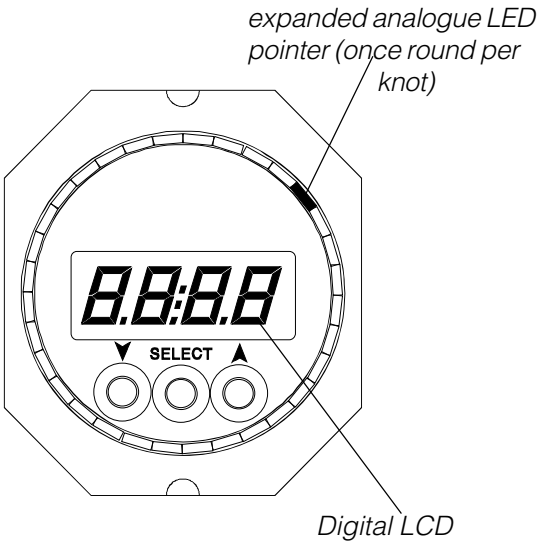
current software versions
E-19 Nov 2019
cwt17.03, mth19.09
mot19.01, dis16.03
Download newest manual from
www.tecnautic.com/public/anlt_e.pdf

Autopilot and Instruments

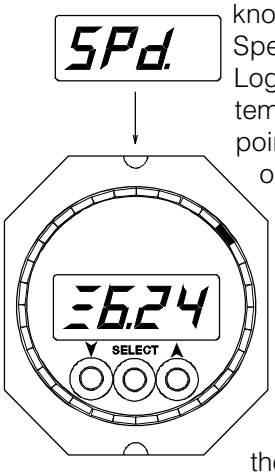
Log Function



Primary Functions:

Primary Display Functions are selected in sequence by briefly pressing the SELECT button.

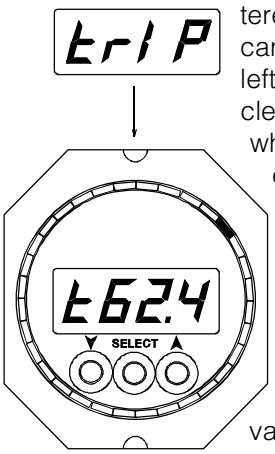
Boat Speed



Actual water speed in knots. Replaced by GPS-Speed in case there is no Log Sensor in the system. The analog LED pointer is expanded to once round per knot.

If desired, the LED can be configured OFF and the speed averaged over 15 seconds by selecting dF=24 instead od dF=20 in the configuration menu.

Trip Distance



Trip distance is registered up to 999,9 NM. It can be cleared with the left button or it is cleared automatically, when TRIP TIME starts either manually or after the race timer has counted down to zero.

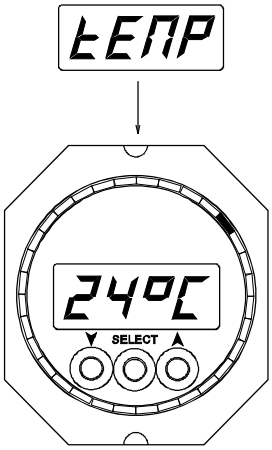
Trip distance is a local function and may be running independently on various displays.

Secondary Functions:

The Secondary Display Functions can be accessed by holding the SELECT button for two seconds for the first function, and then by briefly pressing it for the succeeding functions.

The last Secondary Function is followed by the first Primary Display Function.

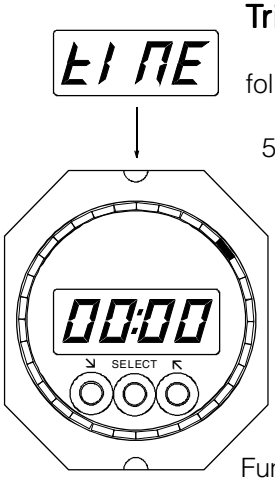
Temperature



Water Temperature is sensed at the Log Sensor.

Dashes are displayed in case of an open sensor circuit (eventually verify correct Sensor Type SE=?? in the display configuration, page 25).

Trip Time



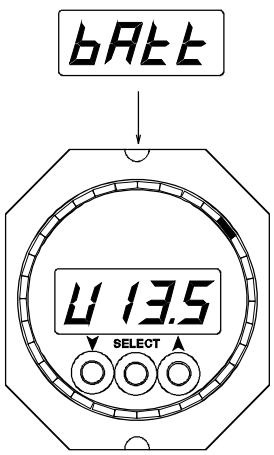
The left button has the following Function:

Stop, Reset, set minus 5 or minus 10 minutes.

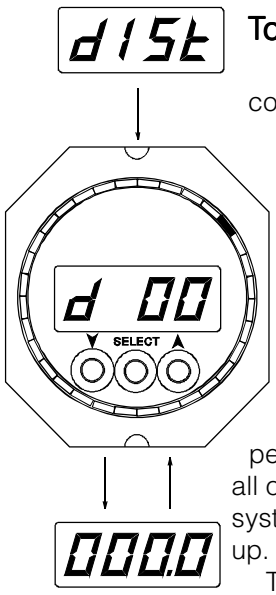
The timer is started with the right button. The Display shows minutes and seconds (up to one hour) and hours and minutes (for more than one hour).

Trip Time is a local Function.

Voltmeter



This function displays the battery voltage (as measured at the display).



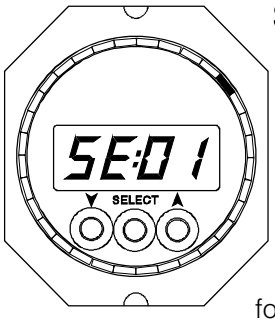
Total log distance

Total log distance is counted up to 99'999,9 NM. The first two most significant digits "d 00" and the four lower digits "000.0" are alternately displayed.

The value is permanently stored in memory. In addition, total log distance is permanently copied into all other displays in the system, to provide a back-up.

Total log distance is a global function in the net.

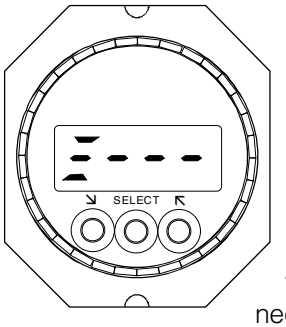
Alerts:



Sensor Type Alert

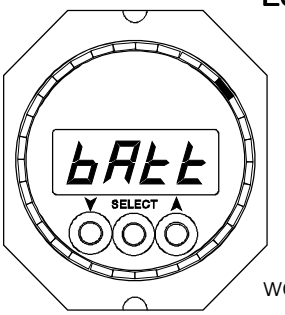
It is displayed automatically, if more than one display unit has been configured for the same log sensor.

All displays should be checked for correct "SE" (see display configuration).



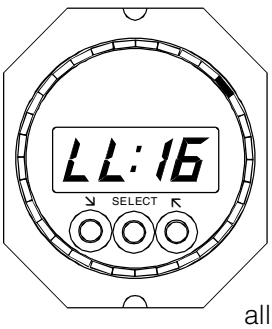
Three dashes instead of the numbers are an indication that no display has been configured for a log sensor. Verify the correct SE=.. of the Display which has the log sensor connected.

Low Battery Alarm



The battery alarm comes on when the supply voltage has dropped below 10 Volts. It disappears after voltage has risen above 11 Volts. The display stops working below 9 Volts.

Settings:



Illumination

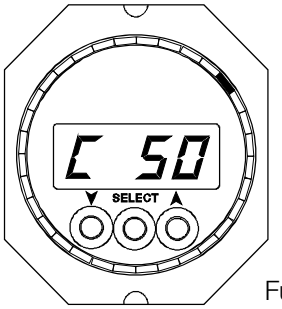
If you have a dimmer installed in the system, it must be used. Only without a dimmer use the push buttons for illumination control:

1. Press and hold all three buttons.
2. Release SELECT button first, then the others.
3. Adjust brightness with left or right button.

All other displays with the same group number will follow in brightness.

4. Exit from the dimmer function with the SELECT-button.

Log Calibration



The calibration number can be entered only at the display(s) where a log sensor is connected (and the Sensor Type Number has been configured).

1. Select Speed Function
2. Press both arrow buttons briefly.
3. Adjust the calibration number "c" with the left or right button. The calibration must be made after installation, since the water speed in vicinity of the sensor may deviate by +/- 20% from the boat speed, depending on the sensor location.

Standard Calibration Factor:

Regatta Speed Sensor:	C 50
Cruise Speed Sensor:	C 31
Planing Speed Sensor:	C 30
Universal Speed Sensor:	C 38
Airmar Ultrasonic Speed Sensor (CS 4500):	C 37

After modifying the calibration number, the indicated boat speed will change by the same relative amount (e.g. changing the calibration number from 50 to 55 will modify the speed indication from 10 to 11 knots).

An accurate calibration has to be done with the Trip Distance counter. E.g. after running 9,0 NM, the Trip Distance shows 10,0 NM. In this case, the calibration number has to be reduced by 10%. If it was 50, it should be set to 45 now.

If a weak set/current is present, the run has to be made in two directions. Calibration can not be done with a strong current.

Calibration has to be done in knots (NM/h).

Special case: should you wish to calibrate two log sensors with different calibration numbers, then the display with the second log sensor should be **disconnected** from the bus during the process.

Log Speed received by NMEA:

Log Speed (water speed) may be received from a different instrument system through NMEA data on any Tecnautic NMEA input (could be a Display unit, Fly-By-Wire unit, Autopilot Drivebox or Engine FADEC-Box).

The received log speed will be displayed and used in the same manner as if it were coming from a log sensor. Except that it cannot be recalibrated, and will not be used for the log distance or trip counter.

Log Speed replaced by GPS-speed:

In the absence of Log Speed Data, Water Speed will be substituted automatically by GPS Ground-Speed.

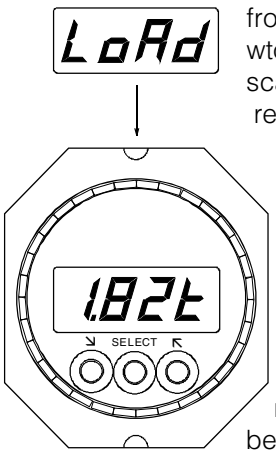
This feature permits the use of the autopilot True Wind Mode, even in the absence of a log sensor.

Keep in mind, that True Wind data will be affected whenever ground speed is not equal to water speed. With water speed available, true wind is shown relative to the water body. When ground speed is substituting water speed, true wind will be shown relative to ground.

Remark: when water speed data are received from an external device and on a different NMEA-input than the GPS-speed, make sure that water speed data are received first, ***BEFORE*** *GPS speed-data come into the system. Only the first source, with valid data will be used for water speed until next reset or power up of the system.*

Load Sensor

Rig Load Display



Rig Load is displayed from zero to 49.9 kiloNewton (4.99t). Different scales are available upon request.

Sensors from various suppliers can be connected (Navtec, B&G).

Installation:

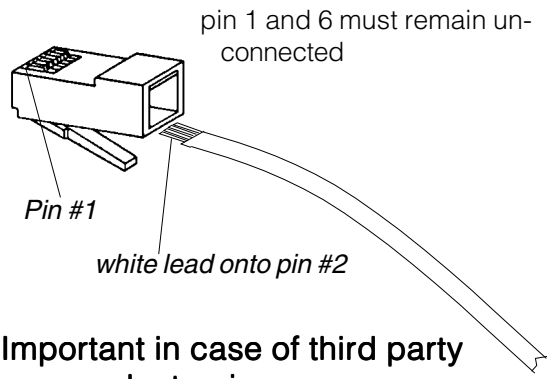
A Tecnautic Load Sensor Interface must be connected between the sensor and the cockpit display. The interface can be calibrated for any particular sensor.

The display unit, to which the Load Sensor is connected, has to be configured with sensor number **SE=14**.

At all display units, where the Rig Load Reading is desired, function number **dF=28** must be active.

Sensor Cable:
6 pin plug RJ-12 (4 pins installed)

pin #	round cable	flat-oval cable	
1	-----	-----	unused
2	white	white	+5 Volts
3	brown	blue	GND
4	yellow	cyan	Sensor signal
5	green	magenta	reserved
6	-----	-----	unused



Important in case of third party sensor electronics:

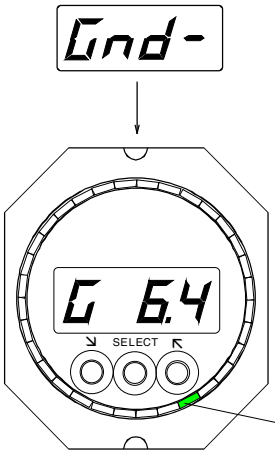
All sensors (including their associated electronics) must only be wired to the display unit via its sensor cable. No other electric connection between sensor and boat must exist. That means only the supply from the display (GND and +5 Volts) may be used. The current drawn should not exceed 15 mA and should be steady (max. ripple +/- 1mA).

Nav Functions

NAV Functions are only available with a GPS or plotter in the system.

A properly aligned and compensated compass is recommended for autopilot operations.

After selecting the "Gnd"-display with the middle button, you may use the right button to toggle between GND-Speed and GND-Course.

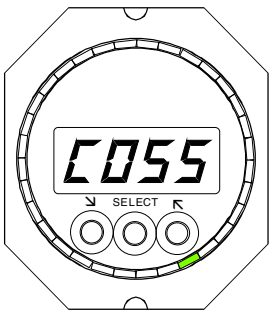


GND-Speed and GND-Track

Ground Speed

Ground speed is shown in knots, as received from the GPS.

Use right button for ground track.



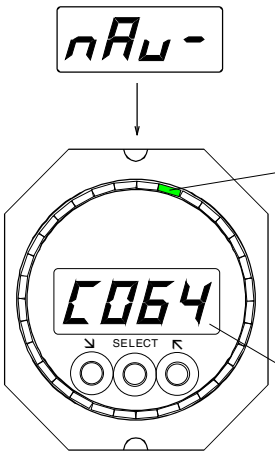
Ground Track

Magnetic ground track, as received from the GPS.

ATTENTION: ground track from the GPS may become inaccurate at low speed.

NAV Function

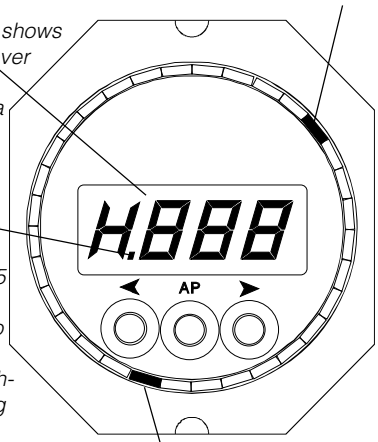
Secondary Function ("nAv-" .. "r.000"). When the ***Autopilot is not engaged,*** an LED in the upper half becomes a Flight Director in NAV Mode. It shows commanded Heading for staying on course of the active route.



Compass Display Function

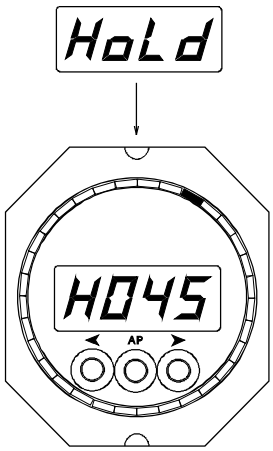
Analogue LED-pointer for the selected heading (upper face of display). Not valid for six-button Autopilot Displays

Digital display (LCD) shows Gyro Heading whenever the Gyro has been slewed by a GPS or a magnetic compass



Decimal-Symbol indicates Heading Gyro readiness (appears 5 minutes after power-up, i.e. when the gyro is slewed, but can take much longer without a slewing heading source).
The autopilot must not be used without an operational gyro!

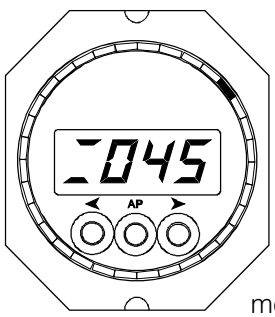
Second LED-pointer for rudder angle (lower face of display)



Heading Hold

The LCD shows the actual heading, the LED-pointer points onto the selected heading (expanded scale).

The Gyro Symbol (the decimal behind the H) should be monitored, when using the autopilot.



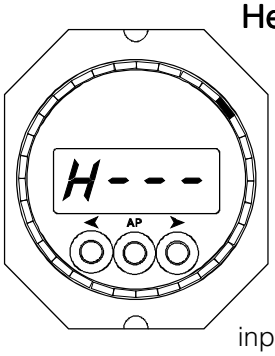
Selected Heading

The selected heading is displayed after pressing briefly either arrow button. With every following button application, the selected heading will be modified by one degree. For larger adjustments of the selected heading, the left or right button may be pressed and held.

After a few seconds of button-inactivity, the actual heading will come up again.

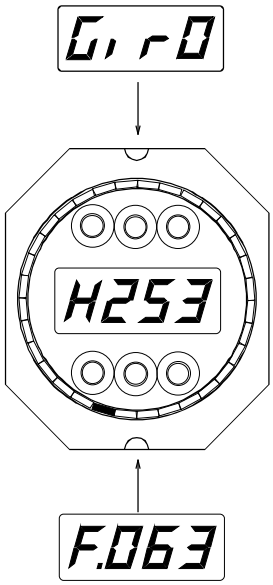
Alerts:

Heading Sensor



Dashes on the heading display are an indication, that no compass sensor has been connected or that no valid heading signal is received from the sensor.

Verify, that the NMEA input of the display, which has the heading sensor connected, is configured correctly: n0=01 for the primary compass or n0=02 for an eventual secondary compass (and also n1=00 for the HS8000 or n1=07 for the PB200 or H2183 Sensor). n3=00 or 01 for bitrate 4800. See page 27 for NMEA setup.

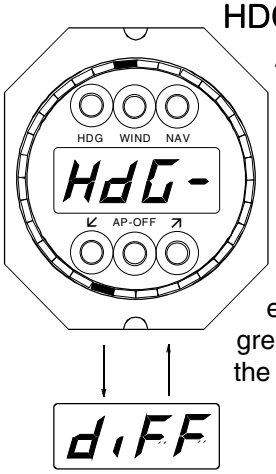


Gyro Alarm

The warning is shown on AP displays, if a previously operational gyro has failed or is in alignment mode or has an abnormal signal. The dot behind the "H" is the gyro NORMAL symbol.

Gyro Signal "F"

The gyro signal alert comes on, if the signal is abnormal. Numbers below 26 and above 103 should only be accepted for a short time after alignment.



HDG Comparator (on AP-Display only)

With two Heading sources in the system (magnetic or SAT compass), their data are continuously compared. When the difference exceeds 25 degrees, a signal sounds and the warning is shown.

Compensation: do alignment first!

Sensor compensation and alignment function are only accessible on the display unit, to which the sensor is physically connected via the NMEA port, and the port has been properly configured n0=01 for the primary compass or n0=02 for a secondary compass, and further n1=00 for the HS8000 or n1=07 for the PB200 or H2183. n3=00 or 01 for bitrate 4800.

Aligning the Sensor

Alignment Procedure

First you need to create a deviation table. That will be the basis for a correct sensor alignment. The deviation table might have positive and negative numbers over the full circle.

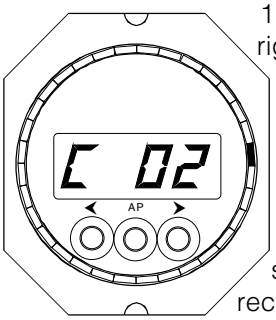
A deviation table can only be created by taking relative bearings of distant objects and comparing them with the indicated heading. Using GPS tracks to build a deviation table may be a simple substitute, when it is assured that there is no current or wind influence at all. At 5kt boat speed, a 0,5kt set will produce a 6 degree drift.

With the table at hand, adjust the alignment correction "C" (offset) until negative and positive deviation values become equal in size.

Note: on the PB100/200 sensor, the offset correction will also be valid for the apparent wind angle.

ATTENTION: the Alignment Correction may not be displayed correctly after (re-) installing either the sensor or the display unit, to which the sensor is connected. The correction must be verified in this case.

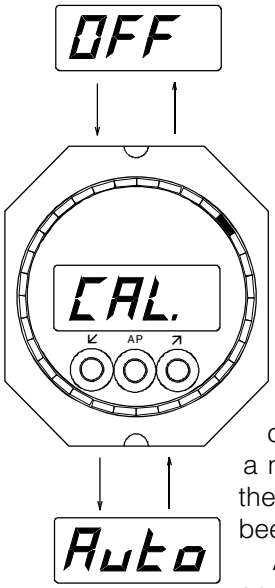
Modifying the alignment



1. Press and hold left and right button.
2. Press middle button twice.
3. Release all three buttons.

For example "C 02" will stand for an alignment correction of +2 degrees. The value may be modified with the left or right button. This correction is added automatically to the sensed heading.

Deviation will become symmetrical after alignment. A deviation of +8/-2 will become +5/-5. For a deviation bigger than +/-1, proceed with the following compensation procedure.



Compensation Status Display:

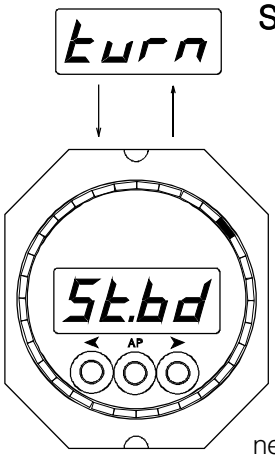
The compensation status display follows the alignment correction display (see left).

OFF means "not compensated", Auto means "compensated".

ATTENTION: compensation status is not correctly displayed after a new installation or after the sensor or display have been replaced.

A new compensation can be started by briefly pressing the left or right button (see below).

The middle button exits from the compensation function.



Starting a new compensation cycle

1. Select the compensation status on the Display (see above).
2. Briefly press the left or right button.
3. Start turning (for the HS8000 a starboard turn through 540 degrees is required, for other sensors only a full turn to either side is needed).

The turn has to be completed within one to three minutes and must be executed under perfectly smooth conditions. The vessel must not be heeled. Power lines or steel structures below or near the vessel must be avoided. A significant depth and a distance of several hundred meters (a few hundred yards) from bridges or buildings would present acceptable conditions.

Completion of a compensation cycle is indicated by CAL-Auto (or by CAL-OFF if not successful).

WARNING: executing a compensation bears the risk of introducing large compensation errors. A bad compensation can only be overwritten by a good one. The quality of a compensation cycle has to be verified with a new deviation table.

The Heading Gyro

The Tecnautic Sonic Gyro is a so called Heading Gyro. As opposed to a north seeking gyro, it needs to be aligned externally. Thereafter it still requires continuous slewing, to avoid drifting away from north due to earth rotation and gyro drift.

The means for slewing the gyro (magnetic compass or GPS) can be selected in the sensor setup (page 25).

Beside of "not knowing NORTH", the heading gyro has all the qualities of a gyro compass, it is immune to linear acceleration and magnetic influences. It senses solely the instant rate of turn and the heading of the vessel, without delay.

After power up, the gyro goes through an automatic alignment and stabilization phase, which normally lasts five minutes. Thereafter it is available for use by the display and the autopilot.

Slewing to a Satellite-Compass

With a Satellite-Compass in the system, the heading gyro can be slewed to magnetic north. Magnetic Variation is required from an RMC-sentence, when the GPS-Compass sends only True Heading data.

It is not recommended to slew the gyro to True North by not providing variation data, since all Navigation Calculations of the Autopilot NAV-Mode are based on magnetic bearings.

Slewing to a Magnetic Compass

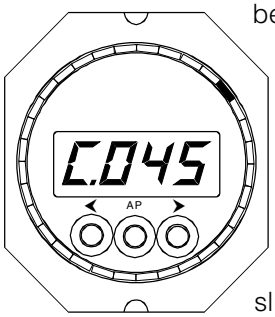
With a magnetic compass in the system, the heading gyro can be slewed to magnetic north.

Coupling of the magnetic compass to the gyro is very weak, in order to avoid reflection of short term magnetic fluctuations (in the range of seconds) onto the gyro heading.

In the longer term however (within minutes), the gyro will be slewed to the average heading of the magnetic compass.

Slewing to GPS-Course

With GPS course in the system, the gyro can be slewed to the GPS course. In this case the gyro heading represents course over ground instead of direction of the bow.



Slewing to a GPS is halted at speeds below 2 knots.

Course data from the GPS must not be dampened or delayed and the vessel must not slip sideways when turning.

Slewing a gyro to the GPS course is not practical in varying drift conditions (associated with turns and Heading changes), as it will lead to heading oscillations of the gyro.

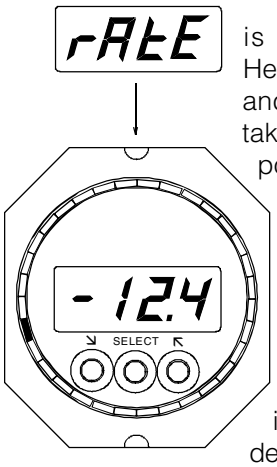
Free running HDG Gyro

Without slewing the gyro, it is still available to the autopilot after a prolonged stabilization phase. The Autopilot Heading Mode can be selected only with the AP button at the FBW Station. Small heading adjustments need to be made from time to time, to counter the gyro drift of the free running gyro.

The Autopilot Wind Modes are also available with a free running heading gyro.

Turn Rate Display

Turn Rate



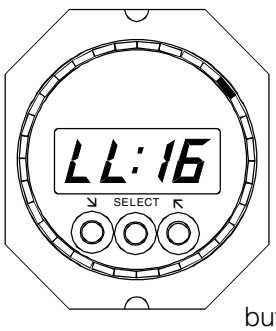
The turn rate display is available with the Heading Gyro installed and aligned. Note that it takes 5 minutes after a power interruption until the gyro is aligned.

The digital LCD displays rate of turn up to +/- 25 degrees per second.

The LED pointer is an expanded analog indicator up to +/- four degrees per second (upper half LED circle). The lower half LED circle displays the rudder angle, if available.

Settings:

Illumination



If you have a dimmer installed in the system, use only the dimmer. Otherwise use the push buttons for illumination control:

1. Press and hold all three buttons.
2. Release SELECT button first, then the others.
3. Adjust brightness with left or right button.

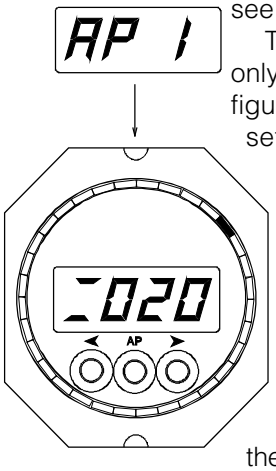
All other displays with the same group number will follow in brightness.

4. Exit from the function with the SELECT-button.

Special Display Configuration (not recommended)

Engaging the Autopilot on a Heading Display (other functions not available)

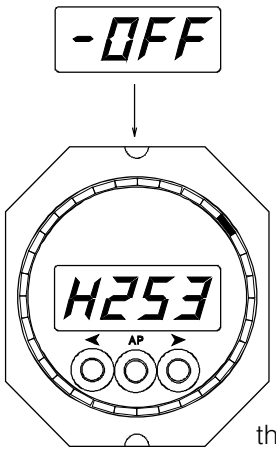
(Valid only for a **three button display** unit. -- For an Autopilot Display see page 14)



The autopilot function is only available if during configuration "di:02" has been set.

Press and hold the AP-button (middle button). When the autopilot gets engaged after two seconds, release the button. The digital display shows briefly the autopilot number (AP1 or 2) and then the selected heading.

Initially the actual heading is taken as selected heading.



Disengaging the Autopilot

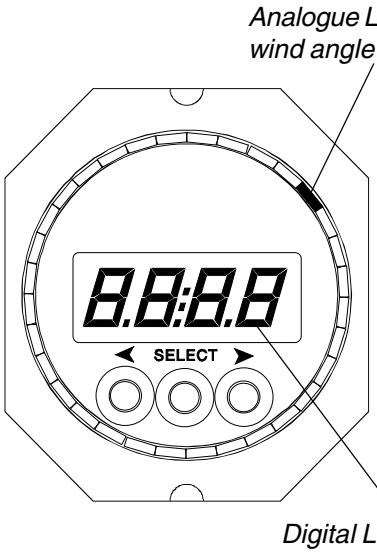
This autopilot function is only available if "di:02" was set during configuration.

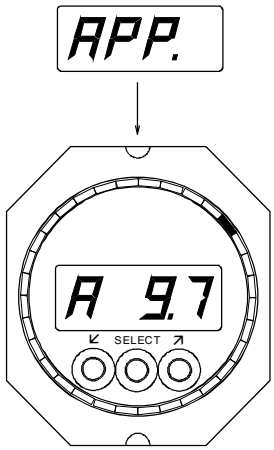
Press the AP-button briefly to disengage the autopilot immediately. The OFF-alert will come on. It may be cleared by briefly pressing any of the three buttons.

Warning

The Autopilot shall only be engaged when the Heading Gyro is operational and stabilized ("H.---" the dot behind the H must be visible).

Wind Functions





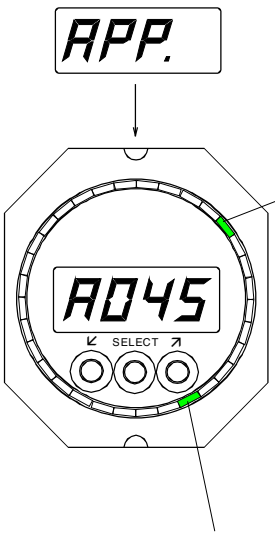
Apparent Wind Speed

Apparent wind speed is displayed in knots.

The apparent wind angle is displayed on the analog LED-pointer. It may be displayed also on the digital LCD by briefly pressing the right button.

Primary Functions:

Primary Display Functions are selected in sequence by briefly pressing the SELECT button.



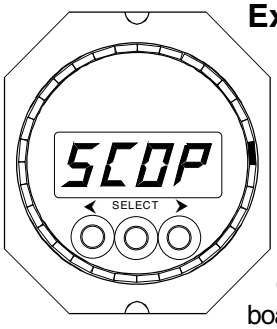
Apparent Wind angle

The relative apparent wind angle is displayed digitally (+/- 180 degrees) on the LCD, and around the face of the display by the analog LED-pointer.

The relative apparent wind speed or an alternating display can be selected with the right button.

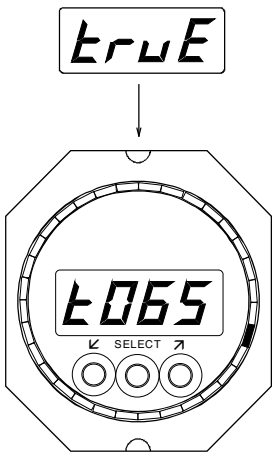
Heel Angle (Clinometer) LED

A visible LED in the lower area shows the **vertical**, which is a representation of the actual heel angle (roll angle). Roll data can be received from some heading sensors. One LED corresponds to four degrees heel angle.



Expanded Apparent Wind angle

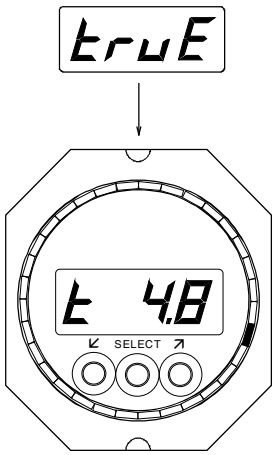
When activating function 31 in the set-up menu, the LED pointer movement is expanded and shows the angle from 15 to 65 degrees port or starboard.



True Wind Angle

The true relative wind angle is displayed digitally on the LCD (+/- 180 degrees) and analogue by the LED-pointer.

Switching the display to TRUE WIND SPEED is or to an alternating display done with the right button.



True Wind Speed

True wind speed is displayed on the LCD in knots.

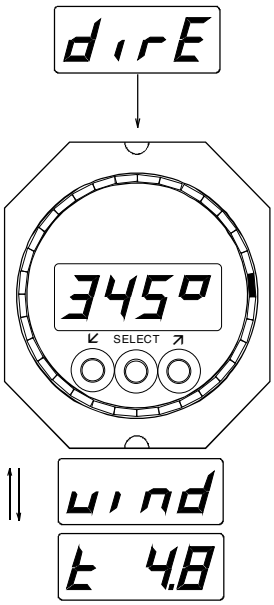
The right button is used to toggle between true wind speed and true wind angle.

The LED-pointer displays the relative true wind angle.

Secondary Functions:

The Secondary Display Functions can be accessed by holding the SELECT button for two seconds for the first function, and then by briefly pressing it for the succeeding functions.

The last Secondary Function is followed by the first Primary Display Function.

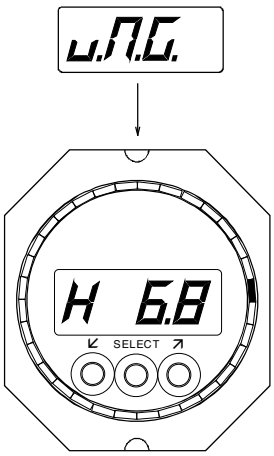


Magnetic Wind

This function requires a heading sensor in the system.

The magnetic wind direction or true wind speed can be selected alternately with the right button.

The analogue LED shows the relative true wind angle.



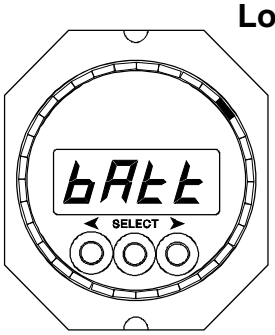
VMG

This is the part of the boat speed in direction of the true wind vector, either upwind or downwind.

The analogue LED shows the relative true wind angle.

Warnings

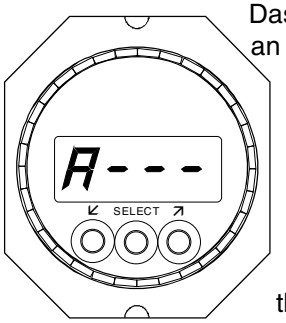
Low Battery Alarm



LCD blinking

The battery alert comes on when the supply voltage has dropped below 10 Volts. It disappears only after voltage has increased above 11 Volts. The display stops working below 9 Volts.

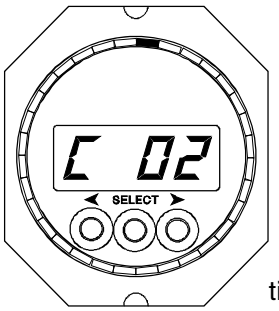
Sensor Warning



Dashes on the LCD are an indication that valid signals are not received from the sensor (or the wind vane sits at zero degrees for a prolonged period). Check also, that the configuration of the display with the wind sensor physically connected is SE=06 or 07 (n0=01 or 02 for the PB100/200 wind sensor).

Settings

Tecnautic Wind Vane Correction



This correction has to be done at a display unit with the wind sensor physically connected and the sensor type number correctly configured and the apparent wind function displayed.

The wind angle can be corrected by modifying the correction "C".

1. Select the apparent wind function, then press both arrow buttons at the same time.
2. Use the right button to increase a starboard wind angle or to decrease a port wind angle.

Use the left button to increase a port wind angle or to decrease a starboard wind angle.

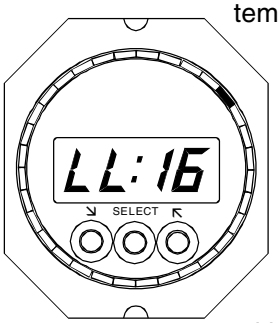
3. Exit the function with the middle button.

PB100/200/WX Wind Sensor

The compass alignment function of the PB100/200 will also align the wind angle.

Illumination

If you have a dimmer installed in the system, use only the dimmer. Otherwise use the push buttons for illumination control:

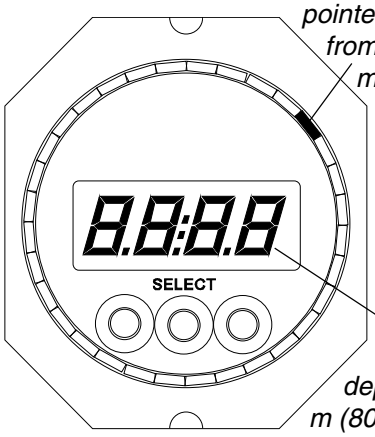


1. Press and hold all three buttons.
2. Release SELECT button first, then the others.
3. Adjust brightness with left or right button.

All other displays with the same group number will follow in brightness.

4. Exit from the function with the SELECT-button.

Depth Functions

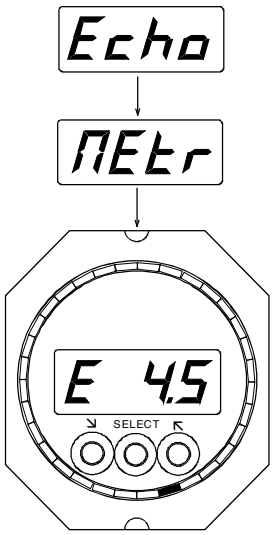


Analogue LED-pointer for depth from zero to 10 meters

Digital display (LCD) for depth up to 250 m (800 ft)

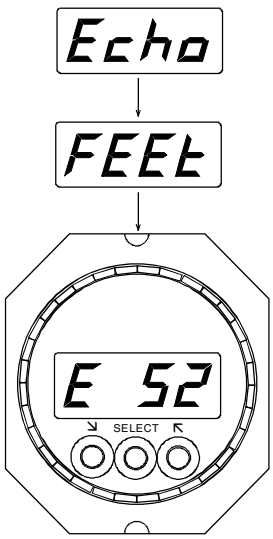
Primary Functions:

Primary Display Functions are selected in sequence by briefly pressing the SELECT button.



Depth Display in Meters

Actual Depth is displayed on the LCD from zero to 250 meters. In addition, the LED-pointer shows depth from zero to 10 m.



Depth Display in Feet

Actual depth is displayed in feet on the LCD from zero to 800 ft. In addition, the analog LED-pointer displays depth from zero to 32 ft.

Aural Depth Alarm:

Echo-Box-2 required. The buzzer comes on when either the depth has fallen below the "L" limit, or when the high depth alarm "H" has been exceeded. The alarm can be silenced by pressing the left or right button on any display unit. The buzzer can be connected to the sensor input of any display unit (SE=17 or 18 has to be set on that unit).

Vocal Depth Alarm:

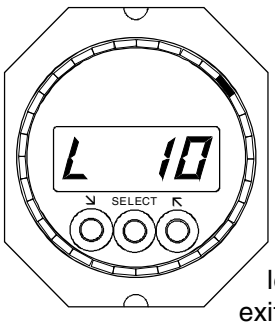
Echo-Box-1 required. The actual depth is announced in English (or German) language, when either the low depth alarm "L" or the high depth alarm "H" has been exceeded.

Any following significant depth variation triggers a new announcement.

To suppress both alarms completely, the values of "H" and "L" have to be set to zero.

For language selection of the announcements see "Echo-Box-1 installation".

Alarm Settings:

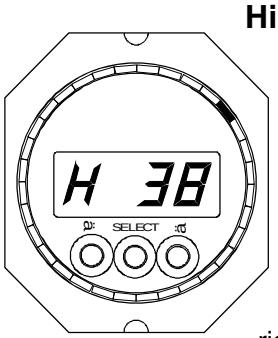


Low Depth Alarm

Select the depth display, then press and hold the left button for two seconds. The "L" alarm setting is shown and the value may be changed by briefly pressing the left or right button. To exit the function, use the SELECT-button.

Set "L 00" to deactivate the alarm.

The warning will be active when actual depth is lower than the set number.



High Depth Alarm

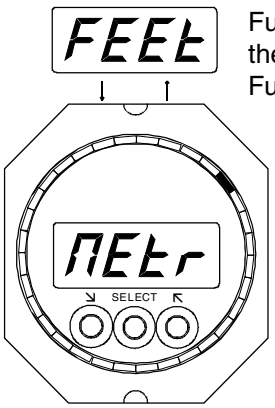
Select the depth display, then press and hold the right button for two seconds. The "H"-alarm setting is shown and its value may be changed by briefly pressing the left or right button. Exit the function with the SELECT-button.

Set "H 00" to deactivate the alarm.

An alarm comes on when the set depth value has been exceeded by actual depth.

Secondary Functions:

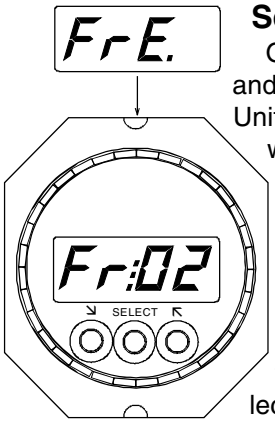
The Secondary Display Functions can be accessed by holding the SELECT button for two seconds for the first function, and then by briefly pressing it for the succeeding functions.



The last Secondary Function is followed by the first Primary Display Function.

Depth Units

The left or right button is used to select the desired units (meters or feet).



Sensor-Frequency

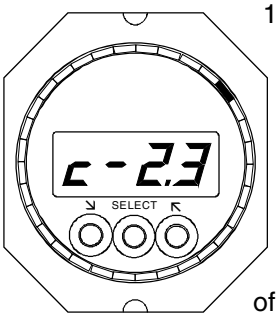
Only with Echo-Box-2 and only on the Display Unit set to n0=05 (and to which the Echo-Box2 is physiclly connected).

This function follows in sequence after the Depth Units function above.

The transducer frequency can be selected with the left or right button. Set the same number as marked on the transducer cable (Important for good transducer function!)

Settings:

Depth offset to keel or surface



1. Select depth display
2. Press and hold both arrow buttons for two seconds.

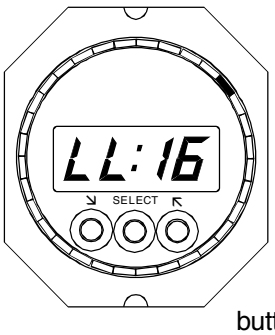
With a zero correction setting (**c 0.0**), depth is measured from the sensor location. A positive value of "**c**" will be added to the sensed depth (used for depth below surface indication), a negative "**c**" will be subtracted from the sensed depth (used for depth below keel).

To alter the correction, press left or right button repeatedly.

Exit this function with the middle button.

Illumination

If you have a dimmer installed in the system, use only the dimmer. Otherwise use the push buttons for illumination control:

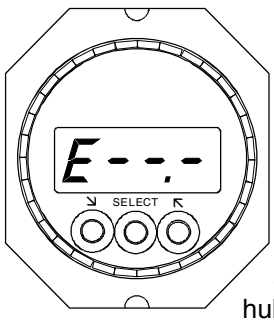


1. Press and hold all three buttons.
2. Release SELECT button first, then the others.
3. Adjust brightness with left or right button.

All other displays with the same group number will follow in brightness.

4. Exit from the function with the SELECT-button.

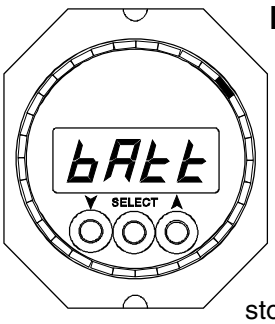
Warnings:



Dashes on the display:

means no echo received. The reason could be depth exceeding the range or excessive sound absorption in the water, at the bottom (or in the hull in case of a within hull installation).

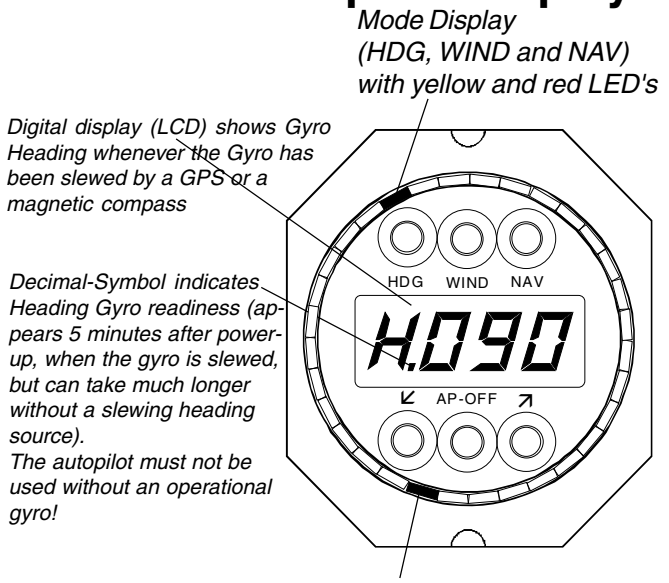
If the Echo-Box does not communicate with the display, there will also be dashes on the LCD. Check the correct configuration of the display with the Echo-Box physically connected (**n0:04** for Echo-Box-1 or **n0:05** for Echo-Box-2 in the NMEA setup).



Low Battery Alarm

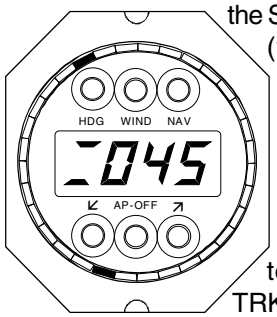
The battery alert comes on when the supply voltage has dropped below 10 Volts. It disappears only after voltage has increased above 11 Volts. The display stops working below 9 Volts.

Autopilot Functions
With Autopilot Display



Heading Mode ("H") and Track Mode ("C")

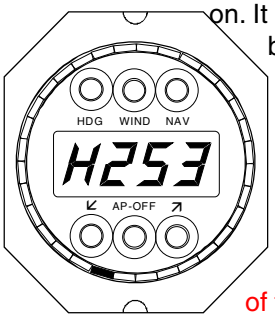
Press the HDG-button briefly. Verify "AP 1" or "AP 2", followed briefly by the SELECTED heading or track (which was taken initially from the actual heading). It can be modified with the left or right arrow button as required. With GPS track data in the system, you may press HDG again to toggle between HDG and TRK mode (if GS above 0.5kn).



The yellow HDG-LED is ON in both modes. It starts blinking whenever the autopilot deviates by more than 15 degrees from the SELECTED heading, or when an automatic mode change into HDG mode has occurred or while turning in TURN-RATE mode.

Autopilot OFF

Press the OFF-button briefly to switch off the autopilot. The OFF-warning comes on. It can be extinguished by briefly pressing either of the three lower buttons.

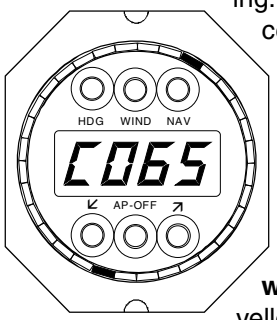


Holding the OFF button for 3 sec will convert the AP display into a Multi-Function display (Return by any of the upper buttons).

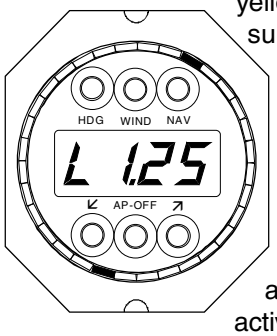
NAV Mode and LAND Mode

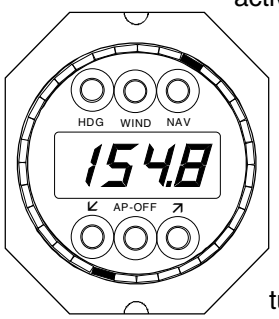
Press the **NAV**-button briefly. This brings up the programmed track **C** (bearing to WPT) as set up in the plotter. The right arrow button can be used to switch to the Cross Track Error XTE **(L** or **r)** and distance or time to the next waypoint.

The NAV-button has to be pushed a second time (within ten seconds) to actually arm or engage the autopilot in **NAV-mode.** Before doing so, you should verify that the displayed bearing **C** is safe (what you really want) and what eventual heading change might result from the intercept. A **yellow** NAV-LED will be shown, when the autopilot is tracking or is about to track the course line. A **red** NAV-LED however means that XTE is > 0.030 NM and you are still responsible to select a reasonable intercept heading. An automatic 30°intercept can be selected by double clicking the NAV-button, while the NAV-LED is red.



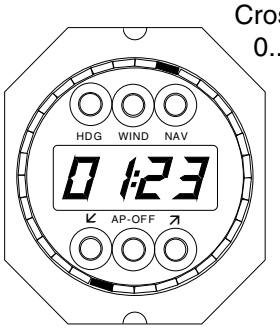
The **LAND**-mode may be selected by double clicking the NAV button again, **while** already tracking in yellow NAV-mode. Make sure **to stay below 5 kt and verify the plotter is sending XTE with four decimal digits** at least. The AP then tries to steer within 0.0001 NM XTE, when side thrust is available and the Slow Mode is active.





The top most picture shows the LCD with the programmed course (bearing) "C". Scroll with lower right button for XTE or distance and time to WP.

In the second picture the LCD shows the Cross Track Error (L or R, 0...9.999 NM).



Third picture gives Distance to next way point, (0.01- 299.9 NM).

Bottom: Estimated Elapsed Time to next way point, hours and minutes

Additional Autopilot Functions:

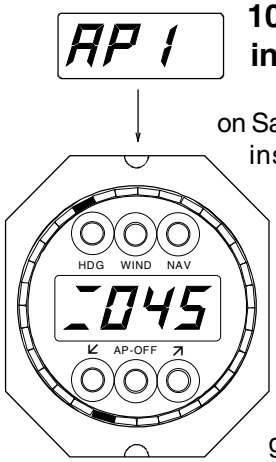
Wind Modes

The Wind Modes require wind data and a gyro in the system. A wind display is not needed. The TRUE Wind Mode is the preferred mode for stable steering. It requires boat speed data or Ground Speed data available (with Ground Speed substituting water speed, the calculated relative true wind angle will be relative to ground track).

Press the WIND-button briefly: The right WIND-LED comes on for the true (**t**) autopilot wind mode. Press the button again and the left WIND-LED comes on for the apparent (**A**) wind mode. The present wind angle (apparent or true) is taken as target wind angle. It can be altered as needed with the left or right arrow buttons.

Tacks and Jibes: Pressing both arrow buttons simultaneously will trigger a tack, when the target wind angle was smaller than 90 degrees. A jibe will be started, if the target wind angle was greater than 90 degrees.

Note: a tack or a jibe may be stopped any time by briefly pressing the HDG-button (if the Heading-Mode is available).

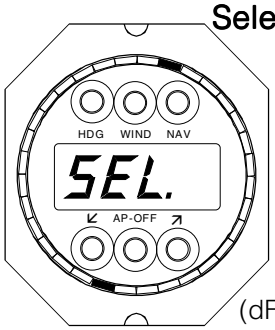


100-degrees tack in Compass Mode: This function is useful on Sailing Yachts with no wind instruments. Press and hold HDG-button for three seconds, until the HDG-LED changes from yellow into **red**. The autopilot is now **armed for tacking**. A 100-degrees heading change can be triggered with the left or right arrow button. The HDG-LED starts blinking (yellow) until the new target heading has been reached.

The heading change may be stopped any time by briefly pressing the HDG-button. Actual heading (or track) will then be followed.

Display Functions

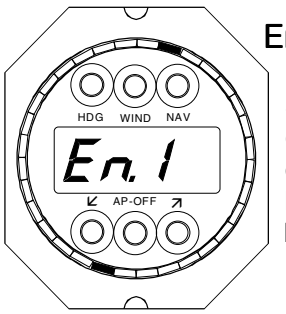
Selected Vessel Speed



This function briefly shows the selected ground speed (or boat speed), when modifying the Target Speed, while Throttles are in ***Speed Mode.***

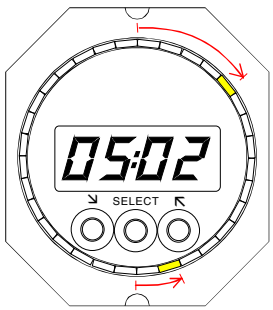
When this function (dF=92) has been selected on a MULTI Function Display, the right button will bring up the engine rpm.

Engine RPM 1 or 2



The function can be selected to monitor engine RPM, when the Tachometer signal has been connected to the FADEC.

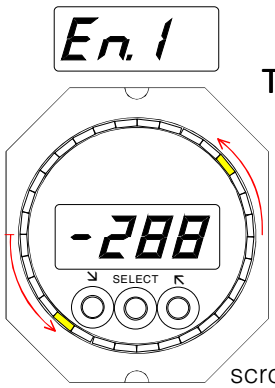
Bow and Stearn Thruster



Bow = 5, Stearn = 2 (out of 10 Steps)

Display Function 32 is for monitoring thruster activity during Autopilot operation. It may hint for a Heading change, before thrusters are reaching their limits in Hover Mode.

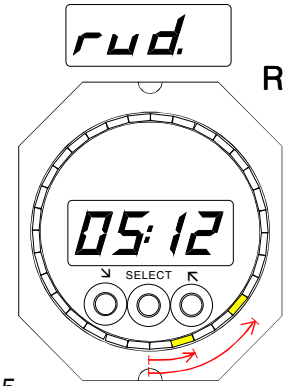
The right button advances to main engine throttle and shift display.



Throttle and Shift

The LED pointers represent equivalent Throttle positions when in gear, the LCD shows a relative thrust number from -432 to +432.

Use the right button for scrolling to the Rudder Display.

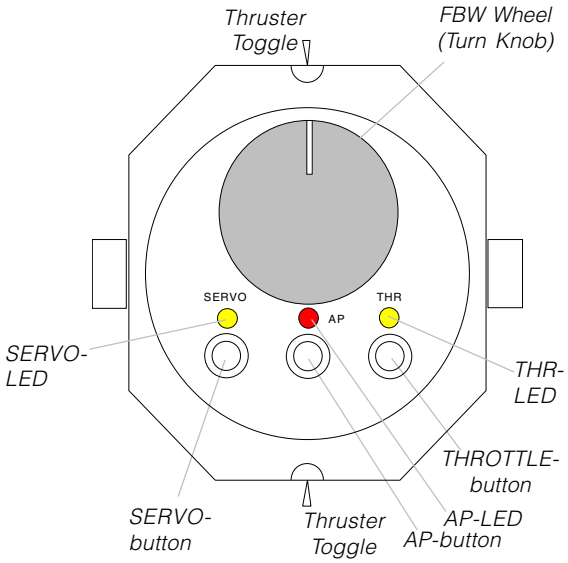


Rudder Display

The LCD and the LED pointers show rudder angle 1 and 2 (unadjusted for an eventual spread angle).

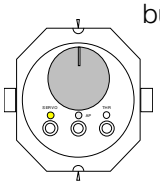
Turn Knob Functions of the Fly-By-Wire unit

The actual operating mode is indicated by yellow and red mode LED's, by the Turn Knob and Throttle position and through a beeper.



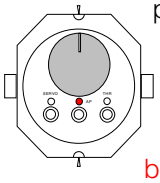
Servo Mode

The rudder follows directly the steering wheel position, when the yellow SERVO-LED is ON and the red AP-LED is OFF. Press the "SERVO" button again, to toggle between ***SERVO*** **Mode** and ***Turn Rate*** **Mode**. The *SERVO* Mode is used when the Heading Gyro is not yet aligned. Further it is used for maneuvering or while going astern.



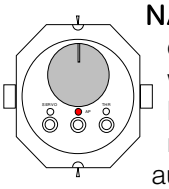
Heading Mode

The AP-button engages the autopilot in **HDG** Mode, same as the HDG button on the AP Display. The red AP-LED comes on at all stations and the FBW wheel will be locked. Heading changes can be made on any AP or heading display. Attention: before pressing the AP button, make sure the AP-Display is showing a stable gyro heading.



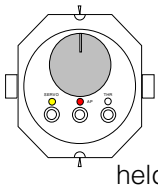
NAV Mode

Double click the AP button to engage the **NAV** Mode. The red AP-LED comes on at all stations and the FBW wheel will be inactive. An active route must be available from the plotter. The route will be intercepted and followed automatically, the intercept angle is 30 degrees (as opposed to engaging NAV Mode at the Display, where the intercept angle can be selected manually).



Turn Rate Mode

The **Turn Rate mode** is the preferred operating mode of the Fly-By-Wire Wheel. It is engaged by a (second) click on the SERVO button and indicated by a lit SERVO **and** AP LED.



Wheel position determines the vessels' **rate of turn, not the rudder angle**, rudder is controlled by the autopilot. With a centered wheel in the detent, the heading will be held. Use the SERVO button to toggle between SERVO and Turn Rate mode.

In Turn Rate Mode . Heading changes can be made through the FBW-wheel or on an autopilot or heading display.

Note: the Turn Rate mode is only available when the heading gyro has completed its alignment (normally 5 minutes after power up, but can take longer with no compass in the system). An operational gyro is indicated by a dot behind the "H." on the heading display. The Turn Rate Mode should always be used instead of SERVO, while going forward.

If SLOW MODE is active, the Turn Rate Mode could even be used when stopped or moving astern, when vectored thrust is available from the propulsion system (as with stern drives or two individually steered rudders, or with thrusters, or water-jet drives).

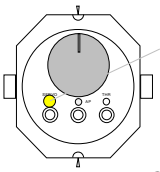
Turn Knob Warning Functions

Additional Warnings exist with FADEC system

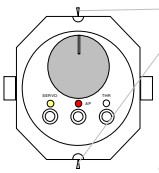
SERVO LED blinking fast and a double beep sounds every two seconds	Rudder not following the Turn Knob position
SERVO LED glowing slowly (On and Off)	STANDBY-mode: continuous pumps are kept running
red AP LED glowing slowly (On and Off)	No communication with DRIVE Box or FADEC-Box
red AP LED flashing slowly and a beep sounds every two seconds.	The temperature of the Drive Box is within 8 C (15 F) of the cut-off limit.
red AP LED flashing fast	The FBW-unit is locked (see Setup)
marching LEDs fast, from right to left	Data loss of the FBW unit: insert set-up data (page 51)

Bow and Stern Thrusters

a) by Toggle Switches

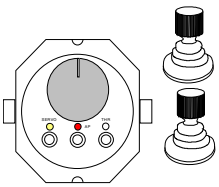


1. To permit thruster use, the **SERVO-Mode** must be active **at the respective station** (SERVO-LED on, AP-LED off) **or THR-Mode (Throttle) active, while in manual steering.**



2. Press and hold the respective toggle towards the desired side. Thruster activation is indicated by flickering LEDs. At low speed (in SLOW Mode) thrusters are commanded by the autopilot, to assist the rudder. With active Speed Mode this occurs even when steering in SERVO Mode.

b) by proportional Thruster-Joysticks



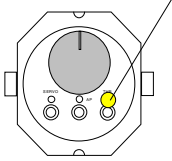
1. The **SERVO-Mode** must be active **at this station or THR-Mode (Throttle) active, while in manual steering (not SERVO).**
2. Move the respective joystick towards the desired side. Thruster speed is proportional to joystick deflection.

Thruster activation is indicated by LEDs.

Slow Mode

SLOW Mode permits the vessel to be steered by the autopilot at low speed or standstill. Bow and Stern Thrusters will be used automatically, if available. In the presence of two engines, these may be put into opposite gear and steered automatically to individual rudder angles.

Changing into and out of Slow-Mode: The THR-button is used to select the Slow-Mode. Switching in and out of Slow-Mode requires the engines either in NEUTRAL or in WARM-UP Mode. Hold the THR-button for 2 seconds until it sends a short beep. The Slow-Mode is indicated by a blinking Throttle-LED.



The steering functions of the Slow-Mode (thruster activation and rudder splitting) will not become active, until boat speed has dropped below a set value.

In Speed or Hover or Anchor Mode, SLOW Mode will be activated automatically as a function of speed.

Tecnautic engine controls required

3-D Joystick

The most intuitive way of steering in SLOW Mode is by the Three-Axis Joystick.

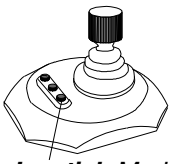
Control is taken in **Joystick Mode** with the THR-button, indicated by a fast flashing THR-Diode.

Heading can be changed by rotating the Joystick, whereas moving it in any direction will move the boat accordingly. All available rudders, engines and thrusters are used automatically.

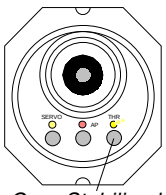
The AP-Display shows intermittently "MAnu", either together with an active Turn Rate Mode (recognized by an illuminated HDG-LED), or without. In the latter case, the Heading has to be controlled manually by twisting the Joystick (similar to SERVO Mode).

Switching between the unstabilized and stabilized Joystick Mode (Turn Rate Mode OFF or ON) is done with the THR button. The red AP-Diode will become faintly lit in *stabilized* Joystick Mode.

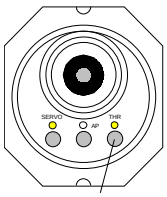
The Joystick will return spring loaded to the neutral position (zero thrust), when let go. However it is possible to freeze the signal at any Joystick position with a Double Click on the THR Button. In this case the Joystick handle must be released first, before removing the finger from the THR Button, after the second push. The Joystick will be unfrozen instantly by any subsequent touch of the handle.



***Joystick**-Mode*



Gyro-Stabilized Joystick



Manual Joystick

Speed-Mode

Selected Boat Speed

Activation of the Speed Mode is either with

the SERVO Button at the 3-D Joystick (which activates also the Turn-Rate Mode of the Joystick), or on a Throttle Station, by pressing the THR and AP button together, starting with the THR button, or on a Wireless Remote.

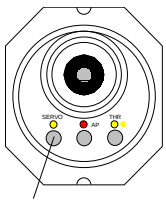
Speed Mode is indicated with a ***double flash*** of the THR button ***at all stations and Joysticks.***

Selected Speed (Ground-Speed or Log Speed) is displayed briefly when modified. It can be altered by forward or aft movement of the Joystick, or with the rear Thruster Toggle (while manual thruster control is not available).

The Speed Mode requires Ground-Speed available (or Log Speed in the absence of Ground Speed).

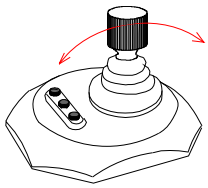
Selected Speed refers to the speed component towards the bow. In SLIDE Mode however, Selected Speed is the speed along the active route or track.

The Speed Mode is compatible with all Autopilot Modes. It also works with manual steering. On Twin Screw vessels, automatic differential thrust can be selected in the setup, for steering assistance at low speed (in Speed and Hover Mode).



***Speed**-Mode*
(toggle between SERVO or Turn Rate Mode)

ModifyTarget Speed with Joystick (by FWD - AFT movement)



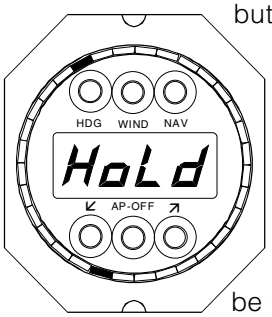
Speed change is possible on all Joysticks, when in Speed Mode

For SLIDE and STOP Mode consult separate NavOpsMemo

Hover and Anchor Mode

Hover Mode

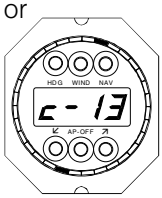
The Hover Mode is engaged with the AP-button on the Joystick. The vessel then holds its present GNSS-position, with the Joystick in Turn-Rate Mode.



Heading control may be transferred to the Wind Mode or Heading Mode (on the AP-Display or Wireless Remote), or to the Turn Rate Mode on a Throttle Station.

To cancel Hover or Anchor Mode, press any THR-button, or press NEUTRAL on the Wireless Remote.

Hover or Anchor position can be adjusted stepwise (sideways and forward or aft) with the Joystick or the Wireless Remote. For example push the Joystick left10 times for 10ft. to Port, or backwards, for 10ft. astern.



A plotter in the system will display the active Hover Position like a radar target named "HOVER" or "ANCR" or "STOP", according the active autopilot mode. Data are transmitted by the autopilot as a TLL sentence.

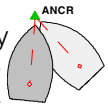
Hover Precision Level

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-3 is the recommended standard setting.

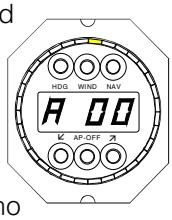
See NavOpsMemo page 11 for more details.

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 or with Jet Drives.

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.



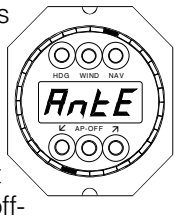
Anchor Mode may become engaged when Hover Mode is selected and the vessel has no Hover capability.

Standard Line length from the GNSS antenna to the virtual buoy is +/-12m and can be altered on the Display while in Anchor Mode. A negative number in the Antenna Offset will make a virtual Anchor buoy at 12m from the stearn, when selecting Anchor Mode.

On single screw vessels, thrusters may be switched off in Anchor Mode with the OFF Button on the Display, or turned on again with the Anchor Button. On Twin Screw vessels thrusters are not used in Anchor Mode.

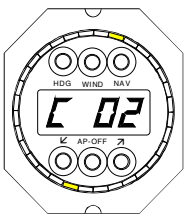
Antenna Display

It is posssible 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.**

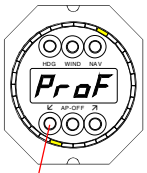


An Antenna Offset zero (C 00) will place the pivot point at the antenna position. A positive offset (e.g. C 02) will place it 2m from the antenna, towards the bow.

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



Profile Mode



The ***Profile Mode*** adds a Speed Profile to the Route in NAV or LAND Mode. The autopilot can read speed profile commands when these are coded into the waypoint names.

When selecting PROFILE without the presence of profile information in the waypoint name, the vessel will slow down and come to a halt in ANCHOR Mode at the upcoming waypoint.

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

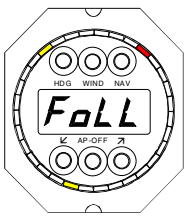
Note: *waypoint data must be available to the autopilot with a BWC or RMB sentence.*

Do not use PROFILE with a negative Antenna Offset! This will swing the vessel around, before tying up by the stearn at the upcoming waypoint.

Profile Mode is cancelled by selecting a different Speed or activating Manual Throttles or when the NAV or LAND Mode is terminated.

FOLLOW mode (automatic tracking behind another vessel)

Enable AIS or ARPA target data by pressing FOLLO on the Android Remote, or press NAV and HDG together on the Autopilot-Display, starting with the NAV button. **FOLLOW mode is armed but not yet engaged.**



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

Target ID of the vessel to follow (= MMSI number) must be inserted in the first line of the Autopilot Target List. Verify target bearing, distance and target course, e.g."c.360", 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.

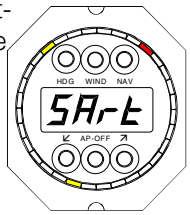
Use Manual Throttles or press SPD or PROF to engage Autothrottles. Speed control is now for **relative Speed**, starting with **closing speed zero**. A different closing speed can be selected on the Remote or with the Joystick and pops up on the Autopilot Display. Modifying the Selected Speed will cancel PROFILE, when it was armed.

Press PROFILE to arm for target capture (this feature is for synthetic targets, rather than real ones). **If PROF 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.

Note: FOLLOW mode will be interrupted when a SART/MOB target from the list becomes active or when target speed is less than 2 kn.

AIS MOB and SART mode

When an AIS SART or MOB beacon *of the own crew* is received, the autopilot starts beeping (short double beeps), the red NAV LED flashes while "SART" is displayed and engines automatically go into idle and out of gear (once, at first signal). Optionally in the setup, 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, in addition to the message "SART".

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, but may always be activated manually 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 comes to a halt at relative speed zero in front of the target, at 30 m (100 ft.) antenna distance. 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 red flashing NAV-button.

Whithout the installed Autothrottle System, the crew has to take manual throttles.

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 will show the AIS SART or MOB target on the plotter and in addition an ARPA (radar) target, which represents the position used by the autopilot for AIS-tracking.

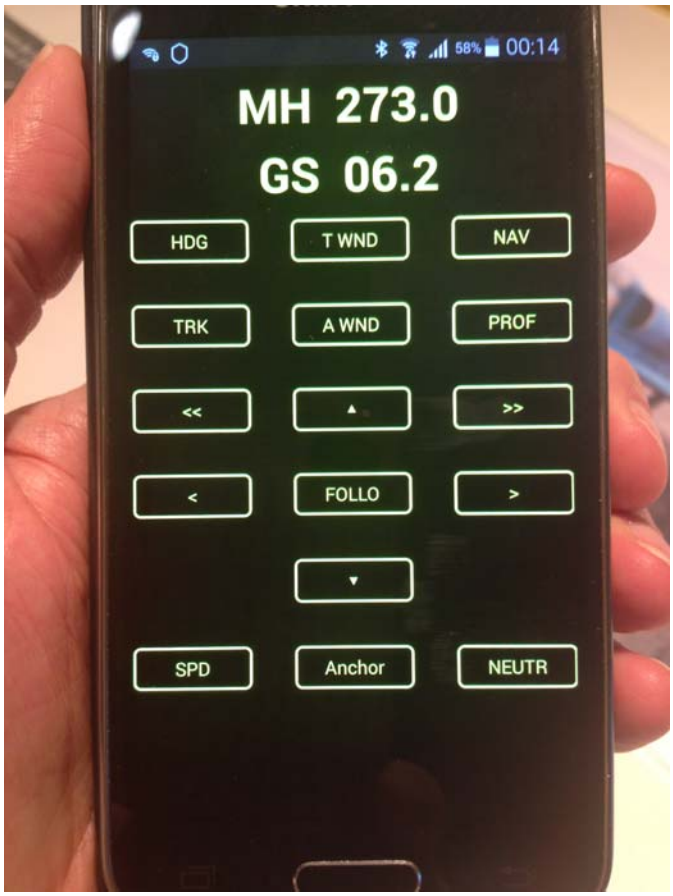
Route data from the plotter are not available as long as an AIS SART or MOB target from the Autopilot Target list is active.

Note:

There will be no automatic MOB or SART tracking out of Hover 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	prepare Follow Mode
SPD	engage Speed Mode
Anchor	engage Anchor Mode
NEUTR	Engines to Neutral

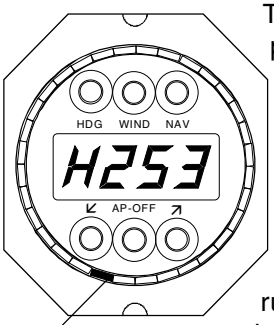
Jumbo Landscape (Galaxy Tablet)

Jumbo Portrait (Galaxy Tablet)

Set up of the Autopilot

Initial Operation

Before going through this chapter, make yourself familiar with "Display Configuration" on pages 25 .. 27



Rudder Angle LED visible!

The DRIVEBOX must be powered and connected to the bus. Make sure there is **no second Drivebox or FADEC-Box** connected to the bus at the same time, when viewing the configuration! Verify the rudder angle LED is lit in the lower half (3 to 9 o'clock), before proceeding (1 LED = 3 degrees).

1. Select Autopilot Configuration "-AP-" on any Autopilot Display (di=01) or on a Compass-Autopilot Display (di=02).

2. Briefly press left or right button (shows A0)

3. Move rudder **manually** into center position and rotate the sensor shaft manually through 360 degrees, until the rudder LED stands at 6 o'clock. **Note:** there might be a second shaft position with the LED in the middle, but the LED would not move gradually, when turning the shaft. Use only the "good" shaft position where the LED can be moved gradually. Then lock the sensor shaft to the rudder with its arresting screw.

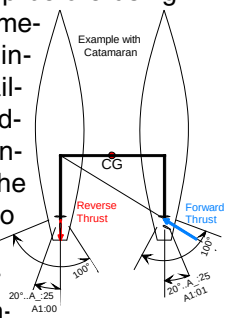
4. Rudder sense: use **A0:00**, move rudder manually to port (for a left turn!) and observe rudder LED also moving left. In case the LED moves the opposite way, alter **A0**. Take a note of the correct setting. Remark: one LED corresponds to three degrees rudder angle.

5. Attention: the rudder will move under power during the following step! Be prepared to press the "OFF"-button immediately if the rudder moves towards either end. Exit the setup mode and press the HDG button on the autopilot display and modify the selected heading by 2 degrees, or if you have a SERVO steering wheel *with an OFF button*, rotate it to the middle and press SERVO.

If the rudder moves to either end, press the "OFF" button immediately and switch off power to the DRIVEBOX.

In case of a reversible drive motor or in case of Servo Valves, reverse the leads at terminals 7 and 8 of the DRIVEBOX; for a continuous running pump and a proportional valve, reverse the leads for the valve at terminals 2 and 4 of the DRIVEBOX. For Danfoss-Valves modify A4* (0 or 1). Switch on power (again) and repeat step 5.

6. Adjusting the rudder travel limits: First set the rudder limit A6=16, to start with. Also set the offset "A_"= 00, put your rudder to the middle *of its range* and engage the autopilot in heading mode. Modify the selected heading by 12 deg (first right, then left) or apply full deflection on the Servo Wheel in "SERVO" mode, if there is one installed (exit setup before using SERVO). If the rudder reaches a mechanical stop, reduce A6, or increase A6 if more range is available. The mid position can be adjusted **mechanically** at the sensor, so as to make full use of the available range. Adjust **"A_"**, to make the boat run straight when the SERVO-wheel (or the rudder LED) is centered. If A1=00 increase A_ to turn the rudder to stbd (or to port if A1=01).



With two independent rudders or drives, the center will be set outwards by 15 to 20 degrees to permit spreading in Slow Mode.

Setup Parameters

Note: There are two sets of parameters. Selection of either set is done by A9.

A0:00 (00 or 01) Rotational sense of the rudder angle sensor (port / stbd).

A1:00 Number of the Autopilot Drive-Box. In case of two independent rudders, number 00 must be assigned to port and 01 to the STBD Drive-Box. Further, with Danfoss proportional valves, the idle signal can be adjusted by A1 within 1%, see also influence of A1 onto "A_".

A2:00 No rudder spreading and no inverse motion. Single rudder or two parallel rudders, twin Jet or Voith-Schneider Drives.

A2:01 No rudder spreading. Bow thruster **plus** a) two straight shafts or b) a single jet.

A2:02 Spread (split) rudders or drives in Slow Mode, rudder deflection reversed at the reversing engine, Bow Thruster optional.

A2:03 Spread rudders or drives in Slow Mode, rudder deflection reversed at the reversing engine in Slow and Normal Mode.

A3:01 automatic heading dead band 01=ON. The width of the dead band is determined from actual boat movement under present sea conditions. The dead band leads to less rudder motion with only slightly less steering accuracy, which is desirable for power saving on yachts, and to make the helm less nervous on boats with mechanical steering.

A4:08 (03..31) upper limit for rate of turn under autopilot (degrees heading change per second). Warning: limit ignored in LAND-Mode, may result in abrupt turns!

A5:07 **a) Reversible Pump:** This function is for current saving of a Bypass valve on terminal 3-4. A5=04 gives 18% of full current. For no reduction set A5=17. A too low current risks the valve falling open.
b) Direct driven Rudder or Thruster Proportional Valve on terminal 1-2 and 3-4: Minimum **rudder or thruster speed** is set by A5. A5=05 results in a minimum valve current of 22%. **Rudder or thruster** should move slowly under min. current, increase A5 if necessary
c) with voltage controlled proportional valve (Danfoss): A5=08? sets the "flow zero" voltage .

A6:16 Rudder travel limit. It works only when initial setup has been completed. Adjust to prevent the rudder drive from pushing against the mechanical stop.

A7:13 (06...30) Magnitude of autopilot rudder and thruster action, to be set as high as possible, for powerful rudder deflections. A too high A7 could result in heading oscillations, if the rudder drive is slow to follow large rudder commands (not to be confused with quick rudder oscillations, see A9). In SLOW Mode, rudder deflections will produce thruster action. Pulse length for ON-OFF thrusters will be TP=(Remainder of A7/4)+1 for Bow, and TP= 4-(Remainder of (A7/4) for Stearn.
Option: A7=31 provides stronger heading control by Thrusters at the expense of total sideways thrust by Joystick or in Hover or SLIDE Mode.

A8:

	Terminal 1..4:	**Terminal 7-8:**
00	Bypass/Clutch	reversbl. AP-Drive
01	--	--
02	Coolg.Fan(1-2)	reversbl. AP-Drive
03	Bow Thruster	reversbl. AP-Drive
04	Rudder Valves	Bow Thruster
05	Stern Thruster	reversbl. AP-Drive
06	Rudder Valves	Stern Thruster
07	Bow Thruster	Stern Thruster
08	--	Bow Thruster
09	Stern Thruster	--
10	Bow Thruster	--
11	--	Stern Thruster
12	Stern Thruster	Bow Thruster

A9:05 a) Stopping distance of the rudder drive. Faster drives need higher numbers. Try the lowest possible number which is not resulting in **quick** rudder oscillations. Note: rudder oscillations are not to be mistaken for heading oscillations and may be present with the vessel moored in port, when the autopilot or servo steering is on.
b) A9 is not applicable for Servo Valves.
c) A9=00 temporary setting for A0*..A8*

AA:12 (06..50) Max. speed. Thrusters are used automatically in Slow Mode when speed is less than 50% of AA. **AA=05 is for Azimuth Drives** (+/-90° steering angle)

A_:05 (00...31) The rudder center position can be offset by 0.8 deg per unit. A higher number turns the rudder to starboard, if A1=00, or to port, if A1=01. **A_:25** corresponds to 20 degrees offset.

Ac:00 This determines the type of an eventually connected Bow or Stearn Thruster. Ac=00 is for ON-OFF type thrusters (commonly electric) and Ac=01 is for proportional thrusters (normally hydraulic).

A-:00 sets NMEA output from the Drivebox (version 1.5 signal, use isolated input!):
A- =00 .. Test data out (ASCII term.)
A- =01 .. Set up flux gate HS8000
A- =02 .. HDM and VHW out (8 Hz each)
A- =03 .. VHW out (8 Hz)
A- =04 .. test heading instead compass
A- =05 ... CAN-Bus splitter for dual Bus
A- =06 ... NMEA bitrate = 9600

Second group of parameters A0*.. A8*, not identical to A0 .. A8. They represent a different set of parameters. The asterisk is not shown on the display unit. A0*.. A8* are displayed, when A9 has been set to zero previously.

A0*:00 Standard setting is 00. Only with proportional rudder valve set A0*=01.

A1*:00 Set A1*=00 for a single rudder drive or two parallel drives on two unconnected rudders. Set A1*=01 for two alternating drives or two parallel drives on the same rudder (hydraulic system).

A2*:03 A2*=00 automatic MOB mode is OFF. A2*=01..vessel turns into the wind A2*>01.. vessel turns towards MOB. ///
For a **proportional thruster** Boxtype 08P: on terminals 7 and 8, set the **valve *current*** by A2*= 02...07.
Boxtype 08PV: set **magnitude of thruster *voltage* signal** by A2*=10...15. Adjust A2* for the signal to change by 50% (e.g. 3V) at thruster step 10, if the zero signal voltage was 6V (the valve must be connected).

A3*:00 Type of rudder sensor: A3*=00 for 90-deg.sensor A3*=01 for 340-deg. sensor.

A4*:00 Set A4*=01 for two pumps working on the same hydraulic system (assisting each other). With Danfoss valves, use A4* to reverse the output signal.

A5*:00 Set A5*=01 for voltage controlled (Danfoss) proportional valves.

A6*:?? **a) twin independent rudders or drives:** Basic spread angle in Slow Mode. A2=02
b) single jet or twin shaft with bow thruster: variable amount of rudder for lateral thrust in Slow Mode. A2=01.
c) twin jet: variable amount of rudder for lateral thrust in Slow Mode. A2=00.

A7*:00 A7*=01 enables the Slow-Mode without a Tecnautic FADEC system installed. A microswitch on AUX-1 is required for sensing an engine in REVERSE (blue-cyan wires closed).

A8*:00 **a)** A8*=01 makes "pull down" signal for ON-OFF thruster on terminals 7-8 (Box 08P required) **b)** A8*=01 makes AP1 (port) a permanent SLAVE, even when AP2 is OFF, and when manually steering the starboard rudder.

Electric Helm connected to an AP-Display

The potentiometer of an electric helm can be connected to the sensor connection of an Autopilot Display. Such helm units are available from various manufacturers. The helm should have adjustable friction and **must have a middle detent**, which can be felt, to permit easy centering of the wheel. The display must be configured for sensor type SE=21, 22 or 23 and display type di=01 (autopilot display only). The helm must be calibrated before use as follows:

Calibration of the Electric Helm

The purpose is to adjust the potentiometer shaft mechanically in such a way, as to have the middle detent coincide with the middle of the potentiometer signal.

Here is the procedure:

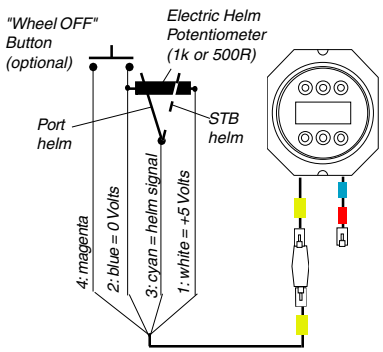
-- Place the helm into the middle detent and call up the configuration mode at the AP-Display, to which the helm is connected. The display will show "Con-FiG".

-- Press the lower left button once and the display will show the Serial Number.

-- Then press the lower right button: "MAnu" and the center-offset number will be displayed.
(In case you are installing a new potentiometer into a helm: rotate the potentiometer shaft but leave the helm resting in the detent. The aim is to get the smallest possible reading near zero. A number smaller than +/- 10 is good enough. Then lock the potentiometer shaft to the helm)

-- Next will be to store the center offset into the display memory. This is done by pressing the lower left button, while the helm sits in the detent. The answer of the display will be "CAL." in case of a successful calibration.
Return to normal operating mode by pressing the OFF-button once.

ATTENTION: if "CAL." is not displayed at the end of the procedure, the electric helm must not be used. Repeat the procedure.



SE=21: Automatic Helm Activation

The electric helm is activated automatically when using it. The autopilot would change into SERVO-mode, no matter in which mode it was. An eventual warning message on the AP-display (red LED) can be extinguished with its OFF button. The warning comes on whenever the autopilot has left an automatic mode, for example when it has switched from HDG-mode to OFF- or SERVO-mode.

If another helm unit has been in SERVO-mode or FBW-mode, the same mode will be present on the newly activated helm and the previously used helm will become inactive.

The AP-Display of an active helm is flashing "MAnu", which stands for MANUAL. Inactive helms are blinking slowly ("MAnu") if another electric helm is active.

An electric helm can also be activated manually by pressing the OFF-button of the associated AP-display, instead of rotating the helm.

Once an electric helm is activated, use the OFF-button of the AP-display to toggle between SERVO-mode and **Fly-By-Wire** mode (FBW). The FBW-mode can be recognized by an illuminated HDG-LED, next to the HDG-button of the AP-Display, same as in heading mode. The HDG-LED will be blinking during turns, or will be steady lit, when going straight. That gives a visual indication on the display, to check if the helm is resting in its center detent or not.

FBW-mode: the vessel is holding it's heading automatically, when the helm rests in the center detent. If the helm is deflected from its center position, a certain rate of turn will be commanded by the helm angle. Rudder movement is fully automatic, to achieve that rate.

Heading changes in FBW mode may also be made from the AP-Display, like in HDG-mode.

The electric helm becomes *inactive* when either another helm is activated or an autopilot mode is selected, or when a separate "Wheel OFF"-button (see diagram at the left) has been pressed. The helm ***and*** the autopilot will go off, if the Wheel OFF-button is depressed. Such action will be necessary, if a mechanical or hydraulic helm or a tiller shall be used for steering.

SE=22 or 23:

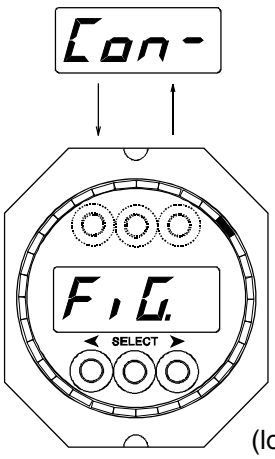
Activation of the helm is only done with the OFF-button of the associated AP-Display. The rest is identical to SE=21 above.

Display Configuration

applicable for displays with three or six push buttons

Note: you might not find all of the following possibilities on a display or you might even see additional functions on some displays.

Attention: During configuration, the display will not transmit data from a connected sensor to the autopilot.



ConFig menu:

1. Press and hold both outer (lower) buttons.
2. Without releasing the outer buttons, press the middle (lower) button four times briefly.
3. Then release all buttons. The "ConFig" mode will appear on the LCD.
4. Use the middle (lower) button to scroll through the ConFig menu:

8.8:8.8	Display Test
SE:00	Sensor Type Selection
di:00	Display Type Selection
dF:00	Display Function Selection
Gr:00	Display Group Selection
-AP-	Autopilot Configuration (or Trim Flaps if di=03). It is not available if di=00.
nMEA	NMEA in- and output

Sensor type Selection:

SE:00

Every display has an "analogue" sensor input (yellow/green marking on cable).

Use left and right (lower) button for selection of the type of the connected sensor, according table below.

For "Digital" Sensors, which are connected to the NMEA in- and output (red marking), like a **Magnetic Compass, a Depth Sounder or a GPS, the NMEA in- and output has to be configured** (see p.28).

Any sensor may be connected to any display. E.g. a wind sensor may be connected to a display with "COMPASS" imprinting, if SE:06 has been selected.

SE:00 - SE:13

00 **No Sensor** connected
01 ***One*** single Log Sensor
02 left Log Sensor (with Mixer)
03 right Log Sensor (with Mixer)
04 left alternating Log Sensor
05 right alternating Log Sensor
06 Standard Wind Sensor
07 Wind Sensor for rotating mast
08 Mast Angle Sensor for rotating mast
09 Heading Gyro: aligned by GPS track only
10 Heading Gyro: aligned by GPS or comp.
11 Heading Gyro: aligned by compass only + Hover (Anchor) button
12 Heading Gyro: aligned by comp. or GPS + Hover (Anchor) button
13 Roll Gyro
14 Rig Load Sensor
15 Anchor button + Display Dimmer
16 Manual Take button and Display Dimmer
17 AP+depth Alarm and Display Dimmer
18 Depth Alarm and Display Dimmer
21 FBW Wheel: autom. selection;only di=1
22 FBW Wheel: manual select.; only di=1
23 FBW Wheel: manual select.; only di=1

Note: If no Sensor has been connected, **SE must be set to zero.**

If **SE:xx** comes on automatically or the function cannot be exited even by switching power off and on, it indicates a **Sensor Number Conflict!** Every display on the bus could be the reason and has to be checked for correct "SE"-number. Only one SE=06 is allowed! Wind data from an external NMEA device must not arrive, before an eventually present Tecnautic Wind sensor is sending its data to the Display.

Display Type Selection:

di:00 - di:03

Use the left and right (lower) buttons to set the desired display type:

di:00 Multi Function Display. All display functions can be activated on a display with di=00 (Log, Wind, Compass etc.)

di:01 Autopilot Display (with six push buttons)

di:02 Compass Display with Autopilot Function (three buttons)

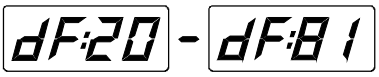
di:03 Trim Flap Display (with six push buttons)

Display Function:

This selection defines, which function will be available on a Multi Function Display (i.e. any display with di=00, independent of the printing on the display bezel).

The right (lower) button is used to scroll from one "Function Number" to the next.

The left (lower) button is used to "activate" or "deactivate" the function. A function has been activated (can be displayed), if the function number is steady. A function has been deactivated (cannot be displayed), if the function number is blinking:



Primary Functions:

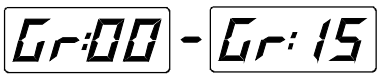
32 Thrusters, Engines and Rudders
F0 Autopilot Fail Codes (see page 50)
11 Gyro signal monitor (for testing only)
20 Log Speed
24 Log Speed 15 sec average (no LED)
23 Trip Distance (resettable)
91 NAV: GPS GND-speed and GND track
30 Apparent Wind (+/- 180 degrees LED)
31 Apparent Wind (expanded LED)
34 True Wind angle and speed
28 Rig Load Sensor
61 Heading Hold (with LED pointer)
62 Magnetic Heading (no LED)
75 Depth

Secondary Functions:

33 Mast Angle (for rotating mast)
35 Magnetic Wind (direction and speed)
36 VMG
64 Rate of Turn (deg / sec)
82 Water Temperature
83 Timer
22 Total Log Distance (cannot be reset)
93 Antenna offset (m) from hover center
90 NAV: Course, XTE, Dist., Time to WP
92 Selected Boat SPD and Engine rpm
77 Depth Unit Selection (meters or feet)
81 Voltmeter

Note: for ease of use, activate only the necessary functions

Illumination Group:



Use the left or right push button to set the group number of every single display unit:

Gr:00 Group Zero = "Master"; When the illumination level (brightness) is set on a display with group number zero, all displays will follow in brightness, independent of their own group number.

Gr:01 .. Gr:15 When changing the brightness on a display with group numbers 1 to 15, only those displays with the same group number will follow.

Autopilot Configuration

This function is only available on an Autopilot Display (di=01 or di=02).

When that legend is shown, apply briefly the left or right lower button, to switch to the first Autopilot Parameter "A0". Be careful not to modify A0 inadvertently!

Thereafter the middle (lower) button is used to scroll to the remaining parameters "A1" to "A-". The left or right button is used to alter the respective parameter.

Only A0 and A6 should be modifyed by the customer during installation. Other parameters should only be altered after consulting with the manufacturer.

The customer should receive a diagram with the recommended parameters for his vessel.

See page 22/23 for significance of the parameters.

Manual Helm Take Over button (Tiller button):

A separate push button can be connected to a Dsiplay unit (with setting SE=16) or to the Drive-box at the AUX-2 connector (with JP1 closed).

Briefly pressing this button disengages the autopilot and the Fly-By-Wire Servo-Wheel.

By holding the button for 3 seconds, the autopilot engages in HDG mode, similar to the application of the HDG button on the AP display, or to the AP button of the Fly-By-Wire Station. The HDG-gyro must be operating.

Installation of the Take-Over button **at the tiller tip** is recommended for yachts with tiller steering. Otherwise install this button within easy reach of the manual helm.

NMEA input and output

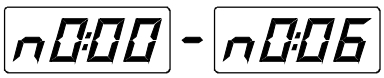
Every display has a NMEA in- and output (red cable marking). From the 

NMEA configuration window use the left or right lower button to display the first parameter "n0:00". Thereafter use the middle button to scroll to the next parameter in sequence (n1, n2, n3).

The left and right buttons are used to alter n0, n1, n2, n3 according to the table below:

IMPORTANT: The NMEA configuration must be entered on **every** display unit, where the NMEA in- or output is used.

NMEA-0183 input:



From the received NMEA sentences below, specific data fields are read, when **n0=00, 01, 02 or 06**.

These data are used for the displays or the autopilot. They can supplement or substitute log, wind or compass data from own sensors.

n0=00 Standard NMEA-0183 **input:** the sentences APB, BOD, BWC, BWW, DBS, DPT, GLL, HDM, HDG, HDT, MTW, MWV, RMB, RMC, TTM, TLL, VHW, VTG, VWR, WDC, WDR, XTE are read. For the PB200 / H2183 sensor set n0=01 or 02, also **n1=07** for the HDG input and **n2=07** to set up for a secondary position data input.

Sentence:		**Data read from sentence:**
APB:	a)	Cross Track Error
	b)	Mag and True bearing between waypoints
BOD, BWW:		Mag bearing between waypoints
BWC,BWR:		Mag.Brg+Dist of pres.pos. to way point and waypoint Lat/Long
DBS, DBT, DPT:		Depth (meters)
GLL:		Lat / Long; Remark: set n3=01 to also accept NMEA-1.5 format
HDM, HDG, HDT:		Magnetic or True Heading
MTW:		Water temperature (deg. Celsius)
MWV:		Apparent Wind Angle and Speed
RMB:		Cross Track Error, Bearing+Distance to WP
RMC:		Ground Track, Speed and variation
RMV:		Proprietary N-S and E-W speed
VHW:	a)	Magnetic Heading
	b)	Water Speed (knots)
VTG:		Ground Track (mag) and Speed
VWR:		Apparent Wind Angle and Speed
WDC:		Distance to Waypoint
WDR:		Distance to Waypoint
XTE:		Cross Track Error (NM)

use HDT or RMB data only when also receiving RMC with mag. variation

n0=01 Compass Sensor (#1) connected
n0=02 Compass Sensor (#2) connected
n0=03 reserved
n0=04 Echo Box-1 connected
n0=05 Echo Box-2 connected

NMEA-0183 output:

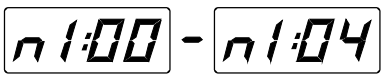
For an output of several available sentences, set **n0=06**. This will transmit the sentences DPT, VHW, MWV, VWR, MTW, RSA, ROT and VTG at a repetition rate of 2Hz.

The GLL sentence output can be added by setting n3=01. However, the pace of all sentences will be slowed down to the input rate of the GLL sentence, which often comes from the GPS only once every two seconds.

Note that the GLL sentence cannot be output from the same display unit, where it has been received.

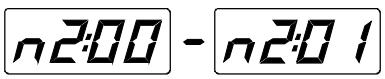
Selected sentences output:

First set n0=00. Then set n1, n2 and n3 as shown below to activate one or more sentences put out:



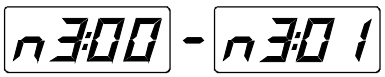
NMEA-0183-output

n1=00 OFF, no HDM, VHW or VTG-output
n1=01 HDM + ROT out (heading and turn rate) repetition at 2Hz.
n1=02 HDG + VHW (heading out at 16Hz). It disables any other sentence output.
n1=03 VHW (heading and log speed) at 2Hz.
n1=04 VHW + VTG out (heading, log speed + ground-track and gnd-speed) at 2Hz.
n1=07 configures PB100/200 heading output



NMEA-0183-output

n2=00 OFF, no VWR-output
n2=01 VWR out@2Hz: rel. wind angle+speed
n2=07 configures PB100/200 for GLL-output
n2=08 saves output configuration to PB100/200



NMEA-0183-output

n3=00 OFF, no GLL-output
n3=01 GLL out (Lat./ Long.) Note: this output may slow down other sentence outputs to the repetition rate of the GLL input from the GPS.
n3=02 $PTHOV out, Hover specific data. SE=00 must be! Reads VTG ***True*** Course at 9600 Baud!
n3=03 Port speed 9600.

Output sentence data content:

GLL	Lat / Long
DPT	Depth (corrected by offset)
HDG	Heading (from Gyro or Magnetometer)
MWV	True relative Wind Angle and Speed
MTW	Water Temperature (degrees C.)
RSA	Rudder Sensor Angle
ROT	Rate of Turn (degrees/minute)
VHW:	a) Gyro Heading, if available (fall back to magnetic heading)
	b) Water Speed (knots)
VWR	a) Apparent relative Wind Angle
	b) Apparent Wind Speed (knots)
VTG	Ground Speed and magnetic Track

NMEA-2000

Use the Tecnautic CAN-Bus Bridge to join the Tecnautic CAN-Bus with an NMEA2000 Bus.

Data from Plotters, Instruments, Autopilots, Sensors and Engines will be available in both networks, without the use of NMEA-0183 connections.

NMEA-0183 data *input at Joystick or FBW Throttle Station:*

The following sentences can be received: APB, BOD, BWC, BWW, HDM, HDG, MWV, RMB, RMC, VHW, VTG, VWR, WDC, WDR, XTE.

(No data in or output at a mobile station on a spiral cord)

Mind the Bitrate (4800 or 9600), same setting is valid for input and output of the same unit.

Drivebox and FADEC-Box NMEA-0183 Data Input:

The following sentences can be received: APB, BOD, BWC, BWW, HDM, HDG, RMB, RMC, VHW, VTG, VWR, WDC, WDR, XTE.

For Bitrate and Output configuration, see "configuration" of the Drivebox or FADEC-Box.

NMEA-0183 data *output from Joystick or FBW Throttle Station:*

The NMEA-0183 data configuration can be set individually at each unit.

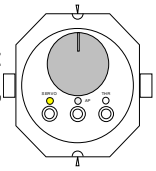
To enter Configuration Mode at the Joystick or Throttle Station: press and hold left and right button (SERVO and THR), then - while holding the buttons - press four times the middle button (AP), then release all.

(in case the station had been locked - shown by red flashes - it will be unlocked)

The red LED (AP) should be ON now, which signals Step 1 of the configuration mode ("P1").

You can use the left button (SERVO) to advance to steps 2, 3, 4, 5, 6, 7 and zero. The right button (THR) serves to exit from configuration mode.

If there is any uncertainty, at which Step the unit is, press the right button (THR) to exit.



For NMEA settings go to Step P6: *only the left LED will be on.*

P6 can have four different values, which can be modified (increased) with the AP button. The value is signaled with short beeps, e.g. two beeps signals P6=2. After P6=4 follows again P6=1.

P6=1:
Illumination Group (of this unit) = 1
NMEA Bitrate = 4800
0183 Output sentence: HDG and TLL

P6=2:
Illumination Group (of this unit) = 2
NMEA Bitrate = 9600
0183 Output sentence: HDG, TLL, MOD

P6=3:
Illumination Group (of this unit) = 3
NMEA Bitrate = 4800
Output of proprietary Test Data

P6=4:
Illumination Group (of this unit) = 4
NMEA Bitrate = 9600
0183 Output sentence: HDG, TLL, MOD

Repetition rate of all sentences is 8Hz

Note: Output of TLL (selected Hover Point position, which can be used for Plotter Display) requires that GLL (actual position) be entered at a different unit, not the same Joystick, for example.

Configure the output of the Plotter or PC

Activate NMEA-0183 output:

It is important to make the necessary settings on your Plotter or PC, to activate the transmission of route data towards the Tecnautic Autopilot and instruments. Here are a few hints, for consideration:

** The Tecnautic Autopilot and Display units use magnetic bearings, not true bearings. It is recommended to select magnetic bearings in the setup of the Plotter.

** Create and activate a route or waypoint on your plotter. Verify that bearing "C", cross track error ("r" or "L") and distance to the active waypoint are displayed on the Autopilot Display. At least bearing and cross track error are required to permit use of the autopilot NAV mode. For LAND Mode, GND Speed is also required, to be received directly, not via the Plotter, if possible.

** If the plotter permits, activate only the following sentences for output: APB and BWC. If this selection is not available, use other sentences from the table on page 27 (lower left), to receive the required data. For example APB can be substituted by (BOD+XTE), BWC by RMB.

** The Anchor or Hover Mode works best with GLL and RMC received at 5 or 10Hz, at 9600 Baud, with five decimal digits of minutes.

** Select a high repetition rate of the route data output on your Nav equipment. For fastest data processing, it is recommended to read RMC at one NMEA port (Display or FBW unit), and GLL, APB and BWC at another port. Do not duplicate readings of GLL and RMC data at different NMEA ports.

** Accuracy of the transmitted **cross track error** data (XTE) of the Nav equipment can be selected on some Plotter models. Select **four or more decimal digits, if available.**

The autopilot **LAND mode** can only be used, when **at least three decimal** digits of cross track error are received. If the third decimal digit on the AP-Display remains always zero, it can mean that it is not sent. Four decimal digits are needed for good accuracy.

The autopilot **NAV mode** can be used with only two decimal digits received. The resolution of the cross track error in this case is only 0.010NM (18.5 meters) however.

** Curved tracks: If the Plotter does ***not*** support curved tracks, you may split a curved approach into a series of consecutive short tracks. The difference to the next track should not exceed 20 degrees, when requiring accurate tracking in **LAND-Mode**.

** The *way point switching law* has to be set up properly in the Plotter. It is recommended to select switching (to the next leg) "when abeam", or "before abeam", where "before" should be set to 5..10 seconds (or 0,010 NM).

Without verifying this setting, the plotter might switch too early to the next way point, already **far ahead** of the active way point. Ideally, switching should occur so as to result in XTE zero at the end of the course change.

Anchor, Hover and Speed Mode

Position data **GLL, BWC and RMB** waypoint location should be received with **five decimal digits** (of minutes), for highest accuracy in HOVER and ANCHOR mode. Minimum is four decimal digits. A high repetition rate for GLL (position) and RMC (speed) of 5 to 10Hz is desirable.

In Hover Mode the Autopilot tries to stabilize the vessel's center of gravity within a couple inches. Position and speed data of common antennae may however differ considerably from the Center of Gravity's position, when the vessel is rolling and pitching. If an inertially stabilized position and speed sensor is not available, selecting the HDG or WIND Mode during Hover will give a smoother reaction of the Autopilot.

Verify on the Tecnautic Display that ground track data are not frozen by the antenna at low speed (<0.1kn).

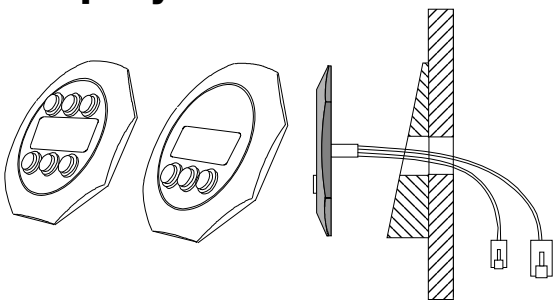
Mounting location of GPS antenna*:*

The antenna **must not be mounted aft** of the vessel's center of gravity.

When the autopilot is commanding a turn, an aft mounted antenna will pick up a speed in the opposite direction. This may lead to heading oscillations in LAND mode.

Cabling

Display Installation



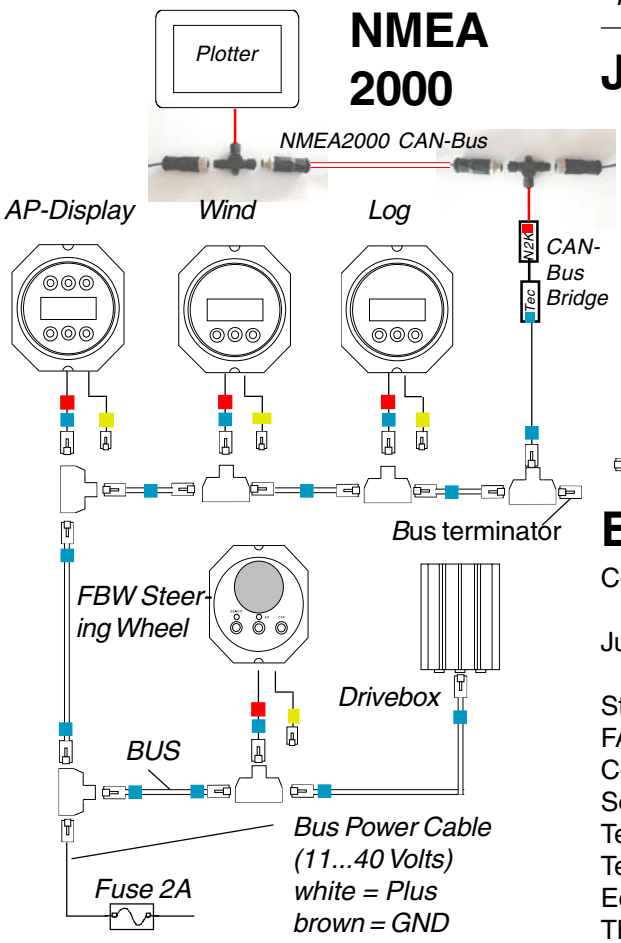
Attention: The cable entrance at the rear as well as the plugs themselves must remain dry.

Displays should be mounted inclined backwards, so that the LCD will be read slightly from below. Otherwise readability will be degraded at night.

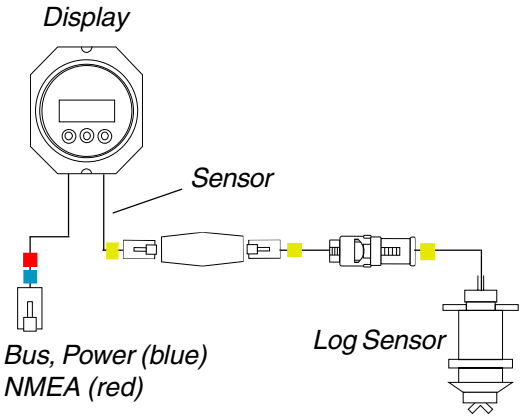
The autopilot display or the compass display respectively, should be mounted within reach of the helmsman.

Installation has to be made on a flat surface to avoid bending of the display housing.

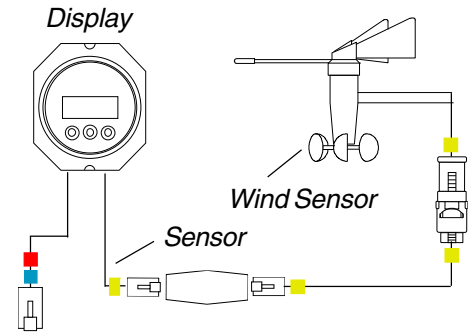
Bus Connection



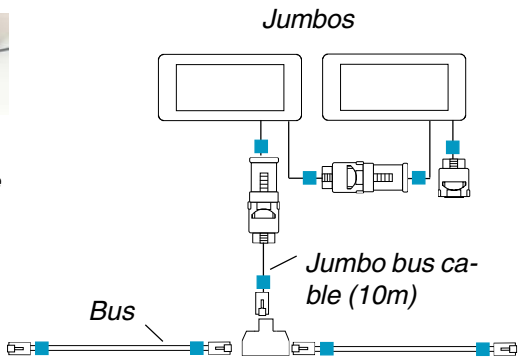
Log Sensor



Wind Sensor



Jumbo Displays



Electrical Specifications

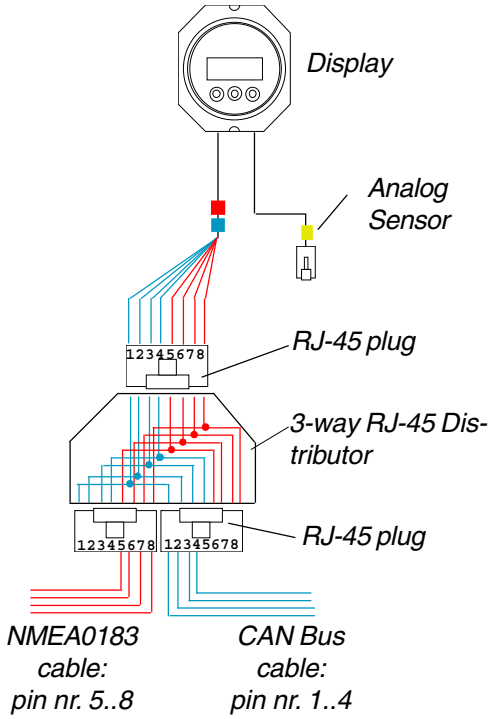
Cockpit Display: 25...50 mA @ 11...40 Volts
(with illumination: 35...90 mA)
Jumbo Display:20...45 mA @ 11...40 Volts
(with illumination: 25...75 mA @ 11..40 Volts)
Steering Wheel: 15...40 mA @ 10,5...40 Volts
FADEC or Drivebox: 35...70 mA @ 9...40 Volts

Compass Sensor:	45 mA
Sonic Heading Gyro:	5 mA
Tecnautic Wind Sensor:	1 mA
Tecnautic Log Sensor:	2 mA
Echo-Box w/ Sensor:	50 mA

The lower current is for the higher voltage.

NMEA0183 Connection:

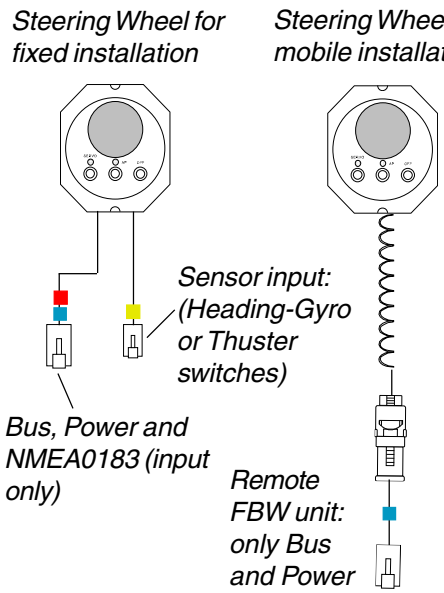
NMEA0183 equipment (like the Compass Sensor) is connected via the NMEA0183 Connection of a display unit. **Attention: use only the bus distributor next to a display unit!** The NMEA-wires are not present in the bus cable!



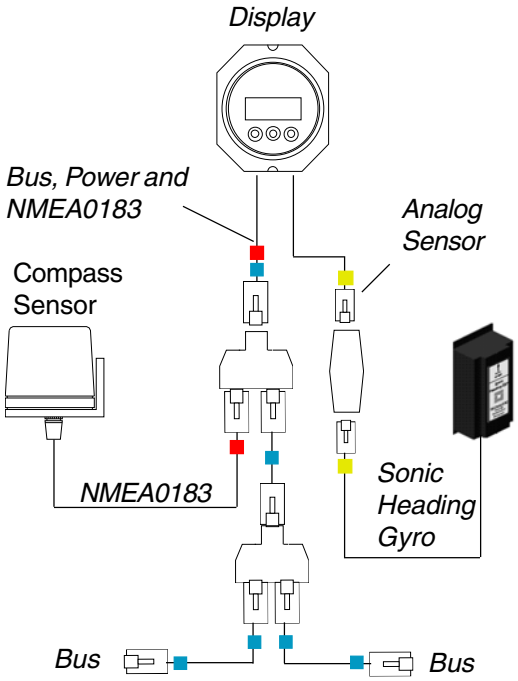
The CAN Bus cable (blue markings) does not carry the NMEA0183 wires (5 to 8).

Therefore it is not possible, to connect NMEA0183 equipment (like a Compass Sensor or a GPS) to the CAN Bus. NMEA0183 devices can only be connected to the distributor that sits directly at a Display Unit.

FBW Steering Wheel



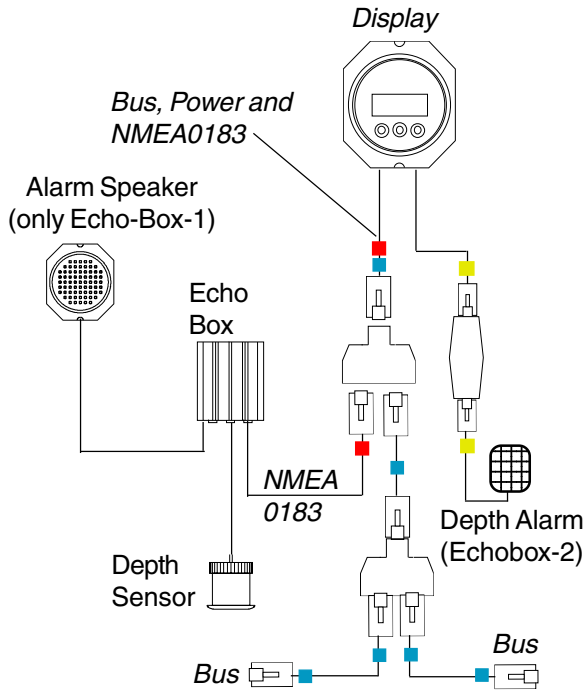
Compass Sensor and Sonic Heading Gyro



The Compass Sensor is connected to the NMEA0183 input of the display.

Attention: use only the bus distributor next to that display unit!

Echo Box and Sensor

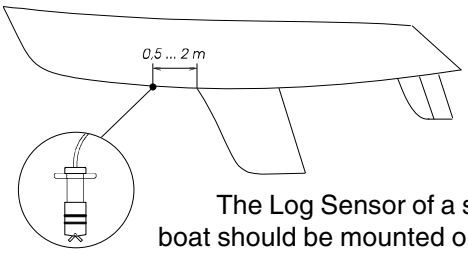


The Echo-Box is connected via the NMEA-0183 Connection of a display unit.

Attention: use only the bus distributor next to that display unit!

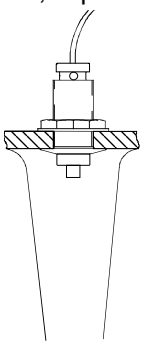
Log Sensor mechanical Installation

Location of Log Sensor



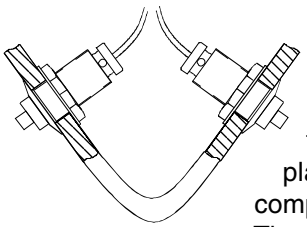
The Log Sensor of a sail boat should be mounted on the centre line. On V-shaped hulls it may be mounted a few centimetres away from the centre line.

It should also be easily accessible from inside, to permit cleaning.



Keel (seen from the front)

In case of yachts with deep V-shape and long keel, a second log sensor should be added. This second sensor is connected to any available display unit, e.g. to a compass display.



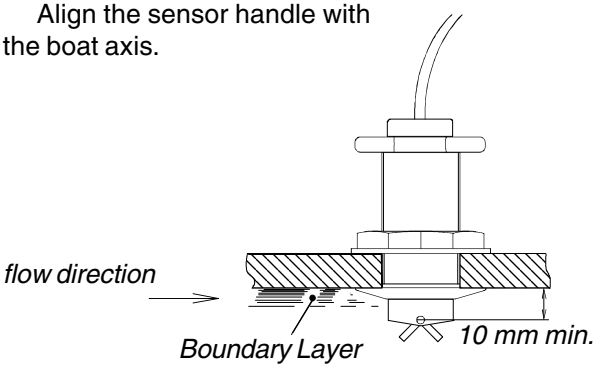
The display configuration will then be set to **SE:02** and **SE:03** respectively. Speed is averaged over both sensors. Should one sensor fail (stop) or be disconnected, only the remaining one will be used automatically.

The boundary layer

Measuring boat speed is not possible inside the boundary layer, since flow speed is not proportional to boat speed.

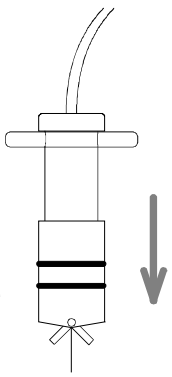
Therefore always push the sensor down as far as it will go. The paddle wheel must be outside the boundary layer.

Align the sensor handle with the boat axis.



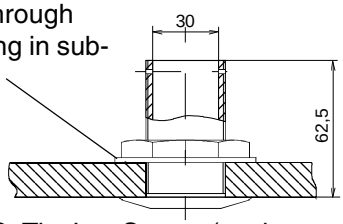
Regatta Speed Sensor

Note: The Sensor could pick up electromagnetic noise. Avoid vicinity of high currents (battery or battery cable).



Attention: In case of a wooden hull, a soft rubber washer should be placed under the nut.

Swelling of the hull could break the through hull fitting, resulting in subsequent flooding.

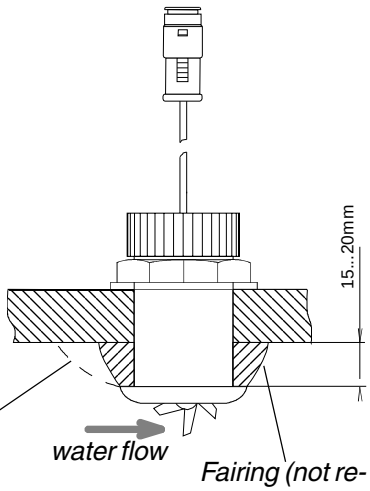


WARNING: The Log Sensor (or alternatively the sealing plug) must always be secured with the locking spring, to prevent unintentional retraction by water pressure or other force.

Never grease the O-ring seals of the sensor, otherwise it might be pushed up by water pressure towards the locking spring and the paddle wheel will be fully or partly retracted.

Cruise-Speed, Planing Boat or Universal Speed Sensor

Note: The Sensor could pick up electromagnetic noise. Avoid vicinity of high currents (battery or battery cable).



Attention:
If the fairing has not a steep leading edge, the boundary layer might be diverted towards the paddle wheel!

Fairing (not required for planing boats!)

Installation of a fairing (of non swelling material) is recommended on displacement hulls (not on planing hulls), to place the paddle wheel outside the boundary layer.

WARNING: The Speed Sensor (or alternatively the sealing plug) must always be secured by tightening it firmly, to prevent unintentional retraction by water pressure or other force.

Airmar CS4500 Ultra-Sonic Speed Sensor

How the Ultrasonic Speed Sensor Works

The speed sensor uses ultrasonic pulses to collect echoes from small particles in the water as they pass under two transducers embedded in the insert. These transducers monitor the particles in their respective beams. As the boat travels through the water, both transducers “view” the same stream of particles.

Because it takes time for particles to travel between the two transducers, the aft transducer detects the particles later than does the fore transducer. By measuring this time lapse, the instrument calculates the boat speed. The ultrasonic speed sensor requires particles in the water to obtain echoes. If the boat is airborne even for a short time or in highly aerated water, the sensor will measure an incorrect speed.

IMPORTANT: The ultrasonic speed sensor must be in good contact with the water at all times for the sensor to function properly.

Compass and Heading Gyro Installation

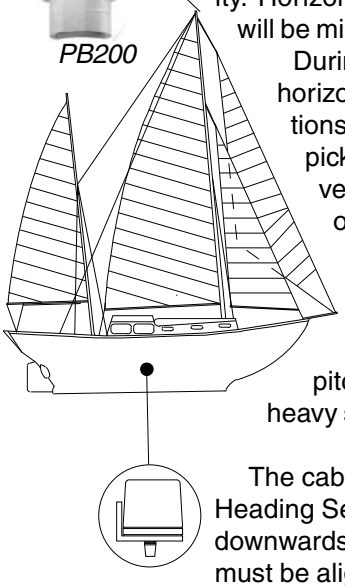
Compass Sensor

Install the sensor at a magnetically undisturbed location. Steady magnetic fields are allowed, if they do not cause more than 20° deviation.

PB200

In the absence of a Heading Gyro, the sensor should be installed near the vessels center of gravity. Horizontal accelerations will be minimal there.

During prolonged horizontal accelerations, the sensor will pick up part of the vertical component of the magnetic field. This can cause large heading errors during roll and pitch motion in heavy seas.



The cable outlet of the Heading Sensor must point downwards and the marking must be aligned with the forward direction of the boat.

Observe the maximum operating voltage of the sensor!

Be aware that the greatest danger lies in movable magnetic objects like small radios, tools, keys, cell phones, the steering compass or a hand bearing compass. A good compromise for above points is often found in a cabinet where clothes are stored. Select a mid level, not at the floor and not just under deck. An anchor chain on deck could make your autopilot turn sharply! Also batteries and their leads can produce strong magnetic fields when the battery is charged or discharged; a distance of two meters from these sources is adequate.


H2183

On steel hulls, an above deck installation is required.

The sensor cable may be extended as necessary.

After installation, the sensor has to be aligned parallel to the vessel's axis. Improper alignment results in a constant heading error on all headings, e.g. always +4°.

At first align the sensor roughly with the mark, to point forward. The next step is to create a deviation table by taking relative bearings from deck. Use the vessel as a bearing compass for a known object and compare the magnetic bearing obtained from the chart with the displayed heading. Use the align function as explained on page 7 and do a compensation cycle only in accordance with page 7.

Sonic Heading Gyro

The TECNAUTIC Sonic Gyro is a strap down heading gyro with a so called vibrating gyro element.

When connected to a properly configured display unit, all compass displays in the system will display the Gyro Heading (see compass and autopilot functions).

The Gyro Heading is neither fluctuating nor has it acceleration errors.

The Compass Sensor or a GPS is still needed to prevent long term drifting of the gyro.

Fluctuations of the Magnetic Heading Sensor have no effect on the Gyro Heading. The Sonic Heading Gyro needs no damping and transmits all heading changes instantly.

For the autopilot the heading is transmitted with a 0.1 degrees resolution every couple milliseconds.

Installation:

The Sonic Gyro must be mounted vertically on a wall with no or little vibration.

Attention: temperature changes can affect the accuracy of the heading. Therefore choose a location where temperature is not changing rapidly, e.g. inside a closet, and protect it from sunshine or other radiated heat.

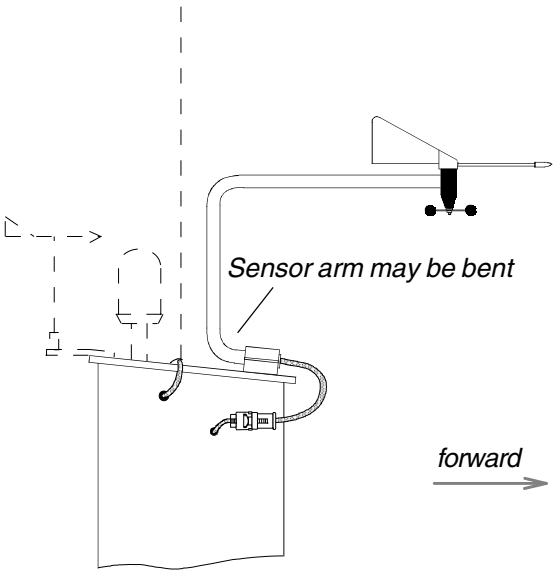
Tecnautic Windsensor

(Use separate instructions for the PB200 Sensor)

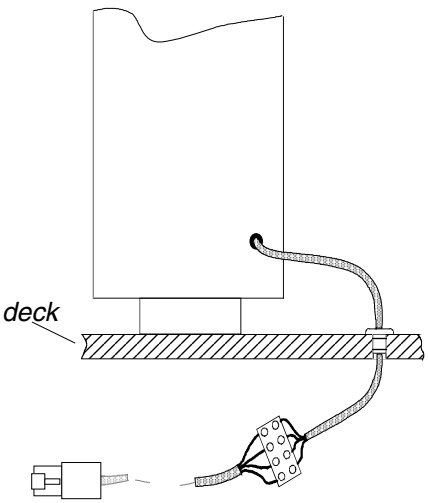
The Wind Sensor must be installed at the forward end of the mast top and its arm must point forward, so as to give the most accurate readings, when close hauled or reaching.

The direction of air flow is nevertheless altered by the presence of the sail underneath. To avoid the resulting inaccuracies of true wind direction, speed and VMG, the wind sensor can be mounted on a small mast about 2 m (7 feet) above the mast top.

The mast cable should be held at the mast top with a cable tie, in order to relief the plug from any strain. The cable must not come in contact with moving halyards.

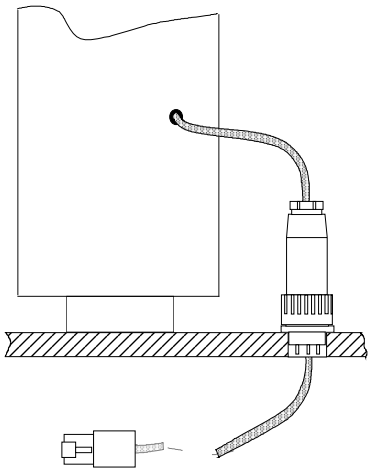


mast



Operating information: when powering up the wind display, the anemometer wheel is driven electrically for a period of two seconds, to break any eventually present cob webs.

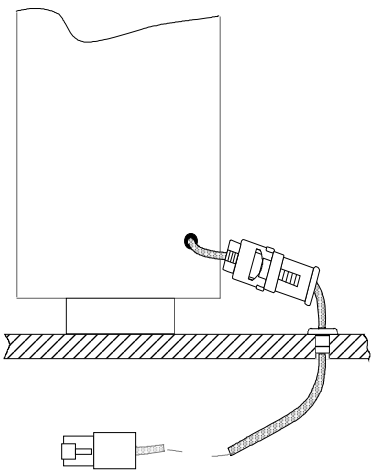
Through deck connector: For easy mast removal, a sealed connector may be mounted. Only gold plated contacts are allowed, because of the low signal level. Silver plated contacts will also work for some time.



Through deck connector (fixed)

Connector installation:

contact-Nr.	lead color	signal:
1	white	+5 Volts
2	brown	0 Volts
3	yellow	wind angle
4	green	wind speed

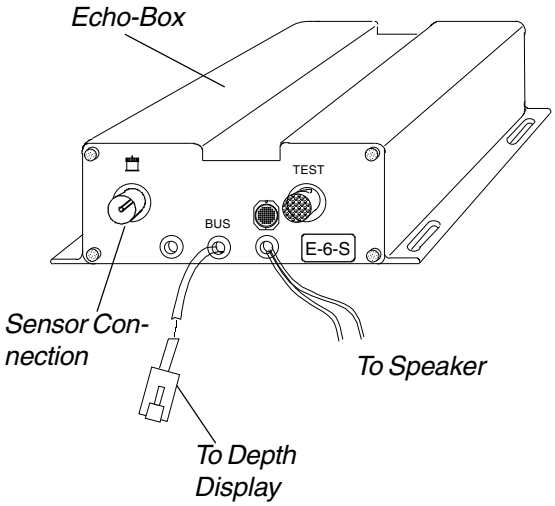


Sealed through deck connector (flying)

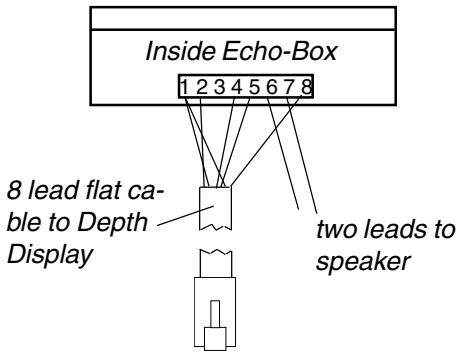
(see page 49 for plug installation)

Echo-Box-1 and -2

The Echo-Box should be mounted at a dry and accessible location.



Electrical Connection Echobox-1

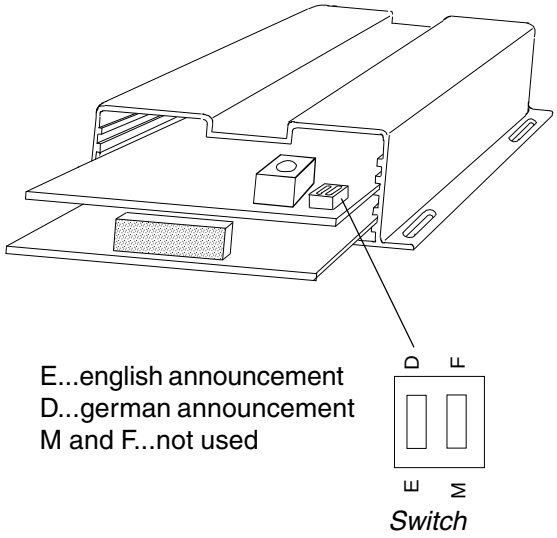


Lead Nr.	Lead Color	Signal	Terminal Number in **Echo-Box**
in the plug			
1 (white)	white	+10..28V	2
2 (brown)	blue	GND	1
3 (green)	cyan	CAN+ .... do not connect!	
4 (yellow)	magent.	CAN- .... do not connect!	
5 (grey)	white	IN-B (to Box)	4
6 (pink)	orange	IN-A (to Box)	5
7 (blue)	brown	OUT-B	1
8 (red)	red	OUT-A	8

Speaker Installation Echobox-1

The speaker should be placed into a cabinet in such a way, that the speaker is sealed from the rear side. This is important for good sound quality. Without such a sealed cabinet, the sound will be distorted and rather weak.

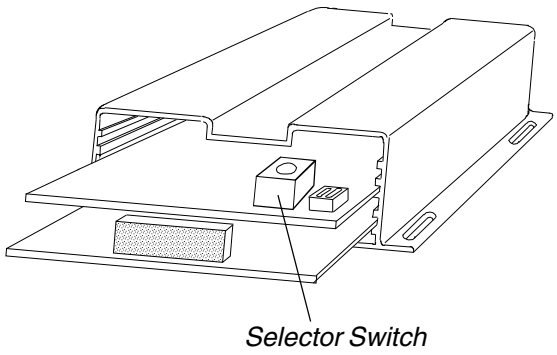
Language Selection Echobox-1



E...english announcement
D...german announcement
M and F...not used

Switch

Sensor-Frequency Selection Echobox-1



Selector Switch

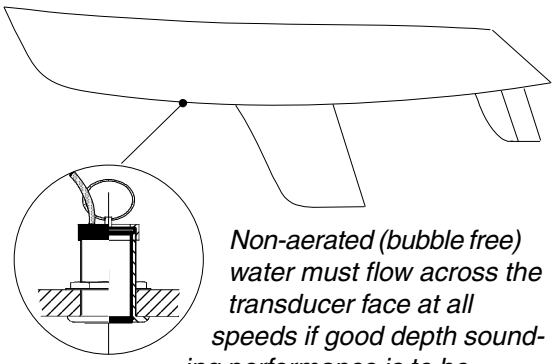
The Echo-Box1 can work with depth transducers of various frequencies within the range of 140 kHz to 160 kHz. Switch position # 8 is the lowest frequency, # 7 is the next higher one, and so on, and # 9 is the highest frequency.

In case the depth transducer is replaced, the new number must be selected on the switch. It can be read from a tag on the cable on all Tecnautic-supplied sensors.

An unknown sensor frequency can be found by selecting a switch position with which the echo sounder would work satisfactory at higher depth values.

Echo-Sensor Installation

Location of the Depth Sensor



Non-aerated (bubble free) water must flow across the transducer face at all speeds if good depth sounding performance is to be achieved. The transducer should be located, where the following conditions can be met:

1. On sailboats the transducer shoud be mounted where the acoustic beam will not be shaded by the keel. A spot forward of a fin keel is usually best. Try to find an accessible spot with a minimum dead rise angle.

2. On displacement hull power boats (e.g. trawlers), the transducer should be mounted amidships, relatively close to the keel (centerline of hull).

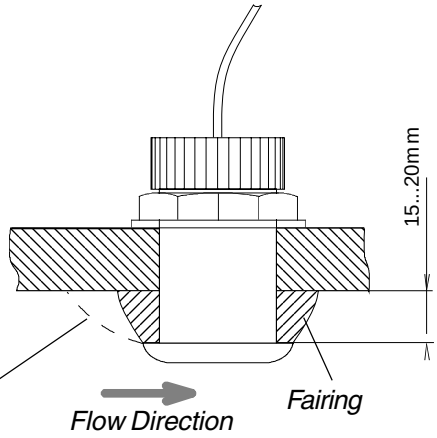
3. On planing power boat hulls, the transducer should be mounted well aft and close to the keel to insure that the transducer is in contact with the water at higher boat speeds. If the vessel is capable of speeds greater than 25 knots, you may wish to review installation location and operational results on similar boats before proceeding.

4. Never position a depth transducer directly behind shaft struts, fittings and paddle wheel speed transducers, since the turbulence can adversely affect depth transducer performance.

5. On I/O's (stern drive) transducer mounting close to the engine(s) usually yields good results. On inboards always mount the transducer well ahead of the propeller(s). Turbulence from props seriously degrades transducer performance. Make sure transducer is not shaded by the prop shaft(s).

6. It is very important that the mounting location have reasonable access from inside the vessel since the transducer will require tightening from inside the hull.

7. The transducer transmits also some energy sideways into the hull. If the returning echoes from inside the hull are strong enough to be received, an acoustic isolation between housing and hull will be required. Any soft (porous) material may be used.



Attention: the fairing must not be too flat; otherwise the boundary layer would be deflected onto the transducer face!

8. At speeds above 10 kts the turbulent boundary layer will provide a shield for the transmitted and received signals, preventing any echo sounder operation. To overcome this, a fairing of non swelling material should be fitted, to place the transducer face below the boundary layer.

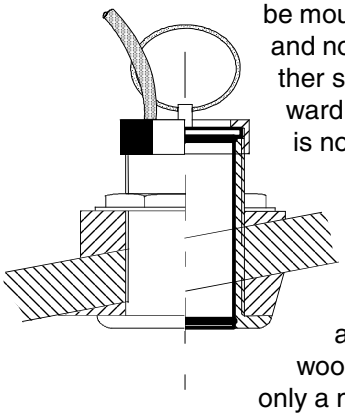
Maintaining the Depth Transducer

Antifouling paint: If the vessel is kept in saltwater, sea growth can accumulate rapidly on the transducer face and seriously reduce performance in a matter of weeks. It is recommended that the external face of the transducer be coated with an antifouling paint. Use only mineral spirits based antifouling paint. Do not use Ketone based paints since they attack the potting materials used in the transducer. If fouling does occur, use a stiff brush or putty knife to remove growth. Wet sanding of fouled transducer face is permissible with NR. 220 or finer grade type emery paper (use plenty of water).

Standard installation with through hull fitting

Advantage of a through hull installation is, that there are no doubts if and how well the sound waves will pass through the hull (compared to a within hull installation).

There are a few points to be considered for the through hull installation:

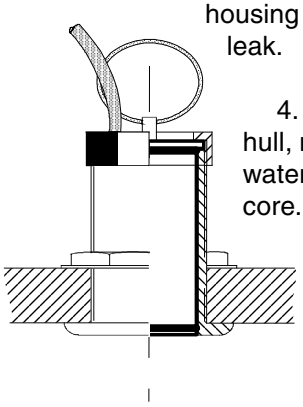


1. The sensor should be mounted vertically and not inclined, neither sideways nor forward or aft. If the hull is not level, a fairing has to be fitted outside and inside.

2. In case of a wooden hull or wooden fairings, use only a metal through hull fitting.

Swelling of the wood may over stress the plastic housing. Also hauling the vessel may over stress and crack the housing.

3. Do not expose a plastic through hull transducer to solvents. The housing might crack and leak.



4. In case of a cored hull, make sure that no water can enter into the core. This might require bonding of a tube to the inner and outer hull, before installing the transducer housing.

5. Do not use metal housings on metal hulls. Electrolytic corrosion will occur.

Always tighten the lid firmly!

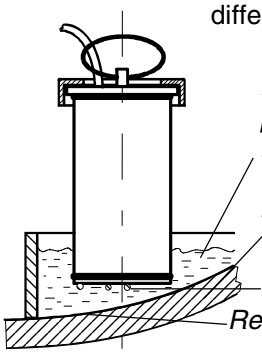
Within hull installation

This kind of installation is only possible on compact non porous plastic hulls.

It is not recommended for boats faster than 10 kts.

Steps of installation:

1. The boat must be in the water. A "sonic window" has to be found in the hull, **where the echo sounder works!** The first step is to find a place where the sound waves can penetrate the hull without losses. This test is absolutely required, because there is no other way to find out. The vessel must be in the water at a place where echoes are not absorbed by mud or other soft ground. This test can best be done with the vessel under way over different sea bottom.



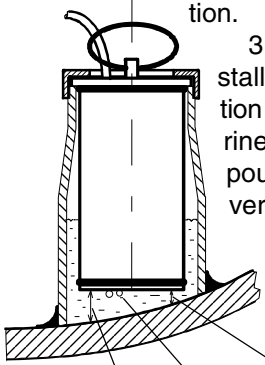
Provide a provisional patch of water at the desired location

Plastic hull (not to be very thick)

Remove air bubbles!

Remove paint and insulation

2. Choose a location where the hull is not very thick. Check also points 1) to 7) listed under “location of depth transducer”. They are equally valid for a within hull installation.

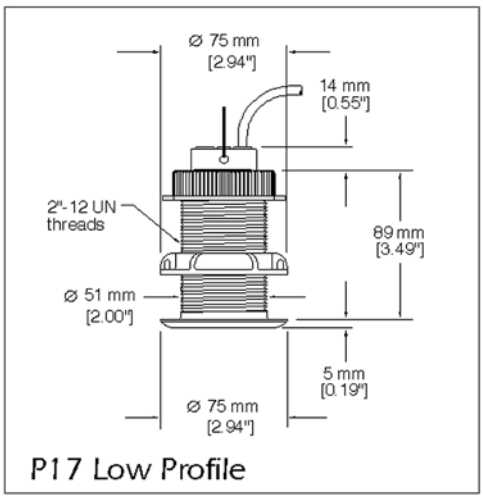


3. The third step is to install the housing at the location determined. Select a marine bedding / caulking compound e.g. Sika 221. Install vertically and fill with water or oil. The transducer face must be in the fluid even when the vessel is heeled.

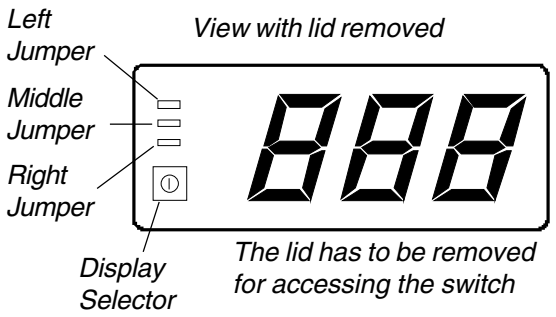
Minimum gap 1 mm

No bubbles under the transducer!

Not more than 20 mm from the hull!



Jumbo Display: Function



The following functions are available when the **jumpers (above) are left open:**

Display Selector

1 **SPD** > **5.7**

Boat Speed in 0,1 kts.

2 **HdG** > **335**

Compass Heading in Degrees.

3 **tru** > **20.5**

True Wind Speed in 0,1 kts.

4 **tru** > **120**

True Wind Angle (+/- 180 degrees)

5 **dir** > **275**

Wind Direction (degrees magnetic)

6 **APP** > **15.4**

Apparent Wind Speed in 0,1 kts.

7 **APP** > **- 35**

Apparent Wind Angle (+/- 180 degrees)

8 **vMG** > **H7.5**

VMG in 0,1 kts.

9 **Eco** > **4.9**

Depth in 0,1 m or 0,1 ft (unit selection on Multi Function Display)

Display Selector

0 **con** > **FiG**

The JUMBO Display works similar to a Multi Function Display when the Display Selector is in position zero. Use the jumpers in the same way as the push buttons on the Multi Function Display.

Leave the jumper open, if the button is not to be pressed (or set the jumper only onto one of the two pins).

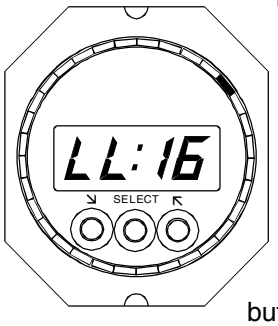
The first active function will be displayed after power on.

If the configuration is to be changed, use the jumpers in the same way as the push buttons on a Multi Function Display.

Note: after turning on power to the JUMBO Display, it takes 30 seconds before the digits start working.

Illumination

If you have a dimmer installed in the system, use it. Otherwise use the push buttons of a Multi Function Display for illumination control. This display must be set to the same Display Group Number as the Jumbo Display:



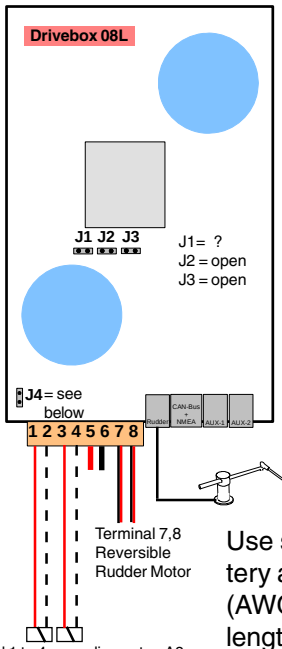
1. Press and hold all three buttons.
2. Release SELECT button first, then the others.
3. Adjust brightness with left or right button.

All other displays with the same group number will follow in brightness.

4. Exit from the function with the SELECT-button.

Autopilot Connection

Reversible Rudder Motor (mechanical or hydraulic): A0*=00, A5*=00, Ac=00



Jumper J1 may be closed to activate AUX-2 for Tiller Button (manual take over button).
J1 also inverts the rudder display sense.

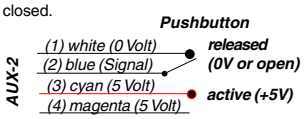
Power Supply
Terminal 5 = +12...24V
Terminal 6 = negative
(fuse with **15A**)

Use short wires for battery and motor! 2.5 mm² (AWG12) up to 3m (10ft) length. Double gauge for double length.

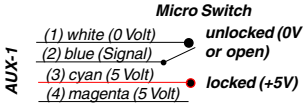
Terminal 1 to 4 according setup A8:
-Bypass+clutch A8=00 J4=closed
-cooling fan A8=02 J4=closed
-Bow Thruster A8=03 J4=open
-Stearn Thruster A8=05 J4=open

A8	Terminal 1-4:	Terminal 7-8:
00	Bypass 3-4, clutch1-2	revers. AP Drive
02	Cool.Fan on 1-2	revers. AP Drive
03	Bow Thruster	revers. AP Drive
05	Stearn Thruster	revers. AP Drive

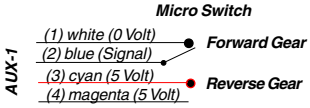
Tiller Button for manual Take over
A push button may be connected to AUX-2 (installed at the helm or tiller). J1 must be closed.



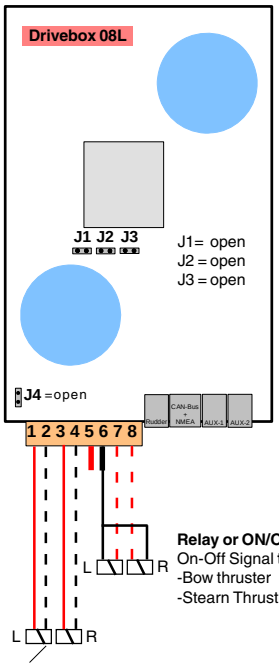
A7*=00 ... for Thruster Lock out
A thruster lock out signal may be connected to AUX-1 to lock out a retracted thruster.



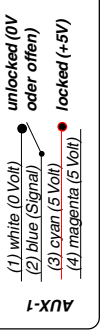
A7*=01 ... SLOW Mode without FADEC
A gear shift *IN REVERSE* signal is connected to AUX-1. Select A7*=01 in the setup menu.



Thruster Box (electric or hydraulic On/Off) A0*=00, Ac=00



A7*=00 ... for Thruster Lock out
A thruster lock out signal may be connected to AUX-1 to lock out a retracted thruster.



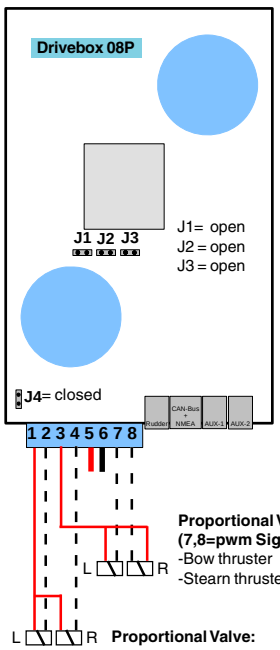
Power Supply
Terminal 5 = +12...24V
Terminal 6 = negative
(fuse with **15A**)

Relay or ON/OFF Valve
On-Off Signal **to positive**
-Bow thruster A8=08, 12
-Stearn Thruster A8=07, 11

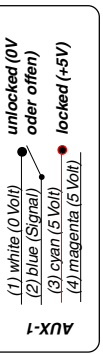
Relay or ON/OFF Valve
On-Off Signal **to negative**
-Bow thruster A8=07, 10
-Stearn Thruster A8=09, 12

A8	Terminal 1-4:	Terminal 7-8:
07	Bow Thruster	Stearn Thruster
08	--	Bow Thruster
09	Stearn Thruster	--
10	Bow Thruster	--
11	--	Stearn Thruster
12	Stearn Thruster	Bow Thruster

Thruster Box for Proportional Valve A0*=00, Ac=01, A8*=01



A7*=00 ... for Thruster Lock out
A thruster lock out signal may be connected to AUX-1 to lock out a retracted thruster.

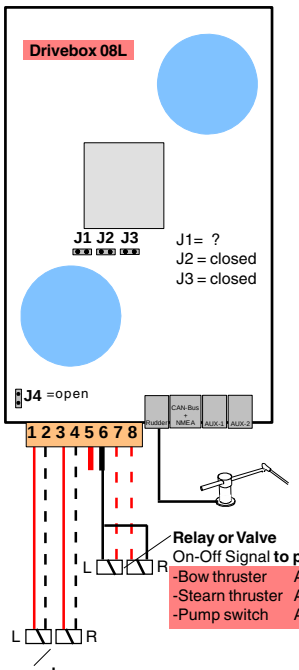


Power Supply
Terminal 5 = +12...24V
Terminal 6 = negative
(fuse with **15A**)

Proportional Valve:
(7,8=pwm Signal to negative)
-Bow thruster A8=08, 12
-Stearn thruster A8=07, 11

Proportional Valve:
(2,4=pwm Signal to negative)
-Bow thruster A8=07, 10
-Stearn thruster A8=09, 12

Rudder valve On/Off (A0*=00), Thruster On/Off (Ac=00)



Jumper J1 may be closed to activate AUX-2 for Tiller Button (manual take over button).
J1 also inverts the rudder display sense.

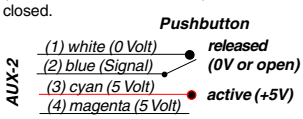
Power Supply
Terminal 5 = +12...24V
Terminal 6 = negative
(fuse with **15A**)

Relay or Valve
On-Off Signal **to positive: Ac=00 A8*=00**
-Bow thruster A8=04
-Stearn thruster A8=06
-Pump switch A8=00 (7=+/8=-) with Box08L

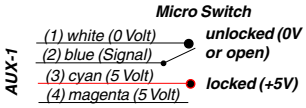
Relay or valve:
On-Off Signal **to negative: A0*=00**
-Rudder A8=00, 04, 06

A8	Terminal 1-4:	Terminal 7-8:
00	Rudder Valve	**Pump (7=+/8=-)**
04	Rudder Valve	Bow thruster
06	Rudder Valve	Stearn thruster

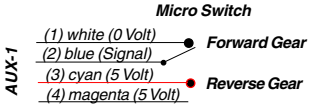
Tiller Button for manual Take over
A push button may be connected to AUX-2 (installed at the helm or tiller). J1 must be closed.



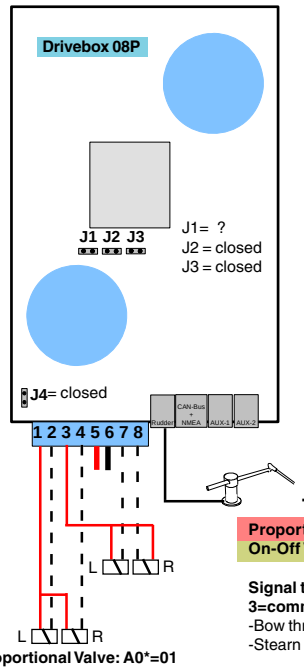
A7*=00 ... for Thruster Lock out
A thruster lock out signal may be connected to AUX-1 to lock out a retracted thruster.



A7*=01 ... SLOW Mode without FADEC
A gear shift *IN REVERSE* signal is connected to AUX-1. Select A7*=01 in the setup menu.



Rudder and Thruster Control with Proportional Valve (pwm Signal directly onto solenoids): A0*=01, A5*=00, Ac=01



Jumper J1 may be closed to activate AUX-2 for Tiller Button (manual take over button).
J1 also inverts the rudder display sense.

Power Supply
Terminal 5 = +12...24V
Terminal 6 = negative
(fuse with **15A**)

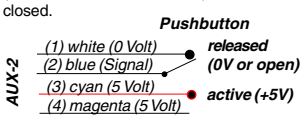
Thruster Term. 7-8:
Proportional Valve: Ac=01 A8*=00
On-Off Valve: Ac=00 A8*=01

Signal to negative
3=common positive
-Bow thruster A8=04, 08, 12
-Stearn thruster A8=06, 07, 11

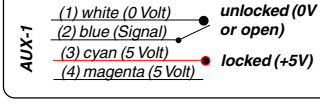
Proportional Valve: A0*=01
(pwm Signal to negative)
-Rudder A8=00, 04, 06
-Bow thruster A8=03, 07, 10
-Stearn thruster A8=05

A8	Terminal 1-4:	Terminal 7-8:
00	Rudder Valve	--
04	Rudder Valve	Bow thruster
06	Rudder Valve	Stearn thruster
07	Bow thruster	Stearn thruster
08	--	Bow thruster
09	Stearn thruster	--
10	Bow thruster	--
11	--	Stearn thruster
12	Stearn thruster	Bow thruster

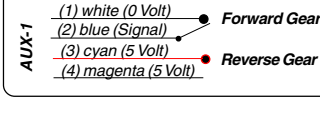
Tiller Button for manual Take over
A push button may be connected to AUX-2 (installed at the helm or tiller). J1 must be closed.



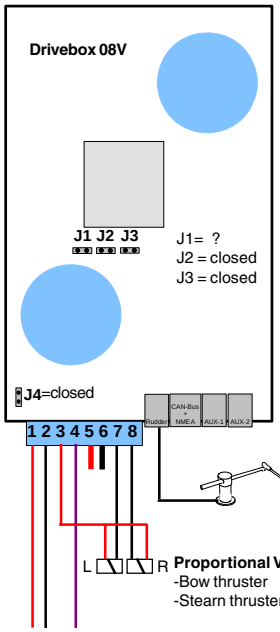
A7*=00 ... for Thruster Lock out
A thruster lock out signal may be connected to AUX-1 to lock out a retracted thruster.



A7*=01 ... SLOW Mode without FADEC
A gear shift *IN REVERSE* signal is connected to AUX-1. Select A7*=01 in the setup menu.



Rudder Control with Proportional Valve (Analog Signal), Thruster with pwm Signal directly onto solenoids: A0*=01, A5*=01, A5=08, Ac=01



Jumper J1 may be closed to activate AUX-2 for Tiller Button (manual take over button).
J1 also inverts the rudder display sense.

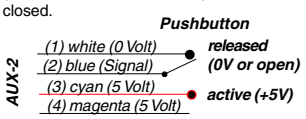
Power Supply
Terminal 5 = +12...24V
Terminal 6 = negative
(fuse with **5A**)

Proportional Valve (pwm to negative):
-Bow thruster A8=04, 08, 12
-Stearn thruster A8=06, 07, 11

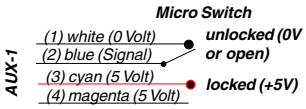
Analog signal to Danfoss PG32 Proportional Valve:
-Rudder A8=00, 04, 06

A8	Terminal 1-4:	Terminal 7-8:
00	Rudder Valve	--
04	Rudder Valve	Bow thruster
06	Rudder Valve	Stearn thruster

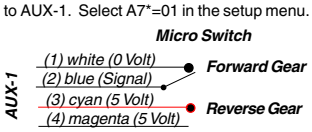
Tiller Button for manual Take over
A push button may be connected to AUX-2 (installed at the helm or tiller). J1 must be closed.



A7*=00 ... for Thruster Lock out
A thruster lock out signal may be connected to AUX-1 to lock out a retracted thruster.

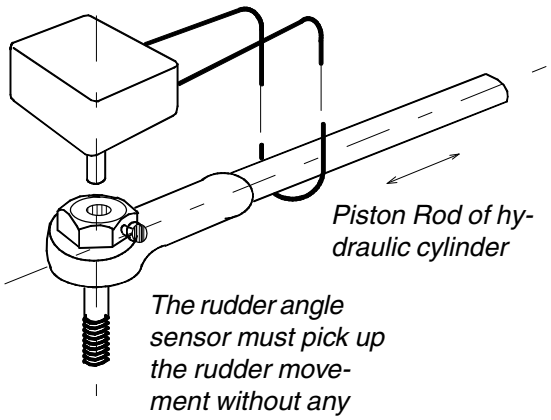


A7*=01 ... SLOW Mode without FADEC
A gear shift *IN REVERSE* signal is connected to AUX-1. Select A7*=01 in the setup menu.



Rudder Angle Sensor Installation

Standard version for mounting on the cylinder piston rod



The rudder angle sensor must pick up the rudder movement without any play.

ATTENTION: The hook length must be adjusted so as not to interfere with the cylinder, when the piston is fully retracted!

To adjust the hook length, proceed as follows:

1. Remove the lid on top of the Sensor
2. Unscrew the hook
3. Adjust the hook length and tighten the hook screws
4. Close the lid

The hook must be bent so as to guarantee a firm grip of the piston rod, even when it is moving vertically! There must be absolutely no play.

WARNING: make sure the hook does not interfere with the rudder arm at full rudder deflection!!!

The sensor is supplied with a hook. The hook is properly bent for a piston rod of 16 mm (5/8") diameter.

A hole (6,5 mm / 2/8" diameter and 10 mm / 3/8" deep) should be drilled along the axis of the bolt. A second hole with a 3 mm (1/8") thread is required to fix the shaft of the potentiometer in the bolt. For different conditions, the wire hook may be bent as required.

If the linear drive unit has been supplied by TECNAUTIC, the bolt with properly drilled holes is provided by the factory.

Checking the Sensor after the installation and setup procedure has been completed

Do not proceed with this test before completing the initial installation and setup (p.22)!

Switch on the SERVO mode, if an electronic steering wheel is installed and turn the wheel to the middle position.

Or, if there is no electronic steering wheel available, have the boat moored firmly, so as not to change its heading. Place the rudder amidships and engage the autopilot HDG mode. Verify the displayed heading to be stable, before engaging the autopilot.

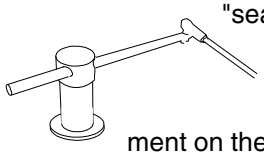
The rudder should be steady at this stage.

Now try to apply very light sideways force with your finger tip onto the hook of the rudder angle sensor. If there is play, the rudder will move. Eliminate the play!

Play leads to rudder oscillations and inaccurate steering.

Conventional Rudder Sensor Installation

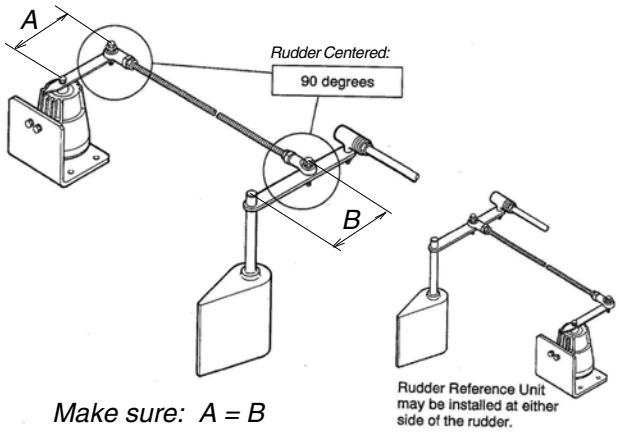
In case of an existing rudder actuator, it might be easier, to install the sensor in a conventional way. Tecnautic recommends its "sealed rudder sensor" (part nr. 23 00 03) for that purpose.



There is no requirement on the orientation of the sensor. The sensor arm A and the effective arm B at the rudder must be of equal length. Only with stern drives A can be bigger than B, to achieve larger rudder deflections.

Symmetric conditions are required in the case of two independent rudders or stern drives.

NOTE: there must be a 90 degrees angle between the arm and the connecting rod, when the rudder is centered.



Make sure: A = B

Linear Drive Unit: Installation

Electro-hydraulic Linear Drive for Tiller-Steering and mechanical Wheel-Steering

Geometric Situation

Fist of all, the geometric layout must be determined. The support with the joint at the rear cylinder end will be attached to the hull structure. The piston rod will be connected to the rudder arm with a bolt.

The cylinder may be mounted in front or behind the rudder shaft, the sense of rotation does not matter.

The piston rod must move in the same plane as the rudder arm. This is achieved by aligning the cylinder support mounting surface perpendicular to the rudder shaft. The length of the rudder arm "F" can be taken from the table next side. The lateral distance "G" should be about (0.86...0.90)R.

The required length of the autopilot tiller arm can be determined after measuring the vessels' maximum rudder deflection: shortly before each cylinder end position, full starboard or port rudder should be reached. Do not use the cylinder as the mechanical rudder limiter.

The standard rudder angle sensor is providing the rudder angle output signal for an angular range of +/- 45 degrees.

The maximum available rudder deflection under autopilot or servo steering can be changed. See "Autopilot Function / Initial Operation" or "Control Wheel Function / Initial Operation".

Installation Hints

The autopilot tiller arm must be locked onto the rudder shaft by a key or wedge. Transmission of the torque by friction alone requires a very heavy design of the arm.

In case a rudder quadrant is present, the piston rod should be attached to it, eliminating the need for a separate tiller arm.

The drive installation must be very rigid and stiff. Especially the distance between rudder shaft and rear cylinder mount must not change under the load of the cylinder force.

Installation

1. Replace the transport tank cap with the cap from the box; it has a breathing hole!

2. Purge air now according procedure below! Then remove the rudder angle sensor from the tiller arm bolt and keep it hanging on the cylinder rod with its hook. Then tighten the tiller arm bolt and the cylinder support screws. Reinsert the rudder angle sensor into the tiller arm bolt, but ***do not lock*** its shaft with the M3 locking screw yet. This will be done during "initial operation".

Fill up the hydraulic tank half way (use automobile automatic transmission fluid available at gas stations). Never use "hydraulic fluid"!

Installation of detached pumps

The pump must be located higher than the cylinder. Air from the cylinder must be able to ascend to the pump. The reservoir must be the highest point in the system.

Adjustment of pump flow

Some pumps permit mechanical adjustment of the pump flow. Always select the maximum pump flow (factory setting).

Rudder Speed Selection

A high maximum rudder speed is desirable for good autopilot function. However it is a must for Servo Steering. A low maximum rudder speed can lead to heading oscillations.

Danger! Therefore the maximum available rudder speed (pump flow) should always be selected. The *Tecnautic Drive-Box* is regulating the pump speed electronically and reducing rudder speed automatically, whenever necessary.

Purging the Hydraulic System

Before installation, it is necessary, to purge air from the hydraulic cylinder and to add automatic transmission fluid to the hydraulic tank, but not more than half full. **The "shipping" tank cap has to be replaced with the regular one, with a breathing hole, before moving the piston and use of the drive.**

For verification connect the Bypass Valve to the battery. Even under great force, the piston rod cannot be moved more than 1 mm (1/32 in.) if air has been purged completely.

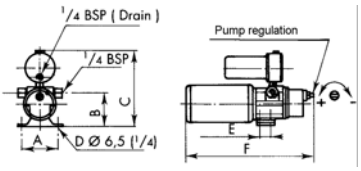
The following symptom will always require purging of the system:

If the rudder can be moved mechanically (by direct force onto the rudder), when the autopilot or Servo Steering is engaged. Exception: very small movements of the piston (less than 1 mm) are permitted.

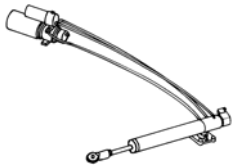
To purge air: disconnect the rudder and the sensor. Switch on SERVO or AP and turn the sensor shaft slowly until the piston hits the cylinder end firmly. Then hit the other end firmly. Repeat 10 times with full rudder speed.

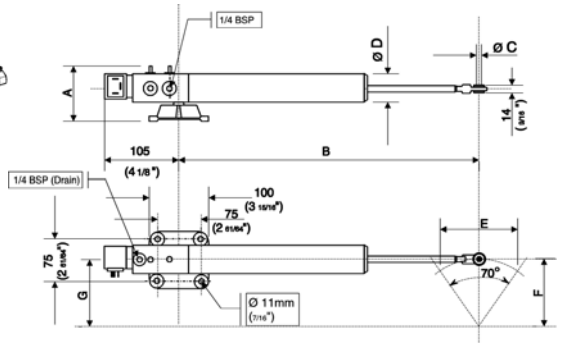
Type V2H32S, V2H40S and V2H50S (Lecomble & Schmitt)

TYPE	V2H32S		V2H40S		V2H50S		V2H53S	
Cylinder weight	3.5 kg	7.7 lbs	3.5 kg	7.7 lbs	5.0 kg	11 lbs	5.0 kg	11 lbs
Torque	500 Nm	369 ft.lbs.	1000 Nm	739 ft.lbs.	2000 Nm	1478 ft.lbs.	2000 Nm	1478 ft.lbs.
Cyl. Dimensions	mm	inches	mm	inches	mm	inches	mm	inches
A	120	4 23/32"	120	4 23/32"	130	5 1/8"	130	5 1/8"
B	563	22 11/64"	627	24 11/16"	727	28 5/8"	727	28 5/8"
C	15	19/32"	15	19/32"	17	43/64"	17	43/64"
D	46	1 13/16"	56	4 55/64"	70	2 3/4"	70	2 3/4"
E	200	7 7/8"	240	9 7/16"	300	11 13/16"	300	11 13/16"
F Tiller Radius	180	7 5/32"	210	8 17/64"	260	10 15/64"	260	10 15/64"
G	165	6 1/2"	190	7 31/64"	240	9 7/16"	240	9 7/16"
Pump Weight	RV1 ST		RV2 ST		RV2 ST		RV3 ST	
	4.5 kg	10 lbs	4.5 kg	10 lbs	4.5 kg	10 lbs	7.0 kg	15.5 lbs



Pump Dimensions	RV1 ST RV2 ST		RV3ST	
	mm	inches	mm	inches
A	80	3 5/32"	100	3 15/16"
B	70	2 3/4"	95	3 3/4"
C	170	6 11/16"	195	7 11/16"
D (number)	4		2	
E	24	15/16"	0	0
F	280	11"	315	12 25/64"





The tiller radius "F" (on the right side) is for a maximum rudder angle of 35 degrees. Use table below for different angles.

Rudder Arm Radius as a function of piston throw and rudder angle:

	Angle (degrees)	30	32	35	37	40	42	45	47	50	52	55
Throw mm	Radius (mm)											
150		150	141.5	130.8	124.6	116.7	112.1	106.1	102.5	97.9	95.2	91.6
155		155	146.2	135.1	128.8	120.6	115.8	109.6	106	101.2	98.3	94.6
160		160	151	139.5	132.9	124.5	119.6	113.1	109.4	104.4	101.5	97.7
165		165	155.7	143.8	137.1	128.3	123.3	116.7	112.8	107.7	104.7	100.7
170		170	160.4	148.2	141.2	132.2	127	120.2	116.2	111	107.9	103.8
175		175	165.1	152.6	145.4	136.1	130.8	123.7	119.6	114.2	111	106.8
180		180	169.8	156.9	149.5	140	134.5	127.3	123.1	117.5	114.2	109.9
185		185	174.6	161.3	153.7	143.9	138.2	130.8	126.5	120.8	117.4	112.9
190		190	179.3	165.6	157.9	147.8	142	134.4	129.9	124	120.6	116
195		195	184	170	162	151.7	145.7	137.9	133.3	127.3	123.7	119
200		200	188.7	174.3	166.2	155.6	149.4	141.4	136.7	130.5	126.9	122.1
205		205	193.4	178.7	170.3	159.5	153.2	145	140.2	133.8	130.1	125.1
210		210	198.1	183.1	174.5	163.4	156.9	148.5	143.6	137.1	133.2	128.2
215		215	202.9	187.4	178.6	167.2	160.7	152	147	140.3	136.4	131.2
220		220	207.6	191.8	182.8	171.1	164.4	155.6	150.4	143.6	139.6	134.3
225		225	212.3	196.1	186.9	175	168.1	159.1	153.8	146.9	142.8	137.3
230		230	217	200.5	191.1	178.9	171.9	162.6	157.2	150.1	145.9	140.4
235		235	221.7	204.9	195.2	182.8	175.6	166.2	160.7	153.4	149.1	143.4
240		240	226.4	209.2	199.4	186.7	179.3	169.7	164.1	156.6	152.3	146.5
245		245	231.2	213.6	203.6	190.6	183.1	173.2	167.5	159.9	155.5	149.5
250		250	235.9	217.9	207.7	194.5	186.8	176.8	170.9	163.2	158.6	152.6
255		255	240.6	222.3	211.9	198.4	190.5	180.3	174.3	166.4	161.8	155.6
260		260	245.3	226.6	216	202.2	194.3	183.8	177.8	169.7	165	158.7
265		265	250	231	220.2	206.1	198	187.4	181.2	173	168.1	161.8
270		270	254.8	235.4	224.3	210	201.8	190.9	184.6	176.2	171.3	164.8
275		275	259.5	239.7	228.5	213.9	205.5	194.5	188	179.5	174.5	167.9
280		280	264.2	244.1	232.6	217.8	209.2	198	191.4	182.8	177.7	170.9
285		285	268.9	248.4	236.8	221.7	213	201.5	194.8	186	180.8	174
290		290	273.6	252.8	240.9	225.6	216.7	205.1	198.3	189.3	184	177
295		295	278.3	257.2	245.1	229.5	220.4	208.6	201.7	192.5	187.2	180.1
300		300	283.1	261.5	249.2	233.4	224.2	212.1	205.1	195.8	190.4	183.1
305		305	287.8	265.9	253.4	237.2	227.9	215.7	208.5	199.1	193.5	186.2
310		310	292.5	270.2	257.6	241.1	231.6	219.2	211.9	202.3	196.7	189.2
315		315	297.2	274.6	261.7	245	235.4	222.7	215.4	205.6	199.9	192.3
320		320	301.9	279	265.9	248.9	239.1	226.3	218.8	208.9	203	195.3

How to purge a Linear Drive after installation

1. Verify that there is no air in the ram:

Disconnect the pump motor from the Drive-box, but keep the Bypass Valve connected.

Engage the autopilot now: the valve will close and lock the rudder. Try to move your helm or tiller with moderate force to Starboard, then reverse your force to Port. The piston rod should not move more than 1 mm (1/32 in.) if air has been purged completely. Otherwise you have to purge the air from the cylinder.

2. Purging the last bit of air:

Important: keep the purge valves closed (at the ram and the pump), do not use them.

Disconnect the rudder sensor mechanically from the rudder, so it will not move, when the rudder moves.

Further, we must be able to work the piston to the very end of the cylinder, both sides. This will normally necessitate detaching the piston rod from the tiller arm or quadrant. Or else we might hit a mechanical rudder stop, before the cylinder reaches its limit.

Rotate the sensor shaft so as to get a center position on the LED of the autopilot display.

With the motor and the valve reconnected to the Drivebox, engage the autopilot in Heading Mode (make sure the heading does not change and the boat is moored firmly).

Turn the sensor shaft about three degrees to either side, this will start the pump. Don't turn the sensor too far or the autopilot will disengage. Stay there until the piston hits the cylinder end firmly. Then turn the sensor shaft quickly back to reverse the pump, and stay there, until the piston hits the other end of the ram. Repeat that 10 times with full rudder speed.

3. Verify again according step 1 above!

Hydraulic Steering

Pump Installation

The electric pump is normally mounted near the steering cylinder. Three hydraulic hoses are required, to connect it to the steering system. The wheel pump must have check valves installed or the Steering Wheel will start turning, when pressure builds up from the electric pump. Some wheel pumps don't have check valves; they require installation of a check valve block next to the wheel pump.

Boats with two hydraulic steering wheels have check valves already installed.

After making the required hydraulic connections, the system needs to be filled with oil. Automatic transmission fluid for automobiles has to be used. Purge air according instructions for the steering system. Eventually repeat purging after brief operation of the autopilot or Servo Steering. Some autopilot pump models allow purging at the pump itself. In case of pressurised hydraulic systems, do not exceed the prescribed air pressure.

Adjustment of pump flow

Some pumps permit to adjust mechanically their flow, to vary the maximum available rudder speed. **Always select the maximum pump flow.**

Maximum Rudder Speed Selection

A high maximum rudder speed is desirable for good autopilot function. However it is a must for Servo Steering. A low maximum rudder speed can lead to heading oscillations.

Danger! Therefore the maximum available rudder speed should always be selected. The *Tecnautic Drive-Box* is regulating the pump speed electronically and reducing rudder speed automatically, whenever necessary.

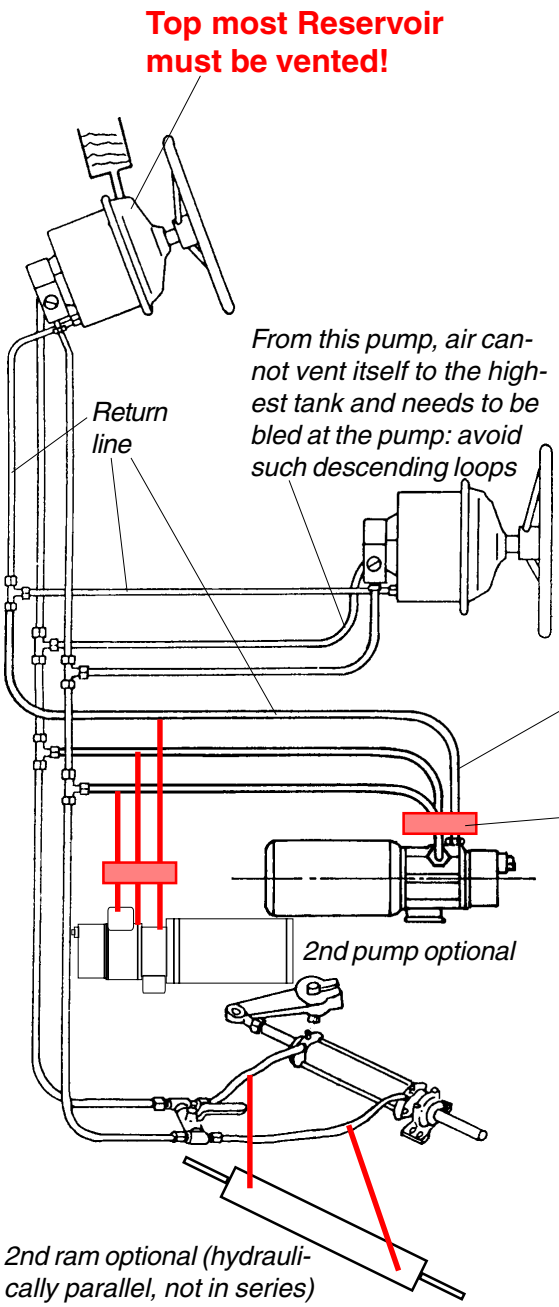
WARNING:

If the autopilot does not keep the selected heading (in HDG mode), the first thing to check is the stiffness of the hydraulic system.

Switch off the autopilot and the electronic servo steering. Then apply physical force onto the rudder with the emrgency tiller. Do NOT(!) use the hydraulic helm. The piston should not move more than 1 mm (1/32") at maximum.

Hydraulic Steering

Single or mechanically connected Rudders



All hydraulic lines should be routed in such a way, that any residual air inside will eventually raise to the tank. This is especially important for the return line, since there is almost no flow.

The autopilot pump requires slight pressure from the tank on the return line. Make sure there are no descending loops in the return line, where air might be trapped. An unpressurized system can drag a few molecules of air into the cylinder, when the piston moves. This air should vent itself to the tank and not stay trapped in a loop.

Do not route the autopilot pump flow through a lock valve! The pump and Drivebox would overheat quickly.

The electric pump may be mounted near the steering cylinder, to keep pressure drop low.

Use larger gauge lines when pumps are more distant from the cylinder.

Three hydraulic lines are required, to connect a pump to the steering system. The helm pumps must have check valves installed.

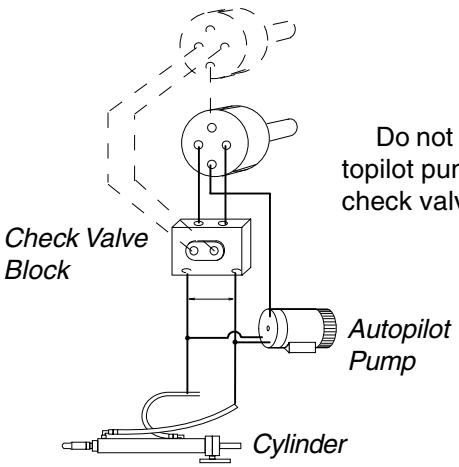
After making the required hydraulic connections, the system needs to be rinsed carefully, before filling it. Any remaining metal chips could harm the pumps.

There are no filters installed on reversing pumps! Think about driving your car without an oil filter!

Be sure there is no contamination in the lines, before connecting the pumps.

Automatic transmission fluid for automobiles can be used for most steering systems. Purge air according instructions for the steering system. Eventually repeat purging after brief operation of the autopilot or Servo Steering. Some autopilot pumps allow purging at the pump itself. In case of pressurized hydraulic systems, do not exceed the prescribed air pressure.

Helm pump without check valve



Do not route the autopilot pump through a check valve.

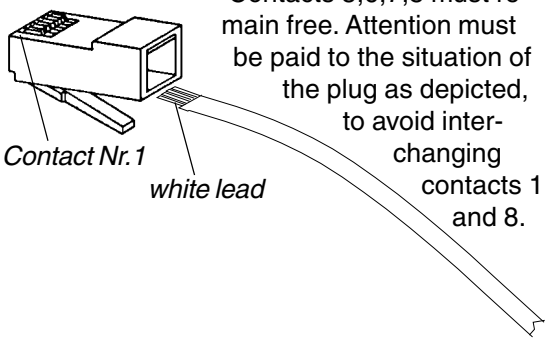
Connectors, Plugs and Cables

Bus cable

Standard version: RJ45 plug

The white lead of the four lead flat cable goes to the left side of the plug (contact nr. 1) and the remaining leads are placed to the adjacent contacts 2,3,4.

Contacts 5,6,7,8 must remain free. Attention must be paid to the situation of the plug as depicted, to avoid interchanging contacts 1 and 8.

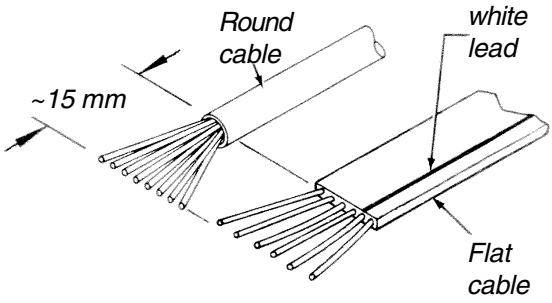


"Western" Plug

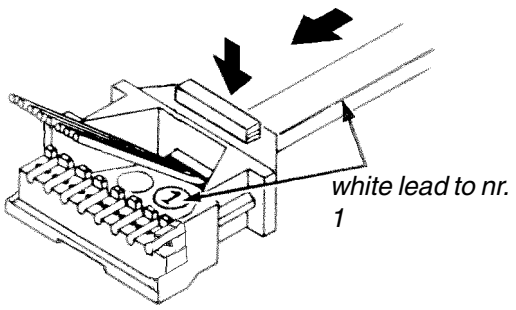
-- For Alternate Bus version (8 lead)
-- For Compass Sensor (8 lead)
-- For NMEA in-/out (8 lead)
-- For Log Sensor (6 lead)
-- For Wind Sensor (6 lead)
-- For Heading Gyro (6 lead)

Plug Installation:

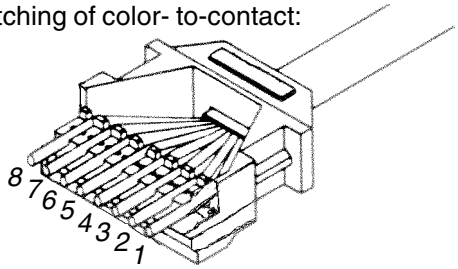
1. Remove the cable's jacket.



2. Insert cable into lid and fix it there.



3. Use the diagrams below for proper matching of color- to-contact:



Bus cable: 8-pin plug, 4-wire cable

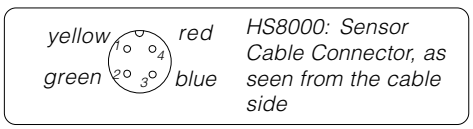
Pin #	round cable	flat cable	
1	white	white	+ supply
2	brown	blue	- supply
3	yellow	cyan	CAN_Hi
4	green	magenta	CAN_Lo

5,6,7 and 8 must remain unconnected

Wind & Compass Sensor and Echo-Box:
8-pin plug:

RJ45 pin#	round cable	flat cable	6-lead cable	4-lead cable	RJ45 pin#
	Flux Gate HS8000	**Echobox -1 or -2**	**PB200, H2183 Sensor**		
1	red (white)	white	1.red	white	1
2	green (brwn)	blue	2.blck	brown	2
3		cyan		(jmpr 2-	3
4	(jumper 2-7	magenta		7 inside	4
5	inside RJ45)	white	8.orng.	RJ45)	5
6	blue (yello.)	orange	7.yello	yell/red	6
7		brown	blue		7
8	yellow (grn.)	red	3.white	green	8

Note: leads 3 and 4 are the CAN-bus signals. They must not be connected to a sensor or to the Echo-Box.



HS8000: Sensor Cable Connector, as seen from the cable side

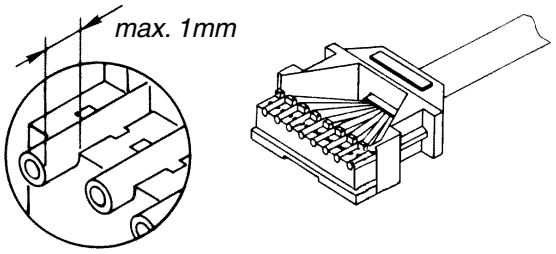
Log and Wind Sensor, Sonic Heading Gyro, Roll and Pitch Angle Sensor, Mast Angle Sensor:

6 pin plug, 4-wire cable:

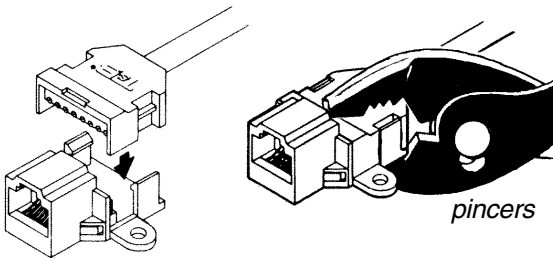
pin #	round cable	flat-oval cable	
2	white	white	
3	brown	blue	
4	yellow	cyan	Anchor Button
5	green	magenta	

pin 1 and 6 must remain unconnected

4. Trim the leads with a sharp knife.



5. Place the lid onto the housing until the latches snap in (use pincers).

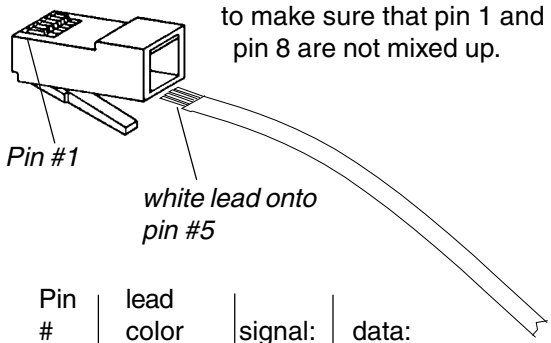


NMEA-Cable

RJ45 Plug

External NMEA data (from a GPS or other equipment) are received on pins 7 and 8 of the display bus connector. Pins 5 and 6 are used for transmitting NMEA data from the display to other equipment.

The white lead of the 4-lead flat cable connects to pin 5, the magenta lead to pin 8. Pins 1 through 4 must remain unconnected. Mind the correct position of the plug, to make sure that pin 1 and pin 8 are not mixed up.



Pin #	lead color	signal:	data:
5	white	out-B (-)	from display
6	blue	out-A (+)	from display
7	cyan	in-B (-)	to display
8	magenta	in-A (+)	to display

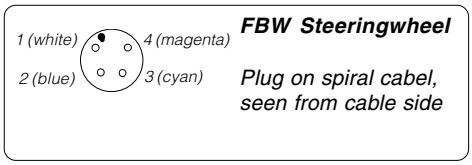
The **NMEA Input** of the display unit can receive signals conforming to NMEA-0183-V1.5 and V.2.0

The **NMEA Output** signal conforms to NMEA-0183 Version 2.x (symmetric signal) with a 5 Volts differential amplitude.

Therefore both version 1.5 and 2.x receivers can be connected.

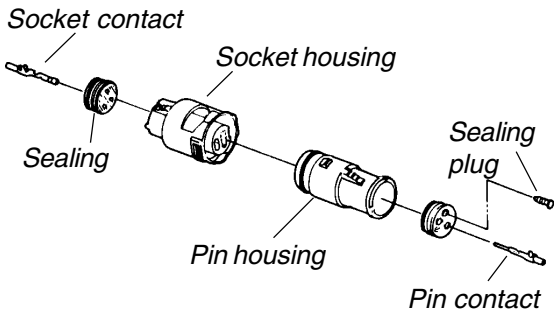
For single pole (Version 1.5) data receivers, you should connect Tecnautic"Out-A" to "Data-IN" of the receiver. All equipment must have a common supply GND in this case.

Mobile Fly-By-Wire Steering Wheel



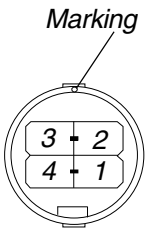
Cylindrical 4-pin plug

For Log Sensor and Wind Sensor



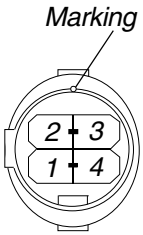
Pin contacts are always located on the sensor side, socket contacts on the display side.

Pin housing (seen from cable entrance):



Pin #	round cable	flat-oval cable
1	white	white
2	brown	blue
3	yellow	cyan
4	green	magenta

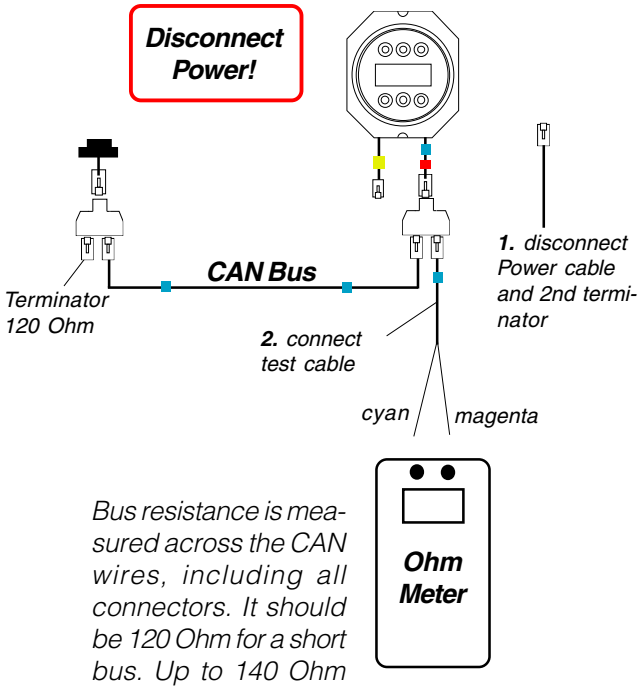
Socket housing (seen from cable entrance):



Pin #	round cable	flat-oval cable
1	white	white
2	brown	blue
3	yellow	cyan
4	green	magenta

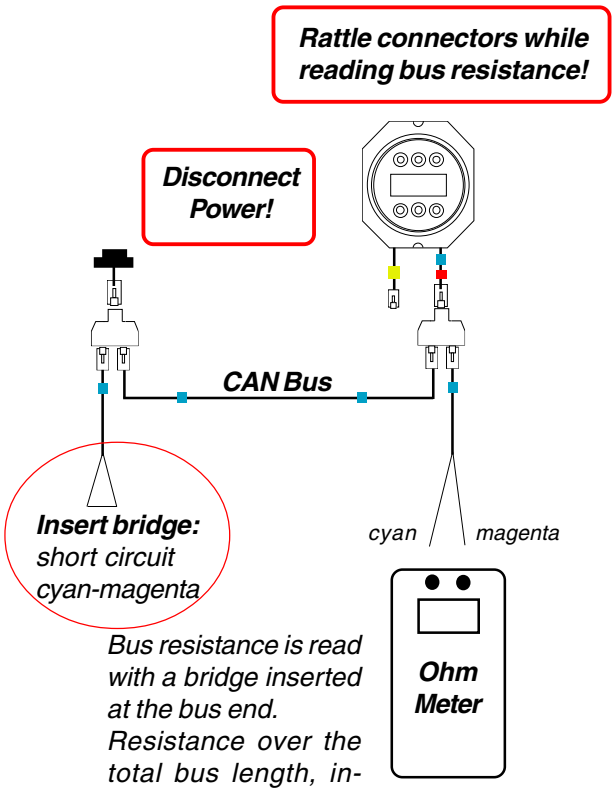
CAN-Bus Cable Testing

1. CAN-Bus and 1 Terminator



Bus resistance is measured across the CAN wires, including all connectors. It should be 120 Ohm for a short bus. Up to 140 Ohm is acceptable for a longer bus.

2. CAN-Bus shorted for test



Bus resistance is read with a bridge inserted at the bus end. Resistance over the total bus length, including all connectors, should not be more than 20 Ohm.

When a CAN-Bus Isolator is in the system, each CAN-Bus should remain below 10 Ohm.

Autopilot FAIL message

Reading last disconnect reason or mode change reason:

In case of an automatic AP disconnect, the reason will be displayed automatically as a "FAIL" code on the AP display. To read it again later, or to read the reason for an automatic mode change, press and hold the OFF-button for 3 seconds.

Use the right button to select a different box: **P.1=Drivebox1, P.2=Drivebox2,** F.1=Fadecbox1, F.2=Fadecbox2.

Failcodes are lost when cycling power to the Display and the box.

01 OFF due to over current
02 OFF due to over temperature
03 OFF due to rudder sensor extreme
04 OFF: CB on DRIVEBOX has dropped
05 Battery voltage low! (no AP disconnect)
06 OFF due to Gate Voltage too low
07 OFF due to 1/4-sec over current limit
08 One of two(!) rudder sensors is inoper.!
09 OFF Setup data loss. Insert setup data!
10 Info: Drivebox internal charge pump failure
12 OFF disconnected by Manual Take button
13 OFF instant short circuit cut off >65A
14 OFF due to missing heading gyro
15 OFF due to 4-second over current limit
16 OFF or HDG mode due to interrupted data stream from FBW (SERVO) Station
17 OFF due to drive current > 45A
18 a) Change from APP wind mode to HDG mode due to missing APP wind data, or b) Change from TRU wind mode to HDG mode, due to missing TRU wind and APP wind or rate of turn data
19 Change from TRU to APP wind mode due to missing TRU wind data
20 Loss of AP Anchor Mode due to loss of Hover Mode in FADEC
21 Change from HDG mode to TRU wind mode due to missing HDG data
22 OFF from HDG mode due to missing HDG (and APP wind or turn rate) data
23 OFF from APP wind mode due to missing HDG and turn rate data
24 Change from TRU to APP wind mode or to OFF-mode due to missing HDG data
25 AP OFF due missing data from external rudder angle sensor
27 Change from NAV mode into HDG mode due to loss of NAV data.
28 OFF or HDG mode on SLAVE-AP due to failure of MASTER-AP (dual AP's)
29 Change from TRK to HDG mode due to low Ground Speed (< 0.5 kts)
30 INFO: gyro slewing has switched to GPS
31 Change from LAND to NAV due to insufficient XTE precision
32 INFO; CAN-Bus has been inactive (earlier)

Throttle Station Setup

Entering the SETUP mode: press and hold the left and right button. Then, while holding the left and right button, press the middle button four times briefly and release all buttons. This procedure would also unlock a locked unit.

The red LED (only) will come on, indicating setup step 1 (P1) of the station.

Step P1: (reserved function) Press SERVO briefly to advance to step 2, or press THR to exit the setup mode.

Step P2: must be one (1 beep when pressing AP). Press SERVO briefly to advance to step 3, or press THR to exit the setup mode.

Step P3: Press AP (the middle button) briefly and listen to the number of beeps. Press AP again to increase the number of beeps. P3 selects the connected equipment (gyro, toggles or joystick).

When finished, press SERVO briefly to advance to step 4, or press THR to exit the setup mode.

Step P4: P4 calibrates the throttle potentiometer after connecting it for the first time to this FBW-unit or after reinstalling it.

When finished, **press and hold** SERVO to advance to step 5a, or press and release the SERVO button to advance to step 5b, or press THR to exit the setup mode.

Step P5a: P5a locks the FBW unit, when the AP button is pressed before the SERVO button has been released.

Step P5b: (no function) press SERVO briefly to advance to step 6, or press THR to exit the setup mode.

Step P6: P6 sets the illumination group number, NMEA bit rate and output sentence.

P6=1: 4800bps, HDG and TLL (hover) out
P6=2 od.4: 9600bps HDG, MOD and TLL out
P6=3: Testoutput 4800bps

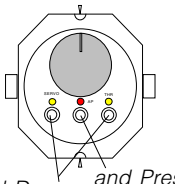
Press SERVO briefly to advance to step 7, or press THR to exit the setup mode.

Step P7: P7 sets the throttle lever type. Press the middle button to select the throttle lever type of this station. **Setting the wrong number is dangerous** and may cause unwanted switchings.

Press SERVO briefly to advance to step 0, or press THR to exit the setup mode. Step 1 follows again after step 0.

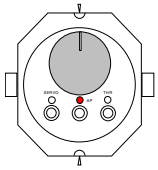
Step P0: P0 defines the right button function: P0=1: THR-button or P0=2: OFF-button (turns off the AP and SERVO-wheel).

Whenever unsure about the present step number, press right button to exit the setup mode.

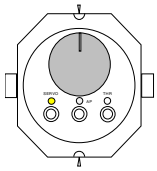


Hold Down left and right button *and Press 4 times middle button.*

Then release all buttons:

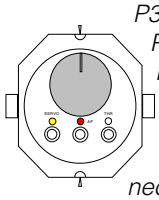


***Step P1:** red LED is on*

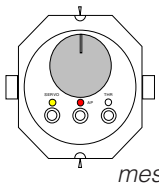


***Step P2:** left LED (yellow) is on*
P2=1 (1 beep) normal setting
P2=2 (2 beeps) reserved

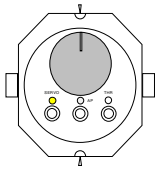
***Step P3**: red + left LED are on.*
P3=0 (no beep) is for a CAN-Bus Joystick
P3=1 (1 beep) HDG gyro+Anchor button
P3=2 (2 beeps) bow and stern thruster
P3=3 (3 beeps) gyro and bow thruster
P3=4 (4 beeps) Toggle Joystick
P3=5 (5 beeps) proportional Joystick
A gyro or thruster toggle would be connected to the cable with a "yellow" plug. A "yellow-green" plug is for one or two throttle levers



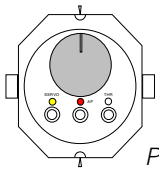
***Step P4:** red + left LED are on.*
Move the throttles to their neutral position.
Two engines: Verify that the left LED will be dimmest with the left throttle at neutral and the middle LED will be dimmest with the right throttle at neutral.
Single engine: Verify that the left LED will be dimmest with the throttle in neutral position.
Then press the middle button briefly, to store the NEUTRAL signal offset in memory.
A mechanical alignment of the throttle potentiometer may be necessary, if the dimmest point is offset by more than one degree throttle angle from neutral.



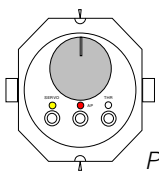
***Step P5 a:** red LED is on, the SERVO button has not yet been released. Press the middle button now, before releasing the SERVO button, to lock the unit. Red LED is flashing quickly when the unit is locked. To unlock the unit, enter the setup mode again (as above).*



Step P6:** left LED is on. **Select illumination group number 1,2,3 or 4 with the middle button (one, two or three beeps). NMEA bit rate is 4800 for group 1 or 3 and 9600 for 2 or 4.



***Step P7**: red + left LEDs are on.*
P7=0 (no beep) throttle type L
P7=1 (1 beep) remote throttles type 1
P7=2 (2 beeps) throttles type F
P7=3 (3 beeps) throttles type N



***Step P0**: red + left LEDs are on. LED brightness shows rudder angle.*
P0 defines right button function:
P0=1 (1 beep) THR-button
P0=2 (2 beeps) OFF-button