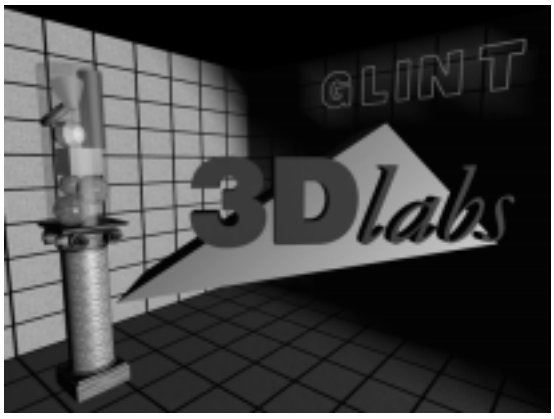
3Dlabs®

GLINT® Gamma

Architecture Overview



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Change History

Document	Issue	Date	Change
146.1.5	0.0	15 Oct 96	Creation
146.1.5	1.0	15 Oct 96	Added some non I/O information
146.1.5	2.0	16 Dec 96	Updated I/O functionality.
146.1.5	2.1	14 Jan 97	First external release.

Contents

1. Introduction

This document gives a high level overview of the architecture of the GLINT® Gamma lighting and geometry processor. It provides the information required by design and project managers and assumes only a basic knowledge of computer graphics. Hardware and software engineers may use this document as an introduction to the GLINT Gamma before progressing to the detailed information in the GLINT Gamma reference manuals.

This first release of the document provides information on GLINT Gamma extensions over the GLINT Delta. There is also a list of features which GLINT Gamma does not support to avoid any confusion.

Notes:

1. There are no details on the graphics functionality yet. These will be added later.
2. Gamma is a provisional name for this product and the name may change before the product launch.

2. What is the GLINT Gamma?

GLINT Gamma is a lighting and geometry processor, designed to break the 3D lighting and geometry bottleneck on PCs. GLINT Gamma implements the full 3D lighting and geometry pipeline for any 3Dlabs rendering device, e.g. GLINT 500TX, GLINT MX or PERMEDIA. The lighting and geometry calculations in GLINT Gamma are general purpose and may be used to accelerate any 3D API, including OpenGL, Direct3D and Apple's QuickDraw 3D.

The GLINT Gamma contains two on-chip PCI Local Bus interfaces: the primary interface communicates with the host processor and the secondary interface communicates with other PCI devices such as GLINT 500TX, GLINT MX, PERMEDIA or a SVGA device.

GLINT Gamma functions as a AGP/PCI to PCI multi-function adaptor. So, in addition to calculating the slope and setup information, the GLINT Gamma can act as a bridge between the PCI bus and multiple graphics devices. This capability may be used in various ways:

- Driving twin GLINT 500TX or GLINT MX devices for increased rendering speed;
- Driving a GLINT rendering device plus an SVGA device for 3D acceleration with on-board VGA.

2.1 The GLINT and PERMEDIA Families

The GLINT 500TX and GLINT MX graphics processors provide 100% OpenGL compliant rendering combined with state-of-the-art Windows acceleration. VRAM framebuffer support enables the high screen resolutions required by professional applications such as CAD and visualization.

The PERMEDIA graphics processor provides high quality 3D, Windows, Video and SVGA acceleration in a single device. Supporting low-cost SGRAM framebuffers, PERMEDIA accelerates a broad range of pervasive multimedia applications including games, animation authoring and Web browsers.

The GLINT Gamma is a completely compatible with the 3Dlabs' rendering devices providing a glueless hardware interface to the GLINT 500TX, GLINT MX and PERMEDIA devices. The GLINT Gamma programming model is fully compatible with the other GLINT and PERMEDIA devices.

2.2 GLINT Gamma - Feature Highlights

- Geometry and lighting calculations in hardware
  - major increase in 3D preformance
- Hardware and software compatible with GLINT 500TX, GLINT MX and PERMEDIA
  - easy design in

- Pin compatible with GLINT Delta
  - simple upgrade for existing designs
- 66MHz 1X AGP and PCI support
  - doubles bus bandwidth
- Full support for AGP side-band addressing
  - faster access to non-linear data structures
- Multi-function AGP/PCI adapter
  - multiple graphics devices on one board, e.g. GLINT 500TX or GLINT MX + onboard VGA
  - multiple GLINT 500TX or GLINT MXs for increased rendering speed
- PCI Master capability
  - fast PCI transfers
- Big-endian processor support
  - Apple PowerMac compatible
- Data broadcast capability
  - efficient communication with twin GLINT 500TX or GLINT MXs
- Hardware handshake with GLINT 500TX, GLINT MX or PERMEDIA
  - reduced bandwidth contention on secondary PCI bus
- Full access to the 8514A extended registers on SVGA devices
  - complete compatibility with existing SVGA device drivers

2.3 GLINT Gamma Extensions Over GLINT Delta

+ Greatly enhanced 3D lighting and geometry processing.
+ Enhanced configuration control with Serial EEPROM.
+ 66 MHz 1X AGP.and PCI
+ AGP Read transfers with side-band addressing over primary Bus.
+ True 'Write Pipeline' for faster bypass write performance.
+ Enhanced Input FIFO DMA controller.
+ Rectangular Bypass DMA controller (writes to GLINT Bypass memory) - compatible with GLINT MX, and PERMEDIA Patching.
+ Graphics Core FIFO read DMA controller.
  Allows high speed data transfer out of the Graphics Core FIFO.
+ 3 Devices on the secondary bus, only two of which may be GLINT devices
  Support for the third device has been added to allow easy implementation of a Twin GLINT system with VGA controller or other standard PCI device.
+ The third device on secondary bus can be a PCI bus master, including access to the Primary PCI bus - except on twin GLINT AGP boards, where there are not enough pins to support a master third device.

The GLINT devices cannot use PCI master accesses. PCI master accesses are not needed for normal GLINT operations as GLINT Gamma DMA controllers will be used.

+ Mix of 33MHz and 66Mhz parts on secondary bus.
  On single GLINT boards it is possible for the third device to run at 33MHz with the GLINT PCI interface running at 66MHz. On AGP systems the third device cannot be a PCI bus master as there are not enough pins.
  This functionality allows the use of a inexpensive 33MHz PCI VGA chip alongside 66MHz 3Dlabs products. This will involve very strict layout constraints.
+ 5 Base Address Registers per secondary bus device.
  Allows two localbuffer and framebuffer apertures to be visible. This is useful for Big-Endian systems.
+ VGA multi-screen support
  GLINT Gamma monitors VGA register writes and only decodes those addresses which are currently enabled. So a Monochrome VGA card may be in a system at the same time as the GLINT Gamma.
+ Enhanced control of VGA aliasing.
  A certain amount of I/O address VGA aliasing is used by a number of VGA parts that could be placed behind GLINT Gamma. However the GLINT Delta approach of only decoding 10 bits of address, although within the PCI Specification, has caused some problems. GLINT Gamma will address these problems.
  Note that the VGA aliasing is normally controlled by fields in the serial EEPROM. Current designs which find the need to adjust the VGA aliasing will be able to do so by simply adding some configuration registers to some of the Delta NC pins.

2.4 What GLINT Gamma Does Not Do

- No AGP transfers over the secondary bus.
  This is not necessary for GLINT devices, and is impossible with the pinout limit.
- No 66MHz secondary PCI bus when GLINT Gamma is attached to a 33MHz primary PCI bus.
  This is technically impossible.

2.5 Package Details

- 176 Pin PQFP Package
- Lead Pitch - 0.5 mm
- Supply Voltage - 3.3 V (5V Tolerant I/O)
- Power Consumption -T.B.D.

2.6 Software and Device Drivers

An extensive suite of optimized software drivers is already available for the GLINT products. These drivers have now been extended to use the extra acceleration provided by the GLINT Gamma. APIs such as OpenGL, Direct3D, Heidi, QuickDraw 3D, Windows NT and Windows 95 are supported. Subject to appropriate licensing the source of these drivers is available for adaptation and further optimization.

The register based programming model for the GLINT Gamma and the 3Dlabs' rendering devices is open to any third party who wishes to drive the GLINT or PERMEDIA devices directly.

The GLINT Gamma Software Development Kit is available for software developers. This kit is based on a PCI reference board with drivers for Windows NT, Windows 95 and OpenGL. The documentation contains the full GLINT register level programming information.

2.7 Reference Designs

Proven reference designs are essential to the rapid development of quality products. To meet this requirement 3Dlabs have produced the GLINT Gamma Hardware Reference Kit and the PERMEDIA Manufacturing Kit. These kits contain a PCI reference board and extensive hardware design documentation, including:

- Full board schematics and pinouts;
- Design guides and application notes;
- Board diagnostic test software source;
- PAL sources.

3. Example GLINT Gamma Systems

3.1 GLINT Systems

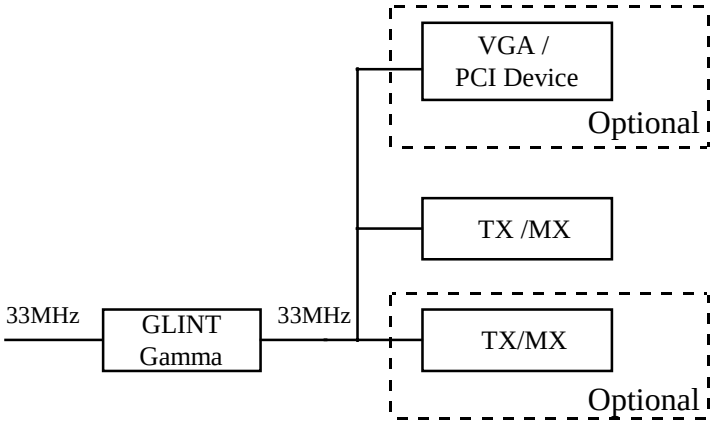

Figure 3.1 33Mhz PCI

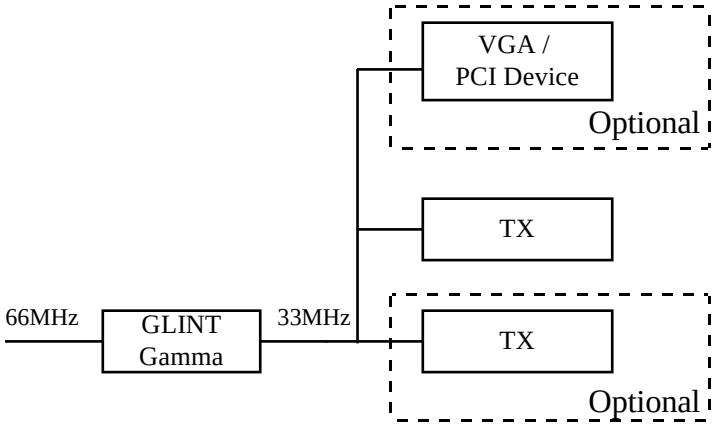

Figure 3.2 66MHz PCI / AGP with GLINT 500TX

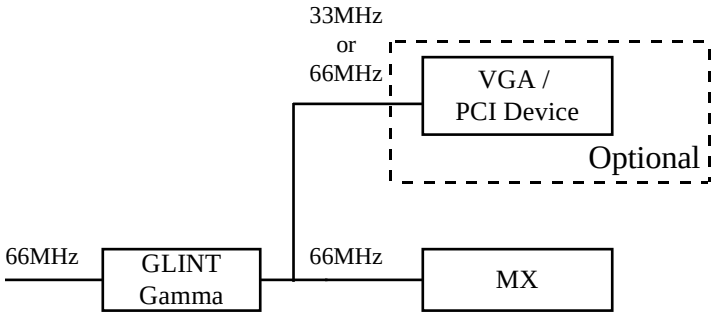

Figure 3.3 66MHz PCI / AGP with Single GLINT MX

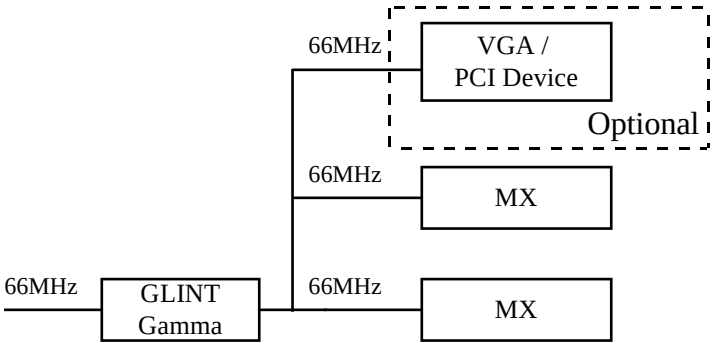

Figure 3.4 66MHz PCI / AGP with Twin GLINT MX

3.2 PERMEDIA Systems

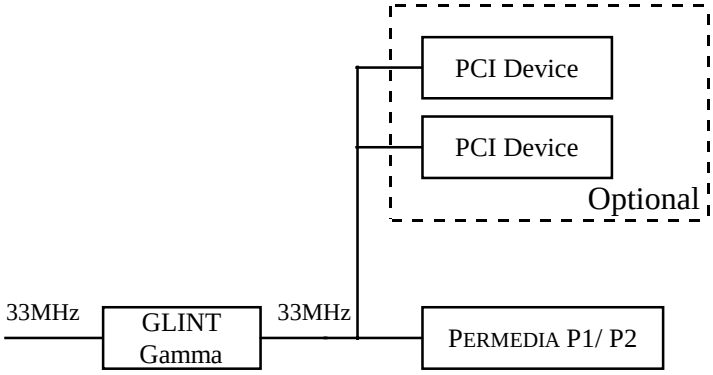

Figure 3.4 33MHz PCI

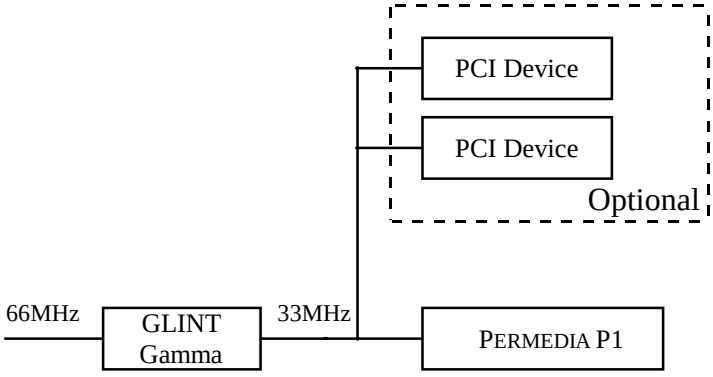

Figure 3.5 66MHz PCI / AGP with Permedia

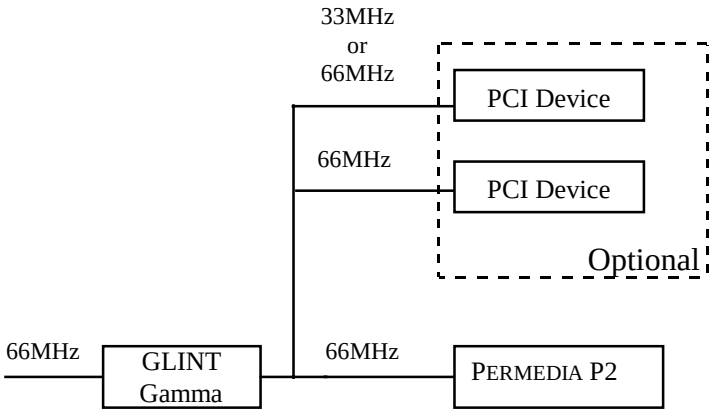

Figure 3.6 66MHz PCI / AGP with PERMEDIA P2

4. GLINT Gamma Architecture

4.1 GLINT Gamma Graphics Acceleration

The GLINT Gamma adds extra 3D graphics acceleration to the 3Dlabs' rendering devices by implementing the 3D lighting and geometry pipeline in hardware.

4.1.1 Geometry and Lighting

TO BE COMPLETED

4.1.2 Setup Unit

The Setup Unit in the GLINT Gamma implements the slope calculations and data conversion for graphics primitives in one unit. This unit can be considered as being positioned in front of the rasterizer in the GLINT 500TX, GLINT MX or PERMEDIA pipelines.

The Setup Unit accepts the coordinates of vertices plus color, depth, fog and texture parameters. The Setup Unit calculates the parameters required by the GLINT 500TX, GLINT MX or PERMEDIA devices. The Setup Unit will accept the input parameters in either fixed point format or IEEE single precision floating point format. Internal calculations in the Setup Unit are performed in floating point format. Vertex sharing for meshes, fans and polylines is supported with the shared vertices being loaded only once.

An optional normalize operation may be applied to texture parameters. This operation calculates the maximum absolute value of the texture parameters for a primitive and normalizes all the texture parameters to lie in range -1.0 to 1.0. Normalizing the texture parameters ensures that maximum accuracy is achieved by the texture unit in the GLINT 500TX, GLINT MX and PERMEDIA.

4.1.3 GLINT Gamma Programming Model

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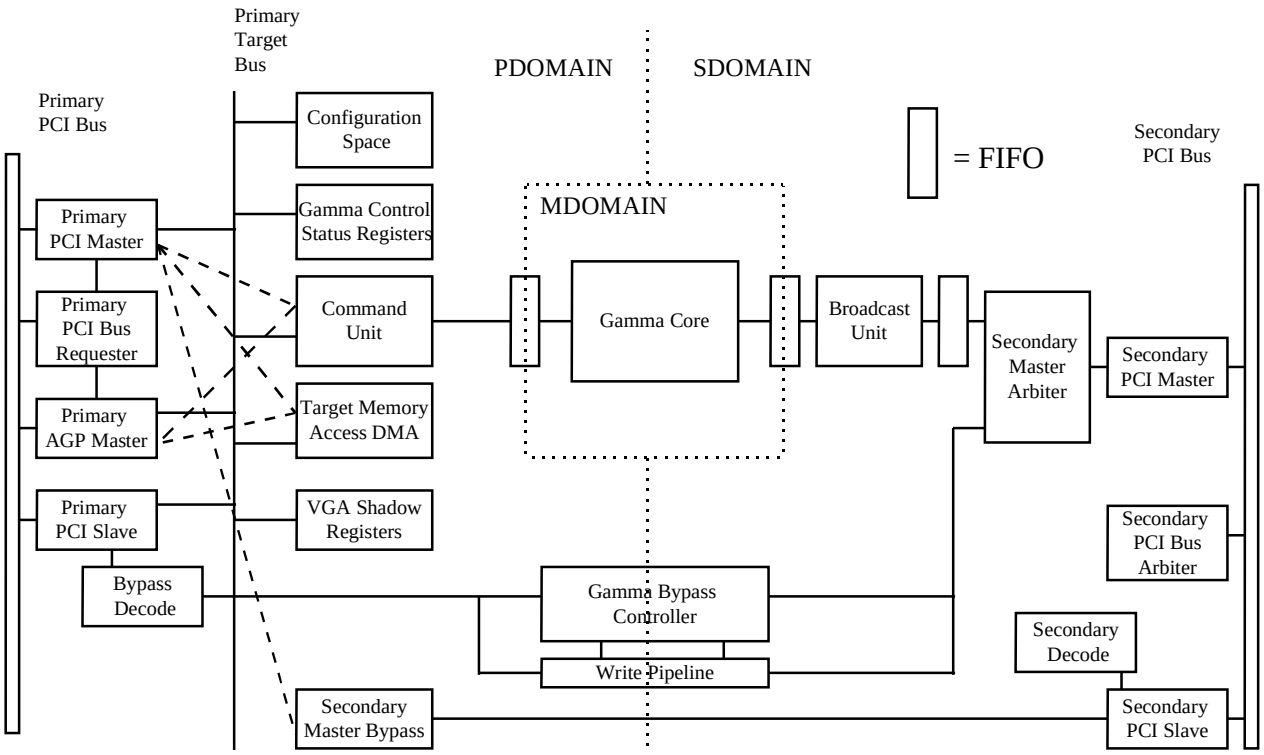
4.2 GLINT Gamma PCI Interface



The GLINT Gamma has two PCI ports; the primary PCI bus which supplies control and data to the chip from the host processor, and the secondary PCI bus to which other PCI devices can be connected without any extra 'glue' logic.

4.2.1 Primary (Host) PCI Interface

The interface between the host and the GLINT Gamma is a Peripheral Component Interconnect (PCI) Local Bus interface, which supports the Advanced Graphics Port (AGP) performance extensions. The AGP interface is intended for use as an high performance interconnect between 3D graphics accelerators and system memory.

The host PCI interface is 32-bit Master/Slave conforming to the PCI Local Bus Specification (Revision 2.1) and contains both a FIFO and a DMA controller. The FIFO is 32 bits wide and 32 locations deep. Control registers for the host interface are memory mapped onto the PCI bus.

The host interface provides a bypass path to the secondary PCI interface. Hence the host may directly access the devices attached to the secondary PCI bus. GLINT 500TX, GLINT MX or PERMEDIA output FIFOs are accessed through the GLINT Gamma bypass path. If two rendering devices are present in the system, then for software compatibility the output FIFO of one rendering device may be accessed through the GLINT Gamma control register space

The GLINT Gamma supports both little-endian and big-endian host processors. A big-endian processor, e.g. PowerPC, will generate byte swapped big-endian data on the PCI

local bus, commonly known as gib-endian. The GLINT Gamma can accept and convert gib-endian data and hence is Apple PowerMac compatible.

A single PCI interrupt is provided as part of the host interface. This interrupt may be configured to the GLINT Gamma DMA control signals and to interrupts supplied by devices on the secondary PCI bus.

4.2.2 Secondary PCI Interface

The secondary PCI interface allows up to three other PCI devices to be connected to the GLINT Gamma. These devices may either be GLINT 500TX, GLINT MX or PERMEDIA devices or may be other PCI devices, e.g. a VGA device.

The secondary PCI interface includes the following features;

- PCI Revision 2.1 compliance
- Support for 3 PCI functions
- Hardware handshake to optimize bus usage
- Multiple broadcast

Any single function PCI device can be placed on this bus with some caveats depending on the number and type of Base Address Registers (BARs) used by the device. **Multi-function Support**

The GLINT Gamma acts as a multi-function adaptor to allow multiple PCI devices to be placed on an expansion card. GLINT Gamma acts as one PCI load.

The PCI specification allows for a PCI device to have up to 8 functions. Each of these functions has its own configuration space. GLINT Gamma supports 3 external functions, and also has one internal function containing the Geometry and Lighting Unit and the Setup Unit.

The external functions support up to 5 BARs, each of which must be in memory space and be greater than 64 Kbytes and less than 64 MBytes in size. VGA devices are supported by the first external function.

Normally the internal GLINT Gamma function will map to PCI function 0 and the first external function will map to PCI function 1. However if the first external function is a VGA device, then it may be mapped to PCI function 0 with the internal GLINT Gamma function mapped to PCI function 1. This capability ensures the correct operation of the PC BIOS for legacy VGA devices. The second external function maps to PCI function 2 and the third external function maps to PCI function 3.

If gaps are left in the PCI function mapping, then this may confuse a PC BIOS. Hence it is recommended that no gaps are left in PCI function mapping, e.g. if there is only one GLINT or PERMEDIA rendering device on the secondary PCI bus, then the internal Gamma function should be mapped to PCI function 0 and the GLINT rendering device should be mapped to PCI function 1.

4.2.4 Twin Rendering Devices

The GLINT Gamma supports up to two GLINT or PERMEDIA rendering devices on the secondary PCI bus and the GLINT 500TX and MX has dedicated hardware to support a twin rendering device configuration.

The GLINT Gamma Region 0 control space is mapped onto the first rendering device control space at reset. The GLINT Gamma Region 0 control space can than be set in software to access either rendering device.

The graphics pipeline allows two rendering devices to be written to simultaneously by implementing a broadcast protocol on the secondary PCI bus.

The GLINT Gamma has a write mask register in the graphics pipeline which may be used by software to steer data to the appropriate rendering device. The write mask register has 2 bits which control the data transfer. To broadcast write to both rendering devices both bits would be asserted.

4.2.5 Hardware Handshake

The GLINT Gamma acts as a master sending commands to the GLINT 500TX, GLINT MX or PERMEDIA rendering devices on the secondary PCI bus. A hardware handshake mechanism has been provided to optimize the use of the secondary PCI bus bandwidth. If the input FIFO in the rendering device is full, then the GLINT Gamma backs off the bus. This allows communication to continue with other devices on the secondary PCI bus.

4.3 GLINT Gamma Clocks

The primary PCI interface on the GLINT Gamma is clocked from the PCI clock, however the Geometry and Lighting Unit and the Setup Unit and are clocked from a separate MClk pin. The GLINT Gamma provides four secondary clock pins which are used by devices on the secondary PCI bus. Note that one of these pins is used to clock the secondary PCI bus on the GLINT Gamma to meet the PCI clock skew requirements.

If one of the secondary clock pins is not required for a device on the secondary bus, then it may be used to supply MClk for the internal Gamma units.

5. Performance Characteristics

5.1 Graphics Performance

TO BE COMPLETED

5.2 PCI Bandwidth

TO BE COMPLETED

6. Further Reading

GLINT Gamma Hardware Reference Manual

GLINT Gamma Programmer's Reference Manual

GLINT Gamma Application Notes and Design Guides

A set of technical notes covering various design issues and containing several example designs are available as part of the GLINT Gamma Hardware Reference Kit and the PERMEDIA + GLINT Gamma Manufacturing Kit.

OpenGL Programming Guide.

OpenGL Architecture Review Board, Neider at al. Addison-Wesley.
ISBN 0-201-63274-8

OpenGL Reference Manual.

OpenGL Architecture Review Board, Neider at al. Addison-Wesley.
ISBN 0-201-63276-4

PCI Local Bus Specification, Revision 2.1.

PCI Special Interest Group, tel. no. 1 800 433 5177 (503 797 4207 outside of the US)