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Koki no-clean **LEAD FREE** solder paste

Multi-feature Halogen Free LF Solder Paste S3X58-HF1100

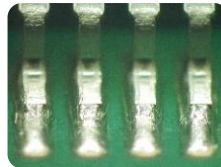


Product Information

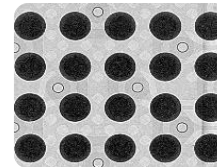
Consistent
Printing



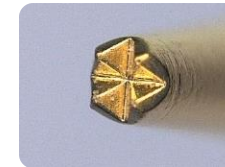
Strong
Wetting



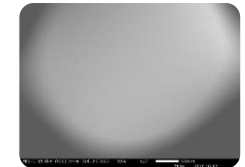
Low Voiding



ICT
Compatible



Super-Low Flux
Splattering



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.



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- 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
- Enables high and consistent first-pass yield at ICT process
- Succeeded to drastically mitigate flux splattering
- Realizes low voiding with BTCs (e.g., PwTr, 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+F+I = <0.05% / IPC J-STD-004B)



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Feature – Integration of various features

- NEW -
Core Technologies

**Powerful
wetting
technique**

**Enhanced
Flux
coagulation
technique**

Solution

Wetting

- HF has as powerful wetting as halogen type regardless of surface finish

**ICT
compatible**

- Secure probe contact and high 1st pass yield

**Low flux
splattering**

- Extremely low flux splattering

Voiding

- Low voiding with variety of components

Halogen Free

- ROL0 by IPC J-STD-004B

Printing

- Excellent printing
- Extended idle time

Tackiness

- Extended tack time

**Electrical
reliability**

- Superior insulation resistance
- Good compatibility with conformal coatings



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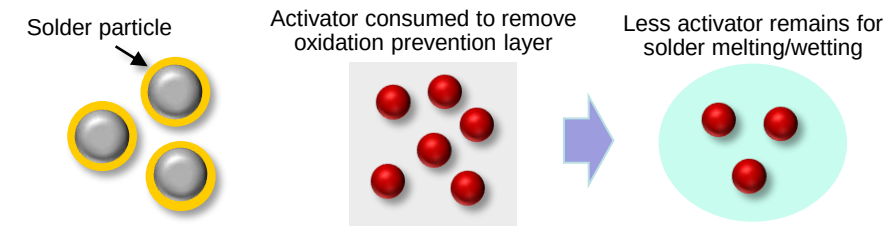
Handling guide

Feature – POWERFUL wetting technique

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

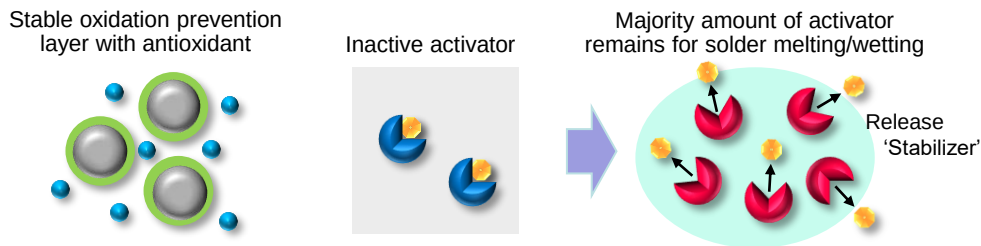
- 1) Protection of solder particles from oxidation by coating effect
- 2) Swift removal/reduction of oxide film from surface of solder particle, component and PC board
- 3) Enhancement of dynamic flow of molten solder

Conventional flux formulation



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

S3X58-HF1100 / 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 O₂ 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** 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.

■ ICT compatibility

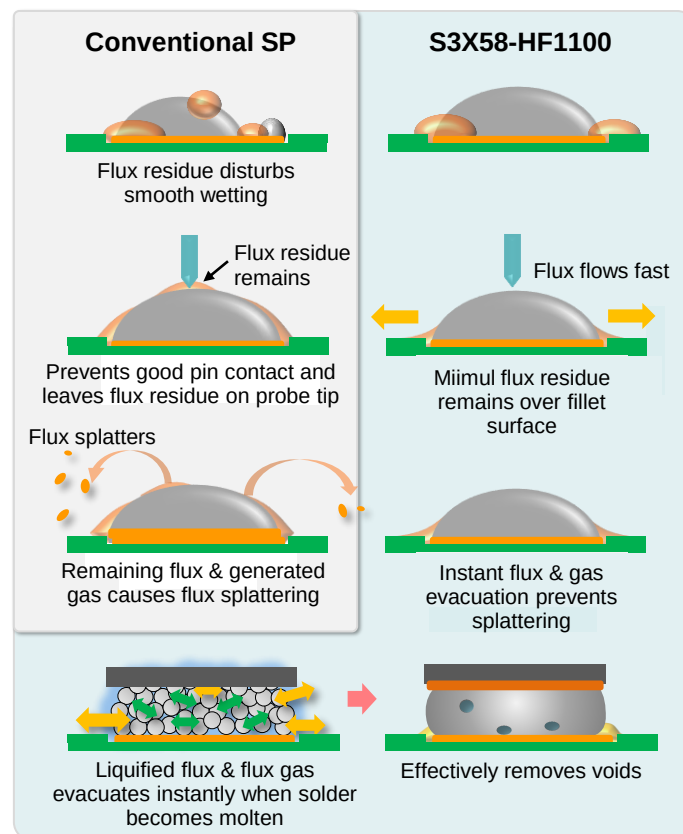
As minimal flux residue remains on the surface of the solder fillet, it ensures easy and secure pin contact.

■ 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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Purpose		Printing
Product Name		S3X58-HF1100
Alloy Property	Alloy Composition (%)	Sn 3.0Ag 0.5Cu
	Melting Point (°C)	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 10°C)	6 months

*1. Flux Designation:

In accordance with IPC J-STD-004B

*2. Viscosity:

Measured by Malcom viscometer at 10rpm at 25°C.

*3. Copper Plate Corrosion:

In accordance with IPC TM650-2.6.15



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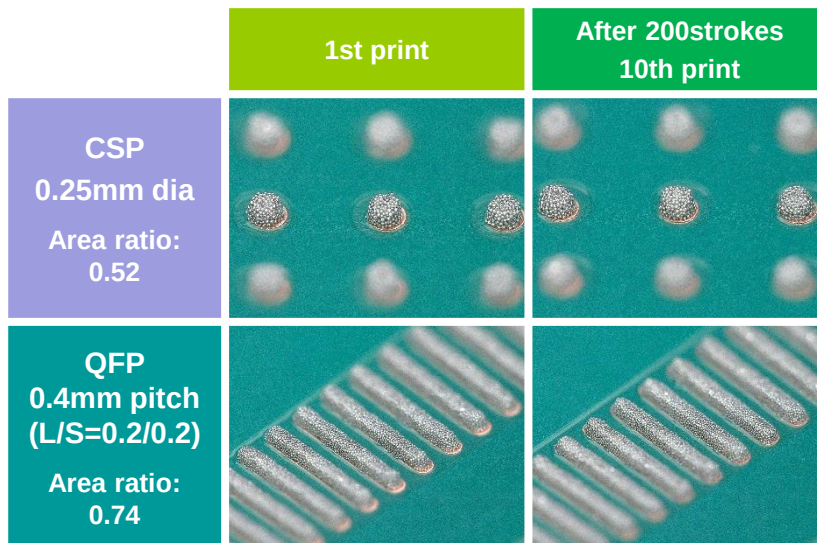
General properties

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Printability - Continual printing

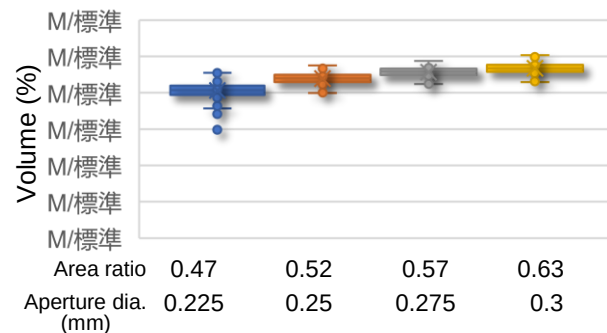
Test Condition

- Printer: Model YVP-Xg YAMAHA Motor
- Squeegee: Metal, 55° angle
- Stencil: 0.12mmt, laser
- Print speed: 40 mm/sec
- Atmosphere: 24~26°C (50~60%RH)
- Pattern: 0.25mm dia. CSP, 0.4mm QFP pitch

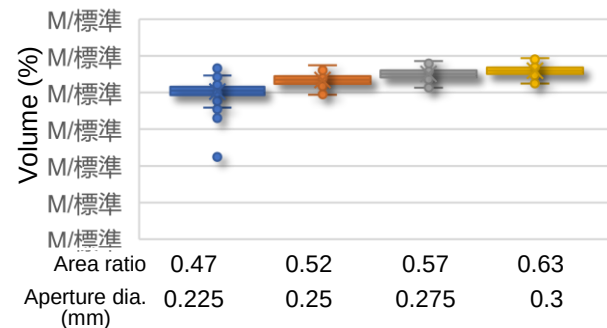


$$\text{Area ratio} = \frac{\text{Aperture area}}{\text{Aperture wall area}}$$

Average of initial 10 prints



Average of 10 prints after 200 strokes



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



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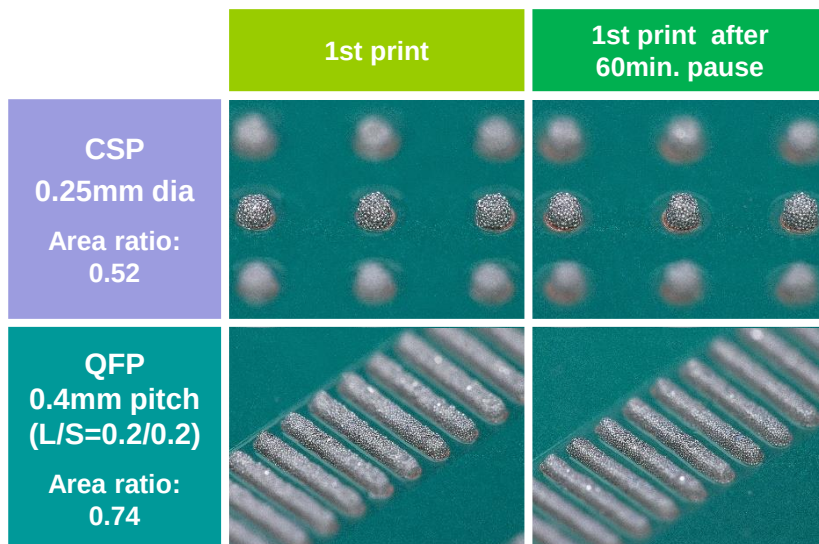
General properties

Handling guide

Printability - Intermittent printing

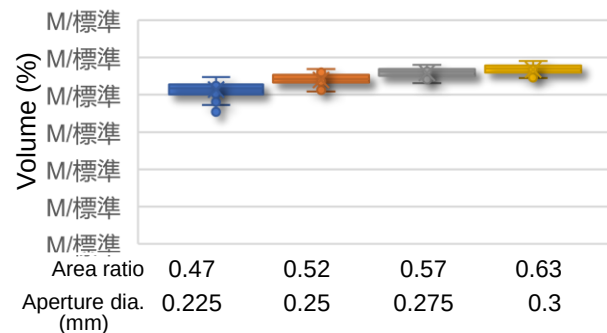
Test Condition

- Printer: Model YVP-Xg YAMAHA Motor
- Squeegee: Metal, 55° angle
- Stencil: 0.12mmt, laser
- Print speed: 40 mm/sec
- Atmosphere: 24~26°C (50~60%RH)
- Pattern: 0.25mm dia. CSP, 0.4mm QFP pitch

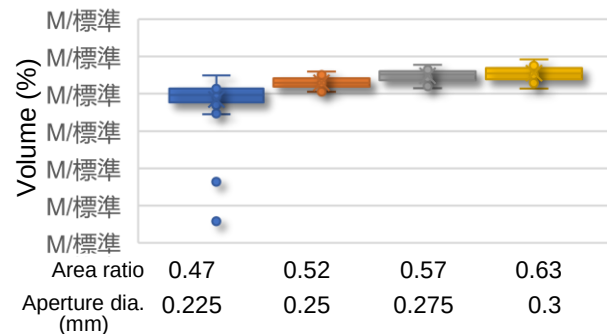


$$\text{Area ratio} = \frac{\text{Aperture area}}{\text{Aperture wall area}}$$

1st print



1st print after 60min. pause



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



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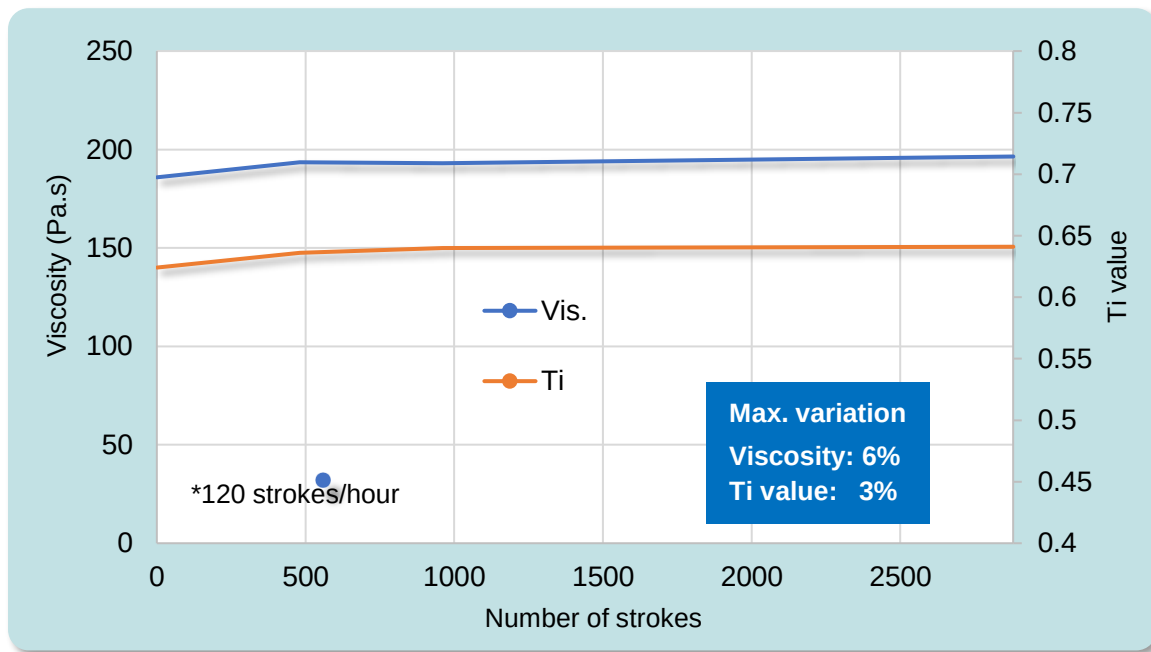
Handling guide

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: 60°
- Squeegee speed: 20mm/sec.
- Print stroke: 300mm
- Printing environment: 23~25°C, 40~60%RH



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



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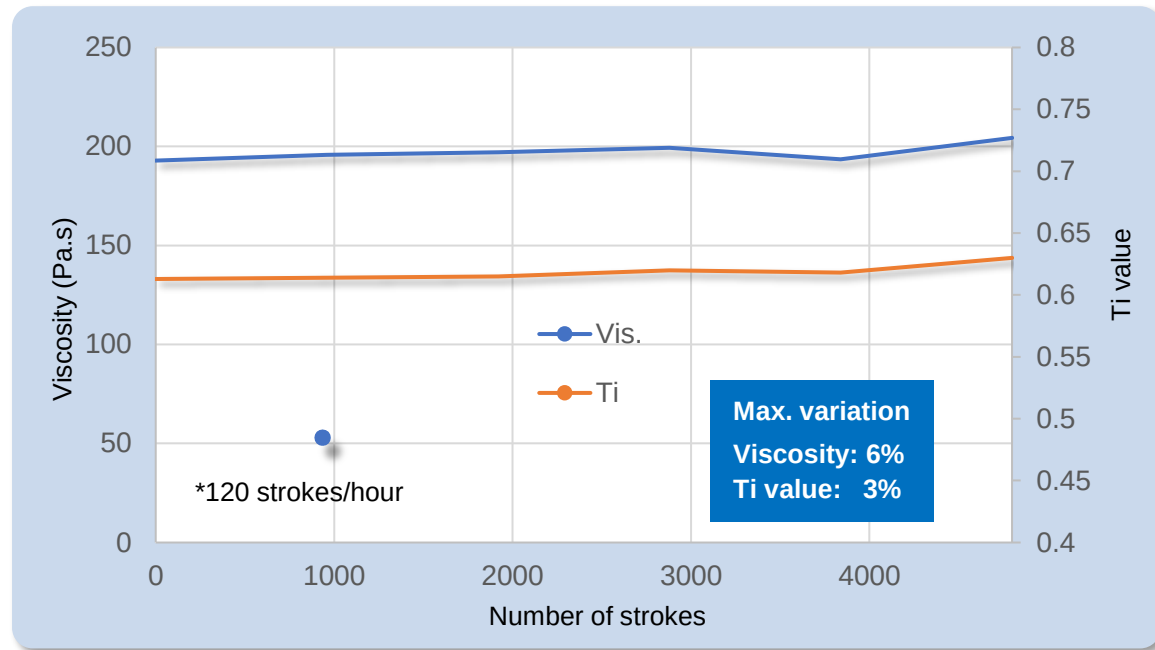
Handling guide

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: 60°
- Squeegee speed: 20mm/sec.
- 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)
- Print stroke: 300mm
- Printing environment: 23~25°C, 40~60%RH



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



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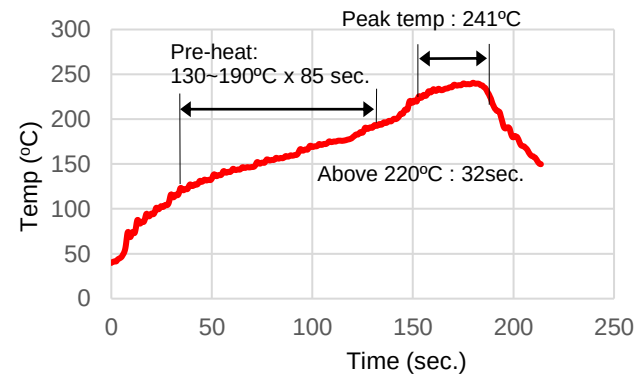
General properties

Handling guide

Meltability – Fine pattern

Test condition

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



	OSP	ImSn	ImAg	ENIG
CSP 0.25mm dia.				
0603R				

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



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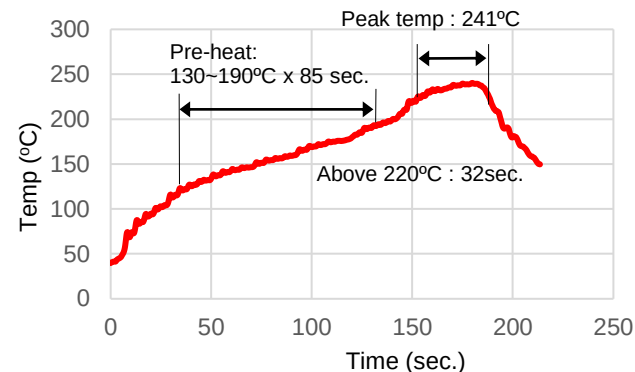
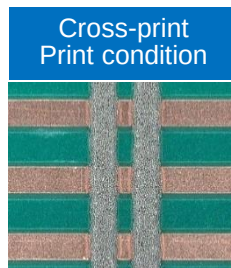
General properties

Handling guide

Meltability – Solder spreading / Coagulation

Test condition

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



	OSP	ImSn	ImAg	ENIG
Spreading 6.5mm 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.



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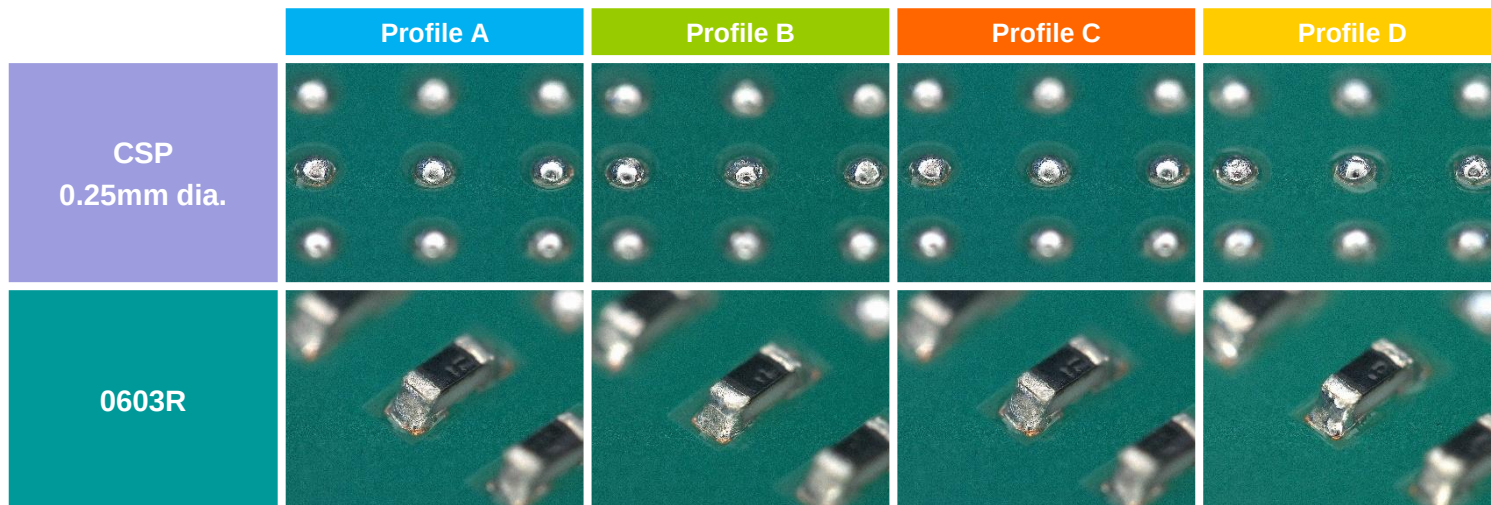
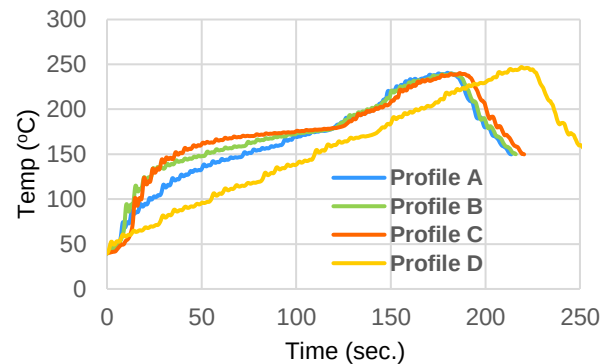
Handling guide

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°C 85 sec.	150-190°C 75 sec.	150-190°C 96 sec.	100-190°C 96 sec.
Peak temp.	241°C	240°C	240°C	247°C
Time >220°C	32 sec.	32 sec.	41 sec.	35 sec.



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



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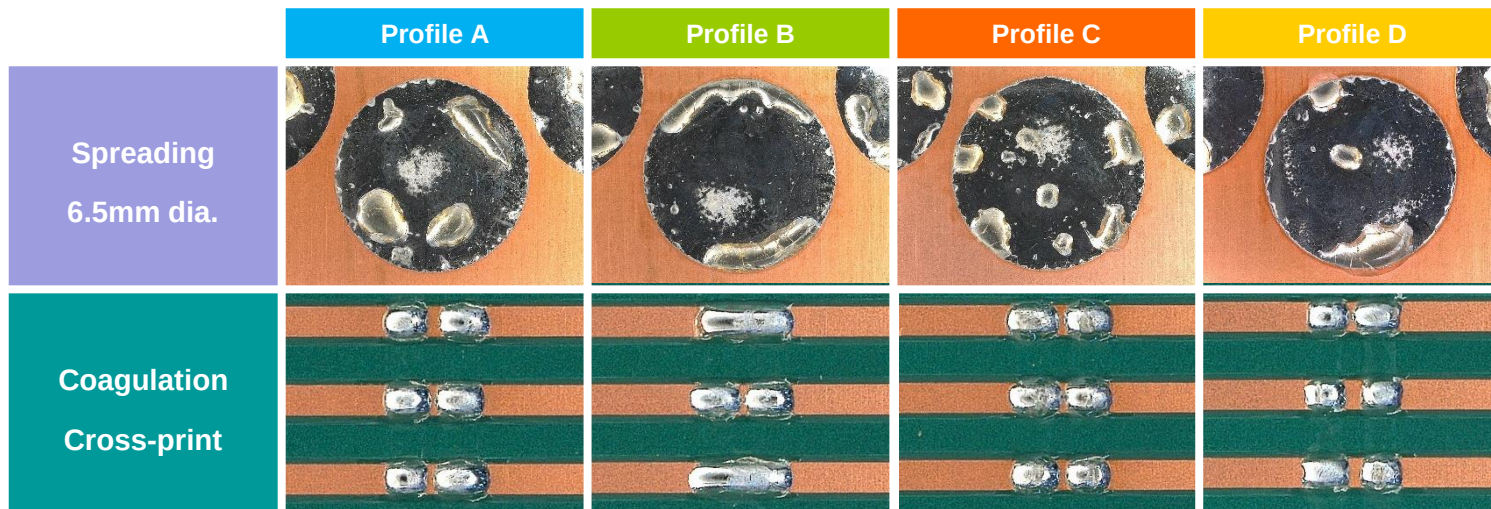
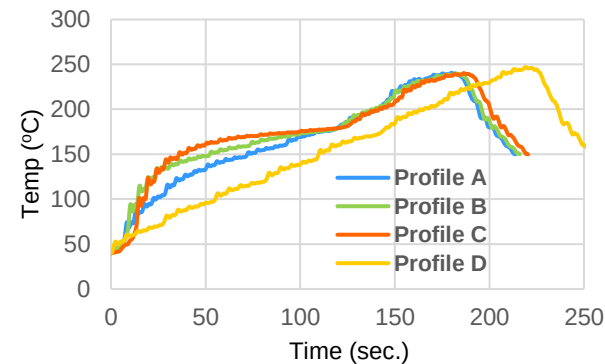
Handling guide

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°C 85 sec.	150-190°C 75 sec.	150-190°C 96 sec.	100-190°C 96 sec.
Peak temp.	241°C	240°C	240°C	247°C
Time >220°C	32 sec.	32 sec.	41 sec.	35 sec.



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



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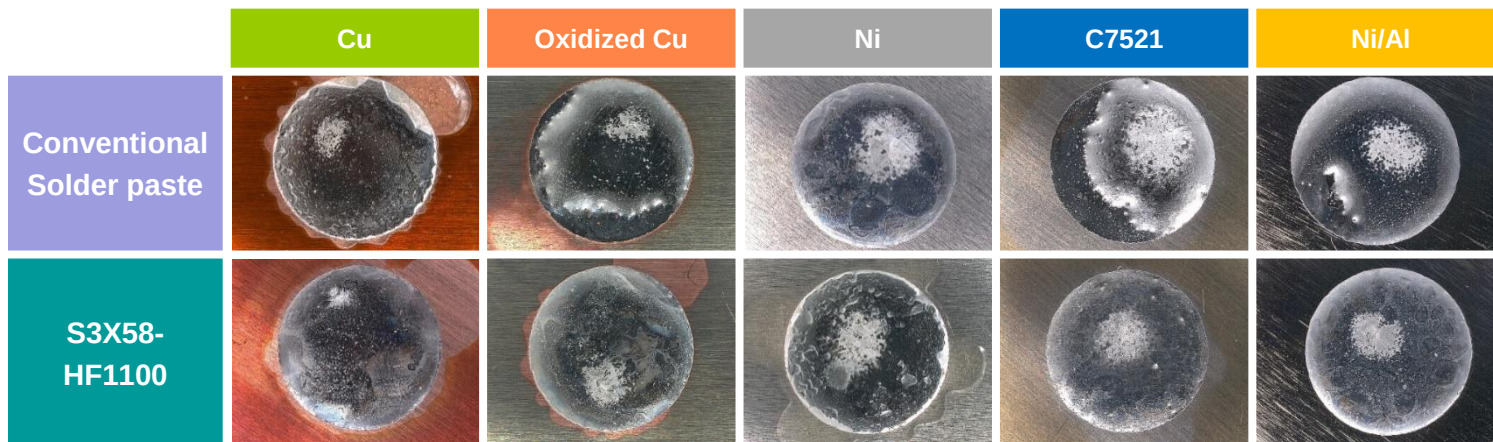
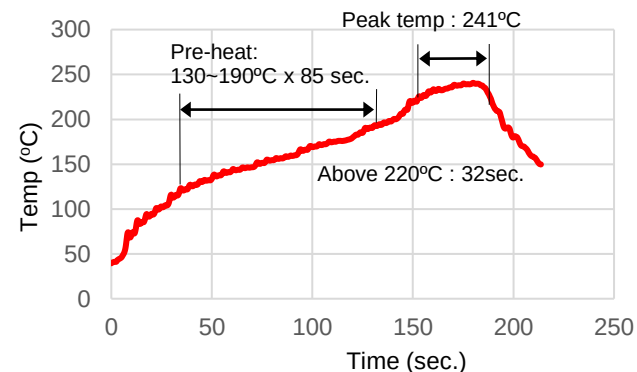
General properties

Handling guide

Meltability – Solder dewetting

Test condition

- Material: Cu, Ni, Oxidized Cu*¹, C7521*, Ni/Al
- Stencil thickness: 0.2mm (laser cut)
- Heat source: Hot air convection
- Atmosphere: Air
- *¹ Oxidization condition: 150°C x 16hrs
- *² C7521: Nickel Silver(64Cu-18Ni-18Zn)



➤ 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.



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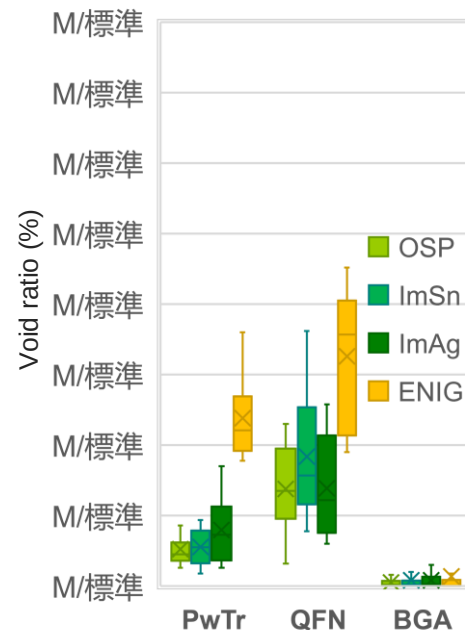
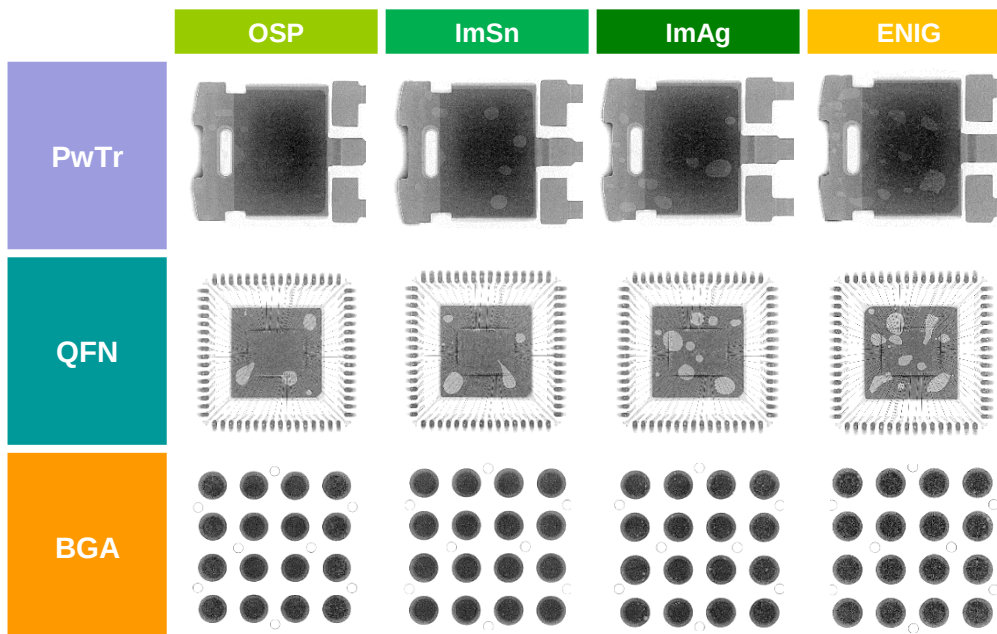
Handling guide

Voiding

Test condition

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

- Component: 100% Sn plated - PwTr, QFN
- Heat source: SAC305 - BGA
- Atmosphere: Hot air convection
- Reflow profile: Air
- See "Meltability - Fine pattern"



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

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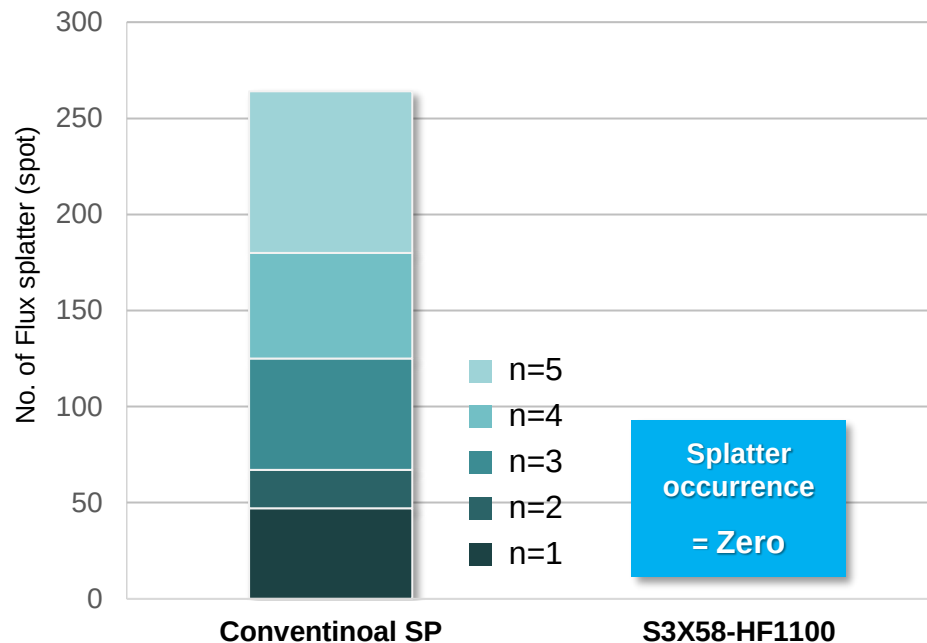
General properties

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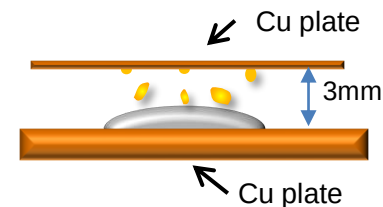
Flux splattering

Test condition

- Material: Phosphorous deoxidized copper (C1220)
- Stencil: 0.2mm thickness, 6.5mm diameter
- No. of specimens: n=6
- 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 number of flux splatter.



Flux splatter / example

- **S3X58-HF1100** resulted in no flux splatter while conventional solder paste splattered in high amounts.

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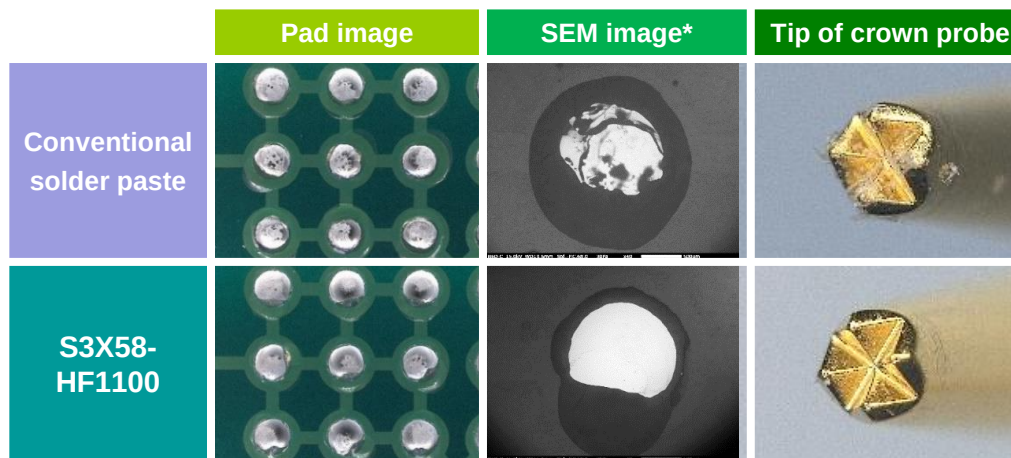
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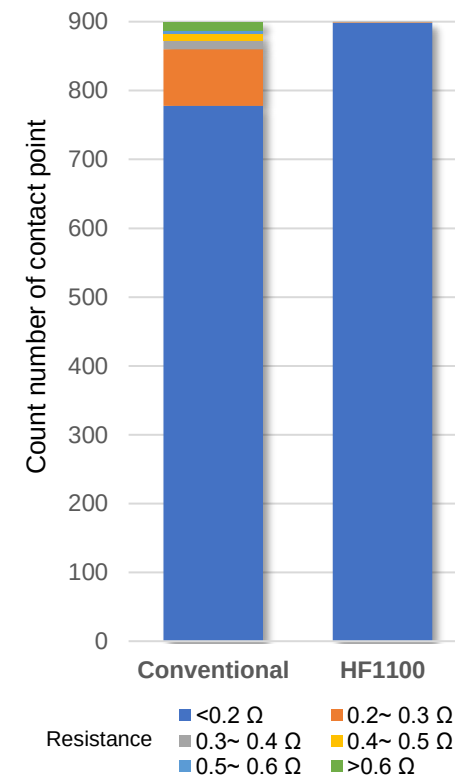
Test condition

- Material: Glass epoxy FR-4
- Surface finish: OSP
- Stencil thickness: 0.15mm (laser cut)
- Stencil aperture: 100% aperture opening to pad
- No. of contact points: 900 points
- Probe (pressure): HIOKI 1171-483 (1.7N) / Crown tip
- Heat source: Hot air convection
- Atmosphere: Air
- Reflow profile: See "Meltability - Fine pattern"



*SEM image: Black area → Flux residue / White area → No presence of flux residue

Contact resistance



➤ **S3X58-HF1100** resulted in contact resistance $<0.2\Omega$ at almost all of the total contact points.



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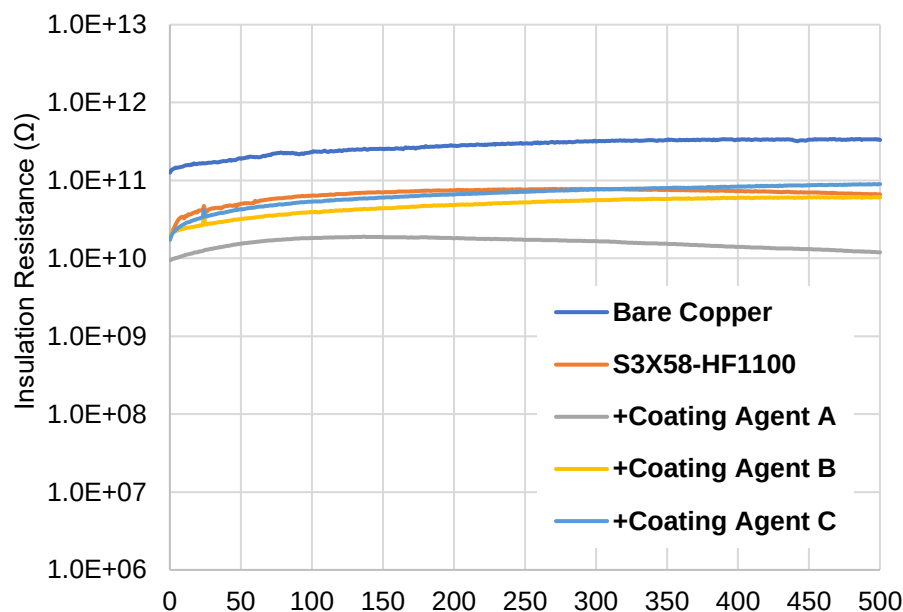
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Electrical reliability - Electro-chemical Migration (ECM)

Test condition

- Test standard: IPC TM-650 2.6.14.1
- Test coupon: IPC-B-25
- Surface finish: OSP
- Chamber condition: 65°C / 88.5RH%
- Voltage: Applied 10V / measurement 100V

- Reflow: Hot air convection in air
- Reflow profile: See "Meltability - Fine pattern"
- Conformal coating: A) Acrylic type
B) Polyolefin type
C) Silicone type



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

N = number of test points (10 minimum),

IR_i = individual insulation resistance measurements

Coupon	IR _{avg}
Control	2.74E+11
S3X58-HF1100 only	6.67E+10
+Coating Agent A	1.56E+10
+Coating Agent B	4.76E+10
+Coating Agent C	6.50E+10

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



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Electrical reliability – Dew test

Test condition

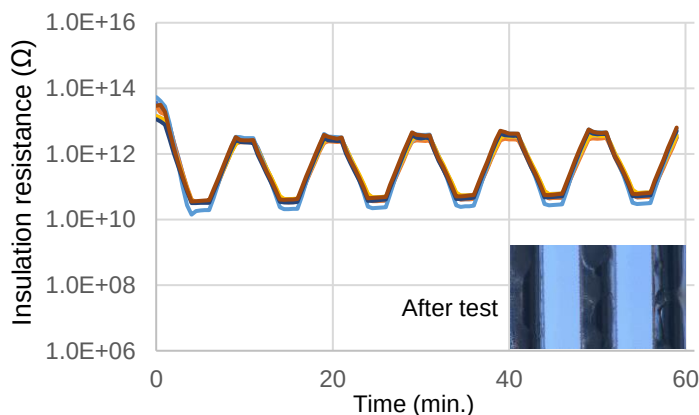
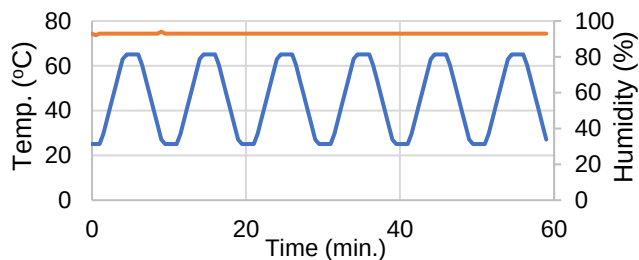
- Test coupon: IPC-B-25
- Surface finish: OSP
- Stencil thickness: 0.15mm (laser)

• Voltage: Applied 50V / measurement 50V

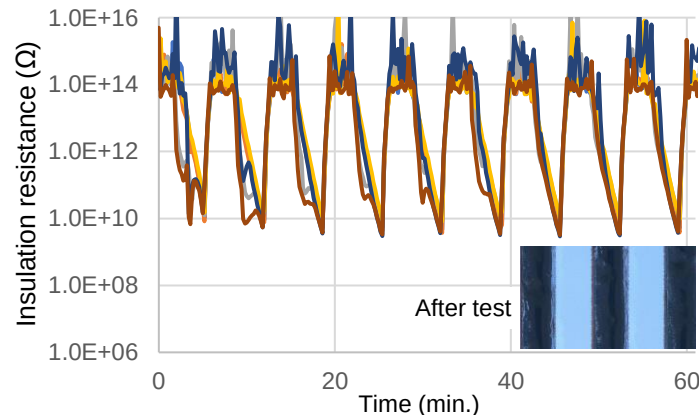
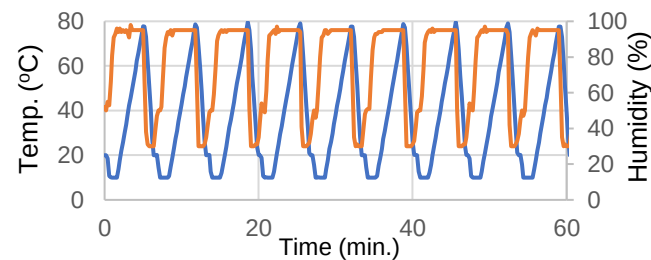
• Reflow: Hot air convection in air

• Reflow profile: See “Meltability - Fine pattern”

Method A: Chamber condition



Method B: Chamber condition



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



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



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Item	Result	Test Method
Slump properties	0.3mm pass	JIS Z 3284-3 150 °C 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 2.6.3.3
Electrochemical migration test	No evidence of migration	IPC-TM-650 2.6.3.7



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1. Printing - Recommended print condition

(1) Squeegee condition

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

(2) Metal stencil

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

(3) Usage condition

- | | |
|----------------------|---|
| 1. Temperature: | 22-25°C |
| 2. Humidity: | 40-60%RH |
| 3. Air conditioning: | Direct air blow on the stencil will dry the solder paste faster.
Adjust the direction of air blow using a shield, etc. |

2. Product life

- | | |
|------------------------------------|--|
| 1. Unopened and refrigerated: | 6 months from the date of production |
| 2. After opening and after mixing: | Use within 1 week to 1 month and store in a refrigerator |
| 3. When used on stencil: | Use within 24 hours |

* How to interpret the lot number:

e.g. Lot No. **1 03 15 1**

# of production batch:	1st batch
Date of production:	15th
Month of production:	March
Year of production:	2021



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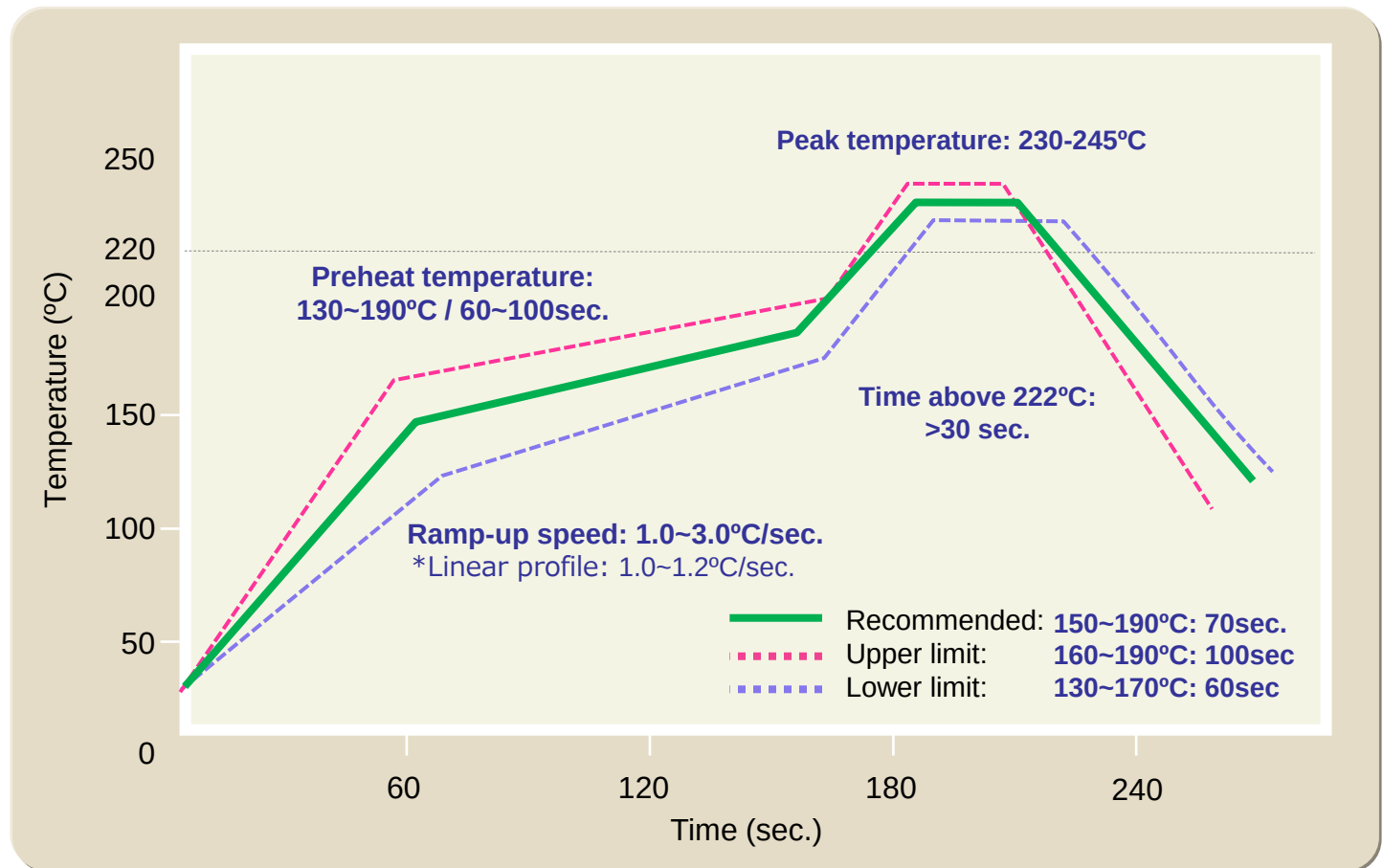
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