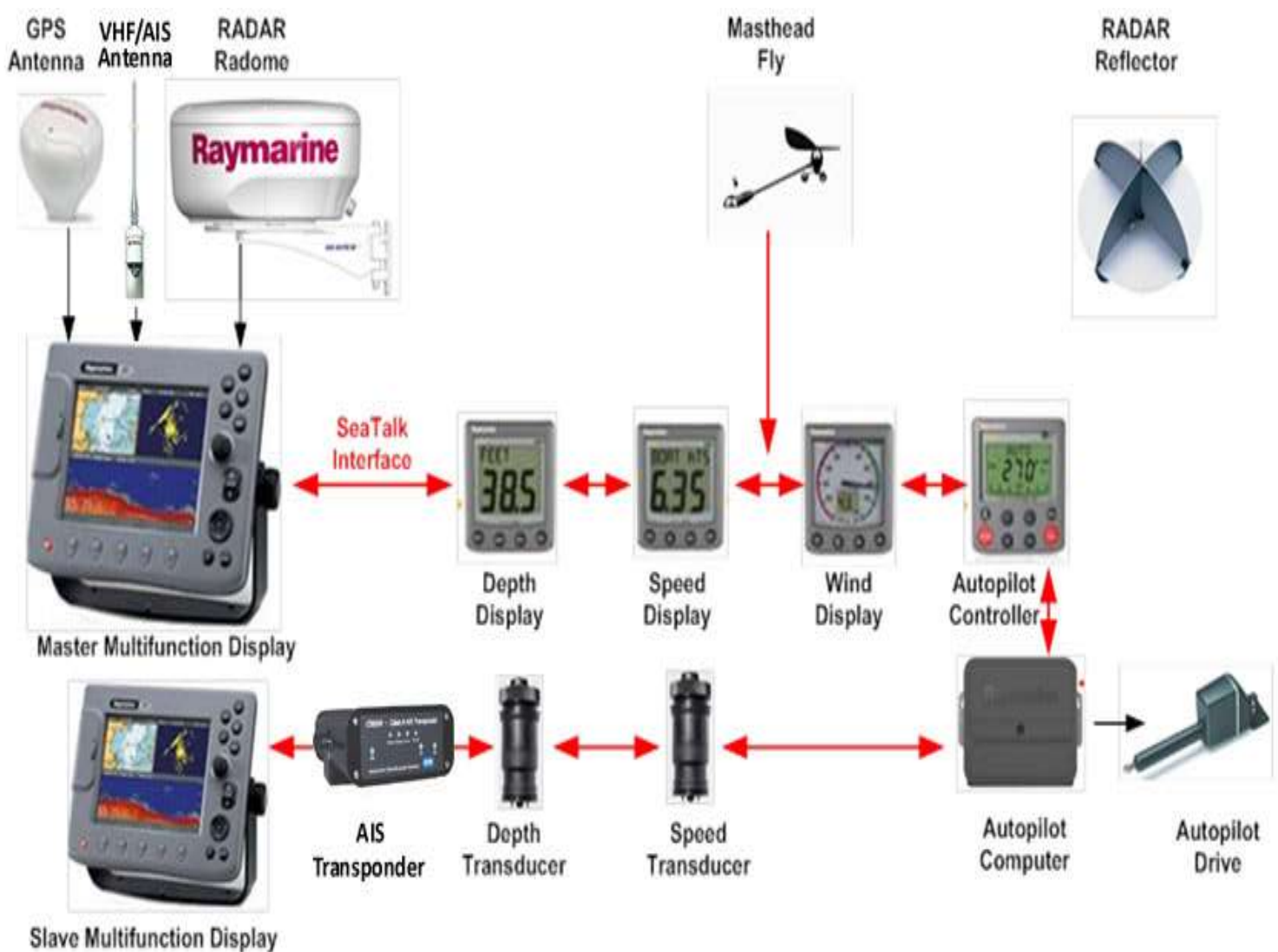


RADAR/GPS

- Common marine RADAR/GPS system
 - Antennas, instruments and displays communicate via a common bus to provide you with information for positional awareness, collision avoidance, weather and navigation.



RADAR

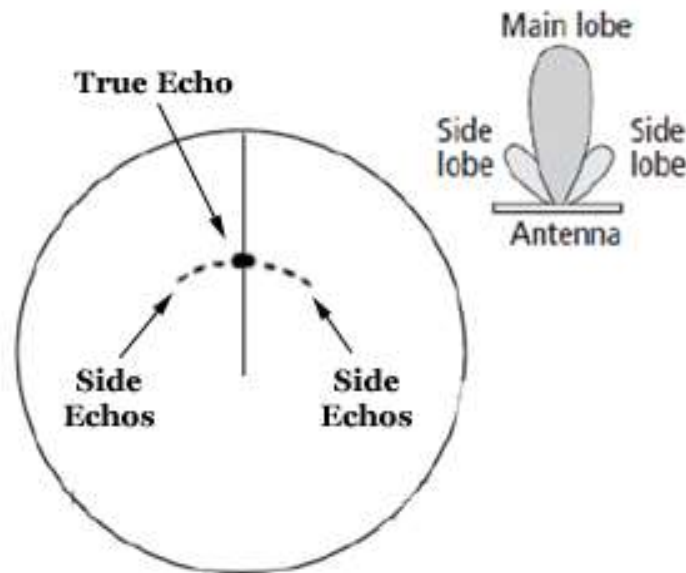
- **RADAR definition**
 - **Radio Detection And Ranging**
- **RADAR uses**
 - **Collision avoidance – in limited visibility and at night**
 - **Navigation – range of bearing of vessels and objects**
 - **Weather – especially squalls**
- **How RADAR works**
 - **Measures roundtrip time from the transmission of a pulse to the reception**
- **Types/Pros & Cons of marine RADAR**
 - **Conventional (pulse wave) - Range and bearing determined by transmitting a pulsing microwave signal and receiving the reflections in between the transmitted pulses.**
 - **Better at long range target detection than Broadband RADAR**
 - **Better in fog, rain, and snow than Broadband RADAR**
 - **Can trigger RACON**
 - **Poorer target resolution than Broadband RADAR**
 - **Broadband (continuous wave) – Range and bearing determined by transmitting a constant microwave signal from one antenna while constantly receiving reflections back from a second antenna.**
 - **Better short range target detection than conventional RADAR**
 - **Better target resolution than conventional RADAR**
 - **Lower power usage than conventional RADAR**
 - **Cannot trigger RACON**

- Major manufactures of marine RADAR
 - Raymarine – conventional (pulse)
 - Simrad, B&G, Lowrance, Naico – broadband (constant)
 - Furuno – commercial/military strength
- RADAR Range – RADAR works on line of sight and is limited by the curvature of the earth.

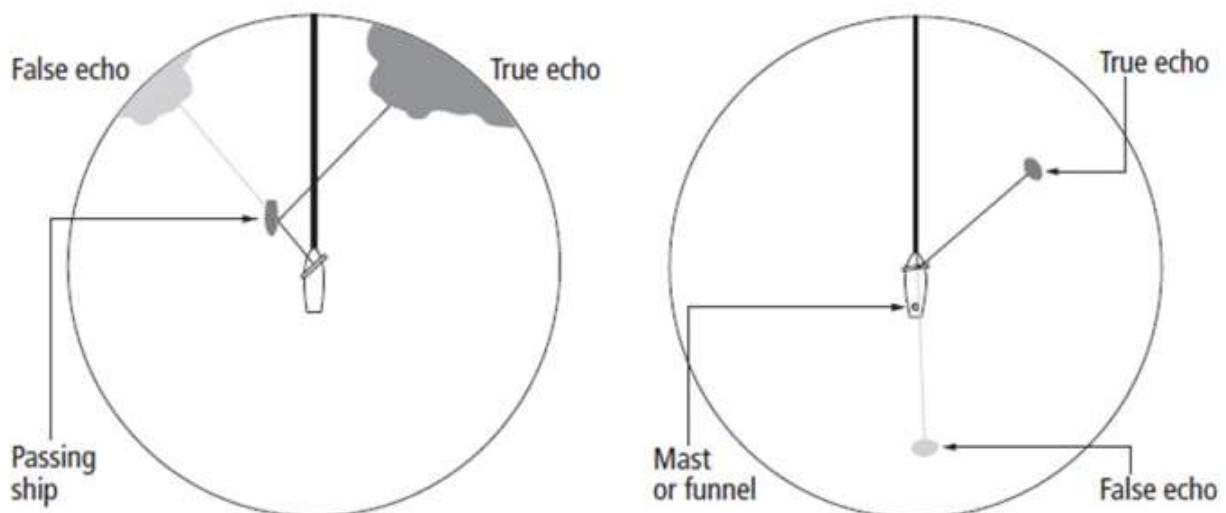


- RADAR depends on
 - Strength of radio signal
 - Radio signal detection sensitivity
 - Height of the antenna
 - Height of the object being detected
- RADAR range
 - Typical maximum RADAR range is 24-36nm
 - Practical RADAR range is 3-8nm

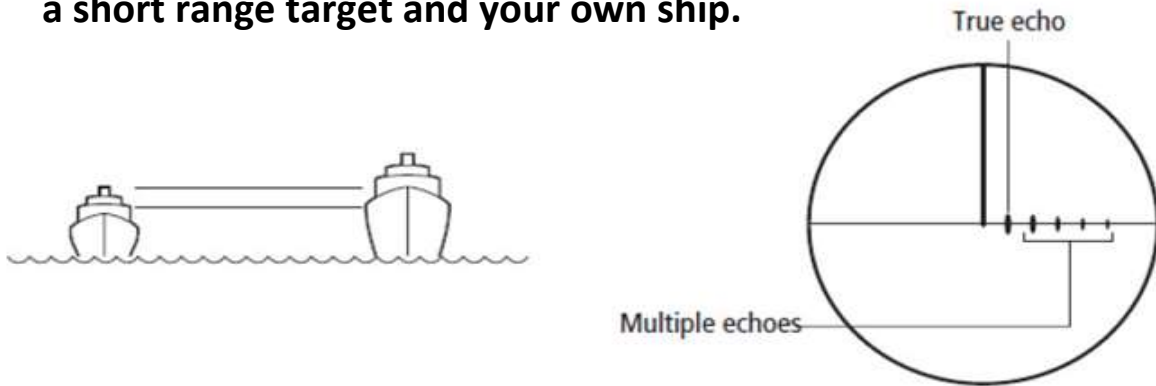
- **RADAR Impairments – not all RADAR echoes are produced by valid targets. Spurious echoes may be caused by:**
 - **Side lobes –a short range target detected by side lobes creates echoes of the primary target.**



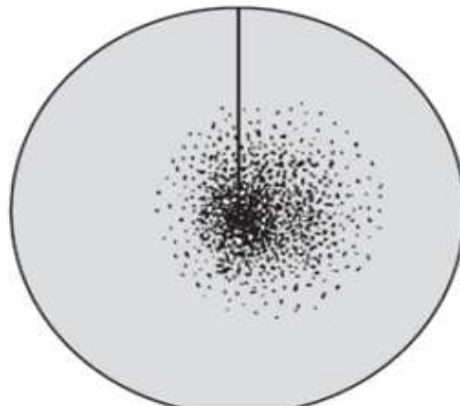
- **Indirect echoes –poorly defined ghost images created by reflected RADAR beams either from a passing ship or a reflecting surface of your own ship.**



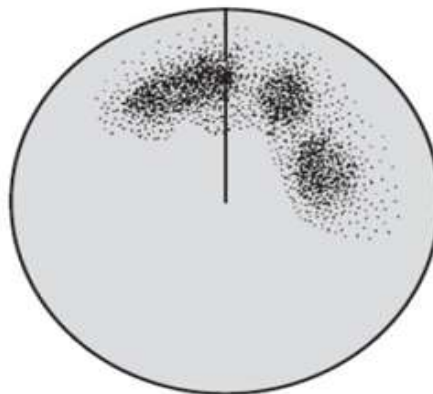
- **Multiple echoes** – transmitted signal reflects back and forth between a short range target and your own ship.



- **Sea clutter (waves)** – appears as multiple echoes at short range scales



- **Rain or snow clutter** – appears as countless small echoes continuously changing size, intensity and position.



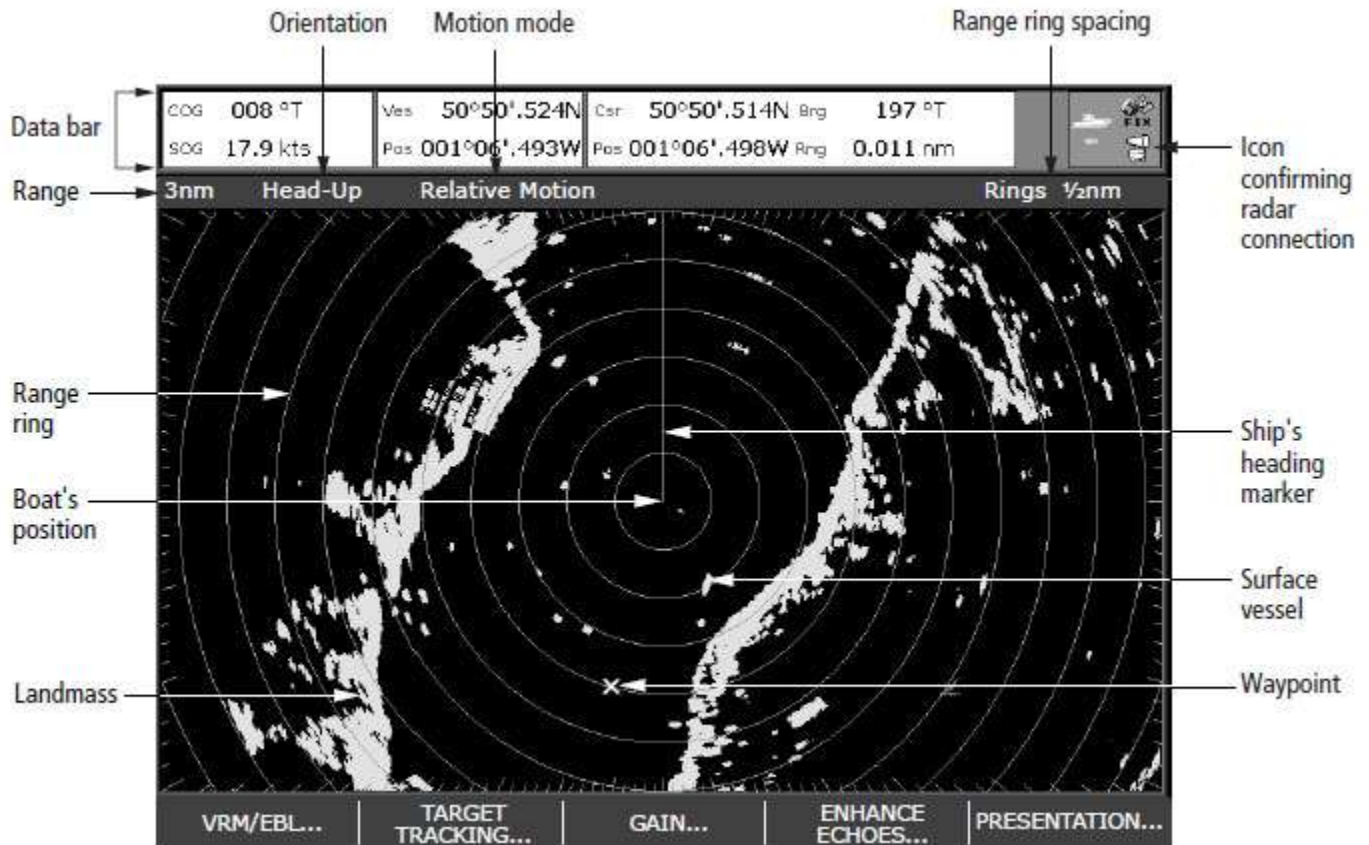
- **Blind and Shadow sectors** - Obstructions (masts etc) near the RADAR antenna may obstruct the RADAR beam and cause shadows or blind sectors. Small targets at close range might not be detected.
- **Interference from other RADARs** – noticeable at long ranges

- Multifunction display commonly called chart plotter – displays RADAR and/or GPS information overlaid on charts. Buttons and knobs have multiple uses depending on whether they're pressed for a short or long duration.

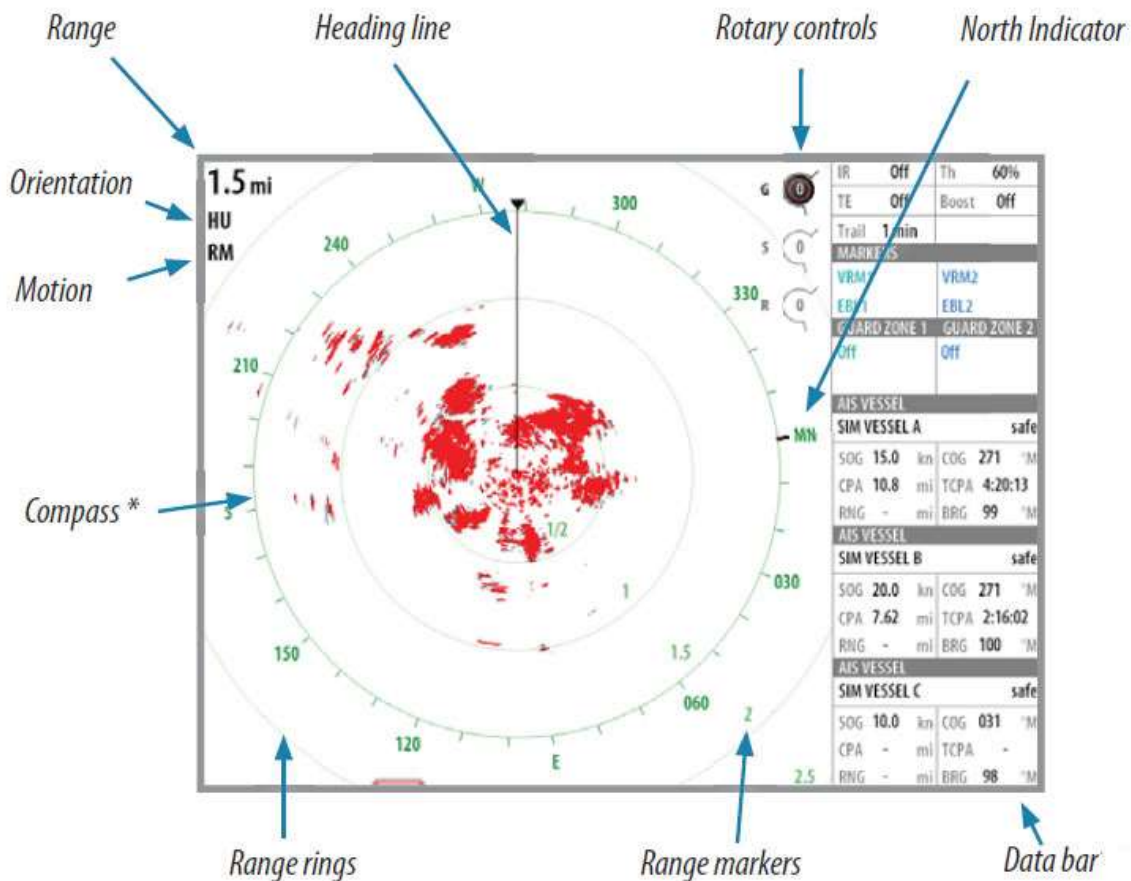


1. Touch Screen – (can be turned off)
2. STBY/AUTO key – auto pilot control
3. Knob – pushing knob is similar to keyboard enter/left mouse click. Rotate knob to zoom chart or scroll through menus
4. MENU/MARK key – short press activates active panel's menu. Long press places mark at vessel's position
5. IN/OUT key – Zoom active panel in and out. Press both simultaneously to position MOB at vessel's position
6. Chart card reader door
7. PAGES/GOTO key – short press displays home page panel. Repeat to toggle pages. Long press displays GOTO menu
8. POWER key – turns unit on and off and adjust brightness/night mode
9. X key – close dialogs, return to previous menu and remove cursor. Similar to keyboard ESC key

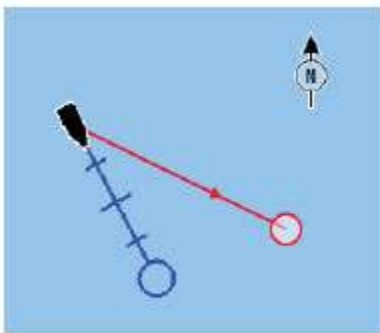
Conventional RADAR Display



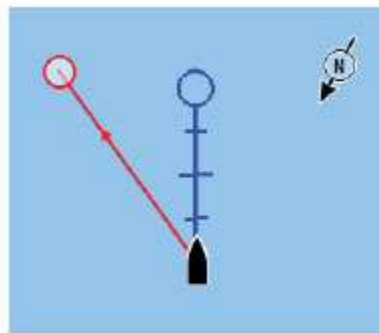
• Broadband RADAR Display



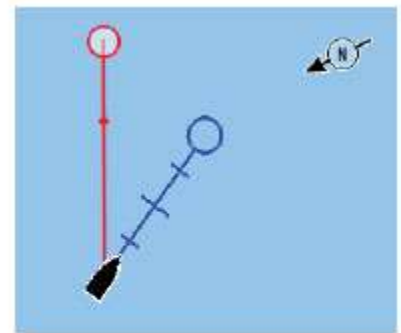
- **Major/Common RADAR controls (soft and/or hard keys)**
 - Gain – adjust the receiver’s sensitivity/filters
 - VRM/EBL – range and distance
 - Target Tracking – MARPA/AIS/Guard Zones
- **RADAR Display**
 - In relative motion (RM) mode your ship is fixed in the center of display and everything moves relative to your boat. In true motion (TM) the land is fixed and everything moves relative to the land.
 - The Ship’s Heading Marker (SHM) always indicates what is ahead (off your bow)
 - Range (distance) is indicated by range rings.
 - Size of reflections (echoes) don’t always indicated size of object
 - Data bar fields are user configurable
- **Display Orientation**



North up



Heading up



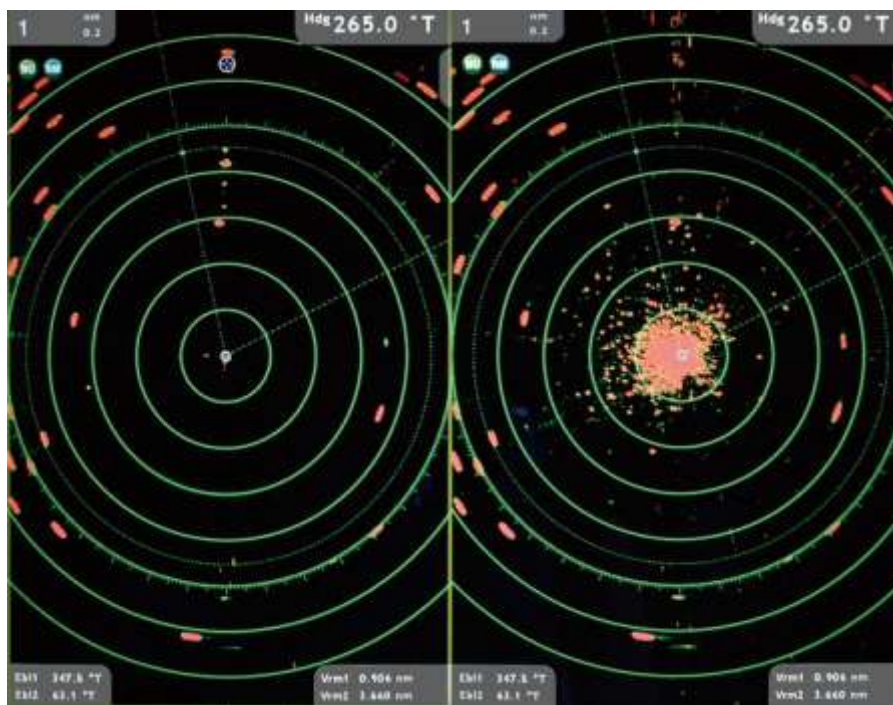
Course up

- **North Up** – Similar to reading a chart. North is always at the top of the display.
- **Heading Up** – most common setting. The vessels heading is always on the top of the display.
- **Course Up** – the next waypoint is always at the top of the display. This option only works when there’s an active waypoint/route.

- **Gain** – controls how much received signals (echoes) get amplified.
 - **Auto** – adjusts gain according to the ring range setting
 - **Manual** – allows user to control gain
 - **Presets (filters):** harbor, offshore and coastal

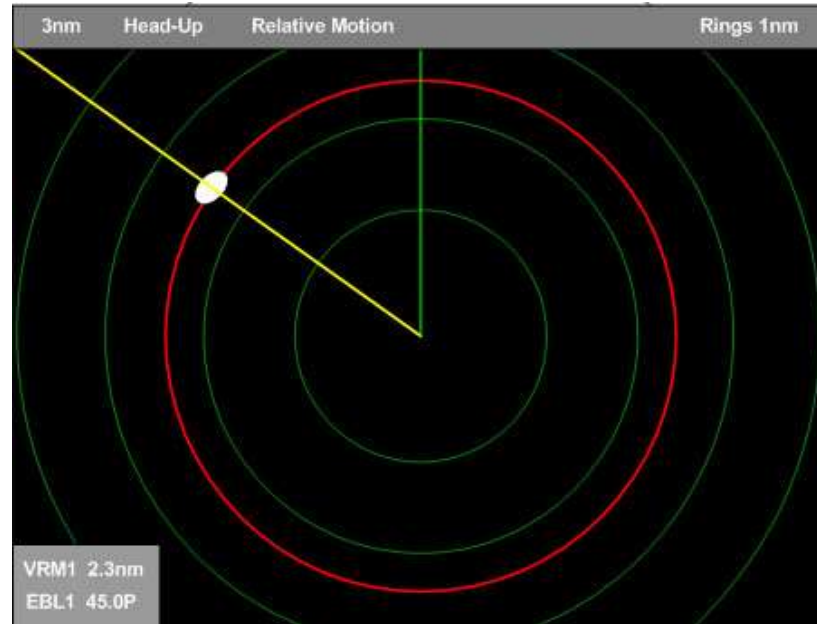
Correct gain

Too much gain (saturation)

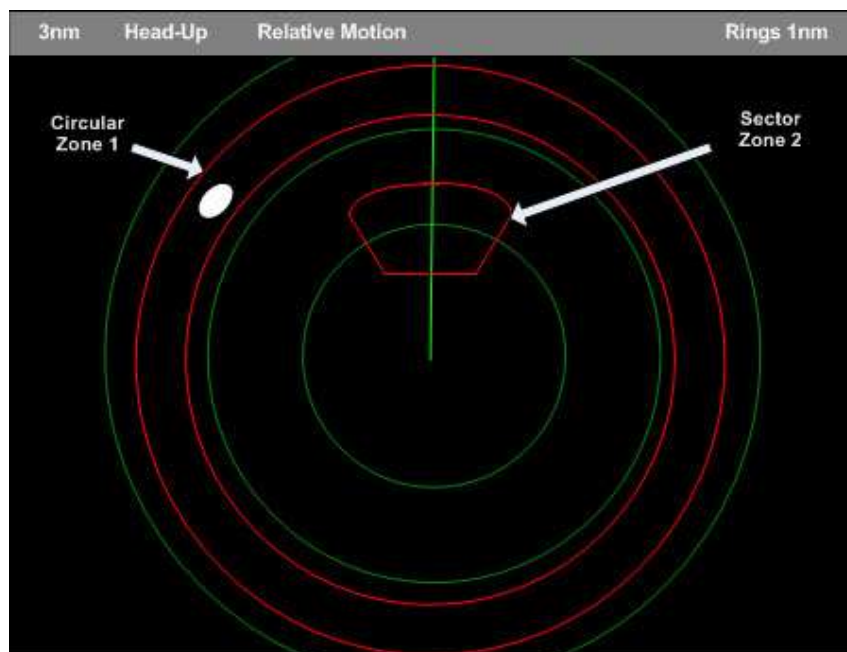


- **Enhance echoes**
 - **Increases the size of return echoes making objects easier to see on the screen**
 - **Allows easier detection of the presence of other RADARs in the vicinity**
 - **Allows you to see the trail (direction and speed) of moving targets.**

- **Variable Range Marker (VRM)** – adjustable ring used to determine the range (distance) of an object from your boat. (red circle)
- **Electronic Bearing Line (EBL)** – adjustable radial line extending from your boat used to determine the relative bearing (angle) of an object from your boat. (yellow line)
- Typically, RADARs have two independently controllable VRM/EBLs



- **Guard Zone** – a sector or a ring of adjustable thickness (distance) that will set off an alarm if an object enters it.



- Mini Automatic RADAR Plotting Aid (MARPA) – allows up to 10 targets to be tracked.
- Place cursor on target to acquire. Once acquired targets are tracked automatically. MARPA provides:
 - target range
 - target bearing
 - target speed
 - target direction (course)
 - CPA – closing point of approach
 - TCPA – time of closest point of approach
 - Safe or dangerous indication
 - Proximity alarm



Dashed box = acquiring target

Circle = target acquired

Triangle = proximity alarm

Double triangle = target lost

- **AIS – Automatic Identification System – uses digital radio signals to broadcast “real-time” information between vessels and shore based stations.**
 - **Used to identify and track vessels and to provide fast, automatic and accurate collision avoidance data.**
 - **An AIS transmitter continuously sends a vessels position, course and speed and optional data fields such as vessels name, draft and destination to land and sea based AIS receivers.**
 - **AIS is available on websites and phone apps but it is sometimes delayed**
 - **All commercial ships over 60’ are required to have AIS**
 - **Shows up on RADAR and chart plotter displays**



- **RACON - RAdar and beaCON**

- A RACON is a RADAR transponder. (transmitter & receiver)
- Transmits a signal resembling a Morse code character after receiving a RADAR pulse
- Can be mounted on bridges, lighthouse, buoys (Harding Rock)
- Broadband RADAR does not turn on RACON
- The Bay Bridge has three RACONs. The Golden Gate has one.

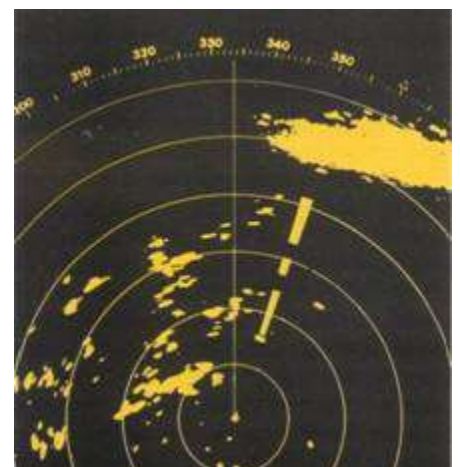
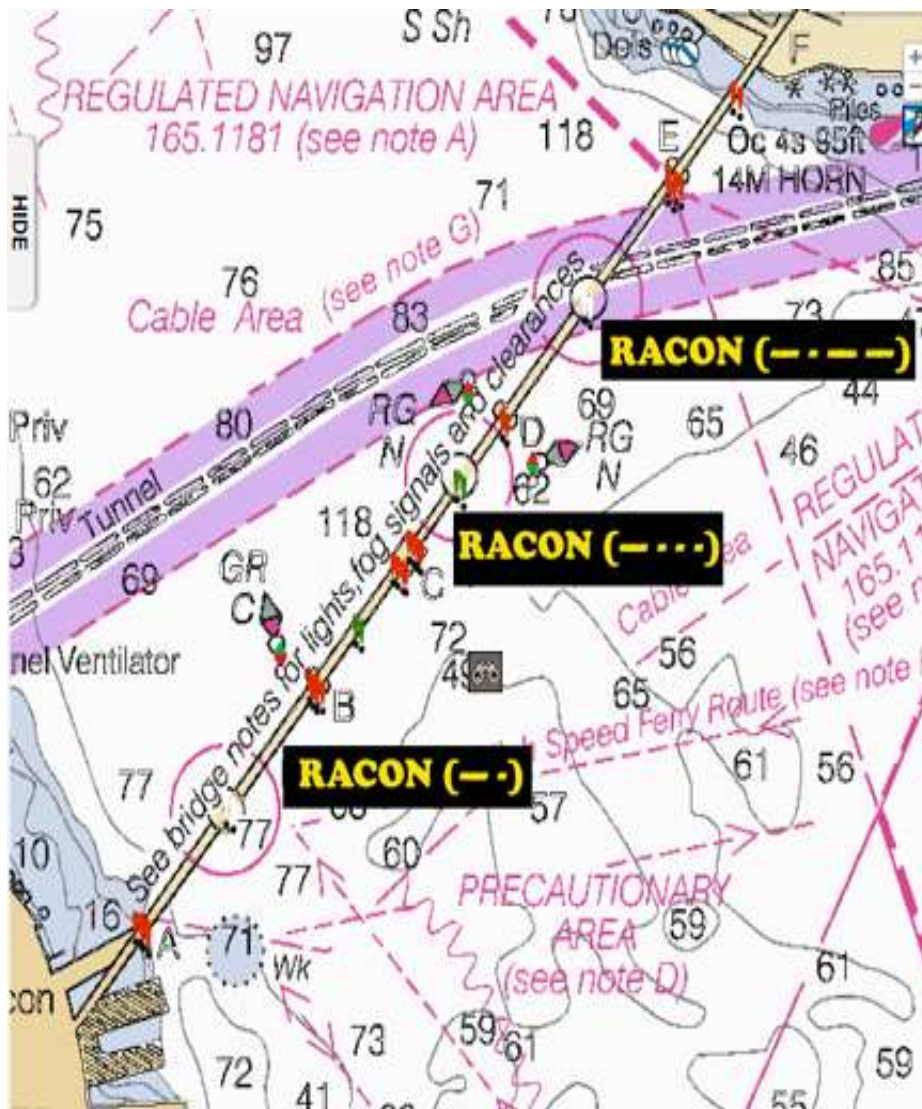
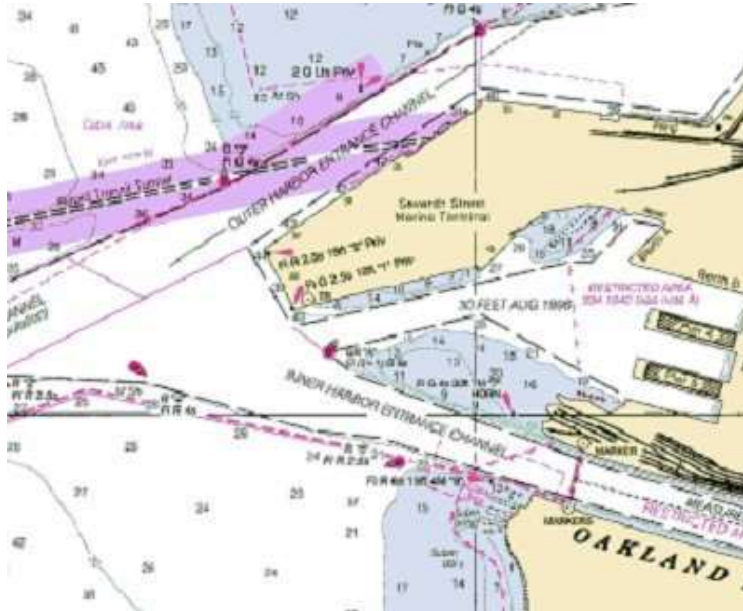
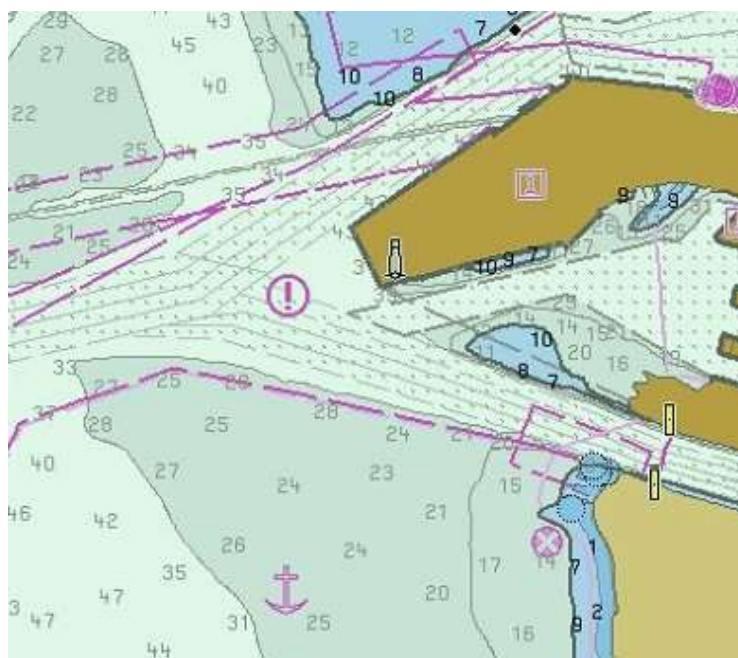


Chart Plotter/GPS

- A chartplotter integrates GPS data with a database of navigational charts to display your ship's position, heading and speed.
- Types of Digital Charts
 - Raster charts are electronic photographs of original paper charts.
 - Zooming does not change information displayed



- Vector charts are digital recreations from information stored in a database.
- Zooming changes information.
- Color, fonts, detail etc can be changed or turned on/off.

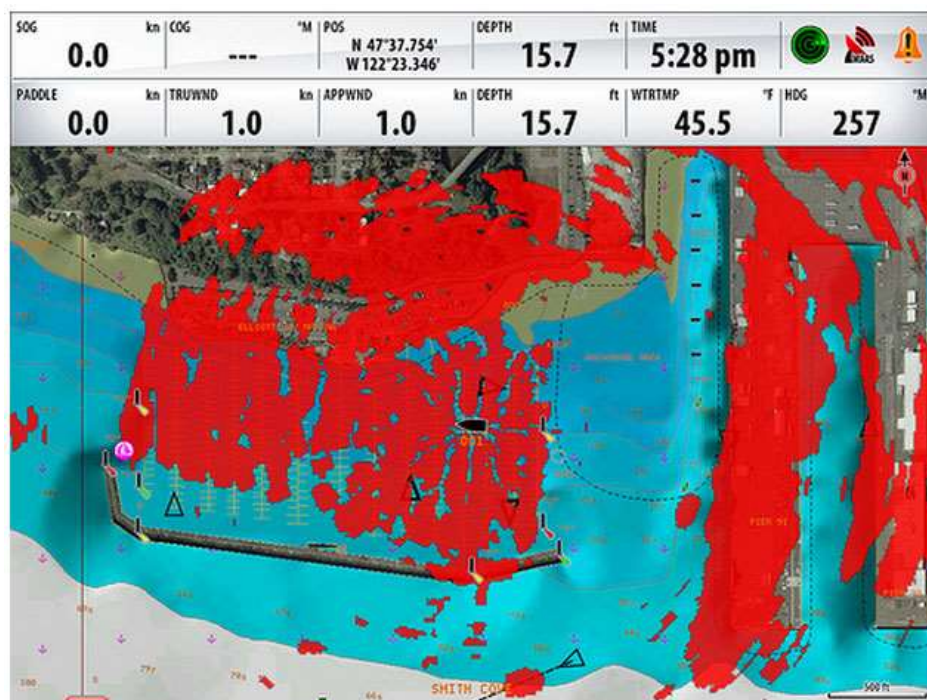


- **Waypoints, Routes & Tracks**

- **Waypoint** – user generated location (lat/long) used to mark a position. Activating MOB creates a waypoint.
- **Route** – two or more waypoints
Auto pilot can steer to a waypoint or navigate an entire route in forward or reverse
- **Track** – a graphical presentation of the historical path of the vessel.
Good for finding your way back from whence you came ☺

- **Overlay**

- **RADAR, weather and AIS** can be overlaid on top of your chart.



- **Alarms**

- Just some of the alarms you can enable/disable are anchor drag, arrival, collision, water depth, voltage and off course.