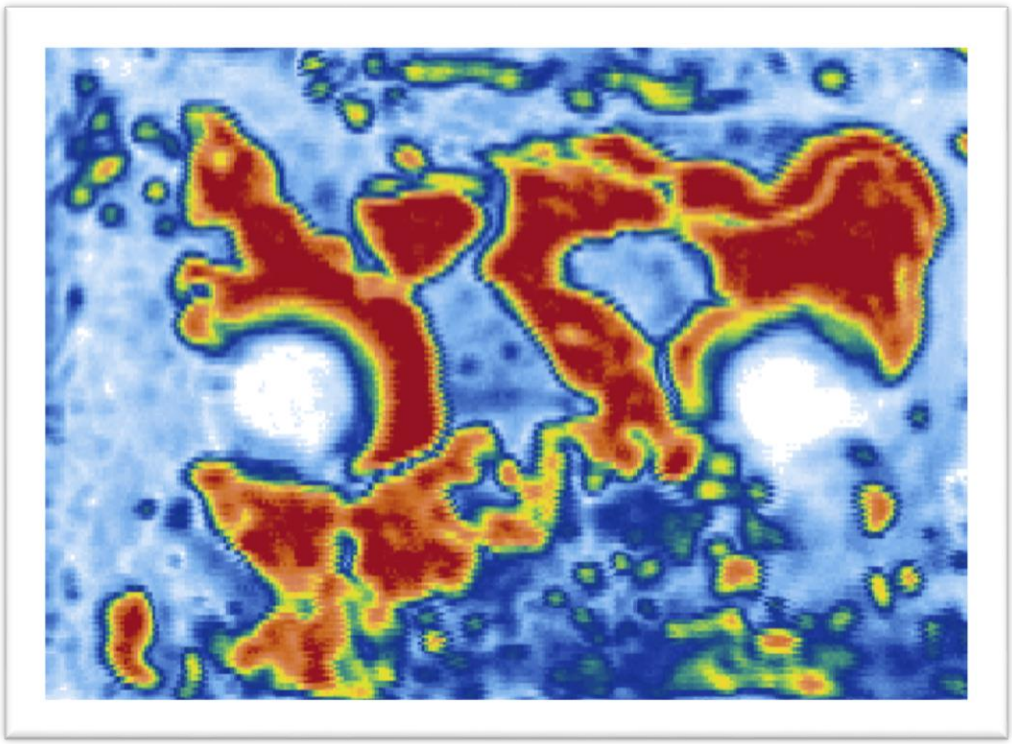

EVALUATION OF BRAZING JOINT QUALITY USING IMMERSION ULTRASONIC INSPECTION

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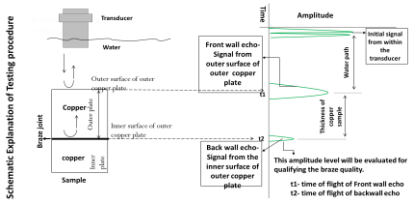
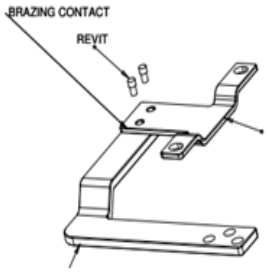
Brazing is one of the conventionally used joining methods for electrical components. The two electrical contacts are filled with a filler material which is melted and made to flow in the gap between the contact metal parts through capillary action. Generally, the filler metals used are copper, silver, tin, and/or zinc with a relatively low melting point must fill the space between the two parts being joined, wet the surfaces, and fuse them when it cools and solidifies. The quality of the brazed joint depends upon the fluidity of the filler metal covering the total contact area and fusing the contact area. If the joint is not properly fused, air gaps will be created in the joint which will affect the quality of the joint. This will lead to inefficient transfer of electrical energy between the contacts. This application note presents the inspection of the brazing quality of bus bar assemblies used in power electronics applications.



Inspection procedure and A-Scan Signal



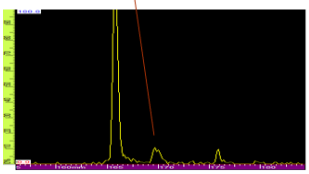
Sample with brazed joint

Ultrasonic immersion scanning is widely accepted as a technique for finding unbonded regions in the brazed joint. The pulse-echo normal beam inspection method is used for evaluating the unbonded region. The inspection setup is made as shown in the figure.

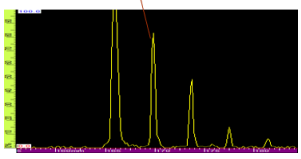
In the non-brazed region (defect region), sound energy reflects

more after hitting the bottom surface of the copper sample (back wall echo). The amplitude of the back wall echo from copper will be evaluated for qualifying the brazing quality. A high back wall echo from the interface is treated as a weak joint. A weak reflection from the interface is treated as a good joint. The respective A-scan signals of the bonded and unbonded regions are shown below:

A-scan signal from bonded region(Low back wall reflection)



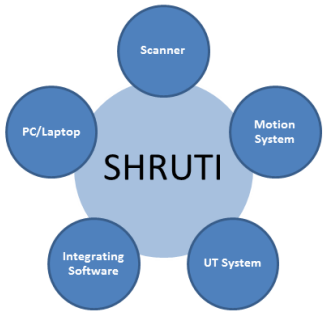
A-scan signal at nonbonded region(high reflection)



The cycle time required for scanning a component takes 10 minutes with good resolution.

The system used for the inspection is **SHRUTI®.** Scanning High-Resolution Ultrasonic Inspection System is an indigenously developed customizable, automated, multi-axis robotic scanner. Along with ultrasonic probe, advanced data analysis (***extut®***) and image analysis packages SHRUTI facilitates easy inspection of samples and components.

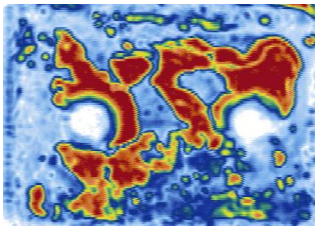
SHRUTI® offers very high-resolution images of the test coupon with very high scanning speeds. The complete instrument control is through the software. Skelton of the system is being built from lightweight aluminum extrusions which are upgraded to Stainless Steel for heavy-du applications. All the electrical connections are rugged and properly routed following industrial standards offering very durable and reliable running.



ROBUST SOFTWARE

The system employs rugged servo motors for motion requirements and had industrial standard safety interlocks.

The C-scan image showing the unbonded region of the brazed joint is shown below



Live C-scan Image

Typical Immersion Ultrasonic Testing System

The system employs a centralized lubrication system to cater to the lubrication requirements, centering rollers, pendent mechanism, and auto cycle to reduce human intervention. The system is capable of running 24 x 7 with minimal human intervention. Both the pulse-receiver are synchronized and interfaced with a central computer which controls both the pulse-receivers and motion hardware at the same time and records the data to a central repository.

The area of the unbonded region is calculated using our indigenously developed software named ***IMAGINE®.*** This software compares the area above the threshold level (defective size) and the total area of the scanned part and gives the percentage of defective area in the brazed joint.

Evaluation of Brazing Joint Quality using Immersion Ultrasonic Inspection- Application Note

A Dhvani Research Application Note

Chennai, INDIA

C-scan image showing the unbonded region (in red) of the brazed joint in a bus bar assembly

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