MINIPAK* HDL Board Mount Receptacle or Plug Connector System

1. INTRODUCTION

1.1. Purpose

Testing was performed on MINIPAK* HDL Board Mount Receptacle or Plug Connector System to
| determine its conformance to the requirements of Product Specification 108-2325, Revision B.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of MINIPAK HDL Board Mount Receptacle or Plug Connector System. Testing was performed at the Engineering Assurance Product Testing Laboratory between 15Oct08 and 20Apr09. The test file number for this testing is EA20080918T. This documentation is on file at and available from the Engineering Assurance Product Testing Laboratory.

1.3. Conclusion

The MINIPAK HDL Board Mount Receptacle or Plug Connector System listed in paragraph 1.4., conformed to the electrical, mechanical, and environmental performance requirements of Product
| Specification 108-2325, Revision B.

1.4. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with the following part numbers were used for test:

Test Group	Quantity	Part Number	Description
1,3,4,5,6,8,10	5 each	7-1926730-7	40 signal (Au) x 24 power (PdNi) MINIPAK HDL plug
1,3,4,5,7,8,9,10	5 each	7-1926733-7	40 signal (Au) x 24 power (PdNi) MINIPAK HDL receptacle
2	15	7-1926730-7	40 signal (Au) x 24 power (PdNi) MINIPAK HDL plug
2	15	7-1926733-7	40 signal (Au) x 24 power (PdNi) MINIPAK HDL receptacle
5	3	60-1042384-1	MINIPAK HDL multi-layered PCB
5	3	60-1042385-1	MINIPAK HDL multi-layered PCB
All	63	60-1042382-1	MINIPAK HDL double-sided PCB
All	63	60-1042383-1	MINIPAK HDL double-sided PCB

Figure 1

1.5. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

! Temperature: 15 to 35°C
! Relative Humidity: 25 to 75%

* Trademark
| Indicates change

1.6. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group (a)									
	1	2	3	4	5	6(b)	7(c)	8	9	10
	Test Sequence (d)									
Initial examination of product	1	1	1	1	1	1	1	1	1	1
LLCR, signal and power contacts	2,4,6	3,7		2,4				2,4,6		
LLCR, power contacts only					2,4,6,8					
Contact resistance at rated current, power contacts					10					
Insulation resistance			2,6							
Withstanding voltage			3,7							
Temperature rise vs current					3(f),9					
Vibration, random		5			7(e)					
Mechanical shock		6								
Durability		4								
Mating force		2(g)								
Unmating force		8(g)								
Compliant pin insertion							2			
Compliant pin retention							3			
Static load, transverse									2	
Contact retention										2
Minute disturbance	5							5		
Component heat resistance to wave soldering						2				
Thermal shock			4							
Humidity/temperature cycling			5							
Temperature life				3	5					
Mixed flowing gas	3(f)(h)									
Dust								3(f)		
Final examination of product	7	9	8	5	11	3	4	7	3	3

NOTE

(a) See paragraph 1.4.
(b) Test on boards.
(c) Insertion only for fully loaded connectors, insertion and retention for loose power plug contacts and loose signal pin contacts.
(d) Numbers indicate sequence in which tests are performed.
(e) Energize at current for 18˚C temperature rise.
(f) Precondition specimens with 10 durability cycles.
(g) Power only in housing, signal only in housing, and signal and power in housing.
(h) Measure LLCR after 10 days unmated exposure.

Figure 2

2. SUMMARY OF TESTING

2.1. Initial Examination of Product - All Test Groups

All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance (C of C) was issued by Product Assurance. Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2 LLCR - Test Groups 1, 2, 4 and 8

All signal contact LLCR measurements were less than 20 milliohms initially and had a change in resistance (ΔR) of less than 10 milliohms after testing. All power contact LLCR measurements were less than 5 milliohms initially and had a change in resistance (ΔR) of less than 5 milliohms after testing.

Test Group	Number of Data Points	Condition	LLCR (milliohms)			
			Minimum	Maximum	Average	Standard Deviation
1		Signal Contacts				
	200	Initial (actual)	10.56	17.22	14.13	1.84
	200	After unmated mixed flowing gas (ΔR)	-1.90	6.21	1.17	1.28
	200	After mated mixed flowing gas (ΔR)	-1.63	9.57	2.38	2.09
	200	After minute disturbance (ΔR)	-1.32	9.17	2.29	2.12
		Power Contacts				
	120	Initial (actual)	0.73	1.22	0.88	0.09
	120	After unmated mixed flowing gas (ΔR)	-0.16	1.48	0.08	0.17
	120	After mated mixed flowing gas (ΔR)	-0.15	0.84	0.05	0.11
	120	After minute disturbance (ΔR)	-0.31	0.27	0.02	0.08
2		Signal Contacts				
	400	Initial (actual)	10.67	17.94	14.24	1.95
	400	After mechanical shock (ΔR)	-2.70	0.68	-0.14	0.30
		Power Contacts				
	240	Initial (actual)	0.61	1.18	0.87	0.09
	240	After mechanical shock (ΔR)	-0.13	0.31	0.07	0.08
4		Signal Contacts				
	200	Initial (actual)	10.28	19.15	14.05	2.06
	200	After temperature life (ΔR)	-1.09	2.41	0.15	0.32
		Power Contacts				
	120	Initial (actual)	0.78	1.20	0.88	0.08
	120	After temperature life (ΔR)	-0.13	0.63	0.06	0.09
5		Power Contacts				
	144	Initial (actual)	0.69	1.35	0.93	0.10
	144	After temperature rise vs current (ΔR)	-0.30	0.16	-0.05	0.08
	144	After temperature life (ΔR)	-0.26	1.14	0.13	0.22
	144	After random vibration (ΔR)	-0.30	1.77	0.24	0.30
8		Signal Contacts				
	200	Initial (actual)	10.74	17.67	14.05	1.92
	200	After dust exposure (ΔR)	-4.54	0.71	-0.15	0.42
	200	After minute disturbance (ΔR)	-4.71	0.83	-0.26	0.47
		Power Contacts				
	120	Initial (actual)	0.79	1.37	0.93	0.12
	120	After dust exposure (ΔR)	-0.51	0.72	0.09	0.19
	120	After minute disturbance (ΔR)	-0.45	0.42	-0.01	0.17

Figure 3

2.3. Contact Resistance at Rated Current - Test Group 5

All power contact resistance at rated current measurements were less than 5 milliohms after testing. All data was taken from specimens on 2 ounce copper 2 layer printed circuit boards. Values were measured per individual contacts.

Minimum		Maximum		Average		Standard Deviation	
Millivolts	Milliohms	Millivolts	Milliohms	Millivolts	Milliohms	Millivolts	Milliohms
8 Contacts Energized at 17 Amperes, 24 Data Points							
15.37	0.90	24.88	1.46	18.76	1.10	2.87	0.17

Figure 4

2.4. Insulation Resistance - Test Group 3

All insulation resistance measurements were greater than 1000 megohms.

2.5. Withstanding Voltage - Test Group 3

No dielectric breakdown or flashover occurred.

2.6. Temperature Rise vs Current - Test Group 5

Currents listed in Figure 5 are for a 30˚C temperature rise at end of life. All data was taken from specimens on 2 ounce copper 2 layer printed circuit boards.

Number of Contacts	1	2	4	8	12	24
Current (DC amperes)	26.6	22.9	20.6	17.9	16.4	13.7

Figure 5

2.7. Random Vibration - Test Groups 2 and 5

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

2.8. Mechanical Shock - Test Group 2

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.9. Durability - Test Group 2

No physical damage occurred as a result of mating and unmating the specimens 250 times.

2.10. Mating Force - Test Group 2

All mating force measurements for signal contacts were less than 1.65 N per contact. All mating force measurements for power contacts were less than 3 N per contact.

2.11. Unmating Force - Test Group 2

All unmating force measurements for signal contacts were greater than 0.5 N per contact. All unmating force measurements for power contacts were greater than 0.15 N per contact.

2.12. Compliant Pin Insertion - Test Group 7

All compliant pin insertion force measurements were less than 44.5 N per pin.

2.13. Compliant Pin Retention - Test Group 7

All compliant pin retention force measurements were greater than 10 N per pin.

2.14. Static Load, Transverse - Test Group 9

No physical damage occurred to the specimens as a result of static loading. There was no displacement on the printed circuit board that would impair normal operation.

2.15. Contact Retention - Test Group 10

All signal contact retention forces were greater than 2 N in the mating direction. All signal pin contact retention forces were greater than 9.5 N in the unmating direction. All signal receptacle contact retention forces were greater than 5 N in the unmating direction. All power contacts had less than 0.1 mm displacement.

2.16. Minute Disturbance - Test Groups 1 and 8

No physical damage occurred as a result of unmating and remating the specimens a distance of approximately 0.1 mm.

2.17. Component Heat Resistance to Wave Soldering - Test Group 6

All specimens were measured prior to and after heat exposure. After heat exposure, no physical damage, warping, blistering or discoloring was observed.

2.18. Thermal Shock - Test Group 3

No evidence of physical damage was visible as a result of thermal shock testing.

2.19. Humidity/temperature Cycling - Test Group 3

No evidence of physical damage was visible as a result of humidity/temperature cycling.

2.20. Temperature Life - Test Groups 4 and 5

No evidence of physical damage was visible as a result of temperature life testing.

2.21. Mixed Flowing Gas - Test Group 1

No evidence of physical damage was visible as a result of exposure to the pollutants of mixed flowing gas.

2.22. Dust - Test Group 8

No evidence of physical damage was visible as a result of exposure to benign dust.

2.23. Final Examination of Product - All Test Groups

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3. TEST METHODS

3.1. Initial Examination of Product

A C of C was issued stating that all specimens in the test package were produced, inspected, and accepted as conforming to product drawing requirements, and manufactured using the same core manufacturing processes and technologies as production parts.

3.2. LLCR

LLCR measurements at low level current were made using a four terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

3.3. Contact Resistance at Rated Current

Millivolt drop measurements were taken at rated current. One contact on each specimen was energized at 26 amperes and allowed to stabilize. The millivolt drops were recorded. Following this, 8 contacts on each specimen was energized at 17 amperes and allowed to stabilize. The millivolt drops were recorded. For final measurements all 24 contacts on each specimen was energized at 13 amperes and allowed to stabilize. The millivolt drops were recorded.

3.4. Insulation Resistance

Insulation resistance was measured between adjacent signal contacts of mated specimens. A test voltage of 100 volts DC was applied for 2 minutes before the resistance was measured. Insulation resistance was measured between adjacent power contacts of mated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured.

3.5. Withstanding Voltage

A test potential of 750 volts DC was applied between the adjacent signal contacts of mated specimens. This potential was applied for 1 minute and then returned to zero. A test potential of 2500 volts DC was applied between the adjacent power contacts of mated specimens. This potential was applied for 2 minute and then returned to zero.

3.6. Temperature Rise vs Current

Infrared temperature measurement points (the bottom of the specimens) were coated with an emissivity correction coating with a known value of 0.93. An infrared camera was used with standard optics (24 degree lens) to image the test specimens. A ThermaCAM™ Researcher 2001 thermal imaging processing system was used for data analysis. The area tool software feature was used to determine maximum temperature of the exposed contacts and tails. The area tool software feature allows a shape, which can be sized, to be placed on an area of interest. The pixels inside the shape are analyzed giving minimum, maximum, average, and standard deviation measurements of temperature. The test specimens were placed in the temperature rise enclosure and measurements were taken after temperature stabilization.

3.7. Random Vibration

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hz. The spectrum remained flat at 0.05 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 4.90 GRMS. The specimens were subjected to this test for 15 minutes in each of the 3 mutually perpendicular axes, for a total test time of 45 minutes per specimen. Specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.8. Mechanical Shock

Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 50 gravity units (g peak) and duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of one microsecond or greater using a current of 100 milliamperes DC.

3.9. Durability

Specimens were mated and unmated 250 times at a maximum rate of 500 cycles per hour using automated cycling equipment.

3.10. Mating Force

The force required to mate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute. The maximum average force per contact was calculated.

3.11. Unmating Force

The force required to unmate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute. The minimum average force per contact was calculated.

3.12. Compliant Pin Insertion

The force required to apply the specimens to a PCB was measured using a tensile/compression device with a rate of travel of 12.7 mm per minute. A flat rock technique was used with a mounting fixture to insert the receptacle halves into the PCBs. Only the receptacle half was tested. Individual power and signal contacts were tested. A clamp typed fixture was used to apply force to the individual contacts.

3.13. Compliant Pin Retention

The force required to remove the specimens from a PCB was measured using a tensile/compression device with a rate of travel of 12.7 mm per minute. A flat rock technique was used to press the connectors off the PCB. Only the receptacle half was tested. Individual power and signal contacts were tested. A clamp typed fixture was used to apply force to the individual contacts.

3.14. Static Load, Transverse

Specified loads were applied to the middle of the specimens approximately 6 and 11 mm above the PCB using a tensile/compression device. Area F1 had 100 N applied, area F2 had 75 N applied, area F3 had 50 N applied.

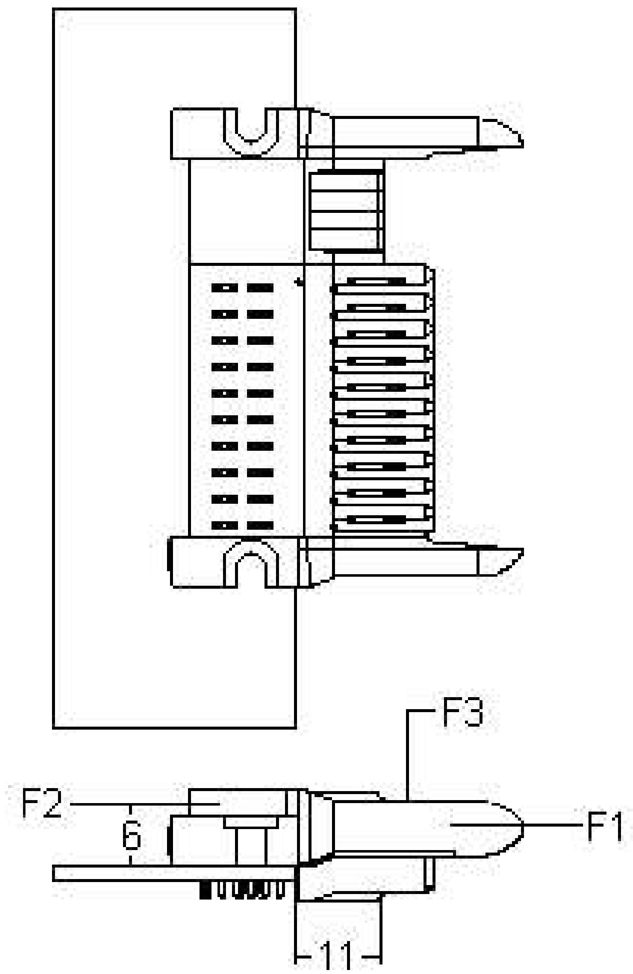

Figure 6

3.15. Contact Retention

A. Signal Contacts

An axial force of 2 N was applied to pin and receptacle contacts in the mating direction at an approximate rate of 2.54 mm per minute. An axial force of 9.5 N was applied to pin contacts and 5 N to receptacle contacts in the unmating direction at an approximate rate of 2.54 mm per minute.

B. Power Contacts

An axial force of 10 N was applied to pin contacts in the unmating direction at an approximate rate of 2.54 mm per minute and held for 5 seconds. An axial force of 5 N was applied to pin contacts in the mating direction at an approximate rate of 2.54 mm per minute and held for 5 seconds. An axial force of 5 N was applied to receptacle contacts in both the mating and unmating direction at an approximate rate of 2.54 mm per minute and held for 5 seconds. Mating direction is considered the direction that is against the tip of the pin. Unmating direction is considered the direction that is against the back of the contact.

3.16. Minute Disturbance

Specimens were manually unmated and remated a distance of approximately 0.1 mm.

3.17. Component Heat Resistance to Wave Soldering

Specimens were dimensionally inspected before and after heat exposure. Each specimen was placed on a PCB with the open end and the bottom area wrapped in Kapton tape to ensure that no solder would flow into the interface area. The solderable areas of the specimens were immersed in type ROL0 flux maintained at room temperature for 5 to 10 seconds, removed from the flux and allowed to drain for 5 to 20 seconds. Specimens were then immersed at an approximate rate of 25.4 mm per second into a 60Sn/40Pb solder bath maintained at 265 ± 5°C until the PCB was laying on the surface of the solder bath. The specimens were held in the bath for 10 seconds and then removed at an approximate rate of 25.4 mm per second, and then cleaned for 5 minutes using isopropyl alcohol. Specimens were visually examined using 30X magnification.

3.18. Thermal Shock

Unmated specimens were subjected to 5 cycles of thermal shock with each cycle consisting of 30 minute dwells at -40 and 125°C with 1 minute transition between temperatures.

3.19. Humidity/temperature Cycling

Unmated specimens were exposed to 10 humidity/temperature cycles. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 65°C twice while maintaining high humidity.

3.20. Temperature Life

Mated specimens were exposed to a temperature of 85°C for 500 hours.

3.21. Mixed Flowing Gas

Mated and unmated specimens were exposed for 20 days (10 days unmated followed by 10 days mated) to a mixed flowing gas Class IIA exposure. Class IIA exposure is defined as a temperature of 30°C and a relative humidity of 70% with the pollutants of Cl_2 at 10 ppb, NO_2 at 200 ppb, H_2S at 10 ppb and SO_2 at 100 ppb. Specimens were preconditioned with 10 durability cycles.

3.22. Dust

Unmated specimens were exposed to dust contamination of #1 benign for 1 hour with airflow of 1000 cfm. The mass of dust used was 9 grams per cubic foot of chamber volume. Following exposure, specimens remained in the chamber for an additional hour with no airflow.

3.23. Final Examination of Product

Specimens were visually examined for evidence of physical damage detrimental to product performance.