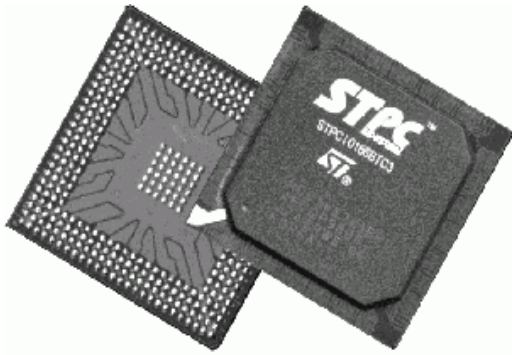
STPC® INDUSTRIAL

PC Compatible Embedded Microprocessor

- POWERFUL X86 PROCESSOR
- 64-BIT BUS ARCHITECTURE
- 64-BIT 66MHz DRAM CONTROLLER
- SVGA GRAPHICS CONTROLLER
- 135MHz RAMDAC
- UMA ARCHITECTURE
- TFT DISPLAY CONTROLLER
- PCI MASTER / SLAVE / ARBITER
- LOCAL BUS INTERFACE
- ISA (MASTER/SLAVE) INTERFACE
  -INCLUDING THE IPC
- PC-CARD INTERFACE
  - PCMCIA
  - CARDBUS
- I/O FEATURES
  - PC/AT+ KEYBOARD CONTROLLER
  - PS/2 MOUSE CONTROLLER
  - 2 SERIAL PORTS
  - 1 PARALLEL PORT
- IPC
  - DMA CONTROLLER
  - INTERRUPT CONTROLLER
  - TIMER / COUNTERS
- POWER MANAGEMENT

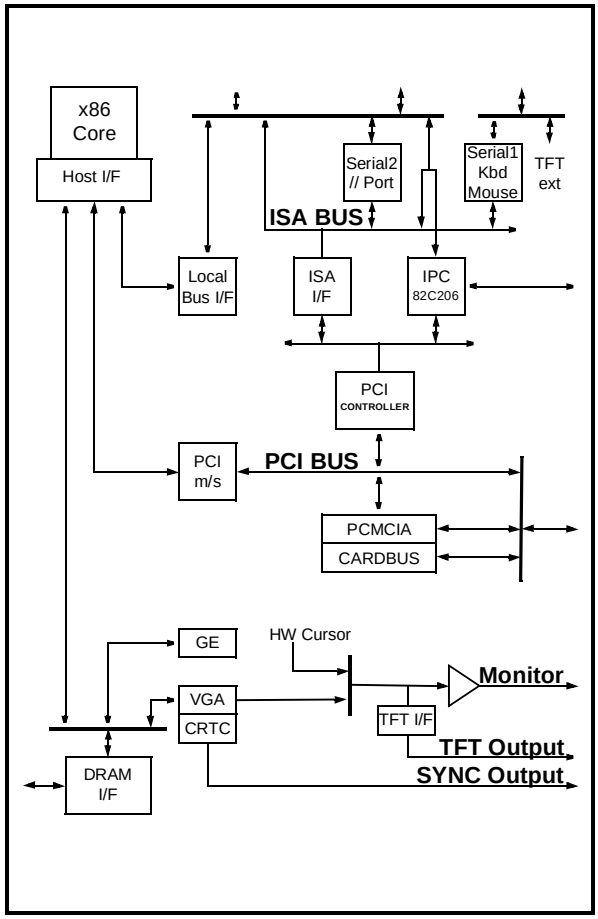
STPC INDUSTRIAL OVERVIEW

The STPC Industrial integrates a fully static x86 processor, fully compatible with standard fifth generation x86 processors, and combines it with powerful chipset, graphics, TFT, PC-Card, Local Bus, keyboard, mouse, serials and parallel interfaces to provide a single Industrial oriented PC compatible subsystem on a single device. The performance of the device is comparable with the performance of a typical P5 generation system.
The device is packaged in a 388 Plastic Ball Grid Array (PBGA).



PBGA388

Figure 1. Logic Diagram



- **X86 Processor core**
- Fully static 32-bit 5-stage pipeline, x86 processor fully PC compatible.
- Access up to 4GB of external memory.
- 8Kbyte unified instruction and data cache with write back capability.
- Parallel processing integral floating point unit, with automatic power down.
- Clock core speeds up to 100 MHz.
- Fully static design for dynamic clock control.
- Low power and system management modes.
- Optimized design for 3.3V operation.

- **DRAM Controller**
- Integrated system memory and graphic frame memory.
- Supports up to 128-MByte system memory in 4 banks and down to as little as 2Mbytes.
- Supports 4-MByte, 8-MByte, 16-MByte, and 32-MByte single-sided and double-sided DRAM SIMMs.
- Four quad-word write buffers for CPU to DRAM and PCI to DRAM cycles.
- Four quad-word read prefetch buffers for PCI masters.
- Supports Fast Page Mode & EDO DRAMs.
- Programmable timing for DRAM parameters including CAS pulse width, CAS pre-charge time, and RAS to CAS delay.
- 60, 70, 80 & 100ns DRAM speeds.
- Memory hole between 1 MByte & 8 MByte supported for PCI/ISA busses.
- Hidden refresh.

To check if your memory device is supported by the STPC, please refer to Table 6-24 in the Programming Manual.

- **Graphics Controller**
- 64-bit windows accelerator.
- Complete backward compatibility to VGA and SVGA standards.
- Hardware acceleration for text (generalized bit map expansion), bitblts, transparent blts and fills.
- Up to 64 x 64 bit graphics hardware cursor.
- Up to 4MB long linear frame buffer.
- 8, 16, 24 and 32 bit pixels.
- Drivers for Windows and other operating systems.

- **CRT Controller**
- Integrated 135MHz triple RAMDAC allowing for 1280 x 1024 x 75Hz display.
- Requires external frequency synthesizer and reference sources.
- 8, 16, 24 and 32-bit pixels.
- Interlaced or non-interlaced output.

- **TFT Interface**
- Programmable panel size up to 1024 by 1024 pixels.
- Support for 640 x 480, 800 x 600 & 1024 x 768 active matrix TFT flat panels with 9, 12, 18-bit interface.
- Support 1 & 2 Pixels per Clock.
- Programmable image positionning.
- Programmable blank space insertion in text mode.
- Programmable horizontal and vertical image expansion in graphic mode.
- A fully programmable PWM (Pulse Width Modulator) signals to adjust the flat panel brightness and contrast.
- Supports **PanelLink**^{TM} high speed serial transmitter externally for high resolution panel interface.

- **PCI Controller**
- Fully compliant with PCI Version 2.1 specification.
- Integrated PCI arbitration interface. Up to 3 masters can connect directly. External PAL allows for greater than 3 masters.
- Translation of PCI cycles to ISA bus.
- Translation of ISA master initiated cycle to PCI.
- Support for burst read/write from PCI master.
- 0.33X and 0.5X CPU clock PCI clock.

- **Local Bus interface**
- 66MHz, low latency bus.
- Asynchronous / synchronous.
- 22-bit address and 16-bit data busses.
- 2 Programmable Flash EPROM Chip Select.
- 4 Programmable I/O Chip Select.
- Separate memory and I/O address spaces.
- Memory prefetch (improved performances).

- **ISA master/slave**
- Generation of the ISA clock from either 14.318MHz oscillator clock or system clock
- Programmable extra wait state for ISA cycles
- Supports I/O recovery time for back to back I/O cycles.
- Fast Gate A20 and Fast reset.
- Supports the single ROM that C, D, or E. blocks shares with F block BIOS ROM.
- Supports flash ROM.
- Supports ISA hidden refresh.
- Buffered DMA & ISA master cycles to reduce bandwidth utilization of the PCI and Host bus. NSP compliant.

- **PC-Card interface**
- Support one PCMCIA 2.0 / JEIDA 4.1 68-pin standard PC Card Socket.
- Power Management support.
- Support PCMCIA/ATA specifications.
- Support I/O PC Card with pulse-mode interrupts.
- Provides an ExCA™ implementation to PCMCIA 2.0 / JEIDA 4.1 standards.
- DMA support.

- **Keyboard interface**
- Fully PC/AT& compatible

- **Mouse interface**
- Fully PS/2 compatible

- **Serial interface**
- 16550A compatible
- Programmable word length, stop bits, parity.
- 16-bit programmable baud rate generator.
- Interrupt generator.
- Loop-back mode.
- 8-bit scratch register.
- Two 16-bit FIFOs.
- Two DMA handshake lines.

- **Parallel port**
- Standard Centronics mode supported.
- Nibble mode supported.

- **Integrated Peripheral Controller**
- Two 8237/AT compatible 7-channel DMA controllers.
- Two 8259/AT compatible interrupt Controller. 16 interrupt inputs - ISA and PCI.
- Three 8254 compatible Timer/Counters.
- Co-processor error support logic.

- **Power Management**
- Four power saving modes: On, Doze, Standby, Suspend.
- Programmable system activity detector
- Supports SMM.
- Supports IO trap & restart.
- Independent peripheral time-out timer to monitor hard disk, serial & parallel ports.
- Supports APM
- Supports RTC, interrupt and DMA wake ups

ExCA is a trademark of PCMCIA / JEIDA.
PanelLink is a trademark of SiliconImage, Inc

1 GENERAL DESCRIPTION

At the heart of the STPC Industrial is an advanced 64-bit processor block, dubbed the 5ST86. The 5ST86 includes a powerful x86 processor core along with a 64-bit DRAM controller, advanced 64-bit accelerated graphics and video controller, a high speed PCI local-bus controller and Industry standard PC chip set functions (Interrupt controller, DMA Controller, Interval timer and ISA bus).

The STPC Industrial has in addition to the 5ST86 a TFT output, a Local Bus interface, PC Card and super I/O features.

The STPC Industrial makes use of a tightly coupled Unified Memory Architecture (UMA), where the same memory array is used for CPU main memory and graphics frame-buffer. This means a reduction in total system memory for system performances that are equal to that of a comparable frame buffer and system memory based system, and generally much better, due to the higher memory bandwidth allowed by attaching the graphics engine directly to the 64-bit processor host interface running at the speed of the processor bus rather than the traditional PCI bus.

The 64-bit wide memory array provides the system with 320MB/s peak bandwidth, double that of an equivalent system using 32 bits. This allows for higher resolution screens and greater color depth. The processor bus runs at 66Mhz further increasing “standard” bandwidth by at least a factor of two.

The ‘standard’ PC chipset functions (DMA, interrupt controller, timers, power management logic) are integrated together with the x86 processor core; additional functions such as communication ports are accessed by the STPC Industrial via an internal ISA bus.

The PCI bus is the main data communication link to the STPC Industrial chip. The STPC Industrial translates appropriate host bus I/O and Memory cycles onto the PCI bus. It also supports the generation of Configuration cycles on the PCI bus. The STPC Industrial, as a PCI bus agent (host bridge class), fully complies with PCI specification 2.1. The chip-set also implements the PCI mandatory header registers in Type 0 PCI configuration space for easy porting of PCI aware system BIOS. The device contains a PCI arbitration function for three external PCI devices.

Graphics functions are controlled through the on-chip SVGA controller and the monitor display is produced through the 2D graphics display engine. This Graphics Engine is tuned to work with the host CPU to provide a balanced graphics system with a low silicon area cost. It performs limited graphics drawing operations which include hardware acceleration of text, bitblts, transparent blts and fills. The results of these operations change the contents of the on-screen or off-screen frame buffer areas of DRAM memory. The frame buffer can occupy a space up to 4 Mbytes anywhere in the physical main memory.

The maximum graphics resolution supported is 1280x1024 in 65536 colours at 75Hz refresh rate and is VGA and SVGA compatible. Horizontal timing fields are VGA compatible while the vertical fields are extended by one bit to accommodate above display resolution.

To generate the TFT output, the STPC Industrial extracts the digital video stream before the RAMDAC and reformats it to the TFT format. The height and width of the flat panel are programmable through configuration registers up to a size of 1024 by 1024.

By default, lower resolution images cover only a part of the larger TFT panel. The STPC Industrial allows to expand the image vertically and horizontally in text mode by inserting programmable blank pixels. It allows expantion of the image vertically and horizontally in graphics mode by replicating pixels. The replication of J times every K pixel is independently programmable in the vertical and horizontal directions.

PanelLink™ is a proprietary interconnect protocol defined by Silicon Image, Inc. It consists of a transmitter that takes parallel video/graphics data from the host LCD graphics controller and transmits it serially at high speed to the receiver which controls the TFT panel. The TFT interface is designed to support the connection of this control signal to the **PanelLink**™ transmitter.

The STPC Industrial CARDBUS / PCMCIA controller has been specifically designed to provide the interface with PC-Cards which contain additional memory or I/O and provides an **ExCA**™ implementation to PCMCIA 2.0 / JEIDA 4.1 standards.

The power management control facilities include socket power control, insertion/removal capability, power saving with Windows inactivity, NCS controlled Chip Power Down, together with further controls for 3.3v suspend with Modem Ring Resume Detection.

The need for system configuration jumpers is eliminated by providing address mapping support for PCMCIA 2.0 / JEIDA 4.1 PC-Card memory together with address windowing support for I/O space.

Selectable interrupt steering from PC-Card to internal system bus is also provided.

The STPC Industrial implements a multi-function parallel port. The standard PC/AT compatible logical address assignments for LPT1, LPT2 and LPT3 are supported.

The parallel port can be configured for any of the following 3 modes and supports the IEEE Standard 1284 parallel interface protocol standards as follow:

-Compatibility Mode (Forward channel, standard)

-Nibble Mode (Reverse channel, PC compatible)

-Byte Mode (Reverse channel, PS/2 compatible)

The STPC Industrial BGA package has 388 balls, but this is not sufficient for all the integrated functions, therefore some features are sharing the same balls and can not be used at the same time. The STPC Industrial configuration is done by 'strap options'. It is a set of pull-up or pull-down resistors on the memory data bus, checked on reset, which auto-configure the STPC Industrial.

We can distinguish three main blocks ***independently configurables*** : The ISA / Local Bus block, the Serial 1 / TFT block, and the PCI / PC Card block.

From the first block, we can activate either the ISA bus and some IPC additionnal features, or the Local bus, the parallel port and the second serial interface.

From the second block, we can activate either the first serial port, or the TFT extension to get from 4 bit per colour to 6 bit per colour.

From the third block, we can activate either the PCI bus, or the PC Card interface (CardBus/ PCMCIA/ZoomVideo).

The STPC Industrial core is compliant with the Advanced Power Management (APM) specification to provide a standard method by which the BIOS can control the power used by personal computers. The Power Management Unit module (PMU) controls the power consumption providing a comprehensive set of features that control the power usage and supports compliance with the United States Environmental Protection Agency's Energy Star Computer Program. The PMU provides following hardware structures to assist the software in managing the power consumption by the system.

- System Activity Detection.

- 3 power-down timers detecting system inactivity:
  - Doze timer (short durations).
  - Stand-by timer (medium durations).
  - Suspend timer (long durations).

- House-keeping activity detection.

- House-keeping timer to cope with short bursts of house-keeping activity while dozing or in stand-by state.

- Peripheral activity detection.

- Peripheral timer detecting peripheral inactivity

- SUSP# modulation to adjust the system performance in various power down states of the system including full power on state.

- Power control outputs to disable power from different planes of the board.

Lack of system activity for progressively longer periods of time is detected by the three power down timers. These timers can generate SMI interrupts to CPU so that the SMM software can put the system in decreasing states of power consumption. Alternatively, system activity in a power down state can generate SMI interrupt to allow the software to bring the system back up to full power on state. The chip-set supports up to three power down states described above, these correspond to decreasing levels of power savings.

Power down puts the STPC Industrial into suspend mode. The processor completes execution of the current instruction, any pending decoded instructions and associated bus cycles. During the suspend mode, internal clocks are stopped. Removing power down, the processor resumes instruction fetching and begins execution in the instruction stream at the point it had stopped. Because of the static nature of the core, no internal data is lost..

Figure 1.1. Functionnal description.

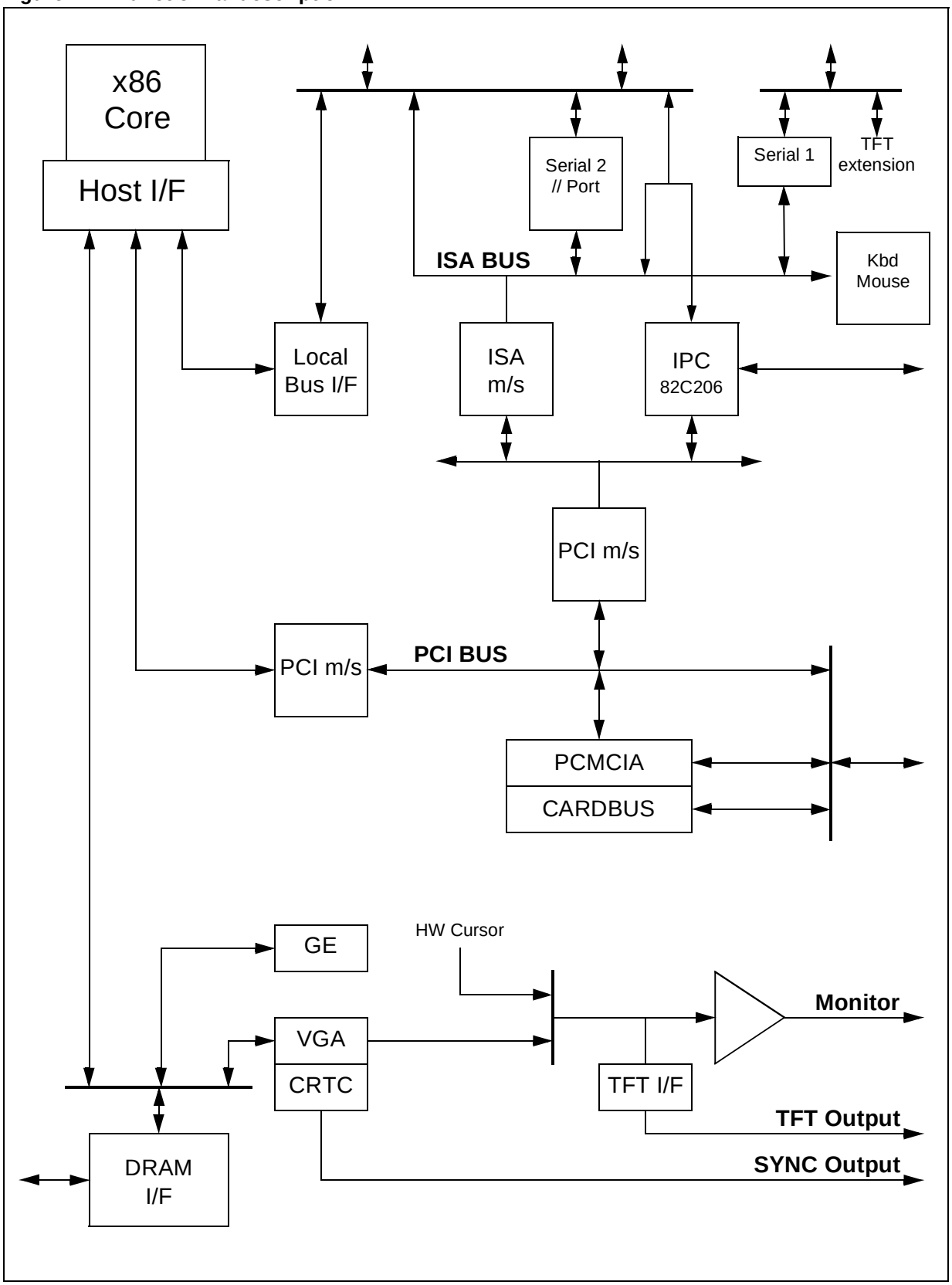


Figure 1.2. PCI, PCMCIA & CARDBUS modes:

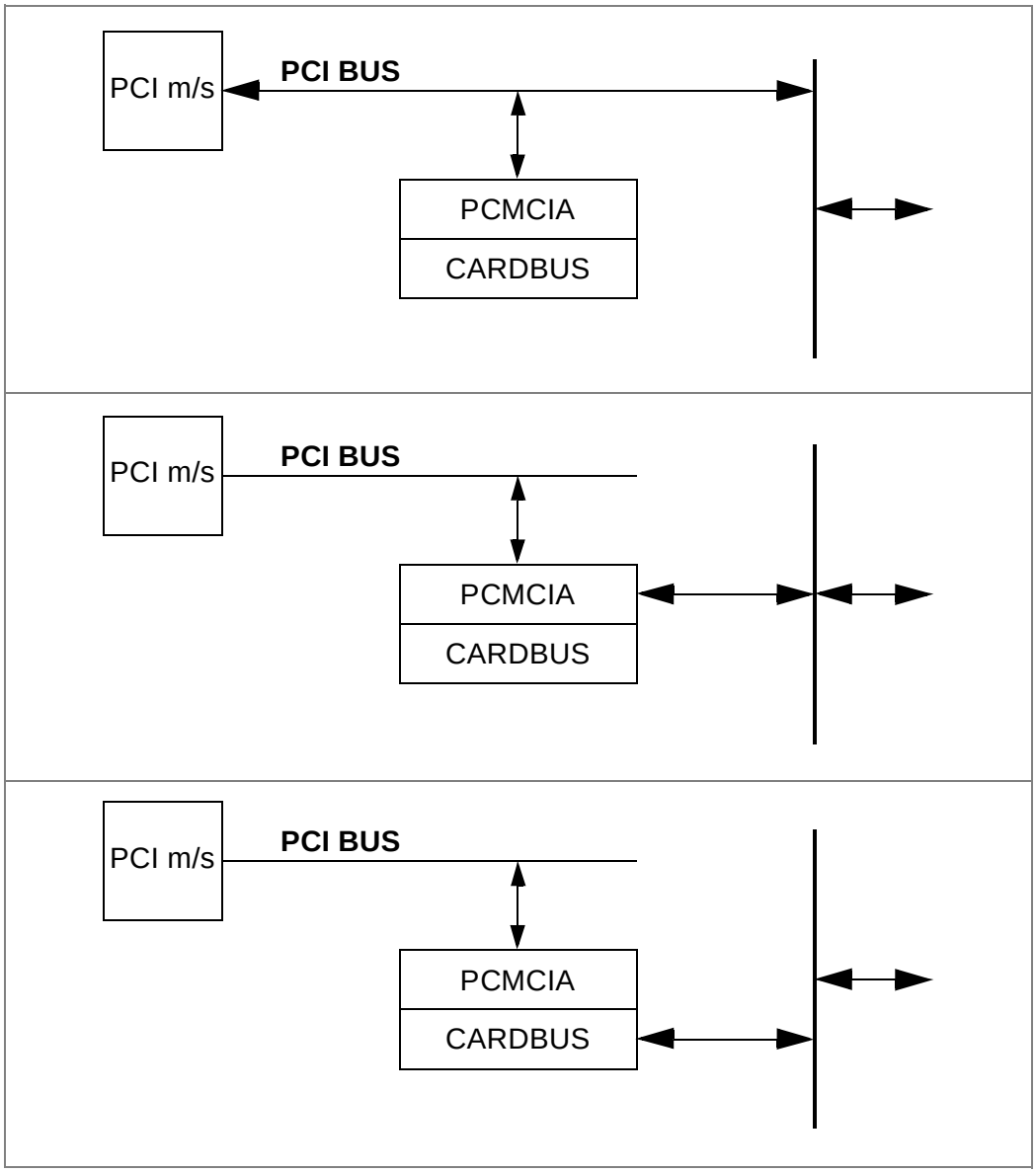


Figure 1.3. Local Bus and ISA bus modes:

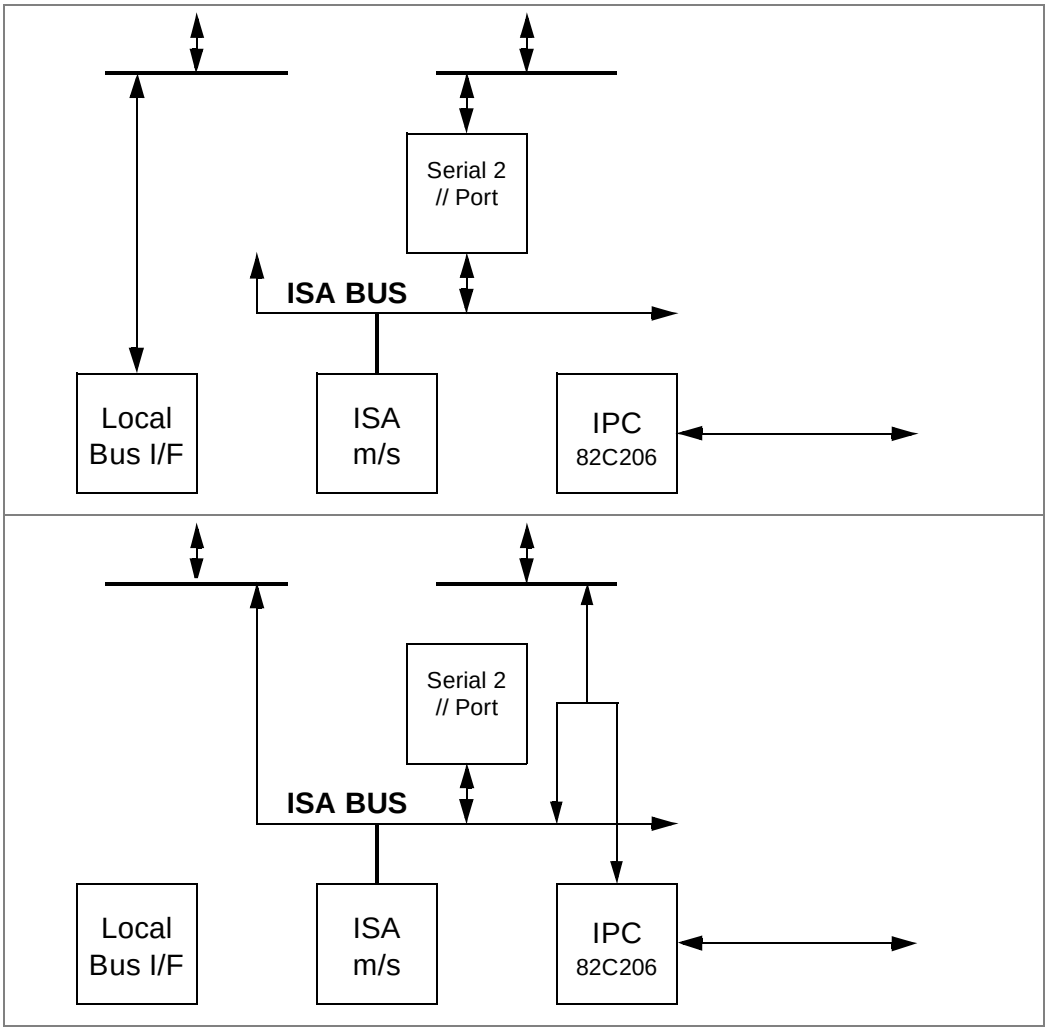


Figure 1.4. TFT in normal (serial 1 available) and extended modes (serial 1 unavailable).

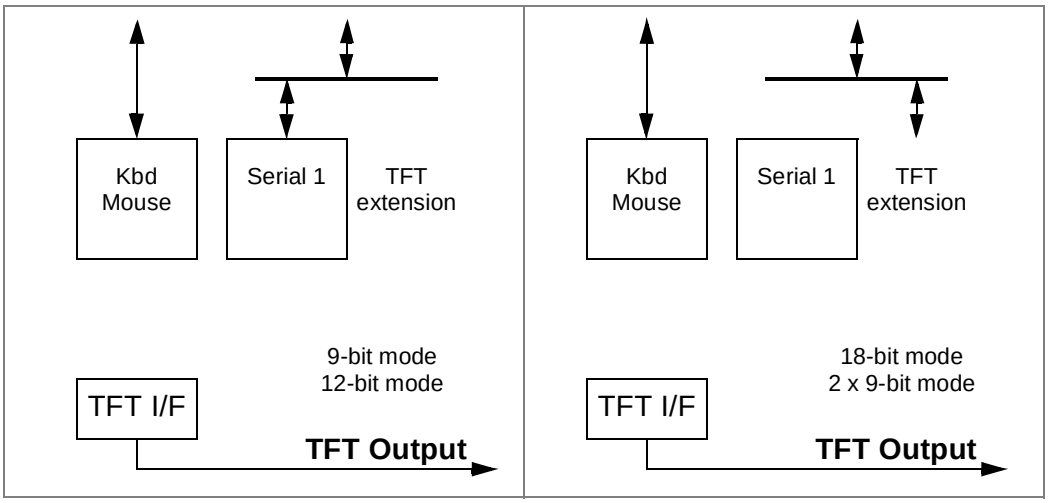


Figure 2. Typical PC oriented Application

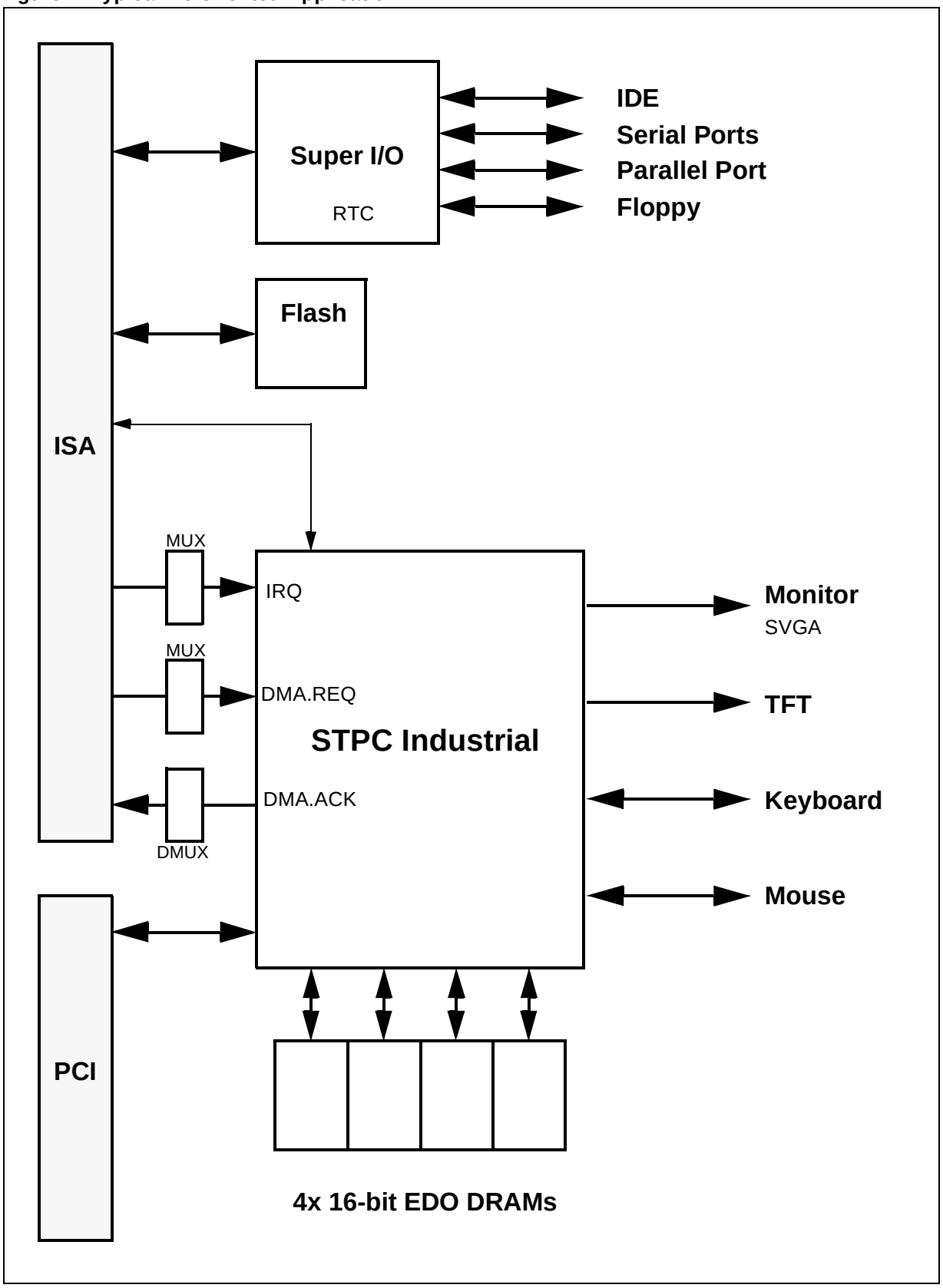
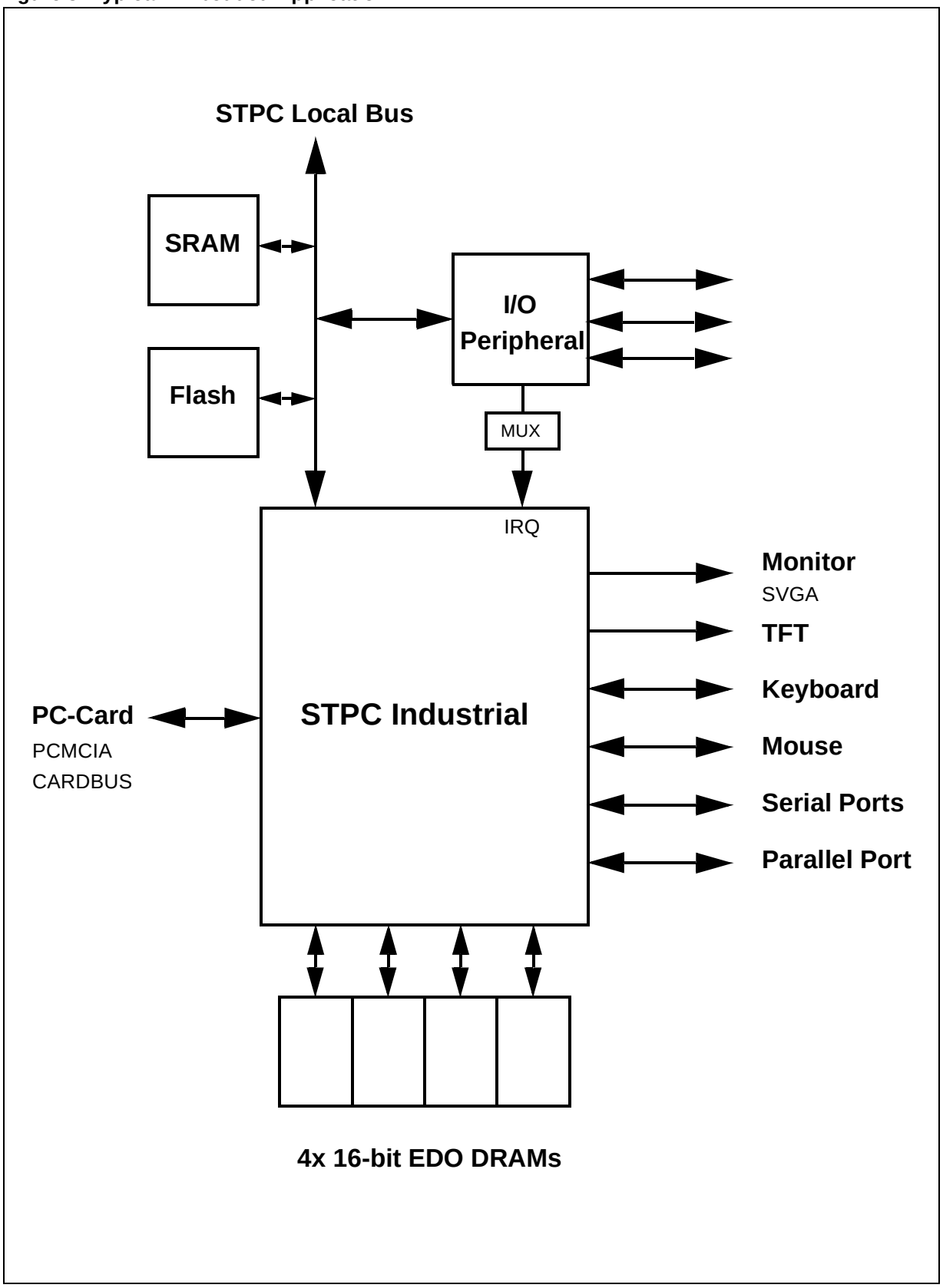


Figure 3. Typical Embedded Application



2 PIN DESCRIPTION

2.1. INTRODUCTION

The STPC Industrial integrates most of the functionalities of the PC architecture. Therefore, many of the traditional interconnections between the host PC microprocessor and the peripheral devices are totally internal to the STPC Industrial. This offers improved performance due to the tight coupling of the processor core and it's peripherals. As a result many of the external pin connections are made directly to the on-chip peripheral functions.

Figure 2-1 shows the STPC Industrial external interfaces. It defines the main buses and their function. Table 2-1 describes the physical implementation listing signal types and their functionalities. Table 2-2 provides a full pin listing and description.

Table 2-4 provides a full listing of the STPC Industrial package pin location physical connection. Please refer to the pin allocation drawing for reference.

Due to the number of pins available for the package, and the number of functional I/Os, some pins have several functions, selectable by strap option on Reset. Table 2-3 provides a summary of these pins and their functions.

Table 2-1. Signal Description

Group name		Qty
Basic Clocks, Reset & Xtal (SYS)		13
DRAM Controller(DRAM)		89
PCI Controller	55	64
PC Card Interface	64	
Keyboard/Mouse Controller (SIO)		4
Local Bus I/F, Parallel I/F, Serial 2	75	75
ISA Interface/IPC extensions	73	
Serial 1 (SIO)	8	26
TFT output	24	
VGA Controller (VGA)		10
Grounds		74
V_{DD}		16
Analog specific V_{CC}/V_{DD}		16
Reserved		1
Total Pin Count		388

Figure 2-1. STPC Industrial External Interfaces

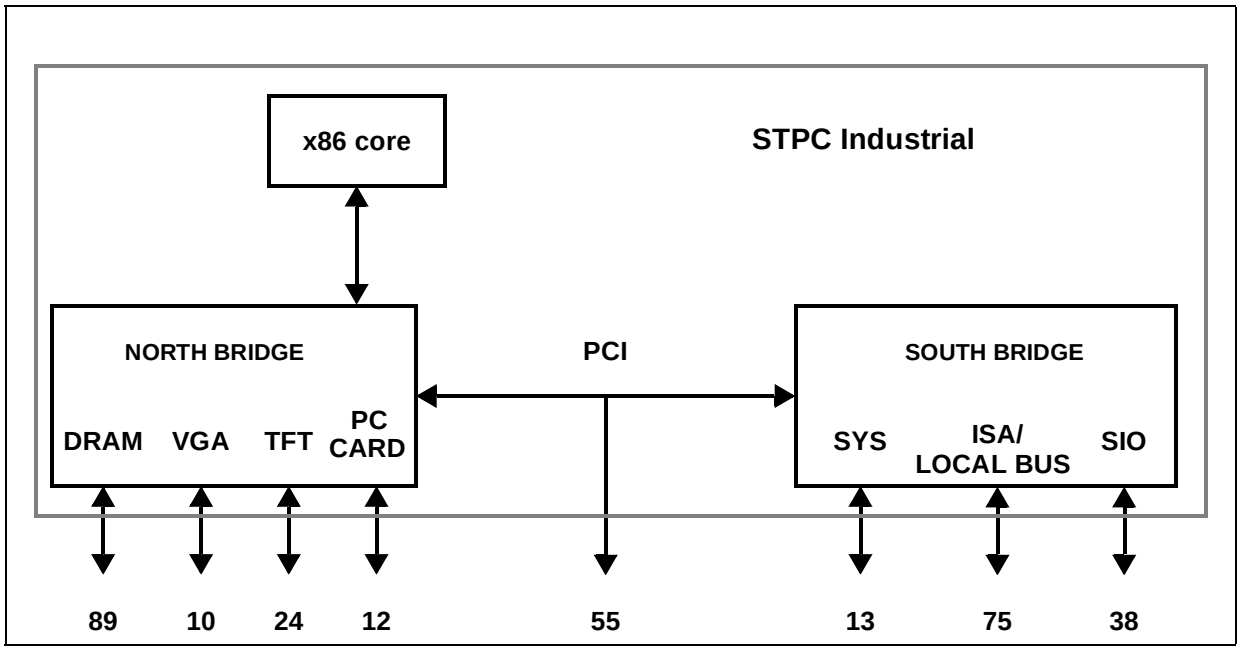


Table 2-2. Definition of Signal Pins

Signal Name	Dir	Description	Qty
BASIC CLOCKS AND RESETS			
SYSRSTI#*	I	System Reset / Power good	1
SYSRSTO#*	O	Reset Output to System	1
XTALI	I	14.3 MHz Crystal Input	1
XTALO	O	14.3 MHz Crystal Output	1
PCI_CLKI*	I	33 MHz PCI/CardBus Input Clock	1
PCI_CLKO	O	33 MHz PCI/CardBus Output Clock	1
ISA_CLK, ISA_CLK2X	O	ISA Clock x1 and x2 (also Multiplexer Select Line For IPC)	2
CLK14M	O	ISA bus synchronisation clock	1
HCLK*	I/O	33 / 66 MHz Host Clock (Test)	1
DEV_CLK*	O	24 MHz Peripheral Clock	1
GCLK2X	I/O	80 MHz Graphics Clock	1
DCLK	I/O	135 MHz Dot Clock	1
V_{DD}_xxx_PLL		Power Supply for PLL Clocks	
MEMORY INTERFACE			
MA[11:0]	O	Memory Address	12
RAS#[3:0]	O	Row Address Strobe	4
CAS#[7:0]	O	Column Address Strobe	8
MWE#	O	Write Enable	1
MD[63:0]	I/O	Memory Data	64
LOCAL BUS INTERFACE (COMBINED WITH ISA BUS)			
PA[21:0]*	O	Address Bus [21:0]	22
PD[15:0]*	I/O	Data Bus [15:0]	16
PRDY#*	I	Ready	1
PWR#[1:0]*	O	Memory and I/O Write signals	2
PRD#[1:0]*	O	Memory and I/O Read signals	2
FCS#[1:0]*, IOCS#[3:0]*	O	Flash Memory and I/O Chip Select	6
ISA BUS INTERFACE (COMBINED WITH LOCAL BUS, PARALLEL PORT, SERIAL INTERFACE)			
LA[23:17]*	O	Unlatched Address	7
SA[19:0]*	O	Latched Address	20
SD[15:0]*	I/O	Data Bus	16
IOCHRDY*	I	I/O Channel Ready	1
ALE*	O	Address Latch Enable	1
BHE#*	O	System Bus High Enable	1
MEMR#*, MEMW#*	I/O	Memory Read & Write	2
SMEMR#*, SMEMW#*	O	System Memory Read and Write	2
IOR#*, IOW#*	I/O	I/O Read and Write	2
MASTER#*	I	Add On Card Owns Bus	1
MCS16#*, IOCS16#*	I	Memory Chip Select 16, I/O Chip Select 16	2
REF#*	I	Refresh Cycle	1
AEN*	O	Address Enable	1
IOCHCK#*	I	I/O Channel Check (ISA)	1
RTCRW#*	O	RTC Read / Write#	1
RTCDS#*	O	RTC Data Strobe	1
RTCAS#*	O	RTC Address Strobe	1

Table 2-2. Definition of Signal Pins

Signal Name	Dir	Description	Qty
RMRTCCS#*	O	ROM / RTC Chip Select	1
GPIOCS#*	I/O	General Purpose Chip Select	1
IRQ_MUX[3:0]*	I	Multiplexed Interrupt Request	4
DACK_ENC[2:0]*	O	DMA Acknowledge	3
DREQ_MUX[1:0]*	I	Multiplexed DMA Request	2
TC*	O	ISA Terminal Count	1
KEYBOARD & MOUSE INTERFACE			
KBDATA*, MDATA*	I	Keyboard & Mouse Data Line	2
KBCLK*, MCLK*	O	Keyboard & Mouse Clock Line	2
SERIAL INTERFACE (SERIAL 1 COMBINED WITH TFT INTERFACE / SERIAL 2 COMBINED WITH IPC)			
SIN1*, SIN2*	I	Serial Data In (Serial 1, 2)	2
SOUT1*, SOUT2*	O	Serial Data Out (Serial 1, 2)	2
CTS1#*, CTS2#*	I	Clear To Send (Serial 1, 2)	2
RTS1#*, RTS2#*	O	Request To Send (Serial 1, 2)	2
DSR1#*, DSR2#*	I	Data Set Ready (Serial 1, 2)	2
DTR1#*, DTR2#*	O	Data Terminal Ready (Serial 1,2)	2
DCD1#*, DCD2#*	I	Data Carrier Detect (Serial 1, 2)	2
RI1#*, RI2#*	I	Ring Indicator (Serial 1, 2)	2
PARALLEL PORT (COMBINED WITH ISA BUS AND IPC)			
PE*	I	Paper End	1
SLCT*	I	SELECT	1
BUSY#*	I	BUSY	1
ERR#*	I	ERROR	1
ACK#*	I	Acknowledge	1
PDDIR#*	O	Parallel Device Direction	1
STROBE#*	O	PCS / STROBE#	1
INIT#*	O	INIT	1
AUTPFDX#*	O	Automatic Line Feed	1
SLCTIN#*	O	SELECT IN	1
PPD[7:0]*	I/O	Data Bus	8
PCMCIA INTERFACE (COMBINED WITH PCI / CARDBUS)			
RESET*	O	Reset	1
A[25:0]*	O	Address Bus	26
D[15:0]*	I/O	Data Bus	16
IORD#*, IOWR#*	O	I/O Read and Write	2
DREQ#* / WP* / IOIS16#*	I	DMA Request // Write Protect // I/O Size is 16-bit	1
BVD1*, BVD2*	I	Battery Voltage Detect	2
READY#*/BUSY#*/IREQ#*	I	Ready / Busy // Interrupt Request	1
WAIT#*	I	Wait	1
INPACK#*	I	Input Port Acknowledge	1
OE#* / TCw*	O	Output Enable // DMA Terminal Count	1
WE#* / TCr*	O	Write Enable // DMA Terminal Count	1
DACK* / REG#*	O	DMA Acknowledge // Register	1
CD1#*, CD2#*	I	Card Detect	2

Table 2-2. Definition of Signal Pins

Signal Name	Dir	Description	Qty
CE1#*, CE2#*	O	Card Enable	2
VS1#*, VS2#*	I	Voltage Sense	2
VCC5_EN*	O	Power Switch control : 5 V power	1
VCC3_EN*	O	Power Switch control : 3.3 V power	1
VPP_PGM*	O	Power Switch control : Program power	1
VPP_VCC*	O	Power Switch control : VCC power	1
CARDBUS INTERFACE (COMBINED WITH PCI / PCMCIA)			
CCLKRUN*	I/O	Clock	1
CRST#*	O	Reset	1
CSTSCHG#*	I	System Change	1
CAD[31:0]*	I/O	Address / Data	32
CBE[3:0]*	I/O	Bus Commands / Byte Enables	4
CFRAME#*	I/O	Cycle Frame	1
CTRDY#*	I/O	Target Ready	1
CIRDY#*	I/O	Initiator Ready	1
CSTOP#*	I/O	Stop Transaction	1
CDEVSEL#*	I/O	Device Select	1
CPAR*	I/O	Parity Signal Transactions	1
CSERR#*	I	System Error	1
CPERR#*	I/O	Parity Error	1
CBLOCK#*	I/O	PCI Lock	1
CCD[2:1]*	I	Card Detect	2
CINT#*	I	Interrupt Request	1
CREQ#*	I	Request	1
CGNT#*	O	Grant	1
PCI INTERFACE (COMBINED WITH PCMCIA / CARDBUS)			
AD[31:0]*	I/O	Address / Data	32
BE[3:0]*	I/O	Bus Commands / Byte Enables	4
FRAME#*	I/O	Cycle Frame	1
TRDY#*	I/O	Target Ready	1
IRDY#*	I/O	Initiator Ready	1
STOP#*	I/O	Stop Transaction	1
DEVSEL#*	I/O	Device Select	1
PAR*	I/O	Parity Signal Transactions	1
SERR#*	O	System Error	1
LOCK#*	I	PCI Lock	1
PCI_REQ#[2:0]*	I	PCI Request	3
PCI_GNT#[2:0]*	O	PCI Grant	3
PCI_INT[3:0]*	I	PCI Interrupt Request	4

Table 2-2. Definition of Signal Pins

Signal Name	Dir	Description	Qty
MONITOR INTERFACE			
RED, GREEN, BLUE	O	Red, Green, Blue	3
VSYNC*	I/O	Vertical Sync	1
HSYNC*	I/O	Horizontal Sync	1
VREF_DAC	I	DAC Voltage reference	1
RSET	I	Resistor Set	1
COMP	I	Compensation	1
DDC[1:0]*	I/O	Display Data Channel Serial Link	2
SCL / DDC[1]*	I/O	I²C Interface - Clock / Can be used for VGA DDC[1] signal	1
SDA / DDC[0]*	I/O	I²C Interface - Data / Can be used for VGA DDC[0] signal	1
TFT INTERFACE (COMBINED WITH SERIAL 1)			
R[5:0], G[5:0], B[5:0]	O	Red, Green, Blue	18
FPLINE	O	Horizontal Sync	1
FPFRAME	O	Vertical Sync	1
DE	O	Data Enable	1
ENAVDD	O	Enable Vdd of flat panel	1
ENVCC	O	Enable Vcc of flat panel	1
PWM	O	PWM back-light control	1
MISCELLANEOUS			
SPKRD*	O	Speaker Device Output	1
SCAN_ENABLE	I	Test Pin - Reserved	1

Note; * denotes that the pin is V_{5T} (see Section 4)

2.2. SIGNAL DESCRIPTIONS

2.2.2 BASIC CLOCKS AND RESETS

SYSRSTI# *System Reset/Power good.* This input is low when the reset switch is depressed. Otherwise, it reflects the power supply's power good signal. PWGD is asynchronous to all clocks, and acts as a negative active reset. The reset circuit initiates a hard reset on the rising edge of PWGD.

SYSRSTO# *Reset Output to System.* This is the system reset signal and is used to reset the rest of the components (not on Host bus) in the system. The ISA bus reset is an externally inverted buffered version of this output and the PCI bus reset is an externally buffered version of this output.

XTALI *14.3 MHz Crystal Input*
XTALO *14.3 MHz Crystal Output.* These pins are the 14.318 MHz crystal input; This clock is used as the reference clock for the internal frequency synthesizer to generate the HCLK and CLK24M.
A 14.318 MHz Series Cut Quartz Crystal should be connected between these two pins. Balance capacitors of 15 pF should also be added. In the event of an external oscillator providing the master clock signal to the STPC Industrial device, the TTL signal should be provided on XTALO.

PCI_CLKI *33 MHz PCI Input Clock*

This signal must be connected to a clock generator and is usually connected to PCI_CLKO.

PCI_CLKO *33 MHz PCI Output Clock.* This is the master PCI bus clock output

ISA_CLK *ISA Clock Output (also Multiplexer Select Line For IPC).* This pin produces the Clock signal for the ISA bus. It is also used with ISA_CLK2X as the multiplexer control lines for the Interrupt Controller Interrupt input lines. This is a divided down version of the PCICLK or OSC14M.

ISA_CLKX2 *ISA Clock Output (also Multiplexer Select Line For IPC).* This pin produces a signal at twice the frequency of the ISA bus Clock signal. It is also used with ISA_CLK as the multiplexer control lines for the Interrupt Controller Interrupt input lines.

CLK14M *ISA bus synchronisation clock.* This is the buffered 14.318 MHz clock to the ISA bus. This clock also provides the reference clock to the frequency synthesizer that generates GCLK2X and DCLK.

HCLK *Host Clock.* This is the host 1X clock. Its frequency can vary from 50 MHz to 75 MHz. All host transactions and PCI transactions are synchronized to this clock. Host transactions executed by the DRAM controller are also driven by this clock.

DEV_CLK *24 MHz Peripheral Clock (floppy drive).* This 24 MHZ signal is provided as a convenience for the system integration of a Floppy Disk driver function in an external chip.

GCLK2X *80 MHz Graphics Clock.* This is the Graphics 2X clock, which drives the graphics engine and the DRAM controller to execute the graphics and display cycles.
Normally GCLK2X is generated by the internal frequency synthesizer, and this pin is an output. By setting a bit in Strap Register 2, this pin can be made an input so that an external clock can replace the internal frequency synthesizer.

DCLK *135 MHz Dot Clock.* This is the dot clock, which drives graphics display cycles. Its frequency can go from 8 MHz (using internal PLL) up to 135 MHz, and it is required to have a worst case duty cycle of 60-40.
The direction can be controlled by a strap option or an internal register bit.

2.2.3 MEMORY INTERFACE

MA[11:0] *Memory Address.* These 12 multiplexed memory address pins support external DRAM with up to 4K refresh. These include all 16M x N and some 4M x N DRAM modules. The address signals must be externally buffered to support more than 16 DRAM chips. The timing of these signals can be adjusted by software to match the timings of most DRAM modules.

MD[63:0] *Memory Data.* This is the 64-bit memory data bus. If only half of a bank is populated, MD63-32 is pulled high, data is on MD31-0.
MD20-0 are also used as inputs at the rising edge of PWGD to latch in power-up configuration information into the ADPC strap registers.

RAS#[3:0] *Row Address Strobe.* There are four active low row address strobe outputs, one each for each bank of the memory. Each bank contains 4 or 8 bytes of data. The memory controller allows half of a bank (4 bytes) to be populated to enable memory upgrade at finer granularity.
The RAS# signals drive the SIMMs directly without any external buffering. These pins are always outputs, but they can also simultaneously be inputs, to allow the memory controller to monitor the value of the RAS# signals at the pins.

CAS#[7:0] *Column Address Strobe.* There are 8 active low column address strobe outputs, one each for each Byte of the memory.
The CAS# signals drive the SIMMs either directly or through external buffers.
These pins are always outputs, but they can also simultaneously be inputs, to allow the memory controller to monitor the value of the CAS# signals at the pins.

MWE# *Write Enable.* Write enable specifies whether the memory access is a read (MWE# = H) or a write (MWE# = L). This single write enable controls all DRAMs. It can be externally buffered to boost the maximum number of loads (DRAM chips) supported.
The MWE# signals drive the SIMMs directly without any external buffering.

2.2.4 LOCAL BUS INTERFACE (Combined with ISA Bus)

PA[21:0] *Memory Address.* This is the 22-bit Local Bus Address

PD[15:0] *Data Bus.* This is the 16-bit bidirectional Local Bus Data bus.

PRDY# *Ready.* This input signals the Local Bus Ready state.

PWR#1 *Memory and I/O Write signal* for MS Byte

PWR#0 *Memory and I/O Write signal* for LS Byte.

PRD#1 *Memory and I/O Read signals* for MS Byte.

PRD#0 *Memory and I/O Read signals* for LS Byte.

FCS#[1:0], IOCS#[3:0] *Flash Memory and I/O Chip select.*

2.2.5 ISA BUS INTERFACE

LA[23:17] *Unlatched Address.* These unlatched ISA Bus pins address bits 23-17 on 16-bit devices. When the ISA bus is accessed by any cycle initiated from the PCI bus, these pins are in output mode. When an ISA bus master owns the bus, these pins are tristated.

SA[19:0] *Unlatched Address.* These are the 20 low bits of the system address bus of ISA. These pins are used as an input when an ISA bus master owns the bus and are outputs at all other times.

SD[15:0] *I/O Data Bus (ISA).* These are the external ISA data bus pins.

IOCHRDY *IO Channel Ready.* IOCHRDY is the IO channel ready signal of the ISA bus and is driven as an output in response to an ISA master cycle targeted to the host bus or an internal register of the STPC Industrial. The STPC Industrial monitors this signal as an input when performing an ISA cycle on behalf of the host CPU, DMA master or refresh.
ISA masters which do not monitor IOCHRDY are not guaranteed to work with the STPC Industrial since the access to the system memory can be considerably delayed due to CRT refresh or a write back cycle.

ALE *Address Latch Enable.* This is the address latch enable output of the ISA bus and is asserted by the STPC Industrial to indicate that LA23-17, SA19-0, AEN and SBHE# signals are valid. The ALE is driven high during refresh, DMA master or an ISA master cycles by the STPC Industrial.
ALE is driven low after reset.

BHE# *System Bus High Enable.* This signal, when asserted, indicates that a data Byte is being transferred on SD15-8 lines. It is used as an input when an ISA master owns the bus and is an output at all other times.

MEMR# *Memory Read.* This is the memory read command signal of the ISA bus. It is used as an input when an ISA master owns the bus and is an output at all other times.
The MEMR# signal is active during refresh.

MEMW# *Memory Write.* This is the memory write command signal of the ISA bus. It is used as an input when an ISA master owns the bus and is an output at all other times.

SMEMR# *System Memory Read.* The STPC Industrial generates SMEMR# signal of the ISA bus only when the address is below one MByte or the cycle is a refresh cycle.

SMEMW# *System Memory Write.* The STPC Industrial generates SMEMW# signal of the ISA bus only when the address is below one MByte.

IOR# *I/O Read.* This is the IO read command signal of the ISA bus. It is an input when an ISA master owns the bus and is an output at all other times.

IOW# *I/O Write.* This is the IO write command signal of the ISA bus. It is an input when an ISA master owns the bus and is an output at all other times.

MASTER# *Add On Card Owns Bus.* This signal is active when an ISA device has been granted bus ownership.

MCS16# *Memory Chip Select16.* This is the decode of LA23-17 address pins of the ISA address

bus without any qualification of the command signal lines. MCS16# is always an input. The STPC Industrial ignores this signal during IO and refresh cycles.

IOCS16# *IO Chip Select16.* This signal is the decode of SA15-0 address pins of the ISA address bus without any qualification of the command signals. The STPC Industrial does not drive IOCS16# (similar to PC-AT design). An ISA master access to an internal register of the STPC Industrial is executed as an extended 8-bit IO cycle.

REF# *Refresh Cycle.* This is the refresh command signal of the ISA bus. It is driven as an output when the STPC Industrial performs a refresh cycle on the ISA bus. It is used as an input when an ISA master owns the bus and is used to trigger a refresh cycle.
The STPC Industrial performs a pseudo hidden refresh. It requests the host bus for two host clocks to drive the refresh address and capture it in external buffers. The host bus is then relinquished while the refresh cycle continues on the ISA bus.

AEN *Address Enable.* Address Enable is enabled when the DMA controller is the bus owner to indicate that a DMA transfer will occur. The enabling of the signal indicates to IO devices to ignore the IOR#/IOW# signal during DMA transfers.

IOCHCK# *IO Channel Check.* IO Channel Check is enabled by any ISA device to signal an error condition that can not be corrected. NMI signal becomes active upon seeing IOCHCK# active if the corresponding bit in Port B is enabled.

GPIOCS# *I/O General Purpose Chip Select 1.* This output signal is used by the external latch on ISA bus to latch the data on the SD[7:0] bus. The latch can be use by PMU unit to control the external peripheral devices to power down or any other desired function.

RTCRW# *Real Time Clock RW#.* This pin is used as RTCRW#. This signal is asserted for any I/O write to port 71h.

RTCDS# *Real Time Clock DS.* This pin is used as RTCDS. This signal is asserted for any I/O read to port 71h.

RTCAS# *Real time clock address strobe.* This signal is asserted for any I/O write to port 70h.

RMRTCCS# *ROM/Real Time clock chip select.* This pin is a multi-function pin. This signal is asserted if a ROM access is decoded during a memory cycle. It should be combined with MEMR# or MEMW# signals to properly access the ROM. During an IO cycle, this signal is asserted if access to the Real Time Clock (RTC) is decoded. It should be combined with IOR# or IOW# signals to properly access the real time clock.

IRQ_MUX[3:0] *Multiplexed Interrupt Request.* These are the ISA bus interrupt signals. They are to be encoded before connection to the STPC Industrial using ISACLK and ISACLKX2 as the input selection strobes.
Note that IRQ8B, which by convention is connected to the RTC, is inverted before being sent to the interrupt controller, so that it may be connected directly to the IRQ# pin of the RTC.

2.2.6 IPC (Combined with Serial Interface)

DACK_ENC[2:0] *DMA Acknowledge.* These are the ISA bus DMA acknowledge signals. They are encoded by the STPC Industrial before output and should be decoded externally using ISACLK and ISACLKX2 as the control strobes.

DREQ_MUX[1:0] *ISA Bus Multiplexed DMA Request.* These are the ISA bus DMA request signals. They are to be encoded before connection to the STPC Industrial using ISACLK and ISACLKX2 as the input selection strobes.

TC *ISA Terminal Count.* This is the terminal count output of the DMA controller and is connected to the TC line of the ISA bus. It is asserted during the last DMA transfer, when the Byte count expires.

2.2.7 KEYBOARD/MOUSE INTERFACE

KBCLK, *Keyboard Clock line.* Keyboard data is latched by the controller on each negative clock edge produced on this pin. The keyboard can be disabled by pulling this pin low by software control.

KBDATA, *Keyboard Data Line.* 11 bits of data are shifted serially through this line when data is being transferred. Data is synchronised to KBCLK.

MCLK, *Mouse Clock line.* Mouse data is latched by the controller on each negative clock edge produced on this pin. The mouse can be disabled by pulling this pin low by software control.

MDATA, *Mouse Data Line.* 11 bits of data are shifted serially through this line when data is being transferred. Data is synchronised to MCLK.

Note: **MCLK** and **MDATA** must be pulled when the STPC Mouse interface is **not used**.

2.2.8 SERIAL INTERFACE
(Serial 1 combined with TFT Interface)
(Serial 2 combined with IPC)

SIN1, SIN2 *Input Serial input.* Data is clocked in using RCLK/16.

SOUT1, SOUT2 *Serial Output.* Data is clocked out using TCLK/16 (TCLK=BAUD#).

DCD1#, DCD2# *Input Data carrier detect.*

RI1#, RI2# *Input Ring indicator.*

DSR1#, DSR2# *Input Data set ready.*

CTS1#, CTS2# *Input Clear to send.*

RTS1#, RTS2# *Output Request to send.*

DTR1#, DTR2# *Output Data terminal read.*

2.2.9 PARALLEL PORT (Combined with ISA Bus an IPC)

PE *Paper End.* Input status signal from printer.

SLCT *Printer Select.* Printer selected input.

BUSY# *Printer Busy*.
Input status signal from printer.

ERR# *Error*. Input status signal from printer.

ACK# *Acknowledge.*
Input status signal from printer.

PDDIR# *Parallel Device Direction.*
Bidirectional control line output.

STROBE# *PCS/Strobe#.*
Data transfer strobe line to printer.

INIT# *Initialize Printer.* This output sends an initialize command to the connected printer.

AUTPFDX# *Automatic Line feed.* This output sends a command to the connected printer to automatically generate line feed on received carriage returns.

SLCTIN# *Select In.* Printer select output.

PPD[7-0] *Printer Data Lines* Data transfer lines to printer. Bidirectional depending on modes.
Important Note:
Where the Parallel Port is not used, PPD[0], connected to device pin C25, must be pulled up to '1'. This is to avoid memory access problems associated with the MCS16 Memory Chip Select line when in the ISA Bus mode.

2.2.10 PCMCIA INTERFACE (Combined with PCI / Cardbus)

RESET *Card Reset.* This output forces a hard reset to a PC Card.

A[25:0] *Address Bus.* These are the 25 low bits of the system address bus of the PCMCIA bus. These pins are used as an input when an PCMCIA bus owns the bus and are outputs at all other times.

D[15:0] *I/O Data Bus (PCMCIA).* These are the external PCMCIA data bus pins.

CA[25-0] *Card Address*. Used with the lower 11 bits of the ISA Address Bus to generate the Card Address.

IORD# *I/O Read.* This output is used with REG# to gate I/O read data from the PC Card, (only when REG# is asserted).

IOWR# *I/O Write*. This output is used with REG# to gate I/O write data from the PC Card, (only when REG# is asserted).

WP *Write Protect.* This input indicates the status of the Write Protect switch (if fitted) on memory PC Cards (asserted when the switch is set to write protect).

BVD1, BVD2 *Battery Voltage Detect.* These inputs will be generated by memory PC Cards that include batteries and are an indication of the condition of the batteries. BVD1 and BVD2 are kept asserted high when the battery is in good condition.

READY#/BUSY#/IREQ# *Ready/busy/Interrupt request.* This input is driven low by memory PC Cards to signal that their circuits are busy processing a previous write command.

WAIT# *Bus Cycle Wait.* This input is driven by the PC Card to delay completion of the memory or I/O cycle in progress.

OE# *Output Enable.* OE# is an active low output which is driven to the PC Card to gate Memory Read data from memory PC Cards.

WE#/PRGM# *Write Enable.* This output is used by the host for gating Memory Write data. WE# is also used for memory PC Cards that have programmable memory.

REG# *Attribute Memory Select.* This output is inactive (high) for all normal accesses to the Main Memory of the PC Card. I/O PC Cards will only respond to IORD# or IOWR# when REG# is active (low). Also see Section 2.2.6

CD1#, CD2# *Card Detect.* These inputs provide for the detection of correct card insertion. CD#1 and CD#2 are positioned at opposite ends of the connector to assist in the detection process. These inputs are internally grounded on the PC

Card therefore they will be forced low whenever a card is inserted in a socket.

CE1#, CE2# *Card Enable*. These are active low output signals provided from the PCIC. CE#1 enables even Bytes, CE#2 odd Bytes.

ENABLE# *Enable.* This output is used to activate/select a PC Card socket. ENABLE# controls the external address buffer logic.C card has been detected (CD#1 and CD#2 = '0').

ENIF# *ENIF*. This output is used to activate/select a PC Card socket.

EXT_DIR *EXternal Transceivers Direction Control.* This output is high during a read and low during a write. The default power up condition is write (low). Used for both Low and High Bytes of the Data Bus.

VCC_EN#, VPP1_EN0, VPP1_EN1, VPP 2_EN0, VPP2_EN1 *Power Control.* Five output signals used to control voltages (VPP1, VPP2 and VCC) to a PC Card socket. Also see Section 13.7.5.

GPI# *General Purpose Input. This signal is hardwired to 1.*

2.2.11 CARDBUS INTERFACE (Combined with PCI / PCMCIA)

For card bus pinouts, refer to the PCI pinout.

2.2.12 PCI INTERFACE

AD[31:0] *PCI Address/Data.* This is the 32-bit multiplexed address and data bus of the PCI. This bus is driven by the master during the address phase and data phase of write transactions. It is driven by the target during data phase of read transactions.

BE[3:0]# *Bus Commands/Byte Enables.* These are the multiplexed command and Byte enable signals of the PCI bus. During the address phase they define the command and during the data phase they carry the Byte enable information. These pins are inputs when a PCI master other than the STPC Industrial owns the bus and outputs when the STPC Industrial owns the bus.

FRAME# *Cycle Frame.* This is the frame signal of the PCI bus. It is an input when a PCI master owns the bus and is an output when STPC Industrial owns the PCI bus.

TRDY# *Target Ready.* This is the target ready signal of the PCI bus. It is driven as an output when the STPC Industrial is the target of the current bus transaction. It is used as an input when STPC Industrial initiates a cycle on the PCI bus.

IRDY# *Initiator Ready.* This is the initiator ready signal of the PCI bus. It is used as an output when the STPC Industrial initiates a bus cycle on the PCI bus. It is used as an input during the PCI cycles targeted to the STPC Industrial to determine when the current PCI master is ready to complete the current transaction.

STOP# *Stop Transaction.* STOP# is used to implement the disconnect, retry and abort protocol of the PCI bus. It is used as an input for the bus cycles initiated by the STPC Industrial and is used as an output when a PCI master cycle is targeted to the STPC Industrial.

DEVSEL# *I/O Device Select.* This signal is used as an input when the STPC Industrial initiates a bus cycle on the PCI bus to determine if a PCI slave device has decoded itself to be the target of the current transaction. It is asserted as an output either when the STPC Industrial is the target of the current PCI transaction or when no other device asserts DEVSEL# prior to the subtractive decode phase of the current PCI transaction.

PAR *Parity Signal Transactions.* This is the parity signal of the PCI bus. This signal is used to guarantee even parity across AD[31:0], CBE[3:0]#, and PAR. This signal is driven by the master during the address phase and data phase of write transactions. It is driven by the target during data phase of read transactions. (Its assertion is identical to that of the AD bus delayed by one PCI clock cycle)

SERR# *System Error.* This is the system error signal of the PCI bus. It may, if enabled, be asserted for one PCI clock cycle if target aborts a STPC Industrial initiated PCI transaction. Its assertion by either the STPC Industrial or by another PCI bus agent will trigger the assertion of NMI to the host CPU. This is an open drain output.

LOCK# *PCI Lock.* This is the lock signal of the PCI bus and is used to implement the exclusive bus operations when acting as a PCI target agent.

PCI_REQ#[2:0] *PCI Request.* These pins are the three external PCI master request pins. They indicates to the PCI arbiter that the external agents desire use of the bus.

PCI_GNT#[2:0] *PCI Grant.* These pins indicate that the PCI bus has been granted to the master requesting it on its PCI_REQ#.

PCI_INT[3:0] *PCI Interrupt Request.* These are the PCI bus interrupt signals. They are to be encoded before connection to the STPC Industrial using ISACLK and ISACLKX2 as the input selection strobes.

2.2.13 MONITOR INTERFACE

RED, GREEN, BLUE *RGB Video Outputs.* These are the three analog color outputs from the RAMDACs. These signals are sensitive to interference, therefore they need to be properly shielded.

VSYNC *Vertical Synchronisation Pulse.* This is the vertical synchronization signal from the VGA controller.

HSYNC *Horizontal Synchronisation Pulse.* This is the horizontal synchronization signal from the VGA controller.

VREF_DAC *DAC Voltage reference.* This pin is an input driving the digital to analog converters. This allows an external voltage reference source to be used.

RSET *Resistor Current Set.* This is the reference current input to the RAMDAC. Used to set the full-scale output of the RAMDAC.

COMP *Compensation.* This is the RAMDAC compensation pin. Normally, an external capacitor (typically 10nF) is connected between this pin and V_{DD} to damp oscillations.

DDC[1:0] *Direct Data Channel Serial Link.* These bidirectional pins are connected to CRTC register 3Fh to implement DDC capabilities. They conform to I^2C electrical specifications, they have open-collector output drivers which are internally connected to V_{DD} through pull-up resistors.

They can instead be used for accessing I²C devices on board. DDC1 and DDC0 correspond to SCL and SDA respectively.

2.2.14 FLAT PANEL INTERFACE SIGNALS (Combined with Serial 1)

FPFRAME, *Vertical Sync. pulse Output.*

FPLINE, *Horizontal Sync. Pulse Output.*

DE, *Data Enable.*

R5-0, *Red Output.*

G5-0, *Green Output.*

B5-0, *Blue Output.*

ENAVDD *Enable VDD of Flat Panel.*

ENVCC *Enable VCC of Flat Panel.*

PWM *PWM Back-Light Control.*

2.2.15 MISCELLANEOUS

SPKRD *Speaker Drive.* This is the output to the speaker and is the AND of the counter 2 output with bit 1 of Port 61h and drives an external speaker driver. This output should be connected to a 7407 type high voltage driver.

SCAN_ENABLE *Reserved.* This pin is reserved for Test and Miscellaneous functions. It has to be set to '0' or connected to ground in normal operation.

Table 2-3. Signals Sharing the Same Pin

ISA BUS / IPC	LOCAL BUS	PARALLEL PORT	SERIAL INTERFACE
LA[23:22]	FCS#[0], PRD#[1]		
LA[21:20]	PA[21:20]		
LA[19:17]	PRD#[0], PWR#[1:0]		
SA[19:1]	PA[19:1]		
SA[0]	PRDY#		
SD[15:0]	PD[15:0]		
BHE#	FCS#[1]		
MEMR#, MEMW#	IOCS[3:2]		
SMEMR#, SMEMW#	IOCS[1:0]		
GPIOCS#		PE	
IOCHRDY		SLCT	
IOR#		BUSY#	
IOW#		ERR#	
MASTER#		ACK#	
MCS16#		PDDIR#	
IOCS16#		INIT#	
REF#		AUTPFDX#	
AEN		SLCTIN#	
IOCHCK#		PPD[7]	
RTCRW#		PPD[5]	
RTCDS#		PPD[4]	
RTCAS#		PPD[3]	
RMRTCCS#		PPD[2]	
ALE		PPD[1]	
DACK_ENC[0:2]			DCD2#, DSR2#, SIN2
DREQ_MUX[0:1]			CTS2#, RTS2#
TC			SOUT2

TFT INTERFACE	SERIAL 1
B[0,1]	DCD1#, CTS1#
G[0,1]	DSR1#, RTS1#
R[0,1]	SIN1, SOUT1

PCI	CARDBUS	PCMCIA
	CCLK	A[16]
	CRST#	RESET
AD[31:27]	CAD[31:27]	D[10,9,1,8,0]
AD[26:20]	CAD[26:20]	A[0:6]

PCI	CARDBUS	PCMCIA
AD[19]	CAD[19]	A[25]
AD[18]	CAD[18]	A[7]
AD[17]	CAD[17]	A[24]
AD[16]	CAD[16]	A[17]
AD[15]	CAD[15]	IOWR#
AD[14]	CAD[14]	A[9]
AD[13]	CAD[13]	IORD#
AD[12]	CAD[12]	A[11]
AD[11]	CAD[11]	OE# / TCw
AD[10]	CAD[10]	CE[2]
AD[9]	CAD[9]	A[10]
AD[8:0]	CAD[8:0]	D[15,7,13,6,12,5,11,4,3]
BE[3]	CBE[3]	DACK/REG#
BE[2]	CBE[2]	A[12]
BE[1]	CBE[1]	A[8]
BE[0]	CBE[0]	CE[1]
FRAME#	CFRAME#	A[23]
TRDY#	CTRDY#	A[22]
IRDY#	CIRDY#	A[15]
STOP#	CSTOP#	A[20]
DEVSEL#	CDEVSEL#	A[21]
PAR	CPAR	A[13]
SERR#	CSERR#	WAIT
LOCK#	CBLOCK#	A[19]
PCIREQ#[2]	CREQ#	INPACK#
PCIREQ#[1]	CCD1	CD1#
PCIREQ#[0]	CSTSCHG#	BVD1
PCIGNT#[2]	CGNT#	WE# / TCr
PCIGNT#[1]	CCD2	CD2#
PCIGNT#[0]		BVD2
PCI_INT[3]		VCC3_EN
PCI_INT[2]		VCC5_EN
PCI_INT[1]		VPP_PGM
PCI_INT[0]	CINT#	READY#
	CLKRUN	DREQ# / WP / IOIS16#

Table 2-4. Pinout.

Pin #	Pin Name
C4	SYSRSTI#
A3	SYSRSTO#
AB25	XTALI
AB23	XTALO
G25	PCI_CLKI
H23	PCI_CLKO
B20	ISA_CLK
A20	ISA_CLK2X
AC26	CLK14M
H26	HCLK
J26	DEV_CLK
AC15	GCLK2X
AD16	DCLK
AE13	MA[0]
AC12	MA[1]
AF13	MA[2]
AD12	MA[3]
AE14	MA[4]
AC14	MA[5]
AF14	MA[6]
AD13	MA[7]
AE15	MA[8]
AD14	MA[9]
AF15	MA[10]
AE16	MA[11]
AD15	RAS#[0]
AF16	RAS#[1]
AC17	RAS#[2]
AE18	RAS#[3]
AD17	CAS#[0]
AF18	CAS#[1]
AE19	CAS#[2]
AF19	CAS#[3]
AD18	CAS#[4]
AE20	CAS#[5]
AC19	CAS#[6]
AF20	CAS#[7]
AD19	MWE#
AE21	MD[0]
AC20	MD[1]
AF21	MD[2]
AD20	MD[3]

Pin #	Pin Name
AE22	MD[4]
AF22	MD[5]
AD21	MD[6]
AE23	MD[7]
AC22	MD[8]
AF23	MD[9]
AD22	MD[10]
AE24	MD[11]
AD23	MD[12]
AF24	MD[13]
AE26	MD[14]
AD25	MD[15]
AD26	MD[16]
AC25	MD[17]
AC24	MD[18]
AB24	MD[19]
AB26	MD[20]
AA25	MD[21]
Y23	MD[22]
AA24	MD[23]
AA26	MD[24]
Y25	MD[25]
Y26	MD[26]
Y24	MD[27]
W25	MD[28]
V23	MD[29]
W26	MD[30]
W24	MD[31]
V25	MD[32]
V26	MD[33]
U25	MD[34]
V24	MD[35]
U26	MD[36]
U23	MD[37]
T25	MD[38]
U24	MD[39]
T26	MD[40]
R25	MD[41]
R26	MD[42]
T24	MD[43]
P25	MD[44]
R23	MD[45]
P26	MD[46]
R24	MD[47]

Pin #	Pin Name
N25	MD[48]
N23	MD[49]
N26	MD[50]
P24	MD[51]
M25	MD[52]
N24	MD[53]
M26	MD[54]
L25	MD[55]
M24	MD[56]
L26	MD[57]
M23	MD[58]
K25	MD[59]
L24	MD[60]
K26	MD[61]
K23	MD[62]
J25	MD[63]
B1	PA[0]
P1	LA[17] / PWR#[0]
N3	LA[18] / PWR#[1]
R2	LA[19] / PRD#[0]
C1	LA[20] / PA[20]
C2	LA[21] / PA[21]
P3	LA[22] / PRD#[1]
R1	LA[23] / FCS#[0]
P4	SA[0] / PRDY#
J2	SA[1] / PA[1]
H3	SA[2] / PA[2]
H1	SA[3] / PA[3]
J4	SA[4] / PA[4]
H2	SA[5] / PA[5]
G3	SA[6] / PA[6]
G1	SA[7] / PA[7]
G2	SA[8] / PA[8]
F1	SA[9] / PA[9]
F3	SA[10] / PA[10]
G4	SA[11] / PA[11]
F2	SA[12] / PA[12]
E1	SA[13] / PA[13]
E3	SA[14] / PA[14]
E4	SA[15] / PA[15]
E2	SA[16] / PA[16]
D1	SA[17] / PA[17]

PIN DESCRIPTION

Pin #	Pin Name
D3	SA[18] / PA[18]
D2	SA[19] / PA[19]
P2	SD[0] / PD[0]
M3	SD[1] / PD[1]
N1	SD[2] / PD[2]
M4	SD[3] / PD[3]
N2	SD[4] / PD[4]
L3	SD[5] / PD[5]
M1	SD[6] / PD[6]
M2	SD[7] / PD[7]
L1	SD[8] / PD[8]
K3	SD[9] / PD[9]
L2	SD[10] / PD[10]
K4	SD[11] / PD[11]
K1	SD[12] / PD[12]
J3	SD[13] / PD[13]
K2	SD[14] / PD[14]
J1	SD[15] / PD[15]
T2	BHE# / FCS#[1]
R3	MEMR# / IOCS#[3]
T1	MEMW# / IOCS#[2]
R4	SMEMR# / IOCS#[1]
U2	SMEMW# / IOCS#[0]
AB2	IOCHRDY / SLCT
AB1	IOR# / BUSY#
Y3	GPIOCS# / PE
AA3	IOW# / ERR#
AC2	MASTER# / ACK#
AB4	MCS16# / PDDIR#
AB3	IOCS16# / INIT#
AD2	REF# / AUTPFDX#
AC3	AEN / SLCTIN#
E25	IOCHCK# / PPD[7]
E26	PPD[6]
F24	RTCRW# / PPD[5]
D25	RTCDS# / PPD[4]
E23	RTCAS# / PPD[3]
D26	RMRTCCS# / PPD[2]
E24	ALE / PPD[1]
C25	PPD[0]
AC1	STROBE#
D5	IRQ_MUX[0]
A4	IRQ_MUX[1]

Pin #	Pin Name
C5	IRQ_MUX[2]
B3	IRQ_MUX[3]
AD1	SPKRD
V3	DACK_ENC[0]/DCD2#
Y2	DACK_ENC[1]/DSR2#
W4	DACK_ENC[2] / SIN2
Y1	DREQ_MUX[0]/CTS2#
W3	DREQ_MUX[1]/RTS2#
AA2	TC / SOUT2
Y4	DTR2#
AA1	RI2#
U4	SIN1 / R[0]
V1	SOUT1 / R[1]
V2	CTS1 / B[1]
U3	RTS1# / G[1]
U1	DSR1# / G[0]
W2	DTR1#
T3	DCD1# / B[0]
W1	RI1#
F25	KBCLK
F26	KBDATA
G24	MCLK
G23	MDATA
D18	RESET
C18	A[0]
A17	A[1]
D17	A[2]
B16	A[3]
C17	A[4]
A16	A[5]
B15	A[6]
A15	A[7]
C16	A[8]
B14	A[9]
D15	A[10]
A14	A[11]
C15	A[12]
B13	A[13]
D13	A[14]
A13	A[15]
C14	A[16]

Pin #	Pin Name
B12	A[17]
C13	A[18]
A12	A[19]
B11	A[20]
A11	A[21]
D12	A[22]
B10	A[23]
C11	A[24]
A10	A[25]
D10	D[0]
B9	D[1]
C10	D[2]
A9	D[3]
B8	D[4]
C9	D[5]
B7	D[6]
D8	D[7]
A7	D[8]
B6	D[9]
D7	D[10]
A6	D[11]
C7	D[12]
A5	D[13]
C6	D[14]
B4	D[15]
B22	IORD#
D22	IOWR#
D24	WP
A18	BVD1
C26	BVD2
A21	READY#
C19	WAIT#
A25	INPACK#
C22	OE#
B18	WE#
B19	REG#
B24	CD1#
A24	CD2#
B23	CE1#
C23	CE2#
C20	VS1#
A19	VS2#
D20	VCC5_EN
C21	VCC3_EN

Pin #	Pin Name
B21	VPP_PGM
A22	VPP_VCC
AD4	RED
AF4	GREEN
AE5	BLUE
AF3	VSYNC
AE4	HSYNC
AF5	VREF_DAC
AE6	RSET
AF6	COMP
AE3	SDA / DDC[1]
AF2	SCL / DDC[0]
AE7	B[2]
AF7	G[2]
AD7	R[2]
AE8	B[3]
AC9	G[3]
AF8	R[3]
AD8	B[4]
AE9	G[4]
AF9	R[4]
AE10	B[5]
AD9	G[5]
AF10	R[5]
AC10	RESERVED
AD10	FPLINE
AE11	FPFRAME
AF11	DE
AE12	ENAVDD
AF12	ENVCC
AD11	PWM
C8	SCAN_ENABLE
AD5	VDD_DAC1
AC5	VDD_DAC2
AE17	VDD_GCLK_PLL
AF17	VDD_DCLK_PLL
K24	VDD_ZCLK_PLL
H25	VDD_DEVCLK_PLL
J24	VDD_HCLK_PLL

Pin #	Pin Name
A8	RESERVED
A23	RESERVED
B5	RESERVED
B17	RESERVED
C12	RESERVED
D6	VDD
D11	VDD
D16	VDD
D21	VDD
F4	VDD
F23	VDD
L4	VDD
L23	VDD
T4	VDD
T23	VDD
AA4	VDD
AA23	VDD
AC6	VDD
AC11	VDD
AC16	VDD
AC21	VDD
AC7	VSS_DAC1
AD6	VSS_DAC2
G26	VSS_DLL
H24	VSS_DLL
A1	VSS
A2	VSS
A26	VSS
B2	VSS
B25	VSS
B26	VSS
C3	VSS
C24	VSS
D4	VSS
D9	VSS
D14	VSS
D19	VSS
D23	VSS
H4	VSS
J23	VSS
L11:16	VSS
M11:16	VSS

Pin #	Pin Name
N4	VSS
N11:16	VSS
P11:16	VSS
P23	VSS
R11:16	VSS
T11:16	VSS
V4	VSS
W23	VSS
AC4	VSS
AC8	VSS
AC13	VSS
AC18	VSS
AC23	VSS
AD3	VSS
AD24	VSS
AE1	VSS
AE2	VSS
AE25	VSS
AF1	VSS
AF25	VSS
AF26	VSS

3. STRAP OPTION

This chapter defines the STPC Industrial Strap Options and their location.

Memory Data Lines	Refer to	Designation	Location	Actual Settings	Set to '0'	Set to '1'
MD16		Reserved	Index 4C,bit 0	Pull up		
MD17	PCI Clock	PCI_CLKO Divisor	Index 4C,bit 1	User defined	HCLK / 2	HCLK / 3
MD18	Host Clock	HCLK Pad Direction	Index 4C,bit 2	Pull up	External	Internal
MD19	Graphics Clock	GCLK2x Pad Direction	Index 4C,bit 3	Pull up	External	Internal
MD20	DOT Clock	DCLK Pad Direction	Index 4C,bit 4	User defined	External	Internal
MD21		Reserved		Pull up		
MD22		Reserved	Index 5F,bit 1	Pull up		
MD23		Reserved	Index 5F,bit 2	Pull up		
MD24	HCLK	HCLK PLL Speed	Index 5F,bit 3	User defined	See Section 3.1.6.	
MD25			Index 5F,bit 4			
MD26			Index 5F,bit 5			
MD27		Reserved		Pull down		
MD28		Reserved		Pull down		
MD29		Reserved		Pull down		
MD30		Reserved		Pull down		
MD31		Reserved		Pull down		
MD32		Reserved		Pull down		
MD33		Reserved		Pull up		
MD34		Reserved		Pull down		
MD35		Reserved		Pull up		
MD 36		Reserved		Pull up		
MD 37		Reserved		Pull up		
MD 38		Reserved		Pull up		
MD 39		Reserved		Pull up		
MD 40		PCMCIA or PCI I/F	3C,bit 0	User defined	PCI	PCMCIA
MD 41		Local Bus or ISA I/F	3C,bit 1	User defined	ISA	Local Bus
MD 42		KeyBoard & Mouse	3C,bit 2	User defined	External	Internal
MD 43		Parallel Port	3C,bit 3	User defined	External	Internal
MD 44	Serial Port	UART1	3C,bit 4	User defined	External	Internal
MD 45		UART2	3C,bit 5	User defined	External	Internal
MD 46		Reserved	3C,bit 6	Pull down		
MD 47		Reserved	3C,bit 7	Pull down		
MD 48	TFT	TFT interface	3D,bit 0	User defined	Disable	Enable
MD 49	Cardbus Socket	5V Availability	3D,bit 1	User defined	Unavailable	Available
MD 50		3.3V Availability	3D,bit 2	User defined	Unavailable	Available
MD 51		x.xV Available	3D,bit 3	User defined	Unavailable	Available
MD 52		y.yV Available	3D,bit 4	User defined	Unavailable	Available
MD 53		Reserved		Pull up		
MD 56		Reserved		Pull up		
MD 57		Reserved		Pull down		
MD 58		Reserved		Pull up		
MD 59	CPU	clock speed factor		User defined	X1	X2

3.1. STRAP OPTION REGISTER DESCRIPTION

3.1.1. STRAP REGISTER 0

This register reflect the status of pins MD[7:0] respectively. They are expected to be connected on the system board to the SIMM configuration pins as follows:

Strap0 Access = 0022h/0023h Regoffset = 04Ah

7	6	5	4	3	2	1	0
MD7	MD6	MD5	MD4	MD3	MD2	Rsv	
This register defaults to the values sampled on MD[7:0] pins after reset							

Bit Number Sampled	Mnemonic	Description
Bit 7-2	**MD[7:2]**	User defined
Bits 1-0	**Rsv**	Reserved.

3.1.2. STRAP REGISTER 1

This register reflect the status of pins MD[15:8] respectively. They are expected to be connected on the system board to the SIMM configuration pins as follows:

Strap1 Access = 0022h/0023h Regoffset = 04Bh

7	6	5	4	3	2	1	0
MD15	MD14	MD13	MD12	MB11	MD10	Rsv	
This register defaults to the values sampled on MD[15:8] pins after reset							

Bit Number Sampled	Mnemonic	Description
Bit 7-2	**MD[7:2]**	User defined
Bits 1-0	**Rsv**	Reserved.

3.1.3. STRAP REGISTER 2

Bits 4-0 of this register reflect the status of pins MD[20:16] respectively. Bit 5 of this register reflect the status of pin MD[23]. Bit 4 is writeable, writes to other bits in this register have no effect.

Strap2 Access = 0022h/0023h Regoffset = 04Ch

7	6	5	4	3	2	1	0
Rsv			MD20	MD19	MD18	MD17	Rsv
This register defaults to the values sampled on MD[23] and MD[20:16] pins after reset							

Bit Number Sampled	Mnemonic	Description
Bits 7-5	**Rsv**	Reserved.
Bit 4	**MD20**	This bit reflects the **value sampled on MD[20] pin** and controls the Dot clock (DCLK) source. Note This bit is writeable as well as readable.
Bit 3	**MD19**	This bit reflects the **value sampled on MD[19] pin** and controls the Graphics clock source.
Bit 2	**MD18**	This bit reflects the **value sampled on MD[18] pin** and controls the Host/CPU clock source as follows: setting to '0': External. HCLK pin is an input, setting to '1': Internal. HCLK pin is an output and is connected to the internal frequency synthesizer output.
Bit 1	**MD17**	This bit reflects the **value sampled on MD[17] pin** and controls the PCI clock output as follows: Setting to '0', the PCI clock output = HCLK / 3 Setting to '1', the PCI clock output = HCLK / 2.
Bit 0	**Rsv**	Reserved.

3.1.4. STRAP REGISTER 3

Bits 7-0 of this register reflect the status of pins MD[47:40] respectively.

Strap3 Access = 0022h/0023h Regoffset = 03Ch

7	6	5	4	3	2	1	0
Rsv		MD45	MD44	MD43	MD42	MD41	MD40
This register defaults to the values sampled on MD[47:40] pins after reset							

Bit Number Sampled	Mnemonic	Description
Bits 7-6	**Rsv**	Reserved.
Bit 5	**MD45**	UART2 internal or external. This bit reflects the **value sampled on MD[45] pin** and controls the UART2 I/F as follows: Setting to '0', UART2 is external. Setting to '1', UART2 is internal.
Bit 4	**MD44**	UART1 internal or external and additional TFT outputs. This bit reflects the **value sampled on MD[44] pin** and controls the UART1 I/F and the additional TFT I/F as follows: Setting to '0', UART1 is external and an additional 6 TFT outputs (lowest bits - 2 red, 2 green and 2 blue) are enabled. Setting to '1', UART1 is internal.
Bit 3	**MD43**	Parallel Port internal or external. This bit reflects the **value sampled on MD[43] pin** and controls the Parallel Port I/F as follows: Setting to '0', the Parallel Port is external. Setting to '1', the Parallel Port is internal.
Bit 2	**MD42**	KB/Mouse internal or external. This bit reflects the **value sampled on MD[42] pin** and controls the KB/Mouse controller I/F as follows: Setting to '0', the KB/Mouse controller is external. Setting to '1', the KB/Mouse controller is internal.
Bit 1	**MD41**	Local Bus I/F or ISA I/F. This bit reflects the **value sampled on MD[41] pin** and sets whether the Local Bus I/F or the ISA I/F is available at the device I/F as follows: Setting to '0', selects the ISA I/F. Setting to '1', selects the Local Bus I/F.
Bit 0	**MD40**	PCMCIA I/F or PCI I/F. This bit reflects the **value sampled on MD[40] pin** and sets whether the PCMCIA I/F or the PCI I/F is available at the device I/F as follows: Setting to '0', selects the PCI I/F. Setting to '1', selects the PCMCIA I/F.

3.1.5. STRAP REGISTER 4

Bits 5-0 of this register reflect the status of pins MD[53:48] respectively.

Strap4 Access = 0022h/0023h Regoffset = 03Dh

7	6	5	4	3	2	1	0
Rsv			MD52	MD51	MD50	MD49	MD48
This register defaults to the values sampled on MD[53:48] pins after reset							

Bit Number Sampled	Mnemonic	Description
Bits 7-5	**Rsv**	Reserved.
Bit 4	**MD52**	y.y V present on board. This bit reflects the **value sampled on MD[52] pin** and is used to notify the Cardbus socket management unit if the y.y V vcc voltage (where y.y is less than x.x) is present on board as follows Setting to '0', y.y V Vcc voltage is not available. Setting to '1': y.y V Vcc voltage is available.
Bit 3	**MD51**	x.x V present on board. This bit reflects the **value sampled on MD[51] pin** and is used to notify the Cardbus socket management unit if the x.x V vcc voltage (where x.x is less than 3.3) is present on board as follows: Setting to '0', x.x V Vcc voltage is not available. Setting to '1': x.x V Vcc voltage is available.
Bit 2	**MD50**	3.3 V present on board. This bit reflects the **value sampled on MD[50] pin** and is used to notify the Cardbus socket management unit if the 3.3 V vcc voltage is present on board as follows: Setting to '0', 3.3 V vcc voltage is not available. Setting to '1', 3.3 V vcc voltage is available.
Bit 1	**MD49**	5 V present on board. This bit reflects the **value sampled on MD[49] pin** and is used to notify the Cardbus socket management unit if the 5 V vcc voltage is present on board as follows: Setting to '0', 5 V vcc voltage is not available. Setting to '1', 5 V vcc voltage is available.
Bit 0	**MD48**	This bit reflects the **value sampled on MD[48] pin** and is used to enable the TFT controller outputs.

3.1.6. HCLK PLL STRAP REGISTER 0

Bits 5-0 of this register reflect the status of pins MD[26:21] respectively.

HCLK_Strap0 Access = 0022h/0023h Regoffset = 05Fh

7	6	5	4	3	2	1	0
Rsv		MD26	MD25	MD24	Rsv		Rsv
This register defaults to the values sampled on pins described below after reset							

Bit Number Sampled	Mnemonic	Description
Bits 7-6	**Rsv**	Reserved.
Bits 5-3	**MD[26:24]**	These pins reflect the **value sampled on MD[26:24] pins** respectively and control the Host clock Frequency synthesizer: 000 25 MHz 001 33 MHz 010 40 MHz 011 50 MHz 100 60 MHz 101 66 MHz 110 75 MHz 111 80 MHz
Bits 2-0	**Rsv**	Reserved.

4 ELECTRICAL SPECIFICATIONS

4.1 INTRODUCTION

The electrical specifications in this chapter are valid for the STPC Industrial.

4.2 ELECTRICAL CONNECTIONS

4.2.1 Power/Ground Connections/Decoupling

Due to the high frequency of operation of the STPC Industrial, it is necessary to install and test this device using standard high frequency techniques. The high clock frequencies used in the STPC Industrial and its output buffer circuits can cause transient power surges when several output buffers switch output levels simultaneously. These effects can be minimized by filtering the DC power leads with low-inductance decoupling capacitors, using low impedance wiring, and by utilizing all of the VSS and VDD pins.

4.2.2 Unused Input Pins

All inputs not used by the designer and not listed in the table of pin connections in Section 2 should be connected either to VDD or to VSS. Connect active-high inputs to VDD through a 20 kΩ (±10%) pull-down resistor and active-low inputs to VSS and connect active-low inputs to VCC through a 20 kΩ (±10%) pull-up resistor to prevent spurious operation.

4.2.3 Reserved Designated Pins

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

4.3 ABSOLUTE MAXIMUM RATINGS

The following table lists the absolute maximum ratings for the STPC Industrial device. Stresses beyond those listed under Table 4-1 limits may cause permanent damage to the device. These are stress ratings only and do not imply that operation under any conditions other than those specified in section "Operating Conditions".

Exposure to conditions beyond those outlined in Table 4-1 may (1) reduce device reliability and (2) result in premature failure even when there is no immediately apparent sign of failure. Prolonged exposure to conditions at or near the absolute maximum ratings (Table 4-1) may also result in reduced useful life and reliability.

Table 4-1. Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Units
V_{DDx}	DC Supply Voltage	-0.3	4.0	V
V_I, V_O	Digital Input and Output Voltage	-0.3	VDD + 0.3	V
V_{5T}	5Volt Tolerance	2.5	5.5	V
V_{ESD}	ESD Capacity (Human body mode)		1500	V
T_{STG}	Storage Temperature	-40	+150	°C
T_{OPER}	Operating Temperature	-40	+115	°C
P_{TOT}	Maximum Power Dissipation	-	4.8	W

4.3.1 5V Tolerance

The STPC is capable of running with I/O systems that operate at 5V such as PCI and ISA devices. Certain pins of the STPC tolerate inputs up to 5.5V. Above this limit the component is likely to sustain permanent damage.

All the pin that are V_{5T} have been denoted with a * besides the Signal Name in Table 2-1 .

4.4 DC CHARACTERISTICS

Table 4-2. DC Characteristics

Recommended Operating conditions: VDD = 3.3V ±0.3V, Tcase = 0 to 100°C unless otherwise specified

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{DD}	Operating Voltage		3.0	3.3	3.6	V
P_{DD}	Supply Power	V_{DD} = 3.3V, H_{CLK} = 66Mhz		3.2	3.9	W
H_{CLK}	Internal Clock	(Note 1)			80	MHz
V_{DAC}	DAC Voltage Reference		1.215	1.235	1.255	V
V_{OL}	Output Low Voltage	I_{Load} =1.5 to 8mA depending of the pin			0.5	V
V_{OH}	Output High Voltage	I_{Load} =-0.5 to -8mA depending of the pin	2.4			V
V_{ILD}	Input Low Voltage	Except XTALI	-0.3		0.8	V
		XTALI	-0.3		0.5	V
V_{IHD}	Input High Voltage	Except XTALI	2.1		V_{DD}+0.3	V
		XTALI	2.35		V_{DD}+0.3	V
I_{LK}	Input Leakage Current	Input, I/O	-5		5	µA
C_{IN}	Input Capacitance	(Note 2)				pF
C_{OUT}	Output Capacitance	(Note 2)				pF
C_{CLK}	Clock Capacitance	(Note 2)				pF

Notes:

1. MHz ratings refer to CPU clock frequency.

2. Not yet released.

Table 4-3. RAMDAC DC Specification

Symbol	Parameter	Min	Nom	Max
Vref	Voltage Reference	1.00V	1.12V	1.24V
INL	Integrated Non Linear Error	-	-	2 lsb
DNL	Differentiated Non Linear Error	-	-	1lsb
FS	Full Scale	-	-	20mA
FSR	Full Scale Range	14.00 mA	16.50mA	19.00 mA
LSB	Least Significant Byte Size	54uA	63uA	72uA
Zero	Zero Scale @ 7.5IRE Mode	0.95mA	1.44mA	1.90mA
Compare	DAC to DAC matching	-	-	+/- 5%

4.5 AC CHARACTERISTICS

Table 4-5 through Table 4-22 list the AC characteristics including output delays, input setup requirements, input hold requirements and output float delays. These measurements are based on the measurement points identified in Figure 4-1. The rising clock edge reference level VREF, and other reference levels are shown in Table 4-4 below for the STPC Industrial. Input or output signals must cross these levels during testing.

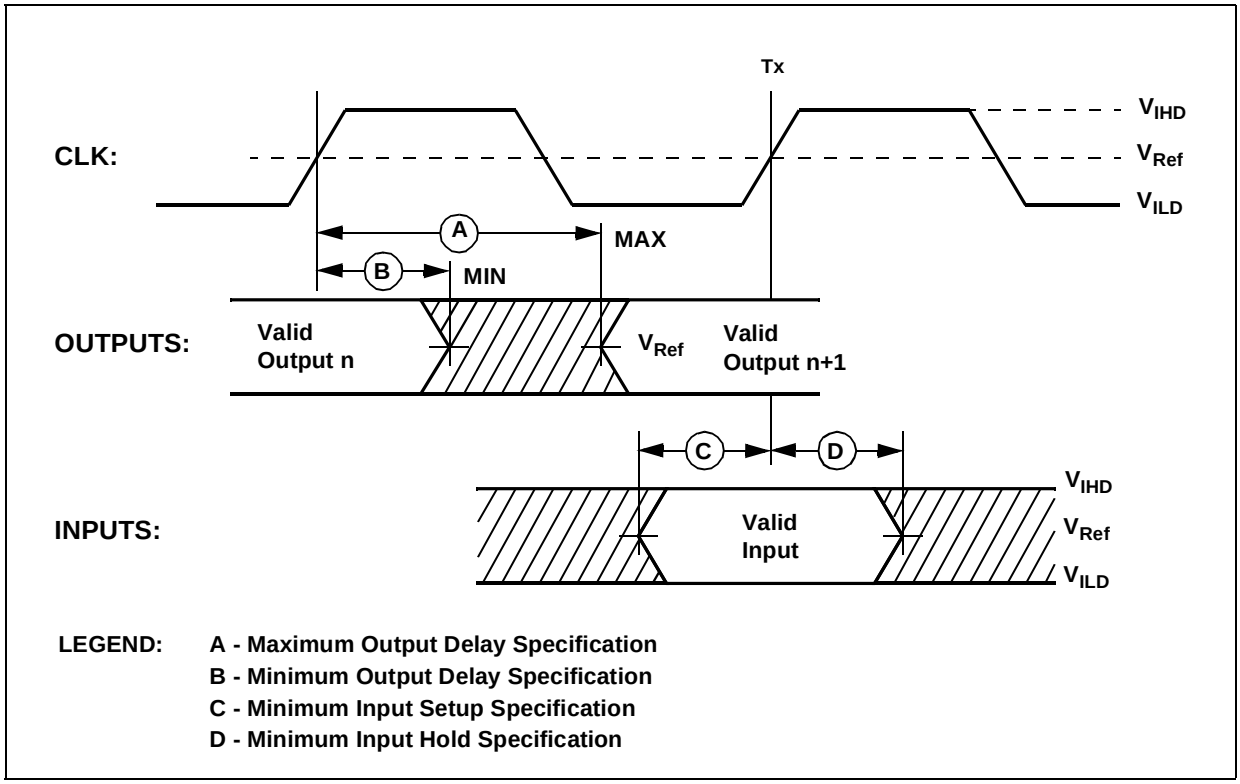
Figure 4-1 shows output delay (A and B) and input setup and hold times (C and D). Input setup and hold times (C and D) are specified minimums, defining the smallest acceptable sampling window a synchronous input signal must be stable for correct operation.

Table 4-4. Drive Level and Measurement Points for Switching Characteristics

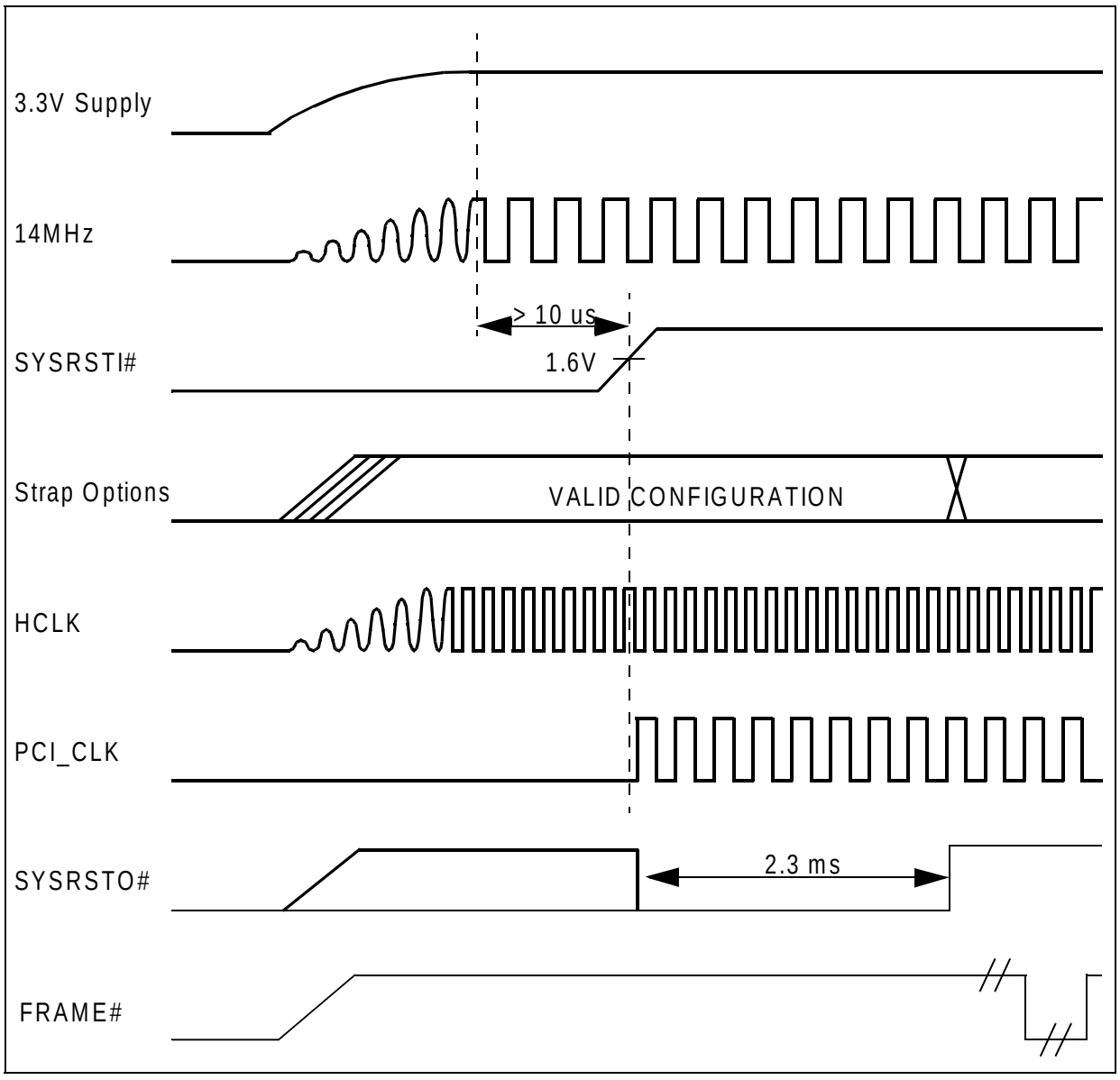
Symbol	Value	Units
V_{REF}	1.5	V
V_{IHD}	3.0	V
V_{ILD}	0.0	V

Note: Refer to Figure 4-1.

Figure 4-1. Drive Level and Measurement Points for Switching Characteristics



4.5.1 POWER ON SEQUENCE



SYSRSTI# has no constraint on its rising time but needs to be set to high at least 10µs after power supply is stable.

Strap Options are continuously sampled during SYSRSTI# low and should be stable. Once SYSRSTI# is high, they MUST NOT CHANGE until SYSRSTO# is high.

4.5.2 PCI AC Timing characteristics

Table 4-5. PCI Bus AC Timing

Name	Parameter	Min	Max	Unit
t1	PCI_CLKI to AD[31:0] valid	2	13	ns
t2	PCI_CLKI to FRAME# valid	2	11	ns
t3	PCI_CLKI to CBE#[3:0] valid	2	12	ns
t4	PCI_CLKI to PAR valid	2	12	ns
t5	PCI_CLKI to TRDY# valid	2	13	ns
t6	PCI_CLKI to IRDY# valid	2	11	ns
t7	PCI_CLKI to STOP# valid	2	14	ns
t8	PCI_CLKI to DEVSEL# valid	2	11	ns
t9	PCI_CLKI to PCI_GNT# valid	2	14	ns
t10	AD[31:0] bus setup to PCI_CLKI	7		ns
t11	AD[31:0] bus hold from PCI_CLKI	3		ns
t12	PCI_REQ#[2:0] setup to PCI_CLKI	10		ns
t13	PCI_REQ#[2:0] hold from PCI_CLKI	1		ns
t14	CBE#[3:0] setup to PCI_CLKI	7		ns
t15	CBE#[3:0] hold to PCI_CLKI	5		ns
t16	IRDY# setup to PCI_CLKI	7		ns
t17	IRDY# hold to PCI_CLKI	4		ns
t18	FRAME# setup to PCI_CLKI	7		ns
t19	FRAME# hold from PCI_CLKI	3		ns

4.5.3 DRAM CONTROLLER AC TIMING CHARACTERISTICS

Figure 4-2 EDO Write Mode (ref table Table 4-6)

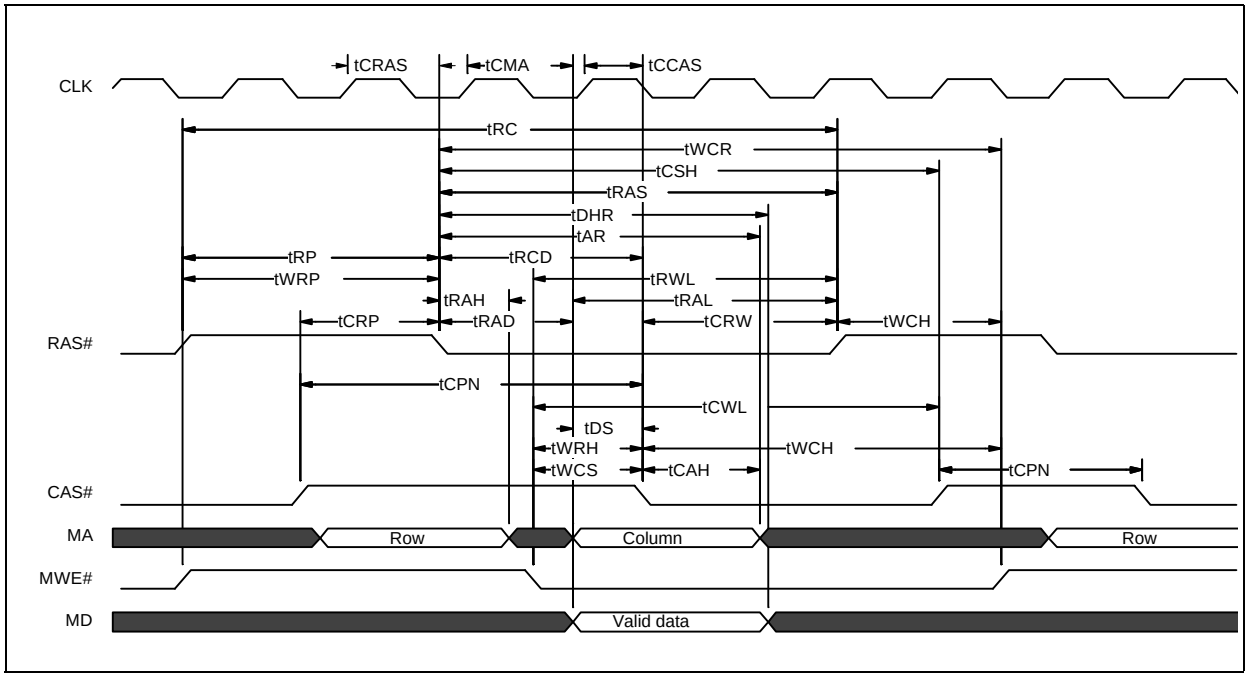


Figure 4-3 Memory Early Write Mode (ref table Table 4-6)

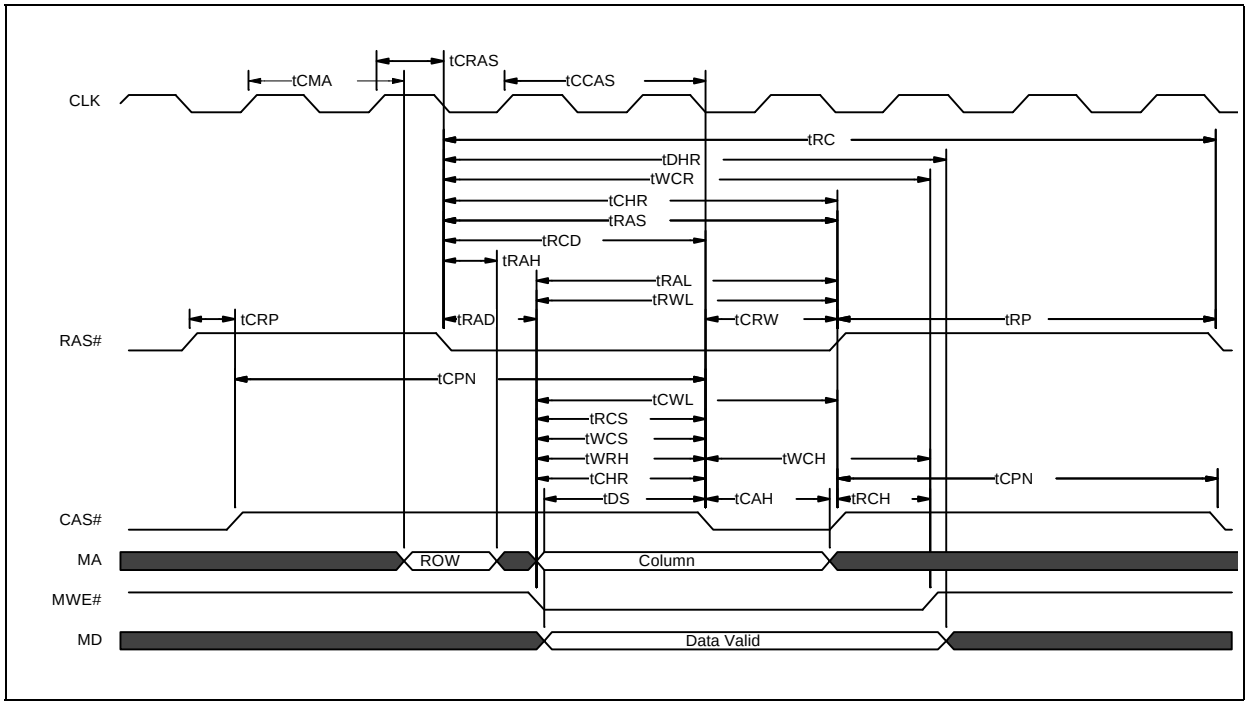


Figure 4-4 EDO Read Mode (ref table Table 4-6)

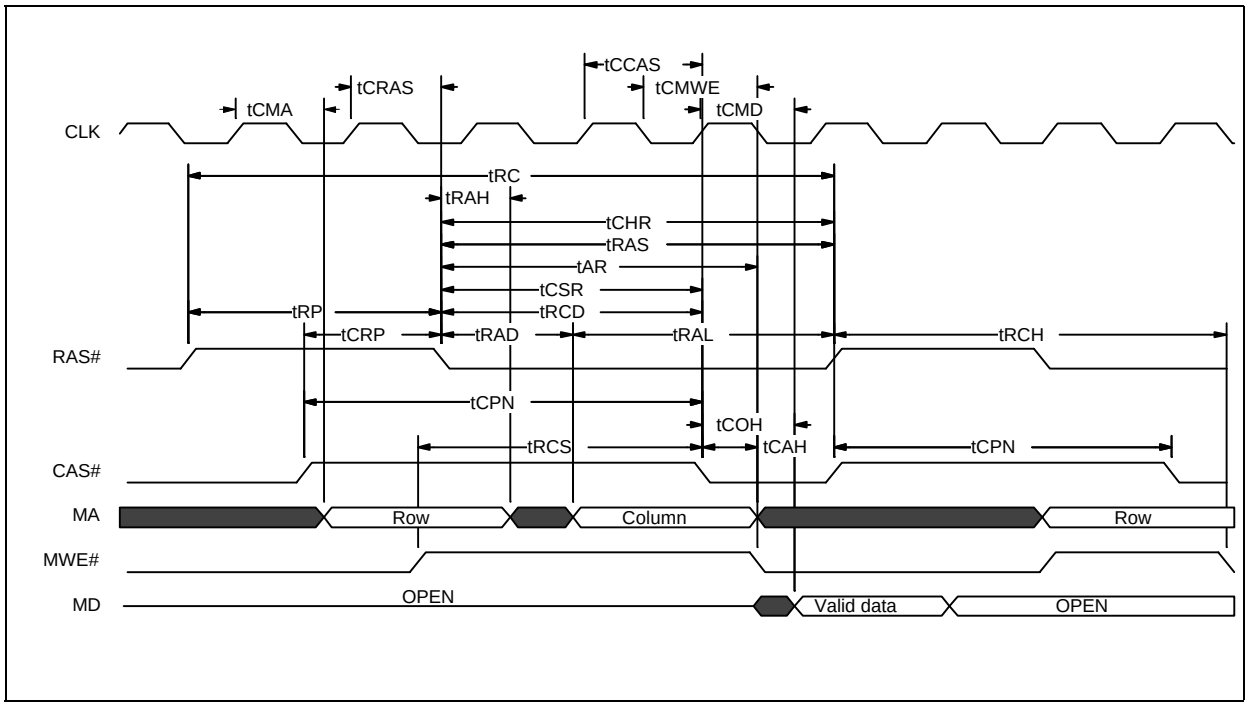


Figure 4-5 Fast Page Mode Read (ref table Table 4-6)

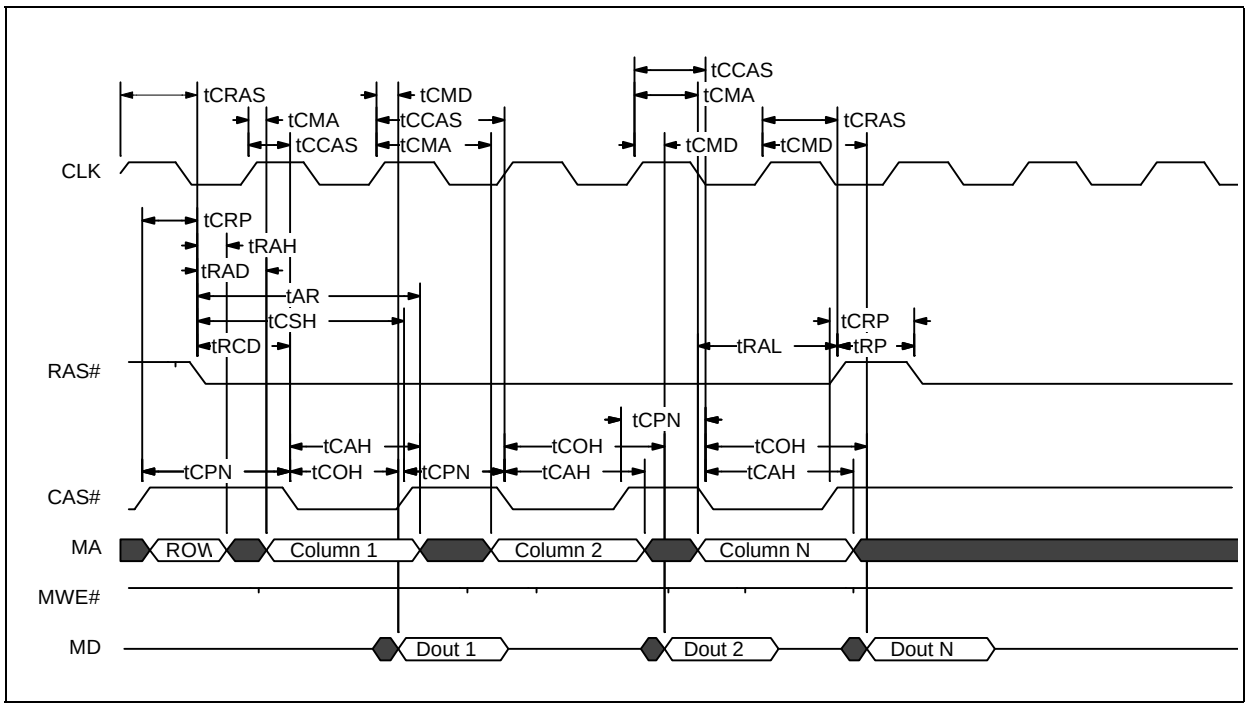


Figure 4-6 Fast Page Mode Write (ref table Table 4-6)

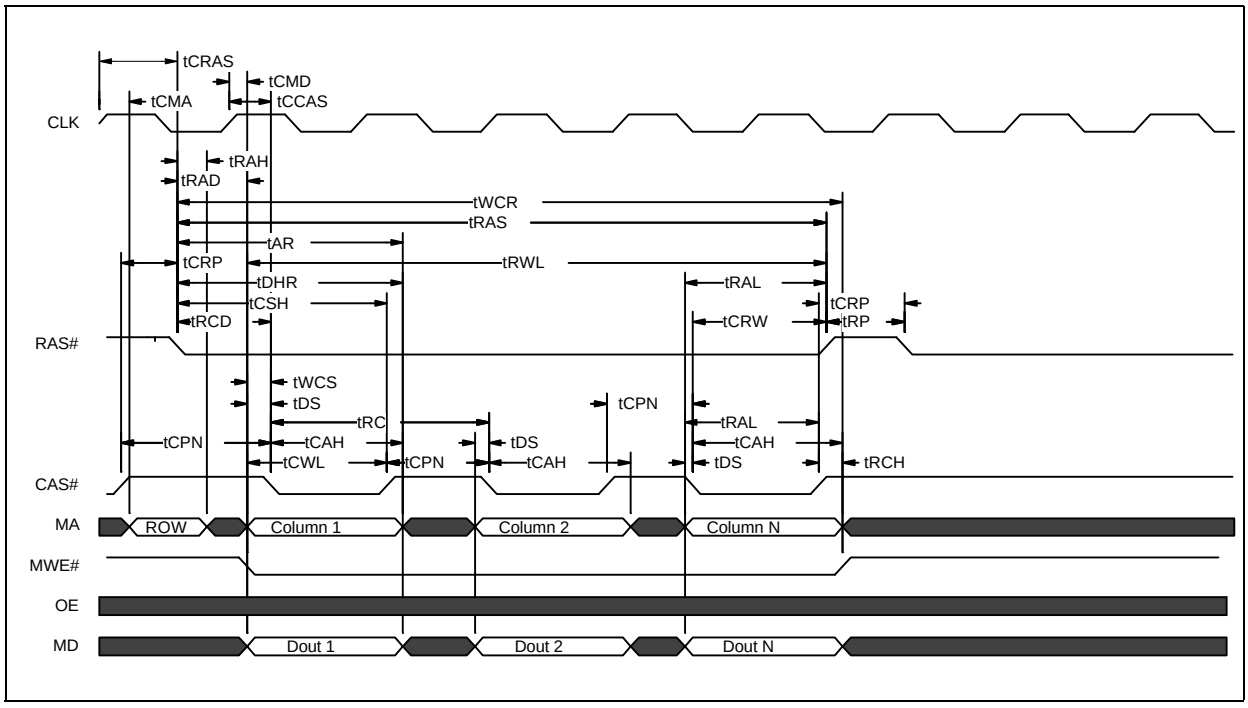


Figure 4-7 Refresh Cycle (ref table Table 4-6)

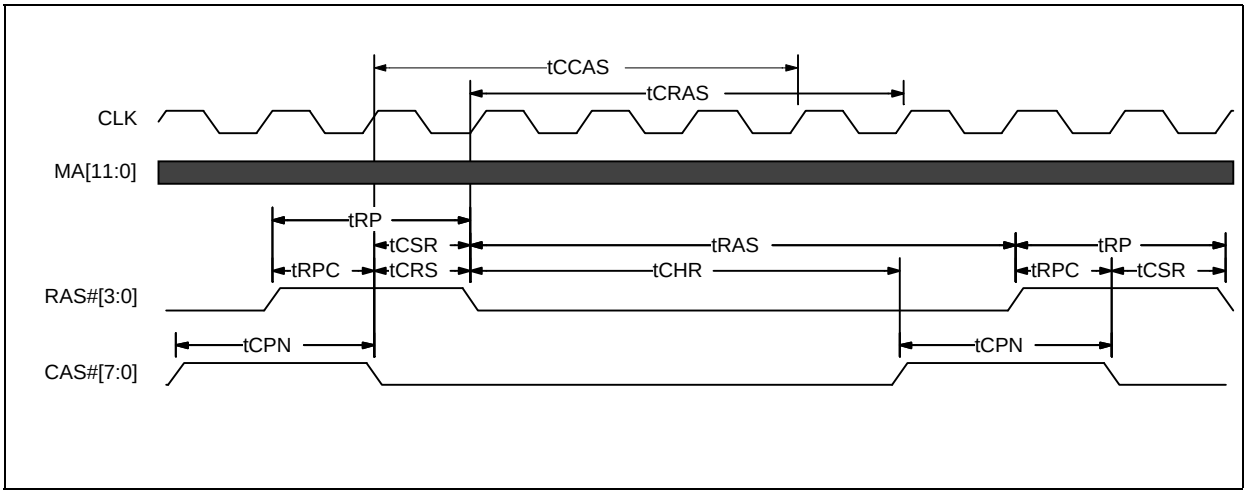


Table 4-6. AC Memory Timing Characteristics

	Parameter	Min	Max	Units
tCRAS	HCLK (or GCLK2X) to RAS#[3:0] valid (see Note 3)		17	ns
tCCAS	HCLK (or GCLK2X) to CAS#[7:0] bus valid (see Note 3)		17	ns
tCMA	HCLK (or GCLK2X) to MA[11:0] bus valid (see Note 3)		17	ns
tCMWE	HCLK (or GCLK2X) to MWE# valid (see Note 3)		17	ns
tCMD	HCLK to MD[63:0] bus valid (see Note 3)		25	ns
tGCMD	GCLK2X to MD[63:0] bus valid (see Note 3)		23	ns
tMDG	MD[63:0] Generic hold	0		ns
tCAH	Column Address Hold Time	$\geq 1T_{Cycles}$		ns
tCHR	CAS Hold Time	$\geq 1T_{Cycles}$		ns
tCOH	Data Hold TIme from CAS Low	Note 1		ns
tCPN	CAS Precharge Time	$1T_{Cycles}$		ns
tCRP	CAS to RAS Precharge Time		$\leq 1T_{Cycles}$	ns
tCRW	CAS Low to RAS HIGH (Write only)	$\geq 1T_{Cycles}$		ns
tCSR	CAS Setup Time	$\geq 1T_{Cycles}$		ns
tDS	Data In Setup Time	$\geq 1T_{Cycles}$		ns
tRAH	Row Address Hold Time	$\geq 1T_{Cycles}$		ns
tRAS	RAS Pulse Width	$\geq 3T_{Cycles}$		ns
tRC	Random Read or Write Time Cycle	$\geq 6T_{Cycles}$		ns
tRCD	RAS to CAS Delay Time	$\geq 1T_{Cycles}$		ns

Note 1; $T_{Cycle} \times n_{CAS} + (t_{Data\ off} - t_{CAS\ out})$

Where T_{Cycle} is the number of clock cycles.

n_{CAS} is the number of CAS Cycles (see Section 6.7.)

$T_{Dataoff}$ is the Generic Datahold

$t_{CAS\ Out}$ the CLK (either HCLK or GCLK2X) to CAS Low.

$T_{Dataoff}$ and $t_{CAS\ Out}$ are used to refine the timing programming.

Note 2; Value to be derived from CAS pulse width which is programmable (see Section 6.7.).

Note 3; for all chronograms, CLK refers to the clock signal that the program is using. It can be either HCLK or GCLK2X

Table 4-6. AC Memory Timing Characteristics

	Parameter	Min	Max	Units
tRCH	Read Command Hold Time	$\geq 1T_{Cycles}$		ns
tRCS	Read Command Setup Time	$\geq 1T_{Cycles}$		ns
tRP	RAS Precharge Time	$\geq 2T_{Cycles}$		ns
tWCH	Write Command Hold Time	$\geq 1T_{Cycles}$		ns
tWCS	WE Command Setup Time	$\geq 1T_{Cycles}$		ns
tWRH	WE Hold Time	Note 2		ns
tWRP	WE Setup Time	$\geq 1T_{Cycles}$		ns
tAR	Column Address Hold Time from RAS	$\geq 1T_{Cycles}$		ns
tRAD	RAS to valid Column Address Delay	$\geq 1T_{Cycles}$		ns
tRAL	Column Address to RAS Setup Time	$\geq 2T_{Cycles}$		ns
tWCR	Write Command Hold Reference to RAS	$\geq 1T_{Cycles}$		ns
tRWL	Write Command to RAS Setup Time (Note 2)	$\geq 1T_{Cycles}$		ns
tCWL	Write Command to CAS Setup Time (Note 2)	$\geq 1T_{Cycles}$		ns
tDHR	Data Hold Reference to RAS	$\geq 3T_{Cycles}$		ns
tRPC	RAS High to CAS Low Precharge	$\geq 1T_{Cycles}$		ns
tCRS	CAS Before RAS Setup Time	$\geq 1T_{Cycles}$		ns
tCHR	CAS Before RAS Hold Time	$\geq 1T_{Cycles}$		ns
tCSH	CAS Hold Time after RAS	$\geq 1T_{Cycles}$		ns

Note 1; $T_{Cycle} \times n_{CAS} + (t_{Data\ off} - t_{CAS\ out})$

Where T_{Cycle} is the number of clock cycles.

n_{CAS} is the number of CAS Cycles (see Section 6.7.)

$T_{Dataoff}$ is the Generic Datahold

$t_{CAS\ Out}$ the CLK (either HCLK or GCLK2X) to CAS Low.

$T_{Dataoff}$ and $t_{CAS\ Out}$ are used to refine the timing programming.

Note 2; Value to be derived from CAS pulse width which is programmable (see Section 6.7.).

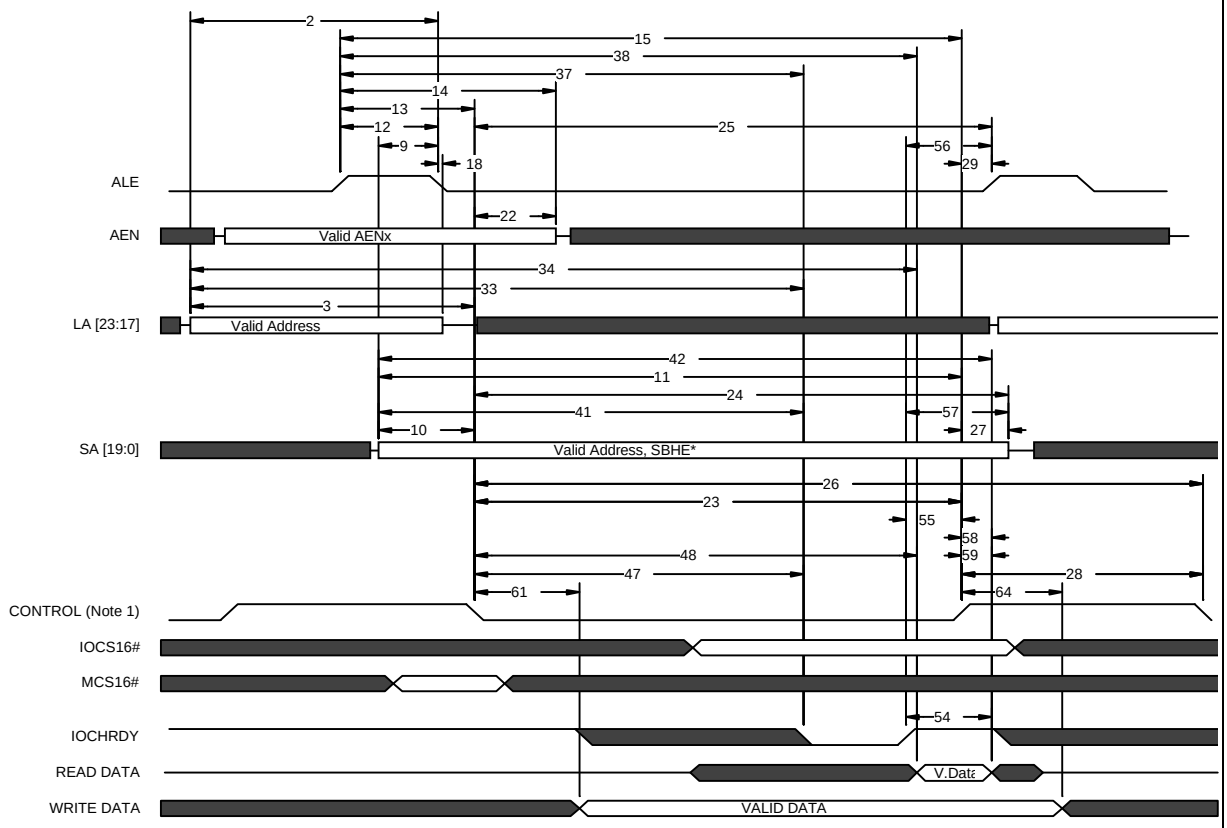
Note 3; for all chronograms, CLK refers to the clock signal that the program is using. It can be either HCLK or GCLK2X

Table 4-7. Graphics Adapter (VGA) AC Timing

Name	Parameter	Min	Max	Unit
t18	DCLK to VSYNC valid		27	ns
t19	DCLK to HSYNC valid		27	ns

4.5.4 ISA INTERFACE AC TIMING CHARACTERISTICS

Figure 4-8 ISA Cycle (ref table Table 4-8)



Note 1; Stands for SMEMR#, SMEMW#, MEMR#, MEMW#, IOR# & IOW#.

Note; The clock has not been represented as it cannot be accurately represented depending on the ISA Slave mode.

Table 4-8. ISA Bus AC Timing

Name	Parameter	Min	Max	Units
2	LA[23:17] valid before ALE# negated	5T		Cycles
3	**LA[23:17] valid before MEMR#, MEMW# asserted**			
3a	Memory access to 16 bit ISA Slave	5T		Cycles
3b	Memory access to 8 bit ISA Slave	5T		Cycles
9	SA[19:0] & SBHE valid before ALE# negated	1T		Cycles
10	**SA[19:0] & SBHE valid before MEMR#, MEMW# asserted**			
10a	Memory access to 16 bit ISA Slave	2T		Cycles
10b	Memory access to 8 bit ISA Slave	2T		Cycles
10	**SA[19:0] & SHBE valid before SMEMR#, SMEMW# asserted**			
10c	Memory access to 16 bit ISA Slave	2T		Cycle
10d	Memory access to 8 bit ISA Slave	2T		Cycle
10e	SA[19:0] & SBHE valid before IOR#, IOW# asserted	2T		Cycles
11	**XTALO to IOW# valid**			
Note; The signal numbering refers to Table 4-8				

Table 4-8. ISA Bus AC Timing

Name	Parameter		Min	Max	Units
	11a	Memory access to 16 bit ISA Slave - 2BCLK	2T		Cycles
	11b	Memory access to 16 bit ISA Slave - Standard 3BCLK	2T		Cycles
	11c	Memory access to 16 bit ISA Slave - 4BCLK	2T		Cycles
	11d	Memory access to 8 bit ISA Slave - 2BCLK	2T		Cycles
11e		Memory access to 8 bit ISA Slave - Standard 3BCLK	2T		Cycles
12	ALE# asserted before ALE# negated		1T		Cycles
13	**ALE# asserted before MEMR#, MEMW# asserted**				
	13a	Memory Access to 16 bit ISA Slave	2T		Cycles
	13b	Memory Access to 8 bit ISA Slave	2T		Cycles
13	**ALE# asserted before SMEMR#, SMEMW# asserted**				
	13c	Memory Access to 16 bit ISA Slave	2T		Cycles
	13d	Memory Access to 8 bit ISA Slave	2T		Cycles
13e	ALE# asserted before IOR#, IOW# asserted		2T		Cycles
14	**ALE# asserted before AL[23:17]**				
	14a	Non compressed	15T		Cycles
	14b	Compressed	15T		Cycles
15	**ALE# asserted before MEMR#, MEMW#, SMEMR#, SMEMW# negated**				
	15a	Memory Access to 16 bit ISA Slave- 4 BCLK	11T		Cycles
	15e	Memory Access to 8 bit ISA Slave- Standard Cycle	11T		Cycles
18a	ALE# negated before LA[23:17] invalid (non compressed)		14T		Cycles
18a	ALE# negated before LA[23:17] invalid (compressed)		14T		Cycles
22	**MEMR#, MEMW# asserted before LA[23:17]**				
	22a	Memory access to 16 bit ISA Slave.	13T		Cycles
	22b	Memory access to 8 bit ISA Slave.	13T		Cycles
23	**MEMR#, MEMW# asserted before MEMR#, MEMW# negated**				
	23b	Memory access to 16 bit ISA Slave Standard cycle	9T		Cycles
	23e	Memory access to 8 bit ISA Slave Standard cycle	9T		Cycles
23	**SMEMR#, SMEMW# asserted before SMEMR#, SMEMW# negated**				
	23h	Memory access to 16 bit ISA Slave Standard cycle	9T		Cycles
	23l	Memory access to 16 bit ISA Slave Standard cycle	9T		Cycles
23	**IOR#, IOW# asserted before IOR#, IOW# negated**				
	23o	Memory access to 16 bit ISA Slave Standard cycle	9T		Cycles
	23r	Memory access to 8 bit ISA Slave Standard cycle	9T		Cycles
24	**MEMR#, MEMW# asserted before SA[19:0]**				
	24b	Memory access to 16 bit ISA Slave Standard cycle	10T		Cycles
	24d	Memory access to 8 bit ISA Slave - 3BLCK	10T		Cycles
	24e	Memory access to 8 bit ISA Slave Standard cycle	10T		Cycles
	24f	Memory access to 8 bit ISA Slave - 7BCLK	10T		Cycles
24	**SMEMR#, SMEMW# asserted before SA[19:0]**				
	24h	Memory access to 16 bit ISA Slave Standard cycle	10T		Cycles
	24i	Memory access to 16 bit ISA Slave - 4BCLK	10T		Cycles
	24k	Memory access to 8 bit ISA Slave - 3BCLK	10T		Cycles
	24l	Memory access to 8 bit ISA Slave Standard cycle	10T		Cycles
24	**IOR#, IOW# asserted before SA[19:0]**				
	24o	I/O access to 16 bit ISA Slave Standard cycle	19T		Cycles
	24r	I/O access to 16 bit ISA Slave Standard cycle	19T		Cycles
Note; The signal numbering refers to Table 4-8					

Table 4-8. ISA Bus AC Timing

Name	Parameter		Min	Max	Units
25	**MEMR#, MEMW# asserted before next ALE# asserted**				
	25b	Memory access to 16 bit ISA Slave Standard cycle	10T		Cycles
	25d	Memory access to 8 bit ISA Slave Standard cycle	10T		Cycles
25	**SMEMR#, SMEMW# asserted before next ALE# asserted**				
	25e	Memory access to 16 bit ISA Slave - 2BCLK	10T		Cycles
	25f	Memory access to 16 bit ISA Slave Standard cycle	10T		Cycles
	25h	Memory access to 8 bit ISA Slave Standard cycle	10T		Cycles
25	**IOR#, IOW# asserted before next ALE# asserted**				
	25i	I/O access to 16 bit ISA Slave Standard cycle	10T		Cycles
	25k	I/O access to 16 bit ISA Slave Standard cycle	10T		Cycles
26	**MEMR#, MEMW# asserted before next MEMR#, MEMW# asserted**				
	26b	Memory access to 16 bit ISA Slave Standard cycle	12T		Cycles
	26d	Memory access to 8 bit ISA Slave Standard cycle	12T		Cycles
26	**SMEMR#, SMEMW# asserted before next SMEMR#, SMEMW# asserted**				
	26f	Memory access to 16 bit ISA Slave Standard cycle	12T		Cycles
	26h	Memory access to 8 bit ISA Slave Standard cycle	12T		Cycles
26	**IOR#, IOW# asserted before next IOR#, IOW# asserted**				
	26i	I/O access to 16 bit ISA Slave Standard cycle	12T		Cycles
	26k	I/O access to 8 bit ISA Slave Standard cycle	12T		Cycles
28	**Any command negated to MEMR#, SMEMR#, MEMR#, SMEMW# asserted**				
	28a	Memory access to 16 bit ISA Slave	3T		Cycles
	28b	Memory access to 8 bit ISA Slave	3T		Cycles
28	**Any command negated to IOR#, IOW# asserted**				
	28c	I/O access to ISA Slave	3T		Cycles
29a	MEMR#, MEMW# negated before next ALE# asserted		1T		Cycles
29b	SMEMR#, SMEMW# negated before next ALE# asserted		1T		Cycles
29c	IOR#, IOW# negated before next ALE# asserted		1T		Cycles
33	**LA[23:17] valid to IOCHRDY negated**				
	33a	Memory access to 16 bit ISA Slave - 4 BCLK	8T		Cycles
	33b	Memory access to 8 bit ISA Slave - 7 BCLK	14T		Cycles
34	**LA[23:17] valid to read data valid**				
	34b	Memory access to 16 bit ISA Slave Standard cycle	8T		Cycles
	34e	Memory access to 8 bit ISA Slave Standard cycle	14T		Cycles
37	**ALE# asserted to IOCHRDY# negated**				
	37a	Memory access to 16 bit ISA Slave - 4 BCLK	6T		Cycles
	37b	Memory access to 8 bit ISA Slave - 7 BCLK	12T		Cycles
	37c	I/O access to 16 bit ISA Slave - 4 BCLK	6T		Cycles
	37d	I/O access to 8 bit ISA Slave - 7 BCLK	12T		Cycles
38	**ALE# asserted to read data valid**				
	38b	Memory access to 16 bit ISA Slave Standard Cycle	4T		Cycles
	38e	Memory access to 8 bit ISA Slave Standard Cycle	10T		Cycles
	38h	I/O access to 16 bit ISA Slave Standard Cycle	4T		Cycles
	38l	I/O access to 8 bit ISA Slave Standard Cycle	10T		Cycles
41	**SA[19:0] SBHE valid to IOCHRDY negated**				
	41a	Memory access to 16 bit ISA Slave	6T		Cycles
	41b	Memory access to 8 bit ISA Slave	12T		Cycles
Note; The signal numbering refers to Table 4-8					

Table 4-8. ISA Bus AC Timing

Name	Parameter		Min	Max	Units
	41c	I/O access to 16 bit ISA Slave	6T		Cycles
	41d	I/O access to 8 bit ISA Slave	12T		Cycles
42	**SA[19:0] SBHE valid to read data valid**				
	42b	Memory access to 16 bit ISA Slave Standard cycle	4T		Cycles
	42e	Memory access to 8 bit ISA Slave Standard cycle	10T		Cycles
	42h	I/O access to 16 bit ISA Slave Standard cycle	4T		Cycles
	42l	I/O access to 8 bit ISA Slave Standard cycle	10T		Cycles
47	**MEMR#, MEMW#, SMEMR#, SMEMW#, IOR#, IOW# asserted to IOCHRDY negated**				
	47a	Memory access to 16 bit ISA Slave	2T		Cycles
	47b	Memory access to 8 bit ISA Slave	5T		Cycles
	47c	I/O access to 16 bit ISA Slave	2T		Cycles
	47d	I/O access to 8 bit ISA Slave	5T		Cycles
48	**MEMR#, SMEMR#, IOR# asserted to read data valid**				
	48b	Memory access to 16 bit ISA Slave Standard Cycle	2T		Cycles
	48e	Memory access to 8 bit ISA Slave Standard Cycle	5T		Cycles
	48h	I/O access to 16 bit ISA Slave Standard Cycle	2T		Cycles
	48l	I/O access to 8 bit ISA Slave Standard Cycle	5T		Cycles
54	**IOCHRDY asserted to read data valid**				
	54a	Memory access to 16 bit ISA Slave	1T(R)/2T(W)		Cycles
	54b	Memory access to 8 bit ISA Slave	1T(R)/2T(W)		Cycles
	54c	I/O access to 16 bit ISA Slave	1T(R)/2T(W)		Cycles
	54d	I/O access to 8 bit ISA Slave	1T(R)/2T(W)		Cycles
55a	IOCHRDY asserted to MEMR#, MEMW#, SMEMR#, SMEMW#, IOR#, IOW# negated		1T		Cycles
55b	IOCHRY asserted to MEMR#, SMEMR# negated (refresh)		1T		Cycles
56	IOCHRDY asserted to next ALE# asserted		2T		Cycles
57	IOCHRDY asserted to SA[19:0], SBHE invalid		2T		Cycles
58	MEMR#, IOR#, SMEMR# negated to read data invalid		0T		Cycles
59	MEMR#, IOR#, SMEMR# negated to databus float		0T		Cycles
61	**Write data before MEMW# asserted**				
	61a	Memory access to 16 bit ISA Slave	2T		Cycles
	61b	Memory access to 8 bit ISA Slave (Byte copy at end of start)	2T		Cycles
61	**Write data before SMEMW# asserted**				
	61c	Memory access to 16 bit ISA Slave	2T		Cycles
	61d	Memory access to 8 bit ISA Slave	2T		Cycles
61	**Write Data valid before IOW# asserted**				
	61e	I/O access to 16 bit ISA Slave	2T		Cycles
	61f	I/O access to 8 bit ISA Slave	2T		Cycles
64a	MEMW# negated to write data invalid - 16 bit		1T		Cycles
64b	MEMW# negated to write data invalid - 8 bit		1T		Cycles
64c	SMEMW# negated to write data invalid - 16 bit		1T		Cycles
64d	SMEMW# negated to write data invalid - 8 bit		1T		Cycles
64e	IOW# negated to write data invalid		1T		Cycles
Note; The signal numbering refers to Table 4-8					

Table 4-8. ISA Bus AC Timing

Name	Parameter	Min	Max	Units
64f	MEMW# negated to copy data float, 8 bit ISA Slave, odd Byte by ISA Master	1T		Cycles
64g	IOW# negated to copy data float, 8 bit ISA Slave, odd Byte by ISA Master	1T		Cycles
Note; The signal numbering refers to Table 4-8				

4.5.5 IPC INTERFACE AC TIMING CHARACTERISTICS

Table 4-9. IPC Interface AC Timings

Name	Parameter	Min	Max	Unit
t20	XTALO to DACK_EN[2:0] valid		71	nS
t21	XTALO to TC valid		68	nS
t22	IRQ_MUX Input setup to ISACLK2X	0	-	nS
t23	DREQ_MUX[1:0] Input setup to ISACLK2X	0	-	nS

4.5.6 PCMCIA INTERFACE AC TIMING CHARACTERISTICS

Table 4-10. PCMCIA Interface AC Timing

Name	Parameters	Min	Max	Units
t24	Input setup to ISACLK2X	24		nS
t25	Input hold from ISACLK2X	5		nS
t28	ISACLK2X to IORD	-	55	nS
t29	ISACLK2X to IORW	-	55	nS
t30	ISACLK2X to AD[25:0]	-	25	nS
t31	ISACLK2X to OE#	2	55	nS
t32	ISACLK2X to WE#	2	55	nS
t33	ISACLK2X to DATA[15:0]	0	35	nS
t34	ISACLK2X to INPACK	2	55	nS
t35	ISACLK2X to CE1#	7	65	nS
t36	ISACLK2X to CE2#	7	65	nS
t37	ISACLK2X to RESET	2	55	nS

4.5.7 PARALLEL INTERFACE AC TIMING CHARACTERISTICS

Table 4-11. Parallel Interface AC Timing

Name	Parameters	Min	Max	Units
t37	STROBE# to BUSY setup	0	-	nS
t38	PD bus to AUTPFD# hold	0	-	nS
t39	PB bus to BUSY setup	0	-	nS

4.5.8 KEYBOARD INTERFACE AC TIMING CHARACTERISTICS

Table 4-12. Keyboard Interface AC Timing

Name	Parameters	Min	Max	Units
t40	Input setup to KBCLK	5	-	nS
t41	Input hold to KBCLK	1	-	nS
t42	KBCLK to KBDATA	-	12	nS

4.5.9 MOUSE INTERFACE AC TIMING CHARACTERISTICS

Table 4-13. Mouse Interface AC Timing

Name	Parameters	Min	Max	Units
t43	Input setup to MCLK	5	-	nS
t44	Input hold to MCLK	1	-	nS
t45	MCLK to MDATA	-	12	nS

4.5.10 LOCAL BUS INTERFACE AC TIMING CHARACTERISTICS

Table 4-14. 16 bit Memory Write

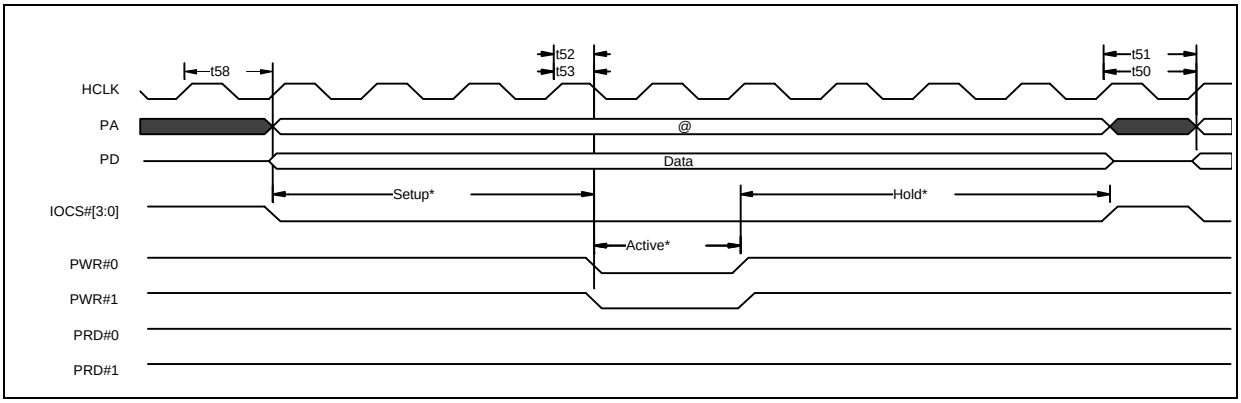


Table 4-15. 16 bit Memory Read

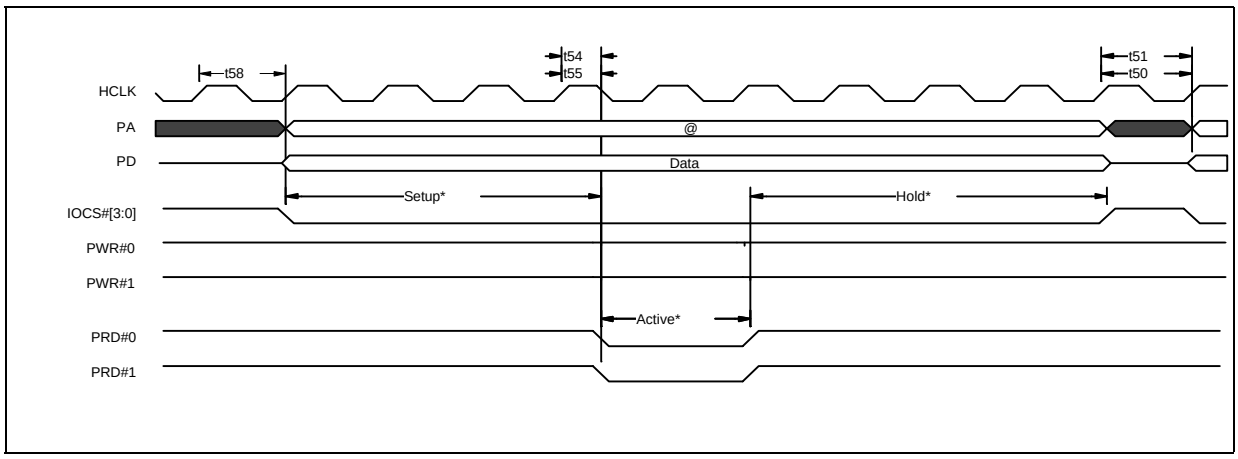


Table 4-16. 16 bit I/O Write

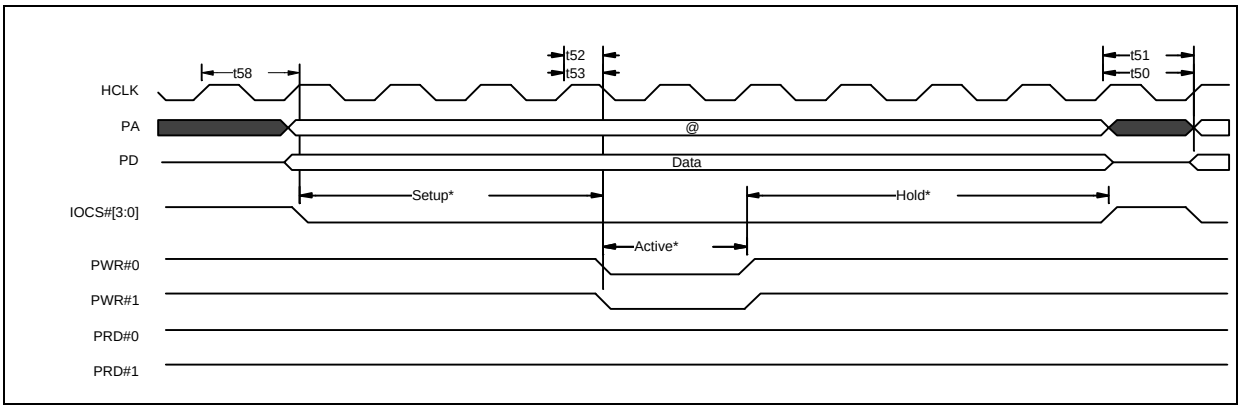


Table 4-17. 16 bit I/O Read

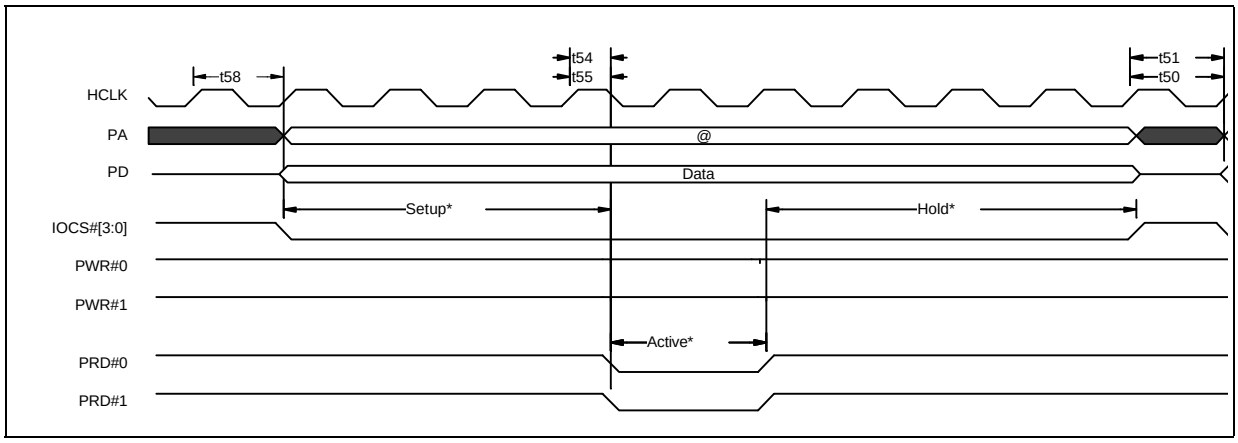


Table 4-18. 8 bit I/O Write at even addresses with IOWIDTH=0 or 1

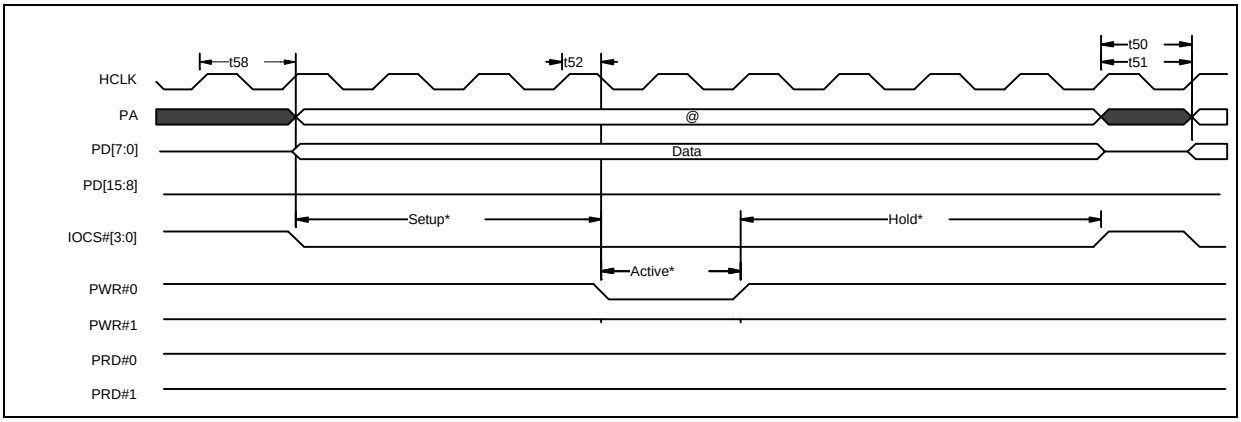


Table 4-19. 8 bit I/O Write at odd addresses with IOWIDTH=0 (8 bit Peripheral)

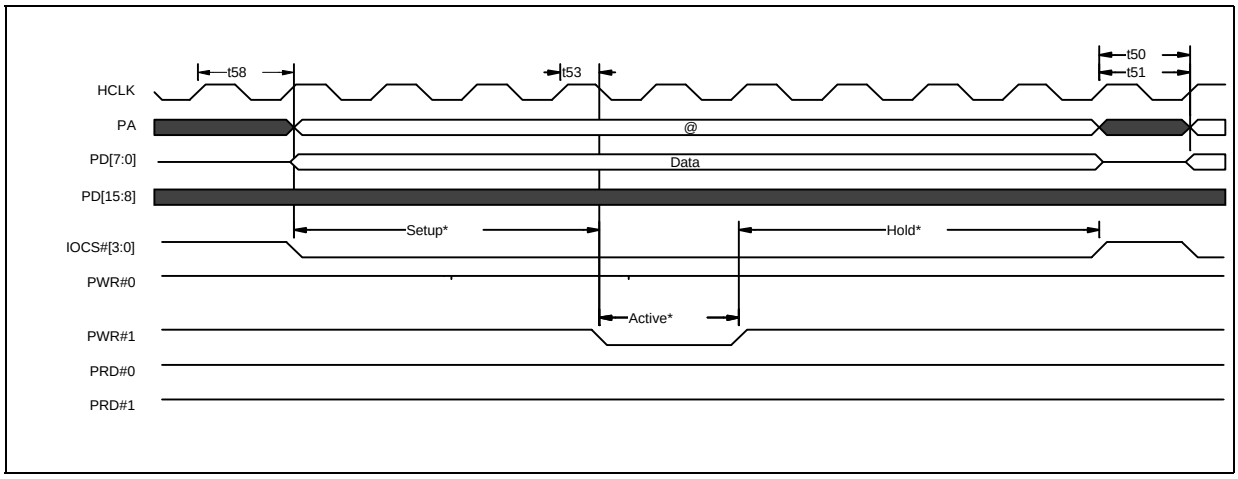


Table 4-20. 8 bit I/O Write at odd addresses with IOWIDTH=1 (16 bit Peripheral)

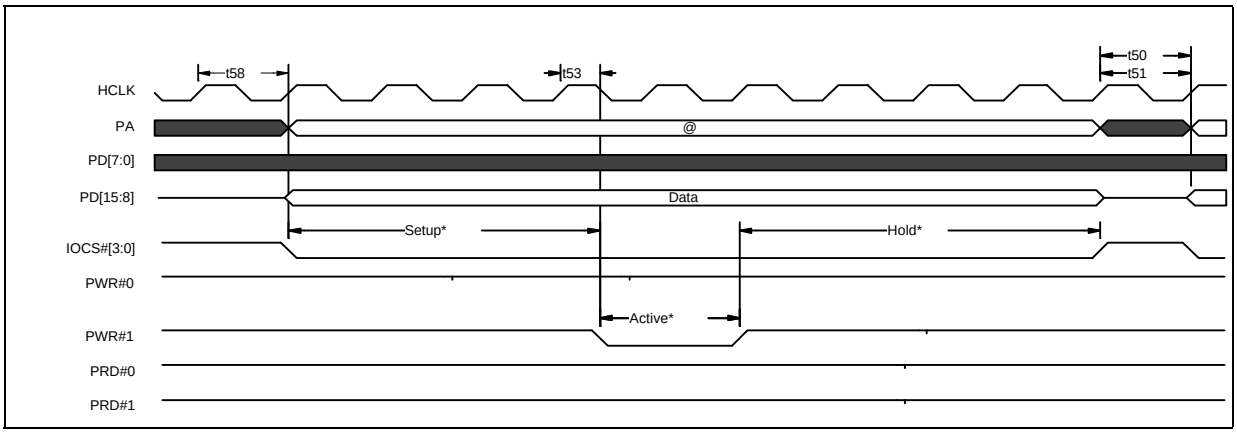


Table 4-21. Local Bus Interface AC Timing

Name	Parameters	Min	Max	Units
t46	PRDY# Input hold to HCLK	2		nS
t47	PD[15:0] Input hold to HCLK	2		nS
t48	PRDY# Input setup to HCLK	1	-	nS
t49	PD[15:0] Input setup to HCLK	2	4	nS
t50	HCLK to PA bus	-	15	nS
t51	HCLK to PD bus	-	15	nS
t52	HCLK to PWR0#	-	15	nS
t53	HCLK to PWR1#	-	15	nS
t54	HCLK to PRD0#	-	15	nS
t55	HCLK to PRD1#	-	15	nS
t56	HCLK to FCS0#	-	15	nS
t57	HCLK to FCS1#	-	15	nS
t58	HCLK to IOCS#[3:0]	-	15	nS
Note; To program the values of Setup, Active and Hold timings, refer to Section 14.4.3.				

4.5.11 TFT INTERFACE AC TIMING CHARACTERISTICS

Table 4-22. TFT Interface Timing

Name	Parameters	Min	Max	Units
t59	DCLK to FPLINE		15	nS
t60	DCLK to R[2]		15	nS
t61	DCLK to R[3]		15	nS
t62	DCLK to R[4]		15	nS
t63	DCLK to R[5]		15	nS
t64	DCLK to G[2]		15	nS
t65	DCLK to G[3]		15	nS
t66	DCLK to G[4]		15	nS
t67	DCLK to G[5]		15	nS
t68	DCLK to B[2]		15	nS
t68	DCLK to B[3]		15	nS
t69	DCLK to B[4]		15	nS

Table 4-22. TFT Interface Timing

Name	Parameters	Min	Max	Units
t70	DCLK to B[5]		15	nS
t71	DCLK to FPFRAME		15	nS

5. MECHANICAL DATA

5.1. 388-PIN PACKAGE DIMENSION

The pin numbering for the STPC 388-pin Plastic BGA package is shown in Figure 5-1.

Dimensions are shown in Figure 5-2, Table 5-1 and Figure 5-3, Table 5-2.

Figure 5-1. 388-Pin PBGA Package - Top View

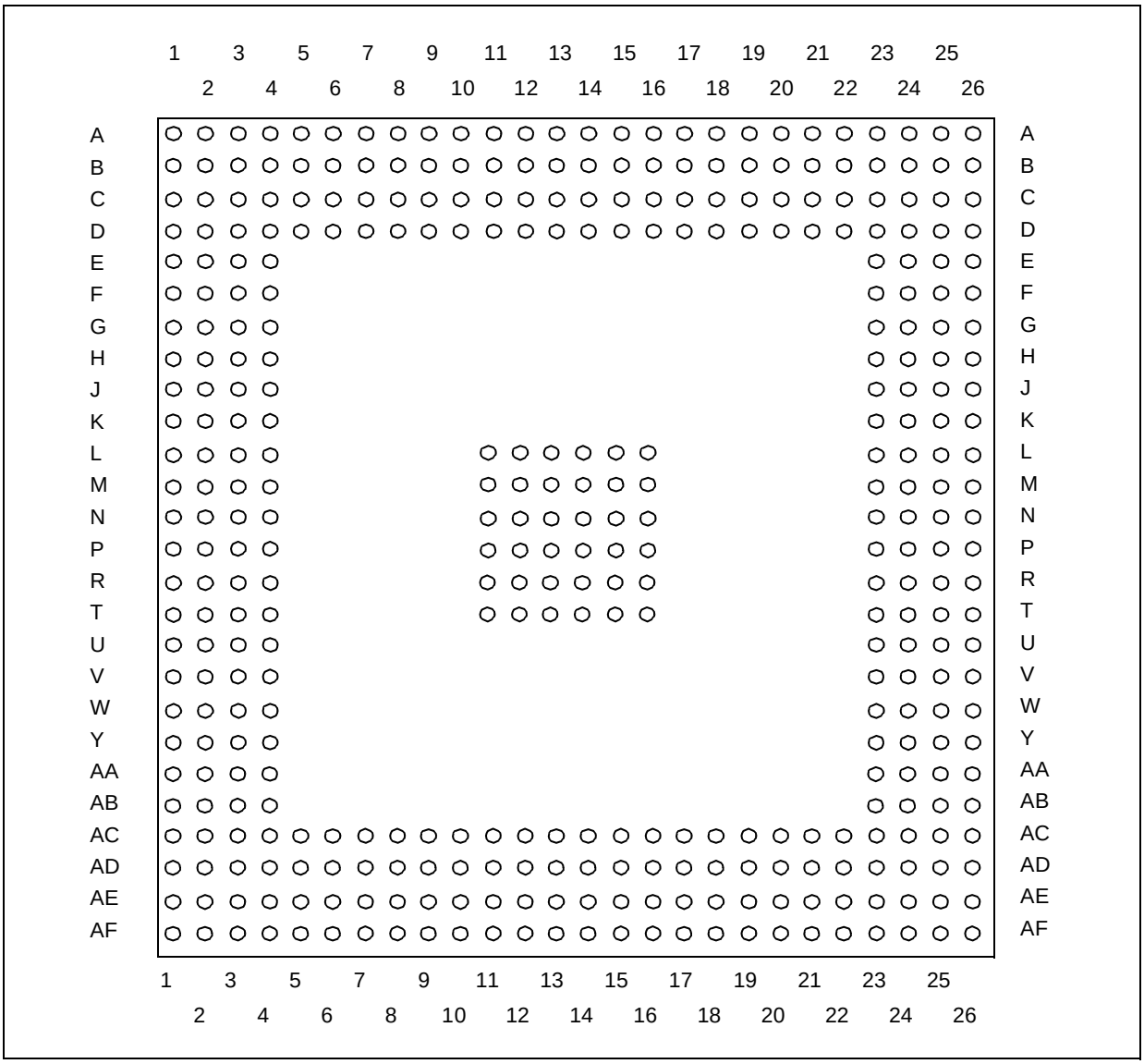


Figure 5-2. 388-pin PBGA Package - PCB Dimensions

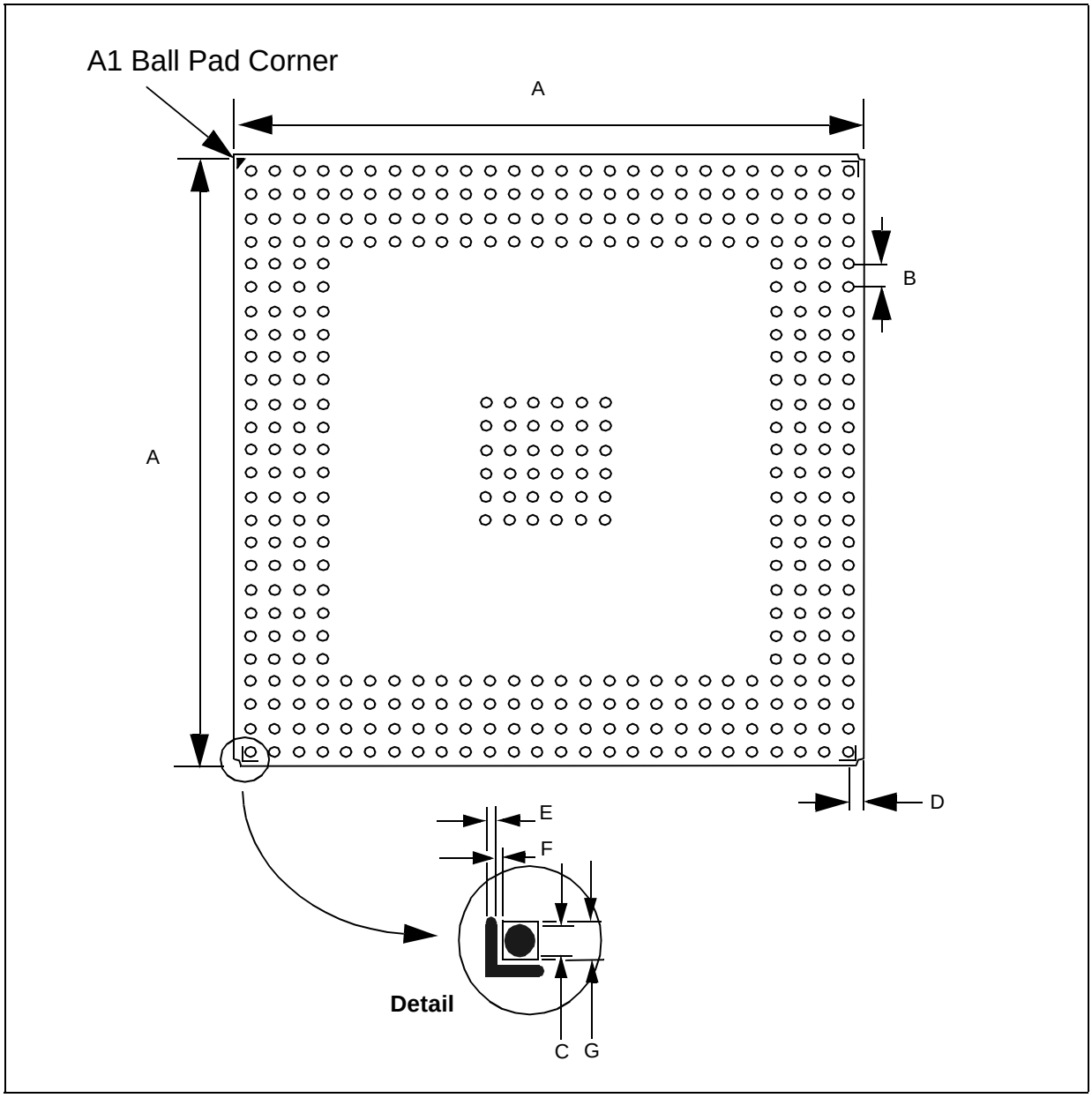


Table 5-1. 388-pin PBGA Package - PCB Dimensions

Symbols	mm			inches		
	Min	Typ	Max	Min	Typ	Max
A	34.95	35.00	35.05	1.375	1.378	1.380
B	1.22	1.27	1.32	0.048	0.050	0.052
C	0.58	0.63	0.68	0.023	0.025	0.027
D	1.57	1.62	1.67	0.062	0.064	0.066
E	0.15	0.20	0.25	0.006	0.008	0.001
F	0.05	0.10	0.15	0.002	0.004	0.006
G	0.75	0.80	0.85	0.030	0.032	0.034

Figure 5-3. 388-pin PBGA Package - Dimensions

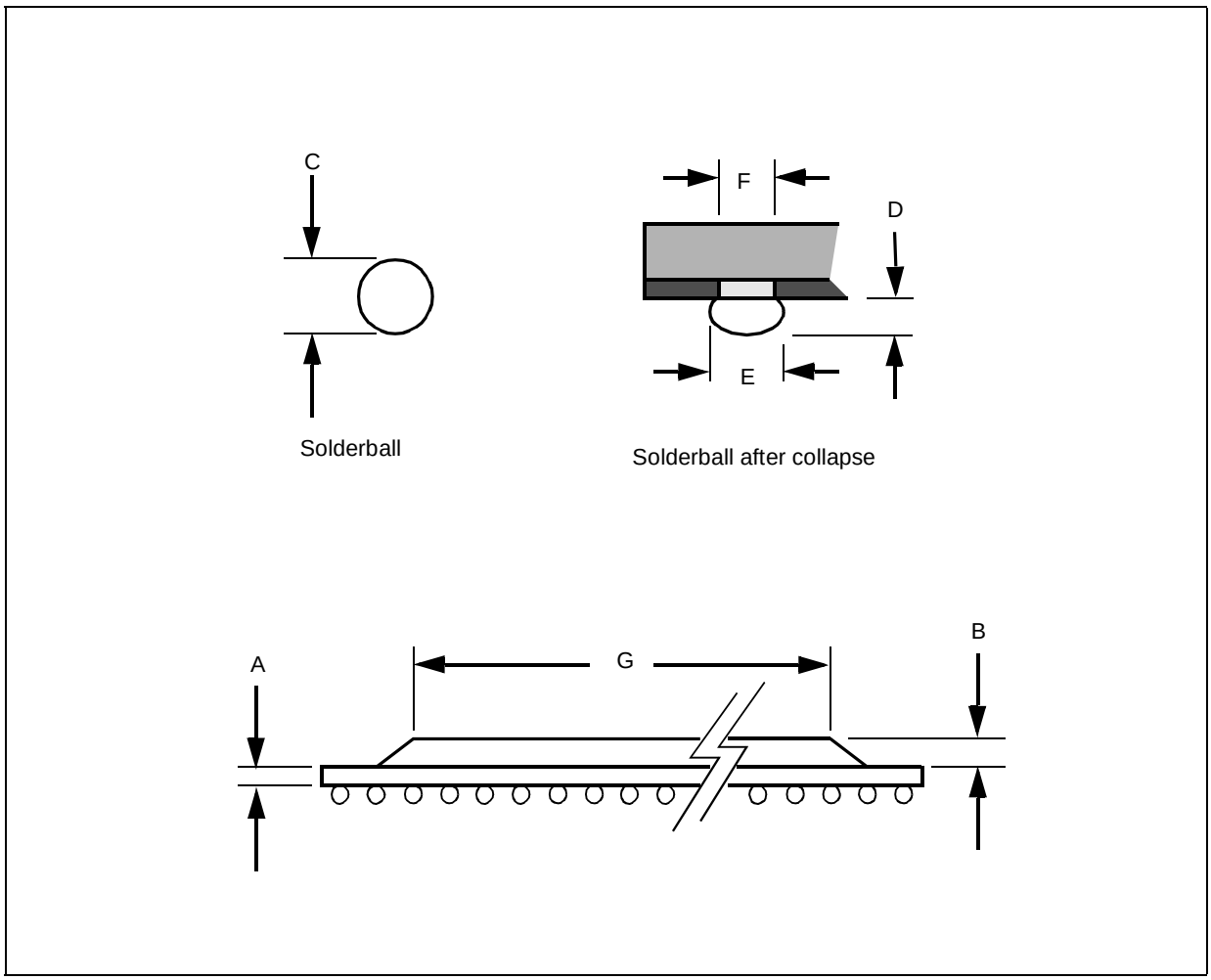


Table 5-2. 388-pin PBGA Package - Dimensions

Symbols	mm			inches		
	Min	Typ	Max	Min	Typ	Max
A	0.50	0.56	0.62	0.020	0.022	0.024
B	1.12	1.17	1.22	0.044	0.046	0.048
C	0.60	0.76	0.92	0.024	0.030	0.036
D	0.52	0.53	0.54	0.020	0.021	0.022
E	0.63	0.78	0.93	0.025	0.031	0.037
F	0.60	0.63	0.66	0.024	0.025	0.026
G		30.0			11.8	

5.2. 388-PIN PACKAGE THERMAL DATA

The 388-pin PBGA package has a Power Dissipation Capability of 4.5W. This increases to 6W when used with a Heatsink.

The structure in shown in Figure 5-4.

Thermal dissipation options are illustrated in Figure 5-5 and Figure 5-6.

Figure 5-4. 388-Pin PBGA structure

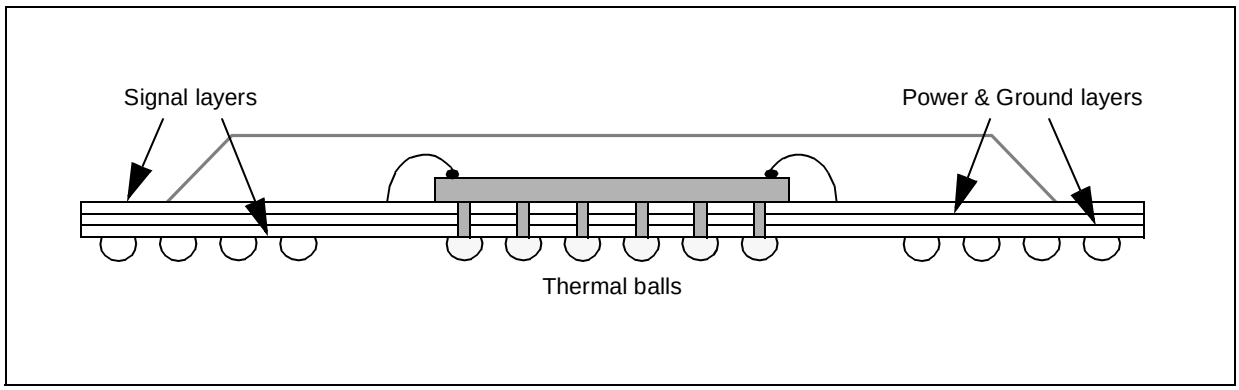


Figure 5-5. Thermal Dissipation Without Heatsink

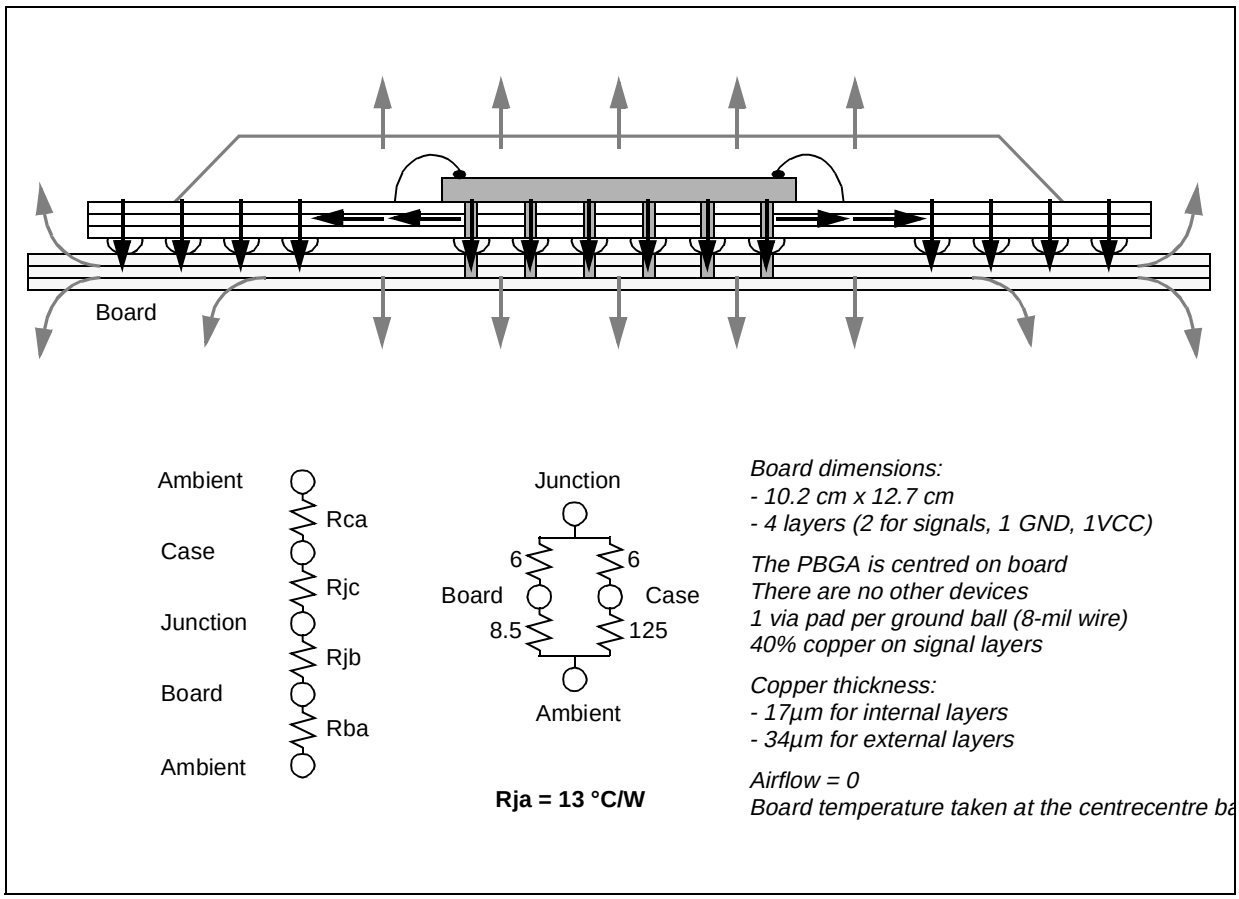
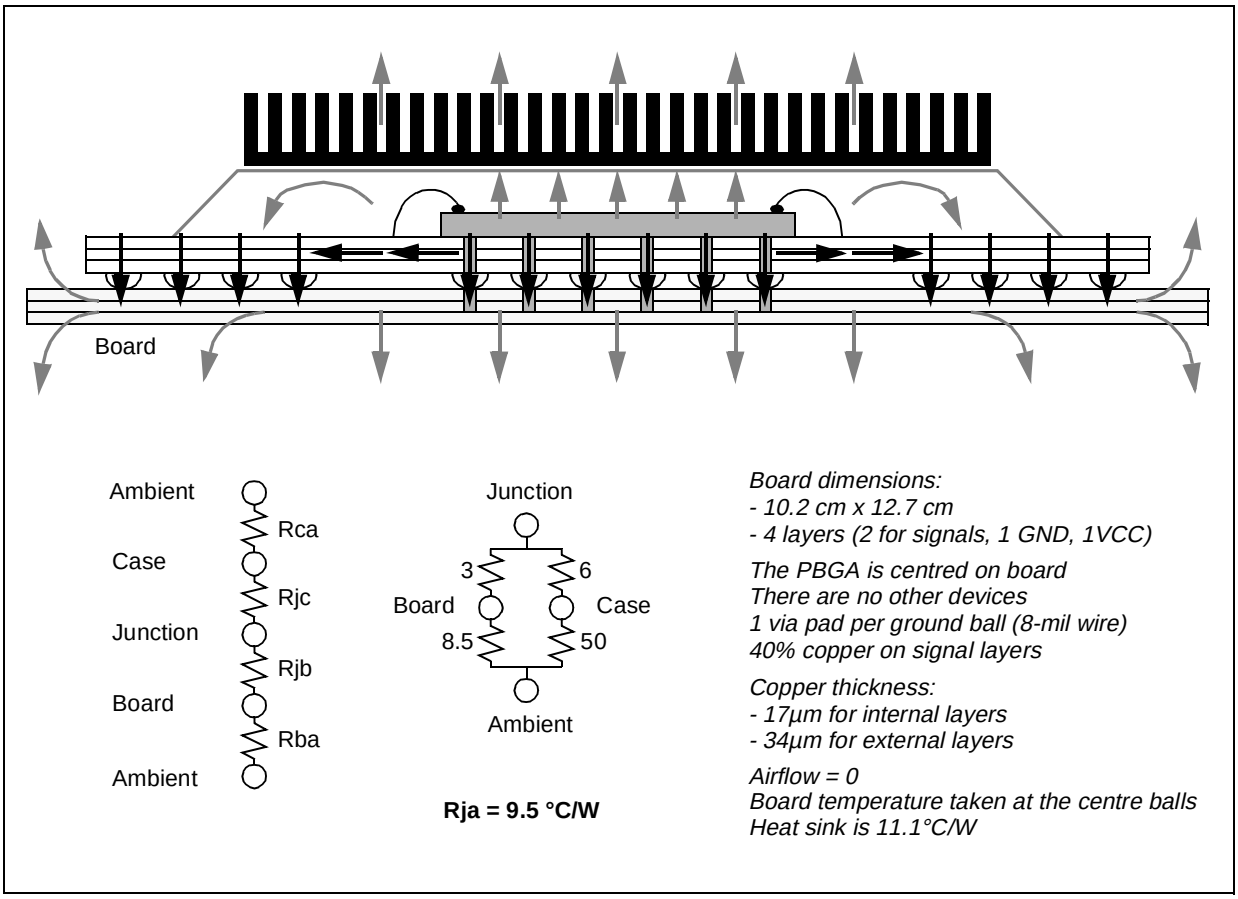


Figure 5-6. Thermal Dissipation With Heatsink



5.3. SOLDERING RECOMMENDATIONS

High quality, low defect soldering requires identifying the **optimum temperature profile** for reflowing the solder paste, therefore optimizing the process. The heating and cooling rise rates must be compatible with the solder paste and components. A typical profile consists of a preheat, dryout, reflow and cooling sections.

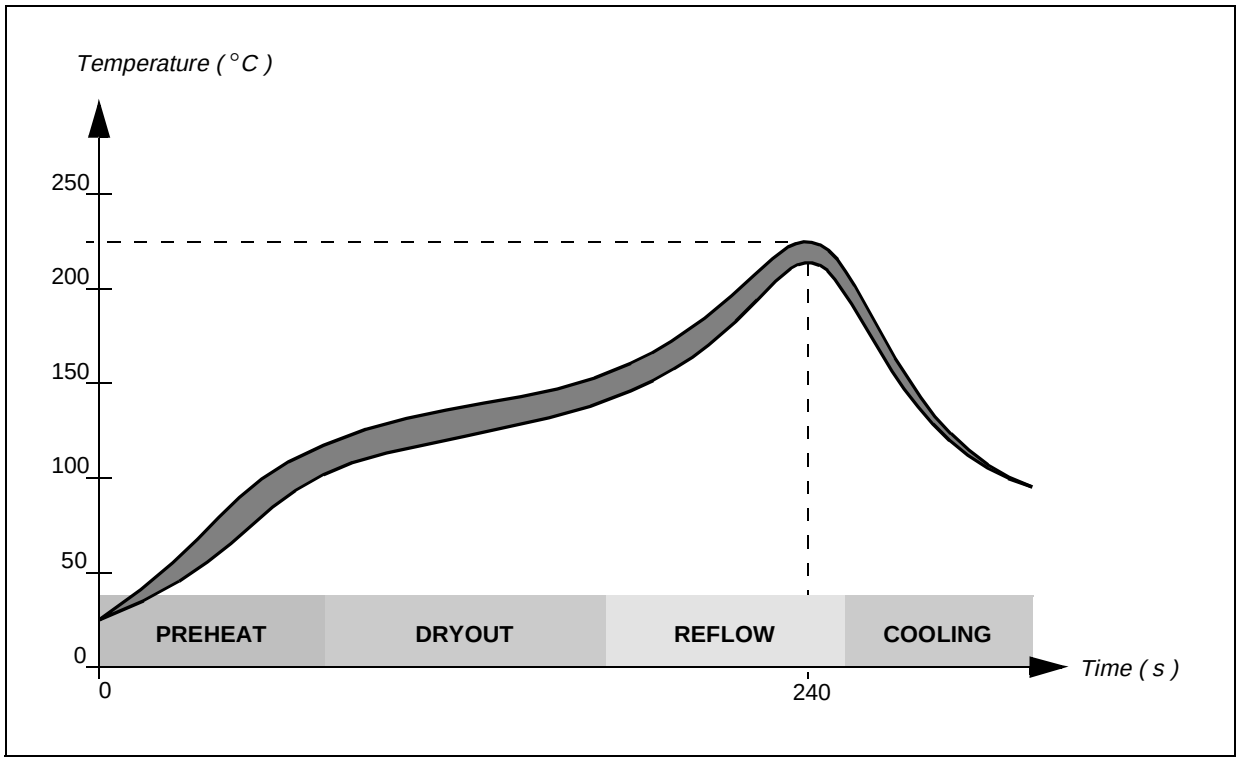
The most critical parameter in the **preheat section** is to minimize the rate of temperature rise to less than 2°C / second, in order to minimize thermal shock on the semi-conductor components.

Dryout section is used primarily to ensure that the solder paste is fully dried before hitting reflow temperatures.

Solder reflow is accomplished in the **reflow zone**, where the solder paste is elevated to a temperature greater than the melting point of the solder. Melting temperature must be exceeded by approximately 20°C to ensure quality reflow.

In reality the profile is not a line, but rather **a range of temperatures** all solder joints must be exposed. The total temperature deviation from component thermal mismatch, oven loading and oven uniformity must be within the band.

Figure 5-7. Reflow soldering temperature range



6. BOARD LAYOUT

6.1. THERMAL DISSIPATION

Thermal dissipation of the STPC depends mainly on supply voltage. When the system does not need to work at 3.3 V, it may be beneficial to reduce the voltage to, for example, 3.15 V. This may save a few 100's of mW.

A further area to consider is unused interfaces and functions. Depending on the application, some input signals can be grounded, some blocks left un- powered, other blocks shutdown. Clock speed dynamic adjustment offers a further solution, together with the integrated power management unit.

The standard way to route the thermal balls to the internal ground layer uses one via for each ball pad, connected using 8-mil wire.

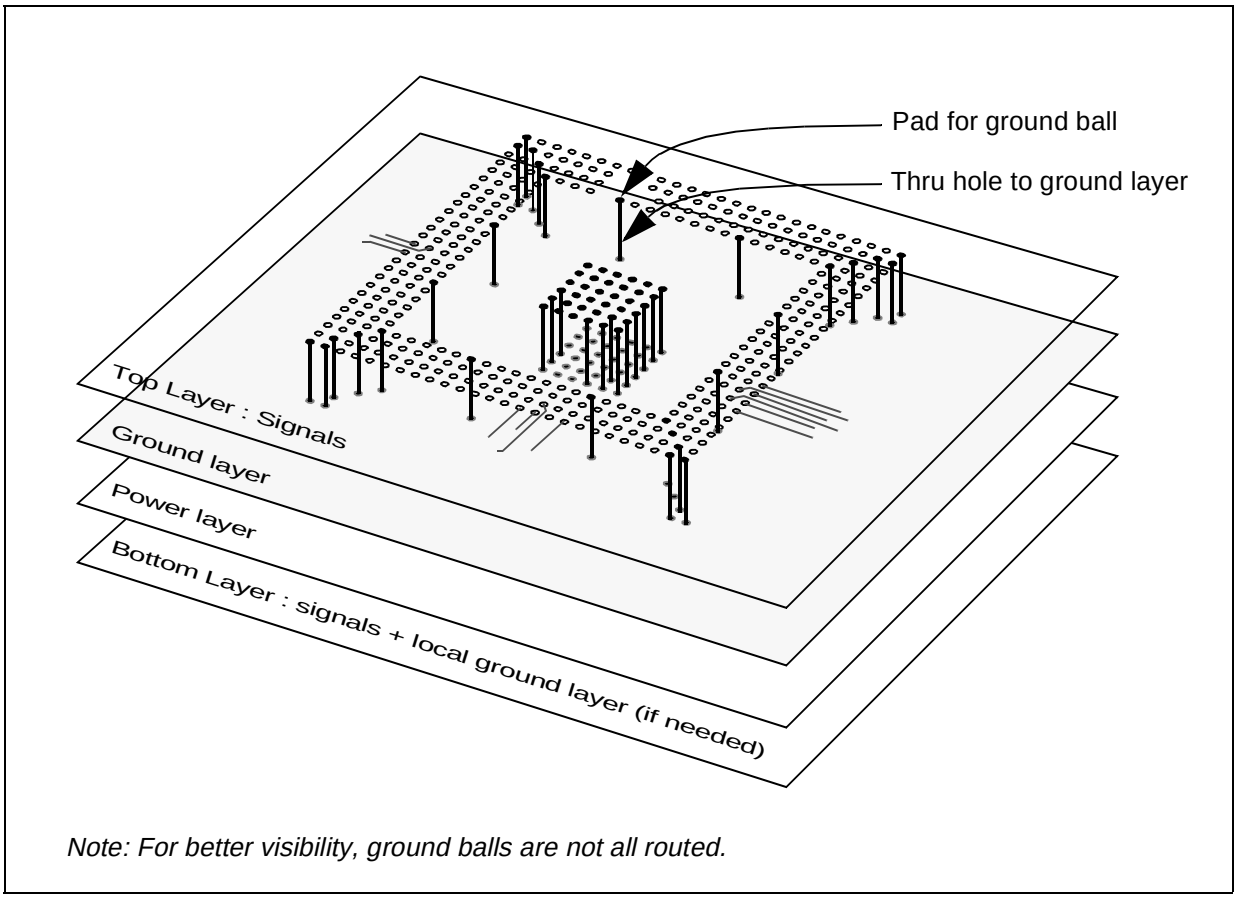
With such a configuration, the Plastic BGA 388 package provides 90% of the thermal dissipation through the ground balls, in particular the central thermal balls, as these are directly connected to the die. The remaining 10% of heat is dissipated through the case. Adding a heat sink can reduce this value by 85%.

To avoid thermal problems when routing to the STPC, some basic rules must be applied.

Firstly, the ground balls must be directly connected to the ground layer, which acts as a heat sink. This is illustrated in Figure 6-1.

If one ground layer is not enough, a second ground plane may be added on the solder side.

Figure 6-1. Ground Routing



Note: For better visibility, ground balls are not all routed.

When considering thermal dissipation, the most important - if not the most obvious - part of the layout is the connection between the ground balls and the ground layer.

A 1-wire connection is shown in Figure 6-2. The use of 8-mil wire results in a thermal resistance of 105°C/W assuming copper is used (418 W/m.°K). This high value is due to the thickness (34 µm) of the copper on the external side of the PCB.

Considering only the central matrix of 36 thermal balls and one via for each ball, the global thermal resistance is 2.9°C/W. This can be improved by using four 10 mil wires to connect to the four vias around the ground pad link, as in Figure 6-3. This gives a total of 49 vias and a global resistance for the 36 thermal balls of 0.6°C/W.

The use of a ground plane, as shown in Figure 6-4, is even better.

To avoid solder wicking over to the via pads during soldering, it is important to have a solder mask of 4 mil around the pad (NSMD pad). This gives a diameter of 33 mil for a 25 mil ground pad.

To obtain the optimum ground layout, place the vias directly under the ball pads. In this case, no local board distortion can be tolerated.

The thickness of the copper on PCB layers is typically 34 µm for external layers and 17 µm for internal layers. The resulting thermal dissipation is not good, with areas of high temperature being concentrated around the devices, falling off quickly with increased distance.

Where possible, place a metal layer inside the PCB. This will improve dramatically the spread of heat and hence improve the thermal dissipation of the board..

Figure 6-2. Recommended 1-wire Ground Pad Layout

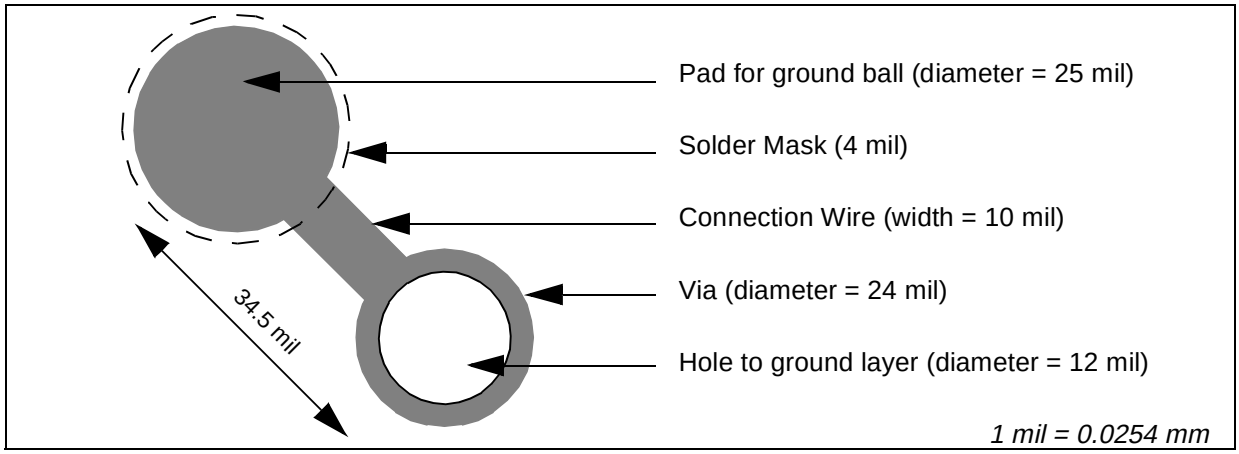


Figure 6-3. Recommended 4-wire Ground Pad Layout

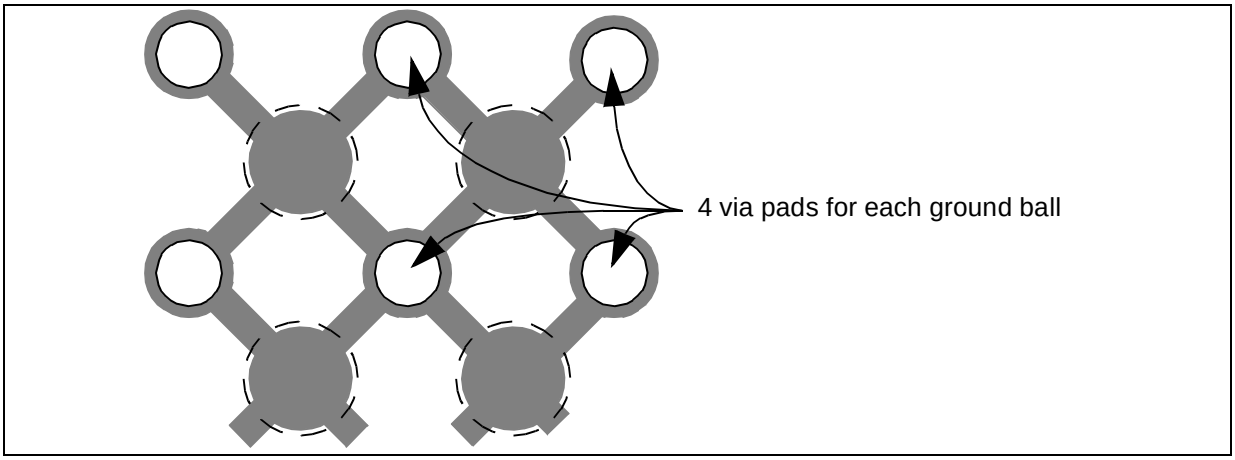
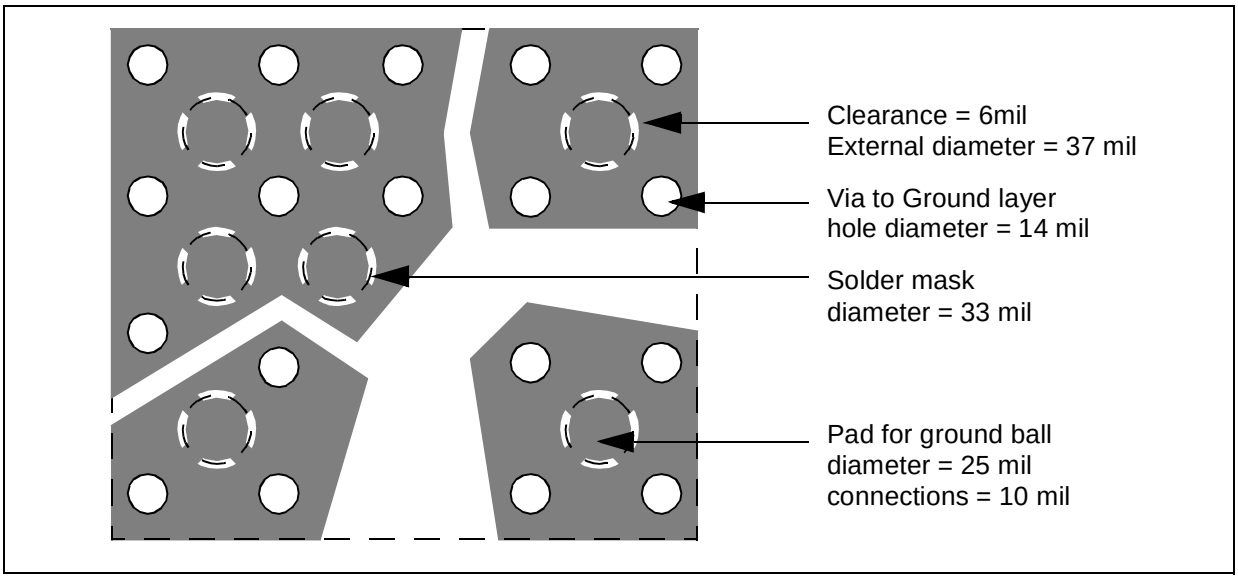


Figure 6-4. Optimum Layout for Central Ground Ball



The PBGA Package also dissipates heat through the peripheral ground balls. When a heat sink is placed on the device, heat is more uniformly spread throughout the moulding, increasing the dissipation of heat through the peripheral ground balls.

The higher the number of via pads connected to each ground ball, the higher the amount of heat dissipated. The only limitation is the risk of losing routing channels.

Figure 6-1 shows a routing with a good trade off between thermal dissipation and the number of routing channels.

A local ground plane on the opposite side of the board, as shown in Figure 6-2, improves thermal dissipation. It is used to connect decoupling capacitors but can also be used for connection to a heat sink or to the system metal box for better dissipation.

This possibility of using the whole system box for thermal dissipation can be very useful in cases of high internal temperature and low external temperature. In such cases, both sides of the PBGA should be thermally connected to the metal chassis in order to propagate the heat flow through the metal. Figure 6-3 illustrates a typical example.

Figure 6-1. Global Ground Layout for Good Thermal Dissipation

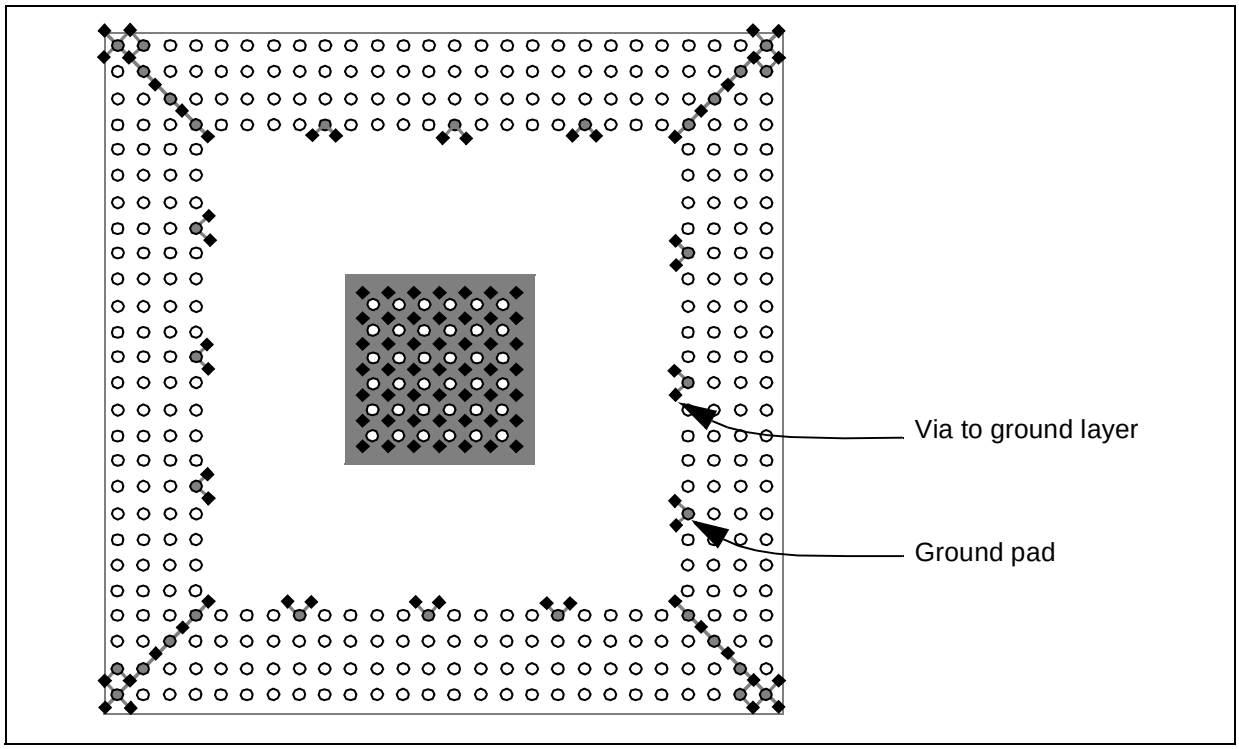


Figure 6-2. Bottom Side Layout and Decoupling

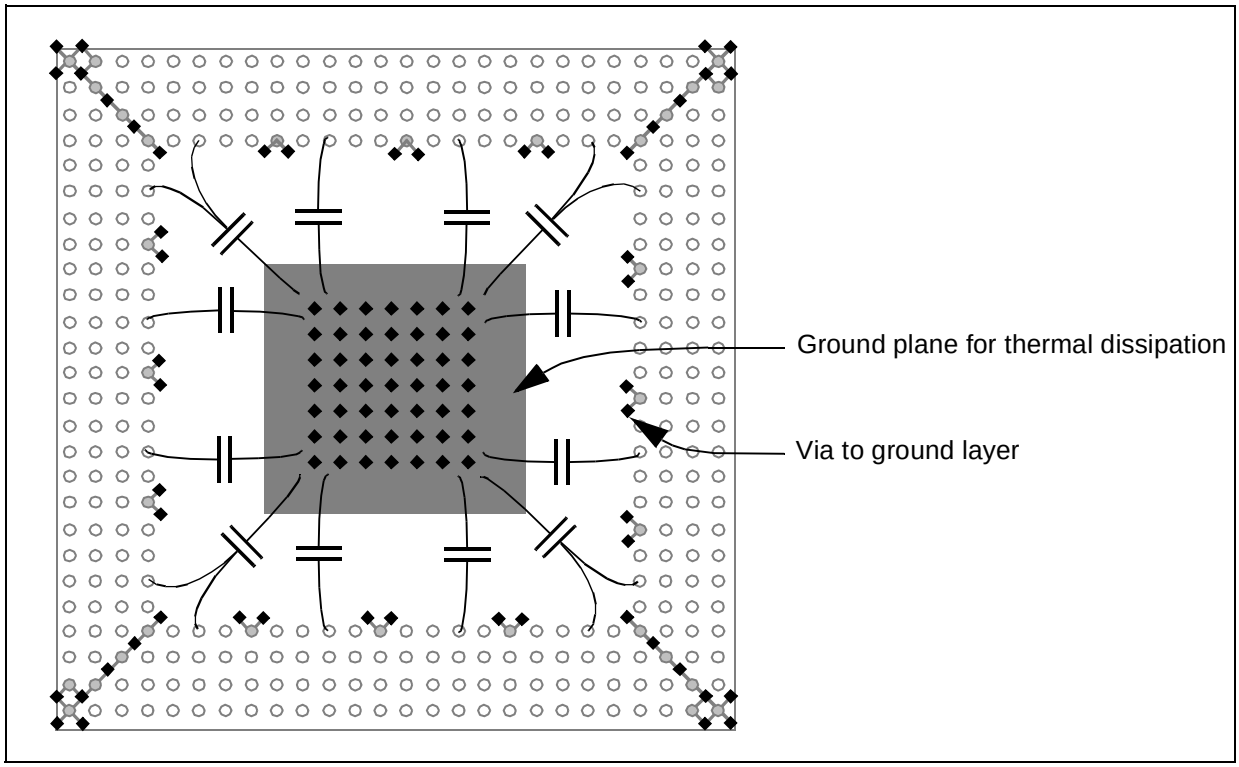
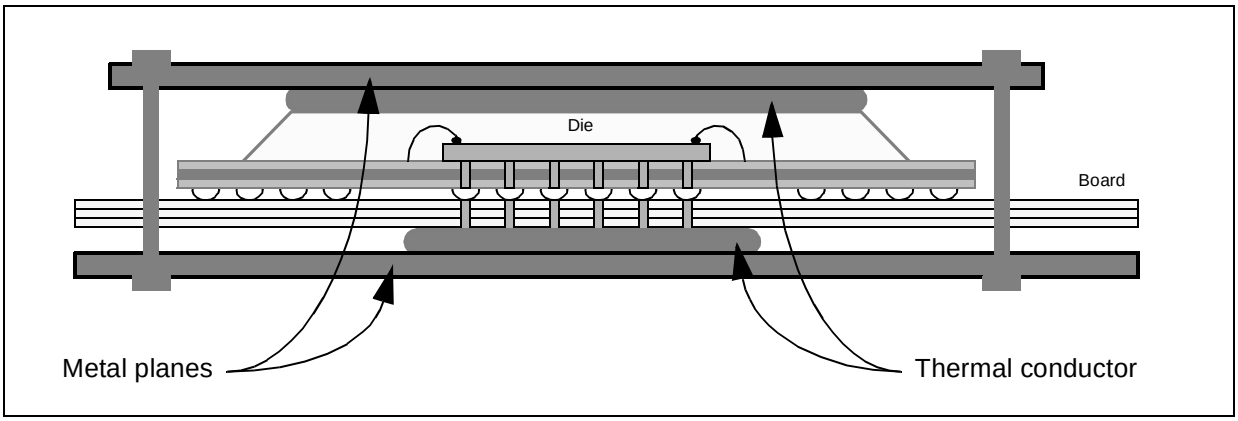


Figure 6-3. Use of Metal Plate for Thermal Dissipation



6.2. HIGH SPEED SIGNALS

As some STPC interfaces (listed below in decreasing speed order) run at high speeds, they must be carefully routed or even shielded.

1) Memory interface.

2) Graphics and video interfaces.

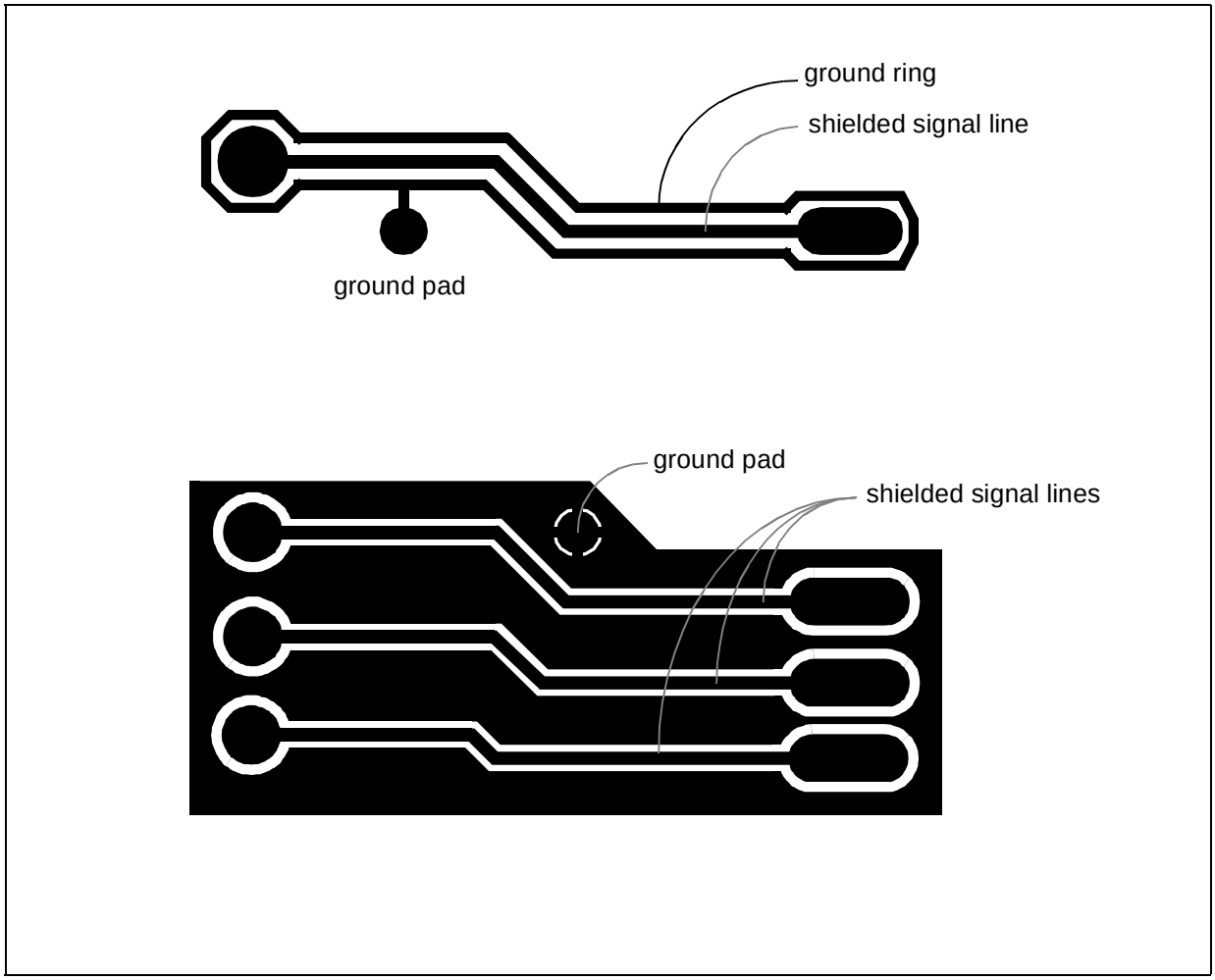
3) PCI bus.

4) 14 MHz oscillator stage.

All clock signals must be routed first and shielded for speeds of 27 MHz or higher. All high-speed signals, such as memory control signals and PCI control signals, require the same constraints.

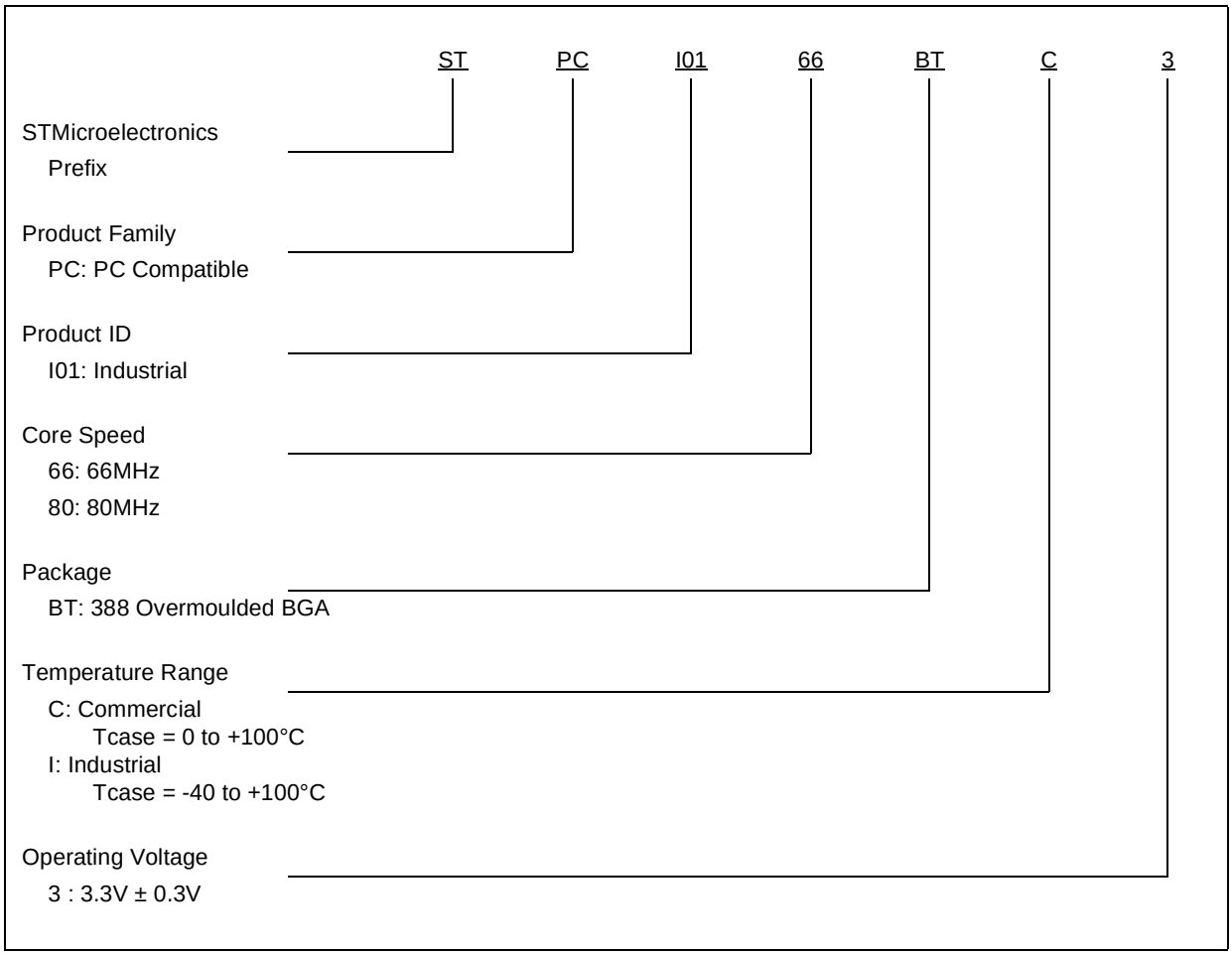
All analog noise-sensitive signals should be routed in a separate area and hence can be routed indepedently.

Figure 6-5. Shielding Signals



7 ORDERING DATA

7.1 ORDERING CODES



7.2 AVAILABLE PART NUMBERS

Part Number	Core Frequency (MHz)	CPU Mode	Tcase Range (C)	Operating Voltage (V)
STPCI0166BTC3	66	DX	0°C to +100°C	3.3V ± 0.3V
STPCI0180BTC3	80	DX		
STPCI0166BTI3	66	DX	-40°C to +100°C	
STPCI0180BTI3	80	DX		