

To be used for:

- 23 02 01 .. mechanical throttle and shift
- 23 02 05 .. mechanical shift, electronic
throttle signal (analog)
- 23 02 10 .. mechan. throttle, electric shift
- 23 02 11 ... and Trolling Valve

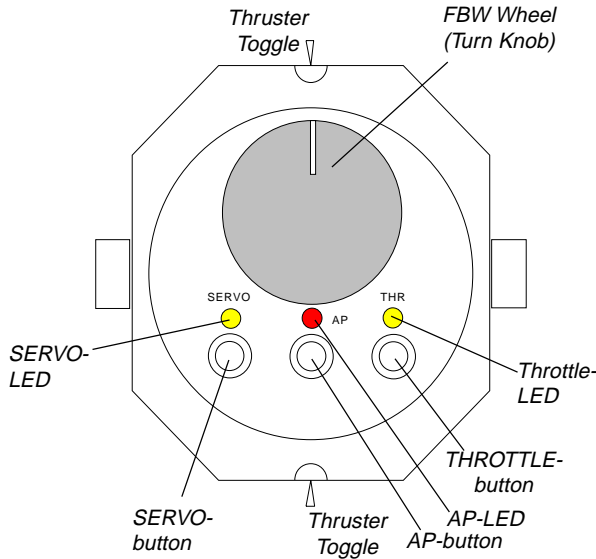
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Turn Knob Functions of the Fly-By-Wire unit and Joystick

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



Turn-Rate Mode

The **Turn-Rate Mode** is the preferred operating mode of the Fly-By-Wire Wheel. It is engaged by clicking (again) on the SERVO button and indicated by a lit SERVO and AP LED. The knob position determines the vessels' rate of turn. With a centered knob (in the detent), the heading will be maintained. Use the SERVO button to toggle between the SERVO and Turn-Rate Mode.

In Turn-Rate-Mode heading changes can be made either with the Turn Knob or with the push buttons on an autopilot or heading display.

Note: the Turn Rate mode is only available when the heading gyro has completed its alignment (5 minutes after power up). An operational gyro is also indicated by a dot behind the "H." on the heading display. The Turn Rate Mode is always used while going forward.

In DOCKING MODE, it should even be used while halted or moving astern, when vectored thrust is available from the propulsion system (as with two individually steered rudders or stern drives, or with bow and stern thrusters, or with jet drives). Use the FBW-wheel to change or keep the heading.

Servo Mode

Press the "SERVO" button briefly to toggle between the **SERVO Mode** and **Turn Rate Mode**. The rudder follows directly the steering wheel position, when the yellow SERVO-LED is ON and the red AP-LED is off. The SERVO Mode is used when the Heading Gyro is not yet aligned.

Further it is used for maneuvering or while going astern, in case the autopilot Docking-Mode is not available. An inactive Turn Knob would be activated by the SERVO button, taking over an eventually existing **Turn Rate Mode** of another FBW-unit.

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

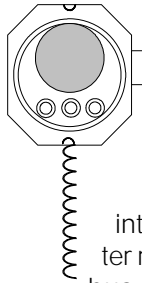
Double click the AP button to engage the **NAV** Mode. The red AP-LED comes on on all units and the turn knob will be "disconnected". An active route must be available (from a GPS or plotter). The route will be intercepted and followed automatically, the intercept angle is 30 degrees on the active leg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

Turn Knob 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 nor 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)

"Moving" your remote control

When disconnecting the cable of an active FBW-unit 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 or surge 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, then the system resumes normal operation as soon as power has been reestablished. No user action is required. This is for sure a good reason, to use two separate power sources for the CAN-Bus and the FADEC-Boxes, when installing the system.

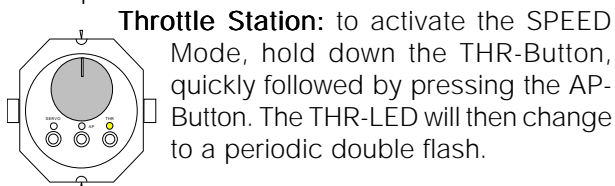
Only when the throttle stations *and* the FADEC-Boxes have been unpowered, none of the throttle stations will be active when power returns, until the THR-button has been pressed again at the desired station.

Speed Mode

In SPEED Mode either ground speed (or water speed, in the absence of a GPS) 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 shown briefly on the AP-Display.

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 then change to a periodic double flash.

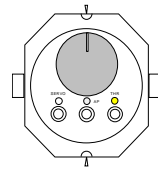
Note: when selected speed is lower than 5 kt, the system will automatically switch into Docking Mode. Selecting a speed of 5 kt or above will cancel the Docking Mode.



The SPEED Mode is activated automatically on the **Joystick**, when applying the SERVO button or selecting the LAND mode with a double click on the AP button.

Throttle Lever Functions

Engaging the Throttle Station



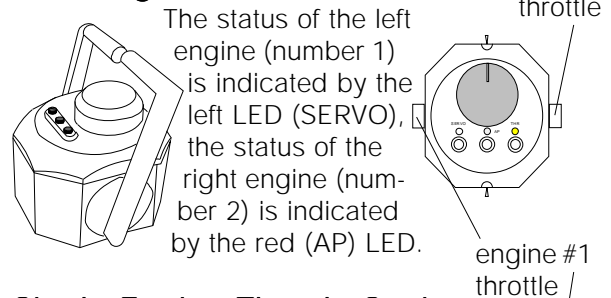
Press the THR-button briefly, to activate the throttle(s) of the unit. The engine(s) will immediately respond to the existing lever position(s) and the THR-LED of the unit will be lit, to indicate the active throttle station.



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

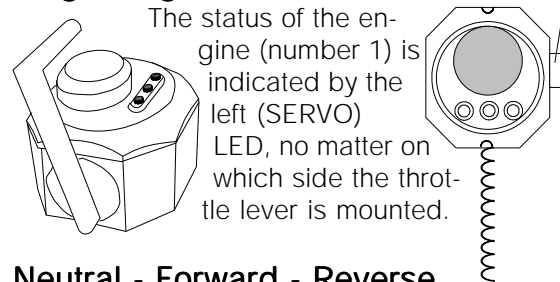
The existing throttle mode(s) at the previously active throttle station will be continued on the newly activated station. For example with the left engine in WARM UP Mode and the right engine in FWD gear, this will be copied to the newly activated station, when the THR button is pressed.

Twin Engine Throttle Station



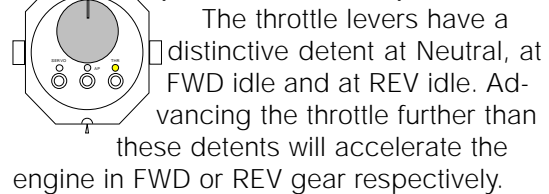
The status of the left engine (number 1) is indicated by the left LED (SERVO), the status of the right engine (number 2) is indicated by the red (AP) LED.

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 - Forward - Reverse (Ahead - Astern)



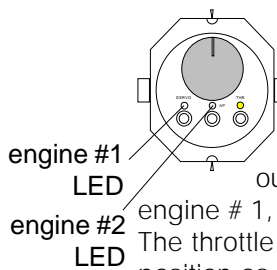
The throttle levers have a distinctive detent at Neutral, at FWD idle and at REV idle. Advancing the throttle further than these detents will accelerate the engine in FWD or REV gear respectively.

Shifting of the gear is displayed by a flickering LED of the respective engine. After the shift actuator has reached the new position, the flickering LED will stop with a short beep.

If desired, an engine rev-up or a speed dependent shift delay can be selected in the setup.

Warm-Up Mode (gear neutral)

Put the engine into NEUTRAL, then press and hold the THR-button. Move the respective throttle lever to FWD (idle or above), and release the THR-button. Repeat that for the second engine. The WARM-UP Mode is indicated by a continuous double flash of the left LED for engine # 1, or the middle LED for engine # 2. The throttle lever is controlling the governor position 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).

Starter Interlock

The engines can only be started in NEUTRAL or in WARM-UP Mode. For this feature, the Starter button or key has to be wired over the FADEC box.

Engine Stop Mode

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

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

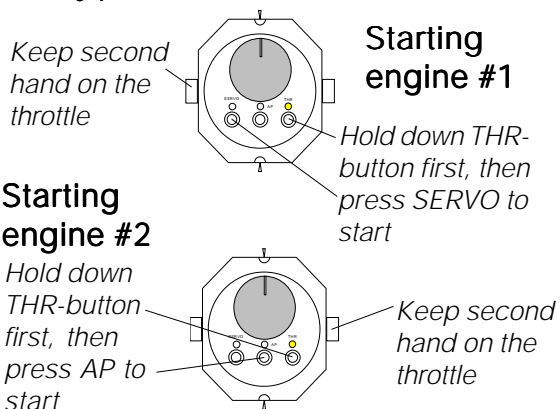
When you want to leave the STOP Mode, simply move the throttle back to NEUTRAL.

Engine Start Mode

The FADEC-Box permits to duplicate the engine start button. The starter motor can therefore be activated from any throttle station. The throttle of the *respective engine* has to be in WARM-UP Mode. Then press and hold down the THR-button, and also press the SERVO-button to start engine #1, or the AP-button to start engine #2.

You will probably have one hand on the throttle lever and the other hand on those two buttons. When the engine fires, release the buttons and adjust the throttle as needed.

Engine Start from the Fly-By-Wire Station is only possible in WARM-UP Mode!



Manual Docking-Mode

Autopilot in Docking-Mode: the vessel can be steered (turned) at standstill and also be shifted sideways. If available, Bow and Stern Thrusters will be used automatically. In the presence of two engines they will be put into opposite gear and steered individually to different rudder angles.

FADEC in Docking-Mode: the system may be configured to limit engine power in Docking-Mode, permitting large throttle movements for small thrust adjustments.

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 to less than 5 kt.

Docking-Mode with Bow and Stern Thrusters

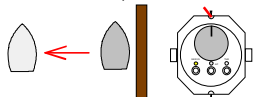
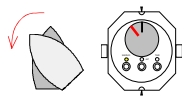
In Docking-Mode (flashing THR-LED) mainly **thrusters** will be used for steering by the FBW-wheel, except in pure SERVO-Mode, where thrusters are commanded manually through their toggles. Even the autopilot will be using the thrusters, when in Docking-Mode.

Using the FBW-Wheel **in Turn-Rate Mode** lets you turn the boat even at stand still or while going astern, when the Docking-Mode is on.

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

In the presence of both Bow- **and** Stern-Thrusters, the boat can be commanded side-

ways by use of the forward toggle, when the **Turn-Rate Mode** is on. The selected heading or rate of turn will be held automatically at the same time.



Docking-Mode with individually steered Rudders (or Stern-Drives)

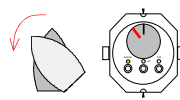
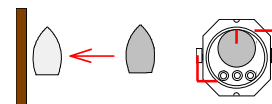
In Docking-Mode (THR-LED is flashing) both rudders or both drives will be spread out automatically by a certain angle. One engine has to go into reverse, the other into forward thrust. Use above idle throttle settings either way.

In *case of fixed shafts*, very effective rudders are required, so as to deflect forward thrust enough sideways (since thrust on the reversing engine will remain merely straight).

The simplest situation is with two Stern-Drives which are commanded separately by the autopilot.

Semi-Automatic Docking

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.

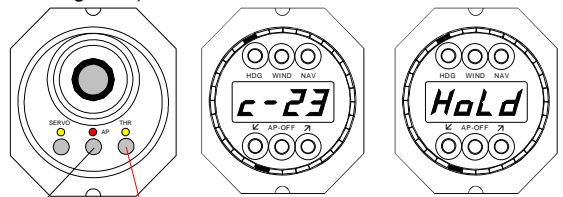
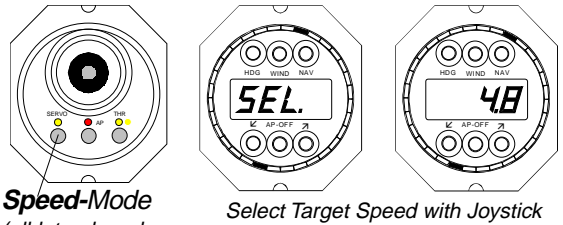
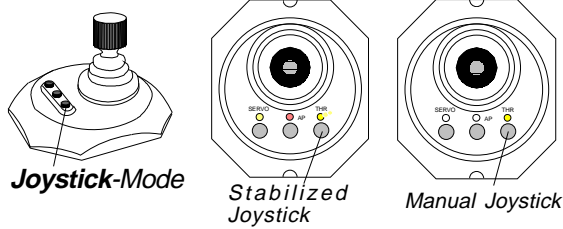


The Rate of Turn can be selected with the Turn-Knob. The heading will be held, when the Turn-Knob is centered.

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

The amount of sideways thrust is increasing with engine speed (boats with a larger distance between drives will generally have more sideways thrust available). To stop sideways motion, move the throttles to the opposite position.

Three-Axis Joystick



Wind Mode
 E 65
Anchor Mode
 A 00
In Hover Mode use WIND button to switch into Wind- or Anchor-Mode. Thrusters may be disabled in Anchor-Mode with the OFF-button.

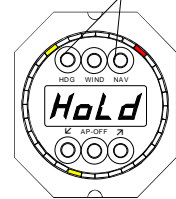
Turn Rate or Servo
 Thrust
 SERVO THR
 THR-button for Turn-Rate or Servo Mode

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

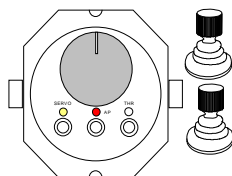
To connect your Anchor Point to a waypoint, the Hover Mode must be armed. To arm for waypoint capture press both buttons together, start with the NAV button

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

Throttle Station with Proportional Thruster Joysticks



Steering Functions

Rudder Bow Stern
 SERVO THR
 Servo + manual Thrusters

Throttle
 Hold down THR button for Docking Mode (blinking)

Turn Rate Sideways
 Turn Rate + Sideways motion in Docking Mode

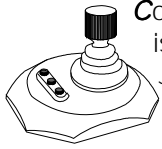
Speed
 Press THR+AP for Speed Mode (blinking fast)
 Speed Select

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.

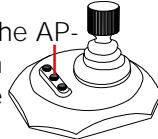
The Joystick-Mode has a very fast and continuous double flash of the THR-LED.

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.

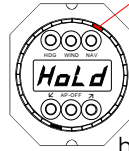
Anchor Mode can be selected out of Hover Mode with the WIND button on the Display.

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.

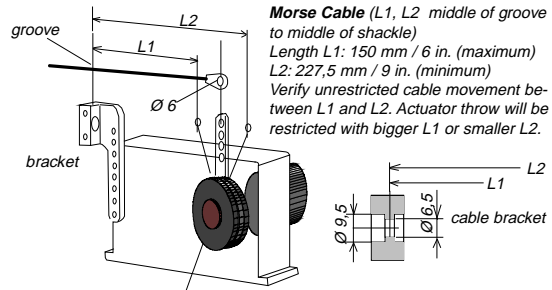
Mounting the Actuators

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 shift actuators are marked differently. They have different internal sensor wiring. The shift actuator is shipped in NEUTRAL-gear position. The throttle actuator comes in IDLE-power (retracted) position. These zero-positions can be adjusted later, if necessary.

Mounting the Shift 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-GEAR position. If the pen marking is found at a different angle, it means the actuator has been moved out from its NEUTRAL-GEAR 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 shift cable at the actuator crank. Use the outermost hole for now.

The outer hole of the shift 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), respectively A6=15 (reverse throw).

Next connect the cable to the gear box shift crank, while the crank rests in NEUTRAL position. Adjust the fork length on either cable end as required. Use an appropriate hole on the crank, that will engage the gear, when the

FADEC mechanical

cable moves by 35 mm (1.5 in.) approximately. When the cable has been mounted on both ends, disengage the QUICK DISCONNECT at the actuator. Then move the actuator crank by hand to FORWARD gear and to REVERSE gear, and verify the gear box is shifting properly, with no interference of the forks at the cable ends.

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

Non-Standard setting: selecting FWD gear 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 shift throw can be adjusted separately in the FADEC-Setup by A5 and A6 at a later stage:

A5, A6 (5...17)	throw [mm] outer hole	throw [inches] 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 Shift Cable.

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

The outer hole of the throttle actuator crank will pull the cable approximately 68 mm (2.67 in.) out of IDLE, with a Setup setting of A7=64.

Next connect the cable to the governor crank, while the crank rests in IDLE position. Adjust the fork length at either cable end as required.

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 [mm] outer hole	throw [inches] outer hole
32	37	1.46
64 (standard)	68	2.68

New Cables First Electric Operation

Disconnect the red QUICK DISCONNECT screw of the **throttle and shift** 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".

[If a second display is available, display "FL" (fail codes) on it. This might be useful later]

At the desired throttle station press THR for one second. The THR-LED should illuminate steady. Move the throttle lever to the IDLE-FWD detent. Watch the shift actuator flange turning into FWD-gear position. The throttle servo flange should stay at IDLE-power. Then exercise the throttle through forward and reverse, from idle to full power.

Verify the actuator cranks could be connected (cranks in the groove) with the red QUICK DISCONNECT, after moving the cables manually to the corresponding position.

Adjusting the idle and neutral crank-position

Both the throttle and the shift actuator's "zero"-position can be set mechanically.

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 shift actuator by using a throttle station.

The throttle IDLE position can now be adjusted by first moving the throttle lever to the NEUTRAL detent.

Then loosen the three adjustment screws of the potentiometer-holder, just enough to rotate the holder 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.

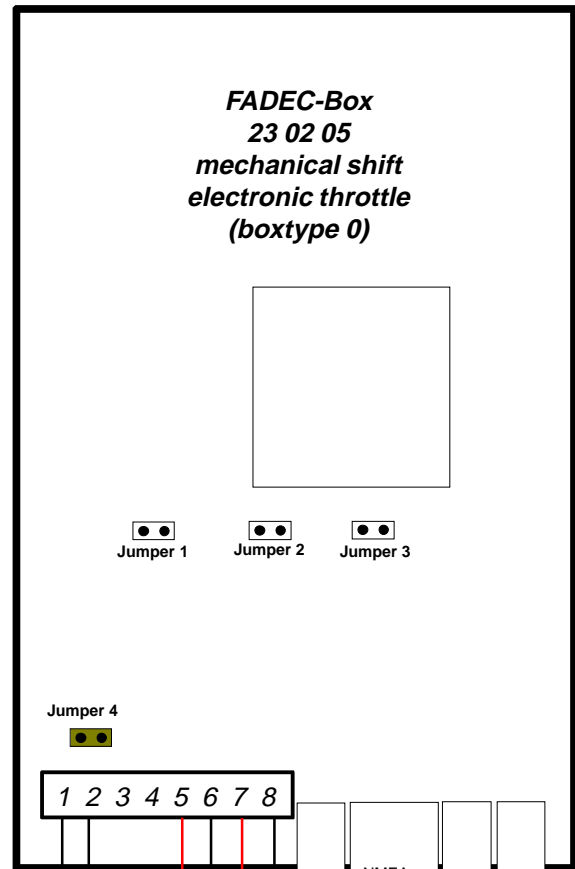


WARNING: the "New Cables First Operation" procedure must be repeated, to ensure there will be the correct actuator throw, after setting a new idle point.

The Shift NEUTRAL position is adjusted much like the throttle-IDLE position, except that the Shift Actuator will not move to a different position, before the throttle lever has been taken out from NEUTRAL and back to NEUTRAL.

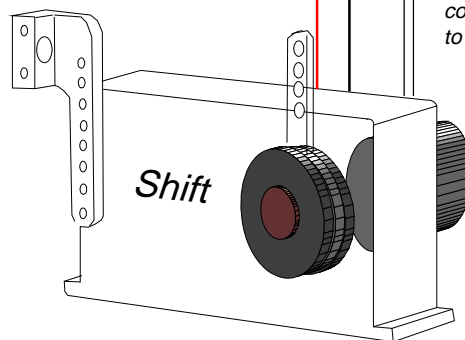
WARNING: the "New Cables First Operation" procedure must be repeated, to ensure there will be the correct actuator throw, after setting the new neutral point.

Mechanical Shift, Electronic Throttle



Terminals 1,2: Starter Lockout (max. 10 A) closed in Neutral

FADEC-Box Power: 5=+12..24 Volts 6=Minus Fuse with 5 A. Use AWG16 stranded wire (red/black twisted pair)

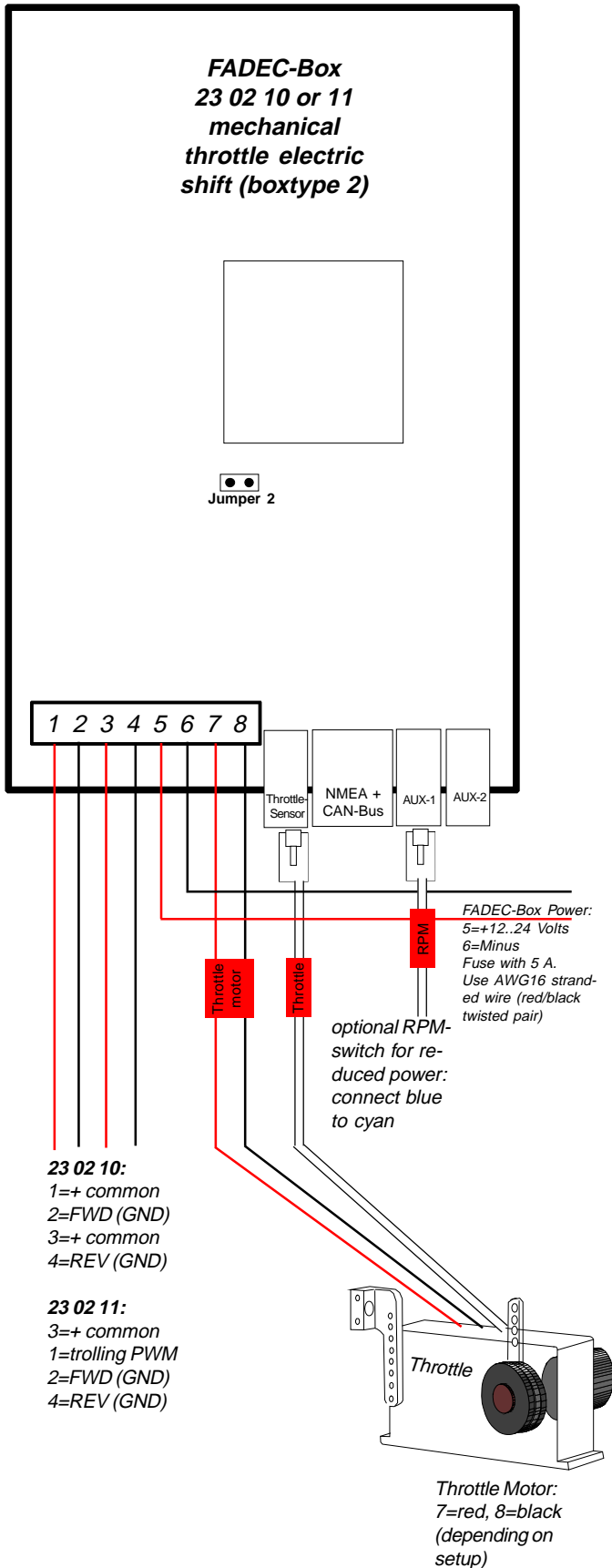


optional RPM-switch for reduced power: connect blue to cyan

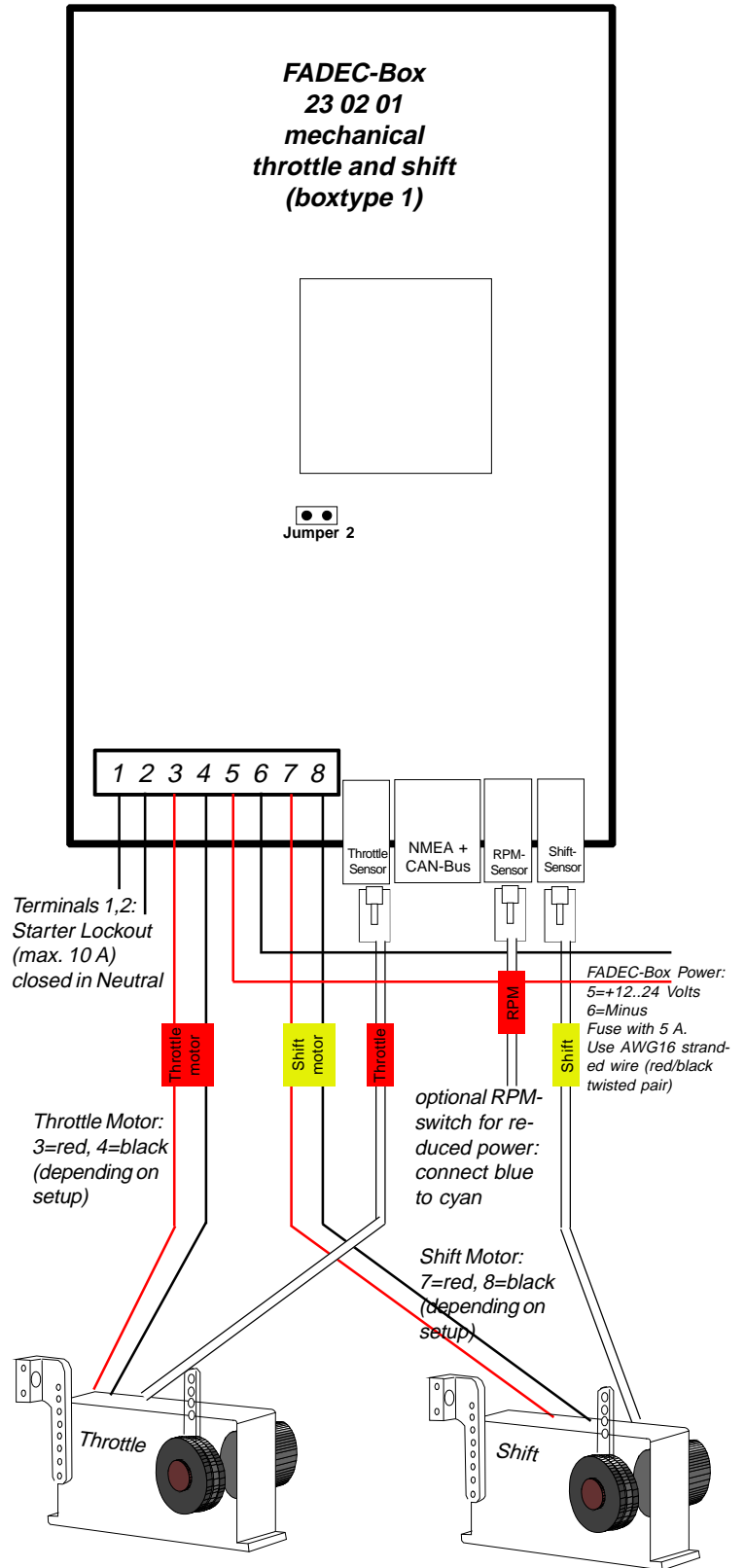
RJ-11 RPM-CMD	to Bosch Throttle CMD
1=white (switch - out)	1= yellow (switch - in)
3=cyan (signal - out)	2=white (signal - in)
2=blue (0 V - in)	3=grey (0 V - out)
	4=brown (0 V - out)
4=magenta (5V - in)	5=green (5 V - out)

Different signal ranges are available for various engines, consult with Tecnautic

Mechanical Throttle, electric Shift



Mechanical Throttle and Shift



FADEC-Box Setup

Initial Operation

Possible Problems

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 (shift 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 and returning it to 00 within approximately 2 to 4 seconds. This should bring both servos to their zero position. Verify parameters A0 and A1 before applying again the THR-button.

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

Reason: incorrect connection and setup of Shift Actuator.

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

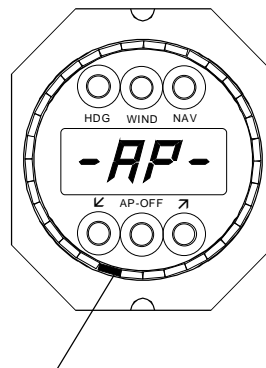
Shift Actuator has incorrect throw:

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

For configuration, the FADEC-BOX must be powered and connected to the bus.

1. Select the AP-Configuration Mode 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.

- 1) Press and hold the lower outer buttons
- 2) Press the lower middle button 4 times
- 3) Release all buttons (Con-FiG is shown)
- 4) Use the lower middle button to scroll forward until "-AP-" is displayed.

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.

Setup 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 (3=black and 4=red when A0=00, the throttle cable will be pushed).
- A1:00** (Boxtype 0 or 1) Rotational sense of the shift actuator. A1=00 is the standard setting. It requires the red shift-motor wire on terminal 7, black on 8. The actuator will *pull* the shift cable for shifting to FORWARD. Reverse the wires when A1=01!
- A2:0?** Boxtype-0: 00= electronic throttle, mech. shift, Boxtype-1: 01= mechanical throttle and shift, Boxtype-2: 02= mech. throttle, electric shift
- A3:01** (01...02) Engine selection. Set A3=01 for the left (port) engine or a single engine (engine #1) and A3=02 for the right (starboard) engine (engine #2).
- A4:0?** Boxtype 1: A4=01 Throttle actuator "Retard"-throw. The throttle cable will be moved back below IDLE, to stop the engine, when the STOP-Mode is selected. Boxtype 2: A4=05 Trolling Valve break off time
- A5:16** Boxtype 0 or 1: Shift actuator FORWARD shift travel. Boxtype2: Trolling Valve break off current
- A6:12** Boxtype 0 or 1: Shift actuator REVERSE shift travel. Boxtype 2: Min. Trolling pressure
- A7:64** (25...64) Throttle actuator travel. Keep A7 as high as possible, select inner crank hole first, before reducing A7.
- A8:00** A8=00 .. automatic shift delay (protection) before shifting into gear after high power settings. See also A9.
A8=01..31 .. Engine RPM increase (Spin Up) when shifting into gear. **Note: no automatic shift delay** when A8 not zero.

- A9:?** a) This 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) For Boxtype-1 (if A8=00): A9 is defining the minimal shift delay (A9=05 sets 0,5 sec delay).
c) Trolling Valve response (A9=10).

- AA:00** a)Min.desired thrust in Hover- or Joystick-Mode (twin screw without thusters) or b) Min.possible thrust (single screw vessel /w thrusters).

- A_:20** a) Alternate setting for throttle actuator travel. A_ is valid instead of A7 when blue and cyan wires are tied together on the RPM Sensor Cable (and A- = 06)
b) throttle setting in Docking Mode

- Ac:00** **Caution:** open the red QUICK DISCONNECT on both actuators. Set Ac=01 to start a sensor alignment cycle of the actuators, when needed. The cycle finishes within 2 minutes (indicated by Ac=00 again). Press THR again and verify correct movement of both actuators, before reconnecting the DISCONNECTS.



- 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
A- =06 .. RPM switch connected

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*:00** use A0*=01 for higher idle rpm in Docking Mode according A8 (only Boxt.0+2).
- A1*:00** A1*=00 Spin Up according A8 will fade out after shifting into gear (only box-type 1 or 2), but not in Docking Mode. A1*=01 Spin Up according A8 is maintained after shifting into gear.
- A2*:00** 01 = with Trolling Valve
- A3*:00** Reserved
- A4*:00** The Docking-Mode is enabled when setting A4*=01.
- A5*:00** A5*=01 always for Boxtype-2.
A5*=01 for Boxtype 1: throttle is pitch selector (+/-) without shift actuator
- A6*:03** Hover Mode accuracy (0..3)
- A7*:00** A7*=01 for *Twin screw* tractor (front) drive or with Bow Thruster only.
- 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 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: (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).

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.

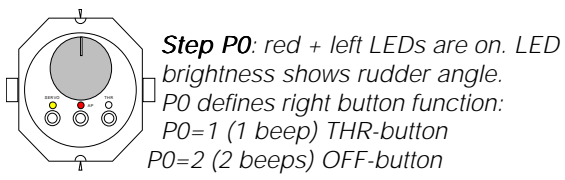
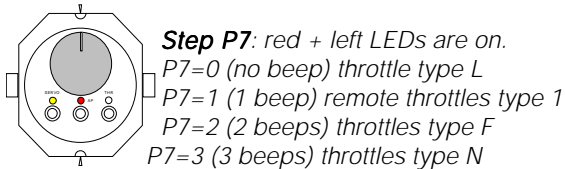
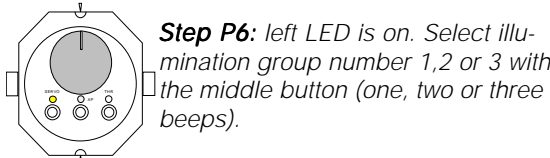
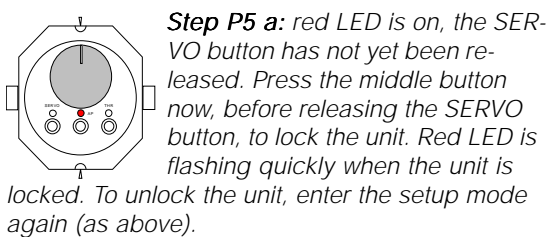
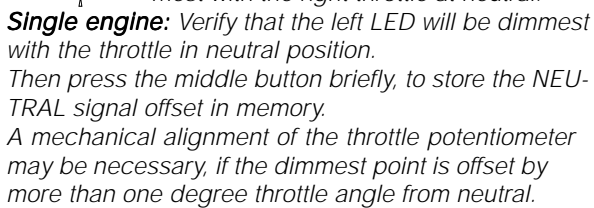
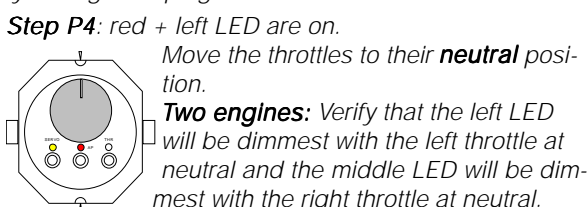
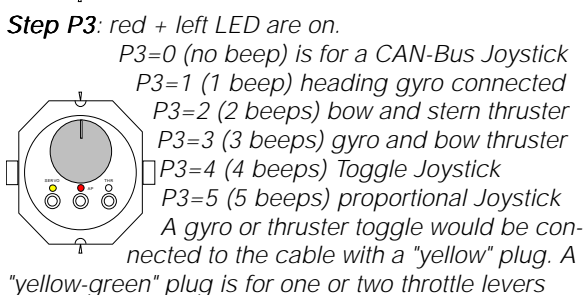
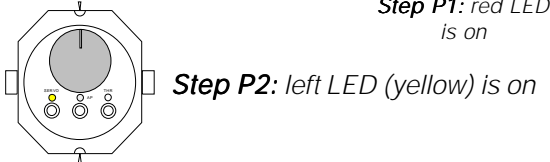
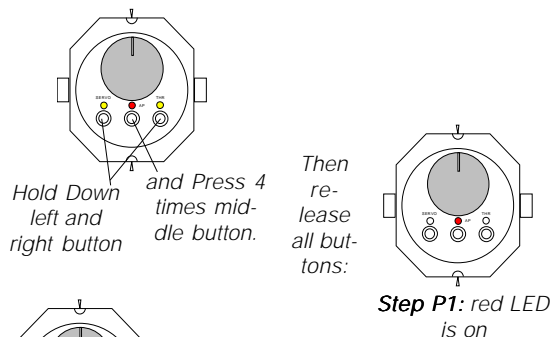
Press SERVO briefly to advance to step 7, or press THR to exit the setup mode.

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.



FADEC fail codes

FADEC fail codes are produced by the FADEC-Box. This is very useful during installation.

Reading FAIL codes from the display unit is done with function "F0", which is shown after holding the OFF-button (for about 3 seconds). The lower right button is then used to select the desired Box:

P.1=Drivebox1, P.2=Drivebox2,
F.1=Fadeebox1, F.2=Fadeebox2.

For example F.2=08 points to a problem with the Shift Servo on the Starboard engine.

Note: when switching off bus power **and** FADEC power, any code stored inside the display units will be lost; a random number (e.g. 32) 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.

"OFF" stands for automatic disconnect of the FADEC-Box:

Code	FADEC Failure Cause
01	OFF due to over current
02	OFF due to box over temperature
03	OFF due throttle-servo extreme angle
04	OFF: CB at the Fadeebox has dropped
05	INFO: Battery voltage low! (no throttle disconnect, only warning)
06	OFF due to low internal Gate Voltage
08	OFF due to shift-servo extreme position
10	INFO: sensed late dblvlt (> 18 V)
12	OFF shift-servo time-out (into gear)
13	OFF 65 A short circuit cut off. For reset power must be disconnected briefly
14	OFF due to throttle or joystick fault
15	OFF due to 4-sec 15 A over current limit
17	OFF due to servo current > 30 A
19	INFO shift-servo time-out (into 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 slave FADEC-Box
26	INFO: unlock code required for joystick or hover mode

Failure treatment

Reconnect any throttle station by pressing the THR-button. Continue with manual throttles. Remove failure cause if known.

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

From the following NMEA 0183-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)