

## RAMBUS MEMORY

KINGSTON—THE TRUSTED SOURCE  
FOR RAMBUS MEMORY PRODUCTS



**COMMITTED  
TO MEMORY**

[www.kingston.com](http://www.kingston.com)



## Kingston's RIMM Modules

Kingston® is a recognized leader in delivering RIMM modules, having worked closely with Intel Corporation and Rambus Inc. since 1997. Kingston has received an award from Intel on its outstanding contribution to the launch of the Pentium® 4 processor which was initially paired with Rambus or RDRAM memory only. Kingston has also been recognized by Rambus Inc. for bringing the high-speed RIMM modules to market quickly and in volume.

Excluding global DRAM memory chip manufacturers, no one has built, tested, and shipped more RIMM modules to customers than Kingston.

Kingston has built millions of RIMM modules for its own Kingston and ValueRAM brands as well as private-label RIMM modules for major memory manufacturers such as Toshiba and others. These RIMM modules were then shipped to leading system manufacturers.

Kingston builds these RIMM modules in leading manufacturing centers worldwide which have equipment that is optimized for assembling Chip Scale Package (CSP) RDRAM chips onto modules. Kingston has also developed highly-effective, proprietary Rambus memory module testers which were verified by Intel as meeting a very low 500 Defective Parts Per Million (DPPM) screening target, as presented to the Intel Developers Forum.

Today, Kingston, Intel, and Rambus engineers continue to work together to support the high-performance Rambus systems and platforms available in the marketplace.

Kingston offers a complete line of RIMM modules, ranging from 64MB up to 512MB (for updated offerings, please visit our web site at [www.kingston.com](http://www.kingston.com)).



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*“Kingston’s strong commitment to the new Rambus memory architecture and its early involvement in the technology development process will help ensure that there will be ample capacity to manufacture, test, and deliver Rambus modules to customers worldwide,”*

*Peter MacWilliams, Director of Platform Architecture and Fellow at Intel.*



## Rambus Memory Technology

Rambus Dynamic Random Access Memory (RDRAM) technology was created by Rambus Inc., which licenses its memory technology to semiconductor, processor and motherboard-chipset manufacturers.

Rambus memory is a high-speed and high-bandwidth serial memory architecture that is ideally suited for high-end gaming computers, workstations, other performance-oriented PC platforms as well as high-speed networking and telecommunications applications. Unlike the 64-bit (72 if ECC) wide SDRAM bus that transfers 8 Bytes of data at a time, the Rambus channel transfers 2 Byte packets over its narrow 16-bit (18 bits if ECC) bus.

RDRAM is different from SDRAM or DDR memory technologies. RDRAM memory technology uses a 16-bit memory bus called channel (or 18-bit channel with ECC support), compared to SDRAM and DDR which use a wide, 64-bit data bus (or 72-bit with ECC support). However, like DDR, RDRAM memory technology supports two transactions per clock cycle.

Rambus modules are called RIMM™ modules.



FOR MORE DETAILS ON RAMBUS TECHNOLOGY, PLEASE VISIT US AT <http://www.kingston.com/newtech/rambus.asp>

## RDRAM Chips

The Rambus memory chips are basically composed of the silicon wafer that is bonded with a special chip connector (called the Ball Grid Array) to attach to a module's printed circuit board. Rambus memory chips come in a special package type called Chip Scale Package (CSP). Because of the tight electrical specifications of the RDRAM high-speed signaling technology, a plastic package, such as the black-plastic Thin Small Outline Package (TSOP) used for SDRAM and DDR, could not be used. Most of the RDRAM chips come in a special package called Micro-BGA®.

Rambus memory modules are covered with a riveted cover, called a heatspreader, that dissipates heat from the RDRAM chips while also protecting them.

Rambus memory chips and modules come in 2 speeds:

- 800MHz, with modules classified as PC800
- 1066MHz, with modules classified as PC1066

Older 600 and 700MHz RDRAM chips, which were available until 2001, are now obsolete and replaced by 800MHz RDRAMs (PC800 modules are backward-compatible with PC600 and PC700 modules).



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## RIMM Modules

**RAMBUS MEMORY MODULES COME IN A VARIETY OF TYPES:**

**Standard RIMM Modules (also called 16-bit RIMMs):**

For computers utilizing two RDRAM channels with 4 RIMM sockets. These RIMMs come with and without ECC support.



**32-bit RIMM Modules:**

The memory controller sees each 32-bit RIMM module as two 16-bit RIMMs for systems with only 2 RIMM sockets. These RIMMs come with and without ECC support.



**Continuity RIMM modules:**

These chipless RIMM modules are required to fill up any empty RIMM sockets on motherboards. Continuity RIMM modules ensure that the Rambus channel is not interrupted. They come in 3 varieties:

- Continuity RIMM Modules *(pictured)*
- Continuity SO-RIMM Modules
- 32-bit Continuity and Termination RIMM Modules *(pictured)*



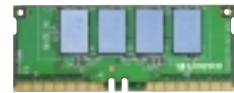
C-RIMM



CT-RIMM32

**SO-RIMM modules:**

These Small-Outline RIMM modules, sized like SDRAM SO-DIMMs, are mainly targeted at the telecommunications and networking industry for use in high-speed networking switches, routers, and other bandwidth-hungry devices.



## Naming Conventions

**RAMBUS MEMORY MODULES ARE CLASSIFIED AS FOLLOWS:**

	SPEED IN MHz	RIMM MODULE CLASSIFICATION	PEAK CHANNEL BANDWIDTH
RAMBUS	600	PC600	1.2 GB/s Single-Channel (Obsolete – Replaced by PC800)
STANDARD	700	PC700	1.4 GB/s Single-Channel (Obsolete – Replaced by PC800)
RIMMs (16-bit)	800	PC800	1.6 GB/s Single-Channel, 3.2 GB/s Dual-Channel
RIMMs (16-bit)	1066	PC1066	2.1 GB/s Single-Channel, 4.2 GB/s Dual-Channel
RIMMs (32-bit)	800	RIMM 3200	3.2 GB/s (Dual-Channel RIMM)
RIMMs (32-bit)	1066	RIMM 4200	4.2 GB/s (Dual-Channel RIMM)

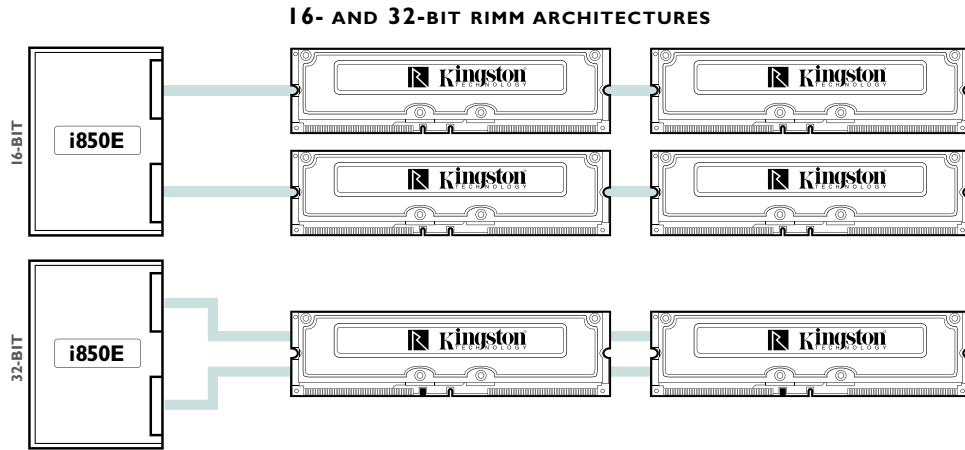
**THERE ARE TWO SPEEDS OF RDRAM CHIPS AND RIMM MODULES:**

- 800MHz RDRAM-based, or PC800 RIMMs
- 1066MHz RDRAM-based, or PC1066 RIMMs

Intel i850, i860, or i850E chipset-based motherboards and systems support two channels of Rambus memory. Using both channels at the same time, these systems are able to achieve a peak bandwidth of 3.2 Gigabytes (GB) per second for PC800, and 4.2 GB/s for PC1066. *(see illustration on following page)*



continued...



## Core-Speed Requirements for new Pentium 4 Processors

THE REQUIREMENTS ARE SUMMARIZED IN THE TABLE BELOW

The newer Intel i850E chipset-based motherboards require RIMM modules built with RDRAMs with shorter memory core access

INTEL CHIPSET	PENTIUM 4 PROCESSOR FRONT SIDE BUS (FSB)	RIMM MODULES	MEMORY CORE ACCESS TIME
i820/i840/i850/i860	400MHz	PC800	40 or 45 ns
i850E	400Mhz	PC800	40 or 45 ns
i850E	533MHz	PC800	40 ns only
i850E	533MHz	PC1066	32 ns only

time. Shorter memory core access time means that the RDRAM's memory cells switch faster, thereby minimizing some of the turnaround time needed to transfer data out of the RDRAM. This is similar to the "CAS Latency" specification in SDRAM or DDR memory modules.

## Continuity RIMM Modules

Whether a system is using PC800 or PC1066 RDRAM modules, empty sockets must be populated with special modules called Continuity RIMM modules (or C-RIMM modules). These modules, which have no memory chips, are special modules that are required for properly continuing the Rambus channel. 16-bit Rambus channels have a channel termination on the motherboard, and 32-bit RIMMs have channel termination that is built-in on the RIMM modules. In either case, a compatible C-RIMM is required for empty RIMM sockets for proper system functionality; when the system is upgraded, the C-RIMMs are then replaced by RIMM modules.

Note: 16-bit C-RIMM modules are not compatible with 32-bit C-RIMM modules. C-RIMM modules have the same notches or keys as do their corresponding RIMM modules and cannot be plugged into the wrong socket types. 32-bit C-RIMM modules are also called Continuity and Termination RIMMs.



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