

To: _____

Notification about Change of Frame of MP6D Products

TOSHIBA

Issue No. H440-1G-001P-E

Date of issue: July 12, 2021

Quality And Reliability Engineering Group

Quality Assurance Department

Himeji Operations - Semiconductor

Toshiba Electronic Devices & Storage Corporation

1. Outline of the change

1) Background of the change

One of our frame manufacturers, Company A, has informed us that it will stop producing the frames for package MP6D. We will change the manufacturer to Company B which has already mass-produced the frames for package DFN5B. Please confirm the details of the change shown on the following pages.

Item	MP6D	DFN5B
Frame manufacturer (Before change)	Company A	Company B
Frame manufacturer (After change)	Company B	

We have used Company B's frames for package DFN5B. The manufacturer has a solid track record of production. More than 100 million DFN5B products with the frames have been manufactured.

2) Product subjected to the change

Package name	Product name
MP6D	TC7SB3157DL6X,L(S2

The product is identified by the name for our smooth manufacturing after the change. Therefore, the product name for order is to be changed. We are sorry for the inconvenience, but your understanding would be sincerely appreciated.

3) Schedule of the change

The change is scheduled to start from the production of January 2022.

We apologize for the short notice, but your understanding would be highly appreciated for our continuous supply.

2. Schedule for supplying products with new frames

Products with new frames are scheduled to be mass-produced from January 2022.

Please contact our sales representatives to ask for samples after the change and/or inform of necessary quantity of products before the change. Your cooperation would be appreciated.

Item	2021									2022		
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Internal evaluation on representative products		Done										
Change notification to customer, customer's approval				In production → Gather information about quantity of products customers need								
Start of mass-production with new frames										Production start		

3. Description of the change (5M1E)

Changes in **5M1E** resulting from the frame change are shown below.

5M1E	Change point
Man	No change
Machine	No change
Measurement	No change
Method	No change
Material	To be changed (Frame manufacturer from Company A to Company B)
Environment	No change

The change will not affect the product's electrical characteristics, reliability, etc.

4. Description of the change (QC process flow)

Control plan (QC process flow)

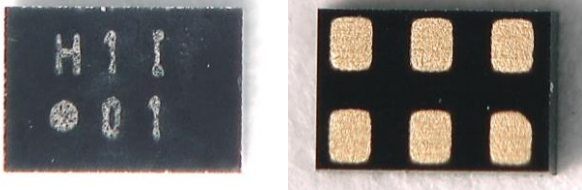
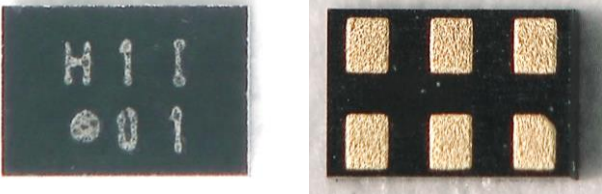
There are no differences before and after the change.

Manufacture Production		Items Controlled/Inspected	Check Frequency
Flow Chart	Process		
	(Wafer)		
○□	Back grind	Wafer thickness	Once / Day
○	Dicing	Appearance	
▽▽	(Lead Frame) (DAF)		
○□	Die Bonding	Appearance	Once / Lot
▽○□	(Bonding Wire) Wire Bonding	Bonding Strength	Once / Week
▣	Appearance Inspection	Bonding Status	Once / Lot
▽○□	(Molding Resin) Molding	Temperature	Once / Day
○	Marking		
○	Sheet Sticking		
○	Dicing		
▣	Appearance Inspection	Appearance	
▣	Testing	Electrical Characteristics	
▽○	(Taping Material) Taping		
▽○	(Packing Material) Packing		
▣△	Quality Monitoring	Electrical Characteristics Reliability test	
▽	Shipping		
Symbol	▽:Storage ○:Operation □:100%Test ▣: Sampling inspection ▣△:Special check ○□:Check		

The above process may be changed or rationalized based on the result in our process.

5. Description of the change (Detailed)

Details of the change

Item	Product before change (Company A)	Product after change (Company B)
Package name	MP6D (No change)	
Product name (Only additional code, ADDC, changes.)	TC7SB3157DL6X,L(S2	TC7SB3157DL6X,(S2E
Frame structure (Electroforming)	Ag/Pd/Ni/Au	Ag/Ni/Au
Appearance photo		
Electrical characteristics, reliability, mark specifications	No change	

The new frame entails a change in frame structure (electroforming). However, the product's specifications (dimensional drawing), appearance, and size will be the same. Also, there will be no change in land pattern (for reference).

6. Change points and evaluations (DRBFM)

DRBFM regarding the frame change is shown below.

DRBFM: Evaluation Sheet for Change

Created on: March 26, 2021

Change of frame manufacturer: (Before change) Company A

(After change) Company B

Created by: Device development dept., Device engineering dept., Application engineering dept., Quality assurance dept.

No.	Part & product/Change and its purpose		Function	Concern from change (Failure mode)	Case where a concern arises	Effects on customer	Item reflected (Removal of concerns)	Action (based on result of DRBFM): What action was taken?				
	Ban against change without purpose		Required performance	Loss of function, lack of merchantability, and side effect caused by change	Cause, factor		(Current process control/design)	Item to be reflected on design drawing	Item to be reflected on evaluation (New evaluation method)			Item to be reflected on manufacturing (Measure)
	Part, product	Change							Item	Test result (Defectives/quantity tested)	Judgment	
1	Frame	Change in frame	Electrical connection with board	Deterioration of solderability	Change in the state of mounting surface	Failure in mounting	Based on QCS	None	1) Solderability test 2) Salt spray test (Use of results of evaluating antecedently developed package)	1)0/10p 2)0/11p	OK	Check by IQC - Appearance inspection after molding
2		Change in frame structure (Electroforming) Ag/Pd/Ni/Au→Ag/Ni/Au	Electrical connection between frame and wire	Deterioration of bonding between frame and wire	Improper conditions of bonding due to frame change	Deterioration of reliability	Based on QCS	None	1) Wire pull strength 2) Bonding shear strength 3) Ball thickness 4) Ball diameter 5) Temperature cycle test: 100cyc	1)0/30p 2)0/30p 3)0/30p 4)0/30p 5)0/30p	OK	Check by IQC - Regular monitoring on reliability of representative products
3			Mechanical connection with chip	Decrease in die shear strength	Improper conditions of electroforming	Deterioration of reliability	Based on QCS	None	Die shear strength	0/30p	OK	Check by IQC
4			Securing of electrical characteristics	Change in electrical characteristics	Change in electrical characteristics due to change in frame structure	Abnormality in characteristics	100% inspection (Guarantee of design values)	None	Initial characteristics	0/1 lot	OK	100% check in the test process (Guarantee of design values)
5			Frame (Change in internal shape)	Securing of adhesion to molding resin	Decrease in mounting strength	Insufficient adhesion between frame and molding resin (Decrease in device adhesion)	- Failure in mounting - Deterioration of device reliability after mounting	Based on design values	None	1) Mounting shear strength: Directions X and Y 2) Mounting temperature cycle test: 100cyc, Directions X and Y	1)0/11p 2)0/11p	OK
6		Decrease in package strength			Insufficient adhesion between frame and molding resin (Decrease in device adhesion)	- Deterioration of reliability - Failure in mounting	Based on design values	None	1) Temperature cycle test: 100cyc 2) Static load test	1)0/30p 2)0/12p	OK	None
7		Moisture intrusion due to poor adhesion to molding resin			Insufficient adhesion between frame and molding resin (Decrease in device adhesion)	- Failure in operation - Deterioration of reliability	Based on design values	None	1) Initial characteristics 2) Pressure cooker test: 127°C/100%/96h	1)0/1 lot 2)0/30p	OK	None
8		Electrical/mechanical connection with board	Abnormality in electrode shape	Improper mask dimensions of frame (for electroforming)	Unusable	Based on design values	None	Frame incoming inspection: Electrode dimensions measurement	0/30p	OK	Incoming inspection data	

7. Evaluation summary

Results of evaluations which were conducted based on the DRBFM are shown below.
No problems were found.

Evaluation	Item		Condition	Result (Sample size = n)	Judgment	Document attached
Material check	Frame incoming inspection		Based on the internal control specifications	30p	OK	-
Evaluation after each process	Die bonding evaluation	Die shear strength	Based on the internal control specifications	30p	OK	Attached
	Wire bonding evaluation	Wire pull strength	Based on the internal control specifications	30p	OK	Attached
		Bonding shear strength	Based on the internal control specifications	30p	OK	Attached
		Ball thickness	Based on the internal control specifications	30p	OK	Attached
		Ball diameter	Based on the internal control specifications	30p	OK	Attached
	Product yield		Based on the internal control specifications	1 lot	OK	-
Product function check	Initial characteristics		Based on the TD	1 lot	OK	Attached
	Solderability test		240°C/3s	10p	OK	-
	Static load test		20N, 40N, 50N	12p	OK	-
Reliability check	Temperature cycle test (Pretreatment = Moisture absorption + Reflow)		-65°C(30 min)-150°C(30 min), 100 cyc	30p	OK	-
	Pressure cooker test (Pretreatment = Moisture absorption + Reflow)		127°C/100% 96h	30p	OK	-
	Salt atmosphere test (Use of results of evaluating antecedently developed package, DFN5B)		35°C/5% NaCl/48h	11p	OK	-
Mounting check	Mounting shear strength		Directions X, Y (Initial)	11p	OK	Attached
	Shear test after mounting temperature cycle test		Directions X, Y (100 cyc)	11p	OK	Attached
Finished product	Appearance check after reliability testing	After temperature cycle test	There shall be no defect in appearance.	30p	OK	-
		After mounting temperature cycle test	There shall be no defect in appearance.	11p	OK	-
		After static load test	There shall be no defect in appearance.	12p	OK	-

8. Results of evaluations for the change (Bonding)

Bonding evaluation results (Die/Wire)

The following items were checked. There were no problems with the process capability of die bonding and wire bonding.

Product subjected to change: TC7SB3157DL6X

Check item	Frame	Process capability (Cpk)	Specification	Quantity	Judgement
Die shear strength	Before change	1.76	Based on internal control specifications	30p	OK
	After change	1.88		30p	OK
Wire pull strength	Before change	2.26	Based on internal control specifications	30p	OK
	After change	2.08		30p	OK
Wire bonding shear strength	Before change	2.19	Based on internal control specifications	30p	OK
	After change	1.80		30p	OK
Ball thickness	Before change	2.27	Based on internal control specifications	30p	OK
	After change	2.46		30p	OK
Ball Diameter	Before change	3.08	Based on internal control specifications	30p	OK
	After change	2.89		30p	OK

9. Product function check

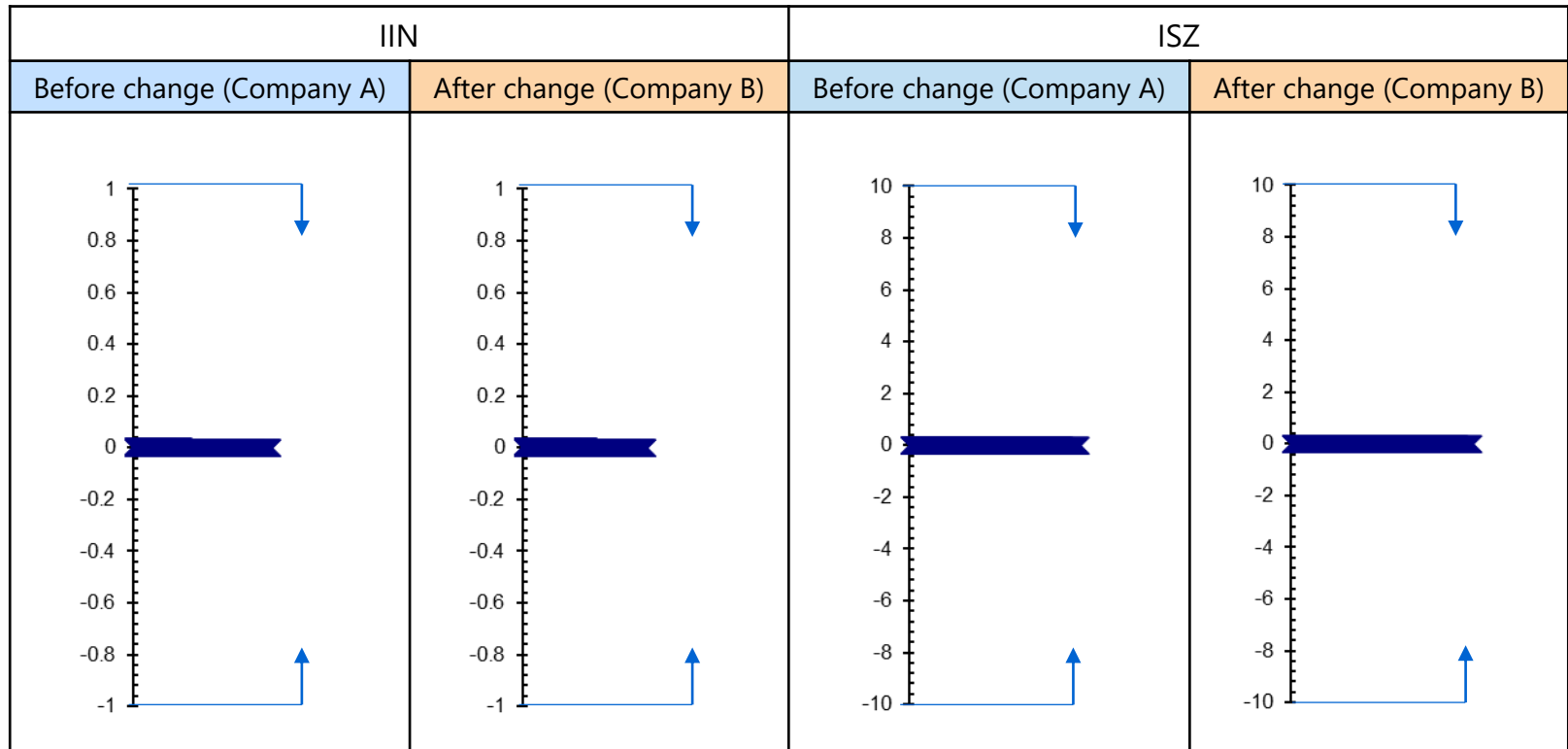
Comparison in initial characteristics

Initial characteristics (electrical characteristics) were measured. The measurements fell within the specifications. No differences were found in the results and no problems were found.

Product subjected to change: TC7SB3157DL6X

n= 1 Lot Ta=25°C

Item	Symbol	Measurement condition	Specification (TD)				Before change (Company A)		After change (Company B)	
			Min	Typ	Max	Unit	Average	Cpk	Average	Cpk
Input leakage current	IIN	VIN=0 to 5.5V	-1	-	1	uA	0.001	546	0.002	523
Switch OFF-state leakage current	ISZ	B1, B2=0 to VCC	-10	-	10	uA	0.001	4274	0.002	4304



9. Product function check

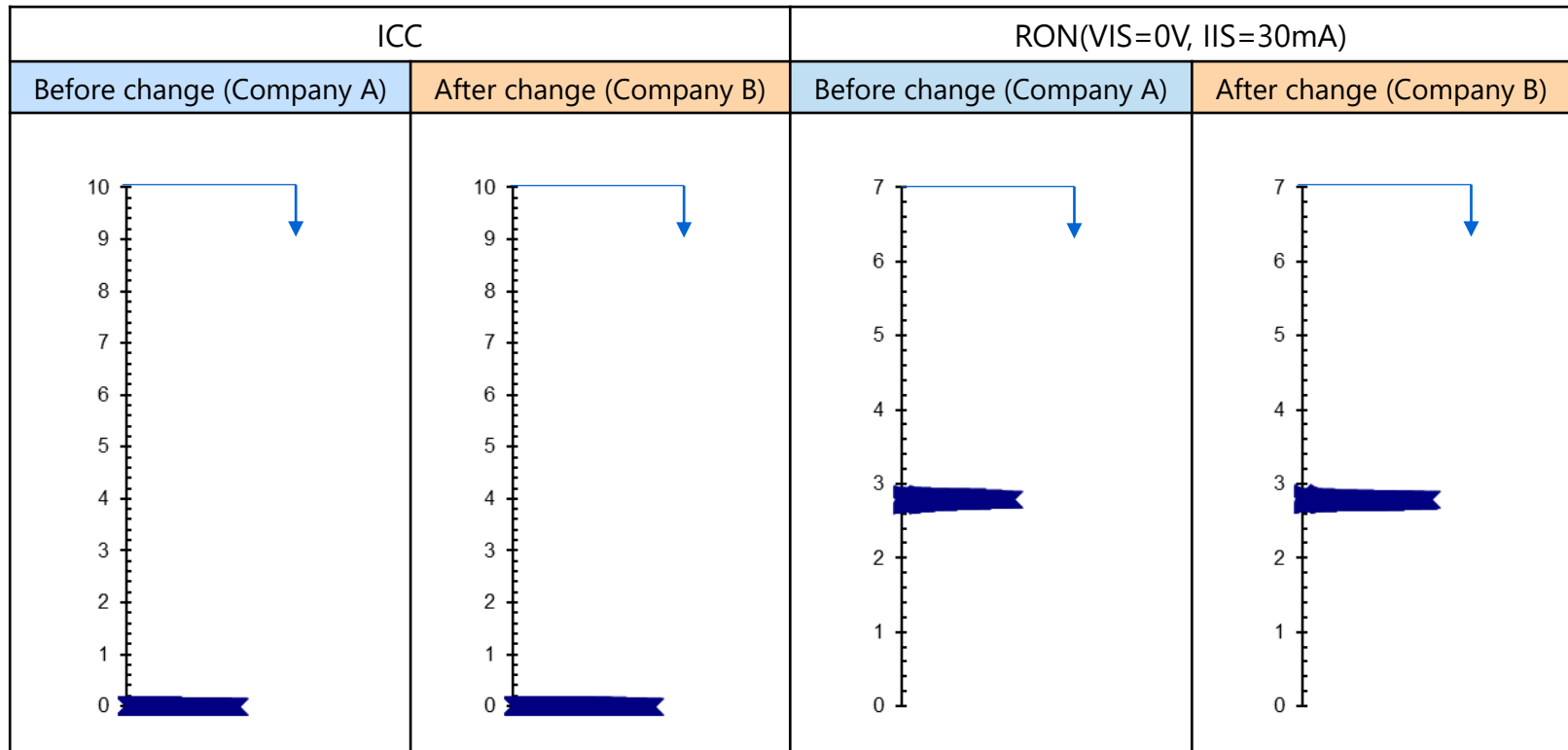
Comparison in initial characteristics

Initial characteristics (electrical characteristics) were measured. The measurements fell within the specifications. No differences were found in the results and no problems were found.

Product subjected to change: TC7SB3157DL6X

n= 1 Lot Ta=25°C

Item	Symbol	Measurement condition	Specification (TD)				Before change (Company A)		After change (Company B)	
			Min	Typ	Max	Unit	Average	Cpk	Average	Cpk
Quiescent supply current	ICC	VIN=VCC or GND, IOU=0A	-	-	10	uA	0.003	1398	0.003	1380
ON-resistance	RON	VIS=0V, IIS=30mA	-	4	7	Ω	2.79	52.9	2.78	63.4



9. Product function check

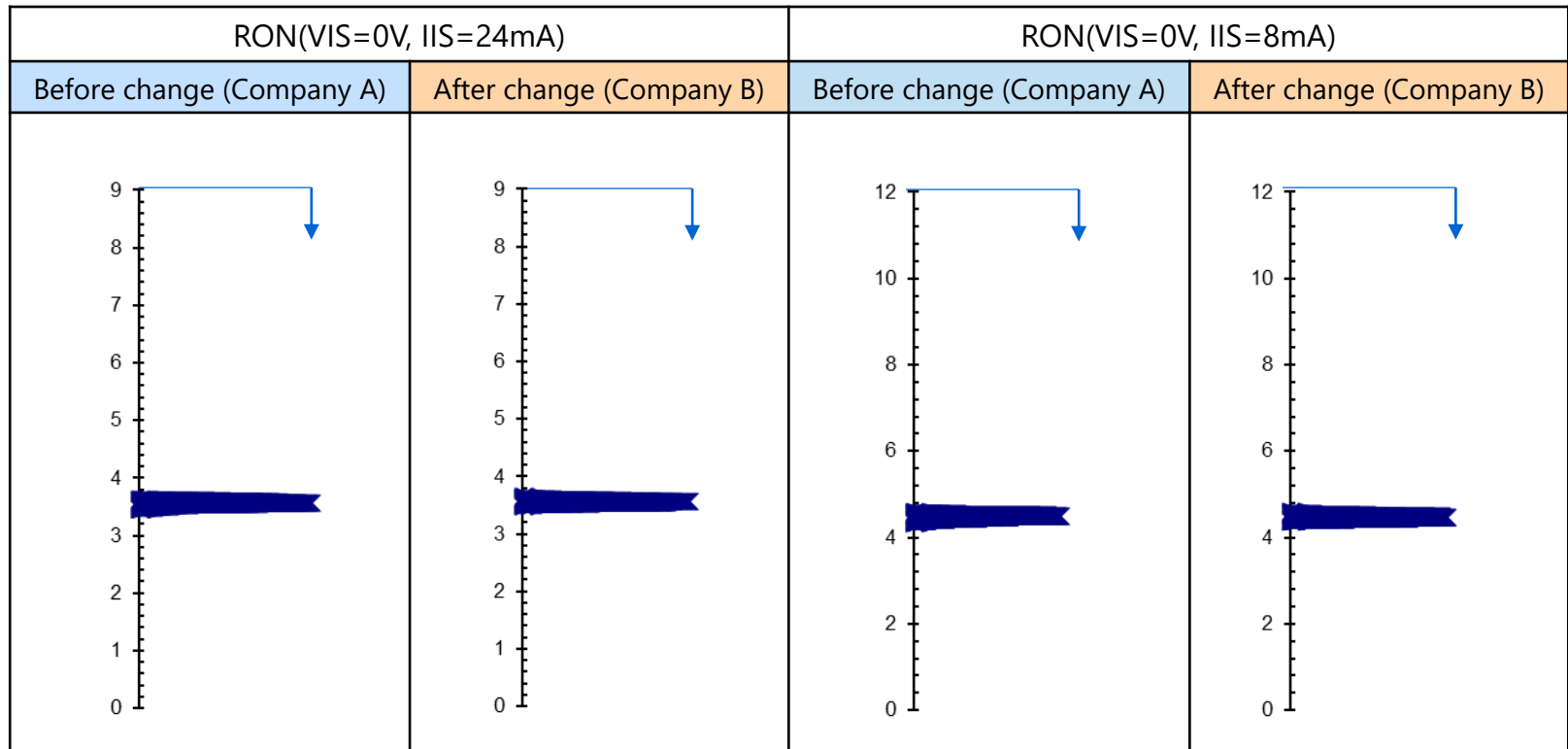
Comparison in initial characteristics

Initial characteristics (electrical characteristics) were measured. The measurements fell within the specifications. No differences were found in the results and no problems were found.

Product subjected to change: TC7SB3157DL6X

n= 1 Lot Ta=25°C

Item	Symbol	Measurement condition	Specification (TD)				Before change (Company A)		After change (Company B)	
			Min	Typ	Max	Unit	Average	Cpk	Average	Cpk
ON-resistance	RON	VIS=0V, IIS=24mA	-	5	9	Ω	3.56	62.8	3.56	78.9
ON-resistance	RON	VIS=0V, IIS=8mA	-	6	12	Ω	4.48	63.1	4.47	71.8



9. Product function check

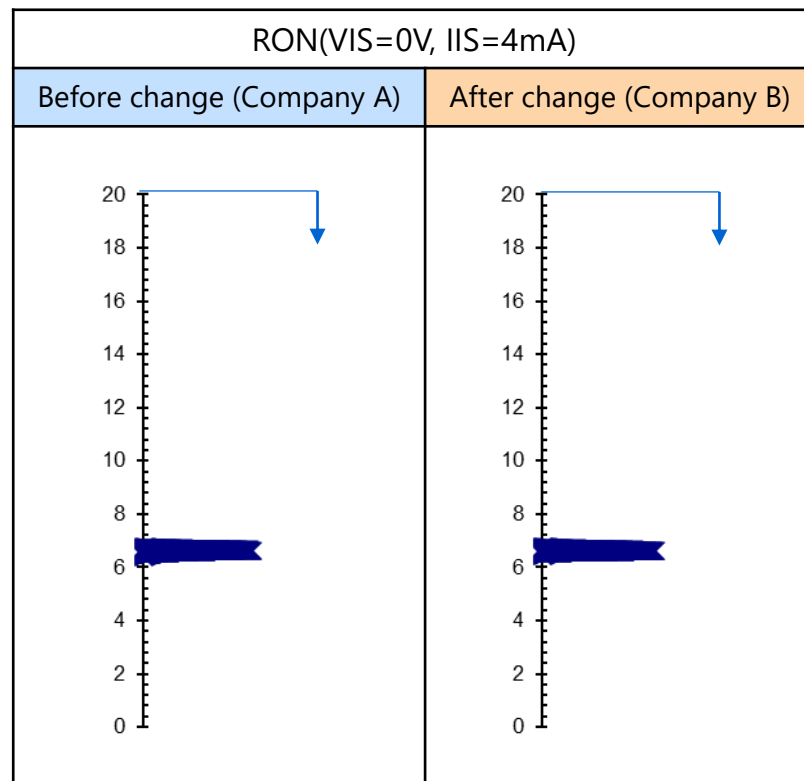
Comparison in initial characteristics

Initial characteristics (electrical characteristics) were measured. The measurements fell within the specifications. No differences were found in the results and no problems were found.

Product subjected to change: TC7SB3157DL6X

n= 1 Lot Ta=25°C

Item	Symbol	Measurement condition	Specification (TD)				Before change (Company A)		After change (Company B)	
			Min	Typ	Max	Unit	Average	Cpk	Average	Cpk
ON-resistance	RON	VIS=0V, IIS=4mA	-	8	20	Ω	6.62	80.5	6.63	93.1



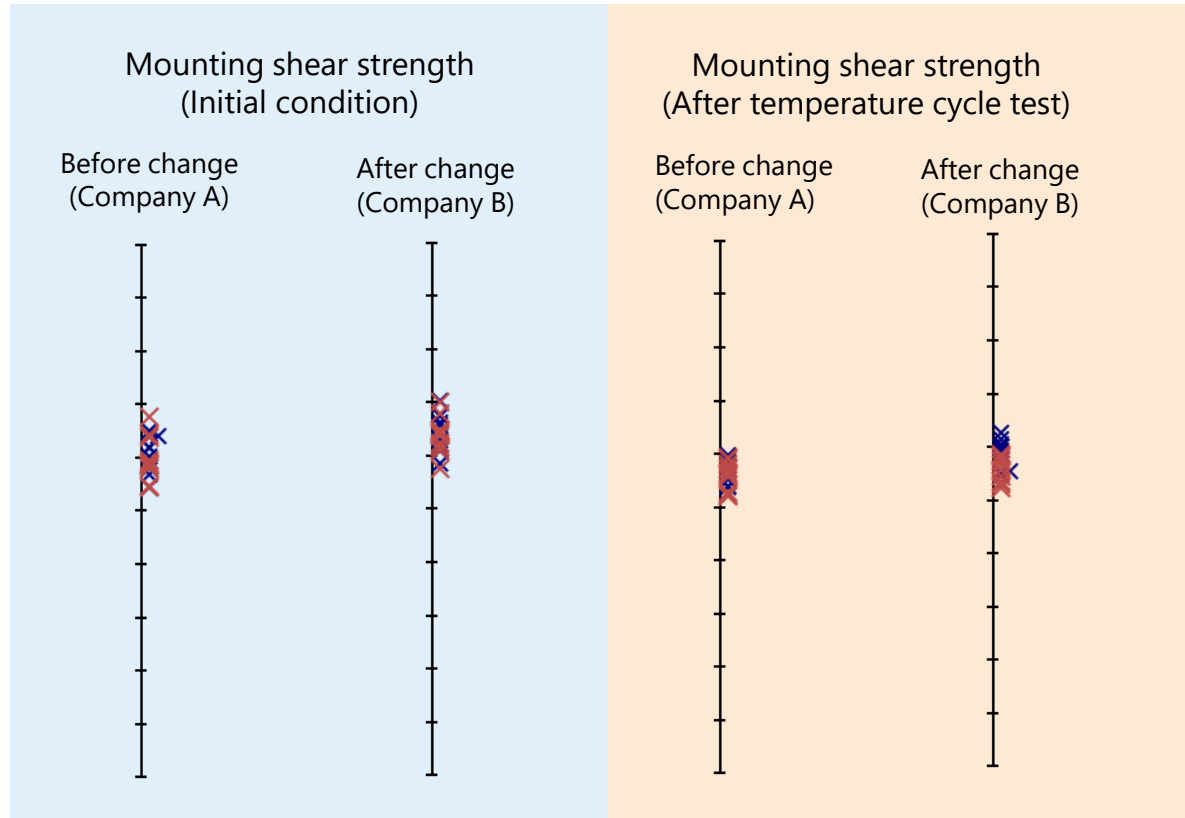
10. Device mounting check (Mounting shear strength, mounting temperature cycle test)

Mounting shear strength and mounting temperature cycle tests were conducted.

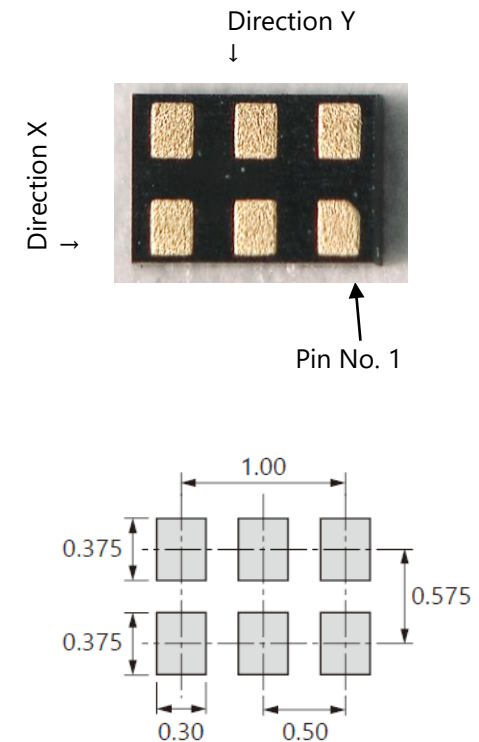
The results showed that both before and after the temperature cycle test, the shear strength of products after the change (Company B) was equivalent to that of products before the change (Company A). No problems were found.

Product subjected to change: TC7SB3157DL6X

Direction Y: X
Direction X: X (n=11 pcs each)



• Shear direction



• Mounting conditions

Reflow condition	TOSHIBA standard
Peak temp	Peak: 260°C
Reflow zone	230°C or more/ 30-50s
Preheat	180-190°C, 60-120s

Board

- Metal mask thickness: 100μm
- Metal mask aperture ratio: 100%
- Mount pad size (Figure on the right)

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Toshiba Electronic Devices and Storage, together with our customers, will accelerate our future journey.
We aim to be a company that will be chosen for our pioneering technology and spirit embedded in our products.

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