Socket AM2
Design Specification

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Advanced Micro Devices 

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Revision History

Date	Revision	Description
May 2008	3.00	Initial Public release.

Chapter 1 Introduction

This design specification defines the requirements for a 940-pin, 1.27-mm pitch, surface mount technology (SMT), zero insertion force (ZIF) socket (herein referred to as Socket AM2) for use with Advanced Micro Devices (AMD) 940-pin, organic, micro pin grid array (µPGA) package. Socket AM2, shown in Figure 1, is designed to provide a reliable electrical interconnect between the printed circuit board (PCB) and the 940 pins of the organic µPGA package, throughout the life of the product.

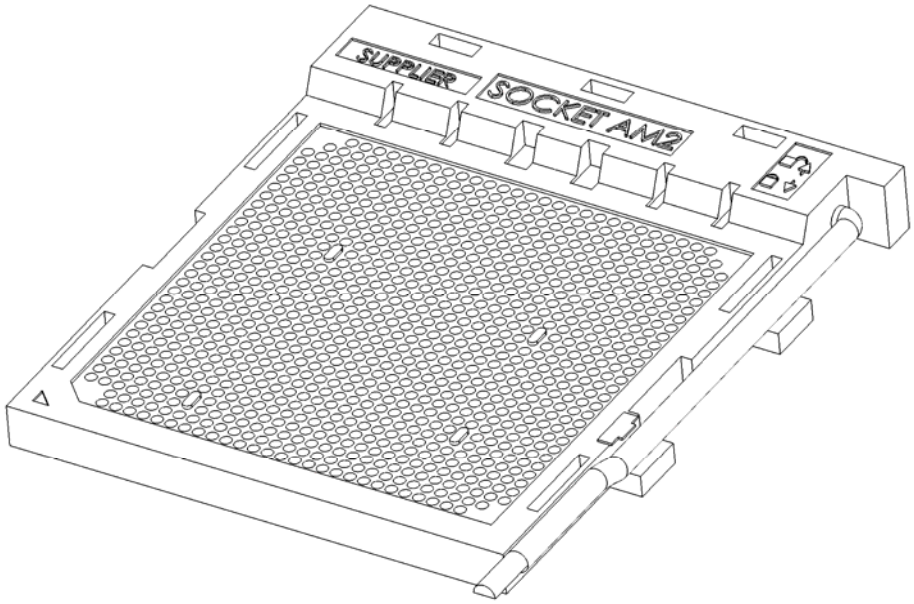


Figure 1. A 3-D View of Socket AM2

1.1 Purpose

This document specifies the dimensional, electrical, mechanical, and reliability requirements for the Socket AM2 that are necessary to meet the performance requirements of AMD microprocessor products.

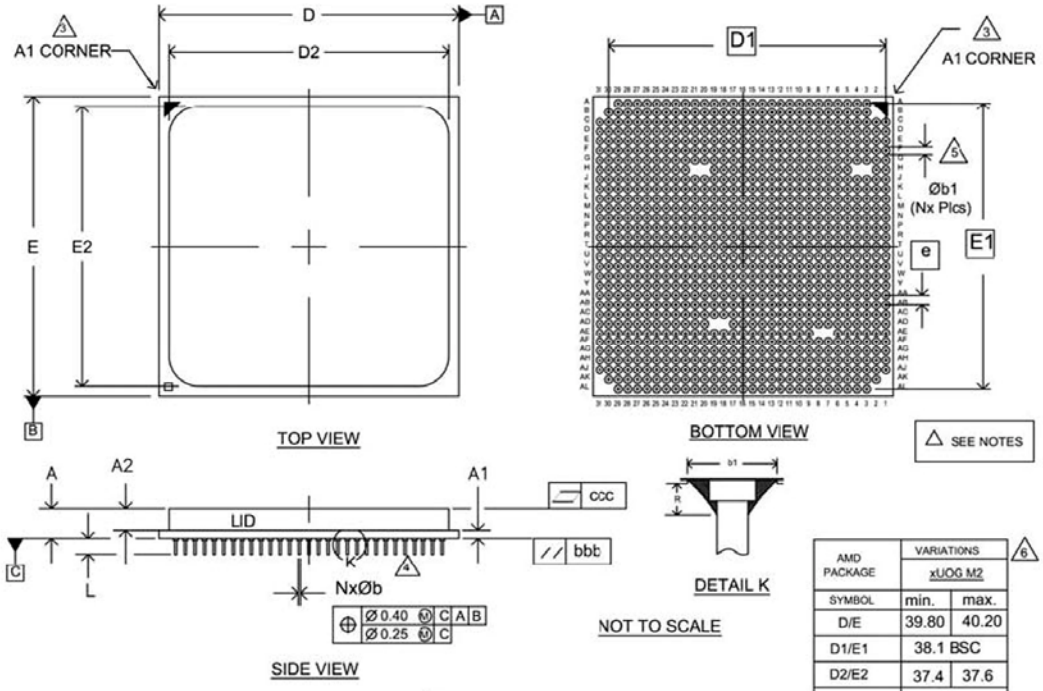
1.2 Supplier Requirements

To become an AMD qualified supplier for Socket AM2, the potential socket supplier must demonstrate that their product meets the requirements listed in this document and must conduct qualification testing on their production run sockets in accordance with the *Socket AM2 Qualification Plan, order# 32889*.

Chapter 2 Microprocessor Package Description

Figure 2 shows the substrate and pin dimensions, tolerances, and true position parameters of the 940-pin organic µPGA package that mates with the Socket AM2.

Socket AM2 is designed to be functional with the lidded, as well as with the lidless, package configuration.



GENERAL NOTES

1. All dimensions are specified in millimeters (mm).
2. Dimensioning and tolerancing per ASME-Y14.5M-1994.
3. This corner is marked with a triangle on both sides of the package Identifying the pin A1 corner and can be used for handling and orientation purposes.
4. Pin tips should have radius 0.13.
5. Symbol "M" determines pin matrix size and "N" is number of pins.
6. "x" in front of package variation denotes non-qualified package per AMD 01-002.3.

AMD PACKAGE	VARIATIONS xUOG M2	
SYMBOL	min.	max.
D/E	39.80	40.20
D1/E1	38.1 BSC	
D2/E2	37.4	37.6
A	4.56 REF	
A1	1.26	1.46
A2	3.05	3.35
e	1.27 BSC	
b	0.275	0.325
b1	0.98	1.08
L	1.95	2.11
M	31	
N	940	
R	0.30 MAX	
bbb	0.10	
ccc	0.125	
WT (gms)	39.275 REF	

Figure 2. 940-Pin Organic µPGA Package Drawing

Chapter 3 Socket Mechanical Requirements

This chapter describes the socket outline and mechanical requirements for the Socket AM2.

3.1 Socket Outline

Figure 3 shows the maximum allowable outline for the Socket AM2. All dimensions are shown in millimeters.

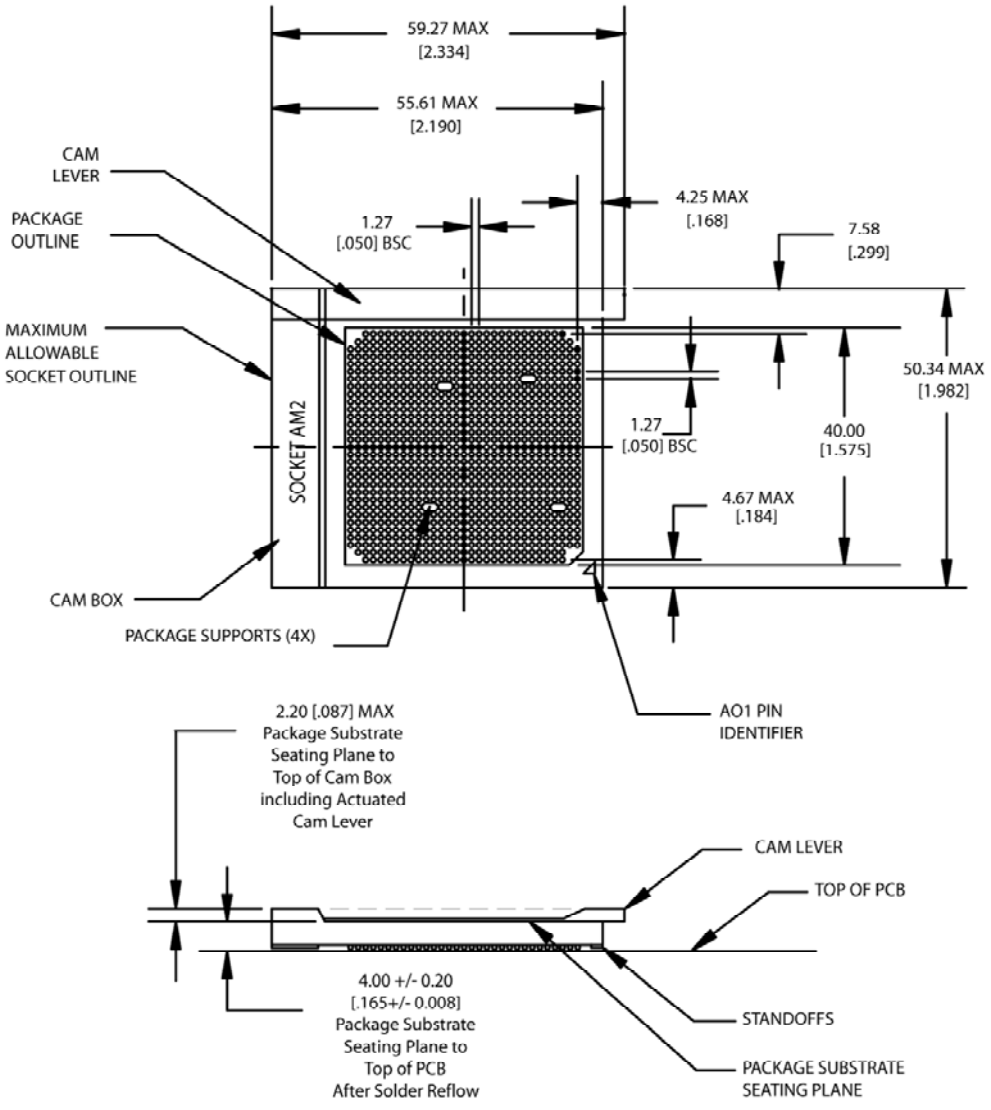


Figure 3. Socket AM2 Outline

3.2 Package Seating Plane

The cover for the Socket AM2 is designed to accommodate the package pin shoulder and braze/solder fillet as shown by the 940-pin organic µPGA package drawings in Figure 2, on page 9. Package support structures are incorporated into the socket cover to provide sufficient mechanical support (seating plane) for the package substrate without causing damage to the package pins at any time.

The package-seating plane on the socket cover has a surface flatness of 0.25 mm or smoother when unmated, as well as when mated, with a package. After the socket is mounted to the PCB, the package-seating plane on the socket cover is 4.00 ± 0.20 mm from the mounting surface of the PCB.

3.2.1 Package Supports and Seating Plane Dimensional Requirements

To ensure proper support of the processor package while it is situated in the socket, the outer region of the socket seating plane that supports the outer portion of the processor package and the inner package supports (indicated in Figure 3, on page 11) must meet the following dimensional requirements:

1. The outer support region step height is 0.30 ± 0.05 mm.
2. The flatness of the outer support region must not exceed 0.25 mm.
3. The inner supports is + 0.03 ± 0.06 mm above the least mean squares defined plane of the outer support region.

Refer to measurement requirements in Section 3.2.2.

3.2.2 Measurement Method for Package Supports and Seating Plane

The features in Section 3.2.1 must be measured using the following methodology:

Measurement Conditions

1. The socket to be measured must be reflowed to a PCB using the recommended reflow process for the socket for the particular solder ball composition.
2. A fixture that maintains the cover plate in contact with the base plate at the inner seating plane supports must be used for this measurement.

Outer Support Region Step Height Measurement

1. Measure the outer step height at 24 evenly-spaced points (6 per side) around the outer support using a local point-to-point method. Refer to Figure 4, on page 13.
2. The step height is the difference in height between a point on the outer support region and an adjacent point on the recessed plane of the socket. See Figure 5, on page 13, for the measurement area of the step height.

3. Acceptance criteria: Step height conforms to dimensional requirement in Section 3.2.1, item 1, on page 12.

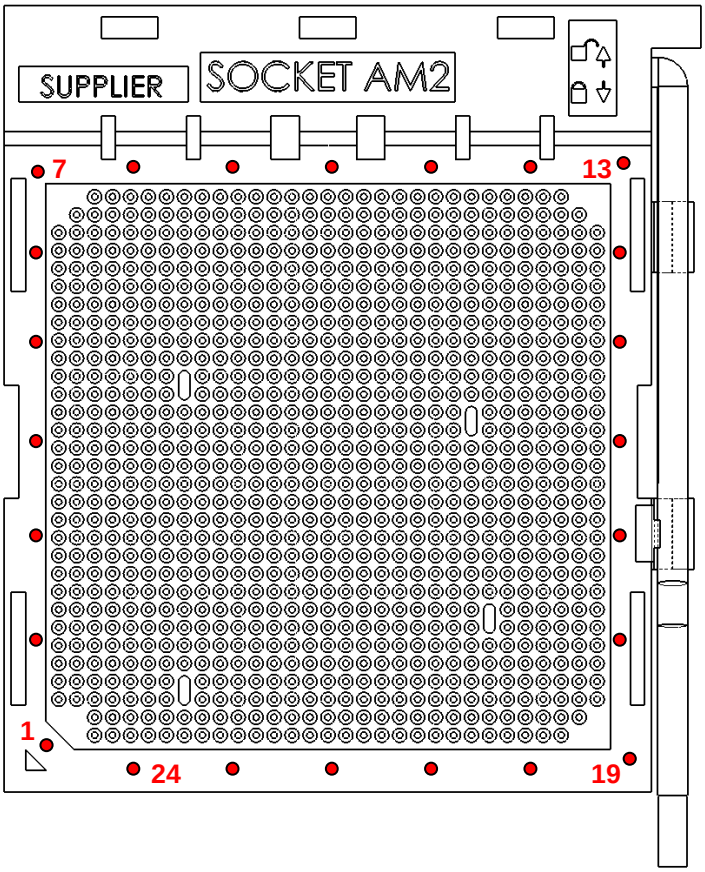


Figure 4. Illustration of Outer Region Measurement Points

Figure 5 shows the measurement area of the step height.

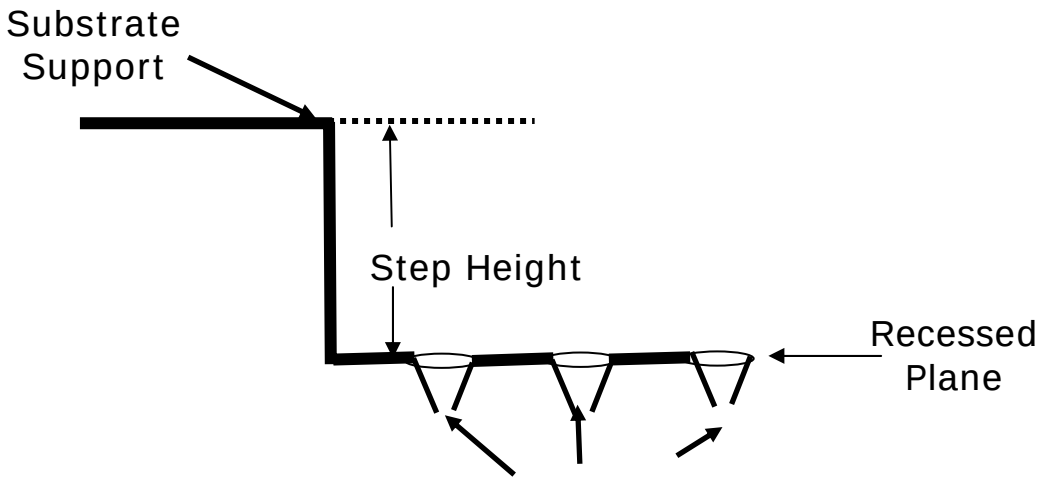


Figure 5. Definition of Step Height

Outer Support Region Flatness Measurement

1. Determine the best-fit plane the LMS (least mean squares) method to the 24 points measured on outer support region used in the step height measurement.

2. Calculate the normal distance from each point to the LMS plane.

   Outer support region flatness = [Maximum normal distance of all points above the LMS plane] –[Maximum normal distance of all points beneath the LMS plane (which is a negative number)]. Refer to Figure 6.

3. Acceptance criteria: Outer support region flatness meets criteria in Section 3.2.1, item 2, on page 12.

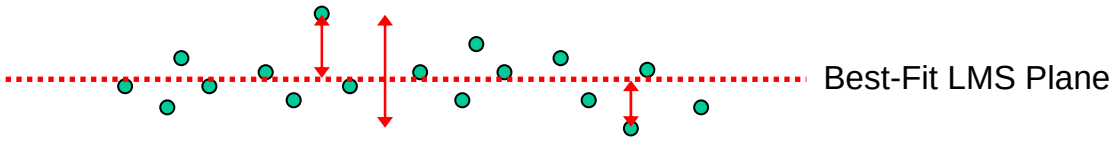


Figure 6. Illustration of Best-Fit Plane and Outer Support Region Flatness

Inner Support Region Measurement

1. Using the outer support region LMS plane defined in the previous subsection, measure the distance between four support posts and the defined plane using a point-to-plane method. Refer to Figure 7 for an illustration of the measurement method and Figure 8, on page 15, for an illustration of the measurement locations.

2. Acceptance criteria for all four support posts measured must meet the dimension requirement of Section 3.2.1, item 3, on page 12.

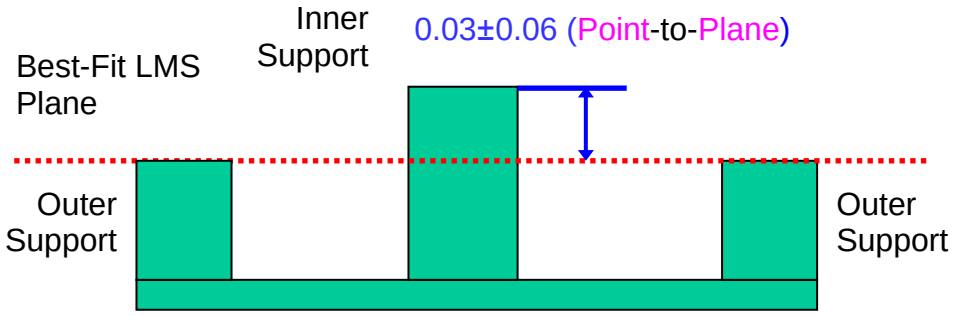


Figure 7. Illustration of Inner Support Measurement Method

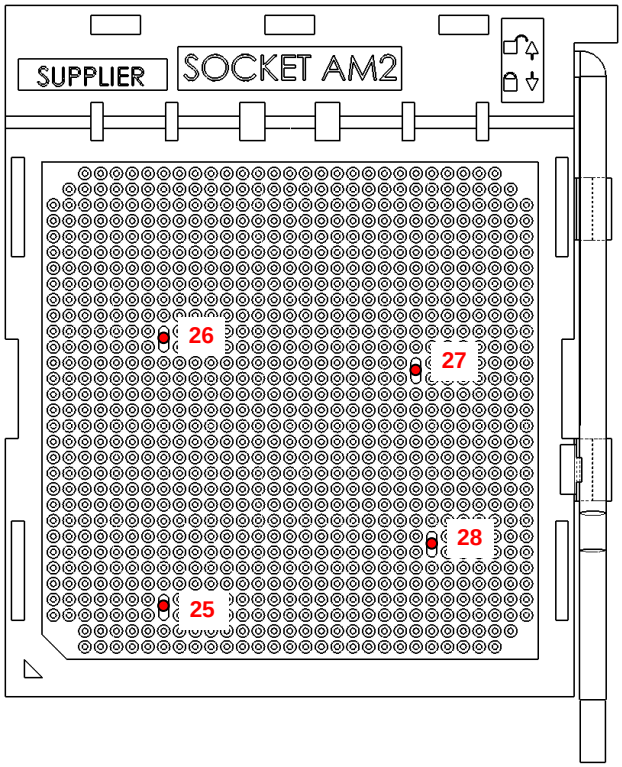


Figure 8. Illustration of Inner Support Measurement Locations

3.3 Socket Base and Socket Cover

The socket base and socket cover are made from liquid crystal polymer (LCP) with a UL flammability rating of 94 V-0. The colors for the socket base and cover are as follows:

- Socket base color — black
- Socket cover color — natural or ivory

The thickness of the socket cover (including the 0.30-mm pocket recess) must not exceed 1.17 mm. The socket cover flatness is less than 0.25 mm before and after the SMT reflow to the PCB. The flatness measurement must remain less than 0.25 mm after environmental and mechanical testing.

Either a removable tape or plastic cover acts as an overlay for the pinholes in the top of the socket cover. The overlay facilitates socket pick-and-place operation with a vacuum nozzle during board assembly. The overlay must not outgas during the solder reflow processes or leave any residue upon removal prior to package pins insertion.

3.3.1 Socket Markings

The requirements for socket markings are as follows:

- The socket identifier marking "SOCKET AM2" must be molded into the top surface of the socket cover cam box region. See Figure 1 on page 7.
- A locked and unlocked directional designator is molded into the top surface of the cam box in close proximity to the actuation lever. See Figure 1 on page 7.
- A triangular shape symbol must be molded into the top of the socket cover for proper package pin A01 orientation. This orientation symbol is located to remain visible after the package is mated to the socket as shown in Figure 1 on page 7 and Figure 3 on page 11.
- The supplier's UL approved symbol must be molded on the socket cover. This marking is located such that it remains visible and readable after the socket is solder mounted onto the PCB.
- The lot traceability number can be ink, laser, or impact marked on the socket cover. This marking must be located to be visible and readable after the socket is solder mounted onto the PCB.

3.4 Socket Contact

This section describes the contact material and solder balls for socket attachment to the PCB.

Note: *No lubricants can be present on the contact mating areas of fully assembled sockets that are shipped to customers by the supplier.*

3.4.1 Contact Base Metal

The contact base metal is high-strength copper alloy.

3.4.2 Contact Plating

The specifications for the contact plating are as follows:

- Plate the entire contact with 1.27-µm minimum thickness of nickel.
- Plate the contact mating area with 0.76-µm minimum thickness of gold over the 1.27 µm minimum thickness of nickel underplating. Gold porosity in the contact mating areas must be minimized, with no more than two pores with a diameter greater than 0.05 mm allowed per set of 25 contacts examined.

3.4.3 SMT Solder Balls

The specifications for the SMT solder balls are as follows:

- The socket is mounted to the PCB by SMT, with a PCB solder pad diameter of 0.64 mm.
- The solder balls on the socket have a diameter of 0.76 ± 0.15 mm and are either leaded or lead-free in composition.
  - Leaded solder ball composition is tin/lead (63/37 ± 5%).
  - Lead-free solder ball composition can be Sn4.0Ag0.5Cu(SAC405), Sn3.0Ag0.5Cu(SAC305), or Sn3.5Ag.
- The contact must include a solder barrier feature to prevent solder from wicking up into the contact mating area during solder reflow.
- The Socket AM2 solder ball field must meet the co-planarity requirement of 0.20 mm.
- The force required to shear off the solder ball from the contact must be a minimum of 0.75 kgf.

3.5 Socket Actuation Lever

The socket incorporates a lever to the right side of the cam box for actuating and deactuating the socket contacts with the package pins. This actuation lever provides the mechanical advantage to easily actuate the socket in an OEM high-volume manufacturing environment and also facilitates toolless socket actuation and deactuation operations by the end-user.

3.5.1 Lever Material

Stainless steel is the recommended material for the actuation lever.

3.5.2 Package Insertion and Extraction Force

With the actuation lever in the open position, the package insertion and extraction forces, conceptually, are zero. These insertion and extraction forces must not exceed 2 kgf in actual applications.

3.5.3 Socket Retention Force

With the actuation lever in the closed position, the force required to extract the package pins out of the socket contacts must be a minimum of 0.013 kgf per pin.

3.5.4 Locking Latch

The socket cover incorporates a latch mechanism to lock the lever in the closed position after the socket contacts are mated with the package pins. Support tab(s) are added to the socket cover to cradle the actuation lever in the closed position. The tab(s) prevent the actuation lever from contacting the PCB.

3.5.5 Lever Actuation and Deactuation Force

The force required to actuate or deactuate the lever must be less than 3.6 kgf.

3.5.6 Pin Field Actuation Displacement

The package pins must be displaced less than 1.0 mm during socket actuation or deactuation.

3.6 Socket Durability

The socket must maintain electrical and mechanical integrity after 50 actuation and deactuation cycles with each mating package used no more than 5 mating cycles.

3.7 Visual Inspection

All visual inspections must be at 1X magnification, except for solder balls that must be inspected at 5X magnification.

3.7.1 Solder Balls

No missing, malformed, damaged, or misaligned solder balls can be attached to the contacts.

3.7.2 Contacts

No missing or damaged contacts that prevent the socket from functioning properly are allowed. Contact mating surface must not be missing gold plating.

3.7.3 Cover and Base

No cracks or flashing can be visible on the socket cover and base. All tabs that secure the socket cover to the base must not be damaged or missing. The socket cover must fit properly on the socket base with no visible gap between them. The lever latch cannot be damaged or malformed.

3.7.4 Actuation Lever

The actuation lever cannot be damaged, malformed, or missing.

Chapter 4 Socket Electrical Requirements

This chapter describes the contact current rating, inductance, capacitance, differential impedance, propagation delay, crosstalk, dielectric withstanding voltage, and insulation resistance of the Socket AM2.

4.1 Contact Current Rating

The contact must be rated at a current rating of 1.5-Amp per contact with less than 30 °C temperature rise and with a minimum of ten rows of mated contacts and pins energized.

4.2 Low Level Circuit Resistance (LLCR)

Contact resistance applies to the mounted socket with actuated package pin and includes the bulk resistance of the contact, solder ball, package pin, and the interface resistance between the contact and the package pin, but does not include the package internal trace resistance.

4.2.1 Initial Resistance

Initial contact resistance must be measured immediately after the first mating of the package pins to the socket contacts. The 200 daisy-chained pairs (400 contact locations) must be measured per socket sample. Initial LLCR must not exceed 20 mΩ per contact when mated with Cu Alloy-194 pins, based on measurements made on a daisy-chained pair of contacts.

4.2.2 Final Resistance

Final contact resistance must be measured after completing the mechanical and environmental testing of the mated package and socket. The same 200 daisy-chained pairs (400 contact locations) must be measured per socket sample. Final LLCR must not exceed 20 mΩ per contact when mated with Cu Alloy-194 pins, based on measurements made on a daisy-chained pair of contacts.

4.3 Inductance

The inductance specifications for the Socket AM2 are as follows:

- The mated, partial self-inductance of a single pin must be less than 4 nH.
- The mated-loop inductance of two nearest pins must be less than 3.3 nH.
- The mated partial-loop inductance matrix of three neighboring pins must be less than 3.3 nH for the diagonal entries, and must be less than 2.2 nH for the off-diagonal entries.

Note: *Measurements are made at frequencies of 500 MHz and 2 GHz.*

4.4 Capacitance

The capacitance specifications for the Socket AM2 are as follows:

- The mated capacitance between two nearest pins must be less than 1 pF.
- The mated capacitance matrix of three neighboring pins must be less than 1 pF.

Note: *Measurements are made at frequencies of 500 MHz and 2 GHz.*

4.5 Differential Impedance

The differential (or odd mode) impedance for three, mated-pins configuration (one pin as the voltage/current reference—S1, S2, and G) must be 100 Ω ± 10% between the two nearest pins (with an additional ± 2-Ω measurement error). If the Time Domain Method is used, the signal must have a rise time of 150 ps for the signal amplitude to go from 10% to 90%.

4.6 Propagation Delay

The propagation delay specifications for the Socket AM2 are as follows:

- The propagation delay skew among single-ended signals must be less than 10 ps, plus a maximum measurement error of 3 ps.
- The propagation delay skew among differential signal pairs must be less than 10 ps, plus a maximum measurement error of 3 ps.

4.7 Crosstalk

Crosstalk between the nearest single-ended and differential signals must be measured and compared to results from the measured partial-loop inductance and the Maxwell capacitance matrices.

4.8 Dielectric Withstanding Voltage (DWV)

The contact-to-contact dielectric withstanding voltage between randomly selected adjacent lateral, diagonal, and vertical contacts must be a minimum of 650 Vac.

4.9 Insulation Resistance

The contact-to-contact insulation resistance between randomly selected adjacent lateral, diagonal, and vertical contacts must be a minimum of 1000 MΩ.

Chapter 5 Socket Environmental Requirements

This section describes the socket design required to meet reliability requirements for the end-user field-use environment, OEM high volume manufacturing environment, and shipping and handling conditions of desktop computers.

5.1 Thermal Shock

Sockets must meet LLCR and visual inspection requirements after being subjected to 10 thermal shock cycles with the cold temperature extreme at –55°C and the hot temperature extreme at +110°C. The dwell at each temperature extreme is 30 minutes with less than 15 seconds transition time. The test should be conducted with the associated heatsink assembly (AMD part number TBD) attached to the processor package.

5.2 Cyclic Humidity

Sockets must meet LLCR, DWV, IR, and visual inspection requirements after being subjected to 1000 hours of cyclic humidity tests with a cycle time of 8 hours. Temperature range is 25°C to 85°C with relative humidity maintained between 90 to 95%. This test should be conducted with the associated heatsink assembly (AMD part number TBD) attached to the processor package.

5.3 Thermal Cycling

Sockets must meet LLCR and visual inspection requirements after being subjected to a minimum of 1000 cycles of thermal cycles with testing continued until 60% of the sockets failed or 3000 cycles are completed. Cold temperature extreme is –55°C with a dwell time of 20 minutes, and hot temperature extreme is +110°C with a dwell time of 15 minutes. The average rate of temperature change between the hot and cold temperature extremes must not exceed 10°C per minute. This test should be conducted with the associated heatsink assembly (AMD part number TBD) attached to the processor package.

5.4 Temperature Life

Sockets must meet LLCR and visual inspection requirements after being subjected to 500 hours of temperature life testing at 115°C. This test should be conducted with the associated heatsink assembly (AMD part number TBD) attached to the processor package.

5.5 Industrial Mixed Flowing Gas

Sockets must meet LLCR and visual inspection requirements after being subjected to mixed flowing gas testing with half the samples mated and the other half samples unmated for the first

five days, and then all samples mated for the final five days. The test temperature is 30°C with a relative humidity of 70%. Mixed flowing gas constituents are 10-ppb chlorine, 10-ppb hydrogen sulfide, 200-ppb nitrogen dioxide, and 100-ppb sulfur dioxide.

5.6 Mechanical Shock

Sockets must meet LLCR, continuity intermittency of less than 1-µs duration, and visual inspection requirements after being subjected to mechanical shock testing at 50 g, 11-ms duration, half-sine waveform with three shocks per positive and negative directions on all three axes — totaling 18 shocks. This test should be conducted with the associated heatsink assembly (AMD part number TBD) attached to the processor package.

5.7 Random Vibration

Sockets must meet LLCR, continuity intermittency of less than 1-µs duration, and visual inspection requirements after being subjected to random vibration testing at 3.1 g rms between 20 to 500 Hz for duration of 45 minutes per axis for each of the three axes. This test should be conducted with the associated heatsink assembly (AMD part number TBD) attached to the processor package.

5.8 Resistance to Solder Heat

Sockets must meet LLCR, cover flatness, and visual inspection requirements after being subjected to four convection-solder-reflow processes for mounting the socket to the PCB. Deterioration of the markings on the socket is not permissible.

5.9 Resistance to Solvents

Sockets must meet visual inspection requirements after being subjected to the Four Solutions test. Deterioration of the markings on the socket is not permissible.

5.10 Heatsink Assembly

The associated heatsink assembly (AMD part number TBD) attached to the processor package in the environmental testing can weigh up to 500 grams.