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Lead Free SOLUTIONS you can TRUST

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#60011E
Rev. 2
July.7, 2022

Koki no-clean LEAD FREE solder paste

Contents

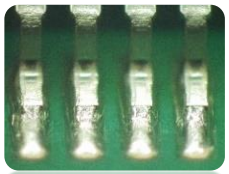
Multi-feature Lead-free Solder Paste
S3X58-HF1100-3

Halogen Free HF

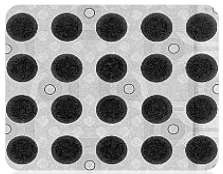
Product Information

Consistent Printing

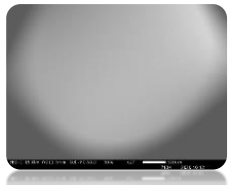
Powerful Wetting



Low Voiding



Super-Low Flux Spattering



Disclaimer

This Product Information contains product performance assessed strictly according to our own test procedures and is not the guaranteed result at end-users. Please conduct thorough process optimization before mass production application.

S3X58-HF1100-3

Contents

Feature

- Solder alloy composition： Sn3.0Ag0.5Cu
- Exhibits excellent print quality response with >1hour stencil idle time
- Powerful wetting as good as Halogen containing solder paste
- Succeeded to drastically mitigate flux splattering
- Realizes low voiding with BTCs (e.g., Pw.Tr., QFN, LGA) and BGA
- Comply with Halogen Free standard (Cl+Br = 0ppm): BS EN14582
  No artificial addition of any halogen element
- Flux type: ROL0 (Cl+Br+I+F = <0.05% / IPC J-STD-004B and 004C)
- RoHS, REACH compliant product

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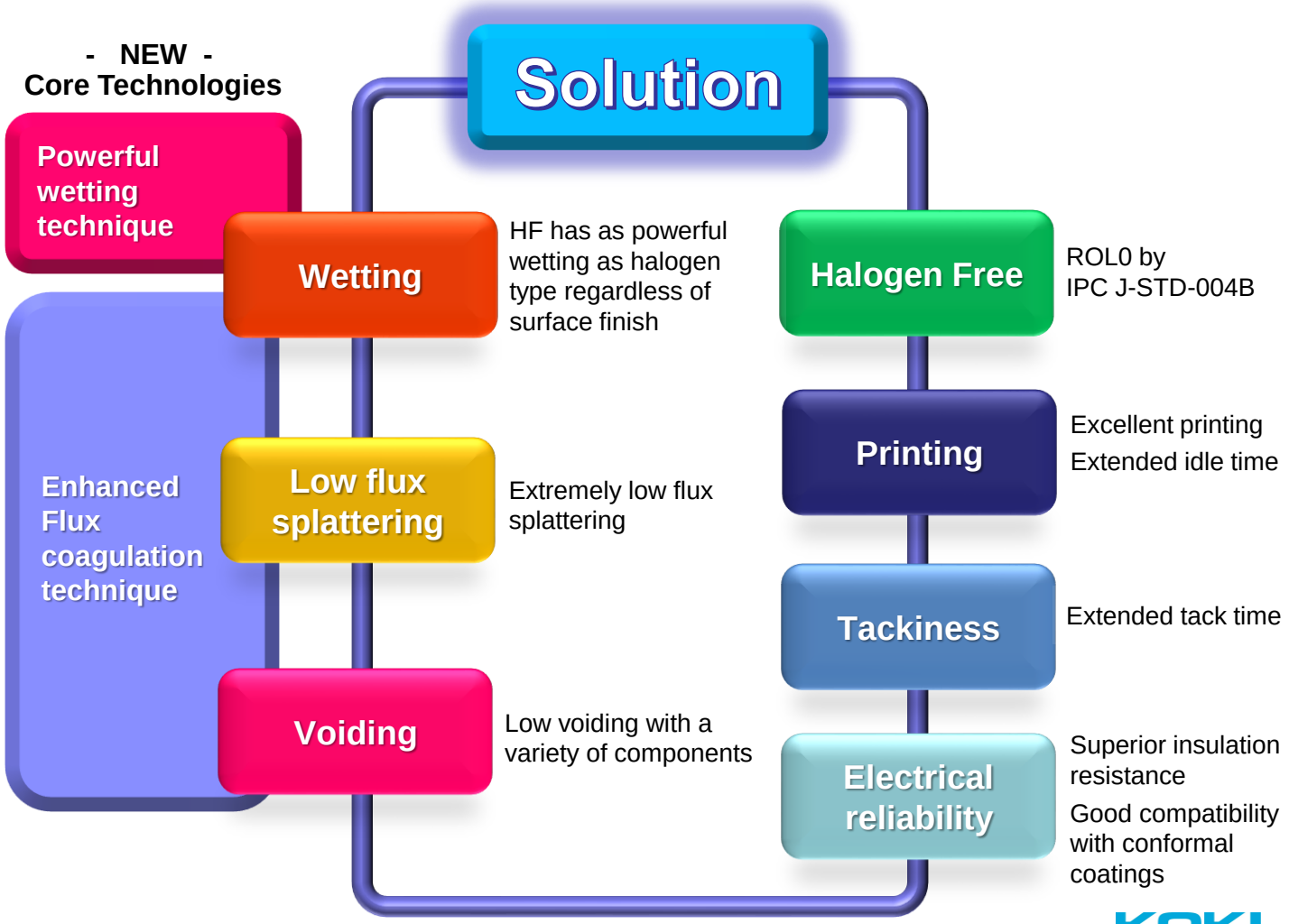
Feature – Integration of various features



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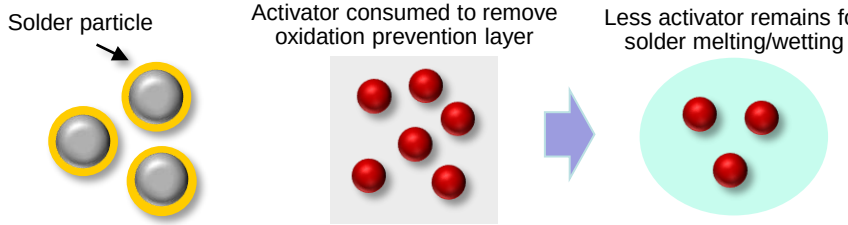
Feature – POWERFUL wetting technique

In order for **S3X58-HF1100-3** to exert effective solder meltability under various conditions, the following effects are included in its flux formulation;

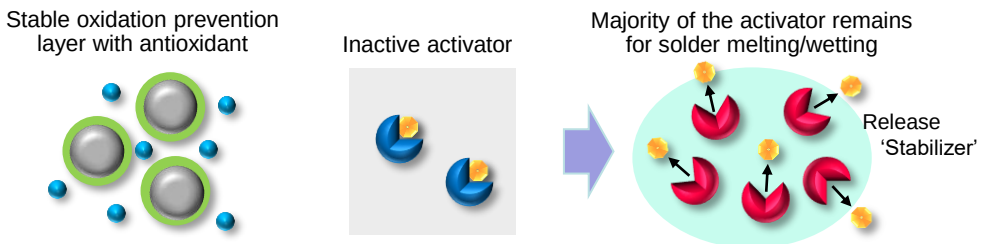
1) Protection of solder particles from oxidation by a coating effect
2) Swift removal/reduction of oxide film from the surface of the solder particle, component and PC board
3) Enhancement of dynamic flow of molten solder

Conventional flux formulation



Considerable activator is consumed to remove the thick oxidation prevention layer. Subsequently limited activator remains for wetting/melting.

S3X58-HF1100-3 / New flux formulation



Solder particles are protected from being oxidized by an easy-to-remove protective layer and the antioxidant suppresses continued oxidation over time. Such effects help save the amount of activator needed for oxidation prevention, as well as the activator capping technique which allows maximum activation strength when the solder is molten.

- Oxidation prevention layer → requires considerable activation to remove thick layer
- Primary oxidation prevention layer easily removable but prone to be oxidized
- Activator to remove oxidation prevention layer and enhance wetting strength
- Secondary antioxidant traps O_2 that continues being generated over time
- Activator with 'Stabilizer' keeps activator inactive at room temp. and turns active by releasing 'Stabilizer' only when heated

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Feature – Enhanced flux COAGULATION technique

Flux formulation of **S3X58-HF1100-3** is specifically designed to exhibit enhanced flux coagulation at the time when the solder starts to melt.

Instant coagulation and evacuation of the liquified flux when the solder gets molten, brings about various benefits in soldering performance.

- **Solder wetting/ spreading**

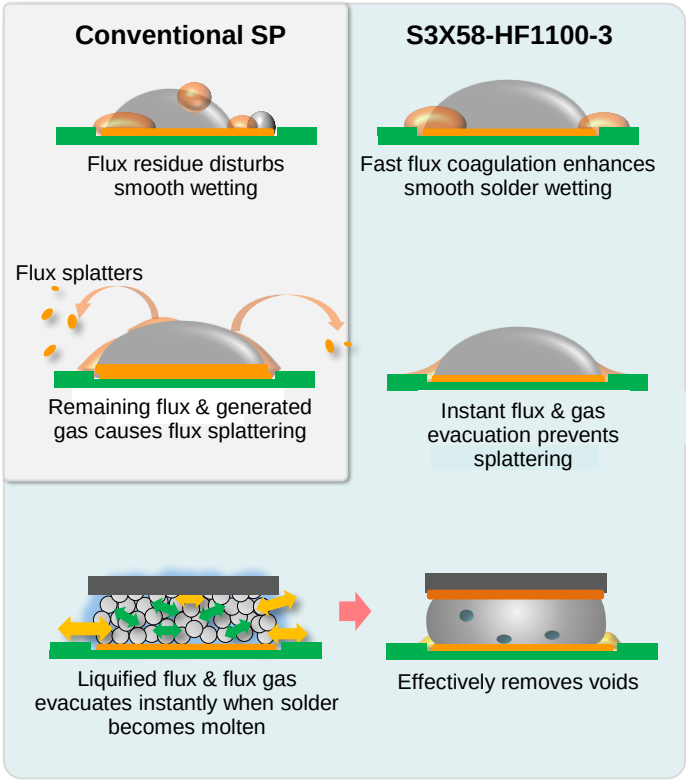
  As the flux evacuates out of the molten solder, it does not prevent the solder to wet/spread.

- **Reduction of flux splattering**

  Swift evacuation of the liquified flux out of the molten solder effectively reduces the chance of flux splattering.

- **Lower voiding**

  Swift coagulation and evacuation of the liquified flux carries flux gas out of the molten solder and leaves less remaining flux residue that could be a source of void generation.



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Specification

Purpose		Printing
Product Name		S3X58-HF1100-3
Alloy Property	Alloy Composition (%)	Sn3.0Ag0.5Cu
	Melting Point (ºC)	217 - 219
	Powder Shape	Spherical
	Grain Size (µm)	20 - 38
Flux Property	Halide Content (%)	0
	Flux type*1	ROL0
Solder Paste Property	Flux Content (%)	11.7±1.0
	Viscosity *2 (Pa.s)	190±30
	Copper Plate Corrosion*3	Passed
	Tack Time	≥ 72 hours
	Shelf Life (below 10ºC)	6 months

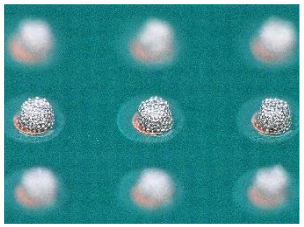
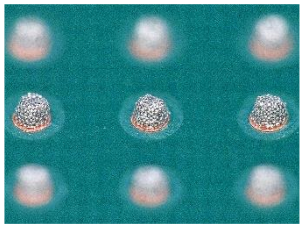
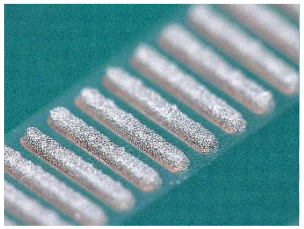
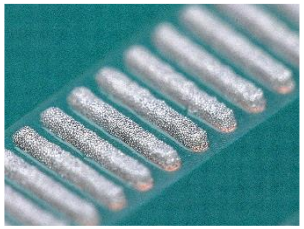
*1. Flux Designation: In accordance with IPC J-STD-004B and 004C
*2. Viscosity: Measured by Malcom viscometer at 10 rpm at 25ºC.
*3. Copper Plate Corrosion: In accordance with IPC TM650-2.6.15

Contents

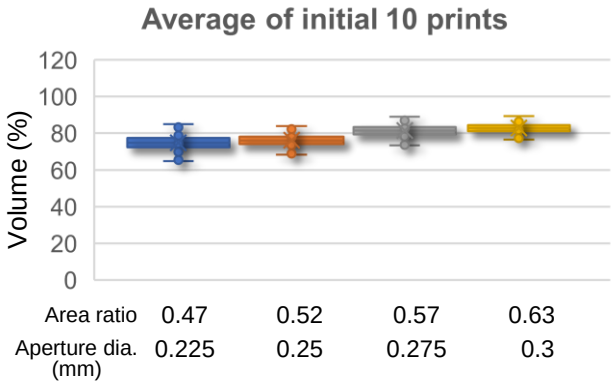
Printability - Continual printing

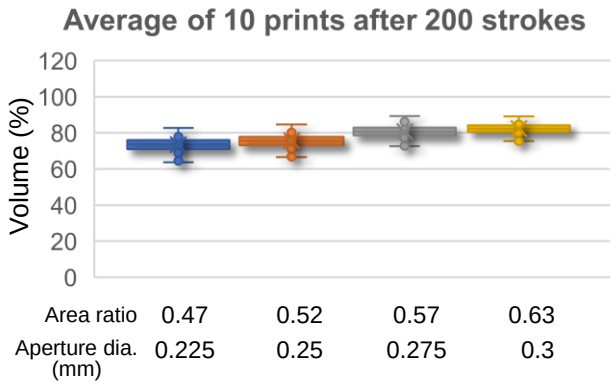
Test Condition

- Printer: Model YVP-Xg YAMAHA Motor
- Squeegee: Metal, 55º angle
- Stencil: 0.12 mm thick, laser
- Print speed: 40 mm/sec
- Atmosphere: 24~26ºC (40~60%RH)
- Pattern: 0.25 mm dia. CSP, 0.4 mm pitch QFP

	1st print	After 200 strokes 10th print
CSP 0.25 mm dia. Area ratio: 0.52		
QFP 0.4 mm pitch (L/S=0.2/0.2) Area ratio: 0.74		

Area ratio = Aperture area / Aperture wall area





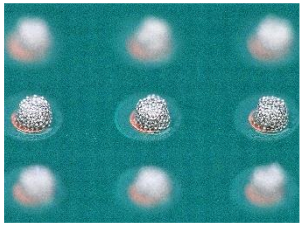
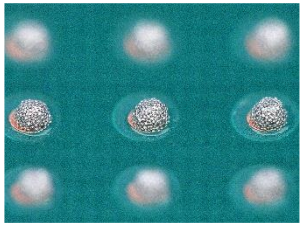
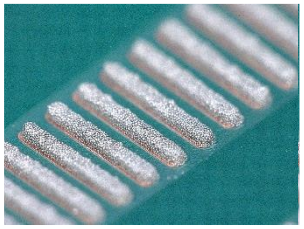
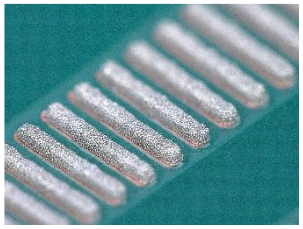
➢ Consistent print quality with good printed paste shape even with area ratio ≥0.52.

Contents

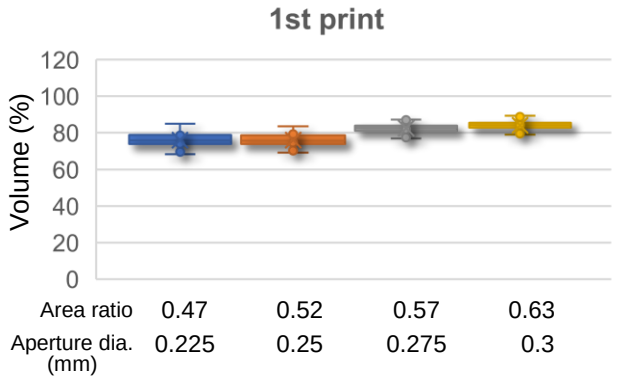
Printability - Intermittent printing

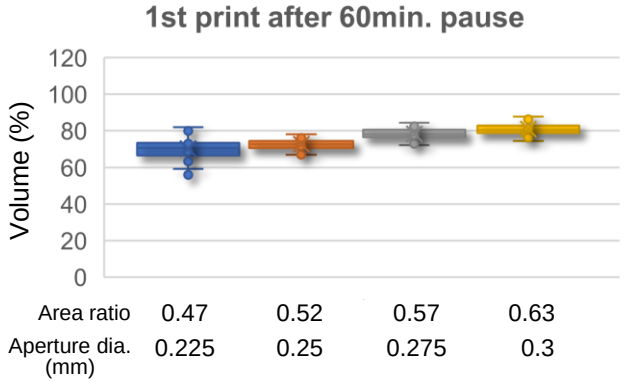
Test Condition

- Printer: Model YVP-Xg YAMAHA Motor
- Squeegee: Metal, 55º angle
- Stencil: 0.12 mm thick, laser
- Print speed: 40 mm/sec
- Atmosphere: 24~26ºC (40~60%RH)
- Pattern: 0.25 mm dia. CSP, 0.4 mm pitch QFP

	1st print	1st print after 60 min. pause
CSP 0.25 mm dia. Area ratio: 0.52		
QFP 0.4 mm pitch (L/S=0.2/0.2) Area ratio: 0.74		

Area ratio = Aperture area / Aperture wall area





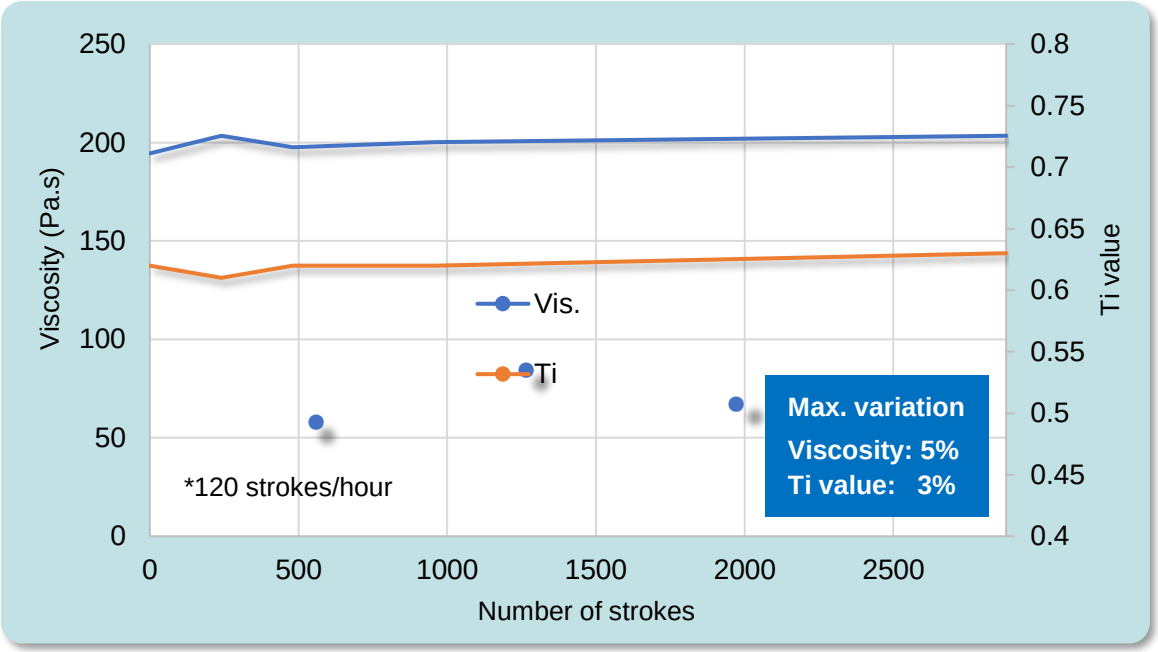
➢ Consistent paste transfer volume from the initial paste print even after 60 min. pause even with area ratio ≥0.52.

Viscosity stability - During continual paste printing

Test condition

Print (knead) solder paste on the sealed-up stencil continually for 24 hours to observe viscosity variation.

- Squeegee: Metal blades
- Squeegee angle: 55°
- Squeegee speed: 20 mm/sec.
- Print stroke: 300 mm
- Printing environment: 24~26 °C, 40~60%RH



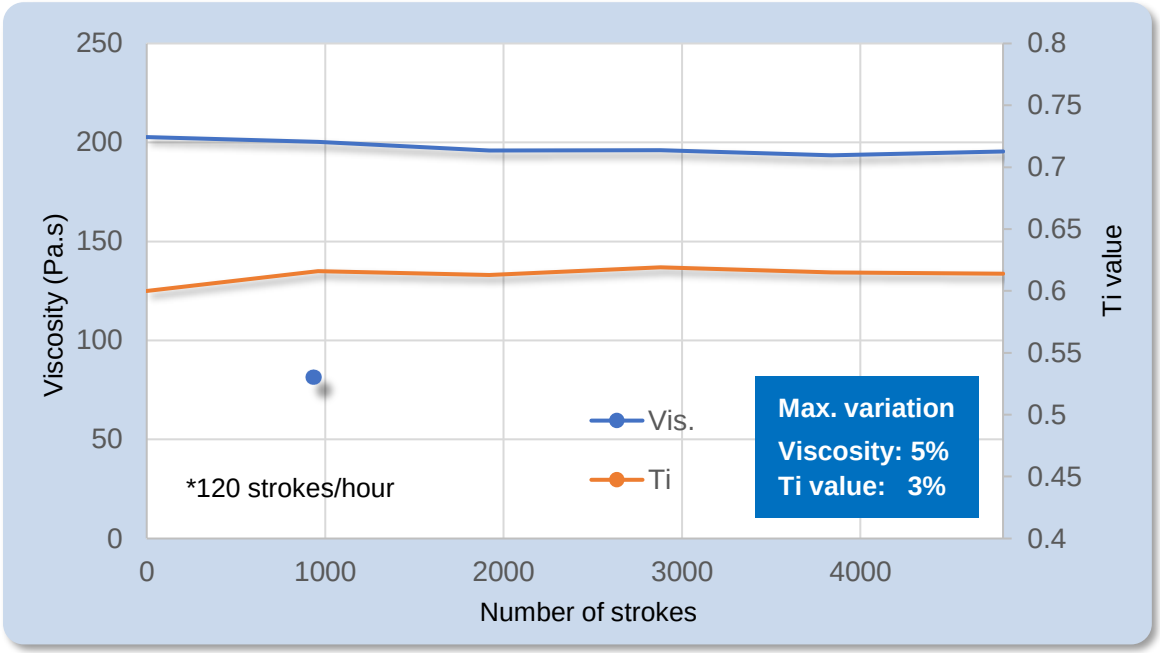
➢ Activator stability technology ensures minimal variation of rheology (viscosity & thixotropy) in continual printing.

Viscosity stability – During paste replenishment

Test condition

Print (knead) solder paste on the sealed-up stencil continually up to 40 hours to observe viscosity variation.

- Squeegee: Metal blades
- Squeegee angle: 55°
- Squeegee speed: 20 mm/sec.
- Print stroke: 300 mm
- Printing environment: 24~26 °C, 40~60%RH
- Half of the solder paste on the stencil was replaced with fresh solder paste after every 960 strokes (8 hours) of kneading up to 4,800 strokes (40 hours)

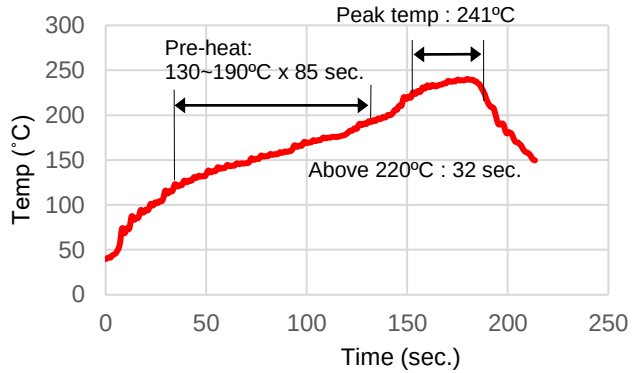


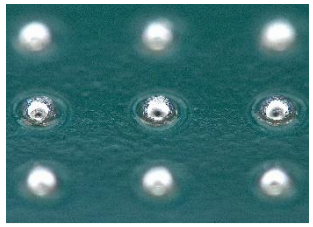
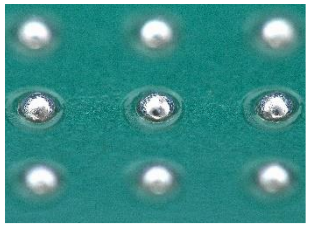
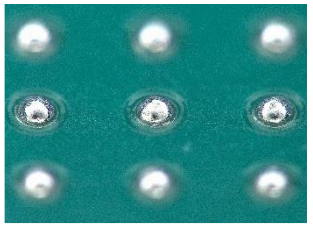
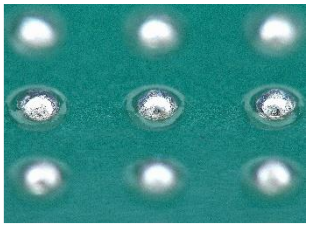
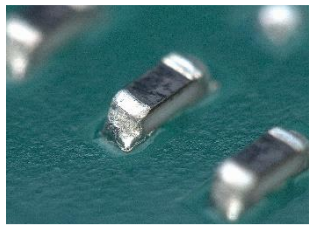
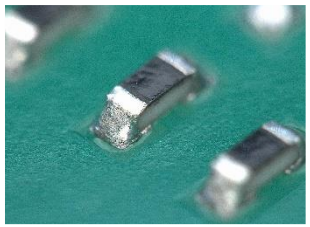
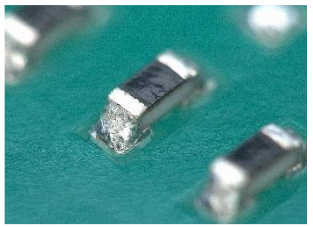
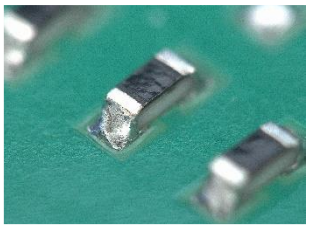
➢ Continual paste print strokes with periodical paste replenishment resulted in stable rheology (viscosity and thixotropy).

Meltability – Fine pattern

Test condition

- Material: Glass epoxy FR-4
- Surface finish: OSP, ImSn, ImAg, ENIG
- 0603chip: 100% Sn plated
- Stencil thickness: 0.12 mm (laser cut)
- Pad size: 0.25 mm dia.,
- 0603 metric chip pattern
- Stencil aperture: 100% aperture opening to pad
- Heat source: Hot air convection
- Atmosphere: Air



	OSP	ImSn	ImAg	ENIG
CSP 0.25 mm dia.				
0603R				

➢ Regardless of the type of surface finish, the solder coalesced completely and caused no unmolten solder particles.

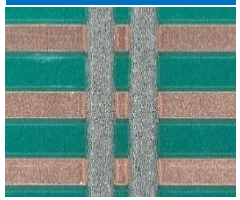
Contents

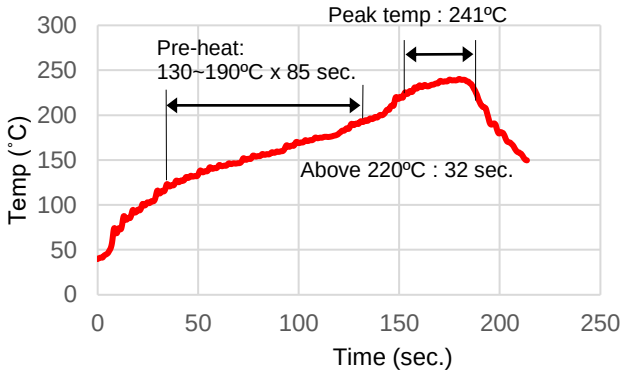
Meltability – Solder spreading / Coagulation

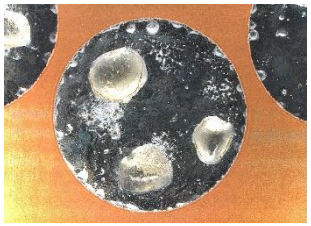
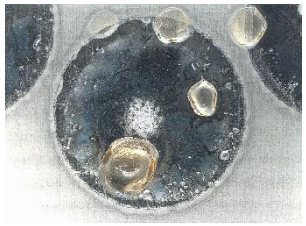
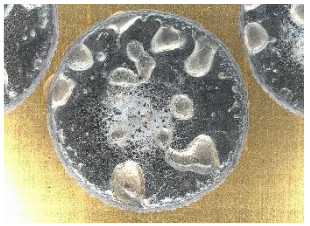
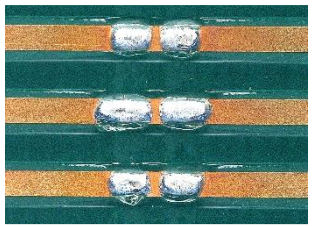
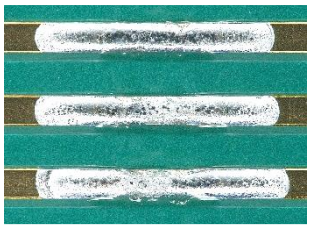
Test condition

- Material: Glass epoxy FR-4
- Surface finish: OSP, ImSn, ImAg, ENIG
- Stencil thickness: 0.12 mm (laser cut)
- Stencil aperture: 100% aperture opening to pad
- Heat source: Hot air convection
- Atmosphere: Air

Cross-print Print condition





	OSP	ImSn	ImAg	ENIG
Spreading 6.5 mm dia.				
Coagulation Cross-print				

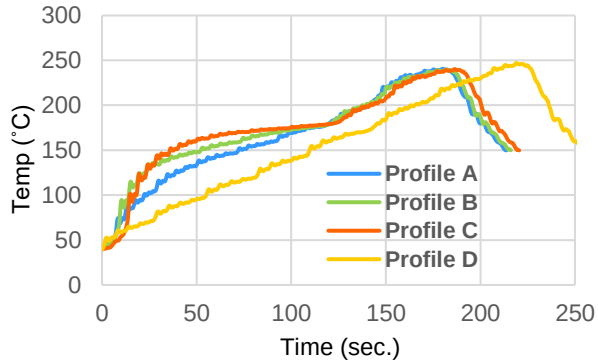
➢ Regardless of the type of surface finish, the solder spread well and no solder balls were left in-between tracks after coagulation.

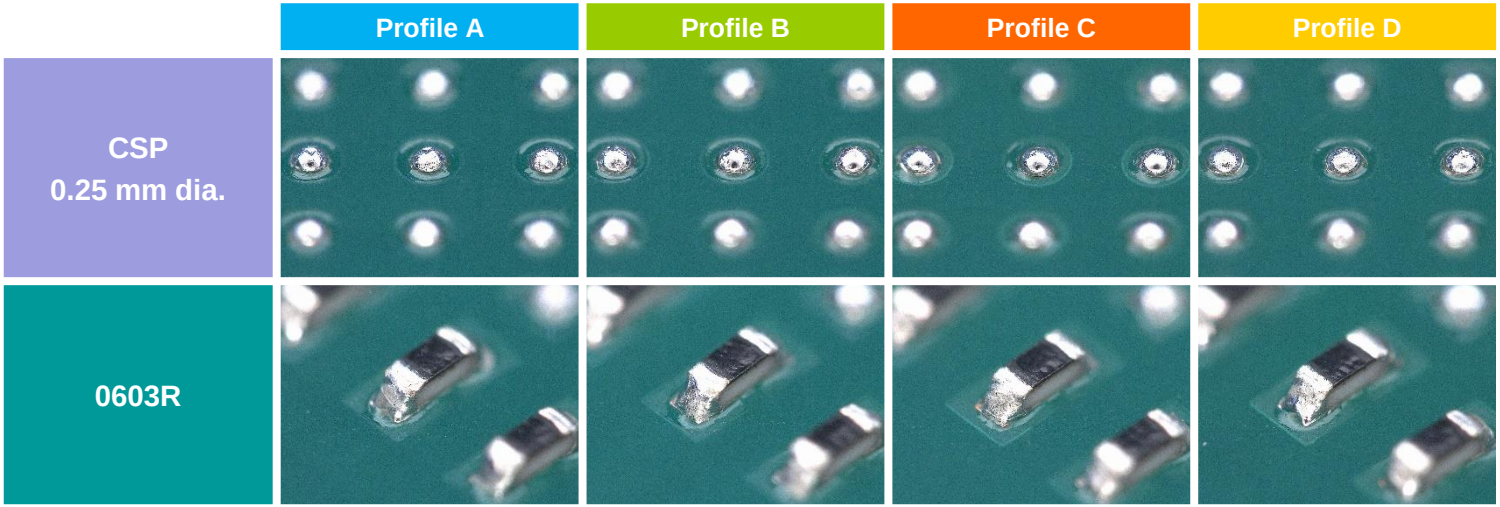
Meltability – Reflow profile dependency – Fine pattern

Test condition

- Surface finish: OSP
- Other conditions: Refer to “Meltability – Fine pattern”

	Profile A	Profile B	Profile C	Profile D
Pre-heating	130-190 ºC 85 sec.	150-190 ºC 75 sec.	150-190 ºC 96 sec.	100-190 ºC 96 sec.
Peak temp.	241 ºC	240 ºC	240 ºC	247 ºC
Time ≥220ºC	32 sec.	32 sec.	41 sec.	35 sec.





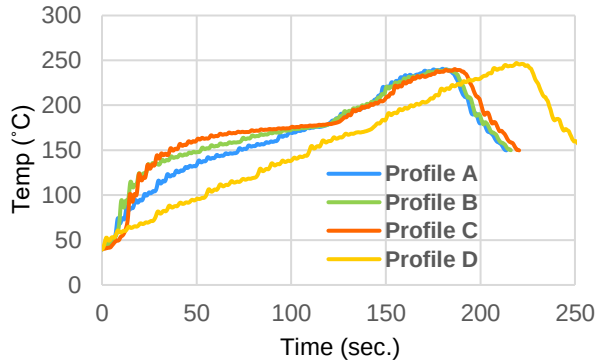
➢ **S3X58-HF1100-3** shows good meltability without dependency on the type of reflow profile used.

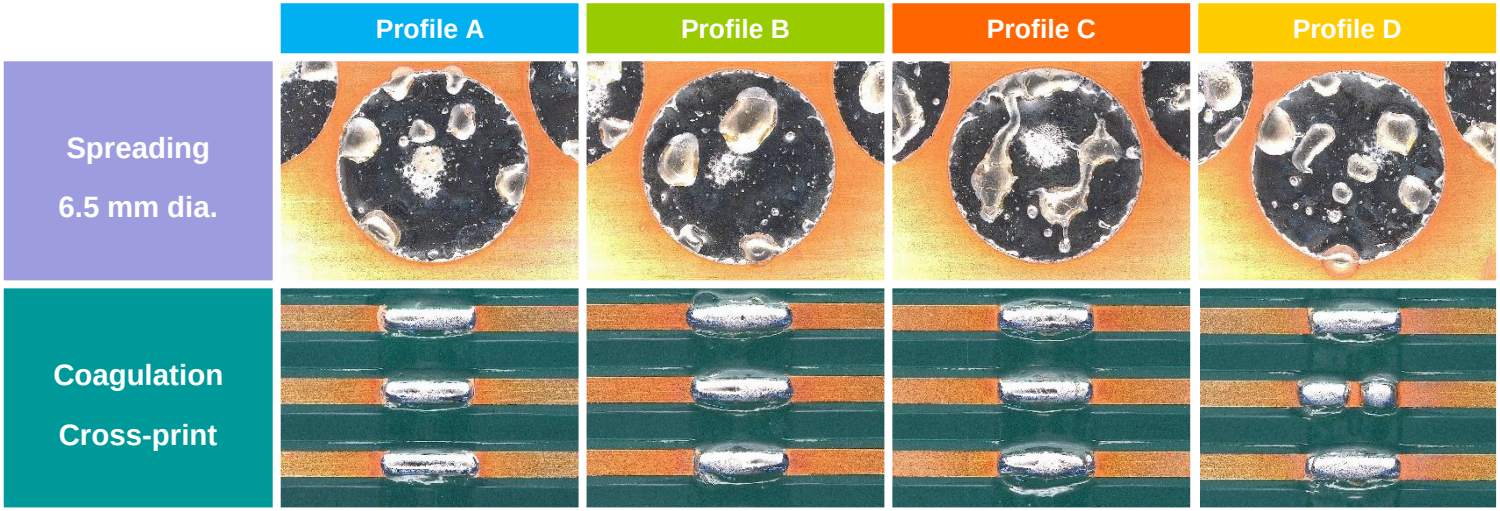
Meltability – Reflow profile dependency – Spreading / Coagulation

Test condition

- Surface finish: OSP
- Other conditions: Refer to “Meltability – Fine pattern”

	Profile A	Profile B	Profile C	Profile D
Pre-heating	130-190 ºC 85 sec.	150-190 ºC 75 sec.	150-190 ºC 96 sec.	100-190 ºC 96 sec.
Peak temp.	241 ºC	240 ºC	240 ºC	247 ºC
Time ≥220ºC	32 sec.	32 sec.	41 sec.	35 sec.





➢ **S3X58-HF1100-3** resulted in good spreading and no solder balls were left in-between tracks after coagulation without dependency on the type of reflow profile used.

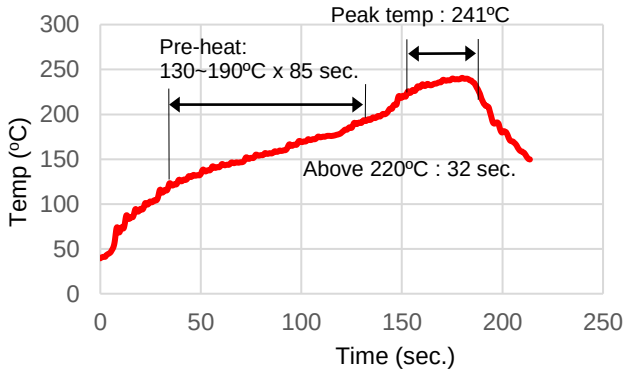
Meltability – Solder dewetting

Test condition

- Material: Cu, Ni, Oxidized Cu*1, C7521*2, Ni/Al
- Stencil thickness: 0.2 mm (laser cut)
- Heat source: Hot air convection
- Atmosphere: Air

*1 Oxidization condition: 150ºC x 16 hrs.

*2 C7521: Nickel Silver(64Cu-18Ni-18Zn)



	Cu	Oxidized Cu	Ni	C7521	Ni/Al
Conventional Solder paste					
S3X58-HF1100-3					

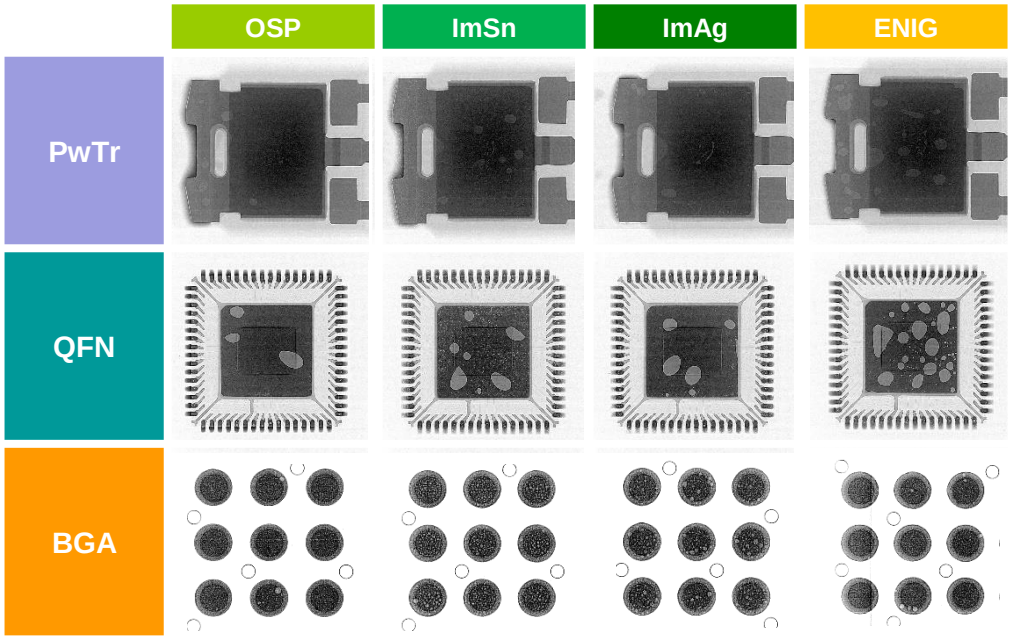
➢ Newly developed powerful activator technology provided excellent solder spreading not only on standard substrates, but also difficult to solder oxidized Cu, C7521 & Al/Ni substrates.

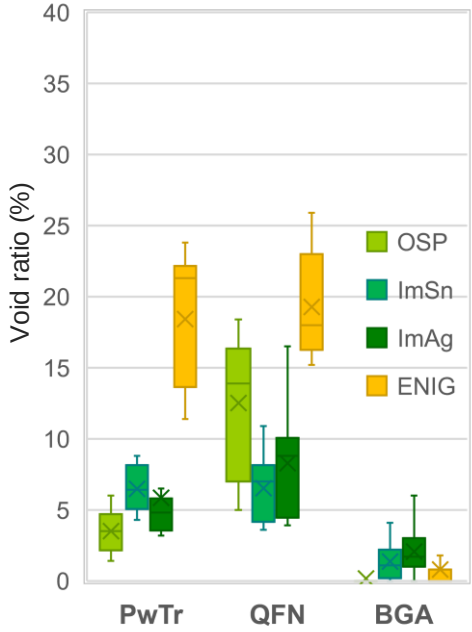
Contents

Voiding

Test condition

- Material: Glass epoxy FR-4
- Surface finish: OSP, ImSn, ImAg, ENIG
- Stencil thickness: 0.12 mm (laser cut)
- Stencil aperture: 100% aperture opening to pad
- Component: 100% Sn plated – PwTr, QFN
  SAC305 - BGA
- Heat source: Hot air convection
- Atmosphere: Air
- Reflow profile: See “Meltability - Fine pattern”





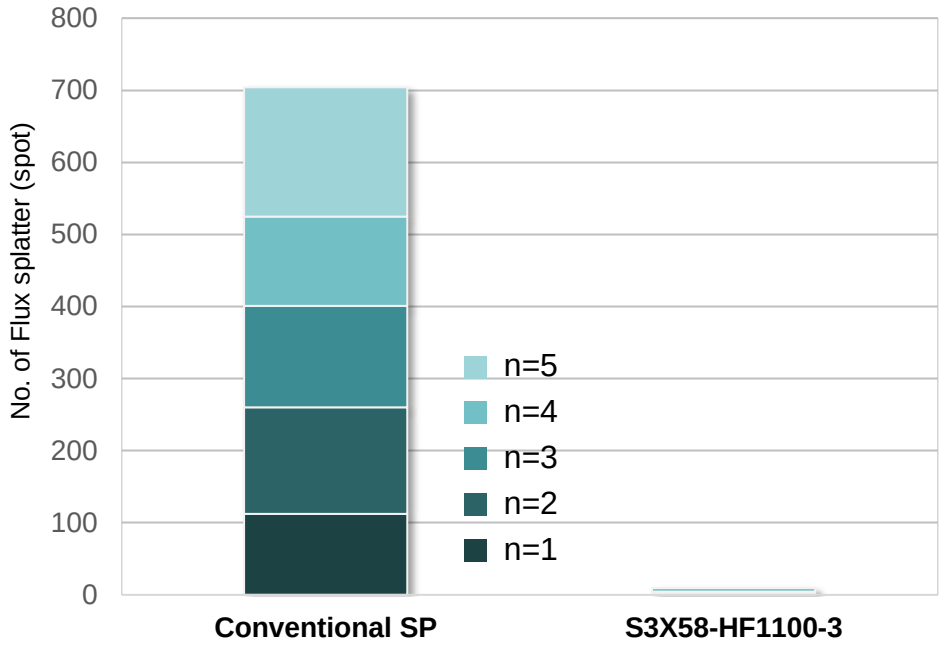
➢ Consistently low voiding is achieved with each type of component and surface finish.

Contents

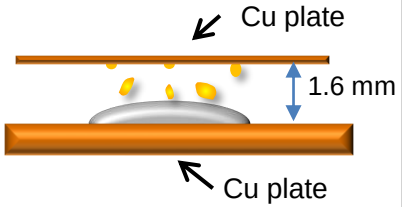
Flux splattering

Test condition

- Material: Phosphorous deoxidized copper (C1220)
- Stencil: 0.2 mm thickness, 6.5 mm diameter
- No. of specimens: n=5
- Reflow profile: See “Meltability - Fine pattern”

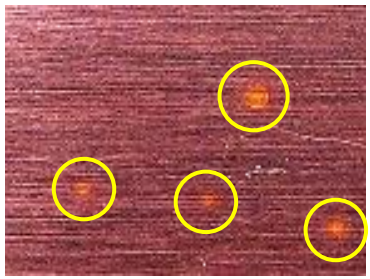


Splatter test



Place Cu plate above deposited solder paste and reflow to allow for attachment of flux splatter.

Count flux splatter number.



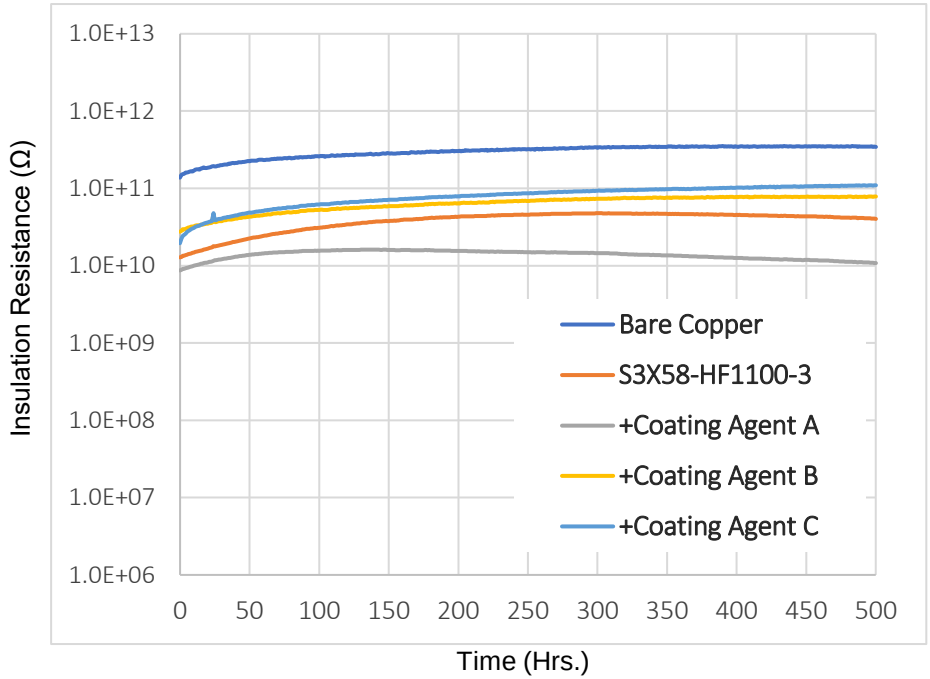
Flux splatter / example

➢ **S3X58-HF1100-3** resulted in **very few flux splatter** while conventional solder paste splattered in high amounts.

Electrical reliability - Electro-chemical Migration (ECM)

Test condition

- Test standard: IPC TM-650 2.6.14.1
- Test coupon: IPC-B-25
- Surface finish: OSP
- Chamber condition: 65ºC / 88.5%RH
- Voltage: Applied 10 V / measurement 100 V
- Reflow: Hot air convection in air atmosphere
- Reflow profile: See “Meltability - Fine pattern”
- Conformal coating: A) Acrylic type
  B) Polyolefin type
  C) Silicone type



$$IR_{avg} = 10^{\left[\frac{1}{N}\sum_{1}^{N}\log IR_i\right]}$$

N = number of test points (10 minimum),

IR_i = individual insulation resistance measurements

Coupon	IR_{avg} (Ω)
Bare Copper (Control)	2.98E+11
S3X58-HF1100-3 only	3.75E+10
+Coating Agent A	1.38E+10
+Coating Agent B	6.29E+10
+Coating Agent C	7.77E+10

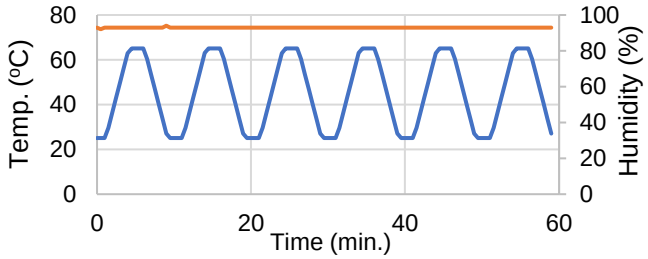
➢ With or without conformal coating applied, **S3X58-HF1100-3** had high insulation resistance.

Electrical reliability – Dew test

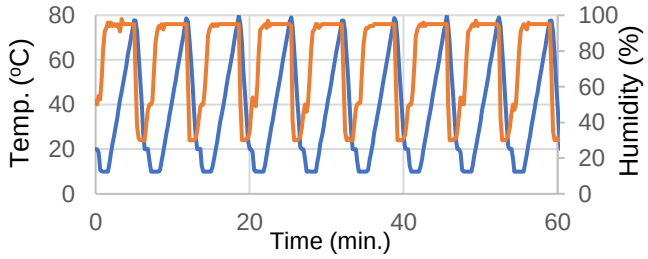
Test condition

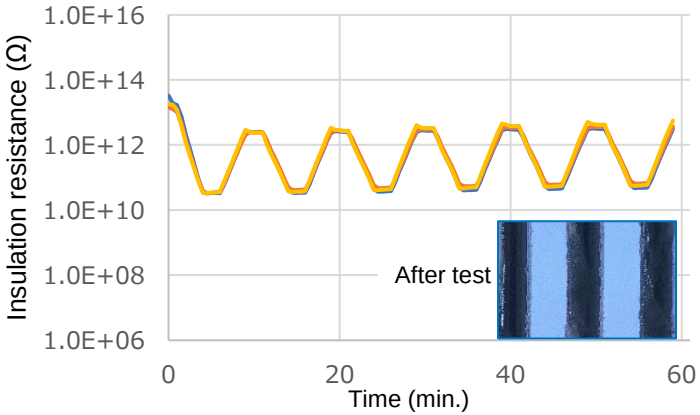
- Test coupon: IPC-B-25
- Surface finish: OSP
- Stencil thickness: 0.15 mm (laser)
- Voltage: Applied 50 V / measurement 50 V
- Reflow: Hot air convection in air atmosphere
- Reflow profile: See “Meltability - Fine pattern”

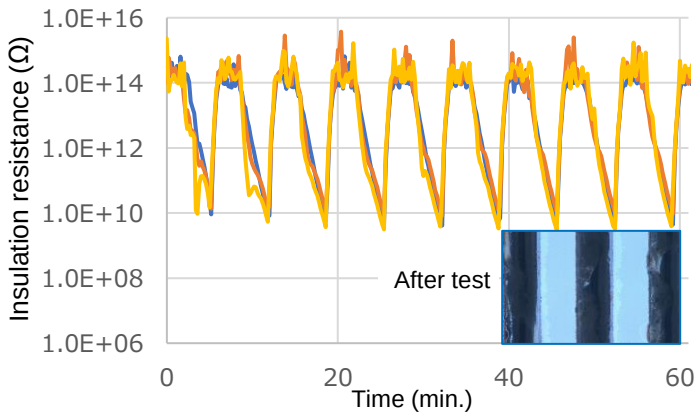
Method A: Chamber condition



Method B: Chamber condition







➢ **S3X58-HF1100-3** showed robust high reliability under harsh conditions, with no evidence of dendrite growth observed.

Halogen content

Measurement Method

Ion Chromatography, Quartz combustion tube

Elements	Results
F	Not detected*
Cl	Not detected
Br	Not detected
I	Not detected

*Not detected: Detection limit <50ppm

➢ **S3X58-HF1100-3** has no addition of any of the halogens and is classified as ROL0 (Cl+Br+I+F = <500ppm according to IPC J-STD-004B).

Contents

General properties

Item	Result	Test Method
Slump properties	**0.3 mm pass**	JIS Z 3284-3 150ºC for 10 min.
Solder ball test	**Category 3**	JIS Z 3284-4
Tack time	**≥ 72 hours**	JIS Z 3284-3
Cu mirror test	**Type L**	IPC-TM-650 2.3.32
Cu plate corrosion test	**No corrosion**	IPC-TM-650 2.6.15
Insulation resistance test	**≥ 1E+11 Ω**	IPC-TM-650 2.6.3.7
Electrochemical migration test	**No evidence of migration**	IPC-TM-650 2.6.14.1

Contents

Handling guide – Recommended print condition

Recommended print condition

1) Squeegee condition

1. Shape	Flat
2. Material	Metal or Urethane blade
3. Angle	50-60º
4. Print pressure	Relatively low (40-60 N)
5. Squeegee speed	20 - 80 mm/sec.

2) Stencil

1. Thickness	0.15-0.10 mm for 0.65-0.4 mm pitch pads
2. Fabrication method	Laser or chemical etch
3. Stencil release speed	7.0-10.0 mm/sec.
4. Snap-off speed	0 mm

3) Usage condition

1.Temperature	23-26ºC
2. Humidity	40-60%RH
3. Air conditioning	Direct air blowing on the stencil will dry the solder paste faster. Adjust the direction of air blowing on the stencil using a shield, etc.

4) Usage Notes

1. Stencil thickness	The maximum recommended stencil thickness is 0.2 mm. A thicker stencil than this may induce the occurrence of solder balling around the solder fillet.
2. Pin-in-Paste	Flux residue may accumulate on the tip of connector pins. It is not recommended to strike the ICT probe at the tip of the connector pins.

Caution: When handling solder paste, personal protective measures as advised by your Health and Safety department should always be adhered to.

Handling guide – Pot life & Shelf life

1. Pot life

1) Once paste has returned to ambient temperature it is fit for use.

2) Once the solder paste is opened, but not kneaded by a spatula nor a mixing machine

→ **Within the remaining shelf life of the product by storing it back in the refrigerator at 0-10ºC.**

3) Once the solder paste is opened and kneaded by a spatula or a mixing machine

→ **Within 1 week to 1 month by storing it back in the refrigerator at 0-10ºC**

4) Once the solder paste is opened, kneaded by a spatula and worked on the stencil with the squeegee blades.

→ **Within 24 hours**

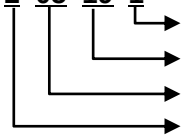
*NOTE: What is described in this guide does not necessarily mean a guarantee of the performance/quality of the solder paste.

2. Shelf life (at 0 ~ 10ºC)

Storage temperature	Package	Shelf life
0 ~ 10ºC	Jar	6 months from manufacturing date
	Cartridges	6 months from manufacturing date

Attention: "Storage temperature" is applicable upon receipt by customer – label information on product also relates to storage conditions of product upon receipt by customer.

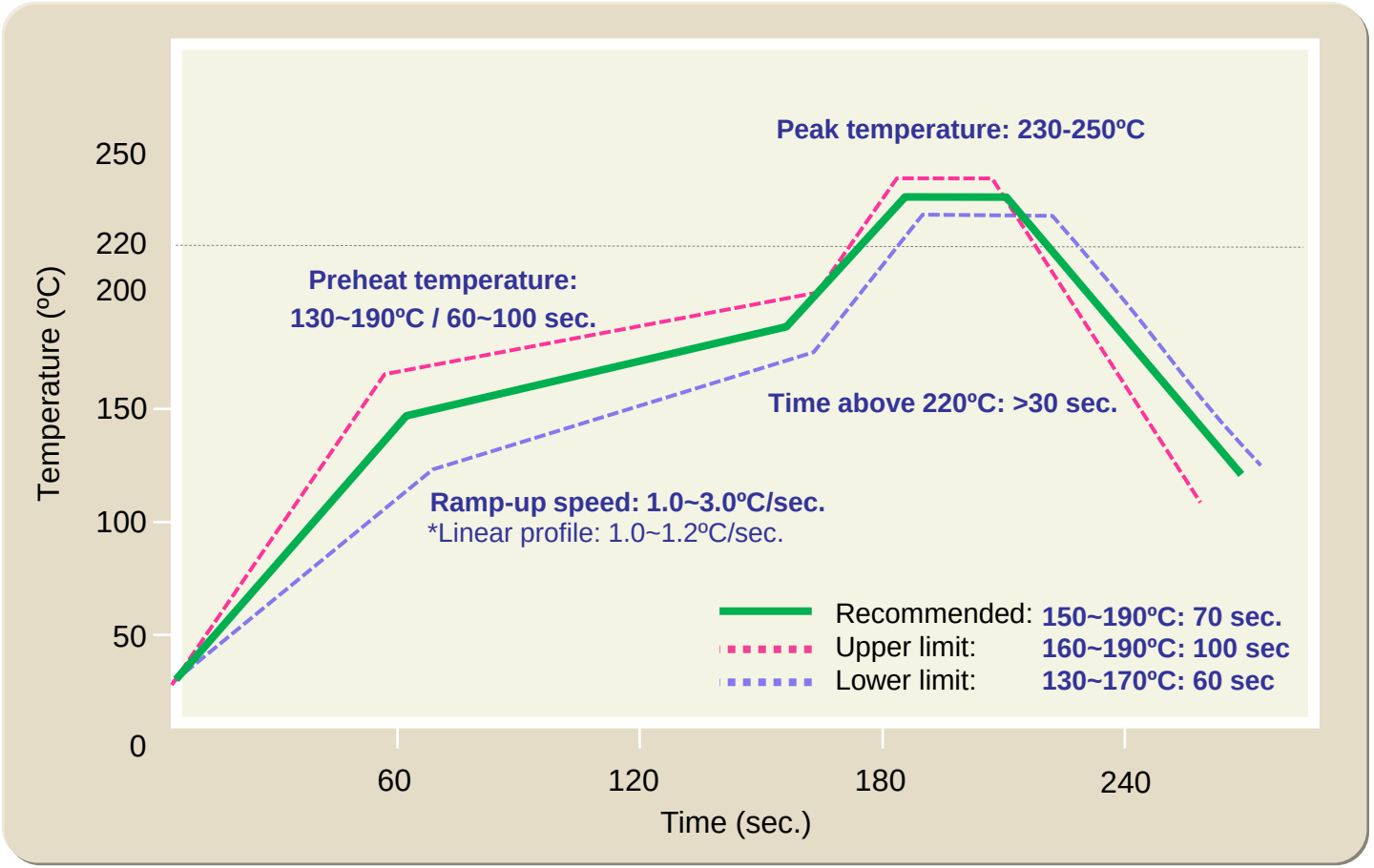
* How to interpret the lot number: e.g. Lot No. **2 05 19 1**



# of production batch:	1st batch
Date of production:	19th
Month of production:	May
Year of production:	2022

Contents

Handling guide – Recommended reflow profile



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Handling guide – Supplemental information