



Memory Experts

The friendly team of Memory Experts at Mr Memory have on average 9 years experience. They are fully knowledgeable on all things memory. Have a read through just some of that knowledge...

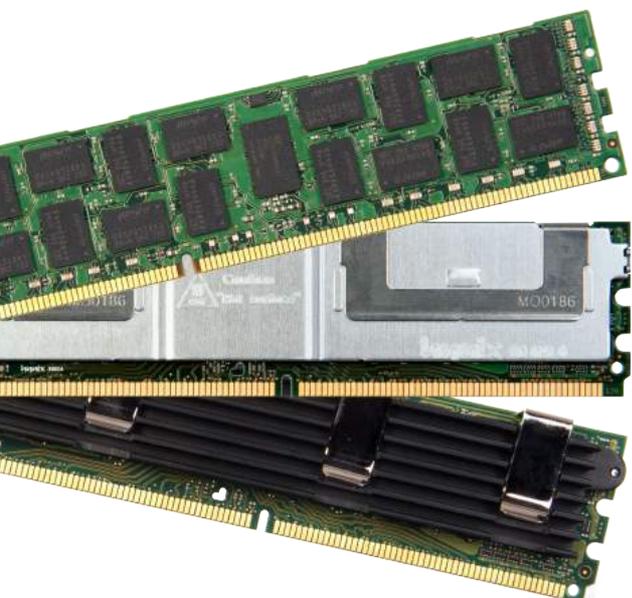
What is DRAM?

DRAM stands for Dynamic Random Access Memory. This is the memory that you use in Desktops, Laptops, Servers and other devices. A computer stores quickly accessible data in the form of 0's and 1's. It is dynamic because it refreshes its capacitor charge periodically with new electricity, compared to the older SRAM (Static Random Access Memory). Data is stored in the capacitors within an integrated circuit (also known as a Chip).

DRAM memory is a volatile memory – which means it loses its data very quickly once the power is removed. This is different from NAND Flash Memory used in devices such as USB Pen Drives or SD Cards. This is non-volatile (the data is permanently stored regardless of a power source).

DRAM History

Dr Robert Dennard at IBM invented DRAM in 1968. For the next few years, IBM developed this technology, releasing a commercially available DRAM in 1970, called the Intel 1103.



As the density increased throughout the 1970's and in the 1980's, Japanese DRAM manufacturers, who could sell higher quality modules at lower prices, overtook IBM.

Traditionally DRAM modules have an asynchronous interface, which means that they respond as quickly as possible to changes in control inputs.

SDRAM History

Synchronous Dynamic Random Access Memory (SDRAM) is memory that is synchronised with the System Bus (which connects all the major components of a computer system). Unlike DRAM, SDRAM waits for a clock signal before responding to control inputs.

SDRAM is organised into a grid structure (Banks) with rows (Word lines) and columns (Bit lines). Data stored is in blocks and are defined by the coordinates of the row and column of the specific information.

SDRAM was universally accepted in 1993, with the invention of the Samsung KM48SL2000. By 2000, SDRAM had replaced DRAM in nearly all computers, due to its better performance.

Memory Packaging

DIMM

DIMM (Dual In-line Memory Module) is a series of DRAM integrated circuits. The modules are mounted onto a PCB (Printed Circuit Board). They are replacements to SIMMs (Single In-line Memory Module), as the most popular type of module. They have separate electrical contacts on each side of the module and a 64-bit data path.

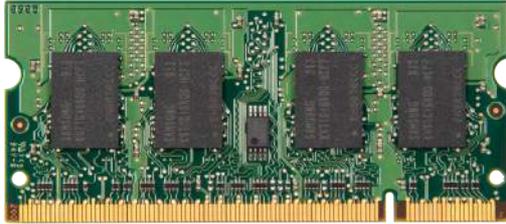


Non ECC DIMMs will have 8 chips on each side of the board. ECC DIMMs will have multiples of 9 chips per side.



SO DIMM

SO DIMMs (Small Outline Dual-Inline Memory Modules) are also built using integrated circuits. These are commonly used on Laptops, Netbooks, Routers, Printers, Notebooks and some Desktops (such as Apple iMacs). They are smaller in design than DIMMs (although roughly half the size) and have 4 or 8 chips on each side of the board.



Form Factors

Commonly used in DIMM's, modules can have different profile sizes. Most modules commonly used today are the same height and known as Low Profile (30.48mm). There is memory available known as 'Very Low Profile' (VLP), which is 18.75mm high. These were originally designed to fit into 1U Rackmount servers but are now used in many server designs, especially where access to the sockets is limited.



Generations of SDRAM

There are 5 main types of SDRAM on the market – SDR, DDR, DDR2, DDR3 & DDR4.

DDR (1) SDRAM

DDR (Double Data Rate) was introduced to read and write 2 words of data per clock cycle, to make the most of the potential bandwidth of DRAM. The voltage is also lower than SDR memory. Typical DDR types are 266, 333 and 400MHz.

DDR DIMMs have 184 pins in total (92 on each side) and a single notch. DDR SO-DIMMs have 200 pins in total and a single notch near one side. The usual voltage is 2.5V.

DDR2 SDRAM

Introduced in 2003, DDR2 doubles the minimum read and write of data to 4 words. It requires lower power as it runs the internal clock at half the speed of the data bus. The best DDR2 modules are twice as fast as the best DDR(1) modules. Typical DDR2 types are 533, 667 and 800MHz.



DDR2 DIMMs have 240 pins in total and a single notch. DDR2 SO-DIMMs have 200 pins in total and a single notch nearer to one side. You can use higher speed DDR2 modules with lower speed modules – the motherboard controller will be bound to the limits of the lower speed modules. We would always recommend using matching modules though, to give the best performance (and what is known as Dual Channel mode).

DDR3 SDRAM

Launched in 2007, DDR3 modules can transfer data at twice the rate of DDR2 modules and use less power (1.5V or 1.35V). Common speeds of DDR3 are 1066, 1333 and 1600MHz. Faster speeds than this are usually found in machines used for gaming – where speed is critical.

DDR3 DIMMs have 240 pins in total and a single notch. DDR3 SO-DIMMs have 204 pins in total and a single notch, closer to the centre than on 200 pin SO-DIMMs.

DDR3 also works in Dual Channel mode (kit of 2) and mainly benefit from Triple Channel mode (kit of 3).

DDR4 SDRAM

DDR4 modules have faster clock frequencies and data rates than DDR3 modules. They also have a lower voltage of 1.2V, compared to the DDR3 standard of 1.5V.

DDR4 DIMMs have 284 pins, which are slightly closer together than pins on older boards, to fit more on the board. DDR4 SO-DIMMs have 256 pins, which are also spaced closer together.

Error Correction Code

Error Correction Code (ECC) is a technique on certain kinds of RAM modules that detects data errors and corrects them. Errors occur due to electrical or magnetic interference inside the machine. This interference can corrupt the data being processed.

ECC memory is mostly used in Servers & Workstations. This is because the ECC function is able to detect and correct these errors with no input from a user - therefore increasing data reliability. This is vital because if an error occurred and was not corrected, the server would crash, causing problems for those reliant on the server and the information that it stores. Particularly those that host websites, as the websites would go down too.

These modules are manufactured in different ways to allow for different functions. The types are: Unbuffered, Registered & Fully Buffered.

Unbuffered

ECC Unbuffered memory does not include any buffers. It is the most commonly used memory and has a lower maximum capacity than Registered. The standard memory used for Laptops & Desktops is also called Unbuffered Memory, but it is the NON-ECC type. ECC Unbuffered modules will have nine chips on one or both sides of the module as opposed to 8 on a standard Non-ECC module. The ninth chip is the ECC chip.

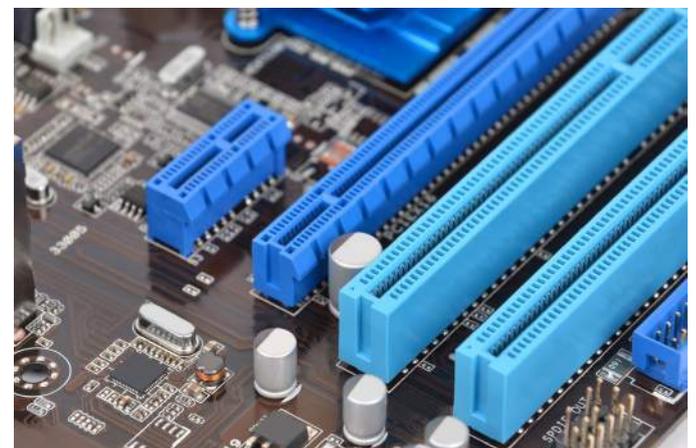


So the physical layout of the different ranked modules does not necessarily vary, but you will always be able to tell the rank of the module from the manufacturer's label or from the part code.

When talking about ranks, you will often hear the term banks. These go hand in hand as the amount of ranks on a module is always followed by the amount of banks. For instance a module may be 2Rx8, the x8 part refers to the number of banks that are on each memory chip. It is the amount of banks on a chip combined with how many chips there are that determine the rank of a module. The amount of banks on a chip and chips on a module does vary which leads to many different combinations of ranks and banks such as 1Rx4, 2Rx4 and 4Rx8 to give just a few examples.

This combination of ranks and banks is commonly referred to as the chip settings of the memory, or 'Chipset'.

Generally Single Rank is faster than Dual Rank and both are faster than Quad Rank. This is simply because when the computer accesses the memory it only needs to go around the Single Rank memory once, rather than twice for Dual Rank memory.



Some machines will only work with one particular Rank but some can have Single and Dual Rank modules installed, some servers actually require this combination in order to use a certain amount of memory, such as 16Gb.

The ranks and banks of a module tends to be much more important when adding memory to a server, but can also affect desktop computers. Some models have a limitation for the amount of ranks they can accept and the memory may need to be of a particular bank design.

For example, if a server can address 8 ranks and has a 16Gb maximum, you could have 8 x 2Gb Single Rank modules but it would not work with 8 x 2Gb Dual Rank modules as this is exceeding 8 ranks. Also a server may need Dual Rank 2Gb modules but will only work with 2Rx4 and not 2Rx8.

It is important to know the rank and bank specifications of your server as some servers will only accept a certain rank and bank combination and this could also change with different speeds and sizes of memory within the same server. But this is something that we have a great understanding on so can easily assist if you are not sure which rank and bank of memory you require.

Registered

Registered Modules have buffers for a better flow of data. This increases data reliability when compared to Unbuffered memory (which does not have any buffers). They place less electrical load on the Memory Controller, allowing systems to be stable with more memory modules in. These modules also have the extra ECC chip but will have an added chip to make it ECC registered.

Modern Servers are equipped to deal with either DDR3 Unbuffered or Registered memory. However, they cannot accept mixed, it must be one or the other.

Fully Buffered

FB DIMM (Fully Buffered Memory) takes some of the functions of the Memory Controller and puts it on the memory module. It has an advanced memory buffer, enabling an increase to the width of the module but keeping the pin count of the memory controller at a reasonable level.

These are only available for DDR2 memory. However the notch on the FB DIMM is in a different location compared to a standard DDR2 DIMM so that you can't install the wrong one into a machine.

Ranking

The term "Rank" was created by JEDEC. It is a 64-bit of data (72-bit on ECC). A memory rank is an area of data that is created using all or some of the memory chips on the module.

The different ranks are: Single Rank (1R), Dual Rank (2R) and Quad Rank (4R). It is not necessarily the amount of chips on a module that determines its rank, it can depend on how the chips are engineered. A module with chips on both sides could still be any of the above ranks.

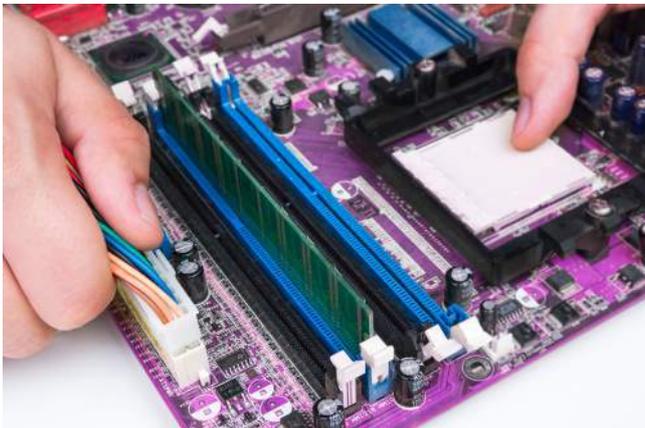
For example, a 4Gb Single Rank module could have 8 chips in total, however both a 4Gb Dual or Quad Rank module could have the same quantity of 16 chips. Not every size of memory will be available in each rank, so for instance you could not get a 1Gb Quad Rank module.

Latency

Latency is the delay between transmitting data between the CPU (Central Processing Unit) and SDRAM. It is measured in memory bus clock cycles.

SDRAM access has 4 main clock cycles:
(t stands for time)

- t_{CAS} – the number of clock cycles required to read a column of data on the SDRAM module (Column Access Strobe).
- t_{RCD} – the delay between the Row Address Strobe (RAS) and the CAS. Represents the delay between CPU defining the row and column of the memory block and the actual read or write to that row and column.
- t_{RP} – Row Precharge time. The number of clock cycles needed to terminate access on a given row, and to open access on the next row.
- t_{RAS} – Active to Precharge delay (Row Active Time). The number of clock cycles between the data request and precharge command of a given row inside a memory block.



The JEDEC Standard defines that each row must be refreshed every 64ms or less. Refresh logic is provided in the DRAM Controller, which ensures that the Data Bus is never required for a read and a write at the same time.

JEDEC

The Joint Electron Device Engineering Council is an independent organisation, which develops standards for the microelectronics industry. They have over 3,000 volunteers who represent almost 300 member companies.



JEDEC committees developed the standards for specifications of DRAM memory and flash components. All memory supplied by Mr Memory is JEDEC compliant and the Memory Experts are fully familiar with all their standards requirements.



DRAM Brands

At Mr Memory, we are not tied to one particular brand. We have a variety of worldwide, billion-dollar brands at our disposal and we work with each manufacturer to find the best solution for our customer's needs. Sometimes our customers will require a specific part number to match modules that they already have installed.

Just some of the brands that we work with daily include – Hynix, Elpida, Elixir, Kingston, Micron, Integral, Nanya, Qimonda and Samsung.

Installation

As part of our DRAM knowledge, we completely comprehend the installation process of the memory modules. For years, Mr Memory have assisted remotely with installation for our customers – be it Desktops, Laptops or Servers.

Some Memory Experts recently assisted with the making of generic installation videos for the Mr Memory YouTube Channel. There are plans for specific video guides too.

With access to detailed technical information on computer models, the Memory Experts regularly assist with explaining which boards should go into which slots, in which combination and will know the best configuration for the particular machine to get the best performance.

Memory Experts also assisted with installation support, in situations where the memory is not working on the first attempt. Due to the years of experience in the industry and the knowledge they have drawn from the founder of Mr Memory, Memory Experts can usually very easily determine the issue and resolve it for the customer on the spot.





Apple Computers

There is no requirement to purchase your RAM directly from Apple, which is great as they are very expensive! The specifications for the RAM modules are not any different from standard PC RAM. Like PC RAM, it simply comes down to matching the requirements of Pin Count and Speed.

It is best, when purchasing your new Apple Computer, to buy it without upgrades. Purchasing the upgrades from Mr Memory will save you a lot of money and your computer will not know any different.

Some Apple computers can be a little tricky to install the memory. Using iMacs within the company, Memory Experts are fully experienced on upgrading them and can also provide detailed installation aides - such as PDFs and Videos to assist with your installation. Memory Experts have access to a complex database and various technical data sheets to ensure the exact memory configuration for your Apple Computer.

Original Mac Pro machines take a type of FB DIMM that will only fit and work in these older Mac Pros. These come with larger than normal heatsinks on the modules. Mac Pros from 2009 onwards do not require these specific FB modules.

Dell Computers

Certain Dell Computers and Servers can be very particular in the type of rank and chipset that they accept. Experts have been heavily involved in perfecting the Mr Memory database on these machines, so that they are fully aware of the specifications of each type.



Specific Dell Poweredge models, for example, will only take Quad Rank Server modules at a certain size and speed. Experts know how valuable Server uptime is to companies and by sending the correct memory first time, can minimise Server downtime – making the company much more efficient. Experts also regularly source Dell Original Branded memory modules for customers that require it.

HP Original Branded Products

Memory Experts know that for some critical HP server systems, there are customers who will only accept HP Original Branded products. In these cases, we happily supply HP Original Branded memory to Mr Memory customers, which is covered by the HP Worldwide Warranty Agreement.



Experts are fully competent in working with part numbers provided, to source the correct speed, chipset and rank to match the individual server specifications.

NAND Flash Memory

NAND Flash memory is non-volatile storage. This means that it retains data even if it is non-powered and it can be electrically erased and reprogrammed. In comparison, RAM is volatile, which means it loses anything it contains when the power is lost. NAND Flash memory is widely used for Camera, Phone and Tablet Storage.



Mr Memory supplies a wide range of USB Pen Drives, SD Cards, Micro SD Cards and Compact Flash Cards. Experts are also fully competent in Encrypted Flash Memory too, including FIPS 197 and military level encryption algorithm standards (FIPS 140-2).

Some of the brands that are used at Mr Memory include SanDisk, Blockmaster, Kingston, Integral, Ironkey and SafeXs. We also have customers that require printed customised memory – which Experts regularly arrange.

Industrial Memory

Mr Memory supplies Industrial Grade memory products that are specifically designed for use in mission-critical applications and the most demanding environments. For example, Healthcare, Military, Aerospace, Nautical, Automotive, Telecommunication, Surveillance and Gaming.



For Secure Digital (SD) and Compact Flash (CF) Cards, Mr Memory works with manufacturers to obtain the precise specifications required to give the optimum perfection in the customer's device.

Mr Memory also supplies Industrial Solid State Drives (SSD), which are available in a variety of formats including SATA and PATA. They are also available with military level AES 256-bit Full Disk Encryption.

Experts regularly supply Industrial DRAM to customers requiring that specific type of memory for their field, which are all JEDEC compliant and range from -40° to + 85°. These are always modules that are certified by the top motherboard manufactures in the world.

Operating Systems

To understand DRAM, you need to have a good awareness of Computer Operating Systems and their limitations. Memory Experts have assisted on a video on this topic for the Mr Memory YouTube Channel.



For example, Experts know that most non-server editions of Windows 32-bit are restricted by a 4Gb memory limitation. The amount of useable RAM in these machines will be between 3 and 3.5Gb. A small percentage of the memory may also be lost for the use of the on-board graphics and video card. This amount can be adjusted in the BIOS.

Solid State Drives (SSDs)

SSDs are a modern replacement to Hard Disk Drives. They are smaller and flatter in their design and have many benefits over traditional Hard Drives.



Solid State Drives are up to 20 times faster than traditional Hard Drives. They also consume far less power and are virtually silent. This is due to SSDs having no moving parts, like Hard Drives do.

Installation is fairly straightforward for SSDs and Memory Experts can provide full detailed advice and support if and when needed. SSDs supplied by Mr Memory also come with Installation Kits.

Installation of SSDs for Apple Computers is more tricky but Mr Memory Experts are fully trained and on hand to assist in any cases of confusion.

Mr Memory Process

In order to constantly improve and keep current DRAM knowledge, Experts regularly interact with all the departments of Mr Memory.

Database & Website

The IT team, responsible for the Mr Memory database and website, often consult with Experts for their knowledge of DRAM and other memory products, to make sure the Mr Memory website is current and accurate. Any changes or updates that Experts are made aware of on particular models, they then pass this knowledge immediately to the IT team so the website can be updated.



The Memory

Mr Memory's stock is stored in anti-static packaging at the optimum temperature. For security purposes, it is held in a secure location. The Dispatch Team use anti-static equipment when handling the memory for testing and packing. Every module is tested using a state-of-the-art Ram Check Machine before it is dispatched to the customer. This machine tests to see that the module is the correct size, speed, rank and voltage.

To get the best memory brands in the world at the best prices, our purchasing team work very closely with manufacturers and suppliers worldwide. Experts get involved with this too, on occasions, again to keep their knowledge fresh and maintain the great relationship they have with Mr Memory's worldwide suppliers.

To protect the memory, it is sent in anti-static bags, within tough and waterproof packaging. Majority of Mr Memory's deliveries are sent via a tracked service, so they can be monitored throughout the delivery process.

Customer Care & Support

Experts have assisted many times with the Customer Care & Support Team, helping with customer queries via telephone, emails, support forms or live chat. This is very rewarding work – assisting a customer very quickly, in a patient and friendly manner, to get their machines up and running in a short space of time.



The Mr Memory brand is all about the customer. We start with the customer and end with the customer. Every procedure that is added is how to make things simpler and quicker for our customers, so they end up with the best performing computers and servers.

To Contact a Memory Expert:

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Live Chat - mrmemory.co.uk/contact

Mr Memory[®]

