

NAV, LAND, TRACK, SLIDE, STOP, HOVER, Anchor and FOLLOW Mode

October 30, 2017

Understanding the NAV Mode

The active route is followed by automatic adjustment of the *Target Heading*. The Autopilot may use thrusters and differential throttle for steering assistance, when in SLOW Mode.

Rate of turn is limited in NAV Mode, for gentle waypoint switching at high speed.

When a cross track error (XTE) develops, the autopilot applies an instant correction on the *basic target heading*. The instant correction is limited to a 30 degree intercept of the ground track. The intercept angle is gradually reduced to zero, inside of the 0.03 NM capture range.

Lateral drift is compensated by gradually adjusting the *basic target heading*. For rapid changes in drift and initially when engaging the NAV Mode, only instant GND Track data are used to calculate the basic target heading.

Autopilot XTE resolution is 0.0001NM (7 inches) in **LAND** Mode, or 0.001NM (6 ft.) in **NAV** Mode.

The NAV Mode works with reduced accuracy, when XTE-data from a plotter come only with a 0.01NM precision.

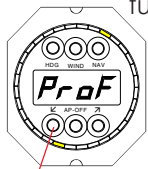
Speed Mode (Autothrottle)

Selected Speed may refer to water speed or to GND Speed, or to relative speed of a moving target. Profile mode always uses GND Speed. SLIDE Mode uses "along track" GND Speed. MOB and FOLLOW Mode are using relative target speed. Other modes let you choose GND or water speed.

Profile Mode

While in NAV or LAND Mode, the autopilot can follow a *Speed Profile*.

When selecting PROFILE, the vessel will slow down and come to a halt in ANCHOR Mode at the upcoming waypoint. Speed reduction will start as a function of distance and speed (page 7).

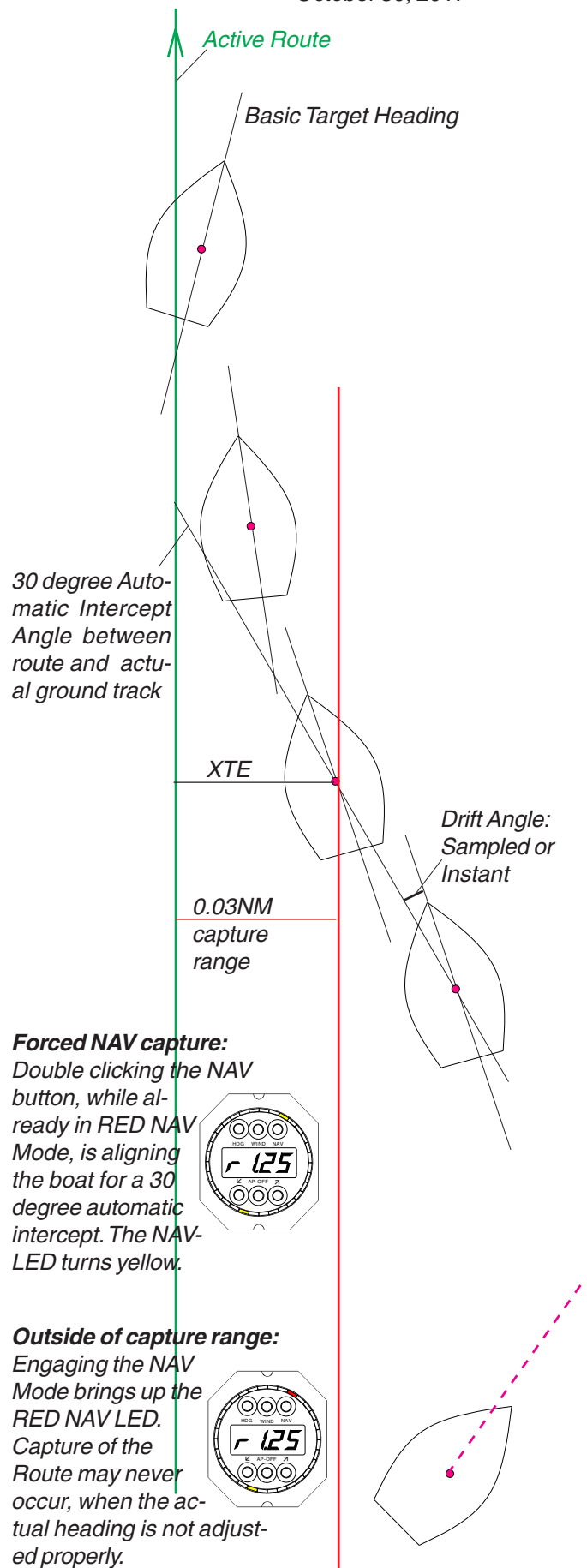


Profile is not available while in **SLIDE** Mode (page 3).

To engage PROFILE Mode: click the lower left button or press PROF on the wireless Remote, while in NAV or LAND Mode. Autothrottle Speed Mode will engage automatically.

Note: waypoint position data must be made available to the autopilot with a BWC or RMB sentence.

Profile Mode may be cancelled by pressing SPD on the wireless Remote or by engaging Manual Throttle or by changing the Autopilot Mode to other than NAV or LAND.

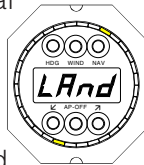


LAND Mode

The route is followed with highest precision. Vessel speed must be kept low and should not exceed 5kn.

LAND Mode can be used with any type vessel. Best results are obtained with lateral thrust available at the Bow and Stern, and a plotter data XTE precision of 0.0001NM (0.2 meter).

A GNSS position sensor with a 0.0001NM (0.2 m) absolute accuracy and a 0.00001NM (0.02m) precision will give the best result.



The LAND Mode offers several options for different situations:

LAND Mode with Manual Throttles

a) NORMAL Throttle Mode:

The Autopilot follows the route with heading adjustments by rudder steering. Thrusters will not be used. That works satisfactorily on sail boats with deep keel and little leeway. Positive forward speed is required to keep the crab angle within reasonable limits.

b) SLOW Mode:

Thrusters will be used by the Autopilot to assist in Heading control and also for pushing the vessel sideways.

The amount of commanded lateral thrust is proportional to the cross track error XTE.

There is no automatic XTE-deadband, and frequent thruster use may be expected in unstable conditions.

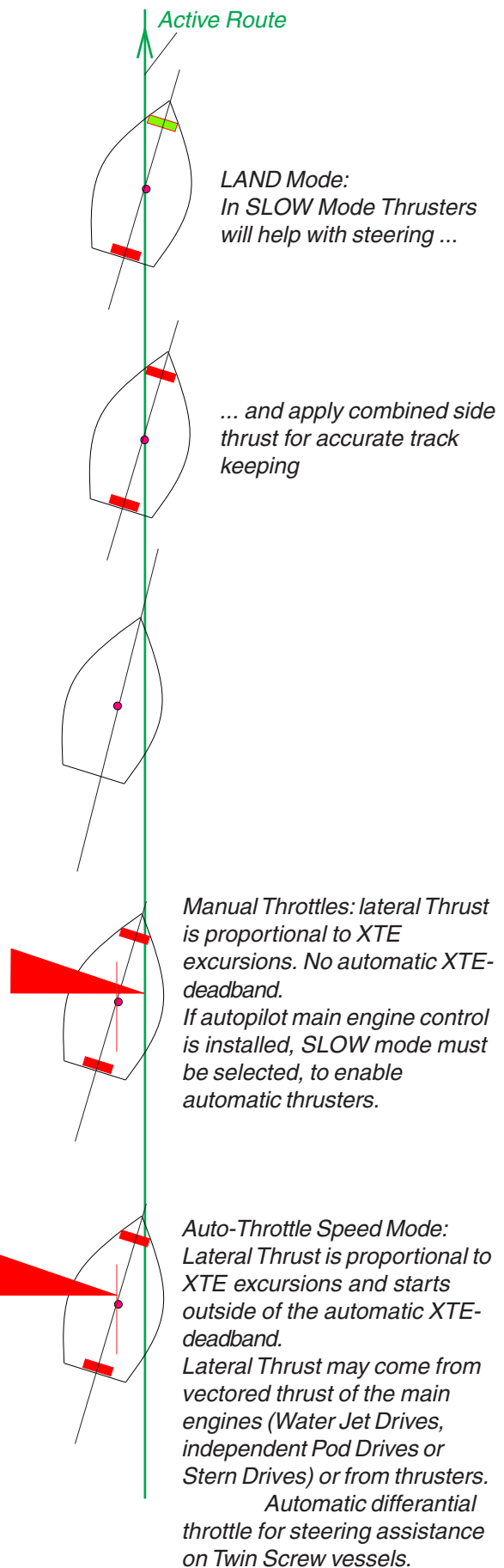
Track keeping tolerance is expected to remain within 0.5 meter, conditions permitting.

LAND Mode with Auto Throttle (Speed Mode)

Steering by rudder and thrusters similar to manual throttles in SLOW Mode, yet with automatic differential throttle for steering assistance on Twin Screw vessels.

An automatic cross-track deadband is applied.

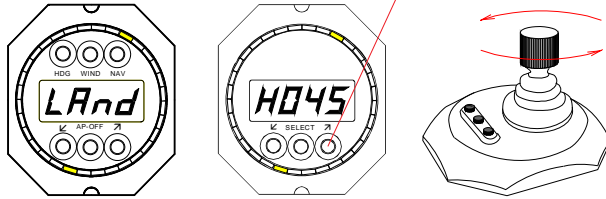
Track keeping tolerance is expected to remain within 0.5 meter, conditions permitting.



SLIDE Mode (with LAND)

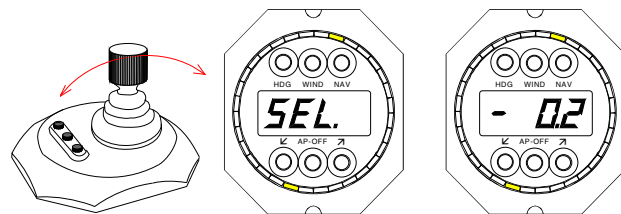
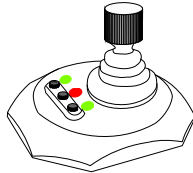
SLIDE is similar to LAND Mode with Auto Throttle. In addition it permits unrestricted heading control, while following the route. Lateral thrust must be available. Sideways speed is taken into account, similar to HOVER Mode. Track keeping tolerance is expected to remain within 0.25 meter, conditions permitting.

Heading selection is identical to Turn Rate Mode. It is done by twisting the Joystick, or by changing the selected heading on a Heading Display or on a Wireless Remote.

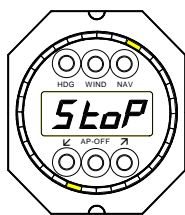


SLIDE Mode can be engaged by twisting the Joystick, while in LAND Mode, when Speed Mode is already active, or on the Wireless Remote, by pressing both arrow buttons (<>) together.

SLIDE Mode is displayed by marching LEDs on the Joystick (1-2-3 1-2-3 ...)



Select "Along Track Speed" with the Joystick.

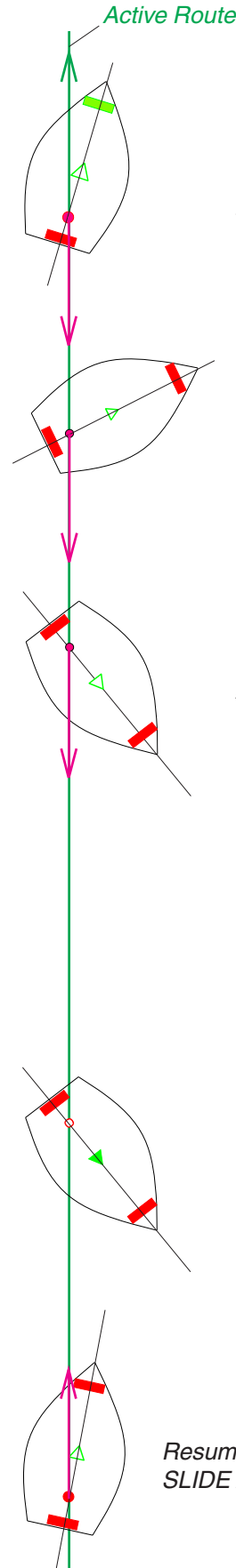


Selecting Ground Speed zero from LAND or TRACK Mode (with or without SLIDE) will activate the STOP Mode (if lateral thrust is available). SLIDE Mode will be active again when selecting speed other than zero.

To cancel SLIDE Mode (with LAND)

To cancel SLIDE Mode and to keep autothrottles engaged, either press SPD on the wireless remote, or press HDG twice, first is for TRACK-slide, second is for HDG Mode, which is always without SLIDE.

Engaging Manual Throttles will also cancel SLIDE.



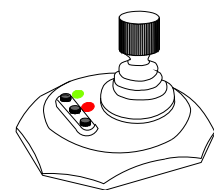
Within available thrust limits, the route is followed precisely ...

... at the Selected „Along-Track“ Speed

▲ ▲ Hover Pivot Point
Antenna Offset
● ○ Antenna position
active / inactive

- negative selected speed
+ positive selected speed

Selected Speed refers to „Along Track Speed“ in the sense of the Route and may be negative as well.



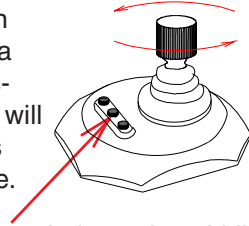
STOP Mode is displayed by alternating LEDs on the Joystick (1-2-1-2 ...)

Resume normal LAND Mode, when SLIDE is no longer needed.

STOP Mode

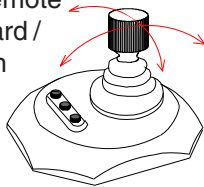
Present position is maintained in STOP Mode, same way as in Hover Mode.

Twisting the Joystick in STOP Mode or selecting a different heading on a Display or Wireless Remote, will turn the vessel around its Pivot Point in Hover Mode.

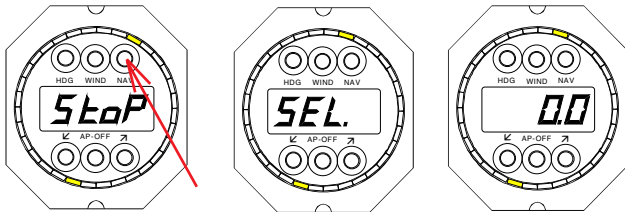


When side stepping is needed, use the middle button to switch into **HOVER Mode**. Heading control may then be transferred from the Joystick to the Wind Mode or Heading Mode (on the AP-Display or Wireless Remote), or to the Turn Rate Mode on a Throttle Station, when desired.

Use the Joystick or Wireless Remote to manually walk sideways or forward / aft, or for changing the heading in HOVER Mode.

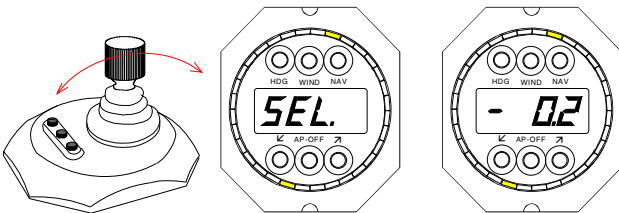


Stepsize can be selected in the setup as multiples of feet.

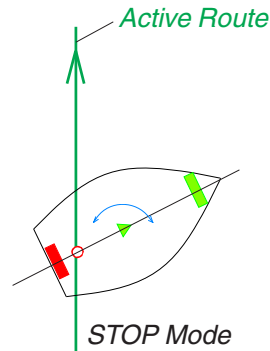


After "walking" back to the Route in HOVER Mode, use the NAV button to engage LAND with SLIDE, when coming within 11 m (0.006 NM) of the Route. The Route has to be active in the Plotter. The Display shows STOP and Selected Speed zero when LAND becomes active.

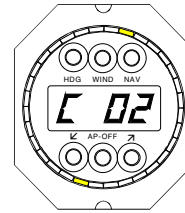
Resume SLIDE



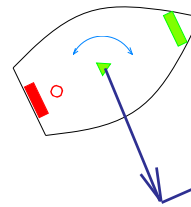
Select desired "Along Track Speed" with the Joystick to resume SLIDE.



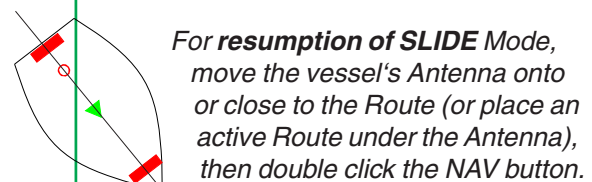
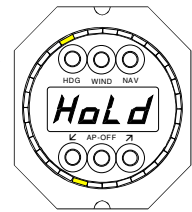
▲ ▲ Hover Pivot Point Antenna Offset
● ○ Antenna position active / inactive



When Hover becomes active, „C“ shows briefly the Hover Precision Level (setting see page 10)



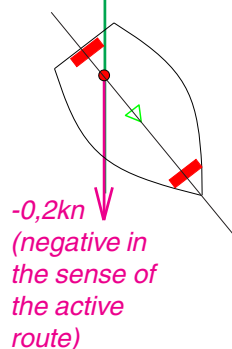
HOVER Mode:
walk stepwise



For resumption of **SLIDE Mode**, move the vessel's Antenna onto or close to the Route (or place an active Route under the Antenna), then double click the NAV button.

Heading will not change when the LAND Mode is accessed out of HOVER Mode.

If the Antenna is not within 0.006 NM of the route, LAND will not become active and HOVER with present position will be maintained.



When Selected Speed becomes other than zero, the STOP Mode switches into SLIDE Mode and the Antenna is pulled exactly over the Route. The vessel advances along the Route, with the Selected Speed.

TRACK Mode

The vessel follows the selected Ground Course (GPS-Course).

Engaging the TRACK Mode:

With Manual Throttles, TRACK Mode is available when Ground Speed is at least 1kn. On the AP-Display press the HDG Button in HDG Mode, to switch from HDG into TRACK Mode, or use the TRK button on the Wireless Remote. When Speed Mode is active, TRACK Mode can be engaged at any speed.



Track selection is similar to HDG selection. Initial Selected Track is taken from actual track. To engage Track Mode out of HOVER Mode, select HDG with Hover and press HDG again, or use the TRK button on the Wireless Remote. Initial Selected Track is taken from actual heading, when in HOVER Mode.

SLIDE (with TRACK) can be engaged by twisting the Joystick, while in TRACK Mode, when Speed Mode is already active.

On the Wireless Remote press both arrow buttons together (<>), to activate SLIDE. Use double arrow buttons to change heading (<<) and single arrow buttons to change track (<), when SLIDE is active.

From LAND+SLIDE to TRACK+SLIDE:

When SLIDE or STOP is active in LAND Mode, then TRACK Mode will be available directly with the HDG Button on the Autopilot Display. The vessel will slide along the selected TRACK instead along the Route. On the *Wireless Remote* use the TRK button.

Any positive or negative Selected Speed is possible.

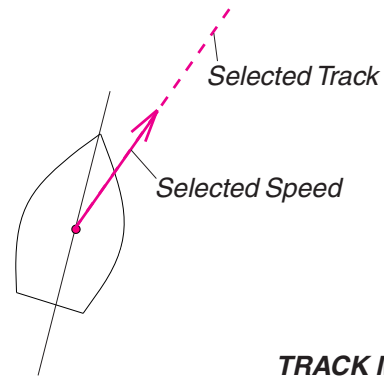
From TRACK+SLIDE to LAND+SLIDE:

Double click the NAV button, when in TRACK-SLIDE. **If** the cross track error XTE is less than 0.0060NM (11m), the LAND Mode will engage and guide the vessel along the route, while SLIDE remains active. Magnitude and sign of the selected speed will not change.

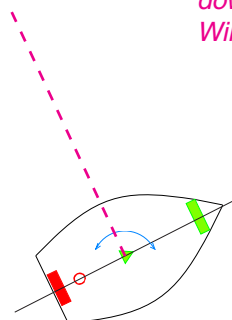
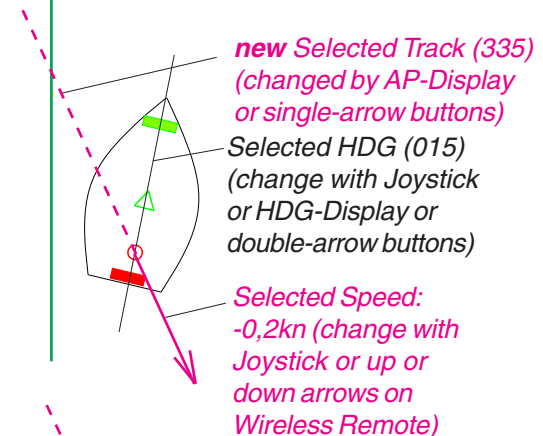
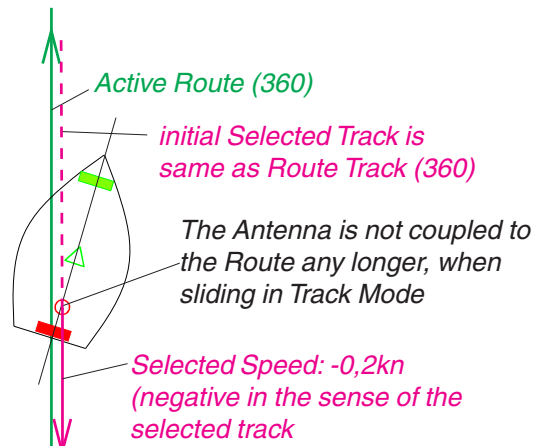
From TRACK with or without SLIDE to STOP:

When reducing Selected GND Speed to zero, STOP Mode becomes active. Present position is maintained like in Hover Mode.

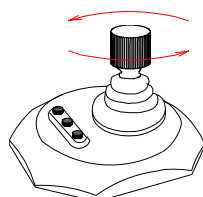
In STOP Mode, selected TRACK, HDG and Speed can be changed like in SLIDE Mode.



TRACK Mode



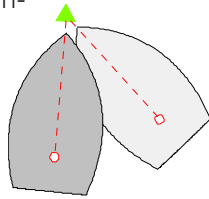
STOP Mode



To cancel SLIDE Mode and to revert to normal TRACK Mode, press SPD on the Wireless Remote, or engage Manual Throttles, or exit TRACK by selecting HDG briefly. A compatible speed should be achieved prior doing this.

Anchor Mode

The vessel is pointed automatically towards a virtual buoy, while distance is maintained constant. Sideways motion capability is not required, only turning capability at standstill is needed. Thrusters will not be used on Twin Screw vessels.



Anchor Mode can be engaged with a **separate Anchor Button** (connected to a Display unit or Fly-By-Wire Throttle Station), or with the Wireless Remote.

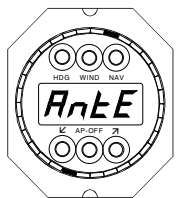
Anchor Mode will be engaged automatically, if the vessel configuration provides no Hover capability, when Hover Mode is selected.

Line length to the virtual buoy (from the GNSS antenna) is preset to 12m and can be altered on the Autopilot Display when Anchor Mode is active. Any negative number in the Antenna Offset will make a virtual Anchor buoy at 12 m towards the stern, when selecting Anchor Mode.

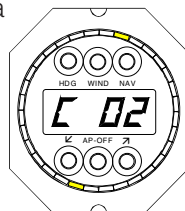
Thrusters may be switched off in Anchor Mode with the OFF Button on the Display, or turned on again with the Anchor Button.

Antenna Offset in Hover Mode

It is possible to adjust the Hover pivot point relative to the GNSS antenna. This has to be done on the "Antenna Display" while **Hover Mode is not active**.



An Antenna Offset zero (C 00) will place the pivot point at the antenna position. A positive offset (e.g. C 05) will place it 5m from the antenna, towards the bow.



towards the bow.

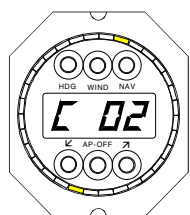
Special function: an offset C 01 activates Water Speed to be used for Selected Speed, when this is compatible with the Autopilot Mode.

Hover Precision Level

It is possible to influence the accuracy of keeping the Hover Point position. Level-3 is strongest, it uses more power, Level-1 is softest.

Level change is (only) possible on the "Antenna" Display **while Hover is active**.

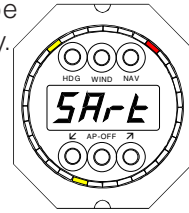
Level-2 is the recommended standard setting. See page 10 for more details.



AIS MOB and SART mode

When an AIS SART or MOB beacon is received, the autopilot starts beeping (short double beeps), the red NAV LED flashes and engines automatically go into idle and out of gear (once, at first signal). Optionally, yachts can also be turned into the wind automatically.

If the MOB beacon sends its first signal immediately after activation, even before it has got a GPS fix, the vessel might only be 15 seconds away, until other crew members on board will be alarmed - long before the MOB target is shown on a plotter.



After the beacon sends its position, the digital display shows bearing and distance to the target and a message "SART" is flashing.

If the alarm tone is not cancelled, automatic target tracking will start one minute after first reception. Automatic tracking can be disabled in the setup. Tracking may be activated any time with the red flashing NAV button. Initially the vessel turns towards the target and accelerates up to 6 kn, depending on the distance.

The Autopilot will reduce speed and comes to a halt at relative speed zero in front of the target, at 30 m (100 ft) distance to the vessel's GNSS antenna. It will stay out of gear as long as the target remains within 0.03 NM (50 m or 170 ft), to permit a safe recovery. If the target drifts farther away, the Autopilot will home in again.

The automatic maneuver can always be interrupted by taking manual throttles or also manual helm. It may be reengaged anytime with the the red flashing NAV-button.

Without the installed Autothrottle System, manual throttles must be used.

To let the Autopilot recognize an MOB situation, the MMSI numbers of the on board SART and MOB beacons must first be inserted in the Autopilot Target List.

A plotter is not required. If available, it can show the AIS SART or MOB target, and in addition a green ARPA (radar) target, which represents the MOB position calculated and used by the autopilot for AIS-tracking.

The normal NAV or LAND mode is not available as long as an AIS SART or MOB target from the Autopilot Target list is active.



Note:

There is no automatic MOB or SART tracking out of Hover Mode.

Understanding the MOB mode

An AIS MOB beacon (target) reports its position in bursts with one minute interval. When reception is weak, the period can be longer.

The autopilot calculates average target speed and direction from two position reports, which are at least one minute apart. The resulting accuracy is better than 0.1 kn. That is better than using the transmitted instant target speed, which may be a couple knots different from average speed.

During every one minute silence of a target, the autopilot must **plot and update** the target position **every second**. With the calculated average target speed, the position error will be smaller than 2 m (6 ft.) during the one minute silence.

Be aware, the autopilot will return to this moving target and hold at an antenna distance of 30 m - the reason why we must have an accurate plot every second!

A reasonable assumption is that the MOB does not change speed.

It may however drift with a steady current, even at 0.1NM per minute in the Gulf Stream, as long as there is no rapid change of speed.

Testing the MOB mode

Having said the above, consider the following when testing with a dinghy. After the dinghy has stopped, **it must not change speed and direction at all**, similar to a submerged floating bucket or a person in the water.

If the beacon has been transmitting already, while the dinghy was moving, plotting of the target will be accurate only after the dinghy has stopped for two minutes.

Triggering the beacon from a dock is an option which can guarantee a steady target speed.

On Twin Screw vessels and also with Single Water Jet drives, turning back towards the beacon in MOB mode is done at zero forward speed, by use of the engines. The vessel is accelerated up to 6 kn relative speed, once it is roughly on course to the target.

Single screw vessels are accelerated early up to 6 kn, to facilitate turning. Thrusters are used for assistance, when available.

If the vessel is unable to maneuver directly in front of the target due to limited thruster or rudder or throttle effectiveness, the autopilot may go out of gear at any position within 0.03 NM (55 m) of the target.

It will also go out of gear before a position at 30m could be stabilized, when distance inadvertently has decreased to less than 20m (0.01NM).

Suggested exercise

Put your vessel into gear and choose any suitable speed, the autopilot may be off or on. Let the MOB trigger the beacon when distance to your vessel is 100 m (300 ft.) or greater. Otherwise the autopilot may stay out of gear without returning, when the target is close, within 0.03 NM.

Practical reception range of an MOB beacon is about 2 NM.

With an S10 or S20 beacon, the first signal is received 15 seconds after triggering the beacon. The autopilot goes into Neutral and out of gear.

If the alarm is silenced, or any autopilot button is touched, the automatic MOB mode is interrupted. It may be reactivated any time with the red flashing NAV button.

Roughly a minute later the beacon should start reporting its position. The autopilot will have a valid target speed a minute after that. If the automatic MOB mode has been enabled in the autopilot setup, the vessel will return to the target, but not earlier than one minute after the MOB alarm came on. It will stop at 30 m antenna distance from the target.

On yachts the autopilot may be set up to turn into the wind one minute after the MOB alarm comes on. When the vessel is ready to change course, the MOB return can be activated with the NAV button.

When required to avoid traffic or obstacles, take manual throttles and manual helm (THR and SERVO). When clear, use the NAV button to engage the MOB mode again.

At the Tecnautic Autopilot Display or Multi Function Display, select course or distance to the target.

On a Plotter monitor the MOB target (green round dot). That represents the accurate plotted position. The Plotter may offer his own plotted MOB target, which may jump rather erratically.

Important:

Pressing the THR button at the Throttle Station lets you take manual throttles, while the autopilot is still steering towards the MOB target. Use the NAV button to reengage the Autothrottle.

The normal NAV or LAND mode is not available as long as an MOB alarm is active. The NAV button then works for the MOB mode only.

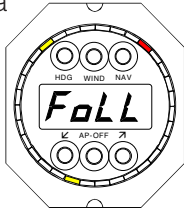
An active MOB alarm is cleared automatically in the autopilot after reception of the beacon has seized for five minutes.

FOLLOW mode (automatic tracking behind another vessel)

Smart Phone Remote Control App

This is an Android Version.

Enable AIS or ARPA target data recognition by pressing FOLLOW on the Android Remote, or press NAV and HDG together on the Autopilot-Display, starting with the NAV button.



The red NAV LED starts flashing, indicating that NAV data will come from a target instead a waypoint. To disable the FOLLOW Mode, use the same button again.

Target ID of the vessel to follow (i.e. the MMSI number) must be inserted in the first line of the Autopilot Target List. Verify target bearing and distance on a Tecnautic NAV Display or on a Plotter.

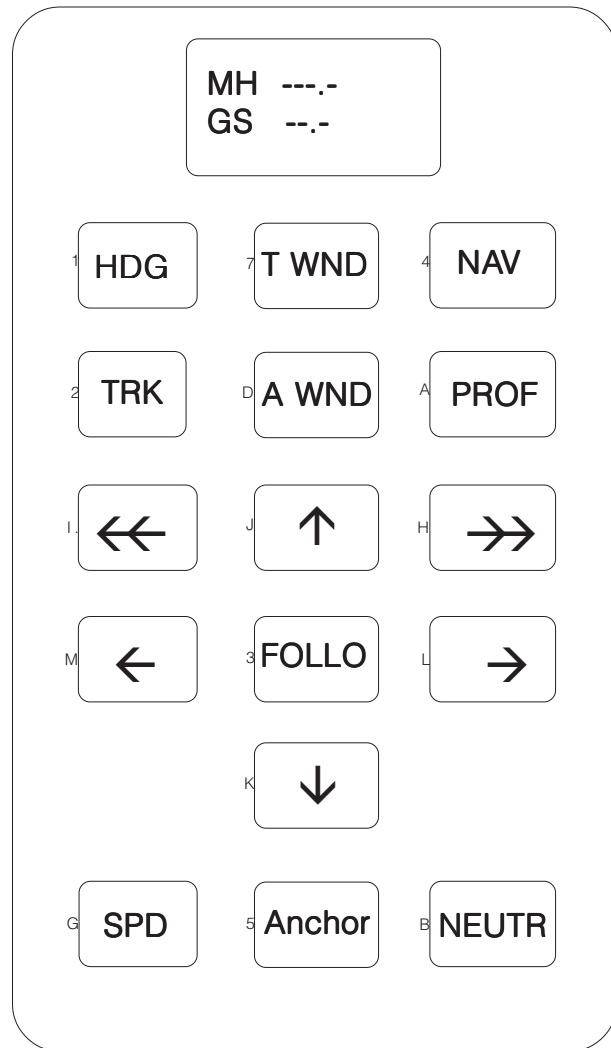
Engage the autopilot FOLLOW mode by pressing the NAV button while the NAV LED is flashing red.

Either use manual Throttles for speed control, or press PROFILE or SPD to activate Autothrottles, which will maintain zero closing speed. A different closing speed can be selected on the Remote or with the Joystick, it then pops up on the Autopilot Display.

Press PROFILE once more to arm for target capture: this feature is for synthetic targets, rather than real ones. If PROFILE is displayed when the target comes within 0.03 NM, the target will be captured and a GNSS antenna distance of 30 m will be maintained. That distance may be reduced when selecting "Antenna" on a Tecnautic Display to modify the distance.

Note:

FOLLOW mode will be interrupted when a SART or MOB target from the list becomes active.



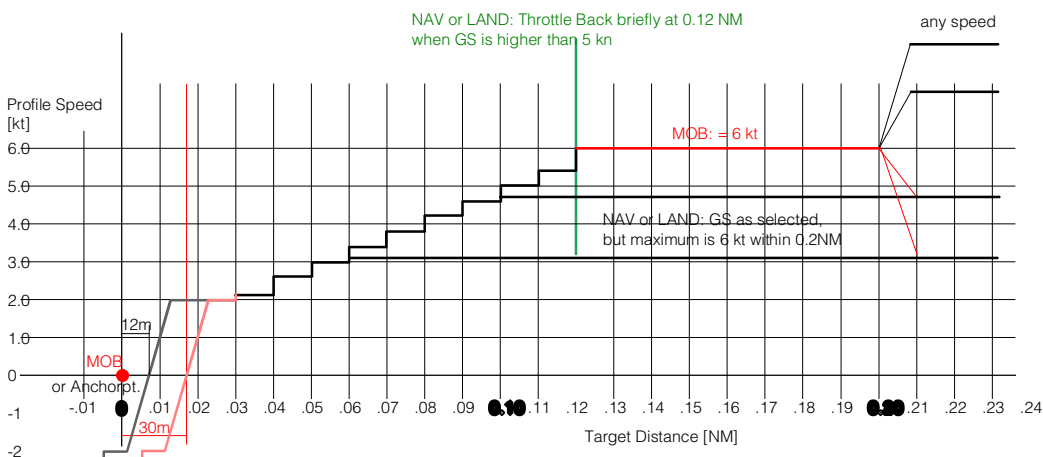
Appendix A

Speed Profile in NAV or LAND Mode with waypoint capture in Anchor Mode (12 m antenna distance)

Speed Profile in MOB Mode in red (for stopping at 30 m distance from GNSS antenna)

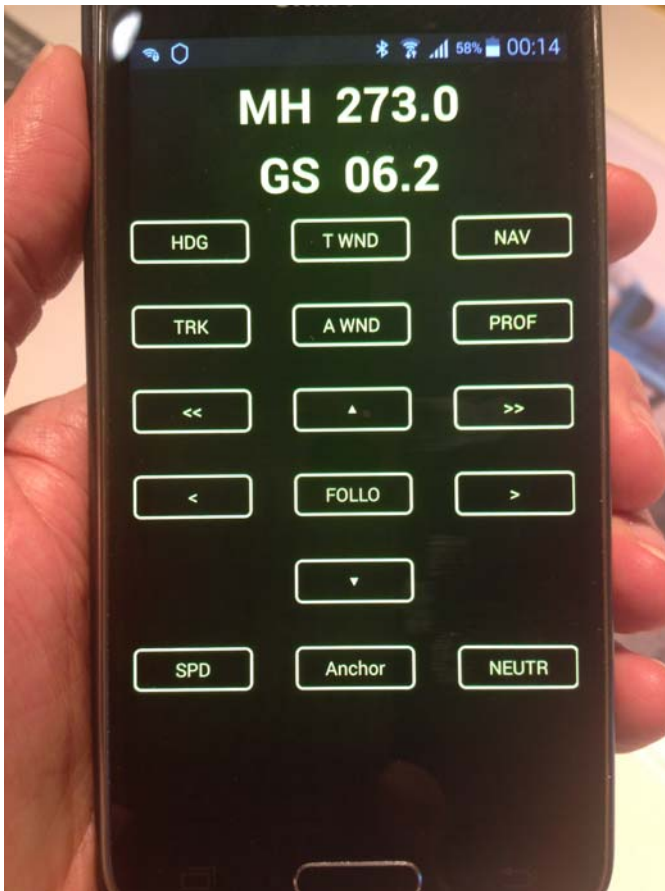
Ground Speed is used in NAV or LAND Mode

Relative Target Speed in MOB Mode



Smart Phone Remote Control App

This is an Android Version.



Remote Control by Smartphone

Button Functions

HDG	engage HDG Mode
TRK	engage Ground Track Mode
T WND	engage True Wind Mode
A WND	engage Apparent Wind Mode
NAV	engage Nav, Land or Follow Mode
PROF	engage Profile Mode
<<	a) in HDG, TRK, WND or TR Mode: -10° b) in SLIDE Mode: -1° Heading
>>	a) in HDG, TRK, WND, TR Mode: +10° b) in SLIDE Mode: +1° Heading
<	a) in HDG, TRK, WND or TR Mode: -1° b) in Hover or Anchormode: 1 ft. to port
>	a) in HDG, TRK, WND or TR Mode: +1° b) in Hover or Anchormode: 1 ft. to stbd
< + >	a) in TRK or LND: engage SLIDE b) in WIND Mode: Tack or Jibe
↑	a) in SPD Mode: +0.2 kn b) in Hover or Anchor Mode: 1 ft. ahead
↓	a) in SPD Mode: -0.2 kn b) in Hover or Anchor Mode: 1 ft. astern
FOLLO	switch: Follow or Nav/Land Mode
SPD	engage Speed Mode
Anchor	engage Anchor Mode
NEUTR	Engines to Neutral



Jumbo Landscape (Galaxy Tablet)



Jumbo Portrait (Galaxy Tablet)

Mode Reaction

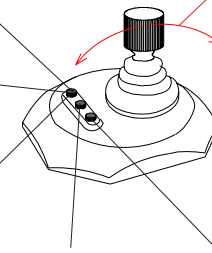
Previous Mode	action or event	New Mode resulting
LAND+SPD	THR button at Throttle Station	LAND+ manual throttle
HDG+SPD Selectd.Spd = 0	LAND (4 times NAV button)	LAND+ STOP
STOP <i>LAND or TRK</i> or SLIDE	THR button at Throttle Station	HDG + *) manual throttle
STOP <i>LAND or TRK</i> or SLIDE	THR button at Joystick	manual *) Joystick
STOP <i>LAND or TRK</i>	SERVO (at any station)	HOVER + Turn-Rate
SLIDE <i>LAND or TRK</i>	SERVO (at any station)	Speed + *) Turn-Rate
STOP <i>LAND</i>	route data interrupted	HOVER + HDG
LAND+SLIDE LAND+STOP	1xHDG button	TRK+SLIDE TRK+STOP
TRK+SLIDE TRK+STOP	2xNAV button (XTE < 0.006nm)	LAND+SLIDE LAND+STOP
HOVER	2xNAV button (XTE < 0.006nm)	LAND+STOP
HOVER+HDG	HDG button	TRK+STOP
TRK+SPD	THR at station (spd < 0,5kn)	HDG+manual throttle
HOVER or ANCR	SPD button	HDG + SPD *)

Joystick Station Transfer

Depending on the operating Mode, different actions are required for transfer from one Joystick to another Joystick.

SERVO button:

- 1) Transfer of an active Anchor or Hover Mode
- 2) in STOP Mode: selection of Hover (with Turn Rate Mode)
- 3) other modes: Selection of Speed Mode (with Turn Rate Mode)



Transfer of Speed, SLIDE or STOP Mode (for transfer to Throttle Station move rear Thruster Toggle or Joystick, then use FBW wheel for HDG control)

AP button:
Selection or Transfer of Hover Mode

THR button:
Selection or Transfer of Joystick Mode

From TRK+SLIDE or TRK+STOP or from Hover: LAND mode is captured when xte is less than 0,0060nm (11m). Outside of that range the LAND mode remains armed, with a red NAV-LED.

**) Attention - vessel may start drifting!*

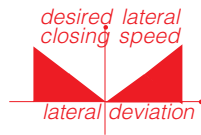
Control laws

Lateral control

Lateral Thrust is a function of lateral closing-speed error

Stop or Slide Mode

- No lateral deadband.

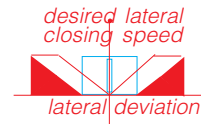


Anchor, MOB or Follow

- No lateral thrust used.
- Instead, Heading Control in SLOW Mode towards position of Anchor Point or Target

LAND with Speed Mode

- Automatic lateral Deadband. +/-1...+/-11 ft.



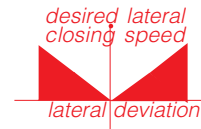
LAND, manual Throttle

- No lateral Deadband



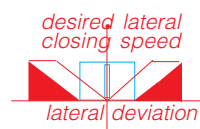
Hover Level 3:

- No lateral deadband



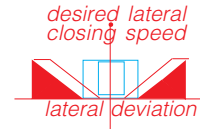
Hover Level 2:

- Automatic lateral Deadband. +/-1...+/-11 ft.
- desired closing speed is zero inside deadband



Hover Level 1:

- Automatic lateral Deadband. +/-5...+/-11 ft.
- closing speed ignored inside deadband



Precision Level

While Hover is active, Level Change is made on "AntE" Display. The selected level is reflected briefly also on AP-Display.

Longitudinal control

Longitudinal Thrust is a function of longitudinal closing-speed error

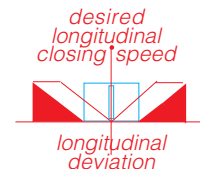
Stop or Slide Mode

- No longitudinal deadband.



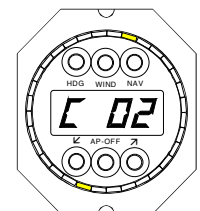
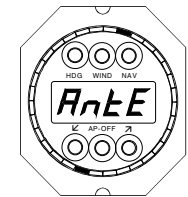
Anchor, MOB, Follow Level=2..3

- Automat. longitudinal Deadband. +/-1...+/-7 ft.
- desired closing speed is zero inside deadband



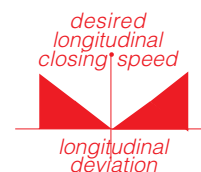
LAND with Speed Mode

- Automatic GND Speed Deadband.



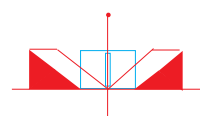
Hover Level 3:

- No longitudinal deadband.



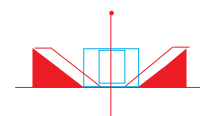
Hover Level 2:

- Automat. longitudinal Deadband. +/-1...+/-7 ft.
- desired closing speed is zero inside deadband



Hover Level 1:

- Automat. longitudinal Deadband. +/-3...+/-7 ft.
- desired closing speed is zero inside deadband



Anchor, MOB, Follow Level 1

- Automat. longitudinal Deadband. +/-3...+/-7 ft.
- desired closing speed is zero inside deadband

