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Power Macintosh: L1 and L2 Cache Explained (4/97)

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TOPIC -----

What are the differences between Level 1 and Level 2 cache on the Power Macintosh computers? Do all Power Macintosh computers use the same type of L2 cache?

DISCUSSION -----

Level 1 Cache
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Level 1 Cache consists of high speed memory built into the PowerPC processor. By using this cache, the processor can access frequently-requested data more quickly. The amount of Level 1 cache varies among the PowerPC chips, and you cannot upgrade it.

The PowerPC 601 microprocessor and the PowerPC 604 microprocessor both have 32K internal cache. However, the PowerPC 601 microprocessor has a single 32K cache for both instructions and data, whereas the PowerPC 604 has two 16K sections, one for instructions and one for data. The PowerPC 604e microprocessor has 64K cache, which consists of two 32K sections, one each for instructions and data.

Begin_Table

Computer	L1 Cache
Power Macintosh 4400 series	32K
Power Macintosh 5200/75 & Performa 5200 Series	16K
Power Macintosh 5260/100, 5300/100 & Performa 5300 Series	32K
Power Macintosh 5400 Series	32K
Power Macintosh 5500 Series	32K
Macintosh Performa 6200 Series	16K
Macintosh Performa 6290CD and 6300 Series	32K
Macintosh Performa 6360/160	32K

Power Macintosh & Performa 6400 Series	32K
Power Macintosh 6500 Series	32K
Power Macintosh & Performa 6100 Series	32K
Power Macintosh 7100 Series	32K
Power Macintosh 8100 Series	32K
Power Macintosh 7200 Series	32K
Power Macintosh 7300 Series	64K
Power Macintosh 7500/100	32K
Power Macintosh 7600/120 and /132	32K
Power Macintosh 7600/200	64K
Power Macintosh 8500/120	32K
Power Macintosh 8500/132	32K
Power Macintosh 8500/150	32K
Power Macintosh 8500/180	64K
Power Macintosh 8600/200	64K
Power Macintosh 9500/120	32K
Power Macintosh 9500/132	32K
Power Macintosh 9500/150	32K
Power Macintosh 9500/180MP	64K
Power Macintosh 9500/200	64K
Power Macintosh 9600/200	64K
Power Macintosh 9600/200MP	64K

End_Table

Level 2 Cache

Level 2 Cache is separate from the processor and it is typically upgradeable. The Level 2 cache works in conjunction with the microprocessor's internal cache to provide maximum performance. The total amount of supported Level 2 Cache also varies from computer.

Performance Benefits

* Native PowerPC Software

You see the greatest performance improvement in tightly written native PowerPC software where code is kept close to the microprocessor.

* Non-Native Software

You will likely see marginal or no performance improvements running software applications written for 68000-series microprocessors.

PowerPC Microprocessors

The reason for performance increases with the addition of L2 cache is the PowerPC microprocessor can keep its pipeline full, allowing for faster and more efficient processing. The microprocessor first checks its internal cache, then L2 cache, and finally main memory (DRAM) for instructions. Because cache memory

is faster than DRAM, it can be accessed more quickly, thus helping keep the pipeline full.

This also accounts for the lack of uniform performance improvements. Tight code will stay near the processor and run faster, while other code may not. In general, you can expect a 10-15% performance improvement with code that benefits from L2 cache.

Power Macintosh Models

The Nubus-based Power Macintosh computers (which include the 6100, 7100, and 8100 series) and the PCI-based Power Macintosh computers (which include the 7200, 7500, 8500, and 9500 series) do not use the same type of L2 cache.

* Power Macintosh 6100, 7100, and 8100

The 6100, 7100 and 8100 Power Macintosh models accept an external L2 cache on a Single Inline Memory Module (SIMM). The Power Macintosh 8100/80 shipped with 256K L2 cache already installed; users of Power Macintosh 6100/60, 6100/60AV, 7100/66, and 7100/66AV can install a L2 cache by installing the appropriate cache SIMM into the 160-pin connector on the main logic board.

The Power Macintosh 6100/66, 7100/80, 8100/100, and 8100/110 computers ship with 256K L2 cache memory installed.

* Power Macintosh 7200, 7300, 7500, 7600, 8500, 8600, 9500, and 9600

The Power Macintosh 7200, 7300, 7500, 7600, 8500, and 8600 series all support L2 cache 160-pin Dual Inline Memory Modules (DIMMs). The cache can be increased by adding L2 cache DIMMs to the expansion slot(s) on the logic board.

The Power Macintosh 7200/75, 7200/90, 7200/120 (8 MB configuration), and the 7500 series computers ship with no L2 cache DIMM installed.

The Power Macintosh 7200/120 (16 MB configurations), 7300 series, 7600 series, 8500 series, and the 8600 series include a 256K L2 cache DIMM installed. The Power Macintosh 7200 is theoretically expandable to 1 MB, while the 7300, 7500, 7600, 8500, and 8600 series computers are theoretically expandable to 4 MB, but those configurations have not been tested and are not supported by Apple.

The Power Macintosh 9500 and 9600 series computers ship with 512K L2 cache memory soldered to the logic board. The Power Macintosh 9500 and 9600 series computers do not have a DIMM socket for adding additional L2 cache memory, and therefore are not expandable beyond 512K.

Begin_Table

Power Macintosh Series	L2 Cache Included	Cache Type	Supported Cache SIMM/ DIMM Sizes	Maximum Total Cache

4400	256K (optional on some configurations)	160-pin DIMM	256K	256K
5200	256K	On logic board	N/A	256K
5260	OPTIONAL	160-pin SIMM	256K	256K
5300	256K	On logic board	N/A	256K
5400	OPTIONAL	160-pin DIMM	256K	256K
5500/225	256K	160-pin DIMM	256K	256K
6200	256K	On logic board	N/A	256K
6300	256K	On logic board	N/A	256K
6360	OPTIONAL	160-pin DIMM	256K	256K
6400/180	NONE	160-pin DIMM	256K	256K
6400/200	256K	160-pin DIMM	256K	256K
6500/225	256K	160-pin DIMM	256K	256K
6500/250	256K	160-pin DIMM	256K	256K
6100/60	OPTIONAL	160-pin SIMM	128K, 256K	256K
6100/66	256K	160-pin SIMM	128K, 256K	256K
7100/66	OPTIONAL	160-pin SIMM	128K, 256K	256K
7100/80	256K	160-pin SIMM	128K, 256K	256K
8100	256K	160-pin SIMM	128K, 256K	256K
7200/75	NONE	160-pin DIMM	256K*	256K*
7200/120	256K DIMM	160-pin DIMM	256K*	256K*
7300 Series	256K DIMM	160-pin DIMM	256K,512K,1 MB**	1 MB**
7500/100	NONE	160-pin DIMM	256K,512K,1 MB**	1 MB**
7600 Series	256K DIMM	160-pin DIMM	256K,512K,1 MB**	1 MB**
8500 Series	256K DIMM	160-pin DIMM	256K,512K,1 MB**	1 MB**
8600 Series	256K DIMM	160-pin DIMM	256K,512K,1 MB**	1 MB**
9500 Series	512K	On logic board	N/A	512K
9600 Series	512K	On logic board	N/A	512K

End_Table

Notes

Apple does not sell cache modules larger than 256K.

Apple does not support cache modules larger than 256K.

*These computers theoretically support 512K and 1 MB of L2 cache, but these configurations have not been tested and are not supported by Apple.

** These computers support a theoretical limit of 4 MB of L2 cache, but this has not been tested and is not supported by Apple.

The Power Macintosh 7200/120 configuration with 8 MB of memory does NOT include the L2 Cache DIMM.

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