

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
28 June 2001 (28.06.2001)

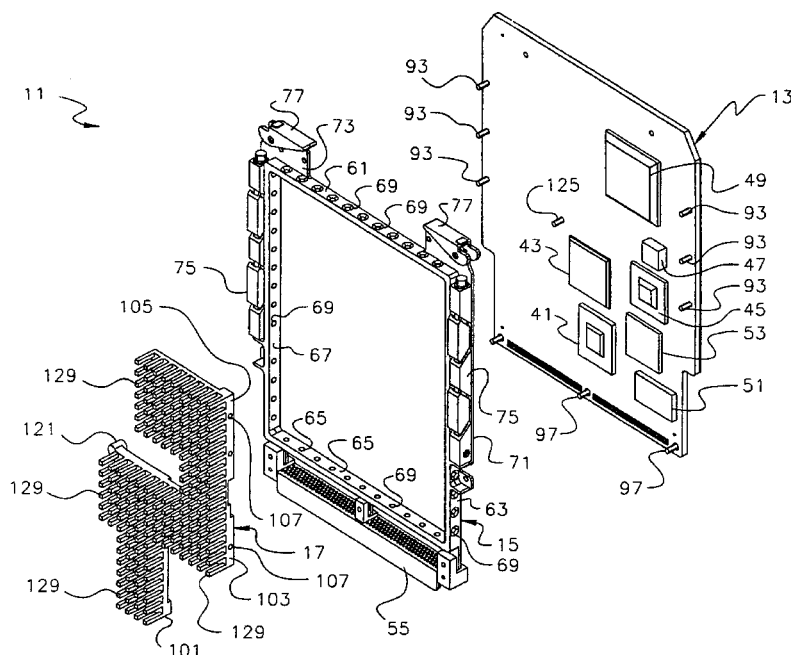
PCT

(10) International Publication Number  
**WO 01/47333 A2**

- (51) International Patent Classification<sup>7</sup>: **H05K 7/20**
- (21) International Application Number: **PCT/US00/33532**
- (22) International Filing Date:  
11 December 2000 (11.12.2000)
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:  
09/460,196 13 December 1999 (13.12.1999) **US**
- (71) Applicant: **HONEYWELL INTERNATIONAL INC.**  
[US/US]; 101 Columbia Road, P.O. Box 2245, Morris-  
town, NJ 07960 (US).
- (72) Inventors: **TEHAN, Matthew, A.**; 8701 Democracy Road  
NE, Albuquerque, NM 97109 (US). **LOSINSKI, Armand**;  
12705 Calle Cereza N.E., Albuquerque, NM 87111 (US).  
**PARKINSON, Jay, Berkley**; 1637 Cliffside Drive, Albu-  
querque, NM 87111 (US).
- (74) Agents: **HOIRIIS, David et al.**; Honeywell International  
Inc., 101 Columbia Road, P.O. Box 2245, Morristown, NJ  
07960 (US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,  
DE, DK, DM, DZ, 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, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,  
TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.
- (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, GW, ML, MR, NE, SN, TD, TG).
- Published:**  
— Without international search report and to be republished  
upon receipt of that report.

[Continued on next page]

(54) Title: INTEGRATED CONVECTION AND CONDUCTION HEAT SINK FOR MULTIPLE MOUNTING POSITIONS



(57) Abstract: An integrated thermal management system for electronic devices includes a printed wiring board (13) for supporting electronic devices, at least one die-up (41-49) and one die-down electronic device (51, 53), a frame (15) and a heat sink (17). The board (13) includes at least one thermally conductive layer (25, 31), to which the die-down device (51, 53) is thermally connected. The frame member (15), which includes at least a first heat sink mounting location, is connected to one of the first (63) and second surfaces (65) of the board (13), adjacent to the edge. The heat sink (17) itself, which is cantilevered over the die-up electronic device (41-49) from at least one heat sink mounting location (63, 65), includes a portion (111, 119) which is adapted to engage the die-up electrical device (41-49), a portion (63, 65) connected to the

frame member (15) to provide a conductive path from the die-up device (41-49) to the frame member (15), and a convective cooling portion (129). The thermal management structure also includes a cold wall (169, 171), which engages the frame (15) to provide a thermally conductive connection between the frame member (15) and the cold wall (169, 171). The heat sink(s) (17) covers only the die-up electronic device(s) (41-49) and those portions of the board surface(s) between the die-up electronic device(s) (41-49) and the the frame necessary to thermally connect the die-up electronic device(s) (41-49) to the frame (15), to thereby provide access to the board surfaces for inspection or testing without removal of the heat sink(s) (17).



---

*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.*