

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

April 10, 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.

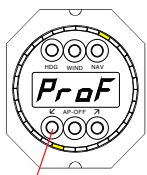
Autopilot XTE resolution is 0.0001NM (7 inches) in **LAND** Mode, or 0.001NM (6 ft.) in **NAV** Mode.

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

Profile Mode

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

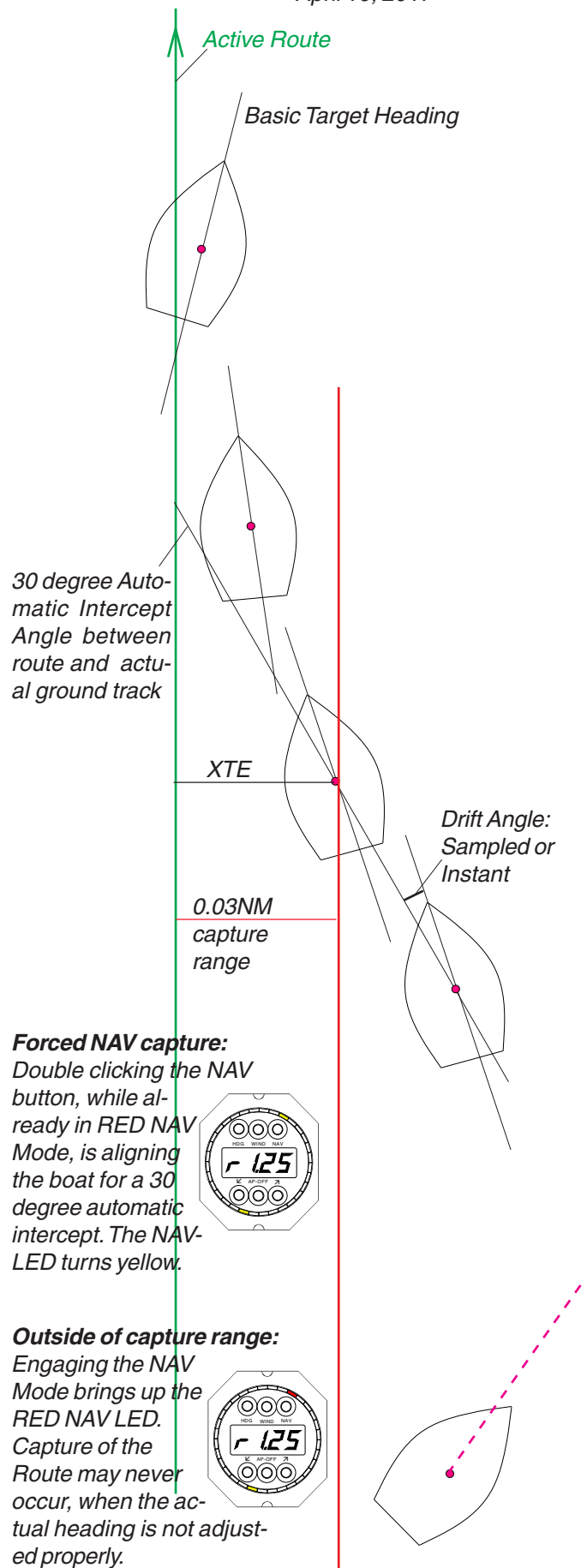
When selecting PROFILE, the vessel will slow down and come to a halt in ANCHOR Mode at the upcoming waypoint. Speed reduction will start as a function of distance and speed (page 7).



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 modifying the *Selected Speed* or by engaging Manual Throttle or by changing the Autopilot Mode.



30 degree Automatic Intercept Angle between route and actual ground track

XTE

0.03NM capture range

Drift Angle: Sampled or Instant

Forced NAV capture: Double clicking the NAV button, while already in RED NAV Mode, is aligning the boat for a 30 degree automatic intercept. The NAV-LED turns yellow.

Outside of capture range: Engaging the NAV Mode brings up the RED NAV LED. Capture of the Route may never occur, when the actual heading is not adjusted properly.

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 XTE precision of 0.0001NM (0.2m).



A GNSS position sensor with a 0.0001NM (0.2m) 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.

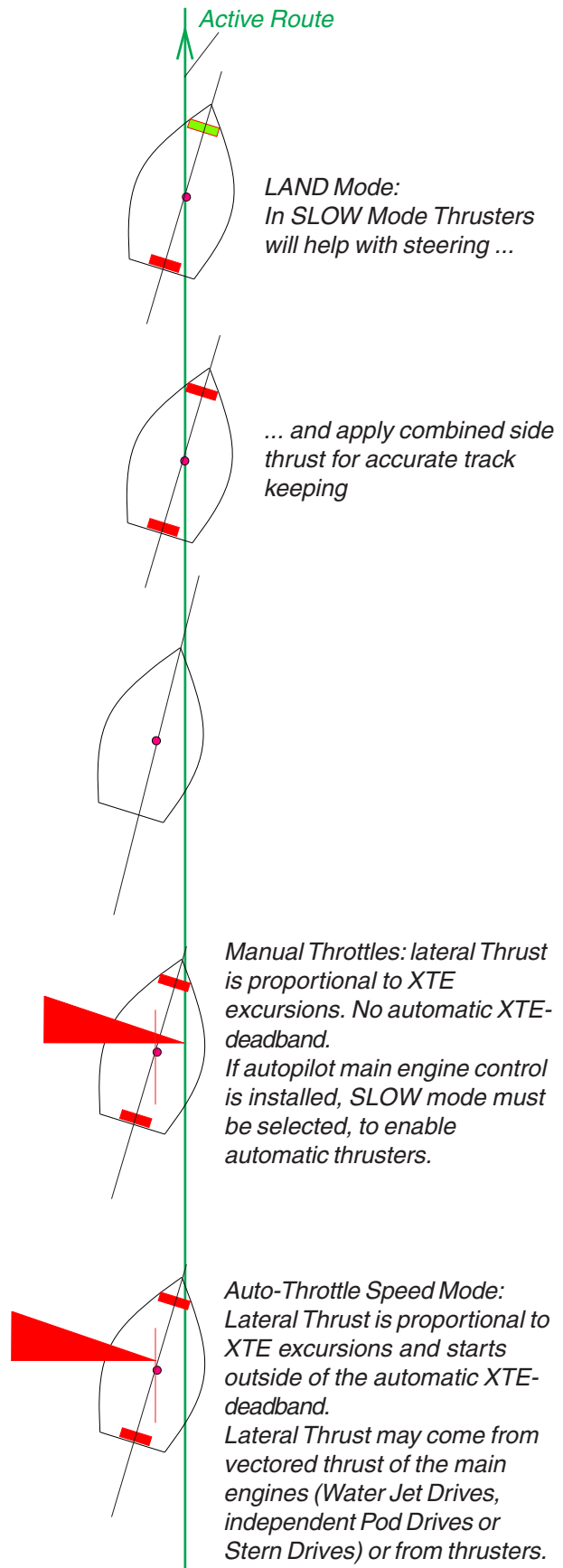
Track keeping tolerance is expected to remain within 0.5 meter, conditions permitting.

LAND Mode with Auto Throttle (Speed Mode)

Steering similar to manual throttles in SLOW Mode, yet with automatic differential throttle for heading assistance.

An automatic cross-track deadband is applied.

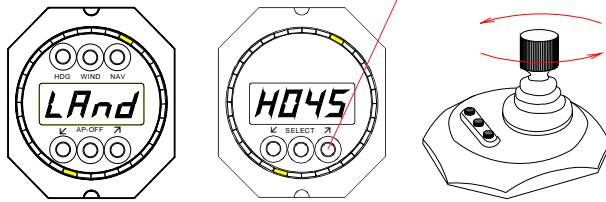
Track keeping tolerance is expected to remain within 0.5 meter, conditions permitting.



SLIDE Mode (with LAND)

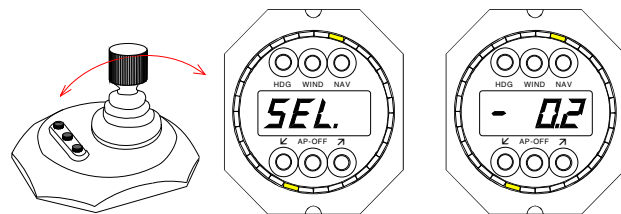
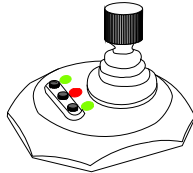
SLIDE is similar to LAND Mode with Auto Throttle. In addition it permits unrestricted heading control, while following the route. Lateral thrust must be available. Sideways speed is taken into account, similar to HOVER Mode. Track keeping tolerance is expected to remain within 0.25 meter, conditions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

Heading selection is identical to Turn Rate Mode and 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 ...)



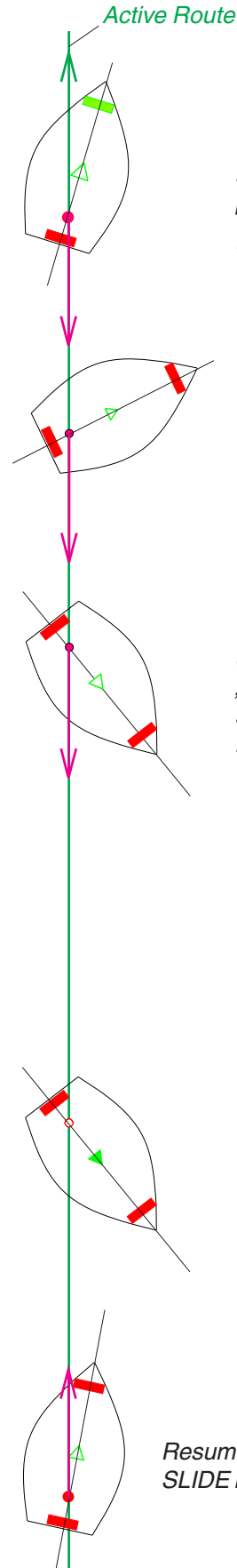
Select "Along Track Speed" with the Joystick



Selecting Speed zero from LAND or TRACK Mode (with or without SLIDE) will activate the STOP Mode. SLIDE Mode will be active again when selecting any speed other than zero.

To cancel SLIDE Mode (with LAND)

To cancel SLIDE Mode and to revert to any other desired mode, either engage Manual Thrusts, or in order to remain in Speed Mode, press HDG twice, first is for TRACK-slide, second is for HDG Mode, which is always without SLIDE.



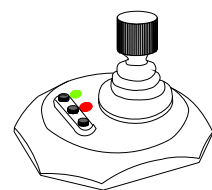
Within available thrust limits, the route is followed precisely ...

... 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.



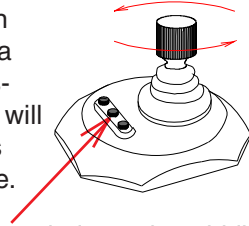
STOP Mode is displayed by alternating LEDs on the Joystick (1-2-1-2 ...)

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

STOP Mode

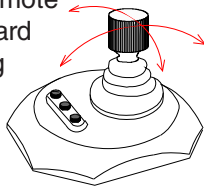
Present position is maintained in STOP Mode, same way as in Hover Mode.

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.

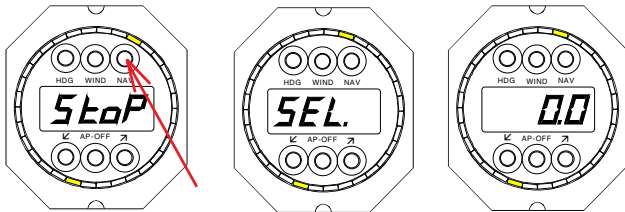


When side stepping is needed, use the middle button to switch into **HOVER Mode**. Heading control may then be transferred from the Joystick to the Wind Mode or Heading Mode (on the AP-Display or Wireless Remote), or to the Turn Rate Mode on a Throttle Station, when desired.

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

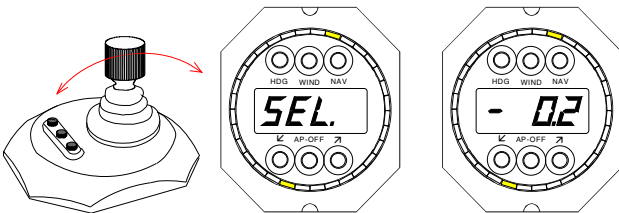


Stepsize can be selected in the setup as multiples of feet.

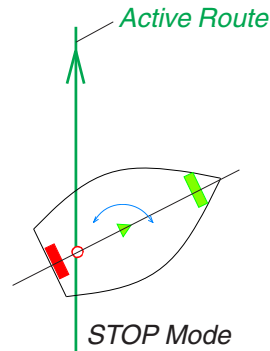


After "walking" back to the Route in HOVER Mode, use the NAV button to engage LAND and SLIDE when coming within 11 m (0.006 NM) of the Route. The Route has to be active in the Plotter. The Display shows STOP and Selected Speed zero when LAND becomes active.

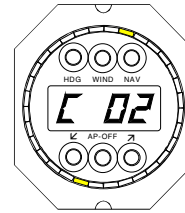
Resume SLIDE



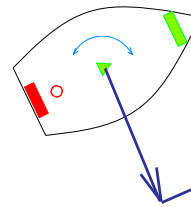
Select desired "Along Track Speed" with the Joystick to resume SLIDE.



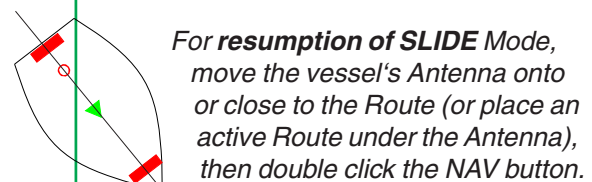
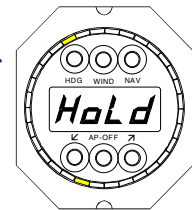
▲ ▲ Hover Pivot Point Antenna Offset
● ○ Antenna position active / inactive



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



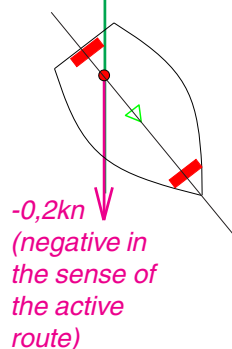
HOVER Mode:
walk stepwise



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 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.

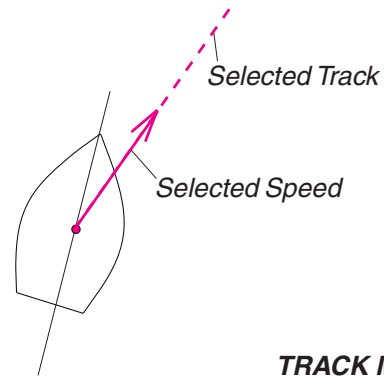
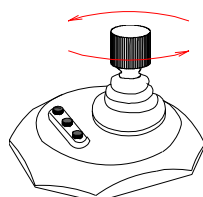
From TRACK+SLIDE to LAND+SLIDE:

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.

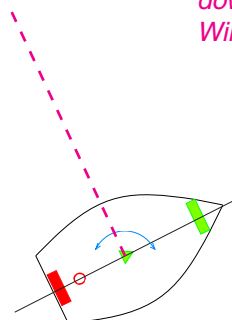
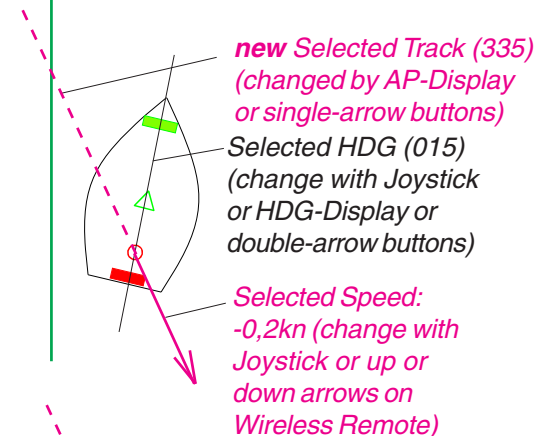
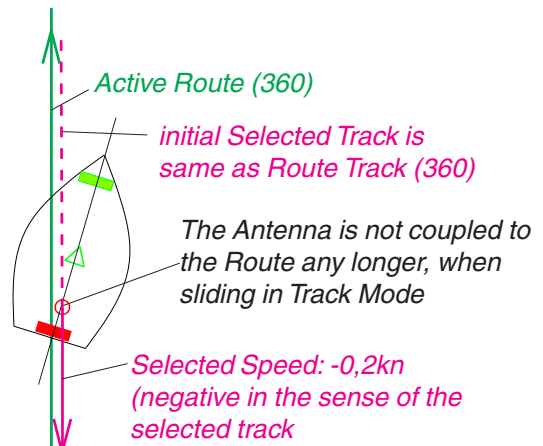
From TRACK with or without SLIDE to STOP:

When reducing Selected 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

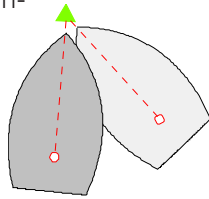


STOP Mode

To cancel SLIDE Mode and to revert to normal TRACK Mode, 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.

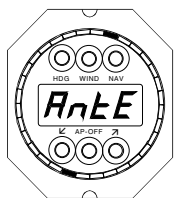
Anchor Mode will be engaged automatically, if the vessel configuration provides no Hover capability, when Hover Mode is selected.

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.



Hover Precision Level

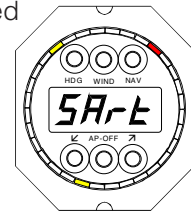
It is possible to influence the accuracy of keeping the Hover Point position. Level-3 is strongest, it uses more power, Level-1 is softest. Level change is (only) possible on the "Antenna" Display **while Hover is active**.



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 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 the plotter.

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

If the alarm tone is not cancelled, automatic target tracking will start one minute after first reception. The automatic mode can be disabled in the setup, but 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 distance.

The Autopilot will reduce speed and come to a halt at relative speed zero in front of the target, at 30 m (100 ft.) distance of the vessel's GNSS antenna. It will stay out of gear as long as the target remains within 50 m (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 controls. 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 be inserted in the Autopilot Target List.

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

Route data from the plotter are not available as long as an AIS SART or MOB target from the Autopilot Target list is active.

Note:

There will be no automatic MOB or SART tracking out of Hover or Anchor Mode.

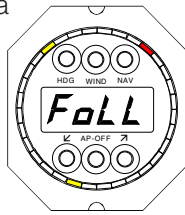


FOLLOW mode (automatic tracking behind another vessel)

Smart Phone Remote Control App

This is an Android Version.

Enable AIS or ARPA target data 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 (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.

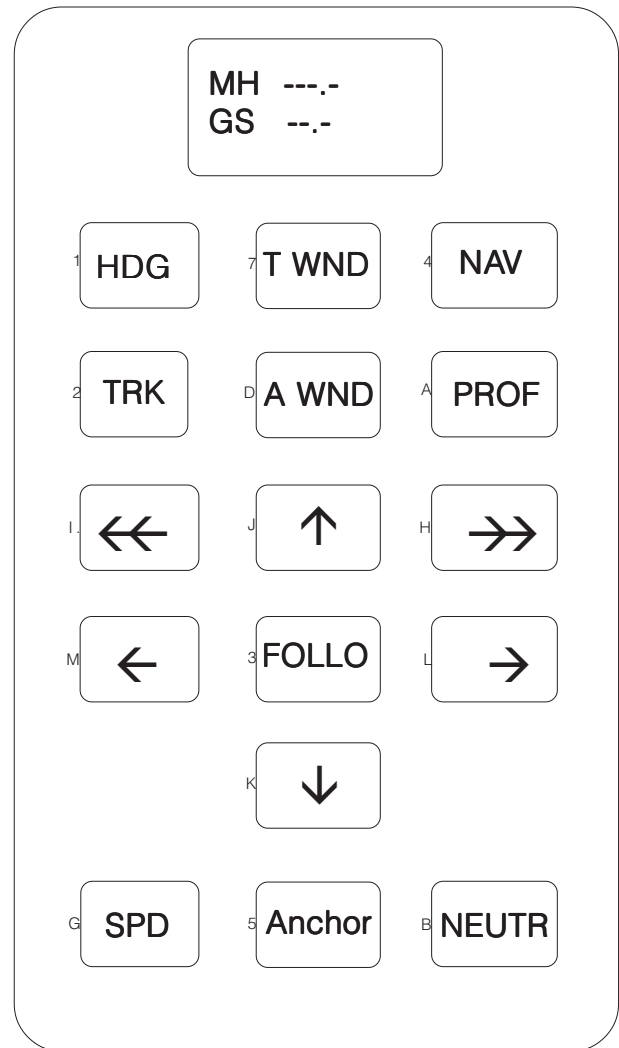
Engage the autopilot FOLLOW mode by pressing the NAV button while the NAV LED is flashing red.

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.



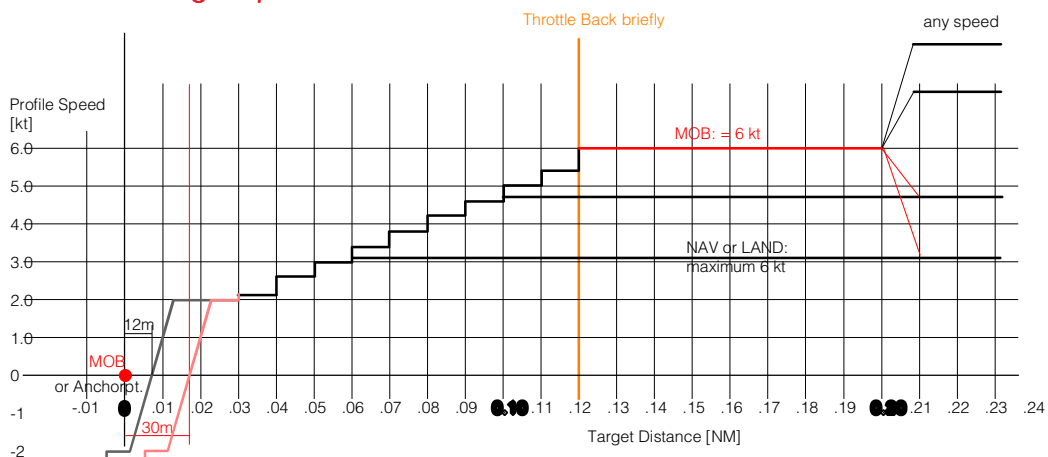
Appendix A

Speed Profile in NAV 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)

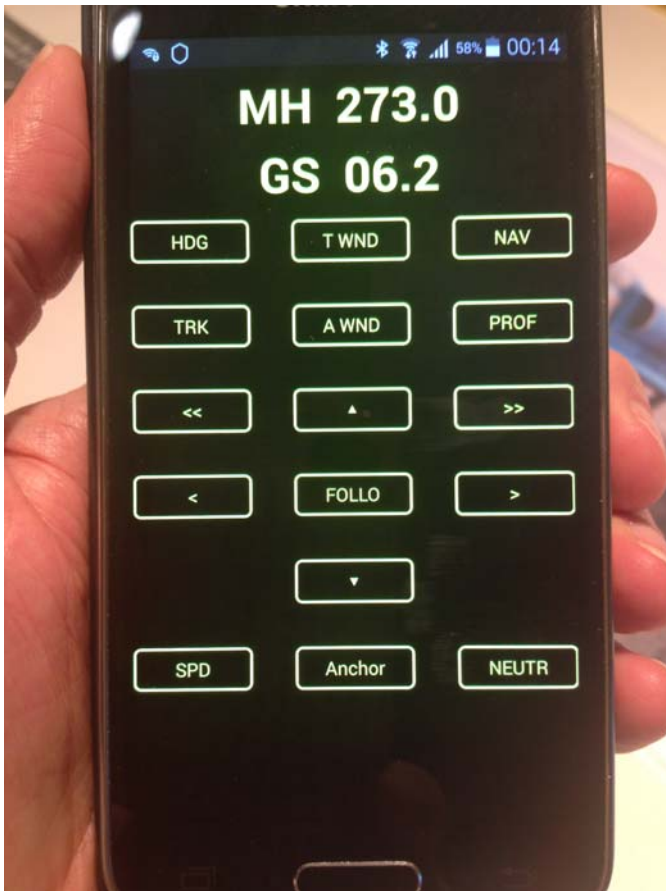
Ground Speed is used in NAV Mode

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

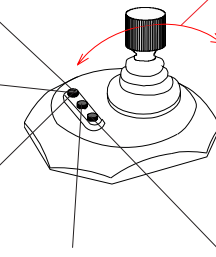
Previous Mode	action or event	New Mode resulting
LAND+SPD	THR button at Throttle Station	LAND+ manual throttle
HDG+SPD Selectd.Spd = 0	LAND (4 times NAV button)	LAND+ STOP
STOP <i>LAND or TRK</i> or SLIDE	THR button at Throttle Station	HDG + *) manual throttle
STOP <i>LAND or TRK</i> or SLIDE	THR button 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)



AP button:
Selection or Transfer of Hover Mode

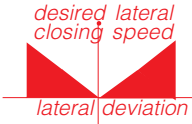
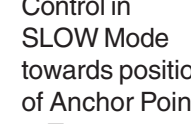
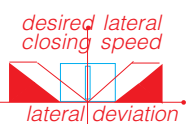

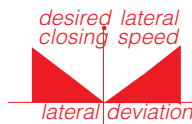
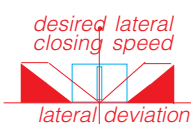
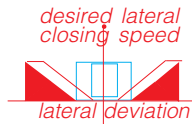

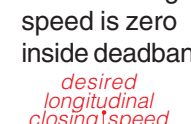



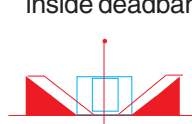
Transfer of Speed, SLIDE or STOP Mode (for transfer to Throttle Station move rear Thruster Toggle or Joystick, then use FBW wheel for HDG control

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

	Stop or Slide Mode	Anchor, MOB or Follow	LAND with Speed Mode	LAND, manual Throttle
Lateral control Lateral Thrust is a function of lateral closing-speed error	- No lateral dead-band. 	- No lateral thrust used. - Instead, Heading Control in SLOW Mode towards position of Anchor Point or Target 	- Automatic lateral Deadband. +/-1...+/-11 ft. 	- No lateral Dead-band 
	Hover Level 3: - No lateral dead-band 	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 <i>While Hover is active, Level Change is made on "AntE" Display. The selected level is reflected briefly also on AP-Display.</i>
	Longitudinal control Longitudinal Thrust is a function of longitudinal closing-speed error	- No longitudinal deadband. 	- Automat. longitudinal Deadband. +/-1...+/-7 ft. - desired closing speed is zero inside deadband 	- 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 