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Valid for:
23 02 05J Box Type-0 mechanically actuated propeller pitch, electronic throttle signal

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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.

Danger for actuator! Support the lever when opening red disconnect!

Installing the 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 could misalign their internal position sensor and possibly complicate the installation.

Warning 3:

Do not connect the actuator directly to a higher than a 12 Volt source, this could damage the motor.

Warning 4:

During installation keep the red disconnect nut open, to permit the crank to move freely, until instructed otherwise.

Warning 5:

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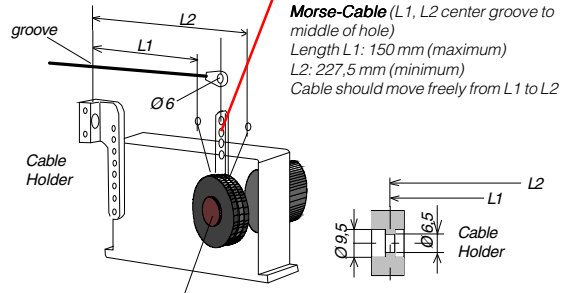
Mounting the Actuators

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 at a dry location. Special attention should be paid to protect the electrical cables 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 Pitch actuators are marked differently. They have different internal sensor wiring. The Pitch 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 Pitch Actuator cable

Disconnected the FADEC-Box from power or from the CAN-Bus.

Move the mechanically disconnected actuator crank to the upright position and engage the crank by gently tightening 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), 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 Bowden (Morse) 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 gear box pitch lever, while the actuator crank rests in NEUTRAL position. Adjust the length on either cable end as required and use an appropriate hole on the gearbox lever.

When the Bowden 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 that pitch is following properly, with no interference of the cable at either end.

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

Non-Standard setting: selecting FWD thrust will push the actuator 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] outer hole	throw [inches] outer hole
5	23	0.9
10	28,5	1.12
15	35	1.38
17	38	1.5
45	62 mm	2.44 in.

Adjusting Pitch NEUTRAL position

The adjustment is done with running engine and the pitch lever in Neutral.

The precise position can be modified by altering "A₃₂" between 0 and 63. A higher setting will produce more forward thrust if A1=01 (less, if A1=00).

Adjusting the actuator "zero" crank-position internally

The actuator "zero"-position can be set mechanically. Only required when a new potentiometer has been installed in the actuator.

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 actuator with the pitch lever control station.

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 08 (pitch actuator extreme) is displayed.

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

Action: verify connections and setup data, then start an alignment cycle by setting "Ac" to 01. This should bring the actuator to the zero position.

Actuator moving wrong way: (FWD instead REVERSE).

Reason: incorrect connection and setup of the Actuator.

Action: Interchange actuator Motor wires and modify setup parameter "A1" at the same time.

Actuator has incorrect throw:

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

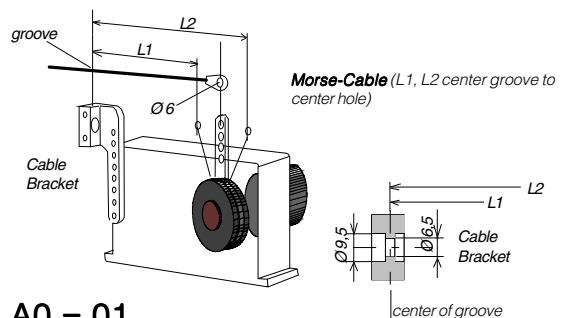
Sample settings

A0 = 00 (full pitch by 100% throttle)

No throttle signal from FADEC

Sample Initial settings:

L1 = 143,5 max. reverse pitch - 23 mm A6=15
 L0r = 155,5 (in gear REV idle) - 11 mm AA=32
 L0 = 166,5 neutral pitch 0
 L0f = 178,5 (in gear FWD idle) + 12 mm
 L2 = 223,5 max. FWD pitch + 43 mm A5=45



A0 = 01

Slow: full slow-pitch by 28% throttle,
Normal: max-pitch whenever in gear.

Analog throttle signal from FADEC (A7=64, A8=08, AA=20)

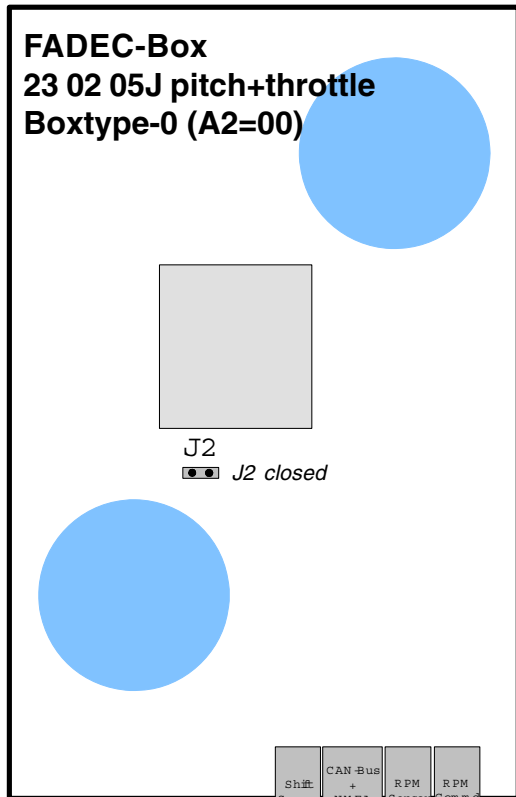
Sample Initial settings: (A5=32, A6=20) **Norm Slow**

L1n = 142,5 max. FWD Normal .. - 40 mm 4,55V
 L1s = 156,5 max. FWD Slow .. - 38 mm 0,78-3,68V
 L0f = 184,5 (in gear FWD idle) slo - 2 mm 0,34V 0,78V
 L0 = 186,5 neutral pitch norm/slo .. 0 0,36V 0,80V
 L0r = 188,5 (in gear REV idle) slo .. + 2 mm 0,34V 0,78V
 L2s = 212,5 max. REV Slow .. + 26 mm 0,78-3,68V
 L2n = 217,5 max. REV Normal .. + 31 mm 4,55V

Mechanical Pitch Control Electronic Throttle

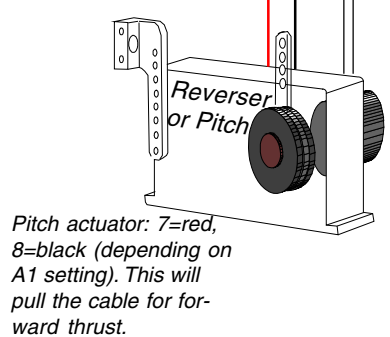
FADEC-Box Setup

Initial Operation



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

FADEC Power: 5=+12V, 6=Neg. Fuse with 8 A. Use AWG16 stranded wire (red/black twisted pair)

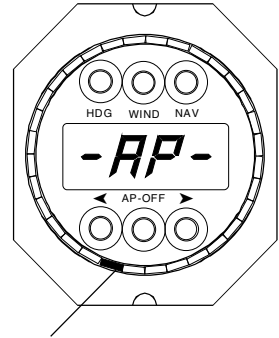


B/U Panel Harness:

Deutsch Connector

DT04-12PC-CE07	RPM Cmd	RJ11 4p-4c
pin 8 VCPA power +5V	pin 4	magenta
pin 9 VPA throttle signal 0,4...4,4V	pin 3	cyan
pin 10 EPA GND 0V	pin 2	blue
	pin 1	white not used

FADEC-Setup is done on any of the Autopilot-Displays in the System. Only one box must be powered or connected to the bus during FADEC or DRIVEBOX configuration. Disconnect other boxes or switch off their power.



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

Throttle-Servo Position LED

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.

Note: for a non standard SLOW mode speed range, write the limit into ROM address 0007, e.g. 64h for a SLOW mode range up to 10 kn (available on request)

FADEC-Box Parameters

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

A0:01 In SLOW mode proportional propeller pitch control for up to +/- 25% throttle lever. Above that the analog engine throttle signal is increasing.
In NORMAL mode only fixed pitch for NEUTRAL and according A5 and A6 for FWD and REV available.

A0:00 Propeller pitch control by throttle lever movement. Requires external throttle signal to the engine.

A1:01 (00 or 01) Rotational sense of the pitch control actuator. A1=01 is the standard setting. It requires the red actuator motor wire be on terminal 7, black on 8. The actuator will **pull** the cable for FORWARD thrust. When reversing the wires, set also A1=00, the actuator will push the cable for FWD thrust.

A2:00 Boxytype 00 only.

A3:01 Engine selection. Set A3=01 for the left (port) engine (engine #1) or A3=02 for the right (starboard) engine (engine #2). For a single engine set A3=01. (A3=00 makes a Bow Thruster, A3=03 makes a Stern Thruster)

A4:08? (04..16) makes the lateral thrust by differential throttle on twin engine vessels in Joystick, Hover or Speed mode.

A5:45? Pitch actuator FORWARD travel limit.

A6:15? Pitch actuator REVERSE travel limit.

A7:35 A7 has no function for the pitch actuator. It sets the analog throttle signal, when A0=01.

A8:00 (00..21) Engine idle RPM markup in SLOW Mode. **Must be 00** when A0=00 (with pure pitch control)

A9:06? A9 is the longitudinal thrust factor in Hover, Speed and Anchor Mode (A9=06..16).

A9 is also a switch for selected parameter group. A9=00 shows parameters A0* ... A8*, while A9 other than zero displays parameters A0 ... A8.

AA:25? 1) "Pitch only", when A0=00:
AA sets Initial pitch (out of NEUTRAL) when pitch lever is in FWD or REV detent. Further, it sets the pitch limit in SLOW mode, when smaller than A5 or A6 respectively.

2) A0=01 ... AA is the pitch limit in SLOW mode, when it is smaller than A5 or A6 respectively.

A_:32? (0..63) Adjust the propeller zero thrust position with this parameter. Higher number is for more forward thrust. Throttle should be in Neutral while adjusting, with engine running.

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

A-:00 NMEA output from the FADEC-box:
A- =00 .. Test data out (ASCII terminal)
A- =01 .. Set up data for HS8000
A- =02 .. HDM and VHW out (8 Hz)
A- =03 .. VHW out (8 Hz)
A- =04 .. Test heading instead fluxgate
A- =05 .. CAN-Bus separator active

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

A1*:00 Must be 00

A2*:00 Must be 00

A3*:01 Must be 01

A4*:01 Must be 01

A5*:00 Must be 00

A6*:02? 00..03 Amount of differential throttle by rudder in Joystick, Hover and Speed mode.

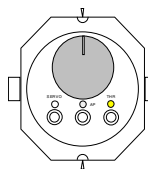
Note: only thrust increase, no reduction, when at the same time differential throttle is used for lateral thrust.

A7*:01 Must be 01

A8*:02? 00..06 Joystick **longitudinal** Throttle Gain. Sets the maximum forward or reverse thrust by Joystick, corresponding to 20 .. 85% throttle lever angle. The range can be verified on the thrust display (En. 1) or (En. 2).

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.

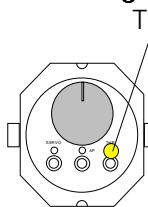


The throttle function is activated independently from the Turn Knob Function at each station.

When moving to another helm station, the existing throttle mode(s) at the previously active throttle station will be continued on the newly activated station.

SLOW-Mode

Changing into and out of SLOW-Mode: The



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

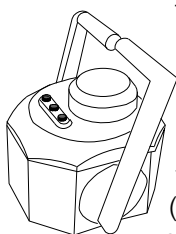
The autopilot can automatically switch between SLOW Mode and NORMAL Mode, when manual throttles are not active (like in Speed mode, Joystick or Hover mode).

Engine Synchronizer

The engine RPM can be synchronized automatically through propeller pitch variation by the FADEC when the following conditions are met:

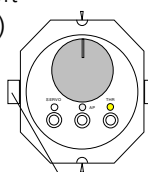
- A0=00 (pure pitch control by throttle) and
- RPM data are made available for the FADEC boxes from NMEA2000 with the Tec nautic CAN-Bus bridge and
- Manual throttles are used and
- an external (Cummins) synchronizer must be off, in case of an external engine throttle signal.

Twin Engine Throttle Station

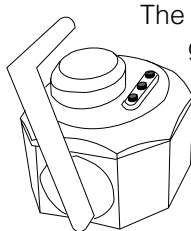


The status of the left engine (number 1) is indicated by the left (SERVO) LED, the status of the right engine (number 2) is indicated by the red (AP) LED.

engine #2 throttle

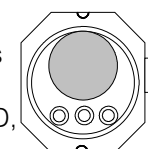


Single Engine Throttle Station



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

engine #1 throttle

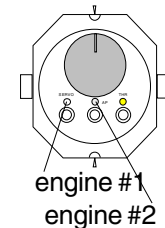


Speed Mode

Use the Speed Mode only in SLOW mode, when surplus power is available through sufficiently high engine rpm.

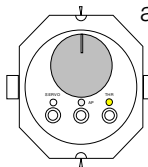
Warm-Up Mode (use when A0=01 with electronic throttle signal)

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.



NEUTRAL, AHEAD and ASTERN

Throttle levers have a distinct detent at Neutral (zero thrust) and also at forward-idle and at astern-idle.



The starting pitch in the forward or astern idle can be adjusted with the AA setting.

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).

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 when the fault condition has been rectified.

Failure treatment

Clear the fault and reconnect throttle station by pressing the THR-button.

- 01 OFF due to over current
- 02 OFF due to box over temperature
- 04 OFF: CB on FADEC-BOX has dropped
- 05 INFO: Battery voltage low! (no disconnect)
- 06 OFF due to low internal Gate Voltage
- 08 OFF due to propeller pitch sensor extreme position
- 09 INFO: setup data loss. Insert setup data!**
- 10 INFO: sensed late dblvlt (> 18 V)
- 12 OFF pitch time-out, to either end position
- 13 OFF due to > 65 A short circuit
- 14 OFF due to throttle station or joystick fault
- 15 OFF due to 15A over current limit
- 17 OFF due to servo current > 30A
- 18 INFO: pitch time-out in working range
- 19 INFO: pitch time-out (towards neutral)
- 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 in Anchor or MOB Mode (by thrusters or engines)
- 31 INFO: FADEC-Box restarted during operation for unknown reason