SonoSite Technology

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SONOSITE TECHNOLOGY

Broadband Imaging

ASIC Chip Technology

Digital Beam Former

DaVinci Chip

Tissue Harmonics Imaging

SonoAdapt

ColorHD

SonoHD

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SonoMBe

ColorHD

SonoHD2

Xtreme Definition Imaging (XDI)

Company History and Overview

Originally, SonoSite began, as a skunkworks project at Advanced Technology Laboratories for the Department of Defense. The purpose of this project was to create an ultrasound system that was less than ten pounds and was durable enough to withstand the precarious and dangerous conditions of the battlefield. To accomplish this feat meant leveraging over a decade of expertise in digital ultrasound and customized ASIC design technology. The resulting product was the SonoSite 180 system. In 1998 after the purchase of ATL by Philips, SonoSite was spun off as a separate, public company with a large-company IP portfolio. Currently SonoSite has in excess of 150 patents and numerous design awards.

This core competency in digital ultrasound and customized ASIC design has driven the development of innovative, high-performing portable ultrasound products that empower clinicians at the point of care. As a result, ultrasound has been in adopted in non-traditional areas of medicine such as Emergency Medicine, Anesthesiology and now Critical Care. The technologies and advancements covered in this book, have allowed the delivery of ultrasound at the point of care.

1st SonoSite project was to create an ultrasound system:

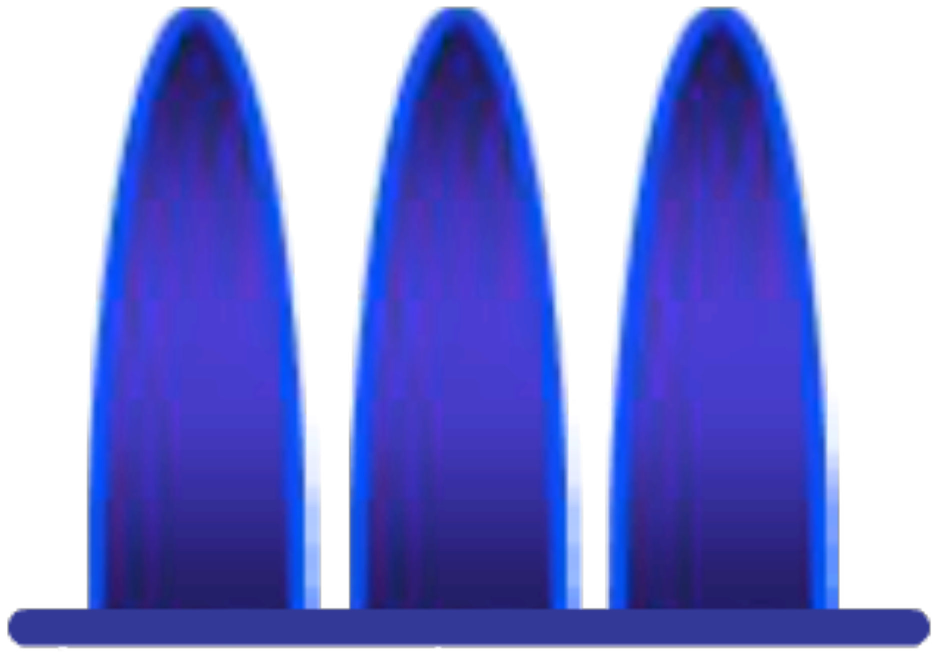
Under ten pounds

Battlefield ready / Resulted in SonoSite 180 system.

SonoSite spun off as a separate, public company in 1998

SonoSite has in excess of 150 patents and numerous design awards

Broadband Frequencies



Narrow Bandwidth

BROADBAND IMAGING

SonoSite was the 1st manufacturer to offer broadband imaging on a system less than 10 lbs. A full bandwidth of frequencies are transmitted and received with broadband imaging. RES, GEN, and PEN allow us to move up and down through the frequency range. RES mode transmits and receives the higher range of frequencies in the broadband range. GEN transmits and receives all the frequencies. PEN utilizes the lower frequencies. In each mode all the frequencies are used, RES amplifies the highest, PEN amplifies the lowest. Broadband Imaging allows more tissue characteristics to be displayed since different types of tissues resonate differently to different frequencies.

- SonoSite was the 1st manufacturer to offer broadband on an ultrasound less than 10 lbs
- A full bandwidth of frequencies are transmitted and received compared to a narrow bandwidth that some of the competitors use
- Increases the utility of a transducer, allowing it to be used on many different body types.
- RES, GEN, PEN operates the broadband frequency

ASIC CHIP

SonoSite's proprietary Chip Fusion Technology integrates digital signal processing and multiple system functions into a custom application-specific integrated circuit (ASIC) microchip. As a result complex system functions that typically require several large circuit boards can be accomplished using a small chip in a compact space. This technology enables miniaturization of the ultrasound unit, and also increases reliability and reduces power consumption. While cart based systems typically use up to 20 circuit boards, Chip Fusion technology permits a high performance system on just one circuit board.

- Integrates digital signal processing and multiple functions into one custom application-specific integrated circuit (ASIC) microchip
- Enables miniaturization of the ultrasound system
- Increases reliability
- Reduces power consumption
- Permits a high performance system on just one circuit board

DIGITAL BEAM FORMER

The beam former correctly aligns the returning signals so when all the channels are properly summed together the exact tissue signature is obtained (focusing). Broadband digital beam forming is used to preserve true acoustic information without distortion for the entire frequency spectrum bandwidth. More tissue information is acquired, improving axial, spatial and contrast resolution while displaying images with outstanding resolution and clarity.

In contrast, analog or hybrid digital beam former technology uses analog delay lines. These analog delay lines impose significant limitations on beam former performance. This causes limited focusing accuracy and susceptibility to changes in values over time and temperature. The result is distortion of the acoustic information.

- Correctly aligns the returning signals (focusing)
- Broadband digital beam forming preserves true acoustic information without distortion for the entire frequency bandwidth
- Improves axial, spatial and contrast resolution

DAVINCI CHIP™

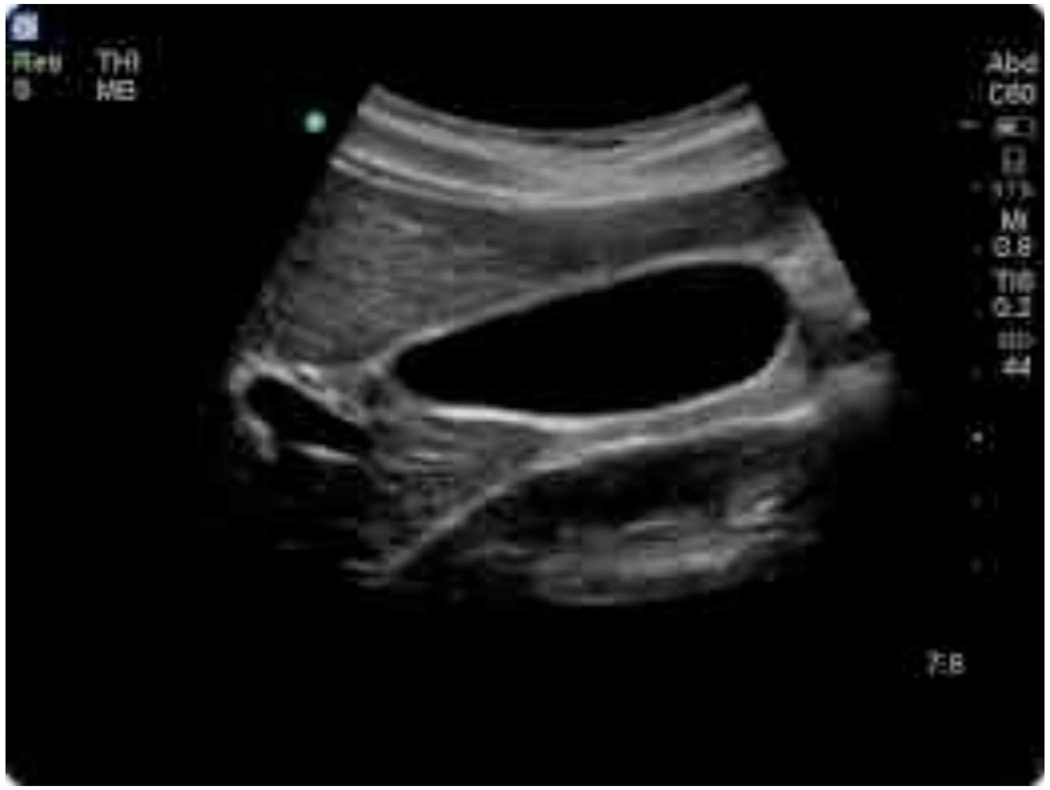
Developed by Texas Instruments, the DaVinci Chip is used for state of the art digital video signal processing. DaVinci Technology integrates a central processing unit (CPU) and digital signal processor (DSP) onto a single chip. The integration of these two components simplifies system design and improves signal processing efficiency. This video technology is used in many portable devices such as digital cameras, video telephones or media players. Integration of this technology into the M-Turbo and S- Series system marks the first time this technology has been used in medical imaging devices, and enables the multi-media functions of the machines, including video playback for on-site tutorials and clinical instruction.

- Developed by Texas Instruments
- Used for state of the are digital video signal processing
- Integrates a CPU (Central Processing Unit) and DSP (Digital Signal Processor) onto a single chip
- Simplifies system design and improves signal processing efficiency
- DaVinci technology into the M-Turbo and S Series systems marks the first introduction into a medical imaging device
- Enables multi-media functions to include on board tutorials and clinical instruction

THI TISSUE HARMONIC IMAGING

Tissue Harmonic Imaging demonstrates significant improvements in grayscale imaging, especially on patients considered to be technically difficult. The fundamental ultrasound signal is transmitted at a broadband of low frequencies. The signal then resonates off the body at twice the transmitted frequency. The higher frequency signals travel one way from the tissue to the transducer and are not attenuated by round trip travel. The returning THI signals do not include fundamental frequencies and are virtually free of image artifacts resulting in less haze, clutter and noise in the image. This in turn, creates improved visualization of tissue information and interfaces.

- The fundamental ultrasound signal is transmitted at a broadband of low frequencies
- The signal resonates off tissue in the body at twice the transmitted frequency
- Higher-Frequency signals travel one way from the tissue to the transducer
- Returning THI signals are virtually free of artifacts
- Results in less haze, clutter and noise, producing an improved image



SONOADAPT™

SonoADAPT is a an adaptive imaging technology that enhances performance and usability through intelligent execution of image enhancement technologies. This innovative technology is unique to SonoSite products. The enhancement occurs through continuous automatic manipulations of multiple imaging parameters as the user simply changes the depth in the imaging field. No other manipulations are needed because these manipulations are automatic and adaptive.

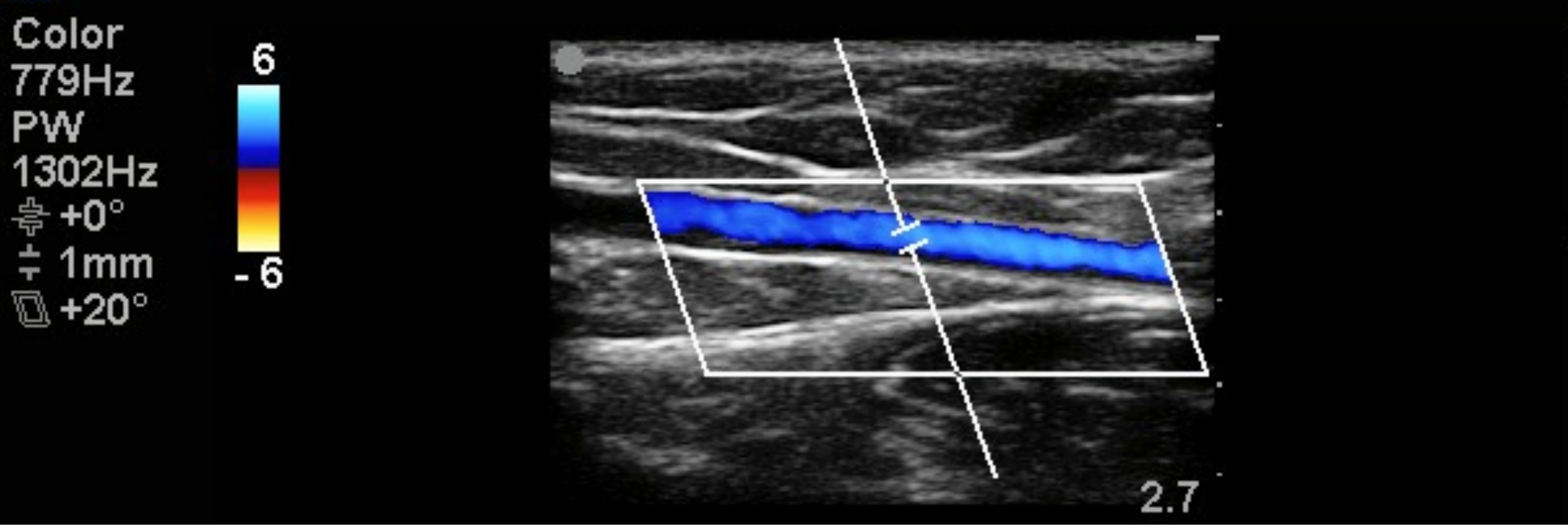
• intelligent execution of image enhancement technologies

• continuous automatic adjustments of multiple imaging parameters integrated through depth of the imaging field

•Significantly reduces manual image optimization adjustments. Creating ease of use.

Parameters Dynamically Optimized:

SonoMB	THI
Focal Zones	SonoHD
Dynamic Range	Compression
Grey Scale Maps	Persistance
Lateral and Axial Smoothing	



COLORHD TECHNOLOGY

ColorHD technology is a color doppler imaging algorithm which leverages the increased processing speed on the M-Turbo, S, and Edge platforms. Essentially, it increases color performance, sensitivity and frame rates offering more diagnostic information. The venous exam types have been optimized for low flow settings.

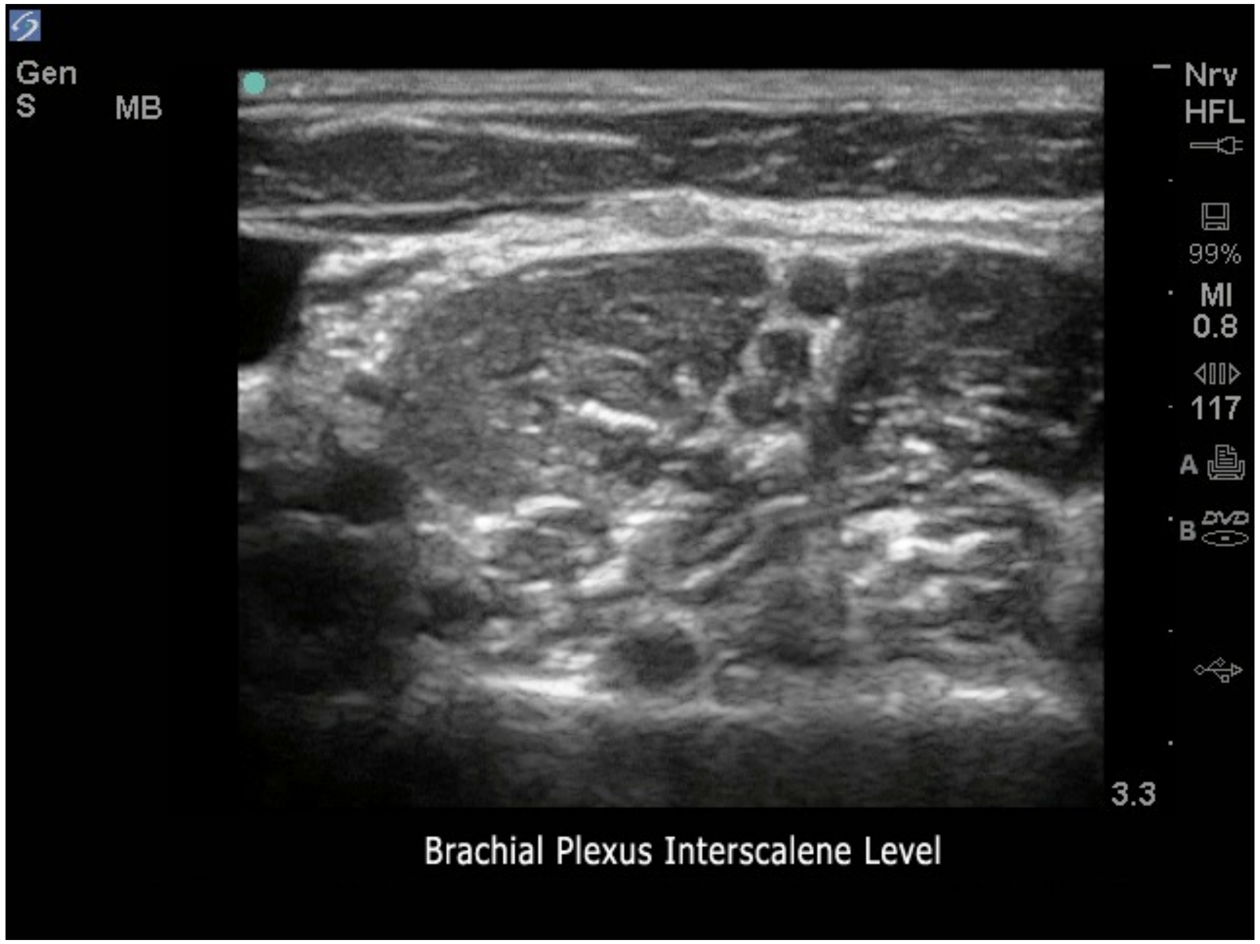
- Increases color performance, sensitivity and frame rates
- Leverages the increased processing speed
- Improved color doppler and color power doppler sensitivity on all transducers
- Low flow settings optimized for the venous exam type

SONOHD™

SonoHD Imaging Technology underlies the brilliant imaging in the M-Turbo and S Series Ultrasound Tools. The imagining generated by SonoHD results from the combination of 16 x increase in power and image enhancement algorithms. The combination reduces speckle noise and image artifacts while preserving and sharpening tissue information. The results are an image with dramatically improved contrast resolution and edge enhancement to display more sharply defined structures and finer structure detail.

SonoHD enhances, in real-time, both the aesthetic and clinical value of the ultrasound image, well beyond the imaging delivered by earlier generations.

- 16 fold the processing power of MicroMaxx
- Includes image enhancement algorithms
- Reduces speckle noise
- Reduces image artifacts
- Preserves and sharpens tissue information
- Improved contrast resolution



SONOMB™

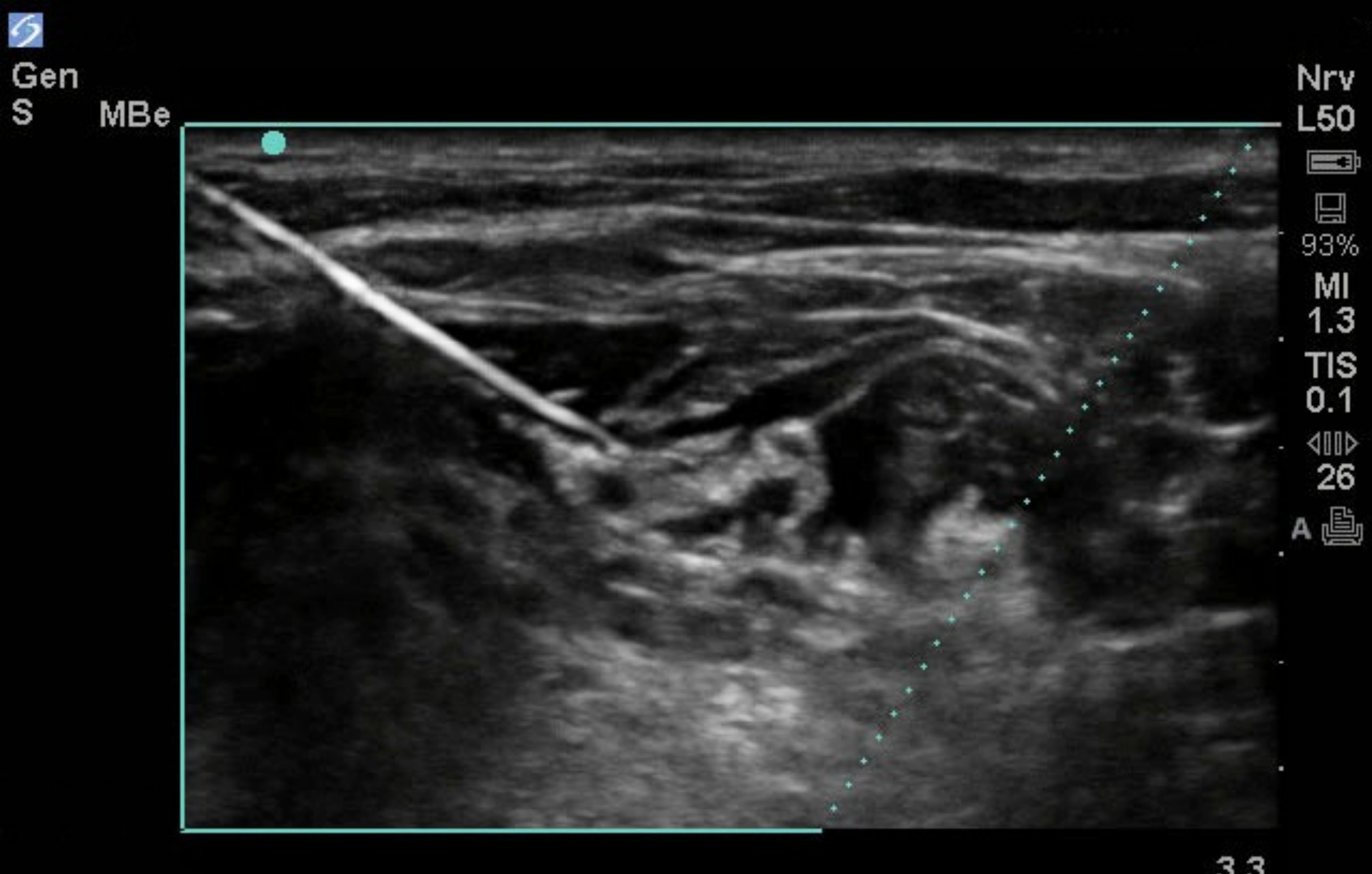
SonoMB™ is a proprietary image gathering technique that uses electronic beam steering of a transducer array to rapidly acquire several overlapping scans of an object from different lines of sight. Signal information from these views is compiled and correlated in real-time. If the information is correlated in all views it is retained, information that is not validated from all lines of sight is considered artifact or noise and suppressed.

SonoMB shows improved image quality and reduced artifacts versus conventional ultrasound images primarily because of reduction of speckle, clutter, and other acoustic artifacts. Additionally, the SonoMB technique results in faster frame rates than competitors' spatial compounding techniques. SonoMB provides improved contrast resolution, tissue differentiation and edge detection to improve diagnostic confidence. SonoMB is available on the Edge, M-Turbo, S Series and MicroMaxx lines of ultrasound tools.

- SonoSite proprietary image gathering technique
- Uses electronic beam steering of a transducer array to rapidly acquire several overlapping scans of an object from different lines of sight
- Information that is not validated from all lines of sight is considered artifact or noise and suppressed
- Improves image quality by reducing artifacts
- Faster frame rate vs. competitors' spatial compounding
- Improved contrast resolution, tissue differentiation and edge detection

Reduces:

- Speckle
- Clutter
- Other acoustic artifacts



SONOMBE ADVANCED NEEDLE VISUALIZATION

SonoMBe (Steep Needle Profiling on X-porte) is a proprietary algorithm that adaptively optimizes imaging of the needle at steep angles. This technique maintains the fundamental 2D image quality over the entire image area while simultaneously enhancing needle visualization. There is no compromise to the 2D image quality like some of our competitors needle enhancement software. MBe allows you to see the entire needle tip to shaft throughout the procedure as well as the tissue.

There are 3 steering options to ensure visibility of the needle at various angles and depths. The options are: Shallow 20 degrees, Medium 30 degrees, Steep 40 degrees. The software can accommodate LT or RT needle approaches by simply choosing LT/RT steer. With one button push and and on/off functionality, MBe is easy to use. No special hardware, equipment, needles or calibration is needed.

• MBe is a proprietary algorithm that adaptively optimizes imaging of the needle at steep angles.

• 3 steering options - Shallow 20 degrees, Medium 30 degrees and Steep 40 degrees to ensure needle visualization at varying depths and angles

• LT/RT steer for flexibility in injection approach.

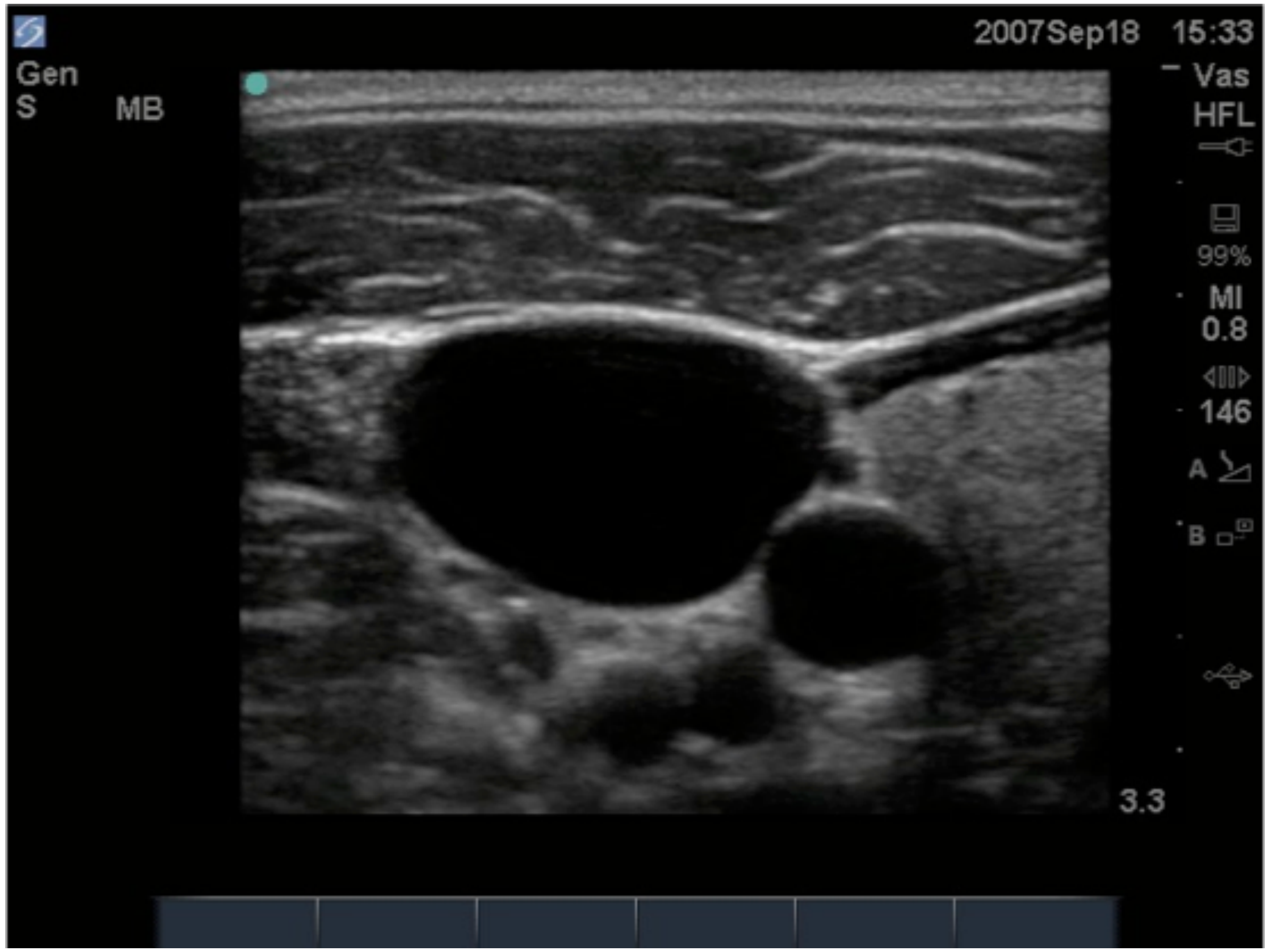
• One button to activate

• No compromise to 2D image quality

SONOHD2™

SonoHD2™ Imaging Technology

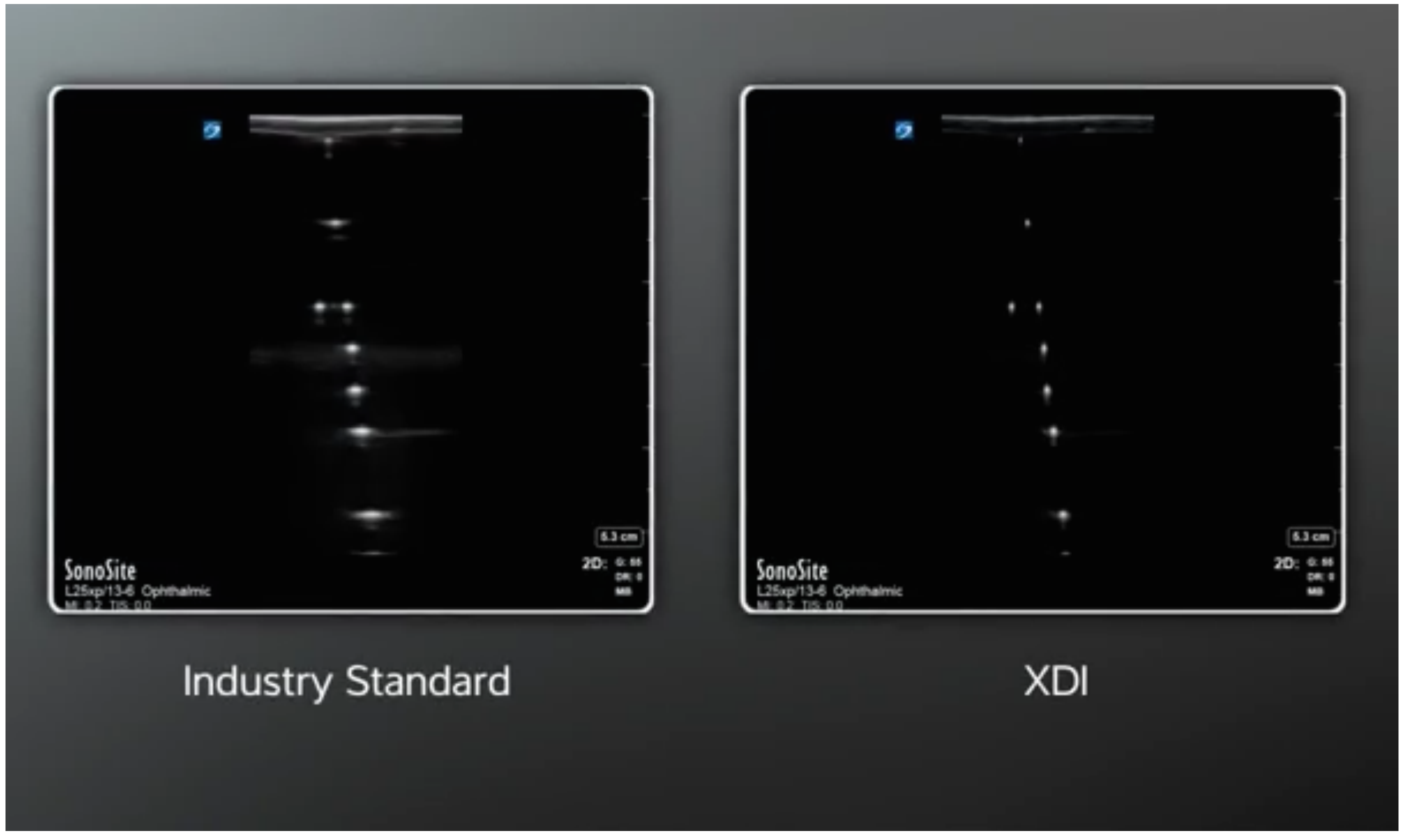
SonoHD2, available on the Edge, is the second generation in SonoHD technology giving the user power to see more. The advanced imaging algorithm significantly reduces speckle noise within the ultrasound image while improving contrast resolution. The end result is a crisp image with whites appearing more white and the blacks more black.



XDI™

Extreme Definition Imaging --Available on the Xporte

An ultrasound beam leaves the transducer as a complex 3-D bow tie shape with unwanted low energy beams that project radially from the main beam called side lobes. Since the ultrasound machine assumes that all reflections are from the main ultrasound beam, reflections detected from the side lobe beams are depicted in the image as if they arise from the main beam. As a result, phantom echoes are displayed in the image. Examples of side lobe artifacts include: borders that look fuzzy instead of sharp, black anechoic regions filled with ghost shadows, blurring of neighboring imaging areas. All in all, tissue differentiation is lost and the image looks smeared instead of detailed and well resolved.



Side lobe artifacts are ubiquitous and they decrease the lateral resolution of the image. Unfortunately, it is very difficult to correct the image degradation that results from side lobe artifacts. Conventional ultrasound platforms use several methods to address side lobe artifacts: increasing channel count, increasing power intensity or adding multiple processing engines to improve beam formation. All of these measures add costly system expense and drive up the price of ultrasound technology yet don't completely solve the problem.

As the SonoSite engineering team began development for the X-Porte platform, they were determined to overcome the detrimental effect of side lobe artifacts in ultrasound imaging. To achieve this technological feat, an innovative beamforming technology was designed as the foundation for a novel imaging technique – Extreme Definition Imaging (XDI) to address this important issue.

The X-Porte system was developed from the ground up to incorporate this unique proprietary beamforming technology so improved imaging could be realized.

XDI is a dynamic signal analysis algorithm that shapes the ultrasound beam to pinpoint precision. Improving the beam shape enhances the differentiation of real tissue echo signals in the main beam from clutter signals generated by side lobes. Using this approach, the real tissue echo signals that you want to see are maximized and the background clutter signals that you don't want to see are minimized. As a result, ultrasound images with superior contrast resolution and detailed tissue information are possible.