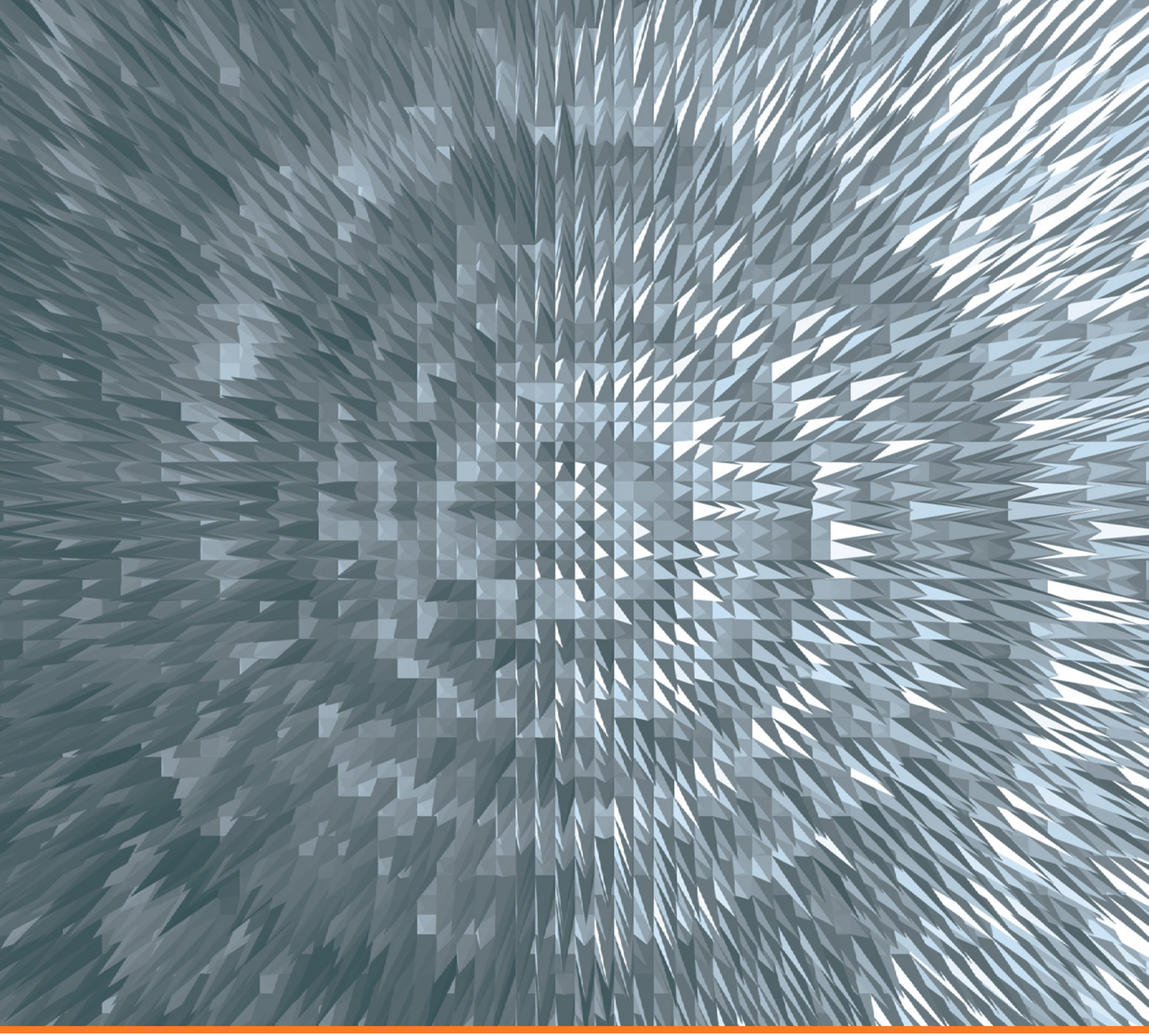


AMI Products Portfolio

C-SAM & SpinSAM Acoustic Inspection

www.nordson.com/TestInspect

Nordson
Test & Inspection

Leaders in Nondestructive Internal Inspection

Nordson Test & Inspection has a worldwide reputation of being the most trusted authority on the application of Acoustic Microscopy (AM) technology for nondestructive inspection and analysis using our C-SAM® (C-Mode Scanning Acoustic Microscope) solutions. Our systems are recognized as the benchmark for accuracy and quality and, through our Applications department, customers benefit from the unmatched expertise.

Superior Technology

We provide customers with superior acoustic microscope tools and technology to help build higher quality products. As a provider of a full range of analytical and testing services for clients that need immediate problems solved.

We deliver:

- Expertise in Acoustic Microscopy
- Outstanding image resolution
- Incredibly accurate results

Unsurpassed Laboratory Expertise

The Applications Team at Nordson Test & Inspection is the world's leading resource specializing in AM. Staffed by dedicated applications engineers, our team has more experience in AM applications than any other resource. This expertise is available to customers for assistance with compatibility and verification of parameters as well as system demonstrations.

Inspect With Confidence

We uphold the dual core values of a dedication to AM and a passion for quality results. Our advanced C-SAM technology is the most relied upon worldwide for inspecting and finding defects in a wide range of samples – especially wherever the bonding between layers or the integrity of the materials themselves is of critical importance.

Setting the Pace and Industry Standard

Nordson Test & Inspection invented the commercial field of Acoustic Microscopy (AM), in particular C-SAM tools. Our scientists and engineers work closely with our application development team to continually develop advanced systems and techniques for evolving technologies. The result is unrivaled technology, supported by more than 20 U.S. and foreign patents, adding value and confidence for users.

Industry Leaders Rely on Us

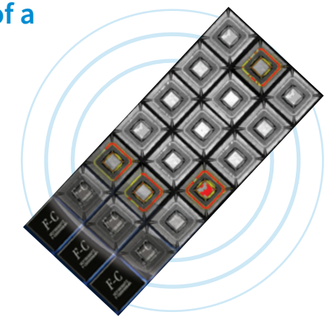
Reputations are built on quality. That's why the world's best-known companies rely on Nordson Test & Inspection for their AM needs. We partner with:

- All of the top ten global semiconductor companies
- Nine of the top ten automotive semiconductor companies
- Seven of the top ten defense contractors
- Four of the top five MEMS manufacturers
- Seven of the top ten 300mm wafer companies
- All of the top five semiconductor memory manufacturers

Join the best-known multinational corporations who have selected us for their nondestructive inspection needs.

AM Adds Value at Every Stage of a Product's Lifecycle

- Research and Development
- Qualification
- In-Line Process Control
- Quality Control
- Failure Analysis
- Reliability



Today, we work with numerous organizations to help develop qualification standards that improve component reliability. Many of these standards have been researched, authored or partially authored by our engineers. These include:

- IPC/JEDEC
  - J-STD-020
  - J-STD-035
  - J-STD-075
- MEMS STANDARD
  - SEMI MS8-0309
- MILITARY PERFORMANCE SPECIFICATION
  - MIL-PRF-123
  - MIL-PRF-31033
  - MIL-PRF-32535
  - MIL-PRF-49470
- AEROSPACE (NASA & ESA)
  - PEM-INST-001 (NASA/TP–2003–212244)
  - ESA/ESCC Basic Specification No. 25200
  - NASA S-311-P829
- MIL/AERO STANDARD
  - GEIA-STD-0006
- MILITARY STANDARD
  - MIL-STD-883, METHOD 2030
  - MIL-STD-1580B
  - REQUIREMENT 16.5.1.3

Timeline

1975 Shipped the first-ever commercial acoustic microscope, SLAM™

1977 Opened main applications development laboratory

1984 First analog C-SAM® acoustic microscope developed under "Star-Wars" contract

1987 Digital C-SAM acoustic microscope developed (patents issued)

1988 C-SAM Balanced Scanner developed (patent issued)

1989 Acoustic Impedance Polarity Detection (AIPD) (patent issued)

1993 First C-SAM installed for Si to Si bond research

1997 230 MHz transducer technology developed for Flip Chip

Autoloader for Controlled Immersion Inspection Mechanism developed (patent issued)

FACTS²™ (Fast Automated C-SAM Tray Scanning System) (patent issued)

2002 Automated system for wafer inspection and small part hold-down (patents issued)

2004 Turbo speed developed for high frequency and high resolution applications

2005 VRM™ (Virtual Rescanning Mode) and FDI™ (Frequency Domain Imaging) (patents issued)

2006 Nordson SONOSCAN China Lab Opens & CSA™ (Cavity Seal Analysis) for automated seal integrity evaluation

2007 Thickness Measurement Module & Automated Flip Chip Analysis Functions released

2008 ASF™ (Acoustic Surface Flatness) measurement mode (patents issued)

2009 First automated C-SAM for 300mm wafer inspection

2010 FastLine P300™ manual screening system for manufacturing floor (patent issued)

PolyGate™ platform released with the P300™ system

2011 Gen6™ laboratory system introduced with PolyGate™ platform

2012 SonoSimulator™ released for Stacked Die analysis

2013 First WaterPlume™ feature for dry inspection of IGBT Power Modules

2014 Introduced next generation FACTS™ instrument

2015 Global Tool Matching™

Quantitative Dynamic Z™

2018 Nordson Acquires SONOSCAN

The Gen7 C-SAM is launched with Windows® 10 and dual 4K monitors

2021 D9650 Manual production & laboratory system introduced

2024 SpinSAM™ automated wafer inspection system

Artificial Intelligence capability added to DIA™

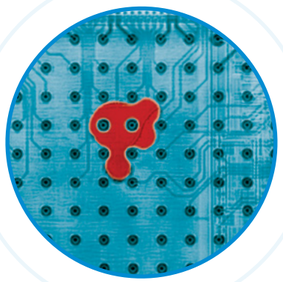
C-SAM®–The Leading AM Technology

Acoustic Microscopy's most notable benefit is its ability to find hidden defects within assemblies and materials that can occur during manufacturing or reliability testing.

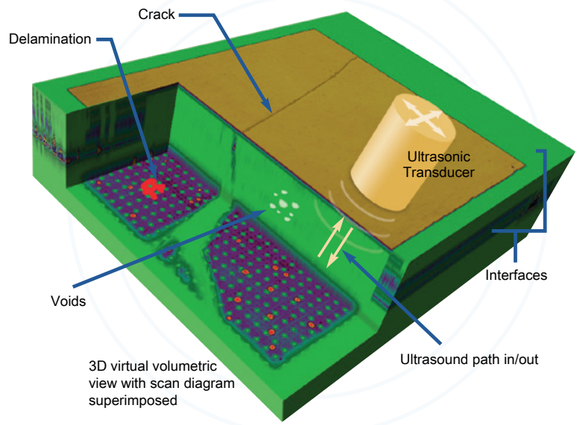
Unlike other nondestructive techniques, such as x-ray and infrared imaging, acoustic microscopy is highly sensitive to the elastic properties of the materials it passes through. Ultrasound waves may be absorbed, scattered or reflected by the material changes that they encounter, and they are especially sensitive to air gaps.

Nordson Test & Inspection offers various imaging modes, allowing an operator to gain the ideal viewing perspective based on the orientation of the feature within the sample. In addition, our proprietary advanced features deliver the optimum images, highest efficiencies and most accurate results.

These capabilities make C-SAM tools the preferred AM method for finding and characterizing physical defects that occur during the manufacturing process or during reliability testing. Delaminations, voids and cracks can be identified and analyzed more effectively using acoustic microscopy than with any other inspection method.



Flip Chip
300 MHz image showing
void (red) in underfill



Nordson Test & Inspection's technologies offer many advantages:

- Locates hidden flaws before they lead to failures
- Detects delaminations as thin as 200 angstroms
- Isolates material property variations
- Measures material density, porosity, inclusions, cracks and voids
- Assesses thermal, impact and fatigue damage
- Assesses interface adhesion and delamination
- Nondestructive

Image Quality Advantages

The image quality produced by an acoustic microscope is critically dependent upon the imaging lens. Since the transducer/ lens is such an important component, we manufacture these elements ourselves.

The off-the-shelf transducers found in other AM equipment can't match our unique, proprietary characteristics. Nordson Test & Inspection transducers are specifically developed for C-SAM analysis by our transducer lab located near Chicago, Illinois. Staffed by some of the world's most knowledgeable acoustic scientists and engineers, our transducers are carefully developed and manufactured to deliver maximum image clarity and quality data.

We offer the broadest range of standard and custom designed transducers. We also have the expertise to optimize the design parameters for specific applications. Nordson Test & Inspection transducers include, but are not limited to, the following design parameters:

Frequencies (MHz) Available

- 5MHz
- 10MHz
- 15MHz
- 20MHz
- 25MHz
- 30MHz
- 50MHz
- 75MHz
- 100MHz
- 120MHz
- 230MHz
- 300MHz

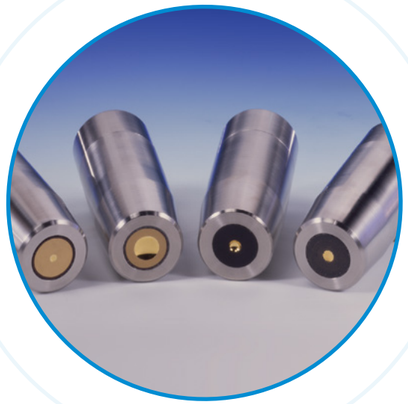
F# (FL/D) Available

- F# 1.5
- F# 2
- F# 3
- F# 4
- F# 5
- F# 6
- F# 7

Focal Length (FL) Available

- 2.5 mm
- 3.0 mm
- 3.8 mm
- 6.4 mm
- 8.0 mm
- 12.7 mm
- 19.1 mm
- 25.4 mm
- 31.8 mm
- 38.1 mm
- 57.2 mm

Transducers



Nordson Test & Inspection develops and manufactures these critical components with unique, proprietary characteristics. Available in standard or custom, application specific designs

Actual subsurface image, 3 micron lines

Test results demonstrating extremely small details deep within silicon (as measured in microns)

Quality control is critical. Therefore, all Nordson Test & Inspection transducers undergo a detailed quality and calibration test to verify resolution and ensure optimal performance. Our transducers can deliver high quality AM images and result in verified superior resolution.

Precision Instruments

From the laboratory to the production floor, Nordson Test & Inspection ’s advanced Acoustic Microscope (AM) tools and technology help build higher quality products. We manufacture our own instruments in our state-of-the-art production and engineering facility near Chicago, Illinois.

Highest Quality

Our AM instruments are built with the highest level of quality. To ensure that all instruments measure up to Nordson Test & Inspection’s rigid specifications, every system undergoes rigorous testing before shipment to ensure reliability, longevity and superior performance.

Suitable for a Wide Range of Applications

From component analysis, to high-speed wafer inspection, to intensive laboratory analysis, to efficient manual screening capabilities, our instruments meet our customers’ needs. So whether you’re seeking equipment for a scientific, production or specialty use, we offer a wide range of styles, models and options that deliver the best solution.

Designed for Efficiency

Nordson Test & Inspection instruments deliver results. Ergonomic and smart designs minimize operator fatigue and maximize throughput. Proprietary hardware such as our Waterfall Transducer™ and Inertially Balanced Scanning Mechanism™ allow for higher-speed scanning and yield the highest levels of productivity and return on investment.

Superior Technologies

Nordson Test & Inspection’s proprietary signal processing algorithms provide the most reliable and accurate assessments. A wide variety of analysis functions help quantify the defect significance, and a wide range of color maps accentuate features within the AM image. In addition, proprietary and patented technologies such as Virtual Rescanning Mode (VRM™) provide exceptional advantages and unique capabilities.

Expert Support

Customers have access to more than 20 dedicated and highly experienced AM applications engineers. This remarkable pool of talent provides a level of training, support and service that is unmatched in the industry.

Production Instruments

Facts^{2}™ DF2400

The FACTS^{2} delivers state-of-the-art, automated in-line inspection for quality and process control. Simultaneously inspecting two trays and utilizing multiple scan heads, the DF2400 improves throughput between two and seven times that of previous tools. FACTS^{2} automatically inspects parts in JEDEC trays or Auer Boat carriers. The FACTS^{2} can also handle lead frame strips, IGBT power modules, multi-layer ceramic chip capacitors, flip chips and other components. Equipped with our industry preferred Sonolytics software platform, FACTS^{2} is the ideal solution for production environments.

Selected Features:

- Global Tool Matching™
- SECS-II/GEM (SEMI E30) and SMEMA compliant
- Non-immersion scanning using WaterFall™ and/or WaterPlume™ Transducers
- Automated Data Analysis Package
- Vacuum Hold Down option to stabilize small parts in place during scan
- Separate drying chamber with up to four oscillating air knives and optional heated air
- Numerous configuration options including JEDEC trays, Auer boats and IGBT modules

Laboratory Systems

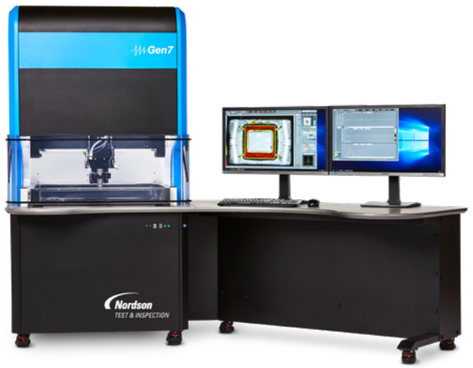
D9600

Representing the latest in C-SAM® acoustic micro imaging technology, the D9600 delivers the unrivaled accuracy and robustness that you would expect from Nordson Test & Inspection instruments, plus improved electronics and software that raises the performance level for laboratory acoustic microscopes. Specifically designed to serve as a general purpose tool for failure analysis, process development, material characterization and low volume production inspection, the capabilities of the D9600 are truly unmatched.

Selected Features:

- PolyGate™ technology with Multi-Gate™ and Probing-Gate™ functions capable of single and multi-focus imaging
- Up to 100 gates per channel
- Windows®10 Ultimate for multi-language and 64 bit capabilities
- Precise scanning with tower mounted scan reference platform and sample fixture
- Optional Digital Image Analysis (DIA™), water recirculation, Waterfall™ transducer and inline temperature control

Gen7™



The Gen7 C-SAM is the highest performing and highest resolution acoustic microscope. Taking the best from its predecessor, the Gen6™ (such as, cutting-edge technology, advanced features, aesthetics and ergonomics), the Gen7 goes beyond the D9600 and takes acoustic imaging to the highest level. It delivers the broadest range of capabilities available for nondestructive failure analysis, process development, R&D, high-reliability qualification or medium-volume screening. The Gen7 is the one machine that can meet your present and future needs.

All the D9600 Features PLUS the Following Advanced Features:

- SonoSimulator™ for multilayer analysis
- Virtual Rescanning Mode (VRM™)
- 400 MHz capable
- Windows®10
- Digital Image Analysis (DIA™)
- Inertially Balanced Scanning
- Dual 4k resolution monitors
- Wrap, straight or narrow cabinet options
- Real time Frequency Domain Imaging (FDI™)

Production Wafer System

SpinSAM

The SpinSAM automated inspection tool delivers high throughput and better sensitivity for accurately locating defects in wafer based assemblies. Successful applications include bonded wafers, Chip-on-Wafer, stacked wafers, MEMS, over-molded wafers and more. Efficiently spin scan up to 4 wafers simultaneously with matched transducers, wafers can be inspected over the widest frequency range ever achieved in a production environment.

Waterfall transducer provides non-immersion scanning which minimizes risks of contamination and false bond indications.

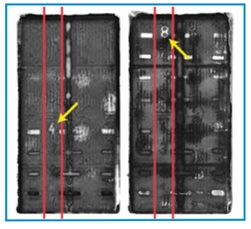
Selected Features:

- Fastest data collection possible 41 WPH @ 100 µm
- Continuous non-stop scan path. Using four combined scanners (each capable of 10 WPH @ 100 µm) provides unmatched speed
- Uniform, streak free images
- A 100 µm scan (from wafer load to wafer load) takes less than six minutes
- Global Tool Matching™
- SECS-II/GEM (SEMI E30) and SMEMA compliant
- Non-immersion scanning using WaterFall™ Transducers

Advanced Features

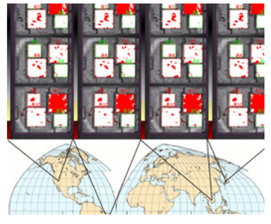
SonoSimulator™

Simplifies and accelerates the task of generating C-SAM® images on components constructed with multiple thin layers, such as Stacked Die packages.



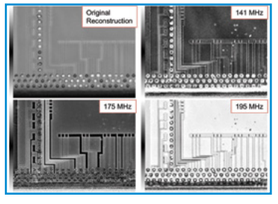
Global Tool Matching™

Global matching will produce the same result using the same recipe settings on any tool at any location worldwide.



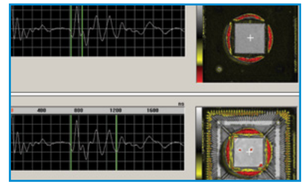
Frequency Domain Imaging (FDI™)

Allows you to select any single frequency or a range of frequencies to capture and utilize for imaging. FDI brings out subtle details that are not easily detected with conventional pulse-echo methods.



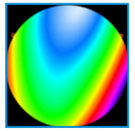
Time Domain Imaging (TDI™)

Another way of expressing an image that utilizes an echo (amplitude & polarity) arrival “time” as a reference, such as standard A-Scan, B-Scan and C-Mode type images.



Quantitative Dynamic Z (Q-DZ™)

Q-DZ uses collected data to instantly adjust the height of the transducer allowing the scanner to follow the shape of a non-flat surface to keep a constant focus time of flight during the scan, resulting in an optimal image.



Without Q-Dynamic Z

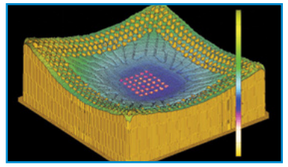
With Q-Dynamic Z

WaterPlume™

In addition to non-immersion WaterFall™ technology, WaterPlume inspects the sample from underneath by means of a column of water. With the help of gravity the water stays below the sample keeping the sensitive top surface dry.

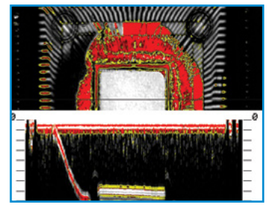
Acoustic Surface Flatness (ASF™)

Provides surface flatness and warpage images plus quantitative measurements of the flatness, while obtaining C-SAM images of internal features.



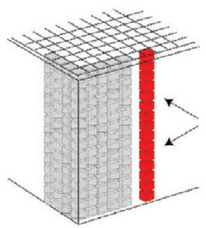
Quantitative B-Scan Analysis Mode (Q-BAM™)

Q-BAM is a calibrated, nondestructive cross-section image in the X-Z plane of a sample, which is completely in focus through the entire Z depth and contains both amplitude and polarity data.



Virtual Rescanning Mode (VRM™)

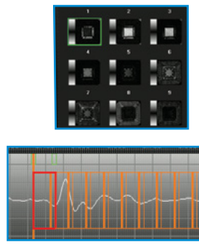
VRM collects and digitally stores comprehensive acoustic data, enabling a complete analysis of a sample, even when it is no longer available or destroyed.



Digitally Stored A-Scan Data

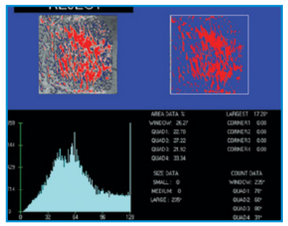
Visual PolyGate™

Allows you to select up to 100 gates/depths of interest in a single recipe. There are several modes of PolyGate, such as Multi-Gate/Single Focus (MG/SF) and Probing-Gate/Single Focus (PG/SF), plus Multi-Focus variants that ensure in-focus data while retaining polarity and amplitude data.



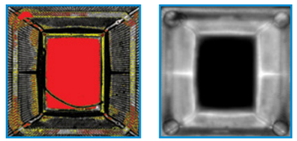
Digital Image Analyzer (DIA™)

Uses advanced algorithms to quantify the C-SAM data allowing you to perform quantitative analysis to accurately and automatically accept/reject a part per your criteria.



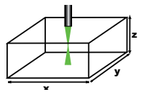
Simultaneous Transmission and Reflection (STaR™)

STaR simultaneously captures both a reflective mode and a complete through-the-package view.

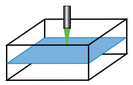


Imaging Modes

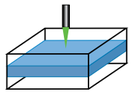
Nordson Test & Inspection's wide variety of acoustic imaging modes helps you to thoroughly investigate a sample. The optimum viewing perspective, or imaging mode, is based on the orientation of a feature within a sample. In addition, multiple imaging modes are often used to provide an even more complete evaluation and to verify defects revealed in another mode.



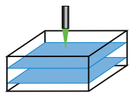
A-Scan – Digital waveform display of what the transducer sees. The A-Scan is the foundation of creating and interpreting C-SAM® images.



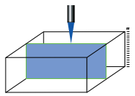
C-Mode – Created by focusing and collecting amplitude and polarity information from a particular X-Y plane at a selected depth in the sample.



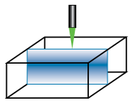
Bulk-Scan – Provides information on bulk material properties and discontinuities indicating features or flaws.



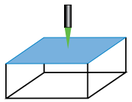
PolyGate™ & Multi-Scan – View multiple levels within a device simultaneously.



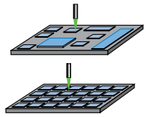
Q-BAM™ – A nondestructive, multi-focus, cross-sectional view of a sample. It ensures in-focus data while retaining polarity and amplitude data.



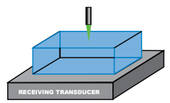
B-Scan – A nondestructive, single-focus, cross-sectional view of a sample.



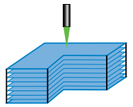
Surface-Scan – A near surface scan that reveals surface and near surface defects.



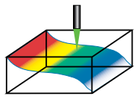
AutoScan™ – Programs the system to inspect multiple parts in a tray, on a PWB or anywhere within the available scan area automatically, even if the parts are different.



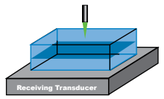
THRU-Scan™ – An acoustic image through the entire thickness of the sample is captured, providing a complete view of the part.



3V™ – Generates a three-dimensional view of a component from captured acoustic images.



3D TOF – By tracking the transit time from a reference to an internal feature or defect, a topographic image is created of the internal structure.



STaR™ – Creates images in both the reflection and transmission modes simultaneously, providing the complete through-the-part view and level-specific information on defects and feature depth.

Applications

Acoustic Microscopes are relied upon for finding defects in a wide range of samples - wherever the bonding between layers or the integrity of the materials themselves is critically important.

Microelectronics
- Plastic Encapsulated Microcircuits
- Ceramic Chip Capacitors
- Die Attach
- Chip Scale Packages (CSPs)
- Flip Chips
- Stacked Dies & 3D Integration
- Ball Grid Arrays (BGAs/CBGAs)
- Tape Automated Bond (TAB)
- Hybrids, MCMs, SIPs
- Flex Circuits
- Printed Circuit Boards (PCBs)
- Smart Cards
- Bonded Wafers
- Thermo Electric Coolers (TECs)
- Power Modules
- Counterfeit Devices

Microelectromechanical Systems (MEMS)
- Bonded Wafers
- Fabrication Process Evaluation
- Zero Level Packaging
- Cavity Seal Analsyis
- Packaging
- Sensors
- IMEMS
- MOEMS
- Lab-on-Chips
- BioChips
- Microarrays

Solar Energy
- Thin Film
- Polymer-Based
- Silicon

Composites
- Fiberglass
- Polymers
- Graphite
- Metal Matrix
- Hybrid
- Other

Materials
- Glass
- Ceramics
- Plastics
- Adhesives
- Metals
- X-ray Target

Medical
- Materials
- Devices

Military, Aerospace and Automotive
- High-Rel Qualification
- Upscreening COTS
- Qualification
- Lead-free Devices
- Counterfeit Devices

Packaging Seals
- Food
- Medical
- Pharma
- Other Hermetic

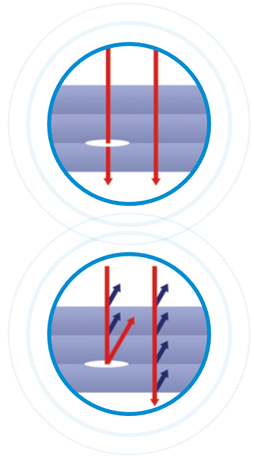
HB/SSL LEDs
- Multi-Layer Wafers
- LED Modules
- LED Drivers

How Acoustic Microscopy (AM) and X-ray Differ

AM and x-ray are complementary techniques that are frequently found in the same laboratories, but they reveal different features.

X-rays can be used to see inside a sample based upon material density differences. Denser materials are more absorptive to x-rays, but because air has such low density, delaminations, cracks and disbonds can be missed. Also, common x-ray systems operate in a through-transmission mode and provide a composite image of the entire sample thickness, rather than layer specific data.

Acoustic Microscopy imaging, however, shows differences in material continuity and is very sensitive to the presence of even the smallest air gaps, making inspection for the integrity of bonding between layers a unique advantage. In addition to visualizing interior features of samples, Nordson Test & Inspection's C-SAM® systems produce images on a layer-by-layer basis. Images can be made in a reflection mode, which requires access to only one surface of a sample or in a through-transmission mode.



X-ray transmission is unaffected by delamination

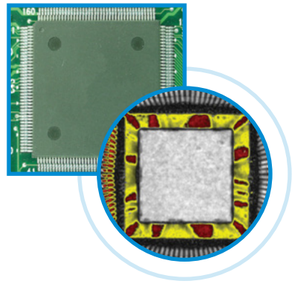
AM transmission and reflection identifies delamination

Applications

ME – Plastic Encapsulated Microcircuit

Hidden defects within an electronic package can often lead to catastrophic failure of the device.

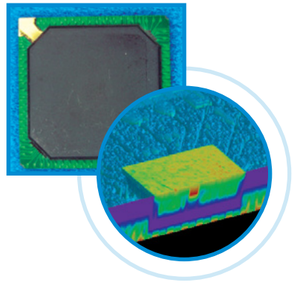
Critical delaminations (red and yellow areas) are revealed



ME – Ball Grid Array

This three-dimensional image also includes a cross-sectional view through the center of this BGA. Depth information is gained from these views.

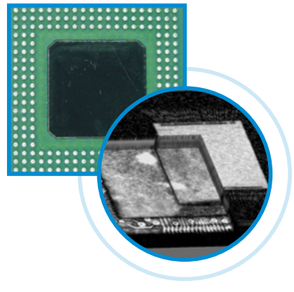
The red feature near the center is from a void in the die attach



ME – Stacked Die

This image is from a BGA package containing a two-die stack.

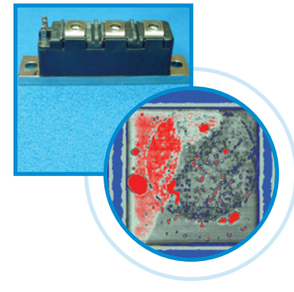
There are two basic concerns about stack die, delamination and cracked die. This 3D reconstruction reveals delamination between die



ME – Power Module

The ability to transfer heat from the die to the heat sink will often characterize how long a power device will function.

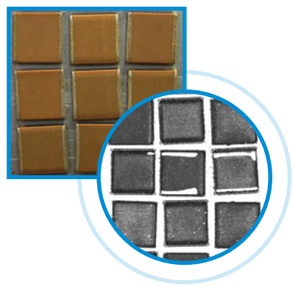
The red areas are voids and delaminations between the die and heat sink



ME – Ceramic Chip Capacitor

Internal defects such as delaminations, cracks and voids within ceramic chip capacitors can lead to product failure.

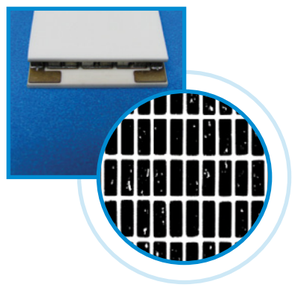
This inspection revealed delaminations and voids (bright white areas) within the active area



ME – Thermo Electric Cooler

The ability to actively transfer heat makes thermo electric coolers (TECs) useful devices in a variety of applications.

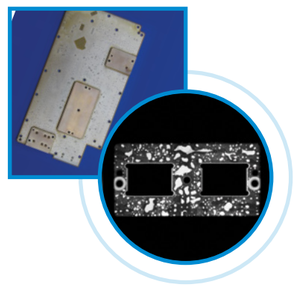
The bright white features within the dark rectangles indicate voids at the direct bond copper (DBC) to ceramic substrate interface, which can block heat transfer



ME – PCB to Metal Stiffener

For some high reliability PCB applications stiffeners and heat sinks are added. The bond quality between the PCB and stiffener is critical to its reliability.

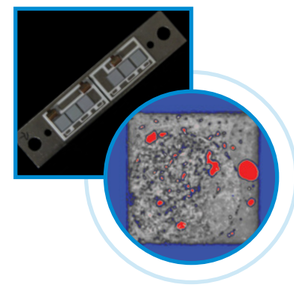
The bright white areas indicate voids in the attachment material used between the PCB and stiffener



ME – Power Die

Similar to power modules and devices, individual power die must have adequate bonding to allow proper heat transfer and performance.

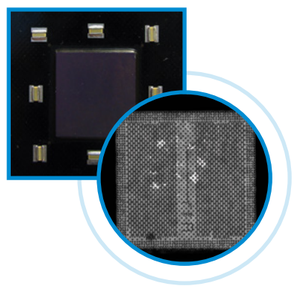
The red areas within the image indicate voids and delaminations between the die and substrate



ME – Flip Chip

Flip chip devices are routinely inspected for underfill, bump and silicon quality.

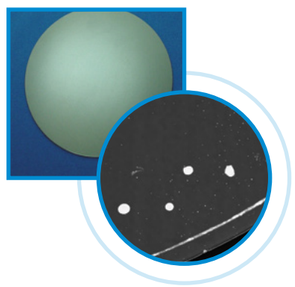
The bright white areas observed in this flip chip image are voids in the underfill, which can lead to electrical failure



ME – Bonded Wafer

Evaluating the bond quality in wafer pairs can uncover delaminated and voided regions that can lead to yield loss.

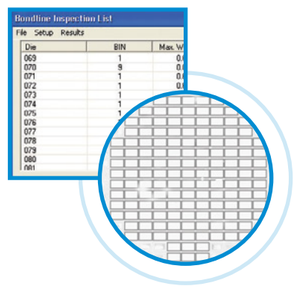
White areas indicate voids and delaminations detected between the wafers



MEMS – Wafer Cavity Seal Analysis

To ensure that MEMS operate properly the integrity of the cavity seal is vital. Any breach of the hermetic cavity is a reliability issue.

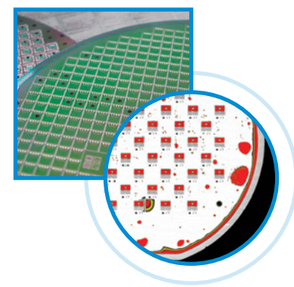
The integrity of these MEMS cavity seals (gray boxes) is compromised - too thin of a seal width for some devices or nonexistent, incomplete perimeter seal, for others



MEMS – Bonded Wafer

Delaminations and voids can compromise the hermeticity of these devices.

The regularly spaced red features are intentional air cavities that contain the actual MEMS devices. The remaining red areas are defects

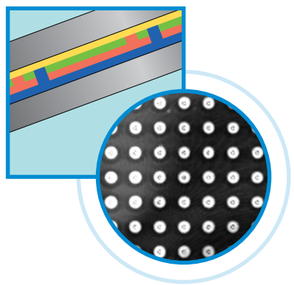


World-Leading Applications Department

Solar – Thin Film

The thin film cell structure is a multi-layered composite, where each layer must be interconnected and uniformly deposited and bonded.

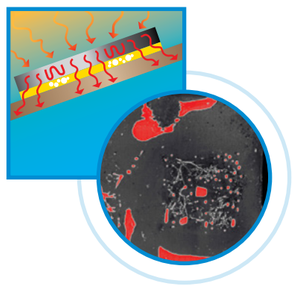
A missing interconnect can be seen in the center of the grid, along with delaminations in the lower left



Solar – Concentrator

The key reliability issue is the proper transfer of the excess solar thermal energy, requiring a consistent bond between the solar cell and the heat sink.

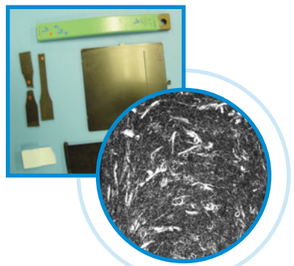
The red areas indicate gaps in the cell-to-solder interface, which could cause loss of efficiency or failure of the structure



Materials – FRP Composite Integrity

The mechanical strength of a composite can affect its performance.

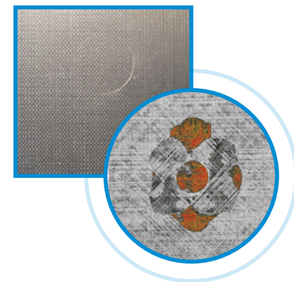
The bright white areas indicate voids and cracks - stress points that can lead to mechanical failure, as happened here



Materials – FRP Composites (Impact Damage)

Unlike other materials, polymer composites can look perfectly good on the outside with hidden impact damage internally.

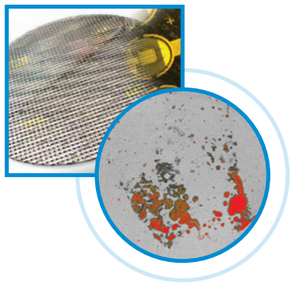
The petal shaped feature outlines the extent of the internal impact damage and the red indicates delamination between layers at this depth within the polymer/glass laminate



SSL LED – Wafers

The quality of the bond between layers of an SSL LED wafer will determine the yield of that wafer and the number of useable die from it.

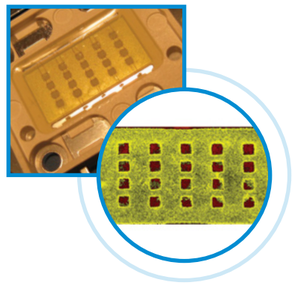
Improper bonding between layers within this SSL LED wafer is indicated by the yellow/red areas



SSL LED – Chip Bond

High-brightness, SSL LEDs require proper heat transfer from the LED chip to achieve optimum performance and to prevent premature failure.

The variation in the bond quality between these 20 die and the substrate indicates poor production process control, leading to premature failure of the SSL LED module



Materials – Ceramic Composites

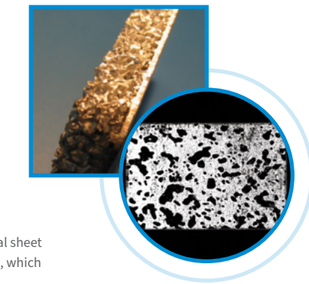
Ceramic and powdered metal parts can be inspected for internal and near surface defects that may cause premature failure.

Unlike the C-SAM® image of the ceramic disc on the front cover, this image indicates a near surface crack (black and gray shadows)

Materials – Metal Foam to Metal (Bond Quality)

Metallic composite structures, such as metal foam/metal sheet, require adequate bonding between layers to ensure the integrity and strength of the structure.

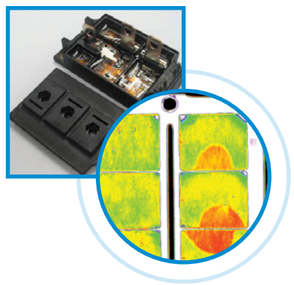
The analysis of the metal foam to metal sheet interface indicates a bond area of 39%, which matches the expected foam density



IGBTs

IGBTs, like other power devices, require adequate bonding between layers with the proper thickness tolerance for good heat transfer and reliable performance.

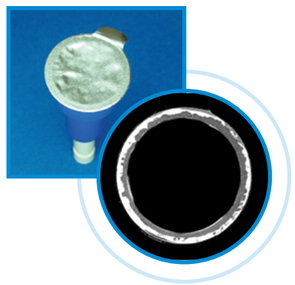
Three of the nine power die within this IGBT module show delaminated corners (white areas)



Foil Seal

In medical devices and pharmaceutical packaging, a seal is often used to keep the device or cavity contents sterile and contaminant-free.

The bright white areas along the outer perimeter show several leak paths across the width of the seal



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