snapSHOT®

EMI SHIELD

S3 Fixture Design Guide

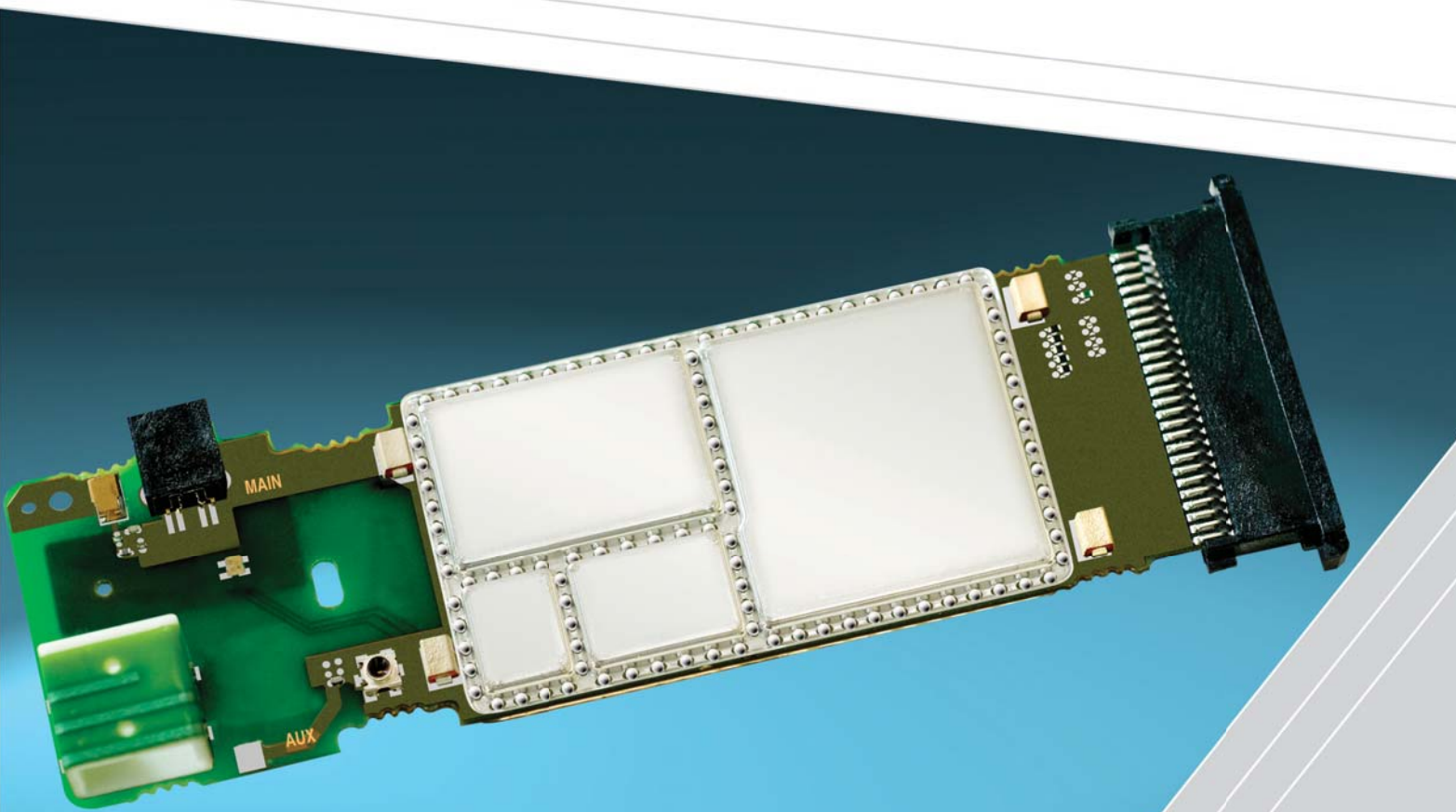


Figure 1. Reference panel to have spheres

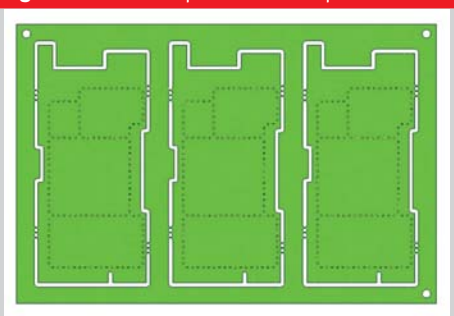
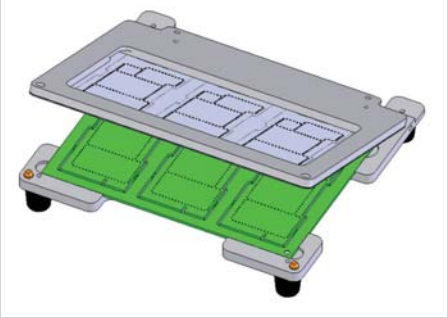


Figure 2. Overview of the fixture to populate the S3 reference board



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OVERVIEW

S3 fixtures were developed to populate the spheres required to attach GORE™ snapSHOT® EMI Shields to a PCB. For medium to high volume device production, the time on the pick and place machine for populating solder spheres becomes significant. These fixtures enable a single step population which utilizes spheres in bulk form. The following guide has been developed to aid the design and implementation of the fixtures into an SMT production line.

DESIGN DETAIL

The fixture is a precision tool utilizing stencil technology. The clamshell design of the fixture allows for easy insertion and removal of a panel while maintaining the required registration. There are 4 critical components in the fixture which will be reviewed in more detail:

1. Standoff
2. Sphere stencil
3. Frame
4. Registration features

The example provided for reference is for a three-up panel which has a 0.005" paste laydown. It was a lead-free process using a SAC 305 paste composition with an equivalent alloy sphere. See figures 1 and 2.

STANDOFF

The recommended clearance is at least 0.010" from the surface of the deposited paste. For this example, the standoff would be determined as follows:

- Paste Thickness = 0.005"
- Paste Clearance = 0.010"
- Standoff ≥ Paste Thickness + Paste Clearance ≥ 0.005" + 0.010" ≥ **0.015"**

The standoff represents the minimum thickness of the clearance plate between the surface of the board and the bottom of the sphere stencil. This is the plate which will prevent the paste laydown from being disturbed during the sphere deposition process. Figure 3 shows the upper assembly containing the standoff along with the stencil and upper frame. Figure 4 shows an isolated image of the standoff.

SPHERE STENCIL

The sphere stencil is a precision stencil manufactured using the same processes as would be utilized for a paste stencil. It determines the pattern which the spheres will be deposited onto the board. There are 3 main features of the stencil:

Thickness

The thickness is independent of the paste. This is because the standoff already accounts for the paste thickness. The sphere stencil will be stacked atop the standoff and therefore will already be positioned relative to the top surface of the paste laydown. The recommended thickness is **0.020"**. This is a standard gauge and is determined by accounting for the sphere diameter, the paste clearance and the sphere protrusion above the top surface of the stencil. Gore recommends this protrusion to be 0.005".

- Paste Clearance = 0.010"
- Sphere Protrusion = 0.005"
- Sphere Diameter = 0.035"
- Thickness = Sphere Diameter – Paste Clearance – Sphere Protrusion

= 0.035" – 0.010" – 0.005" = **0.020"**

Sphere through hole diameter

The through holes for the sphere pattern are critical to the operation of the fixture. The hole must be large enough to allow free passage of a single sphere while preventing other spheres from becoming engaged in the hole. At the same time, the sphere must be presented to the paste pad consistently and precisely. Gore recommends the opening to be **0.0365"** in diameter and centered nominally on over each sphere pad on the PCB.

Registration features

In order that the separate plates of the fixture work together, a common registration feature must be utilized. As represented in the generic example, these are the tapered pins along the front edge. To interface with these pins properly, the recommended diameter of the corresponding registration hole should be ± 0.001" to ensure a close fit. Figure 5 shows an isolated image of the sphere stencil.

Figure 3. Section view of upper assembly components from bottom to top: standoff, sphere stencil, frame

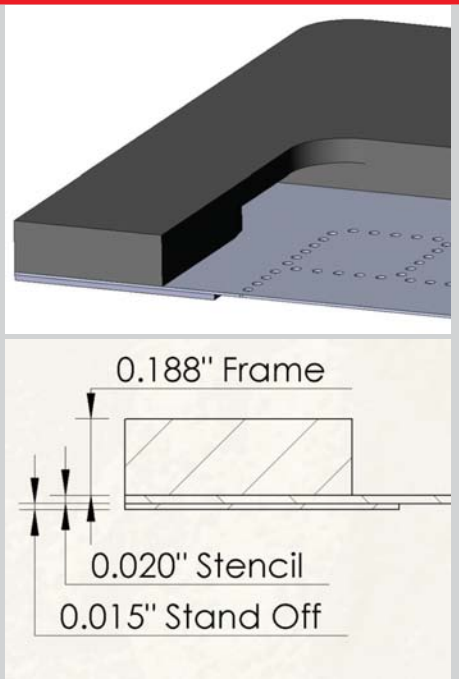


Figure 4. Isolated image of the standoff for this assembly

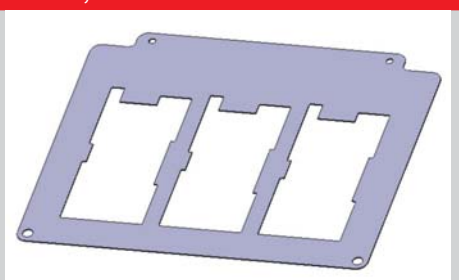


Figure 5. Isolated image of the sphere stencil for this assembly with registration features circled in red

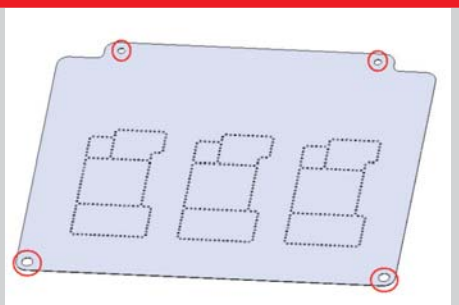


Figure 6. Upper frame assembly showing sphere deposition area

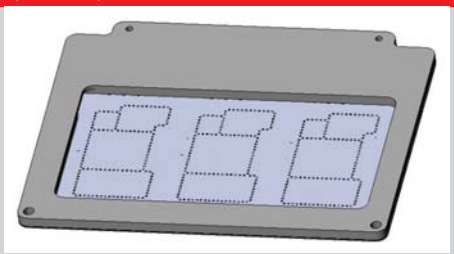


Figure 7. Isolated image of the upper frame showing the sphere exit channel

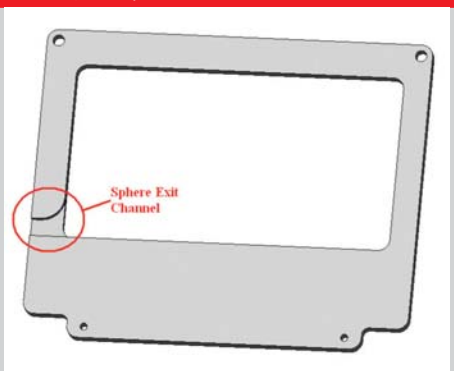
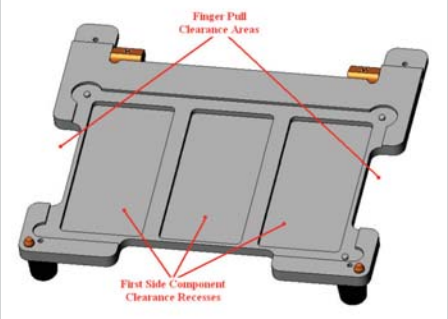


Figure 8. The lower frame showing ergonomic features, registration features and first side component clearance recesses



FRAME

The frame acts a support for the stencils as well as provides the means by which the board/panel will be registered to the sphere apertures in the stencil. It is manual fixture and should therefore be designed with ergonomic features in mind. Specifically the weight should be limited in order to ensure ease of handling during use. This can be accomplished by using aluminum for the base material and removing unnecessary material.

Upper Frame

The upper frame has both the standoff and the sphere stencil mounted to it. This attachment is accomplished using a combination of approaches. The first is to use an adhesive between the layers to bond the surfaces. The second is to utilize the hinges to aid in alignment as well as provide a means for incorporating hardware. More detail will be provided on the hinges in the “Registration Features" section to follow.

In addition to attaching the stencil and standoff, the upper frame incorporates the containment mechanism and removal chute to help with sphere handling. While populating spheres, the upper frame creates the recess in which the spheres are deposited. Following population, the spheres are guided through the exit chute into a storage vessel. These features can be seen in Figures 6 and 7.

Lower Frame

The lower frame acts as the basis for registration for the PCB. In addition, it incorporates the features which allow for easy handling and for attaching the hinges. The alignment features will be discussed further in the “Registration Features" section to follow. Also, the lower frame needs to be designed such that second side population is enabled by providing clearance recesses for the first side components. These recesses are milled pockets (or through holes) which provide clearance for the previously affixed componentry of the PCB during the first side pass through the SMT line.

The features typically associated with the lower frame are weight reduction measures, recesses to allow for finger pulls, rubber feet to enable gripping of the fixture and positive stops to control the degree to which the upper frame angles back. Figure 8 shows these features incorporated into the reference design.

REGISTRATION FEATURES

For accurate and repeatable placement of the spheres onto the corresponding paste pads of the PCB, there are four main mechanisms for registration. These are:

1. PCB tooling hole pins
2. Upper frame locating pins
3. Milled hinge pin through holes
4. Hinge bosses for upper plate alignment

PCB Tooling Hole Pins

The tooling holes in the panel generally serve as a positive mechanism for locating the panel array. If a non-panelized board is being populated, hardware holes in the PCB will suffice for locating as well. Although not recommended as a first option, board edges can also be used to register. This is not recommended as a first course of action because the PCB routing operation generally has a larger allowable tolerance than do the drilling operations. The pins corresponding to the features being utilized for alignment are milled directly into the lower frame. This ensures there is direct correlation between the pins and the locations of the rest of the lower frame features. The pins are highlighted in Figure 9.

Upper Frame Locating Pins

The upper frame locating pins are pins are pressed pins located along the opposite edge as the hinges. These pins allow any misalignment of the upper plate to be picked up as the two halves close together. This pin is tapered to allow for easy engagement. Figure 10 shows the upper frame alignment pins highlighted.

Hinge Pin Holes

The mounting for the hinges is typically achieved utilizing a through hole milled directly into the lower frame. Using a through hole and corresponding pin allows for more accurate alignment of the upper and lower frames since the tolerance stack-up associated with commonly used hinges and mounting hardware is eliminated. Figure 11 shows the milled through hole which receives the corresponding hinge pins.

Hinge Pin Locating Boss

The hinge pin is typically milled from brass. It contains a precision turned pin section for insertion into the corresponding base plate through hole. It also has a flat section milled to accept the standoff plate. Finally it has the locating boss which aligns the standoff, sphere stencil and upper frame. Contained within this boss is a threaded hole which allows for the use of hardware to lock the plates together and fasten them to the hinge. A representation of this pin can be seen in Figure 12.

Figure 9. Milled PCB locating pins (shown circled)

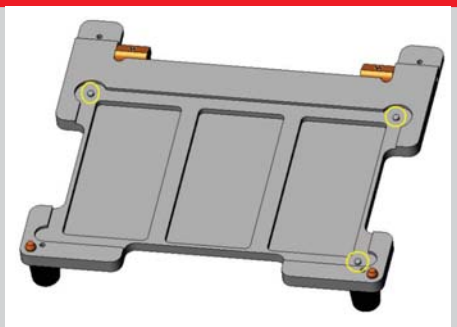


Figure 10. Upper frame alignment pins (shown circled)

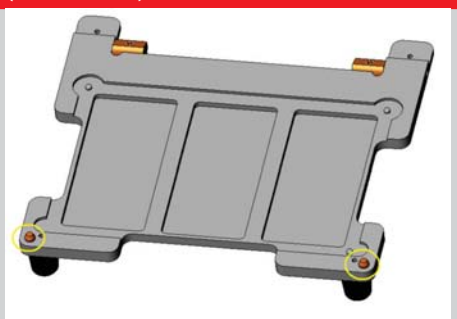


Figure 11. Milled hinge pin holes (shown circled) allow for more accurate registration of the frames

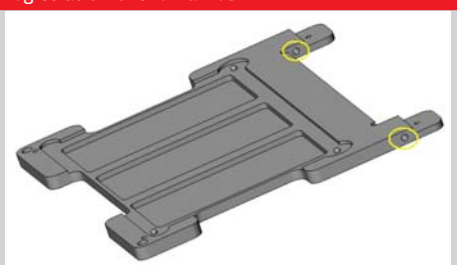
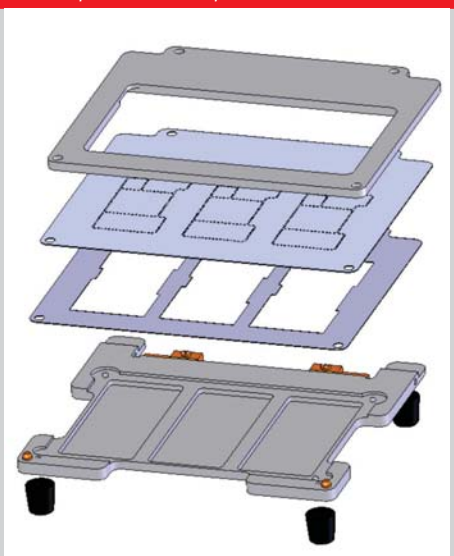


Figure 12. Brass hinge pin containing registration features to align the upper and lower frames

Figure 13. Exploded view of the fixture showing the component stack up for installation.



ASSEMBLY

Once the components have been fabricated, the assembly operation will need to be performed. There are a couple of considerations during this process and there is a recommended sequence for completion. These are outlined below. Figure 13 shows an exploded view of the fixture.

1. Assemble the lower frame.
The first operation should be pressing in the tapered upper frame locating pins. This should be followed by installing the rubber feet and inserting the hinge pins into the hinge mounting holes.

2. Prepare the standoff.
Clean surfaces with IPA. Adhesive should be applied to the surface which will interface with the sphere stencil only. Care should be taken to avoid applying adhesive near the upper frame alignment holes. These are close fit holes which can bind on the pins if contaminated.

3. Place the standoff onto the lower frame.
With the adhesive side facing away from the lower frame, place the standoff onto the upper frame locating pins and the hinge pin locating bosses.

4. Place the sphere stencil onto the standoff.
Clean stencil surfaces with IPA. Noting the intended orientation of the stencil, place the stencil onto the standoff using the upper frame locating pins and hinge pin locating bosses to align the standoff and stencil. Apply pressure. The stencil is now adhered to the standoff.

5. Prepare the upper frame.
Clean upper frame surfaces with IPA. Apply adhesive to the upper frame surface which will interface with the sphere stencil. Take care to keep the adhesive away from the inner edge. Contamination within the sphere cavity can cause spheres to stick to the edge during operation.

6. Place the upper frame onto the stencil.
Using the upper frame locating pins and the hinge pin locating bosses to align the components, place the upper frame onto the sphere stencil. Apply pressure. The stencil/standoff is now adhered to the upper frame.

7. Insert hardware.
Using screws with lock washers, insert fasteners into threaded holes of the hinges pins. Tighten screws.

8. Clean.
Wipe all surfaces with IPA. Clean surfaces will prevent spheres from sticking to the plate surfaces as well as prevent contamination in the tight fit apertures of the stencil. It is important that through the use of the fixture, the surfaces are cleaned periodically to maintain contamination free surfaces.

NOTES

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EMI SHIELD

W. L. Gore & Associates, Inc.

North America
1 (800) 445-GORE (4673)

Europe
+49 9144 6010
+44 1382 561511

International
1 (302) 292-5100

China: Beijing
+86 10 6408 8060

China: Shanghai
+86 21 6247 1999

China: Shenzhen
+86 755 8359 8262

gore.com/emi

More international phone numbers can be found at gore.com/phone

Japan
+81 33 570 8712

Korea
+82 2 393-3411

Taiwan
+886 2 8771 7799

Singapore
+65 6 733 2882

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