Application Note 011

Introduction

In 1998, Sonix™ revolutionized the SAM inspection industry by introducing the Tomographic Acoustic Micro Imaging (TAMI™) feature. At first, the TAMI™ feature allowed customers to slice the sample into 30 images that could be obtained in a single scan. The resulting image data set allowed the user to slice down through a sample to investigate different interfaces and / or determine the proper gate position for specific interfaces. This innovation was possible because Sonix™ was the first SAM supplier to digitize the A-scans from the sample allowing for many gates in a single scan without the need for multiple analog peak detectors and for other features such as frequency domain imaging (Filtered C-scans, F-scans and P-scans). With improvements to the A/D converters, the TAMI™ feature can now allow the user to collect up to 100 images from a sample in a single scan. With the advent of 3D packaging technologies, this feature is more important than ever.

However, a limitation of the TAMI™ feature has been that each of the gates (up to 100) is identical in size and spacing. While this does provide a convenient way to rapidly slice through a sample, each TAMI™ slice may not always be perfectly placed on a half cycle in the region of interest. Even with simple packages, there are attenuation effects as the ultrasound goes deeper into the sample that tend to mimic a frequency downshift since higher frequencies are attenuated more than lower frequencies. So, the gate width needed at deeper interfaces is often larger than that needed at shallower interfaces. Further, with 3D packaging there are different materials with different sound speeds, so different gate widths are needed to optimally cover the interfaces of different materials. Using the existing TAMI™, the user may have to cover one interface that is larger in time with several smaller gates, resulting in many TAMI™ gates that may not be of interest and that increase the file size beyond what is necessary.

Sonix™'s new Flexible TAMI™ feature allows the user to independently set the spacing and length for each gate in the TAMI™ region, so that each gate contains meaningful data and fewer gates are required, which reduces the file size.

Lidded Flip Chip Example

As an example, we will consider the case of a lidded flip chip that is being inspected with a S1463 75 MHz 12mm transducer. With the existing TAMI™ setup, the user would tend to match the gate widths to the earliest half cycles, in this case the lid to attach reflections and then all of the resulting gates would be the same (Figure 1). This results in 26 gates being required to cover the area of interest down to the die top interface. 16 of these gates are covering the attach layer because it is long in time. Ideally, only one gate would be needed to cover the bulk section of the attach layer.

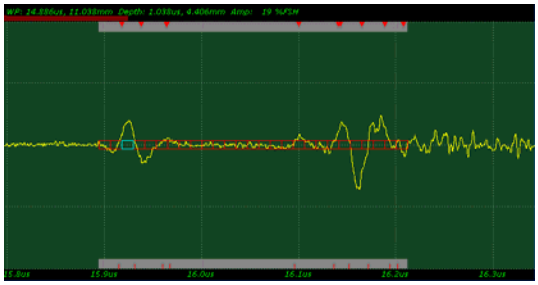

Figure 1: A-scan from the lidded flip chip sample, showing the existing TAMI™ gate setup (26 gates)

Using Flexible TAMI™, the user can properly set the gate widths for the first interface reflection, use a single gate for the bulk section of the attach layer, and then set the gates for the attach-to-die layer (Figure 2). In this sample there was die tilt, so using a larger width gate helps to get all of the die top in one image. With the Flexible TAMI™ technique, the number of gates has been reduced from 16 to 5, resulting in each TAMI™ slice containing meaningful data and a reduction in overall file size.

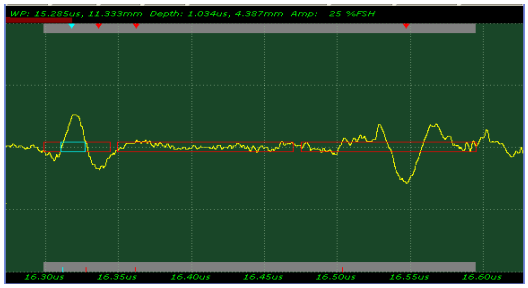

Figure 2: A-scan from the lidded flip chip sample, showing the Flexible TAMI™ gate setup (5 gates)

The lid-to-attach images using the existing TAMI™ and Flexible TAMI™ techniques are quite similar since similar gate widths have been used and are not shown. Figure 3 shows a comparison of the images of the bulk section of the attach layer. With the existing TAMI™ each image only shows a thin slice of the attach material, so we can only see voids that are present at that thin slice. With Flexible TAMI™ we are able to cover the full bulk of the attach material with a single slice allowing all voids present within the bulk of the attach to be seen at once.

Sonix™, Inc., 8700 Morrissette Drive, Springfield, VA 22152
Phone: (703) 440-0222 Fax: (703) 440-9512 Email: support@sonix.com

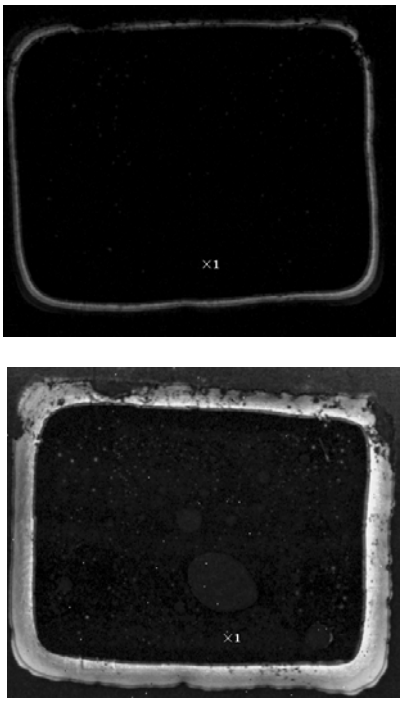

Figure 3: Bulk attach image obtained using existing TAMI™ (top) and Flexible TAMI™ (bottom). Flexible TAMI™ allows all voids present in the attach layer to be seen in one image.

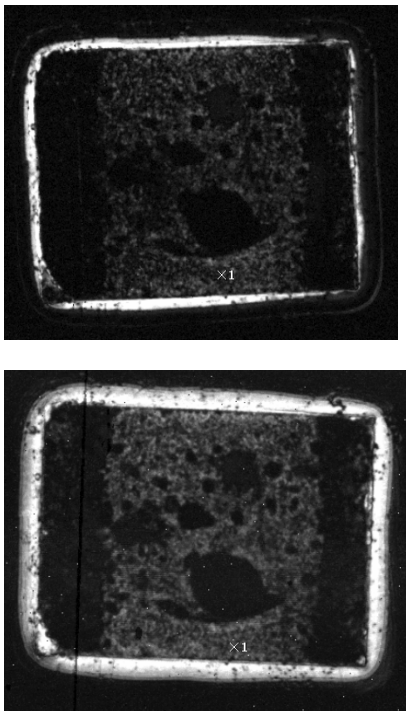

Figure 4: Attach-to-die image obtained using existing TAMI™ (top) and Flexible TAMI™ (bottom). Flexible TAMI™ allows the tilted die to be seen in one image.

Figure 4 shows a comparison of the images of the attach-to-die interface. Due to die tilt present in the sample, the existing TAMI™ image is not able to show the full die top at once. However, with Flexible TAMI™ a larger gate width can be used allowing for the full die top to be seen.

Flexible TAMI™ Setup

As in the past, TAMI™ gates are enabled and adjusted by selecting TAMI Region from the drop down menu on the Gates Tab. At the bottom of this tab there is now a "Flexible" button that when clicked, allows the user to create a Flexible TAMI™ setup (Figure 5). The start and length of the TAMI™ region is set as before, but the spacing and length values for each gate can be set independently either using the text boxes on the Gates Tab or the mouse on the A-scan display. When you select a gate either by clicking on it with the mouse or by using the Gate (1 of X) arrows on the Gates Tab, that gate will turn blue, so you know which gate's values you are adjusting.

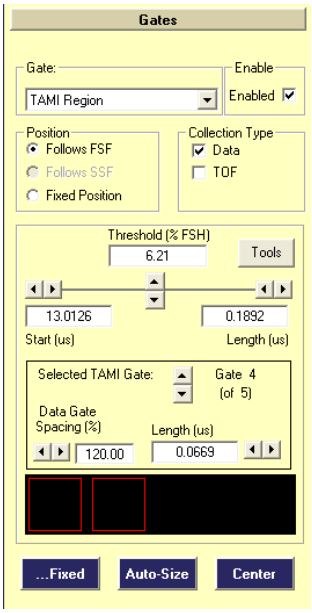

Figure 3: Flexible TAMI™ setup on the Gates Tab

The Flexible TAMI™ option is available on WinIC™ 4.6.x or later versions.

To convert back to the existing TAMI™ mode, e.g. if it is necessary to save a parameter file for a system running older software, simply click on the "Fixed" button at the bottom of the Flexible TAMI™ Gates Tab and WinIC™ will convert the gate setup back to all TAMI™ gates having the same length and spacing.

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Phone: (703) 440-0222 Fax: (703) 440-9512 Email: support@sonix.com