TOSHIBA

TOSHIBA Semiconductor Lead(Pb)-Free Memory Products

Toshiba America Electronic Components, Inc.
Memory Business Unit
September 2005

August 2005

Announcement of a plan for Lead(Pb)-Free semiconductor products

Dear Customers,

We would like to express our gratitude to our Customers for using Toshiba semiconductor products and announce Toshiba Semiconductor Company's plan to transition to Lead(Pb)-Free semiconductor products.

Awareness of environmental issues has been rapidly increasing as is the adoption of laws and regulations that restrict the use of certain substances in electronic components. We at Toshiba Semiconductor Company have been making efforts to help our customers comply with these various laws and regulations by reducing these restricted substances in production lines. As a part of this effort, we have also developed a fundamental process to produce Lead(Pb)-Free products, which is described in more detail in the attached plan. Many products have already been shifted according to Customers' plans. Toshiba Semiconductor Company is beginning the next phase of its conversion plan, working with customers to gradually convert all memory product shipments to Lead(Pb)-Free, with a goal of completing this transition by the end of 2005.

The conversion of lead(Pb)-contained products to Lead(Pb)-Free products will be implemented gradually in accordance with your plan(s) upon your approval. In addition, the existing lead(Pb)-contained versions of products may be produced in parallel with the Lead(Pb)-Free versions of products, in consideration of various conditions you might have.

I hope the attached materials that describe our plan for Lead(Pb)-Free semiconductors are helpful. If you have any questions, please feel free to contact us through your sales representative. We look forward to your continued support and patronage.

Respectfully yours,
Yoichi Takakubo
Director, Quality Assurance
Toshiba America Electronic Components, Inc.

1. Lead(Pb)-Free* Regulations and Global Trends

(1) Regulations

Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the use of certain hazardous substances in electrical and electronic equipment (the "RoHS Directive") will restrict use of lead(Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (Cr^{6+}) and PBB/PBDE from July 2006.

(2) Global Trends

Table 1-1 Global Lead(Pb)-Free Trends

EU	Legislated RoHS Directive. Lead(Pb) use will be restricted beginning in July 2006.
Japan	Corporations propose to enhance competitive edge through voluntary compliance with Lead(Pb)-Free standards. Various electronic products using Lead(Pb)-Free solder have been manufactured and are available in Japan..
US	Regulations similar to those in the EU are being proposed and adopted in various jurisdictions. Moreover, the Lead(Pb)-Free trend is accelerated by major customers from the Lead(Pb)-Free movement in EU.

*Toshiba Semiconductor Company defines "Lead(Pb)-Free" in accordance with current industry standards as containing no more than 0.1 percent lead(Pb) by weight in homogenous materials. This does not mean that Toshiba products that are labeled Lead(Pb)-Free are entirely free of lead(Pb).

2. Basic Philosophy for TOSHIBA Lead(Pb)-Free Memory Products

Shift to Lead(Pb)-Free Products

TOSHIBA completed Lead(Pb)-Free implementation for all memory products by the end of December 2003.

Toshiba plans to change main memory Products to Lead(Pb)-Free products.

We are working with customers to convert all memory shipments to Lead(Pb)-Free, with a goal of completing this transition by the end of 2005.

(1) Lead-Finish Plating Materials

Sn-Ag and Sn-Cu are selected as alternative solder plating materials for our Lead(Pb)-Free products.

(2) Lead(Pb)-Free Solder Ball Materials

Sn-Ag-Cu is selected as an alternative solder ball material for our Lead(Pb)-Free products.

(3) Part Numbers of Lead(Pb)-Free Products

Part numbers have been changed to distinguish Lead(Pb)-Free from the lead(Pb)-contained products.

Note: The plating and ball materials are subject to change due to technology improvements.

3. Identifying Lead(Pb)-Free Products

(1) Part Number

A letter of "G" is specified in a part number field of Lead(Pb)–Free packages to distinguish Lead(Pb)-Free products from lead(Pb)-contained products.
(Except for some custom products. Please contact your TOSHIBA sales representatives for details.)

Table 3 Example of Part Number Comparison of Lead(Pb)-contained and Lead(Pb)–Free Products

Products	Lead(Pb)-contained Part Number	Lead(Pb)-Free Part Number
NAND 128Mb TSOP	TC58DVM72A1FT00	TC58DVM72A1TG00
PSRAM 32Mb P-TFBGA	TC51WHM516AXBN	TC51WHM516AXGN

Note: underlined letters show the package type

(2) Packing Label

Lead(Pb)-Free marking is indicated in the outer box label as follows:
Lead(Pb)-Free products: “Lead (Pb)-Free”
Lead(Pb)-Free Finish products: “Lead (Pb)-Free Finish”

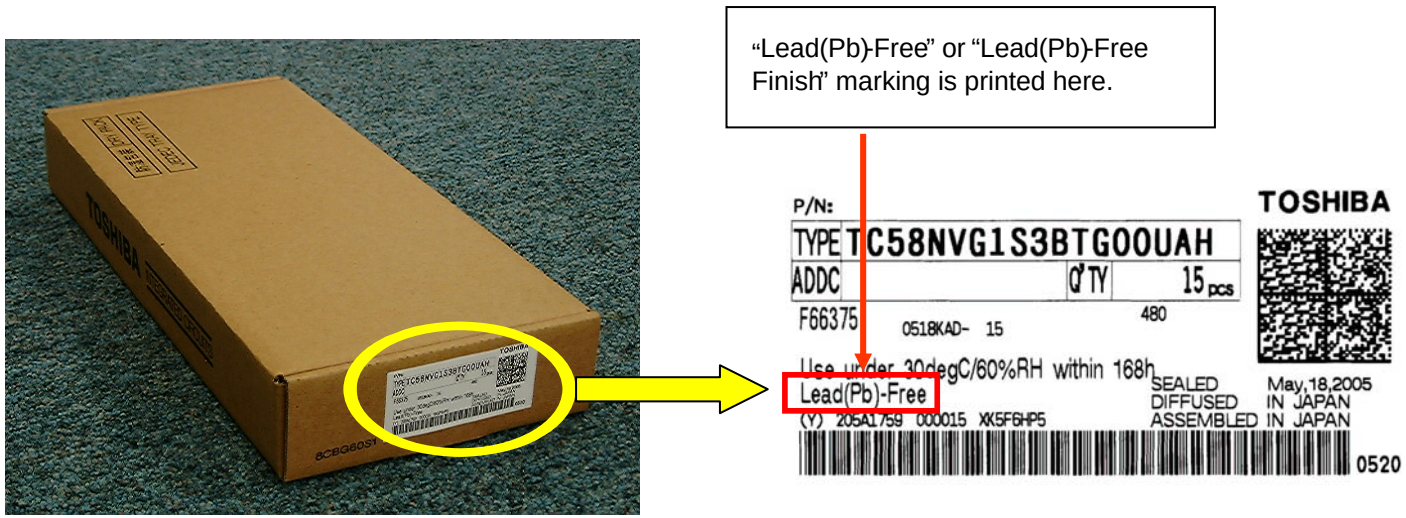


Fig 3 Location of Lead(Pb)-Free Marking

4. Definitions

(1) Lead(Pb)-Free Components

As discussed in the preceding pages, there are various regulations that will limit the use of lead(Pb) in products. As a result, the term “Lead(Pb)-Free” or “Pb-Free” has become a commonly used term to the electronics industry to designate products that are intended to satisfy the various regulations regarding lead(Pb). However, at present there is no legally established uniform standard for the level of lead(Pb) that be allowed in a product under the various regulations. Notwithstanding the lack of a uniform legal standard, the electronics industry has generally adopted a standard of no more than 0.1 percent by weight in Homogenous Materials**. Under these circumstances, Toshiba Semiconductor Company will define “Lead(Pb)-Free” in accordance with the industry standard as no more than 0.1 percent lead(Pb) by weight in Homogenous Materials. This does not mean that Toshiba semiconductor products that are labeled Lead(Pb)-Free are entirely free of lead(Pb).

During a transitional phase, in addition to Lead(Pb)-Free products (that contain no more than 0.1 percent lead(Pb) by weight) Toshiba Semiconductor Company will also offer products that have Lead(Pb)-Free terminals, which will be referred to as “Lead(Pb)-Free Finish”. The Lead(Pb)-Free Finish products may contain greater than 0.1 percent lead(Pb) by weight in portions of the product other than the terminals.

**Toshiba Semiconductor Company defines “Homogenous Material” to mean a material that cannot be mechanically disjointed into different materials. The term “homogenous” is understood as “of uniform composition throughout,” so examples of “Homogenous Materials” would be individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins and coatings. Toshiba Semiconductor Company defines the term “mechanically disjointed” to mean that the materials can be, in principle, separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

4. Definitions

(2) RoHS-Compatible***

Reduction of lead(Pb) to a level of no more than 0.1% by weight is considered to be one requirement of the RoHS Directive******. However, to be RoHS-Compatible, a device must not contain more than the specified maximum concentration value of any of the six regulated substances or fall within the scope of an exemption. Of the regulated substances, lead(Pb) is the most widely used in semiconductor manufacturing, which accounts for the greater emphasis on Lead(Pb)-Free materials than on the other regulated substances in the semiconductor industry.

***Toshiba Semiconductor Company defines "RoHS-Compatible" semiconductor products as products that either (i) contain no more than a maximum concentration value of 0.1% by weight in Homogenous Materials for lead(Pb), mercury, hexavalent chromium, polybrominated byphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) and no more than 0.01% by weight in Homogenous Materials for cadmium; or (ii) fall within one of the stated exemptions set forth in the Annex to the RoHS Directive.

****Toshiba Semiconductor Company defines the "RoHS Directive" as the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Table 4 Classification of Lead(Pb)-Free Parts

The “Lead(Pb)-Free Soldering Roadmap” published by the Japan Electronics and Information Technology Industries Association (JEITA) classifies products into the following phases in view of the heat resistance in packaging, types of component parts and materials. Toshiba Semiconductor Company has adopted this classification scheme.

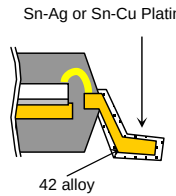
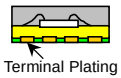
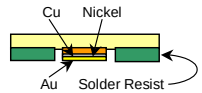
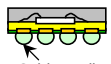
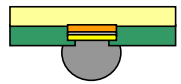
Classification	Criteria
Parts that withstand Lead(Pb)-Free soldering temperature	Parts with the solder heat resistance to withstand the higher temperature soldering requirements for Lead(Pb)-Free manufacturing processes.
Parts with Lead(Pb)-Free terminals	The plating of the terminals to be fitted to the board and electrodes of the part should be Lead(Pb)-Free. However, it is acceptable for the other components and materials of the part to have greater than 0.1 percent lead(Pb) by weight.
Lead(Pb)-Free parts	All sections of the part, including internal connections and/or components and materials are Lead(Pb)-Free.

Quoted from “Roadmap 2002 Commercialization of Lead-free Solder version. 2.1” of JEITA

5. Lead(Pb)-Free Materials

Lead(Pb)-Free materials of main package are shown in Table 5.

Table 5 Lead(Pb)-Free Materials by Package Types

Package			Lead(Pb)-Free Material				
Package	Appearance	Structure	Sn-Ag	Sn-Ag-Cu	Sn-Cu	Au	Description
SOP, TSOP			●		●		
LGA						●	
BGA				●			

Note: When more than two materials for Lead(Pb)-Free terminals are stated, the specification depends on the part type.

6. Product Status

6.1 Network FCRAM

Product	Capacity (bit)	Organization	Power (V)	Design (um)	Package	Part Number (Lead(Pb)-Free)	ES	CS	MP	Part Number (Current Product)	ES	CS	MP
	256M	32M x 8	2.5	0.175	TSOP II 66-P-400-0.65	TC59LM806CTG	-	July/05	July/05	TC59LM806CFT	-	Now	Now
		16M x 16				TC59LM814CTG	-	July/05	July/05	TC59LM814CFT	-	Now	Now
	288M	16M x 18		130nm	P-BGA60-0917-1.00AZ	TC59LM818DMG	-	Now	TBD	TC59LM818DMB	-	Now	Now
Network		8M x 36			P-TFBGA144-1119-0.80BZ	TC59LM836DKG	-	Now	TBD	TC59LM836DKB	-	Now	Now
FCRAM	512M	64M x 8		130nm	P-BGA64-1317-1.00AZ	TC59LM905AMG	-	TBD	TBD	TC59LM905AMB	-	TBD	TBD
		32M x 16				TC59LM913AMG	-	TBD	TBD	TC59LM913AMB	-	Now	Now
		64M x 8				TC59LM906AMG	-	Now	Now	-			
		32M x 16				TC59LM914AMG	-	TBD	TBD	-			

6.2 SRAM(1)

Product	Capacity (bit)	Organization	Power (V)	Design (um)	Package	Part Number (Lead(Pb)-Free)	ES	CS	MP	Part Number (Current Product)	ES	CS	MP
			5		SOP32-P-525-1.27	TC55NEM208AFGN	-	Now	Now	TC55NEM208AFPN	-	Now	Now
					TSOP II 32-P-400-1.27	TC55NEM208ATGN	-	Now	Now	TC55NEM208AFTN	-	Now	Now
		512K x 8	2.7-5.5		SOP32-P-525-1.27	TC55NEM208AFGV	-	Now	Now	TC55NEM208AFPV	-	Now	Now
					TSOP II 32-P-400-1.27	TC55NEM208ATGV	-	Now	Now	TC55NEM208AFTV	-	Now	Now
			3.3		TSOP I 40-P-1014-0.50	TC55VCM208ASGN	-	Now	Now	TC55VCM208ASTN	-	Now	Now
SRAM	4M			0.15	TSOP I 32-P-0.50	TC55VEM208ASGN	-	Now	Now	TC55VEM208ASTN	-	Now	Now
			5		TSOP II 54-P-400-0.80	TC55NEM216ATGN	-	Now	Now	TC55NEN216AFTN	-	Now	Now
			2.7-5.5			TC55NEN216ATGV	-	Now	Noe	TC55NEN216AFTV	-	Now	Now
		256K x 16			TSOP II 44-P-400-0.80	TC55NEM216ASGV	-	Now	Now	TC55NEM216ASTV	-	Now	Now
			3.3		TSOP I 48-P-1214-0.50	TC55VCM216ASGN	-	Now	Now	TC55VCM216ASTN	-	Now	Now
					P-TFBGA48-0608-0.75BZ	TC55VEM216AGXN	-	Now	Now	TC55VEM216ABXN	-	Now	Now
			1.8			TC55YEM216AGXN	-	Now	Now	TC55YEM216ABXN	-	Now	Now

SRAM(2)

Capacity (bit)	Organization	Power (V)	Design (um)	Package	Part Number (Lead(Pb)-Free)	ES	CS	MP	Part Number (Current Product)	ES	CS
	1M x 8/512K x 16		0.15	TSOP I 48-P-1220-0.50	-				TC55VBM316AFTN	-	Now
	512K x 16		0.13		TC55VCM316BTGN	-	Now	Jun./05	-		
	1M x 8/512K x 16	3.3	0.15	TSOP I 48-P-1214-0.50	TC55VBM316ASGN	-	Now	Now	TC55VBM316ASTN	-	Now
8M			0.13		TC55VCM316BSGN	-	Now	Jun./05	-		
			0.15	P-TFBGA48-0811-0.75BZ	TC55VEM316AXGN	-	Now	Now	-		
	512K x 16		0.13	P-TFBGA48-0607-0.75AZ	TC55VEM316BXGN	-	Now	Jun/05	-		
		1.8	0.15	P-TFBGA48-0811-0.75BZ	TC55YEM316AXGN	-	Now	Now	-		
			0.13	P-TFBGA48-0607-0.75AZ	TC55YEM316BXGN	-	Now	TBD	-		
	2M x 8/1M x 16		0.15	TSOP I 48-P-1220-0.50	TC55VBM416ATGN				TC55VBM416AFTN	-	Now
			0.13		TC55VCM416BTGN	-	Now	Now	-		
		3.3		TSOP I 48-P-1214-0.50	TC55VCM416BSGN	-	Now	Now	-		
16M	1M x 16		0.15		TC55VEM416AXGN	-	Now	Now	-		
			0.13	P-TFBGA48-0811-0.75BZ	TC55VEM416BXGN	-	Now	Now	-		
		1.8	0.15		TC55YEM416AXGN	-	Now	Now	-		
			0.13		TC55YEM416BXGN	-	Now	TBD	-		

6.3 PSRAM

Product	Capacity (bit)	Organization	Power (V)	Design (um)	Package	Part Number (Lead(Pb)-Free)	ES	CS	MP	Part Number (Current Product)	ES	CS	MP
	32M	2M x 16			P-TFBGA48-0607-0.75AZ	TC51WHM516AXGN	-	Now	Now	TC51WHM516AXBN	Now	Now	Now
						TC51WKM516AXGN	-	Now	Now	TC51WKM516AXBN	Now	Now	Now
PSRAM	64M	4M x 16	2.7	0.175	P-TFBGA48-0811-0.75BZ	TC51WHM616AXGN	-	Now	Now	TC51WHM616AXBN	Now	Now	Now
						TC51WKM616AXGN	-	Now	Now	TC51WKM616AXBN	Now	Now	Now
	128M	8M x 16			P-FBGA69-0912-0.80B3	TC51WHM716AXGN	-	Now	Now	TC51WHM716AXBN	Now	Now	Now
						TC51WKM716AXGN	-	Now	Now	TC51WKM716AXBN	Now	Now	Now

6.4 NOR Flash

Product	Capacity (bit)	Organization	Power (V)	Design (um)	Package	Part Number (Lead(Pb)-Free)	ES	CS	MP	Part Number (Current Product)	ES	CS	MP
					TSOP I 48-P-1220-0.50	TC58FVM5T2ATG	Now	Now	Now	TC58FVM5T2AFT	Now	Now	Now
	32M	4M x 8/2M x 16				TC58FVM5B2ATG	Now	Now	Now	TC58FVM5B2AFT	Now	Now	Now
					P-TFBGA56-0710-0.80AZ	TC58FVM5T2AXG	Now	Now	Now	TC58FVM5T2AXB	Now	Now	Now
						TC58FVM5B2AXG	Now	Now	Now	TC58FVM5B2AXB	Now	Now	Now
NOR			3.3	0.15	TSOP I 48-P-1220-0.50	TC58FVM6T2ATG	Now	Now	Now	TC58FVM6T2AFT	Now	Now	Now
Flash	64M	8M x 8/4M x 16				TC58FVM6B2ATG	Now	Now	Now	TC58FVM6B2AFT	Now	Now	Now
					P-TFBGA56-0710-0.80AZ	TC58FVM6T2AXG	Now	Now	Now	TC58FVM6T2AXB	Now	Now	Now
						TC58FVM6B2AXG	Now	Now	Now	TC58FVM6B2AXB	Now	Now	Now
	128M	16M x 8/8M x 16			TSOP I 48-P-1220-0.50	TC58FVM7T2ATG	Now	Now	Now	TC58FVM7T2AFT	Now	Now	Now
						TC58FVM7B2ATG	Now	Now	Now	TC58FVM7B2AFT	Now	Now	Now

6.5 NAND Flash

Product	Capacity (bit)	Block Size	Power (V)	Design (um)	Package	Part Number (Lead(Pb)-Free)	ES	CS	MP	Part Number (Current Product)	ES	CS	MP
	128M			0.13		TC58DVM72A1TG00	Now	Now	Now	TC58DVM72A1FT00	Now	Now	Now
	256M	16KB				TC58DVM82A1TG00	Now	Now	Now	TC58DVM82A1FT00	Now	Now	Now
NAND	512M					TC58DVM92A1TG00	Now	Now	Now	TC58DVM92A1FT00	Now	Now	Now
Flash	1G		3.3		TSOP I 48-P-1220-0.50	TC58DVG02A1TG00	Now	Now	Now	TC58DVG02A1FT00	Now	Now	Now
						TC58NVG0S3ATG05	Now	Now	Now	TC58NVG0S3AFT05	Now	Now	Now
	2G	128KB				TH58NVG1S3ATG05	Now	Now	Now	TH58NVG1S3AFT05	Now	Now	Now
				90nm		TC58NVG1S3BTG00	Now	Now	Now	TC58NVG1S3AFT00	Now	Now	Now

7. Precautions for Lead(Pb)-Free Soldering

(1) Various Lead(Pb)-Free solder materials are available in the market.
Some examples are described in Fig 2-1.
It will be necessary to select soldering material carefully and confirm reliability and workmanship of Lead(Pb)-Free soldering before actual production.

Note: Melting Points are determined by representative value, which depends on composition ratio.
Please consult solder vendor for details.

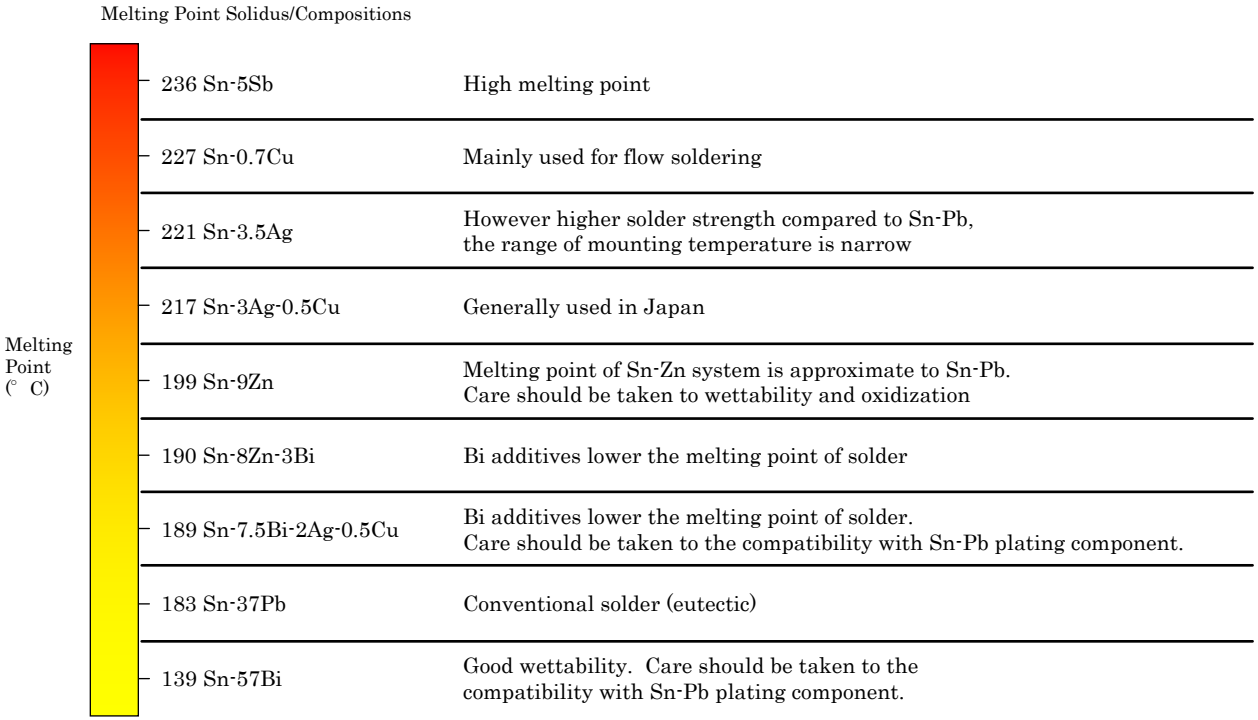


Fig 7-1 Characteristics of General Lead(Pb)-free Solder

(2) Generally, the soldering temperature of Lead(Pb)-Free solder is higher than that of lead(Pb)-contained solder.
Please ensure that the soldering temperature does not exceed maximum rated temperature of components.
Fig 2-2 shows the example of reflow temperature profile by the use of Lead(Pb)-Free paste (Sn-3Ag-0.5Cu) for your reference.

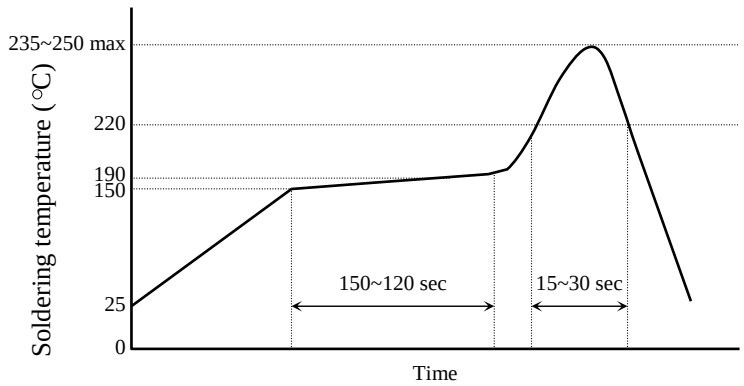


Fig 7-2 Example of Reflow Temperature Profile of Sn-3Ag-0.5Cu

8. Reflow Temperature Profile for Heat Resistance Test

Fig 8-1 shows the reflow temperature profile for heat resistance test of lead(Pb)-contained products and Fig 8-2 shows that of Lead(Pb)-Free products.

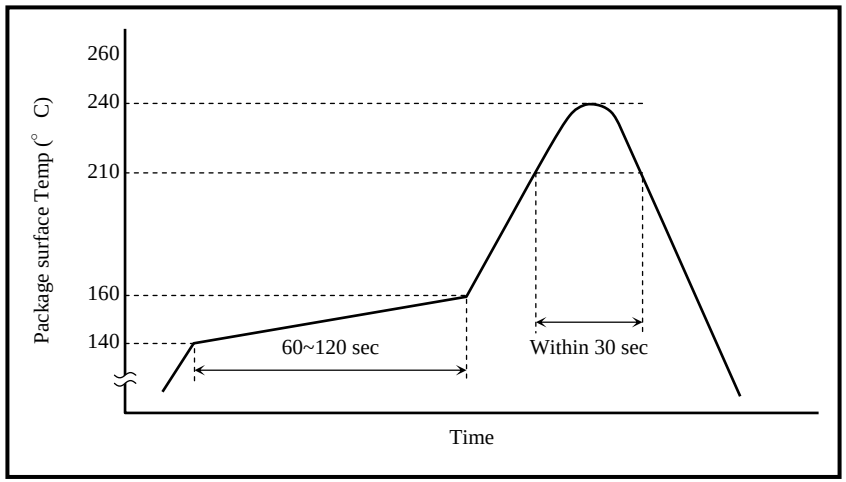


Fig 8-1 Reflow Temperature Profile for Heat Resistance Test of lead(Pb)-contained Products

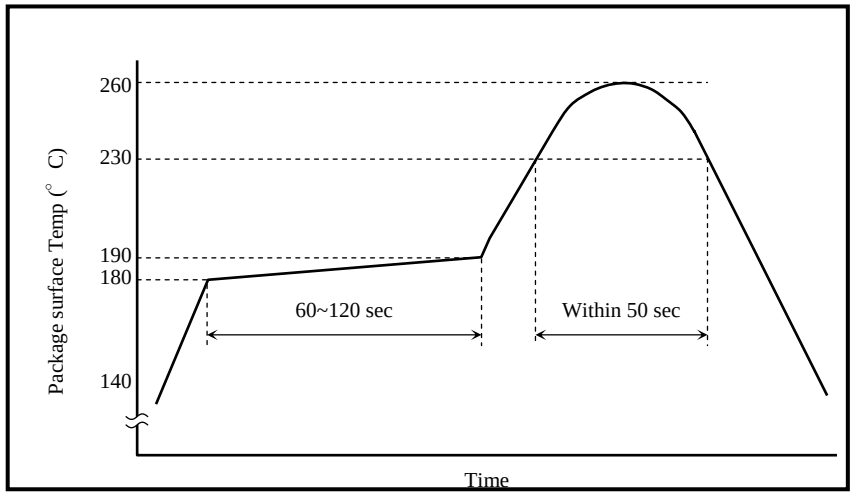


Fig 8-2 Reflow Temperature Profile for Heat Resistance Test of Lead(Pb)-Free Products

For further information, please visit www.rohs.toshiba.com or contact tech.questions@taec.toshiba.com.

Legal Note: The definitions included in this document for Lead(Pb)-Free and RoHS-Compatible and the related discussions are not intended to interpret the RoHS Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the use of certain hazardous substances in electrical and Electronic equipment (the "RoHS Directive") or any other law or regulation and do not constitute legal advice. The RoHS Directive itself should always be read and understood (as it constitutes the law), in contrast with the information contained herein, which is intended to be informative but has no legal authority. You should refer to the RoHS Directive itself for a full statement of the legal requirements and in the case of any doubt take independent advice, including your own legal advice. The RoHS Directive may be revised from time to time, so users should take care to keep themselves informed.

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TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.

The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.) These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.

TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.

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