FADEC JET electronic
Sep 2018

Covers engines with analog voltage or current throttle signal (Boxtype_3) or PWM signal (Boxtype_4) and provides follow-up reverser ops by hydraulic ON-OFF valves

Software Version
mth18.07

Download newest Manual from:
www.tecnautic.com/public/fadec_electronic.pdf

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.

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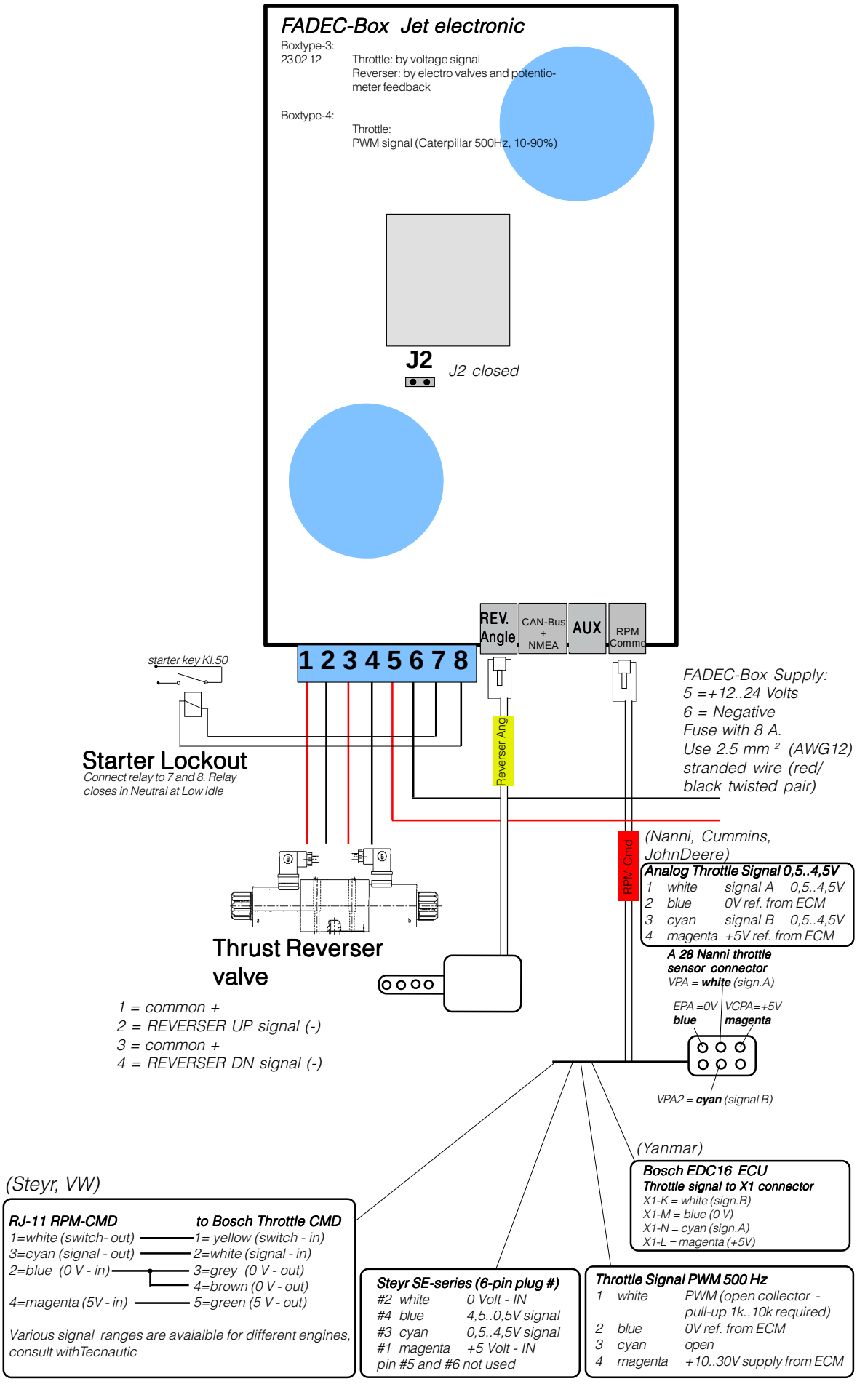
FADEC-Box Jet electronic
Boxtype-3:
23 02 12
Throttle: by voltage signal
Reverser: by electro valves and potentio-meter feedback
Boxtype-4:
Throttle:
PWM signal (Caterpillar 500Hz, 10-90%)
J2
J2 closed
REV. Angle
CAN-Bus + NMEA
AUX
RPM Commd
1 2 3 4 5 6 7 8
starter key Kl.50
Starter Lockout
Connect relay to 7 and 8. Relay closes in Neutral at Low idle
Reverser Ang
FADEC-Box Supply:
5 =+12..24 Volts
6 = Negative
Fuse with 8 A.
Use 2.5 mm ² (AWG12) stranded wire (red/ black twisted pair)
RPM-Cmd
(Nanni, Cummins, JohnDeere)
Analog Throttle Signal 0,5..4,5V
1 white signal A 0,5..4,5V
2 blue 0V ref. from ECM
3 cyan signal B 0,5..4,5V
4 magenta +5V ref. from ECM
A 28 Nanni throttle sensor connector
VPA = white (sign.A)
EPA =0V blue
VCPA=+5V magenta
VPA2 = cyan (signal B)
Thrust Reverser valve
1 = common +
2 = REVERSER UP signal (-)
3 = common +
4 = REVERSER DN signal (-)
(Yanmar)
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)
(Steyr, VW)
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)
Various signal ranges are avaialble for different engines, consult withTecnautic
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
Throttle Signal PWM 500 Hz
1 white PWM (open collector - pull-up 1k..10k required)
2 blue 0V ref. from ECM
3 cyan open
4 magenta +10..30V supply from ECM

Electrical Connection

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Wiring the ECU

Connect the ECU (engine control unit, supplied by the engine manufacturer) according the wiring diagram.

Throttle signal by Voltage:

Depending on the engine, there are different voltage signals available. Some versions provide a second signal, to permit verification of validity by the ECU.

Throttle by PWM signal:

Pin 1 = PWM signal (open collector, 1k..10k pull-up required)
Pin 2 = 0 Volt (supplied from ECU)
Pin 3 = open
Pin 4 = 10 to 30 V (supply from ECU)

Throttle signal by current 4-20mA:

Pin 1 = open
Pin 2 = - Signal
Pin 3 = + Signal 4-20mA
Pin 4 = open

Leave the gearbox initially in NEUTRAL, when testing the throttle response of the engine.

Adjusting engine RPM settings in SLOW Mode

When switching from *NORMAL Mode* to *SLOW Mode*, the engine(s) will accelerate automatically to Hi-idle (maneuvering) RPM.

The SLOW Mode RPM-setting is adjusted by A8. Select an appropriate setting that has sufficient maneuvering thrust in Neutral.

Adjusting Reverser NEUTRAL (zero thrust) position

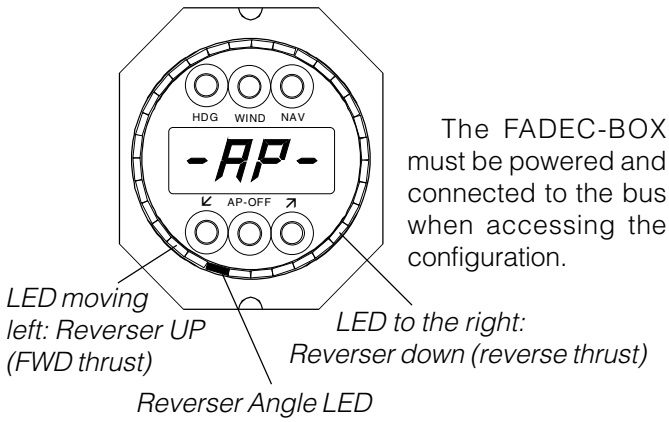
The adjustment is done with running engine in SLOW-Mode and the throttle in NEUTRAL.

The precise reverser angle can be modified by altering "A4:32" betwenn 01 and 63. A higher setting will produce more forward thrust.

FADEC-Box Setup

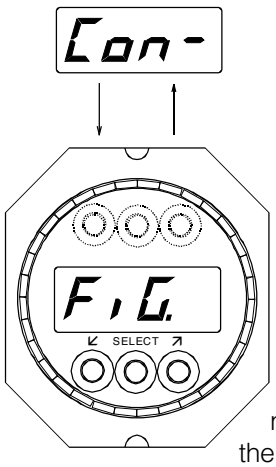
Initial Operation

FADEC-Setup is done on an Autopilot-Display. **Only** one box must be connected to the bus during setup. Disconnect all other FADEC-Boxes and Dribevoxes when checking or modifying the configuration.



The FADEC-BOX must be powered and connected to the bus when accessing the configuration.

ConFig menu:



1. Select the AP-Configuration Mode on an Autopilot Display (or set "di=01" on any other Tecnautic Display and select "ConFig"). 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 set-up cannot start:

1) Press and hold the lower outer buttons
2) In addition 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 with the left or right lower button, when needed.

Setup Parameters

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

A0:00 00 or 01 is for the reverser angle sense. Reverser bucket UP (forward thrust): LED on the left. Set A0 correctly!

A1:00 With manual throttles in SLOW mode, A1=00 or 01 selects the amount of minimum in-gear FWD or reverse thrust.

A2:03 ***Boxtype*** **A2=03:** throttle signal is analog voltage or current; **A2=04:** throttle signal is 500 Hz PWM (Caterpillar).

A3:01 Engine selection. A3=01 for the left engine (port engine) or A3=02 for the right engine (starboard engine).

A4:32 (01...63) Adjust the reverser zero thrust position with this number. Higher number is for more forward thrust. Throttle should be in SLOW Mode and Neutral, while adjusting with engine running.

A5:12 (01...17) Reverser travel UP limit.

A6:12 (01...17) Reverser travel DOWN limit.

A7:44 (25...58) Throttle Gain. In order to utilize the available throttle lever range, reduce A7, to decrease *full throttle signal* so as to achieve full power short of the throttle stop.

A8:04 (0...31) Sets Engine RPM increase (Hi idle) in SLOW Mode.

A9:07 *a)* -- reverser control dead band
b) -- A9 is a switch between selected parameter groups. A9=00 shows second group of parameters: A0* ... A8*

AA:10 (0...32) Reverser travel UP-limit in SLOW Mode. When throttles are advanced more than 25% in SLOW Mode, it holds the reverser bucket close above the water stream, to guarantee an instant thrust reaction, when retarding the throttle.

A_:08 A_ is the longitudinal thrust setting in Hover and Speed Mode. Use higher numbers on large vessels.

Ac:00 Must be 00

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

Note: for a non standard switching speed from SLOW mode to NORMAL mode, order special version (the speed value is written into ROM address 0007, e.g. 64h for mode change at 10 kn).

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. *Remember A9!*

A0*:00 not used

A1*:01 01 .. No spinup when selecting FWD or REV idle thrust, in NORMAL mode.
A1*=00 .. automatic spinup (to maneuvering rpm = Hi-idle) when selecting FWD or REV idle in NORMAL mode.

A2*:01 Must be 01

A3*:01 Must be 01

A4*:01 Must be 01

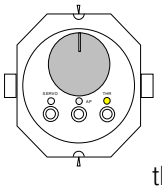
A5*:00 Must be 00

A6*:00 00..03 Amount of automatic differential throttle for heading control, in Joystick mode, in Speed mode or in Hover mode.
Note: only thrust increase, no reduction, when at the same time differential throttle is used for lateral thrust.

A7*:00 Must be 00

A8*:02 00..06 Joystick longitudinal Throttle Gain. It limits the maximum available forward or reverse thrust when using the Joystick.

Activating the Throttle Station

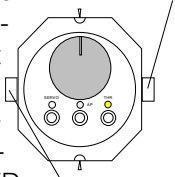


Press the THR-button briefly, to activate the throttle(s) of the unit. The engine(s) will immediately respond to the commanded lever position(s) and the THR-LED of the unit will be lit, to indicate the active throttle station.

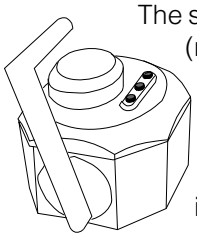
! The throttle function is activated independently from the Turn Knob Function at each station.

Twin Engine Throttle Station

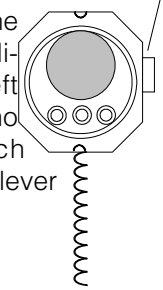
The status of the port engine (number 1) is indicated by the left (SERVO) LED, the status of the Stbd engine (number 2) is indicated by the red (AP) LED.



Single Engine Throttle Station

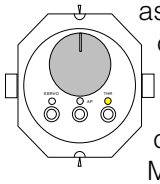


The status of the engine (number 1) is indicated by the left (SERVO) LED, no matter on which side the throttle lever is mounted.



NEUTRAL, AHEAD and ASTERN

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



Movement of the reverser helm is displayed by a flickering LED of the respective engine. When the reverser has reached the proper position, the flickering LED will stop with a short beep.

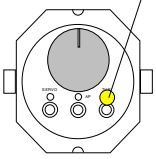
Starter Lockout

Engine start is only possible after selecting manual throttles with the THR button at a Throttle Station. The throttles should be either in NEUTRAL, or in WARM-UP Mode near the forward idle detent.

A relay connected to the FADEC Box at terminal 7 and 8 will close if the above condition is met.

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 may automatically switch between SLOW Mode and NORMAL Mode, when manual throttles are not active.

Throttle: In the lower thrust settings (first 25% of throttle range) reverser buckets are moving proportional to the throttle lever, while the engine remains at constant rpm. Only beyond 25% throttle lever will the engine accelerate.

A small amount of thrust is automatically applied, when manual throttles are placed into the FWD or AFT idle detent,

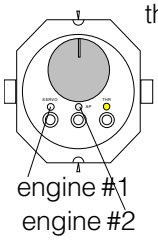
Steering: In SLOW Mode, the vessel can be steered at standstill by moving the nozzle with the Turn Knob. On Twin waterjets, the autopilot may also use differential thrust, when it has control of the engines (in Hover, Anchor or Speed Mode).

Gearbox and Flushing

Controlling the gearbox has to be done independently from the FADEC system. A separate selector switch for forward and reverse gear should be installed.

Engine Only (Warm-Up) Mode

Put the throttle lever into NEUTRAL, then press and hold the THR-button. Now move the throttle lever to AHEAD idle, 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 engine rpm while the reverser is commanded to zero thrust.



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

! **WARNING:** Forward and reverse thrust are cancelled out by the reverser bucket in Warm-Up Mode - **provided reverser hydraulics is available!** Considerable side thrust may be developed, when the nozzle is not centered!

It is safer, to disconnect the engine from the jet pump by putting the gearbox into NEUTRAL, when an engine run up is performed.

FADEC fail codes

Fail codes are produced by the FADEC-Box. Reading FAIL codes from the display unit is done by holding the OFF-button (for about 3 seconds). Scroll forward with the OFF-button until FAIL is displayed briefly. Then use lower right button to select the desired Box:
P.1=Drivebox1, P.2=Drivebox2,
F.1=Fadecbox1, F.2=Fadecbox2.

For example F.2=03 points to a problem with the Reverser Angle signal on the Stbd 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 are cleared with the THR-button.

Failure treatment

- Read FAIL code of the respective Box.
- Rectify fault (repair or replace ..)
- Clear FAIL code with THR button

FAIL code F1:03 or F2:03

Reverser feedback signal lost

- The Reverser LED is flickering permanently as long as fault persists (SERVO LED is for Port Reverser, AP-LED for Stbd Reverser).

A .. **Repair / Restore** Reverser feedback signal if possible, **then clear FAIL code with the THR button**, resume normal operation.

B .. if FAIL 03 cannot be cleared:

If the engine responds to forward throttle movement, it has automatically switched into emergency Warm-Up Mode. The Warm-Up Mode may not be indicated by the Reverser LED, instead it may continue flickering.

For emergency operations, the Reverser may be moved up manually at the Reverser Valve, if hydraulics are available. The engine can be accelerated in Warm-Up Mode.

Use Manual Throttles only. Do not use the Joystick or Speed, Hover and Anchor Mode!

Hint:

When a second Throttle Station is available: Place lever into FWD idle detent, **thereafter** select THR. This will bring up the Warm-Up Mode with its normal double flash. Do NOT pull back throttle into NEUTRAL until repair has been made.

FAIL code F1 / F2 = 18 or 19

Reverser bucket not reaching commanded position within 4 seconds

A ..The Reverser LED stops flickering after commanded Reverser position is attained. FAIL 18 or 19 is simply an indication for slow Reverser Hydraulics.

B .. if Reverser LED continues flickering: this means the Reverser bucket is unable to reach the commanded position. Possible reason:

- Reverser Hydraulics not available, or
- Reverser stuck for mechanical problem, or
- an unreachable Reverser Position has been configured in the FADEC setup.

Code	FADEC Failure Cause
	"OFF" stands for automatic disconnect of the FADEC-Box:
01	OFF due to over current
02	OFF due to Fadec box over temperature
03	OFF due to bad reverser angle signal
04	OFF: CB on Fadec box has dropped
05	INFO: Battery voltage low! (no throttle disconnect, only Info)
06	OFF due to low internal Gate Voltage
09	INFO: setup data lost. Insert setup data!
13	OFF due to > 65A short circuit. To reset the fault, cycle power to the box.
14	OFF due to throttle or joystick fault
15	OFF due to 4-sec 15A over current limit
17	OFF due to over current > 30 A
18	INFO reverser not following in FWD or REV
19	INFO reverser not following to Neutral
20	OFF due to Autopilot-Drivebox fault in Joystick or Hover mode
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 has restarted during operation