
# VIA VT8251 South Bridge

**White Paper**

**VIA Technologies, Inc.**
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we connect

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## Introduction: Leading Connectivity for the VIA Platform

The VIA VT8251 South Bridge brings together leading technologies, connectivity, and rich media options that strengthen VIA's comprehensive and leading platform for the future. The VIA VT8251 brings to market full PCI Express connectivity, along with support for the latest peripheral devices including SATA II HDDs for high speed storage, and HD Audio for advanced audio solutions. The VIA VT8251 can be enabled on a complete range of VIA core logic chipset platforms supporting the full spectrum of Intel® Pentium® 4, AMD Athlon™64, AMD Opteron™, VIA C7™,C3™, and Eden™ processors.

As the role of the PC increasingly migrates to a multimedia device, the Chipset South Bridge enables critical functionality for this demanding role. As the amounts of multimedia data on the PC increase, the chipset South Bridge needs to enable quick transfers of that data, and the capability to store the data with maximum security and redundancy. The Chipset South Bridge also provides high speed links to the latest devices such as PVR recorders and network connections, giving the modern day PC ever increasing living room functionality.

The VIA VT8251 builds upon the highly acclaimed VIA VT8237 and further strengthens VIA's legacy of South Bridge technologies, enabling all the key connectivity, memory and storage applications for the next generation of PCs. The first VIA South Bridge to deliver cutting edge PCI Express Peripheral support, the VIA VT8251 makes possible connection to the latest PCI Express x1 devices such as Gigabit Ethernet Controllers and TV tuners. Each PCI Express connection enables a 250Mb/s full duplex connection, ensuring plenty of bandwidth for even the most demanding applications.

Featuring the VIA DriveStation™ Controller Suite, the VIA VT8251 enables multiple drive connectivity options and native support for Serial ATA II and Serial RAID, alongside more traditional South Bridge functions such as IDE and PCI. In addition, the VT8251 delivers exceptional surround sound capabilities through its support for integrated VIA Vinyl Audio Suite, and also offers a host of high-bandwidth connectivity options, including support for up to eight high-speed USB 2.0 ports and high-throughput 10/100Mb/s Ethernet.

Based on VIA's unique V-MAP (VIA Modular Architecture Platform) architecture, the VIA VT8251 features the Ultra V-Link bus, which delivers data throughput speeds of up to 1066MB/sec from the South Bridge to the emerging new generation of high performance VIA North Bridge solutions. Through its support for the standard V-Link interface, the VT8251 is also fully compatible with existing VIA North Bridge solutions, giving OEMs and motherboard manufacturer's unprecedented flexibility in integrating new levels of advanced I/O functionality into existing platform designs.

**Figure: 1 VIA VT8251 South Bridge Architecture**

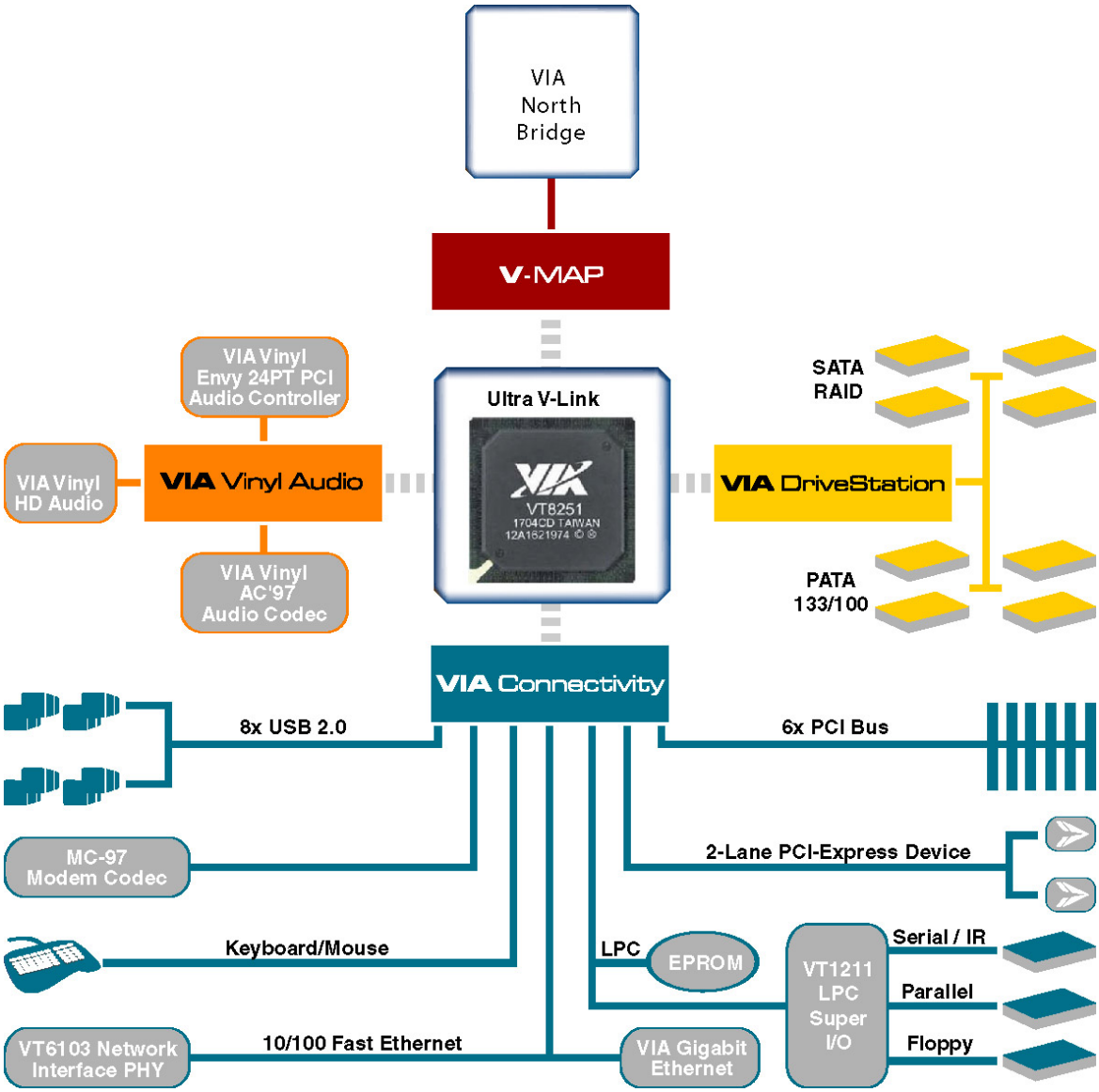

- **VIA DriveStation™ Controller Suite**
  - Serial ATA
    - Supports up to 4 SATA master devices at 3.0Gb/s
    - Backwards compatible with 1.5Gb/s devices
  - VIA V-RAID
    - Supports RAID Level 0, RAID Level 1, RAID Level 0+1[1], RAID Level 5, and JBOD configurations
  - Parallel ATA 133
    - Supports up to four PATA devices

- **VIA Advanced Connectivity Controller Suite**
  - PCI Express
    - Supports two PCI Express x1 connections
  - USB 2.0 Controller
    - Supports 8 USB 2.0/1.1 ports
  - Network Controller
    - Integrated Enterprise Class 10/100Mb/s Fast Ethernet MAC
  - PCI & LPC bus controllers

- **VIA Vinyl™ Multichannel Audio Suite**
  - VIA Vinyl HD Audio
  - VIA Vinyl AC'97 Audio integrated 6 surround sound
  - VIA Vinyl Gold Audio onboard 8 surround sound
    - 24/96 resolution audio
    - VIA Envy24PT + VIA Eight-TRAC Codec + additional DAC

- **VIA V-MAP Architecture**
  - Ultra V-Link
    - High throughput 1GB/s South Bridge/North Bridge interconnect
    - Supports the new generation of high performance VIA North Bridge solutions
    - Supports all processor platforms
  - VIA Hyperion 4in1 Unified Drivers
    - Optimized system performance and stability

**Figure: 2 VIA VT8251 System Architecture**



## VIA DriveStation™ Controller Suite

The VIA DriveStation™ Controller Suite in the VIA VT8251 provides the most comprehensive set of high-performance integrated storage interface technologies available on the market today. It not only enables high-speed 300MB/s dual channel connections to new generation Serial ATA Hard Drives while retaining support for today's Parallel ATA-133 IDE devices, but also combines exceptionally fast disk data transfer rates and optimal data integrity with easy installation and manageability through the VIA V-RAID controller interface.

## VIA DriveStation™ Serial ATA Controller

The VT8251 South Bridge offers full support for the latest SATA specification enhancements as defined by SATA-IO, including support for 3 Gb/s transfer rates, Native Command Queuing (NCQ), port multipliers, staggered spin-up and hot plug connections.

### Multiple SATA Ports

The VT8251 South Bridge features four SATA ports for direct connection to up to four SATA master devices featuring the latest 3.0Gb/s transfer rates while remaining backwards compatible with devices featuring 1.5Gb/s data transfer rates. It is also possible to configure devices in two separate master/slave connections (a total of four drives), with the master drive data transfer rate of 3Gb/s, and a slave drive at 1.5Gb/s.

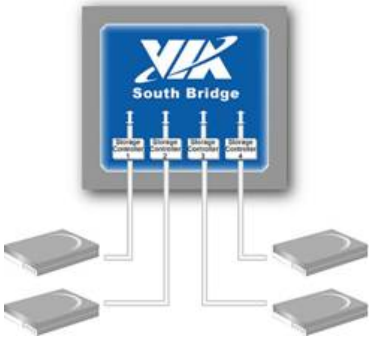



**Figure: 3 SATA Internal Architecture**

### Native Command Queuing (NCQ)

Native Command Queuing (NCQ) increases storage performance by allowing supporting drives to deal with more than one command at a time, while dynamically reordering the commands for maximum efficiency.

NCQ minimizes the number of I/O interrupts a server makes on the drive when carrying out multiple commands, allowing it to complete 32 commands without interruption. Without NCQ running, the host interrupts the process before each

command. NCQ also reduces general wear and tear on the drives, potentially extending drive life expectancy.

Intelligent reordering of commands within the drive's internal command queue helps improve performance by reducing mechanical positioning (both seek and rotational) latencies on the drive. The Server and Workstation market has utilized Command Queuing technology in SCSI drives for more than a decade, but SATA NCQ represents the first time such technology is available for the desktop PC market.

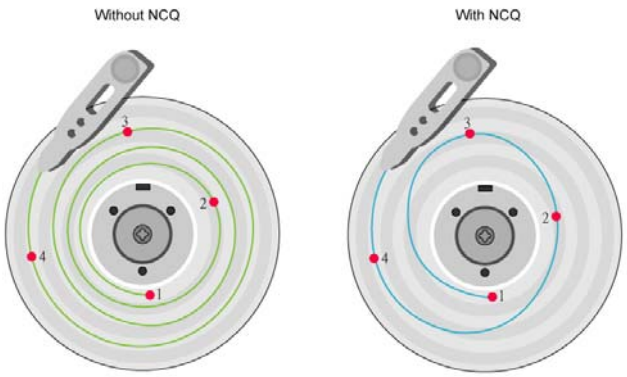



**Figure: 4 NCQ vs Non NCQ Internal Command Queue**

### Additional SATA features

In combination with supporting drives, the VT8251 South Bridge enables support hot plug and staggered spin-up capabilities to boost drive reliability. Hot plug operation allows a user to swap out a failed drive or add a new drive without taking down all the drives in an array. Staggered spin-up lets users control the sequence that drives power up, avoiding the massive power drain caused by all drives starting simultaneously.

## VIA DriveStation™ Serial ATA Controller Performance

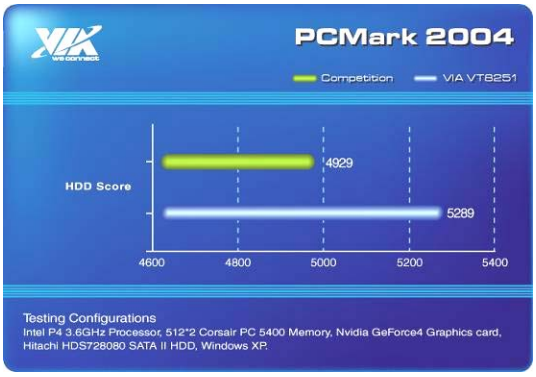



**Figure: 5 Serial ATA Performance: PCMark 2004**

As shown in Figure 5, the integrated VIA DriveStation™ Serial ATA Controller delivers an increase of over 25% in performance when compared to our competitors using PCMark 2004. When measuring read speed performance with the HD Tach 2.7 benchmark, the VIA DriveStation™ Serial ATA Controller also shows a performance advantage over our competitors, as shown in Figure 6.

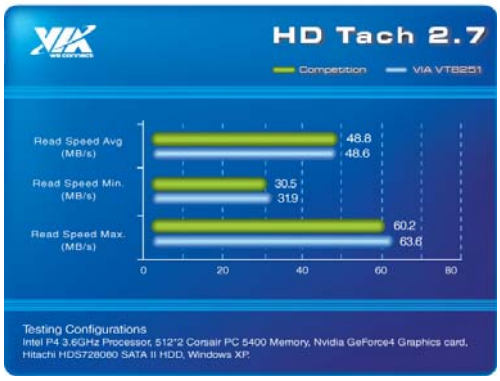



**Figure: 6 Serial ATA Performance: HD Tach Read Speed**

## DriveStation™ Parallel ATA-133 Controller

The VIA DriveStation™ Controller Suite also includes an enhanced IDE controller with a dual channel DMA engine and interlaced dual channel commands, allowing for full backwards compatibility with up to four Parallel ATA 133/100/66 devices delivering data transfer rates of up to 133 MB/s.

## VIA DriveStation™ V-RAID Controller

The advanced VIA DriveStation™ V-RAID Controller implemented in the VIA VT8251 South Bridge enables users to benefit from all the enhanced performance and rock solid data security benefits of a high-end RAID system, but without the complicated setup procedures that are normally found in such a PC and at a much more affordable price.

With digital media applications such as digital video creation and editing, and digital audio storage and playback becoming increasingly popular, the demands on hard disk drive throughput are growing at a dramatic rate. But although memory, processor, and Front Side Bus technologies have improved in recent years, significantly enhancing the performance of desktop systems, storage performance has not scaled at the same rate. V-RAID overcomes this bottleneck by delivering a significant boost in desktop storage performance.

V-RAID is the first native RAID controller to support a complete range of RAID Level 0, RAID Level 1, RAID Level 0+1[1], RAID Level 5, and JBOD configurations (shown in the table below), giving the user maximum flexibility in tuning their disk array to achieve the optimum balance of performance and data integrity depending on their requirements.

**Table 1: RAID Configurations Supported by V-RAID**

| RAID Level | Effect | Capacity | Performance | Fault Tolerance |
|---|---|---|---|---|
| 0 | Striping | 100 % | High | Low |
| 1 | Mirroring | 50 % | Medium/High | High |
| 0+1[1] | Mirroring & Striping | 50 % | High | High |
| 5 | Striping & Parity | 80 % | High | High |
| JBOD | None | 100 % | Normal | Low |

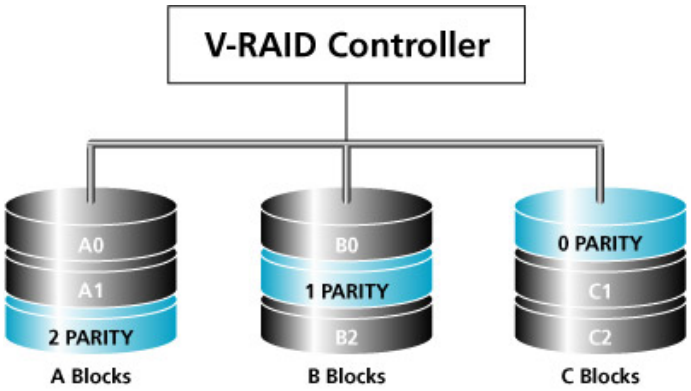



**Figure: 7 Serial ATA Internal Architecture**

Based on VIA's ground breaking DriveThru™ technology, V-RAID also enables 'on-the-fly' upgrades to RAID configurations, and an exceptionally user friendly software interface for V-RAID installation and management. Its key benefits are described in more detail below.

## V-RAID Software Interface

With its unique user-friendly V-RAID Tool software interface, VIA V-RAID makes it easier and faster than ever before to install and manage RAID configurations. Users who are not confident in using the RAID BIOS to configure RAID arrays can do so from within their Microsoft® Windows® or Linux operating system in a few easy steps. VIA's DriveThru™ technology also enables users to easily migrate from a standard Parallel ATA or Serial ATA drive configuration to a higher performance RAID configuration 'on-the-fly' – without having to endure lengthy installation procedures involving complicated BIOS set-ups and OS re-installations.

## VIA Advanced Connectivity Suite

The VIA Advanced Connectivity Suite in the VIA VT8251 offers a host of high-bandwidth network and peripheral connectivity options, including support for two PCI Express x1 connections, up to eight high-speed USB 2.0 ports, and high-throughput 10/100Mb/s Ethernet.

### PCI Express

To meet the ever increasing demands being placed on system bandwidth, the PC industry is transitioning to PCI Express connectivity, which delivers the bandwidth needed for today's most bandwidth hungry applications, as well providing the headroom needed for future generations of application.

#### Performance

Of all PC subsystems today, graphics processing places by far the largest demand on system bandwidth. PCI Express addresses this demand with 16 PCI Express lanes of dedicated bandwidth, providing up to 4GB/s transfer speeds - an almost 100% increase over the 2.1GB/s bandwidth offered by AGP8X. This significant boost in bandwidth is expected to take the PC into new realms of high-definition, cinematic quality graphics.

PCI Express also delivers a significant boost in bandwidth for peripheral connections, with a single PCI Express lane offering transfer speeds of up to 250MB/s, again an almost 100% increase over the existing PCI standard. Furthermore, the flexible nature of the PCI Express standard allows the implementation of four lane (1GB/s) or eight lane (2GB/s) PCI Express connections for higher-bandwidth peripheral connections.

#### Scalability and Headroom

The layered, point-to-point architecture of the serial bus based PCI Express standard allows PCI Express lanes to be stacked together to increase bandwidth. This offers a significant advantage over the existing PCI standard, which was confined to the limitations of its parallel bus architecture, and provides guaranteed longevity and improved flexibility. It is expected that PCI Express has the headroom to meet all our I/O needs for at least the next decade.

#### Simplified Design and Flexibility

In comparison with other I/O buses, PCI Express offers unparalleled levels of bandwidth per pin. With up to 100MB/s/pin bandwidth, component chips will require fewer pins and less silicon space, ultimately helping reduce component cost, or alternatively, freeing up silicon real estate for additional features.

A welcome boost for motherboard and system designers is the fact that fewer pins means smaller connector size, fewer traces and signals, and improved signal integrity. This, allied with improved power management capabilities, will help enable a new generation of high-performance, small form factor devices that don't compromise on I/O connectivity.

## VIA VT8251 PCI Express Connectivity

The VIA VT8251 South Bridge integrates PCI Express connectivity offering a total of 500Mb/s of bandwidth for the latest peripheral devices. PCI Express is a next generation standard intended to replace existing PCI and AGP connections. The PCI Express ports in the VIA VT8251 can be configured in as two PCI Express x1 connections or a single PCI Express x2 connection. Through the PCI Express connectivity VIA chipsets can be paired with the latest third party PCI Express Gigabit Ethernet solutions for unparalleled networking access. Other leading PCI Express peripherals include the latest HDTV tuner cards and high fidelity audio devices.

The flexible nature of the V-MAP Express architecture brings PCI Express connectivity to mature VIA chipset-based platforms. The pin-compatible design approach of V-MAP Express allows the VT8251 South Bridge to be paired with mature VIA North Bridges, such as the VIA K8M800/K8T800/K8T800 Pro for the AMD Athlon 64 platform, the VIA PM800/PT800/PT880 for the Intel platform, the VIA CLE266/CN400 for the VIA C3™-M, VIA C3™ and VIA Eden™ processors as well as the latest VIA VN800 for the VIA C7-M™ processor. In combination with the VT8251 South Bridge, these platforms can support the latest PCI Express peripheral devices.

## USB 2.0

The VT8251 enhances connectivity options with its support for eight high-speed USB2.0 ports, delivering forty times the bandwidth of USB 1.1. The VT8251 includes four root hubs with eight function ports featuring integrated physical layer transceivers. All eight ports support a full range of USB 2.0 and USB1.1 devices, and achieve data transfer rates of up to 480Mb/s. The USB controller allows hot plug and play and isochronous peripherals to be inserted into the system with universal driver support. The controller also implements legacy keyboard and mouse support so legacy software can run transparently in a non-USB-aware OS environment.

## Network Controller

The VT8251 features industrial strength networking capabilities courtesy of an integrated VIA IEEE 802.3 compliant 10/100Mb/s 32-bit PCI bus master Ethernet MAC with standard MII interface to an external PHYceiver. With native driver support ensuring instant connectivity, the reliable Fast Ethernet controller is ideal for both enterprise class and home networking applications.

## PCI Interface & LPC Bus

Featuring a PCI 2.2 compliant PCI controller, the VT8251 offers support for up to six PCI masters, and supports a full range of legacy controllers, including Serial and Parallel ports, Keyboard and PS2 mouse.

## VIA Vinyl™ Multichannel Audio Suite

The VT8251 South Bridge provides OEMs and motherboard makers with an unrivaled choice of market leading integrated and onboard audio performance options, delivering rich, warm surround sound at resolutions as high as 32-bit/192kHz through up to six- or eight-channel outputs. VIA Vinyl Audio enable users to enjoy music, watch the latest DVD movies, play games, record and create content, and connect to the latest devices with crisp, clear performance, representing the highest levels of audio quality in a mainstream integrated or onboard solution.

### VIA Vinyl HD Audio

The VIA VT8251 South Bridge supports connection to the latest HD Audio Codecs, enabling high performance audio solutions. Support audio resolutions up to 24-bit/192KHz and up to 8-channels, VIA Vinyl HD Audio can also support up to four independent playback streams, and multiple recording jacks. In addition HD audio is designed to eliminate the pops or glitches previously associated with PCI audio by providing dedicated system bandwidth for audio functions. HD Audio also enables the use of array microphones enabling better quality voice input for applications such as VOIP and audio-driven PC inputs.

To make setup easier for users, VIA Vinyl HD Audio provides advanced jack sensing that can automatically determine what type of device is connected to an audio port and then change the port function to fit the device.

### VIA Vinyl Gold Audio

To meet the growing demand for the highest fidelity, multi-channel surround sound, the VT8251 South Bridge can also be coupled with the PCI-based VIA Envy24PT onboard audio controller.

Enabling 24-bit resolution and 96KHz sampling rates for digital connections, the VIA Envy24PT is the only integrated PC audio solution that supports up to eight-channel outputs for improved flyover effects with the latest Dolby® Digital EX and DTS ES DVD-Video soundtracks.

To connect with other devices, the VIA Envy24PT comes equipped with an integrated S/PDIF transmitter and IEC958 line driver that allows the easy and accurate transfer of PCM, DTS, and AC3 digital audio formats to items like stereos and portable audio devices.

For high-resolution eight-channel surround sound, the VIA Envy24PT can be paired with the VIA Six-TRAC codec plus an additional DAC though an $I^2S$-link. Further provisions will enable the VIA Envy24PT to be connected to the forthcoming VIA Vinyl VT1618 codec for even higher levels of audio fidelity.

## VIA Vinyl AC'97 Audio

The VIA VT8251 South Bridge integrates a high-performance VIA Vinyl AC'97 controller to enable eight-channel audio support and the transfer of the highest resolution audio possible over the AC'97 standard.

**Table 2: VIA Vinyl Features**

| Audio Standard | Maximum Bit Rate Supported | Maximum Sampling Rate Supported | Additional Features |
|---|---|---|---|
| VIA Vinyl AC'97 Audio | 20-bit | 48kHz | Baseline Integrated Audio |
| VIA Vinyl HD Audio | 32-bit | 192kHz | - Jack Sensing<br>- Multi-Audio Streams |
| VIA Vinyl Gold | 24-bit | 192kHz | - Ultra high fidelity<br>- VIA Immerzio Gaming support |

## VIA V-MAP Architecture

As an integral component of VIA's unique V-MAP (VIA Modular Architecture Platform) Architecture, the VIA VT8251 has been designed to be fully compatible with a complete range of current and future VIA North Bridge designs across all the major Intel Pentium 4, Intel Celeron, AMD Athlon XP, AMD Opteron, VIA C7, VIA C3 and VIA Eden processors.

Through this approach, OEMs and motherboard vendors can minimize development costs and speed up time to market by consolidating their product lines on a standard but scalable platform that enables them to meet the diverse needs of multiple market segments through the rapid integration of different feature sets. As an added benefit, V-MAP also allows a common VIA Hyperion driver base that optimizes system performance while maintaining full stability and compatibility and facilitates technical support.

### Ultra V-Link Bus

The VT8251 features the new Ultra V-Link bus, a 16-bit 66MHz client interface that delivers data throughput speeds of up to 1066MB/s from the South Bridge to the next generation of high performance VIA North Bridge solutions, including the PT800, PT880, PM800, and PM880, as shown in Figure 10 below. The Ultra V-Link bus delivers the necessary bandwidth and low latency required by today's increasingly demanding multimedia applications, and also provides headroom for ever increasing CPU and memory bus speeds. Not only does Ultra V-Link speed up data transfer rates, it also addresses potential bottlenecks on the South Bridge that may be created by the growing use of high-speed USB2.0 and 1394 peripherals.

### VIA Hyperion 4in1 Unified Driver Set

A pioneering unified driver set, the VIA Hyperion 4in1 drivers optimize system stability and performance for all systems running Microsoft® Windows® operating systems.

## Conclusion

With increasing demands for connectivity and multimedia support the VIA VT8251 South Bridge sets a new standard for integration and performance. With its advanced support for VIA V-MAP, the VIA VT8251 South Bridge also extends support for the latest PCI Express Peripheral devices across VIA's extensive array of chipset North Bridge offerings.

Through the advanced VIA DriveStation™ Controller Suite, the VIA platform enables fast and safe storage of personal content especially critical for PCs as they take on ever expanding multimedia roles. For advanced connectivity the VIA VT8251 delivers the highest levels of audio quality available today with support for VIA Vinyl HD Audio with 8-channels at resolutions of up to 24-bit/192KHz. The VIA VT8251 also includes support for up to eight high-speed USB2.0 ports and Gigabit Ethernet capabilities allowing convenient management and transfer of digital content from peripheral devices to the PC.

Leveraging the highest levels of performance and stability, storage and protection of digital content, and providing advanced high-speed connectivity, the VIA VT8251 makes it possible for people get the most out of their digital entertainment experience and continues to strengthen VIA's comprehensive and leading platforms for the future.