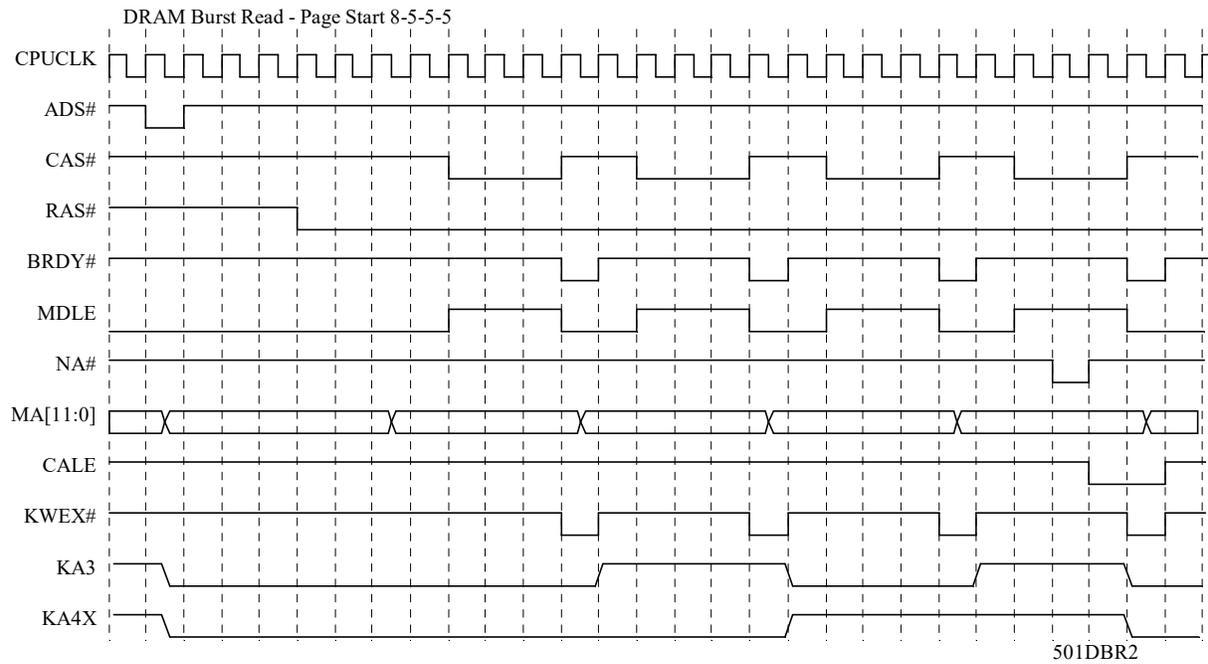
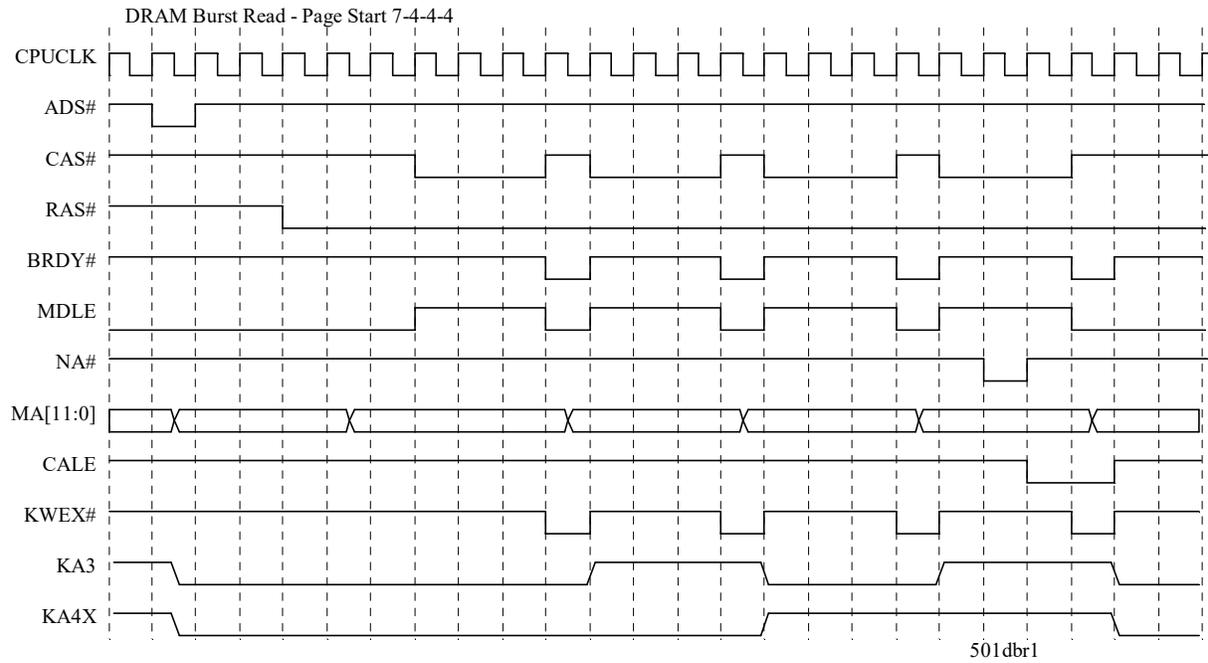


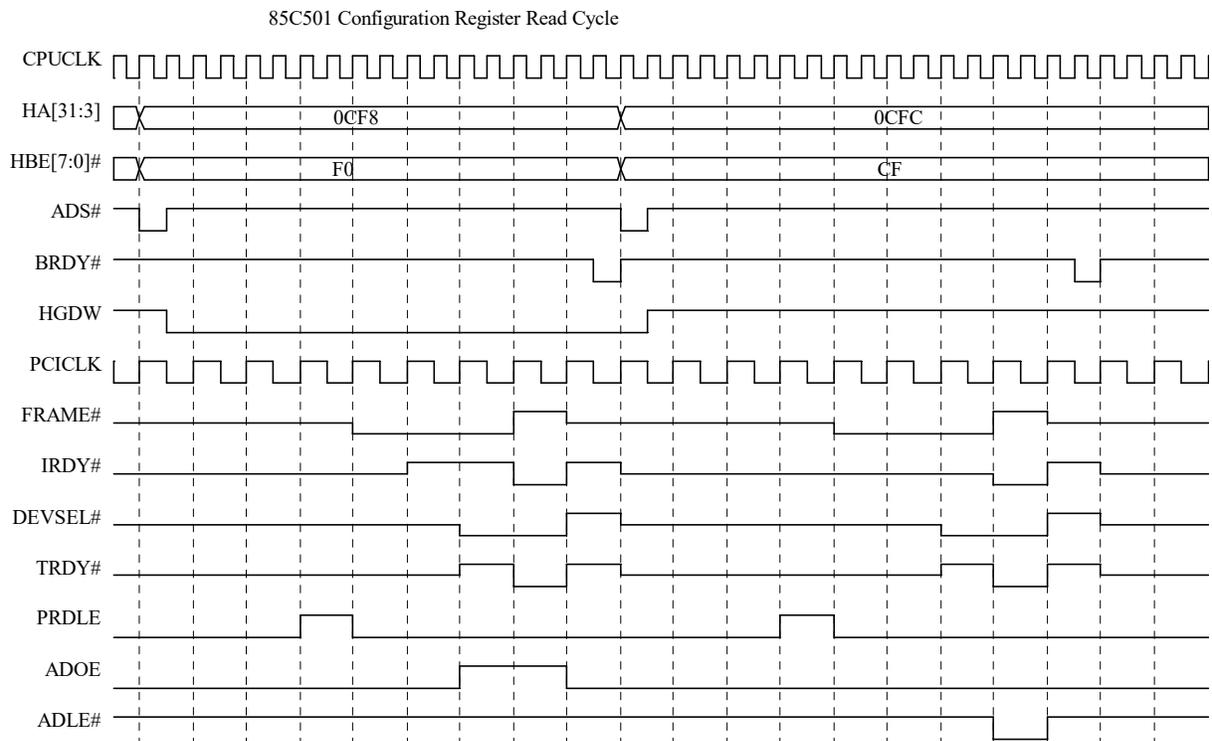
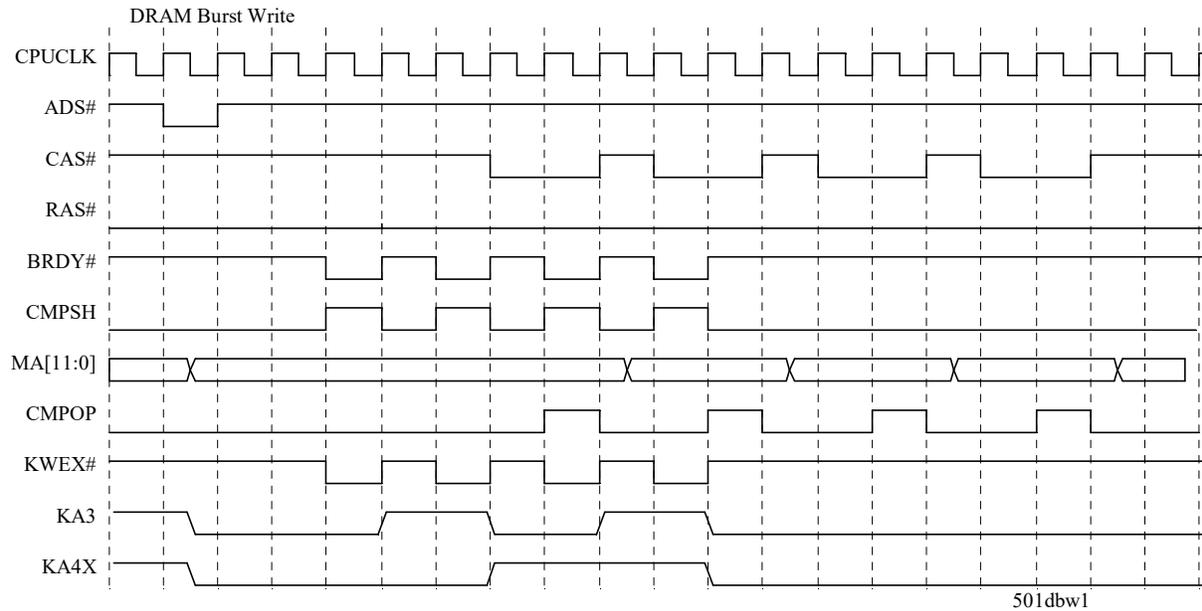
2.12 Timing Diagram





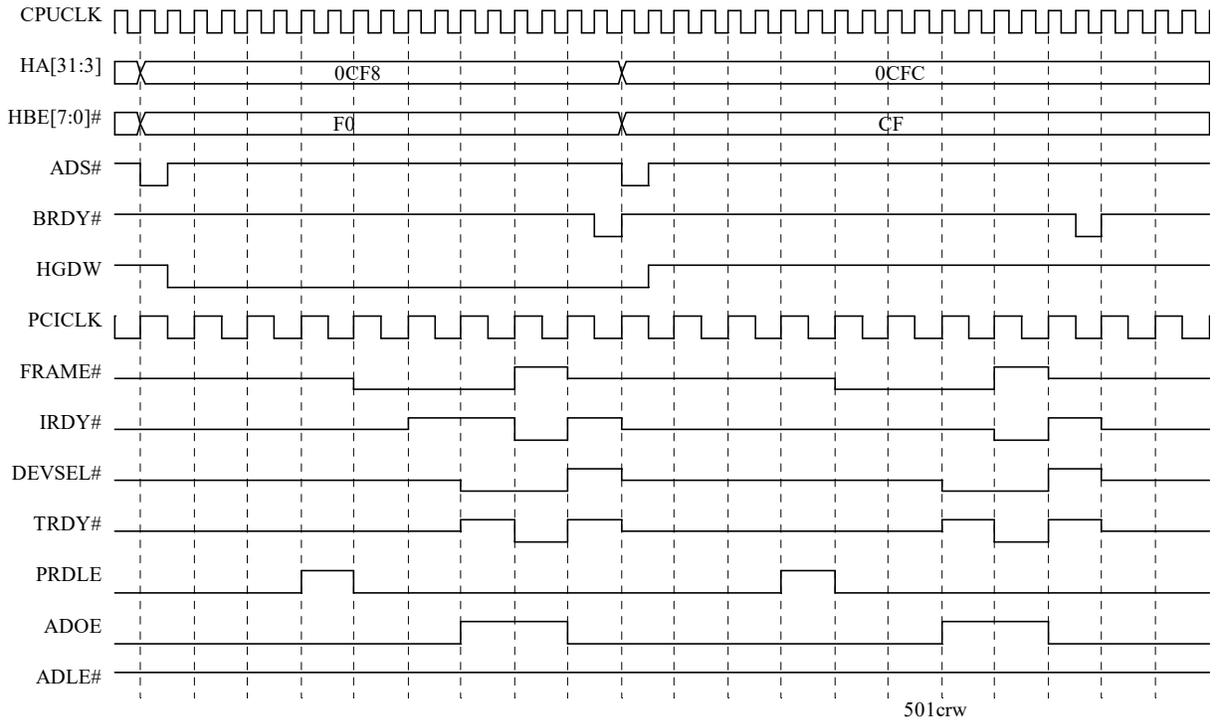


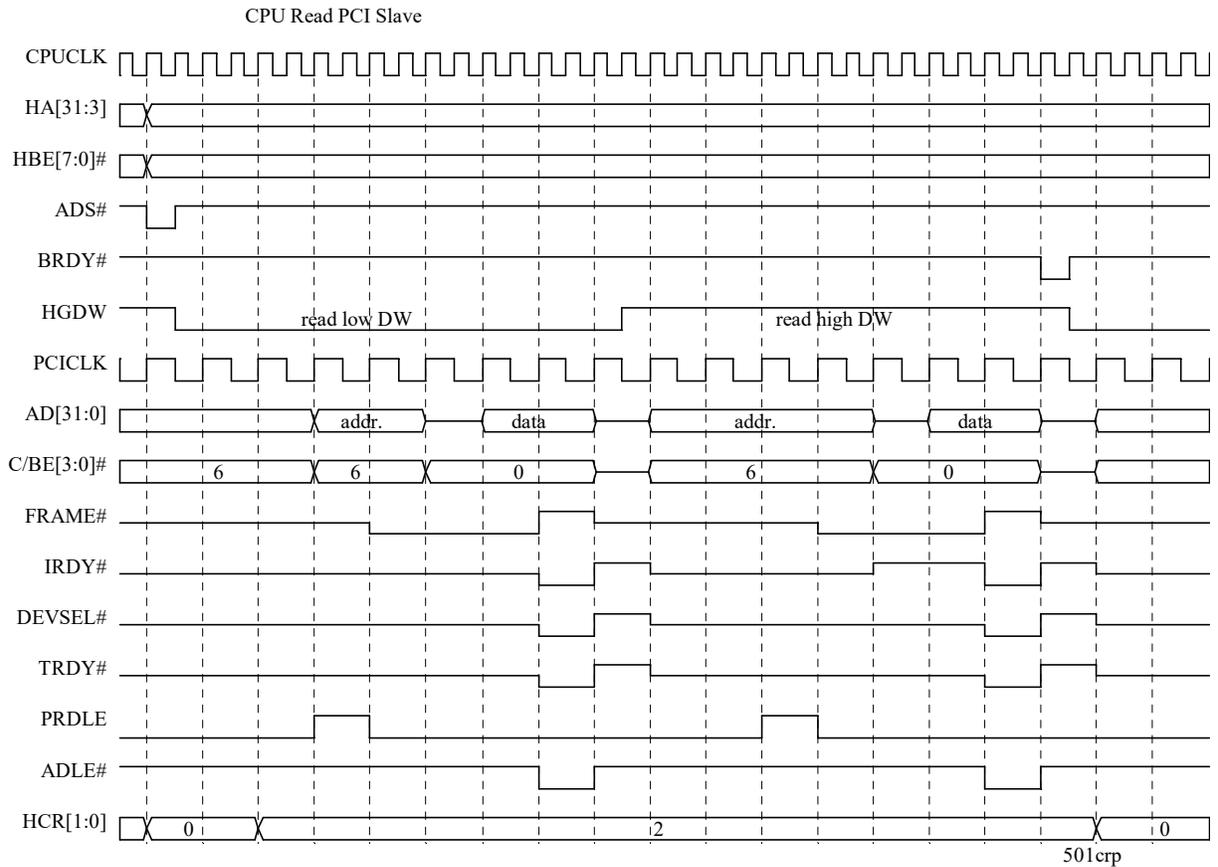






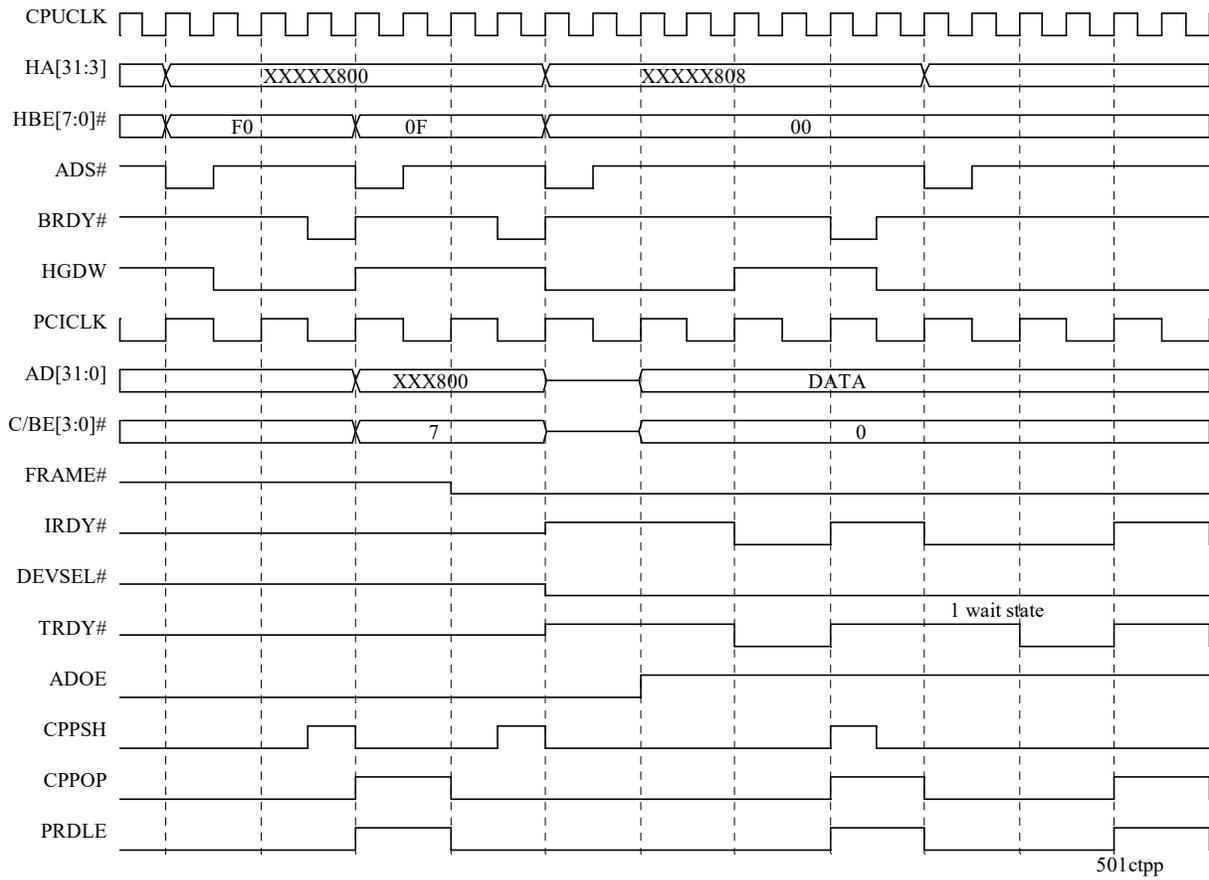
85C501 Configuration Register Write Cycle



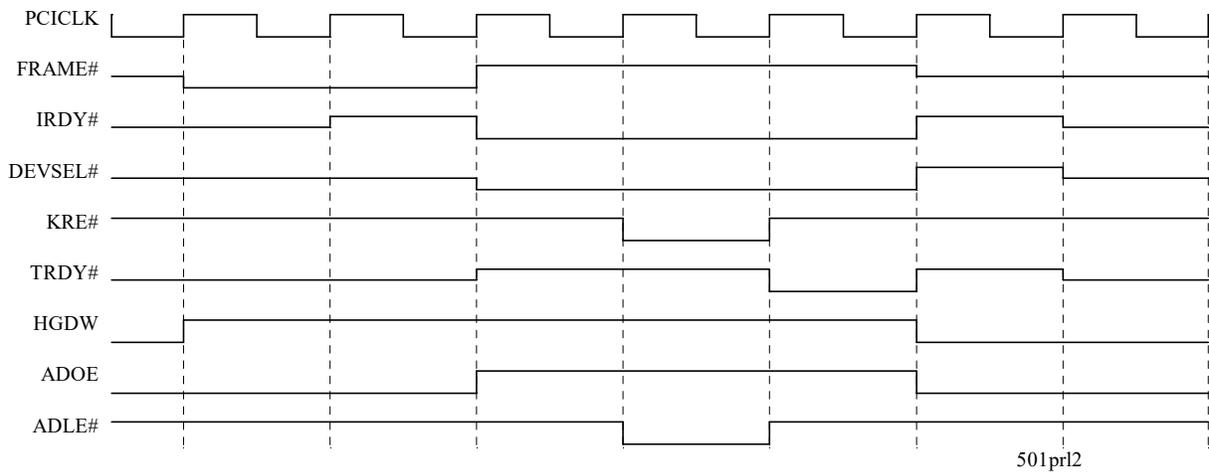


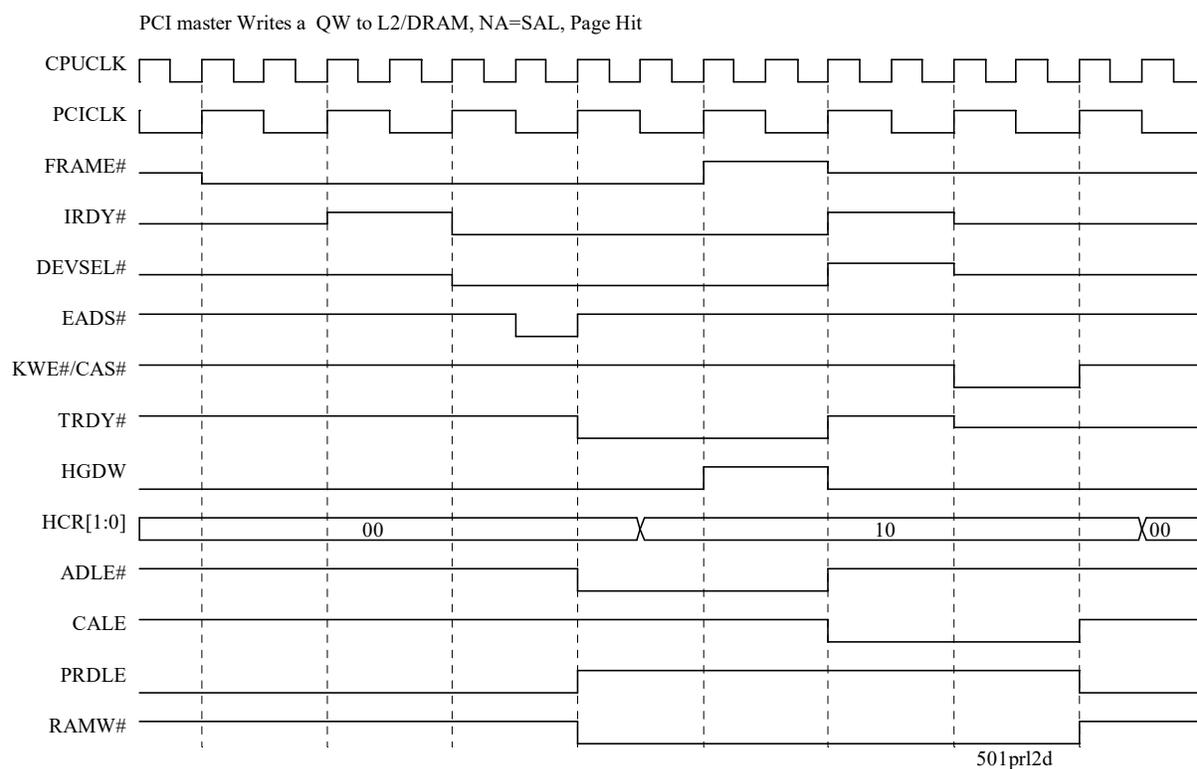


CPU to PCI Psoted Write Cycle



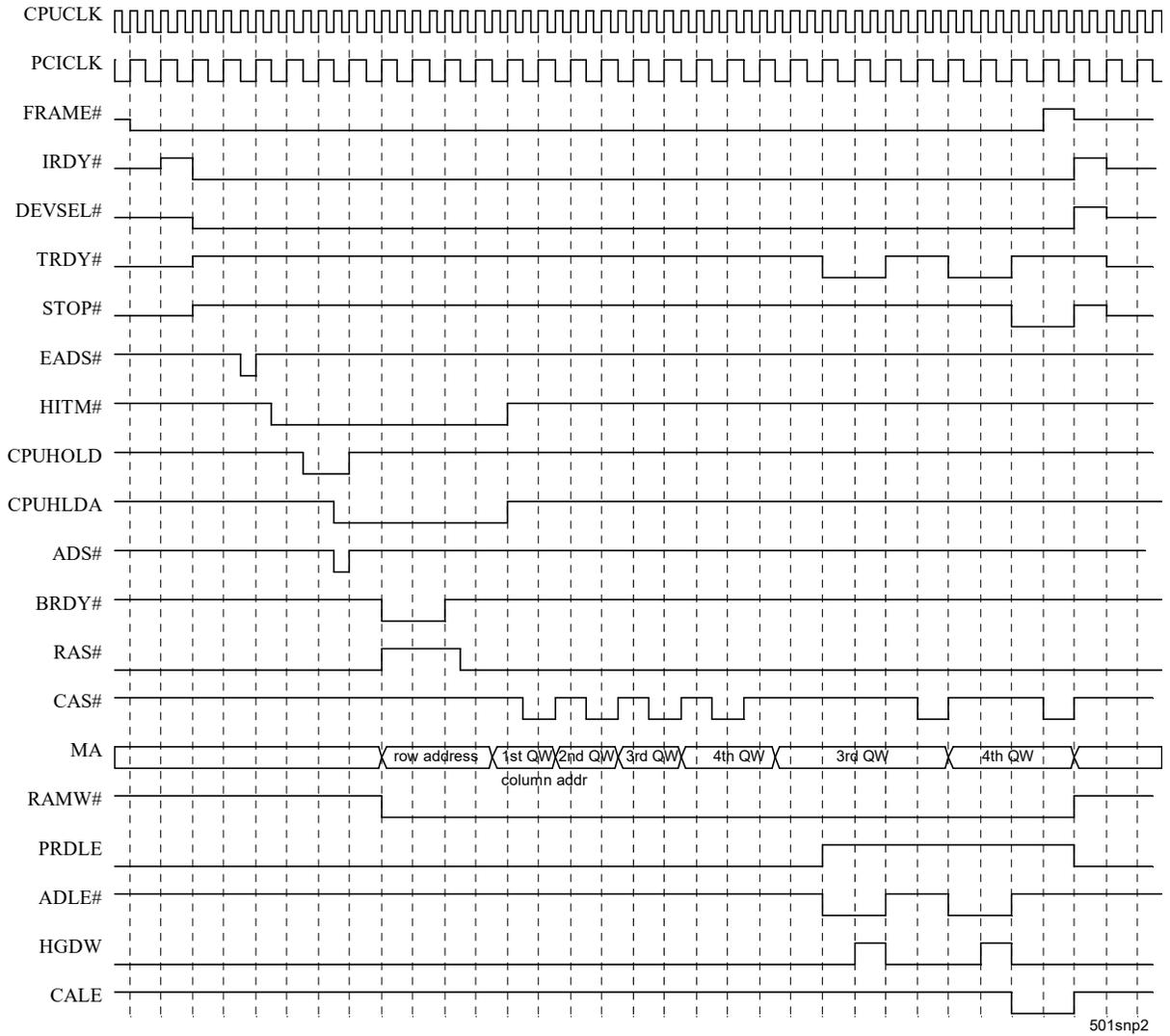
PCI master Reads a High DW from L2,NA=SAL

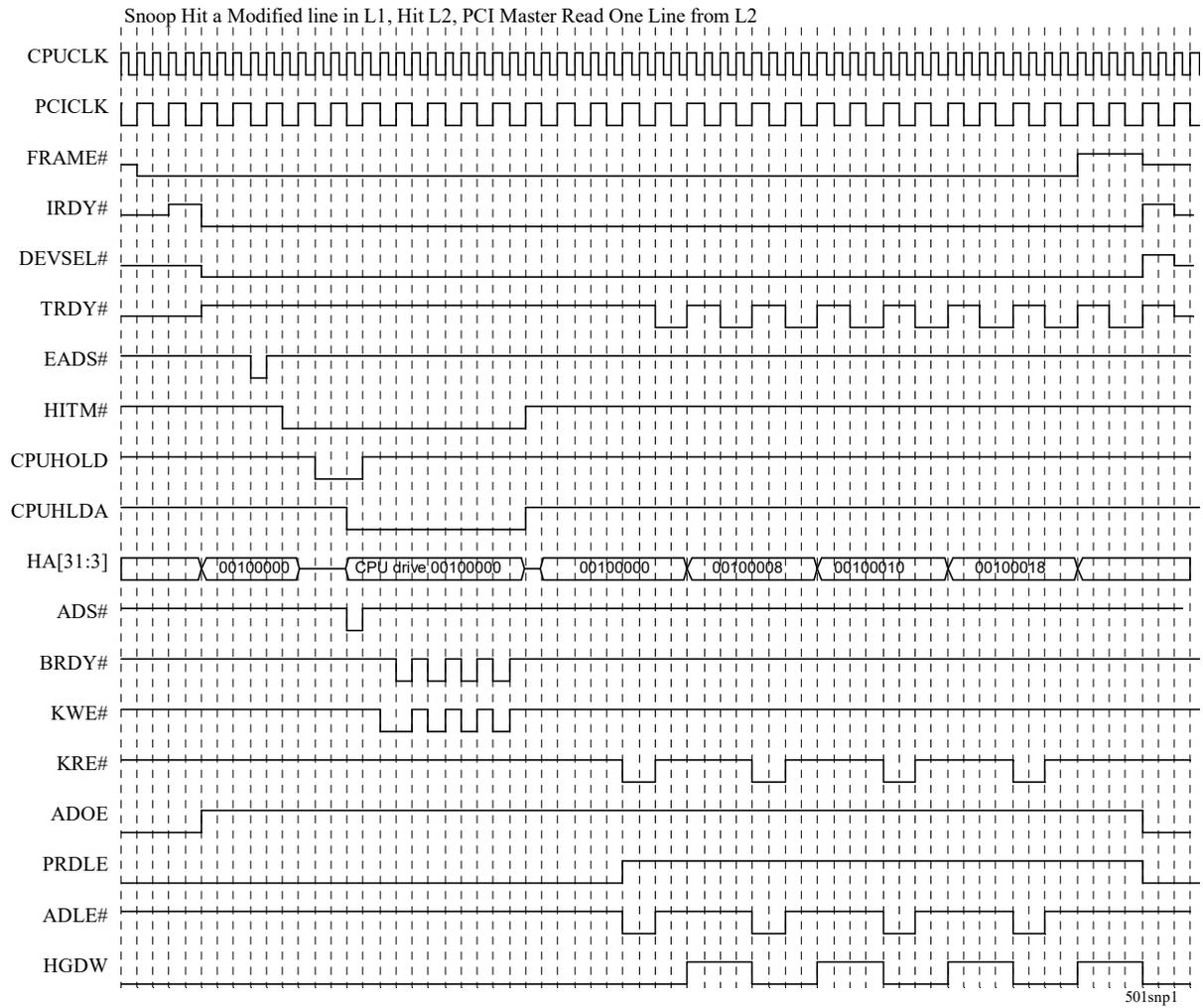






Snoop Hit a Modified line in L1, L2 miss
PCI Master Writes the Last Two QW in the 16 Line Boundary, Disconnect







2.13 Electrical Characteristics

2.13.1 Absolute Maximum Ratings

| Parameter | Min | Max | Unit |
|-------------------------------|------|-----|------|
| Ambient operating temperature | 0 | 70 | °C |
| Storage temperature | -40 | 125 | °C |
| Input voltage | -0.3 | 5.5 | V |
| Output voltage | -0.5 | 5.5 | V |
| Power Dissipation | | 1 | W |

Note:

Stress above these listed may cause permanent damage to device. Functional operation of this device should be restricted to the conditions described under operating conditions.

2.13.2 DC Characteristics

TA = 0 - 70 °C, VSS = 0V , VDD=5V±5%, VDD3=3.3V±5%

| Symbol | Parameter | Min | Max | Unit | Condition |
|------------------|--|--------|-----------|------|-------------------|
| V _{IL1} | Input low voltage | -0.3 | 0.8 | V | Note 1, VDD3=3.3V |
| V _{IH1} | Input High Voltage | 2.2 | VDD3+0.3V | V | Note 1 |
| V _{IL2} | Input low voltage | -0.3 | 0.8 | V | Note 2 |
| V _{IH2} | Input high voltage | 2.2 | VDD+0.3 | V | Note 2 |
| V _{T1-} | Schmitt Trigger Threshold Voltage Falling Edge | 1.6 | | V | Note 3 |
| V _{T1+} | Schmitt Trigger Threshold Voltage Rising Edge | | 3.2 | V | Note 3 |
| V _{H1} | Hysteresis Voltage | 0.3 | 1.2 | V | Note 3 |
| V _{OL1} | Output Low Voltage | | 0.45 | V | Note 4 |
| V _{OH1} | Output High Voltage | 2.4 | | V | Note 4 |
| V _{OL2} | Output Low Voltage | | 0.4 | V | Note 5 |
| V _{OH2} | Output High Voltage | 2.0 | VDD3 | V | Note 5 |
| I _{OL1} | Output Low Current | 4 | | mA | Note 6 |
| I _{OH1} | Output High Current | 4 | | mA | Note 6 |
| I _{OL2} | Output Low Current | 6 | | mA | Note 7 |
| I _{OH2} | Output High Current | 6 | | mA | Note 7 |
| I _{OL3} | Output Low Current | 4,8,12 | | mA | Note 8 |
| I _{OH3} | Output High Current | 4,8,12 | | mA | Note 8 |
| I _{OL4} | Output Low Current | 16 | | mA | Note 9 |
| I _{OH4} | Output High Current | 16 | | mA | Note 9 |
| I _{OL5} | Output Low Current | 4 | | mA | Note 10 |



| | | | | | |
|------------------|------------------------------|---|-----|----|------------------|
| I _{OH5} | Output High Current | 1 | | mA | Note 10, Note 11 |
| I _{IH} | Input Leakage Current | | +10 | mA | |
| I _{IL} | Input Leakage Current | | -10 | mA | |
| C _{IN} | Input Capacitance | | 12 | pF | Fc=1 Mhz |
| C _{OUT} | Output Capacitance | | 12 | pF | Fc=1 Mhz |
| C _{I/O} | I/O Capacitance | | 12 | pF | Fc=1 Mhz |
| I _{CC3} | Power Supply Current of VDD3 | | 40 | mA | 3.3V, 66MHz |

Note:

1. V_{IL1} and V_{IH1} apply to the following signals: HA[31:3], W/R#, HBE[7:0]#, HITM#, D/C#, ADS#, CPUHLDA, SMIACT#, CACHE#, M/IO#
2. V_{IL2} and V_{IH2} apply to the following signals: TA[7:0], ALT, CPUCLK, ACLK, PARITY#, AD[31:0], C/BE[3:0]#, REQ[3:0]#, STOP#, DEVSEL#, TRDY#, IRDY#, FRAME#, LOCK#, PCICLK, SIOGNT#, SIOREQ#, WAKEUP[1:0], TURBO, KBRST#, OSC
3. V_{TI-}, V_{TI+} and V_{HI} apply to PWRGD
4. V_{OL1} and V_{OH1} apply to the following signals: TA[7:0], ALTWE#, ALT, TAGWE#, CAS[7:0]#, RAS[3:0]#, RAMW#, MA[11:0], HGDW, ADLE#, CPPOP, CPPSH, CMPOP, CMPSH, MDLE, PRDLE, ADOE, HCR[1:0], HLDA, PCICLKO, AD[31:0], GNT[3:0]#, STOP#, DEVSEL#, TRDY#, FRAME#, PAR, SERR#, PCIRST#, SMOUT
5. V_{OL2} and V_{OH2} apply to the following signals: CALE, KA4Y, KA4X, KWY[1:0]#, KWY[1:0]#, KREX#, KREY#, ADSC#/FLUSH#, ADSV#, STPCLK#, INIT, SMI#, HA[31:3], CPURST, W/R#, A20M#, EADS#, CPUHOLD, NA#, BRDY#, KEN#, KCE[7:0]#
6. I_{OL1} and I_{OH1} apply to the following signals: TA[7:0], ALTWE#, ALT, TAGWE#, RAMW#, MA[11:0], HGDW, ADLE#, CPPOP, CPPSH, CMPOP, CMPSH, MDLE, PRDLE, ADOE, HCR[1:0], HLDA, PCICLKO, AD[31:0], C/BE[3:0]#, GNT[3:0]#, PAR, SERR#, PCIRST#, SMOUT, WAKEUP[1:0]
7. I_{OL2} and I_{OH2} apply to the following signals: FRAME#, IRDY#, TRDY#, DEVSEL#, STOP#.
8. I_{OL3} and I_{OH3} apply to the following signals: CAS[7:0]#
9. I_{OL4} and I_{OH4} apply to the following signals: KA4X, KA4Y, KWY[1:0]#, KWY[1:0]#, ADSV#, ADSC#, RAS[3:0]#
10. I_{OL5} and I_{OH5} apply to the following signals: CALE, KREY#, KREX#, STPCLK#, INIT, SMI#, HA[31:3], W/R#, EADS#, CPUHOLD, NA#, BRDY#, KEN#, KCE[7:0]#, CPURST, A20M#
11. I_{OH5} is 1mA in 3.3 system, when in 5V system, the I_{OH4} is 4mA.

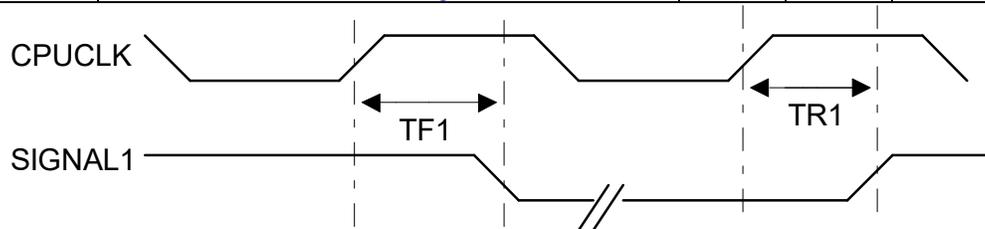


2.13.3 AC Characteristics

| Symbol | Parameter | Typ | Max | Unit | CL |
|--------|--|-----|-----|--------|-------|
| T1 | BRDY# Active delay from CPUCLK | 8 | 12 | ns | 35pf |
| T2 | BRDY# Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T3 | KEN# Active delay from CPUCLK | 7 | 11 | ns | 35pf |
| T4 | KEN# Inactive delay from CPUCLK | 5 | 8 | ns | 35pf |
| T5 | NA# Active delay from CPUCLK | 8 | 12 | ns | 35pf |
| T6 | NA# Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T7 | EADS# Active delay from CPUCLK | 8 | 12 | ns | 35pf |
| T8 | EADS# Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T9 | CPUHOLD Active delay from CPUCLK | 8 | 12 | ns | 35pf |
| T10 | CPUHOLD Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T11 | CPURST Inactive delay from CPUCLK | 7 | 11 | ns | 35pf |
| T12 | CPURST High Pulse Width | 25 | | cpuclk | 35pf |
| T13 | KREX#,KREY# Active delay from ACLK | 9 | 13 | ns | 100pf |
| T14 | KREX#,KREY# Inactive delay from ACLK | 6 | 9 | ns | 100pf |
| T15 | KWX[0:1]#,KWY[0:1]# Active delay from ACLK | 8 | 12 | ns | 100pf |
| T16 | KWX[0:1]#,KWY[0:1]# Inactive delay from ACLK | 6 | 9 | ns | 100pf |
| T17 | KWX[0:1]#,KWY[0:1]# Active delay from CPUCLK | 8 | 12 | ns | 100pf |
| T18 | KWX[0:1]#,KWY[0:1]# Inactive delay from CPUCLK | 6 | 9 | ns | 100pf |
| T19 | KCE[7:0]# Active delay from ADS# falling edge | 7 | 12 | ns | 35pf |
| T20 | KCE[7:0]# Inactive delay from CPUCLK | 7 | 12 | ns | 35pf |
| T21 | MDLE High Active delay from CPUCLK | 5 | 8 | ns | 35pf |
| T22 | MDLE High Inactive delay from CPUCLK | 7 | 11 | ns | 35pf |
| T23 | KA4X,KA4Y Low Valid delay from ACLK | 7 | 11 | ns | 100pf |
| T24 | KA4X,KA4Y High Valid delay from ACLK | 6 | 9 | ns | 100pf |
| T25 | KA4X,KA4Y Low Valid delay from CPUCLK In Update Cycle & Write cycle | 7 | 11 | ns | 100pf |
| T26 | KA4X,KA4Y High Valid delay from CPUCLK In Update Cycle & Write cycle | 6 | 9 | ns | 100pf |
| T27 | Tag Output Valid delay from CPUCLK In Update Cycle | 14 | 23 | ns | 35pf |
| T28 | RAS[3:0]# Active delay from CPUCLK | 12 | 18 | ns | 250pf |
| T29 | RAS[3:0]# Inactive delay from CPUCLK | 9 | 14 | ns | 250pf |
| T30 | CAS[7:0]# Active delay from CPUCLK | 11 | 16 | ns | 120pf |
| T31 | CAS[7:0]# Inactive delay from CPUCLK | 8 | 12 | ns | 120pf |
| T32 | MA[11:0] Low Valid delay from CPUCLK | 12 | 18 | ns | 35pf |
| T33 | MA[11:0] High Valid delay from CPUCLK | 11 | 16 | ns | 35pf |
| T34 | MA[11:0] Propagation delay from A[27:3] | 8 | 12 | ns | 35pf |
| T35 | ALT Output Valid delay from CPUCLK | 10 | 15 | ns | 35pf |
| T36 | ALTWE#,TAGWE# Active delay from CPUCLK | 9 | 14 | ns | 35pf |
| T37 | ALTWE#,TAGWE# Inactive delay from CPUCLK | 9 | 14 | ns | 35pf |
| T38 | A20M# Active delay from CPUCLK | 9 | 14 | ns | 35pf |
| T39 | A20M# Inactive delay from CPUCLK | 8 | 12 | ns | 35pf |
| T40 | AD[31:0],C/BE[3:0]# Output valid delay from PCICLKI | 10 | 15 | ns | 50pf |
| T41 | PRDLE Active delay from PCICLKI | 9 | 14 | ns | 35pf |
| T42 | DEVSEL#,FRAME#,IRDY#,STOP#,TRDY# Active delay from PCICLKI | 10 | 15 | ns | 50pf |



| | | | | | |
|-----|--|------|----|----|-------|
| T43 | DEVSEL#,FRAME#,IRDY#,STOP#,TRDY# Inactive delay from PCICLK | 9 | 14 | ns | 50pf |
| T44 | GNT[3:0]#,PAR,SERR#,SIOGNT#,STPCLK# Active delay from PCICLK | 10 | 15 | ns | 50pf |
| T45 | GNT[3:0]#,PAR,SERR#,SIOGNT#,STPCLK# Inactive delay from PCICLK | 10 | 15 | ns | 50pf |
| T46 | HA[31:3] Drive Output Valid delay from PCICLK | 12 | 18 | ns | 50pf |
| T47 | HCR[1:0],HGDW Active delay from CPUCLK | 7 | 11 | ns | 35pf |
| T48 | HLDA Active delay from CPUCLK | 8 | 12 | ns | 35pf |
| T49 | HLDA Inactive delay from CPUCLK | 7 | 11 | ns | 35pf |
| T50 | INIT# Active delay from CPUCLK | 7 | 11 | ns | 35pf |
| T51 | INIT# Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T52 | MDLE Active delay from CPUCLK | 7 | 11 | ns | 35pf |
| T53 | MDLE Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T54 | PCICLK0,PCIRST Active delay from CPUCLK | 8 | 12 | ns | 50pf |
| T55 | RAMW# Active delay from CPUCLK | 11 | 16 | ns | 35pf |
| T56 | RAMW# Inactive delay from CPUCLK | 8 | 12 | ns | 35pf |
| T57 | SMOUT Active delay from CPUCLK | 10 | 15 | ns | 50pf |
| T58 | ADSC# Active delay from CPUCLK | 7 | 11 | ns | 90pf |
| T59 | ADSC# Inactive delay from CPUCLK | 6 | 9 | ns | 90pf |
| T60 | ADSV# Active delay from CPUCLK | 7 | 11 | ns | 150pf |
| T61 | ADSV# Inactive delay from CPUCLK | 6 | 9 | ns | 150pf |
| T62 | CPPSH Active delay from CPUCLK | 4 | 6 | ns | 35pf |
| T63 | CPPOP Active delay from PCICLK | 8 | 12 | ns | 35pf |
| T64 | CPPSH Inactive delay from CPUCLK | 7 | 11 | ns | 35pf |
| T65 | CPPOP Inactive delay from PCICLK | 10 | 15 | ns | 35pf |
| T66 | ADOE Active delay from PCICLK | 6 | 9 | ns | 35pf |
| T67 | ADOE Inactive delay from PCICLK | 6 | 9 | ns | 35pf |
| T68 | ADLE# Active delay from PCICLK | 6 | 9 | ns | 35pf |
| T69 | ADLE# Inactive delay from PCICLK | 6 | 9 | ns | 35pf |
| T70 | PCICLK0 high time (Divided by 2) | 15.2 | | ns | 50pf |
| T71 | PCICLK0 low time (Divided by 2) | 12.6 | | ns | 50pf |
| T72 | PCICLK0 high time (Divided by 1.5) | 12.5 | | ns | 50pf |
| T73 | PCICLK0 low time (Divided by 1.5) | 15.8 | | ns | 50pf |
| T74 | PCICLK0 rise time (Divided by 2) | 1.16 | | ns | 50pf |
| T75 | PCICLK0 fall time (Divided by 2) | 0.66 | | ns | 50pf |
| T76 | PCICLK0 rise time (Divided by 1.5) | 1.06 | | ns | 50pf |
| T77 | PCICLK0 fall time (Divided by 1.5) | 0.9 | | ns | 50pf |
| T78 | HCR[1:0] fall time to CPUCLK rising | 4.5 | | ns | 35pf |
| T79 | HCR[1:0] rise time to CPUCLK rising | 3.7 | | ns | 35pf |
| T80 | CALE# Active delay from CPUCLK | 8 | 12 | ns | 35pf |
| T81 | CALE# Inactive delay from CPUCLK | 6 | 9 | ns | 35pf |
| T82 | SMI# rise time to CPUCLK rising | 7.8 | 10 | ns | 35pf |
| T83 | SMI# fall time to CPUCLK rising | 7.8 | 10 | ns | 35pf |

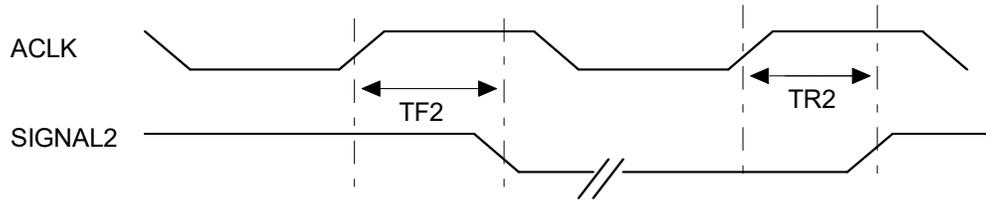




TF1 = T1, T3, T5, T7, T10, T11, T17, T22, T23, T25, T27, T28, T30, T32, T36, T38, T49, T50, T53, T55, T58, T60, T64, T78, T80, T83

TR1 = T2, T4, T6, T8, T9, T18, T20, T21, T24, T26, T27, T29, T31, T33, T35, T37, T39, T47, T48, T51, T52, T54, T56, T57, T59, T61, T62, T79, T81, T82

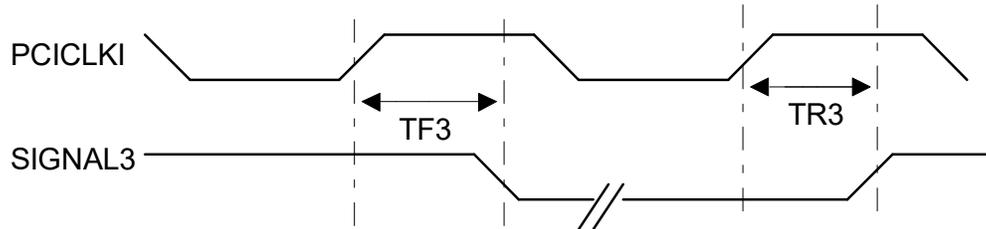
SIGNAL1 = BRDY#, KEN#, NA#, EADS#, CPUHOLD, CPURST, KWX[0:1]#, KWY[0:1]#, KCE[7:0]#, MDLE, CALE, KA4X, KA4Y, TA[7:0], RAS[3:0]#, CAS[7:0]#, MA[11:0], ALT, ALTWE#, TAGWE#, A20M#, HLDA, INIT#, PCICLK0, PCIRST, RAMW#, SMOUT, ADSC#, ADSV#, GNT[3:0]#, PAR, SERR#, SIOGNT#, STPCLK#, CPPSH



TF2 = T13, T15, T23

TR2 = T14, T16, T24

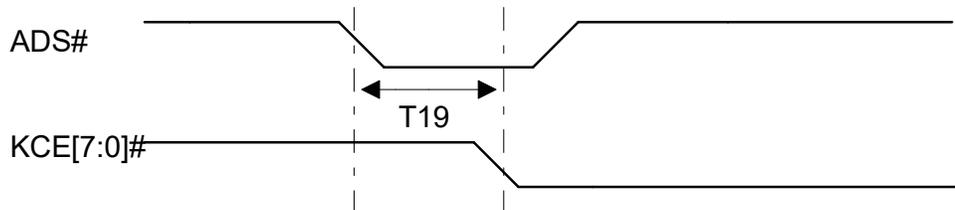
SIGNAL2 = KREX#, KREY#, KWX[0:1]#, KWY[0:1]#, KA4X, KA4Y

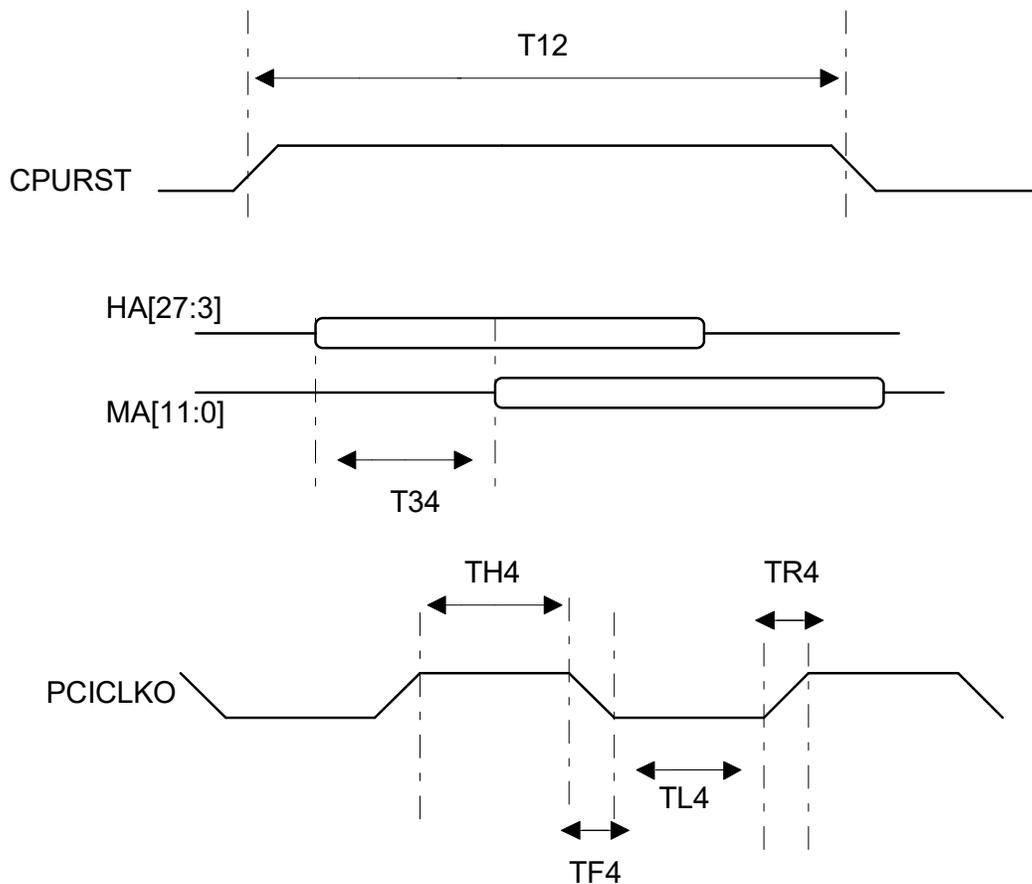


TF3 = T40, T41, T42, T46, T44, T65, T67, T68

TR3 = T40, T41, T43, T46, T45, T63, T66, T69

SIGNAL3 = AD[31:0], C/BE[3:0], ADLE#, ADOE, PRDLE, DEVSEL#, FRAME#, IRDY#, STOP#, TRDY#, HA[31:3], CPPOP, ADOE, ADLE





$TH4 = T_{70}, T_{72}$
 $TL4 = T_{71}, T_{73}$
 $TR4 = T_{74}, T_{76}$
 $TF4 = T_{75}, T_{77}$

3 SiS85C502

3.1 Features

- **Supports the Full 64-bit Pentium Processor Data Bus**
- **Provides a 64-Bit Interface to DRAM Memory**
- **Provides a 32-bit Interface to PCI**
- **Three Integrated Posted Write Buffers and Two Read Buffers Increase System Performance**
 - 1 level CPU-to-Memory Posted Write Buffer (CTMPB) with 4 QuadWords (QWs) Deep
 - 4 level CPU-to-PCI Posted Write Buffer (CTPPB) with 4 DoubleWords (DWs) Deep
 - 1 level PCI-to-Memory Posted Write Buffer (PTMPB) with 1 QW Deep
 - 1 level Memory-to-CPU Read Buffer (CRMB) with 1 QW Deep
 - 1 level Memory-to-PCI Read Buffer (PRMB) with 1 QW Deep
- **Near Zero Wait State Performance on CPU-to-Memory and CPU-to-PCI writes**
- **Operates Synchronously to the 66.7 MHz CPU and 33.3 MHz PCI Clocks**
- **Provides Parity Generation for Memory Writes**
- **208-Pin PQFP**
- **0.6 um CMOS Technology**

3.2 General Description

The SiS85C502 PCI Local Data Buffer(PLDB) provides a bi-directional data buffering among the 64-bit Host Data Bus, the 64-bit Memory Data Bus, and the 32-bit PCI Address/Data Bus. The PLDB incorporates three Posted Write Buffers and two Read Buffers along the bridges of the CPU, PCI and Memory buses. This buffering scheme smoothes the differences in access latencies and bandwidths among three buses, therefore improves the overall system performance. A four level/4DWs deep write buffer (CTPPB) provides buffering on CPU write to PCI bus. A one level/4QWs deep write buffer (CTMPB) is used for buffering write data from the CPU to Memory. A one level/1QW deep write buffer (PTMPB) is used to buffer PCI write to Memory data. A one QW Read Buffer (CRMB) is used to latch CPU read Memory data and a one QW Read Buffer (PRMB) is used to latch data in a PCI master read from L2 Cache or DRAM cycle. During bus operation between the Host, PCI and Memory, the PLDB receives control signals from the PCMC, performs functions such as latching data, forwarding data to destination bus, data assemble and disassemble. Figure 3.1 shows the PLDB block diagram.

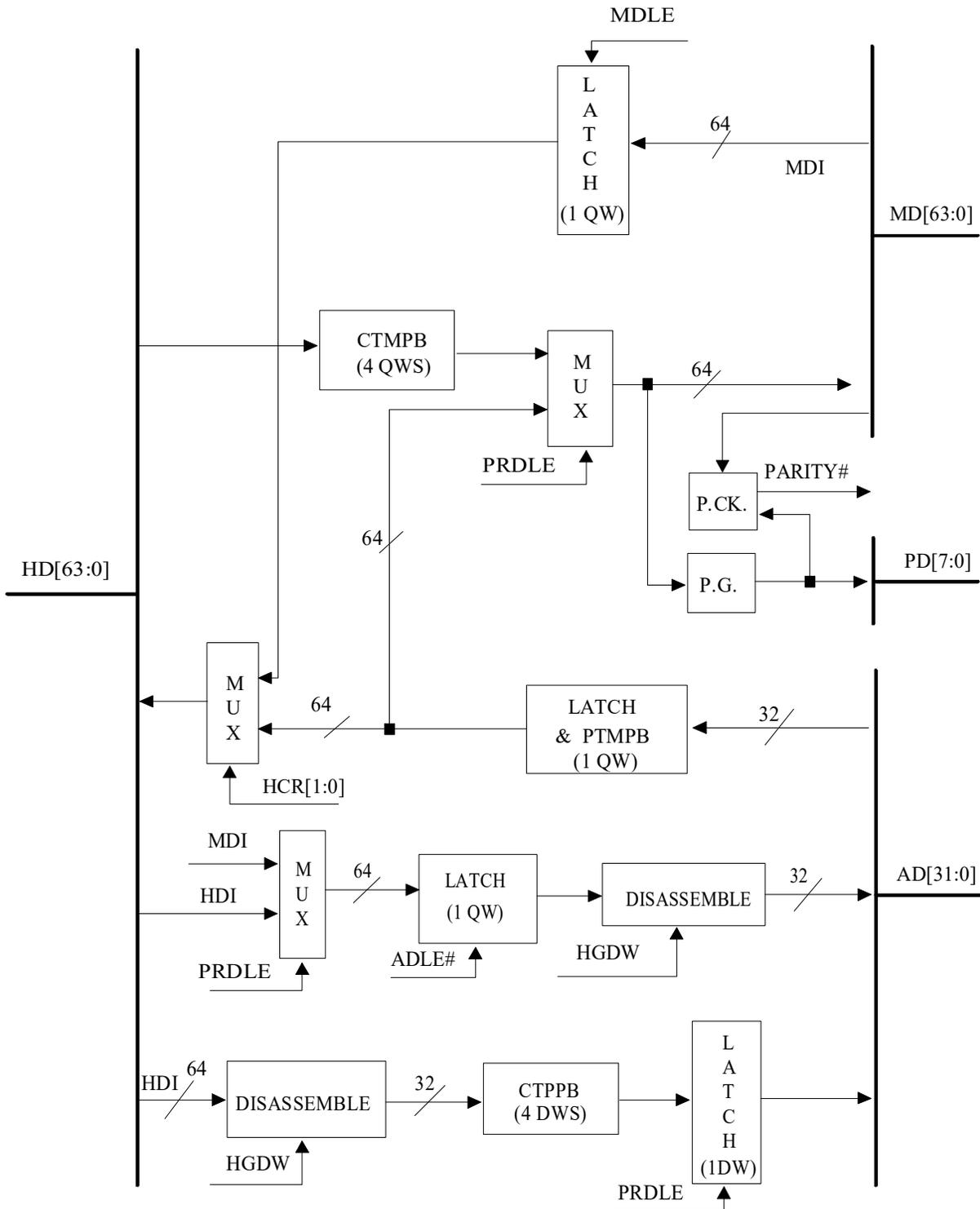


Figure 3.1 PLDB Block Diagram

3.3 Functional Description

3.3.1 Data Flow Between HD Bus and MD Bus

- **HD Bus to MD Bus**

Data flows from HD bus to MD bus when the CPU writes to local memory or the PCMC writes back a dirty line from the L2 cache to local memory in a CPU read miss/line fill cycle. All the data written to memory are first pushed into the CPMPB. The data are then popped from the buffer and written to Memory.

- **MD Bus to HD Bus**

During a CPU read local memory cycle, the data read are first latched in the 64-bit read buffer (CRMB) in order to provide enough hold time for the CPU and the L2 cache. The PLDB also checks the parity on the read data.

3.3.2 Data Flow Between HD Bus and AD Bus

- **HD Bus to AD Bus**

This path is used in the following two cases. The first case is in a CPU writes PCI slave cycle. The second case is in a PCI master read cycle that hits modified data in local cache which is implemented using write-back policy. All the CPU data sent to PCI memory slave is first pushed into the CTPPB. The data are then popped onto the PCI AD bus at later time when the PCI bus is not busy. Any further write to the PCI bus is suspended if the CTPPB is full. The I/O writes are not posted, but still exploit the CTPPB write buffer.

The path for PCI master read from the L2 cache is implemented through the PRMB, a built-in 64-bit PCI read memory buffer. Since one QW is read each time, the PCMC always sustains 1 wait state for reading the second DW.

- **AD Bus to HD Bus**

This path is exercised in two cases. The first case is during CPU reads PCI slave and the second case is during PCI master write cycles. All the CPU reads PCI cycle is stalled until the CTPPB is empty. When the CPU reads PCI slave, the data are latched and assembled in the PTMPB before they are transmitted to HD bus. During PCI master writes to local memory, the PCI data are first posted in the PTMPB. They are then transferred to local memory and host bus if the PCI master write also hits L2 cache.

3.3.3 Data Flow Between AD Bus and MD Bus

- **AD Bus to MD Bus**

Write data from PCI master is buffered in PTMPB before transferred to local memory. Parity is generated for memory write data.

- **MD Bus to AD Bus**

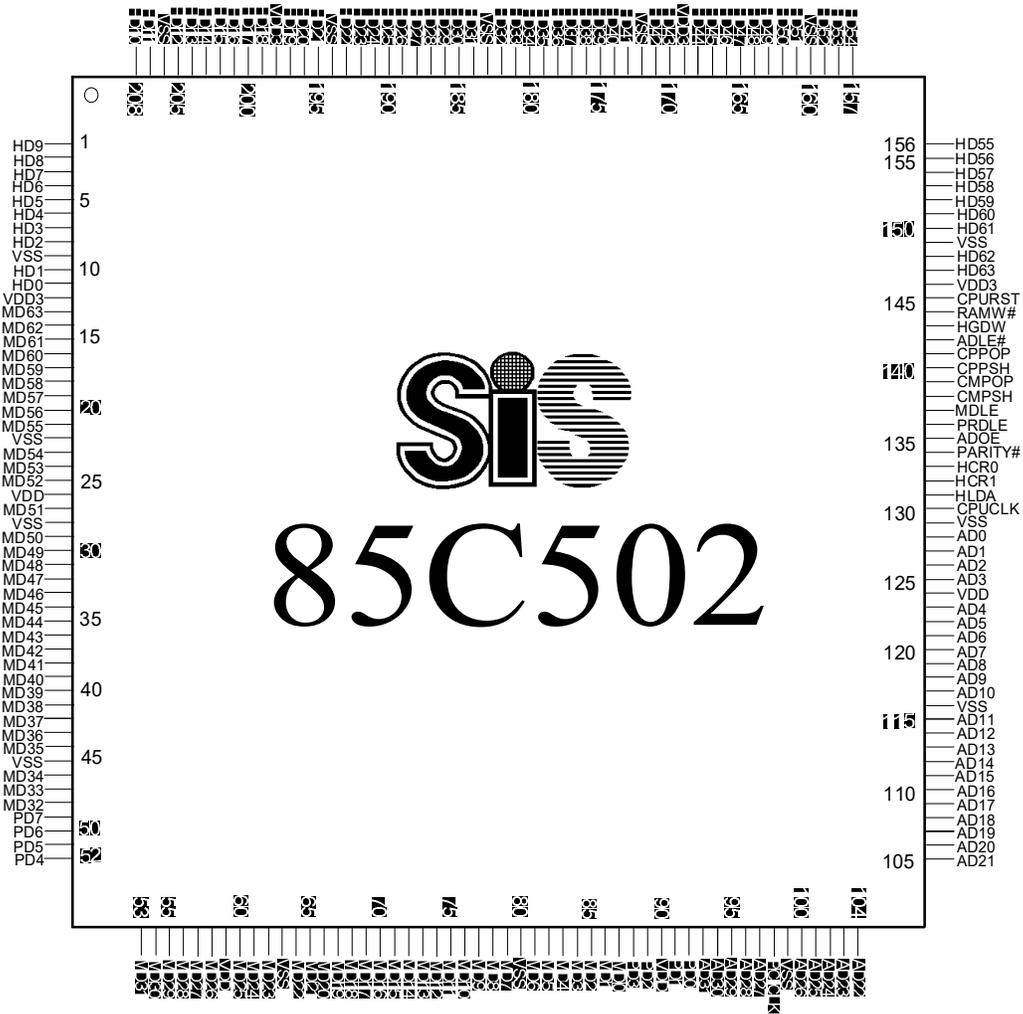
PCI masters receive data from local memory through this path. The PRMB, a 64-bit PCI read Memory buffer is implemented on this path. The read parity is ignored inside the PLDB.

**3.3.4 Address Flow and Data Flow of Basic Cycles**

| Cycles | Address Flow | Data Flow |
|-------------------------------|------------------------------|------------------|
| 1. CPU/R/PCI | HAÜ501ÜAD | ADÜ502ÜHD |
| 2. CPU/W/PCI | HAÜ501ÜAD | HDÜ502ÜAD |
| 3. CPU/R/ISA | HAÜ501ÜADÜ503Ü LA,SA | SDÜ503ÜADÜ502ÜHD |
| 4. CPU/W/ISA | HAÜ501ÜADÜ503Ü LA,SA | HDÜ502ÜADÜ503ÜSD |
| 5. CPU/R/DRAM | HAÜ501ÜMA | MDÜ502ÜHD |
| 6. CPU/W/DRAM | HAÜ501ÜMA | HDÜ502ÜMD |
| 7. CPU/R/L2 | Independent | Independent |
| 8. CPU/W/L2 | Independent | Independent |
| 9. CPU/R/PCI(master abort) | HAÜ501ÜAD | 502ÜHD |
| 10. PCI/R/L2 | ADÜ501ÜHA | HDÜ502ÜAD |
| 11. PCI/W/L2 | ADÜ501ÜHA | ADÜ502ÜHD |
| 12. PCI/R/DRAM | ADÜ501ÜHA | MDÜ502ÜAD |
| 13. PCI/W/DRAM | ADÜ501ÜHA | ADÜ502ÜMD |
| 14. ISA/R/L2 | LA,SAÜ503ÜADÜ501Ü HA | HDÜ502ÜADÜ503ÜSD |
| 15. ISA/W/L2 | LA,SAÜ503ÜADÜ501Ü HA | SDÜ503ÜADÜ502ÜHD |
| 16. DMA/R/L2 | 503ÜADÜ501ÜHA, 503Ü LA,SA | HDÜ502ÜADÜ503ÜSD |
| 17. DMA/W/L2 | 503ÜADÜ501ÜHA, 503Ü LA,SA | SDÜ503ÜADÜ502ÜHD |
| 18. ISA/R/DRAM | LA,SAÜ503ÜADÜ501Ü MA | MDÜ502ÜADÜ503ÜSD |
| 19. ISA/W/DRAM | LA,SAÜ503ÜADÜ501Ü MA | SDÜ503ÜADÜ502ÜMD |
| 20. DMA/R/DRAM | 503ÜADÜ501ÜMA, 503Ü LA,SA | MDÜ502ÜADÜ503ÜSD |
| 21. DMA/W/DRAM | 503ÜADÜ501ÜMA, 503Ü LA,SA | SDÜ503ÜADÜ502ÜMD |
| 22. ISA Refresh | 503ÜSA | |

3.4 Pin Assignment and Description

3.4.1 Pin Assignment





3.4.2 Pin Listing (# means active low)

| | | | | | |
|---------|---------|---------|----|-------------|----|
| 1=HD9 | 5V/3.3V | 48=MD32 | 5V | 95=AD29 | 5V |
| 2=HD8 | 5V/3.3V | 49=PD7 | 5V | 96=AD28 | 5V |
| 3=HD7 | 5V/3.3V | 50=PD6 | 5V | 97=AD27 | 5V |
| 4=HD6 | 5V/3.3V | 51=PD5 | 5V | 98=PCICLK | 5V |
| 5=HD5 | 5V/3.3V | 52=PD4 | 5V | 99=VSS | |
| 6=HD4 | 5V/3.3V | 53=MD31 | 5V | 100=AD26 | 5V |
| 7=HD3 | 5V/3.3V | 54=MD30 | 5V | 101=AD25 | 5V |
| 8=HD2 | 5V/3.3V | 55=MD29 | 5V | 102=AD24 | 5V |
| 9=VSS | | 56=MD28 | 5V | 103=AD23 | 5V |
| 10=HD1 | 5V/3.3V | 57=MD27 | 5V | 104=AD22 | 5V |
| 11=HD0 | 5V/3.3V | 58=MD26 | 5V | 105=AD21 | 5V |
| 12=VDD3 | 5V/3.3V | 59=VDD | 5V | 106=AD21 | 5V |
| 13=MD63 | 5V | 60=MD25 | 5V | 107=AD19 | 5V |
| 14=MD62 | 5V | 61=MD24 | 5V | 108=AD18 | 5V |
| 15=MD61 | 5V | 62=MD23 | 5V | 109=AD17 | 5V |
| 16=MD60 | 5V | 63=VSS | | 110=AD16 | 5V |
| 17=MD59 | 5V | 64=MD22 | 5V | 111=AD15 | 5V |
| 18=MD58 | 5V | 65=MD21 | 5V | 112=AD14 | 5V |
| 19=MD57 | 5V | 66=MD20 | 5V | 113=AD13 | 5V |
| 20=MD56 | 5V | 67=MD19 | 5V | 114=AD12 | 5V |
| 21=MD55 | 5V | 68=MD18 | 5V | 115=AD11 | 5V |
| 22=VSS | | 69=MD17 | 5V | 116=VSS | |
| 23=MD54 | 5V | 70=MD16 | 5V | 117=AD10 | 5V |
| 24=MD53 | 5V | 71=MD15 | 5V | 118=AD9 | 5V |
| 25=MD52 | 5V | 72=MD14 | 5V | 119=AD8 | 5V |
| 26=VDD | 5V | 73=MD13 | 5V | 120=AD7 | 5V |
| 27=MD51 | 5V | 74=MD12 | 5V | 121=AD6 | 5V |
| 28=VSS | | 75=MD11 | 5V | 122=AD5 | 5V |
| 29=MD50 | 5V | 76=MD10 | 5V | 123=AD4 | 5V |
| 30=MD49 | 5V | 77=MD9 | 5V | 124=VDD | 5V |
| 31=MD48 | 5V | 78=MD8 | 5V | 125=AD3 | 5V |
| 32=MD47 | 5V | 79=MD7 | 5V | 126=AD2 | 5V |
| 33=MD46 | 5V | 80=VSS | | 127=AD1 | 5V |
| 34=MD45 | 5V | 81=MD6 | 5V | 128=AD0 | 5V |
| 35=MD44 | 5V | 82=MD5 | 5V | 129=VSS | |
| 36=MD43 | 5V | 83=MD4 | 5V | 130=CPUCLK | 5V |
| 37=MD42 | 5V | 84=MD3 | 5V | 131=HLDA | 5V |
| 38=MD41 | 5V | 85=MD2 | 5V | 132=HCR1 | 5V |
| 39=MD40 | 5V | 86=MD1 | 5V | 133=HCR0 | 5V |
| 40=MD39 | 5V | 87=MD0 | 5V | 134=PARITY# | 5V |
| 41=MD38 | 5V | 88=PD3 | 5V | 135=ADOE | 5V |
| 42=MD37 | 5V | 89=PD2 | 5V | 136=PRDLE | 5V |
| 43=MD36 | 5V | 90=VDD | 5V | 137=MDLE | 5V |
| 44=MD35 | 5V | 91=PD1 | 5V | 138=CMPSH | 5V |
| 45=VSS | | 92=PD0 | 5V | 139=CMPOP | 5V |
| 46=MD34 | 5V | 93=AD31 | 5V | 140=CPPSH | 5V |
| 47=MD33 | 5V | 94=AD30 | 5V | 141=CPPPOP | 5V |



| | | | |
|------------|---------|----------|---------|
| 142=ADLE# | 5V | 176=HD38 | 5V/3.3V |
| 143=HGDW | 5V | 177=HD37 | 5V/3.3V |
| 144=RAMW# | 5V | 178=HD36 | 5V/3.3V |
| 145=CPURST | 5V | 179=HD35 | 5V/3.3V |
| 146=VDD3 | 5V/3.3V | 180=HD34 | 5V/3.3V |
| 147=HD63 | 5V/3.3V | 181=HD33 | 5V/3.3V |
| 148=HD62 | 5V/3.3V | 182=HD32 | 5V/3.3V |
| 149=VSS | | 183=VSS | |
| 150=HD61 | 5V/3.3V | 184=HD31 | 5V/3.3V |
| 151=HD60 | 5V/3.3V | 185=HD30 | 5V/3.3V |
| 152=HD59 | 5V/3.3V | 186=HD29 | 5V/3.3V |
| 153=HD58 | 5V/3.3V | 187=HD28 | 5V/3.3V |
| 154=HD57 | 5V/3.3V | 188=HD27 | 5V/3.3V |
| 155=HD56 | 5V/3.3V | 189=HD26 | 5V/3.3V |
| 156=HD55 | 5V/3.3V | 190=HD25 | 5V/3.3V |
| 157=HD54 | 5V/3.3V | 191=HD24 | 5V/3.3V |
| 158=HD53 | 5V/3.3V | 192=HD23 | 5V/3.3V |
| 159=HD52 | 5V/3.3V | 193=HD22 | 5V/3.3V |
| 160=VSS | | 194=VSS | |
| 161=HD51 | 5V/3.3V | 195=HD21 | 5V/3.3V |
| 162=HD50 | 5V/3.3V | 196=HD20 | 5V/3.3V |
| 163=HD49 | 5V/3.3V | 197=HD19 | 5V/3.3V |
| 164=HD48 | 5V/3.3V | 198=VDD3 | 5V/3.3V |
| 165=HD47 | 5V/3.3V | 199=HD18 | 5V/3.3V |
| 166=HD46 | 5V/3.3V | 200=HD17 | 5V/3.3V |
| 167=HD45 | 5V/3.3V | 201=HD16 | 5V/3.3V |
| 168=HD44 | 5V/3.3V | 202=HD15 | 5V/3.3V |
| 169=VDD3 | 5V/3.3V | 203=HD14 | 5V/3.3V |
| 170=HD43 | 5V/3.3V | 204=HD13 | 5V/3.3V |
| 171=HD42 | 5V/3.3V | 205=HD12 | 5V/3.3V |
| 172=VSS | | 206=VSS | |
| 173=HD41 | 5V/3.3V | 207=HD11 | 5V/3.3V |
| 174=HD40 | 5V/3.3V | 208=HD10 | 5V/3.3V |
| 175=HD39 | 5V/3.3V | | |



3.4.3 Pin Description

| Pin No. | Symbol | Type | Function |
|--|----------|------|--|
| 147,148 150-159 161-168 170,171 173-182 184-193 195-197 199-205 207,208 1-8,10,11 | HD[63:0] | I/O | CPU data bus. |
| 13-21,23- 25, 27,29- 44,46-48, 53-58 60-62,64- 79, 81-87 | MD[63:0] | I/O | Memory data bus. |
| 93-97, 100-115, 117-123 125-128 | AD[31:0] | I/O | PCI address/data bus. |
| 91,92,49- 52, 88,89 | PD[7:0] | I/O | Parity bit bus. |
| 134 | PARITY# | O | Parity Error signal. |
| 135 | ADOE | I | Drive PCI AD bus. This signal is used to enable the 85C502 to drive PCI AD bus. It is asserted in CPU writes PCI or PCI master reads local memory cycles. |
| 131 | HLDA | I | Hold Acknowledge is asserted in response to the assertion of CPUHLDA. |
| 137 | MDLE | I | Memory data Read Latch Enable. This signal latches the data on the MD bus when negated. |
| 142 | ADLE# | I | AD Bus Data Latch Enable. This signal has the following functions: 1. Latch HD or MD data into the PCI read buffer (PRMB) 2. Latch AD data into CPU read PCI buffer on the rising edge of PCICLK1. 3. Latch AD data into PCI posted write buffer (PTMPB) on the rising edge of PCICLK1. |



| | | | |
|------------------|----------|---|--|
| 140 | CPPSH | I | Push Post Write Data into the CTPPB of the 85C502. The data on the HD bus is latched into the CTPPB on CPPSH rising edge. The edge also increases the write pointer to the next available loading entry in the buffer. |
| 141 | CPPOP | I | On the rising edge of CPPPOP, the read pointer is changed to address the next available reading location. |
| 138 | CMPSH | I | When this signal is asserted, the data on the HD bus is written into the CPU to memory posted write buffer (CTMPB) on the rising edge of CPUCLK, and the write pointer is also changed to address the next available location. |
| 139 | CMPOP | I | When this signal is asserted, the read pointer of the CTMPB is increased on the rising edge of CPUCLK. |
| 136 | PRDLE | I | This signal latches the current output entry of the CTPPB, the CPU to PCI post write buffer, into the prelatck in the 85C502. The output of the prelatck is driven to the PCI AD bus. In the PCI master cycles, PRDLE is also asserted when PCI master is reading data from the secondary cache, or when PCI master is writing data to local memory. |
| 143 | HGDW | I | High Double Word Indicator. The signal is driven high by the 85C501 when : (1) a high DW from HD bus is written into CPU to PCI Posted Write Buffer, (2) the CPU reads a high DW from PCI bus, (3) PCI master writes a high DW to local memory, (4) PCI master reads a high DW from local memory. |
| 132,133 | HCR[1:0] | I | Host Data Bus Control. These signals are driven by the 85C501 and they are used to control the 85C502 HD[63:0] bus. They are defined as: 00: 502 floats HD bus 01: 502 drives FFFFFFFF to HD bus 10: 502 drives data from AD bus to HD bus 11: 502 drives data from MD bus to HD bus |
| 144 | RAMW# | I | DRAM Write Enable. |
| 145 | CPURST | I | CPU Reset. |
| 130 | CPUCLK | I | CPU Clock. |
| 98 | PCICLK | I | PCI Bus Clock. |
| 26,59,90, 124 | VDD | | +5V DC power |



| | | | |
|--|------|--|--|
| 12, 146, 169, 198 | VDD3 | | +3.3V DC power in 3V system +5V DC power in 5V system |
| 9,22,28,45 ,63,80,99, 116,129, 149,160 172,183, 194,206 | VSS | | Ground |



3.5 Electrical Characteristics

3.5.1 Absolute Maximum Ratings

| Parameter | Min | Max | Unit |
|-------------------------------|------|-----|------|
| Ambient operating temperature | 0 | 70 | °C |
| Storage temperature | -40 | 125 | °C |
| Input voltage | -0.3 | 5.5 | V |
| Output voltage | -0.5 | 5.5 | V |
| Power Dissipation | | 1 | W |

Note:

Stress above these listed may cause permanent damage to device. Functional operation of this device should be restricted to the conditions described under operating conditions.

3.5.2 DC Characteristics

TA = 0 - 70 °C, VSS = 0V, VDD=5V±5%, VDD3=3.3V±5%

| Symbol | Parameter | Min | Max | Unit | Condition |
|------------------|------------------------------|------|-----------|------|---------------------------|
| V _{IL1} | Input Low Voltage | -0.3 | 0.8 | V | Note 1 , VDD3=3.3V |
| V _{IH1} | Input High Voltage | 2.2 | VDD3+0.3V | V | Note 1 |
| V _{IL2} | Input Low Voltage | -0.3 | 0.8 | V | Note 2 |
| V _{IH2} | Input High Voltage | 2.2 | VDD+0.3 | V | Note 2 |
| V _{OL1} | Output Low Voltage | | 0.45 | V | Note 3 |
| V _{OH1} | Output High Voltage | 2.4 | | V | Note 3 |
| V _{OL2} | Output Low Voltage | | 0.4 | V | Note 4 |
| V _{OH2} | Output High Voltage | 2.0 | VDD3 | V | Note 4 |
| I _{OL1} | Output Low Current | 4 | | mA | Note 5 |
| I _{OH1} | Output High Current | 4 | | mA | Note 5 |
| I _{IH} | Input Leakage Current | | +10 | mA | |
| I _{IL} | Input Leakage Current | | -10 | mA | |
| C _{IN} | Input Capacitance | | 12 | pF | Fc=1 Mhz |
| C _{OUT} | Output Capacitance | | 12 | pF | Fc=1 Mhz |
| C _{I/O} | I/O Capacitance | | 12 | pF | Fc=1 Mhz |
| ICC3 | Power Supply Current of VDD3 | | 27 | mA | 3.3V, 66MHz |

**Note:**

1. V_{IL1} and V_{IH1} apply to the following signals: HD[63:0].
2. V_{IL2} and V_{IH2} apply to the following signals: MD[63:0], AD[31:0], CPURST, PD[7:0], CPUCLK, ADOE, HLDA, HCR[1:0], PRDLE, MDLE, CMPSH, CMPOP, CPPSH, CPPOP, ADLE#, HGDW, RAMW#.
3. V_{OL1} and V_{OH1} apply to the following signals: MD[63:0], AD[31:0], PD[7:0], PARITY#.
4. V_{OL2} and V_{OH2} apply to the following signals: HD[31:0].
5. I_{OL1} and I_{OH1} apply to the following signals: HD[63:0], MD[63:0], AD[31:0], PD[7:0], PARITY#.

3.5.3 AC Characteristics

| Symbol | Parameter | Min | Typ | Max | Fig |
|--------|--|-----|-----|-----|----------|
| T1 | MD Data Setup Time to MDLE falling | | 6 | | 3.2, 3.9 |
| T2 | MD Data Hold Time to MDLE falling | 2 | | | 3.2, 3.9 |
| T3 | HD Data Valid Delay from MD data valid | 10 | 15 | | 3.2 |
| T4 | ADLE# Setup Time to PCICLK rising | 6 | | | 3.3,3.8 |
| T5 | ADLE# Hold Time to PCICLK rising | 2 | | | 3.3,3.8 |
| T6 | HGDW Setup Time to PCICLK rising | 6 | | | 3.3,3.8 |
| T7 | HGDW Hold Time to PCICLK rising | 2 | | | 3.3,3.8 |
| T8 | AD Data Setup Time to PCICLK rising | 6 | | | 3.3,3.8 |
| T9 | AD Data Hold Time to PCICLK rising | 2 | | | 3.3,3.8 |
| T10 | HD Data Valid Delay from PCICLK rising | 10 | 15 | | 3.3,3.8 |
| T11 | CMPSH Setup Time to CPUCLK rising | 6 | | | 3.4 |
| T12 | CMPSH Hold Time to CPUCLK rising | 2 | | | 3.4 |
| T13 | CMPOP Setup Time to CPUCLK rising | 6 | | | 3.4 |
| T14 | CMPOP Hold Time to CPUCLK rising | 2 | | | 3.4 |
| T15 | HD Data Setup Time to CPPSH rising | 6 | | | 3.4,3.5 |
| T16 | HD Data Hold Time to CPPSH rising | 2 | | | 3.4,3.5 |
| T17 | MD Data Valid Delay from CPUCLK rising | 12 | 20 | | 3.4 |
| T18 | PD Data Valid Delay from CPUCLK rising | 15 | 25 | | 3.4 |
| T19 | RAMW# Setup Time to MDLE rising | | | | 3.7 |
| T20 | RAMW# Hold Time to MDLE falling | | | | 3.7 |
| T21 | PARITY# Active Delay from MDLE falling | 6 | 9 | | 3.7 |
| T22 | AD Data Valid from PRDLE rising | 7 | 11 | | 3.6 |
| T23 | AD Data Valid from MD data valid | 12 | 18 | | 3.10 |
| T24 | HGDW Setup Time to CPPSH rising | 6 | | | 3.5 |
| T25 | HGDW Hold Time to CPPSH rising | 2 | | | 3.5 |
| T26 | MD Data Valid Delay from PCICLK rising | 12 | 18 | | 3.8 |
| T27 | PD Data Valid Delay from PCICLK rising | 15 | 23 | | 3.8 |
| T28 | HD Data Setup Time to ADLE# falling | 6 | | | 3.9 |
| T29 | HD Data Hold Time to ADLE# falling | 2 | | | 3.9 |
| T30 | AD Data Valid Delay from HD data valid | 12 | 18 | | 3.9 |

| | | | | | |
|-----|---|----|-----|----|------|
| T31 | MD Output Delay from RAMW# asserted | 5 | 7.5 | | 3.11 |
| T32 | MD Output Float Delay from RAMW# inactive | 25 | 43 | | 3.11 |
| T33 | AD Output Delay from ADOE asserted | 4 | 6 | | 3.12 |
| T34 | AD Output Float Delay from ADOE inactive | | | 26 | 3.12 |
| T35 | HD Output Delay from HCR asserted | 6 | 9 | | 3.13 |
| T36 | HD Output Float Delay from HCR inactive | | | | 3.13 |

Unit :ns

3.5.4 AC Timing Diagram

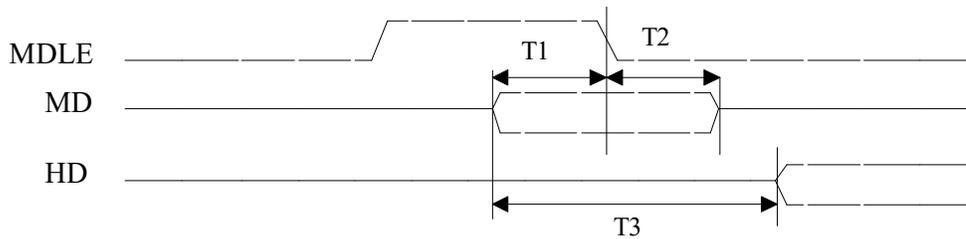


Figure 3.2 CPU Read DRAM Cycle

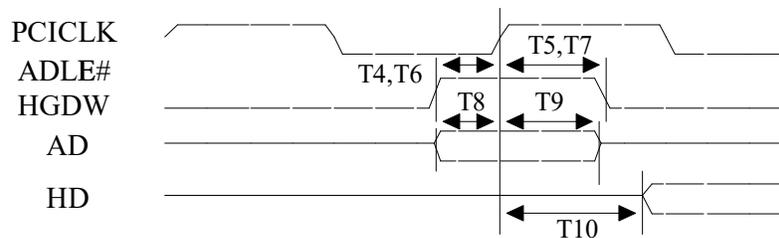


Figure 3.3 CPU Read PCI Slave Cycle

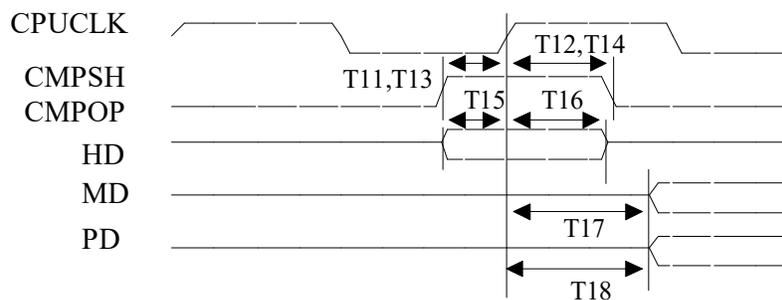


Figure 3.4 CPU Write DRAM Cycle

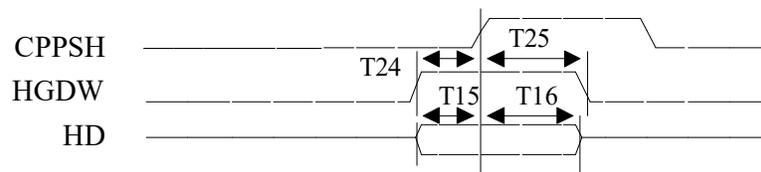


Figure 3.5 CPU Write PCI Post Write Buffer

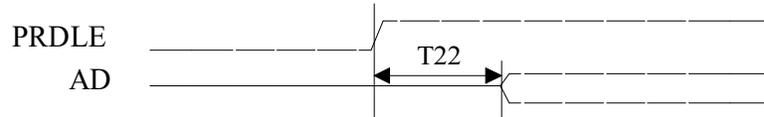


Figure 3.6 Write Posted Data onto PCI Bus

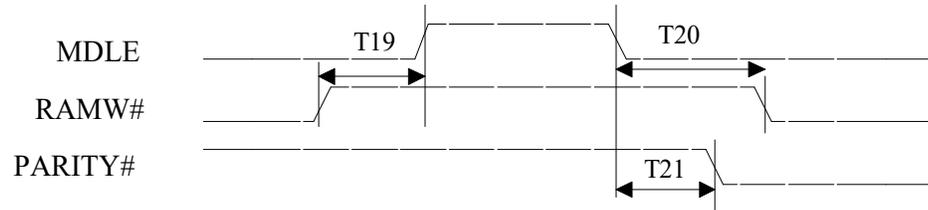


Figure 3.7 PARITY# Generation Reading DRAM Cycle

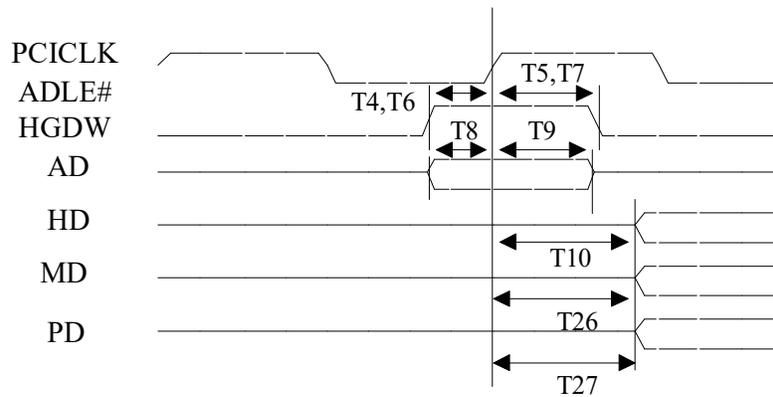


Figure 3.8 CPU Read PCI Slave Cycle

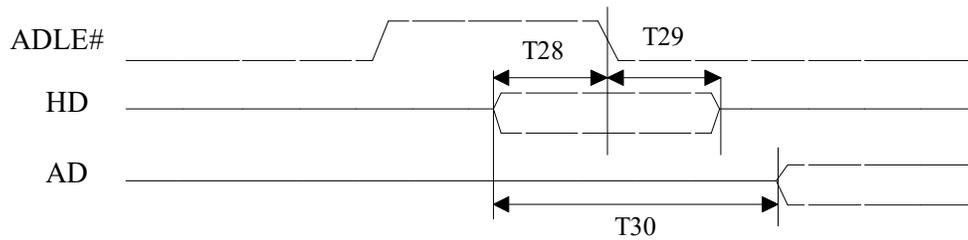


Figure 3.9 PCI Master Read Secondary Cache

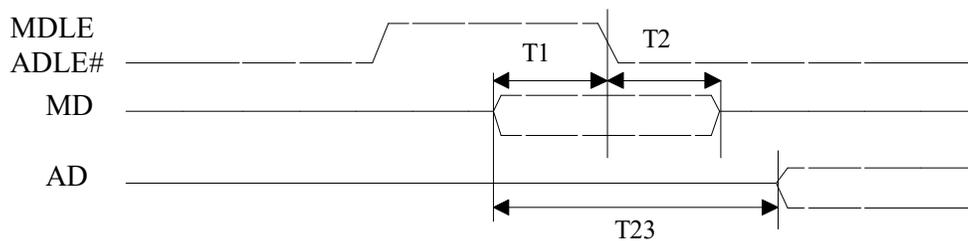


Figure 3.10 PCI Master Read DRAM

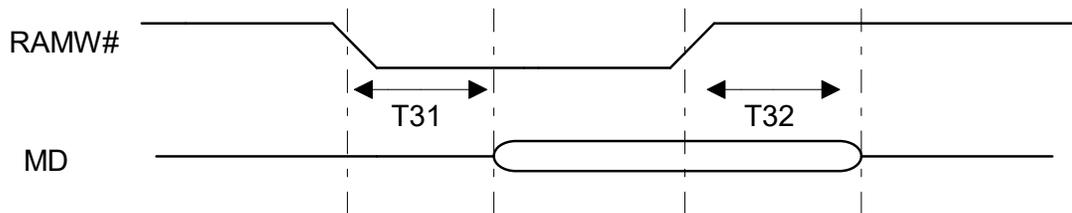


Figure 3.11 CPU Write DRAM Cycle

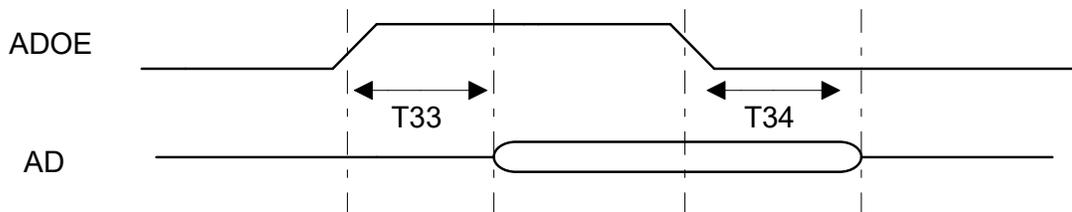


Figure 3.12 Write Posted Data onto PCI Bus

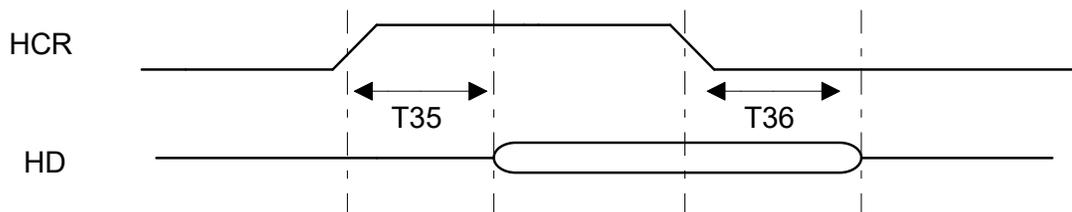


Figure 3.13 CPU Read DRAM or PCI Cycle

4 SiS85C503

4.1 Features

- **Integrated Bridge Between PCI Bus and ISA Bus**
 - Translates PCI Bus Cycles into ISA Bus Cycles
 - Translates ISA Master or DMA Cycles into PCI Bus Cycles
 - Provides PCI-to-ISA Memory one DoubleWord Posted Write Buffer
- **Integrated ISA Bus Compatible Logic**
 - ISA Bus Controller
 - ISA Arbiter for ISA Master, DMA Devices, and Refresh
 - Built-in Two 8237 Compatible DMA Controllers
 - Built-in Two 8259A Compatible Interrupt Controllers
 - Built-in One 8254 Timer
- **Supports Reroutibility of four PCI Interrupts to Any Unused IRQ Interrupt**
- **Supports Flash ROM**
- **160-Pin PQFP**
- **0.6 μ m CMOS Technology**

4.2 Functional Description

The SiS85C503 is a highly integrated PCI/ISA system I/O (PSIO) device that integrates all the necessary system control logic used in PCI/ISA specific applications. The SiS85C503 consists of: a PCI bridge that translates PCI cycles onto ISA bus, and ISA master/DMA device cycles onto PCI bus; a seven-channel programmable DMA Controller, a sixteen-level programmable interrupt controller, and a programmable timer with three counters.

4.2.1. PCI Bridge

The SiS85C503 PCI bus interface provides the interface between PSIO and the PCI bus. It contains both PCI master and slave bridge to the PCI bus. When SIOGNT# is asserted, the master bridge translates the ISA master or DMA cycles onto the PCI bus based on the decoding status from ISA address decoder. When SIOGNT# is negated, the slave bridge accepts these cycles initiated on the PCI bus targeted to the PSIO internal registers or ISA bus, and then forwards the cycles to the ISA Bus Interface that further translates them onto the ISA Bus. The PCI address decoder provides the information on which the slave bridge depends to respond and process the cycle initiated by PCI Masters.

PCI Slave Bridge

As a PCI slave, PSIO responds to both I/O and memory transfers. PSIO always target-terminates after the first data phase for any bursting cycle.

SiS85C503 always converts the single interrupt acknowledge cycle (from 501) into two cycles that the internal 8259 pair can respond to.

The PSIO is assigned as the subtractive decoder in the Bus 0 of the SiS PCI/ISA system by accepting all accesses not positively decoded by some other agent. In reality, the PSIO only subtractively responds to low 64K I/O or low 16M memory accesses. PSIO also positively decodes I/O addresses for internal registers, and BIOS memory space by asserting DEVSEL# on the medium timing.

PCI Master Bridge

As long as SIOGNT# is asserted, the PCI master bridge on behalf of DMA devices or ISA Masters starts to drive the AD bus, C/BE[3:0]# and PAR signal. When MRDC# or MWTC# is asserted, the PSIO will generate FRAME#, and IRDY# to PCI bus if the targeted memory is not on the ISA side. The valid address and command are driven during the address phase, and PAR is asserted one clock after that phase. PSIO always activated FRAME# for 2 PCLKs because it does not conduct any bursting cycle.

The ISA address decoder is used to determine the destination of ISA master or DMA devices. This decoder provides the following options as they are defined in configuration registers 48 to 4B.

- a. Memory: 0-512K
- b. Memory: 512K-640K
- c. Memory: 640K-768K(video buffer)
- d. Memory: 768K-896K in eight 16K sections(Expansion ROM)
- e. Memory: 896K-960K(lower BIOS area)
- f. Memory: 1M-XM-16M within which a hole can be opened. Access to the hole is not forwarded to PCI bus.
- g. Memory:>16Mb automatically forwards to PCI.

4.2.2 ISA Bus Controller

The SiS85C503 ISA Bus Interface accepts those cycles from PCI bus interface and then translates them onto the ISA bus. It also requests the PCI master bridge to generate PCI cycle on behalf of DMA or ISA master. The ISA bus interface thus contains a standard ISA Bus Controller and a Data Buffering logic. IBC provides all the ISA control, such as ISA command generation, I/O recovery control, wait-state insertion, and data buffer steering. The PCI to/from ISA address and data bus bufferings are also all integrated in SiS85C503. The SiS85C503 can directly support six ISA slots without external data or address buffering.

Standard ISA bus refresh is requested by Counter 1, and then performed via the IBC. IBC generates the pertinent command and refreshes address to the ISA bus. Since the ISA refresh is transparent to the PCI bus and the DMA cycle, an arbiter is employed to resolve the possible conflicts among PCI cycles, refresh cycles, and DMA cycles.



4.2.3 DMA Controller

The SiS85C503 contains a seven-channel DMA controller. The channel 0 to 3 is for 8-bit DMA devices while channel 5 to 7 is for 16-bit devices. The channels can also be programmed for any of the four transfer modes, which include single, demand, block, and cascade. Except in cascade mode, each of the three active transfer modes can perform three different types of transfers, which include read, write, and verify. The address generation circuitry in SiS85C503 can only support 24-bit address for DMA devices.

4.2.4 Interrupt Controller

The SiS85C503 provides an ISA compatible interrupt controller that incorporates the functionality of two 82C59 interrupt controllers. The two controllers are cascaded so that 14 external and two internal interrupts are supported. The master interrupt controller provides IRQ<7:0> and the slave one provides IRQ<15:8>. The two internal interrupt are used for internal functions only and are not available externally. IRQ2 is used to cascade the two controllers together and IRQ0 is used as a system timer interrupt and is tied to interval Counter 0. The remaining 14 interrupt lines are available for external system interrupts.

| Priority | Label | Controller | Typical Interrupt Source |
|----------|-------|------------|---|
| 1 | IRQ0 | 1 | Timer/Counter 0 Out |
| 2 | IRQ1 | 1 | Keyboard |
| 3-10 | IRQ2 | 1 | Interrupt from Controller 2 |
| 3 | IRQ8# | 2 | Real Time Clock |
| 4 | IRQ9 | 2 | Expansion bus pin B04 |
| 5 | IRQ10 | 2 | Expansion bus pin D03 |
| 6 | IRQ11 | 2 | Expansion bus pin D04 |
| 7 | IRQ12 | 2 | Expansion bus pin D05 |
| 8 | IRQ13 | 2 | Coprocessor Error Ferr# |
| 9 | IRQ14 | 2 | Fixed Disk Drive Controller Expansion bus pin D07 |
| 10 | IRQ15 | 2 | Expansion bus pin D06 |
| 11 | IRQ3 | 1 | Serial port 2, Expansion Bus B25 |
| 12 | IRQ4 | 1 | Serial port 1, Expansion Bus B24 |
| 13 | IRQ5 | 1 | Parallel Port 2, Expansion Bus B23 |
| 14 | IRQ6 | 1 | Diskette Controller, Expansion Bus B22 |
| 15 | IRQ7 | 1 | Parallel Port, Expansion Bus B21 |

In addition to the ISA features, the ability to do interrupt sharing is included. Two registers(ECLR) located at 4D0h and 4D1h are defined to allow edge or level sense selection to be made on an individual channel by channel basis instead of on a complete bank of channels. Note that the default of IRQ0, IRQ1, IRQ2, IRQ8# and IRQ13 is edge sensitive, and can not be programmed. Also, each PCI Interrupt(INTx#) can be programmed independently to route to one of the eleven ISA compatible interrupts(IRQ<7:3>, IRQ<15:14>, and IRQ<12:9>) through configuration registers 41h to 44h.

4.2.5 Timer/Counter

The SiS85C503 contains 3 channel counter/timer that is equivalent to those found in the 82C54 programmable interval timer. The counters use a division of 14.31818MHz OSC input as the clock source. The outputs of the timers are directed to key system functions. Counter 0 is connected to the interrupt controller IRQ0 and provides a system timer interrupt for a time-of-day, diskette time-out, or the other system timing function. Counter 1 generates a refresh-request signal and Counter 2 generates the tone for the speaker.

4.3 Functional Block Diagram

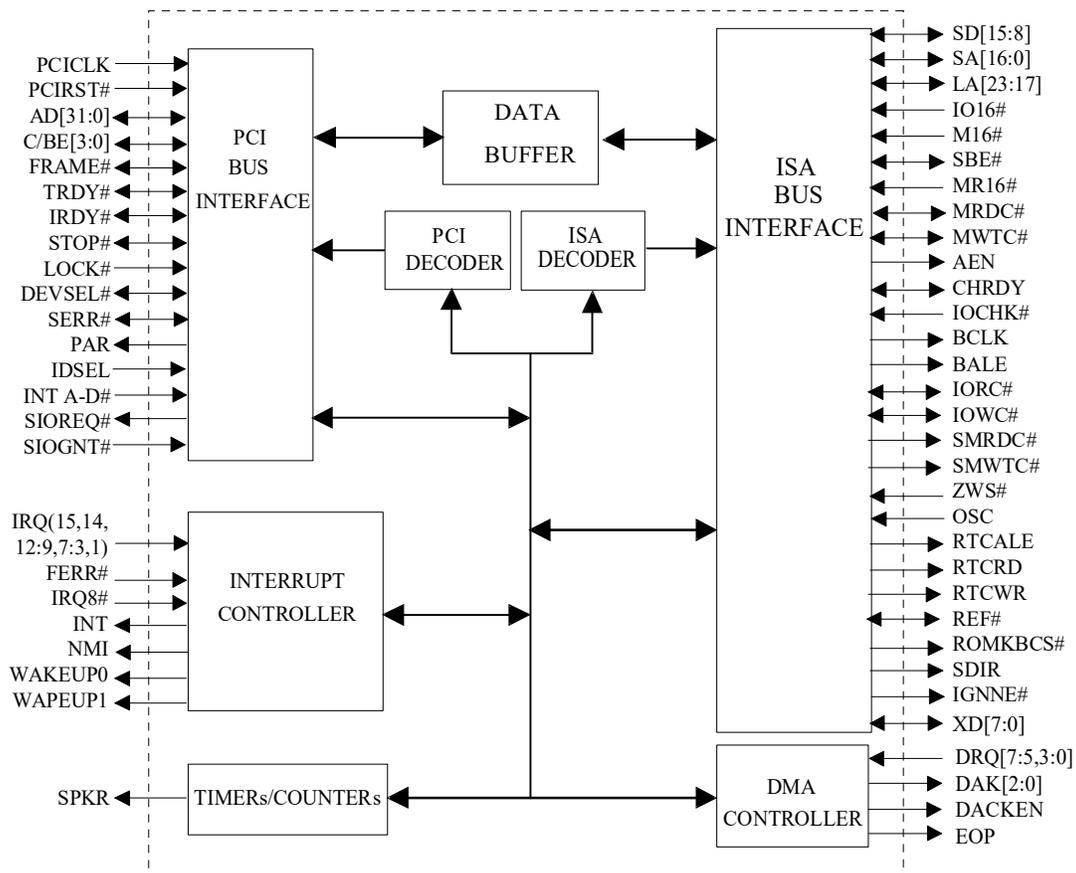


Figure 4.1 SiS85C503 Functional Block Diagram



4.4 Configuration Registers

Registers 00h, 01h Vendor ID

Bits 15:0 = 1039h (Read Only)

Registers 02h, 03h Device ID

Bits 15:0 = 0008h (Read Only)

Registers 04h, 05h Command = 07h

Bits 15:4 Reserved. Read as 0's

Bit 3 Monitor Special Cycle Enable = 0

Bit 2 Behave as Bus Master Enable = 1

Bit 1 Respond to Memory Space Accesses = 1

Bit 0 Respond to I/O Space Accesses = 1

Registers 06h, 07h Status

Bits 15:14 Reserved. Read as 0's

Bit 13 Received Master-Abort

When the 85C503 generates a master-abort, this bit is set to a 1. This bit is cleared to 0 by writing a 1 to this bit.

Bit 12 Received Target-Abort

When the 85C503 receives a target-abort, this bit is set to a 1. Software clears this bit to 0 by writing a 1 to this bit location.

Bit 11 Reserved. Read as a 0

Bits 10:9 DEVSEL# Timing

The 85C503 always generates DEVSEL# with medium timing, these two bits are always set to 01.

Bits 8:0 Reserved. Read as 0's.

Register 08h Revision ID

Bits 7:0 = 00h (Read Only)

Register 0B-09h Class Code

Bits 23:0 060100h (Read Only)

Register 40h BIOS Control Register

Bit 7 Reserved. Read as a 0.



Bit 6 **Reserved. Read as a 0.**

Bit 5

When ISA MASTER retries, Arbiter deasserts SIOGNT#. This bit defaults to 0.

Bit 4 **PCI Posted Write Buffer Enable**

The default value is 0 (disabled).

Bits [3:0] determine how the 85C503 responds to F segment, E segment, and extended segment (FFF80000-FFFDFFFF) accesses. 85C503 will positively respond to extended segment access when bit 0 is set. Bit 1, combining with bits [3:2], enables 85C503 to respond to E segment access.

Bit 3 **Positive Decode of Upper 64K BYTE BIOS Enable.**

Bit 2 **BIOS Subtractive Decode Enable.**

| bits [3:2] | F segment | | E segment | | comment |
|---------------|-----------|---|-----------|---|--|
| | + | - | + | - | |
| 00 | | | √* | | 503 positively responds to E segment access. |
| 01 | | √ | | | 503 subtractively responds to F segment access. |
| 10 | √ | | √* | | 503 positively responds to E and F segment access. |
| 11 | √ | | | | 503 positively responds to F segment access. |

*: enabled if bit 1 is set.

Bit 1 **Lower BIOS Enable.**

Bit 0 **Extended BIOS Enable. (FFF80000~FFFDFFFF)**

Register 41h **INTA# Remapping Control Register**

Bit 7 **Remapping Control**

When enabled, INTA#, is remapped to the PC compatible interrupt signal specified in IRQ remapping table. This bit is set to 1 after reset.

0: Enable

1: Disable

Bits 6:4 **Reserved. Read as 0's.**

Bits 3:0 **IRQx Remapping table.**

| | | | | | | | |
|------|----------|------|----------|------|----------|------|-------|
| Bits | IRQx# | Bits | IRQx# | Bits | IRQx# | Bits | IRQx# |
| 0000 | reserved | 0101 | IRQ5 | 1010 | IRQ10 | 1111 | IRQ15 |
| 0001 | reserved | 0110 | IRQ6 | 1011 | IRQ11 | | |
| 0010 | reserved | 0111 | IRQ7 | 1100 | IRQ12 | | |
| 0011 | IRQ3 | 1000 | reserved | 1101 | reserved | | |



| | | | | | |
|------|------|------|------|------|-------|
| 0100 | IRQ4 | 1001 | IRQ9 | 1110 | IRQ14 |
|------|------|------|------|------|-------|

Register 42h INTB# Remapping Control Register

- Bit 7** Remapping Control
- Bits 6:4** Reserved. Read as 0's.
- Bits 3:0** IRQ Remapping table.

Register 43h INTC# Remapping Control Register

- Bit 7** Remapping Control
- Bits 6:4** Reserved. Read as 0's.
- Bits 3:0** IRQ Remapping table.

Register 44h INTD# Remapping Control Register

- Bit 7** Remapping Control
- Bits 6:4** Reserved. Read as 0's.
- Bits 3:0** IRQ Remapping table.

Note: The difference INT[A:D]# can be remapped to the same IRQ signal, but this IRQ signal should be set to level sensitive.

Register 48h ISA Master/DMA Memory Cycle Control Register 1

The ISA master or DMA memory access cycles will be forwarded to PCI bus when the address fall within the programmable region defined by bits[7:4]. The base address of the programmable region is 1MByte, and the top addresses is programmed in 1MByte increments from 1MByte to 16MByte. All memory cycles will be forwarded to PCI bus besides the cycle fall within memory hole defined in register 4Ah and 4Bh.

Bits 7:4

| Bits | 7 | 6 | 5 | 4 | Top of Memory |
|------|---|---|---|---|---------------|
| | 0 | 0 | 0 | 0 | 1 MByte |
| | 0 | 0 | 0 | 1 | 2 MByte |
| | 0 | 0 | 1 | 0 | 3 MByte |
| | 0 | 0 | 1 | 1 | 4 MByte |
| | 0 | 1 | 0 | 0 | 5 MByte |
| | 0 | 1 | 0 | 1 | 6 MByte |
| | 0 | 1 | 1 | 0 | 7 MByte |
| | 0 | 1 | 1 | 1 | 8 MByte |



| | | | | |
|---|---|---|---|----------|
| 1 | 0 | 0 | 0 | 9 MByte |
| 1 | 0 | 0 | 1 | 10 MByte |
| 1 | 0 | 1 | 0 | 11 MByte |
| 1 | 0 | 1 | 1 | 12 MByte |
| 1 | 1 | 0 | 0 | 13 MByte |
| 1 | 1 | 0 | 1 | 14 MByte |
| 1 | 1 | 1 | 0 | 15 MByte |
| 1 | 1 | 1 | 1 | 16 MByte |

ISA master and DMA memory cycles to the following memory regions will be forwarded to PCI bus if they are enabled.

Bit 3 896-960KByte Memory Region

0: Disable

1: Enable, the cycle is forwarded to PCI bus.

Bit 2 640-768KByte memory Region

0: Disable

1: Enable, the cycle is forwarded to PCI bus.

Bit 1 512-640KByte Memory Region

0: Disable

1: Enable

The cycle is forwarded to PCI bus.

Bit 0 0-512KByte Memory Region

0: Disable

1: Enable

The cycle is forwarded to PCI bus.

Register 49h ISA Master/DMA Memory Cycle Control Register 2

ISA master and DMA memory cycles to the following memory regions will be forwarded to PCI bus if they are enabled.

Bit 7 880-896K (DC000h-DCFFFh) Memory region

0: Disable

1: Enable

Bit 6 864-880K (D8000h-D8FFFh) Memory Region

0: Disable



- 1: Enable
- Bit 5** **848-864K (D4000h-D7FFFh) Memory Region**
- 0: Disable
- 1: Enable
- Bit 4** **832-848K (D0000h-D3FFFh) Memory Region**
- 0: Disable
- 1: Enable
- Bit 3** **816-832K (CC000h-CFFFFh) Memory Region**
- 0: Disable
- 1: Enable
- Bit 2** **800-816K (C8000h-CBFFFh) Memory Region**
- 0: Disable
- 1: Enable
- Bit 1** **784-800K (C4000h-C7FFFh) Memory Region**
- 0: Disable
- 1: Enable
- Bit 0** **768-784K (C0000h-C3FFFh) Memory Region**
- 0: Disable
- 1: Enable

Register 4Ah **ISA Master/DMA Memory Cycle Control Register 3**

Register 4Ah and register 4Bh are used to define the ISA address hole. The ISA address hole is located between 1Mbyte and 16MByte, and sized in 64KByte increments. ISA master and DMA memory cycles fall within this hole will not be forwarded to PCI bus. Register 4Ah and 4Bh are used to define the bottom and top address of the hole respectively. The hole is located between top and bottom address, and the bottom and top address must be at or above 1MByte. If bottom address is greater than top address, the ISA address hole is disabled.

- Bit 7** **A23**
- Bit 6** **A22**
- Bit 5** **A21**
- Bit 4** **A20**
- Bit 3** **A19**
- Bit 2** **A18**



Bit 1 **A17**

Bit 0 **A16**

Register 4Bh ISA Master/DMA Memory Cycle Control Register 4

This register is used to define the top address of the ISA Address hole.

Bit 7 **A23**

Bit 6 **A22**

Bit 5 **A21**

Bit 4 **A20**

Bit 3 **A19**

Bit 2 **A18**

Bit 1 **A17**

Bit 0 **A16**



4.5 Non-Configuration Registers

DMA Registers

These register can be accessed from PCI bus.

| Address | Attribute | Register Name |
|---------|-----------|---|
| 0000h | R/W | DMA1 CH0 Base and Current Address Register |
| 0001h | R/W | DMA1 CH0 Base and Current Count Register |
| 0002h | R/W | DMA1 CH1 Base and Current Address Register |
| 0003h | R/W | DMA1 CH1 Base and Current Count Register |
| 0004h | R/W | DMA1 CH2 Base and Current Address Register |
| 0005h | R/W | DMA1 CH2 Base and Current Count Register |
| 0006h | R/W | DMA1 CH3 Base and Current Address Register |
| 0007h | R/W | DMA1 CH3 Base and Current Count Register |
| 0008h | R/W | DMA1 Status(r) Command(w) Register |
| 0009h | WO | DMA1 Request Register |
| 000Ah | WO | DMA1 Write Single Mask Bit |
| 000Bh | WO | DMA1 Mode Register |
| 000Ch | WO | DMA1 Clear Byte Pointer |
| 000Dh | WO | DMA1 Master Clear |
| 000Eh | WO | DMA1 Clear Mask Register |
| 000Fh | R/W | DMA1 Write All Mask Bits(w) Mask Status Register(r) |
| 00C0h | R/W | DMA2 CH0 Base and Current Address Register |
| 00C2h | R/W | DMA2 CH0 Base and Current Count Register |
| 00C4h | R/W | DMA2 CH1 Base and Current Address Register |
| 00C6h | R/W | DMA2 CH1 Base and Current Count Register |
| 00C8h | R/W | DMA2 CH2 Base and Current Address Register |
| 00CAh | R/W | DMA2 CH2 Base and Current Count Register |
| 00CCh | R/W | DMA2 CH3 Base and Current Address Register |
| 00CEh | R/W | DMA2 CH3 Base and Current Count Register |
| 00D0h | R/W | DMA2 Status(r) Command(w) Register |
| 00D2h | WO | DMA2 Request Register |
| 00D4h | WO | DMA2 Write Single Mask Bit Register |
| 00D6h | WO | DMA2 Mode Register |
| 00D8h | WO | DMA2 Clear Byte Pointer |
| 00DAh | WO | DMA2 Master Clear |
| 00DCh | WO | DMA2 Clear Mask Register |
| 00DEh | R/W | DMA2 Write All Mask Bits(w) Mask Status Register(r) |

These registers can be accessed from PCI bus or ISA bus.

| Address | Attribute | Register Name |
|---------|-----------|---------------------------------|
| 0080h | R/W | Reserved |
| 0081h | R/W | DMA Channel 2 Low Page Register |
| 0082h | R/W | DMA Channel 3 Low Page Register |
| 0083h | R/W | DMA Channel 1 Low Page Register |



| | | |
|-------|-----|---------------------------------|
| 0084h | R/W | Reserved |
| 0085h | R/W | Reserved |
| 0086h | R/W | Reserved |
| 0087h | R/W | DMA Channel 0 Low Page Register |
| 0088h | R/W | Reserved |
| 0089h | R/W | DMA Channel 6 Low Page Register |
| 008Ah | R/W | DMA Channel 7 Low Page Register |
| 008Bh | R/W | DMA Channel 5 Low Page Register |
| 008Ch | R/W | Reserved |
| 008Dh | R/W | Reserved |
| 008Eh | R/W | Reserved |
| 008Fh | R/W | Refresh Low Page Register |

Interrupt Controller Registers (These registers can be accessed from PCI bus or ISA bus.)

| Address | Attribute | Register Name |
|---------|-----------|-----------------------------|
| 0020h | R/W | INT 1 Base Address Register |
| 0021h | R/W | INT 1 Mask Register |
| 00A0h | R/W | INT 2 Base Address Register |
| 00A1h | R/W | INT 2 Mask Register |

Timer Registers (These registers can be accessed from PCI bus or ISA bus.)

| Address | Attribute | Register Name |
|---------|-----------|--|
| 0040h | R/W | Interval Timer 1 - Counter 0 |
| 0041h | R/W | Interval Timer 1 - Counter 1 |
| 0042h | R/W | Interval Timer 1 - Counter 2 |
| 0043h | WO | Interval Timer 1 - Control Word Register |

Other Registers (These registers can be accessed from PCI bus or ISA bus.)

| Address | Attribute | Register Name |
|---------|-----------|--|
| 0061h | R/W | NMI Status Register |
| 0070h | WO | CMOS RAM Address and NMI Mask Register |
| 00F0h | WO | Coprocessor Error Register |

Register 4D0h IRQ Edge/Level Control Register 1

- Bit 7 IRQ7**
- 0: edge sensitive
1: level sensitive
- Bit 6 IRQ6**
- 0: edge sensitive
1: level sensitive
- Bit 5 IRQ5**
- 0: edge sensitive



- 1: level sensitive
- Bit 4 IRQ4**
- 0: edge sensitive
1: level sensitive
- Bit 3 IRQ3**
- 0: edge sensitive
1: level sensitive
- Bit 2 IRQ2**
- This bit must be set to 0. Read as 0.
- Bit 1 IRQ1**
- This bit must be set to 0. Read as 0.
- Bit 0 IRQ0**
- This bit must be set to 0. Read as 0.
After reset this register is set to 00h.

Register 4D1h IRQ Edge/Level Control Register 2

- Bit 7 IRQ15**
- 0: edge sensitive
1: level sensitive
- Bit 6 IRQ14**
- 0: edge sensitive
1: level sensitive
- Bit 5 IRQ13**
- This bit must be set to 0. Read as 0.
- Bit 4 IRQ12**
- 0: edge sensitive
1: level sensitive
- Bit 3 IRQ11**
- 0: edge sensitive
1: level sensitive
- Bit 2 IRQ10**
- 0: edge sensitive
1: level sensitive



Bit 1

IRQ9

0: edge sensitive

1: level sensitive

Bit 0

IRQ8

This bit must be set to 0. Raed as zero.

After reset this register is set to 00h.

4.6 ISA Internal Register

ISA internal registers are accessed through an address/data registers pair. Address register located at port 22h is written with the index of ISA internal register. Then ISA internal register content can be read or written through the data register at port 23h. The port 22h can be read to get the last written-in value.

Register 80h

Bits 7:6 **Bus clock selection**

00: 7.159MHz

01: PCICLK/4

10: PCICLK/3

Bit 5 **Flash EPROM Control bit 0 (Please refer to Register 80h bit 2 for details.)**

Bits 4:3 **Reserved**

Bit 2 **Flash EPROM Control bit 1**

Previous implementation on flash EPROM support limits that EPROM is flashed upon power on till bit 5 of register 80h is set to 1. The new added feature will allow EPROM to be flashed anytime. Bit 2 of the register 80h is added and the setting of both bit 2 and bit 5 will now control the EPROM flash operation.

| Register 80h bit 5 | Register 80h bit 2 | Operation |
|--------------------|--------------------|--|
| 0 | 0 | EPROM can be flashed |
| 1 | 0 | EPROM can't be flashed again |
| X | 1 | EPROM can be flashed whenever bit 5 is 0 |

Bit 1 **Relocatable ISA Configuration Registers Control**

ISA configuration registers are now relocatable through bit 1 of ISA configuration register 80h. Upon power on, ISA configuration registers are located between index 80h to 8Fh by default. These index can be relocated to 70h to 7Fh by programming bit 1 of register 80h to 1.

Bit 0 **ISA Slew Rate Control**

The default value of the following ISA signals is 8mA(min), including SA[16-0], LA[23-17], SBHE#, MRDC#, MWTC#, SMRDC#, SMWTC#, IORC#, and IOWC#. Besides, Bit 0 of ISA configuration register 80h is used to program the currents of the above signals to 12mA(min) when it is set to 1.

Register 81h

Bits 7:6 **16-bit I/O cycle command recovery time**

00 : 5 BUSCLK

01 : 4 BUSCLK

10 : 3 BUSCLK

11 : 2 BUSCLK



Bits 5:4 **8-bit I/O cycle command recovery time**

00 : 8 BUSCLK

01 : 5 BUSCLK

10 : 4 BUSCLK

11 : 3 BUSCLK

Bit 3 **Reserved**

Bit 2 **16-bit memory, I/O wait state selection**

0 : 1 wait state

1 : 0 wait state

Bits 1:0 **Reserved**

Register 84h **BIOS Register**

Bits 7:0 **BIOS can use this register to store data.**

Register 85h

Bits 7:0 **the same value as port 70h.**

Register 88h

Bits 7:1 **corresponds to the mask bits of the IRQ7-1.**

When disabled, any event from the corresponding IRQ will cause the system to exit the system standby state.

Bit 0 **is the mask bit of the NMI.**

When disabled, an event from the NMI will cause the system to exit the system standby state.

Register 89h

Bits 7:0 **corresponds to the mask bits of the IRQ8-15.**

When disabled, any event from the corresponding IRQ will cause the system to exit the system standby state.

Register 8Ah

Bits 7:1 **corresponds to the mask bits of the IRQ7-1.**

When disabled, any event from the corresponding IRQ will cause the system to exit the monitor standby state.

Bit 0 **is the mask bit of the NMI.**

When disabled, an event from the NMI will cause the system to exit the monitor standby state.

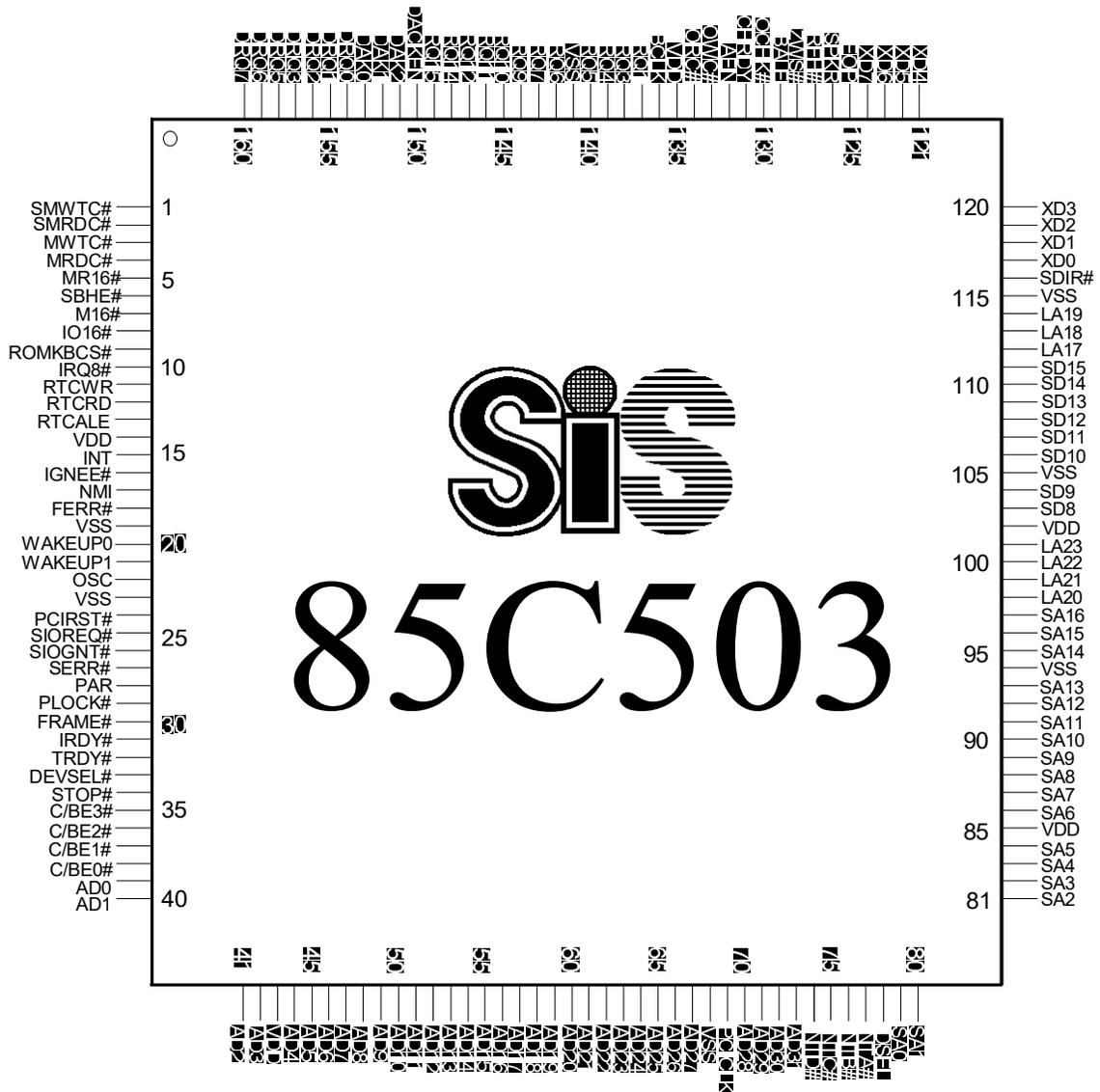
Register 8Bh

Bits 7-0 **corresponds to the mask bits of the IRQ8-15.**

When disabled, any event from the corresponding IRQ will cause the system to exit the monitor standby state.

4.7 Pin Assignment and Description

4.7.1 Pin Assignment





4.7.2 Pin Listing (# means active low)

| | | | |
|------------|-----------|-----------|------------|
| 1=SMWTC# | 41=AD2 | 81=SA2 | 121=XD4 |
| 2=SMRDC# | 42=AD3 | 82=SA3 | 122=XD5 |
| 3=MWTC# | 43=VDD | 83=SA4 | 123=XD6 |
| 4=MRDC# | 44=AD4 | 84=SA5 | 124=XD7 |
| 5=MR16# | 45=AD5 | 85=VDD | 125=EOP |
| 6=SBHE# | 46=AD6 | 86=SA6 | 126=SPKR |
| 7=M16# | 47=AD7 | 87=SA7 | 127=RFH# |
| 8=IO16# | 48=AD8 | 88=SA8 | 128=ZWS# |
| 9=ROMKBCS# | 49=AD9 | 89=SA9 | 129=BALE |
| 10=IRQ8# | 50=AD10 | 90=SA10 | 130=IOCHK# |
| 11=RTCWR | 51=AD11 | 91=SA11 | 131=CHRDY |
| 12=RTC RD | 52=AD12 | 92=SA12 | 132=AEN |
| 13=RTCALE | 53=AD13 | 93=SA13 | 133=IOWC# |
| 14=VDD | 54=AD14 | 94=VSS | 134=IORC# |
| 15=INT | 55=AD15 | 95=SA14 | 135=VDD |
| 16=IGNEE# | 56=AD16 | 96=SA15 | 136=BCLK |
| 17=NMI | 57=AD17 | 97=SA16 | 137=IRQ1 |
| 18=FERR# | 58=AD18 | 98=LA20 | 138=IRQ3 |
| 19=VSS | 59=AD19 | 99=LA21 | 139=IRQ4 |
| 20=WAKEUP0 | 60=AD20 | 100=LA22 | 140=IRQ5 |
| 21=WAKEUP1 | 61=AD21 | 101=LA23 | 141=VSS |
| 22=OSC | 62=AD22 | 102=VDD | 142=IRQ6 |
| 23=VSS | 63=AD23 | 103=SD8 | 143=IRQ7 |
| 24=PCIRST# | 64=AD24 | 104=SD9 | 144=IRQ9 |
| 25=SIORQ# | 65=AD25 | 105=VSS | 145=IRQ10 |
| 26=SIQNT# | 66=AD26 | 106=SD10 | 146=IRQ11 |
| 27=SERR# | 67=AD27 | 107=SD11 | 147=IRQ12 |
| 28=PAR | 68=VSS | 108=SD12 | 148=IRQ14 |
| 29=PLOCK# | 69=PCICLK | 109=SD13 | 149=IRQ15 |
| 30=FRAME# | 70=AD28 | 110=SD14 | 150=DACKEN |
| 31=IRDY# | 71=AD29 | 111=SD15 | 151=DAK2 |
| 32=TRDY# | 72=AD30 | 112=LA17 | 152=DAK1 |
| 33=DEVSEL# | 73=AD31 | 113=LA18 | 153=DAK0 |
| 34=STOP# | 74=INTD# | 114=LA19 | 154=DRQ0 |
| 35=C/BE3# | 75=INTC# | 115=VSS | 155=DRQ1 |
| 36=C/BE2# | 76=INTB# | 116=SDIR# | 156=DRQ2 |
| 37=C/BE1# | 77=INTA# | 117=XD0 | 157=DRQ3 |
| 38=C/BE0# | 78=IDSEL | 118=XD1 | 158=DRQ5 |
| 39=AD0 | 79=SA0 | 119=XD2 | 159=DRQ6 |
| 40=AD1 | 80=SA1 | 120=XD3 | 160=DRQ7 |



4.7.3 Pin Description

PCI Interface

| Pin No. | Symbol | Type | Function |
|-------------------------|------------|------|---|
| 35-38 | C/BE[3:0]# | I/O | PCI Bus Command and Byte Enables define the PCI command during the address phase of a PCI cycle, and the PCI byte enables during the data phases. C/BE[3:0]# are outputs when the 85C503 is a PCI bus master and inputs when it is a PCI slave. |
| 73-70 67-44 42-39 | AD[31:0] | I/O | Address and data are multiplexed on AD[31:0]. During the address phase of a transaction, AD[31:0] contains a physical address. During the data phase, AD[31:0] contains data. When the 85C503 is a PCI master, it drives address on AD[31:2] and drives AD[1:0] low during the address phase. During the data phase, it drives data or latches data on AD[31:0] for write or read cycle respectively. When the 85C503 is a target, AD[31:0] are inputs during the address phase. During the data phases, the 85C503 drives data on AD[31:0] for read cycle, or latches data for write cycle. |
| 30 | FRAME# | I/O | FRAME# is asserted to indicate the beginning of a bus transaction and asserted until the last data phase. When the PCI master is ready to complete the final data phase, it deasserts FRAME#. When the 85C503 is the target, FRAME# is an input to the 85C503. 85C503 drives FRAME# out when it is the PCI master. FRAME# is tri-state during reset. |
| 31 | IRDY# | I/O | When 85C503 is the PCI master, it drives IRDY# to complete the current data phase of the transaction. During write cycles, the assertion of IRDY# indicates the 85C503 has driven valid data on AD[31:0]. During read cycles, it indicates the 85C503 is ready to latch the data. IRDY# is an input to the 85C503 when the 85C503 is the target and an output when the 85C503 is a master. |



| | | | |
|----|---------|-----|---|
| 32 | TRDY# | I/O | TRDY# is an output when the 85C503 is a PCI slave. The assertion of TRDY# indicates the target agent's ability to complete the current data phase of the transaction. For a read cycle, TRDY# indicates that the target has driven valid data onto the PCI bus. For a write cycle, TRDY# indicates that the target is prepared to accept data from the PCI bus. When the 85C503 is a PCI master, it is an input. |
| 33 | DEVSEL# | I/O | The 85C503 asserts DEVSEL# when 85C503's configuration registers or internal registers are addressed. DEVSEL# is also asserted when the 85C503 subtractively decodes a cycle. When 85C503 is the PCI master, DEVSEL# is an input to indicate a PCI target has responded to a 85C503 initiated transaction. For all PCI transactions, the 85C503 also samples DEVSEL# to decide to subtractively decode the cycle. |
| 34 | STOP# | I/O | When the 85C503 is a target it asserts STOP# to request master to stop the current transaction. When 85C503 is a master, the inputted STOP# causes the 85C503 to stop the current transaction. |
| 28 | PAR | O | PAR is even parity across AD[31:0] and C/BE[3:0]# and regardless of whether or not all lines carry meaningful information. Both address and data phases the PAR is generated. PAR is driven one PCI clock after the corresponding address or data. PAR is driven by 85C503 during the address phase of 85C503 initiated transactions. During the data phase, 85C503 also drives PAR when (1) 85C503 is the master of a PCI write transaction. (2) 85C503 is the target of a read transaction. |
| 27 | SERR# | I | System Error. SERR# can be pulsed active by any PCI device that detects a system error condition. Upon sampling SERR# active, the 85C503 generates a non-maskable interrupt to the CPU. |
| 78 | IDSEL | I | Initialization Device Select. The 85C503 samples IDSEL during the address phase of a transaction. If IDSEL is sampled active, and the bus command is a configuration read or write, the 85C503 responds by asserting DEVSEL# on the next PCI clock. |



| | | | |
|-------|-----------|---|--|
| 29 | PLOCK# | I | PLOCK# is always an input to the 85C503. When the 85C503 is the target of a transaction and samples PLCOK# negated during the address phase of a transaction, the 85C503 considers itself a locked resource until it samples PLOCK# and FRAME# negated. When other masters attempt accesses while the 85C503 is locked, the 85C503 responds with a target initiated retry termination. |
| 69 | PCICLK | I | PCI Clock. PCICLK provides timing for all transactions on the PCI bus. All other PCI signals are sampled on the rising edge of PCICLK, and all timing parameters are defined with respect to this edge. Frequencies supported by the 85C503 include 25 and 33 MHz. |
| 24 | PCIRST# | | PCI Reset. PCIRST# forces the 85C503 to a known state. All I/O and sustained tri-state I/O signals are forced to a high impedance state. All registers are set to their default values. PCIRST# may be asynchronous to PCICLK when asserted or negated. Although asynchronous, negation must be a clean, bounce-free edge. Note that PCIRST# must be asserted for more than 1us. |
| 77-74 | INT[A:D]# | I | PCI Interrupt A to Interrupt D |

**ISA Interface**

| | | | |
|-------------------------|-----------|-----|---|
| 97-95 93-86 84-79 | SA[16:0] | I/O | System address. They are inputs when an external bus master is in control and are outputs at all other times. |
| 101-98 114-112 | LA[23:17] | I/O | Latched system address. They are inputs when an external bus master is in control and are outputs at all other times. |
| 124-117 | XD[7:0] | I/O | Peripheral Data Bus lines. |
| 111-106 104,103 | SD[15:8] | I/O | System Data Bus are directly connected to the ISA slots. |
| 8 | IO16# | I | 16-bit I/O chip select indicates that the AT bus cycle is a 16-bit I/O transfer when asserted or an 8-bit I/O transfer when it is negated. |
| 7 | M16# | I | 16-bit memory chip select indicates a 16-bit memory transfer when asserted or an 8-bit memory transfer when it is negated. |
| 6 | SBHE# | I/O | Byte high enable signal indicates that the high byte has valid data on the ISA 16-bit data bus. This signal is an output except during ISA master cycles. |
| 5 | MR16# | I | Master* is an active low signal from AT bus. When active, it indicates that the ISA bus master has the control of the system. The address and control signals are all driven by the ISA bus master. |
| 4 | MRDC# | I/O | AT bus memory read command signal is an output pin during AT/DMA/refresh cycles and is an input pin in ISA master cycles. |
| 3 | MWTC# | I/O | AT bus memory write command signal is an output pin during AT/DMA cycles and is an input pin in ISA master cycles. |
| 2 | SMRDC# | I/O | AT bus memory read. It instructs the memory devices to drive data onto the data bus. It is active only when the memory being accessed is within the lowest 1MB. |
| 1 | SMWTC# | I/O | AT bus memory write. It instructs the memory devices to store the data presented on the data bus. It is active only when the memory being accessed is within the lowest 1MB. |



| | | | |
|-----|--------|-----|--|
| 134 | IORC# | I/O | AT bus I/O read command signal is an output pin during AT or DMA cycles and is an input pin in ISA master cycles. When low, it strobes an I/O device to place data on the data bus. |
| 133 | IOWC# | I/O | AT bus I/O write command signal is an output pin during AT or DMA cycles and is an input pin in ISA master cycles. When low, it strobes data on the data bus into a selected I/O device. |
| 132 | AEN | O | Address Enable is driven high on the ISA bus to indicate the address lines are valid in DMA or ISA master cycles. It is low otherwise. |
| 131 | CHRDY | I/O | I/O channel ready is normally high. It can be pulled low by the slow devices on the AT bus to add wait states for the ISA memory or I/O cycles. When a DMA or an ISA master accesses a VL-Bus target, IORDY is an output to control the wait states. |
| 130 | IOCHK# | I | I/O channel Check is an active low input signal which indicates that an error has taken place on the I/O bus. |
| 129 | BALE | O | Bus address latch enable is used on the ISA bus to latch valid address from the CPU. Its falling edge starts the ISA command cycles. |
| 128 | ZWS# | I | Zero wait state is an active low signal. The system ignores the IORDY signal and terminates the AT bus cycle without additional wait state when it is asserted. |
| 136 | BCLK | I/O | ISA bus clock, for ISA bus controller, ISA bus interfaces and the DMA controller. It can be programmed to derive from the SYSCLK or from the 14MHz clock. |
| 127 | RFH# | I/O | Refresh signal is used to initiate a refresh cycle. This signal is an input in ISA bus master cycles and is an output in other cycles. |
| 22 | OSC | I | OSC is the buffered input of the external 14.318MHz oscillator. |



| | | | |
|--------------------------------------|--|---|---|
| 125 | EOP | O | <p>Terminal Count of DMA. A pulse is generated by the DMA controller when the terminal count (TC) of any channel reaches 1.</p> <p>When a TC pulse occurs, the DMA controller will terminate the service, and if auto-initialize is enabled, the base registers will be written to the current registers of that channel. The mask bit and the TC bit in the Status word will be set for the currently active channel unless the channel is programmed for auto-initialize. In that case, the mask bit remains clear.</p> |
| 160-154 | DRQ7-5,3-0 | I | <p>DMA Request inputs are used by external devices to indicate when they need service from the internal DMA controllers.</p> |
| 137-140 142,143 10,144- 149 | IRQ1, 3-7, IRQ 8#, 9, 10- 12,14,15 | I | <p>These are the asynchronous interrupt request inputs to the 8259 controller.</p> |

**Others**

| | | | |
|---------|----------|---|--|
| 151-153 | DAK[2:0] | O | The DAK output lines indicate that a request for DMA service has been granted by the 85C503 or that a 16 bit master has been granted the bus. One external 74138 decodes these signals to DAK[7:0] for the corresponding peripheral. |
| 150 | DACKEN | O | DMA acknowledge enable signal is used to control the external 74138. |
| 25 | SIOREQ# | O | SIO Request. The 85C503 SIOREQ# to request the PCI bus. |
| 26 | SIOGNT# | I | SIO Grant. It is driven by the 85C501 to indicate that the PCI arbiter has granted the use of the PCI bus to the 85C503. |
| 13 | RTCALE | O | Address strobe of the real time clock device. It is used to latch the address from the XD bus when the CPU accesses the RTC. |
| 12 | RTCRD | O | Data read strobe of the real time clock device. It is used to drive the RTC data onto the XD bus when the CPU accesses the RTC. |
| 11 | RTCWR | O | Data write strobe of the real time clock device. It is used to store the data presented on the XD bus when the CPU accesses the RTC. This pin must be connected to the R/W of the RTC. |
| 9 | ROMKBCS# | O | Keyboard or System ROM Chip Select |
| 126 | SPKR | O | Speaker is the output for the speaker. |
| 116 | SDIR# | O | SD Low Byte Data Direction controls the direction of the low byte buffer between SD and XD. A high sets the data path direction from XD to SD and a low sets the data path direction from SD to XD. |
| 21 | WAKEUP1 | O | This signal is directly connected to the 85C501. When activated, it will reload the system standby timer. If it is inactive and the system standby timer expires, the system will enter into system standby state. During the system standby state, if this input become active, the system will wake up from standby state and return back to normal state. |



| | | | |
|-------------------------------|---------|----|--|
| 20 | WAKEUP0 | O | This signal is directly connected to the 85C501. When activated, it will reload the monitor standby timer. If it is inactive and the monitor standby timer expires, the system will enter into monitor standby state. During the monitor standby state, if this input become active, the system will wake up from standby state and return back to normal state. |
| 18 | FERR# | I | Floating point error from the CPU. It is driven active when a floating point error occurs. |
| 16 | IGNEE# | OD | IGNEE# is normally in high impedance state, and is asserted to inform CPU to ignore a numeric error. A resistor connected to either 3.3V (for P54C) or 5V (P5) is required to maintain a correct voltage level to CPU. |
| 17 | NMI | OD | Non-maskable, interrupt is rising edge trigger signal to the CPU and is generated to invoke a non-maskable interrupt. Normally, this signal is low. It goes high impedance state when a non-maskable interrupt source comes up. An external pull up resistor is required to be directly connected to CPU. |
| 15 | INT | OD | Interrupt goes high impedance whenever a valid interrupt request is asserted. Hence, an external pull up resistor is required to be directly connected to the CPU's interrupt pin. |
| 14,43,85 102,135 | VDD | | +5V DC power |
| 19,23,68 94,105 115,141 | VSS | | Ground |



4.8 Electrical Characteristics

4.8.1 Absolute Maximum Ratings

| Parameter | Min | Max | Unit |
|-------------------------------|------|-----|------|
| Ambient operating temperature | 0 | 70 | °C |
| Storage temperature | -40 | 125 | °C |
| Input voltage | -0.3 | 5.5 | V |
| Output voltage | -0.5 | 5.5 | V |
| Power Dissipation | | 1 | W |

Note:

Stress above these listed may cause permanent damage to device. Functional operation of this device should be restricted to the conditions described under operating conditions.

4.8.2 DC Characteristics

TA = 0 - 70 °C, VSS = 0V , VDD=5V±5%

| Symbol | Parameter | Min | Max | Unit | Condition |
|------------------|------------------------|------|------|------|---------------|
| V _{IL} | Input Low voltage | -0.3 | 0.8 | V | |
| V _{IH} | Input High Voltage | | | V | |
| V _{OL} | Output Low Voltage | | 0.45 | V | |
| V _{OH} | Output High Voltage | 2.4 | | V | |
| I _{OL1} | Output Low Current | 4 | | mA | Note 1 |
| I _{OH1} | Output High Current | 4 | | mA | Note 1 |
| I _{OL2} | Output Low Current | 8 | | mA | Note 2 |
| I _{OH2} | Output High Current | 8 | | mA | Note 2 |
| I _{OL3} | Output Low Current | 8,12 | | mA | Note 3 |
| I _{OH3} | Output High Current | 8,12 | | mA | Note 3 |
| I _{OL4} | Output Low Current | 6 | | mA | Note 4 |
| I _{OH4} | Output High Current | 6 | | mA | Note 4 |
| I _{IL} | Input Leakage Current | | +10 | mA | |
| I _{OL} | Output Leakage Current | | -10 | mA | |
| C _{IN} | Input Capacitance | | 12 | pF | |
| C _{OUT} | Output Capacitance | | 12 | pF | |
| C _{I/O} | I/O Capacitance | | 12 | pF | |

**Note:**

1. I_{OL1} and I_{OH1} apply to the following signals: ROMKBCS#, RTCWR, RTCRD, RTCALE, WAKEUP0, WAKEUP1, SIOREQ#, PAR, C/BE3#, C/BE2#, C/BE1#, C/BE0#, AD[31:0], SDIR#, XD[7:0], SPKR, BCLK, DAK[2:0], DACKEN, INT, IGNEE#, NMI.
2. I_{OL2} and I_{OH2} apply to the following signals: , RFH#, CHRDY, AEN, BALE, EOP, SD[15:8].
3. I_{OL3} and I_{OH3} apply to the following signals: SMWTC#, SMRDC#, MWTC#, MRDC#, SBHE#, LA[23:17], SA[16:0], IOWC#, IORC#. Please refer to Register Description.
4. I_{OL4} and I_{OH4} apply to the following signals: FRAME#, IRDY#, TRDY#, DEVSEL#, STOP#.

4.8.3 AC Characteristics

The AC characteristic is measured under the following capacitive condition.

Capacitive load Pin

| | |
|-------|---|
| 35pf | BCLK, DAK[0:2], DACKEN, BALE, AEN, NMI, SDIR, EOP, SPKR, INT |
| 50pf | FRAME#, IRDY#, TRDY#, DEVSEL#, STOP#, C/BE[3:0]#, XD[7:0] |
| 150pf | SD[15:8], SBHE#, RFH#, CHRDY, MWTC#, MRDC#, IORC#, IOWC#, SA[19:0], LA[23:17] |

| Parameter | Description | Min | Typ | Max | Unit |
|--|--|-----|------|-----|------|
| ISA Bus Interface Signals (Figure 4.2) | | | | | |
| | BCLK High | | 63.2 | | ns |
| | BCLK Low | | 56.8 | | ns |
| t1 | BALE valid delay from BCLK | | 4.5 | 7 | ns |
| t2 | IORC#, IOWC#, MRDC#, MWTC# valid delay from BCLK | | 16.5 | 24 | ns |
| t3 | IORC#, IOWC#, MRDC#, MWTC# invalid delay from BCLK | | 12 | 18 | ns |
| t5a | M16# setup time to BCLK rising | | 15 | | ns |
| t5b | M16# hold time from BCLK rising | | 6 | | ns |
| t6a | IO16# setup time to BCLK falling | | 19 | | ns |
| t6b | IO16# hold time from BCLK falling | | 6 | | ns |
| t7 | 16 bit IORC#, IOWC# pulse width | | 1.5 | | BCLK |
| | 8 bit IORC#, IOWC# pulse width | | 4.5 | | BCLK |
| | 16 bit MRDC#, MWTC# *1 | | 2 | | BCLK |
| | 8 bit MRDC#, MWTC# | | 4.5 | | BCLK |
| | ROM MRDC#, MWTC# *1 | | 2 | | BCLK |



| Data Buffer Interface | | | | | |
|--|---|------|------|-----|--------|
| t8 | SD, XD data set up time to IORC#, MRDC# inactive | 10 | | | ns |
| t9 | SD, XD data hold time to IORC#, MRDC# inactive | 3 | | | ns |
| t10 | SD, XD valid data delay from IOWC#, MWTC# active (for data swapping) | 15 | 22 | | ns |
| t11a | SD, XD data hold time from IOWC#, MWTC# inactive in write disassembly cycle | 15 | 22 | | ns |
| t11a | SD, XD data hold time from IOWC#, MWTC# inactive in write cycle | | 172 | | ns |
| t12 | SD, XD valid to IOWC#, MWTC# active | | 142 | | ns |
| t13 | SDIR deassertion to IORC#, MRDC# active (16 bit) | | 1 | 2 | BCLK |
| | SDIR deassertion to IORC#, MRDC# active (8 bit) | 1.5 | | 2.5 | BCLK |
| t14 | SDIR assertion delay from IORC#, MRDC# inactive | | 2 | | BCLK |
| Address Buffer Interface | | | | | |
| t15 | SA, LA propagation delay from PCICLK in Frame# address phase | | 34 | 51 | ns |
| t16 | SA0, SA1, SBHE# hold time from the negation of IORC#, IOWC#, MWTC#, MRDC# | 10 | | | ns |
| t17a | CHRDY setup time to BCLK rising | | 15.2 | | ns |
| t17b | CHRDY hold time to BCLK rising | 14.8 | | | ns |
| t44 | ZWS# setup time to BCLK falling | | 10 | | ns |
| t45 | ZWS# hold time to BCLK falling | 20 | | | ns |
| DMA Compatible Timings (Figure 4.3, 4.4) | | | | | |
| t18 | DAK active to IORC# active | | 0.5 | | DMACLK |
| t19 | DAK active to IOWC# active | | 1.5 | | DMACLK |
| t20 | DAK active hold from IORC# inactive | | 0.5 | | DMACLK |
| t21 | DAK active hold from IOWC# inactive | | 0.5 | | DMACLK |
| t22a | AEN active to IORC# active | | 6 | | DMACLK |
| t22b | AEN active to IOWC# active | | 7 | | DMACLK |
| t23a | AEN inactive from IORC# inactive | | 3 | | DMACLK |
| t23b | AEN inactive from IOWC# inactive | | 4 | | DMACLK |
| t24a | BALE active to IORC# active | | 1.5 | | DMACLK |
| t24b | BALE active to IOWC# active | | 2.5 | | DMACLK |
| t25a | BALE inactive from IORC# inactive | | 1 | | DMACLK |



| | | | | | |
|------|---|--|-------|--|-------|
| t25b | BALE inactive from IOWC# inactive | | 1 | | DMACK |
| t26a | LA, SA, SBHE# valid set up time to IORC# | | 1 | | DMACK |
| t26b | LA, SA, SBHE# valid set up time to IOWC# | | 2 | | DMACK |
| t27a | LA, SA, SBHE# valid hold from IORC# | | 0.5 | | DMACK |
| t27b | LA, SA, SBHE# valid hold from IOWC# | | 0.5 | | DMACK |
| t28 | IORC# pulse width | | 4 | | DMACK |
| t29 | IOWC# pulse width | | 2 | | DMACK |
| t30 | MRDC# pulse width | | 3 | | DMACK |
| t31 | MWTC# pulse width | | 3 | | DMACK |
| t32 | MWTC# active from IORC# active | | 1 | | DMACK |
| t33 | IOWC# active from MRDC# active | | 1 | | DMACK |
| t34 | MWTC# inactive from IORC# inactive | | 0 | | ns |
| t35 | IOWC# inactive from MRDC# inactive | | 1.5 | | ns |
| t36 | Read data valid from IORC# active | | 267.5 | | ns |
| t37 | Read data valid hold from IORC# inactive | | 32.2 | | ns |
| t38 | Write data valid setup to IOWC# inactive | | 162.5 | | ns |
| t39 | Write data valid hold from IOWC# inactive | | 13.2 | | ns |
| t40 | EOP active delay from IOWC# active | | -7.6 | | ns |
| t41 | EOP active delay from IORC# active | | 112.3 | | ns |
| t42 | EOP active delay from IOWC# inactive | | 0.7 | | ns |
| t43 | EOP active delay from IORC# inactive | | 0.8 | | ns |

Note: DMACK = BCLK or BCLK/2 depends on bit 0 of ISA configuration register 01H.

| | | | | | |
|---|---|-----|-----|-----|------|
| Refresh Timing (Figure 4.13) | | | | | |
| t44 | RFH# active setup to MRDC# active | | 2 | | BCLK |
| t45 | RFH# active hold from MRDC# inactive | | 0.5 | | BCLK |
| t46 | AEN active to RFH# active delay | | 3 | | ns |
| Miscellaneous Timing (Figure 4.5 ~ 4.9, 4.11, 4.12) | | | | | |
| t47 | SERR#, IOCHK# active to NMI output floating active | | | 200 | ns |
| t48 | INT output floating delay from IRQ active | | | 100 | ns |
| t49 | IRQ active pulse width | 100 | | | ns |
| t50 | IGNEE# active from IOWC# active for port F0h access | | | 220 | ns |



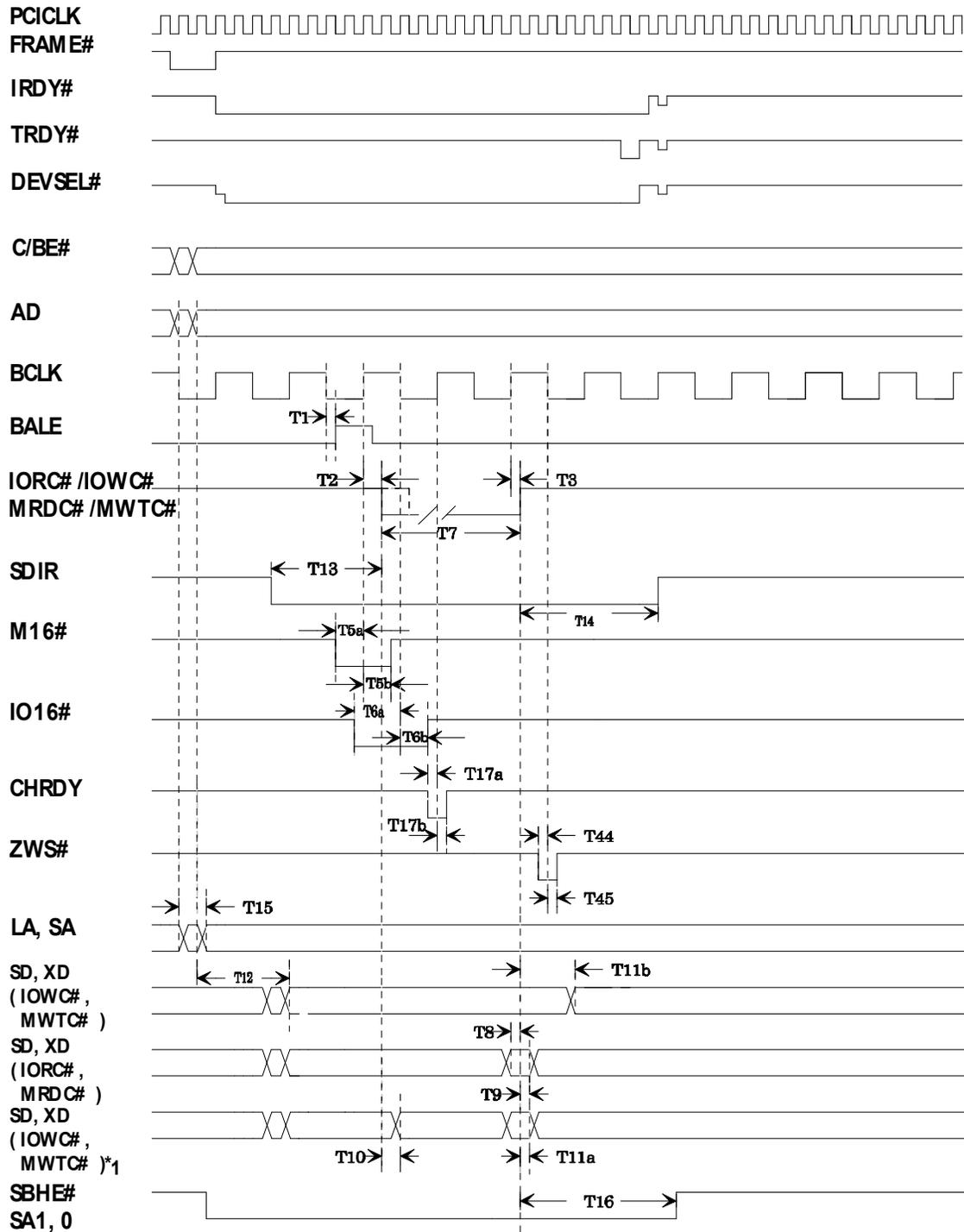
| | | | | | |
|------|-------------------------------------|-----|-------|-----|----|
| t51 | IGNEE# inactive from FERR# inactive | | | 150 | ns |
| t52 | SPKR valid delay from OSC timing | | | 200 | ns |
| t53 | RTCALE pulse width | | 532.3 | | ns |
| t54 | RTCALE active from IORW# active | | 4 | | ns |
| t54a | RTCWR active from IOWR# active | | 5 | | ns |
| t54b | RTC RD active from IORD# active | | 5 | | ns |
| t54c | RTCWR inactive from IOWR# inactive | 3.5 | 5 | 10 | ns |
| t54d | RTC RD inactive from IORD# inactive | 3.5 | 5 | 10 | ns |

*1: No command delay

| PCI Bus AC Specifications (Figure 4.10) | | | | | |
|---|---|-----|-----|-------|---------|
| PCI shared signals A.C. Characteristics (VDD=5V±5%, Tcase=0 to 85°C) | | | | | |
| | | Min | Max | Units | Notes |
| t57 | PCICLK to signal valid delay | | 11 | ns | CL=50pf |
| t58 | PCICLK to signal invalid delay | 2 | | ns | |
| t59 | Hi-Z to Active delay from PCICLK | 2 | | ns | |
| t60 | Active to Hi-Z delay from PCICLK | | 28 | ns | |
| t61 | Input signal valid setup time before PCICLK | 7 | | ns | |
| t62 | Input signal hold time from PCICLK | 0 | | ns | |

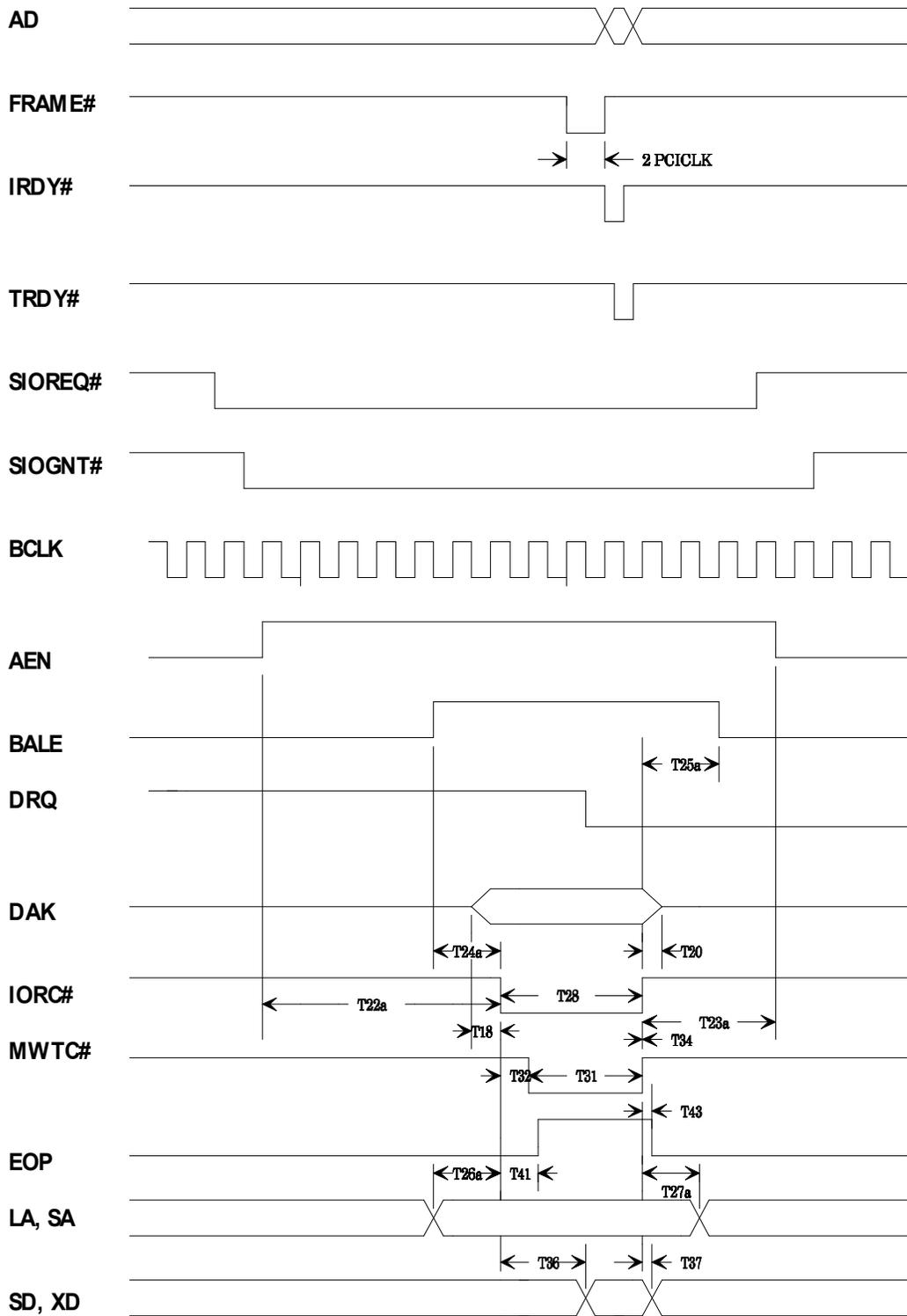
Note: PCI shared signals are AD[31:0], C/BE[3:0]#, FRAME#, TRDY#, IRDY#, STOP#, LOCK#, IDSEL#, DEVSEL#, PAR, SERR#

4.8.4 AC Timing Diagram



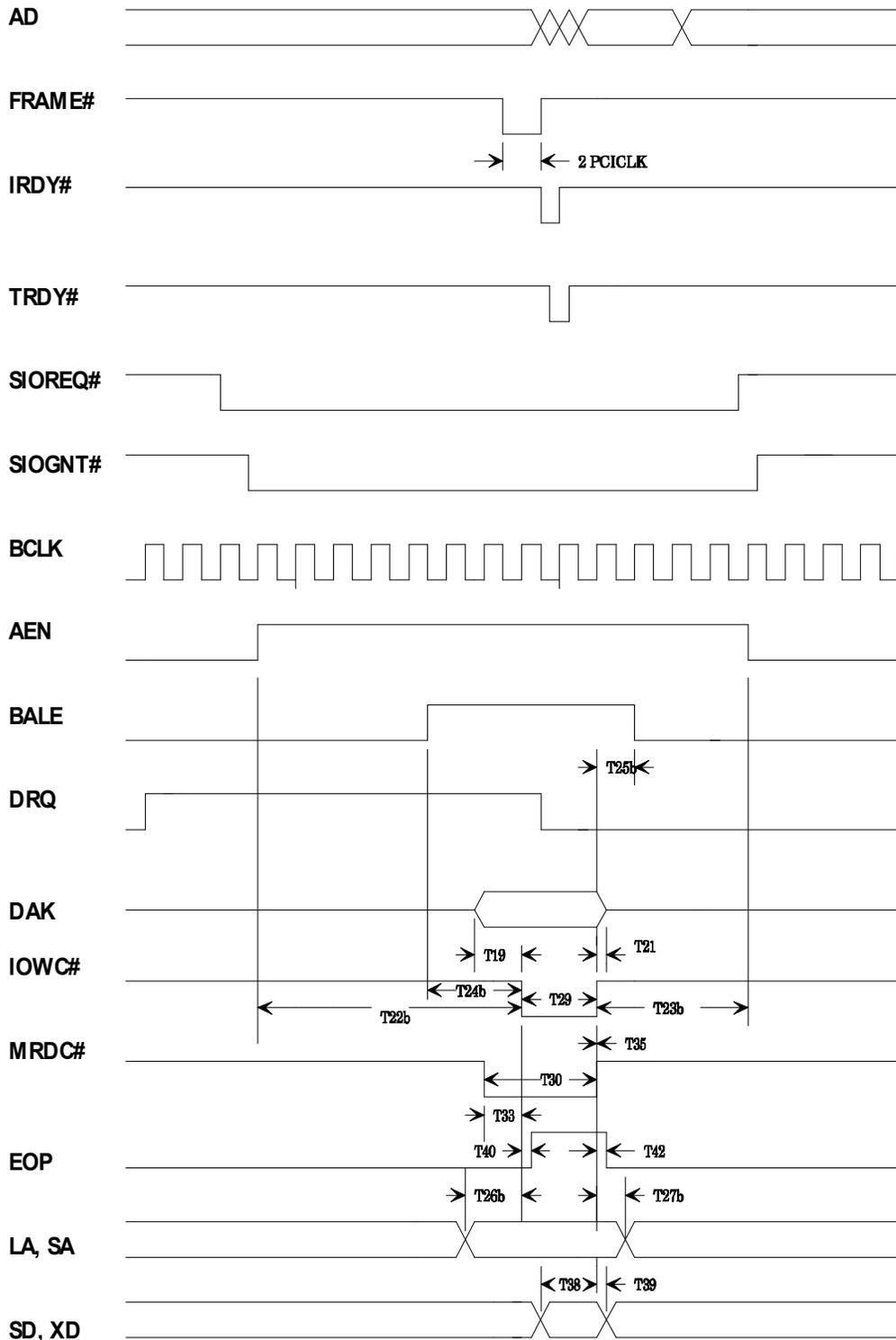
* 1 IS FOR DATA SWAPPING

Figure 4.2 PCI to AT Bus Cycle



DMA cycle (IOWC#, MRDC#), DMACLK = BCLK

Figure 4.3 DMA Cycle (IOWC#, MRDC#)



DMA cycle (IOWC#, MWTC#), DMACLK = BCLK

Figure 4.4 DMA Cycle (IOWC#, MWTC#)

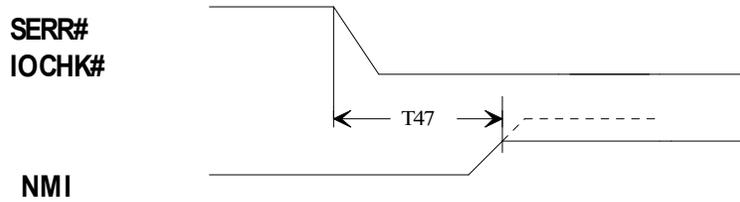


Figure 4.5 NMI Timing

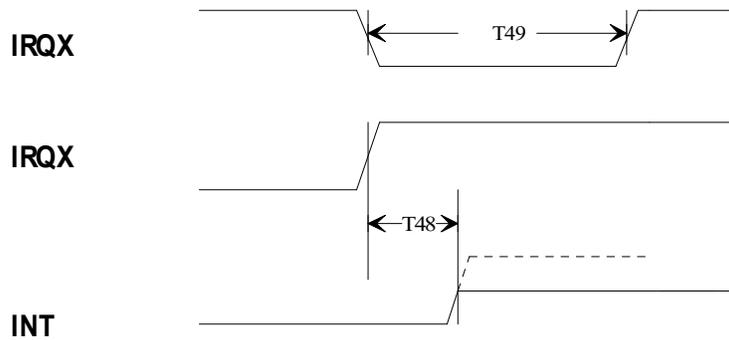


Figure 4.6 Interrupt Timing

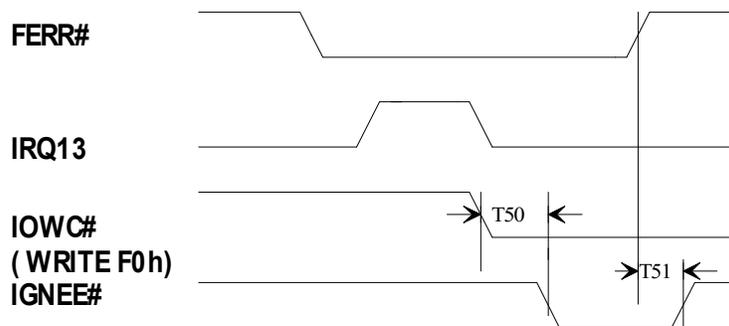


Figure 4.7 Coprocessor Error Support Timing

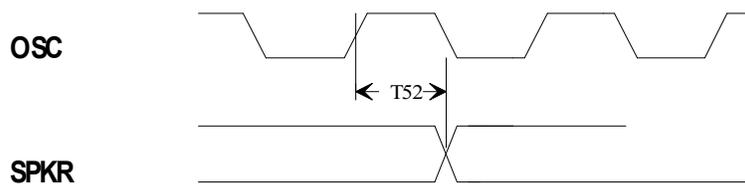


Figure 4.8 Speaking Timing

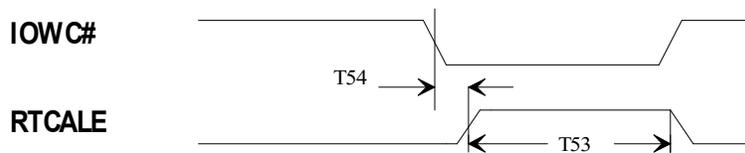


Figure 4.9 RTC Timing

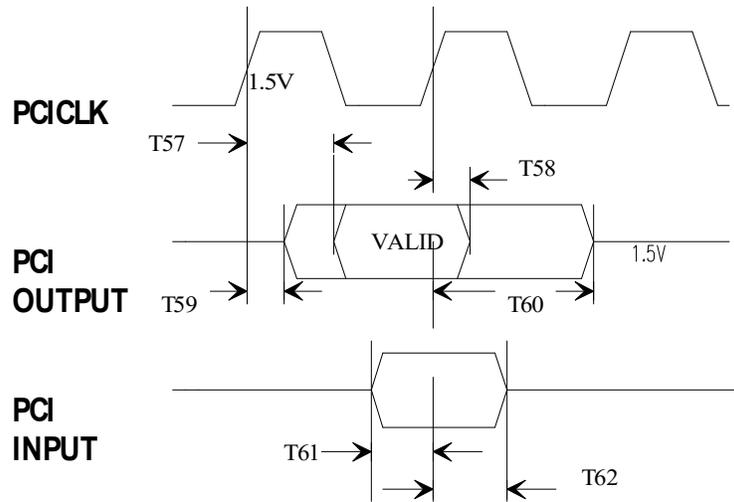


Figure 4.10 PCICLK Timing

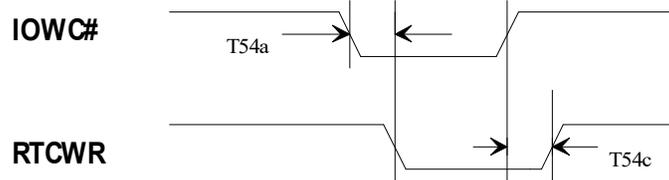


Figure 4.11 RTC Timing

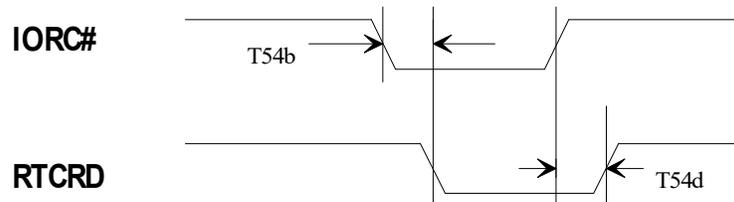


Figure 4.12 RTC Timing

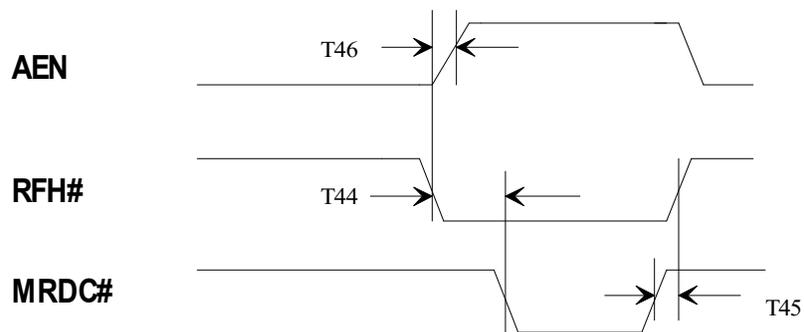
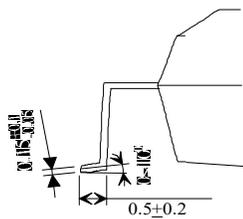
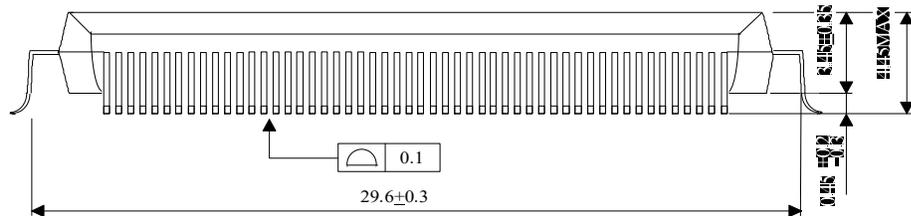
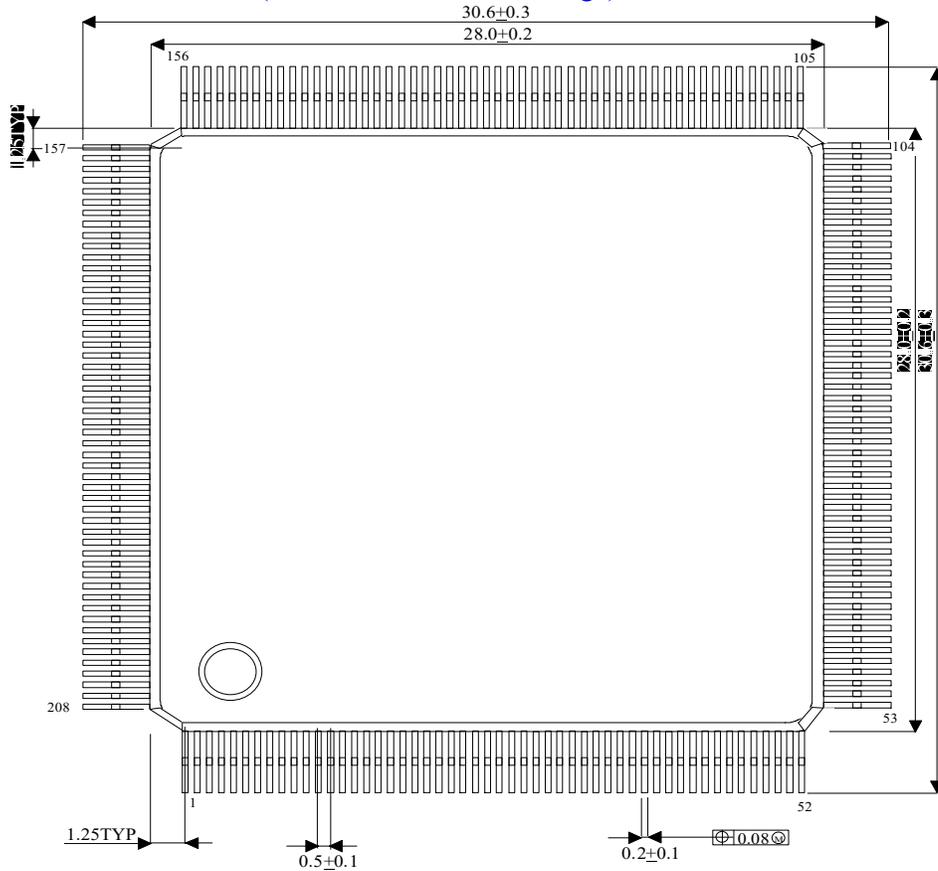


Figure 4.13 Refresh Timing

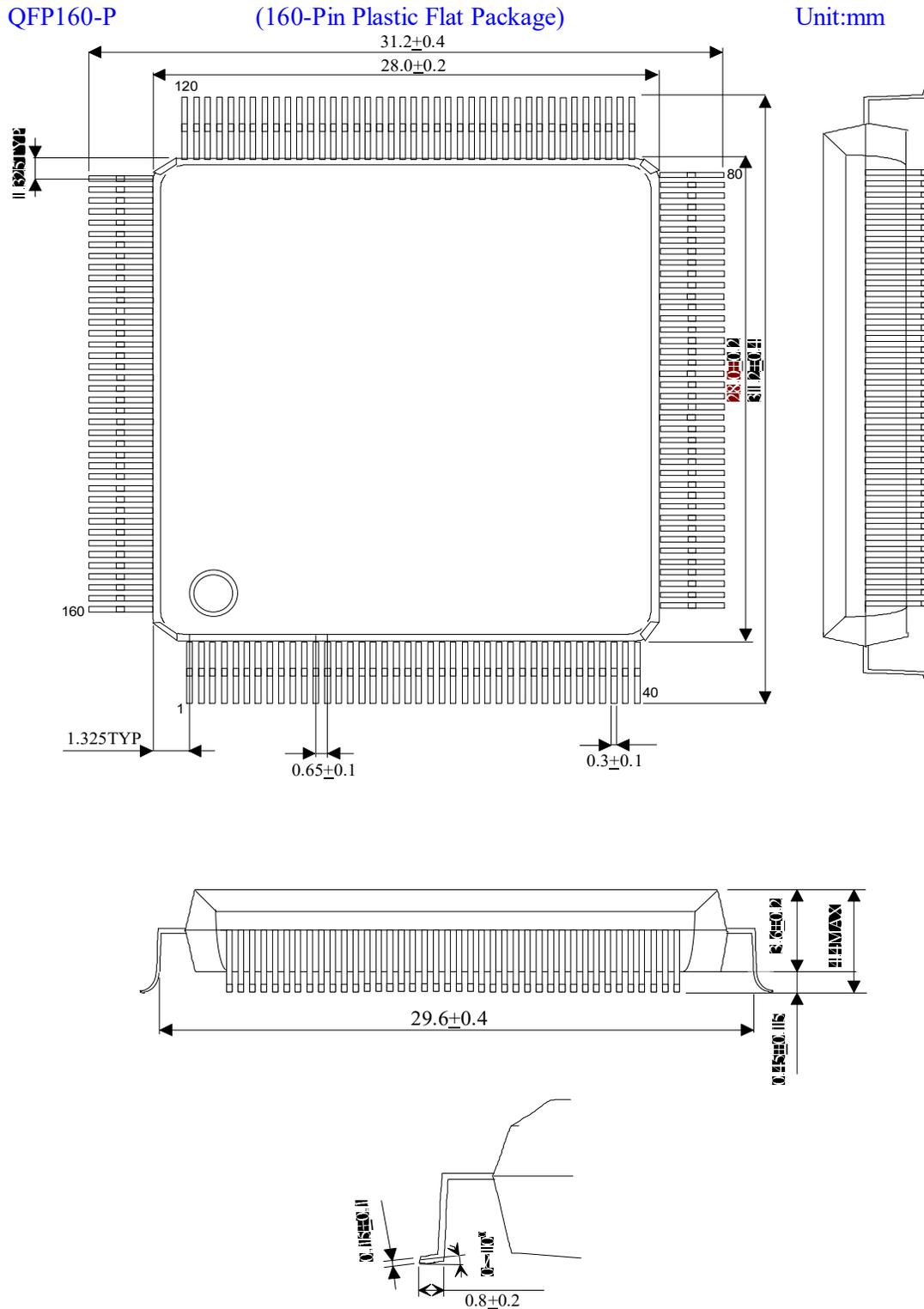
5. Mechanical Dimension

5.1 SiS85C501, SiS85C502 (208 pins)

QFP208-P (208-Pin Plastic Flat Package) Unit:mm



5.2 SiS85C503 (160 pins)





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