# TI OMAP4xxx POP SMT Design Guideline

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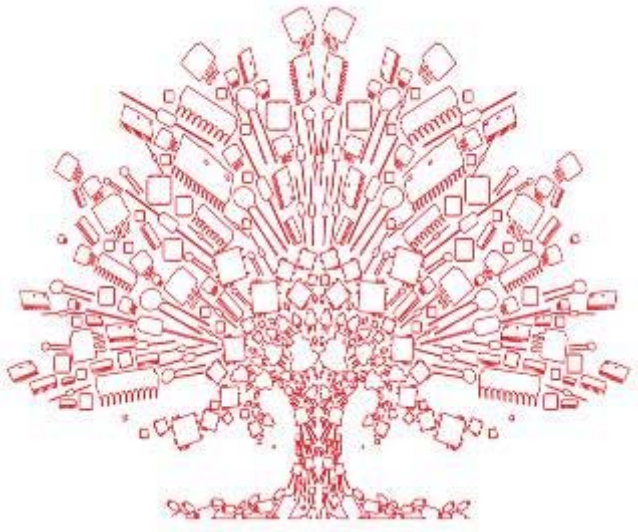

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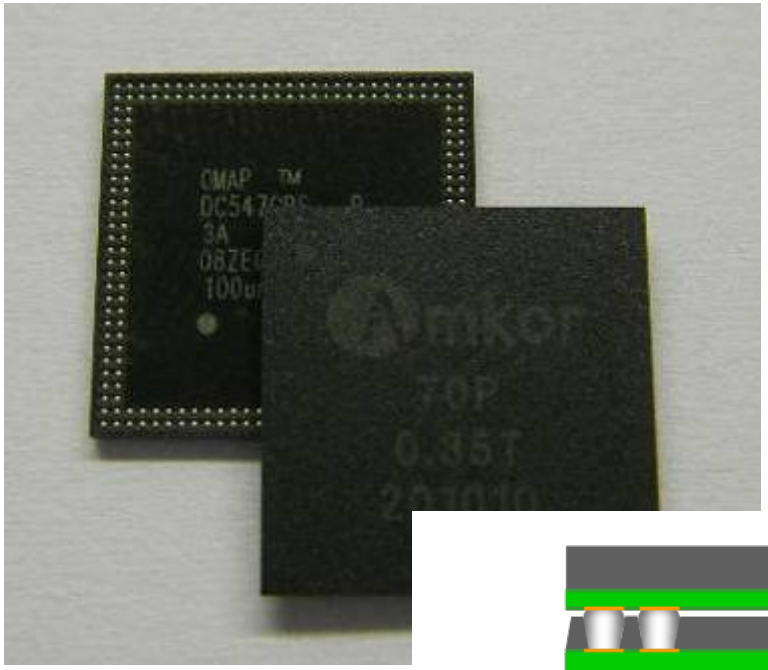
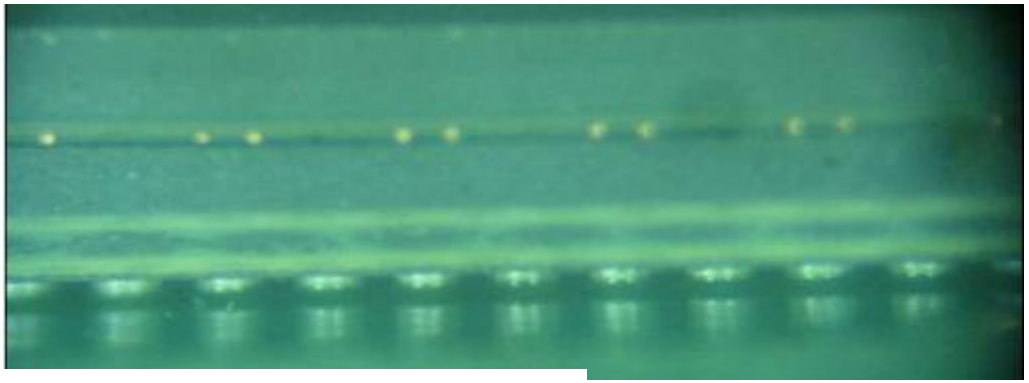
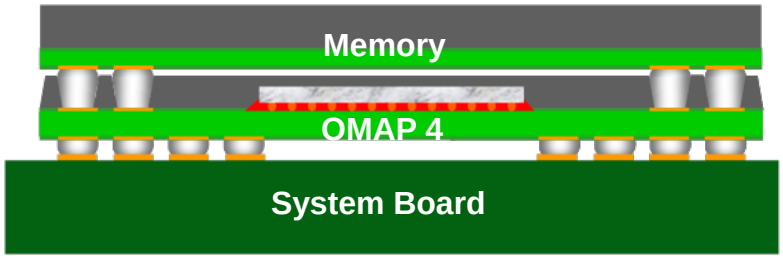
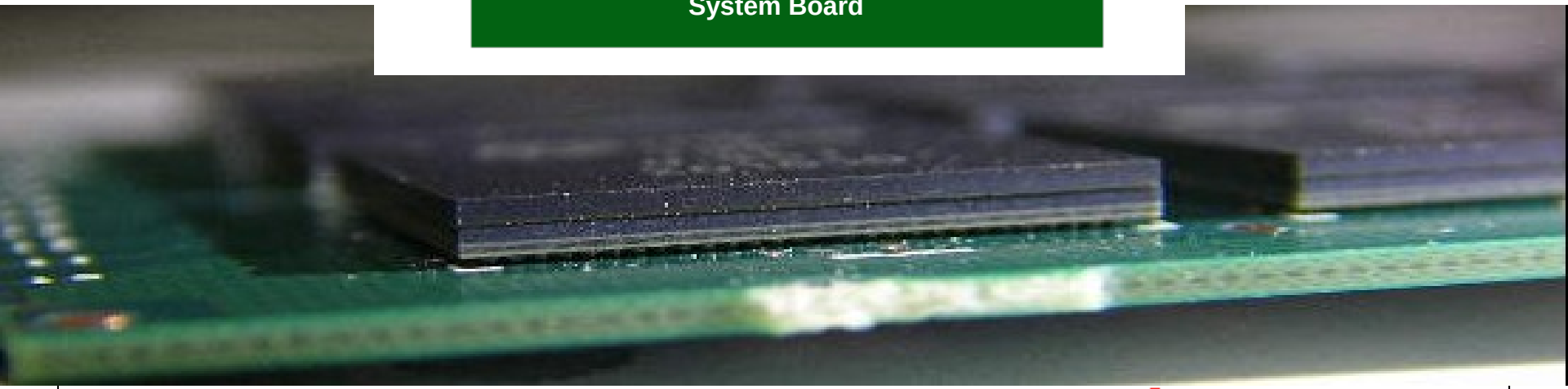
# OMAP4XXX POP Packages



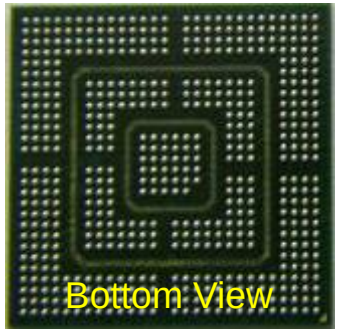


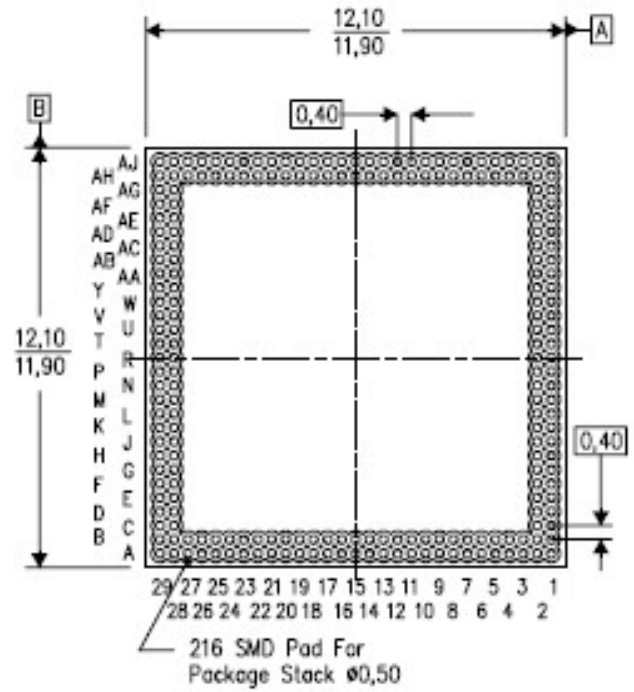


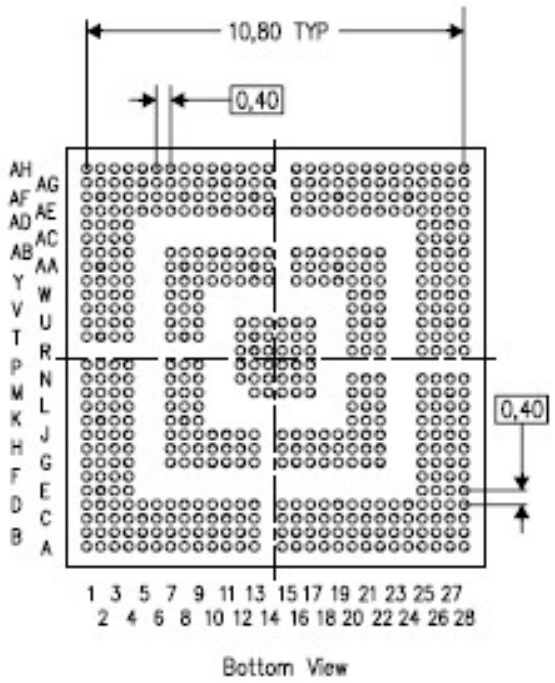



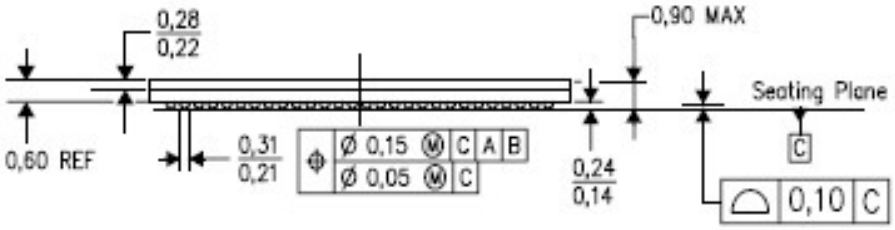
# Mechanical Drawing of OMAP4xxx CBS (TMV)

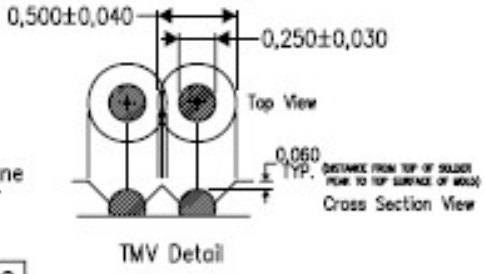
OMAP4xxx

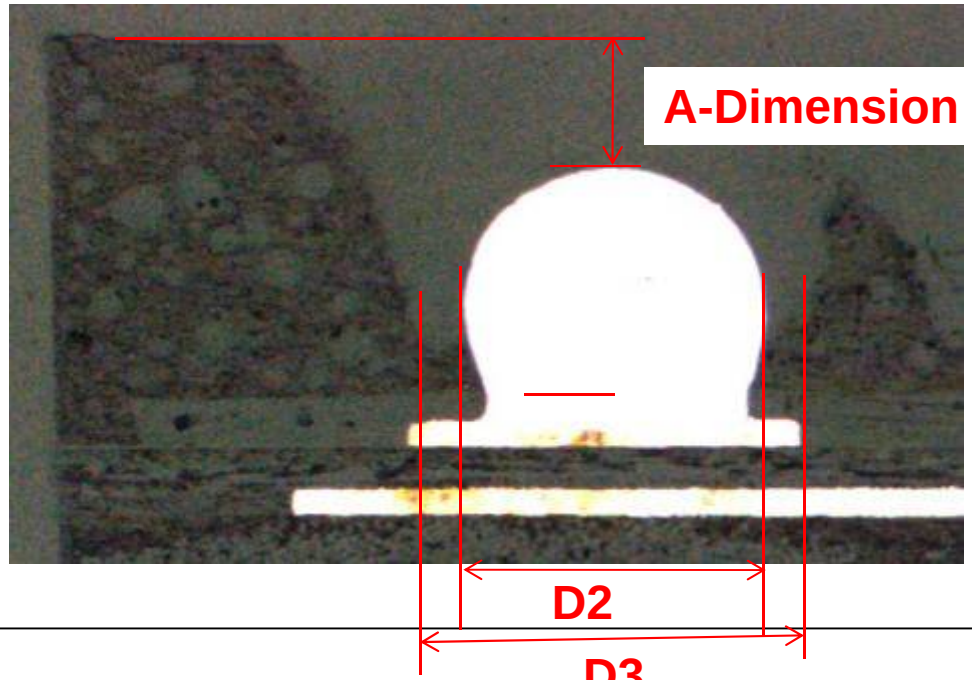



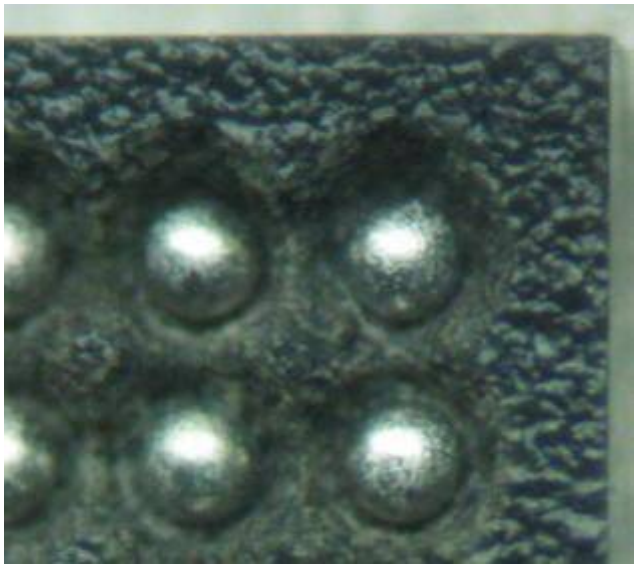



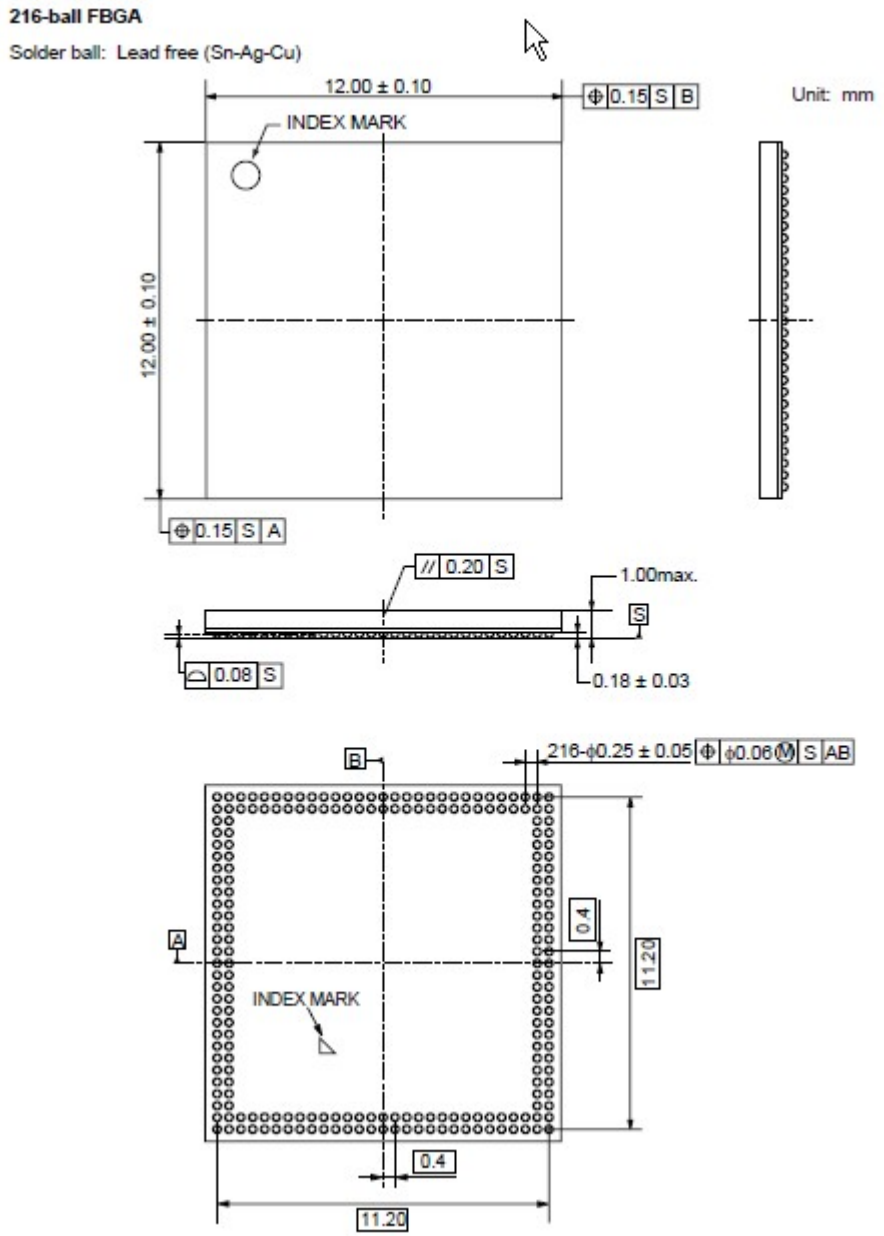



# OMAP4xxx TMV

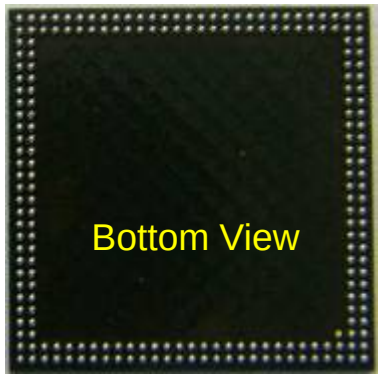


# Mechanical Drawing of Memory Chip




Memory Chip



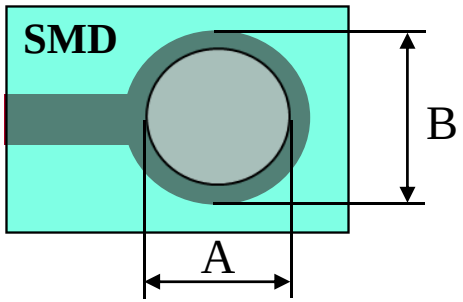
# Agenda:

- Package Introduction
- OMAP4 SMT Process sharing
  - ✓Stencil/PCB design guide
  - ✓Memory chip flux/solder dipping in 1-step mounting
  - ✓The example of Pick & Place machine condition setting
  - ✓Reflow profile recommendation
  - ✓SMT experiment examples
- Q& A

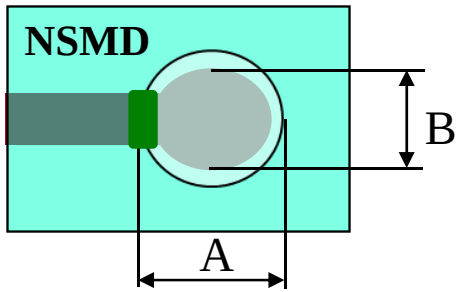
# Stencil/PCB design guide for P0.4 OMAP4

PWB Land & Stencil aperture design Recommendation for pitch 0.4mm

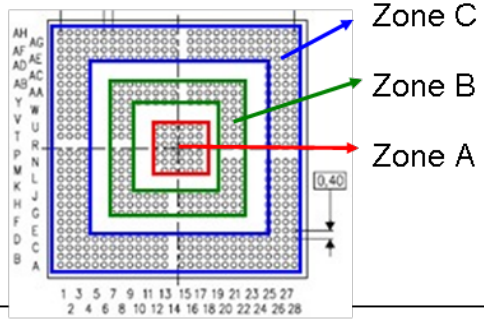
**Solder Mask Defined**




**Non Solder Mask Defined**



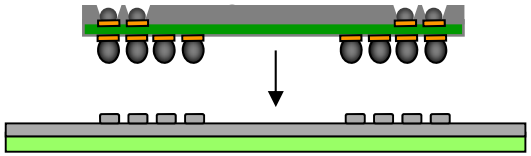

| Ball Pitch | | PWB Design A | PWB Design B | Stencil Design Thickness | Stencil Design Opening | |
|---|---|---|---|---|---|---|
| 0.4mm | SMD* | 0.23 | 0.28 | 0.08/0.1 | 0.25 | (Zone C) |
| | | | | 0.08/0.1 | 0.20 | (Zone A+B) |
| | NSMD | 0.28 | 0.23 | 0.08/0.1 | 0.25 | (Zone C) |
| | | | | 0.08/0.1 | 0.20 | (Zone A+B) |




- Avoid VIP( Via in Pad) design. If should do it, the plugged via with flatten surface is recommended.
- SMD design is more suggested than NSMD to prevent the solder starvation form trace neck or irregular joint shape.
- Trace design: No big ground with several pads connection or wide trace neck.
- Square opening of Stencil can get more volume for joint print.

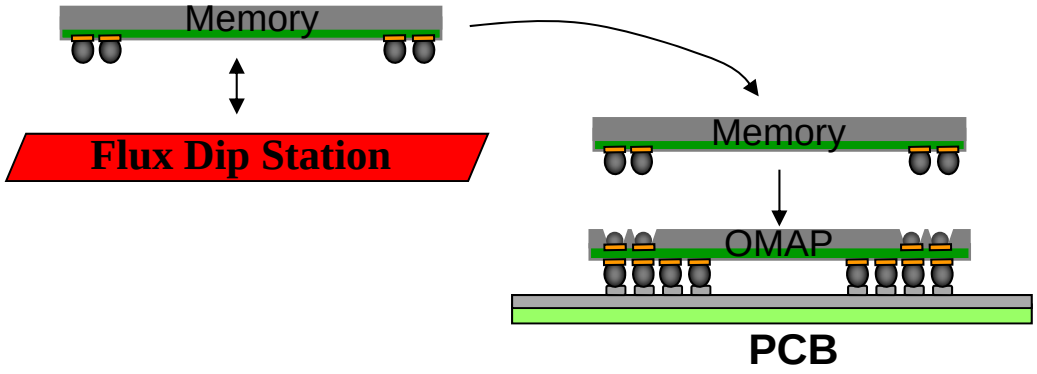
# Package on Package (POP)
# Surface Mount Assembly Process Flow

- Screen print solder paste to PCB
- Pick and place OMAP BGA



PCB

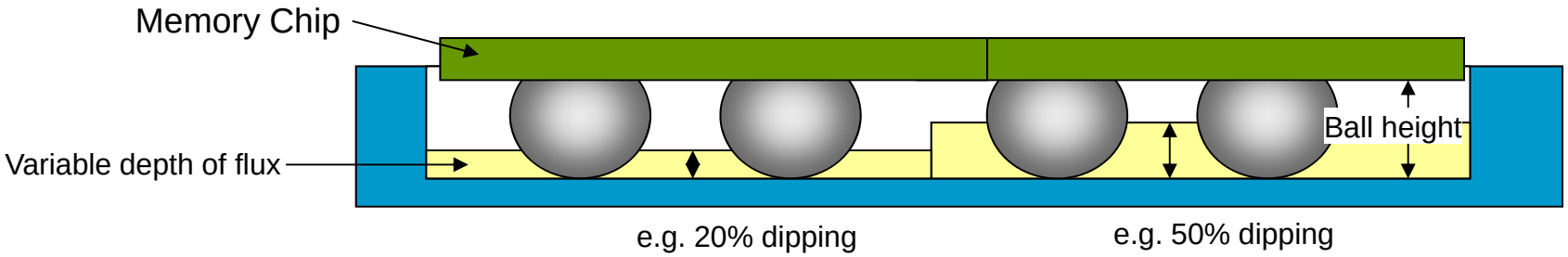
- Dip Memory package into flux or paste
- Place on top of OMAP package

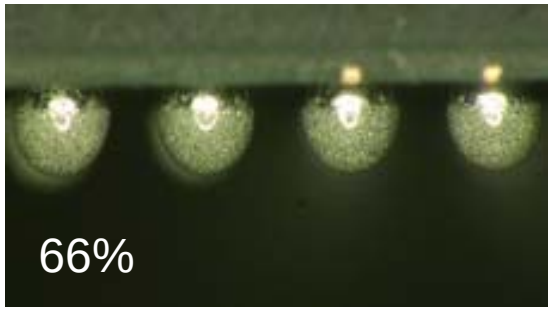


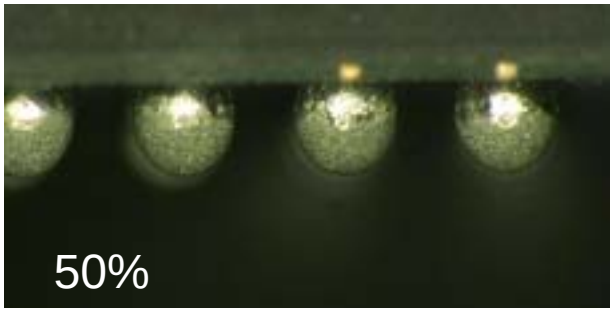

- Reflow to form POP stack

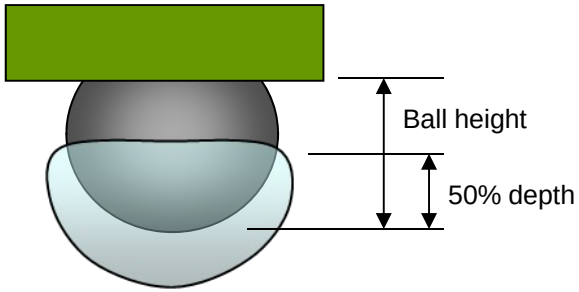
# Memory chip flux/solder dipping recommendation in 1-step mounting

"A" memory DC package, is dipped into flux with variable depth



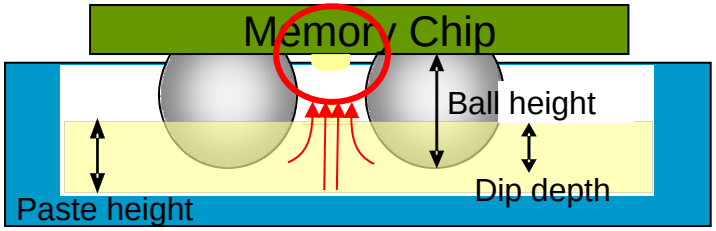



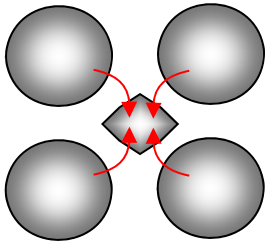

50% is appropriate dipping depth

**Flux/solder past dip depth:**

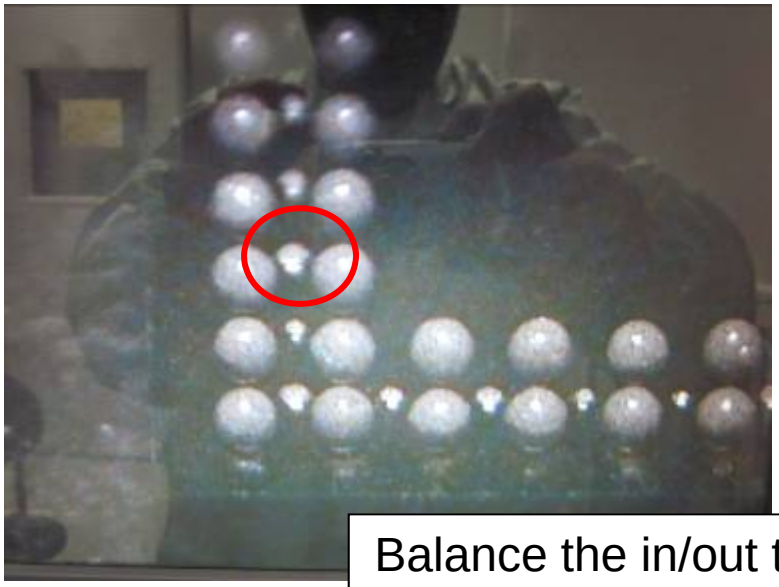
From the evaluation, the optimal results at 50-70 % flux dip and solder paste.

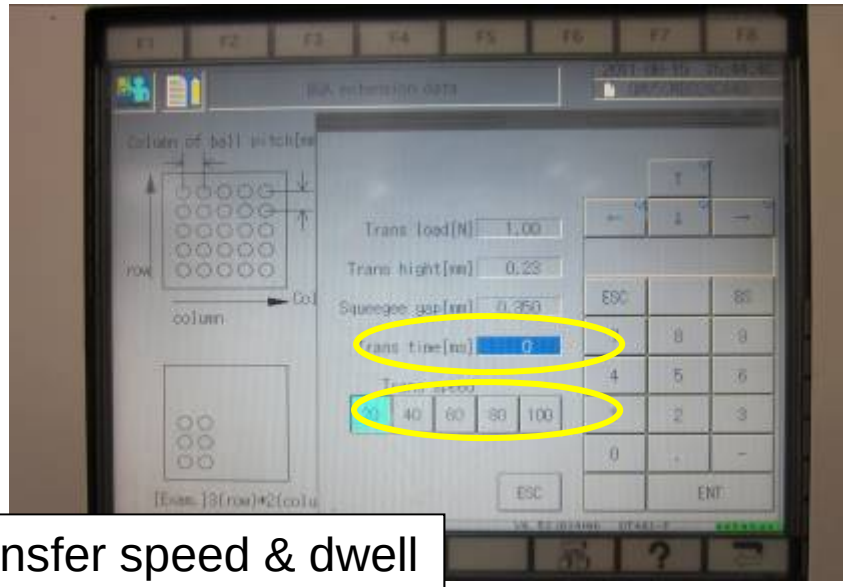
# Memory Paste dipping & SMT Machine Control Setting



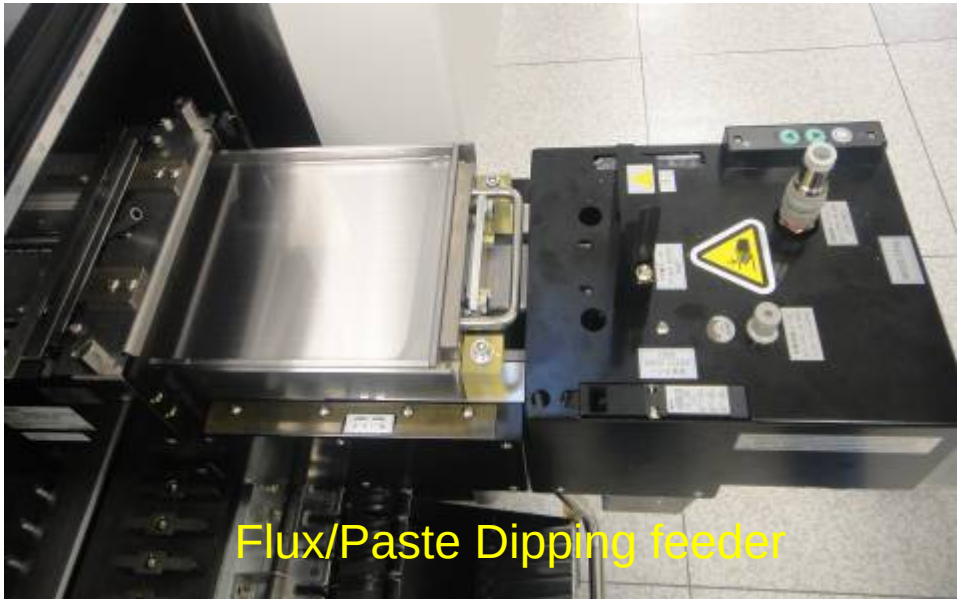
**Memory Dip too fast + paste suppress by 4 balls and extrude the additional paste up & attached on the bottom of substrate surface.**



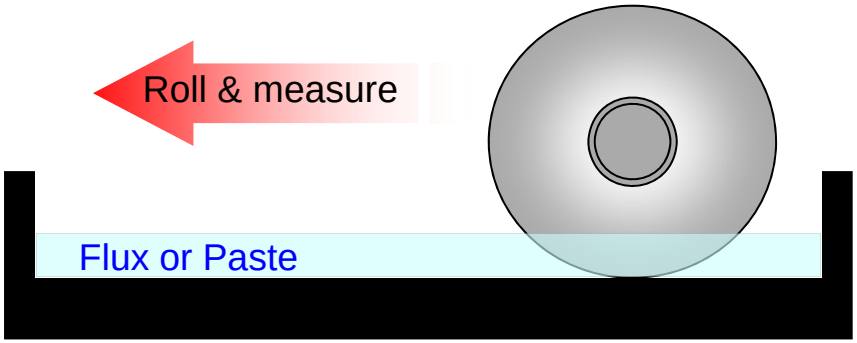


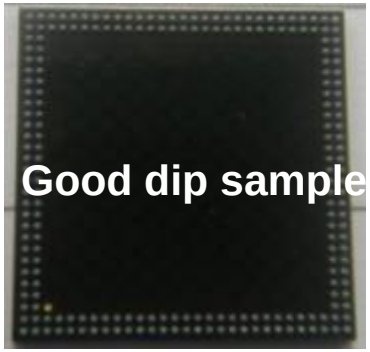

Balance the in/out transfer speed & dwell time to get optimized solder dipping.

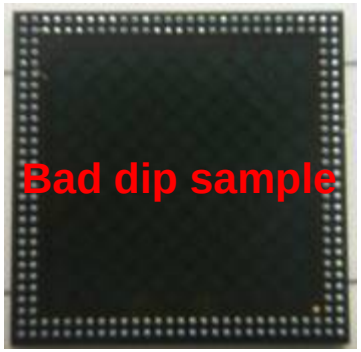
# Flux/Solder Paste Depth Measurement


Flux/paste dipping depth was measured by using height gauge shown in below picture.




The dipping performance contributed the top level soldering yield directly.

# Measurement of flux depth (Example)

ERICHSEN
TESTING EQUIPMENT

## Wet Film Thickness Gauge 433

**ISO, BS**

One instrument only for 4 measuring ranges: 5 - 100 microns, 100 - 500 microns, 300 - 700 microns, 700 - 1500 microns. This comb-shaped instrument, made of stainless steel, stands out for high accuracy.

## Wet Film Thickness Gauge 234

**DIN, ASTM, BS, ISO, NF**

A hardened and ground double wheel with an eccentric cam in the middle is rolled over a newly applied film. The wetting line on the middle cam is read off on a scale as wet film thickness. Total measuring range: 1500 microns, available in 8 different sub-ranges.

# Condition of PnP M/C setting (example)

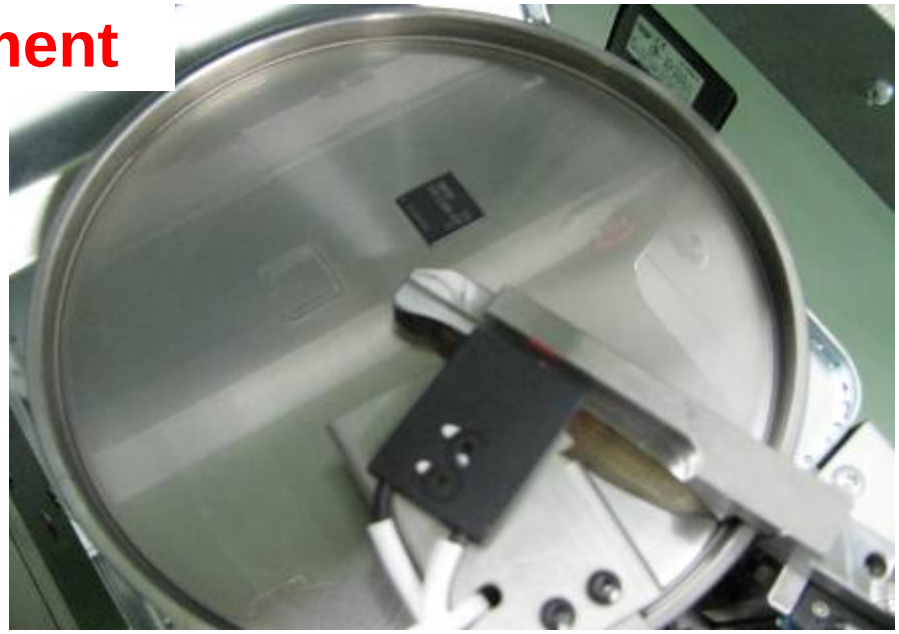
## Placement Parameters:

- ✓SMT M/C Brand: Panasonic
- ✓Type: NPM
- ✓Device Placement: OMAP4 + Memory Chip
- ✓Placement method: By 1-step
- ✓Fiducial marks recognition for placement:
  By Board fiducial
- ✓Pick up Nozzle type: 1004
- ✓Nozzle size: ~8mm (with robber tip)
- ✓Memory Vision sequence: Pickup + Camera vision + Memory Dipping + Placement
- ✓Dwell time of memory dipping: 400ms ~1 sec
- ✓Placement Force (N) or placement depth (um):
  - For OMAP4: package height+1~2.5N (push down)
  - For Memory Chip: package height+1~2.5N (push down)

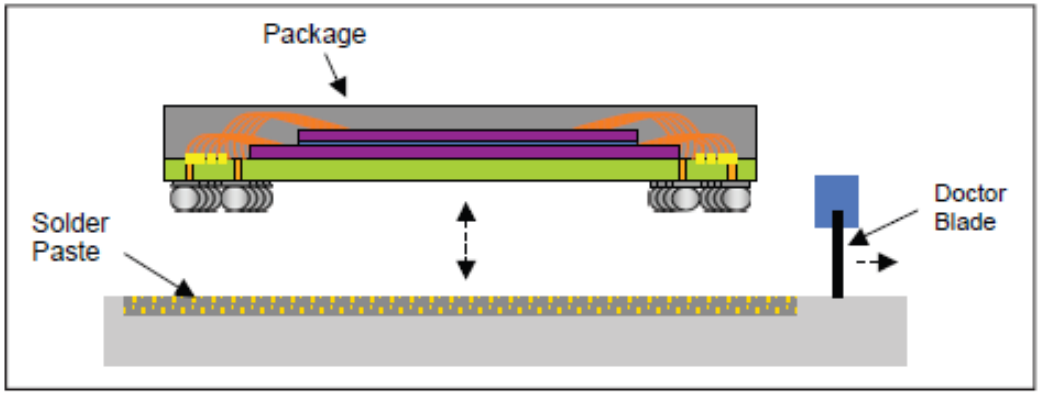

Nozzle type: 1004

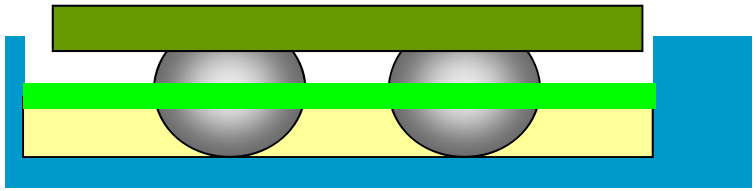
# Bottom and Top BGA Placement

Surface Mounter: Fuji NXT



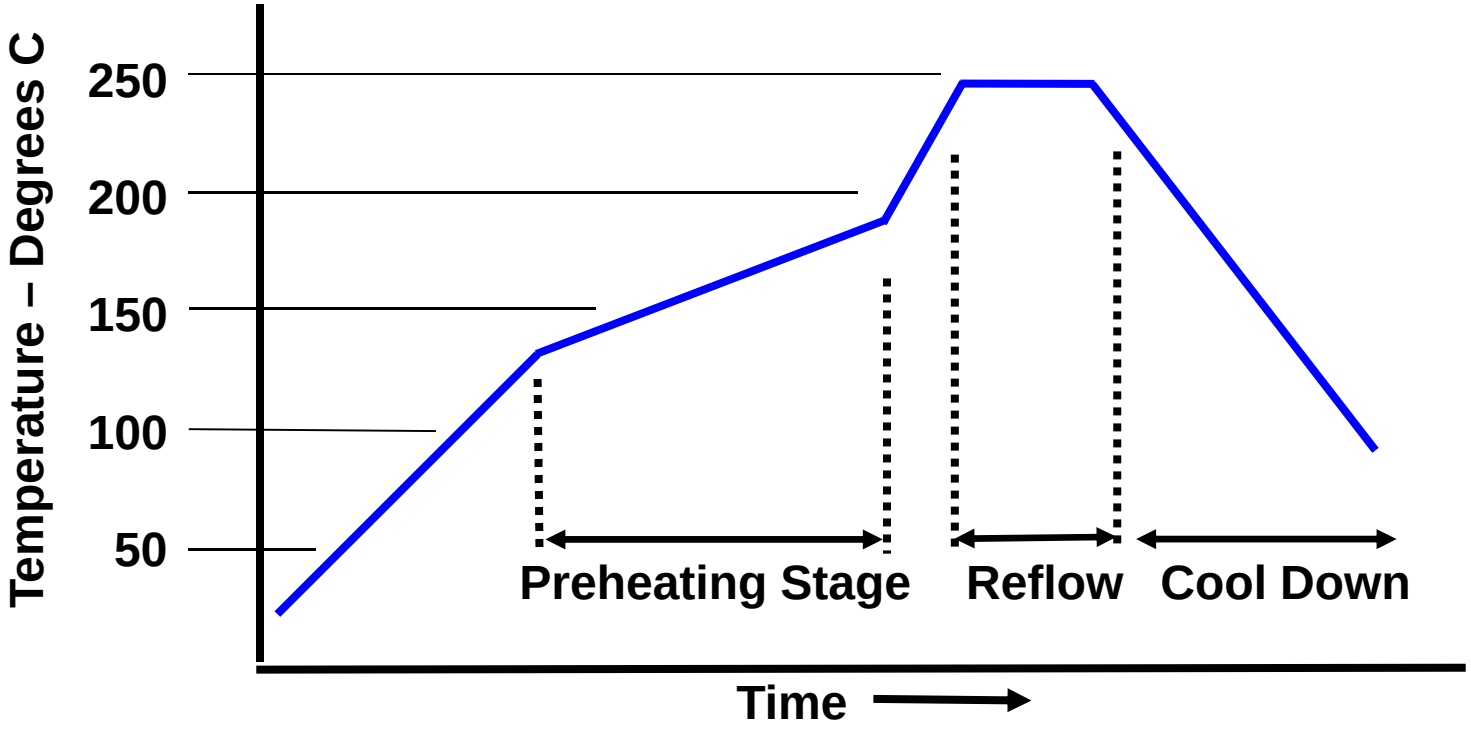
Memory Package
Flux Dipping Reservoir



Ideal Flux Depth = 50-60%

# Profile Recommendation for OMAP4xxx (TMV)

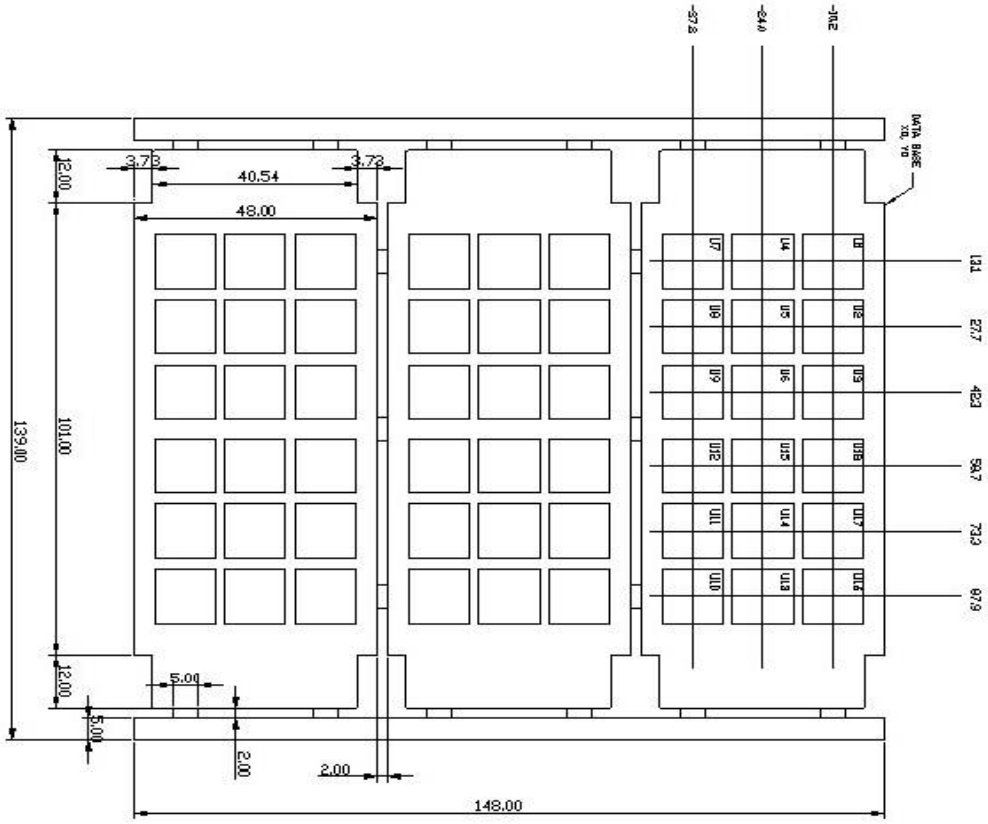


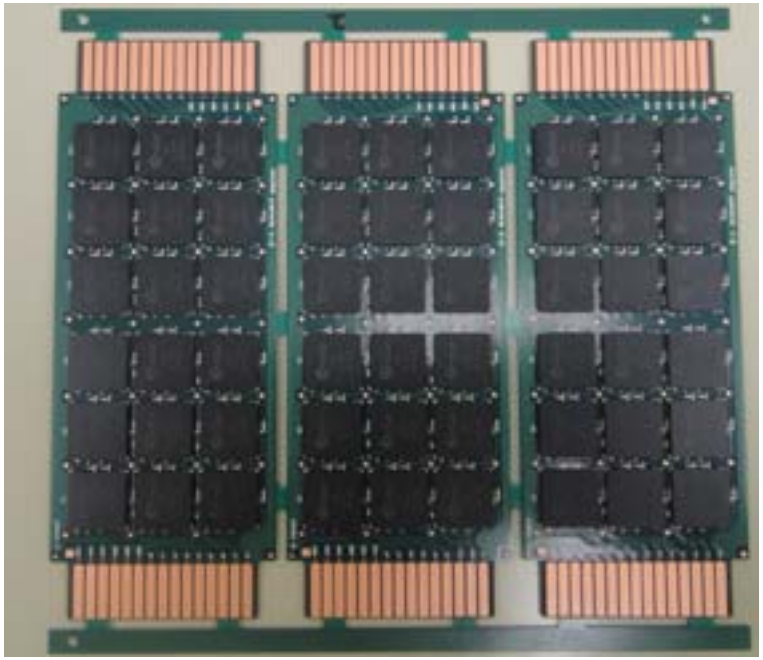

**Reflow conditions:**

| | |
|---|---|
| ➢ RT to 150˚C | 1~3˚C/s |
| ➢ Pre –heat temp(150~200 ˚C) | 60~120sec |
| ➢ Time above melting 220˚C | 50~80sec |
| ➢ Peak temp | 240-250˚C |
| ➢ Cool down rate | 2~6˚C/sec (max.) |

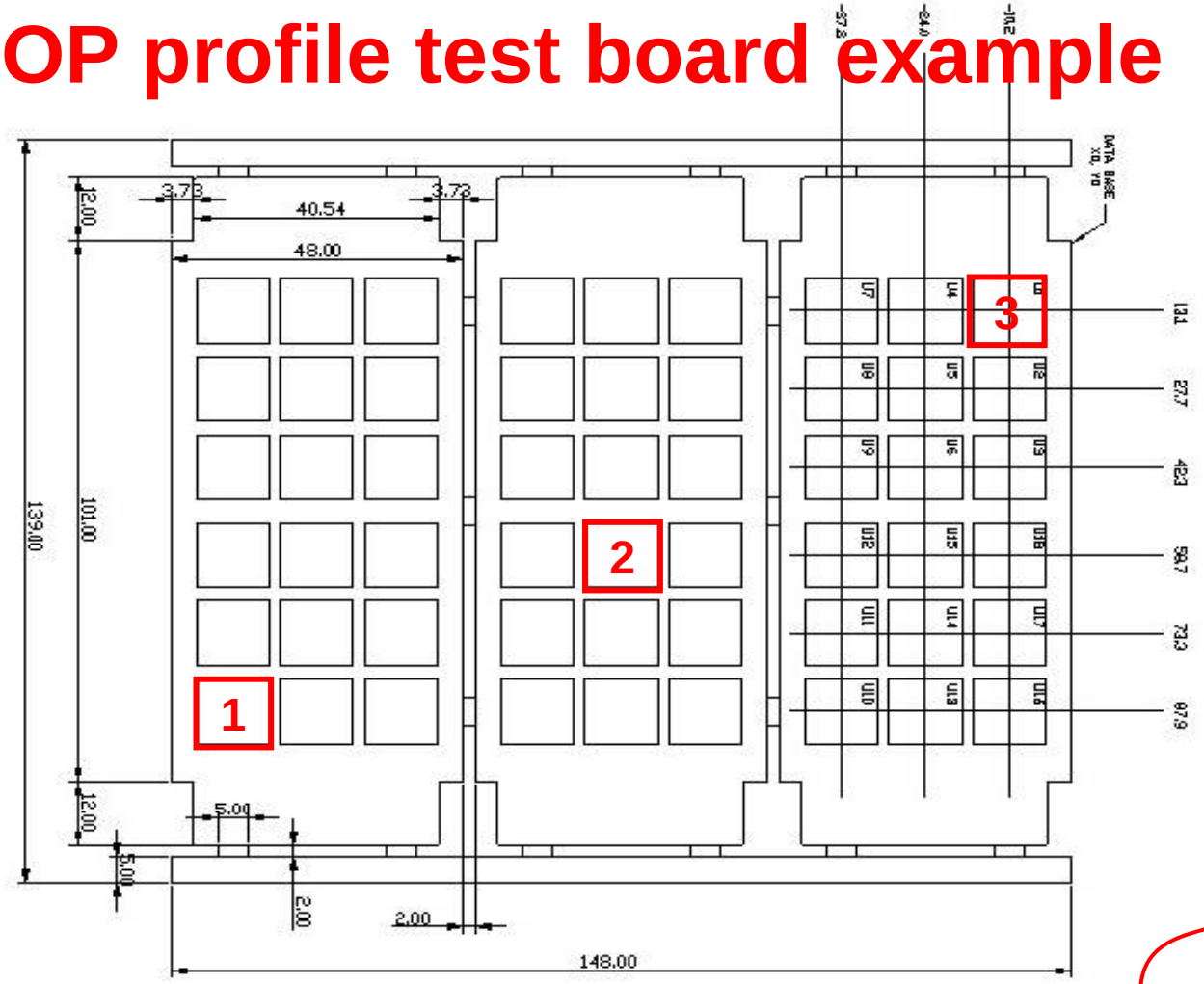
- ✓ Evaluated solder paste:
  - ✓ Shenmao PF-606-P (SAC305)
  - ✓ Tamura TLF-204-19A
- ✓ Evaluated Memory dip flux/paste:
  - ✓ Senju M705-TVA03.9F (Paste)
  - ✓ Senju Deltalux-901K3 (Flux)
- ✓ <700 ppm O2 reflow atmosphere is recommended to provide the widest process window.
- ✓ The real profile must be fine-tuned for each product to meet the optimized soldering results

# PCB panel



# POP profile test board example



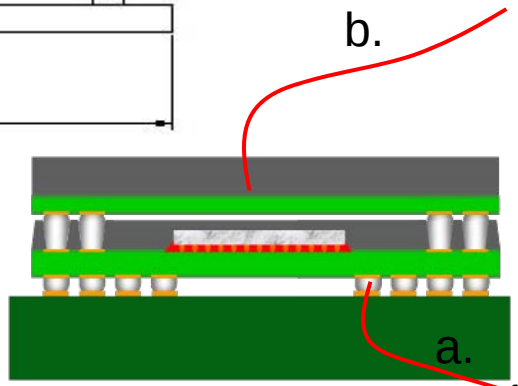

-Thermal couple test locations: see above picture

-Thermal couple test points:

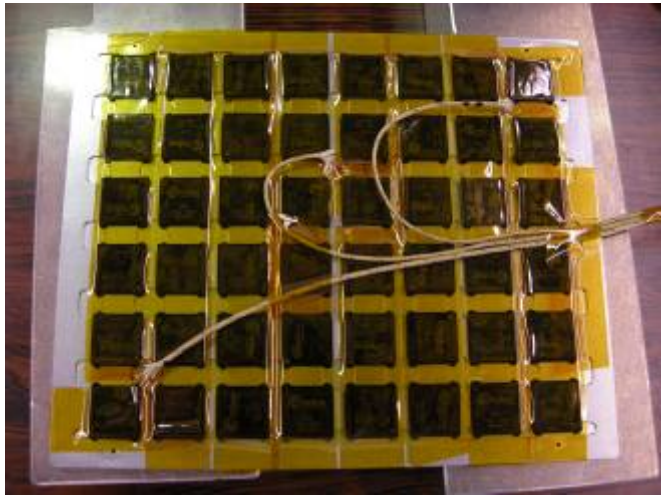
a. The central point btw PCB & OMAP

b. The central point btw OMAP & Memory

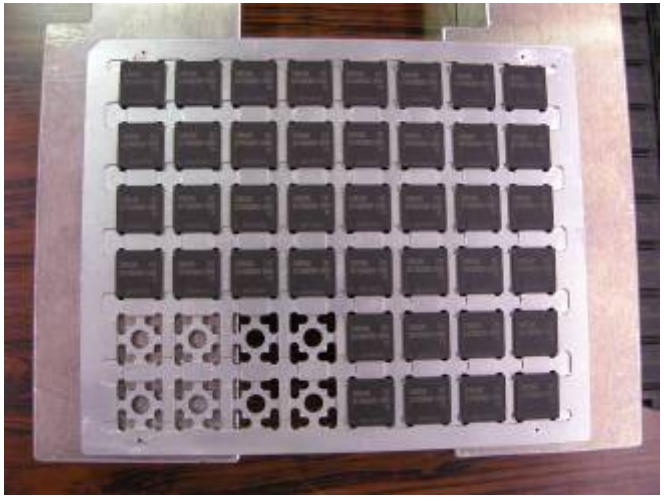
-Total 6 test points



# 2-pass reflow: Pre-stack tray for FCPOP

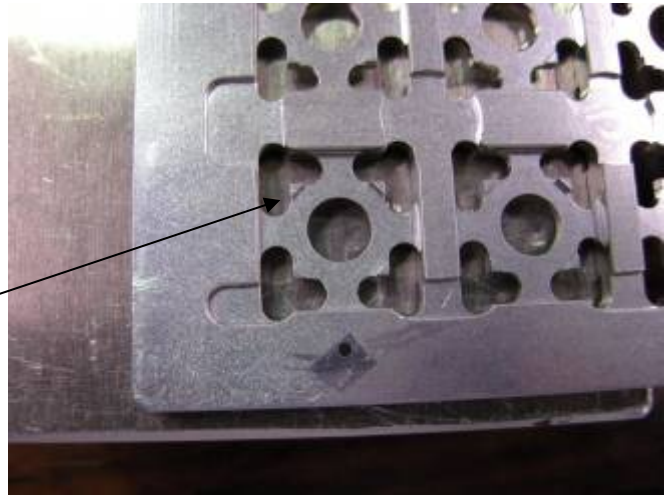


To check temperature profile



Pre-stack tray designed for TI OMAP3430

Bottom POP is supported by
this rib to depopulated ball area



Pre-stack tray designed for TI OMAP3430

# Agenda:

- Package Introduction
- OMAP4 SMT Process sharing
  - ✓Stencil/PCB design guide
  - ✓Memory chip flux/solder dipping in 1-step mounting
  - ✓The example of Pick & Place machine condition setting
  - ✓Reflow profile recommendation
  - ✓SMT experiment examples
- Q& A

# OMAP4xxx SMT Evaluation

## Preliminary experiments performed concurrent to package design and material selection

| Experiments | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Dippable mat'l | Senju 529D-1 | Senju 529D-1 | Senju 529D-1 | Senju 529D-1 | Senju M705-TVA03.9-F | Senju Deltalux-901K3 | Senju Deltalux-901K3 |
| | Flux | Flux | Flux | Flux | Paste | Flux | Flux |
| Dipping plate depth | 170um | 170um | 170um | 170um | 140um | 170um | 160um |
| Reflow Atmosphere | Air | N2 | N2 | Air | N2 | N2 | N2 |
| Reflow preheat time (sec) | 80-90 | 80-90 | 60-65 | 60-65 | 70-80 | 70-80 | 70-80 |
| Dwell time for TMV package placement (ms) | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Dwell time for memory package dipping (ms) | 300 | 300 | 300 | 300 | 600 | 600 | 300 |
| Dwell time for memory package placement (ms) | 300 | 300 | 300 | 300 | 500 | 500 | 500 |
| | | | | | | | |
| Sample Size | 1635 | 204 | 2310 | 1700 | 972 | 216 | 700 |
| Rejects | 114 | 0 | 5 | 37 | 0 | 3 | 8 |
| Yield | 93% | 100% | 100% | 98% | 100% | 99% | 99% |

| Total Air Atmosphere | |
|---|---|
| Sample Size | 3335 |
| Rejects | 151 |
| Yield | 95.5% |

| Total N2 Atmosphere | |
|---|---|
| Sample Size | 4402 |
| Rejects | 16 |
| Yield | 99.6% |

**Summary:**

- **Nitrogen atmosphere better than air**
- **Senju 901K3 better in air than Senju 529D-1***
- **Dipping depth too deep***

*reference follow up tests in this report

# OMAP4xxx DOE Experiments

# OMAP4xxx DC (TMV) SMT Evaluation
## DOE1

# DOE1 Set Up

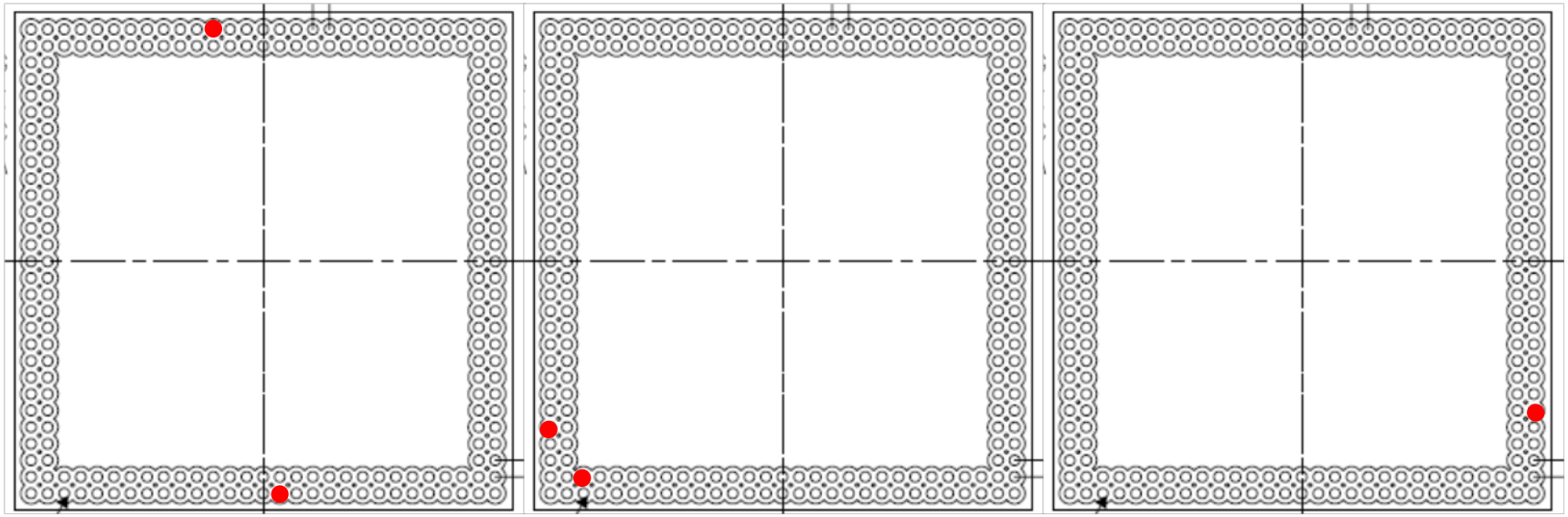
| | Flux Dipping | Paste Dipping |
|---|---|---|
| **OMAP4 Package** | OMAP4 CBS Daisy Chain | OMAP4 CBS Daisy Chain |
| **Memory Package** | Mock Up | Mock Up |
| **SMT Board** | NSMD Pads | SMD Pads |
| **Bottom BGA Paste** | Shenmao PF-606-P (SAC305) | Shenmao PF-606-P (SAC305) |
| **Top BGA Flux or Paste** | Senju Deltalux-901K3 **(No-Clean dipping flux)** | Senju M705-TVA03.9F **(SAC305, No-Clean dipping paste)** |
| **Solder Stencil** | Laser and electro-polished | Laser and electro-polished |
| Thickness (um) | 80 | 80 |
| Shape | Round | Round |
| Outer Four Rows Diameter (um) | 250 | 250 |
| Inner Rows Diameter (um) | 200 | 200 |
| **Memory Package Dipping Depth (um)** | 120 - 140um | See other table |
| **Reflow Profile** | | |
| Pre-heat time | 70-80 sec | 70-80 sec |
| Time above Liquid | 65 - 75 sec | 65 - 75 sec |
| Peak temp and time | 245-250oC | 245-250oC |
| **Reflow Atmosphere** | Nitrogen (700 O2 ppm) | Nitrogen (700 O2 ppm) |
| **Sample Size** | 540 packages | 270 |
| **Yield** | | |
| Opens (DC net test) | 0/540 | See other table |
| Shorts (X-Ray) | 0/540 | See other table |

# DOE1 Results

| | Run 1 | Run 2 |
|---|---|---|
| | **Flux Dipping** | **Paste Dipping** |
| **Memory Ball Height** | 190um | 190um |
| **Top BGA Flux or Paste** | Senju Deltalux-901K3 **(No-Clean dipping flux)** | Senju M705-TVA03.9F **(SAC305, No-Clean dipping paste)** |
| Warm up time | > 8 hours | See below table |
| **Memory Package Dipping Depth (um)** | 120 - 140um | See below table |
| **Sample Size** | 540 ea | 270ea |
| **Yield** | | |
| Opens (DC net test) | 0/540 | See below table |
| Shorts (X-Ray) | 0/540 | See below table |

| Run | 2-1 | 2-2 | 2-3 | 2-4 | 2-5 |
|---|---|---|---|---|---|
| Bottom BGA Paste | Shenmao PF-606-P (SAC305) | | | | |
| Warm up time | > 18 hours | | | | |
| Top BGA Paste | Senju M705-TVA03.9F (SAC305, No-Clean dipping paste) | | | | |
| Warm up time | 30 min | > 18 hours | | | |
| | | | | | |
| Memory Package Dipping Depth (um) | 140 | 125 | 124 | 122 | 122 |
| Yield | | | | | |
| Opens (DC net test) | 0/54 | 0/54 | 0/54 | 0/54 | 0/54 |
| Shorts (X-Ray) | 54/54 | 2/54 | 0/54 | 0/54 | 0/54 |

# Top BGA Typical Solder Joint Defects



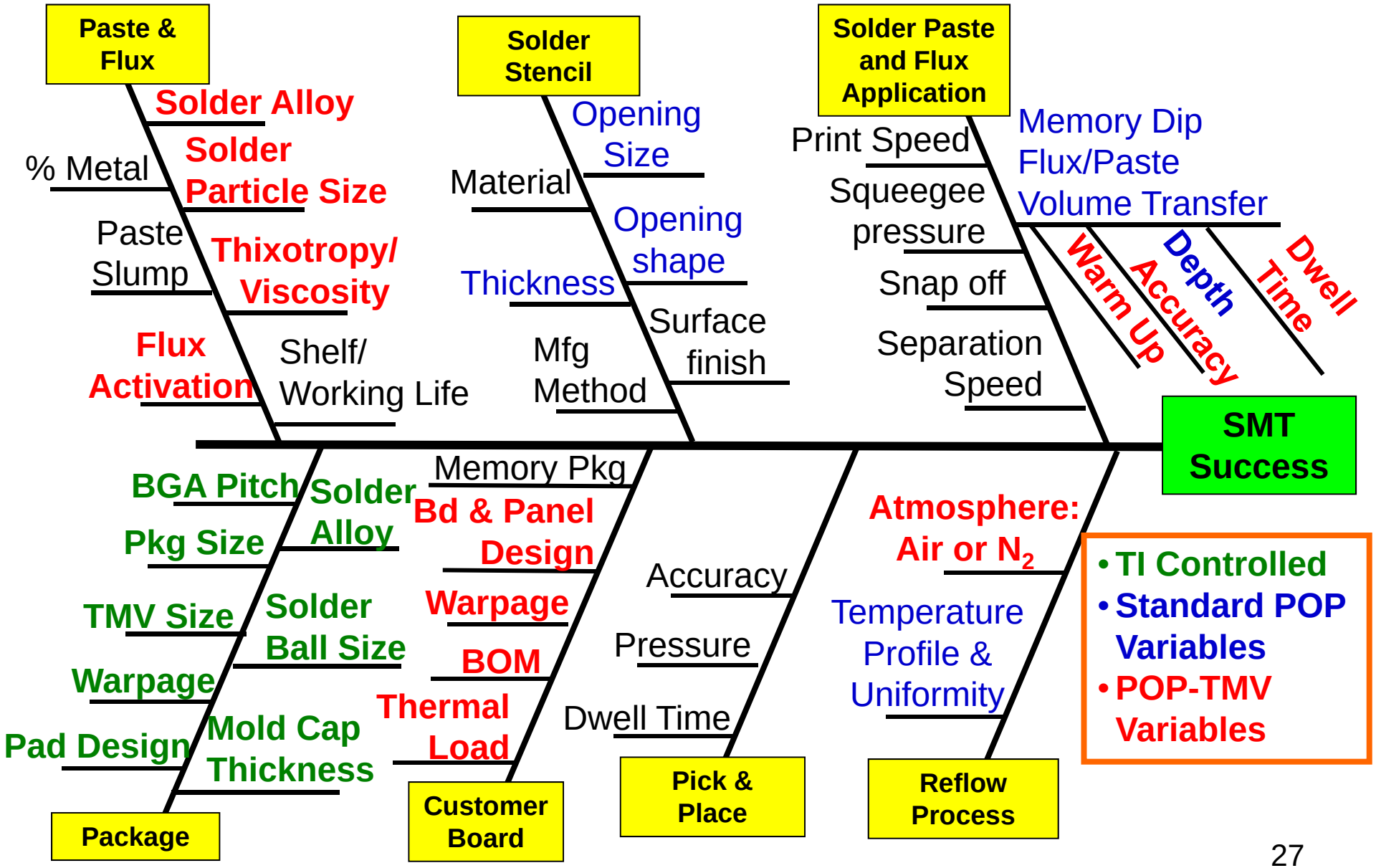
**Defect**: Random single or double non-wet solder joints

**Root Causes**:

- Insufficient flux
- OMAP and/or Memory solder ball height and gap variation during the reflow process

**Solution**: Flux volume transfer control

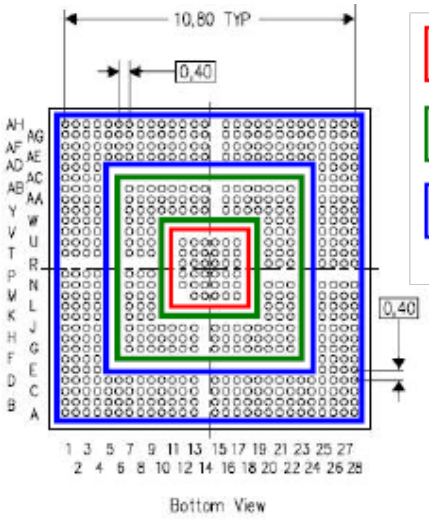
# POP SMT Process Variables



# OMAP4xxx DC (TMV) SMT Evaluation
## DOE2

# DOE2 Set up: Screen Print Stencil Design & Reflow Process

| Stencil Designs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Shape | Round 80 Variable, Nano | Round 80 Variable | Round 80 | Square 80 Uniform | Square 80 Variable | Square 80 variable Nano | Round 100 Uniform | Round 100 Uniform |
| Thickness (um) | 80 | 80 | 80 | 80 | 80 | 80 | 100 | 100 |
| Zone C | 250 | 250 | 250 | 250 | 250 | 250 | 210 | 255 |
| Zones A & B | 200 | 200 | 250 | 250 | 200 | 200 | 210 | 255 |
| Opening Ratio | | | | | | | | |
| Zones C | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.53 | 0.64 |
| Zone A & B | 0.63 | 0.63 | 0.78 | 0.78 | 0.63 | 0.63 | 0.53 | 0.64 |




Zone A: Center Array

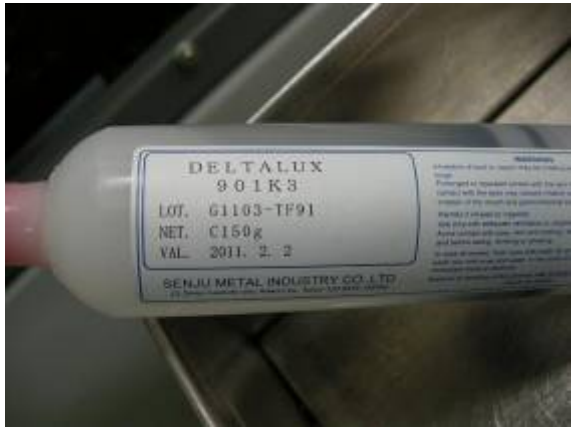
Zone B: Middle Array

Zone C: Outer Array

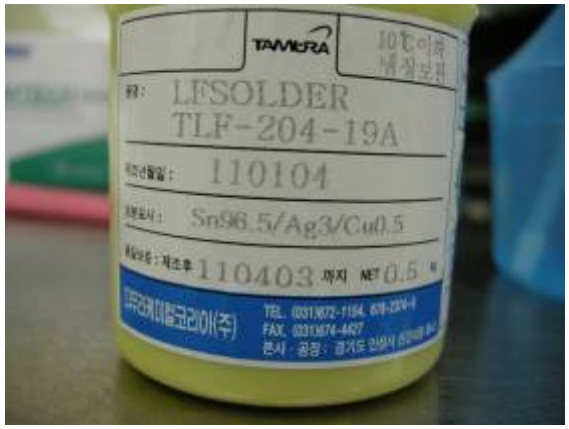
| Reflow Profiles | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| Preheat Zone | | | |
| Temperature | R/T-120C | R/T-120C | R/T-120C |
| Time | 70 | 90 | 110 |
| Soak Zone | | | |
| Temperature | 120-180c | 120-180c | 120-180c |
| Time | 90 | 110 | 130 |
| Reflow Zone | | | |
| Peak Temperature | 235 | 240-245 | 245-250 |
| Time above Liquid | 60 | 80 | 100 |
| Cooling Zone | 3°/sec | 3°/sec | 3°/sec |

# DOE2: Solder Paste and Flux

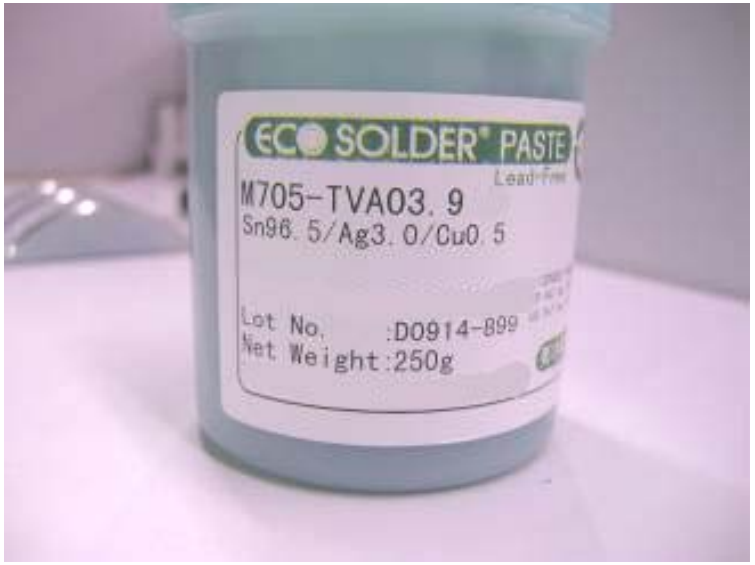
Flux for memory dipping:
Senju DELTALUX 901K3




Solder paste for POP mount:
Tamura TLF-204-19A




Solder paste for memory dipping:
Senju M705-TVA03.9-F

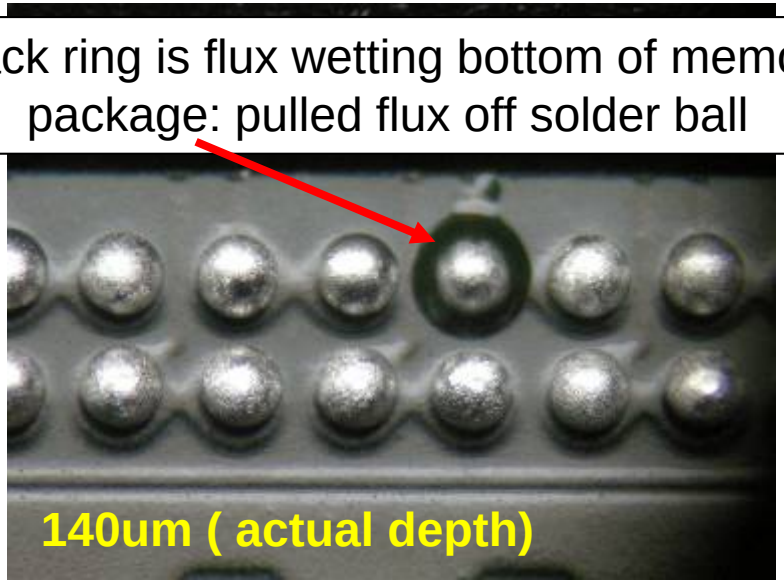


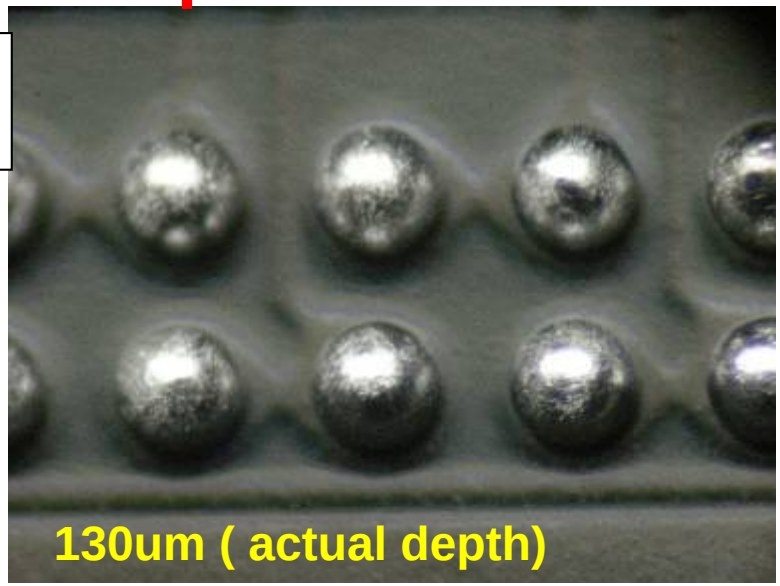
# DOE2 Results

| Legs | Stencils | | | | | POP Memory Process | | Reflow Profile | | | Reflow Atmosphere | | Qt'y | Opens | | Shorts | Yield | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 4 | 5 | 7 | 8 | Dipping Material | Dipping Depth (um) | A | B | C | Air | $N_2$ <700ppm $O_2$ | | Bottom | Top | Any | Bottom | Top |
| 1 | | | | | | Paste: Senju M705-TVA03.9F | 105 | | | | | | 216 | 0 | 0 | 0 | 100% | 100% |
| 2 | | | | | | | 140 | | | | | | 216 | 0 | 0 | 0 | 100% | 100% |
| 3 | | | | | | | 180 | | | | | | 54 | 0 | | 54 | 100% | 0% |
| 4 | | | | | | Flux: Senju 901K3 | 140 | | | | | | 216 | 0 | 76 | 0 | 100% | 65% |
| 5 | | | | | | | 130 | | | | | | 216 | 0 | 0 | 0 | 100% | 100% |
| 6 | | | | | | | 130 | | | | | | 216 | 1 | 1 | 0 | 99.5% | 99.5% |
| 7 | | | | | | | 130 | | | | | | 216 | 0 | 1 | 0 | 100% | 99.5% |
| 8 | | | | | | | 130 | | | | | | 216 | 0 | 0 | 0 | 100% | 100% |
| 9 | | | | | | | 130 | | | | | | 216 | 0 | 216 | 0 | 100% | 0% |
| 10 | | | | | | | 130 | | | | | | 108 | 0 | 108 | 0 | 100% | 0% |
| 11 | | | | | | | 130 | | | | | | 108 | 0 | 1 | 0 | 100% | 99% |
| 12 | | | | | | | 130 | | | | | | 216 | 0 | 216 | 0 | 100% | 0% |
| 13 | | | | | | | 130 | | | | | | 108 | 0 | 102 | 0 | 100% | 6% |
| 14 | | | | | | | 130 | | | | | | 108 | 0 | 0 | 0 | 100% | 100% |
| 15 (15 air bake, 150oC, 8 hrs) | | | | | | | 130 | | | | | | 108 | 0 | 108 | 0 | 100% | 0% |
| 16 (15 air bake, 150oC, 8 hrs) | | | | | | | 130 | | | | | | 108 | 0 | 0 | 0 | 100% | 100% |
| 17-1 | N/A (Pre-Stack) | | | | | Paste: Senju M705-TVA03.9F | 140 | | | | | | 108 | N/A | N/A | N/A | N/A | N/A |
| 17-2 | N/A (Pre-Stack) | | | | | Flux: Senju 901K3 | 130 | | | | | | 108 | N/A | N/A | N/A | N/A | N/A |
| 17-1a | | | | | | 17-1 pre-stack | | | | | | | 108 | 0 | 0 | 0 | 100% | 100% |
| 17-2b | | | | | | 17-2 pre-stack | | | | | | | 108 | 0 | 0 | 0 | 100% | 100% |
| | | | | | | | | | | | | Total | 2862 | | | | | |

# Memory Dipping Defect Example

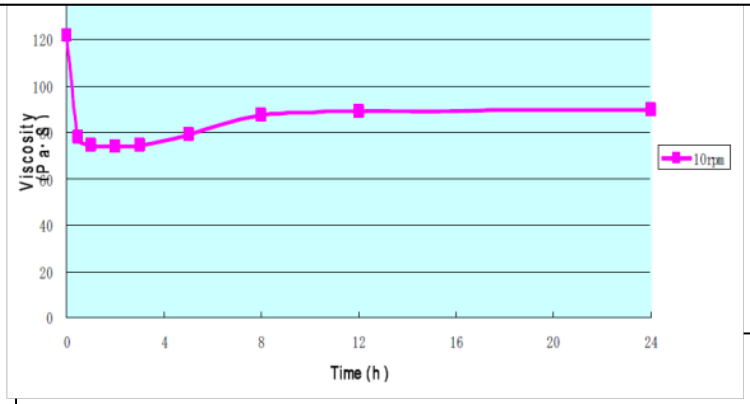
Black ring is flux wetting bottom of memory package: pulled flux off solder ball




| Flux Legs | Flux Dipping Mat'l | Dipping Depth | Reflow Peak Temp (oC) | Reflow Atmosphere | Package Quantity | Yield |
|---|---|---|---|---|---|---|
| 1 | Senju Deltalux-901K3 | 140um | 240-245 | $N_2$ (<700ppm $O_2$) | 216 | 65% |
| 2 | Senju Deltalux-901K3 | 130um | 240-245 | $N_2$ (<700ppm $O_2$) | 216 | 100% |

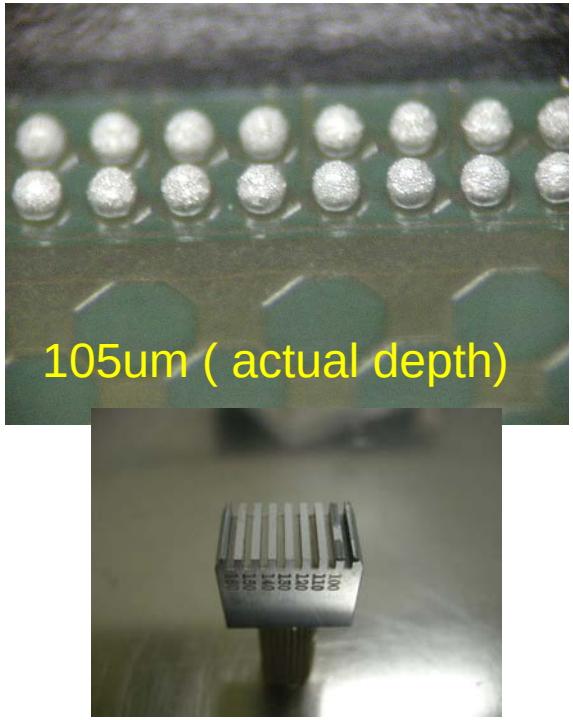
Flux viscosity with continuous stirring

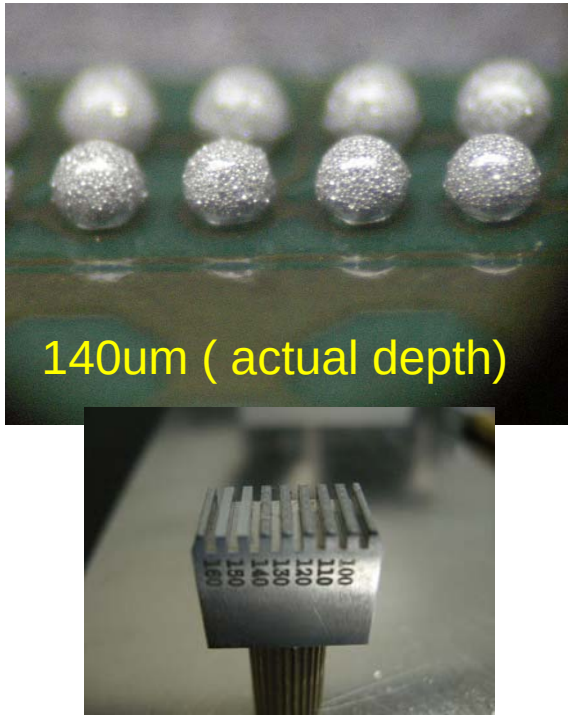


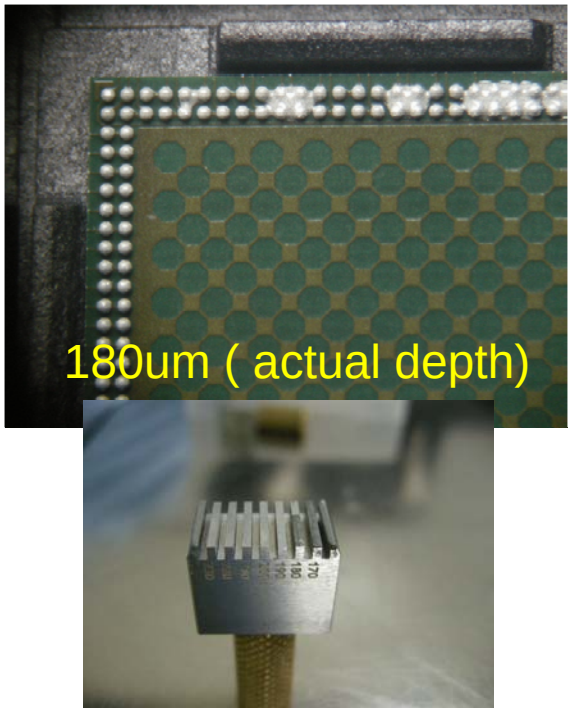

**Flux transfer to memory package is critical:**

- Type of flux
- Viscosity of flux
- Dipping depth
- Dwell time of package in flux tray

# Paste Dipping Experiment Result




| Paste Legs | Paste Dipping Mat'l | Dipping Depth (um) | Reflow Peak Temp (oC) | Reflow Atomosphere | Package Q'ty | Yield |
|---|---|---|---|---|---|---|
| 1 | Senju M705-TVA03.9F | 105 | 240-245 | $N_2$ (<700ppm $O_2$) | 216 | 100% |
| 2 | Senju M705-TVA03.9F | 140 | 240-245 | $N_2$ (<700ppm $O_2$) | 216 | 100% |
| 3 | Senju M705-TVA03.9F | 180 | 240-245 | $N_2$ (<700ppm $O_2$) | 54 | 0% |

# DOE2 Result

**Summary:**

- Bottom BGA yield robust vs. stencil design
- Top BGA yield sensitive to flux dipping process
  - Depth
  - Viscosity
  - Dwell time
- Top BGA dipping in paste successful: verification required
- Nitrogen atmosphere (<700ppm $O_2$) required in this test
- Experiments will continue to define assembly capability in an Air reflow atmosphere

# OMAP4xxx DC (TMV) SMT Evaluation
## DOE3

# DOE3 Set up:

| Reflow Profile | |
|---|---|
| **Preheat Zone** | |
| Temperature | R/T-120C |
| Time | 90 |
| **Soak Zone** | |
| Temperature | 120-180c |
| Time | 110 |
| **Reflow Zone** | |
| Peak Temperature | 240-245 |
| Time above Liquid | 80 |
| **Cooling Zone** | 3°/sec |

| Stencil Design | |
|---|---|
| **Shape** | Round 80 Variable |
| **Surface Finish** | Laser Job nano coating |
| **Thickness (um)** | 80 |
| **Opening Diameter(um)** | |
| Zone C | 250 |
| Zones A & B | 200 |
| **100% Volume Transfer Rate** | |
| Zones C ($um^3$) | 3926991 |
| Zone A & B ($um^3$) | 2513274 |
| **Opening Ratio** | |
| Zones C | 0.78 |
| Zone A & B | 0.63 |

| Material in DOE3 | | Recommended reflow atmosphere | Notes |
|---|---|---|---|
| Paste | Senju M705-TVA03.9K | Air | [Halogen Free ROLO (<500ppm) per JSTD-004A, No-Clean Dip Paste] |
| Paste | Senju TVA 107K | Air | [Halogenated ROL1 per JSTD004A, No-Clean Dip Paste] |
| Flux | Senju Deltalux 529D-1 | Air | [Halogenated ROL1, No-Clean Dip Flux] |
| Flux | Senju Deltalux-GTN68-HF | Air | [Halogen Free ROLO (<500ppm) per J-STD004A/B, No-Clean Dip Flux] |

# DOE3: Results

| DOE Leg | Bottom BGA Printing Material | Memory Dipping Mat'l | | Dipping Depth (Actual depth) | Dipping Dwell Time (ms) | With EMI Shield | Reflow | | Q'ty | | # Opens | # Shorts | Yield % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Air | N2 ($O_2$<700 ppm) | Panels | PKGs | | | |
| 1 | Tamura TLF-204-19A | Paste | Senju TVA 107K | 130 | 600 | No | | | 4 | 216 | 1 | 0 | 99.5 |
| 2 | Tamura TLF-204-19A | Paste | Senju TVA 107K | 130 | 900 | No | | | 19 | 1000 | 0 | 0 | 100 |
| 3 | Tamura TLF-204-19A | Paste | Senju M705-TVA03.9K | 130 | 600 | No | | | 1 | 54 | 24 | 0 | 56 |
| 4 | Tamura TLF-204-19A | Paste | Senju M705-TVA03.9K | 130 | 900 | No | | | 1 | 54 | 19 | 0 | 65 |
| 5 | Tamura TLF-204-19A | Paste | Senju M705-TVA03.9K | 130 | 600 | No | | | 1 | 54 | 0 | 0 | 100 |
| 6 | Tamura TLF-204-19A | Paste | Senju M705-TVA03.9K | 130 | 900 | No | | | 1 | 54 | 0 | 0 | 100 |
| 7 | Tamura TLF-204-19A | Flux | Senju Deltalux 529D-1 | 130 | 600 | No | | | 1 | 54 | 13 | 0 | 76 |
| 8 | Tamura TLF-204-19A | Flux | Senju Deltalux 529D-1 | 130 | 900 | No | | | 1 | 54 | 22 | 0 | 59 |
| 9 | Tamura TLF-204-19A | Flux | Senju Deltalux-GTN68HF | 130 | 600 | No | | | 4 | 216 | 1 | 0 | 99.5 |
| 10 | Tamura TLF-204-19A | Flux | Senju Deltalux-GTN68HF | 130 | 900 | No | | | 19 | 1000 | 0 | 0 | 100 |
| 11 | Tamura TLF-204-19A | Flux | Senju Deltalux-GTN68HF | 130 | 900 | Yes | | | 3 | 18 | 0 | 0 | 100 |
| 12* | Tamura TLF-204-19A | Flux | Senju Deltalux-GTN68HF | 130 | 900 | No | | | 2 | 108 | 108 | 0 | 0 |
| 13* | Tamura TLF-204-19A | Paste | Senju TVA 107K | 130 | 900 | No | | | 2 | 108 | 108 | 0 | 0 |
| | | | | | | | | Totals | 59 | 2990 | | | |

*Preconditioned: 150C for 1.5 hrs in Air, followed with 8 hrs at 85RH/85C

# DOE3 Result

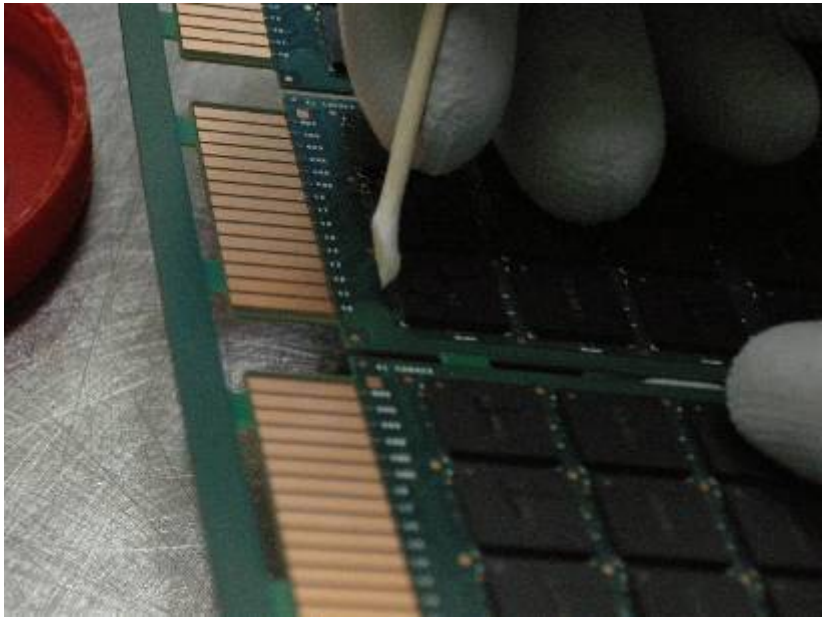
**Summary:**

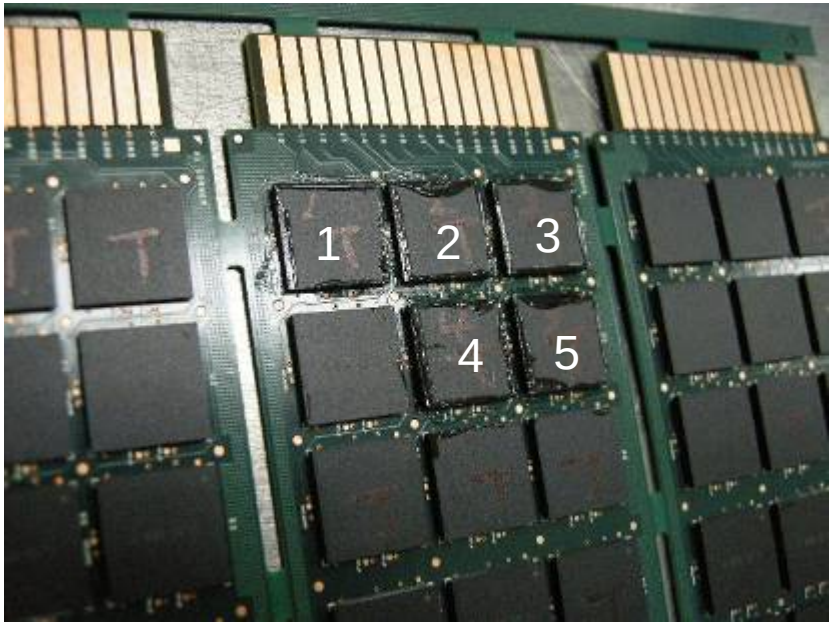
- Flux and Paste chemistry and rheology are critical factors for use in an air reflow atmosphere
- Time out of refrigeration and time worked in dipping tray affects coating uniformity
- Dipping time change from 600ms to 900ms improved yield
- A paste that did not work in air worked in nitrogen reflow atmosphere
- Bottom BGA process continues to be robust
- Pre-conditioned parts shifted and yielded zero bottom BGA connections:  X-ray of top BGA looked normal but unable to test due to lack of connection through bottom BGA

## Appendix

- ✓A1: Through molded via solder rework methods
  - **Brush with flux repair method**
  - Manual rework method
- ✓A2: X-ray examples
- ✓A3: Screen print material and reflow equipment examples
- ✓A4: Package warpage affect examples

# Brush with flux for repair in TMV level (1)

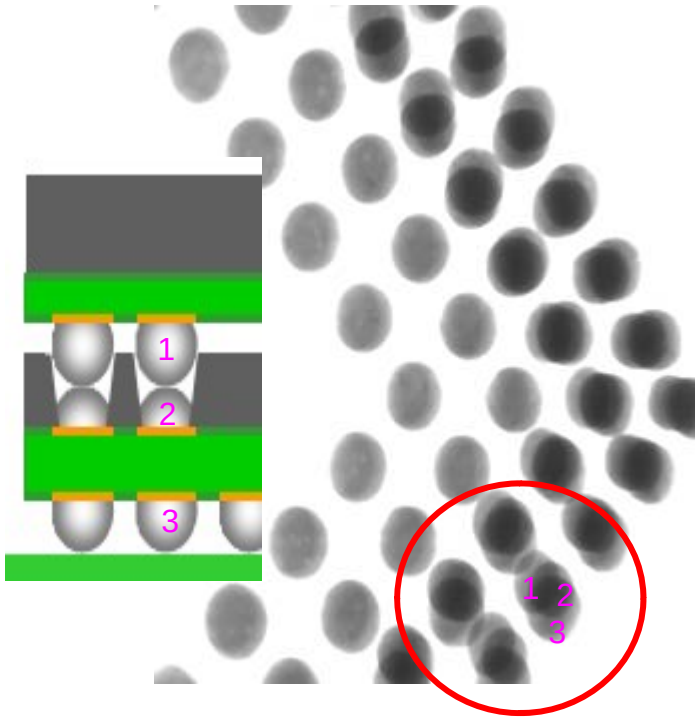





-Use cotton swab to apply adequate flux at the side-walls of defective POP.
-Reflow then Check in X-ray (see next slide) & O/S test.

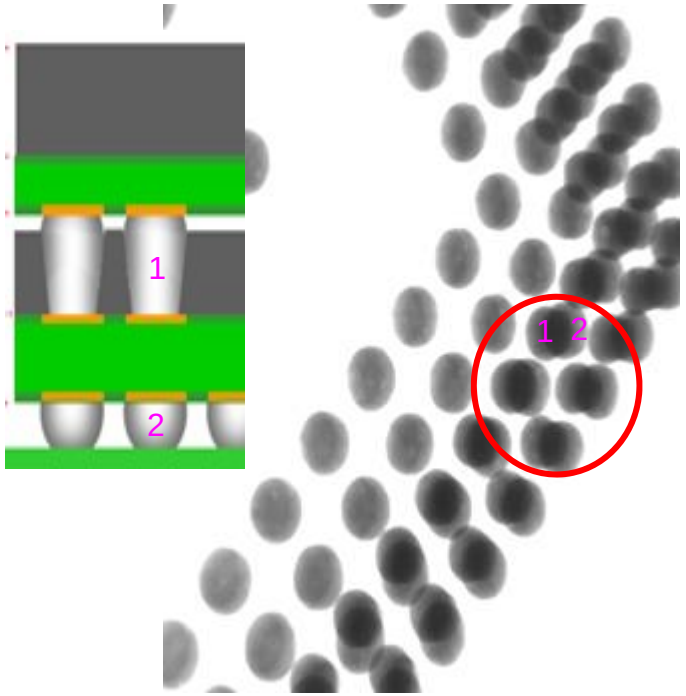
| Evaluate samples | | | Test result (Xray, O/S) | |
|---|---|---|---|---|
| Size | Flux type | Repair level | OK | NG |
| 5 | Senju 529D-1 | TMV | 5 | 0 |

# Brush with flux for repair in TMV level (2)




**Non-wet Solder Joint**

The non-wetting TMV joints show as 3 balls overlapped with bottom BGA ball in X-ray inspection.




**Repaired Solder Joint**

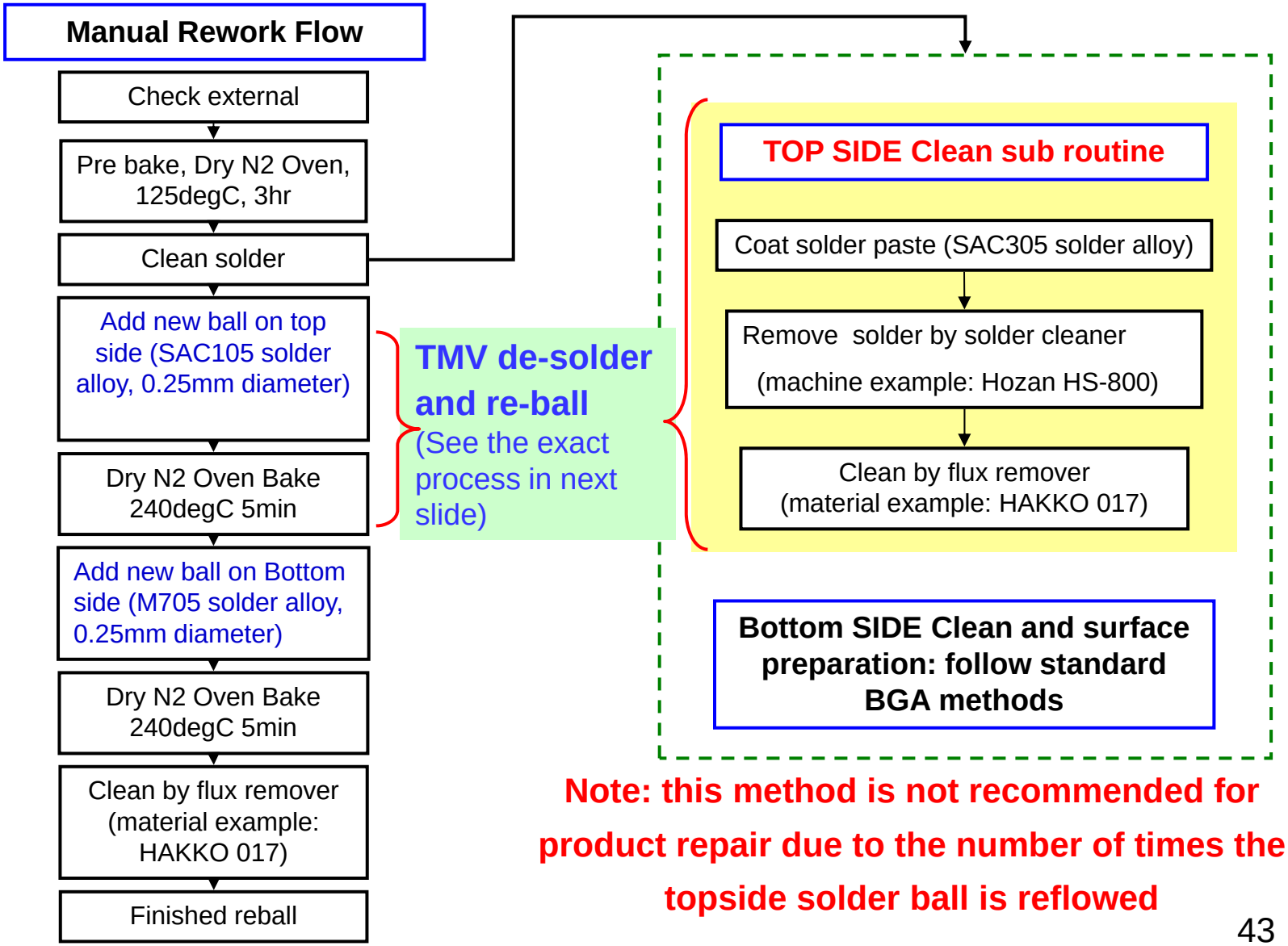
The defect TMV joints are re-healed & show as 2 balls overlapped with bottom BGA ball in X-ray inspection.

## Appendix

- ✓A1: Through molded via solder rework methods
  - Basic repair method
  - **Manual rework method**

  **Note: this method is not recommended for product repair due to the number of times the topside solder ball is reflowed**
- ✓A2: X-ray examples
- ✓A3: Screen print material and reflow equipment examples
- ✓A4: Package warpage affect examples

# Process Flow of Manual TMV Rework (1)

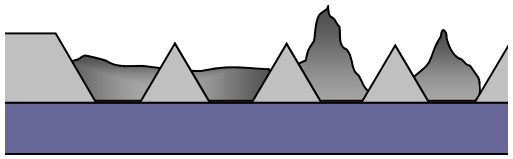


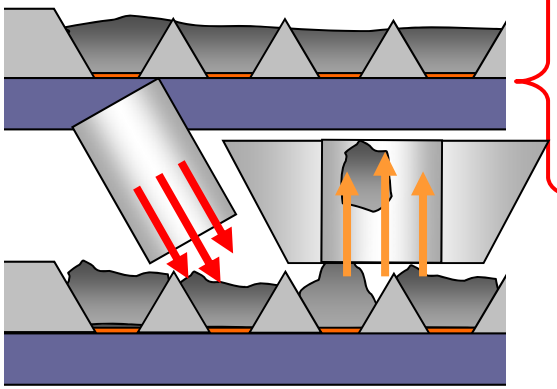

**Note: this method is not recommended for product repair due to the number of times the topside solder ball is reflowed**

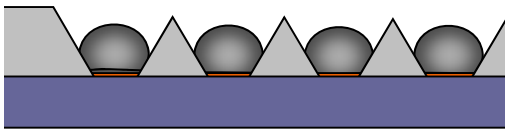
# Manual TMV Removal and Re-ball (2)

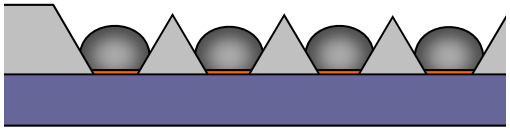
## Reball Approach

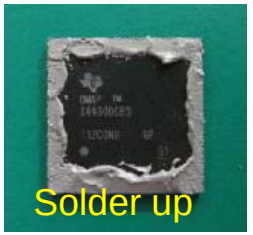
- Customer retur
- Solder up
- De-soldering
- Re-balling
- Bake
- Bottom reball process












• Thicker solder contributes better thermal conduction

• More flux help the solder soften and extract out , vacuum pressure ~80kPa

• Paint with flux and place 0.25mm solder ball and reflow

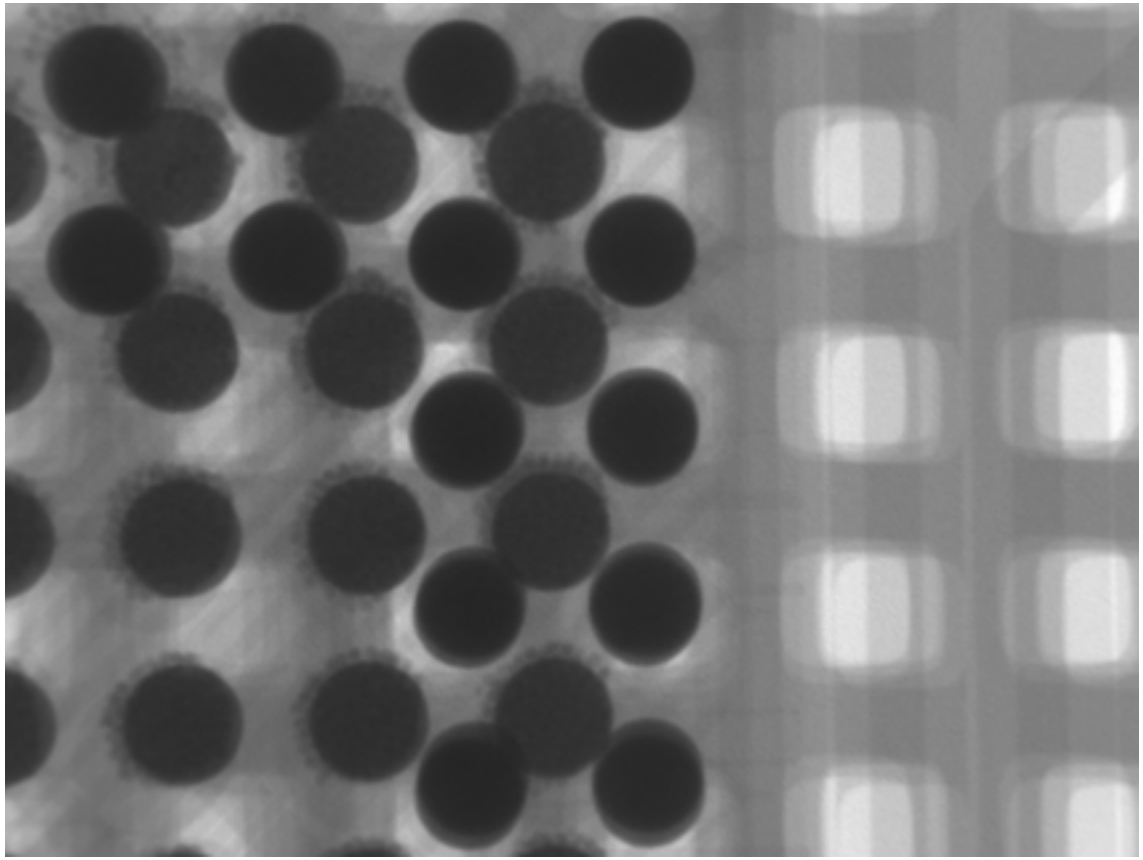
• measure coplanarity by an Equipment

# Appendix

- ✓A1: Through molded via solder rework methods
  - Basic repair method
  - Manual rework method
- ✓A2: X-ray examples
- ✓A3: Screen print material and reflow equipment examples A4: Package warpage affect examples

# Solder ball analysis by X-ray -1

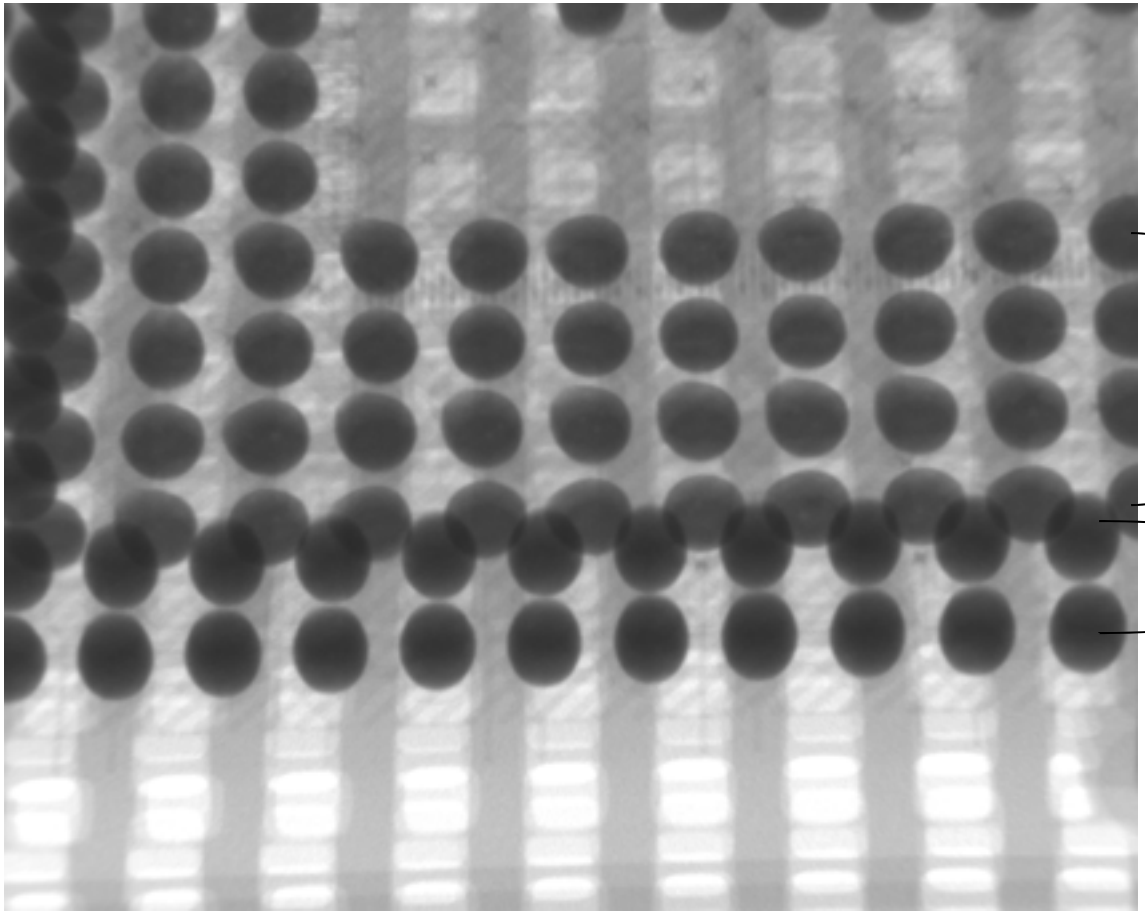
1-pass reflow



Picture: POP and Memory mount on PCB. Before reflow.
Solder paste printing check was good. Memory is mount on POP by flux with good accuracy.

# Solder ball analysis by X-ray -2

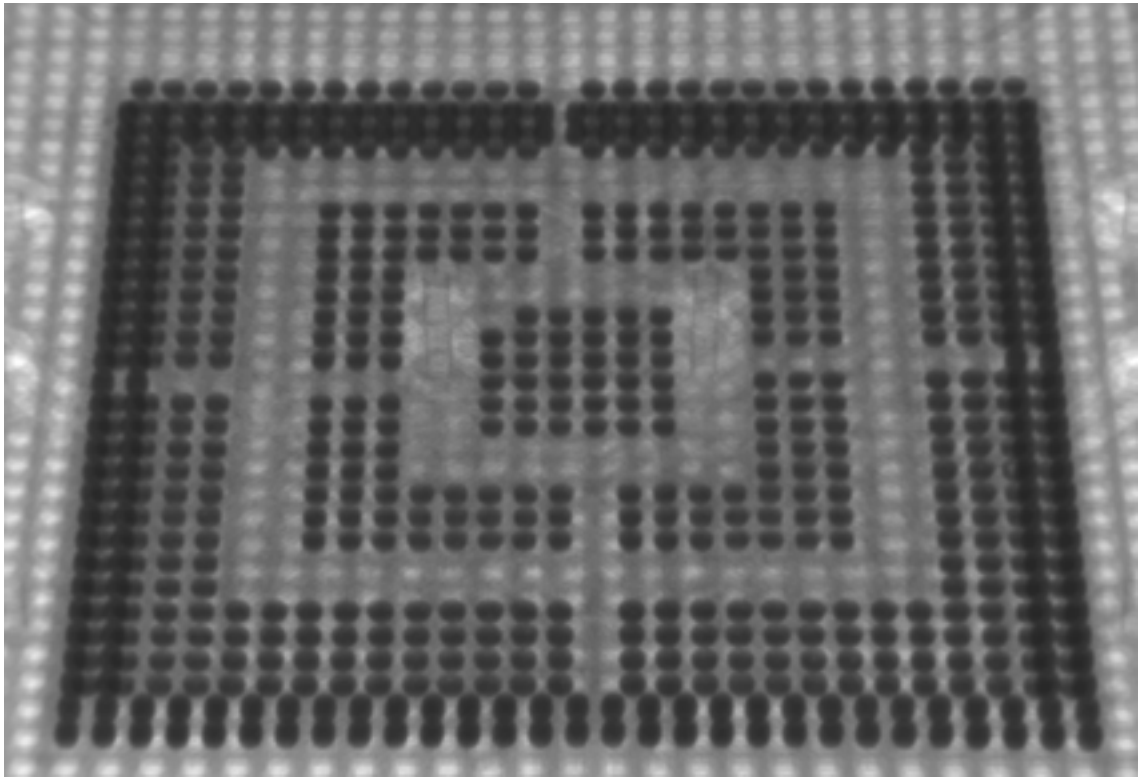
1-pass reflow




Picture: Memory mounted by flux, NSMD board, After reflow
Memory solder ball was jointed with POP showing good barrel shape

# Solder ball analysis by X-ray -3

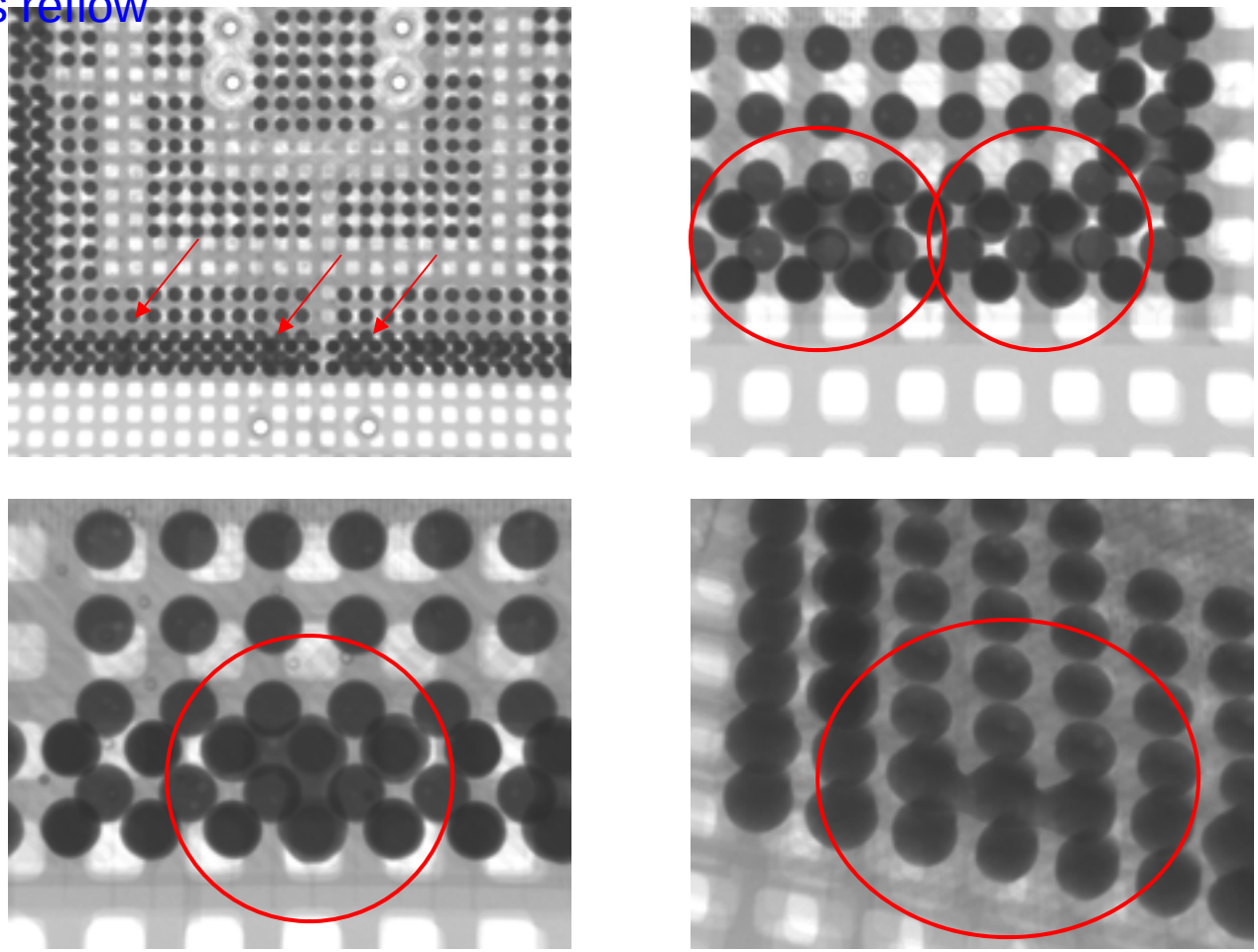
1-pass reflow



Picture: Memory mounted by flux, SMD board, After reflow
Memory jointed with POP with good barrel shape.
No anomaly is found for POP solder balls.

# Solder ball analysis by X-ray -4

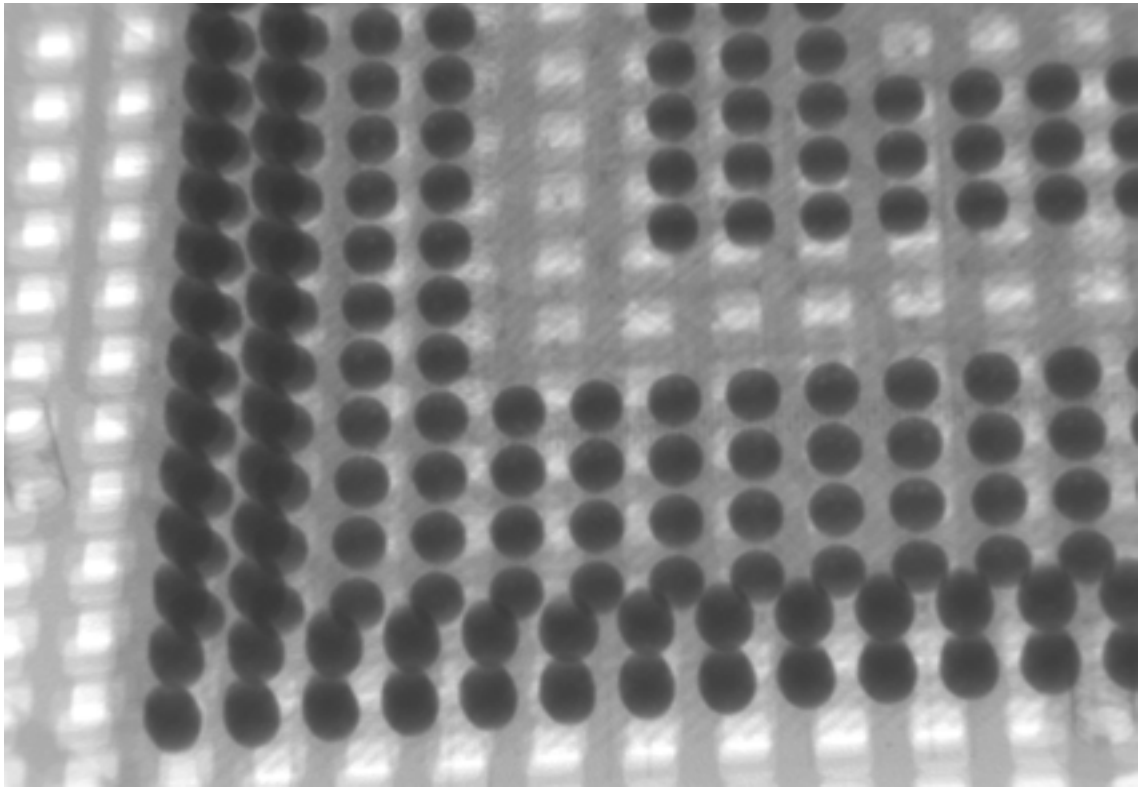
1-pass reflow



Picture: Memory mounted by solder paste, SMD board, After reflow
Excess solder paste caused solder ball short

# Solder ball analysis by X-ray -5

1-pass reflow

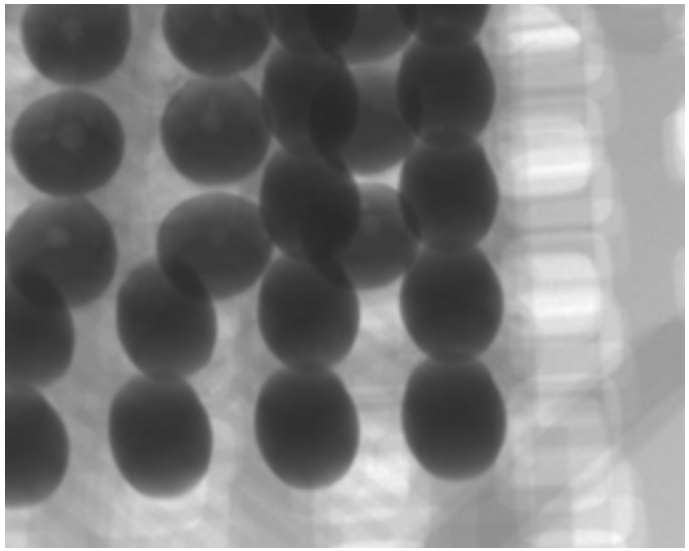


Picture: Memory mounted by solder paste, SMD board, After reflow.
Reduced solder paste dipping depth then solder ball short did not happen

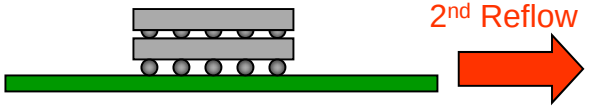
# Solder ball analysis by X-ray -6

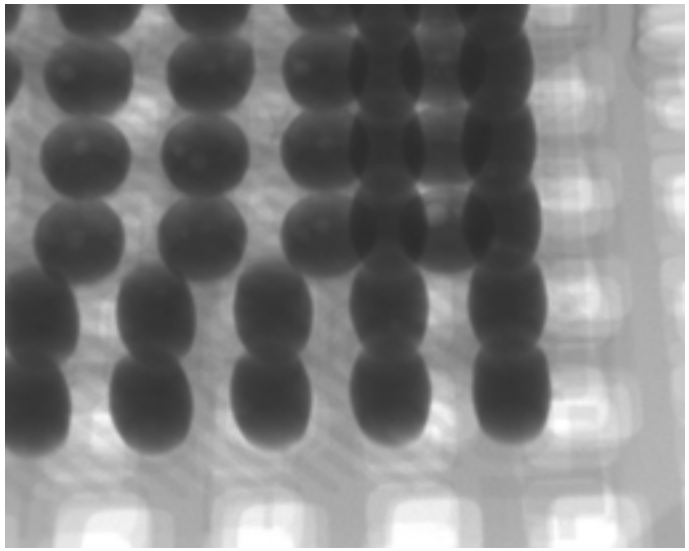
1-pass reflow

2nd reflow result. Run POP+Memory mount board reflow again

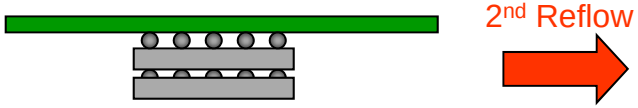


Paste dip, After reflow, SMD pad
Package upward



Paste dip, After reflow, SMD pad
Package downward

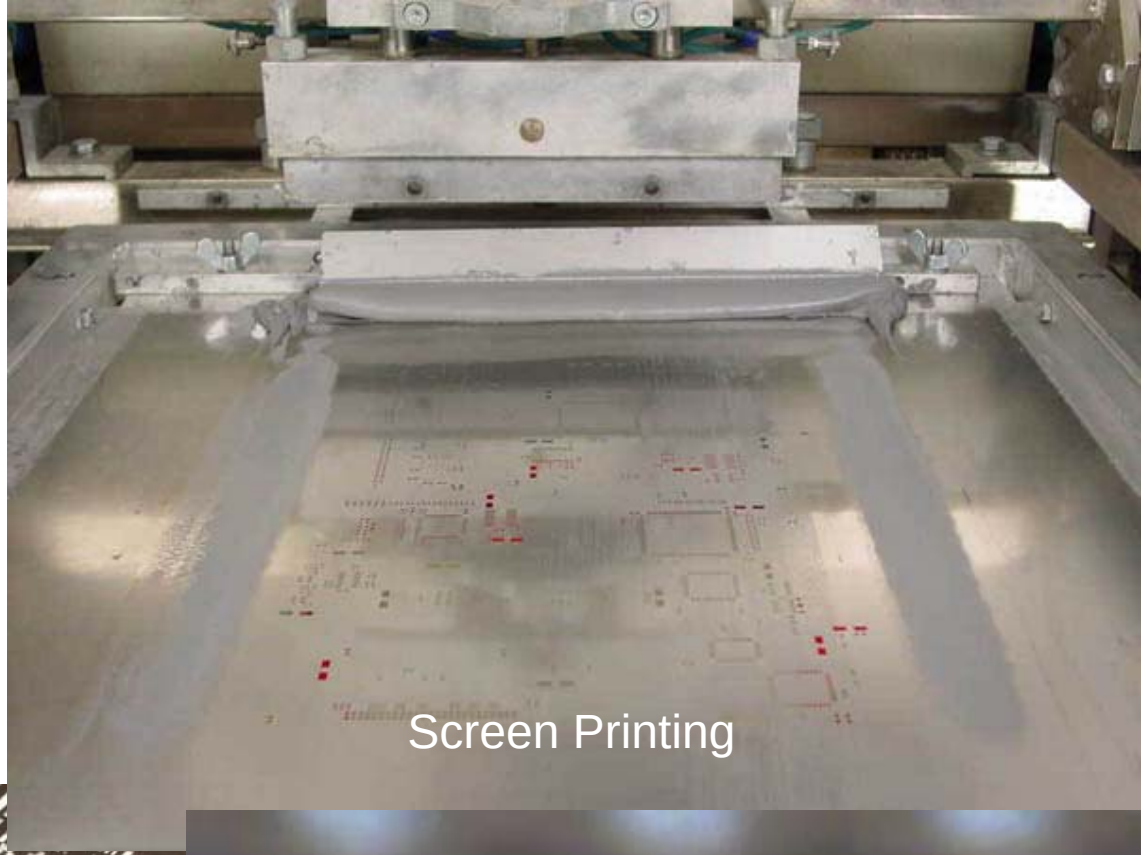


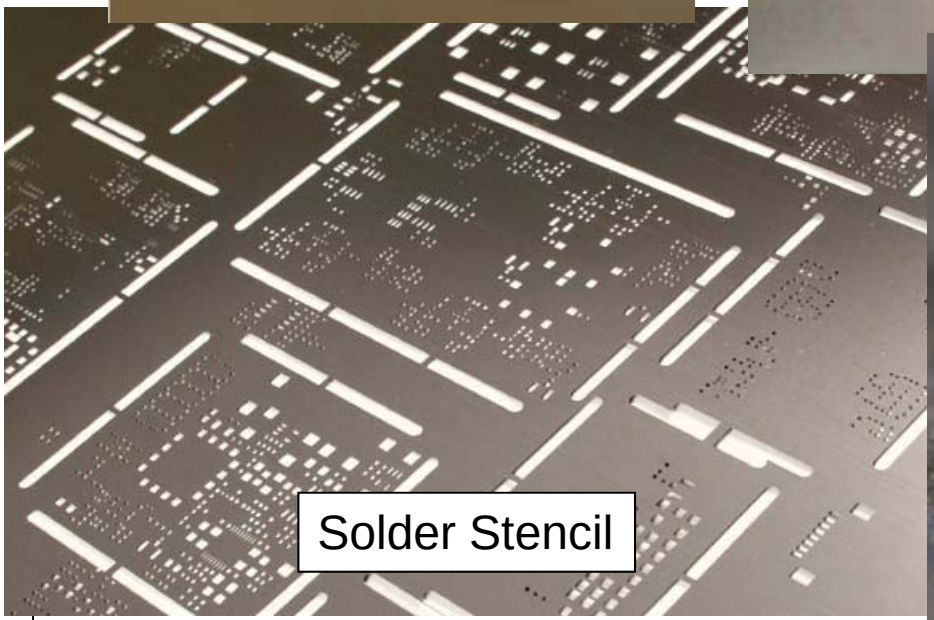

Memory solder ball joint did not change by 2nd reflow

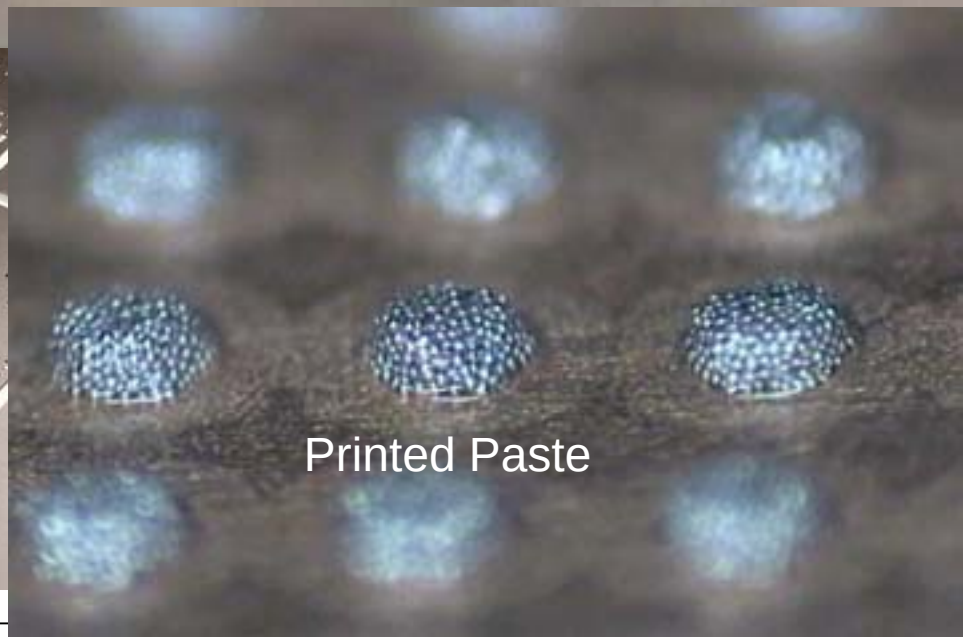
# Appendix

- ✓A1: Through molded via solder rework methods
  - Basic repair method
  - Manual rework method
- ✓A2: X-ray examples
- ✓A3: Screen print material and reflow equipment examples
- ✓A4: Package warpage affect examples

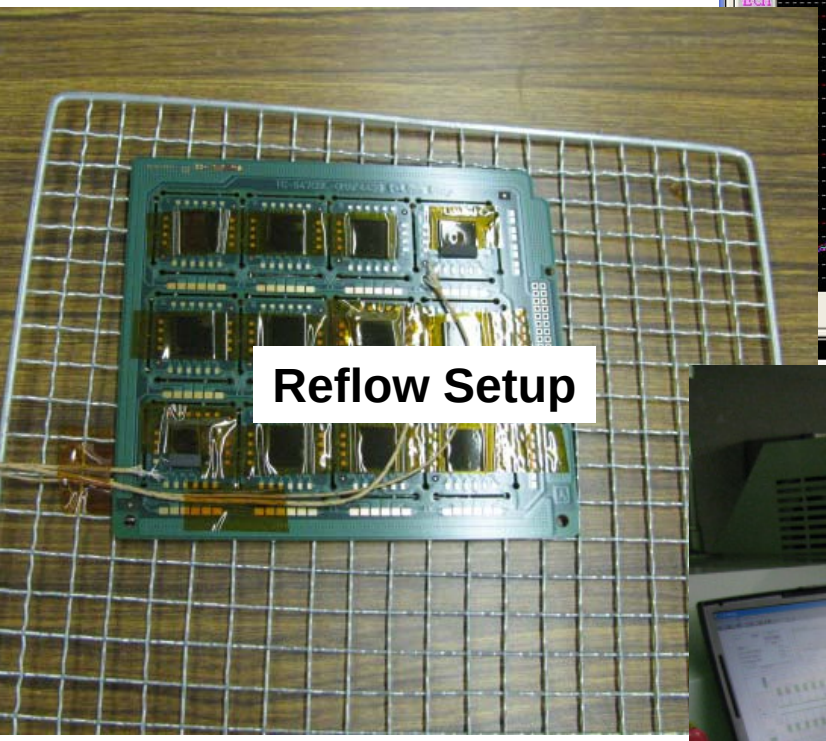

Solder Paste

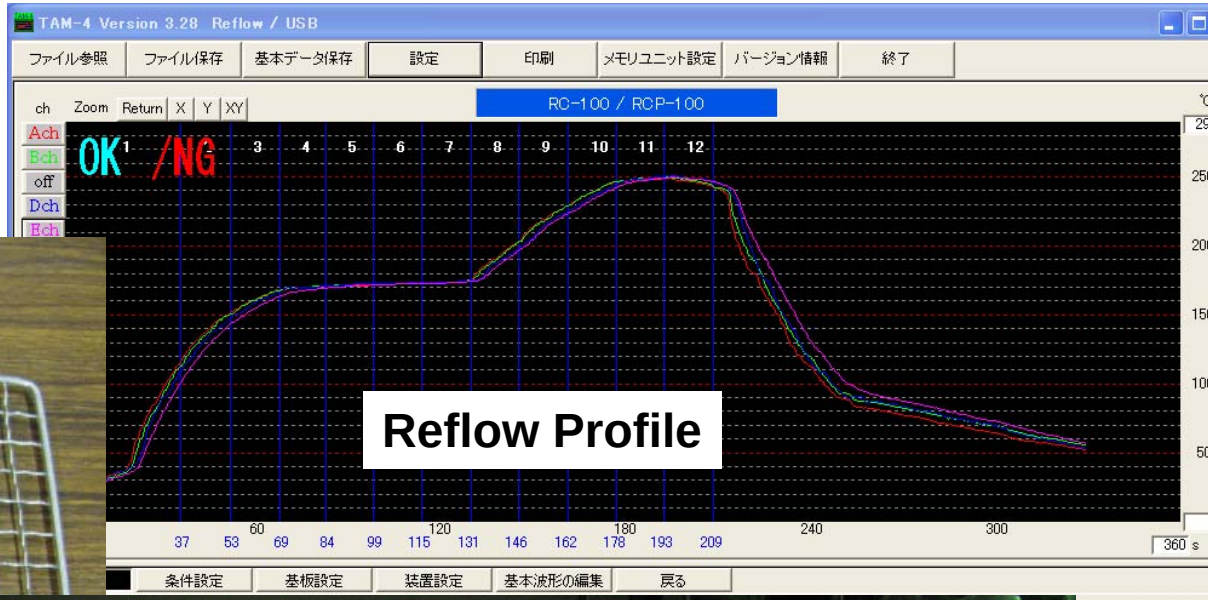

Screen Printing


Solder Stencil


Printed Paste

# Solder Reflow

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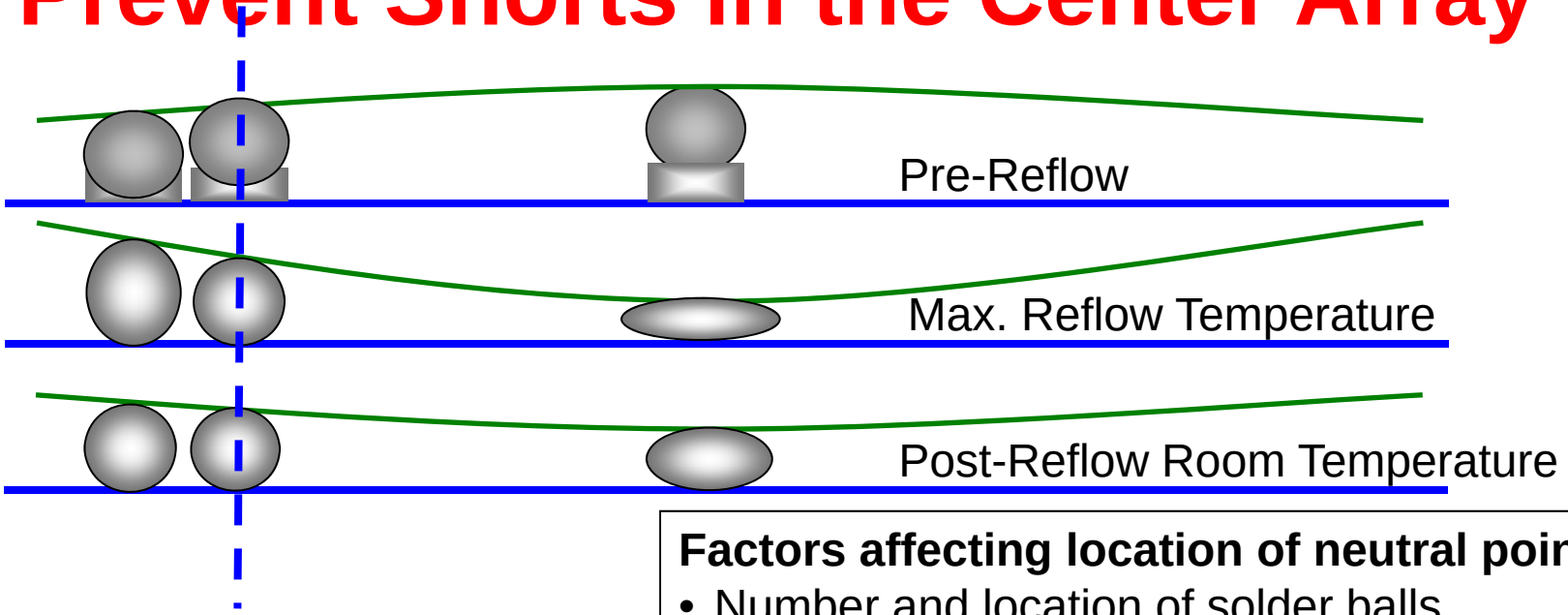
# Calculating Solder Paste Volume to Prevent Shorts in the Center Array




Neutral solder ball at maximum reflow temperature (nominal height)

**Factors affecting location of neutral point**:

- Number and location of solder balls
- Solder surface tension
- Pad shape
- Weight of OMAP and Memory packages
- Phone board warpage
- Temperature ramp, uniformity & maximum
- Paste
- Reflow atmosphere

Sketches not to scale

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