Lever Actuated ZIF Micro PGA 939 and 940 Position Sockets

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics lever-actuated Zero Insertion Force (ZIF) micro Pin Grid Array (PGA) 940 and 939 position sockets to determine their conformance to the qualification requirements of AMD* Publication #QPS940 Rev 3.0 dated July-2002 (940 position), and test groups 1 and 6 of Advanced Micro Devices™ Publication #30467 Rev 1.01 dated July-2003 (939 position).

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the lever-actuated ZIF micro PGA 939 and 940 position sockets. Testing was performed at the Engineering Assurance Product Testing Laboratory between 08Nov02 and 19Apr04. Test file numbers for this testing are CTLB027193-003, CTLB027193-007 and CTLB021793-008. This documentation is on file at and available from the Engineering Assurance Product Testing Laboratory

1.3. Conclusion

The lever-actuated ZIF micro PGA 940 position socket listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of test groups 1 through 6, and 8 through 10 of AMD Publication #QPS940 Rev 3.0 dated July-2002. Test group 7, per section 5 of the AMD specification, is not included in this test report. The lever-actuated ZIF micro PGA 939 position socket listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of test groups 1 and 6 of AMD Publication #30467 Rev 1.01 dated July-2003.

1.4. Product Description

The lever-actuated ZIF micro PGA 939 and 940-position sockets are designed to accept like position PGA devices with 1.27 x 1.27 mm (.050 x .050 inch) contact pattern. The sockets are designed to prevent damage to the device during installation or replacement of the device. The socket consists of a housing and a cover. The housing features surface-mount solder balls, an integral lever, and contact cavities that accept the device pin contacts. The cover features a locking latch that holds the lever closed, a molded triangle for Pin 1 identification, and finger reliefs. The finger reliefs allow proper handling of the device when removing it from the socket.

1.5. 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	Revision	Description
1b,2,4,5	8 each	1489228-1	O4	Lever-Actuated ZIF Micro PGA 940 Position Socket
1a	8	1489228-2	E	Lever-Actuated ZIF Micro PGA 939 Position Socket
3,8a,9a,9b	4 each	1489228-1	O4	Lever-Actuated ZIF Micro PGA 940 Position Socket
6b	4	1489228-1	O3	Lever-Actuated ZIF Micro PGA 940 Position Socket
6a	4	1489228-2	E	Lever-Actuated ZIF Micro PGA 939 Position Socket
10	8	1489228-1	B	Lever-Actuated ZIF Micro PGA 940 Position Socket
8b,8c	25 each	1489859-3	O3	Loose Piece Socket Contact

Figure 1

* Trademark
| Indicates change

1.6. Environmental Conditions

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

- Temperature: 15 to 35˚C
- Relative Humidity: 25 to 75%

1.7. Qualification Test Sequence

Test or Examination	Test Groups (a)											
	1a,1b	2	3	4	5	6a,6b	8a	8b	8c	9a	9b	10
	Test Sequence											
Initial Examination of Product	1	1	1	1	1	1	1	1	1	1	1	1
Low Level Circuit Resistance	3,5,7	2,4,6,8		3,5	2,4,6	2,4						2,4
Dielectric Withstanding Voltage			2,5,8									
Insulation Resistance			3,6,9									
Mechanical Shock	4											
Random Vibration	6											
Durability		3			3							
Thermal Shock		5	4									
Cyclic Humidity		7	7									
Preconditioning, Thermal Aging	2			2								
Temperature Life				4								
Mixed Flowing Gas					5							
Contact Current Rating						3						
Socket Retention Force							2					
Contact Porosity								2				
Plating Thickness									2			
Resistance to Soldering Heat										2		
Resistance to Solvents											2	
Thermal Cycling												3
Metallurgical Analysis	8	9										
Final Examination of Product	9	10	10	6	7	5	3	3	3	3	3	5

NOTE (a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.

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

2.2. Low Level Circuit Resistance

A. 940 Position - Test Groups 1b, 2, 4, 5, 6b and 10

All termination resistance measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 25 milliohms per contact. Resistance data per contact is calculated from the measured data of 2 daisy-chained contacts. Data excludes the bulk resistance of the series-wired traces connecting the contacts on the test board and interposer board.

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Mean
1	1600	After Preconditioning Thermal Aging	8.40	15.96	11.87
	1600	After Mechanical Shock	8.46	16.21	11.91
	1600	After Random Vibration	7.99	15.78	11.38
2	1600	Initial	9.74	19.07	13.40
	1600	After 50 Durability Cycles	8.19	14.45	11.79
	1600	After Thermal Shock	7.83	14.07	11.30
	1600	After 264 hours of Cyclic Humidity	7.74	13.70	11.11
	1600	After 500 hours of Cyclic Humidity	7.76	13.86	11.14
	1600	After 760 hours of Cyclic Humidity	7.74	14.47	11.15
	1600	After 1000 hours of Cyclic Humidity	7.69	14.01	11.12
4	1600	After Preconditioning Thermal Aging	8.81	14.39	12.19
	1600	After 256 hours of Temperature Life	8.94	17.00	12.34
	1600	After 500 hours of Temperature Life	8.75	16.37	12.32
5	1600	Initial	10.01	17.63	13.59
	1600	After 5 Durability Cycles	9.28	14.86	12.30
	1600	After 5 days of Mixed Flowing Gas	9.77	15.32	12.58
	1600	After 10 days of Mixed Flowing Gas	9.56	14.94	12.42
6	720	Initial	10.89	16.77	13.08
	720	After Contact Current Rating	10.35	14.69	12.52
10	1600	Initial	9.81	14.17	12.08
	1600	After 250 Thermal Cycles	9.66	13.46	11.14
	1600	After 500 Thermal Cycles	9.46	12.89	10.95
	1600	After 750 Thermal Cycles	9.44	13.41	10.97
	1600	After 1000 Thermal Cycles	9.38	13.40	10.91

NOTE *All values in milliohms.*

Figure 3A

B. 939 Position - Test Groups 1a and 6a

All termination resistance measurements taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than the requirement of 20 milliohms per contact. Resistance data per contact is calculated from the measured data of 2 daisy-chained contacts. Data includes the bulk resistance of the series-wired traces connecting the contacts on the package board.

Test Group	Number of Data Points	Condition	Termination Resistance		
			Min	Max	Mean
1a	1584	After Preconditioning Thermal Aging	4.73	10.45	6.77
	1584	After Mechanical Shock	4.65	10.57	6.76
	1584	After Random Vibration	4.66	10.57	6.67
6a	792	Initial	5.05	15.84	6.92
	792	After Contact Current Rating	4.90	15.59	6.55

NOTE *All values in milliohms.*

Figure 3B

2.3. Dielectric Withstanding Voltage - Test Group 3

No dielectric breakdown or flashover occurred.

2.4. Insulation Resistance - Test Group 3

All insulation resistance measurements were greater than 1000 megohms.

| 2.5. Mechanical Shock - Test Groups 1a and 1b

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

| 2.6. Random Vibration - Test Groups 1a and 1b

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

2.7. Durability - Test Groups 2 and 5

No physical damage occurred as a result of mating and unmating the specimens for the specified number of cycles. Two specimens of test group 2 did not retain the lever with the locking latch for 1 actuation cycle during the middle of durability cycling.

2.8. Thermal Shock - Test Groups 2 and 3

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

2.9. Cyclic Humidity - Test Groups 2 and 3

No evidence of physical damage was visible as a result of exposure to cyclic humidity.

| 2.10. Preconditioning Thermal Aging - Test Groups 1a, 1b and 4

No evidence of physical damage was visible as a result of exposure to preconditioning thermal aging.

2.11. Temperature Life - Test Group 4

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

2.12. Mixed Flowing Gas - Test Group 5

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

| 2.13. Contact Current Rating - Test Groups 6a and 6b

No physical damage occurred to the specimens as a result of pin current rating. Maximum temperature rise at 1.5 amperes DC was less than 30˚C.

2.14. Socket Retention Force - Test Group 8a

All socket retention force measurements were greater than 12.5 kilograms.

Test Group	Number of Data Points	Condition	Socket Retention Force		
			Min	Max	Mean
8a	4	Initial	56.47	68.04	61.05

NOTE *All values in kilograms.*

Figure 4

2.15. Contact Porosity - Test Group 8b

No countable pores were observed after exposing loose piece contacts to nitric acid vapors.

2.16. Plating Thickness - Test Group 8c

No plating thickness measurements were less than 30 µin for gold or less than 50 µin for nickel.

2.17. Resistance to Soldering Heat - Test Group 9a

No physical damage occurred to the specimens as a result of 4 passes through reflow soldering. Flatness measurement data were less than 0.25 mm.

Test Group	Number of Data Points	Condition	Flatness		
			Min	Max	Mean
9a	4	Initial	0.136	0.189	0.170
	4	After 4 passes through reflow	0.184	0.245	0.216

NOTE *All values in millimeters.*

Figure 5

2.18. Resistance to Solvents - Test Group 9b

Specimens showed no physical damage and markings were legible as a result of individual exposure to 4 solutions of solvent based systems.

2.19. Thermal Cycling - Test Group 10

No physical damage occurred to the specimens as a result of exposure to thermal cycling.

| 2.20. Metallurgical Analysis - Test Groups 1a, 1b and 2

No evidence of wear through the gold plating into the nickel underplate was observed.

2.21. 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 Examination of Product

A Certification of Conformance was issued stating that all specimens in this test package have been 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. Low Level Circuit Resistance

Termination resistance measurements at low level current were made using a 4 terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Retention load was removed for termination resistance measurement.

3.3. Dielectric Withstanding Voltage

A test potential of 650 volts AC was applied between the adjacent contacts of unmated and unmounted specimens. This potential was applied for 1 minute and then returned to zero.

3.4. Insulation Resistance

Insulation resistance was measured between adjacent contacts of unmated and unmounted specimens. A test voltage of 100 volts DC was applied for 2 minutes before the resistance was measured.

3.5. Mechanical Shock

Mated and mounted specimens, which included a 454 gram heat sink/fan and retention module assembly, 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 10 nanoseconds or greater using a current of 100 milliamperes DC.

3.6. Random Vibration

Mated and mounted specimens, which included a 454 gram heat sink/fan and retention module assembly, were subjected to a random vibration test. The vibration test was specified by a random vibration spectrum, with excitation frequency bounds of 20 and 500 Hz. The spectrum was flat at 0.02 G2/Hz from 20 to 500 Hz. The root-mean square amplitude of the excitation was 3.10 gRMS. This was performed for 45 minutes in each of 3 mutually perpendicular planes for a total vibration time of 135 minutes. Specimens were monitored for discontinuities of 10 nanoseconds or greater using a current of 100 milliamperes DC.

3.7. Durability

Mounted specimens were mated and unmated for the specified number of times at a maximum rate of 300 cycles per hour. Test Group 2 was subjected to 50 cycles, Test Group 5 was subjected to 5 cycles.

3.8. Thermal Shock

Specimens were subjected to 10 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55 and 110˚C. The transition between temperatures was less than 15 seconds. Test Group 2 specimens were exposed in a mated and mounted condition, Test Group 3 specimens were exposed in an unmated and unmounted condition.

3.9. Cyclic Humidity

Specimens were exposed to 1000 hours of cyclic humidity. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 85°C twice while maintaining high humidity. Test Group 2 specimens were exposed in a mated and mounted condition, termination resistance was measured after 264, 500, 760 and 1000 hours exposure. Test Group 3 specimens were exposed in an unmated and unmounted condition.

3.10. Preconditioning Thermal Aging

Mated and mounted specimens were exposed to a temperature of 85°C for 24 hours.

3.11. Temperature Life

Mated and mounted specimens were exposed to a temperature of 115°C for 500 hours. Termination resistance was measured after 256 and 500 hours of exposure.

3.12. Mixed Flowing Gas, Class IIA

Mounted specimens were exposed for 10 days to a mixed flowing gas Class IIA exposure. One half of the specimens were exposed unmated during the first 5 days of exposure. All specimens were mated for the second 5 days of exposure. Termination resistance was measured after 5 and 10 days of 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.

3.13. Contact Current Rating

Mated and mounted specimens were simultaneously energized through the terminals of 3 series-wired circuits of the printed circuit board. Test specimens included heat sink, energized fan, and retention mechanism. Thermocouples were placed under the socket at 6 locations through pre-drilled holes in the printed circuit board. Data was recorded as current was increased to yield a temperature-rise curve through 30°C.

3.14. Socket Retention Force

Mated and mounted specimens were subjected to a force necessary to remove the micro PGA package from the mated socket. Peak force to remove the package was measured. Rate of removal was 12.7 mm per minute.

3.15. Contact Porosity

Loose piece contact specimens were subjected to a nitric acid porosity test, which consists of a 75 minute exposure to nitric acid vapor. Following exposure, specimens were examined for countable pores greater than 0.05 mm diameter.

3.16. Plating Thickness

Loose piece contact specimens were measured for gold and nickel plating thickness using x-ray.

3.17. Resistance to Solder Heat

Unmated and unmounted specimens were subjected to 4 passes through a convection solder reflow oven, which attained a maximum temperature of 240°C for 5 minutes. Flatness data was measured initially and after passing through the reflow oven.

3.18. Resistance to Solvents

Unmated and unmounted specimens were submersed in 4 different solutions for solvent-based systems with the following compositions: alcohol based; aliphatic hydrocarbon; ester plus glycol; terpene and alcohol. One test specimen was submersed for 1 minute per solution.

3.19. Thermal Cycling

Mated and mounted specimens with heat sink and retention mechanisms were subjected to 1000 thermal cycles between -55 and 110˚C. Transfer between chamber temperature extremes was less than 1 minute. Temperature measured at the specimen was dwelled for a minimum of 5 minutes at each temperature extreme. Termination resistance was measured after 250, 500, 750 and 1000 thermal cycles.

3.20. Metallurgical Analysis

Ten contacts, which exhibited the highest increase in termination resistance, were removed from 2 specimens and were examined by scanning electron microscope for wear through the gold plating into the nickel under plating.

3.21. Final Examination of Product

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