PROCESSING RECOMMENDATIONS

For Samtec's SEARAY™ (SEAM/SEAF Series) Vertical Connectors

The method used to solder these high density connectors is the same as that used for many BGA devices. While BGA's have spherical solder balls attached to the leads, the SEARAY™ employs the unique solder charge design.

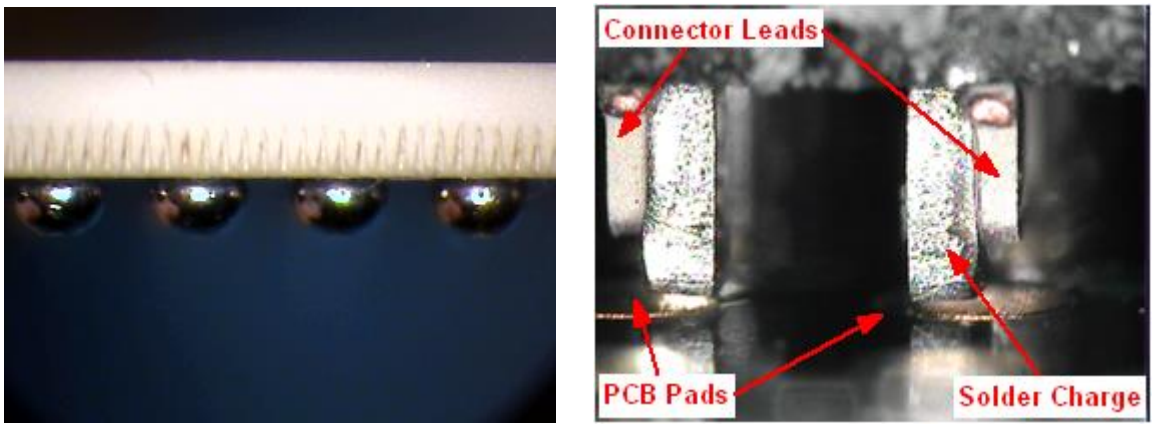


Fig. 1. Solder Balls on BGA's v. Solder Charges on SEARAY™.

Another difference is that unlike the uniform grid arrangement of BGAs the solder charges are offset making the leads appear to be in pairs. The leads themselves are on a .050" x .050" pitch but because the lead orientation alternates from row to row, the solder charges are positioned back to back.

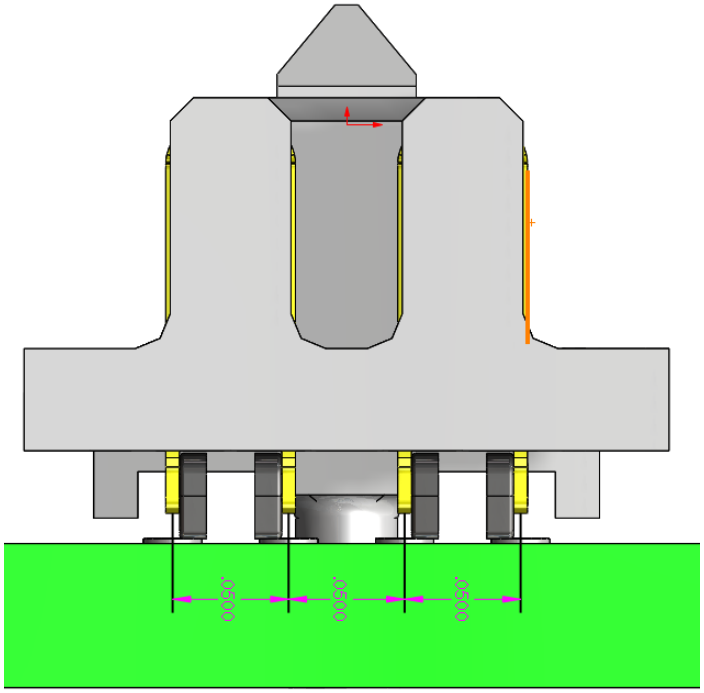


Fig. 2. Solder charge locations on adjacent rows – end view.

The tails of the connector are designed to be centered about the solder pads. Figure 2 illustrates that the solder charges (dark gray) are off-set from the solder pads, but the tails (gold) are centered about the solder pads.

These differences are minor however and customers will have success by following these simple guidelines:

1. Basic Recommendations

- *Minimum* stencil thickness to be .005" (0.13mm),
- Follow our recommended footprints, found here:
  - SEAM – Surface Mount Footprint,
  - SEAF – Surface Mount Footprint

2. Solder Screen Printing Process

- Complete solder pad coverage is critical. The recommended aperture size of .035" (0.89mm) is intentionally larger than the pad to ensure that the solder charge comes into contact with the solder paste. If this does not occur, proper wetting will not be achieved (see **Fig. 3**). Automated inspection of each print is recommended. If solder paste does not completely cover the solder pad the assembly should be rejected, cleaned and re-printed.

- Stencil cleaning may need to be monitored more frequently to ensure complete solder pad coverage is maintained.

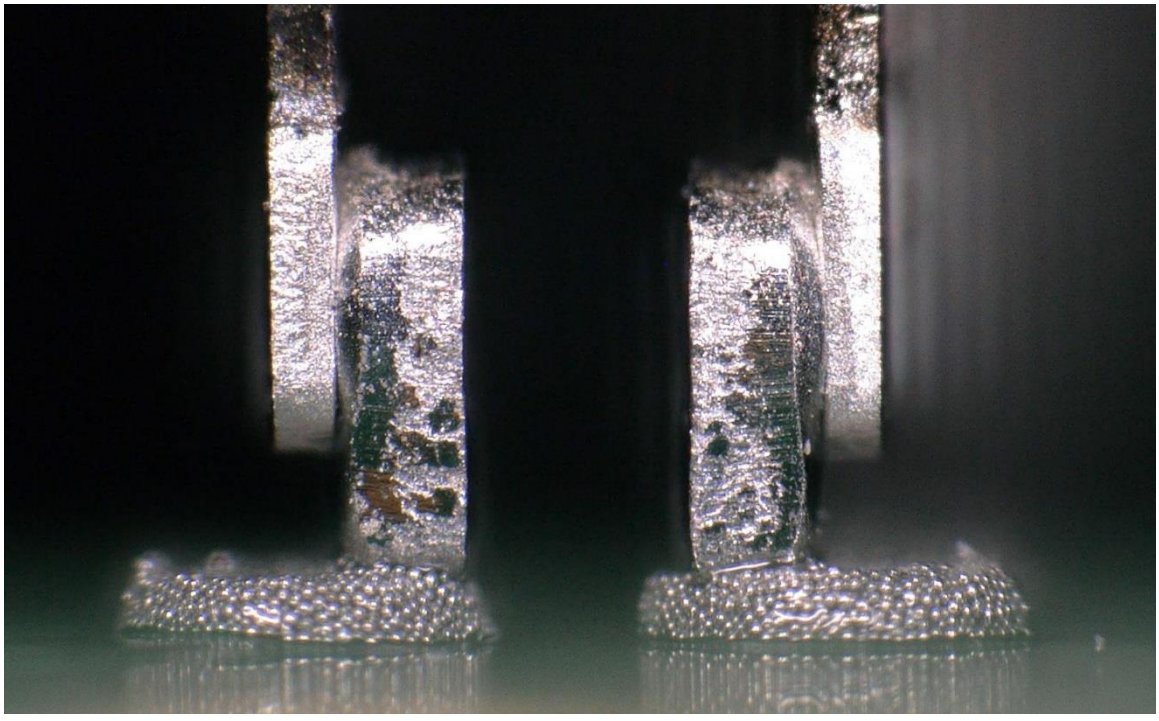


Fig. 3. Solder charge location relative to solder print. Notice good contact between solder charges and solder paste.

3. Component Placement

- The connector must be fully seated. As previously stated and shown in **Fig. 3**, it is critical that the solder charge comes into contact with the solder paste to ensure proper wetting. When using automated pick and place equipment, ensure the Z-axis dimension fully seats the solder charges onto the board surface. Due to nominal variances in solder charge positioning, i.e., coplanarity, not all charges will contact the board at the same time. **Fig. 4** illustrates a fully seated connector prior to reflow.

- As the solder charges reflow, the weight of the connector causes it to settle so that the body rests on or slightly above the board after processing. This phenomenon is why the upper coplanarity specification of .009" (.22mm) is acceptable for the SEARAY™ connector family (see **Fig. 5** below).

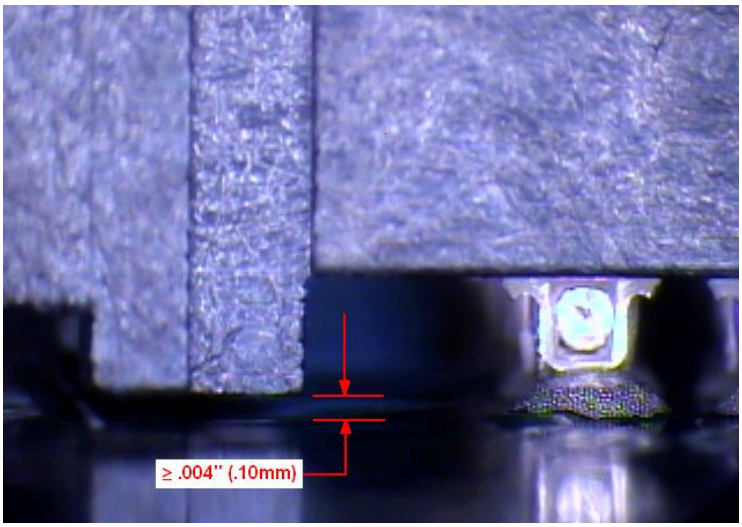


Fig. 4. The insulator housing of a fully seated SEARAY™ connector prior to reflow will rest approximately .004" (.10mm) above the board surface.

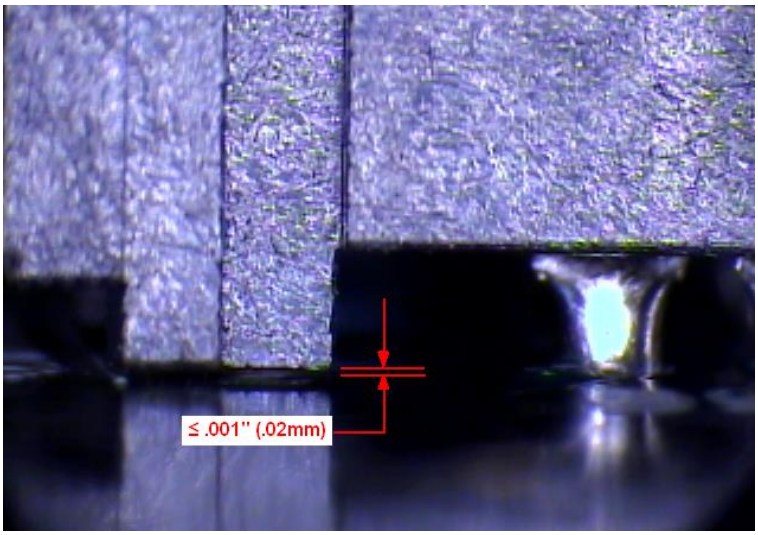


Fig. 5. The insulator housing of a reflowed SEARAY™ connector will rest on the board surface or slightly above.

4. Proper Profiling

- Samtec strongly recommends the use of a low level oxygen environment (typically achieved through nitrogen gas infusion) in the reflow process to increase the wettability of the soldering surfaces. SEARAY ™ testing has consistently shown a dramatic increase in solder yields in a low level oxygen environment as opposed to an air environment. Many variables affect the level of residual oxygen required to optimize a given reflow process, but generally the levels should be less than 1000 ppm.

- The importance of properly profiling the fully populated printed circuit assembly cannot be overstated. The reflow process that forms the solder joint is sometimes overshadowed by other processes but is critical to ensuring the solder charge reaches proper reflow conditions. Certain components can be sensitive to time and temperature, so both variables must be controlled and a thermal profile must be performed prior to processing or production. Thermocouples should be placed as close to the solder charge as possible (**underneath the part**) in the center and on the outside edge (see **Fig. 6**).

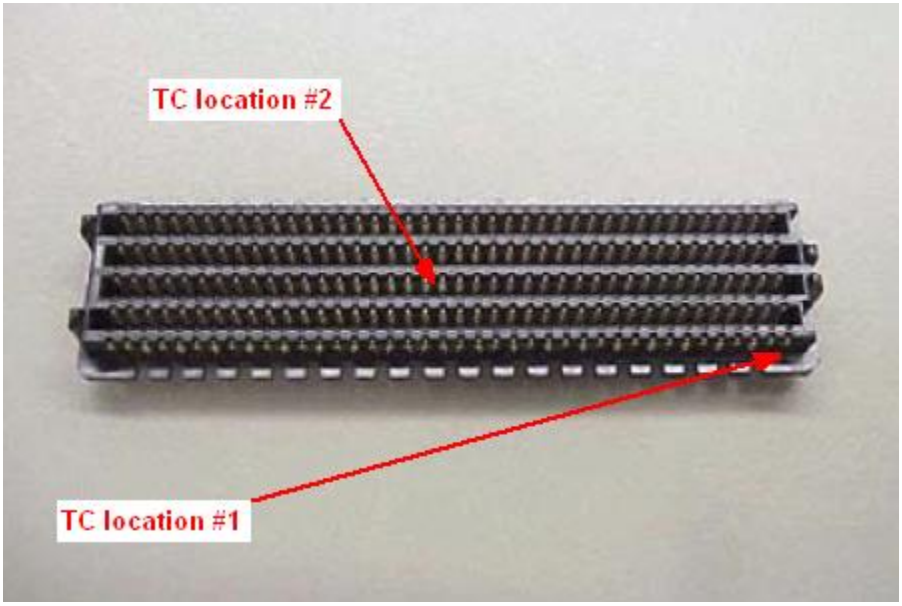


Fig. 6. Top side reference of thermocouple locations for reflow profiling.

Listed below are some profile recommendations for both Lead and Lead-Free reflow. Please note that these are only recommendations. Samtec strongly suggests that each customer perform their own reflow profile study prior to processing or production.

PROCESSING RECOMMENDATIONS

For Samtec's SEARAY™ (SEAM/SEAF Series) Vertical Connectors

Lead (Sn63Pb37)

- Max Rising Slope: Ramp up 1.5 - 2°C / second
- Soak: Soak at 120 - 160°C for 60 seconds
- Time Above Liquidous: 60 - 70 seconds
- Peak Temperature: 225 - 230°C

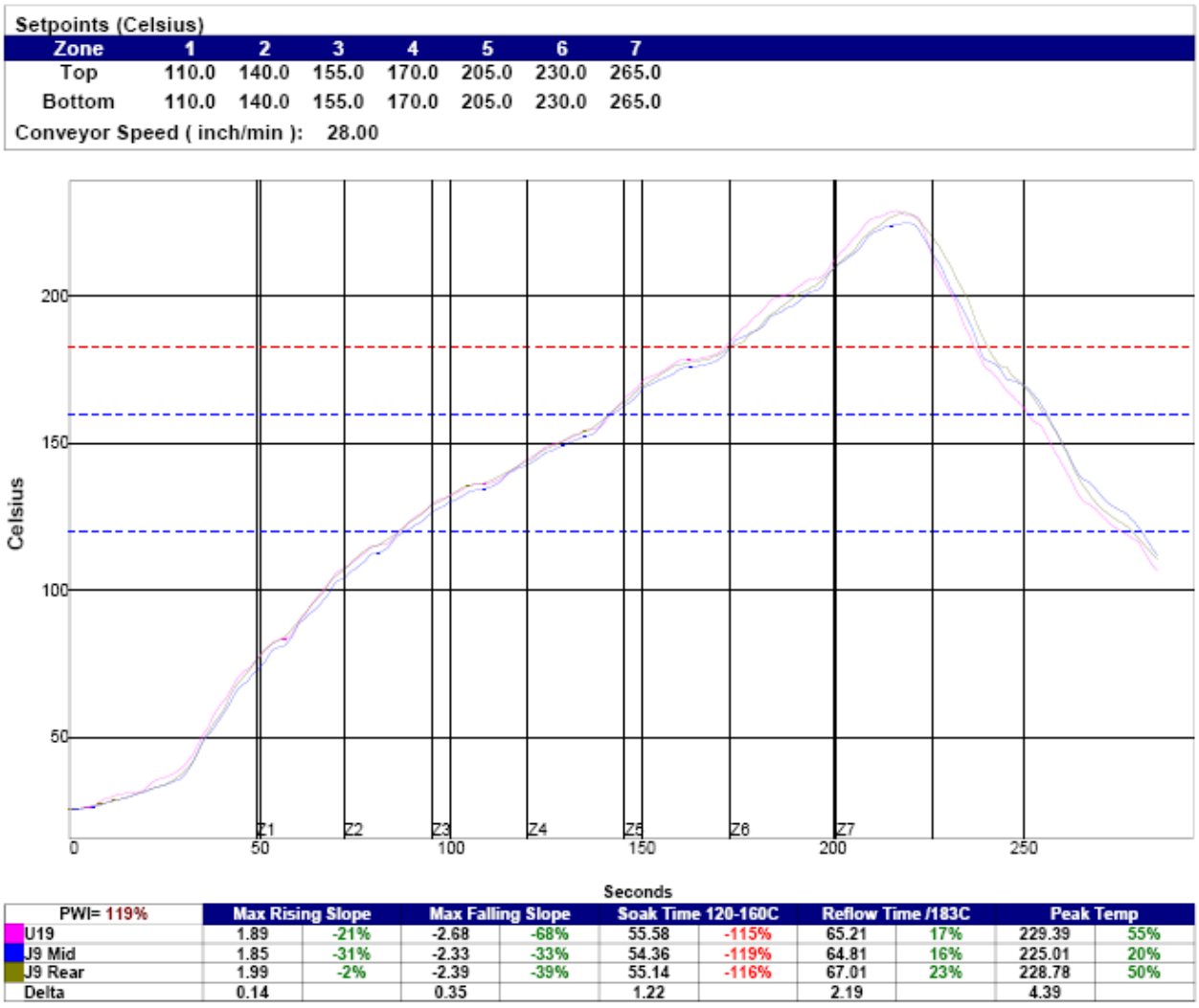


Fig. 7. Example of Lead (Sn63Pb37) - Straight Ramp Reflow Profile

PROCESSING RECOMMENDATIONS

For Samtec's SEARAY™ (SEAM/SEAF Series) Vertical Connectors

Lead-Free (Sn96.5 Ag3.0 Cu0.5)

- Max Rising Slope: Ramp up 1.5 - 2°C / second
- Soak:
  - Straight ramp: 120 - 180°C for 70 seconds
  - Traditional Soak 145 - 180°C for 80 - 90 seconds
- Time Above Liquidous: 60 - 70 seconds
- Peak Temperature: 240 – 245 °C

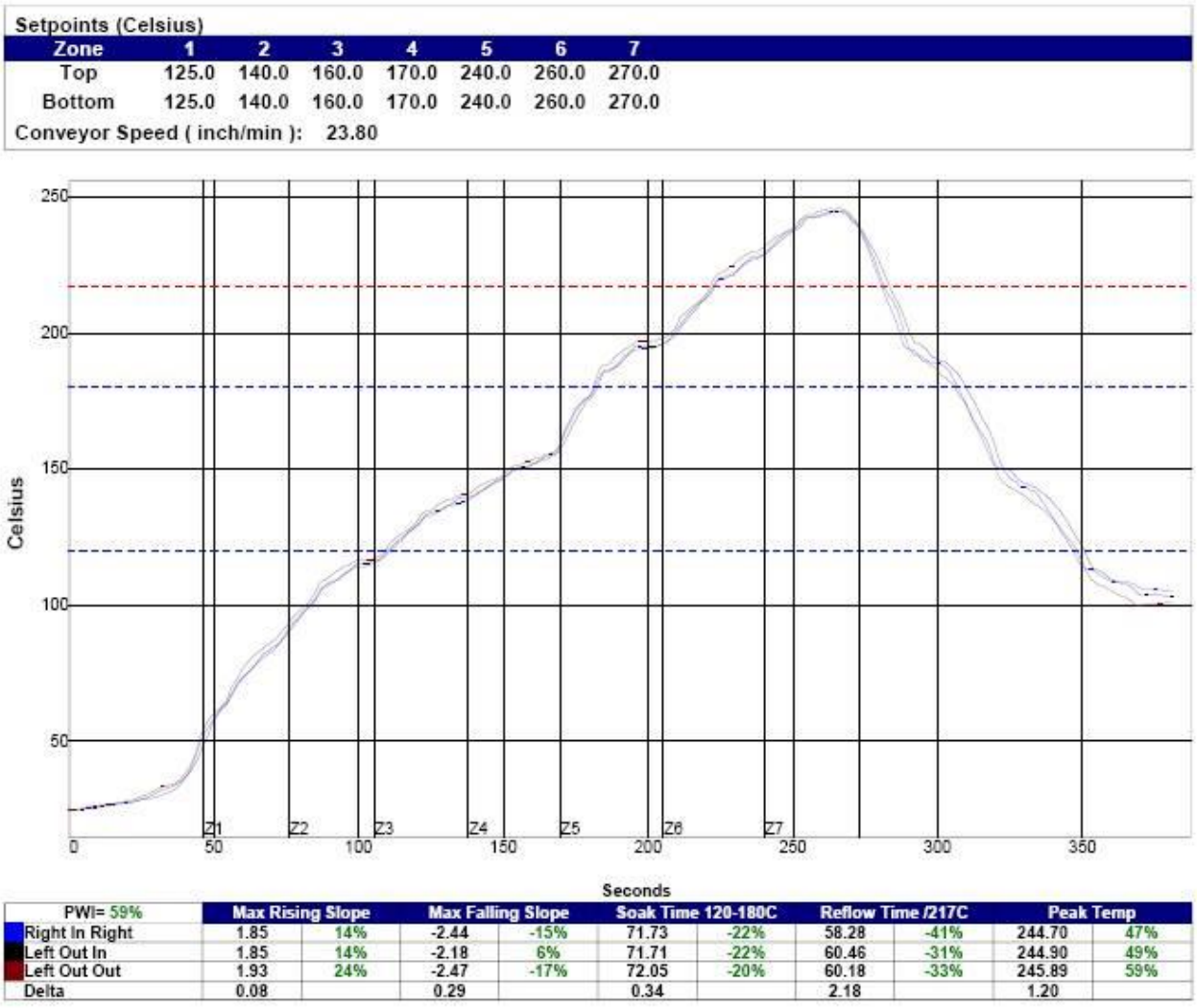
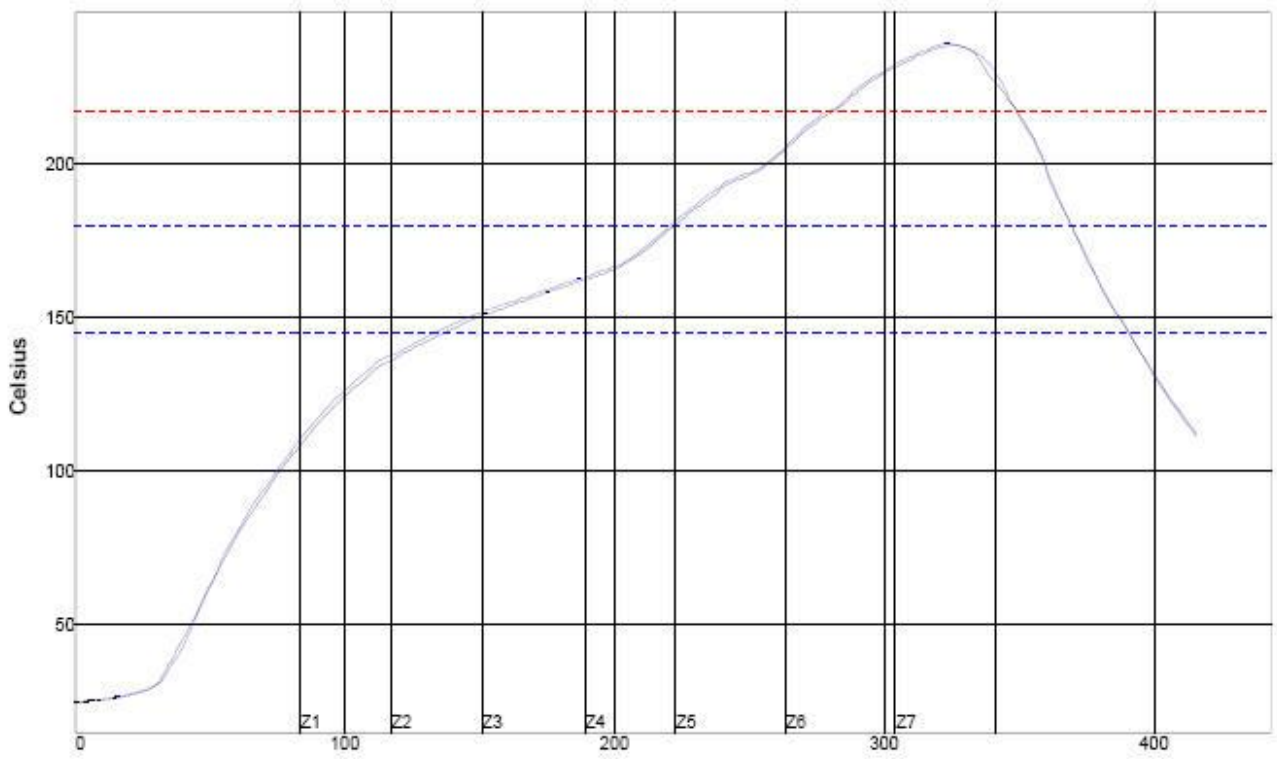


Fig. 8. Example of Lead-Free (Sn96.5 Ag 3.0 Cu 0.5) - Straight Ramp

Setpoints (Celsius)

Zone	1	2	3	4	5	6	7
Top	165.0	168.0	168.0	175.0	230.0	270.0	265.0
Bottom	165.0	168.0	168.0	175.0	230.0	270.0	265.0

Conveyor Speed (inch/min): 18.00



PWI= 71%	Max Rising Slope		Max Falling Slope		Soak Time 145-180C		Reflow Time /217C		Peak Temp	
B RIGHT	1.87	16%	-1.99	21%	87.17	-64%	70.78	15%	239.51	-5%
B LEFT	1.70	-7%	-1.97	22%	85.88	-71%	69.14	7%	239.00	-10%
Delta	0.17		0.02		1.30		1.65		0.51	

Fig. 9. Example of Lead-Free (Sn96.5 Ag 3.0 Cu 0.5) – Traditional Soak

NOTE: One of the most common issues customers face during the initial profiling stage is inadequate heating of the solder charges. **Fig. 10** below is an example of how the solder charges appear when they have not reached proper reflow temperatures. Even though the leads touched the solder printed on the board the wetting was not sufficient to form a good joint. When this is the result, the profile must be adjusted until the solder joints look like those in **Fig. 11**.

NOTE: When using SEARAY elevated connectors large temperature differences between the PCB and solder joints may occur. PCB composition and component types/layout may affect these differences.

Rework Considerations

- Should rework be required, the method used will depend on the severity of the defect. Total connector replacement is accomplished using a hot-air rework system. For more information on this method, please see the application note found here:
  - SEARAY™ SEAM/SEAF Rework Guidelines
- Samtec recommends a minimum spacing of .125" between adjacent connectors to allow adequate room for hot-air rework equipment.
- The defects shown in **Fig. 10** below occurred on the outer row of contacts and were reworked using a Hakko FR-802 Hot-Air Rework System and 4.4mm nozzle. The liquid water-soluble flux was applied with a brush at the defect sites and hot-air was introduced by moving the nozzle in a circular motion so as not to damage the connector or board. With the addition of flux and the already present solder, wetting easily occurs and the terminations are soldered. **Fig. 11** shows the same two joints after they were reworked using this method.

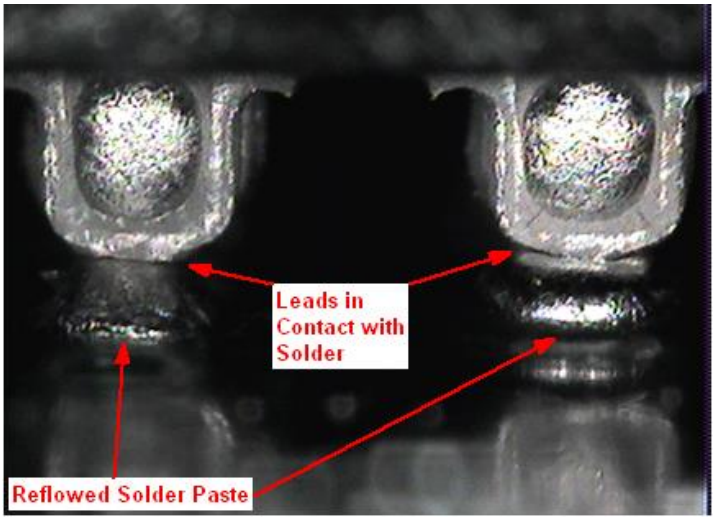


Fig. 10. Defective outer row solder joints.

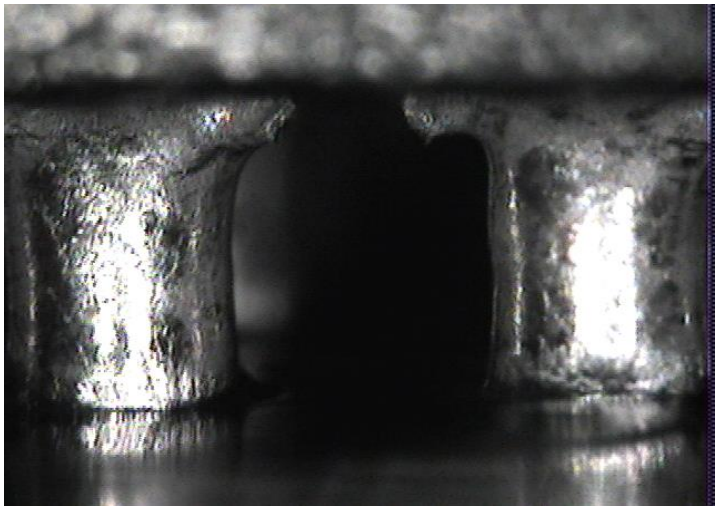


Fig. 11. Outer row solder joints from Fig. 9 reworked using a hand held hot-air system.

5. Handling

- These connectors are typically packaged in trays or tape and reel which protect the solder charges from damage. They should be handled like any other BGA or IC device.
    - Avoid resting the connector on the solder charges except during final placement onto the board,
    - When using tape and reel packaging, ensure the bottom of the pocket is protected as it travels through the feeder,
    - Avoid touching the solder charges,
    - When a partially used tray needs to be stored, use the flat cover from the original shipment or an empty tray to cover connectors. Band trays using flex wrap or rubber bands.

For further information or questions about anything in this document or processing questions about any Samtec connectors, please contact the Interconnect Processing Group at:

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