CHIRP Technology
Seminar Agenda

• Overview of CHIRP technology compared to traditional fishfinder technology – What’s different?
• Advantages vs disadvantages of CHIRP technology
• Give feedback, offer product suggestions, and ask tough transducer questions
Traditional “Toneburst” Fishfinder

• Traditional sounders operate at discrete frequencies such as 50kHz and 200kHz.

• This limits range resolution, and ultimately, what targets can be detected in the water column.
Fish Imaging at Different Frequencies

LF 33-60 KHz

70Khz  60Khz  50Khz  40Khz  30Khz
Resolution Comparison

Conventional sonar

ClearPulse™ CHIRP Sonar
Traditional “Toneburst” Fishfinder

- Traditional sounders operate at discrete frequencies such as 50kHz and 200kHz.

- This limits resolution, range and ultimately, what targets can be detected in the water column.

- Tone burst transmit pulse may be high power but very short duration. This limits the total energy that is transmitted into the water column.
CHIRP

A major technological advance in
Sounder Technology
CHIRP is a technique that involves three principle steps

1. Use *broadband* transducer (Airmar)

2. Transmit CHIRP pulse into water

3. Processing of return echoes by method of pattern matching (pulse compression)
CHIRP Starts with the Transducer

- AIRMAR CHIRP-ready transducers are the enabling technology for manufacturers designing CHIRP sounders.

- Only sounders using AIRMAR CHIRP-ready transducers can operate as a true CHIRP system.
CHIRP Starts with the Transducer

- **NOTE:** With the ability to adjust frequency, an echosounder with advanced digital processing can operate Airmar’s broadband ceramics anywhere in the frequency band.
CHIRP Starts with the Transducer

• AIRMAR CHIRP-ready transducers are the enabling technology for manufacturers designing CHIRP sounders

• Only sounders using AIRMAR CHIRP-ready transducers can operate as a true CHIRP system
1. Use of a *broadband* transducer (Airmar)

What is bandwidth?

Why is it important?
CHIRP is a technique that involves three principle steps

1. Use *broadband* transducer (Airmar)

2. Transmit CHIRP pulse into water
Transmit pulse is only at one discrete frequency. The short pulse limits the total energy that is transmitted into the water column. It is high power but short duration.

CHIRP sounders use a precise sweep pattern of many frequencies (i.e., 28-60 kHz or 130-210 kHz)

Requires a long duration transmit pulse in order to sweep through all of the frequencies.

In order to send a CHIRP pulse, the transducer MUST HAVE BANDWIDTH
**Drive Voltage**

- **200 kHz**
- **130 kHz**
- **210 kHz**

**Traditional Tone Burst** – *‘ping’* (single frequency)

**CHIRP** (varying frequency) (longer pulse)
What is different so far?

• CHIRP ready transducers have bandwidth at both the high, medium and low frequency.
  – Some models offer 117 kHz of bandwidth
    • i.e., 42-65 kHz, 28-60 kHz, 130-210 kHz

• Traditional transducers operate at only two discrete frequencies — i.e., 50 & 200 kHz
BENEFITS to you...

• It like having 117 transducers on your boat!
  – Better chance of seeing what is in the water column – FISH!

• Can use in CHIRP mode – all done automatically
  Or

• Can select discrete frequencies (sounder dependent) and fine tune the display
Benefits to YOU…

• The long transmit CHIRP pulse transmits more energy in the water column
  – Up to 10-1000 times more energy on target!
    • Will get different echo returns from all of the frequencies transmitted – which are then processed and shown on the display.
  – Ability to sound deeper – (more amplitude)
Benefits to YOU...

• Toneburst fishfinders only send out a waveform at one frequency.

• If a long pulse is used at one frequency, you will lose resolution. Multiple fish will get lost in the long pulse and cannot be distinguished.
CHIRP is a technique that involves three principle steps

1. Use *broadband* transducer (Airmar)

2. Transmit CHIRP pulse into water

3. Processing of return echoes by method of pattern matching (pulse compression)
What else is different?

• The CHIRP sound wave that is transmitted is stored in memory
  – Sounder knows the frequency band and pulse length that was transmitted
  – The sounder listens for the return echo, and will match the echo received by the transducer with the reference wave form.
  – AKA: Pattern Matching or Correlation
Pattern Matching/Pulse Compression

- A more powerful digital processor is required compared to a traditional toneburst fishfinder.

- The echo returning to the transducer is processed by the fishfinder’s DSP (Digital Signal Processing) computer and displayed in ultra-sharp detail on the display.
  - This is called Pulse Compression
How can a computer do a correlation?
Procedure for Pulse Compression

Shift, Multiply and Add

calculation performed by computer
Incoming echo

Reference pulse

replica of drive pulse

Correlation
Pulse Compression

Correlation
Pulse Compression
Pulse Compression

Correlation
Pulse Compression

Correlation
Pulse Compression
Pulse Compression

Correlation
Pulse Compression

Correlation
Pulse Compression

Correlation
Pulse Compression

Correlation

... etcetera
Why is pattern matching (pulse compression) important?

Significantly improved signal to noise ratio
  – Noise does not correlate with the stored waveform
  – Ability to pull targets from the noise floor
  – Low Frequency
  – Bottom tracking at high speed and deep depths

Resolution
  – Resolve individual targets – no blobs
  – Crisp images
Impressive resolution of swordfish going after baitfish at the bottom in deep waters.

Excellent resolution in deep waters.
Is a CHIRP system for YOU?

Advantages versus Disadvantages
CHIRP: Many advantages when the conditions are challenging

• Operating in a noisy environment
CHIRP: Many advantages when the conditions are challenging

- Operating in a noisy environment
- When detailed resolution is needed to separate individual fish (range resolution)
Detailed Resolution:
Tuna working on baitfish

R599LH & BSM2
Canary Islands – High CHIRP

Same big eye tuna found the shoal of mackerel and started working on them
CHIRP: Many advantages when the conditions are challenging

• Operating in a noisy environment
• When detailed resolution is needed to separate individual fish (range resolution)
• Crisp images
Crisp, detailed images
Raymarine CP450C Screenshots
Raymarine CP450C Screenshots
CHIRP: Many advantages when the conditions are challenging

- Operating in a noisy environment
- When detailed resolution is needed to separate individual fish (range resolution)
- Crisp images
- Bottom fishing – resolve targets close to the bottom or near structure
Bottom fishing

Two large fish targets clearly separated from each other over the bait.

Gain at 91%
CHIRP: Many advantages when the conditions are challenging

- Operating in a noisy environment
- When detailed resolution is needed to separate individual fish (range resolution)
- Crisp images
- Bottom fishing – resolve targets close to the bottom or near structure
- Searching for fish at high boat speeds
CHIRP: Many advantages when the conditions are challenging

- Operating in a noisy environment
- When detailed resolution is needed to separate individual fish (range resolution)
- Crisp images
- Bottom fishing – resolve targets close to the bottom or near structure
- Searching for fish at high boat speeds
- Tracking bottom at deep depths
More advantages

• One transducer can offer 117 kHz of selectable frequencies
  – Can I use a CHIRP transducer with a non-CHIRP sounder?

• Significant resolution improvements at low frequency

• More energy on target

• Up to 1,000 times greater sensitivity than traditional fishfinders
Things to consider (Disadvantages):

- Affects of Pulse Compression in relation to how images are shown on the display.
Pulse Compression

- DSP can cause the fish to appear smaller on the display when compared to traditional fishfinders because DSP is compressing the return echoes from the entire frequency band.

- For example, if you are sweeping the frequency band 130-210kHz, you are transferring 80kHz of total bandwidth into one compressed echo on the display.
Pulse Compression

- Keep in mind – the display is limited by the available pixels.
  - The deeper the depth, the less pixels available to show details in the water column
  - CHIRP is able to show fine resolution/detail
  - If too much range, the images will be limited by the resolution of the display
For Comparison

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Three times deeper water
and
Three times display range
Fish at mid-depth
Things to consider (disadvantages)

- Affects of Pulse Compression in relation to how images are shown on the display.
- Beamwidth
Introducing **NEW!** Wide Beam CHIRP

- **Product Line Features**
  - High Frequency Range of **150-250 kHz**
  - Wide Beam – constant **25° beam width**
  - Available in many housing options:
    - Pocket/Keel Mount – PM275LH-W
    - Tank Mount – CM275LH-W
    - Thru Hull – B275LH-W
    - Transom Mount – TM275LH-W
    - Tilted-Element – B175H-W
Introducing NEW! Wide Beam CHIRP

B265 High Frequency - 8°
B275 High Frequency - 25°
## Comparing CHIRP Beam Widths

<table>
<thead>
<tr>
<th>Transducer/ Beamwidth*</th>
<th>Depth</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B265LH/ 10° to 6°</strong></td>
<td>50 ft</td>
<td>9 ft</td>
</tr>
<tr>
<td></td>
<td>100 ft</td>
<td>17 ft</td>
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<tr>
<td></td>
<td>300 ft</td>
<td>52 ft</td>
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<tr>
<td><strong>R109LH/ 8° to 4°</strong></td>
<td>50 ft</td>
<td>7 ft</td>
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<tr>
<td></td>
<td>100 ft</td>
<td>14 ft</td>
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<tr>
<td></td>
<td>300 ft</td>
<td>42 ft</td>
</tr>
<tr>
<td><strong>R509LH/ 8° to 4°</strong></td>
<td>50 ft</td>
<td>7 ft</td>
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<tr>
<td></td>
<td>100 ft</td>
<td>14 ft</td>
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<tr>
<td></td>
<td>300 ft</td>
<td>42 ft</td>
</tr>
<tr>
<td><strong>B275LH/ 25°</strong></td>
<td>50 ft</td>
<td>22 ft</td>
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<tr>
<td></td>
<td>100 ft</td>
<td>44 ft</td>
</tr>
<tr>
<td></td>
<td>300 ft</td>
<td>133 ft</td>
</tr>
</tbody>
</table>

*High frequency beamwidth only
Unique Transducer ID®

• All of AIRMAR’s CHIRP-ready transducers include a unique, patented Transducer ID®
  – measures and stores the operating parameters for each transducer
  – enables the fishfinder to automatically configure itself to the transducer being used
  – minimal set up or customization is needed – transmitting across the bandwidth is done automatically by the sounder
  – sounder is able to monitor the transducer during operation to maintain optimal performance

• Stored data also assists with troubleshooting, warranty or required information about the transducer
Heat Management System

- To install a CHIRP transducer in a way other than intended by the manufacturer could lead to the transducer overheating – resulting in transducer failure.

- Due to the nature of CHIRP technology, CHIRP transducers generate more heat than traditional tone burst transducers operating at discreet frequencies like 50 and 200 kHz.

- CHIRP transducers require heat sinks in the construction to dissipate heat/usually located above the high frequency ceramic.

- *Airmar’s CHIRP transducers have been designed to be installed in specific ways according to the number and placement of the heat sinks.*
Heat Management System

- XID provides real time temperature data from the ceramic assembly in the CHIRP transducer.
- Temperature data relates to impedance tables for the ceramic assemblies.
- CHIRP sounders continually monitor the temperature data to apply the right of amount of power to the ceramics for optimal performance.
- Airmar transducers are the only transducers with this capability.
- CHIRP echosounder manufacturers worked closely with Airmar to incorporate this technology.
The Complete CHIRP Product Line

- CHIRP is available to ANY angler with ANY size boat
- Twenty-four (24) CHIRP transducers available in seven (7) different mounting options
CORE
In hull, transom mount, tank mount, pocket and keel mount versions available.

LH model provides 103 kHz of bandwidth

LM model provides 73 kHz of bandwidth
HARD CORE
In-hull and Keel/Pocket Mount options also are available

LH model provides 117 kHz of bandwidth

LM model provides 83 kHz of bandwidth
ELITE

In-hull and Keel/Pocket Mount options also are available

LH Model provides 112 kHz of bandwidth

LM model provides 83 kHz of bandwidth
Core Products –
Tilted Element

- **B175L**: Tilted Element™
  - Operating Range: 40 kHz - 60 kHz
  - Low-Frequency Ceramic Array

- **B175M**: Tilted Element™
  - Operating Range: 85 kHz - 135 kHz
  - Medium-Frequency Ceramic

- **B175H**: Tilted Element™
  - Operating Range: 130 kHz - 210 kHz
  - High-Frequency Ceramic
Price point Broadband

Operating Range:
40 kHz - 80 kHz
Low-Frequency Ceramic

Operating Range:
140 kHz - 210 kHz
High-Frequency Ceramic

Operating Range:
40 kHz - 80 kHz
Low-Frequency Ceramic

Operating Range:
80 kHz - 130 kHz
Medium-Frequency Ceramic
Conclusions

• To operate as a true CHIRP system, you will need:
  – Broadband transducer with bandwidth
  – CHIRP transmit pulse (driven by CHIRP sounder)
  – Digital processing, pattern matching & pulse compression

• Once you have these, you can gain all the benefits of CHIRP technology!
Importance of Proper Transducer Selection & Installation
Regardless of mounting style, a properly installed transducer delivers a vertical beam that aims straight down toward the bottom, resulting in strong echo returns and accurate depth readings.
Optimum Fishfinder Performance...

...starts with optimum transducer placement.
Transducer placement should be aft and close to the centerline. It needs to be located low enough that the transducer is in the water at all times.
Consider items such as the lifting strap placement into the location as well as trailer bunks and rollers if it is a trailered vessel.
Transducers used on stepped hull vessels **must** be located in front of the first step and low to the keel to operate properly.
Bubbles create noise and disturbance on the face of the transducer
Installation Guidelines

• Bow thrusters, live well or cooling intakes as well as chines, steps and strakes can all introduce aerated water into the path of the transducer.

• Remember to always look forward all the way to the bow of the vessel to see if there will be any interference in front of the transducer’s mounting location.

• If there is an intake 50 feet ahead, in line with the transducer, it *will* affect performance at high speeds.
This installation of a B164 looks good, however notice the strake 10 feet directly in front of the transducer. This causes turbulence and air bubbles making the transducer stop reading bottom at 12 knots.
Poorly located transducer installations

This intake shown in the photos above will cause turbulence and send air bubbles over the transducer face as vessel speed increases. The transducer will work great when the vessel is drifting, but will not work well at speed.
This transducer is mounted too far aft and will be affected by the turbulent water that the starboard propeller will create at ANY speed.
This is a excellent installation of a B260. There are no hull protrusions in front or alongside the transducer. The transducer is also installed away from the keel so that the beam is not shaded. An installation like this will give clear bottom readings up and above 30 knots.
Be sure that the transducer signal will not intersect the prop shaft(s), keel or any other hull projections, and that it is not directly in-line with the prop(s)
Thru-Hull Transducers

B164, SS164, SS264, B175L/M/H

Tilted Element

- Tighten two set screws on the threaded nut

**NOTE**: After screw makes contact with housing, tighten additional 1/8 - 1/4 turn.

Figure 6. Cutting the spacer

Figure 7. Tightening the two set screws

Stainless steel housing—SS164
Thru-Hull Transducers

B258, B260 Thru-Hulls

- Apply marine sealant as recommended
- Use isolation sleeve on metal hull installations

Figure 2. Bedding and installing in a metal hull (SS258 with Standard Fairing shown)
Thru-Hull Transducers

B258, B260, SS270W, B265LH/LM Thru-Hulls

- Mounting in cored hulls

Figure 8. Preparing a cored fiberglass hull
External-Mount Transducers

R99, R109LM/LH, R509LM/LH
External-Mounts

- The Fairing Block MUST be Mounted independent of the transducer

Figure 7. Bedding and installing the fairing and backing block (non-metal hull shown)

Figure 8. Threaded rod
External-Mount Transducers

R99, R109LM/LH, R509LM/LH
External-Mounts

- The transducer hangs or suspends from the pre-mounted fairing
- Apply marine sealant as indicated

**Figure 9. Bedding and installing the transducer** (non-metal hull shown)
In-Hull Transducers for Fiberglass Hulls

Mounting:
Sand/grind the fiberglass until rough. Clean the fiberglass, then mount with:
1. Fiberglass Resin (best choice for long-term adhesion)
2. Fusor® 100EZ / T10.
3. 3M 5200,

Filling the tank:
Use non-toxic Marine & RV red/pink anti-freeze

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**Figura 8. Sezione trasversale del trasduttore installato**
In-Hull Location Selection

The same installation placement guidelines for Thru-Hulls apply for In-Hulls.

The selected location should be aft and close to the centerline so that the transducer is in the water at all times.
Before installing the transducer tank, perform one of the 3 methods below in as deep of water as possible. Connect the transducer cable to the fishfinder to verify strong bottom readings.

A. Flood the area with bilge water.
B. Place the transducer in a garbage bag and fill with water
C. Apply a water based lubricant to the transducer face and press against the hull

Figure 4. Testing the transducer at the selected location
Custom Installations

- B260 recess mount in the keel – courtesy Mako Marine
Custom Installations

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- B260 recess mount in the keel – courtesy Pangaforum
Custom Installations

- Pocket-Mount courtesy Garmin
• Do you have:
  – Transducer feedback for Airmar?
  – Product suggestions?
  – Tough questions?
THANK YOU FOR ATTENDING!

www.airmar.com