

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
7 March 2002 (07.03.2002)

PCT

(10) International Publication Number  
**WO 02/019424 A3**

(51) International Patent Classification<sup>7</sup>: **H01L 23/433**,  
23/42

Avenue, San Jose, CA 95119 (US). **VODRAHALLI, Nagesh** [US/US]; 20276 Pinntage Parkway, Cupertino, CA 95014 (US).

(21) International Application Number: PCT/US01/26902

(74) Agents: **VIKSINNS, Ann, S.** et al.; Schwegman, Lundberg, Woessner & Kluth, P.A., P.O. Box 2938, Minneapolis, MN 55402 (US).

(22) International Filing Date: 29 August 2001 (29.08.2001)

(25) Filing Language: English

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(26) Publication Language: English

(30) Priority Data:  
09/652,430 31 August 2000 (31.08.2000) US

(71) Applicant (*for all designated States except US*): **INTEL CORPORATION** [US/US]; 2200 Mission College Boulevard, Santa Clara, CA 95052 (US).

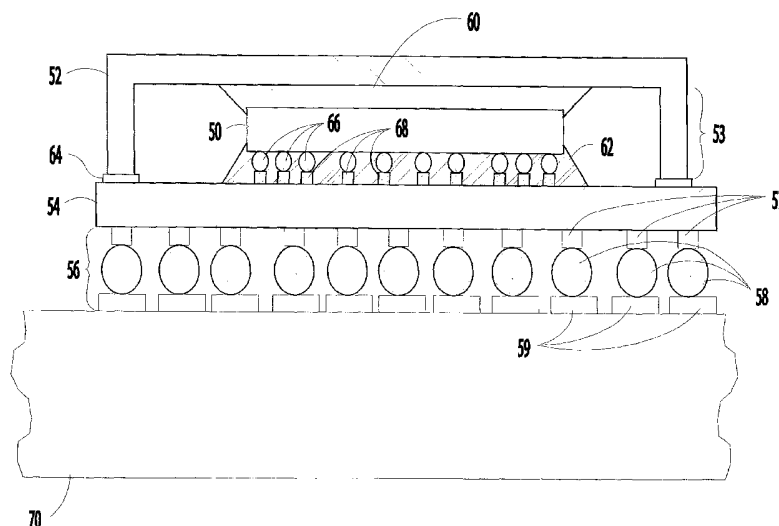
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **WORKMAN, Thomas** [US/US]; 1430 Cherrydale Drive, San Jose, CA 95125 (US). **SUR, Biswajit** [IN/US]; 6915 Rockton

[Continued on next page]

(54) Title: ELECTRONIC ASSEMBLY COMPRISING SOLDERABLE THERMAL INTERFACE AND METHODS OF MANUFACTURE



(57) Abstract: To accommodate high power densities associated with high performance integrated circuits, heat is dissipated from a surface of a die through a solderable thermal interface to a lid or integrated heat spreader. In one embodiment, the die is mounted on an organic substrate using a C4 and land grid array arrangement. In order to maximize thermal dissipation from the die while minimizing warpage of the package when subjected to heat, due to the difference in thermal coefficients of expansion between the die and the organic substrate, a thermal interface is used that has a relatively low melting point in addition to a relatively high thermal conductivity. Methods of fabrication, as well as application of the package to an electronic assembly, an electronic system, and a data processing system, are also described.



WO 02/019424 A3



**Published:**

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**(88) Date of publication of the international search report:**

7 November 2002

INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 01/26902

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 H01L23/433 H01L23/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 091 603 A (DAVES GLENN G ET AL) 18 July 2000 (2000-07-18)  column 4, line 16 -column 6, line 18; figure 4A  ---	1-5, 8-14, 17-26
X	US 4 561 011 A (KOHARA MASANOBU ET AL) 24 December 1985 (1985-12-24)  column 2, line 16 - line 55; figures 5,14 column 6, line 19 - line 40  ---  -/--	1,3,8,9, 11,13, 17-19, 21-23

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

6 March 2002

Date of mailing of the international search report

04.08.02

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

ZEISLER, P

INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 01/26902

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	A. AMENDOLA, C.A. PECK AND C. PRASAD: "COOLING STRUCTURE FOR AN INTEGRATED CIRCUIT MODULE" IBM TECHNICAL DISCLOSURE BULLETIN., vol. 23, no. 2, July 1980 (1980-07), page 602 XP002191051 IBM CORP. NEW YORK., US ISSN: 0018-8689	1,4,8,9, 11,17, 18,21,23
A	the whole document	3,13,19, 22
X	--- R.C.MILLER: "Structure for achieving thermal enhancement in a semiconductor package" IBM TECHNICAL DISCLOSURE BULLETIN., vol. 23, no. 6, November 1980 (1980-11), page 2308 XP002191052 IBM CORP. NEW YORK., US ISSN: 0018-8689	1,4,5,8, 9,11,12, 17,18, 21,23
A	the whole document	3,13,19, 22
X	--- PATENT ABSTRACTS OF JAPAN vol. 015, no. 365 (E-1111), 13 September 1991 (1991-09-13) -& JP 03 142860 A (HITACHI LTD), 18 June 1991 (1991-06-18) the whole document -----	1,4,8,9, 11,17, 18,21

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 01/26902

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1-5, 8-14, 17-26

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-5,8-14,17-26

An assembly for a die comprising a lid and a solderable thermally conductive element to couple the die to the lid

2. Claims: 6,7,15,16,27-30

A die comprising at least one metal layer to which the solderable thermally conductive element can be coupled to the lid

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No <b>PCT/US 01/26902</b>
--

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6091603	A	18-07-2000 CN 1290961 A	11-04-2001
US 4561011	A	24-12-1985 JP 1450754 C	11-07-1988
		JP 59065457 A	13-04-1984
		JP 62059888 B	14-12-1987
		JP 1450755 C	11-07-1988
		JP 59065458 A	13-04-1984
		JP 62059887 B	14-12-1987
		US 4654966 A	07-04-1987
JP 03142860	A	18-06-1991 NONE	