12.2.2 *True Adhesive Strength* — The true adhesive strength (CKic) excluding residual stress, is calculated as follows:

$$K_{ic}\left(MPa\sqrt{m}\right)=\frac{K_{ib1}+K_{ib2}}{2}$$

where :

K_{ib1} : Apparent adhesive strength when testing is performed with molded side up ($MPa\sqrt{m}$)

K_{ib2} : Apparent adhesive strength when testing is performed with leadframe side up ($MPa\sqrt{m}$)

13 Report

13.1 The following items should be reported:

13.1.1 Leadframe

13.1.1.1 Material Designation

13.1.1.2 Thickness

13.1.1.3 Production Method (etching or stamping)

13.2 *Pre-Treatment* — In case that surface pre-treatment is necessary, the process and their condition should be reported as follows:

13.2.1 Pre-treatment by plating

13.2.1.1 Plating type

13.2.1.2 Plating thickness

13.2.2 Post treatment after plating

13.2.2.1 Corrosion prevention treatment

13.2.2.2 Cleaning treatment

13.2.2.3 Coupling material

13.2.3 Pre-treatment by heating

13.2.3.1 Temperature

13.2.3.2 Atmosphere

13.2.3.3 Oven or Hot Plate

13.3 *Molding Compound*

13.3.1 Material Designation

13.4 *Molding Compound Configuration and Dimension*

13.5 *Molding Condition*

13.5.1 Pre-heat condition (Temperature, Time)

13.5.2 Molding condition (Cure temperature, Cure time, Injection speed, Injection pressure)

13.5.3 Post-cure condition (Temperature, Time)

13.5.4 Sample storage conditions

13.6 *Measurement Method (Shear, Pull, or Three-point bending method*)

13.7 *Measurement Equipment*

13.8 *Adhesive Strength (maximum, minimum, average, and where possible, standard deviation, σ)*

APPENDIX 1
SAMPLE OF MOLD FOR SHEAR METHOD

NOTICE: The material in this appendix is an official part of SEMI G69 and was approved by full letter ballot procedures.

A1-1

A1-1.1 A mold to prepare samples for shear method is shown in Figure A1-1 as a sample.

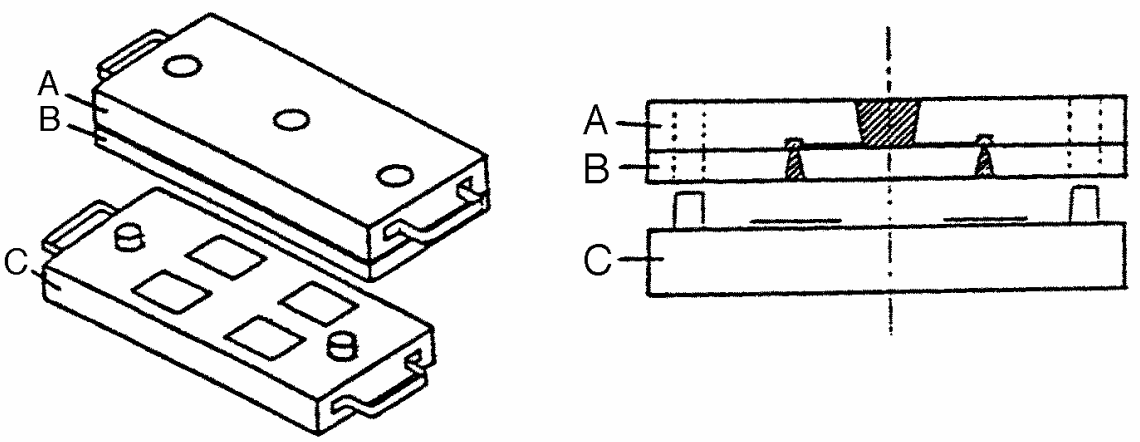


Figure A1-1
Mold Sample

APPENDIX 2
SAMPLE SIZE

NOTICE: The material in this appendix is an official part of SEMI G69 and was approved by full letter ballot procedures.

A1-2

A1-2.1 Results of adhesive strength measurement made by some companies using the same leadframe material and molding compound are shown in Figure A2-1. The figures show that apparent adhesive strength decreases with an increase in adhesive area due to residual stress.

A1-2.2 Sample size in this document was determined in consideration of the effect of residual stress and easiness of handling for samples.

A1-2.3

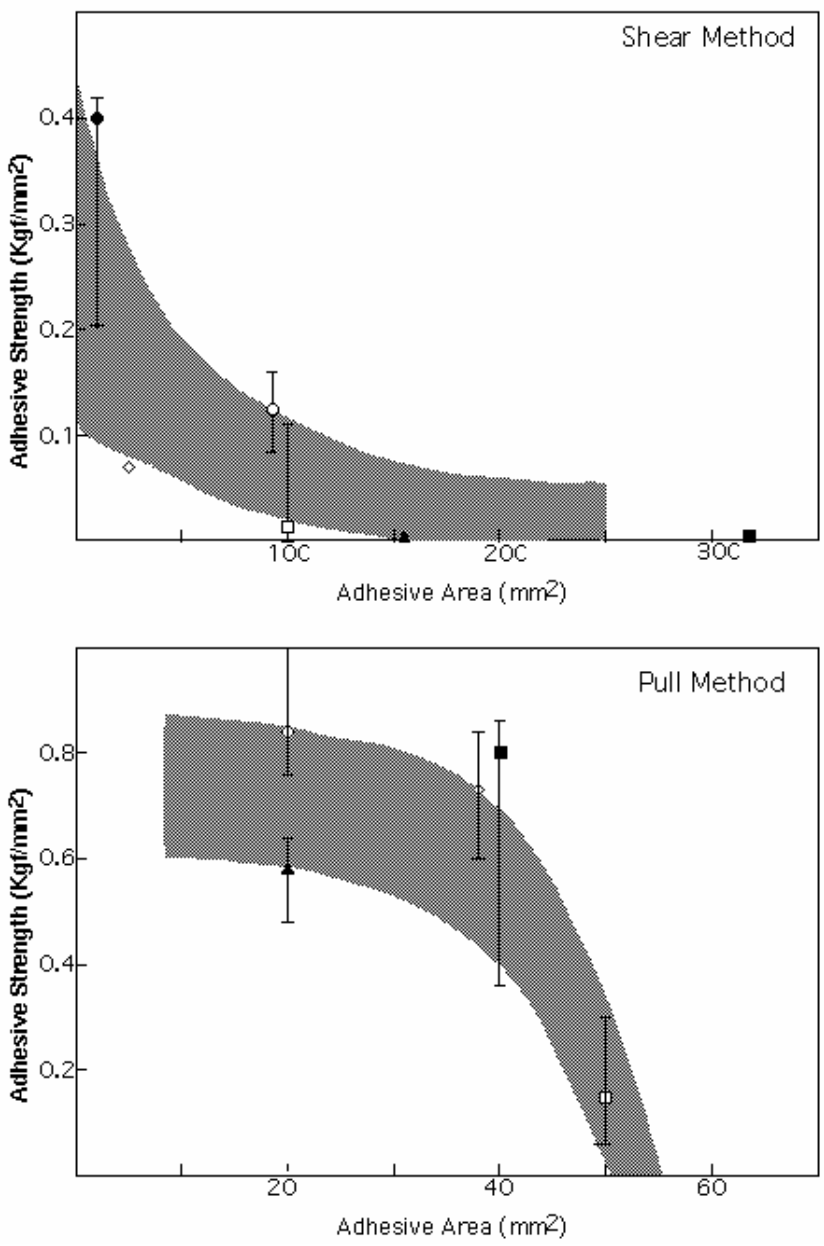


Figure A1-2
Dependence of Measurement Results on Sample Size

APPENDIX 3
EFFECTIVENESS OF RESIDUAL STRESS SEPARATION IN THREE-POINT BENDING METHOD

NOTICE: The material in this appendix is an official part of SEMI G69 and was approved by full letter ballot procedures.

A1-3

A1-3.1 Since the three-point bending method can eliminate the effect of residual stress and also that of stress distribution on the interface (stress singularity at the adhering edges), the measurement results are almost independent of sample dimensions (Figure A3-1[2]). This method can evaluate both the true adhesive strength and the magnitude of residual stress; mainly due to the thermal expansion mismatch between materials, simultaneously (Figures A3-2 and A3-3[3]).

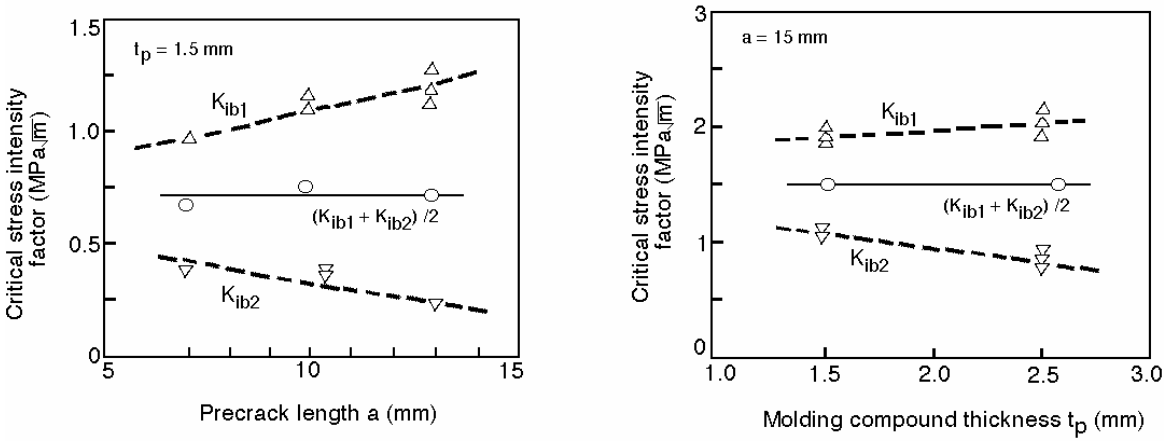


Figure A3-1
Dependence of Measurement Results on Specimen Dimensions

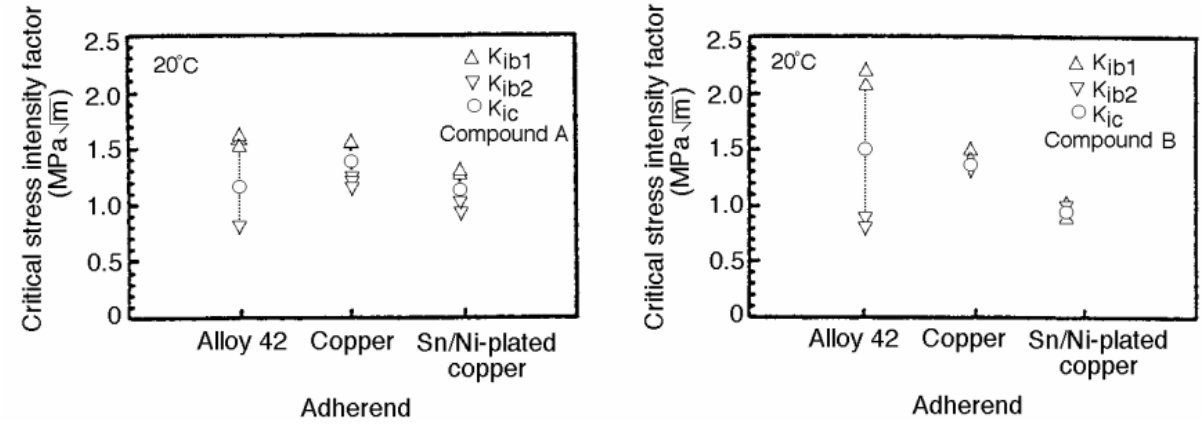


Figure A3-2
Dependence of Adhesion Strengths on Adherend Material

2 A. Nishimura, I. Hirose, and N. Tanaka, "A New Method for Measuring Adhesion Strength of IC Molding Compounds", ASME Journal of Electronic Packaging, Vol. 114, pp. 407-412, 1992

3 A Nishimura amd N. Tanaka, "Measurement of IC Molding Compound Adhesion Strength and Prediction of Interface Delamination within Package", Advanced in Electronic Packaging, edited by T.R. Hsu et al., ASME, EEP-Vol. 10.2, pp. 765-773, 1995

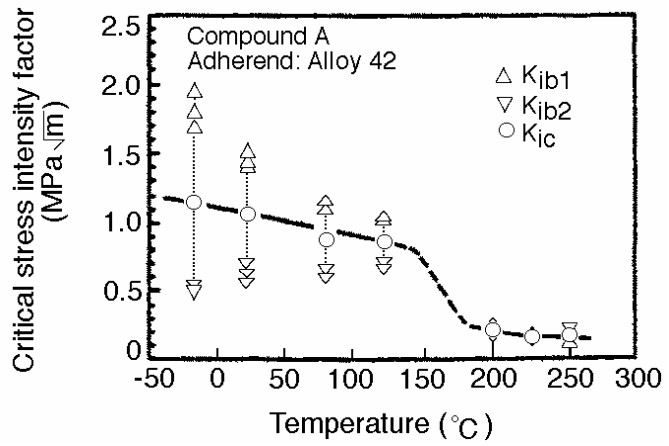


Figure A3-3
Temperature Dependence of Adhesion Strength

APPENDIX 4
LEADFRAME DESIGN FOR PULL METHOD

NOTICE: The material in this appendix is an official part of SEMI G69 and was approved by full letter ballot procedures.

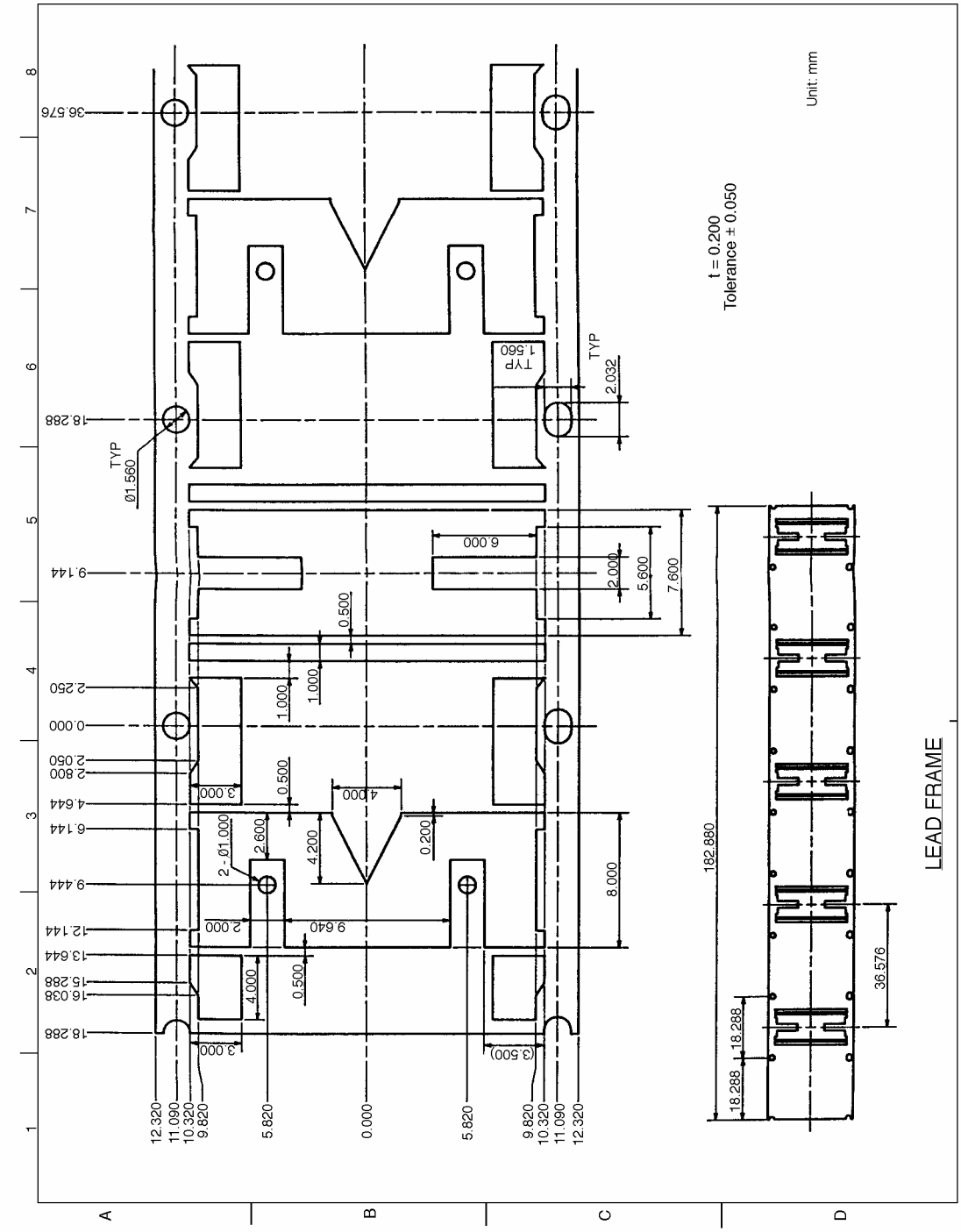


Figure A1-4

NOTICE: SEMI makes no warranties or representations as to the suitability of the standard set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

SEMI G70-0996 (Reapproved 1104)
STANDARD FOR EQUIPMENT AND LEADFRAME FIXTURES FOR MEASUREMENT OF PLASTIC PACKAGE LEADFRAMES

This standard was technically approved by the Global Assembly & Packaging Committee and is the direct responsibility of the Japanese Packaging Committee. Current edition approved by the Japanese Regional Standards Committee on July 23, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1996.

1 Purpose

1.1 This standard describes the equipment and leadframe fixtures used for measurement of Z-axis dimensions of plastic package leadframes.

2 Scope

2.1 This standard mainly describes the equipment and leadframe fixture for measurement of leadframes that are ≤ 0.15 mm in thickness as used for TSOP and TQFP packages listed in group II in Table 1.

2.2 This standard also may be applied for leadframe of conventional packages which are ≥ 0.2 mm in thickness.

Table 1 Package Classification

Group I	*Group II*
	SSOP
DIP	TSOP
ZIP	TSSOP
SOJ	QFP
SOP	TQFP
QFJ (PLCC)	LQFP
	SVP

NOTE 1: Packages should be classified by EIAJ and JEDEC specifications.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

3.1 *SEMI Standard*

SEMI G57 — Guideline for Standardization of Leadframe Terminology

3.2 *EIAJ Standard*[1]

ED-7411 — General Rules for the Preparation of Outline Drawings of Integrated Circuits, Packages Name and Code

3.3 *JEDEC Specifications*[2]

Pub. No. 95 — Registered and Standard Outlines for Semiconductor Devices

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Definitions*

NOTE 2: See SEMI G57 for leadframe features terminology.

4.1.1 *burr height* — maximum height of burr above the plane which it protrudes, (see Figure 1).

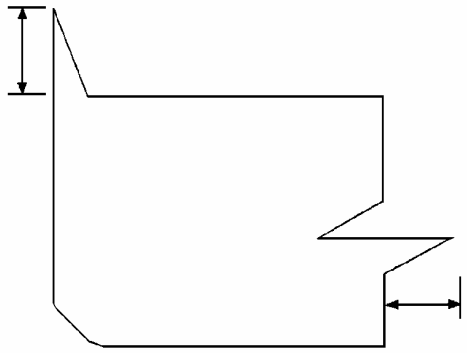


Figure 2
Burr Height

1 Electronic Industries Association of Japan, available through: Japan Electronics and Information Technology Industries Association, 3rd Fl., Mitsui Sumitomo Kaijo Bldg. Annex 11, Kanda Surugadai 3-chome, Chiyoda-ku, Tokyo 101-0062, Japan, http://www.jeita.or.jp/eiaj/english/

2 JEDEC Solid State Technology Association (aka the Joint Electron Device Engineering Council), 2500 Wilson Boulevard, Arlington, VA 22201-3834, USA. Telephone: 703.907.7560; Fax: 703.907.7583, Website: www.jedec.org

4.1.2 *coil set* — longitudinal bowing of the leadframe strip length (see Figure 2).

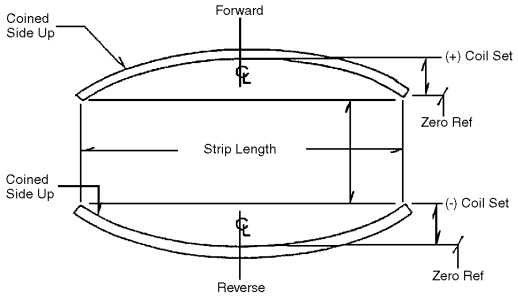


Figure 2
Coil Set

4.1.3 *coined depth* — the difference in height between the top surface of the coined area of an inner lead and the top surface of the coined area at the tip of the lead. Inner lead coining produces a flattened section of the lead that is suitable for wire bonding (see Figure 3).

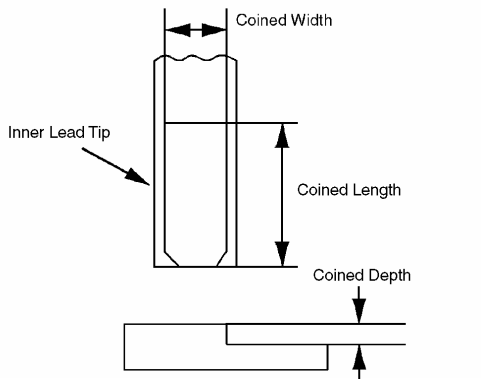


Figure 3
Coined Depth

4.1.4 *crossbow* — transverse bowing of the leadframe (see Figure 4).

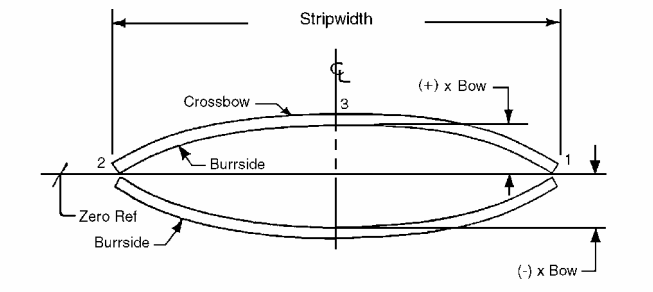


Figure 4
Crossbow

4.1.5 *die pad dimple* — a hollow formed in a die pad using a half-etching technique or stamping to improve the adhesive strength with the die or molding compound and to reduce the stress between the die pad and the die.

4.1.6 *die pad dimple depth* — the maximum depth of the dimple (see Figure 5).

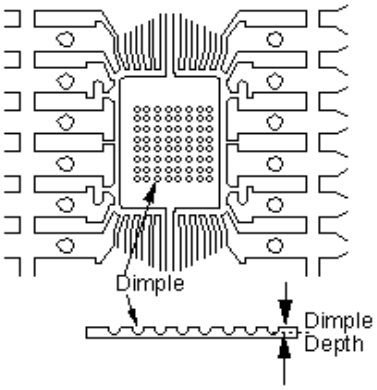


Figure 5
Die Pad Dimple Depth

4.1.7 *die pad flatness* — deviation of the center point of die pad surface from a plane established by the four corner points of die pad (see Figure 6).

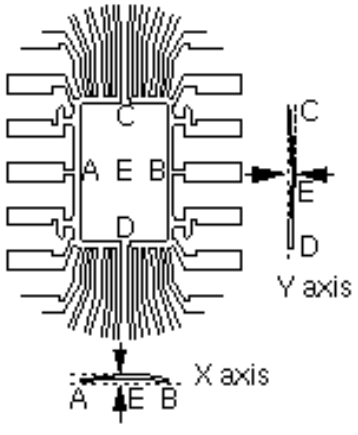


Figure 6
Die Pad Flatness

4.1.8 *die pad location* — deviation of the center point of die pad surface from a plane established by the dam bars (see Figure 7).

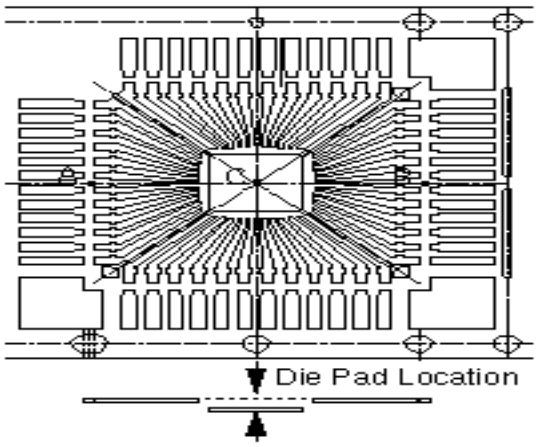


Figure 7
Die Pad Location

4.1.9 *die pad tilt* — deviation of the plane of die pad from a condition parallel to the plane formed by the dam bars (see Figure 8).

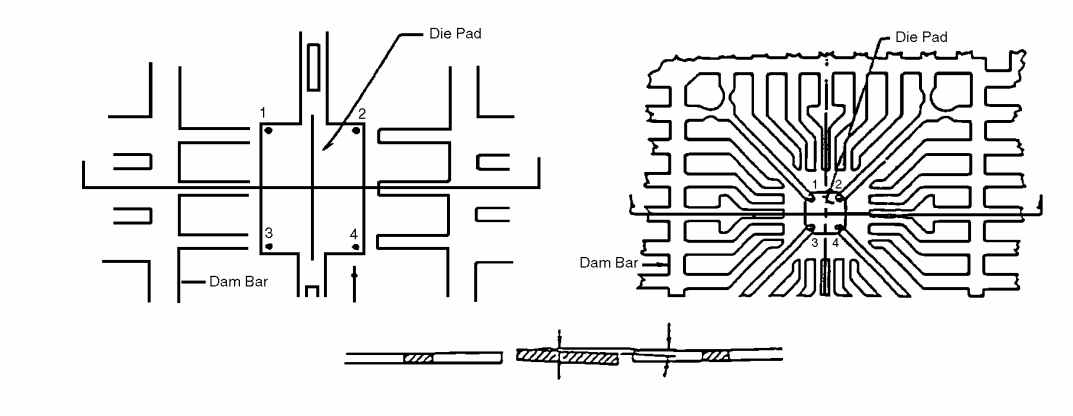


Figure 8
Die Pad Tilt

4.1.10 *downset depth* — (see Figure 9).

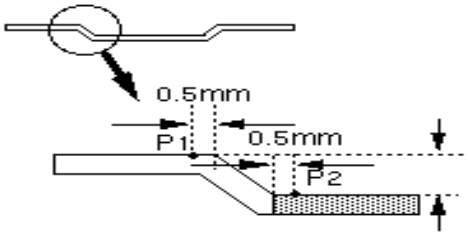


Figure 9
Downset Depth

NOTE 3: The measurement points P1 and P2 should be agreed between user and supplier.

4.1.11 *half-etch* — some designed part or area of leadframe where the thickness is reduced by one side etching.

4.1.12 *half-etch depth* — the maximum depth of the half-etch (see Figure 10).

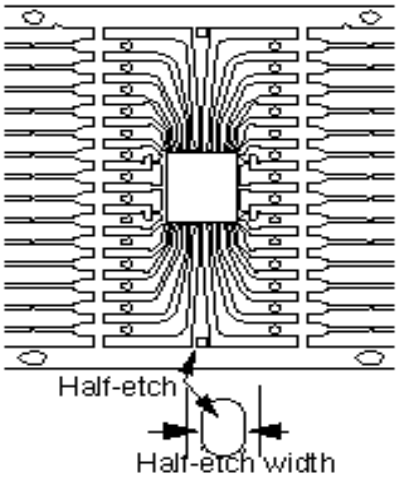


Figure 10
Half-Etch Depth

4.1.13 *lead coplanarity* — total indicator reading difference of the lead tips in the Z direction (see Figure 11).

Figure 11
Lead Coplanarity

4.1.14 *lead planarity* — total indicator reading of the lead tips in the Z direction relative to the datum formed by the dam bars (see Figure 12).

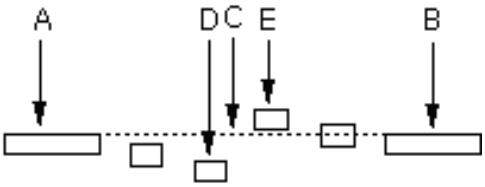


Figure 12
Lead Planarity

4.1.15 *lead lock groove* — a groove formed in leads using the half-etching technique or stamping to increase the adhesive strength of plastic molding compound to the leads and improve resistance to water intrusion into the package (see Figure 13).

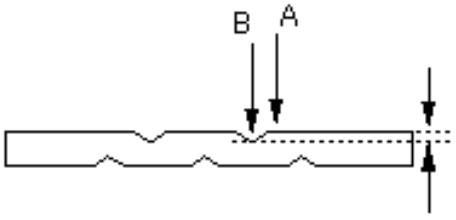


Figure 13
Lead Lock Groove

4.1.16 *lead lock groove depth* — the maximum depth of the groove.

4.1.17 *lead tilt* — deviation of the plane of coined area from a condition parallel to the plane formed by the dam bars (see Figure 14).

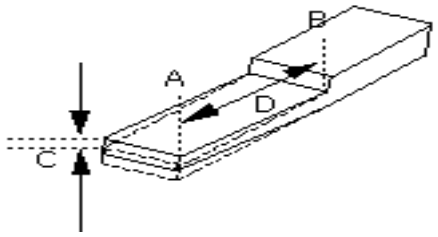


Figure 14
Lead Tilt

4.1.18 *leadframe twist* — angular rotation of one end of the leadframe or strip with reference to the other end (see Figure 15).

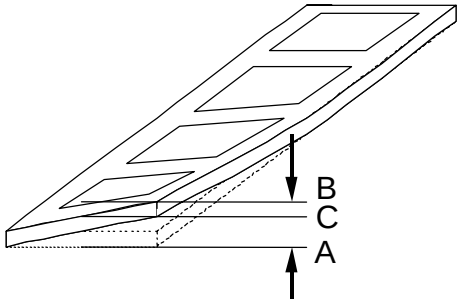


Figure 15
Leadframe Twist

5 Equipment

5.1 *Measurement Equipment* — The equipment and required accuracy used for the measurements are shown in Table 2.

Table 2 Measurement Equipment

Type	*Equipment*	*Minimum Reading*	*Accuracy (2σ)*
A	Height measurement equipment with non-contact method	0.1 μm	1 μm
B		1 μm	4 μm
C	Clearance gage	10 μm	-
D	Scanning probe microscope	0.1 μm	-

5.2 *Leadframe Fixtures* — Leadframe fixtures are shown in Figures 16–20. The materials, dimensions, and accuracy shall be agreed between the vendor and customer.

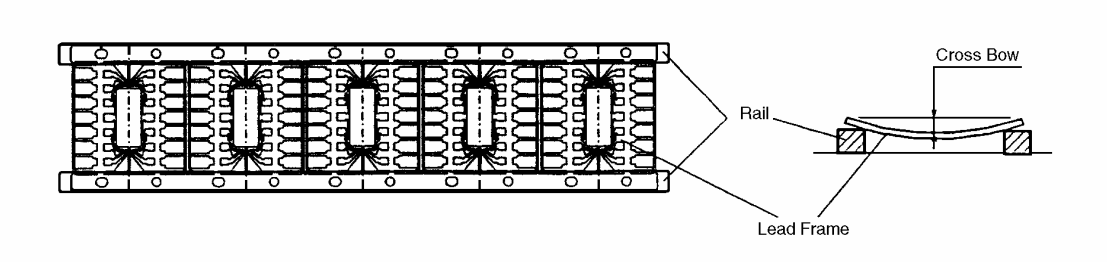


Figure 16
Leadframe Fixture — Type 1

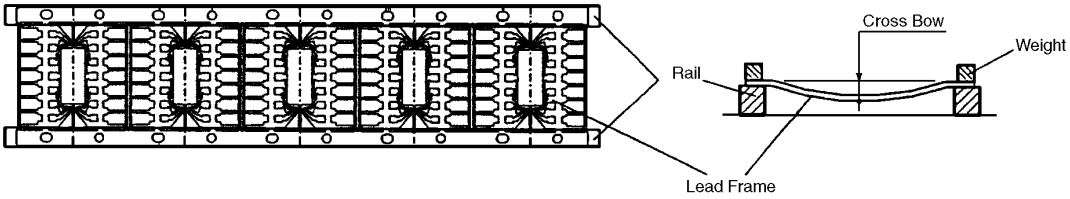


Figure 17
Leadframe Fixture — Type 2

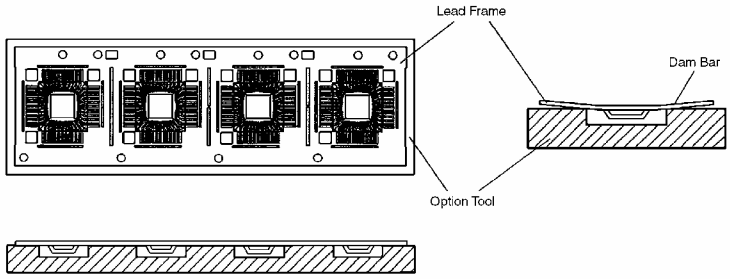


Figure 18
Leadframe Fixture — Type 3

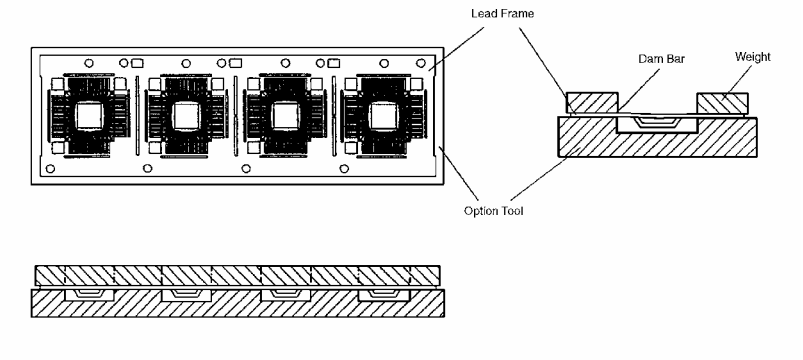


Figure 19
Leadframe Fixture — Type 4

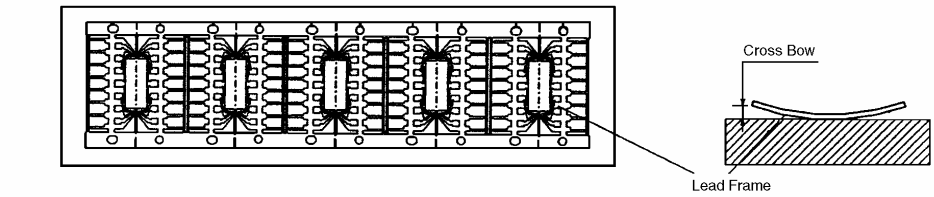


Figure 20
Leadframe Fixture — Type 5

6 Measurement

6.1 Leadframe fixtures and measurement equipment for each measurement item are shown in Tables 3 and 4.

Table 3 Leadframe Fixtures and Measurement Equipment (Independent of Package Type)

Items	*Leadframe Fixture*	*Equipment*
Burr height	1. 2. 3. 4. 5.	A. B. D.
Coil set	5	A. B. C.
Coined depth	1. 2. 3. 4. 5.	A. B.
Die pad dimple depth	1. 2. 3. 4. 5.	A. B.
Lead lock groove depth	1. 2. 3. 4. 5.	A. B.
Half-etch depth	1. 2. 3. 4. 5.	A. B.
Leadframe twist	1. 2. 3. 4. 5	A. B.

Table 4 Leadframe Fixtures and Measurement Equipment (Dependent on Package Type)

Items	*Group I*		*Group II*	
	Leadframe Fixture	*Equipment*	*Leadframe Fixture*	*Equipment*
Crossbow	1.	A. B.	1. 3.	A.
Die pad flatness	1. 3.	A. B. D	3. 4.	A. D.
Die pad location	1. 3	A. B	4	A.
Die pad tilt	1. 3.	A. B	3. 4	A.
Downset depth	1. 3.	A. B	4	A.
Lead planarity	1. 3.	A. B	4	A.
Lead coplanarity	1. 3.	A. B	4	A.
Lead tilt	1. 3.	A. B	3. 4	A.

7 Related Documents

7.1 *SEMI Standard*

SEMI G10 — Standard Method for Mechanical Measurement for Plastic Package Leadframes

SEMI G71-0996 (Reapproved 1104)
SPECIFICATION FOR BARCODE MARKING OF INTERMEDIATE CONTAINERS FOR PACKAGING MATERIALS

This standard was technically approved by the Global Assembly & Packaging Committee and is the direct responsibility of the Japanese Packaging Committee. Current edition approved by the Japanese Regional Standards Committee on July 23, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1996.

1 Purpose

1.1 This specification describes a common format, content, size, and location for printed, machine-readable labels on an intermediate container of materials used for semiconductor packaging.

1.2 This specification provides for a smooth transition from existing traceability and labeling procedures to a comprehensive, unified system envisioned for the future.

2 Scope

2.1 This document applies to the following packaging materials:

2.1.1 Leadframe

2.1.2 Molding compound

2.1.3 Bonding wire

2.1.4 Die attach materials

2.2 This document applies to only the intermediate container. Barcode specification for shipping pack is referred to EIA 556A or EIAJ barcode specification.

2.3 This document does not apply to product package label.

NOTE 1: There are requests for labeling on product packages from the customers. However, task force concluded that the product package label was not included in scope of the specification because of limitation of area to be labeled on the package. For further activity, two-dimensional barcode symbol may be needed to standardize the barcode marking specification for product packages.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

3.1 *AIM Specification*[1]

USS-39 — Universal Symbol Specification Code 39

3.2 *ANSI Specifications*[2]

ANSI X3.182 — Barcode Print Quality - Guideline

ANSI/FACT-1 — Data Application Identifier Standard

3.3 *EIA Specification*[3]

EIA 556A — Outer Shipping Container Bar Code Label System

3.4 *EIAJ Specification*[4]

EIAJ — Standard, Bar Code Label System

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Definitions*

4.1.1 Many items relating to barcode technology are defined in EIA 556, Appendix Definitions, and EIAJ Bar Code Label Systems, Appendix A.

4.1.2 *intermediate container* — a container housing one or more product packages for the purpose of product/ order segregation in a shipping container.

---

1 AIM USA, 634 Alpha Drive, Pittsburg, PA 15238

2 American National Standards Institute, Headquarters: 1819 L Street, NW, Washington, DC 20036, USA. Telephone: 202.293.8020; Fax: 202.293.9287, New York Office: 11 West 42nd Street, New York, NY 10036, USA. Telephone: 212.642.4900; Fax: 212.398.0023, Website: www.ansi.org

3 Electronic Industries Alliance, EIA Engineering Department, Standards Sales Office, 2001 Eye Street, NW, Washington, D.C. 20006, USA., Website: www.eia.org

4 Electronic Industries Association of Japan, Available through: Japan Electronics and Information Technology Industries Association, 3rd Fl., Mitsui Sumitomo Kaijo Bldg. Annex 11, Kanda Surugadai 3-chome, Chiyoda-ku, Tokyo 101-0062, Japan, http://www.jeita.or.jp/eiaj/english/

4.1.3 *product package* — the first tie, wrap, or container to a single item or quantity thereof that constitutes a complete identifiable pack. Product package may be packaged together or a group of the parts packaged together. Product package is also called unit pack.

4.1.4 *shipping pack* — a package or shipping container/ final container that is of sufficient strength to be used in commerce for packing, storing, and transporting products (see Figure 1).

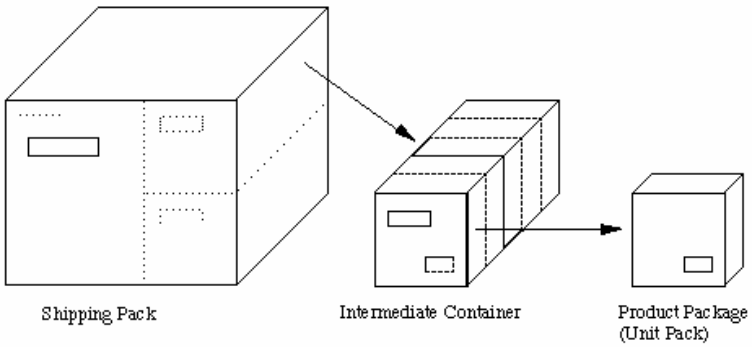


Figure 1
Definition of Package Form

4.1.5 Package forms for each material type are defined in Table 1.

5 Ordering Information

5.1 Purchase orders for the materials furnished in an intermediate package to the specification shall be include the following:

5.1.1 Content of message characters for customer product ID.

5.1.2 User-specified data, if required.

5.2 In addition, the following optional items may be specified.

5.2.1 Label location on the intermediate container.

5.2.2 Label size, if a label larger than the specified size in this specification.

6 Content of Data Field

6.1 The label shall include vendor field and customer field.

6.2 The customer field shall contain three data fields for barcode symbols. Each data field shall contain a maximum 17 message in addition to the start and stop characters. The content of the barcode symbol is shown in Table 2.

6.2.1 The upper data field shall contain a barcode symbol with customer product ID which consists of maximum 15 characters, preceded by a “P”, the data identifier for this item as specified in ANSI/FACT-1.

6.2.2 The middle data field shall contain a barcode symbol with lot number which consists of maximum 12 characters, preceded by a “1T”, the data identifier for this item as specified in ANSI/FACT-1.

6.2.3 The lower data field shall contain quantity and the production date concatenated into a single barcode symbol. Quantity is indicated by maximum 7 characters, preceded by a “7Q”, the data identifier for this item as specified in ANSI/FACT-1. The production date is indicated by 6 characters, preceded by a “D”, the data identifier for this item as specified in ANSI/FACT-1. The quantity and the production date are separated by a space.

6.2.3.1 Quantity indicated in this field shall be quantity in the intermediate container. The unit of measure should follow the quantity data to indicate what unit of measure is being used in the quantity count. The Unit uses 2 characters listed in Appendix D of ANSI/FACT-1.

6.2.3.2 Quantity that are not filled by a message characters shall contain hyphen (-) as a place saver to that the symbol always has exactly 7 characters.

6.3 Vendor company name and its logo mark; supplier's ID may be included in the supplier's field.

Table 1

	Explanation	*Data Identifier*	*No. of Characters*
Part No.	Customer part number. The number is assigned by the customer in the ordering information.	P	15 max.
Lot No.	Lot number is assigned by the supplier to identify or trace a unique group of the entries.	1T	12 max.
Quantity	Quantity and unit within the package. The unit uses characters listed in Appendix D of ANSI/FACT-1.	7Q	7
Production Data	The Date of production. The date is shown by "YYMMDD".	D	6
Supplier's Field	Supplier's name, supplier's company logo mark, supplier's code (agreed between supplier and customer) country, etc.	-	(Option)

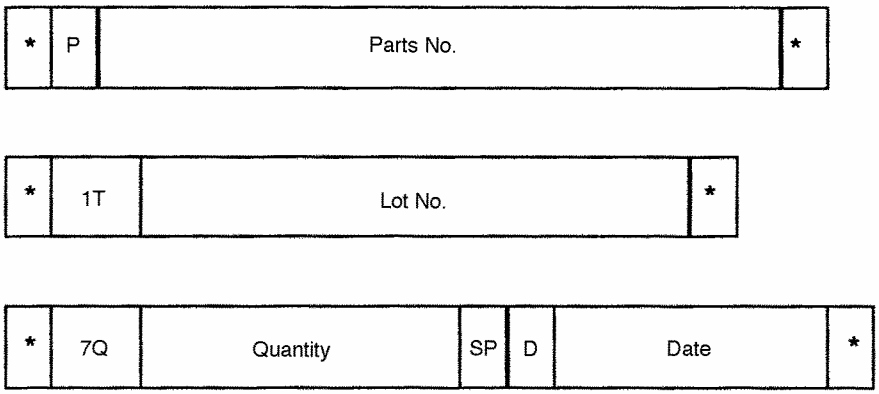


Figure 2
Barcode Arrangement

7 Barcode Character

7.1 The barcode characters specified in AIM USS-39 shall be used.

7.2 *Character Set* — The Code 39 character set consists of 43 characters: 0–9, A–Z, ., $, /, %, and space. In addition, an asterisk (*) is used only for both the stop and stop characters.

7.3 *Print Quality* — The Code 39 print quality shall be B/03/630 or better in accordance with ANSI X3.182. To assure reading efficiency, the minimum reflectance of the quiet zones shall be 60%, the minimum reflectance of spaces shall be 51%, and the maximum reflectance of bars shall be 10%.

7.4 *Symbol Dimensions* — Barcode symbol dimensions shall be as listed in Table 2.

Table 2 Symbol Dimensions

Code 39	*Dimension*
Narrow Element Width	0.250 mm
Wide Element Width	0.625 mm (Element Width Ratio 1:2.5)
Space between Characters	0.250 mm
Character Height	8.0 mm
Quiet Zone	5.0 mm (after and before barcode symbol)
Space between Barcode Field	5.0 mm

8 Human-Readable Interpretation (HRI) Symbols

8.1 Each barcode symbol data field on the customer field shall have an associated human-readable data field either immediately above or below it.

8.1.1 Start and stop characters shall not be included, but the data field identifier shall be included.

8.2 The height of human-readable characters shall be 3.0 mm.

8.3 The spaces above and below the human-readable characters shall be 1.0 mm.

9 Dimensions and Placement of Data Field on Label

9.1 The size of barcode label shall be 42 mm in height and 120 mm in width.

9.2 The dimensions and placement of data field on label are shown in Figure 3.

9.3 The barcode and human-readable characters shall be placed within this area of the label as indicated in Figure 3.

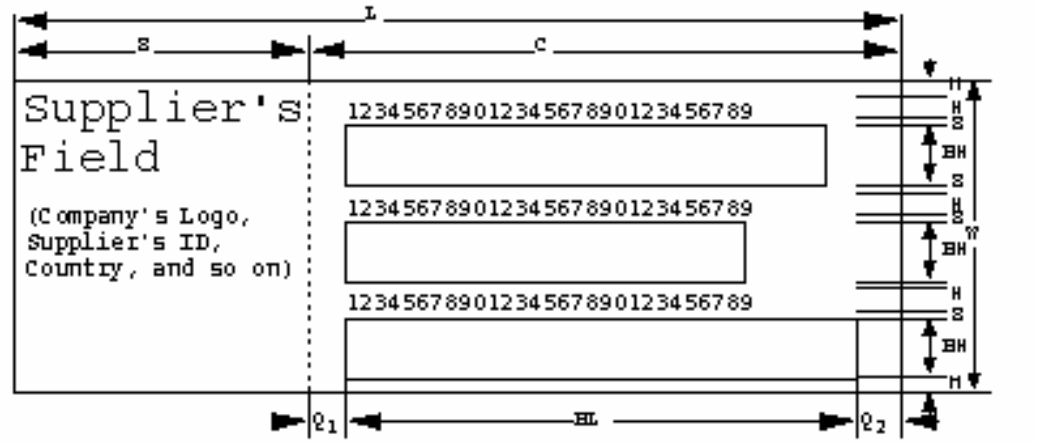


Figure 3
Dimensions and Placement of Data Field on Label

Horizontal Dimension	*Value (mm)*	*Vertical Dimension*	*Value (mm)*
L	120.0	W	40
S	40.0	M	2.0
C	80.0	H	3.0
BL	68.625	S	1.0
Q1	5.0	BH	8.0
Q2	6.375		

10 Barcode Label Location

10.1 The barcode label shall be located on the end of the packages for easy identification when the packages are temporarily stored in the storage shelf.

11 Label Material and Adhesive

11.1 Label material should not generate particles.

11.2 Label adhesive should not prohibit recyclability of the shipping packages.

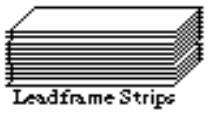
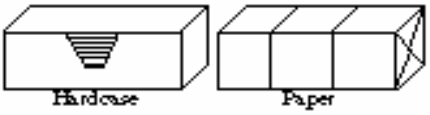
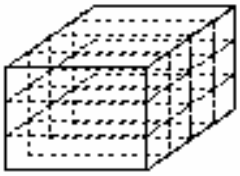
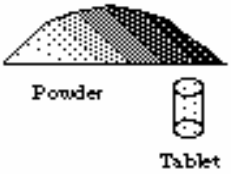
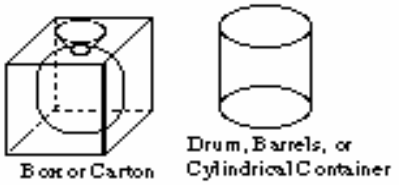
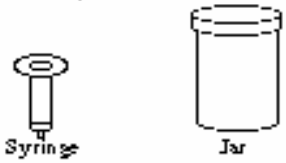
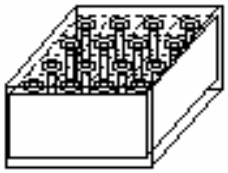
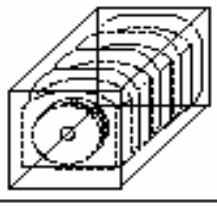
Material	Unit Pack	Intermediate Container
Leadframe 	The leadframes of specified quantity are packaged in a hardcase or wrapped by paper such as OP sheet. 	The unit packs of specified number are packaged in a box, a sterol case, a plastic case and etc. 
Molding Compound 		Molding compound of powder or tablet is wrapped by plastic bag and then it is packaged in a box or a drum. 
Die Attach Materials	Die attach material of specified quantity is poured into a syringe and the syringe is corked up. Or die attach material is poured into a plastic jar or a bottle. 	The unit packs of specified number are packaged in a box, a carton case, a plastic case and a plastic bag. 
Bonding Wire	Bonding wire is winded into a spool and then each spool is packaged in a clear plastic case. 	The unit packs of specified number are packaged in a box or a plastic case. 

Figure 4
Definition of Packaging Forms for Leadframe, Molding Compound, Die Attach Material, and Bonding Wire

NOTICE: SEMI makes no warranties or representations as to the suitability of the standard set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

SEMI G72-0997
SPECIFICATION FOR BALL GRID ARRAY DESIGN LIBRARY

1 Purpose

The purpose of this specification is to promote industry use of common BGA designs that may be distinguished by their form, fit, function, and reliability requirements and to record designs by category that meet these requirements.

2 Scope

2.1 This document provides a library of company-sponsored BGA designs for the purpose of promoting the use of these common designs and to minimize the unnecessary proliferation of new designs. New designs will be added as they become sponsored by and approved by member companies.

2.2 This library shall include ceramic, plastic, tape, metal and other (as new categories of designs are identified and added to this specification) BGA designs that are fully compliant with existing JEDEC-registered or standard mechanical outlines. Proposals for new designs may be balloted in parallel with congruent JEDEC registrations or standards, but will not be published in this library until such registration and/or standard is an approved JEDEC outline.

2.3 Controlling dimensions are metric (Systems International units).

3 Referenced Documents

3.1 *SEMI Documents*

SEMI International Standards Compilation of Terms

Regulations Governing SEMI Standards Committees

3.2 *ASME* [1]

ASME Y14.5M-94 — Dimensioning and Tolerancing

3.3 *EIA/JEDEC* [2]

EIA JEDEC Publication 95 — Registered and Standard Outlines for Semiconductor Devices

JEDEC BGA Design Guide 95-1 — Section 14

J-*STD-020* —

JESD 22-A113 — Preconditioning of Plastic Surface Mount Devices Prior to Reliability Testing

4 Terminology

4.1 *ball grid array (BGA) package* — A square or rectangular substrate package with an array of metallic balls on one surface of the package. The metallic balls form the electrical and mechanical connection between the package and the PC board or socket.

4.2 *column grid array* — Same as ball grid array except that metallic columns are used in place of the metallic balls for the electrical and mechanical interconnection between the package and the PC board.

NOTE 1: In the text of this specification, whenever ball grids are mentioned, a reference to column grids is also implied.

4.3 *wire bond ring* — Metalized area in the shape of a complete or partial ring surrounding the die mounting area intended for group electrical interconnections.

5 Ordering Information

5.1 *Order of Precedence* — To avoid conflicts, the order of precedence when ordering ball grid array substrates or assembled packages when using BGA Library Designs from this specification shall be as follows:

a. Purchase Order

b. Customer BGA Drawing

c. BGA Library Design from this specification

d. Referenced Documents from Section 3.0

e. Other related documents

6 General Design Characteristics Listing Format

6.1 Each design addition to this library shall include a general design characteristics description which shall be listed in Appendix 1 of this specification and also be formatted on top of the title block for each design drawing.

6.1.1 Description listings in the General Design Characteristics, Appendix 1 shall be organized into category sections: Plastic, Ceramic, Tape, Metal, or Other.

6.1.2 These descriptions shall be listed across a row of characteristics classification columns and may determine the uniqueness of each design.

1 American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, New Jersey 07007-2900.

2 Electronic Industries Association, Joint Electron Device Engineering Council, 2500 Wilson Blvd., Arlington, VA 22201, (703) 907-7560.

6.2 The characteristics classification columns may be used in a data base format to sort the design listings sequentially, top to bottom according to their sequential listing by column, left to right, in the following order. These listings and their descriptive designations are as follows:

6.2.1 *Ball Count* — List the actual number of balls on the package.

6.2.2 *Signal I/O* — List the available balls for individual signal I/O. This does not include balls that are interconnected with other balls, bond rings, power or ground planes or other electrically interconnected features, such as die attach pads.

6.2.3 *Body Size* — List ##×## (i.e., 27×27) to represent JEDEC Publication 95 registration values in millimeters for "D" & "E" nominal body dimensions.

6.2.4 *Pitch* — List number representing JEDEC Publication 95 registration values in millimeters for the "e" pitch dimension.

6.2.5 *Matrix* — List ##×## (i.e., 20×20) to represent JEDEC Publication 95 matrix values determined by the number of balls on the outside row and column.

6.2.6 *Array* — List either Full, Staggered, Peripheral, or Depopulated:

- Full — Completely filled matrix, as defined by the JEDEC Publication 95 registration and variation shown for each design.
- Staggered — A full matrix which has been depopulated by every other ball in each row and column.
- Peripheral — Balls missing in the center of the BGA package. Outer rows of the matrix are fully populated.
- Depopulated — Any variation not described by full, staggered, or peripheral as described above.

NOTE 2: Any of the above matrix designs may have one ball missing from its defined matrix description above, for purposes of package orientation, and still be classified according to that description.

6.2.7 *Thermal Enhancement* — List #×# (i.e., 6×6) or "Cu Slug," to designate either a specific matrix of balls for thermal enhancement purposes or copper heat slug for the same. Other metal slugs may be listed by their appropriate metal constituent. List "N/A" if the design has no thermal enhancement.

6.2.8 *Profile Height* — List the dimension of the nominal profile height in millimeters.

6.2.9 *Package Cavity Orientation* — List either up or down with reference to the board to which the package design would be surfaced mounted (a cavity facing the board would be cavity, down).

6.2.10 *Wire bond Rings* — List the number of wire-bond rings. If the design has no rings, list "N/A."

6.2.11 *Substrate Materials* — Generic description of the materials the substrate is made from, excepting the electrical trace and solder mask materials.

6.2.12 *Metal Layers* — The number of metal interconnect layers in the BGA substrate. List a(bscpdg) where:

a= total number of metal layers
b= number of signal layers
s= signal layer designator
c= number of power layers
p= power layer designator
d= number of ground layers
g= ground layer designator

e.g., 4(2slplg) would have 4 total layers made up of 2 signal layers and 1 power and ground layer each.

6.2.13 *Die Interconnect* — Interconnect method for electrically connecting the die to the package. Normal methods include wire bond, flip chip and TAB.

6.2.14 *Encapsulation Design* — Design description. Normal categories are over-molded, liquid encapsulant or lid.

6.2.15 *Encapsulation Material* — General description of the material used to mechanically cover or encapsulate the chip or die. The materials normally used are epoxy for over-molding or liquid encapsulant designs, metal, ceramic or laminate for lid designs.

6.2.16 *Ball Composition* — Description of the material and composition of the ball. Should include a percentage of tin/lead or other metals, if solder ball (i.e., 63/37 Sn/Pb, alloy coated, copper or plastic).

6.2.17 *JEDEC Designation* — List JEDEC designation from its Publication 95. This should include registration or standard number, the specific variation and revision designations (i.e., MO-151, BAE-1, B) (this indicates Issue, Revision B).

6.2.18 *Preconditioning Level* — The specified JEDEC, J-STD-020 moisture sensitivity performance level requirement. This should also include a reference to the revision of the J-STD-020 specification (e.g., Level 4, Revision A).

NOTE 3: JEDEC, JESD 22 - A113 specifies the moisture preconditioning requirement for the moisture test to J-STD-020.

6.2.19 *Design Number* — SEMI assigned design number for this design. The numbers will be assigned by SEMI (upon ballot approval) and will be an alphanumeric designation in sequential order as follows:

- Plastic BGA Designs will be assigned PBDxxxx designations, where xxxx numbers are sequentially assigned beginning with 0001.
- Ceramic BGA Designs will be assigned CBDxxxx designations, where xxxx numbers are sequentially assigned beginning with 0001.
- Tape BGA Designs will be assigned TBDxxxx designations, where xxxx numbers are sequentially assigned beginning with 0001.
- Metal BGA Designs will be assigned MBDxxxx designations, where xxxx numbers are sequentially assigned beginning with 0001.

NOTE 4: The second letter designator may be assigned as either a B or C to designate whether the design is a ball grid or column grid array.

6.3 Appendix 1 is an example of a general design characteristics listing for a plastic BGA.

7 Drawing Format

7.1 Appendix 2 is an example of the drawing format.

7.2 Dimensions

7.2.1 All dimensions, and tolerances shown or not shown shall be in conformance with the JEDEC Publication 95 registration or standard outline referenced by the designation shown in the general design characteristics listing for each design.

7.2.2 Nominal and basic dimensions shown in the drawing may have minimum and maximum values and associated tolerances that may be referenced in JEDEC Publication 95 according to the registration designation shown in the general design characteristics listing for each design.

7.2.3 Dimension values will be shown on the drawing, not in a table.

7.2.4 Basic dimensions only will be used for package length and width dimensions (JEDEC “D” and “E” dimensions), the ball pitch (JEDEC “e” dimension), and the JEDEC “s” dimension.

7.2.5 The JEDEC “s” dimension will be shown only for even row matrix designs. Odd row matrix designs will only reference a centerline coincident with the center of the center row of balls.

7.2.6 A nominal and maximum dimension for the overall profile height (JEDEC dimension A) will be shown. The maximum dimension shown may be less than but may not exceed that maximum dimension designated by the JEDEC Publication 95 registration reference for this design.

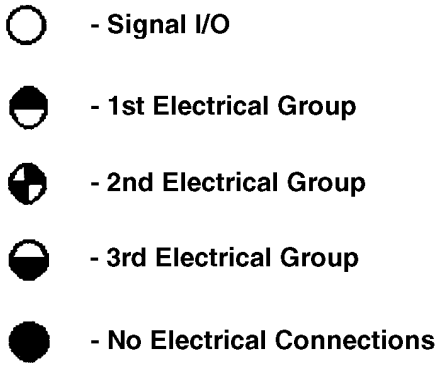
7.2.7 Reference or nominal dimensions may be shown for the package body thickness, substrate thickness, encapsulation layer or lid thickness, and the standoff height dimensions.

7.3 *Ball Configurations*

7.3.1 Retain and show the JEDEC method for numbering the ball columns and rows.

7.3.2 The ball configuration drawing will show the exact number and location of balls for each design.

7.3.3 The following symbols are to be used for designating the electrical interconnections or lack thereof for the balls shown on the design drawing:



7.3.4 Notes on the drawing will show the above symbols and designations for each of the electrical groups used with each specific design.

7.4 The orientation of the internal bond finger peripheral pad locations to the external package will be illustrated by a top view of the package which indicates the Pad 1 and A1 ball locations relative to the package sides, 1–4, for all designs using wire bond or peripheral die interconnection layout schemes.

7.4.1 For peripherally bonded layouts, the Pad 1 bond finger will always be located in the same corner as the A1 ball, and the pads will be sequentially numbered, for purposes of the net list, in a counterclockwise rotation as viewed from the die side of the substrate. This applies to all cavity orientations (cavity up or down).

7.5 The design drawing must have a BGA design title, a BGA design number, a revision number, the date of

issue and a design page number shown at the bottom of each page.

7.6 The design drawing shall include a general design characteristics description which will also be listed in Appendix 1 of this specification. This description should be re-formatted on top of the title block for each design drawing and may exclude the BGA design number, which will be shown in the title block at the bottom of the page.

8 Net List Format

8.1 Appendix 3 is an example of the net list format including all reference notes.

8.2 The net list shall follow the drawing as part of the BGA design and shall be formatted in columns as follows:

- Column 1: Lists BGA wire bond pad and wire bond ring numbers.
- Column 2: Lists solder ball connections.
- Column 3: Open column for later use in listing die wire bond pad numbers.
- Column 4: Open column for later use in listing die I/O name.
- Column 5: Lists package side location number of bond pad connection.
- Column 6: Lists note reference numbers.

8.2.1 The listing of ball numbers should begin with A1, and continue in sequential order (i.e., A1, A2...An, B1, B2...Bn, C1, C2...Cn).

8.2.2 Wire bond ring numbers in the first column should be designated in sequential order from inner most to outermost (i.e., w/b ring 1, w/b ring 2, and w/b ring 3) if there are three separate rings. The innermost ring being w/b ring 1 and the outermost ring being w/b ring 3.

8.3 Notes in the net list will reference each of the electrical groups used with that specific design and will list all additional associated interconnections for those groups, if any.

8.4 Notes may consist of explanation of bond finger orientation relative to top view illustration on drawing for reference (independent of general specification explanations) of net list to BGA design drawing.

8.5 Notes may also consist of applications warnings or guidelines to insure correct use of the net list with the design drawing.

8.6 All pages of net list must have a BGA design title, a BGA design number, a revision number, the date of issue and a design page number shown at the top of each page.

9 Addition of Registrations

9.1 This specification will be published initially in a loose leaf notebook and as package design registrations are approved, they will be individually published in a loose leaf format for easy access into the original notebook by the publication owner.

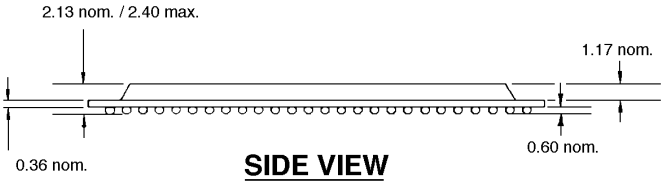
9.2 Each new registration must be added to the specification using the SEMI standard balloting procedures. Refer to the “Regulations Governing SEMI Standards Committees” publication.

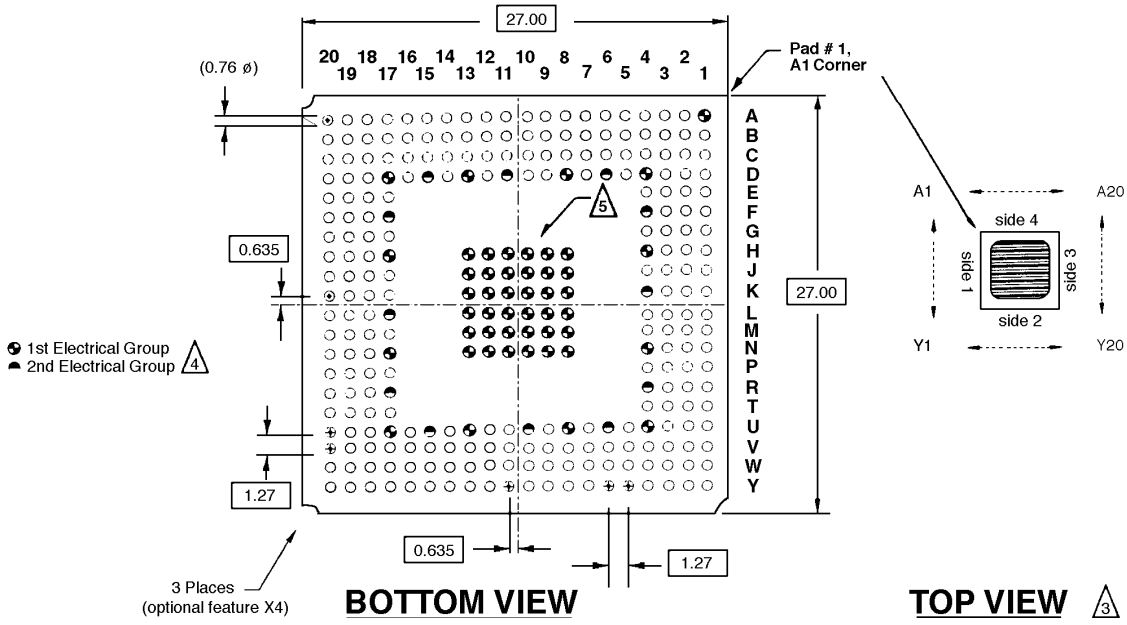
SEMI G72.1-0997
DESIGN PROPOSAL FOR BALL GRID ARRAY DESIGN LIBRARY:292 PIN PLASTIC BALL GRID ARRAY

Table 1 Plastic Ball Grid Array (PBGA) General Design Characteristics

Ball Count	*Signal I/O*	*Body Size*	*Pitch*	*Matrix*	*Array*	*Thermal Enhan.*	*Profile Height*	*Cavity Orient.*	*Wirebond Rings*
292	231	27x27	1.27	20x20	depopulated	6x6	2.13	up	2

Substrate Material	*Metal Layers*	*Die Inter-connect*	*Encapsulation Design*	*/ Material*	*Ball Composition*	*JEDEC Designation*	*Precondition-ing Level*	*Design No.*	*SEMI Designa-tion No.*
BT Laminate	2(2S0P0G)	wirebond	overmolded	epoxy	63/37 Sn/Pb	MO-151 BAL-2, B	Level 3,Rev 0	PBD0001	G72.1





NOTES:

1. Refer to JEDEC MO-151 Issue B Variation BAL-2 for all dimensions and tolerances not shown. This design must be in full conformance with the referenced JEDEC outline drawing.

2. All dimensions are in millimeters unless otherwise noted.

3 Top View illustrates the relationship between external package features, internal wirebond pad number 1, and side 1, 2, 3, and 4 of the internal wirebond pads. Please see SEMI Standard BGA Design Netlist for specific electrical connections and more detailed notes.

4 Solder Balls with this symbol have common electrical connections, and may be connected to other internal package features. Please see SEMI Standard BGA Design Netlist for other specific electrical connections.

5 Thermal enhancement of 6 x 6 solder balls shown. Please see SEMI Standard BGA Design Netlist for other specific electrical connections.

Ball Count	Signal I/O	Body Size	Pitch	Matrix	Array	Thermal Enhan.	Profile Height	Cavity Orientation	Wirebond Rings	Substrate Materials	Metal Layers	Die Inter-Connect	Encap. Design	Encap. Material	Ball Comp.	JEDEC Desig.	Preconditioning
292	231	27 x 27	1.27	20 x 20	depop.	6 x 6	2.13	up	2	BT	2 (2SOPOG)	wire bond	over mold	epoxy	63 / 37 Sn / Pb	MO-151 BAL-2, B	LEVEL 3, Rev. 0

BGA DESIGN LIBRARY DRAWING TITLE	BGA DESIGN LIBRARY NO.		REV.	DATE	PAGE
292 PIN PLASTIC BALL GRID ARRAY 27 X 27mm BODY DESIGN	PBD0001	SEMI STANDARD BGA DESIGN LIBRARY General Specification	INITIAL	4/15/96	1 OF 8

Figure 1
292 Pin Plastic Ball Grid Array 27 x 27 mm Body Design

Table 2 292 Pin Plastic Ball Grid Array 27x27 mm Body Design

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
w/b ring 1	A1				3
230	A2			4	
225	A3			4	
222	A4			4	
218	A5			4	
215	A6			4	
213	A7			4	
210	A8			4	
206	A9			4	
202	A10			4	
201	A11			4	
198	A12			4	
194	A13			4	
191	A14			4	
188	A15			4	
184	A16			4	
181	A17			4	
180	A18			4	
175	A19			4	
174	A20			3	
1	B1			1	
229	B2			4	
228	B3			4	
224	B4			4	
221	B5			4	
217	B6			4	
214	B7			4	
211	B8			4	
207	B9			4	
203	B10			4	
199	B11			4	
197	B12			4	
193	B13			4	
190	B14			4	
187	B15			4	
183	B16			4	
177	B17			4	
176	B18			4	
173	B19			3	
171	B20			3	
6	C1			1	
2	C2			1	
231	C3			4	

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
227	C4			4	
223	C5			4	
220	C6			4	
216	C7			4	
212	C8			4	
208	C9			4	
204	C10			4	
200	C11			4	
196	C12			4	
192	C13			4	
189	C14			4	
185	C15			4	
182	C16			4	
178	C17			4	
172	C18			3	
170	C19			3	
167	C20			3	
7	D1			1	
3	D2			1	
4	D3			1	
w/b ring 1	D4				3
226	D5			4	
w/b ring 2	D6				2
219	D7			4	
w/b ring 1	D8				3
209	D9			4	
205	D10			4	
w/b ring 2	D11				2
195	D12			4	
w/b ring 1	D13				3
186	D14			4	
w/b ring 2	D15				2
179	D16			4	
w/b ring 1	D17				3
169	D18			3	
166	D19			3	
164	D20			3	
10	E1			1	
9	E2			1	
8	E3			1	
5	E4			1	
168	E17			3	
165	E18			3	
163	E19			3	

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
160	E20			3	
14	F1			1	
13	F2			1	
11	F3			1	
w/b ring 2	F4				2
w/b ring 2	F17				2
162	F18			3	
159	F19			3	
157	F20			3	
17	G1			1	
16	G2			1	
15	G3			1	
12	G4			1	
161	G17			3	
158	G18			3	
156	G19			3	
155	G20			3	
20	H1			1	
19	H2			1	
18	H3			1	
w/b ring 1	H4				3
w/b ring 1	H8				3,5
w/b ring 1	H9				3,5
w/b ring 1	H10				3,5
w/b ring 1	H11				3,5
w/b ring 1	H12				3,5
w/b ring 1	H13				3,5
w/b ring 1	H17				3
154	H18			3	
153	H19			3	
152	H20			3	
24	J1			1	
23	J2			1	
22	J3			1	
21	J4			1	
w/b ring 1	J8				3,5
w/b ring 1	J9				3,5
w/b ring 1	J10				3,5
w/b ring 1	J11				3,5
w/b ring 1	J12				3,5
w/b ring 1	J13				3,5
151	J17			3	
150	J18			3	
149	J19			3	

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
148	J20			3	
27	K1			1	
25	K2			1	
26	K3			1	
w/b ring 2	K4				2
w/b ring 1	K8				3,5
w/b ring 1	K9				3,5
w/b ring 1	K10				3,5
w/b ring 1	K11				3,5
w/b ring 1	K12				3,5
w/b ring 1	K13				3,5
147	K17			3	
146	K18			3	
145	K19			3	
144	K20			3	
28	L1			1	
29	L2			1	
30	L3			1	
31	L4			1	
w/b ring 1	L8				3,5
w/b ring 1	L9				3,5
w/b ring 1	L10				3,5
w/b ring 1	L11				3,5
w/b ring 1	L12				3,5
w/b ring 1	L13				3,5
w/b ring 2	L17				2
142	L18			3	
141	L19			3	
143	L20			3	
32	M1			1	
33	M2			1	
34	M3			1	
35	M4			1	
w/b ring 1	M8				3,5
w/b ring 1	M9				3,5
w/b ring 1	M10				3,5
w/b ring 1	M11				3,5
w/b ring 1	M12				3,5
w/b ring 1	M13				3,5
137	M17			3	
138	M18			3	
139	M19			3	
140	M20			3	
36	N1			1	

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
37	N2			1	
38	N3			1	
w/b ring 1	N4				3
w/b ring 1	N8				3,5
w/b ring 1	N9				3,5
w/b ring 1	N10				3,5
w/b ring 1	N11				3,5
w/b ring 1	N12				3,5
w/b ring 1	N13				3,5
w/b ring 1	N17				3
134	N18			3	
135	N19			3	
136	N20			3	
39	P1			1	
40	P2			1	
42	P3			1	
45	P4			1	
128	P17			3	
131	P18			3	
132	P19			3	
133	P20			3	
41	R1			1	
43	R2			1	
46	R3			1	
w/b ring 2	R4				2
w/b ring 2	R17				2
127	R18			3	
129	R19			3	
130	R20			3	
44	T1			1	
47	T2			1	
49	T3			1	
52	T4			1	
121	T17			3	
124	T18			3	
125	T19			3	
126	T20			3	
48	U1			1	
50	U2			1	
53	U3			1	
w/b ring 1	U4				3
63	U5			2	
w/b ring 2	U6				2
70	U7			2	

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
w/b ring 1	U8				3
79	U9			2	
w/b ring 2	U10				2
89	U11			2	
93	U12			2	
w/b ring 1	U13				3
103	U14			2	
w/b ring 2	U15				2
110	U16			2	
w/b ring 1	U17				3
120	U18			3	
119	U19			3	
123	U20			3	
51	V1			1	
54	V2			1	
56	V3			1	
62	V4			2	
66	V5			2	
69	V6			2	
73	V7			2	
76	V8			2	
80	V9			2	
84	V10			2	
88	V11			2	
92	V12			2	
96	V13			2	
100	V14			2	
104	V15			2	
107	V16			2	
111	V17			2	
114	V18			2	
118	V19			3	
122	V20			3	
55	W1			1	
57	W2			1	
59	W3			2	
61	W4			2	
67	W5			2	
71	W6			2	
74	W7			2	
77	W8			2	
81	W9			2	
83	W10			2	
87	W11			2	

Design No. PBD0001	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 6/20/96*	*Page 2 of 8*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
91	W12			2	
95	W13			2	
98	W14			2	
101	W15			2	
105	W16			2	
108	W17			2	
112	W18			2	
115	W19			2	
117	W20			3	
58	Y1			1	
60	Y2			2	
64	Y3			2	
65	Y4			2	
68	Y5			2	
72	Y6			2	
75	Y7			2	
78	Y8			2	
82	Y9			2	
85	Y10			2	
86	Y11			2	
90	Y12			2	
94	Y13			2	
97	Y14			2	
99	Y15			2	
102	Y16			2	
106	Y17			2	
109	Y18			2	
113	Y19			2	
116	Y20			2	

NOTES:

*1. Please refer to Notes column for explanations of wirebond (w/b) rings. PBGA Wirebond Pads are numbered counter clockwise, starting with Pad #1 in the upper left hand corner. Please refer to Top View of package for package side #1, 2, 3, or 4 (Figure 1).

*2. Metallized wirebond (w/b) ring 2 surrounds die attach area for wirebonding to electrically common die pads and electrical connection with solder balls designated by 2nd Electrical Group symbol on BGA Design Library Drawing (Figure 1).

*3. Metallized wirebond (w/b) ring 1 surrounds die attach area for wirebonding to electrically common die pads and electrical connection with both die attach pad and solder balls designated by 1st Electrical Group symbol on BGA Design Library Drawing (Figure 1).

*4. If the number of signal Die Wirebond Pads (not including Electrical Groups) total less than 231, the total number may be divided by 4 and wirebond placement centered on each package side.

*5. Thermal enhancement of 6 x 6 solder balls.

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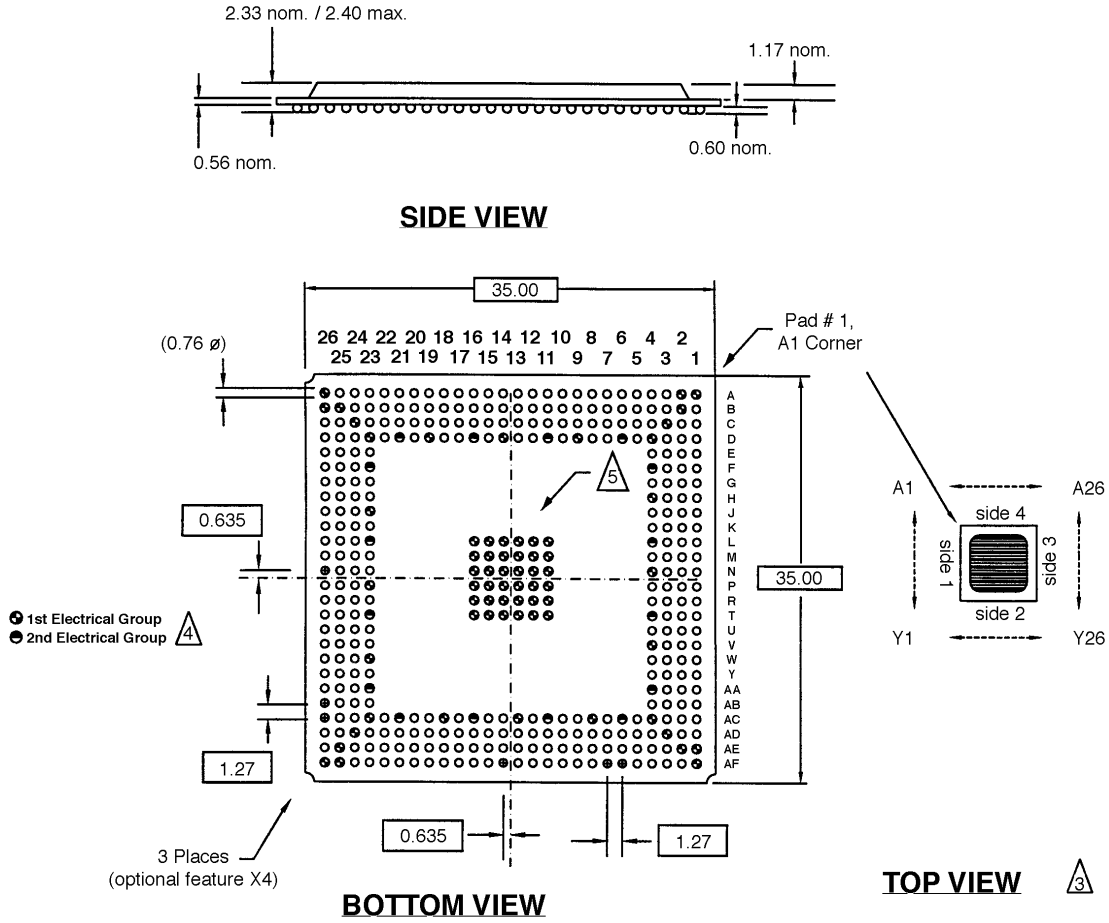
SEMI G72.2-0997
DESIGN PROPOSAL FOR BALL GRID ARRAY DESIGN LIBRARY: 388 PIN PLASTIC BALL GRID ARRAY

Table 1 Plastic Ball Grid Array (PBGA) General Design Characteristics

Ball Count	*Signal I/O*	*Body Size*	*Pitch*	*Matrix*	*Array*	*Thermal Enhan.*	*Profile Height*	*Cavity Orient.*	*Wirebond Rings*
388	304	35×35	1.27	26×26	depopulated	6×6	2.33	up	2

Substrate Material	*Metal Layers*	*Die Inter-connect*	*Encapsulation Design*	*Material*	*Ball Composition*	*JEDEC Designation*	*Precondition-ing Level*	*Design No.*	*SEMI Designa-tion No.*
BT Laminate	2(2S0P0G)	wirebond	overmolded	epoxy	63/37 Sn/Pb	MO-151 BAR-2, B	Level 3,Rev 0	PBD0002	G72.2



NOTES:

1. Refer to JEDEC MO-151 Issue B Variation BAR-2 for all dimensions and tolerances not shown. This design must be in full conformance with the referenced JEDEC outline drawing.

2. All dimensions are in millimeters unless otherwise noted.

3 Top View illustrates the relationship between external package features, internal wirebond pad number 1, and side 1, 2, 3, and 4 of the internal wirebond pads. Please see SEMI Standard BGA Design Netlist for specific electrical connections and more detailed notes.

4 Solder Balls with this symbol have common electrical connections, and may be connected to other internal package features. Please see SEMI Standard BGA Design Netlist for other specific electrical connections.

5 Thermal enhancement of 6 x 6 solder balls shown. Please see SEMI Standard BGA Design Netlist for other specific electrical connections.

Ball Count	Signal I/O	Body Size	Pitch	Matrix	Array	Thermal Enhan.	Profile Height	Cavity Orientation	Wirebond Rings	Substrate Materials	Metal Layers	Die Inter-Connect	Encap. Design	Encap. Material	Ball Comp.	JEDEC Desig.	Preconditioning
388	304	35 x 35	1.27	26 x 26	depop.	6 x 6	2.33	up	2	BT	2 (2S0P0G)	wire bond	over mold	epoxy	63 / 37 Sn/ Pb	MO-151 BAR-2, B	LEVEL 3, Rev. 0

BGA DESIGN LIBRARY DRAWING TITLE	BGA DESIGN LIBRARY NO.	SEMI STANDARD BGA DESIGN LIBRARY General Specification	REV.	DATE	PAGE
388 PIN PLASTIC BALL GRID ARRAY 35 X 35 mm BODY DESIGN	PBD0002		INITIAL	10/18/96	1 OF 10

Figure 1

388 Pin Plastic Ball Grid Array 35×35 mm Body Design

Table 2 388 Pin Plastic Ball Grid Array 35×35 mm Body Design

Design No.PBD0002	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 10/22/96*	*Page 2 of 10*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
w/b ring 1	A1				3
w/b ring 1	A2				3
304	A3			4	
300	A4			4	
296	A5			4	
293	A6			4	
289	A7			4	
285	A8			4	
283	A9			4	
279	A10			4	
275	A11			4	
272	A12			4	
268	A13			4	
264	A14			4	
260	A15			4	
258	A16			4	
254	A17			4	
251	A18			4	
248	A19			4	
244	A20			4	
242	A21			4	
238	A22			4	
234	A23			4	
231	A24			4	
229	A25			4	
w/b ring 1	A26				3
1	B1			1	
w/b ring 1	B2				3
302	B3			4	
298	B4			4	
295	B5			4	
291	B6			4	
287	B7			4	
284	B8			4	
281	B9			4	
277	B10			4	
273	B11			4	
270	B12			4	
266	B13			4	
262	B14			4	
259	B15			4	
256	B16			4	
252	B17			4	

Design No.PBD0002	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 10/22/96*	*Page 2 of 10*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
250	B18			4	
246	B19			4	
243	B20			4	
239	B21			4	
235	B22			4	
232	B23			4	
230	B24			4	
w/b ring 1	B25				3
w/b ring 1	B26				3
3	C1			1	
2	C2			1	
w/b ring 1	C3				3
303	C4			4	
301	C5			4	
297	C6			4	
294	C7			4	
290	C8			4	
286	C9			4	
282	C10			4	
278	C11			4	
274	C12			4	
271	C13			4	
269	C14			4	
265	C15			4	
261	C16			4	
257	C17			4	
253	C18			4	
249	C19			4	
245	C20			4	
241	C21			4	
237	C22			4	
233	C23			4	
w/b ring 1	C24				3
226	C25			3	
228	C26			3	
6	D1			1	
4	D2			1	
5	D3			1	
w/b ring 1	D4				3
299	D5			4	
w/b ring 2	D6				2
292	D7			4	
288	D8			4	
w/b ring 1	D9				3

Design No.PBD0002	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 10/22/96*	*Page 2 of 10*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
280	D10			4	
w/b ring 2	D11				2
276	D12			4	
267	D13			4	
w/b ring 1	D14				3
263	D15			4	
w/b ring 2	D16				2
255	D17			4	
247	D18			4	
w/b ring 1	D19				3
240	D20			4	
w/b ring 2	D21				2
236	D22			4	
w/b ring 1	D23				3
227	D24			3	
222	D25			3	
224	D26			3	
10	E1			1	
7	E2			1	
9	E3			1	
8	E4			1	
223	E23			3	
225	E24			3	
219	E25			3	
220	E26			3	
14	F1			1	
11	F2			1	
13	F3			1	
w/b ring 2	F4				2
w/b ring 2	F23				2
221	F24			3	
215	F25			3	
217	F26			3	
16	G1			1	
15	G2			1	
17	G3			1	
12	G4			1	
216	G23			3	
218	G24			3	
211	G25			3	
213	G26			3	
20	H1			1	
18	H2			1	
21	H3			1	

Design No.PBD0002	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 10/22/96*	*Page 2 of 10*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
w/b ring 1	H4				3
212	H23			3	
214	H24			3	
208	H25			3	
209	H26			3	
23	J1			1	
22	J2			1	
25	J3			1	
19	J4			1	
w/b ring 1	J23				3
210	J24			3	
205	J25			3	
207	J26			3	
26	K1			1	
24	K2			1	
29	K3			1	
27	K4			1	
204	K23			3	
206	K24			3	
201	K25			3	
203	K26			3	
30	L1			1	
28	L2			1	
33	L3			1	
w/b ring 2	L4				2
w/b ring 1	L11				3,5
w/b ring 1	L12				3,5
w/b ring 1	L13				3,5
w/b ring 1	L14				3,5
w/b ring 1	L15				3,5
w/b ring 1	L16				3,5
w/b ring 2	L23				2
202	L24			3	
197	L25			3	
199	L26			3	
32	M1			1	
31	M2			1	
37	M3			1	
35	M4			1	
w/b ring 1	M11				3,5
w/b ring 1	M12				3,5
w/b ring 1	M13				3,5
w/b ring 1	M14				3,5
w/b ring 1	M15				3,5

Design No.PBD0002	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 10/22/96*	*Page 2 of 10*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
w/b ring 1	M16				3,5
200	M23			3	
198	M24			3	
194	M25			3	
196	M26			3	
36	N1			1	
34	N2			1	
41	N3			1	
w/b ring 1	N4				3
w/b ring 1	N11				3,5
w/b ring 1	N12				3,5
w/b ring 1	N13				3,5
w/b ring 1	N14				3,5
w/b ring 1	N15				3,5
w/b ring 1	N16				3,5
191	N23			3	
195	N24			3	
190	N25			3	
192	N26			3	
40	P1			1	
38	P2			1	
43	P3			1	
39	P4			1	
w/b ring 1	P11				3,5
w/b ring 1	P12				3,5
w/b ring 1	P13				3,5
w/b ring 1	P14				3,5
w/b ring 1	P15				3,5
w/b ring 1	P16				3,5
w/b ring 1	P23				3
193	P24			3	
186	P25			3	
188	P26			3	
44	R1			1	
42	R2			1	
46	R3			1	
48	R4			1	
w/b ring 1	R11				3,5
w/b ring 1	R12				3,5
w/b ring 1	R13				3,5
w/b ring 1	R14				3,5
w/b ring 1	R15				3,5
w/b ring 1	R16				3,5
187	R23			3	

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*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
189	R24			3	
183	R25			3	
184	R26			3	
47	T1			1	
45	T2			1	
50	T3			1	
w/b ring 2	T4				2
w/b ring 1	T11				3,5
w/b ring 1	T12				3,5
w/b ring 1	T13				3,5
w/b ring 1	T14				3,5
w/b ring 1	T15				3,5
w/b ring 1	T16				3,5
w/b ring 2	T23				2
185	T24			3	
180	T25			3	
182	T26			3	
51	U1			1	
49	U2			1	
54	U3			1	
52	U4			1	
179	U23			3	
181	U24			3	
176	U25			3	
178	U26			3	
55	V1			1	
53	V2			1	
58	V3			1	
w/b ring 1	V4				3
171	V23			3	
177	V24			3	
174	V25			3	
175	V26			3	
57	W1			1	
56	W2			1	
62	W3			1	
60	W4			1	
w/b ring 1	W23				3
173	W24			3	
170	W25			3	
172	W26			3	
61	Y1			1	
59	Y2			1	
66	Y3			1	

Design No.PBD0002	*SEMI Standard BGA Design Library*		*Revision Initial*	*Date 10/22/96*	*Page 2 of 10*
*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
64	Y4			1	
164	Y23			3	
169	Y24			3	
167	Y25			3	
168	Y26			3	
65	AA1			1	
63	AA2			1	
69	AA3			1	
w/b ring 2	AA4				2
w/b ring 2	AA23				2
165	AA24			3	
163	AA25			3	
166	AA26			3	
68	AB1			1	
67	AB2			1	
73	AB3			1	
71	AB4			1	
160	AB23			3	
161	AB24			3	
159	AB25			3	
162	AB26			3	
72	AC1			1	
70	AC2			1	
75	AC3			1	
w/b ring 1	AC4				3
84	AC5			2	
w/b ring 2	AC6				2
88	AC7			2	
w/b ring 1	AC8				3
95	AC9			2	
103	AC10			2	
w/b ring 2	AC11				2
111	AC12			2	
w/b ring 1	AC13				3
115	AC14			2	
124	AC15			2	
w/b ring 2	AC16				2
128	AC17			2	
1st Group	AC18				3
w/b ring 1	AC19			2	
140	AC20			2	
w/b ring 2	AC21				2
147	AC22			2	
w/b ring 1	AC23				3

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*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
157	AC24			3	
156	AC25			3	
158	AC26			3	
76	AD1			1	
74	AD2			1	
w/b ring 1	AD3				3
81	AD4			2	
85	AD5			2	
89	AD6			2	
93	AD7			2	
97	AD8			2	
101	AD9			2	
105	AD10			2	
109	AD11			2	
113	AD12			2	
117	AD13			2	
119	AD14			2	
122	AD15			2	
126	AD16			2	
130	AD17			2	
134	AD18			2	
138	AD19			2	
142	AD20			2	
145	AD21			2	
149	AD22			2	
151	AD23			2	
w/b ring 1	AD24				3
154	AD25			3	
155	AD26			3	
w/b ring 1	AE1				3
w/b ring 1	AE2				3
78	AE3			2	
80	AE4			2	
83	AE5			2	
87	AE6			2	
91	AE7			2	
94	AE8			2	
98	AE9			2	
100	AE10			2	
104	AE11			2	
107	AE12			2	
110	AE13			2	
114	AE14			2	
118	AE15			2	

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*PBGA Wire Bond Pad (*1)*	*Solder Ball Location*	*Die Wire Bond Pad (*3)*	*I/O Name (& Comments) (*4)*	*Pkg. Side (*1)*	*Notes*
121	AE16			2	
125	AE17			2	
129	AE18			2	
132	AE19			2	
135	AE20			2	
139	AE21			2	
143	AE22			2	
146	AE23			2	
150	AE24			2	
w/b ring 1	AE25				3
153	AE26			3	
w/b ring 1	AF1				3
77	AF2			2	
79	AF3			2	
82	AF4			2	
86	AF5			2	
90	AF6			2	
92	AF7			2	
96	AF8			2	
99	AF9			2	
102	AF10			2	
106	AF11			2	
108	AF12			2	
112	AF13			2	
116	AF14			2	
120	AF15			2	
123	AF16			2	
127	AF17			2	
131	AF18			2	
133	AF19			2	
137	AF20			2	
141	AF21			2	
144	AF22			2	
148	AF23			2	
152	AF24			2	
w/b ring 1	AF25				3
w/b ring 1	AF26				3

NOTES:

*1. Please refer to Notes column for explanations of wirebond (w/b) rings. PBGA Wirebond Pads are numbered counter clockwise, starting with Pad #1 in the upper left hand corner. Please refer to Top View of package for package side #1, 2, 3, or 4 (Figure 1).

*2. Metallized wirebond (w/b) ring 2 surrounds die attach area for wirebonding to electrically common die pads and electrical connection with solder balls designated by 2nd Electrical Group symbol on BGA Design Library Drawing (Figure 1).

*3. Metallized wirebond (w/b) ring 1 surrounds die attach area for wirebonding to electrically common die pads and electrical connection with both die attach pad and solder balls designated by 1st Electrical Group symbol on BGA Design Library Drawing (Figure 1).

*4. If the number of signal Die Wirebond Pads (not including Electrical Groups) total less than 304, the total number may be divided by 4 and wirebond placement centered on each package side.

*5. Thermal enhancement of 6 x 6 solder balls.

NOTICE: These standards do not purport to address safety issues, if any, associated with their use. It is the responsibility of the user of these standards to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. SEMI makes no warranties or representations as to the suitability of the standards set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials mentioned herein. These standards are subject to change without notice.

The user's attention is called to the possibility that compliance with this standard may require use of copyrighted material or of an invention covered by patent rights. By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

SEMI G73-0997 (Reapproved 1104)
TEST METHOD FOR PULL STRENGTH FOR WIRE BONDING

This test method was technically approved by the Global Assembly & Packaging Committee and is the direct responsibility of the Japanese Packaging Committee. Current edition approved by the Japanese Regional Standards Committee on July 23, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1997.

1 Purpose

1.1 This standard defines the pull strength test method for wire bonding.

2 Scope

2.1 This standard defines the destructive pull strength test method and its criterion for evaluating pull strength of wire bonds connecting two points, connected by using ball bonding technique.

2.2 This standard can be applied to measure wires whose diameter is less than 100 microns.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

3.1 *Military Standard* [1]

MIL-STD-883D — Test Methods and Procedures for Microelectronics

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Definitions*

4.1.1 *hook* — L or similar-shaped tool for hooking a wire for pull test.

5 Apparatus

5.1 *Pull Tester or equivalent equipment*

5.1.1 Enough stroke to break a wire.

5.1.2 *Accuracy* — Within ± 0.5% to the full scale of load cell.

5.1.3 *Pull Speed* — Constant speed.

5.1.4 *Hook*s — Between 25–100 microns in diameter.

NOTE 1: Hook must be made of material strong enough to break wire while testing but not with a small diameter so as to cut through the wire.

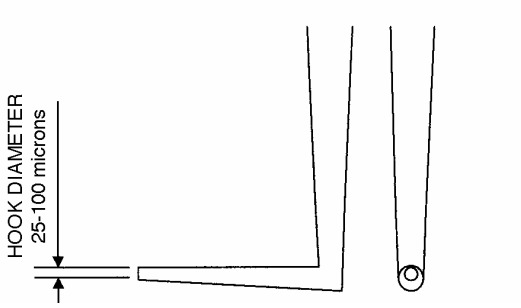

Figure 1
Hook Diameter

5.1.5 Calibration of equipment must be simple enough so that users can calibrate it easily. Instructions for calibration should be described in equipment manual.

6 Sampling

6.1 Measure at least 30 points from at least 2 devices. From each side of the devices, select the same number of wires randomly.

7 Calibration and Standardization

7.1 *Calibration Method*

7.1.1 Calibration of equipment should be done using official and traceable weights.

7.1.2 Display the weight and verify whether the results are within the equipment's accuracy.

7.1.3 Repeat the measurement using other weights to verify repeatability and linearity of the calibration.

7.2 *Interval of Calibration*

7.2.1 Calibrate at regular intervals at least once a year.

7.2.2 Calibration must be able to be done just before testing when necessary or specifically instructed.

1 United States Military Standards, Available through the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099, USA. Telephone: 215.697.3321