US006850414B2

(12) **United States Patent**
Benisek et al.

(10) **Patent No.: US 6,850,414 B2**
(45) **Date of Patent: Feb. 1, 2005**

(54) **ELECTRONIC PRINTED CIRCUIT BOARD HAVING A PLURALITY OF IDENTICALLY DESIGNED, HOUSING-ENCAPSULATED SEMICONDUCTOR MEMORIES**

(75) Inventors: **Martin Benisek**, München (DE); **Martin Schober**, Gröbenzell (DE)

(73) Assignee: **Infineon Technologies AG**, Munich (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 374 days.

(21) Appl. No.: **10/187,763**

(22) Filed: **Jul. 2, 2002**

(65) **Prior Publication Data**

US 2003/0002262 A1 Jan. 2, 2003

(30) **Foreign Application Priority Data**

Jul. 2, 2001 (DE) 101 31 939

(51) **Int. Cl.**[7] **H05K 1/00**; H05K 1/18; H05K 1/16; H05K 7/02; H05K 7/06

(52) **U.S. Cl.** **361/748**; 361/760; 174/260

(58) **Field of Search** 361/728–730, 361/735, 736–737, 748, 749, 760, 763, 767, 768, 807, 808, 785, 788, 790, 791, 803; 257/693, 684, 679, 678; 711/301; 714/773; 365/51–52, 63; 174/250, 253, 255–256, 260

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,656,605	A *	4/1987	Clayton	365/52
5,572,457	A *	11/1996	Michael	365/52
6,208,546	B1 *	3/2001	Ikeda	365/51
6,222,739	B1 *	4/2001	Bhakta et al.	361/790
6,492,714	B1 *	12/2002	Kasatani	257/678
6,725,414	B2 *	4/2004	Seyyedy	714/773
6,784,526	B1 *	8/2004	Mezawa	257/679

OTHER PUBLICATIONS

Internal Publication: "PC SDRAM Serial Presence Detect (SPD) Specification", Intel, Revision 1.2B, Nov., 1999, pp. 1–30.

Internal Publication: "PC SDRAM Registered DIMM Design Support Document", Intel, Revision 1.2, Oct., 1998, pp. 1–61.

Internal Publication: "133 MHz PC SDRAM 64–Bit Non–ECC/Parity 144 Pin Unbuffered SO–DIMM Specification", Intel, Revision 1.0C, Aug., 2000, pp. 1–30.

Internal Publication: "Platinenlayout Nr. ASE0015 im Gerber–Format" [Mounting Plate–Layout No. ASE0015 in Gerber–Format], IBM, picture 1.

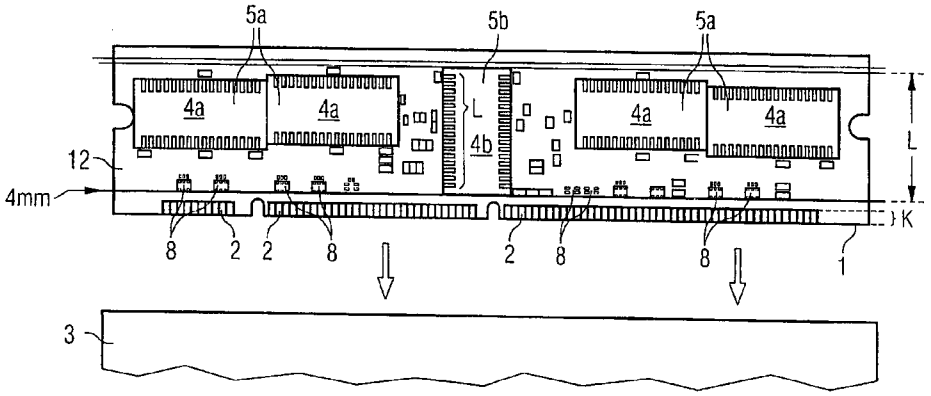
* cited by examiner

Primary Examiner—Phuong T. Vu
(74) *Attorney, Agent, or Firm*—Laurence A. Greenberg; Werner H. Stemer; Ralph E. Locher

(57) **ABSTRACT**

An electronic printed circuit board has a memory module and a contact strip for insertion into another electronic unit. The memory module has at least nine identically designed housing-encapsulated integrated semiconductor memories configured on the printed circuit board. The longer dimension of the housing of one of the semiconductor memories, which is connected as an error correction chip, is oriented perpendicular to the contact strip. The longer dimension of the housings of the other semiconductor memories are oriented parallel to the contact strip. The different orientation of the semiconductor memories makes it possible to reduce the height of the printed circuit board while enabling the rectangular housings to keep the same physical form.

8 Claims, 3 Drawing Sheets



Prior Art

FIG. 1A

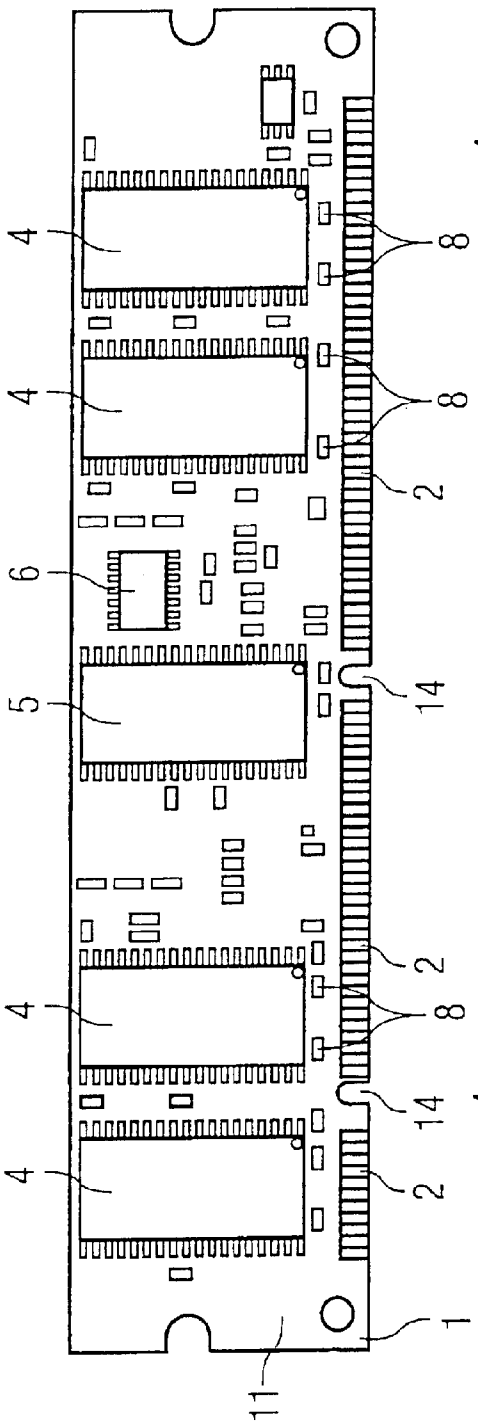
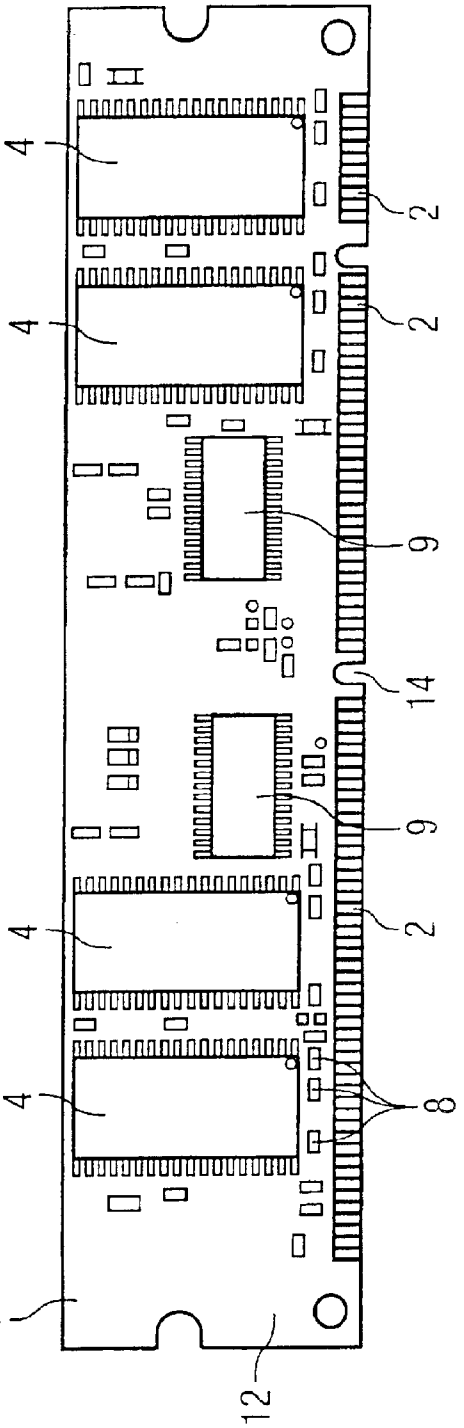


FIG. 1B



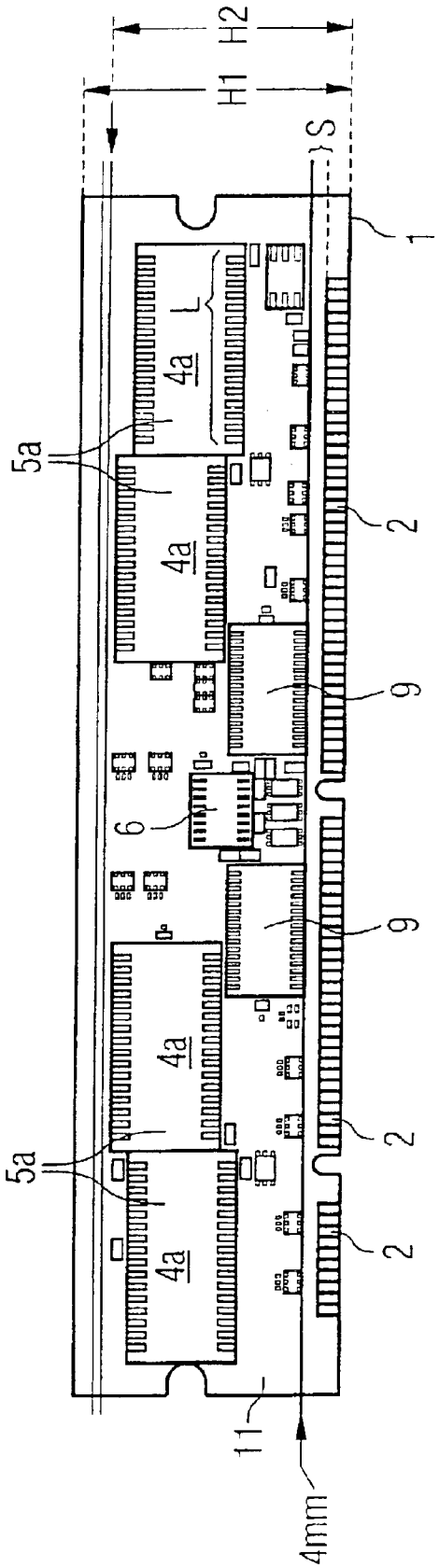


FIG 2

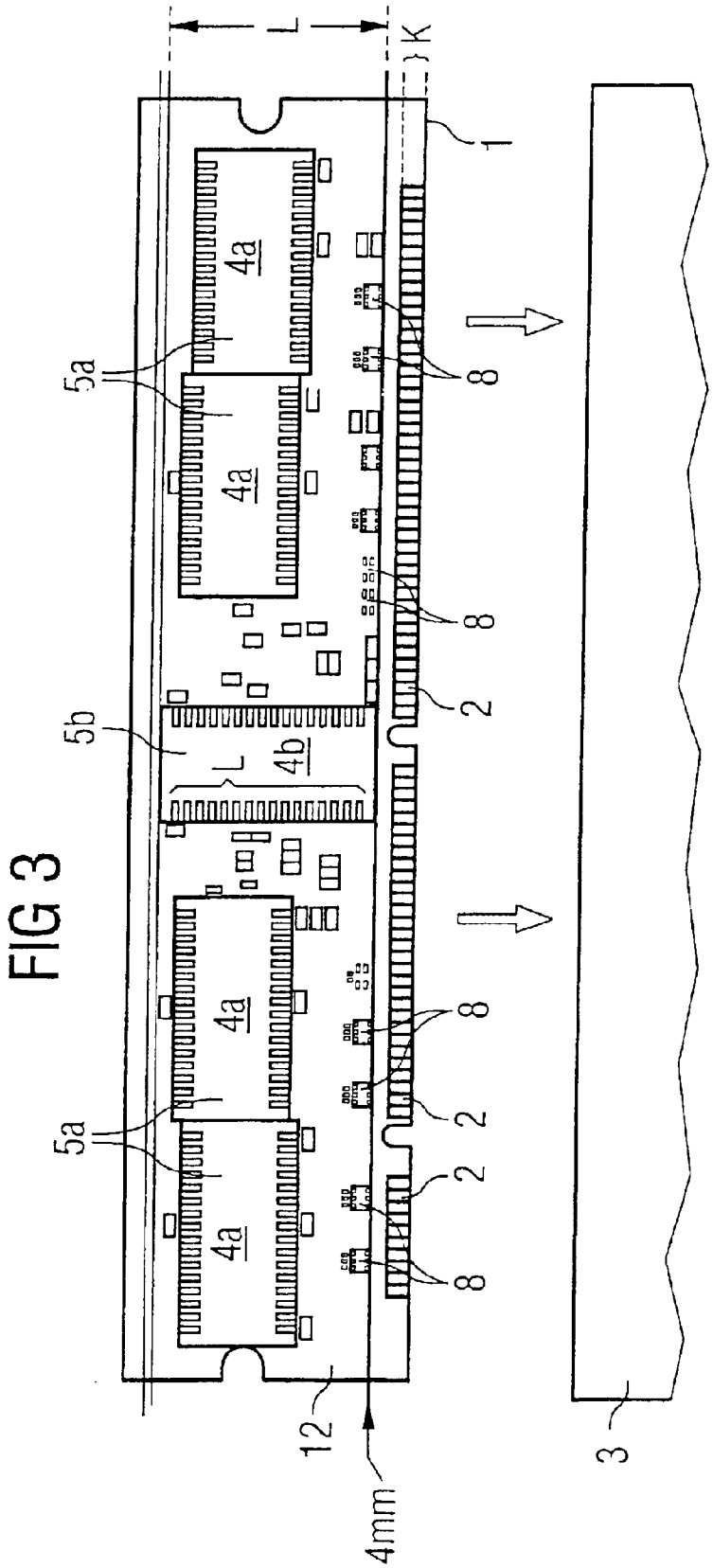


FIG 3

ELECTRONIC PRINTED CIRCUIT BOARD HAVING A PLURALITY OF IDENTICALLY DESIGNED, HOUSING-ENCAPSULATED SEMICONDUCTOR MEMORIES

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to an electronic printed circuit board, which has a memory module and a contact strip that can be inserted into another electronic unit. The memory module has at least nine identically designed integrated semiconductor memories encapsulated in identically designed rectangular housings. The housings are each individually connected to the printed circuit board. One of the semiconductor memories is connected as an error correction chip on the printed circuit board and the rectangular housing of that memory is arranged on the printed circuit board in a manner such that the longer dimension is oriented perpendicular to the contact strip.

Printed circuit boards of this type are inserted into motherboards of personal computers or network computers and serve as the main memory, for example. In network computers, the printed circuit boards are inserted into compartment-type elements having a small height, for which reason the printed circuit boards themselves should also have only a small height (the dimension perpendicular to the contact strip). Therefore, compared with their width, which is essentially determined by the length of the contact strip, insertable printed circuit boards are not very high so that the compartment-type elements can be made very flat.

The height of a printed circuit board essentially depends on the dimensions of the largest components arranged on the printed circuit board. The largest components that are arranged on a printed circuit board are generally housings for semiconductor chips containing integrated circuits. The connections of the semiconductor chips are connected by the housing to corresponding contacts on the printed circuit board that are significantly larger than the chip connections. The housings themselves are also much larger than the integrated circuits and thus concomitantly determine the minimum height of the printed circuit board. In the case of printed circuit boards which carry memory modules, the largest housings are those for semiconductor memories, for example, for SDRAMS (synchronous dynamic random access memories). The housings therefore have a rectangular form and are always arranged on the printed circuit board vertically, i.e they are oriented with their longer dimension perpendicular to the contact strip.

The reason for this arrangement is that one of the semiconductor memories is used as an error correction chip in order to perform error checking on data that will be stored in the rest of the semiconductor memories or that will be read from the memories. The error correction chip is arranged approximately in the center of the contact strip, is arranged above the contact strip, and is arranged vertically, i.e. with the longer dimension of its housing at right angles to the contact strip, because of prescribed lengths of the conductor tracks which connect the error correction chip to the contact strip.

The rest of the semiconductor memories are arranged on both sides of the error correction chip and also on the front and rear sides of the printed circuit board in the same orientation as the error correction chip, so that all of the

contact strip has electrical contacts on the front side and also on the rear side of the printed circuit board. Equally, the housing-encapsulated semiconductor memories are present both on the front side and on the rear side of the printed circuit board. Only a single error correction chip is provided and is situated, for example, on the front side of the printed circuit board.

In addition to further semiconductor chips that are encapsulated in smaller housings than the memory chips and that are arranged in proximity to the center of the contact strip, the printed circuit board has further, still smaller components, primarily passive components such as resistors and capacitors. In particular, many resistors are arranged in the outer regions of the contact strip. The resistors require a short connection to corresponding contacts of the contact strip.

By contrast, the housing-encapsulated semiconductor memories arranged in the outer regions of the contact strip are arranged at a somewhat larger distance from the contact strip, since their leads to the contact strip are permitted to be longer than the leads of the passive components to the contact strip.

The distance of all of the semiconductor memories from the contact strip is chosen in a uniform fashion, so that the vertically arranged memory housings concomitantly determine a certain minimum height of the printed circuit board. This is composed of the longer dimension of a memory housing, the height of resistors that are arranged between the housings and the contact strip, the height of the contact strip itself, and possibly a safety clearance between the contact strip and the components on the printed circuit board. This safety clearance serves, in the event of a slightly inclined attitude of the printed circuit board during insertion into motherboards, to protect the nearest components on the printed circuit board from mechanical damage, and is chosen to be as small as possible.

In the case of this conventional arrangement, in which the edges of the memory housings lined up along the contact strip are aligned, there is no more leeway for a further reduction of the circuit board height (the height of the printed circuit board perpendicular to the contact strip).

SUMMARY OF THE INVENTION

It is accordingly an object of the invention to provide an electronic printed circuit board having a memory module and a contact strip that can be inserted into another electronic unit, in which the printed circuit board overcomes the above-mentioned disadvantages of the prior art apparatus of this general type.

In particular, it is an object of the invention to reduce the height of the printed circuit board still further while using the same memory housings.

With the foregoing and other objects in view there is provided, in accordance with the invention, an electronic printed circuit board configuration including: an electronic printed circuit board having a contact strip for insertion into another electronic unit; and a memory module having at least nine identically designed integrated semiconductor memories. Each one of the semiconductor memories is encapsulated in a rectangular housing having a shorter dimension and a longer dimension. The housing of each one of the semiconductor memories is identically designed and is individually connected to the printed circuit board. One of the semiconductor memories is connected as an error cor-

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.