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Declarations under Rule 4.17:

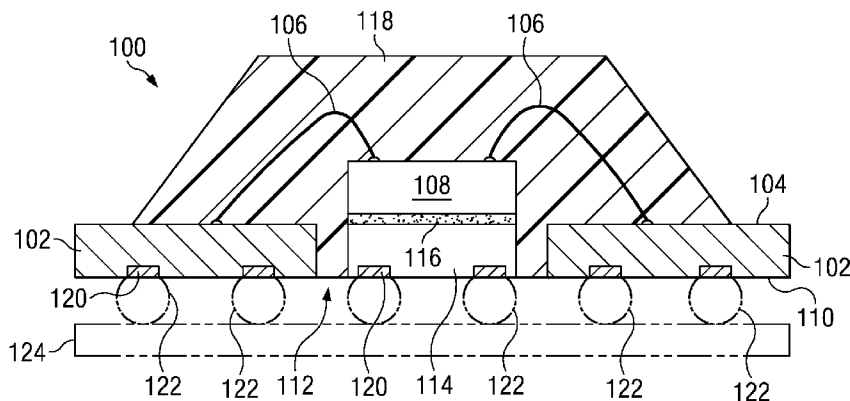
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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[Continued on next page]

(54) Title: THERMALLY ENHANCED BGA PACKAGES AND METHODS



(57) Abstract: Improved ball grid array (BGA) packages are disclosed in which thermal properties are enhanced by means of a heat channel through the substrate, the heat channel element patterned for receiving solder balls. An integrated circuit (IC) chip is coupled to a substrate having a top surface for receiving the IC chip and a bottom surface defining the perimeter of the package bottom. An encapsulant encloses the IC chip and a portion of the substrate top surface, defining the top and sides of the package. The substrate includes an aperture for receiving heat channel element having a surface proximal to the IC chip and an opposing surface defining at least an interior portion of the bottom surface of the package. Methods for assembling packages are also disclosed. The substrate and heat channel element are temporarily held in position, preferably using tape, during assembly.



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<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H05K 7/20 (2008.04) USPC - 361/712 According to International Patent Classification (IPC) or to both national classification and IPC</p>																	
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8): H05K 7/20 (2008.04) USPC: 361/712</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC: 361/600, 679, 688, 704, 707, 712 keyword limited, see search terms below</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PubWest (PGPB,USPT,USOC,EPAB,JPAB), Google Scholar, Google Patent Search terms: ball grid array, heat, thermal, sink, slug, channel, path, aperture, opening, gap, hole, substrate, underside, bottom, lower, coefficient, integrated circuit, IC, encapsulate, solder, silicon, taping, printed circuit board, PCB</p>																	
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X ----- Y</td> <td>US 5,642,261 A (BOND et al.) 24 June 1997 (24.06.1997), col 2, ln 55 to col 3, ln 9, col 4, ln 3-5, 47-53, col 6, ln 7-11</td> <td>1, 5-6 ----- 2-4, 7-9</td> </tr> <tr> <td>Y</td> <td>US 6,800,948 B1 (FAN et al.) 05 October 2004 (05.10.2004), col 2, ln 2-15, 38-50</td> <td>2-4, 7-9</td> </tr> <tr> <td>A</td> <td>US 6,545,351 B1 (JAMIESON et al.) 08 April 2003 (08.04.2003), entire document</td> <td>1-9</td> </tr> <tr> <td>A</td> <td>US 6,060,778 A (JEONG et al.) 09 May 2000 (09.05.2000), entire document</td> <td>1-9</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X ----- Y	US 5,642,261 A (BOND et al.) 24 June 1997 (24.06.1997), col 2, ln 55 to col 3, ln 9, col 4, ln 3-5, 47-53, col 6, ln 7-11	1, 5-6 ----- 2-4, 7-9	Y	US 6,800,948 B1 (FAN et al.) 05 October 2004 (05.10.2004), col 2, ln 2-15, 38-50	2-4, 7-9	A	US 6,545,351 B1 (JAMIESON et al.) 08 April 2003 (08.04.2003), entire document	1-9	A	US 6,060,778 A (JEONG et al.) 09 May 2000 (09.05.2000), entire document	1-9
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>																	
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"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)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed						
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<p>Date of the actual completion of the international search 16 October 2008 (16.10.2008)</p>		<p>Date of mailing of the international search report 30 OCT 2008</p>															
<p>Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201</p>		<p>Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>															