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23 02 01 .. mechanical throttle and shift (Boxtype_1)
23 02 05 .. mechanical shift, electronic throttle signal (Boxtype_0)
23 02 10 .. mechan. throttle, electric shift (Boxtype_2)
23 02 11 .. mech.throttle, el.shift, Troll. Valve (Boxtype_2)

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Warning:

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.

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 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.

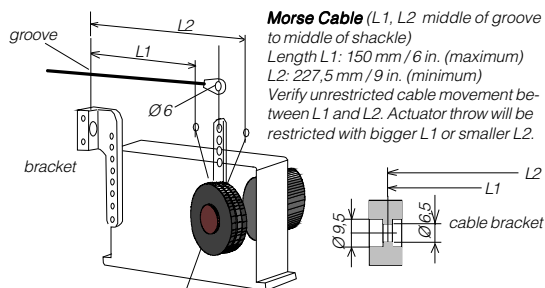
Mounting the Actuators

The actuators are only sealed from the top, water could be leaking in along the base plate. It is necessary to mount them at a dry location which will not be flooded or sprayed eventually.

The FADEC-Box should also be mounted at a dry place with temperatures below 50 degrees Celsius (122F). 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 during installation and initial setup (rotate counter clockwise), 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 gear NEUTRAL 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 at the top, when the flange was in NEUTRAL 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 faster shifting.

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, when the setting of A5 is 15 (forward throw), respectively A6=15 (reverse throw).

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

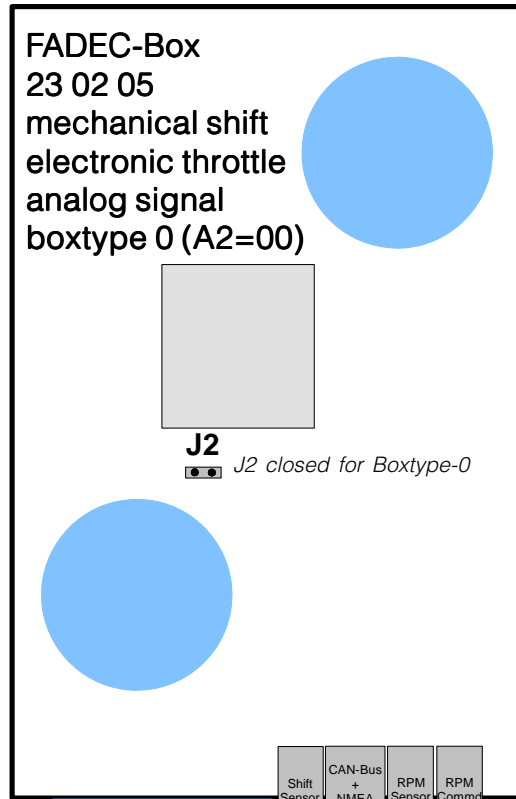


WARNING: the "New Cables First Operation" procedure must be repeated, to ensure there will be the correct actuator throw, after setting a new idle point.

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.

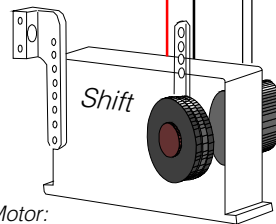
Mechanical Shift, Electronic Throttle



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

FADEC Power:
 5=+12..24V, 6=Neg.
 Fuse with 10A.
 Use AWG16 stranded
 wire (red/black twisted
 pair)

Synchronizer
 input: connect
 Tachometer
 pulses (cyan
 wire, 12.18
 pulses/rev.)



Shift Motor:
 7=red, 8=black
 (when A1=00)

Synchronizer (boxtype 0)

connect Tachometer Signal to
 "RPM-Sensor" connector

Signal (e.g. 12.18 pulses / rev.):
 1=white .. open (0V ref.)
 2=blue ... open
 3=cyan .. Tach-Signal
 4=magenta .. open

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=magenta (5V-in) — 4=brown (0 V-out)
 5=green (5 V-out)

Various signal ranges are available for different engines,
 consult with Tecnautic

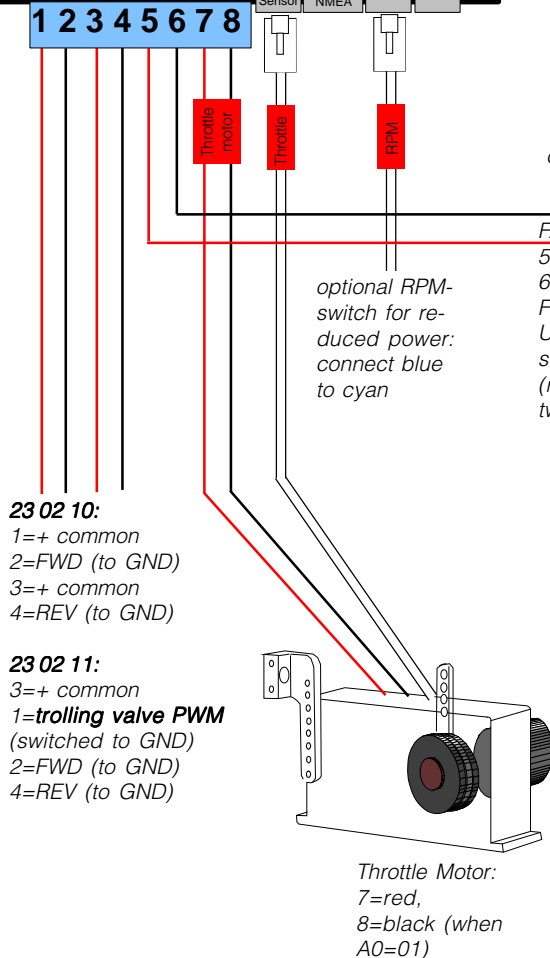
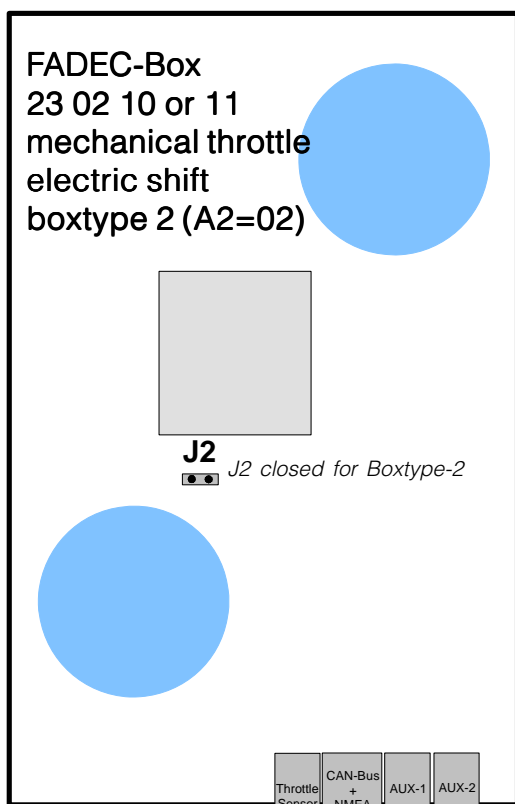
Steyr SE-series (6-pin plug #)
 #2 white 0 Volt - IN
 #4 blue 4.5..0.5V signal
 #3 cyan 0.5..4.5V signal
 #1 magenta +5 Volt - IN
 pin #5 and #6 not used

Bosch EDC16 ECU
 Throttle signal to X1 connector
 X1-K = white (sign.B)
 X1-M = blue (0 V)
 X1-N = cyan (sign.A)
 X1-L = magenta (+5V)

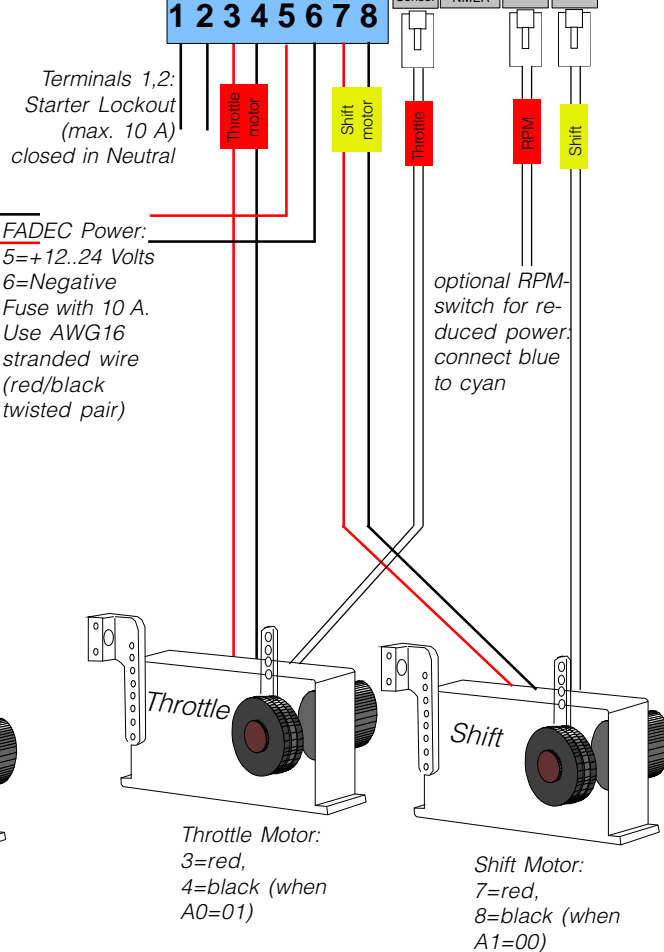
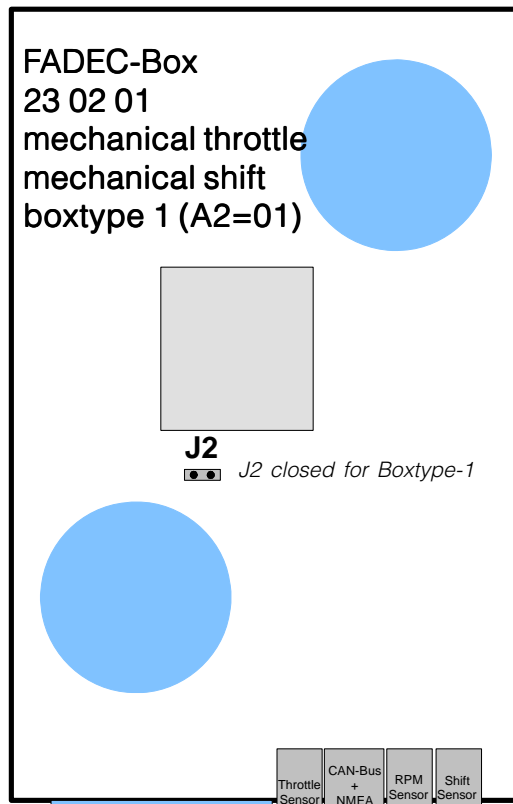
23 02 18 (Yanmar)

FADEC mechanical

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. Repeat if necessary. 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* change setup parameter "A1".

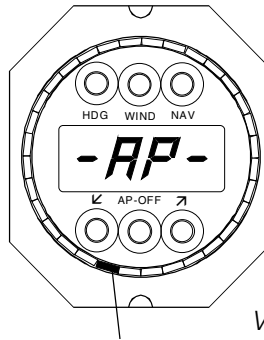
Shift Actuator has incorrect throw:

Action: adjust FWD shift throw by altering "A5" in the setup, REVERSE shift throw by "A6". Use different crank holes (at the actuator or at the gear-box), if needed.

Throttle actuator has incorrect throw:

Action: use different crank holes at the actuator or at the governor. If still needed, also 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. **Make sure that all Autopilot-Driveboxes, Thrusterboxes and other FADEC-Boxes have been disconnected from power or from the CAN-bus.**



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

Visible Throttle LED indicates communication established with the box

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.

Then

- 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.

Then

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.

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.

Note 2: for a non standard SLOW mode limit-speed write it into ROM address 0007, e.g. 64h for SLOW mode up to 10 kn.

Setup Parameters

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

- A0:01** (Boxtype 1) 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 FORWARD. Reverse the wires when A1=01!
- A2:0?** **Boxtype:** 00: electronic throttle, mechanical shift; 01= mechan. throttle and shift; 02= mechanical throttle, electric shift
- A3:01** (01...02) Engine position. Set A3=01 for the port (left) engine or a single engine (engine #1) or A3=02 for the starboard (right) engine (engine #2). A3=00 is for a Bow Thruster, A3=03 a Stern Thruster engine.
- A4:05** A4 = Throttle Retard-throw, in STOP-Mode and also .. **Boxtype 1:** -- A4 = throttle delay after shifting into gear
Boxtype 2 without trolling valve: A4 = throttle delay 0.1s after shifting into gear
Boxtype 2 with trolling valve: A4 = -- Throttle delay (0.1s) after shifting into gear *when not in SLOW mode*
 -- length of trolling valve start pulse *when in SLOW mode*
- A5:16** Boxtype 0 and 1: Shift actuator FORWARD shift travel. Boxtype2: Trolling Valve break off current
- A6:12** **Boxtype 0 and 1:** Shift actuator REVERSE shift travel.
Boxtype 2: Min. Trolling valve pressure.
- A7:64** (25...64) Throttle signal or actuator travel. Keep A7 as high as possible, select inner crank hole first, before reducing A7.
- A8:00** A8=01..31: Engine RPM increase (Spin Up) after shifting into gear or in SLOW Mode, depending on A0* and A1*.
 -- An automatic shift delay (protection) is always on in Joystick, Hover or Speed Mode (with manual throttles only when A8 = 00).
- A9:02** -- This is a switch between selected parameter groups (**A9=00 shows second group of parameters, A0* ... A8***). In addition,
 -- **for Boxtype 1 and 2:**
 A9 sets lower limit for automatic shift delay in Hover, Joystick or Speed Mode

(with manual Throttle only when A8=00).
 A9=01 sets 0.1s delay, A9=20 sets 2.5s delay, A9=31 sets 3.8s minimum delay.

No delay when Trolling Valve installed!

Special case 1: on Twin Screw vessels with only a Bow Thruster: A9 sets amount of fixed differential engine power, when lateral thrust is commanded in Joystick, Hover or Speed mode. Min. shift delay = 0,4s.

Special case 2: on Twin Screw vessels with independent rudders (AA:02): A9 is gain factor for differential power, when lateral thrust is commanded in Joystick, Hover or Speed mode,

AA:01 AA:01 = normal setting.

AA:02 = "split rudder", for independently steered stern or pod drives or ducted rudders.

A_:08 a) longitudinal thrust in Hover Mode
 b) alternative (reduced) manual throttle gain instead of A7, when blue and cyan wires are tied together on the RPM Sensor cable, and A- is set to 06.

Ac:00 **Caution:** open the red QUICK DISCONNECT flanges on both actuators. Set Ac=01 to start an 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 closing the red flanges.

A-:00 FADEC-box NMEA output selection:

A- =00 .. Test data out (ASCII terminal)
 A- =01 .. Pulsing thrust in Hover or Anchor Mode for low thrust; Set up data for HS8000 sent at startup
 A- =02 .. HDM and VHW out (8 Hz)
 A- =03 .. VHW out (8 Hz)
 A- =04 .. Test heading instead fluxgate
 A- =05 .. CAN-Bus isolator active
 A- =06 .. RPM switch connected; pulsing thrust enabled
 A- =07 .. CAN-Bus isolator active; pulsing thrust enabled

A0*:00 A0*=01 requires A8 = 01..09. It sets higher NEUTRAL idle rpm in SLOW Mode according A8, **only for Boxtype 2**.

A1*:00 A1*=00 Spin Up according A8 will fade out after shifting into gear.

A1*=01 Spin Up according A8 is maintained after shifting into gear.

A2*:00 A2*:01 = with Trolling Valve

A3*:00 must be zero

A4*:00 A4*=01 enables the Slow-Mode

A5*:00 **Boxtype 2:** always set A5*=01

Boxtype 1: with A5*=01 throttle becomes pitch selector without shift servo

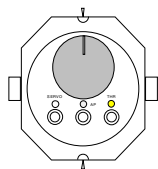
A6*:02 00..03 Amount of differential throttle by rudder (in Anchor, Hover, Speed or Joystick Mode).

A7*:00 A7*=01 for *Twin screw* tractor drive.

A8*:02 00..06 Joystick Throttle Gain. Sets the maximum forward or reverse thrust by Joystick (beside an eventual addition of asymmetric thrust), corresponding to 31% to 97% throttle lever angle. Can be verified on the thrust display.

Throttle Lever Functions

Engaging the Throttle Station



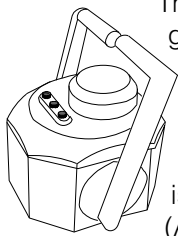
Press the THR-button briefly, to activate the throttle(s) of the unit. The engine(s) will immediately respond to the existing lever position(s) and the THR-LED of the unit will be lit, to indicate the active throttle station.



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

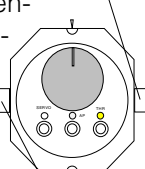
The existing throttle mode(s) at the previously active throttle station will be continued on the newly activated station. For example with the left engine in WARM UP Mode and the right engine in FWD gear, this will be copied to the newly activated station, when the THR button is pressed.

Twin Engine Throttle Station



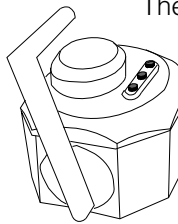
The status of the left engine (number 1) is indicated by the left LED (SERVO), the status of the right engine (number 2) is indicated by the red (AP) LED.

engine #2
throttle



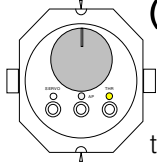
engine #1
throttle

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 set-up.

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.

SLOW-Mode

Changing into and out of Slow-Mode: The

THR-button is used to select the Slow-Mode for engine control and for steering (if the autopilot is installed). Switching in and out of Slow-Mode requires the engines either in NEUTRAL or in WARM-UP Mode. Hold the THR-button for 2 seconds until it sends a short beep. The Slow-Mode is indicated by a blinking Throttle-LED.

FADEC in Slow-Mode: in the presence of a trolling valve or in case of Jet Drives or Voith-Schneider propellers, thrust will be adjusted continuously down to zero.

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

The steering functions of the Slow-Mode will not become active, until boat speed has dropped below 50% of set max. Speed.

Operational aspects

The FADEC controls throttle, shift and clutch, similar like a driver would do in a manual car.

Driving styles can be very different, so can the FADEC either shift cautiously or as fast as possible. The setup permits you to set your personal limits or to let the FADEC decide, as a function of the actual situation.

Variables

- **Shift delay** (when reversing gear): choose either a fixed delay or a variable automatic delay. The automatic shift delay is estimating actual engine rpm from the very recent throttle position. It does neither know nor estimate the actual propeller speed and direction. Shifting quickly into opposite gear from full throttle will produce an automatic delay of up to 3,5 seconds, if so enabled in the setup. In case of a hydraulic clutch, it may take a little extra time until the clutch is filled and clutch pressure has risen.
If a Trolling Valve is installed, the hard onset of full clutch pressure will be smoothed over a period of 0.25 seconds. This smooth engagement often permits to forgo the shift delay. The 0.25 second rise time of the clutch pressure can be preceded by automatically slipping the clutch at a constant pressure (set by A5) over a desired period (set by A4), in order to slow down an eventually opposite spinning propeller.
- **Throttle delay** (after activating the clutch): the purpose is to avoid accelerating the engine significantly, before the clutch has engaged.
Depending on how fast the engine can accelerate and how slow the clutch will carry full torque, a fixed throttle delay can be set with A4. Note the dual function of A4 above. If there is no trolling valve installed, the throttle delay will replace the slip period above.
- **Pitch delay** (variable pitch propellers): Constant speed propellers permit thrust reversal within 0.25 seconds approximately.

Manual or Autopilot Throttle ops

Manual throttle operation lets you choose the Driving Style, you are free to set fixed and long delays or choose an automatic shift delay, which optimally protects the drive train.

However automatic throttle modes, like the Hover mode, may require a very short shift cycle time, especially if a firm Hover Position is required in moderate sea conditions.

Shortest shift cycle time with a trolling valve is 0,7s and without trolling valve 1,0s (FWD to REV or REV to FWD).

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=Fadebox1, F.2=Fadebox2.

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 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 Fadebox 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 |
| 09 | INFO: setup data loss. Insert setup data! |
| 10 | INFO: sensed late dblvt (> 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 | OFF 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 |
| 27 | INFO: Hover Mode not available due to missing GLL data (Lat/Lon) |
| 28 | hover OFF due to loss of master FADEC |
| 29 | INFO: insufficient heading control (by thrusters or engines) in Anchor or MOB Mode |
| 31 | INFO: FADEC-Box restarted during operation for unknown reason |

Failure treatment

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