# Ultrasound QA Workshop AAPM 2006

**G. Wayne Moore, BSEE, MA**
**Sonora Medical Systems, Inc.**

The pan-scanner in 1957

# FirstCall – Scanner-less Probe Tester

Sonora Medical Systems, Inc.

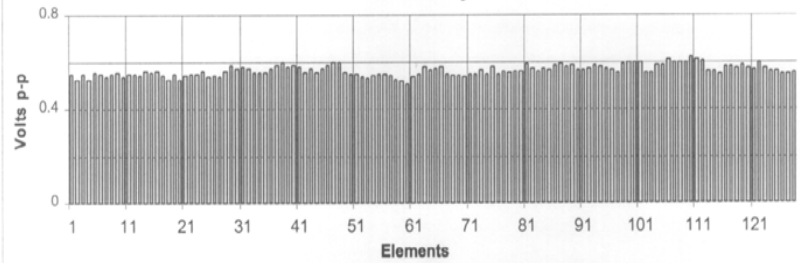
# Sonora Medical Systems

## Transducer Evaluation Report

Sonora

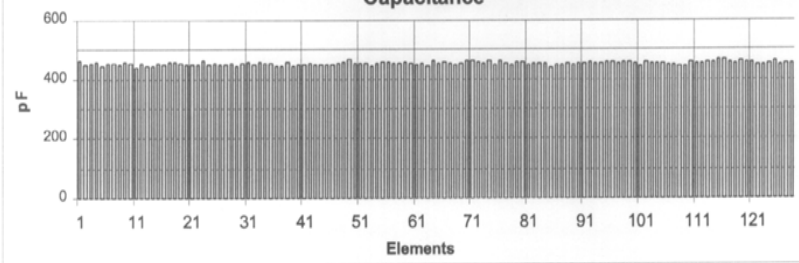
| | | | | | |
|---|---|---|---|---|---|
| *Mfg.:* | ATL | *Model:* | C4-2 | *S/N:* | 00DR7L |
| *Customer* | Gaston Memorial Hospital | *Phone Number:* | 704-834-2102 | *Fax:* | |
| *Address* | 2525 Court Drive | | | *Contact:* | Mac/Kevin |
| *City:* | Gastonia | *State:* | NC | *Zip:* | 28054- |
| *Test Date* | 4/17/02 3:24 PM | | | *Purpose:* | Repair Final Test |
| *Dx/Comments* | | | | | |

### Sensitivity




*Mean:* 0.564 *Max:* 0.620 *Min:* 0.508 *Std Dev:* 0.021 *Gain:* 8 dB

### Capacitance




*Mean:* 454.569 *Max:* 470.331 *Min:* 440.489 *Std Dev:* 31.142



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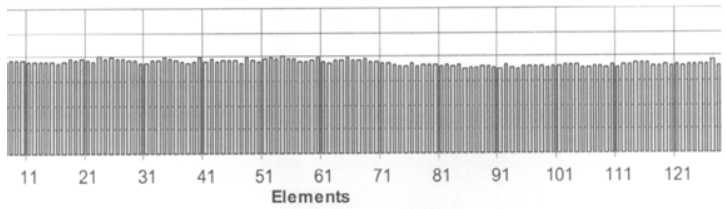
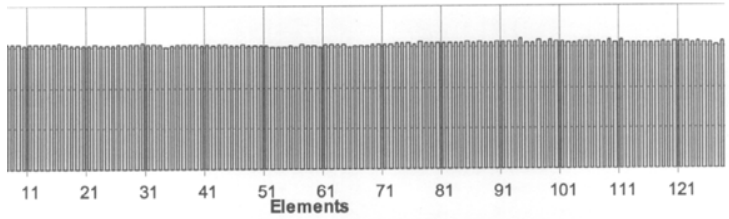
### 20dB Pulse Width



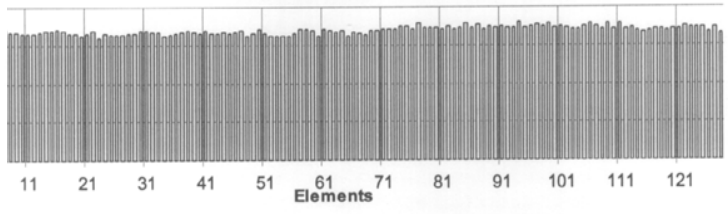

69.242 *Max:* 504.071 *Min:* 441.234 *Std Dev:* 15.412

### Center Frequency




3.071 *Max:* 3.181 *Min:* 2.985 *Std Dev:* 0.041

### Fractional Bandwidth




0.679 *Max:* 0.721 *Min:* 0.642 *Std Dev:* 0.017



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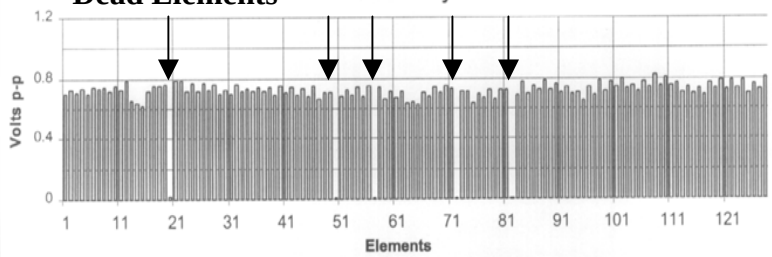
# Sonora Medical Systems

## Transducer Evaluation Report

| | | | | | |
|---|---|---|---|---|---|
| Mfg.: | ATL | Model: | C4-2 | S/N: | 0018VW |
| Customer | Miami Valley Hospital | Phone Number: | 937-208-2896 | Fax: | |
| Address | One Wyoming Ave. | | | Contact: | Jason Wolber |
| City: | Dayton | State: | OH | Zip: | 45409- |
| Test Date | 4/14/03 10:14 AM | | | Purpose: | Customer Evaluation |
| Dx/Comments | | | | | |

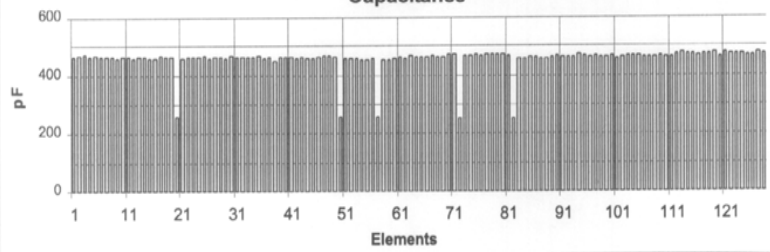
**Dead Elements**

Sensitivity




Mean: 0.697 Max: 0.824 Min: 0.012 Std Dev: 0.144 Gain: 8 dB

Capacitance




Mean: 457.463 Max: 478.485 Min: 252.002 Std Dev: 41.114



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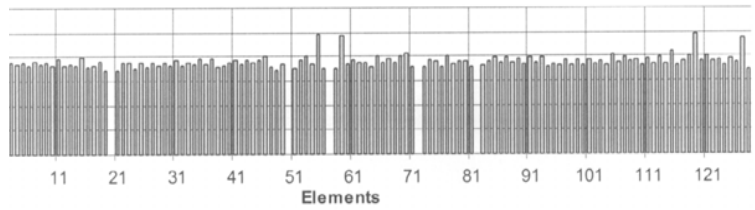
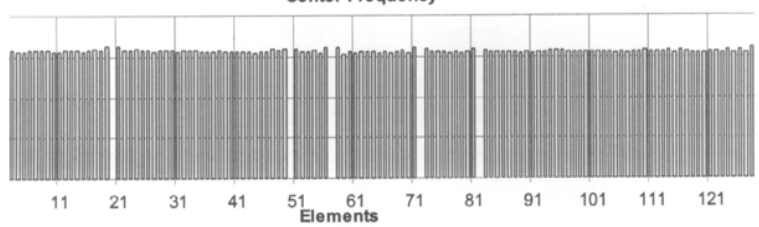
20dB Pulse Width



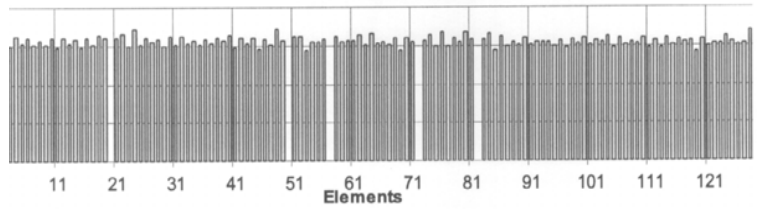

454.365 Max: 616.061 Min: 0.000 Std Dev: 96.596

Center Frequency




ean: 3.015 Max: 3.257 Min: 0.000 Std Dev: 0.609

Fractional Bandwidth




ean: 0.600 Max: 0.684 Min: 0.000 Std Dev: 0.123



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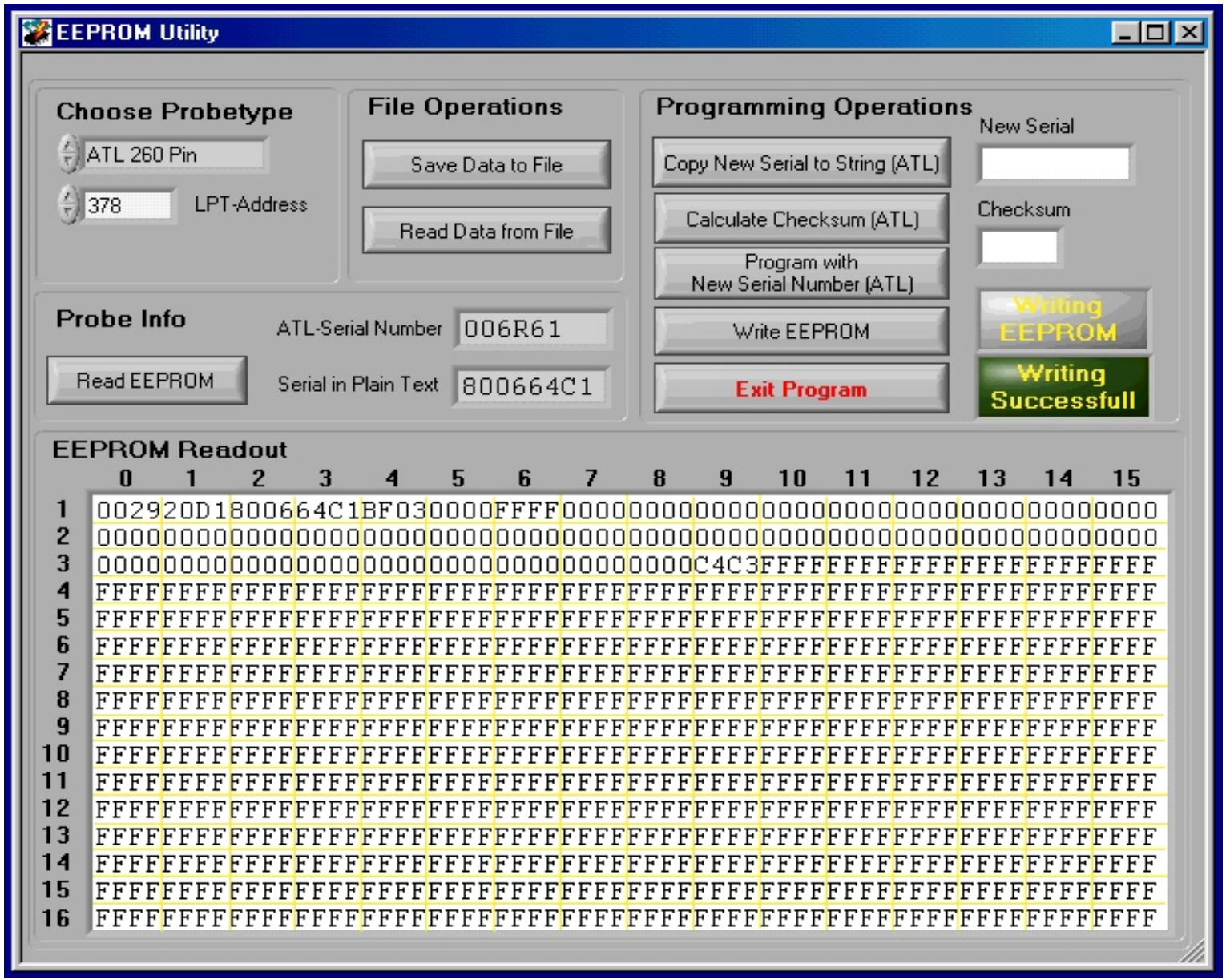
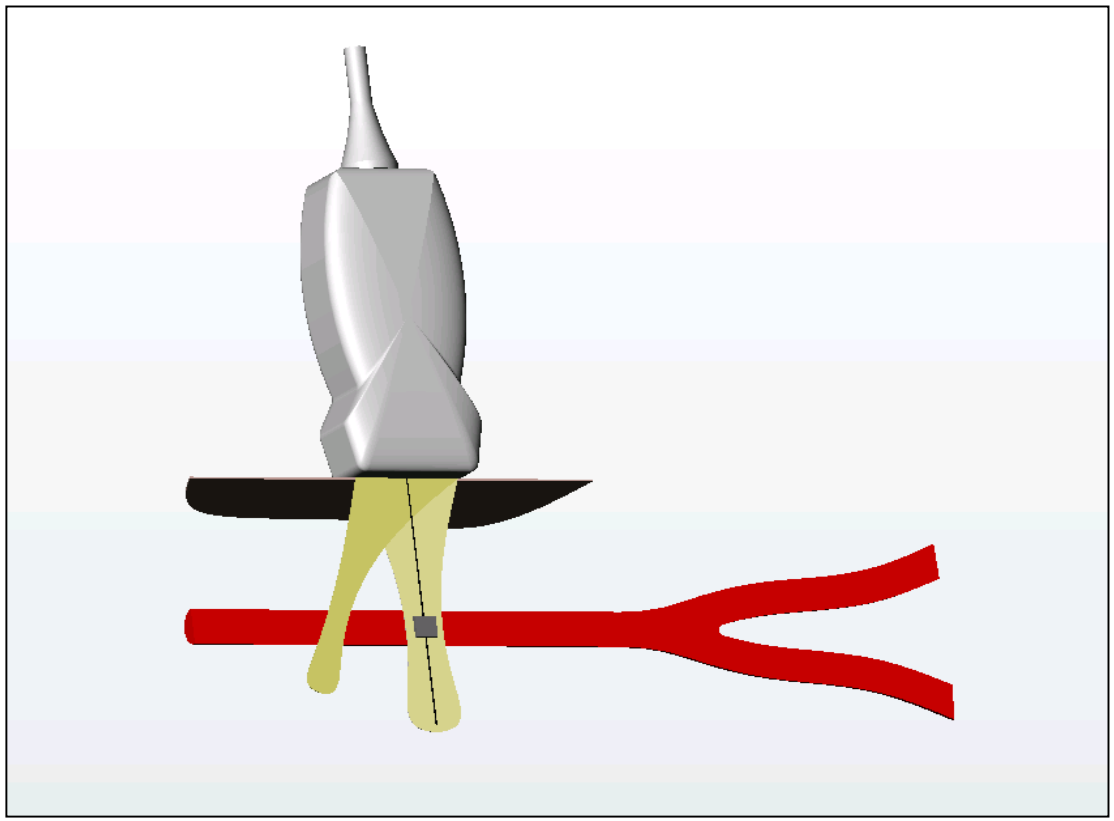
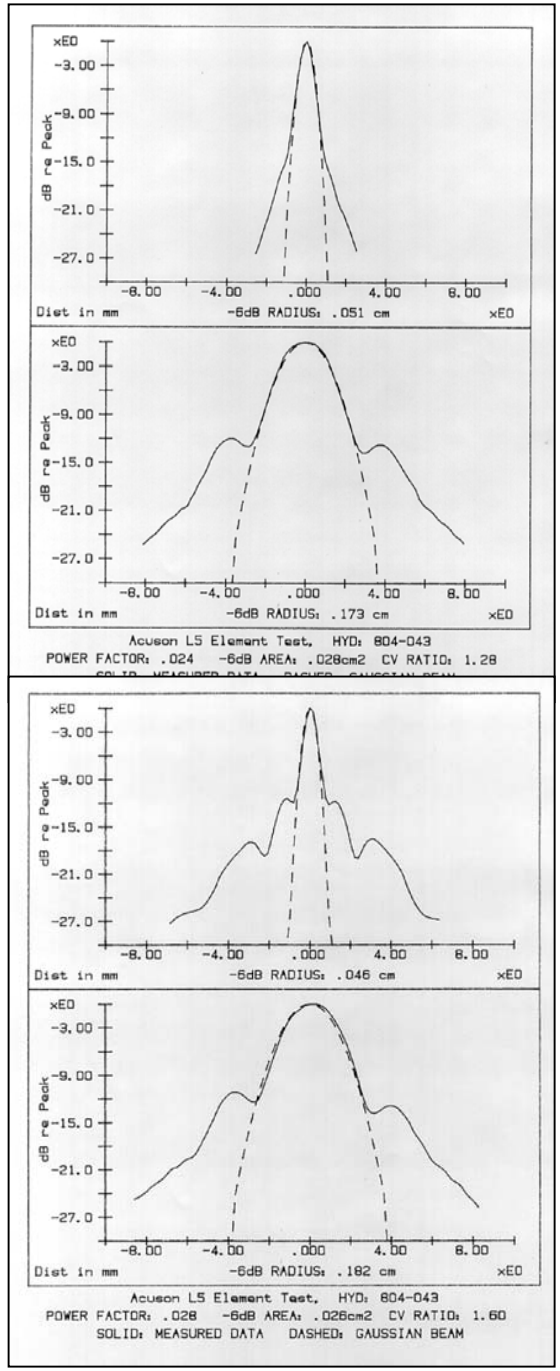
# EEPROM Read/Write – Repair Corrupted Files in Probe Connector



"...if element-to-element uniformity is not good enough, we effectively create a random array with random element spacing. Grating lobes are not well defined in this case; their angles are also random..."

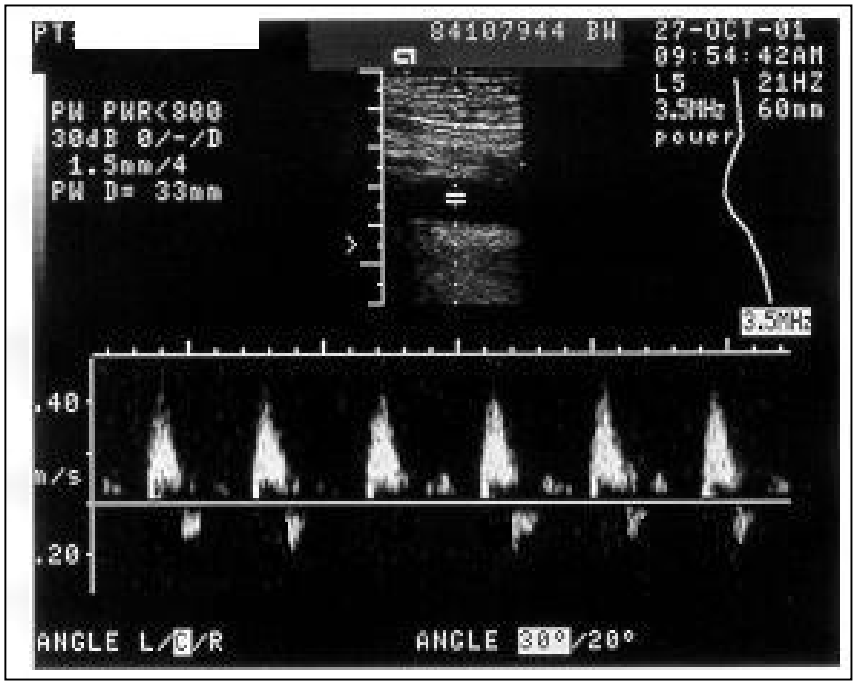
Joe Guess, Ph.D.
*Acoustic Noise from Arrays is Grating* - 1993

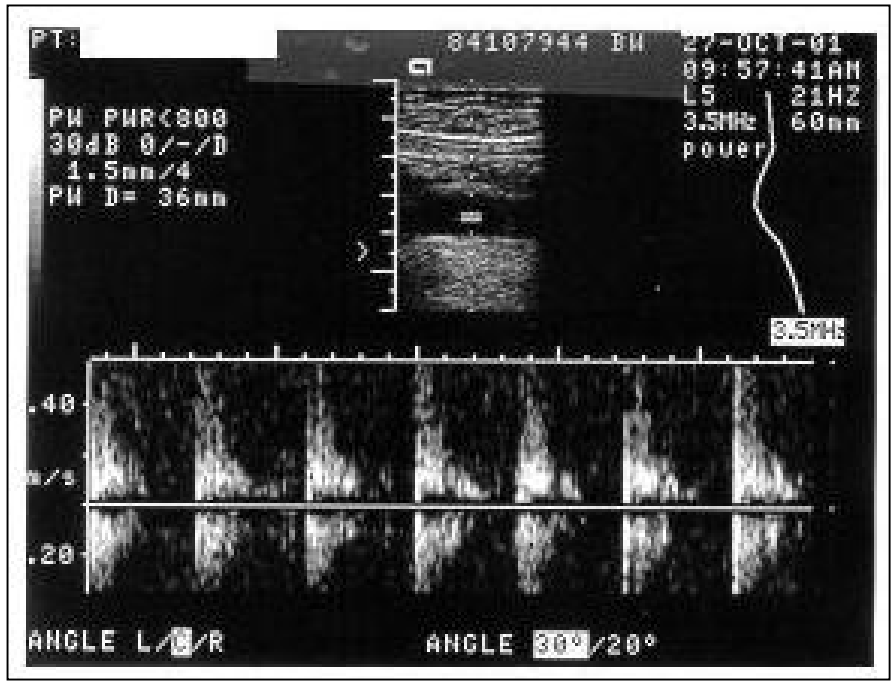




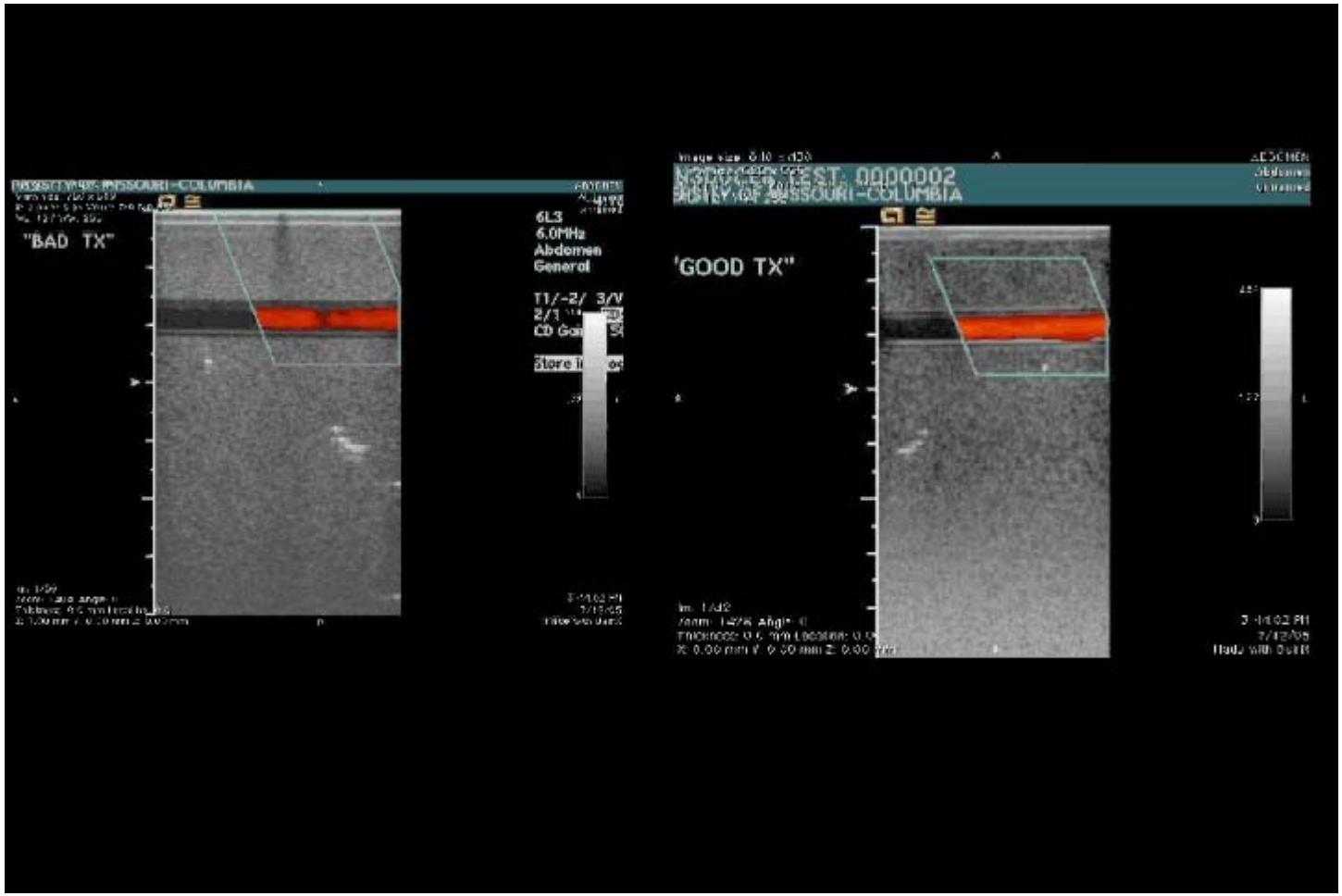
"*Sidelobes of the beam can also allow interference from flow outside the vessel under interrogation and may change the spectral mean velocity*."

Bjorn Angelsen, Doppler Ultrasound in Cardiology, 1985




**Acuson L5 two dead elements side by side (#'s 64 & 65)**




Courtesy of Dr. Evan Boote – University of Missouri - Columbia

# Initial Results

57 Probes from the UW-Hospital Department of Radiology were tested

| Scanner | # of probes tested | >2 “bad” elements | >5 “bad” elements |
|---|---|---|---|
| ACUSON Sequoia (2 systems) | 18 | 7 | 3 |
| ATL HDI 5000 (3 systems) | 18 | 4 | 2 |
| Philips iU-22 (4 systems) | 15 | 3 | 2 |
| GE Logic 9 | 6 | 0 | 0 |

Courtesy of Dr. James Zagzebski, University of Wisconsin - Madison

**If you knew a piece of equipment was broken and produced questionable data, would you allow it to be used?**

The Ultrasound Quality Shuffle

**Clinician**:

" We rely on the OEM service engineer to tell us the system is working correctly"

**OEM**:

" We rely on the clinician to tell us if they are having an imaging or Doppler problem"

**He relies on good aim**

# The Nickel

## Hand Held Electro-Acoustic Test Device

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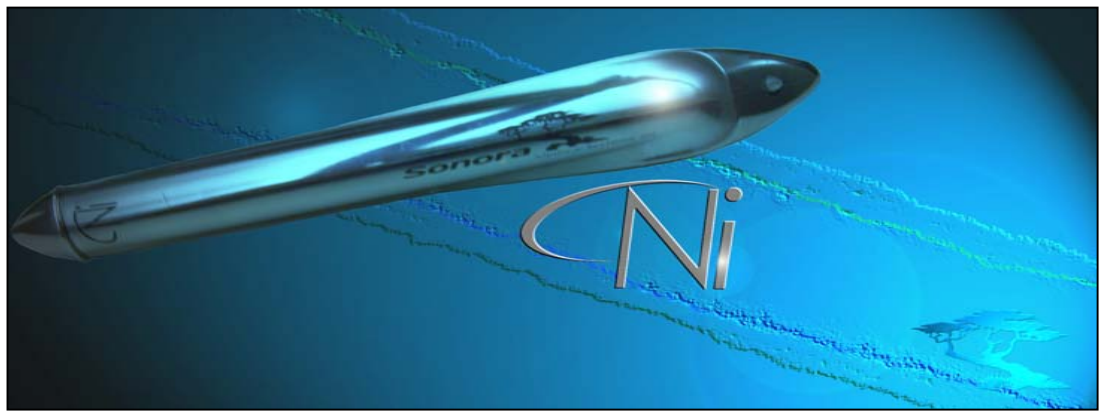

# Intended Use:

1) **Verify transmission from the elements within an array**
2) **Verify reception of an acoustic signal from the Nickel**

**What Modes will the Nickel Signal be Seen on the System Monitor?**

1) **B-mode, along with various special processing schemes such as:**
   **a) SonoCT (spatial compounding)**
   **b) 2nd Harmonic Imaging**
   **c) Dynamic Focusing**
1) **M-Mode**
2) **PW Doppler**
3) **Color Flow**

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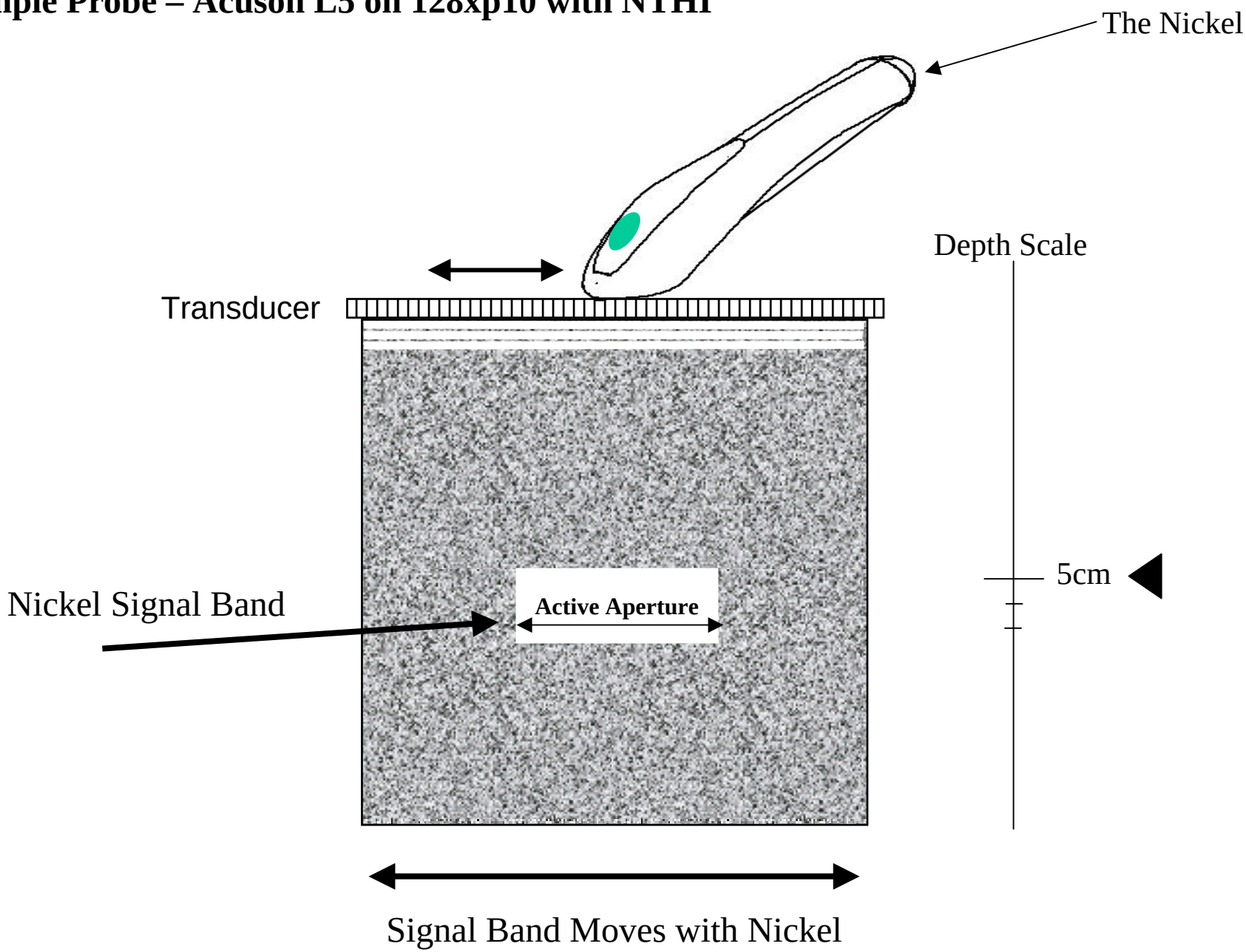
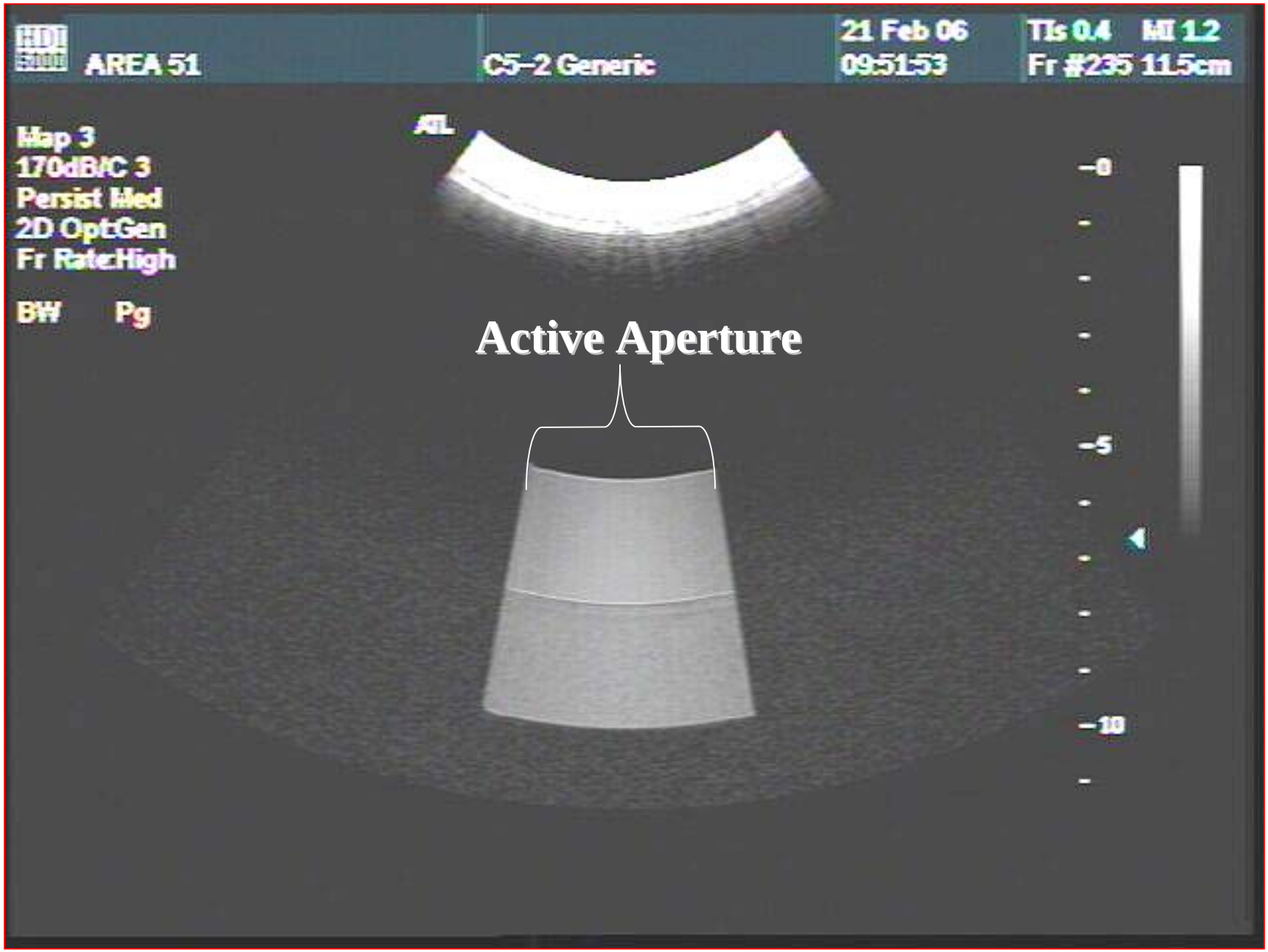
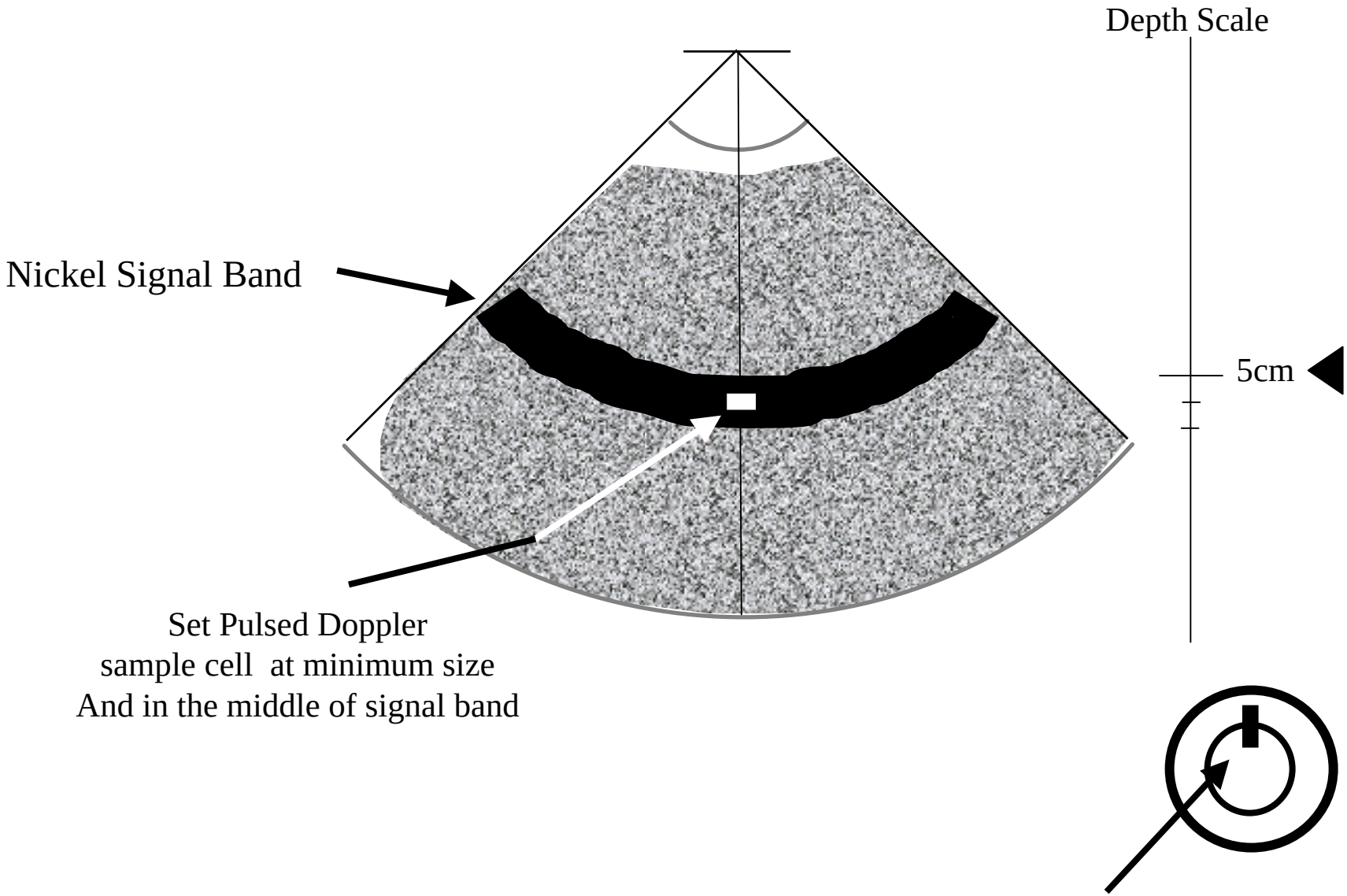
**Sample Probe – Acuson L5 on 128xp10 with NTHI**



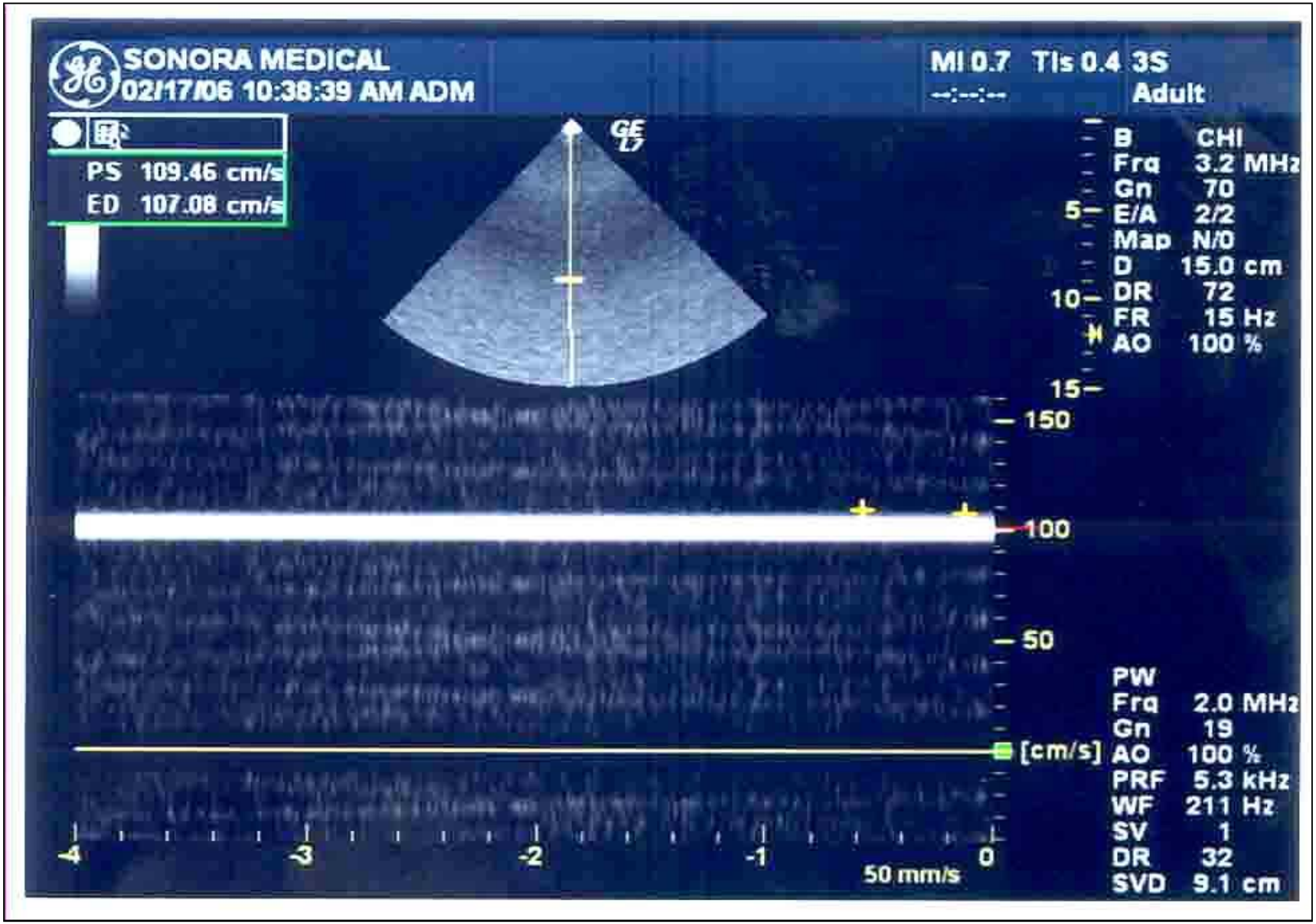
**Linear and Curved Linear use a “walking aperture” to form the acoustic lines**

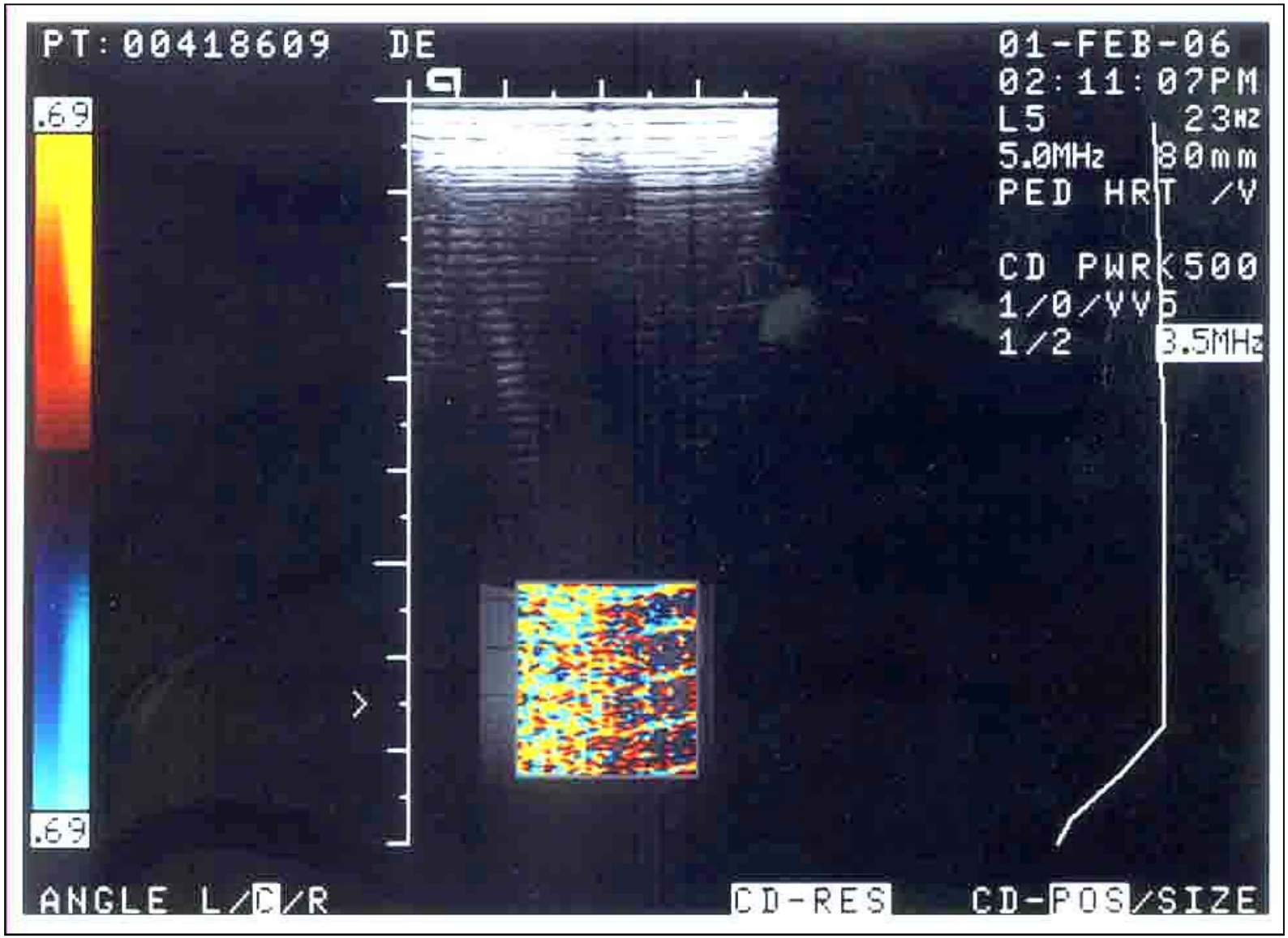

HDI 5000
AREA 51
C5-2 Generic
21 Feb 06
09:51:53
TIs 0.4 MI 1.2
Fr #235 11.5cm
Map 3
170dB/C 3
Persist Med
2D OptGen
Fr Rate:High
BW Pg
ATL
Active Aperture
0
-5
-10

**Sample Probe – GE S3**

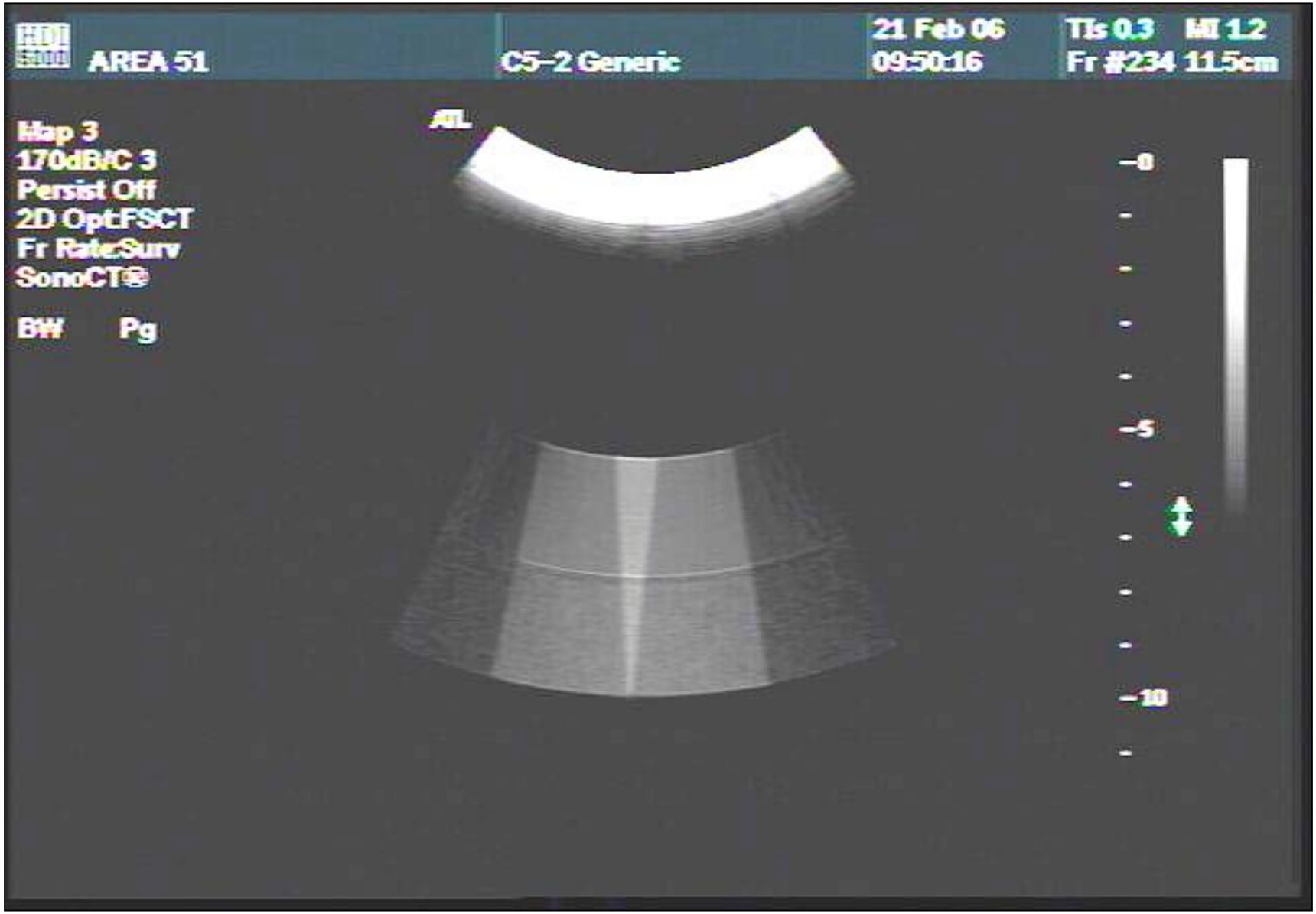



# Initial Pulsed Doppler Mode Settings


SONORA MEDICAL
02/17/06 10:38:39 AM ADM
MI 0.7 TIs 0.4 3S
Adult
PS 109.46 cm/s
ED 107.08 cm/s
B CHI
Frq 3.2 MHz
Gn 70
E/A 2/2
Map N/0
D 15.0 cm
DR 72
FR 15 Hz
AO 100 %
5
10
15
150
100
50
[cm/s]
PW
Frq 2.0 MHz
Gn 19
AO 100 %
PRF 5.3 kHz
WF 211 Hz
SV 1
DR 32
SVD 9.1 cm
-4
-3
-2
-1
0
50 mm/s


PT: 00418609 DE
01-FEB-06
02:11:07PM
L5 23Hz
5.0MHz 80mm
PED HRT /V
CD PWR 500
1/0/VV5
1/2 3.5MHz
.69
.69
ANGLE L/C/R
CD-RES
CD-POS/SIZE

# Color Flow




# Spatial Compounding - SonoCT

# Advanced Development Work

$$E = MC^2 \pm 3dB$$

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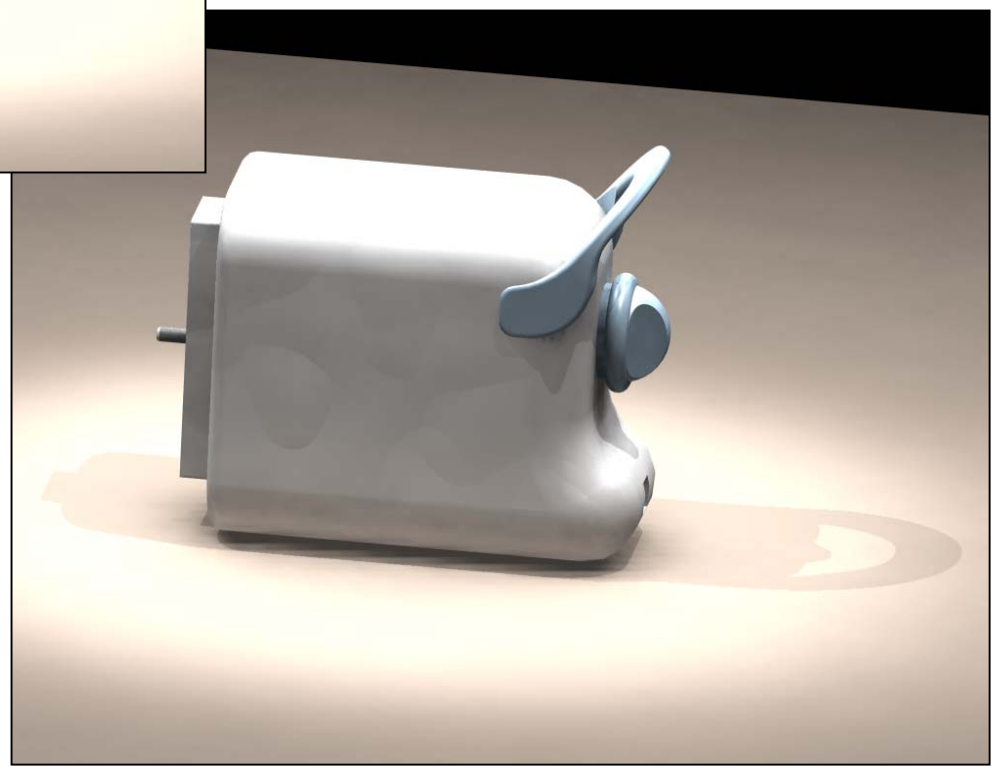

# Synthetic Probe

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# Intended Use:

1) Verify appropriate signal levels from the transmitters of the system for each mode
2) Verify reception, processing and accuracy of display of various calibrated acoustic signals from FirstAssist

# Will Test and Establish Baseline for:

1) B-mode sensitivity, accuracy and functional dynamic range
   a) various operator selectable calibrated signal levels
   b) operator variable frequencies (test 2nd Harmonics, etc)
   c) operator selectable variable aperture
   d) signals with known spatial resolution characteristics
2) PW, Color Flow and CW Doppler
   a) known calibrated velocities
   b) operator variable sensitivity settings
   c) known color registration

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