AIS Training

AIS Technology in Digital Yacht Products Explained
What is AIS?

- The Automatic Identification System (AIS) is the biggest advance in marine navigation since RADAR
- AIS uses GPS, VHF and Digital Signal Processing (DSP) to communicate data between vessels
- Vessels can Transmit their position and Receive other vessel's positions (Transponder) or just Receive other vessel's positions (Receiver)
- An AIS transponder is a mandatory fit on all vessels greater than 300 tonnes or carrying 12 or more passengers

**THE TECHNICAL STUFF**

- AIS uses two VHF frequencies;
  1. 161.975 MHz
  2. 162.025 MHz
- AIS is subject to the same constraints as VHF radio i.e. line of sight range
- AIS data is transmitted in NMEA 0183 serial protocol but at a higher 38,400 baud rate
- There are two NMEA sentences reserved for AIS;
  1. !AIVDM (other vessels)
  2. !AIVDO (own vessel)
- AIS Data is also transmitted in NMEA2000 protocol and a total of 21 PGNs have been published for AIS
- A transponder must have a GPS position, whilst a receiver does not have to have one
What AIS Does

- There are two classes of AIS:
  - Class A – for mandated commercial vessels
  - Class B – for smaller non-mandated vessels

- At regular intervals based on AIS class, navigational status and speed, a transponder will transmit the vessel’s;
  - GPS Position, SOG and COG
  - Heading and Rate of Turn
  - MMSI number

- Every 6 minutes, a transponder will transmit the vessel’s “Static Data”;
  - Vessel Name, Call Sign and MMSI
  - Dimensions and Vessel Type
  - Voyage Data (Destination/ETA)*
  - Navigational Status*

* Note - Class A Transponders Only
<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
</table>
| Class A Transponder | ![Class A Transponder](image) | - Mandatory Fit on large commercial vessels  
- Transmits and Receives  
- Dedicated type approved “Minimum Keyboard+Display” (MKD)  
- Typical Price £2000 |
| Class B Transponder | ![Class B Transponder](image) | - Lower cost transponder for leisure and non-mandated craft  
- Transmits and Receives  
- Normally a “black box” solution  
- Typical Price £500 |
| AIS Receiver     | ![AIS Receiver](image) | - Cost effective way for small craft to see “big ships”  
- Only Receives  
- Normally a “black box” solution  
- Typical Price £150 |
# Comparisons of Class A and B

## Comparison of Functionality

<table>
<thead>
<tr>
<th>Function</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Power</td>
<td>12.5W</td>
<td>2W</td>
</tr>
<tr>
<td>Transmit Rate</td>
<td>Up to every 2-3secs</td>
<td>Every 30 secs</td>
</tr>
<tr>
<td>Minimum Keyboard + Display (MKD)</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Technology</td>
<td>SOTDMA</td>
<td>CSTDMA</td>
</tr>
<tr>
<td>Guaranteed Time Slot Allocation</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Voyage Data</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>External GPS Connection</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Price (approx)</td>
<td>£2000</td>
<td>£500</td>
</tr>
</tbody>
</table>

## Comparison of Transmit Rates

<table>
<thead>
<tr>
<th>Ship's Dynamic Conditions</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship at Anchor or Moored</td>
<td>3 Mins</td>
<td>3 Mins</td>
</tr>
<tr>
<td>SOG 0-2 knots</td>
<td>10 secs</td>
<td>3 mins</td>
</tr>
<tr>
<td>SOG 2-14 knots</td>
<td>10 secs</td>
<td>30 secs</td>
</tr>
<tr>
<td>SOG 2-14 knots and changing course</td>
<td>3.3 secs</td>
<td>30 secs</td>
</tr>
<tr>
<td>SOG 14-23 knots</td>
<td>6 secs</td>
<td>30 secs</td>
</tr>
<tr>
<td>SOG 14-23 knots and changing course</td>
<td>2 secs</td>
<td>30 secs</td>
</tr>
<tr>
<td>SOG &gt; 23 knots</td>
<td>2 secs</td>
<td>30 secs</td>
</tr>
<tr>
<td>Ship Static Information</td>
<td>6 mins</td>
<td>6 mins</td>
</tr>
</tbody>
</table>

## Comparison of Transmitted Data

<table>
<thead>
<tr>
<th>Data Transmitted</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMSI + Vessel Name + Call Sign</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Position + COG + SOG</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>True Heading</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Rate Of Turn</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Nav Status</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>IMO Number</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Type of Vessel</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Vessel Dimensions</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>ETA + Destination + Draught</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>
What AIS Looks Like

Each vessel is displayed in its position on the chart.

Targets constantly moving to reflect real-time position and direction.

Warning of collision or ‘close’ proximity automatically provided.

By selecting any vessel displayed on the screen, all static and dynamic data is displayed.

Your own position is displayed on the chart.
Although AIS data is always the same, it can be displayed in a variety of ways.
Typical AIS Installations

AIS Receiver for Small Open Cockit Boat

PC+Plotter AIS Receiver Installation

Full Class B installation with splitter and N2K

USB Powered AIS Receiver for laptop PC
Benefits of AIS – Collision Avoidance

- Receive clear and regular position reports of all AIS equipped vessels in your area
- Set CPA and TCPA alarms
- Identify and make a DSC radio call to a dangerous vessel using their MMSI number
Benefits of AIS – Identification

- Receive MMSI number, vessel name and boat type of all AIS equipped vessels
- Find any of your friends’ boats “Buddy Tracking”
- Friends and family can use online AIS services to track your trip/race from home
Benefits of AIS – Safety + Security

- Emergency services are now using AIS
- AIS SARTs are ideal for close proximity MOB rescue
- Quick and easy vessel identification for maritime services
Benefits of AIS – “See Round Corners”

- “See Around Corners”
- Vessels, AtoNs, Rescue Craft displayed as objects not “blobs”
- Low power and low cost alternative to radar for small boats
Benefits of AIS – CPA and TCPA

- Most chart plotters, navigation software and apps that are AIS compatible have some form of collision alarm.
- The system calculates the Closest Point of Approach (CPA) of every AIS target and also the Time to CPA (TCPA).
- Users can set alarm values for CPA and TCPA which trigger an audible and visual alarm when dangerous targets are detected.
Class B for Small Craft

• With only a £350 price difference between a Receiver and a Class B Transponder, many people will buy a transponder rather than a receiver.

• Theoretically, if every small craft fitted a Class B Transponder tomorrow, we could see a reduction in the update frequency and range of Class B targets.

• In reality, such a situation would require thousands of Class B Transponders in a very small area and such gatherings of small craft generally only occur in good conditions.

• Diligent use of the “Silence Button” on Class B transponders, only transmitting in poor visibility or when crossing shipping lanes should be considered good practice.

To Transmit or not to Transmit….that is the question!
Class A for Small Craft

- Class A Transponders have been traditionally only found on commercial mandated vessels
- This was mainly due to price (approx £4000) but recently prices have come down (approx £2000) and now some pleasure vessels are starting to look at Class A
- Class A has some real advantages for certain pleasure vessels;
  - 12.5W Transmit Power
  - Fast Update Rate (2-3 sec)
  - Guaranteed Time Slot
  - Built-In display
  - Better Coverage on AIS Tracking Sites
- For large high speed power boats the 30sec update rate of Class B is too slow
- For Blue Water Sail Boats, the 2W transmit power of Class B does not give enough range
Single Channel versus Dual Channel

**Single Channel**
- Some early and current AIS receivers are single channel e.g. Nasa AIS 3 and Smart Radio SR161
- One RF receiver that is switched between the two AIS channels every 30 secs or more
- Targets received on single channel receivers can take twice as long to update

**Dual Channel**
- All Digital Yacht AIS units feature a high performance Dual Channel receiver
- Two RF receivers each one dedicated to the two AIS channels
- Maximum number of received targets with no update delays or missed targets
Splitter versus Dedicated Antenna

Pros
- Single Antenna Solution
- Top of mast for Maximum Range
- Easy Installation – no cables to run
- No loss of performance

Cons
- 4x the cost of dedicated antenna
- Misses targets while VHF transmits

Vs

Pros
- Low Cost
- Backup Emergency Antenna for VHF
- Not affected by VHF voice activity

Cons
- Less Range if mounted at deck level (10-15NM)
- Installation can be time consuming/costly
- “Not Another Antenna!”
Splitter – How it Works

- Single Antenna is shared by the AIS and VHF
- Two intelligent switches inside the splitter sense when AIS or VHF is transmitting
- A Class B AIS transmission only lasts 26mS so the detection and switching is very fast
- VHF gets priority and whilst transmitting no AIS reception is possible
- When neither system is transmitting both systems are connected to the aerial and can receive at the same time
- Some older splitters use to introduce a 3dB (half power) loss on VHF and AIS reception
- No losses in transmission as only one system connected to antenna
- Latest SPL2000 features “Zero Loss” Technology where the signal from the antenna goes through a pre-amplifier before being split
AIS SARTs

- AIS SARTs have recently been approved for GMDSS use
- An AIS SART is basically a low power Class A transmitter (1W)
- It transmits its position every minute and also outputs a Safety Related Message (SRM) every four minutes
- Once activated, an AIS SART should start transmitting its position within 1 min and continue to transmit for 96 hrs
- Battery life is 3 years and an AIS SART should be fully waterproof to 10 m for 5 mins
- When held 1 m above sea level the AIS SART should be received by all AIS units within 5 NM radius
Online AIS Tracking Sites

- More and more customers are using on-line AIS websites to track their vessel
- They expect to be seen and do not appreciate the limitations of the systems
How Online AIS Sites Work

- A network of AIS Receivers (base stations) collect the real time AIS reception and send it to a web server via the base stations internet connection.
Online AIS Receiver Network

- The on-line system is only as good as its network of base stations and on Marine Traffic you can click More>Stations to see the network displayed
Online AIS Coverage for Class B

- The base station network is not perfect and “holes” in coverage exist
- The superior range of Class A means larger coverage with less “holes”
Companies like exactEarth and Orbcom can now track Class A AIS units via satellite.

It is possible to track Class B but they cannot guarantee reception.

Currently this type of tracking is expensive but prices are sure to come down.