

RAM Expansion Card for PowerBook 190 and PowerBook 5300 Computers

The information in this error note supersedes certain information about the RAM expansion card in the developer note for the Macintosh PowerBook 190 computer. Some information in this error note also applies to the Macintosh PowerBook 5300 computer. The developer notes for both those computers are included in *Macintosh Developer Note Number 14*, available through APDA. Electronic versions of the individual developer notes are available on the Reference editions of the developer CDs released since September 1995.

The most immediate error in the *Macintosh PowerBook 190 Developer Note* is in the description of the signals on the RAM expansion connector. Whereas the developer notes for the two computers show identical signal assignments on the connector, in actuality, two signals are swapped in the PowerBook 190 computer. The affected signals are RA(9) and RA(11) on pins 8 and 107.

This error note describes the signals affected by the error and explains the differences in the way the PowerBook 190 and PowerBook 5300 computers handle RAM expansion. This note also provides additional guidelines for developers who are designing RAM expansion cards for those two computers.

Summary of Errors

Here is a list of the errors in the *Macintosh PowerBook 190 Developer Note* that are described in this error note.

- In Table 4-8 on pages 40 and 41, the signal on pin 8 should be RA(9) and the signal on pin 107 should be RA(11). For details, please see page 5.

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- In Table 4-9 on page 42, signals /RASL(1-3) and /RASH(1-3) should be RASL(1-2) and /RASH(1-2). For details, please see page 3.
- In the text under the heading “Banks of RAM” on page 44, signals /RASL(2-3) and /RASH(2-3) should be /RASL(1-2) and /RASH(1-2). For details, please see page 3.

In the remainder of this error note, each of the individual errors listed above appears in context and is described in a paragraph that look like this:

Error

Text describing a specific error. ♦

Explanations and Guidelines

The same RAM expansion card can be used in both the PowerBook 190 computer and the PowerBook 5300 computer, but the design of the card must take into account the differences in the computers. This section describes those differences and explains how they affect the design of the RAM expansion card.

Memory Banks

The signals on the RAM expansion connector include eight RAS lines. Each RAS line selects one of eight banks of memory, as shown in Table E-1.

Table E-1 RAM bank selection

Signal name	Bank number	Bank location
/RASH(0)	0	Main logic board
/RASL(0)	1	Main logic board
/RASH(1)	2	RAM expansion card
/RASL(1)	3	RAM expansion card
/RASH(2)	4	RAM expansion card
/RASL(2)	5	RAM expansion card
/RASH(3)	6*	RAM expansion card
/RASL(3)	7*	RAM expansion card

* Banks 6 and 7 are not used in the PowerBook 190 computer

IMPORTANT

The Macintosh PowerBook 190 computer does not use signal lines /RASH(3) and /RASL(3) and does not support banks 6 and 7. ▲

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Error

Table 4-9 on page 42 of the *Macintosh PowerBook 190 Developer Note* shows signals /RASL(1-3) and /RASH(1-3) available for selecting DRAM devices on the RAM expansion card. In fact, only /RASL(1-2) and /RASH(1-2) can be used for that purpose; /RASL(3) and /RASH(3) are not supported in the PowerBook 190 computer. ♦

Error

The text under the heading “Banks of RAM” on page 44 of the *Macintosh PowerBook 190 Developer Note* states that signals /RASL(2-3) and /RASH(2-3) are used for selecting banks of RAM on the RAM expansion card. The actual signals used are /RASL(1-2) and /RASH(1-2). ♦

Note

Some configurations of the Macintosh PowerBook 5300 computer have only 8 MB of RAM on the main logic board. That RAM is addressed as bank 1 and selected by the /RASL(0) line. In theory, it is possible for RAM expansion cards to make use of the /RASH(0) line and locate bank 0 on the card, but Apple Computer, Inc., does not support such cards. ♦

Memory Controller ICs

The PowerBook 5300 and PowerBook 190 computers use different custom ICs to provide memory control signals.

Memory Controller in the PowerBook 5300

The custom IC that generates the memory control signals in the PowerBook 5300 computer is the PBX IC. It provides the address multiplexing and refresh signals for the DRAM devices.

In the PowerBook 5300 computer, the physical banks of RAM do not have to be populated in order. Any combination of banks may be populated, because the PBX IC has a memory bank decoder that maps the memory pages to the eight banks of physical RAM. At startup time, the system software maps the memory banks to contiguous pages by writing appropriate values into the IC's register file.

Memory Controller in the PowerBook 190

In the PowerBook 190 computer, a custom IC called the Pratt IC generates the memory control signals. The Pratt IC provides address multiplexing and refresh signals for the DRAM devices.

IMPORTANT

Unlike the PowerBook 5300, the PowerBook 190 requires banks of RAM to be populated in order (contiguous). ▲

Address Lines and Multiplexing

Table E-2 is a corrected and expanded version of Table 4-10 in the *Macintosh PowerBook 190 Developer Note*. The first and second rows show the actual address bits that drive each address pin during row addressing and column addressing, respectively. The third row shows how the device's address pins are connected to the signals on the RA(0-11) bus.

IMPORTANT

Some types of DRAM devices don't use all 12 bits in the row or column address. The table shows the bit numbers for those unused bits in italics; bit numbers for the bits that are used are shown in bold. ▲

Table E-2 Address multiplexing for some typical DRAM devices

Type of DRAM device	Individual signals on DRAM_ADDR bus											
	[11]	[10]	[9]	[8]	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]
1 M × 16, 12 row bits, 8 column bits												
Row address bits	21	20	19	18	17	16	15	14	13	12	11	10
Column address bits	<i>19</i>	<i>21</i>	<i>18</i>	<i>22</i>	9	8	7	6	5	4	3	2
Device address pins	11	10	9	8	7	6	5	4	3	2	1	0
2 M × 8, 12 row bits, 9 column bits												
Row address bits	21	20	19	18	17	16	15	14	13	12	11	10
Column address bits	<i>19</i>	<i>21</i>	<i>18</i>	<i>22</i>	9	8	7	6	5	4	3	2
Device address pins	11	10	9	8	7	6	5	4	3	2	1	0
2 M × 8, 11 row bits, 10 column bits												
Row address bits	21	20	<i>19</i>	18	17	16	15	14	13	12	11	10
Column address bits	19	<i>21</i>	<i>18</i>	<i>22</i>	9	8	7	6	5	4	3	2
Device address pins	10	9	—	8	7	6	5	4	3	2	1	0
512 K × 8, 10 row bits, 9 column bits												
Row address bits	<i>21</i>	20	19	<i>18</i>	17	16	15	14	13	12	11	10
Column address bits	<i>19</i>	<i>21</i>	<i>18</i>	<i>22</i>	9	8	7	6	5	4	3	2
Device address pins	<i>10</i>	9	8	—	7	6	5	4	3	2	1	0

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As a comparison of Table E-2 with Table 4-10 in the developer note will show, the address-bit assignments are unchanged for the first two types of DRAM devices—1 M by 16 with 12 by 8 address bits and 2 M by 8 with 12 by 9 address bits.

The address-bit assignments for the third type of DRAM devices—2 M by 8 with 11 by 10 address bits—reflect the interchange of the RA(9) and RA(11) signals.

Error

Table 4-8 on pages 40 and 41 of the *Macintosh PowerBook 190 Developer Note* shows signal RA(11) on pin 8 and signal RA(9) on pin 107. In fact, RA(9) is connected to pin 8 and RA(11) is connected to pin 107. ♦

IMPORTANT

Connecting the RA(9) and RA(11) signals as shown in Table E-2 makes it possible for a RAM expansion card using 2 M by 8 DRAM devices with 11 by 10 address bits to function properly in either a PowerBook 190 computer or a PowerBook 5300 computer. ▲

Table E-2 also shows address-bit assignments for a fourth type of DRAM devices: 512 K by 8 devices with 10 by 9 address bits.

IMPORTANT

An expansion card using 512 K by 8 devices and designed for the PowerBook 190 computer will not function properly in a PowerBook 5300 computer. ▲

E R R O R N O T E

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