Low-Profile Socket S1 Design Specification

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Advanced Micro Devices

Contents

List of Figures

Revision History

Date	Revision	Changes
April 2007	3.01	Modified Section 3.5.5, to reflect 8.3 kgf minimum force.
March 2007	3.00	Initial Public release.

Chapter 1 Introduction

This document defines the requirements for a 638-pin, 1.27mm pitch, surface mount technology (SMT), zero insertion force (ZIF) socket (herein referred to as "Low-Profile Socket S1") for use with mobile AMD 638-pin organic micro-pin-grid-array (µPGA) package. The Low-Profile Socket S1, shown in Figure 1, is designed to provide reliable electrical interconnect between the printed circuit board (PCB) and the 638 pins of the organic µPGA package, throughout the life of the product.

1.1 Purpose

This document specifies the dimensional, mechanical, electrical, and reliability requirements for the Low-Profile Socket S1, that are necessary to meet the performance requirements of the mobile AMD processor family products.

1.2 Scope

The specifications in this document apply to 638-pin µPGA ZIF sockets designed for use with the AMD 638-pin organic µPGA packages.

1.3 Supplier Requirements

To become an AMD qualified supplier for the Low-Profile Socket S1, the potential socket supplier shall demonstrate that their product meets the requirements listed in this document and by conducting qualification testing on their production run sockets in accordance with the *Low-Profile Socket S1 Qualification Plan*, order# 32887.

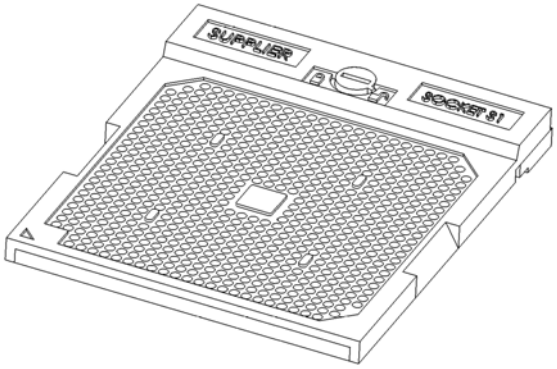


Figure 1. A 3-D View of the Low-Profile Socket S1

Chapter 2 Microprocessor Package Description

Dimensional information is provided in this section for the 638-pin organic µPGA package for mating with the Low-Profile Socket S1.

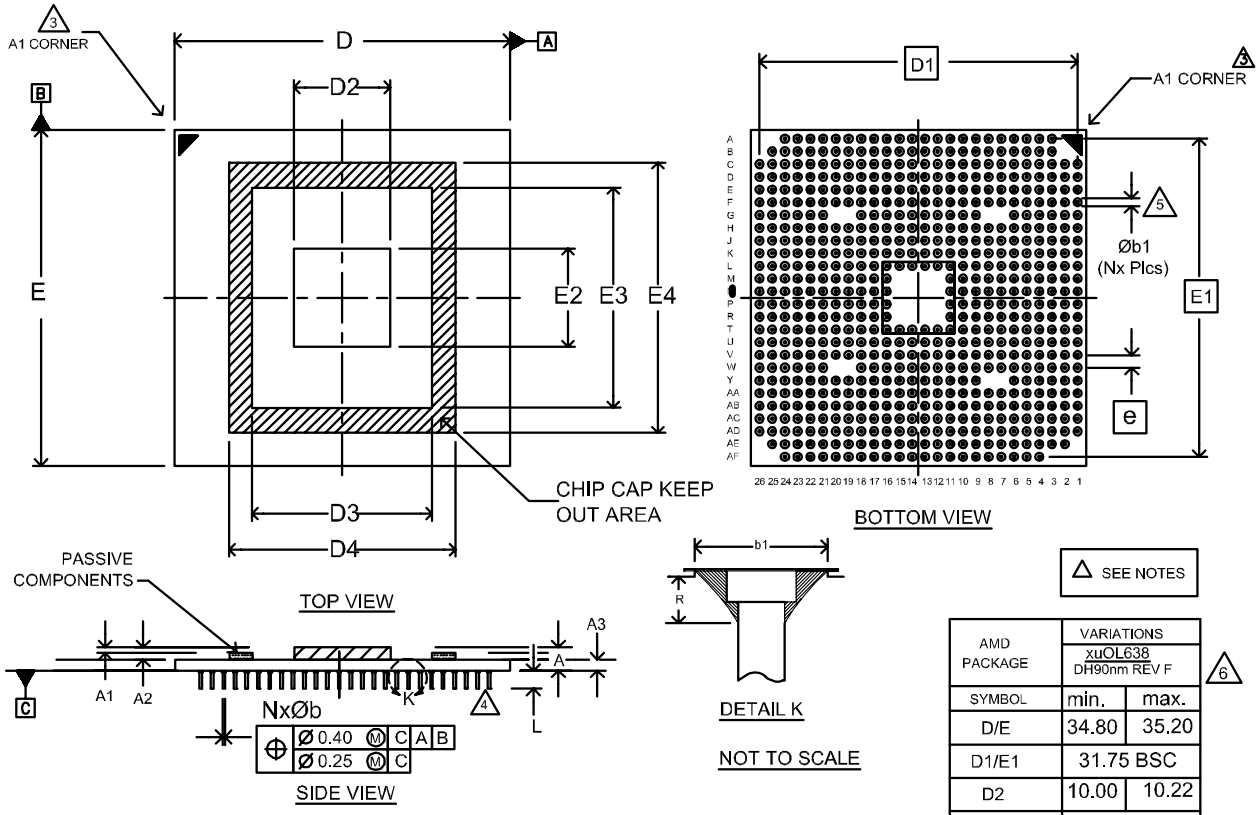
2.1 Organic µPGA Package (638-Pin)

The 638-pin organic µPGA package drawing is shown in Figure 2 on page 10.

2.2 Package Substrate and Pin Dimensions

The package substrate and pin dimensions, tolerances, and true position parameters are shown in Figure 2 on page 10.

The Low-Profile Socket S1 is designed to be functional with the lidded, as well as with the lidless package configuration. The total package thickness for the lidless configuration is 1.50 mm minimum.



GENERAL NOTES

1. All dimensions are specified in millimeters (mm).
2. Dimensioning and tolerancing per ASME-Y14.5M-1994.
3. This corner which consists of a triangle on both sides of the package identify pin A1 corner and can be used for handling and orientation purposes.
4. Pin tips should have radius.
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.
7. "*" Dimensions apply to the package configuration with the minimum substrate thickness only. For the dimensions pertaining to the actual products, refer to the appropriate package diagrams in the Processor Functional Data Sheets (e.g. AMD PID 31731 or 41258).

△ SEE NOTES

AMD PACKAGE	VARIATIONS xuOL638 DH90nm REV F		△6
SYMBOL	min.	max.	
D/E	34.80	35.20	
D1/E1	31.75 BSC		
D2	10.00	10.22	
D3	18.78 MIN		
D4	23.62 MAX		
E2	10.19	10.41	
E3	22.95 MIN		
E4	28.15 MAX		
A	1.94 REF*		△7
A1	0.116*	-----	
A2	0.80*	0.86*	
A3	1.0*	1.2*	
e	1.27 BSC		
b	0.275	0.325	
b1	0.98	1.08	
L	1.95	2.11	
M	26		
N	638		
R	0.30 MAX		

Figure 2. Organic µPGA Package Drawing (638-Pin)

Chapter 3 Socket Mechanical Requirements

This chapter describes the socket outline, package seating plane, socket housing, socket contact, socket actuation cam, socket durability, and visual inspection.

3.1 Socket Outline

Figure 3 on page 13 shows the allowable outline for the Low-Profile Socket S1.

3.2 Package Seating Plane

The cover for the Low-Profile Socket S1 is designed to accommodate the package pin shoulder and braze/solder fillet as shown by the 638-pin organic µPGA package drawings in Figure 2 on page 10. 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 better than 0.25 mm, when unmated as well as when mated with a package. After socket mounting to PCB, the package-seating plane on the socket cover is 3.00 ± 0.20 mm from the mounting surface of the PCB.

3.3 Socket Housing

The socket housing, base, and cover can be seen in Figure 3 on page 13.

3.3.1 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.

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

The socket cover shall include a 0.30 mm ± 0.05 mm deep recess to accommodate the package pin shoulder and braze/solder fillet.

The socket cover flatness is less than 0.25 mm, before and after the SMT reflow to the PCB and after environmental and mechanical testing.

Finger access cutouts with a minimum width of 12 mm must be incorporated into two opposing sides of the socket cover to provide access for package removal.

A removable tape or cover cap shall overlay the pin holes in the top of the socket cover to facilitate socket pick-and-place operation with a vacuum nozzle during board assembly. This removable tape or cover cap must not outgas during the solder reflow processes or leave any residue upon removal prior to package pins insertion.

3.3.2 Socket Markings

The socket identifier marking "SOCKET S1" shall be molded into the top surface of the socket cover cam box region, to the right side of the actuation cam. See Figure 1, on page 7, and Figure 3 on page 13.

A locked and unlocked directional designator is molded into the top surface of the cam box, in close proximity to the actuation cam.

A triangular shape symbol is molded into the top of the socket cover at the lower left corner position for proper package pin A01 orientation. See Figure 1, on page 7, and Figure 3 on page 13.

The supplier's UL approved trademark symbol is molded on the top surface of the socket cover cam box region, to the left side of the actuation cam.

The lot traceability number can be ink, laser, or impact marked on the socket cover. This marking is located such that it remains visible and readable after the socket is solder mounted onto the PCB.

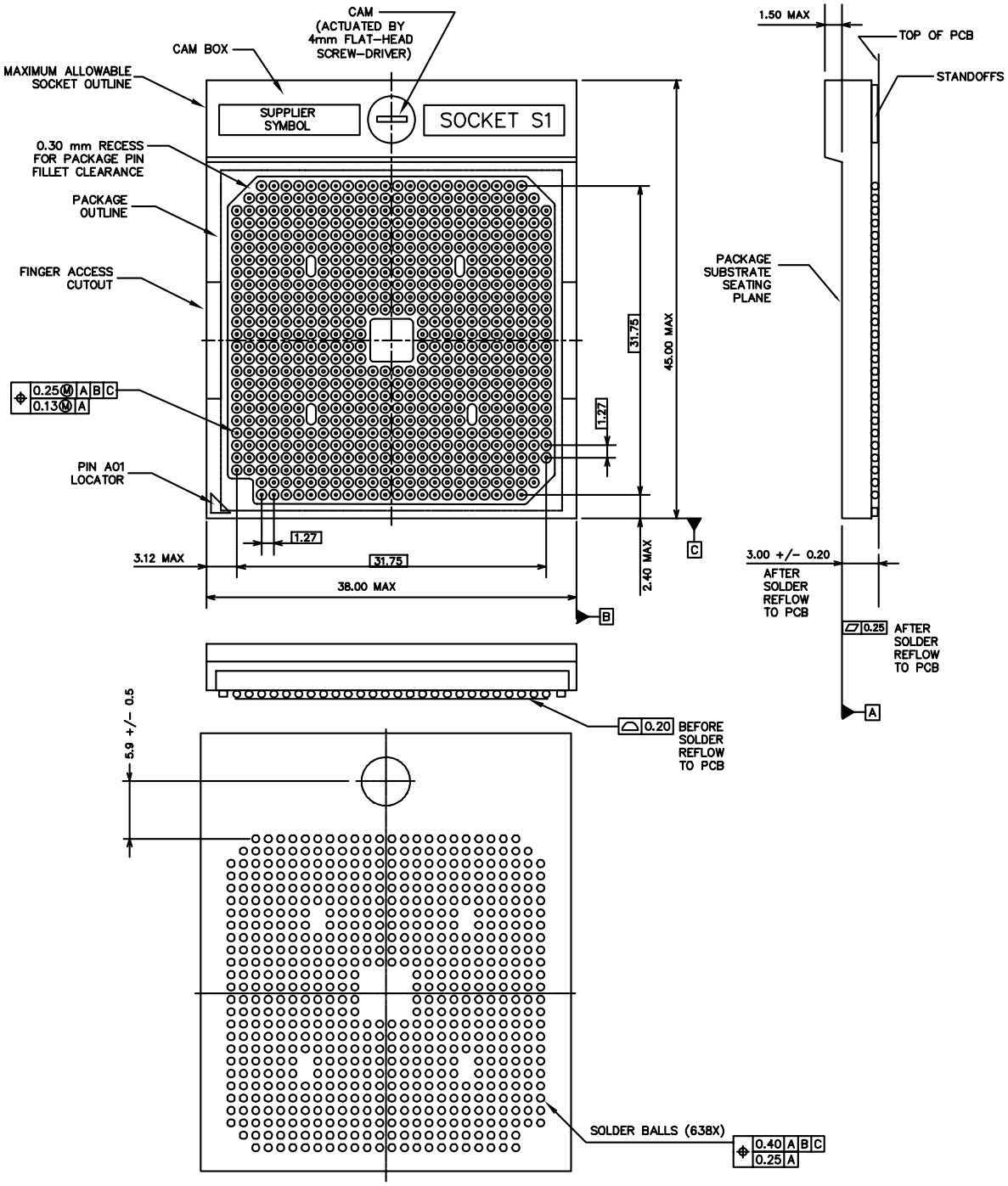


Figure 3. Low-Profile Socket S1 Outline

3.4 Socket Contact

The following sections describe the socket contact base metal, contact plating, SMT solder balls and lubricant requirements for the Low-Profile Socket S1.

3.4.1 Contact Base Metal

The contact base metal shall be high-strength copper alloy.

3.4.2 Contact Plating

The entire contact shall be plated with 1.27-µm minimum thickness of nickel.

The contact mating area shall be plated with 0.76-µm minimum thickness of gold over the 1.27-µm minimum thickness of nickel under-plating. 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 each set of 20 contacts examined.

3.4.3 SMT Solder Balls

The socket is mounted to the PCB by SMT, with minimum solder pad diameter of 0.51 mm on the PCB.

The solder balls on the socket have a diameter of 0.76 ± 0.15 mm, 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 includes a solder barrier feature to prevent solder from wicking up into the contact mating area during solder reflow.

The Socket S1 solder-ball field meets the co-planarity requirement of 0.20 mm before solder reflow to PCB.

The force required to shear off the solder ball from the contact shall be a minimum of 0.75 kgf.

3.4.4 Lubricants

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

3.5 Socket Actuation Cam

The socket incorporates a flat-head screwdriver-actuated cam at the center of the cam box for actuating and de-actuating the socket contacts with the package pins. This actuation cam and the screwdriver provide the mechanical advantage to easily actuate the socket in an OEM high-volume manufacturing environment and also facilitate socket actuation and deactuation operations by the end-user. The socket actuation cam must be operable using a standard 4 mm flat-head screwdriver.

3.5.1 Cam Material

The actuation cam is made of stainless steel.

3.5.2 Package Insertion/Extraction Force

With the actuation cam in the open position, the package insertion and extraction forces conceptually are zero. These insertion and extraction forces must not exceed 0.5 kgf in actual applications.

3.5.3 Cam Actuation/Deactuation Torque

The torque required to actuate or de-actuate the cam must be less than 2.5 in-lbf, using a flat-head screwdriver. The screwdriver-actuated cam can have a rotation range between 90 and 185 degrees between the open and lock positions. The socket must incorporate hard-stop features at the open and lock positions to prevent damage to the package pins and the socket as a result of over-travel by the actuation cam. These hard-stop features must be capable of withstanding a torque value up to 6.5 in-lbf without any damage.

3.5.4 Pin Field Actuation Displacement

The package pins must be displaced less than 1.0 mm during socket actuation or deactuation. With the socket in the lock position, the distance between the centerline of the pin opening in the socket cover and the centerline of the solder ball attached to the associated contact, must be less than 1.0 mm.

3.5.5 Socket Retention Force

With the actuation cam in the lock position, the force required to extract the package pins out of the socket contacts must be a minimum of 8.3 kgf for Cu-194 alloy pins.

3.6 Socket Durability

The socket must maintain electrical and mechanical integrity after 30-actuation and deactuation cycles, with each mating package used no more than five mating cycles.

3.7 Visual Inspection

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

3.7.1 Solder Balls

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

3.7.2 Contacts

There can be no missing or damaged contacts that prevent the socket from functioning properly. Contact mating surface must not be missing gold plating.

3.7.3 Cover and Base

There can be no cracks or flashing visible on the socket cover and base. All tabs for securing 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.

3.7.4 Actuation Cam

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

Chapter 4 Socket Electrical Requirements

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

4.1 Contact Current Rating

The contact must be rated at a current rating of 1.5 A per contact, with less than 30°C temperature rise, and a minimum of ten adjacent rows of mated contacts/pins energized. The current rating test shall be conducted with the associated heat sink assembly (AMD part number TBD) attached to the processor package.

4.2 Contact 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.

Initial Contact

Initial contact resistance shall be measured immediately after the first mating of the package pins to the socket contacts. A total of 200 daisy chain pairs (400 contact locations) must be measured per socket sample. Initial LLCR must not exceed 17 mΩ per contact when mated with Cu-194 Alloy pins, based on measurements made on a daisy chain pair.

Final Contact

Final contact resistance shall be measured after the mechanical and environmental testing of the mated package and socket is complete. The same 200 daisy-chain pairs (400-contact locations) must be measured per socket sample. Final LLCR must not exceed 17 mΩ per contact when mated with Cu-194 alloy pins, based on measurements made on a daisy chain pair.

4.3 Inductance

The mated partial self-inductance of a single pin must be less than 3 nH.

The mated loop inductance of two nearest pins must be less than 2.25 nH.

The mated partial-loop inductance matrix of three neighboring pins must be less than 2.25 nH for the diagonal entries, and must be less than 1.5 nH for the off-diagonal entries.

4.4 Capacitance

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.

4.5 Differential Impedance

The differential (or odd mode) impedance for three mated pins configuration (one pin as the voltage/current reference: S1, S2, G) must be 100 Ω ± 10% between the two nearest pins. 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 skew among single-ended signals must be less than 13 ps.

The propagation delay skew among differential signal pairs must be less than 13 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

The socket design must meet reliability requirements for end-user field use environment, OEM high volume manufacturing environment, and shipping and handling conditions of mobile computers, as described in this section.

5.1 Thermal Shock

The socket must meet LLCR and visual inspection requirements after being subjected to 10 cycles of thermal shock testing between –55°C and +110°C, with 30 minutes dwell time at each temperature extreme, and less than 15 seconds transition time. The test shall be conducted with the associated heat sink assembly (AMD part number TBD) attached to the processor package.

5.2 Cyclic Humidity

The socket must meet LLCR, DWV, IR, and visual inspection requirements after being subjected to duration of 1000 hours of cyclic humidity testing from 25°C to 85°C, at 90% to 95% relative humidity, with a cycle time of eight hours. Conduct the test with an associated heat sink assembly (AMD part number TBD) attached to the processor package.

5.3 Thermal Cycling

The socket must meet LLCR and visual inspection requirements after being subjected to a minimum of 1000 cycles of thermal cycling testing between –55°C ± 5°C solder ball temperature for 5 minutes and +110°C ± 5°C solder ball temperature for 5 minutes, with the average rate of temperature change between the hot and cold temperature extremes at less than 10°C per minute. Conduct the test with the associated heat sink assembly (AMD part number TBD) attached to the processor package.

5.4 Temperature Life

The socket must meet LLCR and visual inspection requirements after being subjected to 500 hours of temperature life testing at 115°C. Conduct the test with the associated heat sink assembly (AMD part number TBD) attached to the processor package.

5.5 Industrial Mixed Flowing Gas

The socket must meet LLCR and visual inspection requirements after being subjected to mixed flowing gas testing with one-half samples mated and one-half samples unmated for the first five days and all samples mated for the final five days.

5.6 Mechanical Shock

The socket must meet LLCR, discontinuity less than 1 µs duration and visual inspection requirements after being subjected to mechanical shock testing at 50 g, 11 ms duration, half-sine wave-form, with three shocks per positive and negative directions, on all three axes. Conduct the test with the associated heat sink assembly (AMD part number TBD) attached to the processor package.

5.7 Random Vibration

The socket must meet LLCR, discontinuity less than 1 µs duration, and visual inspection requirements after being subjected to random vibration testing at 7.3 g RMS between 20 to 500 Hz, for 15 minutes per axis, on all three axes. Conduct the test with the associated heat sink assembly (AMD part number TBD) attached to the processor package.

5.8 Resistance to Solder Heat

The socket must meet LLCR, cover flatness, and visual inspection requirements after being subjected to three-convection solder reflow processes for mounting the socket to the PCB.

5.9 Resistance to Solvents

The socket must meet visual inspection requirements after being subjected to the four solutions test.