



## Product Support

# What is the difference between SDRAM, DDR1, DDR2, DDR3 and DDR4?

Category : Specification / Capacity / Performance

SDRAM (Synchronous Dynamic Random Access Memory):

"Synchronous" tells about the behaviour of the DRAM type. In late 1996, SDRAM began to appear in systems. Unlike previous technologies, SDRAM is designed to synchronize itself with the timing of the CPU. This enables the memory controller to know the exact clock cycle when the requested data will be ready, so the CPU no longer has to wait between memory accesses. For example, PC66 SDRAM runs at 66 MT/s, PC100 SDRAM runs at 100 MT/s, PC133 SDRAM runs at 133 MT/s, and so on.

SDRAM can stand for SDR SDRAM (Single Data Rate SDRAM), where the I/O, internal clock and bus clock are the same. For example, the I/O, internal clock and bus clock of PC133 are all 133 Mhz. Single Data Rate means that SDR SDRAM can only read/write one time in a clock cycle. SDRAM have to wait for the completion of the previous command to be able to do another read/write operation.

DDR SDRAM (Double Data Rate SDRAM):

The next generation of SDRAM is DDR, which achieves greater bandwidth than the preceding single data rate SDRAM by transferring data on the rising and falling edges of the clock signal (double pumped). Effectively, it doubles the transfer rate without increasing the frequency of the clock. The transfer rate of DDR SDRAM is the double of SDR SDRAM without changing the internal clock. DDR SDRAM, as the first generation of DDR memory, the prefetch buffer is 2bit, which is the double of SDR SDRAM. The transfer rate of DDR is between 266~400 MT/s. DDR266 and DDR400 are of this type.

DDR2 SDRAM(Double Data Rate Two SDRAM):

Its primary benefit is the ability to operate the external data bus twice as fast as DDR SDRAM. This is achieved by improved bus signal. The prefetch buffer of DDR2 is 4 bit(double of DDR SDRAM). DDR2 memory is at the same internal clock speed (133~200MHz) as DDR, but the transfer rate of DDR2 can reach 533~800 MT/s with the improved I/O bus signal. DDR2 533 and DDR2 800 memory types are on the market.

DDR3 SDRAM(Double Data Rate Three SDRAM):

DDR3 memory reduces 40% power consumption compared to current DDR2 modules, allowing for lower operating currents and voltages (1.5 V, compared to DDR2's 1.8 V or DDR's 2.5 V). The transfer rate of DDR3 is 800~1600 MT/s. DDR3's prefetch buffer width is 8 bit, whereas DDR2's is 4 bit, and DDR's is 2 bit. DDR3 also adds two functions, such as ASR (Automatic Self-Refresh) and SRT (Self-Refresh Temperature). They can make the memory control the refresh rate according to the temperature variation.

DDR4 SDRAM (Double Data Rate Fourth SDRAM):

DDR4 SDRAM provides the lower operating voltage (1.2V) and higher transfer rate. The transfer rate of DDR4 is 2133~3200 MT/s. DDR4 adds four new Bank Groups technology. Each bank group has the feature of singlehanded operation. DDR4 can process 4 data within a clock cycle, so DDR4's efficiency is better than DDR3 obviously. DDR4 also adds some functions, such as DBI (Data Bus Inversion), CRC (Cyclic Redundancy Check) and CA parity. They can enhance DDR4 memory's signal integrity, and improve the stability of data transmission/access.

DDR SDRAM Standard	Internal rate (MHz)	Bus clock (MHz)	Prefetch	Data rate (MT/s)	Transfer rate (GB/s)	Voltage (V)
SDRAM	100-166	100-166	1n	100-166	0.8-1.3	3.3
DDR	133-200	133-200	2n	266-400	2-1-3-2	2.5/2.6

DDR3	133-200	533-800	8n	1066-1600	8.5-14.9	1.35/1.5
DDR4	133-200	1066-1600	8n	2133-3200	17-21.3	1.2

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Yes

NO

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