TECHNICAL INFORMATION

Lead Free NO CLEAN SOLDER PASTE

SXA48-M301-3 *series*

[Contents]

1. FEATURES .... Page 2
2. SPECIFICATIONS 2
3. ALLOY PROPERTIES 3
4. VISCOSITY CURVE 4
5. TACK FORCE 5
6. SLUMP 6
7. SOLDER BALLING 9
8. SOLDER SPREAD FACTOR & WETTING 12
9. BONDING STRENGTH 14
10. COPPER PLATE CORROSION 16
11. SURFACE INSULATION RESISTANCE 17
12. VOLTAGE APPLIED SIR 18
13. USE OF KOKI SOLDE PASTE 19

KOKI COMPANY LIMITED

1. FEATURES

1) Low melting temperature, superior joint strength as compared to Sn/Pb, less tombstoning than Sn63/Pb37, wets Au, Cu, Pd, HASL as well as, or better than Sn63/Pb37.
2) Carefully selected thixotropic materials ensure excellent slump resistance and significantly reduce the occurrence of bridging and solder beading.
3) Specially developed 'heat resistant' flux system ensures both extremely high reliability and superior solder wetting.
4) Low colour flux residue offers a superior cosmetic appearance.

2. SPECIFICATION

1) Alloy

Item	Unit	SXA48-M301-3	SXA48-M301-3L	Remarks
Composition	%	Sn95.8, Ag3.5, Cu0.5, Sb0.2		JIS S grade
Shape	--	Spherical		Microscope×50
Particle size	μm	20 – 45		

2) Flux

Halogen content		%	0.0	Potentiometer
SIR*[1]	Initial value	Ω	$> 1 \times 10^{13}$	JIS comb type electrode type Ⅱ
	After humidification		$> 1 \times 10^{12}$	
Aqueous solution resistivity*[2]		Ωcm	$> 5 \times 10^{4}$	Conductivity
Flux type		–	ROL0	ANSI/J-STD-004

3) Solder paste

Flux content	%	12.0	12.0	By weight
Viscosity*[3]	Ps	2000 ± 10%	1700 ± 10%	Malcom PCU-205
Copper plate corrosion*[4]	--	Passed		--
Solder spread factor	%	> 85		Copper plate
Tack time	hour	> 24		Malcom FG-1
Shelf life	month	6		Below 10°C

1. SIR .... 40°C×95%RH×96Hr
2. Aqueous solution resistivity.................... In accordance with MIL specifications.
3. Viscosity .... Malcom spiral type viscometer, PCU-205 at 25°C 10rpm
4. Copper plate corrosion .... In accordance with JIS

3. ALLOY PROPERTIES

Item	Unit	Specification	Remarks
Composition	%	Sn95.8, Ag3.5, Cu0.5, Sb0.2	JIS S grade
Melting point	°C	217	DSC method
Specific gravity	--	7.4	
Linear expansion coefficient	1/°C	2.2×10^{-4}	0 – 100 10°C /min.
Electric conductivity	$m/\Omega mm^2$	1.2	
Heat conductivity	Cal/cm·sec·°C	0.15	
Elongation	%	55	Pulling speed 10mm/min.
Young's modulus	MPa	40000	
Hardness	HV	14	Vickers hardness test
Creep strength	Hrs	> 2000	125°C

4. VISCOSITY CURVE

• Test method

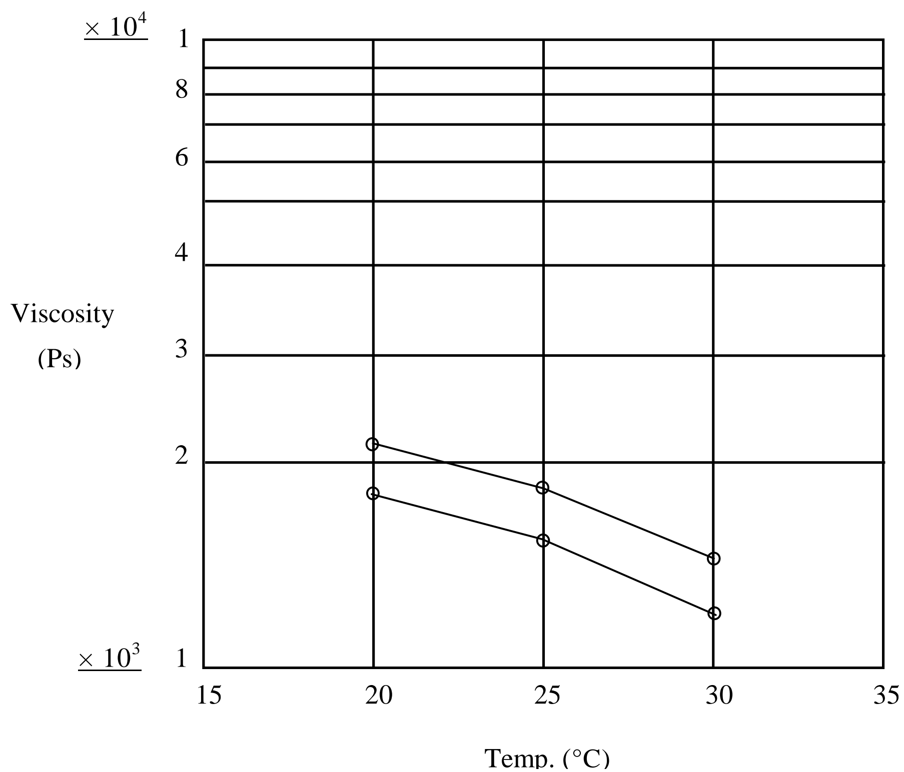
Equipment : Malcom viscometer PCU-2

Rotation of spindle : 10 r.p.m.

Measuring time : 5 min,

• Test result

Measuring temp. (°C)	Viscosity (Ps)	
	SXA48-M301-3	**SXA48-M301-3L**
20	2130	1920
25	1920	1640
30	1560	1290



5. TACKINESS

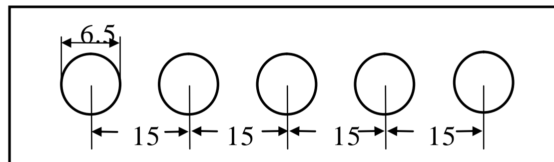
• Test method

Print the solder paste on an alumina plate with a 0.2mm thick stencil that has five 6.5mm dia. holes, to obtain the test piece.

Press the flat tip of the cylindrical probe of a Malcom Solder Checker FG-1 onto the printed solder paste with a pressure of 50gs for 0.2mm sec. and pull it back up at a speed of 10mm/sec. to measure the maximum tensile strength needed to separate the probe from the paste.

Evaluate the tackiness of the solder paste from the obtained tack force and time after printing.

*Ambient condition : 25°C 50 ± 10%RH



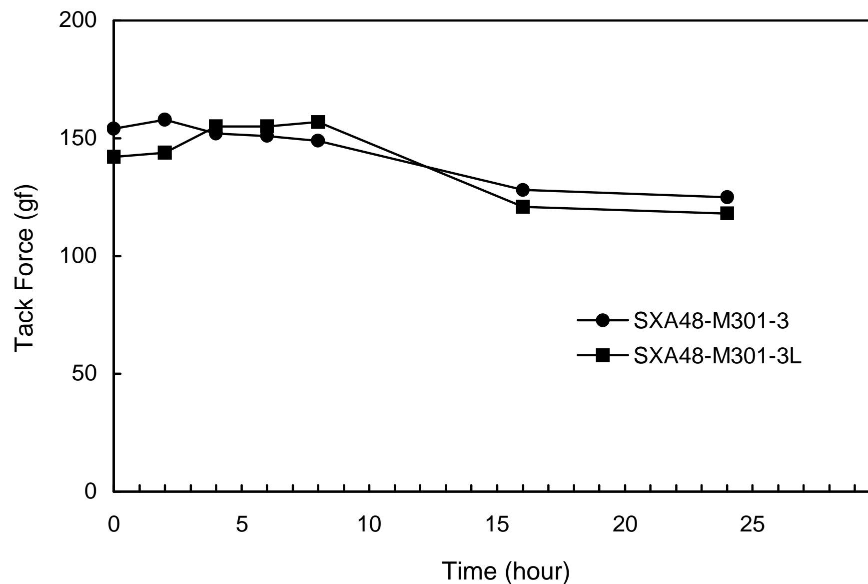
*Unit : mm

Stencil used

Time (hour)		0	2	4	6	8	16	24
Tack force (gf)	**SXA48-M301-3**	154	158	152	151	149	128	125
	SXA48-M301-3L	142	144	155	155	157	121	118

*Unit : (gf) Average of n = 5

Tackiness data



6. SLUMP

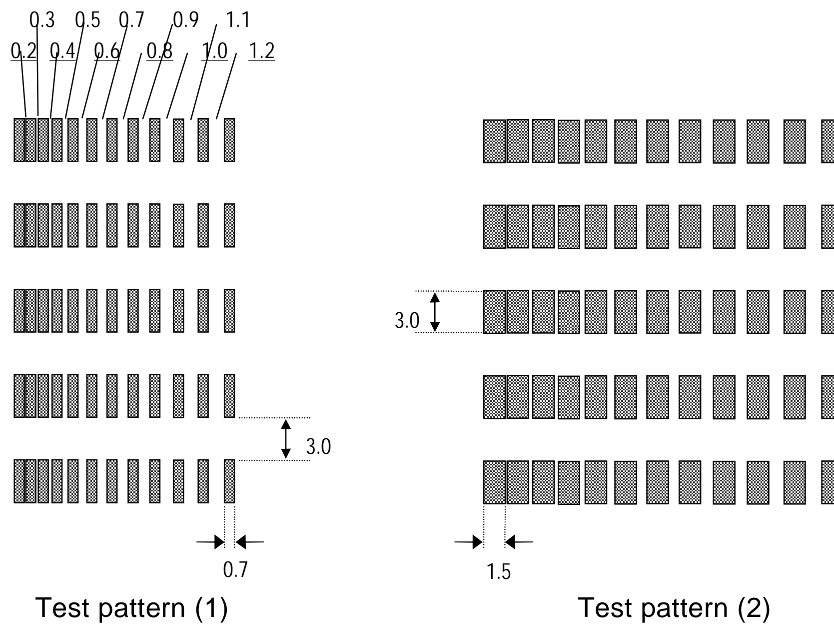
• Test method

Using a 0.2mm thick stainless steel stencil with two patterns of apertures, (1)3.0mm×0.7mm, (2)3.0mm×1.5mm arranged as grids with the spacing between the apertures varying from 0.2mm to 1.2mm in steps of 0.1mm, print the solder paste on 1.6mm thick copper clad laminate plate to obtain the test pieces.

(1) Observe the slump behaviour after leaving the test pieces at room temperature for 1 hour.

(2) Observe the minimum spacing across which the paste has not merged after storing the test pieces at room temperature for 1 hour, and heating it for 20 minutes at 100 °C in the thermostatic oven.

(3) Observe the minimum spacing across which the paste has not merged after storing the test pieces at room temperature for 1 hour, and heating it for 5 minutes at 150 °C in the thermostatic oven.



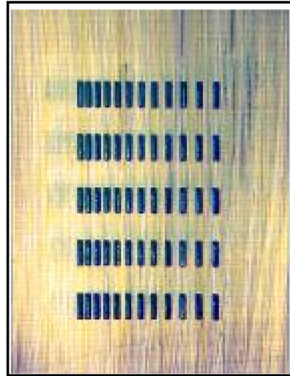
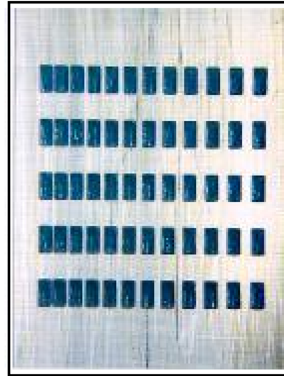
• Test result

Product	Pattern	Stored at room temperature for 1 hour		
		Room temp.	150°C×5min.	180°C × 5min.
S3X58-M301-3	(1)	0.2	0.3	0.3
	(2)	0.2	0.3	0.4
S3X58-M301-3L	(1)	0.2	0.2	0.3
	(2)	0.2	0.2	0.3

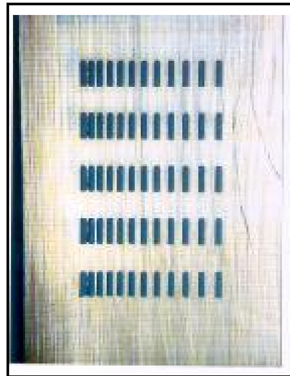
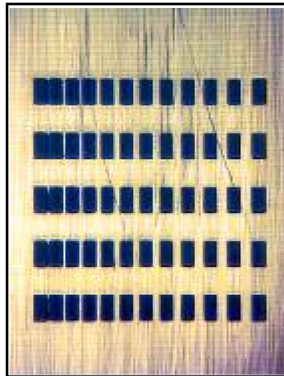
*Store at room temperature for 1 hour.

Product : SXA48-M301-3

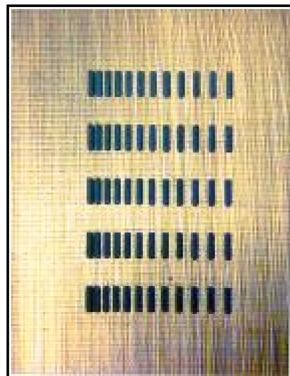
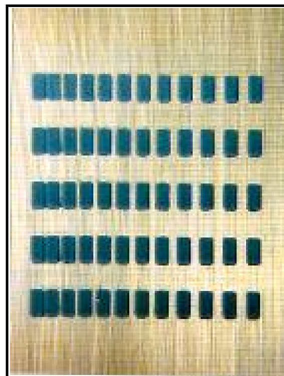
Room temperature (no heating)

150°C × 5min.

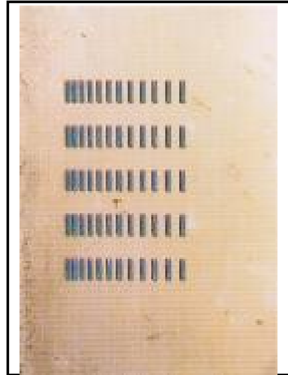
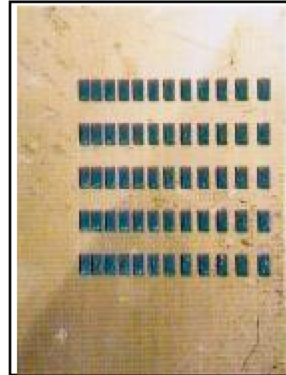
180°C × 5min.

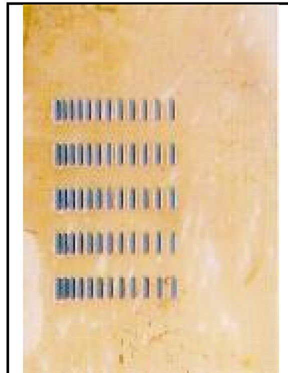
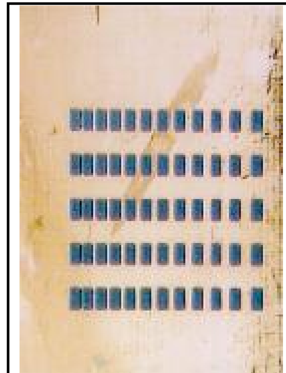
Store at room temperature for 1 hour.

Product : SXA48-M301-3L

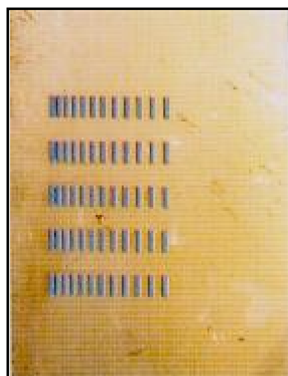
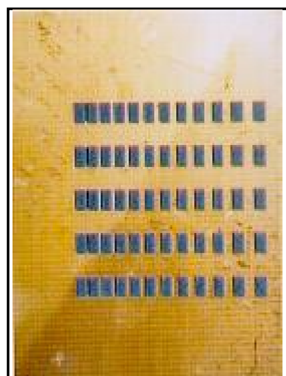
Room temperature (no heating)

150°C × 5min.

180°C × 5min.

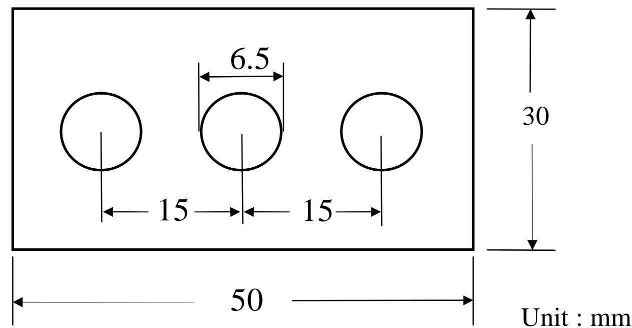
7. SOLDER BALLING

• Test method

Prepare two test pieces by printing the paste on each alumina plate (50×50×0.8tmm) with a 0.2mm thick stencil provided with three 6.5mm diameter apertures with a distance between centres of 15mm.

Reflow one of them 1 hour after printing and the other after storing it at 25 ± 2°C 60 ± 20%RH for 24 hours, on a hot plate at 250°C. Remove the test pieces from the hot plate after 5 seconds once the solder paste has melted completely and cool them down to room temperature.

Inspect the degree of reflow referring to the 'Solder balling evaluation standard' using a ×10 magnifying glass.



Stencil used.

• Solder balling evaluation standard

Category	Status of coalescence of solder	Illustration (ex.)
1	The molten solder from the paste has melted into one solder ball.	
2	The molten solder from the paste has melted into one large solder ball with no more than three isolated small solder balls with a diameter less than 75µm.	
3	The molten solder from the paste has melted into one large solder ball surrounded by more than three solder balls with diameters less than 75µm which do not form a semi-continuous halo.	
4	The molten solder from the paste has melted into one ball accompanied by a large number of smaller solder balls which may form a semi-continuous halo, or has melted to form a number of similarly sized balls.	

• Test result

Product : SXA48-M301-3

Test piece	1 hour after print	24 hours after print
a	Category 2	Category 2
b	2	2
c	2	3

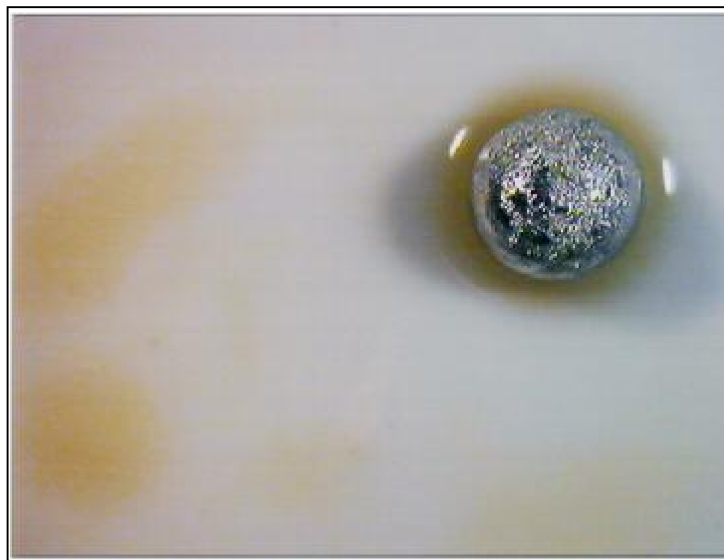
1 hour after printing

24 hour after printing

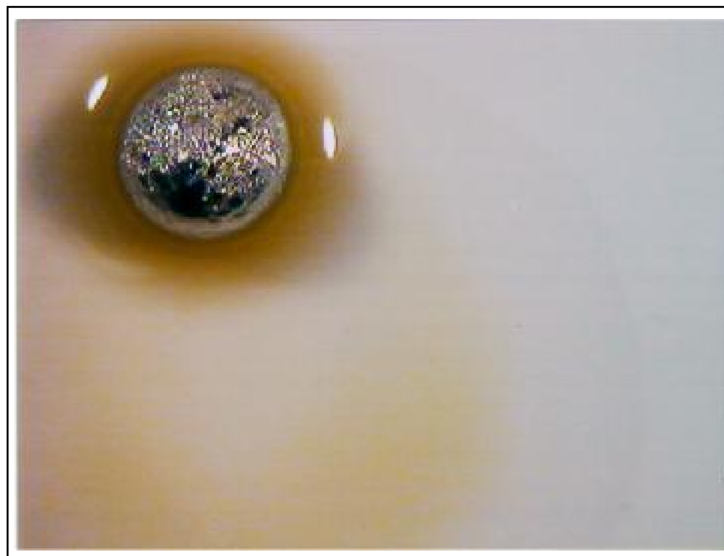
Product : SX48-M301-3L

Test piece	1 hour after print	24 hours after print
a	Category 2	Category 2
b	2	3
c	2	2

1 hour after printing



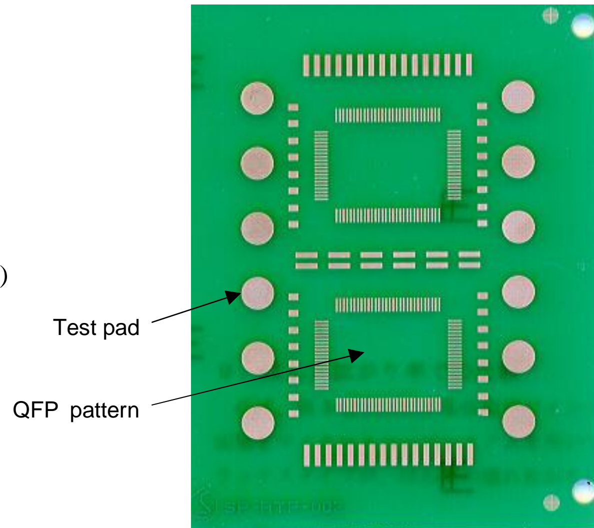
24 hour after printing



8. SOLDER SPREAD FACTOR & WETTING

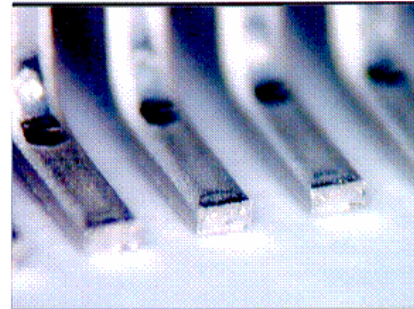
• Test method

1. Test board



Model :	SPRTP-002
Material :	Glass epoxy FR-4
Dimension :	80×100×1.6tmm
Surface treatment :	None (bare copper)
Pad size (round pad) :	6.0mm

2. QFP tested



PC board :	Glass epoxy FR-4
Component :	QFP 0.65mm pitch 100 pins
Lead wire :	Fe/Ni with Sn/Pb plating

3. Print condition

Stencil thickness :	0.150mm (laser cut)
Printer :	Model MK-880SV (Minami Kogaku)
Stencil aperture :	4.2mm diameter

4. Reflow condition

Heat source :	Far infrared + Hot air convection
Zone structure :	3 pre-heat zones + 1 reflow zone
Atmosphere :	Air
Temperature profile :	

Profile	Pre-heat zones	Peak temp.	Time over 220°C
Profile (2)	175 - 190°C × 80 sec.	240°C	55sec.

• Result

1. Solder spread

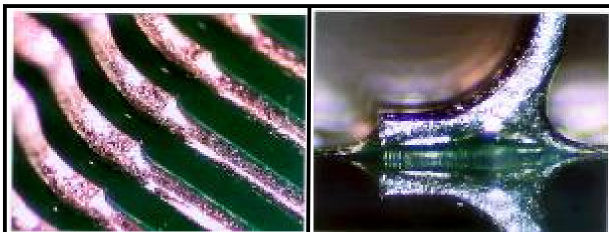
After reflow

Product : SXA48-M301-3

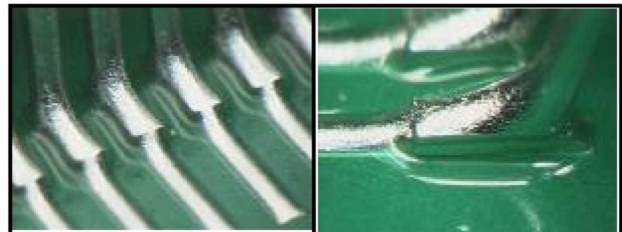
Product : SXA48-M301-3L

2. Wetting

Product : SXA48-M301-3



Product : SXA48-M301-3L



9. BONDING STRENGTH

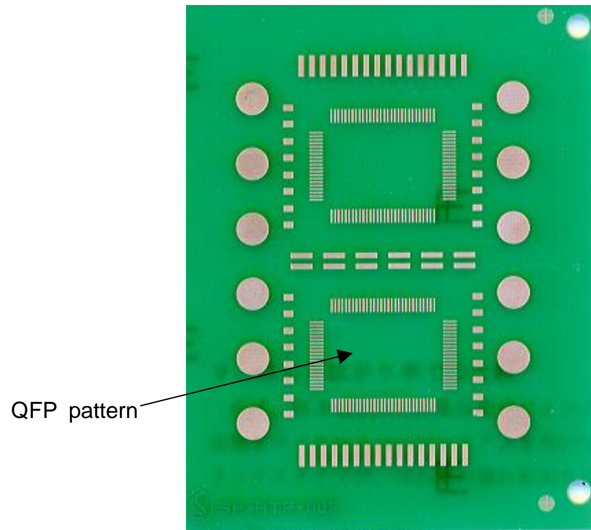
• Test method

Solder 0.65mm pitch QFP on test board and determine bonding strength of solder joints both before and after thermal shock treatment, by peel off test.

• Test conditions

1. Test board

Model :	SPRTP-002
Material :	Glass epoxy FR-4
Dimension :	80×100×1.6tmm
Surface treatment :	None (bare copper)
Pad size:	0.3×2.5mm



2. QFP tested

PC board :	Glass epoxy FR-4
Component :	QFP 0.65mm pitch 100 pins
Lead wire :	Fe/Ni with Sn/Pb plating

3. Print condition

Stencil thickness :	0.150mm (laser cut)
Printer :	Model MK-880SV (Minami Kogaku)
Stencil aperture :	4.2mm diameter

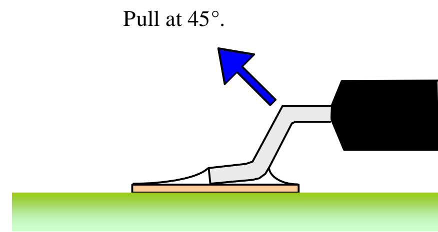
4. Reflow condition

Heat source :	Far infrared + Hot air convection
Zone structure :	3 pre-heat zones + 1 reflow zone
Atmosphere :	Air
Temperature profile :	

Pre-heat zones	Peak temp.	Time over 220°C
140 - 160°C × 78 sec.	235°C	25sec.

5. Bonding strength measurement condition

Measurement equipment : Model SS-30WD
Number of measurement : 60 pins per item
Pull speed : 1.0mm/sec.



6. Thermal shock test condition

- 30°C ~ +85°C (30 cycles per condition) × 500 cycles

• Test results

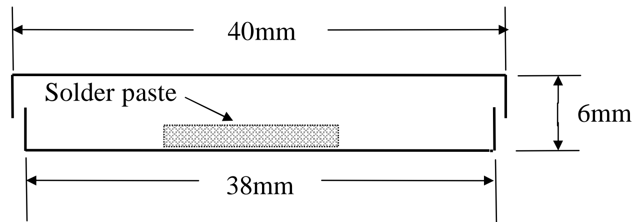
Peel-off strength test

Initial value (no thermal shock)	After thermal shock treatment
2.12 kg	2.06

10. COPPER PLATE CORROSION

• Test method

Prepare 6 pcs. of phosphorus deoxidized copper plate of 50×50×0.5tmm in size (JIS -H-3100). Bend 3 of them at right angles at 5mm (copper plate A), and the rest at 6mm (copper plate B) from both edges to form three open ended boxes.



After removing grease from the both copper plate A and B with acetone, soak them in 5% sulfuric acid for 1 minute and in ammonium persulfate solution (solution which contains 25% of ammonium persulfate in 0.5% of sulfuric acid) for 1 minute to etch the surface uniformly. After washing them with running water , soak in 5% sulfuric acid for 1 minute and rinse thoroughly with running tap water and demineralised water. Then finally, rinse them with acetone and dry.

Obtain the test pieces by printing solder paste on the copper plate B with a 0.2mm thick stencil provided with a 6.5mm diameter aperture.

Place all three copper plates A over the copper plates B and lower each box in a horizontal position onto the surface of the solder bath at a temperature of 235±2°C and maintain the test pieces in this position for 5 seconds.

Remove each test piece from the solder bath and allow it to cool in a horizontal position down to room temperature. Place all three boxes in the thermohygrostat under the condition of 40±2°C, 90~95%RH for 72 hours.

Remove the boxes from the thermohygrostat and inspect the inside surfaces of the boxes (including the lid) for possible corrosion.

• Test result

Solde paste	n	Copper plate A	Copper plate B
SXA48-M301-3	1	No corrosion	No corrosion
	2	No corrosion	No corrosion
	3	No corrosion	No corrosion
SXA48-M301-3L	1	No corrosion	No corrosion
	2	No corrosion	No corrosion
	3	No corrosion	No corrosion

11. SURFACE INSULATION RESISTANCE

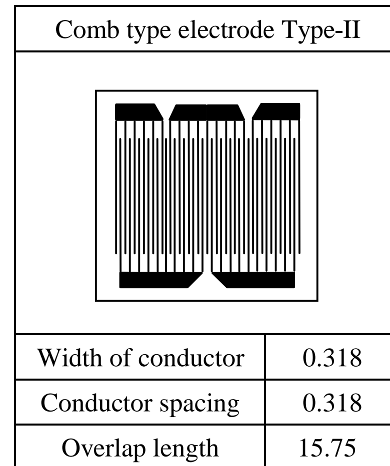
• Print the solder paste with a 0.1mm thick stencil on a comb type electrode type-IIspecified in JIS-Z-3197 6.8. and reflow them to obtain the test piece.

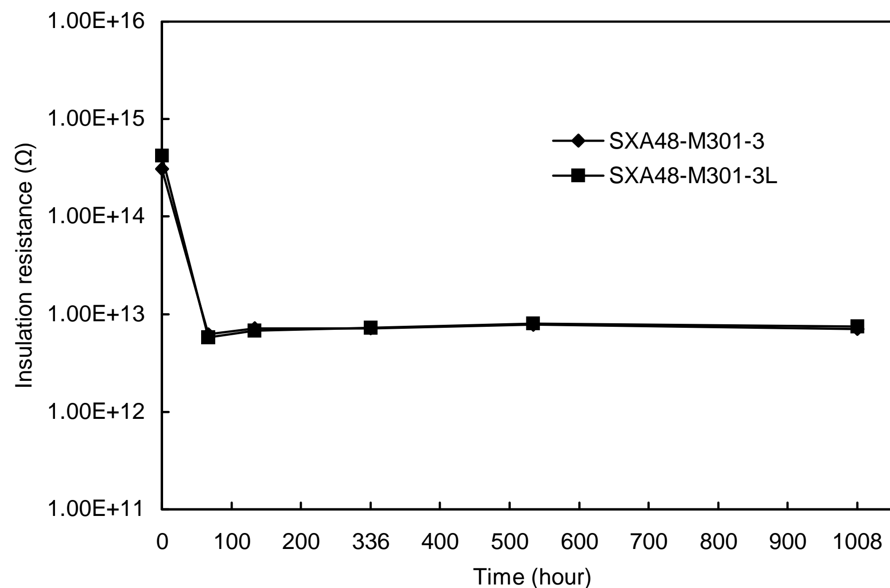
Put the test piece in a thermohygrostat under the conditions of 85±2 °C and 85±2%RH.

Measure the insulation resistance at every specific time taking the test pieces out of the thermohygrostat. DC100V for the measurement.

• Test result

Time (hour)	S.I.R. Value (Ω)	
Product	**SXA48-M301-3**	**SXA48-M301-3 L**
Initial value	3.1×10^{14}	4.2×10^{14}
96	6.2×10^{12}	5.8×10^{12}
168	7.2×10^{12}	6.8×10^{12}
336	7.2×10^{12}	7.3×10^{12}
504	7.8×10^{12}	8.0×10^{12}
1008	7.1×10^{12}	7.5×10^{12}

Comb type electrode Type-II	
	
Width of conductor	0.318
Conductor spacing	0.318
Overlap length	15.75



12. VOLTAGE APPLIED SIR
(Electromigration Test)

• Test method

Print the solder paste with a 0.1mm thick stencil on a comb type electrode Type-II specified in JIS-Z-3196 6.8. and reflow them to obtain the test pieces.

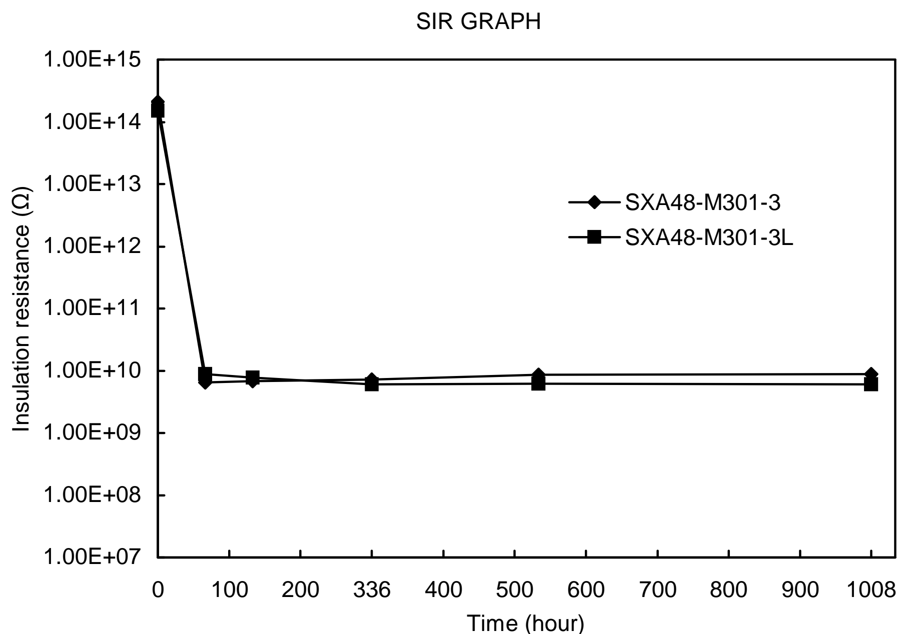
Put the test pieces in a thermogygrostat under the conditions of 85±2 °C and 85±2%RH.

Measure the insulation resistance at every specific time keeping the test pieces in the thermohygrostat and apply DC50V. Apply 100V for the measurement.

• Test result

		Average (Ω)	
Time (hour)	Place measured	**SXA48-M301-3**	**SXA48-M301-3L**
Initial value	Out thermohygrostat	2.1×10^{14}	1.5×10^{14}
96	In thermohygrostat	6.5×10^{9}	8.8×10^{9}
168	In thermohygrostat	6.8×10^{9}	7.8×10^{9}
336	In thermohygrostat	7.2×10^{9}	6.0×10^{9}
504	In thermohygrostat	8.6×10^{9}	6.2×10^{9}
1008	In thermohygrostat	8.8×10^{9}	6.1×10^{9}

² There was no evidence of electromigration.



13. USE OF KOKI SOLDER PASTE

In order to optimise the use of KOKI SOLDER PASTE, please refer to the following guidelines carefully before use.

1. Preparation for printing

1) Temperature

After taking the solder paste from the refrigerator, in which the temperature is controlled to between 5 - 10°C, allow the paste temperature to return to ambient.

*Caution : Do not open the jar while it is cold, as it causes condensation moisture on the paste, and could be the cause of poor performance, such as an increase in viscosity, solder balling etc.

Do not under any circumstances heat the paste prior to use.

2) Stirring

By using a stainless steel or chemically resistive plastic spatula, fold the paste before use.

It is recommended to fold it for at least 1~2 min. to obtain a uniform and stable viscosity.

*Caution : When automatic stirring equipment is used, do not stir the paste for longer than 4 min.

2. Printing

1) Recommended printing parameters

(1) Squeegee

1. Kind : Flat
2. Material : Rubber or metal blade
3. Angle : 80~90°(rubber) or metal blade
4. Pressure : Lowest.
5. Squeegee speed : 10~100mm/sec.

(2) Stencil

1. Thickness : 200~120μm for 0.65~0.4mm pitch pattern
2. Snap-off distance : 0~0.5mm

*Although on-contact (0mm snap-off) is normally recommended for fine pitch printing, if the printing equipment is not provided with a stencil separation speed control system, proper snap-off distance is necessary to ensure smooth and gradual separation of the stencil from the substrate to ensure good solder paste deposits.

3. Fixing method of substrate : It is recommended to have a fixture or vacuum system to hold the substrate in position during printing to prevent movement of the PC board and to have a good separation from the stencil.
4. It is strongly recommended to set the stencil separation speed as slow as possible.

(3) Ambient

1. Temperature : 25 ± 5°C
2. Humidity : 40~60%RH
3. Climate control : Air flow seriously affects stencil life and tack performance of solder pastes.

*Caution : When local air conditioner is equipped, make sure it is not enhancing the drying out of the solder paste.

(4) Printing

1. Initial quantity of solder paste to put on the stencil shall be decided according to the size of the stencil, blade or squeegee and the PC board.

   Ex. Size of PC board. A5 - approx. 200gs
   B5 - 300gs
   A4 - 400gs

   *In order to ensure good rolling of the paste across the stencil and easy separation from squeegees, a certain amount of solder paste is required throughout the printing process.

2. Add paste to replenish only the consumed amount.

   *Minimise the amount of paste left on the stencil as degradation is accelerated once it is processed on the stencil.

3. After a certain number of continuous prints, thoroughly clean the bottom side or both the top and bottom side of the stencil – the number of prints will vary depending on individual set-ups.
4. Clean both the top and bottom side of the stencil before every break.
5. Do not return the used paste into the original jar in order to prevent mixture and contamination of the fresh paste, but put it in a separate container for re-use, if necessary.

3. Reflowing

(°C)
250
200
150
100
50
Pre-heat temp.
150~180°C 60~20sec.
Peak temp.
235~240°C
60 120 180 240 300
(sec.)

4. Storage

Store in a refrigerator at 5 ~ 10°C.

DO NOT FREEZE!

5. Shelf life

1) 5 ~ 10°C : 6 months from manufacturing date
2) At 20°C : 1 month from manufacturing date
3) At 30°C : 1 month from manufacturing date

* Manufacturing date can be obtained from the lot number

ex. **Lot No. 1 07 21 2**

No. of lot : 2nd
Date : 21st
Month : July
Year : 2001