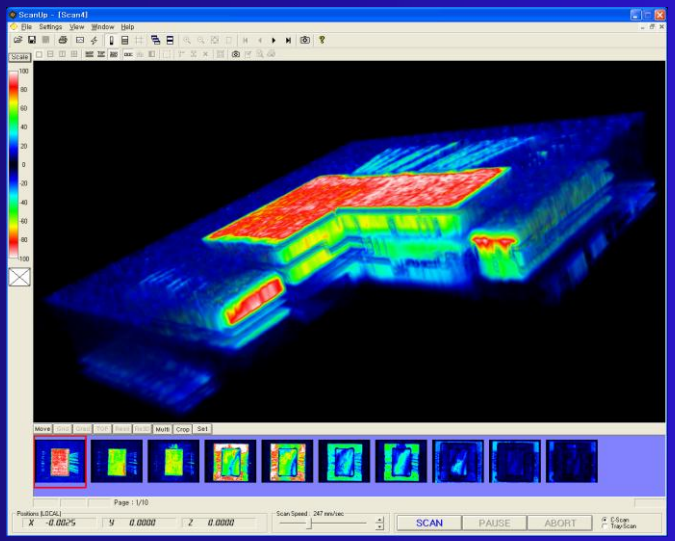
AcouLab

New generation acoustic solution

The Basic Principles of SAM



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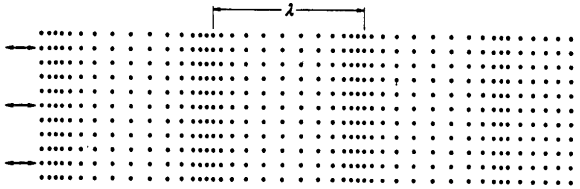
Ultrasonic waves in Materials

What are Ultrasonic Waves?

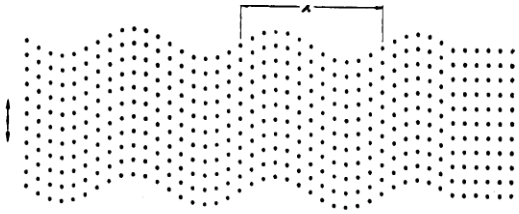
- Sound waves above the range of human hearing, 20kHz.
- Mechanical vibration (elastic waves)

Characteristics of Ultrasonic Waves

- 4 Type waves : **Longitudinal wave**, Shear wave, Surface wave, Plate wave
- Freely propagate through liquids and solids
- Reflect at boundaries of internal flaws and change of material
- Capable of being focused, straight transmission
- Suitable for Real-Time processing
- Harmless to human body
- Non-electromagnetic wave : suitable inspection for heavy density materials



Longitudinal wave



Shear wave

Advantages and Disadvantages

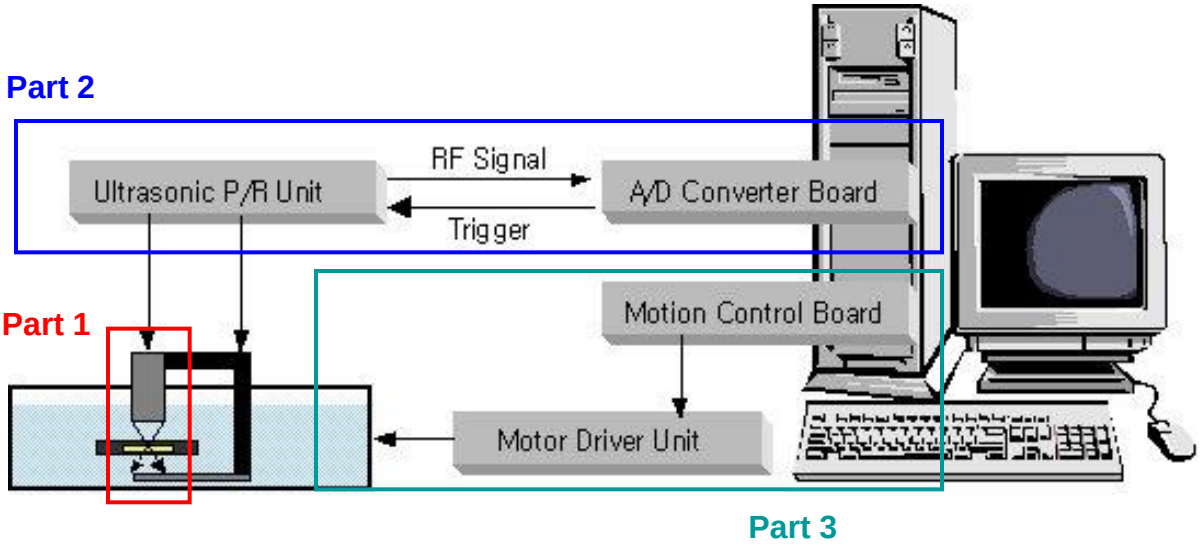
Advantages

- Superior penetrating power, which allows the detection of flaws deep in the part : upto 6m in steel
- High sensitivity, permitting the detection of extremely small flaws
- Greater accuracy than other nondestructive methods in determining the position of internal flaws, estimating their size, and characterizing their orientation, shape and nature
- Volumetric scanning ability and Nonhazardous to operations

Disadvantages

- Required experienced technicians and extensive technical knowledge
- Parts that are rough, irregular in shape, very small or thin, or not homogeneous are difficult to inspect
- Couplants (water) are needed to provide effective transfer of ultrasonic wave energy between transducers and parts being inspected

Schematic of SAM



Part 1 : Ultrasonic transducer

Part 2 : Ultrasonic pulser and receiver, Analog to Digital converter

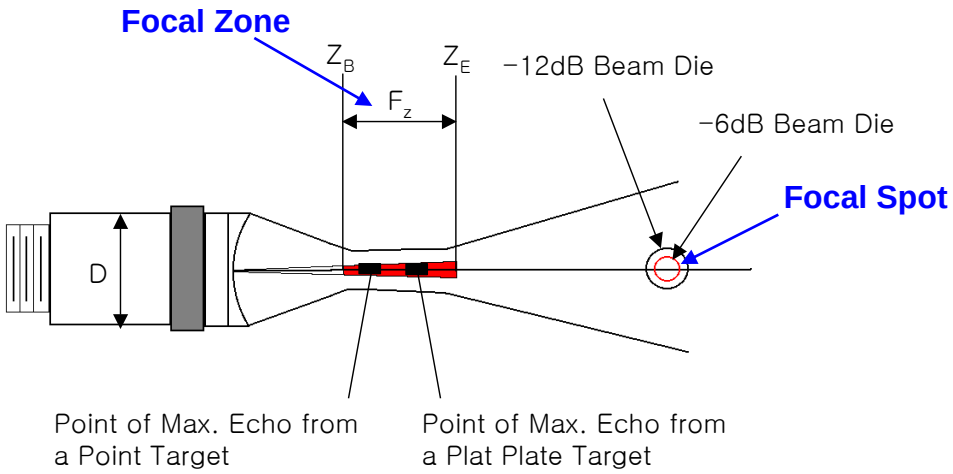
Part 3 : Motion control & driver

Ultrasonic Transducer

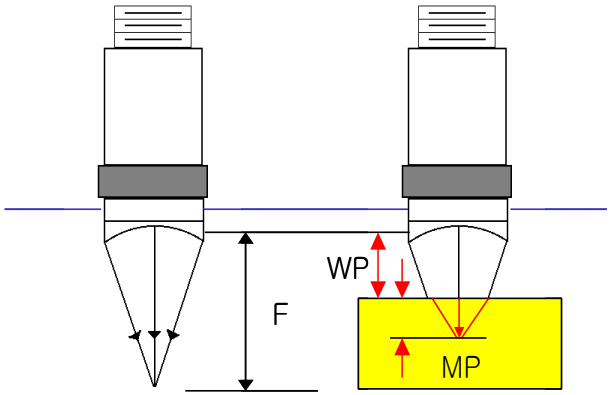
Ultrasonic transducers (piezoelectric transducer) convert electrical energy to mechanical energy (sound) and sound back to electrical energy.

Selection of transducer for semi-conductor

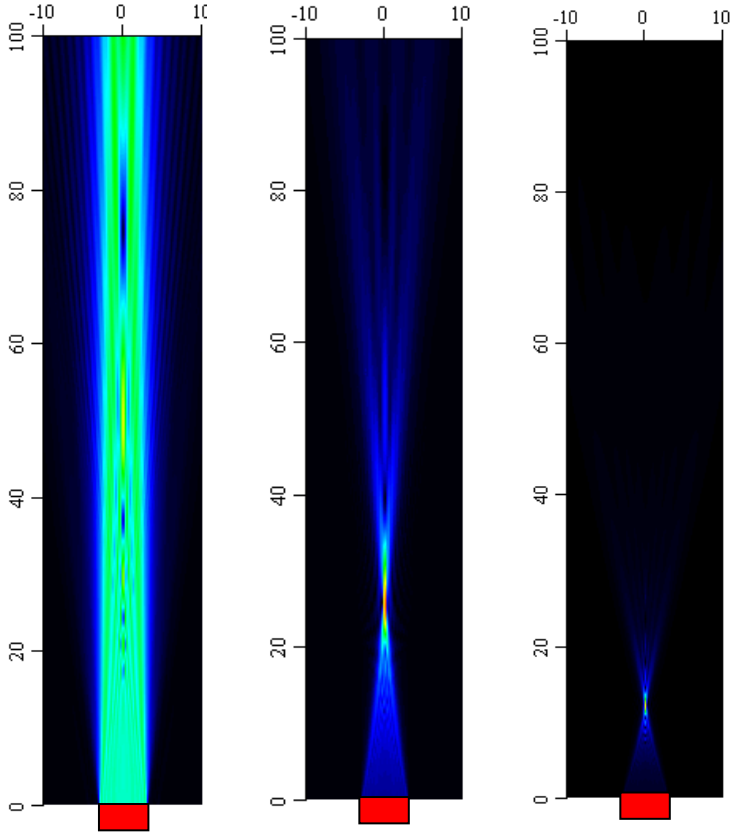
- High frequency and short focal length for thin packages
- Low frequency and long focal length for thicker packages



Ultrasonic Transducer



Ultrasonic Beam Profiles in Water



Flat **FL:25mm** **FL:12mm**

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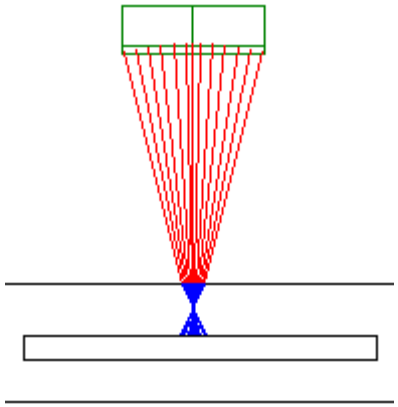
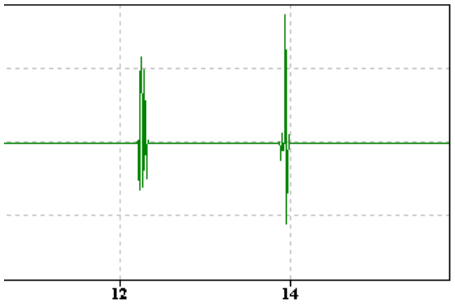
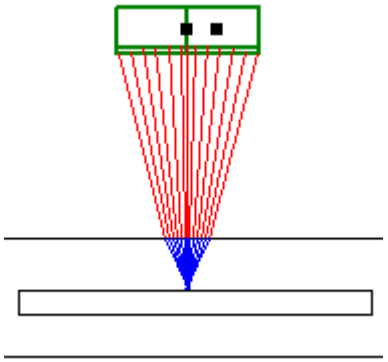
Focusing the Transducer

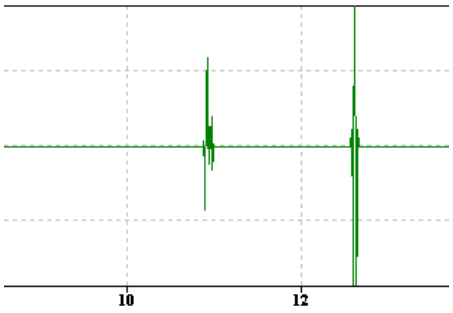


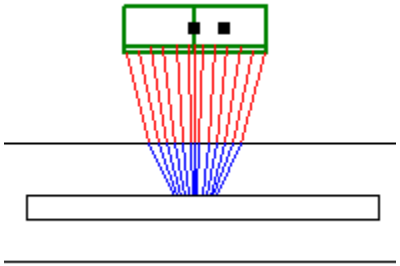
De-Focused : Too Far Away



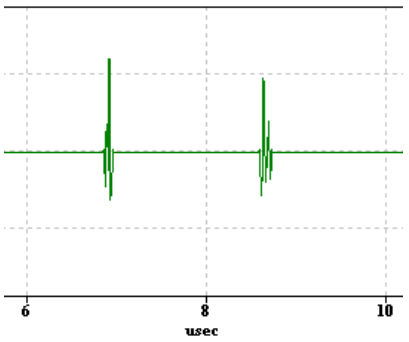


Focused on Die



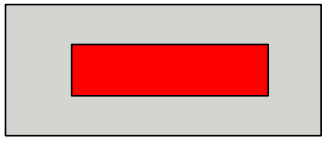


De-Focused : Too Close



Ultrasonic Transducer Selection

Thick IC Package



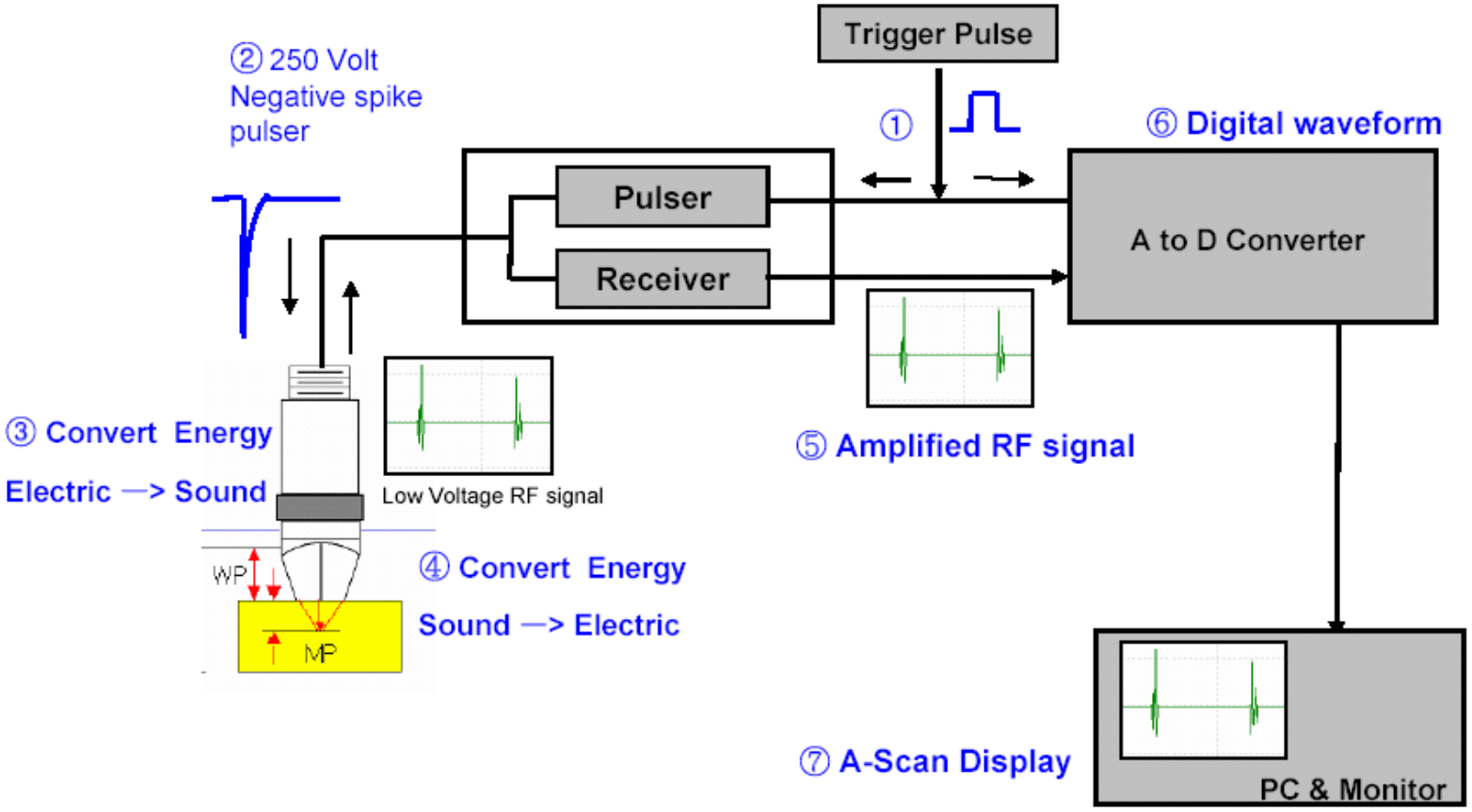
Lower Frequency
Longer Focus

Thin IC Package

Higher Frequency
Shorter Focus

Type of Application	Ultrasonic Transducer
T/X Receiver	10MHz, FL 0.75”
PLCC, QFP, PQFP	15MHz, FL 0.5”
Power Pak	15MHz, FL 0.75”
BGA Top	25MHz, FL 0.5”
Capacitor	50MHz, FL 0.5”
TSOP, CAPS	75MHz, FL 0.375”
Die Inspection	110MHz, FL 0.25”
Flip Chip & Underfill	110MHz, FL 0.375” 150 & 175 MHz, 8mm

Pulser/Receiver & A/D



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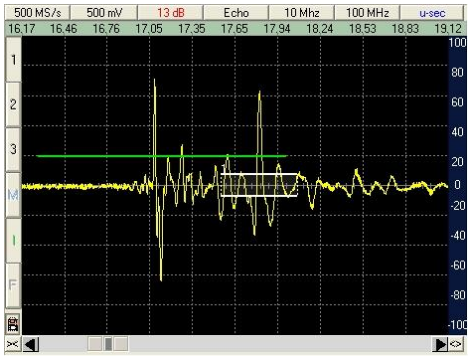
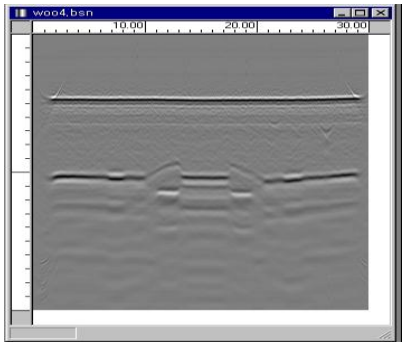
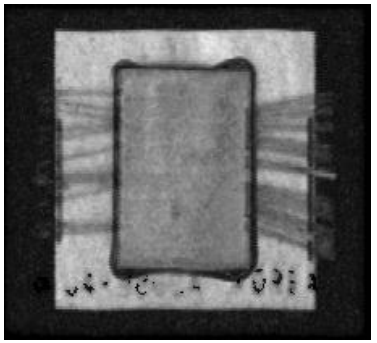
Display Method of Ultrasonic Testing



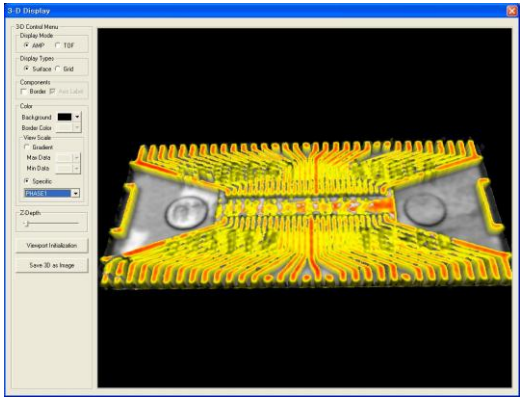
A-Scan



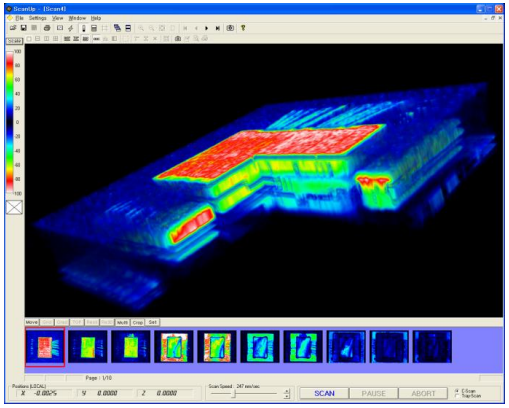
B-Scan



C-Scan



TOFD 3D

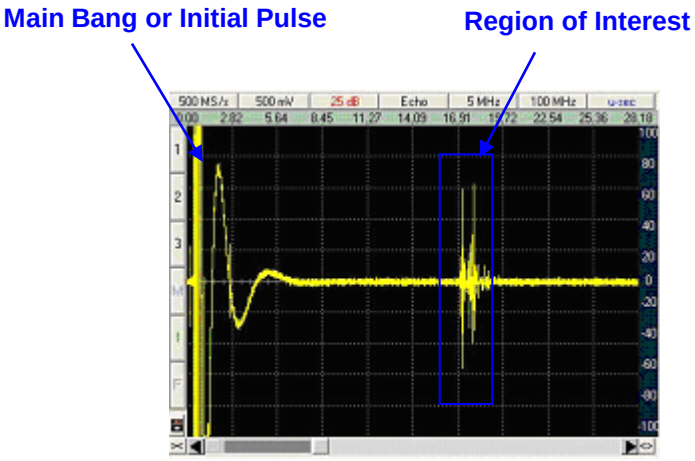


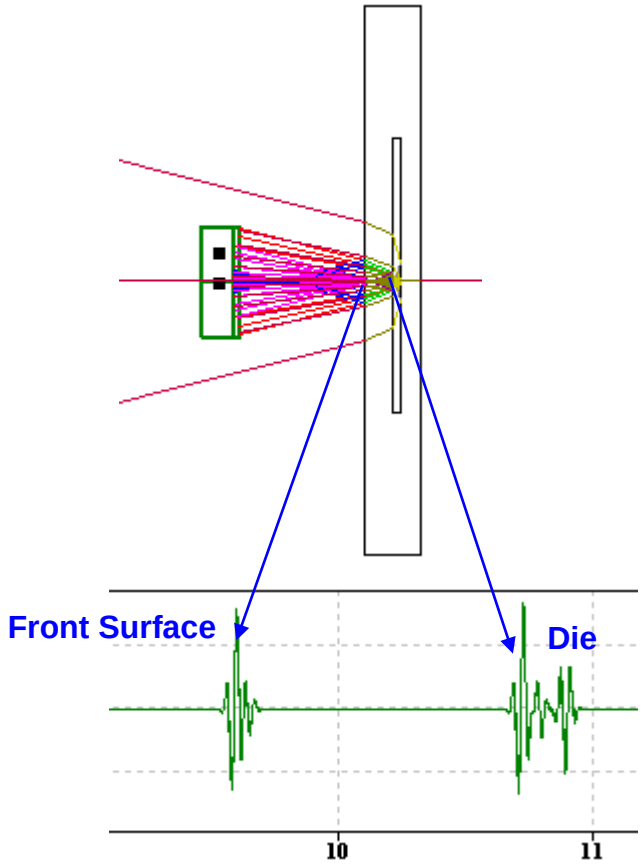
Virtual 3D

Pulse-Echo and Thru-Transmission Method

Pulse-Echo Method :

Single transducer operates both of sending and receiving transducer





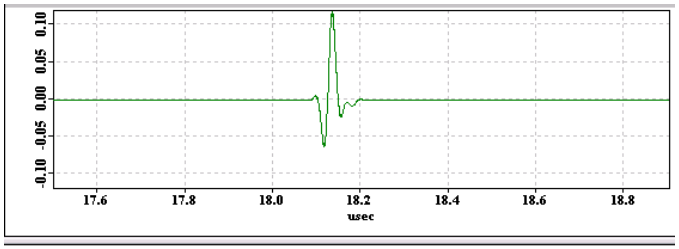
ISO9001:2000

Pulse-Echo and Thru-Transmission Method

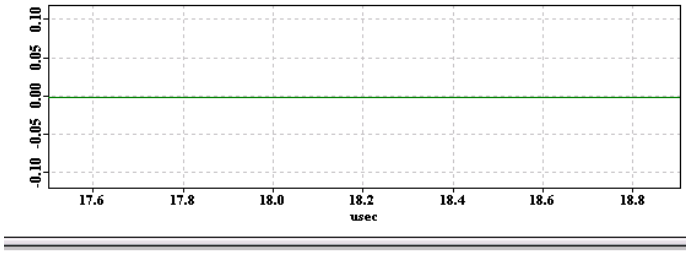
Thru-Transmission Method :

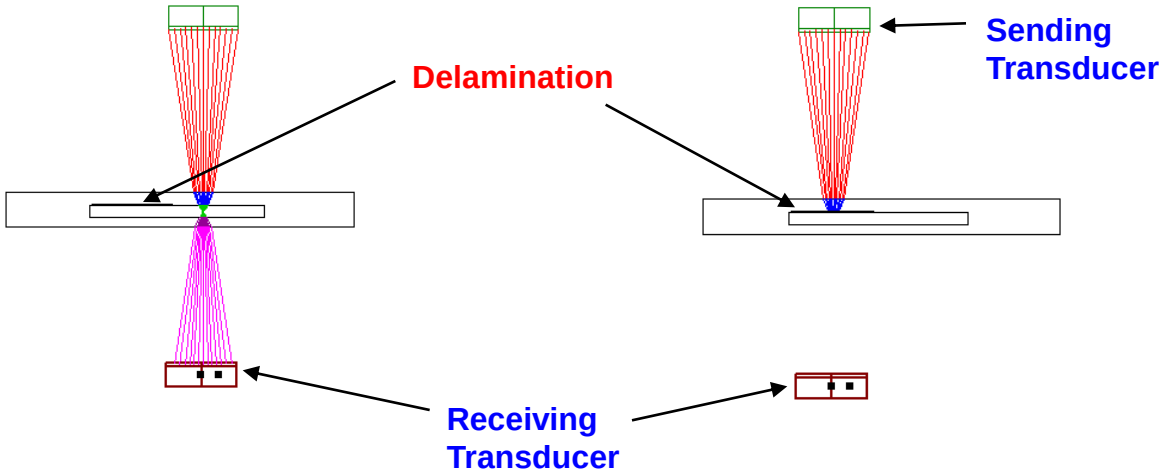
Double transducers operate as a sending and receiving transducers

Signal without delamination



Signal with delamination

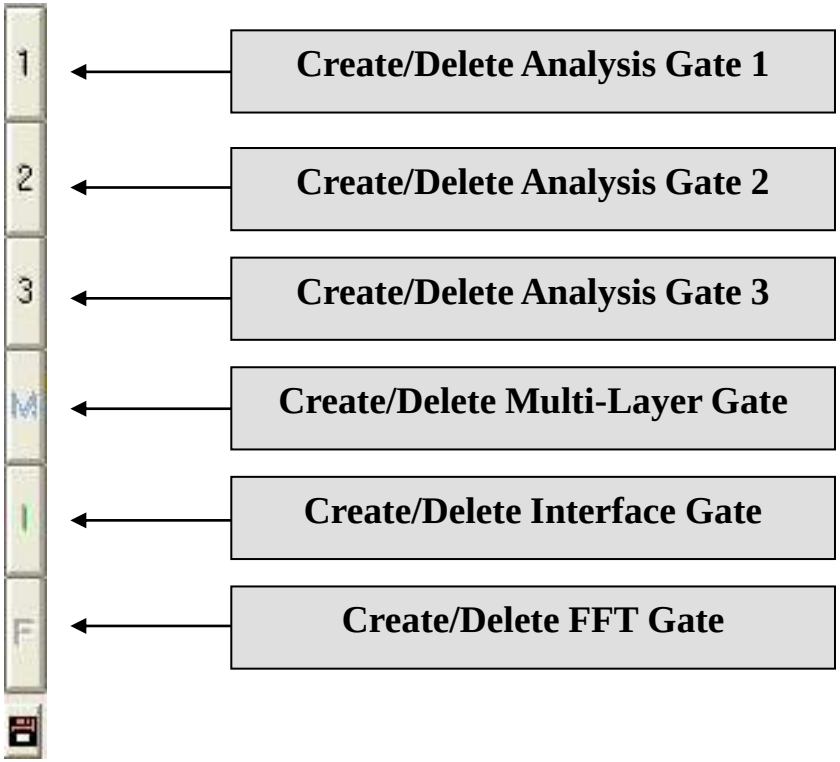




6 Gates in ScanUp™

-**Three data gates, Multi-Layer Gate, Interface Gate, FFT Gate**

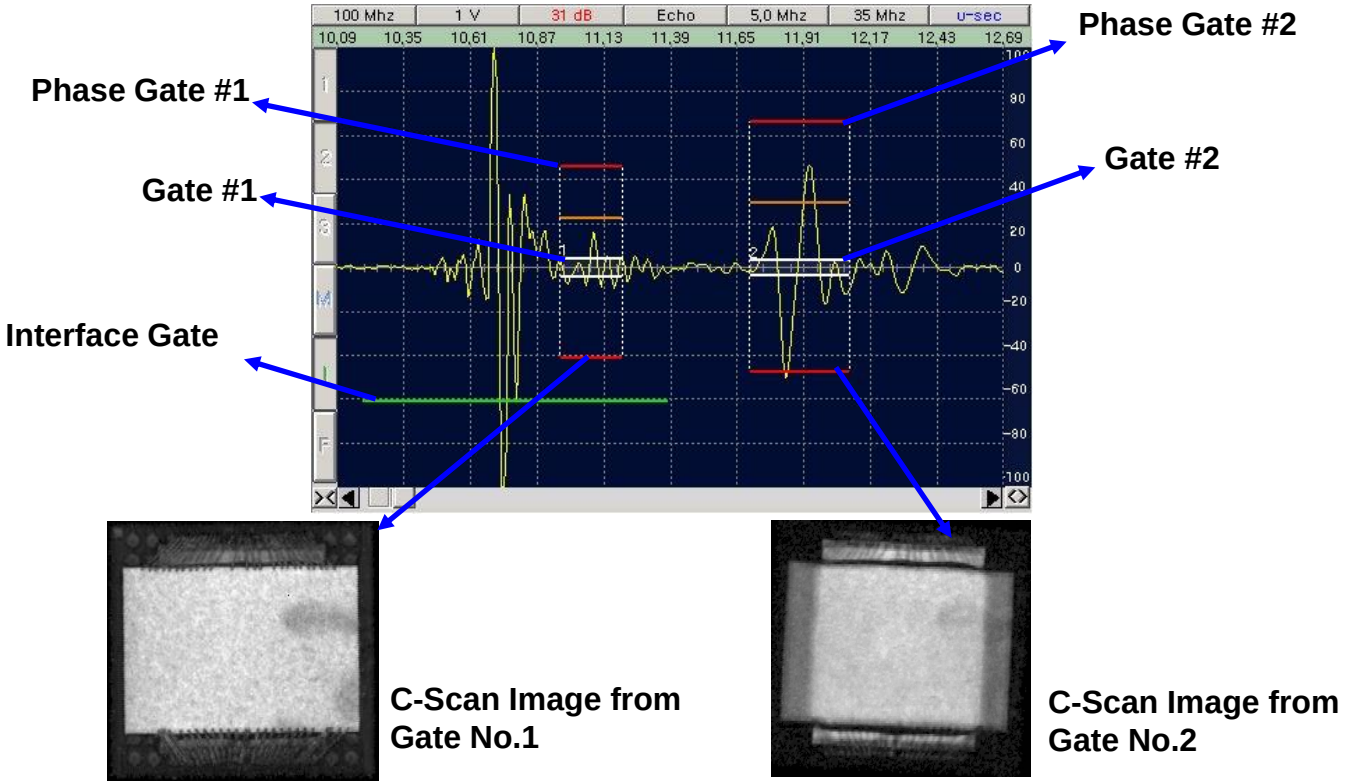
: Upto 23 C-Scan Images with Single Scan



Application of 3 Data Gates

- **Three data gates with individual phase detector (to find the peak AMP and TOF)**

  : Make 3 C-Scan Images with single scan



Surface Follower (Interface) Gate

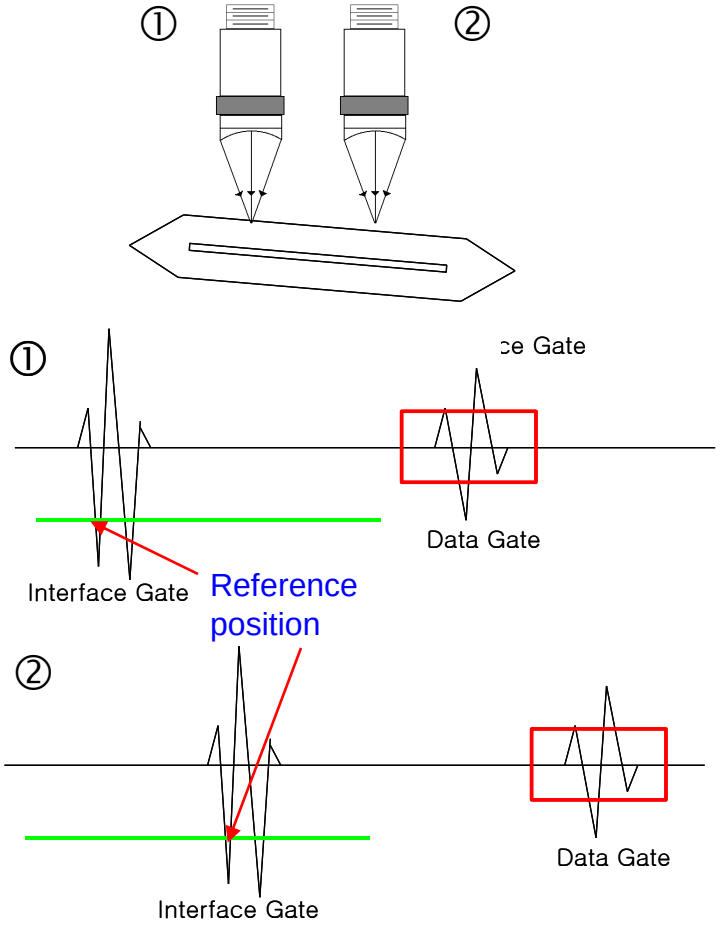
The **Surface Follower Gate (Interface Gate)** compensates for any variation in water path (distance from transducer to test specimen).

The first signal to cross the SFG is considered the surface of the specimen.

The crossing point is a reference which the data gates, multi-layer gate are “slaved” to.

Too long of an SFG will result in slower scan speeds.

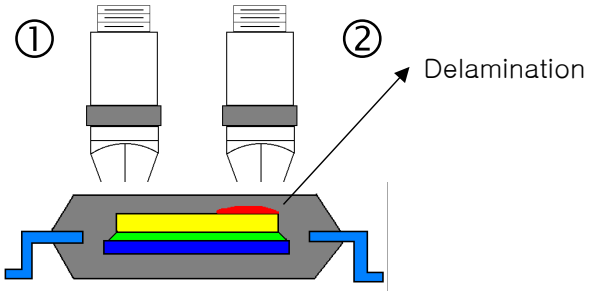
The most common cause of an incorrect C-Scan image is an incorrectly set SFG

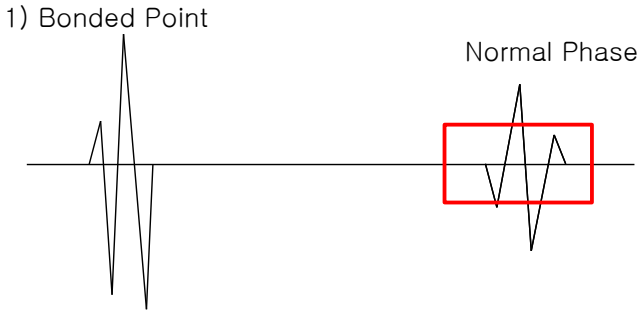


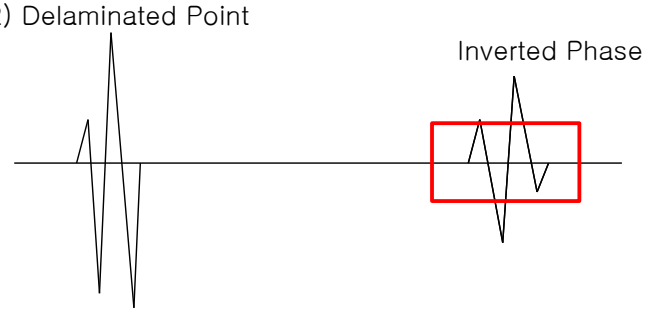
Phase Detector Gate

Phase Inversion :

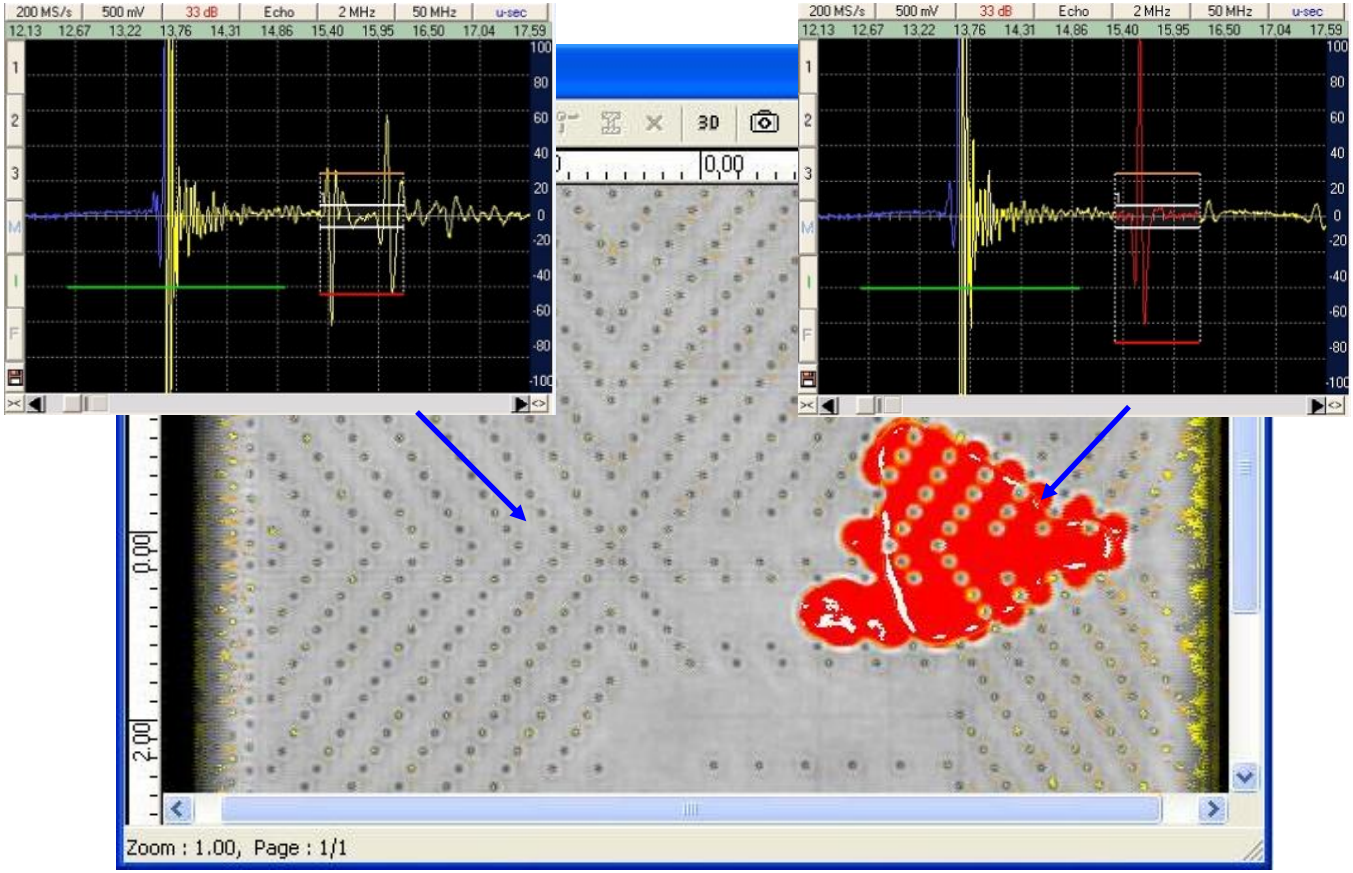
The Amplitude and Phase of a reflected signal from acoustic interface is dependent upon the change in acoustic impedance (Z) at the reflecting interface.



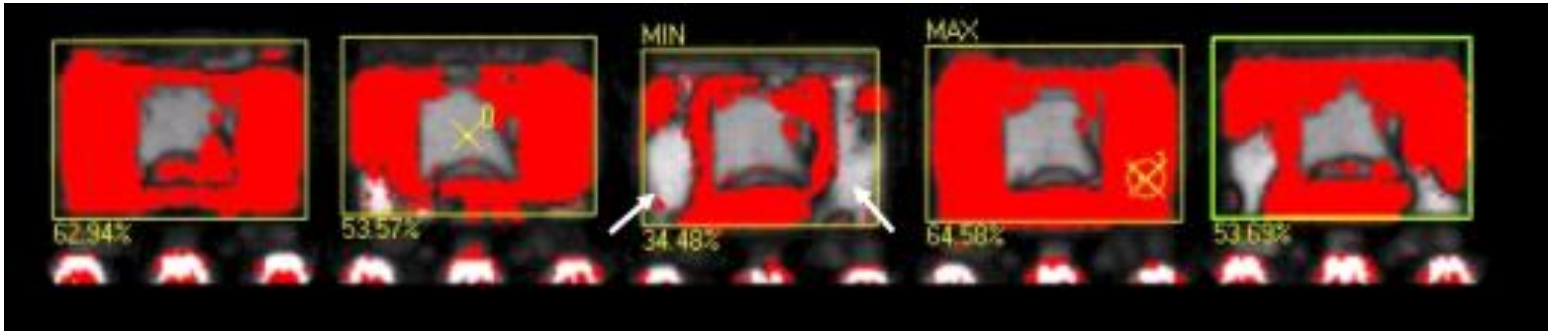


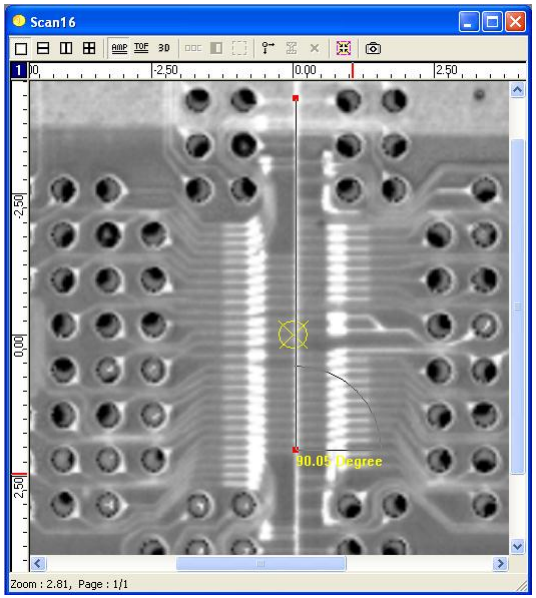


Application of Phase Detector Gates



Measurement of Defects



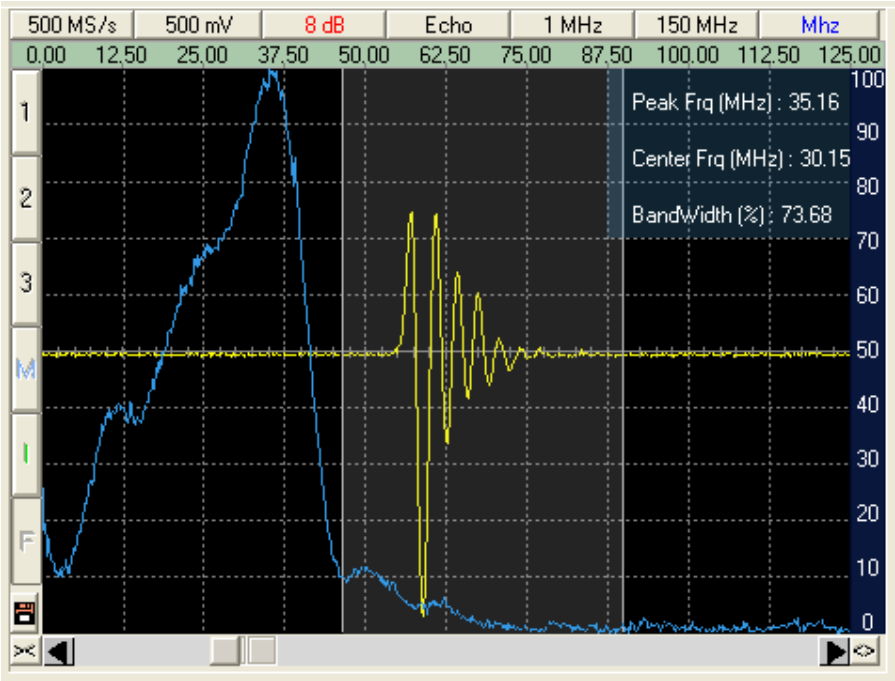


Size and Area of Defect

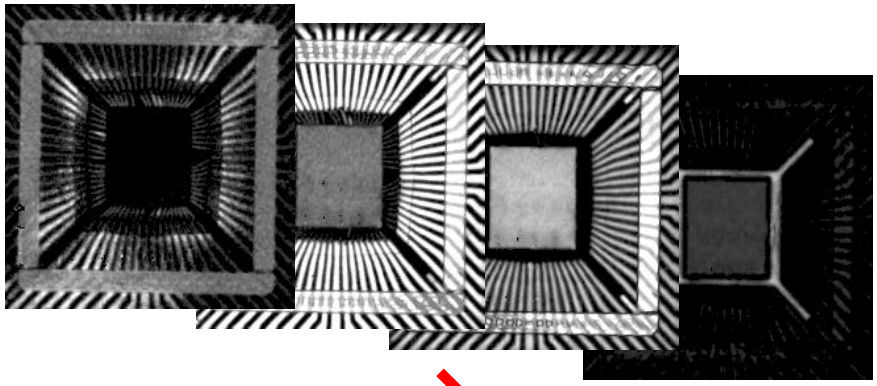
Angle measurement

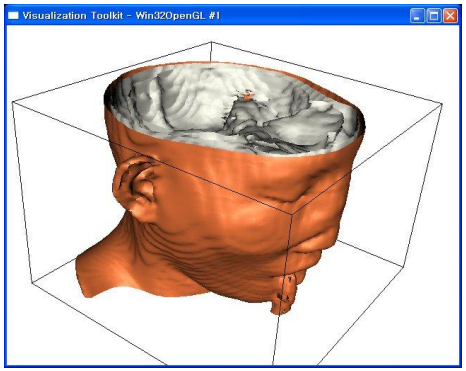
Application of FFT Gate

- **FFT function is useful for the measurement of transducer frequency response that is dependence on the pulse-width, voltage in P/R and the shape and property of target material**

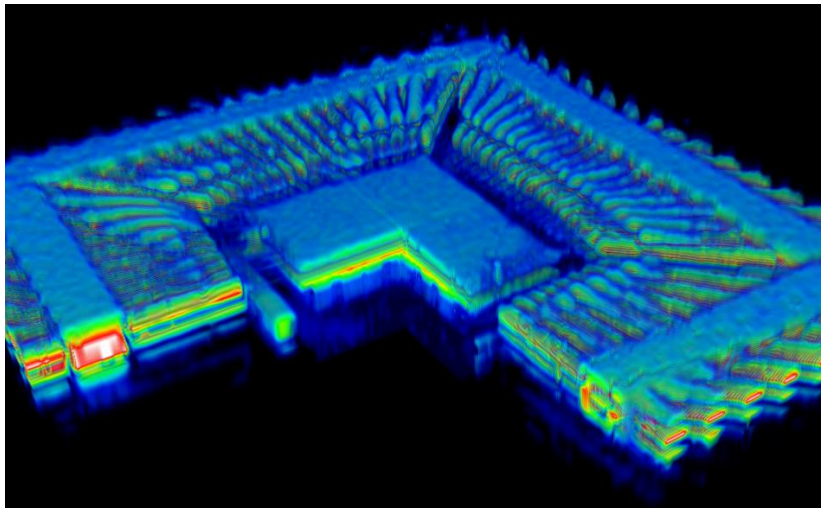


What is V3D™ ?





Virtual 3D Image using
10 layers C-Scan images



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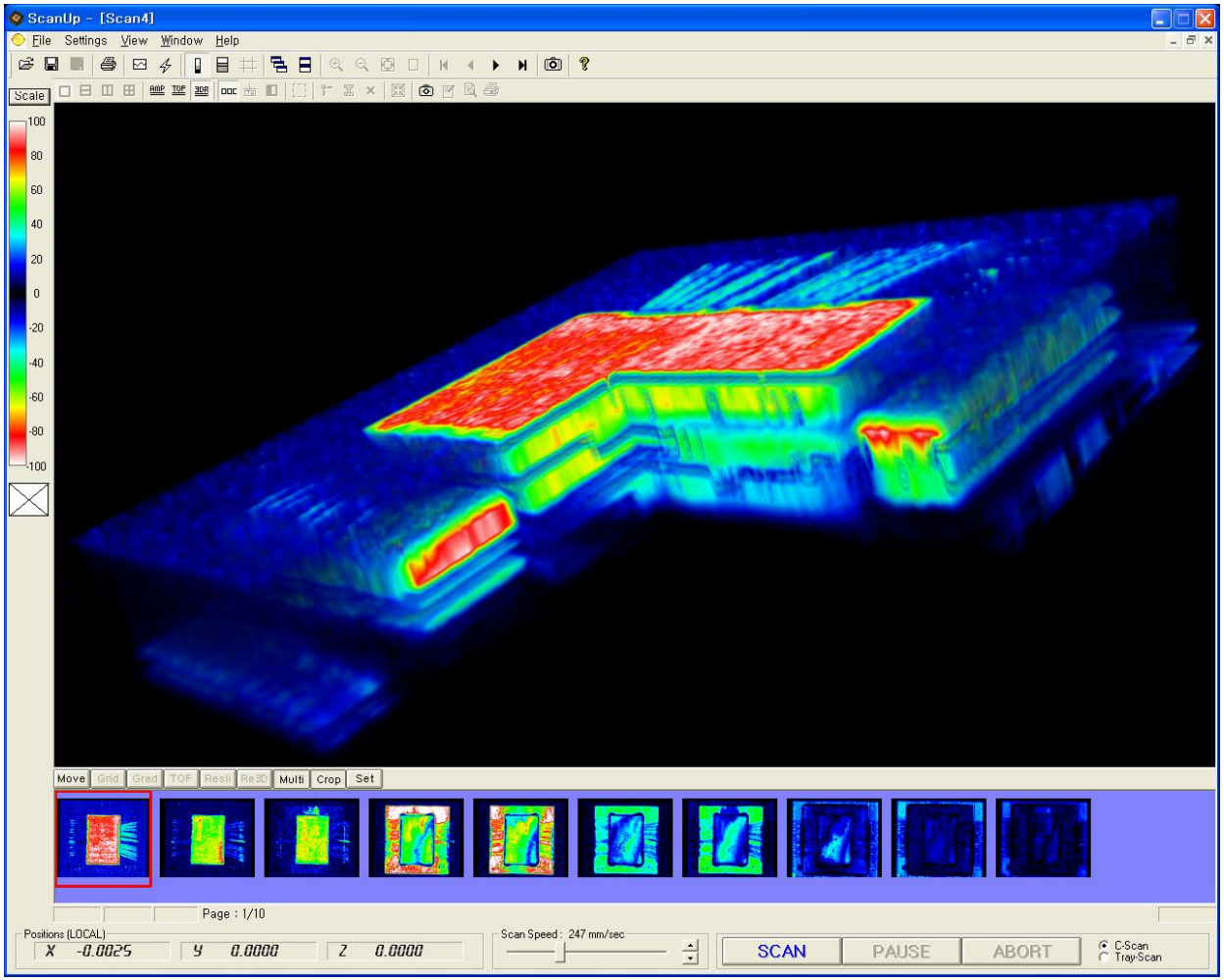
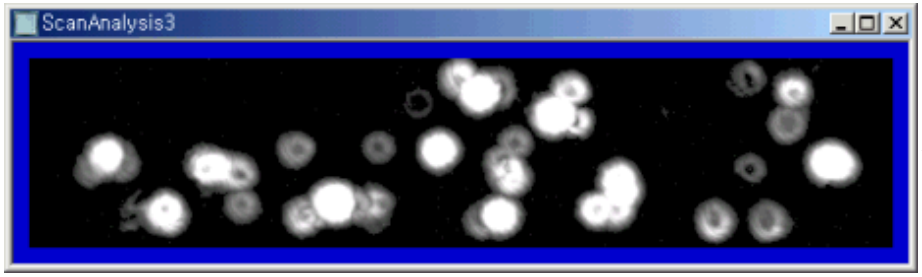
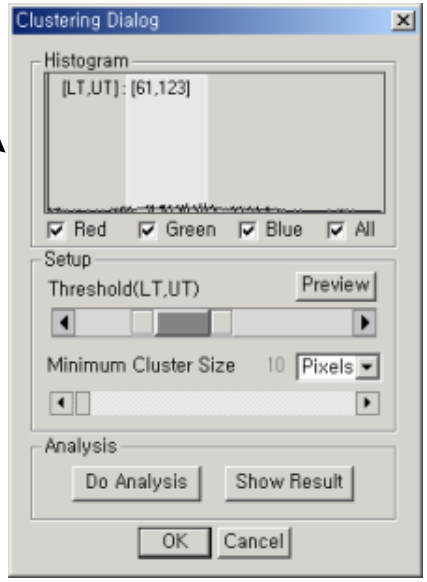
Application with Virtual 3D



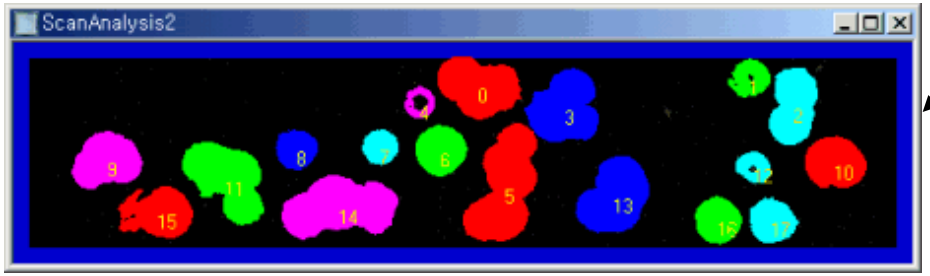
Automatic Measurement of Defects



C-Scan Image



Labeling & Clustering



Automatic Measurement

Automatic Measurement of Defects