

Title:

BGA Rework and X-Ray Operation Procedure

Revision	Description of Change	Date Effective	Author
A	Initial Release	04/27/01	Peter Fang
B	Added VJ Electronics Summit 1800 in (6.3). Modified (6.4) from NIS Nicolet Imaging System NXR-1419i to Comet Fein focus Tiger (X-RAY). Added 'Executive VP Operations' for signed.	5/24/07	Anjum Malik
C	Updated for the addition of High temp soldering process and BGA bake time requirements.	05/27/2009	Parvin Kumar
D	Added 6.9 - Summit LXI. Removed 9.4.15.3, 9.4.15.4 & 9.4.15.5, BGA rework order form. Modified 9.4.16.3, 94.16.6, 94.16.5.	3/18/2024	Mario Baltier

Originator_____
Name
Title_____
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Title:

BGA Rework and X-Ray Operation Procedure**1.0 Purpose**

- 1.1 The purpose of this document is to define a uniform process for BGA Rework to ensure the highest quality yield.

2.0 Scope

- 2.1 This procedure covers all types of BGA removal, installation, replacement, reball, and x-ray inspection.

3.0 Reference

- 3.1 SOP22 Electrostatic Discharge Control (ESD)
3.2 SOP11 First Articles
3.3 IPC-A-610 Acceptability of Electronic Assemblies

4.0 Definitions

- 4.1 PCA: Printed Circuit Assembly
4.2 BGA- Ball Grid Array
4.3 PBGA- Plastic BGA
4.4 CBGA- Ceramic BGA
4.5 Column BGA- Instead of solder balls used, solder columns are used.
4.6 MicroBGA- Any BGA with distance from center of ball to ball less than 0.050"

5.0 Responsibilities

- 5.1 It is everyone's responsibility to follow the ESD and safety rules described in this procedure.
5.2 Program managers are responsible for releasing appropriate and clear procedures to ensure customers' requests are followed. Program Managers are responsible for initiating Customer new change order (PDOC014) forms and issuing all release documents to document control.
5.2 Rework technicians are responsible for following applicable assembly aids and/or customer documents.
5.3 The area supervisor should follow First Article Procedure (SOP11) and ensure only the trained operators/ inspectors assigned to the BGA rework.

6.0 Equipment

- 6.1 Microscope
6.2 Baking oven

Title:

BGA Rework and X-Ray Operation Procedure

- 6.3 SRT Sierre Summit 1000 / VJ Electronics Summit 1800
- 6.4 Comet Fein focus Tiger (X-RAY)
- 6.5 Metro Mini-Mirror or sideview mirror.
- 6.6 Mini stencils
- 6.7 Soldering irons.
- 6.8 Hand tools- mini squeeze and knife
- 6.9 BGA and VJ Summit LXI rework stations

7.0 Materials

- 7.1 BGA components
- 7.2 No-clean solder paste or No-clean flux paste
- 7.3 BGA Preform
- 7.4 Kapton tapes
- 7.5 Solder Mask
- 7.6 Alcohol
- 7.7 Solder wick

8.0 Records

- 8.1 The total retention time for the records is reflected on the Master Forms Listing (PDOC025) under the column heading Record Retention, in which the record may be kept in an active status. If the status is inactive and the customer specifies a longer period, the records may be forwarded to Document Control and filed / maintained in accordance with SOP 29.
- 8.2 PDOC014 – Customer New Change Order Form
- 8.3 First Article Inspection

9.0 Procedures

- 9.1 BGA Removal
 - 9.1.1 Safety- Do not touch the hot heating area. Wash hands after operation and before meal.
 - 9.1.2 Any wipes contact with solder paste or flux must be properly disposed in the recycle drum.
 - 9.1.3 Select a profile setup by engineer.
 - 9.1.4 Select a nozzle size approximately 2mm larger on each side than the component to be removal.
 - 9.1.5 Cover the adjacent components with Kapton tape to prevent damaging components or disturbing existing solder.

Title:

BGA Rework and X-Ray Operation Procedure

- 9.1.6 Select removing function from the SRT machine.
- 9.1.7 Attach a thermal couple with Kapton tape on the bottom side of PCB under the BGA, if a reflow profile needs to be developed.
- 9.1.8 Set up support pins or rails under the PCB to prevent warpage and make sure the PCB is even.
- 9.1.9 Adjust height of nozzle on down position to be 2mm-4mm above PCB. If some components interfered with nozzle, remove them but marked the removed location with arrows. These components must be reinstalled after BGA rework.
- 9.1.10 Ensure that the temperature sensors are showing a temperature that is compatible to the type of solder (Low temperature Vs High temperature) which was originally used. The BGA will be removed automatically.

9.2 PCB/ BGA cleaning

- 9.2.1 Remove solder residue on BGA pads using solder wick and solder iron. Only qualified and trained operators can be assigned for this task. Be careful not to damage solder mask and pads.
- 9.2.2 Hand clean the BGA pads with alcohol and DI water if necessary.
- 9.2.3 Wiping and cleaning the surface of PCB or BGA with Kim-wipe.
- 9.2.4 If BGA is to be reballed, follow the same procedure above. Otherwise, save the removed BGA in original package if available to be returned to customer.

9.3 Solder Paste or Paste Flux Printing

- 9.3.1 Check and make sure the top side of vias between BGA pads are covered with solder mask, if not, stop and tell program manager or engineer.
- 9.3.2 Inspect BGA pads and solder mask condition under microscope. If pads or solder mask are damaged, forward to repair technician for repair.
- 9.3.3 Find a mini stencil to match the patten of BGA.
- 9.3.4 Align the mini stencil on PCB, and tape it with Kapton tape. Tape adjacent components if necessary to prevent solder paste overprint.
- 9.3.5 Printing non-cleaning solder paste using mini squeeze.
- 9.3.6 If the reworked micro BGA pitch is less than 0.025", it is acceptable but not preferred to use no clean flux paste instead of no clean solder paste. Apply no clean flux paste evenly with a brush.
- 9.3.7 If there are multiple BGAs to be reworked on the same board, technician needs to wait for boards cool down to room temperature before proceeding with next printing as hot board will dry up solder paste and create quality problem.

9.4 BGA Placement and Reflow

- 9.4.1 If BGAs to be installed are not in vacuum sealed bag, they need to bake in oven with the following process unless waived by customer:

Title:

BGA Rework and X-Ray Operation Procedure

Tray: The tray(s) to be used must be heat proof.

Temperature 125° C

Baking time: 12 - 24 hours

- 9.4.2 Select a profile for heating from SRT using “Place Release Reflow” function and select the correct size of nozzle. If not sure which profile to use, check with engineer.
- 9.4.3 Attach a thermal couple with Kapton tape on the bottom of PCB under the BGA, if a reflow profile needs to be developed.
- 9.4.4 Set up support pins or rails under the PCB to prevent warpage and make sure the PCB is even.
- 9.4.5 Adjust height of nozzle on down position to be 2mm-4mm above PCB. Make sure the nozzle is leveled. If some components interfered with nozzle, remove them but marked the removed location with arrow. These components must be reinstalled after BGA rework.
- 9.4.6 Inspect the BGA to be installed to make sure the BGA is clean and there are no missing/undersized balls.
- 9.4.7 Place the BGA in pickup location with correct orientation. If not 100% sure about the orientation, stop and ask supervisor or engineer.
- 9.4.8 Ensure that the temperature sensors are showing a temperature that is compatible with the type of solder (Low temperature Vs High temperature) ball being used. The BGA will be placed and reflowed automatically.
- 9.4.9 During the reflow process ensure that the BGA balls collapse properly, if needed use a flashlight.
- 9.4.10 X-Ray inspection:
 - 9.4.10.1 Place the board inside Nicolet X-ray machine.
 - 9.4.10.2 Turn on X-ray.
 - 9.4.10.3 Adjust X-ray image so the BGA balls appears on screen at about ¼” or bigger in diameter.
 - 9.4.10.4 Scan through all solder joints to check for solder bridge, missing solder, and insufficient solder.
 - 9.4.10.5 If there is no problem, zoom out so the whole BGA will appear on screen. Verify again to make sure there are no soldering defects. Freeze the screen and print a copy of the X-ray picture.
 - 9.4.10.6 Turn off X-ray, remove PCA from machine and stamp “X-ray OK” on top of BGA reworked if accepted. If BGA color is light, use black ink, and vice versa.
 - 9.4.10.7 Write down the Serial number of board and location of BGA if available on X-ray printouts.
- 9.4.11 Remove Kapton tapes around BGA if necessary.
- 9.4.12 Inspect adjacent components and bottom side of BGA for overprint, solder bridge, crooked components, fallen off components, damaged components. If found, rework needs to be done or the customer needs to be notified.
- 9.4.13 Inspect outside rows of BGA joints using Metron sideview mirror and microscope for open solder, cold solder, and solder bridge.

Title:

BGA Rework and X-Ray Operation Procedure

9.4.14 Reinstall components removed if any.

9.4.15 Forward the following to final QA for inspection.

9.4.15.1 PCAs

9.4.15.2 Rework instruction.

9.4.16 Final QA

9.4.16.1 Make sure all rework steps are done to meet customer's specifications.

9.4.16.2 Inspect components/ solder joints around BGA and on bottom side of BGA to make sure no problem caused by rework.

9.4.16.3 Check and make sure the Xray section in the First Article Inspection form (PQAP12) has been initialed stating approval.

9.4.16.4 Inspect outside rows of BGA joints using Metron sideview mirror and microscope for open solder, cold solder, and solder bridge.

9.4.16.5 Return to the BGA area for additional X-rays if necessary.

9.4.16.6 Sign the First Article inspection form (PQAP012) for Final QA acceptance section only.

9.4.16.7 Forward the PCAs along with 9.4.15.1-9.4.15.2 if any to shipping.

9.5 BGA Reball (Not necessary unless requested by customer)

9.5.1 Clean the BGA per 9.2

9.5.2 Select the appropriate size of solder ball preform.

9.5.3 Place BGA and perform in the jig.

9.5.4 Reflow BGA with reflow oven or SRT. It is preferred in reflow oven.

9.5.5 Clean off preform and BGAs with DI water.

Title:

BGA Rework and X-Ray Operation Procedure**BGA REWORK FLOW CHART**