Chapter 2 Understanding Component Specifications

2.1 Central Processing Unit (CPU)

The Central Processing Unit, often abbreviated as “CPU”, handles the logical analysis and computation of data, just as the human brain does. The CPU is usually the first item to consider when planning the parts of your new PC, as it is of vital importance and controls the major performance of the PC. CPUs used in PCs today most often use x86 architecture, with computer environments supporting either 64-bit processors or 32-bit. Because of this, most software utilities, applications and Windows operating systems have been developed based on the x86 command set. When planning your PC build, you should choose which CPU you will be using first, and then plan your other components such as motherboard, graphics card(s) and memory in order to ensure the best possible performance for your system.

Featuring both high performance and stability, Intel® processors are the most widely used processors in the world and have became the first choice for most users. With the evolution of manufacturing processes and technology, Intel processor architecture has developed from Pentium®, all the way to the present Core™ 2 Duo, with MMX, SSE, SSE2 and SSE3 command sets incorporated to enhance multimedia and 3D computing performance. Furthermore, the FSB (Front Side Bus) of the Pentium® 4 has been upgraded from 800MHz to 1333MHz and comes with Core™2 Duo or Core™2 Quad technology. Additionally, its pin specifications have also switched from Socket 478 to LGA775 (Socket T). Dual-core Pentium® D has become the mainstream specification for processors, because the performance of the dual-core Pentium® 2 Duo can be doubled to handle CPU intensive tasks such as multimedia entertainment and various applications, while consuming less power than previous generations. Intel® is proud to be be able to offer its cutomers the most reliable products for computer users all over the world.

← Intel’s latest product is the Intel® Core™ 2 Duo processor, delivering revolutionary dual-core performance.

Novice users are often confused about the terminology of the processor's command set, clock, external clock, FSB and cache. The following sections help to explain these specifications. Follow the guidelines to purchase the most cost-effective CPU.

Processor Clock

The computing speed at which the CPU executes commands is called the processor clock. The higher the processor clock, the better the performance. The processor clock is the result of the external clock multiplied by the clock ratio. For example, if the external clock of the Intel® Core™2 Duo E6700 2.66GHz (FSB 1066MHz) is 266MHz, its clock ratio will be 10. (CPU clock = external clock x clock ratio; 266MHz x 10=2.66GHz)

Dual-Core Architecture

With the development of multi-core architectures, processors such as Intel® Core™ 2 Extreme, Intel® Core™ 2 Quad, and Intel® Core™ 2 Duo have already implemented two or four computing cores (also known as quad-core and dual-core processors). Having more than one core greatly enhances the multi-tasking abilities of the operating system. For example, when the PC is performing a virus scan, simultaneous music or movie playback will not be affected. (See later sections in this document for technical details.)

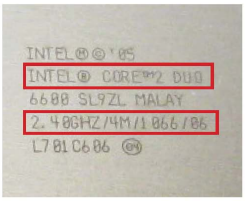
Front Side Bus

The front side bus (FSB) is the interface between the processor and the north bridge of the motherboard chipset. The FSB can be considered a highway of data transfer. When the FSB is higher, the amount of data to be transferred is relatively larger. The clock ratio of the FSB of Core™ 2 Duo is 4 (ie. FSB equals the external clock multiplied by 4). If the external clock is 266MHz, the FSB will be 1066MHz. (Equation: FSB = external clock x 4; FSB 1066=200 x 4, FSB 1333=333 x 4)

Cache

Intel processors use L1 and L2 caches to accelerate the access efficiency between the CPU, memory and hard disk drive in order to reduce the probability of repeated access to the same data. Take the dual-core Core™2 Duo processor for an example: each core comes with a 32KB L1 instruction cache and a 32KB L1 data cache (64KB in total) and 2MB or 4MB L2 cache (depending on the processor version). The processor performs a dynamic allocation of L2 cache based on the workload of each core.

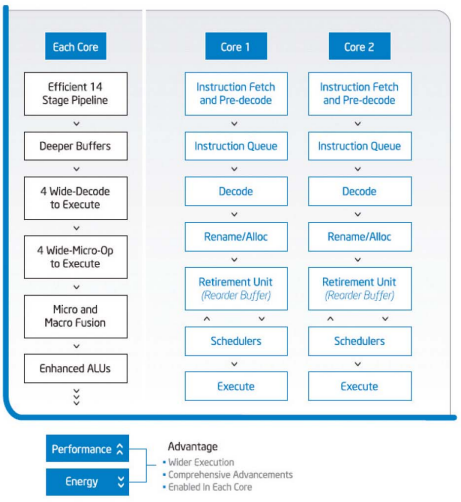
A quad-core Core™2 Quad processor has four 32KB L1 caches (with the sum of 128 KB) and two 4MB L2 caches (4MB shared by two cores; 8 MB in total). The higher the L2 cache, the higher the performance.



You can check the label on the front of the processor for the model number, clock, L2 size and FSB information.

Intel® Wide Dynamic Execution

Dynamic execution is a composite technology initially used in the P6 microarchitecture (e.g. Pentium® Pro Processor, Pentium® II Processor and Pentium® III Processor), featuring data flow analysis, speculative execution, out-of-order execution and scalar. After several function enhancements, the amount of instructions within a single clock cycle under the current Core™ microarchitecture has been increased. Each core can complete 4 instructions from 3 (NetBrust Architecture); therefore, the width of the execution pipeline is enlarged by 33% and the execution speed and power utility rate are significantly improved.



Flow chart of the operation modes of the Intel® Wide Dynamic Execution architecture.

Coding and nomenclature principles

Since LGA775, processors have experienced several architectural breakthroughs in the core and cache development. In addition, even the coding and nomenclature system has changed from using clock indications to using number sequences. With the launch of the Core™2 Duo processor, the processor name now includes an English letter and a four-digit number. The English letter indicates the architecture or feature used. A larger number that come with the same English letter is usually used for higher-end processors; but there are some exceptions.

For instance, the English letter in the Intel® Core™2 Duo family indicates TDP power consumption: E indicating 50W and more, T indicating 25~49W, L indicating 15~24W (low voltage version), U indicating 14W and less (ultra low voltage version). Note that Q in the Core™2 Quad family stands for quad cores, such as Q6600, and X in the Core™2 Extreme family stands for the xXtreme products, such as X6800 which belongs to the eXtreme product of the quad-core series.

The coding of the processors listed in the table may be subject to change, please refer to the Intel® website for details

Table of Intel® Processors and Corresponding Serial Numbers

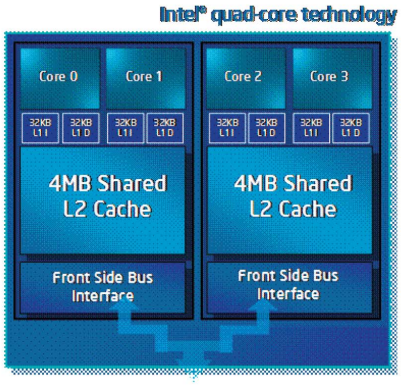
Processor	Core/Pin	Processor Clock	Front Side Bus	L2 Cache	No. of cores	EM64T	XD
Intel® Core™2 Extreme							
QX6850	Kentsfield/LGA775	3.0GHz	1333MHz	shared 2×4MB	4	Yes	Yes
X6800	Conroe/LGA775	2.93GHz	1066MHz	shared 4MB	2	Yes	Yes
QX6800	Kentsfield/LGA775	2.93GHz	1066MHz	shared 2×4MB	4	Yes	Yes
QX6700	Kentsfield/LGA775	2.66GHz	1066MHz	shared 2×4MB	4	Yes	Yes
Intel® Core™2 Quad							
Q6700	Kentsfield/LGA775	2.66GHz	1066MHz	shared 2×4MB	4	Yes	Yes
Q6600	Kentsfield/LGA775	2.40GHz	1066MHz	shared 2×4MB	4	Yes	Yes
Intel® Core™2 Duo							
E6850	Conroe/LGA775	3.0GHz	1333MHz	shared 4MB	2	Yes	Yes
E6750	Conroe/LGA775	2.66GHz	1333MHz	shared 4MB	2	Yes	Yes
E6700	Conroe/LGA775	2.66GHz	1066MHz	shared 4MB	2	Yes	Yes
E6650	Conroe/LGA775	2.33GHz	1333MHz	shared 4MB	2	Yes	Yes
E6600	Conroe/LGA775	2.40GHz	1066MHz	shared 4MB	2	Yes	Yes
E6550	Conroe/LGA775	2.33GHz	1333MHz	shared 4MB	2	Yes	Yes
E6420	Conroe/LGA775	2.13GHz	1066MHz	shared 4MB	2	Yes	Yes
E6400	Conroe/LGA775	2.13GHz	1066MHz	shared 2MB	2	Yes	Yes
E6320	Conroe/LGA775	1.86GHz	1066MHz	shared 4MB	2	Yes	Yes
E6300	Conroe/LGA775	1.86GHz	1066MHz	shared 2MB	2	Yes	Yes
E4500	Conroe/ LGA775	2.2GHz	800MHz	shared 2MB	2	Yes	Yes
E4400	Conroe/LGA775	2.0GHz	800MHz	shared 2MB	2	Yes	Yes
E4300	Conroe/LGA775	1.80GHz	800MHz	shared 2MB	2	Yes	Yes
Intel® Pentium® Duo Core							
E2160	Conroe 1M/LGA775	1.80GHz	800MHz	1MB	2	Yes	Yes
E2140	Conroe 1M/LGA775	1.60GHz	800MHz	1MB	2	Yes	Yes
Intel® Pentium® D							
960	Presler/LGA775	3.6GHz	800MHz	2×2MB	2	Yes	Yes
950	Presler/LGA775	3.4GHz	800MHz	2×2MB	2	Yes	Yes
945	Presler/LGA775	3.40GHz	800MHz	2×2MB	2	Yes	Yes
940	Presler/LGA775	3.2GHz	800MHz	2×2MB	2	Yes	Yes
935	Presler/LGA775	3.20GHz	800MHz	2×2MB	2	Yes	Yes
930	Presler/LGA775	3.0GHz	800MHz	2×2MB	2	Yes	Yes
925	Presler/LGA775	3.0GHz	800MHz	2×2MB	2	Yes	Yes
920	Presler/LGA775	2.8GHz	800MHz	2×2MB	2	Yes	Yes
840	Smithfield/LGA775	3.2GHz	800MHz	2×1MB	2	Yes	Yes
830	Smithfield/LGA775	3.0GHz	800MHz	2×1MB	2	Yes	Yes
820	Smithfield/LGA775	2.8GHz	800MHz	2×1MB	2	Yes	Yes
805	Smithfield/LGA775	2.66GHz	533MHz	2×1MB	2	Yes	Yes
Intel® Pentium® 4 supporting Hyper-Threading							
651	Cedar Mill/LGA775	3.4GHz	800MHz	2MB	1	Yes	Yes
641	Cedar Mill/LGA775	3.2GHz	800MHz	2MB	1	Yes	Yes
631	Cedar Mill/LGA775	3.0GHz	800MHz	2MB	1	Yes	Yes
Intel® Celeron®							
440	Conroe-L/LGA775	2.0GHz	800MHz	512KB	1	Yes	Yes
430	Conroe-L/LGA775	1.8GHz	800MHz	512KB	1	Yes	Yes

The quad-core era of Intel® Core™2 Quad····

Intel has recently launched a single processor with four cores, bringing the computer industry into an even newer multi-core era. The Intel® Core™ 2 Extreme QX6700 Quad Core processor is an ideal solution for multimedia desktop systems, with an 80% performance upgrade over the Intel® Core™ 2 Extreme X6800 processor. Intel Quad Core processors deliver exceptional speed, response and efficiency, making them ideal for multimedia creation, high-end gaming and other market segments that depend on ultimate performance.

Intel has stacked the core circuits of two Core™2 Duo E6700 processors to create the 1st generation quad-core Core™2 Extreme QX6700 processor. This processor consists of two cores, both with 4MB L2 cache that can be controlled independently (8MB L2 cache in total), and features a 1066MHz FSB. In addition to the Core™2 Extreme series that aims at the high-end market, Intel has also launched the Core™2 Quad series for the mainstream market.

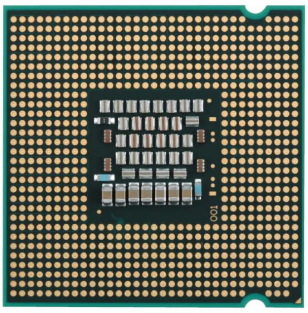
These two series continue with the LGA775 pin specification and 65nm manufacturing process. Intel® Core microarchitecture has contributed greatly to the reduction of hardware circuits and transistors, has increased execution efficiency, and at the same time, has decreased power consumption. These processors both use 8MB L2 cache and support EM64T 64-bit computing. In addition, they also feature Intel® Smart Memory Access and Intel® Advanced Smart Cache technologies that optimize the data access to increase the transmission efficiency and execution performance of computing commands. While the 1st generation quad-core processor was created from the stack of two dual-core modules, the 2nd generation quad-core processor has now evolved to the 45nm manufacturing process, using real quad-core architecture and shared L2 cache (capacity has increased by 50%, up to 12MB), as well as supporting the SSE4 command set. 65nm dual core processors consist of 410 million transistors, while a 45nm quad core processors consists of 820 million transistors. Even though they feature twice the number of transistors, Intel has been able to shrink the processor size by 25%, while delivering greater computing performance and enhanced power efficiency.

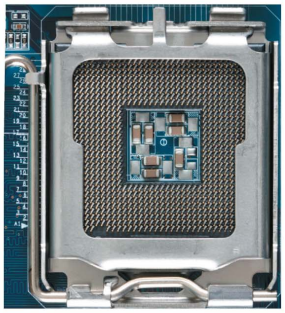


Intel Quad-Core processors support Intel® Advanced Smart Cache technology, utilizing the cache sub-system with greater computing efficiency to optimize multi -thread performance by allocating resources dynamically based on the workload of each processor core.

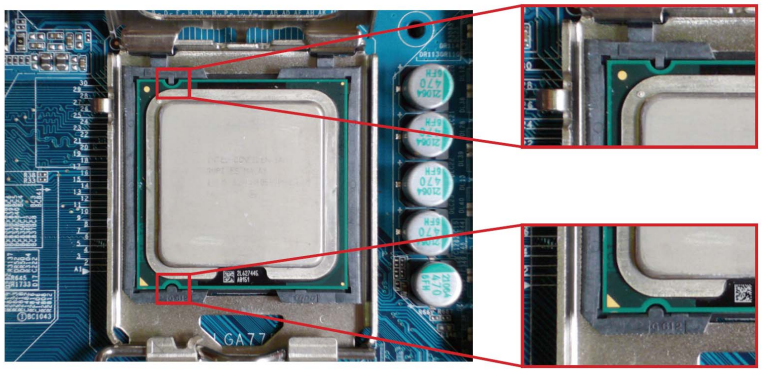
Processor Socket

In addition to the updated hardware architecture in the new generation of processors, there are also differences in the appearance of LGA775 and Socket 478 processors. With an increased number of pins, the square measurement of LGA775 processors is slightly larger, and therefore influences the processor socket on the motherboard. Note that LGA775, unlike previous designs, has moved the contact pins to the processor socket on the motherboard and left only eutectic solder balls on the rear side.





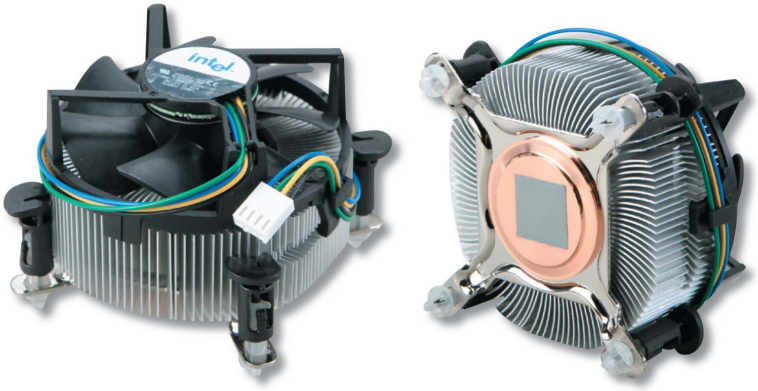
The LGA775 processor has eutectic solder balls on the rear side, while its contact pins are moved to the processor socket on the motherboard.



Cooling Device – A Key Factor for Processor Stability

Because of the increase in processor speed and performance, today's processors can generate a large a mound of heat. The original cooling device usually supplied with Intel® Core™2 Duo processors is used to maintain stability when operating at the default CPU clock. However, advanced users who plan to overclock their processors are recommended to use cooling products from GIGABYTE. After receiving wide recognition for its G-power series, GIGABYTE has introduced its Volar cooler with enhanced cooling performance and reduced fan noise. Volar uses a 12cm fan that produces low fan noise while maintaining high fan speeds in addition to its heatpipe technology.

Cooling Device – A Key Factor for Processor Stability



The Intel® cooler is secured on the motherboard with four clips and features streamlined cooling fins with a copper base for the processor contact area, allowing heat to disperse quickly, for excellent cooling and low noise performance.

After the well-received G-power series, GIGABYTE introduced the quiet, high-speed Volar cooler that allows for lower fan noise and better cooling efficiency.

Gamer's Choice!
GIGABYTE Gaming Solutions

Quality Components
make Quality Motherboards

Unique Technology from GIGABYTE
Ultra Durable 2
- **Lower RDS(on)** MOSFET
- **Ferrite Core** Choke
- **Lower ESR** Solid Capacitor

DDR3 Memory Speed **Up to 106%***
GIGABYTE P35T-DQ6 Ultra Durable2 Motherboard
* under controlled conditions

CPU zone Average Temp. **Lower 33°C***
GIGABYTE P35-DQ6 (rev 1.0) vs. Competitor Motherboard

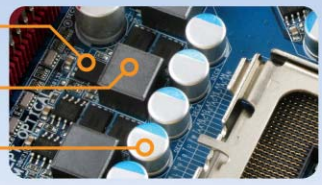
DDR3 1333 DDR2 1066

Supports Intel Core 2 Quad

Intel P35 EXPRESS CHIPSET

GIGABYTE Ultra Durable2 Motherboards
Designed with Top Quality Highly Efficient Components

1. **Lower RDS(on)** MOSFET
2. **Ferrite Core** Chokes
3. **Lower ESR** Solid Capacitors



Better

New Design Ultra Durable 2	Old Design
Low RDS(on) MOSFET	Standard MOSFET
Ferrite Core Choke	Iron Core Power Inductor
Lower ESR Solid Capacitor	Traditional Solid Capacitor

1 Ultra Cooling
Lower RDS(on) MOSFET Design

Lower RDS(on) MOSFETs are specially designed to produce lower switching resistance for faster electric current charging and discharging.

2 Low Power Loss
Ferrite Core Choke Design

Ferrite core chokes are comprised of a compound of iron-oxide and other metal elements whose properties hold energy much longer than common iron-core chokes at high frequency.

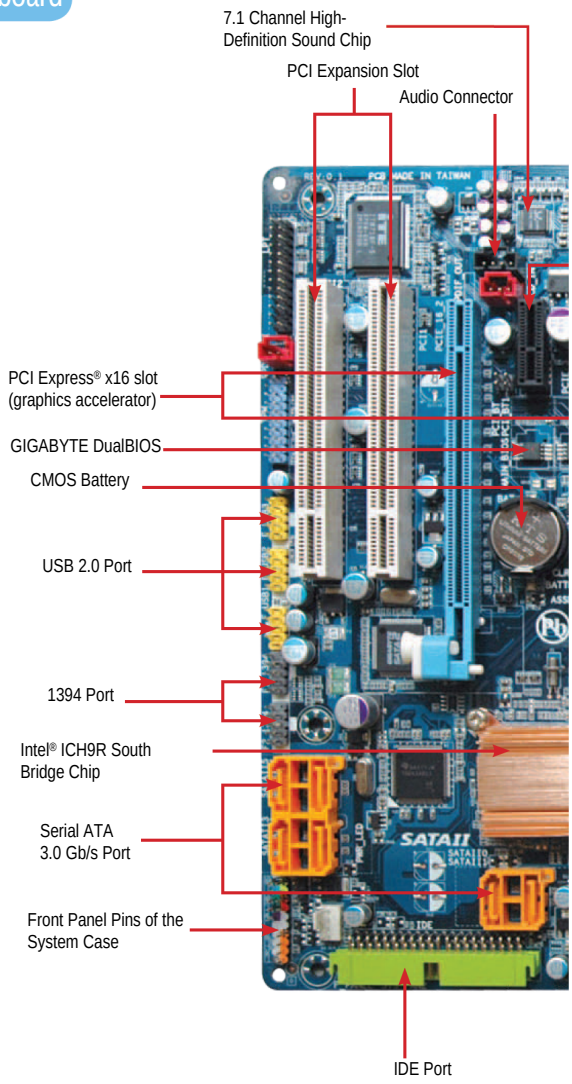
3 Longer Life
Lower ESR Solid Capacitor Design

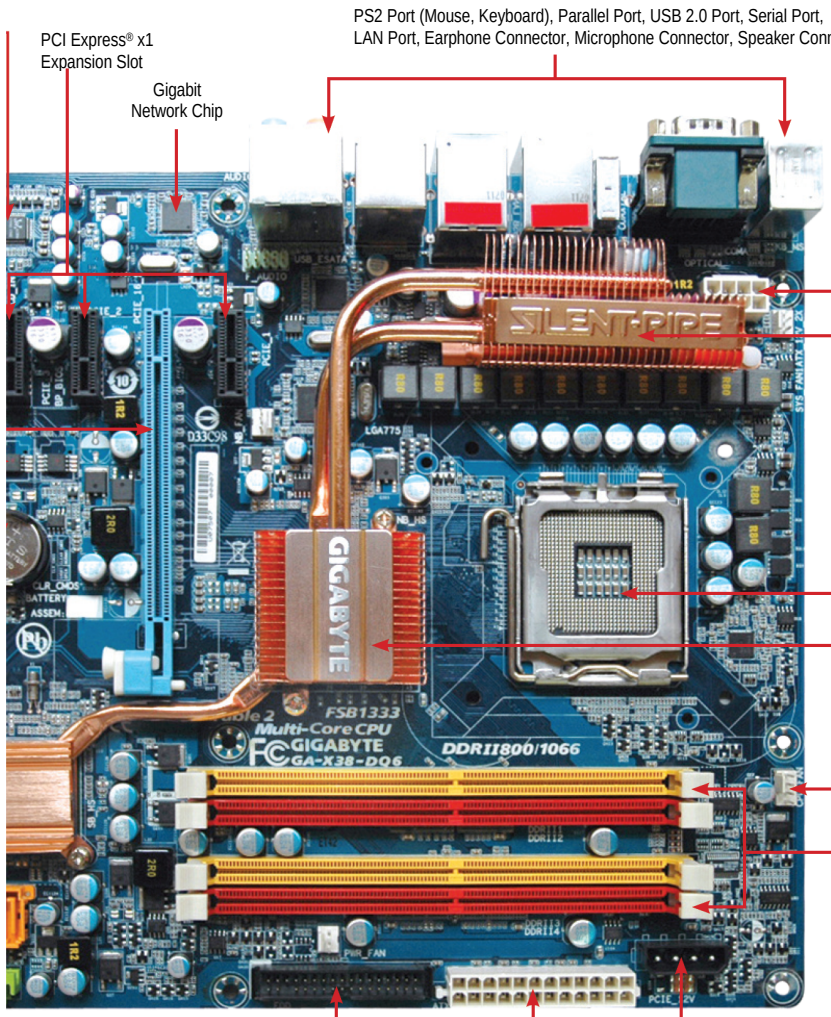
Solid capacitors contain a solid organic polymer, while electrolytic capacitors use a common liquid electrolyte.

2.2 Understanding Your Motherboard

The GIGABYTE GA-X38-DQ6 uses the latest Intel® X38 Express chipset and features support for Intel's 45nm multi-core processor, as well as several exclusive technologies including Quad-BIOS, Quad-Cooling, Quad-eSATA2, Quad-Triple Phase, Quad Core Optimized, and Quad DDR2 Slots. The GIGABYTE GA-X38-DQ6 is in the top of its class, delivering ultimate performance and unprecedented overclocking ability.

Featuring GIGABYTE's 2nd generation Ultra Durable 2 technology, the GA-X38-DQ6 utilizes the highest quality manufacturing materials, including ferrite core chokes, low RDS(on) MOSFETs and solid capacitors from leading Japanese manufacturers. With the advanced Silent-Pipe™ cooling solution, the GIGABYTE GA-X38-DQ6 delivers enhanced power saving, low operating temperature, ultra long product life and powerful overclocking ability, which makes it an excellent choice for both regular users and extreme users alike. In addition to its advanced cooling solution, the GIGABYTE GA-X38-DQ6 features several exclusive applications, including C.I.A. 2, M.I.B. 2 and EasyTune™ 5, to provide users with the optimal level of performance and stability.



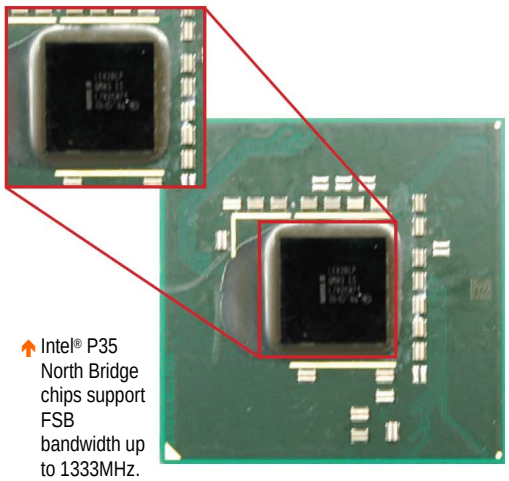

PS2 Port (Mouse, Keyboard), Parallel Port, USB 2.0 Port, Serial Port,
LAN Port, Earphone Connector, Microphone Connector, Speaker Connector
PCI Express® x1
Expansion Slot
Gigabit
Network Chip
ATX_12V_2X Power
Connector (4x2)
GIGABYTE proprietary
Silent-Pipe™ cooling
technology
LGA775 Processor
Socket
Intel® X38 North
Bridge Chip
Processor Fan Connector
DDR2 Memory Slots
(dual channel
distinguished by color)
FDD Slot
24-pin Power Connector
PCIE_12V Port

Chipset - the Soul of the Motherboard····

The motherboard may look complicated, but a basic understanding of the motherboard's support and compatibility with the other components of your system can be obtained by understanding the specifications of the chipset. Modern chipsets (including Intel's) generally comprise of two principal chips: the North Bridge and South Bridge. The North Bridge handles the processor's interaction with the main memory and with the graphics accelerators. It determines the FSB speed of the processors, the bandwidth of the main memory (including supported memory types such as DDR2 and DDR3) as well as the type of graphics accelerator supported. In addition to coordination with the North Bridge, the South Bridge handles data transfer and support of peripheral ports, including Serial ATA (SATA), Ethernet, audio and USB 2.0.

For example, the latest Intel® P35 and X38 North Bridge chips support the Core™2 Duo, Core™2 Quad, Core™2 Extreme and Intel® 45nm multi-core (Wolfdale and Yorkfield) processors, Dual PCI Express® 2.0 x16 (X38), 1333MHz FSB, DDR2 667/800 and DDR3 800/1066/1333 memory and Intel® High Definition Audio. The applicable South Bridge options include ICH9, ICH9R and ICH9DH. The basic ICH9 South Bridge supports 4 SATA ports, 6 PCI Express® x1 slots, 12 USB 2.0 ports, Gigabit Ethernet MAC networking and Quiet System Technology.

The ICH9R South Bridge chips support all the features of ICH9R as well as support for 6 SATA ports with external SATA interface and Intel® Matrix Storage Technology supporting RAID 0/1/5/10. With ICH9DH chips, in addition to the functions mentioned above, Intel® network technology is further added, making it an ideal Intel® ViiV™ digital home platform.



Intel® P35 North Bridge chips support FSB bandwidth up to 1333MHz.

ICH9R, which is paired with the P35 South Bridge chip, supports Serial ATA 3.0Gbps, External SATA interface, and RAID 0/1/5/10 functions.

Comparison Chart for Intel® Series Chipsets

Chipset Name	Intel® X38 Express	Intel® 975X Express	Intel® P35 Express	Intel® P31 Express	Intel® P965 Express	Intel® 945P Express	Intel® 946PL Express
Supported Processor	Core™2 Duo Core™2 Quad Core™2 Extreme	Core™2 Duo Core™2 Extreme Pentium® D Pentium® 4 Celeron® D	Core™2 Duo Core™2 Quad	Core™2 Duo Core™2 Quad	Core™2 Duo Pentium® D Pentium® 4 Celeron® D	Pentium® D Pentium® 4 Celeron® D	Core™2 Duo Pentium® D Pentium® 4 Celeron® D
FSB External Clock	1333/1066/800MHz	1066/800MHz	1333/1066/800MHz	*1333/1066/800MHz	1066/800 533MHz	1066/800 667/533MHz	800/533MHz
Memory Architecture	Dual-Channel DDR2 667/800 DDR3 800/1066/1333	Dual-Channel DDR2 667/533	Dual-Channel DDR2 667/800 DDR3 800/1066	Dual-Channel DDR2 667/800	Dual-Channel DDR2 800/667/533	Dual-Channel DDR2 667/533	Dual-Channel DDR2 667/533
Maximum Memory Capacity	8GB	8GB	8GB	4GB	8GB	4GB	4GB
Graphics Accelerator	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PCI Express®	2.0 x16（2） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）
IDE/ATA	SATA 3Gb/s（4）	SATA 3Gb/s（4）	SATA 3Gb/s（4）	SATA 3Gb/s（4）	SATA 3Gb/s（4）	SATA 3Gb/s（4）	ATA 100（1） SATA 3Gb/s（4）
ICH South Bridge Chip	ICH9 ICH9R ICH9DH ICH9DO	ICH7R	ICH9 ICH9R ICH9DH	ICH7 ICH7R ICH7DH	ICH8 ICH8R ICH8DH	ICH7	ICH7

* P31 and G31 support FSB 1333 and are expected to receive an Intel® certificate in Q1 2008.

The latest Intel® 3 family includes 6 chipsets: X38 (ICH9), P35 (ICH9), P31 (ICH7), G31 (ICH7), G33 (ICH9) and G35 (ICH8). The first three are discrete chipsets while the last three are integrated with a built-in graphics core. These chipsets use either ICH9, ICH8 or ICH7 South Bridge (Intel® ViiV™ platform is supported for ICH9DH) and support DDR2 800 dual-channel memory, up to 12.8GB/s. X38, P35 and G33 also support DDR3 1333 memory modules.

The 3 series uses Intel's Fast Memory Access technology to optimize available bandwidth via the Memory Controller Hub (MCH) in order to shorten the memory access delay. The built-in Matrix Storage Technology (MST) helps protect hard disk data and increases data access speed. In conjunction with NAND flash memory, Intel® Turbo Memory technology allows the system to wake from hibernation mode 1.5 times faster and also decreases application load times by half.

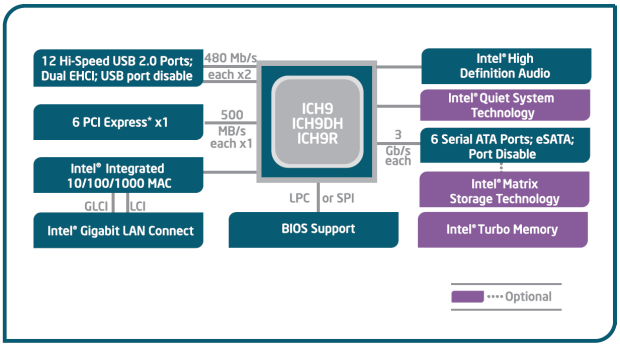
G31 is positioned as an entry-level product and supports 1066MHz FSB and DDR2-800 memory.

X38 is for high-end multimedia and gaming systems and is the only chipset to support 2 PCI Express® 2.0 x16 slots. In addition to ICH9, ICH9R or ICH9DH, X38 can also work with ICH9DO.

These chipsets are geared towards the mainstream market. Intel® G33 and G35 are integrated chipsets. These chipsets support 1333MHz FSB and work with Core™2 Duo and Core™2 Quad processors.

Positioned for the value market, Intel® G31 uses the previous ICH7 and ICH7DH South Bridges, while the Intel® G35 uses the ICH8, ICH8R and ICH8DH. For the extreme and mainstream segment chipsets, Intel pairs them with the latest ICH9 family including the ICH9, ICH9R, ICH9DO and ICH9DH versions.

ICH9 aims at the mainstream market. Giving up the Parallel ATA interface that had been prevailing for years, ICH9 supports 4 SATA interfaces, 1 eSATA interface, 6 PCIe x1 slots, 12 USB 2.0 ports, GbE MAC access control and the Intel® Quiet System Technology. In addition to the functions of ICH9, ICH9R includes 6 SATA2 interfaces in total and supports RAID 0/1/5/10 matrix functionality and Intel® Rapid Recovery data recovery technology. ICH9DO has ICH9R's full functionality with the additional support for Intel's® vPro business computing platform, featuring Intel® Active Management Technology (AMT) via the network. Also included is support for Intel® Trusted Execution Technology (TXT) which can work together with Microsoft's® Vista™ operating system to provide a more complete data security solution. ICH9DH has all the functionality of ICH9Ras well as support for Intel® Quick Resume fast startup technology designed especially for the Intel® ViiV™ digital home platform.



From the mainstream 945 and 965 chipsets to the next-generation Intel® 3 series chipset family, Intel's product line also includes integrated chipsets with built-in graphics functionality, in addition to independent chipsets. For example, the Intel® G31 and G33 integrate the Intel® GMA 3100 graphic engine; and the G35 integrates the Intel® GMA X3500 with support for DirectX® 10, Shader Model 4.0 and OpenGL 2.0 technology. All of the new generation Intel® graphics engines support Intel® Clear Video Technology (Intel® CVT) , High Dynamic Range (HDR) with 1080p resolution, HDMI (High-Definition Multimedia Interface) and Intel® sDVO (srial Digital Video Output) Interface for HD-DVD or Blu-ray disc playback in order to provide the most exhilerating high-definition digital video andaudio playback with enhanced 3D capabilities.

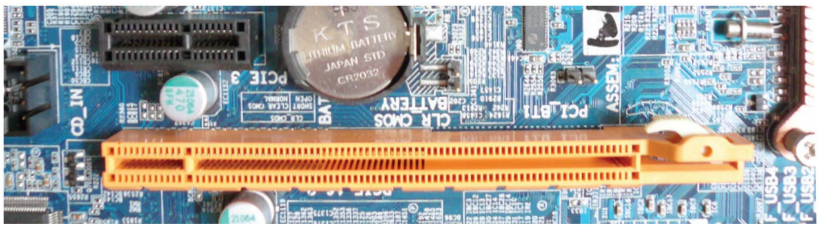
For users who rely mostly on their PC to perform tasks that do not need powerful graphics performance such as surfing the Internet or word processing, an integrated chipset solution is recommended in order to provide the best cost/performance solution. Should the need for more powerful graphic performance arise in the future in order to take advantage of more graphically intensive applications such as FPS (first-person shooter) games, you only need to install a PCI Express® x16 add-on card to enhance the 3D performance.

Comparison Table of Intel Integrated Chipsets

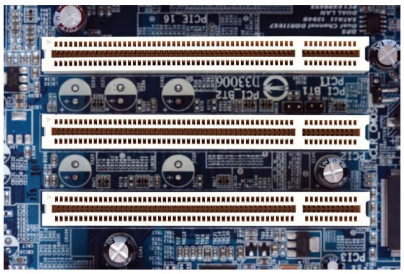
Chipset Name	Intel® G31 Express	Intel® G33 Express	Intel® G35 Express	Intel® G965 Express	Intel® 946GZ Express	Intel® 945G Express
Supported Processor	Core™2 Duo Core™2 Quad	Core™2 Duo Core™2 Quad	Core™2 Duo Core™2 Quad	Core™2 Duo Pentium® D Pentium® 4 Celeron® D	Core™2 Duo Pentium® D Pentium® 4 Celeron® D	Core™2 Duo Pentium® D Pentium® 4 Celeron® D
FSB External Clock	1333/1066/ 800MHz	1333/1066/ 800MHz	1333/1066/ 800MHz	1066/800 533MHz	800/533MHz	1066/800/ 533MHz
DirectX® Technology	DirectX® 9	DirectX® 9	DirectX® 10	DirectX® 9	DirectX® 9	DirectX® 9
Memory Architecture	Dual-Channel DDR2 667/800	Dual-Channel DDR2 667/800 DDR3 800/1066	Dual-Channel DDR2 667/800	Dual-Channel DDR2 800/ 667/533	Dual-Channel DDR2 667/533	Dual-Channel DDR2 667/533
Maximum Memory Capacity	4GB	8GB	8GB	8GB	4GB	4GB
Graphics Accelerator	Intel® GMA 3100	Intel® GMA 3100	Intel® GMA X3500、 Advanced Media Capabilities	Intel® GMA X3000	Intel® GMA 3000	Intel® GMA 950
PCI Express®	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）	x16（1） x1（6）
IDE/ATA	SATA 3Gb/s（4）	SATA 3Gb/s（4）	SATA 3Gb/s（4）	SATA 3 Gb/s（6）	ATA100（1） SATA 3Gb/s（4）	SATA 3Gb/s（6）
ICH South Bridge Chip	ICH7DH ICH7R、ICH7	ICH9DH ICH9R、ICH9	ICH8DH ICH8R、ICH8	ICH8DO ICH8R、ICH8	ICH7	ICH8DO ICH8R、ICH8

Interface Card Slot

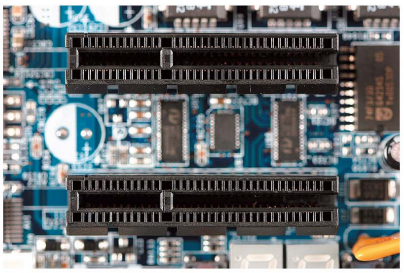
While chipset complexity and functionality has increased greatly in the past several years, the PCI slot, which was first launched in 1992, is still an important part of the motherboard for expanding system functionality. For example, video capture cards use the PCI interface allowing users to take advantage of expanded media capabilities for the PC. While the PCI bus is still commonly used, it is slowly being replaced by the new PCI Express® and even more recent PCI Express® 2.0 interface, which doubles the PCI Express® bandwidth from 2.5 Gbit/s to 5 Gbit/s, meaning a x32 connector can transfer data at up to 16 GB/s in each direction. The new Intel® X38 supports PCI Express® 2.0, and because PCI Express® 2.0 is backwards compatible with PCI Express®, older cards will still work in newer systems.



PCI Express® x16 slots offers high-speed transmission bandwidth to eliminate the performance bottlenecks for data transferring.



The traditional PCI interface is still used by many add-on cards.



Compared with PCI Express® x16, the length of the PCI Express® x1 and x4 card slot is shorter.

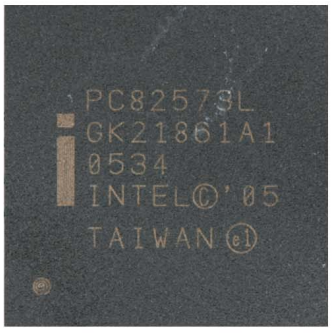
Intel® High Definition Audio

Intel® HD Audio (High Definition Audio) allows users to enjoy movie theater quality sound from their PCs. While audio functionality is provided by Intel® South Bridges, an additional audio chip is still required for HD audio output. Since the 915 chipset, Intel® HD Audio with 7.1 channel output has been included as a standard feature. In addition to reducing common problems or noise often seen in other audio technologies, Intel® HD Audio utilizes Dolby Digital and DTS decoding chips to create multi-channel, stereo surround sound effects. Moreover, Intel® HD Audio supports the matrix microphone, which helps to eliminate noise and enhances the clarity of sound input.

High Definition Audio helps the computer to create either regular stereo sound or multi-channel surround sound.

Even though the current Intel® ICH9/R South Bridge chip is already equipped with many powerful functions, an additional chip is still used to increase the motherboard's peripheral connectivity, including IEEE 1394, Gigabit LAN and SATA RAID.

The IEEE 1394 chip provides the interface for connecting devices such as a DV.



The Intel® Gigabit chip provides high-speed network connection and saves the trouble for future upgrades.

Remote Management Utility – Intel® AMT & vPro Technology……

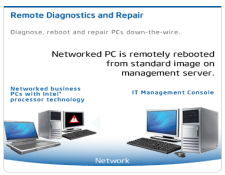
As today's corporate networks become more and more complex, MIS personnel resources have needed to increase in order to keep networks running smoothly and efficiently. Helping to increase network resource efficiency, improve asset management and to reduce downtime, Intel has developed the Intel® Active Management Technology (AMT). AMT combines both hardware and firmware to allow remote access of network resources utilizing Out Of Band (OOB) networking capabilities, regardless of the operating system and platform power source. As long as the network connection functions properly and a backup power source is provided, AMT can access and manage the PC remotely, even if the PC is turned off or the operating system is not operable.

The latest Intel® vPro technology has reinforced AMT functionality and now provides support for the latest platform specifications, including the new Intel® Core™2 Duo processors. Providing improved operation efficiency and optimized performance for applications including remote boot-up and advanced diagnosis and repair, Intel® Core™2 Duo processors and Intel® vPro technology provides the tools necessary to make sure your corporate network runs as smoothly as possible . For more detailed information, users can visit the official Intel® vPro website at www.intel.com/tw/vpro.

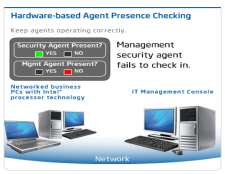
Features of Intel® vPro Technology

- Remote mode – You can check the inventory of computer devices, troubleshoot and restore system resources in order to reduce on-site visits by MIS professionals.
- Active security – An advanced security mechanism assisted by hardware that can effectively block vicious attacks and protect important data.
- Low power consumption and high performance – Intel® Core™2 Duo processors are equipped with several advantages, including excellent computing performance and enhanced power-saving features, for a more efficient and quiet computing environment.
- Extensive industry support – Well-known corporations around the world are constantly developing applications that utilize and expand the functionality of Intel® vPro technology.

Management personnel can use vPro technology to perform remote asset checkups by looking up information on all computer systems throughout the corporation. Remote operation can still be performed even when the computers are turned off.



Intel® AMT technology can decrease time-to-repair and increase management efficiency for MIS personnel.



Under normal conditions, the agents of the computer system will continue to send messages to the administrator to indicate that the system is in a secure and normal state. When message delivery is stopped or any message of abnormality is delivered, it means that the system is in an insecure state and related repair work should be performed immediately.

Secrets of Intel® Remarkable Performance Advance·····

Intel® FMA technology

Since the P965 chipset, Intel® has supported Fast Memory Access (FMA) technology. By optimizing the available bandwidth and shortening the memory access delay time, FMA technology substantially increases system performance, creates a greater width of internal data bus speed and supports up to 800MHz dual-channel DDR2 memory modules (with memory bandwidth up to 12.8GB/s), which provides improved computing performance and memory allocation flexibility.

Intel® MST Technology

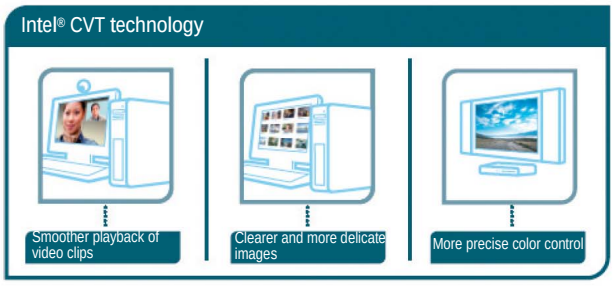
Intel® Matrix Storage Technology (MST) provides easy-to-use settings to allow expansive RAID functionality that previously required complicated configuration. RAID 0/5/10 utilizes a second hard disk drive to create more efficient access to digital pictures, video clips and data files. Users can also use RAID 1/5/10 to prevent data loss when the hard disk drive malfunctions. MST supports the connection of external SATA (eSATA) devices with up to 3GB/s.

Intel® CVT Technology

Intel® Clear Video Technology (CVT) adopts the de-interlacing, directional motion detection and phase algorithm technologies to create clearer images and to eliminate aliasing and image sticking problems. In addition, CVT uses hardware acceleration to produce the smoothest playback of high-definition video clips with support for PIP mode. CVT also supports the latest High-Definition Multimedia Interface (HDMI) digital monitors, simplifying the connections between the computer, set-top box, DVD player and digital TV.

Intel® QST Technology

Intel® Quiet System Technology (QST) can help reduce system noise by automatically adjusting the cooling fan speed according to the working temperature. Users can enjoy a quiet working environment without being interrupted by the cooling fan noise and compromising computing performance.



Intel® CVT technology applies various top hardware and software technologies to create smooth playback of high-definition video clips, clearer and more delicate images and more precise color control to provide the highest quality, visual experience possible.

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2.3 Introduction to Memory

Starting with Bandwidth

The function of system memory is to temporarily store data that has been retrieved from the hard disk so that the processor can access the data more quickly. Therefore, increasing the data transfer bandwidth can effectively reinforce the operating performance. For the memory, bandwidth and clock have a direct proportional relationship; faster clock and broader bandwidth indicate a greater data transfer rate, which is important for system performance. Memory specifications have evolved from the previous SDRAM, DDR SDRAM, DDR2 SDRAM to the next generation DDR3 SDRAM.

Double Data Rate SDRAM (DDR SDRAM) transfers double data per cycle and its transfer rate is twice as fast as the traditional SDRAM (Synchronous Dynamic Random Access Memory) of the same clock rate. With a reinforced architecture, DDR2 has four times the transfer rate of SDRAM. For example, DDR2 400 operates at a 100MHz clock rate.

With the launch of the Intel® P35 and X38 chipsets and the successive introduction of DDR2 1066, DDR3 800/1066/1333, memory specifications have evolved to the DDR3 era with even greater transfer speeds and eight times the data traffic of SDRAM. Motherboard manufacturers currently offer support for DDR3 1333 memory technology (for instance, GIGABYTE has launched P35T-DQ6 that supports DDR3 1333), and future support for DDR3 1600 is expected. It should be also noted that the greater speed and performance of the memory will also generate more heat. However, DDR3 has reduced the working voltage to 1.5V, which will help control the heat problem.

How is DDR bandwidth calculated? In short, DDR bandwidth is the result of the clock multiplied by the pre-fetch width and bus width. All DDR memory modules use the bus width of 64bit (8bytes). For example, the bandwidth of DDR 400 is 3.2 GB/s (200x2x8 bytes), also known as PC3200. Likewise, DDR2 400 of the same speed is known as PC2-3200 (100x4x8bytes), and DDR3 1066 as PC3-8500 (133x8x8bytes), and so on.

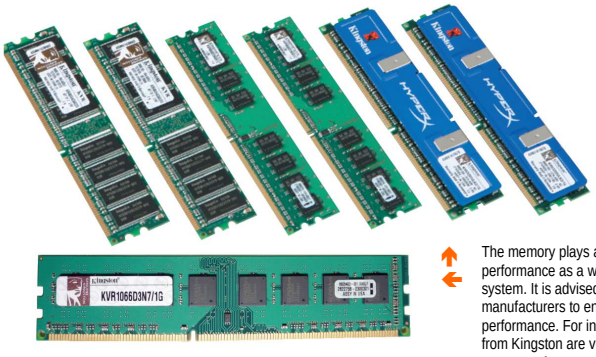
Comparison Table of DDR/DDR2/DDR3

Type	DDR SDRAM	DDR2 SDRAM	DDR3 SDRAM
Package	TSOP、BGA	CSP（FBGA）	CSP（FBGA）
Pin	184Pin	240Pin	240 pin
Supply Voltage	2.5V	1.8V	1.5V
Clock	200、266、333、400	400、533、667、800	800、1066、1333、1600
Bus Speed	100、133、166、200	200、266、333、400	400、533、667、800
Pre-fetch Width	2-bit	4-bit	8-bit
Latency	2、2.5、3	4、5	7、8、9

Promotion of Memory Capacity

When the computer is running, the system will continue to retrieve data from the hard disk and temporarily store the data in the memory so that the processor can use the data as needed. This helps the processor have much quicker access to the data for faster response times. Therefore, in order to maximize system performance, it is important to equip your system with enough memory (Nowadays it's easy to purchase 1GB, 2GB or even 4GB memory modules). Because Windows® Vista™ operating system requires a lot of memory and users may often use multiple applications such as Office and Internet Explorer at the same time, the installation of a certain memory capacity is required to maintain an efficient operation.

For current computer equipment, at least 2GB memory capacity is advised. Considering the dual-channel design, the combination of two 1GB memory modules is usually adopted. If your budget allows, 3~4GB memory modules are even better choices.



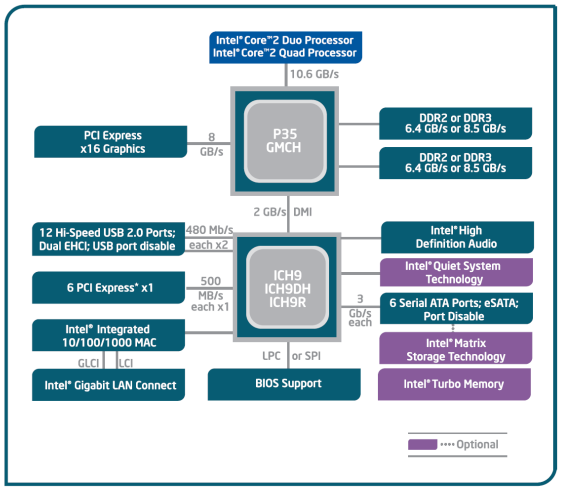
The memory plays a key part in the computer's performance as a whole and affects the stability of the system. It is advised to use modules from brand name manufacturers to ensure the highest levels of performance. For instance, DDR2 and DDR3 modules from Kingston are very reliable and come with a warranty of permanent after-service.

The system memory requirement for the Windows® Vista™ operating system is 1GB (at least 512 MB memory capacity is required to perform basic functions). However, Kingston recommends 2GB (and above) dual-channel memory to reinforce system performance and provide enough headroom for future applications.

Dual Channel - The Solution for Bandwidth

The type, clock rate and capacity of the memory supported by the motherboard are determined by the chipset. To further increase the bandwidth, Intel® has developed a dual channel solution first implemented with the 865 chipset, provided the two DDR2/DDR3 memory modules are of the same capacity and clock speed, and serial technology is used to expand the memory bus to 128bits. With these two DDR/DDR2 memories, data width is doubled, as well as the bandwidth.

For example, using two dual-channel DDR3 800 memory modules can create a total bandwidth of 12.8GB/s (6.4x2). Driven by the Intel® 3 series chipset and the launch of P35, X38 or other new generation chipsets, the motherboard now can support DDR3 1066MHz and 1333MHz memory modules. This means the data transfer rate is increased up to 17.0GB/s, 21.2GB/s or even faster.



The chart shows Intel's® P35 high-speed chipset provides 17.0GB/s data transfer bandwidth for DDR3 modules, and therefore allows users to utilize a dual-channel, DDR3 1066 solution.

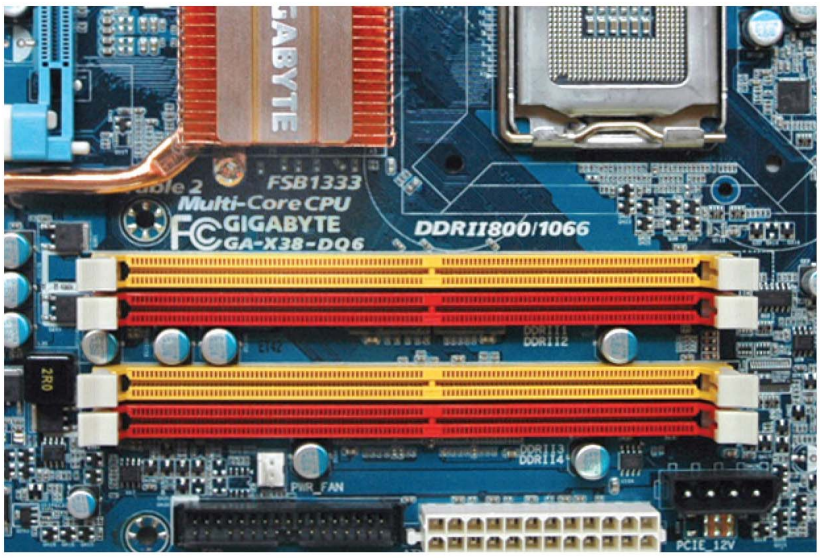
Comparison Table of DDR/DDR2/DDR3

Memory Type	DDR2 533 (PC2-4200)	DDR2 667 (PC2-5300)	DDR2 800 (PC2-6400)	DDR3 800 (PC3-6400)	DDR3 1066 (PC3-8500)	DDR3 1333 (PC3-10600)	DDR3 1600 (PC3-12800)
Single-Channel (64bit)	4.2GB/Sec	5.3GB/Sec	6.4GB/Sec	6.4GB/Sec	8.5GB/Sec	10.6GB/Sec	12.7GB/Sec
Dual-Channel (128bit)	8.4GB/Sec	10.6GB/Sec	12.8GB/Sec	12.8GB/Sec	17.0GB/Sec	21.2GB/Sec	25.4GB/Sec

About Memory Compatibility

When only one memory module is installed on the motherboard, there usually won't be any compatibility issues. However, when two or more memory modules are installed, it is advised to use modules of the same clock; otherwise, all memory modules will automatically work at a lower clock and a lower speed. For example, combining DDR2 667 and DDR2 800 together, the motherboard will default to DDR 667 speed. System stability will not be influenced, but you will not be using the capabilities of the DDR2 800 memory to the fullest. Although different specifications from different manufacturers have been introduced, using a combination of modules of different specifications will cause problems including system inability or failure to boot. To prevent such problems, the best policy is to purchase enough memory modules of the same specification. If users intend to increase the memory capacity at a later time, it is advised to use the modules from the same manufacturer for better compatibility.

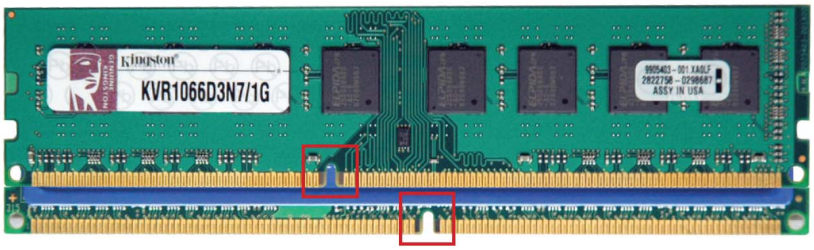
To enable the dual-channel functionality, users need to install the memory modules of the same specification and capacity on the assigned locations of the motherboard. Each pair of memory modules should be exactly the same. For different pairs, users need to use modules of the same speed regardless different capacities. For example, if the motherboard has 4 memory slots, users can install two DDR3 1066 1GB modules and two DDR3 800 512MB modules in a dual-channel mode. The computer will work at the speed of DDR3 800 (the lower speed of the modules) and use the dual-channel 128bits memory bus width to access the 3GB memory (1GBx2+512MBx2).



For motherboards that support the dual-channel architecture, different manufacturers usually use different colors to mark the paired memory slots. Before installation, make sure that the motherboard uses the same color or different colors to identify paired memory slots. The GIGABYTE motherboard above for example uses red and yellow colors to designate paired slot identification.

Understanding DDR2&DDR3·····

Although DDR3 modules are quickly becoming the mainstream solution, there are still DDR2 modules distributed in the market. Because there are so many different memory choices available, many beginning PC builders often purchase the wrong modules. DDR3 and DDR2 memory modules are not compatible as they are different in architecture, specification, working voltage, and even appearance. However, they do have the same amount of pins, so it can be difficult for users to see the differences with their eyes. That is why memory manufacturers have changed the location of the "fool-proof" grooves for DDR 3 memory, to prevent users installing the wrong type of memory on their motherboard, Users have to match the notch of the memory module with the projected part of the memory slot for installation.



The locations of the fool-proof grooves of DDR2 and DDR3 connecting fingers are different. Users cannot insert the modules in the wrong slots, which prevents damage to the modules due to improper installation.

Differences of Single Rank and Dual Rank·····

For both DDR and DDR2 modules, single-sided means single-rank, and double-sided means dual-rank. The number of memory modules supported by the motherboard depends on the chipset. If the chipset supports four ranks and is equipped with two memory slots, it means that the chipset supports two double-sided (dual-rank) memory modules at most. If the chipset supports the same number of ranks but there are four memory slots available, then two of the four slots will only support single-sided memory modules. You can find more detailed information in the documentation supplied with the motherboard.

This is the single-rank memory module.

The dual-rank memory module has two ICs on both sides.

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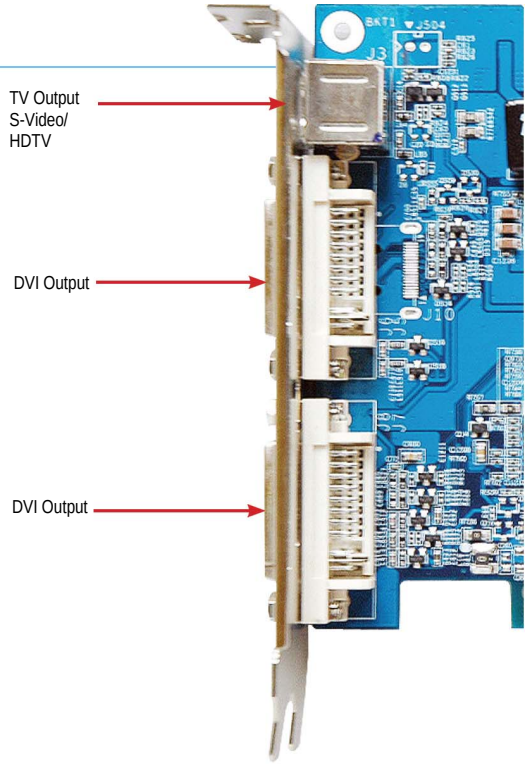
2.4 Graphics Accelerator

Basic Knowledge of Graphics Accelerators

The graphics accelerator, also known as Graphics Processing Units (GPU), has a built-in graphics chip. Two leading graphics chip design companies, NVIDIA® and ATI®, have developed an entirely new and unified GPU architecture compliant with DirectX® 10, addressing the problem of high-end gaming effects taking up too much of the processor's resources. Several DX10 games to be released in the second half of 2007, such as Supreme Commander, World in Conflict and Hellgate: London, require DX10 hardware support to show their new-generation light and shadow effects. DirectX® 10 graphics accelerators support the GeForce® 8 series from NVIDIA® which use GeForce® 8800/8600/8500/8400 graphics chips to meet the different needs of the high-end and mainstream markets.

The GeForce® 8 series from NVIDIA® supports DirectX® 10 unified color command set and Shader Model 4 as the standard for computer and next-generation game consoles. In addition, it has been optimized for the OpenGL® 2.0 technology. The series also uses the 128-bit High Dynamic Range (HDR) technology to create realistic image effects, and produces smooth 16x full scene anti-aliasing. Moreover, the popular NVIDIA® SLI technology allows two graphics accelerators to work in a parallel mode to create a double performance of a single GPU configuration.



➔ The GPU is not the only element to affect the performance of a graphics accelerator; the specific memory specification and capacity (GDDR) are also important factors for a graphics accelerator. The current capacity for the mainstream graphics memory is 128MB or 256MB (GDDR2); high-end products use faster 512MB~1GB GDDR3 or GDDR4 modules.