# Koki No-Clean LEAD FREE Solder Paste

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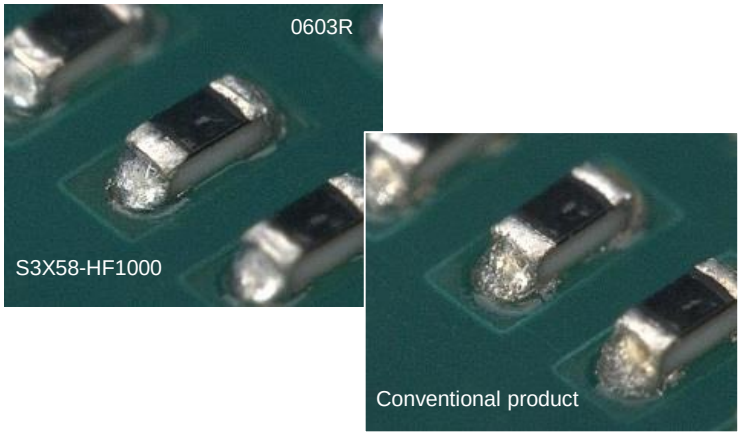
## Powerful Wetting Halogen Free Solder Paste

## S3X58-HF1000

Halogen Free HF

### Product Information



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# Features

- Solder alloy composition is a lead-free Sn 3.0Ag 0.5Cu (SAC305)
- Flux designation is ROL0 (IPC J-STD-004B)

  Cl + Br + I + F = Total halide content <0.05%
- Good wetting on different surface finishes (pad and electrodes)
- Good meltability at the micro-components. It can be utilized with a variety of reflow profiles

# Features - Difficulties of Halogen Free Design

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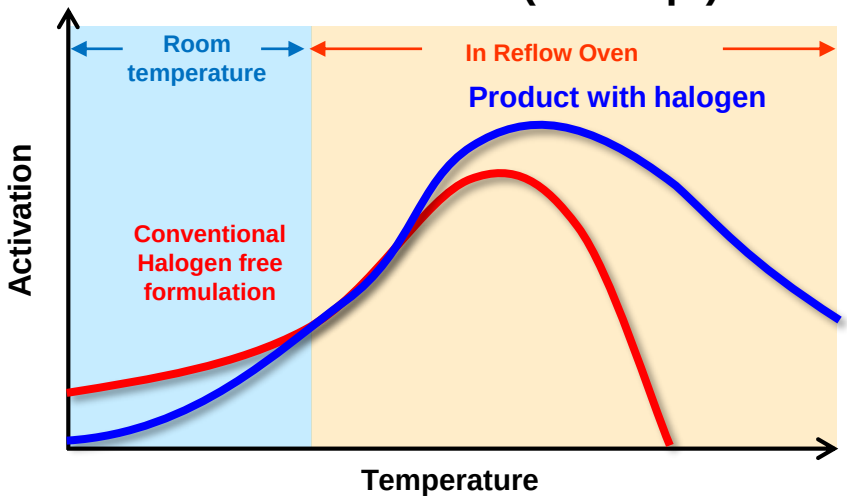
Elements in the halogen group possess a strong oxidation-reduction power and adding just a small amount of halogen in a flux formulation can promote good wetting performance and low void occurrence. Therefore, it is one of the significant flux constituents. In addition, halogens do not decompose at high temperature and are able to maintain its high activation at a wide range of reflow temperatures. It also allows stable reflow soldering with a reflow profile with a high pre-heat temperature owing to its heat resistance.

On the other hand, designing a halogen free flux requires a formulation with a relatively large amount of organic acids, such as carboxylic acids, to compensate for their weaker oxidation-reduction power compared with halogens. Furthermore, organic acids are prone to decompose at high temperature. This makes it challenging to achieve as high a heat resistant flux activation as halogen containing flux.

## - Activation State (Concept) -




Product with halogen
High activation power which continues during reflow.

Conventional Halogen Free formulation
Less activation power compared to product with halogen and loses activation in reflow.

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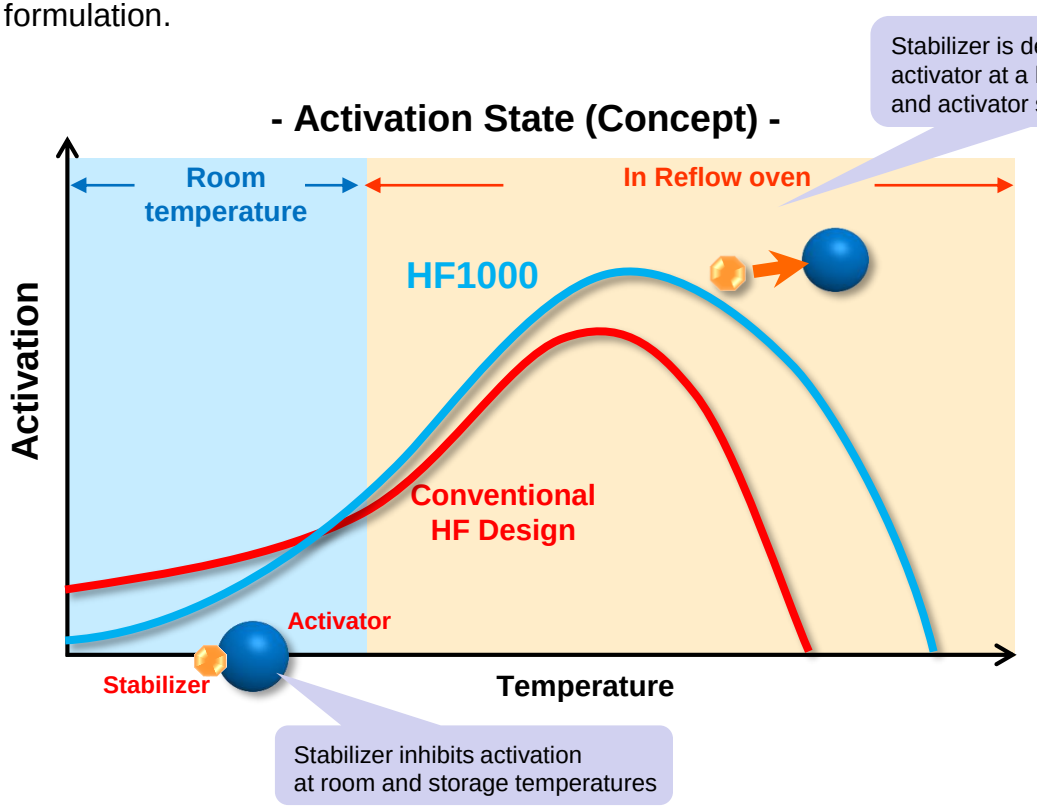
# Features - Activator technique of HF1000

As a newly invented activator technique, “stabilizer” effectively inhibits the chemical reaction between the flux and metal oxide of solder particles during storage, which enables the formulation of the powerful activator component.

The powerful activator gets released from the “stabilizer” only by being heated, efficiently reducing metal oxides from each particle and realizing robust solder wetting despite being a halogen free formulation.




**HF1000 formulation**

The activator chemically attached with “Stabilizer” inhibits oxidation-reduction reaction at room temperature so that there is robust activation strength during the reflow temperatures.

The activator is also designed to be highly heat resistant.

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# Properties

| Application | | Printing |
|---|---|---|
| Product Name | | S3X58-HF1000 |
| Alloy Properties | Alloy Composition [%] | Sn 3.0Ag 0.5Cu |
| | Melting Point [ºC] | 217 - 219 |
| | Shape | Sphere |
| | Grain Size [µm] | 20 - 38 |
| Flux Properties | Halogen Content [%] | 0 |
| | Flux Designation | ROL0 |
| Solder Paste Properties | Flux Content [%] | 12.0±1.0 |
| | Viscosity [Pa.s] | 220±30 |
| | Copper Plate Corrosion | Passed |
| | Tack Time | >48hours |
| | Shelf Life [at <10 ºC] | 6 months |

*1. Flux designation: In accordance with IPC J-STD-004B
*2. Viscosity: Measured at 25ºC, 10rpm by Malcom viscometer
*3. Copper plate corrosion: In accordance with IPC-TM-650 2.6.15

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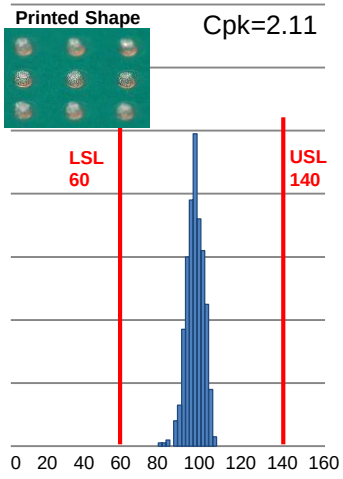
# Continuous Printability

Evaluation Method:

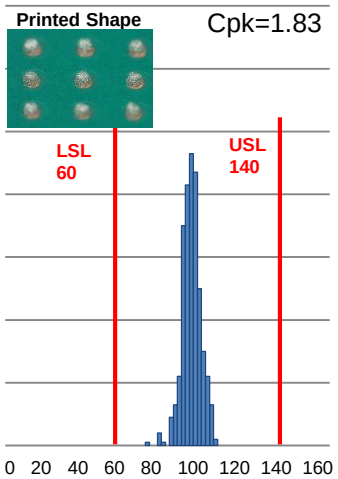
Print 10 PCBs continuously and measure the transfer rate using SPI. Perform 200 rolling strokes on masked stencil. Clean the stencil and print 10 PCBs continuously.

- Stencil thickness: 0.12mm (laser etched)
- Printer: YVP-Xg YAMAHA Motor
- Squeegee: Metal squeegee, 60º angle
- Print speed: 40 mm/sec
- Printer Ambient:: 24~26 ºC (50~60%RH)
- Evaluation pad: 0.4mmP QFP pad (80pins), 0.25mmΦCSP (50 Pads)
- SPI: aSPIre, KOHYOUNG

**0.25mmφ CSP**

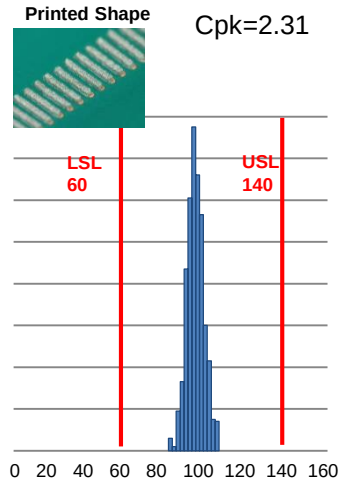



Initial 10 prints: Volume(%) Histogram

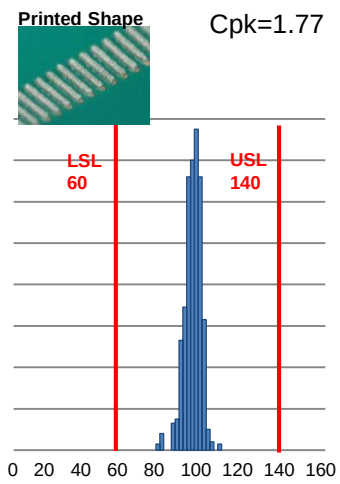



10 prints after 200 strokes: Volume(%)

**0.4mmp QFP**




Initial 10 prints: Volume(%) Histogram




10 prints after 200 strokes: Volume(%)

Stable print shape and paste transfer ratio can be observed at both 0.25mmΦCSP and 0.4mmP pads.

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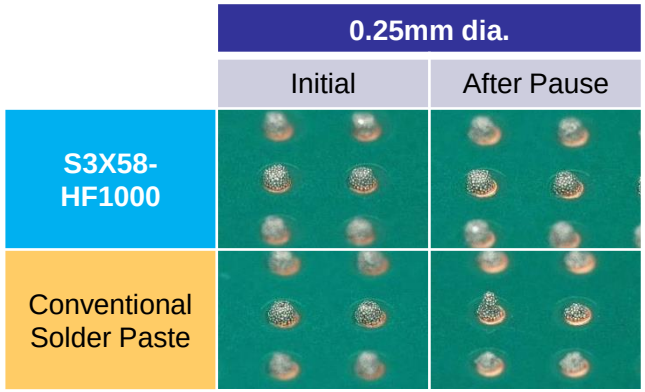
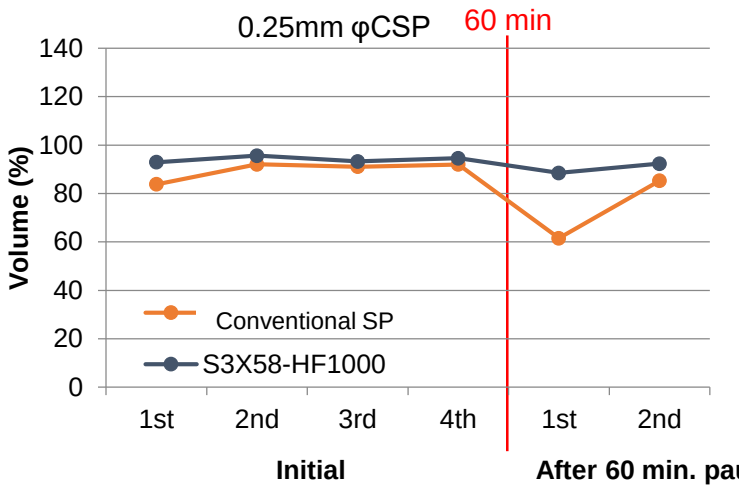
# Intermittent Printability

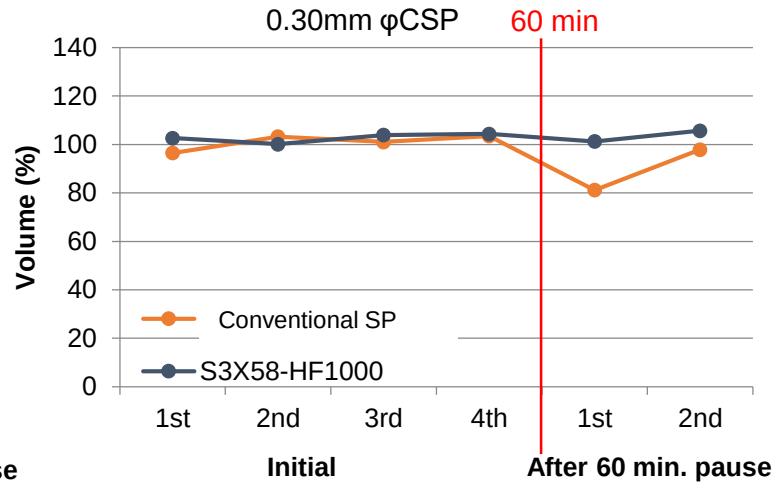
Evaluation Method:

Print initially 4 samples, then let paste stand at the printer and stencil for 60 minutes. Resume printing and evaluate the paste transfer rate.

- Stencil thickness: 0.12mm (laser etched)
- Printer: YVP-Xg, YAMAHA Motor
- Squeegee: Metal squeegee, 60º angle
- Print Speed: 40 mm/sec.
- Test Ambient: 24~26 ºC (50~60%RH)
- Evaluation Pad: 0.25,0.30mmφCSP,
- SPI: aSPIre, KOHYOUNG




S3X58-HF1000 maintained good paste transfer rate when the printing was resumed.

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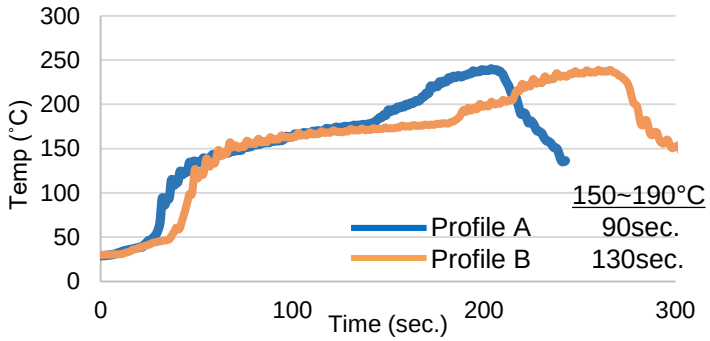
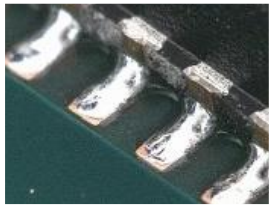
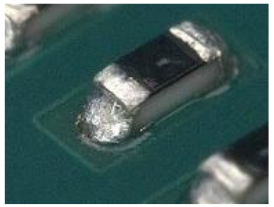
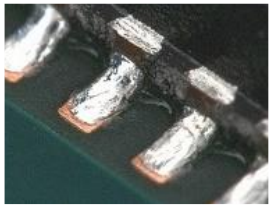
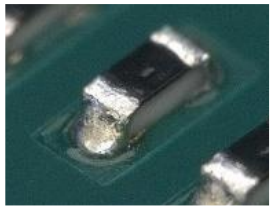
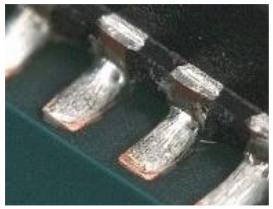
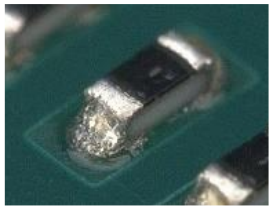
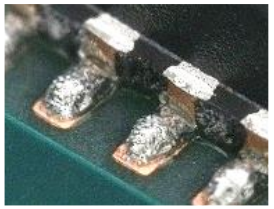
# Meltability

Evaluation Condition:

- Stencil thickness: 0.12mm
- Pad surface finish: OSP
- Mounted component: 0603R (Sn plating), 0.5mmP QFN
- Heating method: Hot air reflow
- Reflow atmosphere: Air
- Reflow profile: See the right diagram




| | Profile A | | Profile B | |
|---|---|---|---|---|
| | 0603R | 0.5mmP QFN | 0603R | 0.5mmP QFN |
| S3X58-HF1000 |  |  |  |  |
| Conventional Solder Paste |  |  |  |  |

S3X58-HF1000 showed comparable melt performance at the micro-components even with longer pre-heat time.

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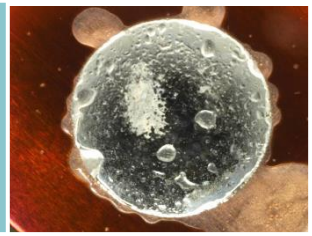
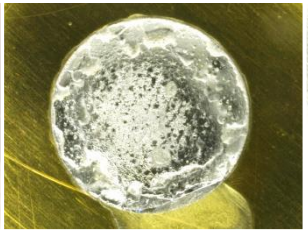
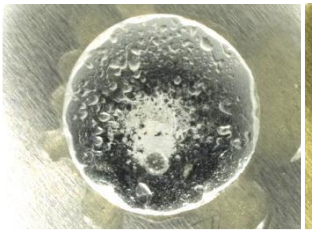
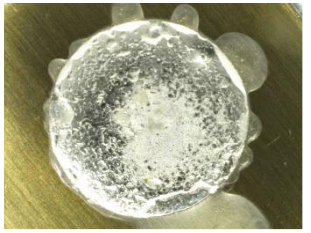
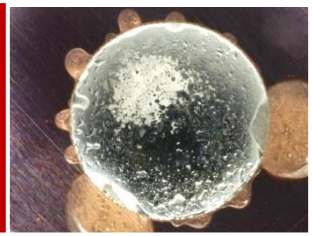
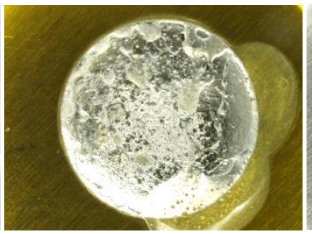
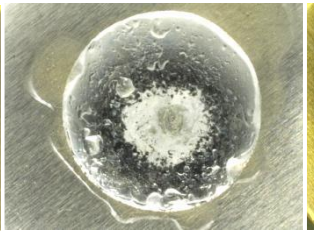
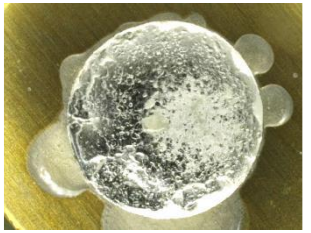
# Meltability (De-wetting Test)

Evaluation Method:

- Substrate: Cu, Brass, Ni, and Nickel silver (C7701)
- Aging (oxidation) process: Reflowed twice prior to test
- Stencil thickness: 0.20mm (laser etched)
- Stencil aperture: 6.5mmΦ
- Heating method: Profile A shown on previous page

| | Cu | Brass | Ni | Nickel Silver(C7701) |
|---|---|---|---|---|
| Without prior aging |  |  |  |  |
| With aging process |  |  |  |  |

S3X58-HF1000 had good solder spreading and no de-wetting occurred regardless of the metal finish even with the intentionally oxidized finishes.

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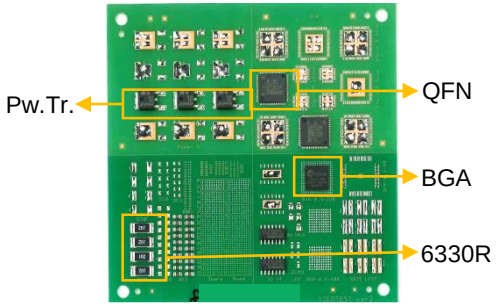
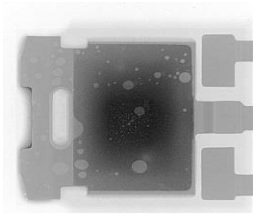
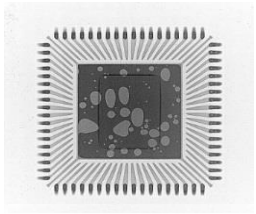
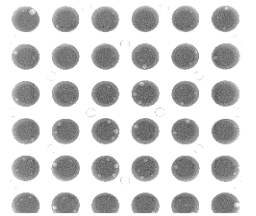
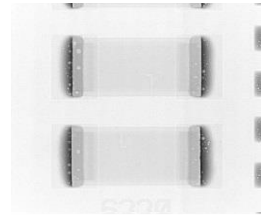
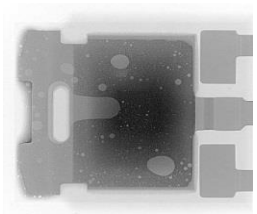
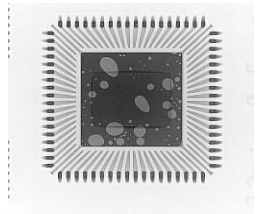
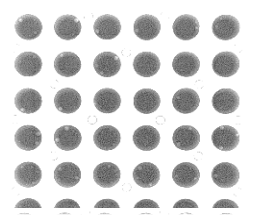
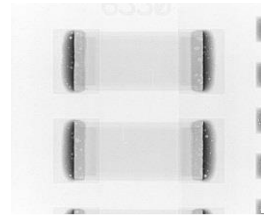
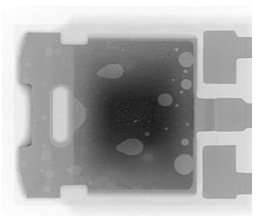
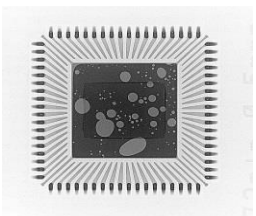
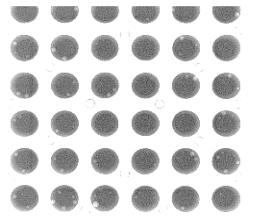
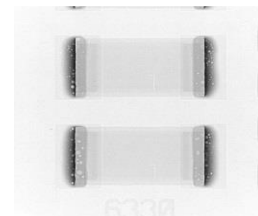
# Low Voiding Property

Evaluation Method:

- Evaluation board: FR-4 (Right image)
- Surface finish: OSP, ENIG and ImAg
- Stencil thickness: 0.12mm (laser etched)
- Components: Pw.Tr., QFN and 6330R pure Sn plated
  BGA - SAC305 ball
- Heating method: Hot air reflow
- Reflow atmosphere: Air
- Reflow profile: Profile A used in Meltability test (slide 8)




| | Pw. Tr. | QFN | BGA | 6330R |
|---|---|---|---|---|
| OSP |  |  |  |  |
| ENIG |  |  |  |  |
| ImAg |  |  |  |  |

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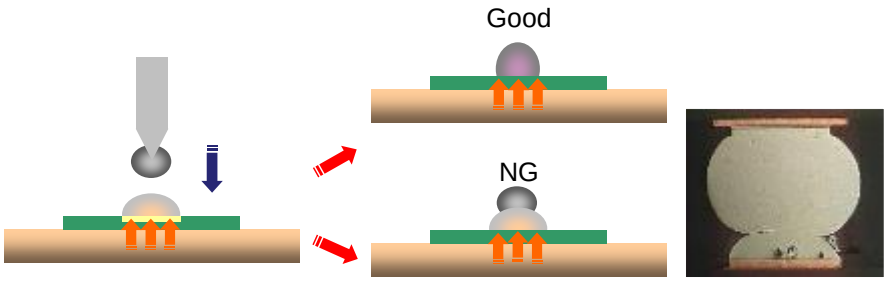
# Head-in-Pillow (HIP) Resistance

Evaluation Method:

| | |
|---|---|
| PCB grade: | FR-4 |
| Pad surface finish: | OSP |
| Stencil thickness: | 0.20mm (laser etched) |
| Evaluation pad: | 0.8 mmΦ |
| Evaluation component: | 0.76mmΦ ball (SAC305) |
| Stencil aperture ratio to board: | 100% |
| Heating method: | Solder bath 280°C |
| Solder drop interval: | Every 10 seconds |




When the solder paste is molten, drop a SAC305 ball every 10seconds.
When the flux is degraded by the heat, ball will no longer be fused with molten paste.

| | 20 sec. | 30 sec. | 40 sec. |
|---|---|---|---|
| S3X58-HF1000 | Completely fused | Completely fused | Completely fused |
| Conventional Product | Completely fused | Incompletely fused | Head-in-pillow defect |

S3X58-HF1000 showed little flux deterioration at higher temperatures and exhibited high head-in-pillow resistance.

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# Halogen Content

Evaluation Method:

- Quartz tube combustion ion chromatography (in accordance with JEITA ET-7304A)

| Halogen | Result |
|---|---|
| F | Not detected |
| Cl | Not detected |
| Br | Not detected |
| I | Not detected |

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# General Properties

| Item | Result | Method |
|---|---|---|
| Tack time | **> 24 hours ( >100g.f)** | JIS Z 3284-3 |
| Slump property | **0.3mm pass** | JIS Z 3284-3<br>150ºC-10min |
| Solder ball test | **Within category 3** | JIS Z 3284-4 |
| Copper mirror corrosion test | **Type L** | IPC-TM-650 2.3.32 |
| Copper plate corrosion test | **Pass** | IPC-TM-650 2.6.15 |
| Surface insulation resistance | **> 1E+9** | IPC-TM-650 2.6.3.3 |
| Electrochemical migration test | **No evidence of migration occurrence** | IPC-TM-650 2.6.14.1 |

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# Handling Guide

**1. Printing -** Recommended print condition

(1) Squeegee

1. Shape: Flat
2. Material: Metal or urethane
3. Angle: 60~70º
4. Squeegee pressure: Low (with no solder paste left behind after squeegee print stroke)
5. Squeegee speed: 20~80mm/second

(2) Metal stencil

1. Thickness: 0.10~0.15mm for 0.4~0.65mm pitch patterns
2. Material: Laser etched or additive manufacturing
3. Snap-off speed: 7.0~10.0mm/sec.
4. Snap-off distance: 0mm

(3) Ambient

1. Temperature: 23~27°C
2. Humidity: 40~60%RH
3. Local air conditioning: Avoid direct draft from the local AC onto the metal stencil as it shall cause fast drying of the solder paste.

(4) Preparation: Recover the solder paste to room temperature before use. Manually knead the solder paste for 1 – 2 minutes with a spatula, or use kneading/mixing equipment.

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**2. Product life**

0~10ºC: 6 months from the date of production

1) Once the solder paste is opened, but not kneaded
→Within the remaining shelf life by storing it back in the refiregerator (The solder paste is still intact.)

2) Once the solder paste is opened, but kneaded by a spatula
→ Within 1 month by storing it back in the refiregerator

3) Once the sodler paste is opened, kneaded by a spatula and worked on the stencil with the sqeegee blades
→ Within 24 hours

**3. Caution** To prevent a print defect, please clean the bottom of stencil every 2 to 10 paste prints.

**4. Lot No.:**

Lot No. is to be interpreted as below;

e.g. **Lot No. 9 05 21 2**

- Batch number: **2nd batch of the day**
- Date of production: **21st**
- Month of production: **May**
- Year of production: **2019**

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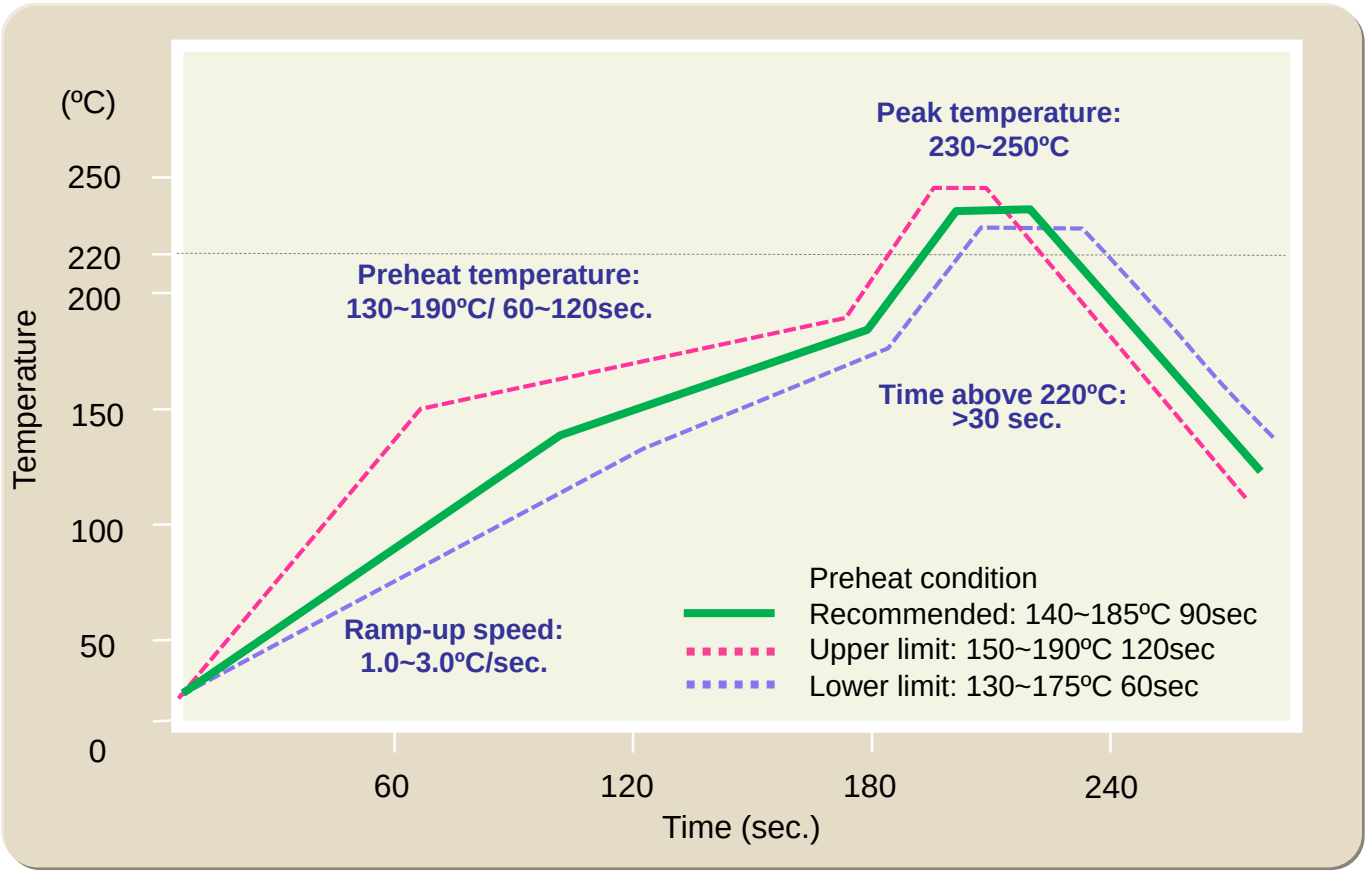
# Handling Guide – Recommended Reflow Profile



# Handling Guide- Supplemental Information on Reflow Profile

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