

To be used for Version 23 02 01:
mechanical throttle and reverser

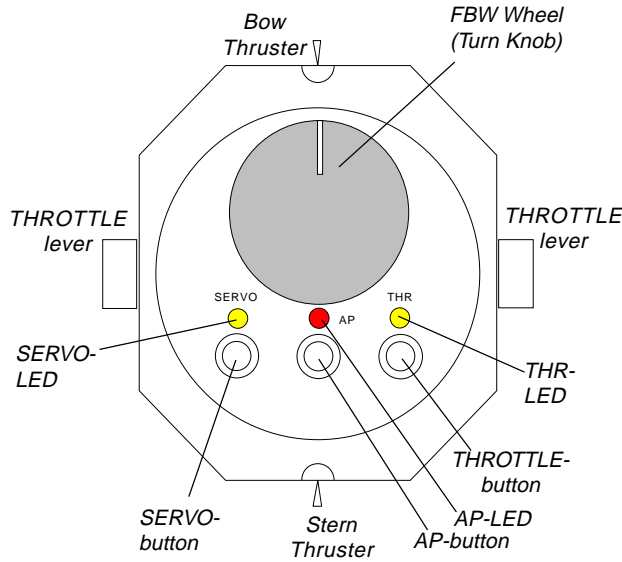
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Turn Knob Functions of the Fly-By-Wire unit or Joystick

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



Turn Rate Mode

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

The Wheel position determines the vessels' rate of turn. With a centered wheel in the detent, the heading will be maintained. Use the SERVO button to toggle between the SERVO and Turn Rate mode.

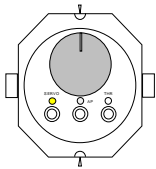
The rudder is controlled by the autopilot. Heading changes can be made through the FBW-wheel or on an autopilot or heading display.

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.

With water jet drives the Turn Rate Mode should also be used while holding position or moving astern. Rotating the Turn Knob will always turn the boat in the same direction.

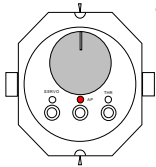
Servo Mode

Press the "SERVO" button briefly to toggle between the *SERVO* Mode and *Turn Rate* Mode. An inactive Turn Knob would be activated by the SERVO button, taking over an eventually existing mode of another FBW-unit. The rudder follows directly the steering wheel position, when only the yellow SERVO-LED is ON. The *SERVO* Mode is used when the Heading Gyro is not yet aligned, otherwise use the Turn Rate Mode.



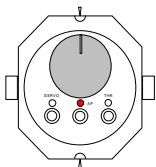
Heading Mode

Press the AP-button briefly to engage the autopilot in **HDG** Mode. The red AP-LED comes on on all FBW-units and the FBW wheel will be "disconnected". Heading changes can now be made on any AP or heading display.



NAV Mode

Double click the AP button to engage the **NAV** Mode. The red AP-LED comes on on all units and the FBW wheel will be "disconnected". An active route must be available (from a GPS or plotter). The route will be intercepted and followed automatically, the intercept angle is 30 degrees on the active leg of the programmed ground track.

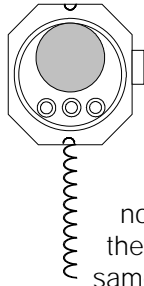


Warning Functions

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)
THR LED flashing fast	Neither a Throttle Station nor an automatic mode are controlling the engines
THR LED fast double flash	Joystick Mode is active at this station

"Moving" your remote control

When disconnecting the cable of an active FBW-unit while in SERVO- or TurnRate-Mode, the autopilot will switch into HEADING-Mode and maintain the present heading.



After reconnecting the unit to the CAN-Bus, the TurnRate-Mode or SERVO-Mode can be selected again.

The throttle mode however will not be interrupted by disconnecting the unit. After reconnecting it (at the same or any other bus-connector), the throttle continues to function, as if it had not been disconnected.

Activation of Throttle Station after Power Interruption

Should a power interruption occur either on the CAN-Bus (which powers the throttle stations), or at the FADEC-Box (which drives the actuators), but not at both of them at the same time, then the system will resume normal operation as soon as power has been reestablished. No user action is required. This also makes a good point for use of two separate power sources for the CAN-Bus and the FADEC-Boxes, when installing the system.

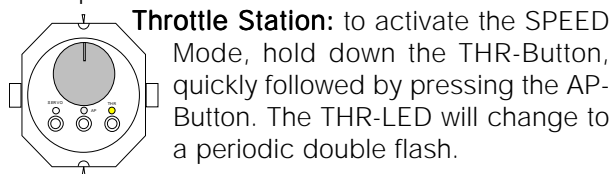
When throttle stations and the FADEC-Boxes have been unpowered, none of the throttle stations will be active, before a THR-button has been pressed at the desired station.

Speed Mode

In SPEED Mode either water speed (or ground speed in the absence of a log) are controlled by the FADEC system.

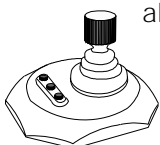
Throttle levers are inactive in Speed Mode. Selected speed can be modified with the rear toggle switch or Joystick and will be displayed briefly on the AP-Display, when speed is modified.

Throttles can be engaged again anytime by pressing the THR-Button, which cancels the Speed Mode.



Throttle Station: to activate the SPEED Mode, hold down the THR-Button, quickly followed by pressing the AP-Button. The THR-LED will change to a periodic double flash.

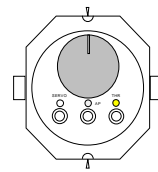
Note: when selected speed is lower than 5 kt, the system will automatically switch into Docking Mode. Selecting a speed of 5 kt or above will cancel the Docking Mode.



At the Joystick: SPEED Mode is activated automatically, when applying the SERVO or AP button.

Throttle Lever Functions

Engaging the Throttle Station



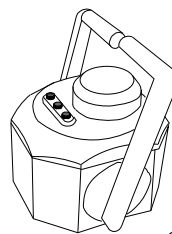
Press the THR-button briefly, to activate the throttle(s) of the unit. The engine(s) will immediately respond to the commanded lever position(s) and the THR-LED of the unit will be lit, to indicate the active throttle station.



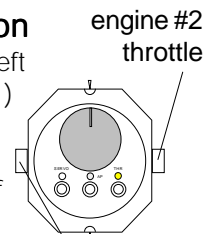
The throttle function is activated independently from the Turn Knob Function at each station.

The existing throttle mode(s) at the previously active throttle station will be continued on the newly activated station. For example with the left engine in WARM UP Mode and the right engine in FWD gear, this will be copied to the newly activated station, when the THR button is pressed.

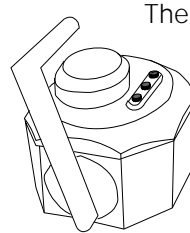
Twin Engine Throttle Station



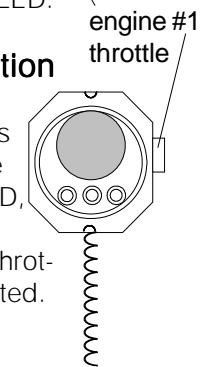
The status of the left engine (number 1) is indicated by the left (SERVO) LED, the status of the right engine (number 2) is indicated by the red (AP) LED.



Single Engine Throttle Station

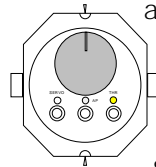


The status of the engine (number 1) is indicated by the left (SERVO) LED, no matter on which side the throttle lever is mounted.



NEUTRAL, AHEAD and ASTERN

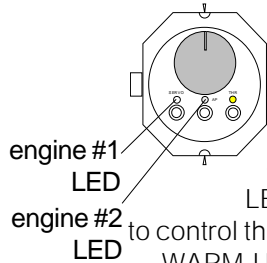
The throttle levers have a distinct detent at Neutral (zero thrust) and also at forward idle and at astern idle. If in NORMAL mode (as opposed to Docking Mode), advancing the throttle further than the forward or astern idle detent will accelerate the engine.



Shifting of the reverser helm is displayed by a flickering LED of the respective engine. After the reverser actuator has reached the full up or down position, the flickering LED will stop with a short beep.

Warm-Up Mode (Zero Thrust)

Put the throttle lever into NEUTRAL, then press and hold the THR-button. Now move the throttle lever to AHEAD idle (or more), and release the THR-button. Repeat that for the second engine, if desired. The WARM-UP Mode is indicated by a continuous double flash of the respective LED. The throttle lever can be used to control the engine governor as needed.



WARM-UP Mode is cancelled by pulling the respective throttle lever back to NEUTRAL. It can be reentered anytime as above (with a running or stopped engine).



WARNING: Forward and reverse thrust are cancelled out by the reverser bucket. However considerable side thrust may be developed in Warm-Up Mode, when the nozzle is not centered!

It is safer, to disconnect the engine from the jet pump, when an engine run up is performed.

Starter Lock Out

A conventional engine start button can be wired through the FADEC-Box, if a starter lock out is desired. The engine can then be started only in NEUTRAL or in WARM UP Mode.

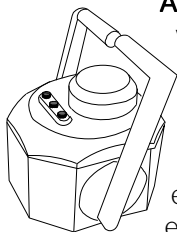
Engine Stop Mode

If enabled in the FADEC setup, the engine can be shut down from any throttle station.

When in NEUTRAL, press and hold down the THR-button, then pull back the respective throttle lever into ASTERN. This will retard the governor crank below idle position and may stall the engine.

When you want the FADEC out from STOP Mode, simply move the throttle back to NEUTRAL.

Manual Docking-Mode



Autopilot in Docking-Mode: the vessel can be steered (turned) at standstill and also be shifted sideways. Engines are running at an elevated idle speed.

FADEC in Docking-Mode: the elevated idle speed can be adjusted in the setup menu. Thrust can be controlled by the throttles continuously from zero to nearly maximum both ways. At low throttle settings, only the reverser buckets are used for thrust control. The engine will accelerate only at higher throttle settings, when the reverser is fully open or closed.

Changing into and out of Docking-Mode: The THR-button is used to select the Docking-Mode for steering **and** for the FADEC. Switching in and out of Docking-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 (without the FADEC system, press the THR-button only briefly). The Docking-Mode is indicated by a flashing Throttle-LED.

The steering functions of the Docking-Mode (rudders and thrusters) will not become active if selected at high speed, until boat speed has dropped below 50% of max. speed (according setup).

Shifting Sideways and Turning

(without Joystick) It is easy to move the boat purely sideways with engines in Docking-Mode

and the **FBW-wheel in Turn-Rate-Mode.** For moving to port, the port throttle will be

pulled into reverse, just above idle, and the starboard throttle will be put into forward thrust, just above idle. RPMs will not change when working the throttles in the lower thrust regions, only the reverser helm position will change and modify the thrust.

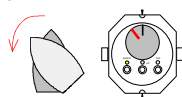
To move ahead or astern, use only **one** throttle for adjustments.

To stop sideways motion, move the throttles to the opposite position. Sideways thrust will be higher with more split between the throttles.

Turning

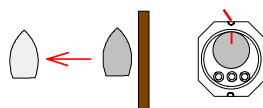
Using the FBW-Wheel **in Docking Mode** lets you turn the boat even at stand still. The **Rate**

of Turn is selected by the Turn Knob position. The boat is always turning in the direction of the wheel, even when moving astern. With a centered Turn Knob (in the detent), the heading will be maintained by the heading gyro.



Docking-Mode with a single Waterjet and Bow Thruster (without Joystick)

FBW-wheel in Turn-Rate-Mode

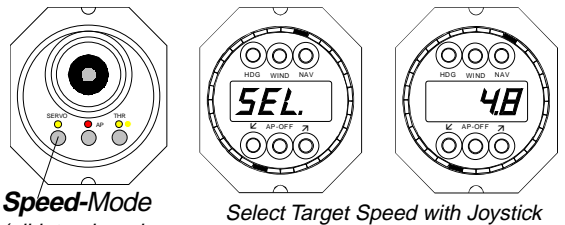
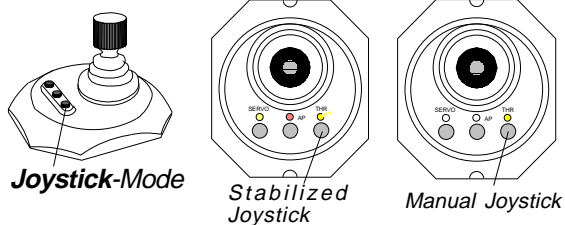


Simply push the Bowthruster toggle to port or starboard. The boat will move purely sideways, without changing heading.

Release or reverse the Bow Toggle to halt sideways motion.

To move the boat forward or astern, use gentle forward or aft throttle adjustments.

Three-Axis Joystick



In Hover Mode use WIND button to switch into Wind- or Anchor-Mode. Thrusters may be disabled in Anchor-Mode with the OFF-button.

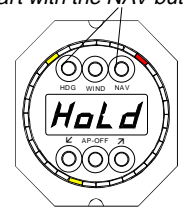
Turn Rate or Servo
 Thrust
 SERVO THR
 THR-button for Turn-Rate or Servo Mode

Turn Rate or Servo
 Speed Select
 SERVO THR
 SERVO-button for Turn-Rate or Servo Mode

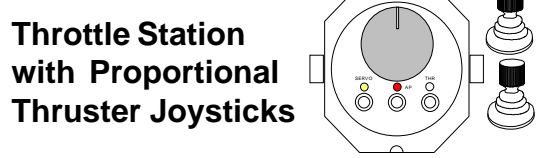
Turn Rate
 Anchor Point offset
 SERVO THR
 Double click for LAND-Mode

To connect your Anchor Point to a waypoint, the Hover Mode must be armed. To arm for waypoint capture press both buttons together, start with the NAV button

The armed state is shown with an intermittent red NAV-LED. It is cancelled with the NAV button or THR button. An armed waypoint is captured within 50m. Moving a captured waypoint in Anchor or Hover Mode will drag the vessel with it.



Throttle Station Functions



Steering Functions

Rudder Bow Stern
 SERVO THR
 Servo + manual Thrusters

Throttle
 Hold down THR button for Docking Mode (blinking)

Turn Rate Sideways
 SERVO THR
 Turn Rate + Sideways motion in Docking Mode

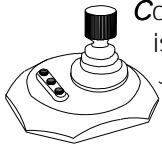
Speed
 Press THR+AP for Speed Mode (blinking fast)
 Speed Select

Autopilot
 HDG-Mode (double click for NAV Mode)

THR-Functions are independent of Steering Functions and can be selected with any Steering Mode

Steering Functions are independent of THR-Functions and can be selected with any Throttle Mode

Joystick Functions



Control of the manual **Joystick-Mode** is taken with the **THR-button** on the Joystick unit.

Heading can be changed by rotating the Joystick knob, whereas moving the stick in any direction will move the boat accordingly. By pressing the THR-button again, it is possible to allow heading control either in SERVO-Mode (not stabilized) or in Turn Rate Mode (gyro stabilized).

All available rudders, engines, propellers and thrusters are controlled by the Autopilot-FADEC system.

When a steady manual input is desired, the signal of the spring loaded Joystick may be frozen by holding the THR-button, until the handle has been released.

A new subsequent Joystick movement will unfreeze it again.

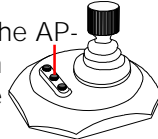
The Joystick-Mode has a very fast and continuous double flash of the THR-LED.

The **SERVO button** will activate the SERVO or Turn Rate Mode in the same manner as on a Throttle Station. In addition, the **Speed Mode** becomes active, permitting speed selection by forward or aft movement of the Joystick.

Lateral Joystick movement has no effect in Speed Mode.

Hover Mode

The Hover Mode is engaged with the AP-button on the Joystick. The vessel then holds its present GPS-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 to the Turn Rate Mode on a Throttle Station.

To cancel Hover Mode, press any THR-button. The SERVO button will not terminate the Hover Mode.

An Anchor Point offset from the SatNav antenna (setup A8*) can be altered by forward or aft Joystick movements, in one-meter steps, while in Hover or Anchor Mode. The offset will return to the stored value A8* when the NAV mode is engaged.

Anchor Mode

In Anchor Mode the vessel is pointed automatically towards a virtual buoy, while distance is maintained constant. Lateral motion is not required for this mode.

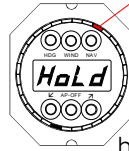
Anchor Mode can be selected out of Hover Mode with the WIND button on the Display.

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

Line length to the virtual buoy can be fed with the Joystick (antenna offset). Negative numbers will attach the buoy to the stern.

Plotter Operation

A hover point may be created by an active waypoint on the plotter screen: **press NAV (first) plus HDG (together), to arm that waypoint for hover capture** (NAV-LED blinking red).



When the vessel comes within close distance of the armed waypoint, it will capture the waypoint and enter hover mode.

If the vessel has only Anchor Mode capability, it will automatically enter Anchor Mode when the capture occurs.

If the armed waypoint is moved on the plotter screen and the boat is already in Hover or Anchor mode, it will be dragged to the new position.

To disarm hover point capture, press the NAV button briefly or press the THR-button (the latter also cancels an actual hover mode).

Installing the Engine Actuators and cables

Unpacking the Actuators

Install the actuator-cable support bracket as shown. Use a higher bracket position, when expecting to use an outer hole of the actuator crank.

Warning 1:

Stay clear from the actuator crank with hands and feet, whenever it is powered. The crank has the potential to cause severe injury. The installer is responsible to prevent anyone from coming close to a working actuator.



Warning 2:

Do not connect the actuators directly to power (for testing them). This would misalign their internal position sensor and possibly complicate the installation.

Warning 3:

Never connect the actuators directly to a higher than a 12 Volts source, this could damage the motors.

Warning 4:

During the whole installation process, keep the red disconnect nut open, to permit the crank to move freely.

Warning 5:

Only trained and qualified professionals should take responsibility to install the FADEC system on any kind of vessel. Only they know about the potential risks for life and property, involved with a potential failure of the system and loss of control of the vessel, as well as applicable laws.

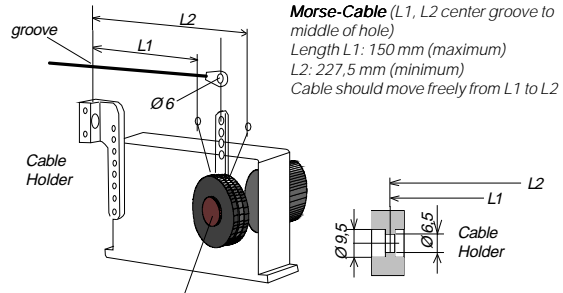
Mounting the Actuators

Although the actuators are sealed, it is imperative to have them at a dry location which will not be flooded or sprayed eventually.

A working temperature below 45 degrees Celsius (113 F) is recommended.

The FADEC-Box should be mounted as close as possible to the actuators, to minimize radio frequency emissions. Special attention should be paid to route the electrical cables at a safe distance from hot engine parts.

Actuator Crank Radius:		
Outer hole	56,7 mm	2.23 in.
2nd hole	49,7 mm	1.96 in.
3rd hole	42,7 mm	1.68 in.
Inner hole	35,7 mm	1.40 in.



Quick Disconnect: keep it open (counter clockwise) during the installation and initial setup, except for measuring the required cable length! Throttle and Reverser actuators are marked differently. They have different internal sensor wiring.

The Reverser actuator is shipped in NEUTRAL position. The throttle actuator comes in IDLE-power (retracted) position. These zero-positions can be adjusted later, if necessary.

Mounting a Reverser Actuator cable

Make sure the actuator is not connected electrically to the FADEC-Box, or at least the FADEC should not be powered.

Move the mechanically disconnected actuator crank to the upright position and engage the crank by tightening gently the red disconnect nut. Make sure the crank sits neatly in the groove of the actuator flange, when it stands up vertically.

The actuator flange has been marked with a black marker pen on the top side, when the flange was in NEUTRAL position. If the pen marking is found at a different angle, the actuator has been moved out from its NEUTRAL position. In this case disengage the cranks (open the red nut) of **both** actuators, connect **both** actuators electrically, put the throttle to NEUTRAL and press THR for one second. The actuator flanges should move to IDLE and NEUTRAL. If they don't, you will have to execute an alignment cycle by setting "Ac" = 01, as described later in this manual. Thereafter turn off power and continue mounting the cables.

Connect the reverser cable at the actuator crank. Use the outermost hole for now.

The outer hole of the actuator crank will move approximately 35 mm (1.5 in.) out of neutral, either to FORWARD or to REVERSE, with a setting of A5=15 (forward throw range), respectively A6=15 (reverse throw range).

Next connect the cable to the reverser crank, while the crank rests in NEUTRAL position. Adjust the fork length on either cable end as required and use an appropriate hole on the crank.

When the cable has been mounted on both ends, disengage the QUICK DISCONNECT at the actuator. Then move the actuator crank by hand to full FORWARD and REVERSE, and verify the reverser is moving properly, with no interference of the fork at either cable end.

Standard setting: selecting FWD thrust will pull on the reverser cable, selecting REVERSE will push (red actuator wire = terminal 7, black actuator wire = terminal 8; FADEC-Setup A1=00).

Non-Standard setting: selecting FWD thrust will push the shift cable, selecting REVERSE will pull on it (red actuator wire = terminal 8, black actuator wire = terminal 7; FADEC-Setup A1=01).

Throw adjustment: the FWD and REV actuator throw can be adjusted separately in the FADEC-Setup with A5 and A6 at a later stage:

A5, A6 (5...17)	throw [mm]	throw [inches]
	outer hole	outer hole
5	23	0.9
10	28,5	1.12
15	35	1.38
17	38	1.5

Numbers above 17 are not recommended for A5 and A6, to limit bending of the cable end.

Mounting the Throttle Cable

Make sure the actuator is not connected electrically to the FADEC-Box, or at least the FADEC-Box should not be powered.

Move the mechanically disconnected actuator crank to a retracted cable position, which is about 30 degrees from upright towards the cable support bracket. Then engage the crank by gently tightening the red QUICK-DISCONNECT nut. Make sure the crank sits neatly in the groove of the actuator flange.

The actuator flange has been marked with a black marker pen on the top side, when the flange was in IDLE POWER position. If the pen marking is found at a different angle, you should move the flanges electrically to their IDLE and NEUTRAL position first, as described already for the Reverser Cable.

Now connect the throttle cable at the actuator crank. Use the innermost hole for now.

The inner hole of the throttle actuator crank will pull the cable approximately 43 mm (1.69 in.) out of IDLE, with a Setup of A7=64.

Next connect the cable to the governor crank, while the crank rests in the IDLE position. Adjust the fork length at either cable end as required. The engine **must accelerate immediately, when the actuator starts moving** out from idle position.

Use an appropriate hole on the governor crank, that will apply full power, when the cable moves by 68 mm (2.67 in.) approximately. After the cable has been mounted on both ends, disengage the QUICK DISCONNECT at the actuator. Move the actuator crank by hand to FULL power, and verify that the engine will accelerate properly, with no interference of the fork at either cable end.

Standard setting: advancing the throttle will pull on the cable (red actuator wire = terminal 3, black actuator wire = terminal 4; FADEC-Setup A0=01).

Non-Standard setting: advancing the throttle will push the cable (red actuator wire = terminal 4, black actuator wire = terminal 3; FADEC-Setup A0=00).

Governor Throw adjustment: the governor throw should normally not be reduced in the FADEC-Setup, to guarantee the highest throttle precision. Use a more inward hole on the throttle actuator, if a smaller throw is needed. It is not recommended to reduce the throttle throw electrically in the setup, by lowering A7 from its standard value of 64. The lowest number is 32, giving only half of the standard angular throw.

A7= (32...64)	throw inner hole		throw outer hole	
	mm	(in.)	mm	(in.)
64	43	(1.69)	68	(2.68)
32	23	(0.91)	37	(1.26)

New Cables First Operation

Open the QUICK DISCONNECT screw (red) of the **throttle and reverser** actuator. Make sure the motor wires and the sensor cables of both actuators are connected correctly to the FADEC-Box.

Disconnect all Autopilot-Boxes and an eventual second FADEC-Box from the CAN-Bus. Call up the AP ConFig-Mode on a Display-Unit and select "A5".

At the desired throttle station move the throttle levers to NEUTRAL and press THR to select the NORMAL Mode (**THR-LED steady**) and move the throttle lever to IDLE-FWD. Watch the reverser actuator flange turning into FWD-thrust position. Advancing the throttle lever further will move the throttle actuator accordingly. Then exercise the throttle through forward and reverse, from idle to full power.

Verify the actuator cranks could be connected with the red QUICK DISCONNECT (cranks in the groove), after moving the cranks manually to the corresponding position. Use a more inward crank hole or adjust A5, A6 and A7 if needed (see page 10). The cranks are now connected to the flanges and follow the movement of the throttle lever.

Adjusting engine RPM settings in Docking Mode

When switching from *NORMAL Mode* to *Docking Mode*, the engine(s) will accelerate automatically.

The FWD Docking RPM-setting is determined by A8. Select an appropriate setting that has sufficient forward maneuvering thrust.

The REVERSE Docking RPM may be a little higher than the FWD Docking RPM. That RPM increase is determined by A9. When moving the throttle lever from NEUTRAL to REVERSE while in Docking mode, the engine will spool up to its reverse Docking RPM, according to its A9 setting. On twin engine vessels select A9 such as to have equal reverse thrust and forward thrust, with full up or down reverser buckets. Do not move the throttle too far, or the engine will accelerate above its Docking RPM.

Adjusting Reverser NEUTRAL position

The adjustment is done with running engine in Docking-Mode and the throttle in the reverse idle detent. Because of the somewhat higher RPM in idle reverse, an unwanted thrust can be detected more easily, when the boat is floating.

The precise helm position can be modified by altering "A_:32" between 0 and 63. A higher setting will produce more forward thrust if A1=01 (less, if A1=00).

Setting the "zero" crank-position mechanically (not recommended)

Both the throttle and the reverser actuator's "zero"-position can be set mechanically, if the adjustment range in the setup or at the cable fork is not sufficient.

Remove the potentiometer lid of the actuator by unscrewing its three holding screws. A 2.5 mm Allen key (0.1 inches) is needed. Pay attention not to loose the O-ring seal of the lid. The adjustment screws of the potentiometer become visible under the lid.

Open the QUICK DISCONNECT on both actuators.

Operate the throttle and reverser actuator by using a throttle station.

The throttle idle position can now be adjusted by first moving the throttle lever to NEUTRAL and setting the throttle mode to normal (THR-diode steady, not flashing!).

Then loosen the three adjustment screws of the potentiometer-holder, just enough to rotate the potentiometer as desired. The throttle motor will instantly rotate the actuator flange by the same angle as the holder has been shifted.

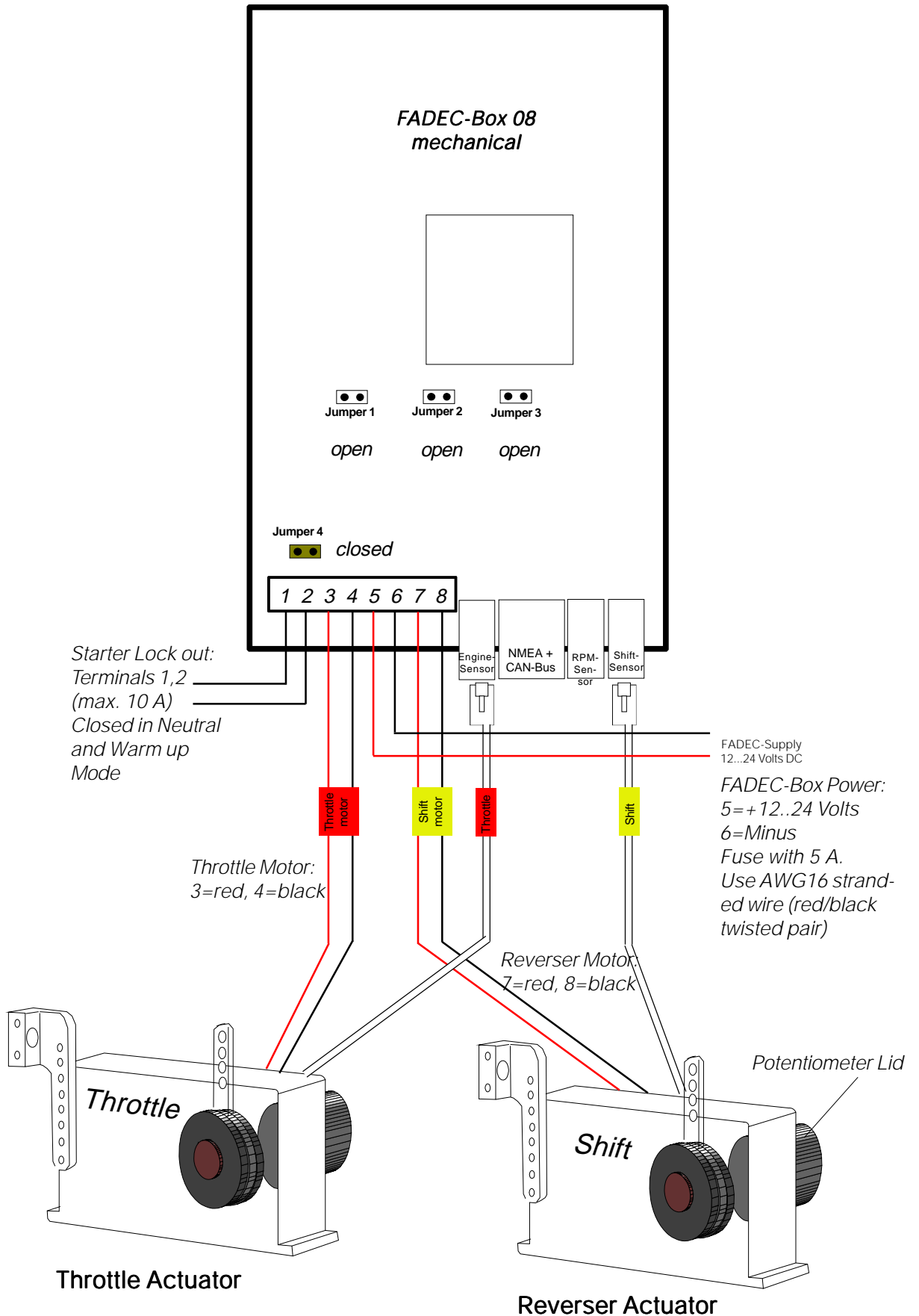
When finished, tighten the three holder-screws and mount the sensor lid. Make sure the O-ring sits correctly under the lid.

WARNING: the "New Cables First Operation" procedure must be repeated, to ensure correct actuator throw, after setting a new idle point.

The reverser actuator can be adjusted in a similar way, after switching the throttle into Docking-Mode (the throttle-diode is flashing) and also placing the throttle lever into forward idle.

FADEC Actuator Connection

Throttle and Reverser Actuator



Trouble Shooting

The actuator flanges are not moving as expected and seem to be locked, with their zero position mark near the bottom. Fail code 03 (throttle servo extreme) or 08 (reverser servo extreme) are displayed.

Reason: at least one of the actuators has reached an extreme position, possibly due to wrong wiring of the motor at the FADEC-Box or wrong setup data (A0 or A1).

Action: verify connections and setup data, then start an alignment cycle by setting "Ac" to 01. This should bring both servos to their zero position. If necessary, repeat that after cutting power to the FADEC-Box for 10 seconds.

Opposite way moving reverser actuator: (FWD instead REVERSE).

Reason: incorrect connection and setup of Reverser Actuator.

Action: Interchange Reverser Motor wires and switch setup parameter "A1".

Reverser Actuator has incorrect throw:

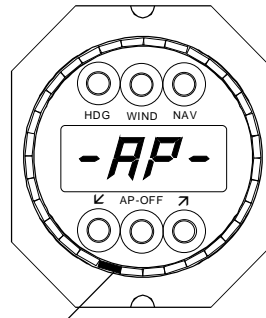
Action: adjust FWD throw by altering "A5" in the setup, REVERSE throw by "A6". Avoid numbers above 17. Use different crank holes (at the actuator or at the reverser), if needed.

Throttle actuator has incorrect throw:

Action: use different crank holes at the actuator or at the governor. Only if still needed, lower "A7" in the setup. The standard value of A7=64 should be kept as close as possible to 64, to improve throttle accuracy.

FADEC-Box Setup Initial Operation

FADEC-Setup is done on any of the Autopilot-Displays in the System, and **only** after the Autopilot-Driveboxes and an eventual second FADEC-Box have been disconnected from the CAN-bus.



Throttle-Servo
Position LED

The FADEC-BOX must be powered and connected to the bus to permit its configuration.

1. Select >Configuration Mode >"AP" on an Autopilot Display (or set "di=01" on any other Tecnautic Display and select >ConFig>AP). Verify that an LED is lit in the lower half of the perimeter, as shown in the picture above. If none of the LEDs is lit, there is no communication with the FADEC-Box and the setup cannot start.

2. Press the lower left button once. The parameter **"A0:"** will be displayed (A0=00 or A0=01). Be careful not to alter A0 unintentionally by pressing (again) the left or right button.

3. Use the lower middle button to scroll forward to the next parameter A1, A2 etc. Each parameter can be altered if needed, with the left or right lower button.

FADEC-Box Parameters

There are two sets of parameters. The proper selection is made with A9.

- A0:01** Rotational sense of the throttle actuator. A0=01 requires the red throttle-motor wire on terminal 3, black on 4. The throttle actuator will *pull* the cable, to increase power (however A0=00 and black=3, red=4 will push the cable).
- A1:00** (00 or 01) Rotation sense of the reverser actuator. A1=00 is the standard setting. It requires the red reverser-motor wire on terminal 7, black on 8. The actuator will *pull* the cable for FORWARD thrust. When reversing the wires, set also A1=01.
- A2:01** 01 .. mechanical throttle and reverser (other setting is not permitted with the mechanical FADEC-Box).
- A3:01** (01...02) Engine selection. Set A3=01 for the left engine (engine #1) and A3=02 for the right engine (engine #2). For a single engine boat, A3 must be 01.
- A4:01** (01...32) Throttle Actuator retard throw in Stop Mode (below idle position).
- A5:17** (05 ...17) Reverser actuator FORWARD travel (up) limit.
- A6:17** (05 ...17) Reverser actuator REVERSE travel (down) limit.
- A7:64** (50...64) Throttle actuator travel. Keep A7 as high as possible, select most inward crank hole if possible, before reducing A7.
- A8:12** (0...31) initial engine RPM increase (Spin Up) when entering the FORWARD Docking mode. Adjust with active throttle lever in NEUTRAL (zero thrust) and Docking Mode.

A9:13 a) A9 is a switch between selected parameter groups. A9=00 shows parameters A0* ... A8*. However A9 other than zero displays parameters A0 ... A8. The asterisk (*) will not be visible!

b) A9 is the engine idle RPM in Docking mode. Adjustments of the setting can be verified with the next throttle movement.

AA:00 (0...32) Reverser travel limit in Docking-Mode. This is an additional limitation to A5 and A6.

A_:32 (0...63) Adjust the reverser zero thrust position with this number. Higher number is for more forward thrust. Throttle should be in Docking Mode in the REVERSE idle detent while adjusting, with engine running.

Ac:00 **Caution:** open the QUICK DISCONNECT on both actuators to permit a 360 degree rotation of the actuator shaft. Set Ac=01 to start an alignment cycle of the actuators. After completion, the actuator shaft should stop with the black marking on top. Press THR and verify movement and throw of both actuators, before reconnecting the QUICK DISCONNECTs. An alignment cycle may take a minute to complete. Repeat when not successful.

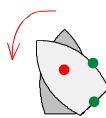


A-:00 NMEA output from the FADEC-box:
 A- =00 .. Test data out (ASCII terminal)
 A- =01 .. Set up for connected heading sensor is sent
 A- =02 .. HDM and VHW out (8 Hz)
 A- =03 .. VHW out (8 Hz)
 A- =04 .. Test heading instead fluxgate

Second group of parameters A0* .. A8*:

The parameters A0* .. A8* are displayed, whenever A9 has been set to zero previously. A0 .. A8 however will be displayed only when A9 is not zero. Note that the asterisk is not shown on the display unit.

- A0*:01** Must be 01 for Jet Drives.
A1*:00 Must be 00 for Jet Drives.
A2*:00 Must be 00 for Jet Drives.
A3*:01 Must be 01 for Jet Drives.
A4*:01 A4*=01..enables the DOCKING-Mode
A5*:00 Must be 00 for Jet Drives.
A6*:03 Hover Mode accuracy (0..3)
A7*:00 Must be 00 for Jet Drives.
A8*:30 Anchor Point offset from Sat-Nav antenna. Anchor Point refers to Hover Mode Position. A8*=30 means no offset. Numbers above 30 will move the Anchor Point towards the bow, below 30 towards the stern. Range +/- 30 m.



Throttle or Joystick 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: (reserved function) 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). P3=0 is for the CAN-Bus 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 for the unit. Press the middle button repeatedly to select the desired number. Standard setting is P6=1 (one beep), for group number 1.

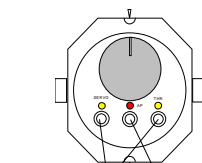
Press SERVO briefly to advance to step 7, or press THR to exit the setup mode.

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.

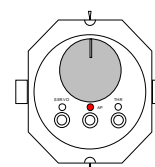
Step P0: P0 defines the right button function: P0=1: THR-button or P0=2: OFF-button (turns off the AP and SERVO-wheel).

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

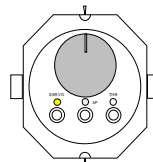


Hold Down left and right button and Press 4 times middle button.

Then re-release all buttons:



Step P1: red LED is on



Step P2: left LED (yellow) is on

Step P3: red + left LED are on.

P3=0 (no beep) is for a CAN-Bus Joystick
P3=1 (1 beep) heading gyro connected

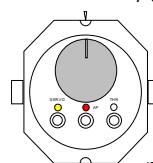
P3=2 (2 beeps) bow and stern thruster

P3=3 (3 beeps) gyro and bow thruster

P3=4 (4 beeps) Toggle Joystick

P3=5 (5 beeps) proportional Joystick

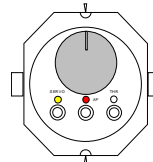
A gyro or thruster toggle would be connected to the cable with a "yellow" plug. A "yellow-green" plug is for one or two throttle levers



Step P4: red + left LED are on.

Move the throttles to their **neutral** position.

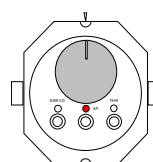
Two engines: Verify that the left LED will be dimmest with the left throttle at neutral and the middle LED will be dimmest with the right throttle at neutral.



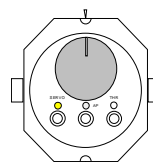
Single engine: Verify that the left LED will be dimmest with the throttle in neutral position.

Then press the middle button briefly, to store the NEUTRAL signal offset in memory.

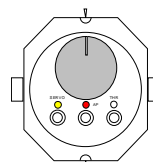
A mechanical alignment of the throttle potentiometer may be necessary, if the dimmest point is offset by more than one degree throttle angle from neutral.



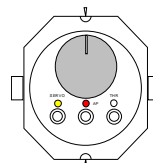
Step P5 a: red LED is on, the SERVO button has not yet been released. Press the middle button now, before releasing the SERVO button, to lock the unit. Red LED is flashing quickly when the unit is locked. To unlock the unit, enter the setup mode again (as above).



Step P6: left LED is on. Select illumination group number 1, 2 or 3 with the middle button (one, two or three beeps).



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



FADEC fail codes

FADEC fail codes are produced by the FADEC-Box and sent to all display units, but only when no other Box is connected to the CAN-Bus. Therefore disconnect all autopilot and thruster boxes (and eventual second Fadec) from the bus temporarily when analyzing FADEC failures.

There are two ways to read the code:

A) select the FAIL code by reading it from a display unit (dF=F0 must be active).

B) select the "Config" mode on a display unit (any unit in the system) and press the right button to read out the last FAIL code of the box.

Note: when switching off bus power **and** FADEC power, any code stored inside the display units will be lost; a random number (e.g. 33) will be displayed after powering up the FADEC again, until a new fail code is transmitted by the box.

FADEC-Fail codes may be cleared with the THR-button.

- 01 OFF due to over current
- 02 OFF due to box over temperature
- 03 OFF due throttle-servo extreme angle
- 04 OFF: CB on FADEC-BOX has dropped
- 05 INFO: Battery voltage low! (no throttle disconnect, only information)
- 06 OFF due to low internal Gate Voltage
- 08 OFF due to reverser extreme position
- 10 INFO: sensed late dblvlt (> 18 V)
- 12 OFF reverser time-out (to either end posit.)
- 13 OFF due to > 65 A short circuit
- 14 OFF due to throttle or joystick fault
- 15 OFF due to 15A over current limit
- 17 OFF due to servo current > 30A
- 18 INFO: reverser time-out in Docking Mode
- 19 INFO: reverser time-out (towards neutral)
- 20 OFF due to Drivebox fault in Joyst. mode
- 21 INFO: throttle servo time-out
- 22 hover OFF due to WP shifted >0,1 NM
- 23 hover OFF due to missing GPS, compass or gyro data
- 24 Speed mode OFF due to missing SPD data
- 25 hover or joystick mode OFF due to fault in the slave FADEC-Box
- 26 INFO: unlock code required for joystick or hover mode

Failure treatment

Reconnect throttle station by pressing the THR-button.

NMEA Input at the throttle station (no NMEA-output is provided):

From the following NMEA sentences, specific data fields are read. The data are used for displaying certain functions and for guidance of the autopilot in NAV mode.

The NMEA input is not available on the remote throttle station.

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 WP and WP Long/Lat
GLL:	Lat / Long present position
HDM, HDG, HDT:	Magnetic or True Heading
MWV:	Apparent Wind Angle and Speed
RMB:	Cross Track Error, Bearing+Distance to WP
RMC:	Ground Track, Speed and variation
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)