WR CONTROLS
FLEXBALL ITALIANA

# Electronic command system for marine engines 3500 and 4500 series


**Operating manual & mounting instructions**

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# 1. Introduction

This manual describes the electronic remote control system in general and its operating, performance and safety aspects. If it is the first time that you install a Flexball electronic control system, go to the next section where you will be guided to the necessary steps.

## 1.1. How to start

Once you have received the system package, follow these steps:

1) identify all the components necessary to build up your system with the help of instructions at sections 4,5,6 and report all the relevant data in the frame here below
2) identify your installation type with the help of section 7.
3) configure the CANBus network, set dip-switches and end of line termination of actuators and command stations, as described at section 7.6
4) mount command stations and actuators with the help of drilling mask (section 23)
5) make electrical wiring (section 10)
6) install push-pull cables, if your application requires it (section 12)
7) make setting of mechanical strokes, if your application requires it (section 13, 14 and 15)
8) program the actuator specific installation parameters (from section 13 to section 18 included)
9) make the programming of the options, if your application requires it (section 19)
10) once you have set-up the electronic system, read the pilot's instruction (section 3). Good navigation!

## 1.2. System configuration and installer remarks

| Component | Position aboard | Serial number |
|---|---|---|
| | | |
| Command station 1 | | |
| Command station 2 | | |
| Command station 3 | | |
| Actuator left engine | | |
| Actuator right engine | | |
| | | |
| Boat registration number | | |
| Date of installation | | |
| Name and signature of authorized installer | | |

# 2. General installation features

## 2.1. Description of the system and its parts

The electronic engine remote control implements mechanical and electronic solutions with digital communication technology. Only few devices are required to compose a complete electronic engine remote control:

- Command stations
- Actuators
- Data communication cables which connect the command stations to the Actuators

## 2.2. Maximum extension of the system

The maximum configuration of the system is as shown in the following table:

| | |
|---|---|
| Actuators | The maximum number of engines that the system can control is 2 |
| Command stations | The maximum number of command stations in the installation is 3 |
| 80 meters | Maximum distance between cockpit and engine room |

## 2.3. System performance

**Temperature**

| | |
|---|---|
| Operating temperature | From -10 to 85°C |
| Storage temperature | From -40 to 90°C |

**Humidity max operating limit**: 90% (relative humidity)

**Protection degree of main system components**

| | |
|---|---|
| Command Station series 4500 | IP 67 |
| Actuator | IP 54 |

**Mechanical features**

| | |
|---|---|
| Nominal load when actuator is providing a pushing force | 150 N (15 kg) with power consumption 1.5 A |
| Max load when actuator is providing a pushing force | 450 N (45 kg) with power consumption 5 A (with time <1 s) |
| Stroke of gearbox – forward | Stroke can be set to between 5 and 40 mm |
| Stroke of gearbox – reverse | |
| Throttle stroke | Stroke can be set to between 5 and 80 mm |

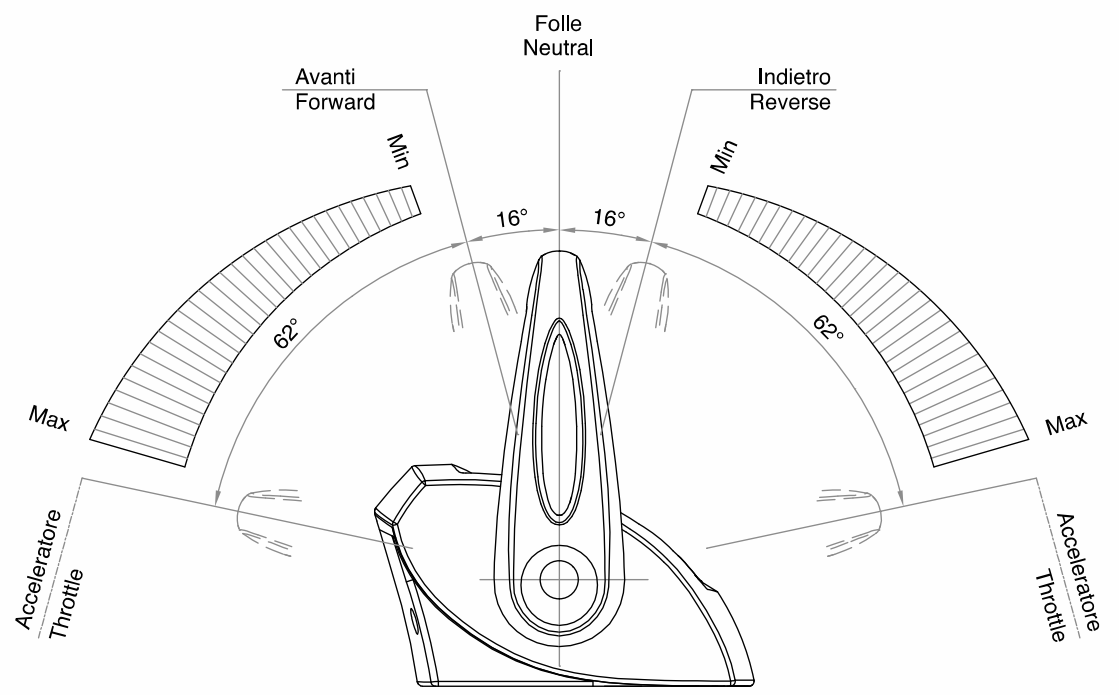
**Electrical features**

| | |
|---|---|
| Power supply | from 9,0 to 28 $V_{dc}$ (for standard installations)<br>from 20,0 to 28,0 $V_{dc}$ (for special installations) |
| Max. current absorbed | 5 A |
| Current absorbed when the system isn't loaded | 0,5 A |

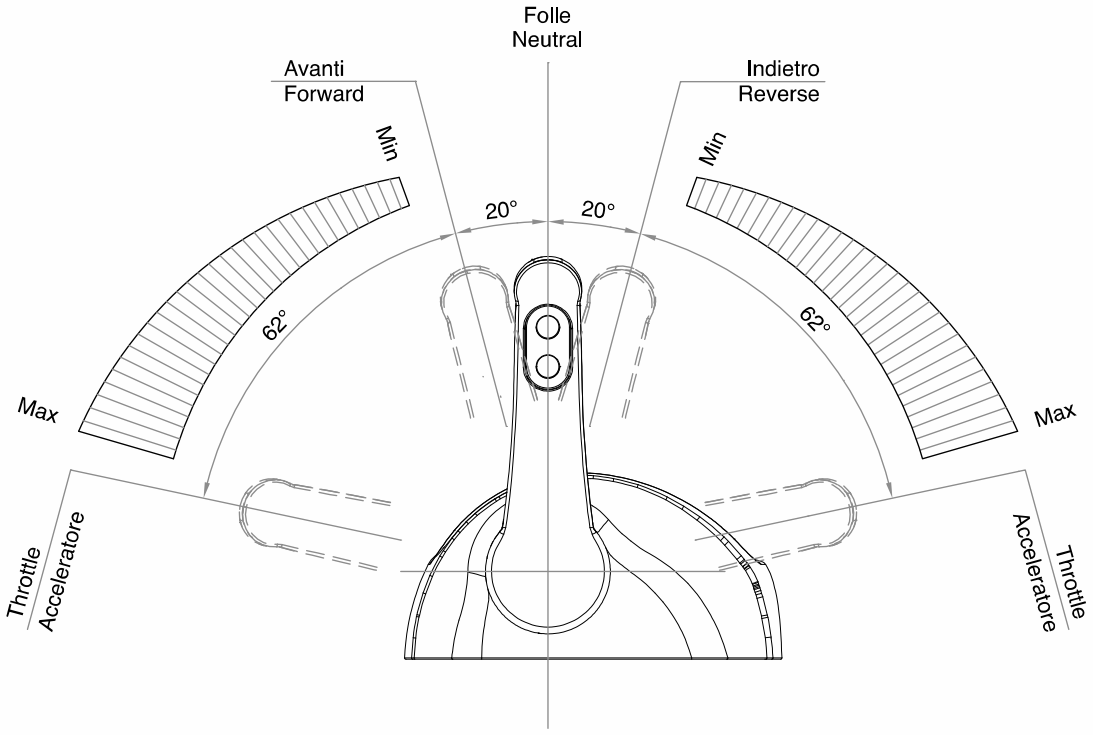
# 3. Pilot instructions

Each station can be programmed for the control of one or two engines. Each lever repeats the functionality of a traditional mechanical lever.
Moving the lever from the neutral position, after 16° (or 20°) forward or reverse automatically the electronic system clutches-in respectively the forward or reverse gear. The accelerator lever has a stroke of 62° both in forward and backward direction.

**Command station series 3500**




**Command station series 4500**



## 3.1. Control keypad

On the command station it is mounted an electronic keypad with 4 push-buttons and 4 LEDs.

**Command station series 3500**


**Command station series 4500**


| Description | LEDs colour |
|---|---|
| Engine (*) | Green |
| Warm/Sync | Yellow |
| Command | Red |
| Engine (*) | Green |

(*) In installations with single engine, both the green LEDs are referring to the same engine. In systems with 2 engines the push button and the green LED on the right are referring to the starboard engine while the push button and the green LED on the left side are referring to the port engine.

It follows the table with the definition of LED and push buttons.

| Push-button | LED | Description |
|---|---|---|
| (Command) | (Meaning) | |
| | Engine | The left LED is for the port (left) engine, while the right LED is for the starboard (right) engine. If the LED has a fixed light on (green), the corresponding gearbox is in neutral position.<br>If the LED is blinking (green), the lever on the LED's side is synchronised with the lever of the station that at the moment has the Command. |
| | Command | If it is switched off, the Station has not the command.<br>If is switched on, the Station has the command. |
| | Warm/Sync | If it is blinking, the navigation system is in Warm-up mode; this means that the engines can be warmed up without clutching-in the gear.<br>If the LED is fix lighted, the system is in Synchro mode. |
| *Warm/Sync* | | When both the levers of the Station that has the command are in neutral position, if you press for 1,5 seconds the button Warm, it is activated the function Warm-up. |
| *Command* | | If you press Command for 1,5 seconds the station takes the command, only if one of these two conditions are respected:<br>- both the lever of the station are in neutral<br>- both the lever are synchronized with respect to the levers of the station that at the moment has the command. |
| All LEDs are blinking | | The control system isn't working correctly. |

## 3.2. Acquisition of the command

It is possible to acquire the command of the boat from any Station in the following cases:

- **The boat isn't moving**
  1. Position all the levers in neutral and press Command for 1,5 seconds.
  2. LED "Command" is now lighted on while the warm/synch LED is blinking. You are in Warm-up mode: throttle command is enabled but clutch command is disabled.
  3. To take the command you must press for 1,5 seconds the Warm/Sync bush-button, afterwards the station acquires the command.

- **In navigation**
  1. Synchronize the 2 levers of the Station which wants to acquire the command with respect to the Station which has the command.
  2. When LEDs "Engine" of two levers of the station which wants to acquire the command are blinking, these levers are synchronised with respect to the levers of the Station which still has the command.
  3. By pressing the pushbutton Command for 1,5 seconds, the new Station takes the command.

► **Important:** before taking the command, proof that all the passengers are safely on board.

## 3.3. Engine Warm-up

If both levers are in neutral, by pressing for 1,5 seconds the button Warm/Sync of the Station which has the command, you enter in Warm-up mode. If you move the lever, it is only affected the accelerator but not the gear. In Warm-up mode the LED Warm/Sync is blinking.

After positioning again both levers in neutral and pressing for 1,5 seconds the Warm/Sync, the system comes back to the normal operation mode.

## 3.4. Synchro mode

It is possible to command both engines at the same speed and direction with only one lever. This function can be activated only by the command station which has the command.

With both levers in neutral position, press at the same time for 1,5 seconds the two “engine” push-buttons. The command of both engines is now on the right lever. In Synchro operation mode, the LEDs “Warm/Sync” and “Command” are lighted on.

From “Synchro” operation mode, if you position both levers in neutral, and press contemporaneously for 1,5 seconds the two “Engine” push buttons, the command of each engine is again assigned to the respective lever and LED “Warm/Sync” is switched off.

The same operation of synchronisation or de-synchronisation can be performed on the station which has the command, in case the RPM between the two engines doesn’t differ more than 10%.

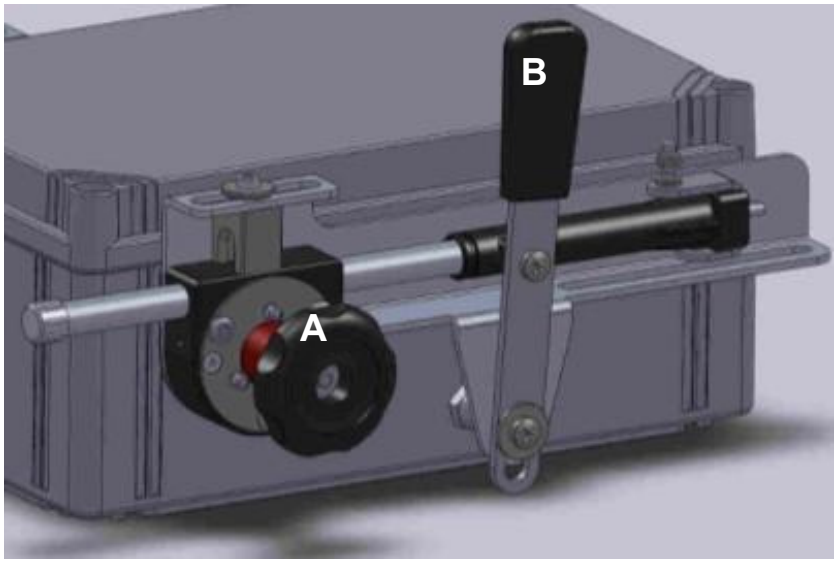
## 3.5. Fast Start-up Mode

This function is available on the first command station as described in section 7.6 of this manual. When the configuration FSM (Fast Start-up Mode) is enabled, the command station with the FSM enabled takes automatically the command at the power on, only if this command station is in neutral position.
If the command station is not in neutral position, the command station will take the command as soon the neutral position will be reached.

## 3.6. Emergency lever

In case of emergency, the electronic system can be switched off quickly and the engines can be operated directly with the mechanical emergency levers.
Emergency levers are fitted on the control box. It is sufficient to turn completely on (clockwise) knob (A). After this operation, the gearbox can be operated manually using levers (B) and with the throttle set to minimum.

In order to reset the system, unscrew completely (counter-clockwise) knob (A). The emergency lever automatically goes back to the position where it was before activating the emergency mode, at the first movement of the command lever.



# 4. Command station

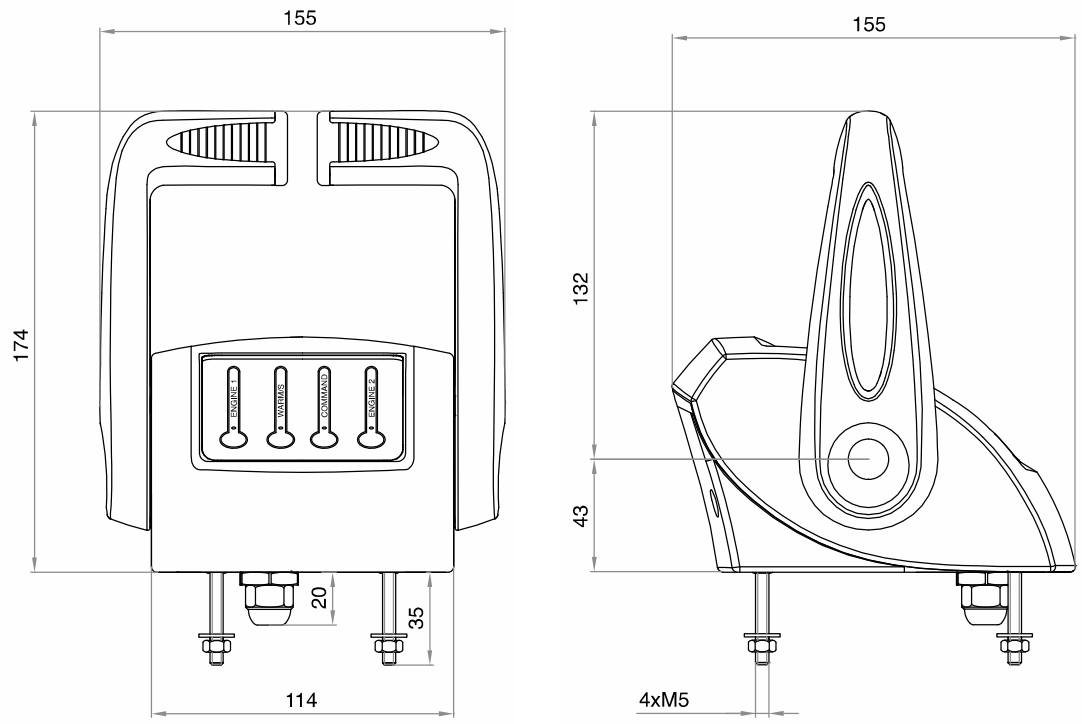
Command stations are classified as devices for the control of one or two engines, with or without trim/flap command. Up to three command stations can be mounted in the same installation. Depending on the application, it is very important to set the dip-switches present on the bottom part of the command station, as described in sections 4.4 and 7.6 of this manual.

### How to mount the Command Station

Command Station cannot be directly or indirectly mounted onto sources of vibrations. At chapter 23 of this manual you find the drilling mask schemes.

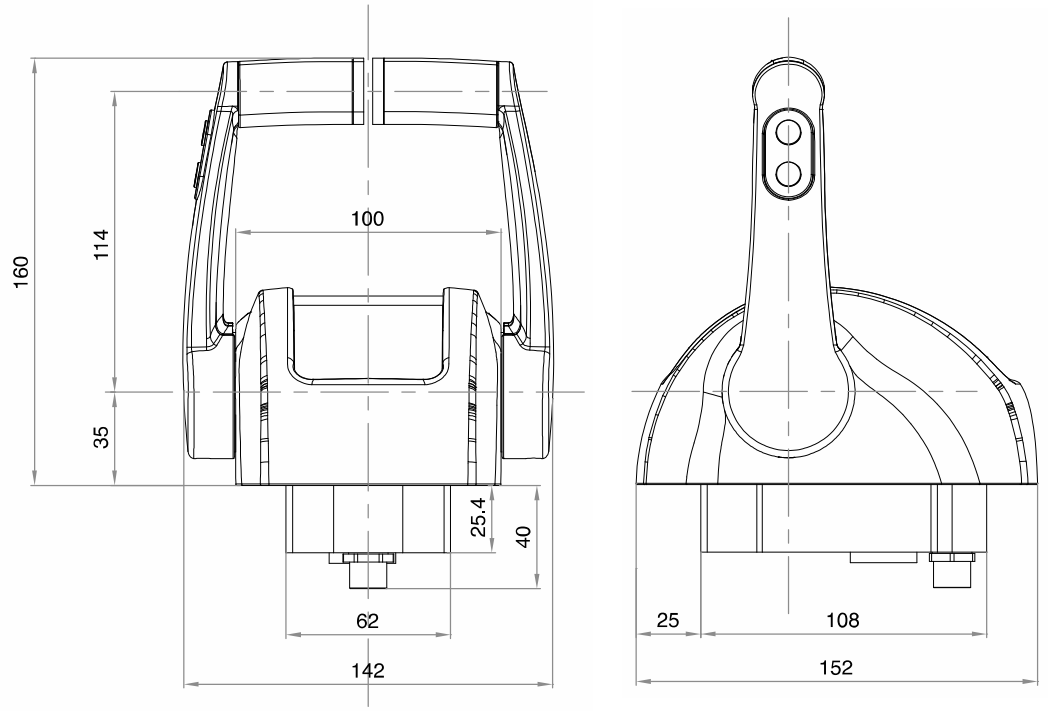
## 4.1. Dimensions

### 4.1.1. Command station series 3500




► **Important:** in case the screws to fix command station to the dashboard panel are not long enough, don't open the command station to replace them but ask for an adaptation kit.

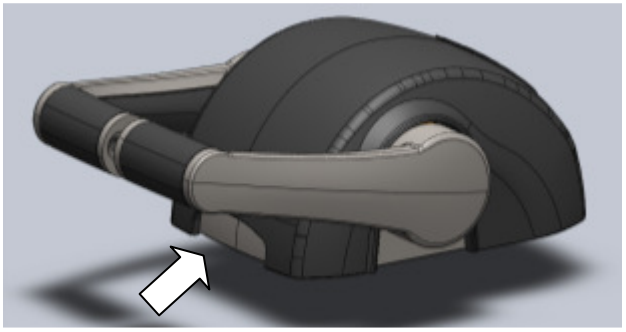
### 4.1.2. Command station series 4500



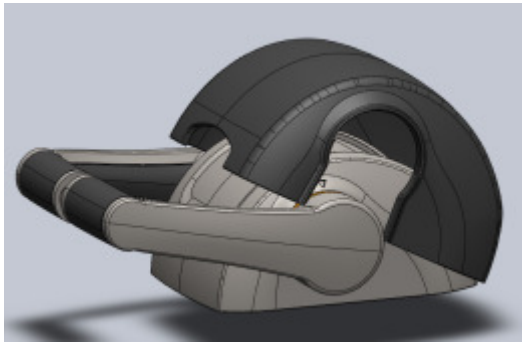

### 4.1.3. Removal of the protective cover (when present)

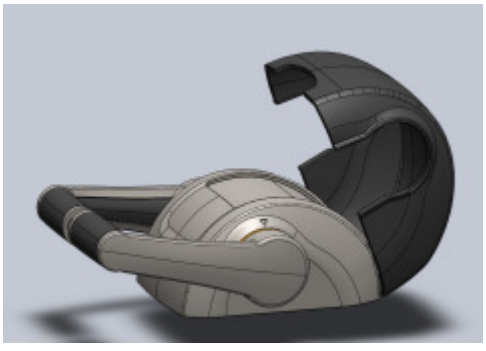
With the engines switched off and the command station deactivated:

1. move both levers to " maximum throttle" position;



2. place the fingers of your hand under the slot as shown by the arrow;
3. pull up to the complete removal of the protective cover.

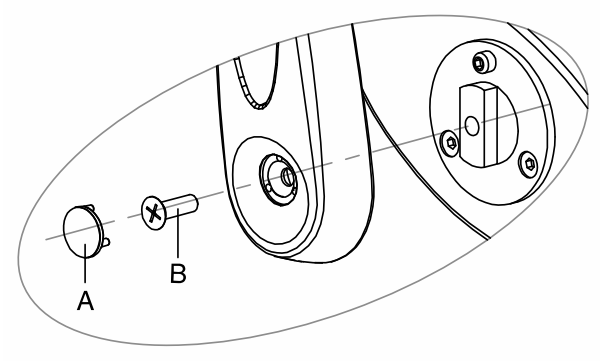




► **Important 2:** the max water protection of this protective cover is obtained when both levers are placed in full forward throttle position.

## 4.2. Friction adjustment

### 4.2.1. Command station series 3500




To adjust the inner friction of the command lever, remove the PVC cap (A) and unscrew the fixing screw. It is possible to adjust the friction screwing and unscrewing the inner screw placed into the hole (B). When the regulation will be done, mount the screw and the plastic cap.

► **Important:** in case of command station for one engine, the friction is placed under the right command lever.

## 4.3. Programming of the command station

At power up, the command station makes a sequence of two flashes. The first flash identifies the number of engines and the second identifies the number of actuators present in the system. According to the length of each flash, the command station is differently configured.
You need to configure the command station in relation to the type of installation. It is also possible to modify the configuration of the command station by keeping pressed before powering up and continuing to keep them pressed for 6 seconds after power up, the following push buttons:

- Warn/Sync + Command, in this case you want to change the number of actuators
- Engine left + Engine right, in this case you change the number of engines on the boat

Possible configurations are according to the following table:

| | 1° flash<br>(identifies the number of engines) | 2° flash<br>(identifies the number of actuators) |
|---|---|---|
| Installation with 1 engine and 1 actuator | Long (3 seconds) | Long (3 seconds) |
| Installation with 2 engines and 1 actuator | Short (less than 1 second) | Long (3 seconds) |
| Installation with 2 engines and 2 actuators | Short (less than 1 second) | Short (less than 1 second) |

► **Important:** from the factory, the command station is configured with the first flash short and the second flash long.

1. To configure the command lever for an installation with 2 actuator boxes, press the push buttons Warm/Sync e Command before powering up the command station and continue to keep them pressed for 6 seconds. The lever is now configured for installations with two engines and two actuators. At the next normal power up, the command lever will make a sequence of 2 short flashes.
2. In case you need to configure again the command lever for installation with 2 engines and 1 actuator, repeat the procedure of point 1.

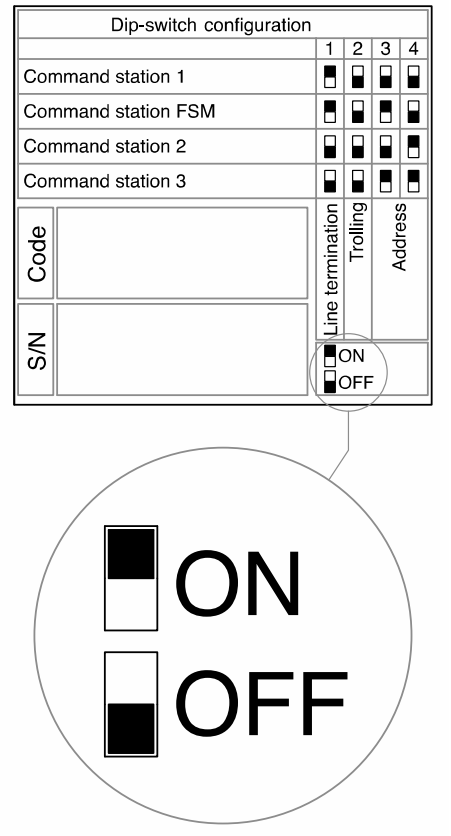
## 4.4. Command station label

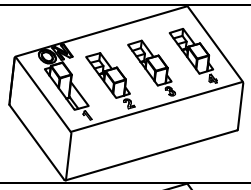
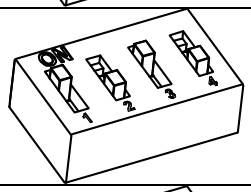
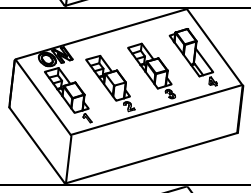
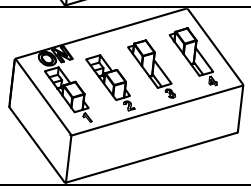
Under the base of the command station it is present the label here below.

This labels reports the code of the command station, the serial number. The dip-switches configure the command station according to its position in the CANBus network. This label reports code and serial number of the command station. The dip-switches configure the command station according to its position in the CANBus network. The selector of the dip switch is represented in the nearby label with the black square.

► **Important 1:** these configurations are valid according to scheme at section 7.1; for different system configurations please refer to schemes from section 7.2 to 7.5 where are reported the correspondent dip-switch positions.

► **Important 2:** in the same installation can't coexist a "1st command station FSM" and a "1st command station". "1st command station FSM" replaces "1st command station" and vice versa.




| Dip-switch configuration details | |
|---|---|
| Command station 1 |  |
| Command station FSM (Fast Start-up Mode) |  |
| Command station 2 |  |
| Command station 3 |  |

## 4.5. Trim/Flap option

Flap/trim command can be activated directly from the command station with the buttons '+' and '-'. The commands are sent to the actuator from the command station. The relay card fitted on the actuator box activates the flap/trim commands on the hydraulic pump.
For installations with two engines, in case of "Synchro" mode operation, the buttons on the right-hand side operate the trims of both engines simultaneously.

**Command station series 3500**

1 engine version

2 engines version

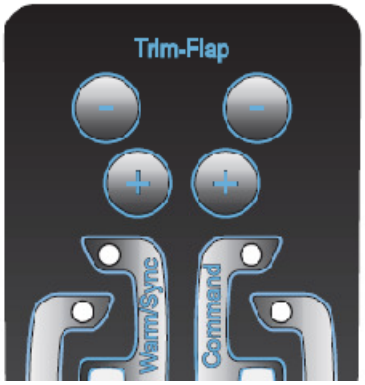
**Command station series 4500**

1 engine version

Trim or flap can be activated directly from the command station with "+" and "-" pushbuttons. These pushbuttons are placed on the side of the left lever.

2 engines version

+

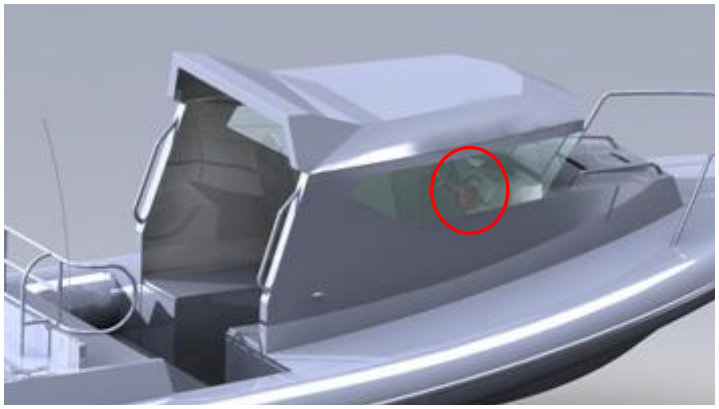


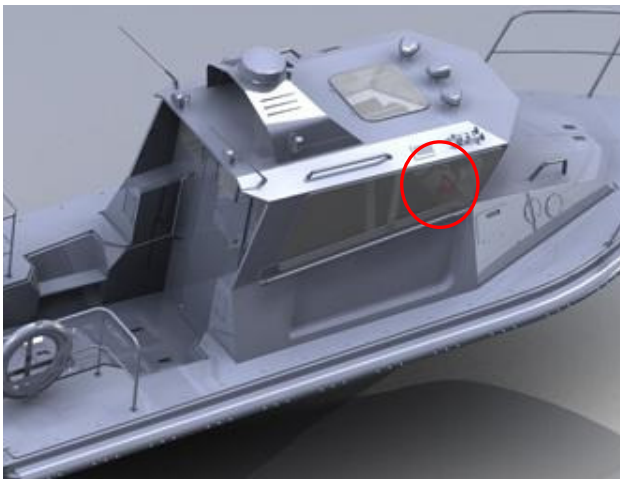

Trim or flap are tuned with "+" and "-" pushbuttons placed on the keypad (a couple for each engine).
It is also possible to command in sychro trim or flap of both engines with the "+" and "-" pushbuttons placed on the side of the left lever.
This feature is very comfortable during navigation.

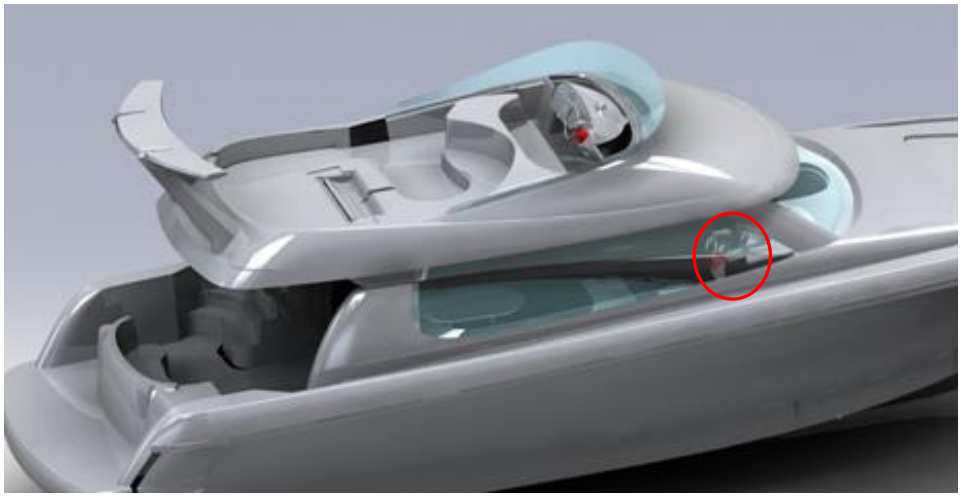
## 4.6. Classification of indoor and outdoor installation

The following section is a guideline to help the installer to define if the place where will be mounted the command station is indoor or outdoor. It follows a list of pictures and examples.

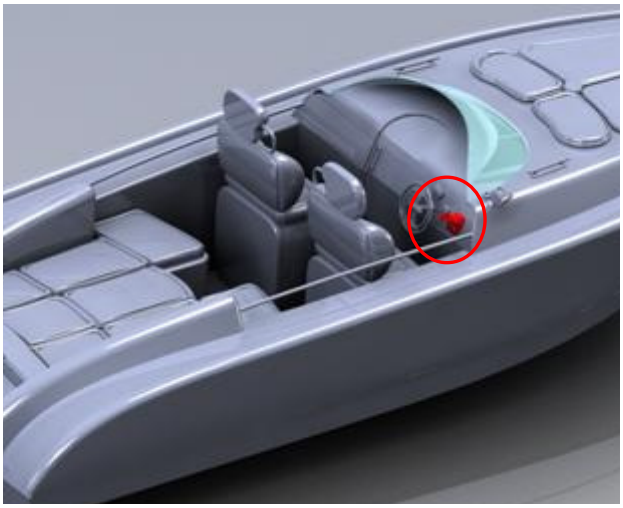
**Indoor installation**
The command station is installed into a place bordered by ceiling and, at least, three walls, windows or doors. Considering these conditions, it is impossible that the command station is exposed to rain water and splashes.

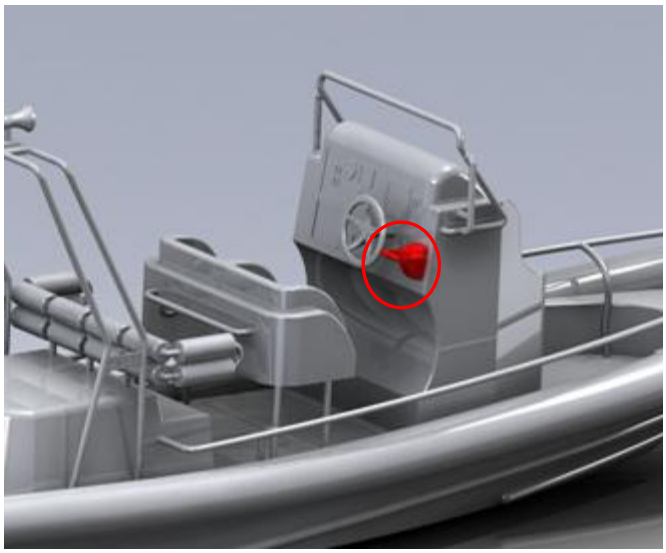


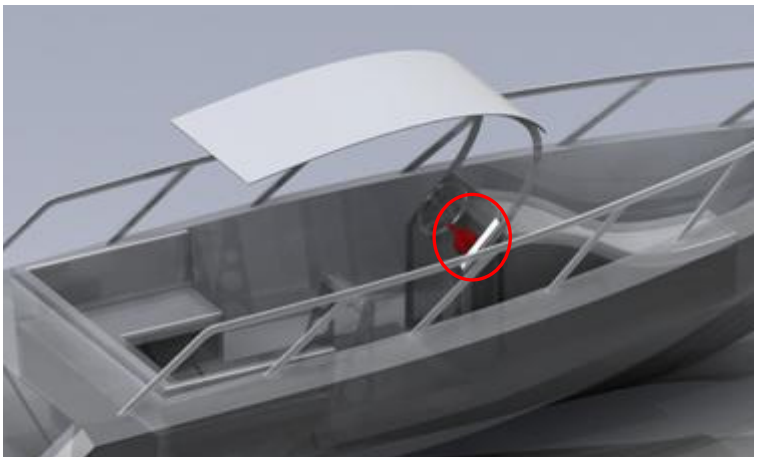


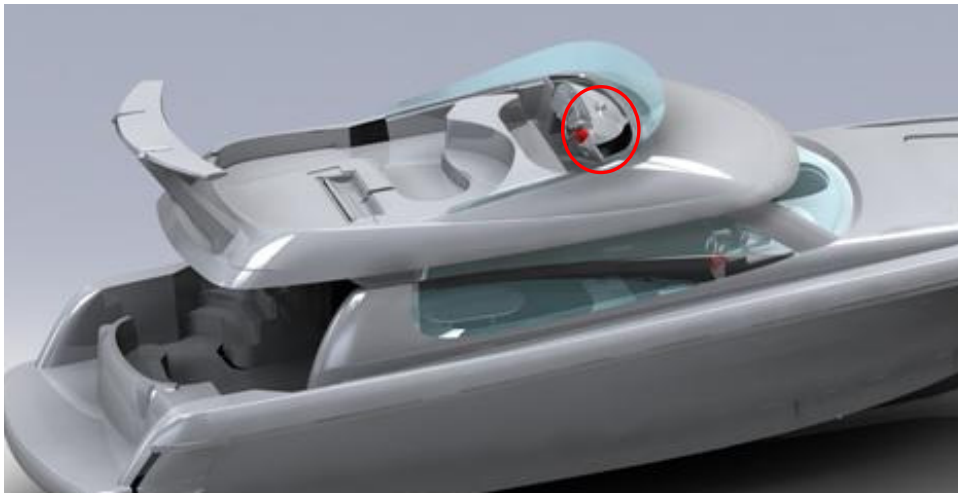


**Outdoor installation**
The command station is installed at open air, and it is exposed directly to rain water and splashes.





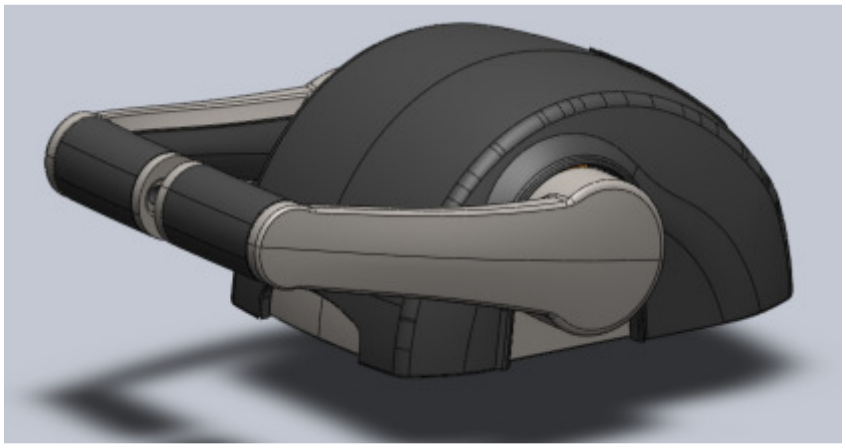




## 4.7. Advices about command station mounting and preservation

In case of outdoor installation, being the command station not designed to be submerged by water, to be exposed directly to water jets, or to be cleaned with pressurized water/steam, please notice:

- Command station cannot be installed in areas where water can be retained or where there is the potential risk of creating water puddles.
- Command station cannot be submerged or directly exposed to waves or water jets.
- It is not allowed to clean the command station with hydro-cleaner or any watering directly to the command station.
- Do not use aggressive chemicals for cleaning the command station.
- When unused, put on the command station the protection cover as described in section 4.1.3 of the present manual. In case the cover is not included into the supply, it is possible to order it separately.



## 4.8. Command station codes

| Command stations | |
|---|---|
| **Description** | **Code** |
| Command station 1 engine series 3500 | 3500 . C - 1 0 0 0 0 5 |
| Command station 1 engine series 3500 with TRIM option | 3500 . C - 1 1 0 0 0 5 |
| Command station 2 engines series 3500 | 3500 . C - 2 0 0 0 0 5 |
| Command station 2 engines series 3500 with TRIM option | 3500 . C - 2 2 0 0 0 5 |
| Command station 1 engine series 4500 | 4500 . C - 1 0 0 0 0 5 |
| Command station 1 engine series 4500 with TRIM option | 4500 . C - 1 1 0 0 0 5 |
| Command station 2 engines series 4500 | 4500 . C - 2 0 0 0 0 5 |
| Command station 2 engines series 4500 with TRIM option | 4500 . C - 2 2 0 0 0 5 |
| Command station 1 engine series 4500 with Trolling option | 4500 . T - 1 0 0 0 0 5 |
| Command station 1 engine series 4500 with TRIM option & Trolling | 4500 . T - 1 1 0 0 0 5 |
| Command station 2 engines series 4500 with Trolling option | 4500 . T - 2 0 0 0 0 5 |
| Command station 2 engines series 4500 with TRIM option & Trolling | 4500 . T - 2 2 0 0 0 5 |

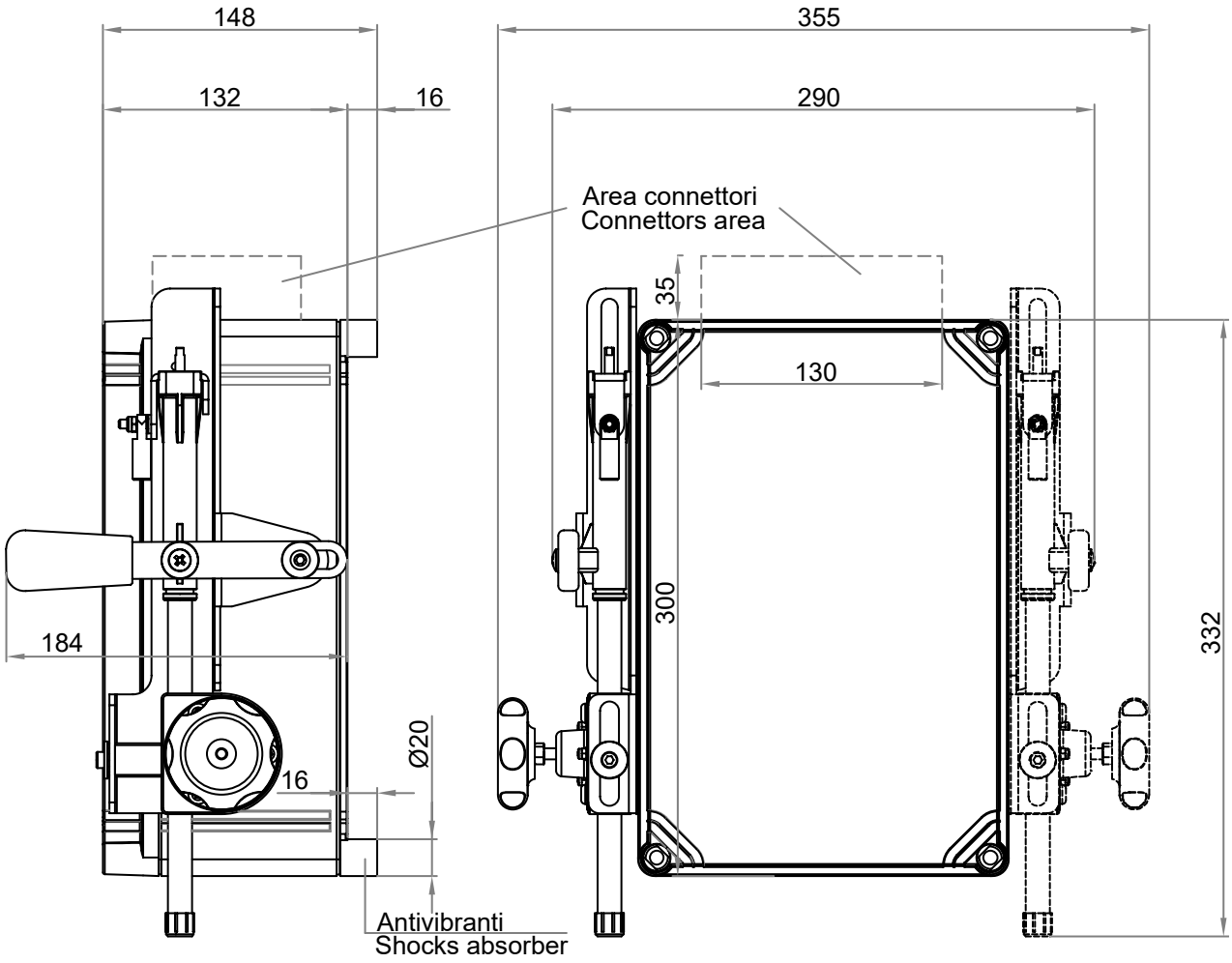
# 5. Actuator

With reference to the type of engine and gearboxes, with or without trim/flap, actuators are classified as follow:

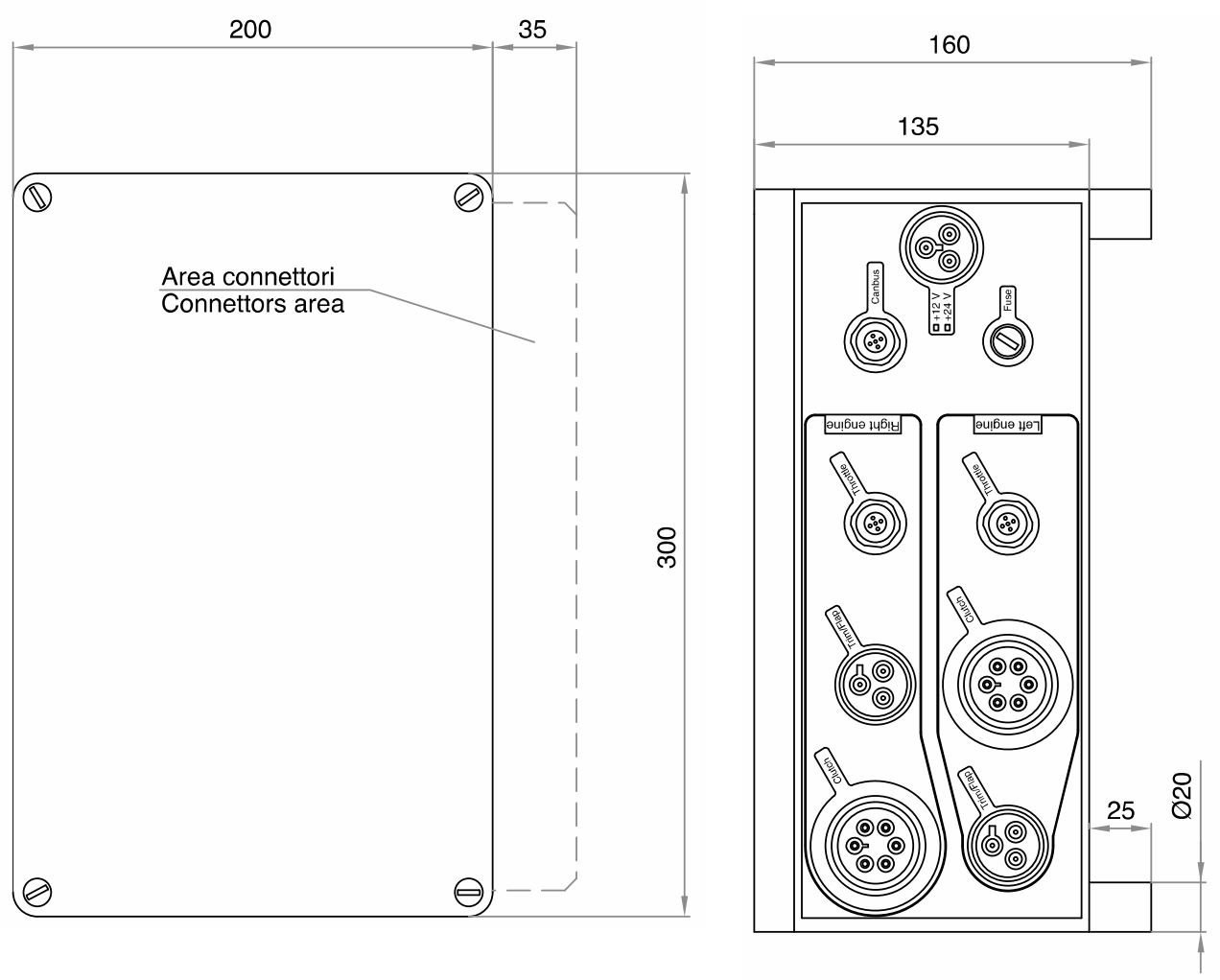
- mechanical
- electronic
- mechanical & electronic (hybrid)

It follows the mechanical drawings of the different types of actuators. In the last page of this manual you find the footprint of the actuator in scale 1:2.

## 5.1. Drawing of actuators with mechanical interface



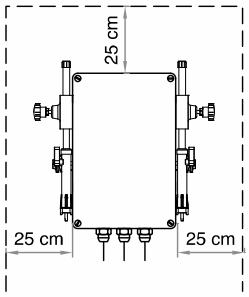
## 5.2. Drawing of full electronic actuator

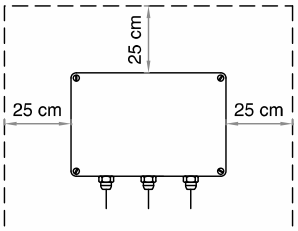



## 5.3. How to mount the Actuator

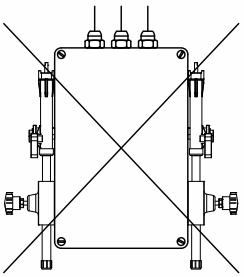
The Actuator must be mounted in the engine room in a safety place and as near as possible to the propulsion engine. The actuator cannot be exposed directly to the source of vibrations, e.g. it cannot be mounted directly on the engine, on the gearbox or on the engine's basement.

Mount the actuator leaving a space of at least 25 cm on each side



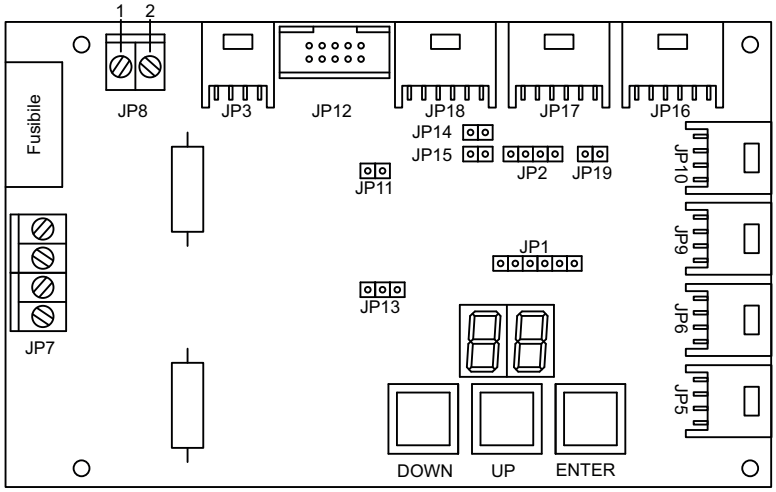




Do not install the actuator with the connectors upwards



## 5.4. Electronic Actuator Boards

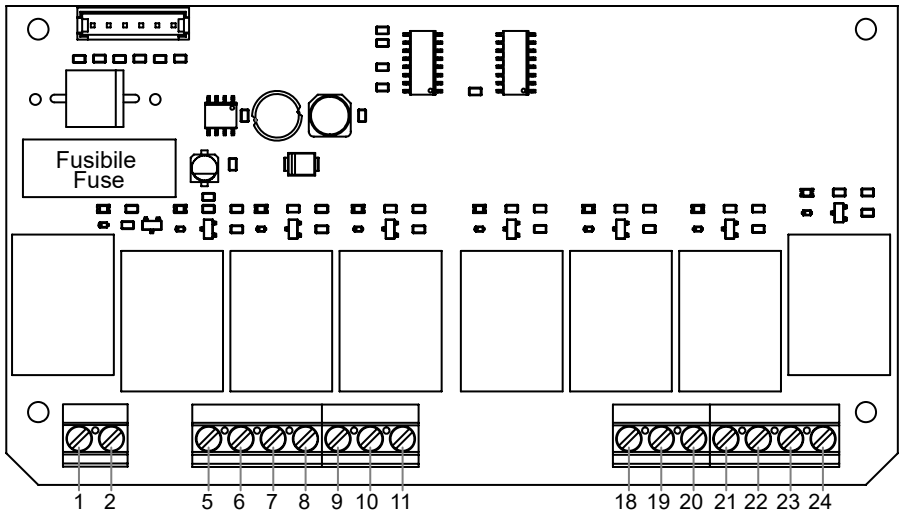
### 5.4.1. Actuator board ver. 3.1




| Position on board | Pin | | Description | Output cable |
|---|---|---|---|---|
| JP8<br>Supply | 1 | | Vdc | Wall connector |
| | 2 | | GND | |
| JP9<br>Engine right | 2 | MOD2 (Rev.3) | V_out CH1 | 4 poles |
| | 3 | | V_out CH2 | |
| | 1 | | GND CH2 | |
| | 4 | | GND CH1 | |
| JP10<br>Engine left | 2 | MOD2 (Rev.3) | V_out CH3 | 4 poles |
| | 3 | | V_out CH4 | |
| | 1 | | GND CH4 | |
| | 4 | | GND CH3 | |

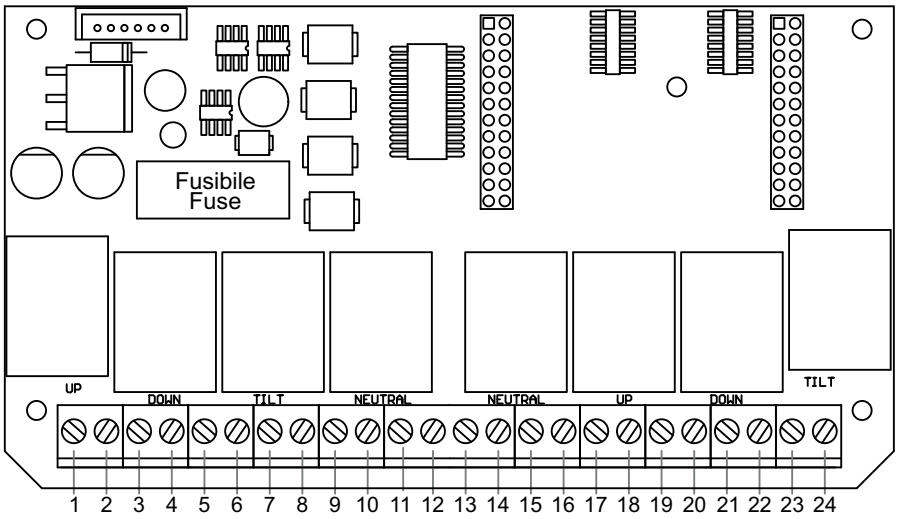
► **Important:** connectors JP9 and JP10 are dedicated to the electronic engine (ECU); in case of hybrid engine application, channels 1 and 3 of each connector are dedicated to the inverter of the electric engines.

### 5.4.2. Relays PCB version RB 1.0 for TRIM-FLAP and neutral relays



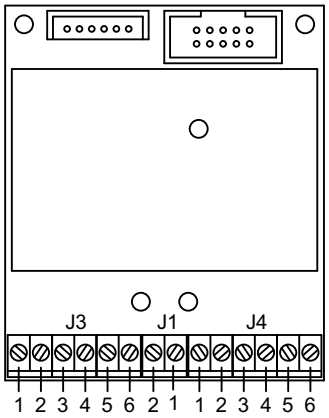

| Pin | Description | |
|---|---|---|
| 1 | Vdc | |
| 2 | GND | |
| 3 | (Not used) | |
| 4 | (Not used) | |
| 5 | Left engine | Trim common contact |
| 6 | | Trim + |
| 7 | | Trim - |
| 8 | | Trailer |
| 9 | | Common neutral relays contact |
| 10 | | NO contact neutral relays |
| 11 | | NC contact neutral relays |
| 12 | (Not used) | |
| 13 | (Not used) | |
| 14 | (Not used) | |
| 15 | (Not used) | |
| 16 | (Not used) | |
| 17 | (Not used) | |
| 18 | Right engine | Common neutral relays contact |
| 19 | | NO contact neutral relays |
| 20 | | NC contact neutral relays |
| 21 | | Common trim contact |
| 22 | | Trim + |
| 23 | | Trim - |
| 24 | | Trailer |

### 5.4.3. Relays PCB version 2.0 for electronic gearboxes




| Pin | Description | |
|---|---|---|
| 1 | Vdc | |
| 2 | GND | |
| 3 | Vdc | |
| 4 | GND | |
| 5 | Left engine | Trim common contact |
| 6 | | Trim + |
| 7 | | Trim - |
| 8 | | Trailer |
| 9 | | Common neutral relays contact |
| 10 | | NC contact neutral relays |
| 11 | | Forward gear |
| 12 | | GND |
| 13 | | Reverse gear |
| 14 | | GND |
| 15 | Right engine | Forward gear |
| 16 | | GND |
| 17 | | Reverse |
| 18 | | GND |
| 19 | | Common neutral relays contact |
| 20 | | NC contact neutral relays |
| 21 | | Common trim contact |
| 22 | | Trim + |
| 23 | | Trim - |
| 24 | | Trailer |

### 5.4.4. CANBus PCB for engine with CANBus interface

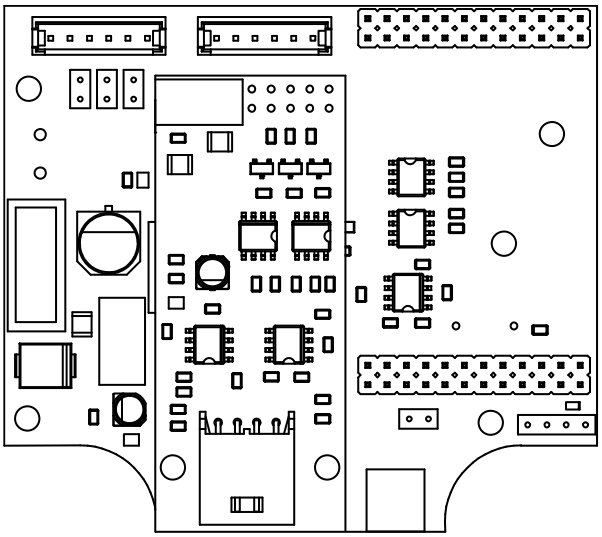



| terminal block | Terminal n° | description | wire colour | Kind of cable |
|---|---|---|---|---|
| J4 | 4 | Can_H | Yellow | 2 poles |
| | 5 | Can_L | Green | |

**Important:** you need a CANBus board per each CANBus engine

The out-coming cable has a length of 3, 5 or 7 meters (section 6.2.8). Maximum current per each channel is 100 mA. Can_H and Can_L signals are protected against short circuit towards ground and towards power supply.
CANBus termination resistor of 120 ohm is already mounted on the PCBoard (between terminals 4 and 5 of J4) but, if necessary, it can be removed: in case contact Flexball technicians.

### 5.4.5. Galvanic insulation PCB for analogue voltage signals



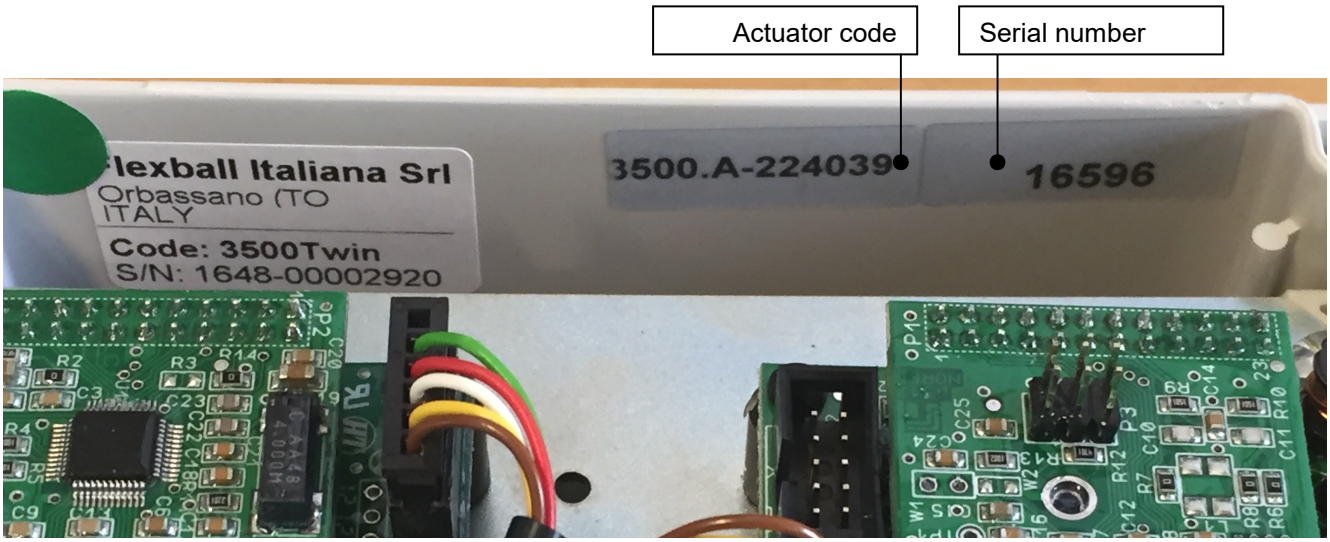
This option can be used in those cases where there are voltage differences between different ground points on the boat. A non optimum ground network can generate circuit currents and therefore disturbances in the transmission of command signals (see section 10.1.6.).
Each PCB performs the galvanic insulation of 2 command signal up to 250 Vdc. On each actuator it is possible to mount 2 PCBs for the interface towards:

- Electronic ECU with voltage signal
- Electronic ECU with CANBus interface
- Frequency converter driven through a voltage signal, in case of hybrid propulsion systems

The PCB is mounted inside of the actuator and there aren't any special precaution to follow during commissioning.

## 5.5. Actuator labels and codes

Inside the actuator there are two labels indicating code and serial number. Please write them down in case you call for assistance.



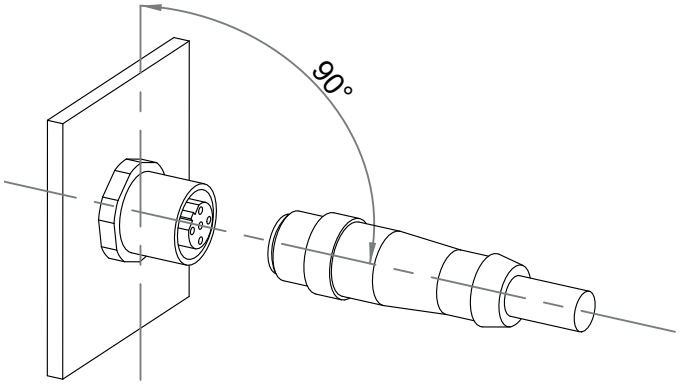

**Actuator's Codes**

| | |
|---|---|
| 1 mechanical engine and 1 gearbox mechanical (no trim) | 3500 . A - 0 0 4 0 * 9 |
| 1 mechanical engine and 1 gearbox mechanical (no trim) + neutral relay | 3500 . A - 0 8 4 0 * 9 |
| 1 mechanical engine and 1 gearbox mechanical (with trim) | 3500 . A - 0 0 4 1 * 9 |
| 1 mechanical engine and 1 gearbox mechanical (with trim) + neutral relay | 3500 . A - 0 8 4 1 * 9 |
| 1 electronic engine (V) and 1 gearbox mechanical (no trim) | 3500 . A - 1 1 4 0 * 9 |
| 1 electronic engine (V) and 1 gearbox mechanical (no trim) + neutral relay | 3500 . A - 1 8 4 0 * 9 |
| 1 CANBus engine and 1 gearbox mechanical (no trim) | 3500 . A - 5 1 4 0 * 9 |
| 1 CANBus engine and 1 gearbox mechanical (no trim) + neutral relay | 3500 . A - 5 8 4 0 * 9 |
| 1 electronic engine (mA) and 1 gearbox mechanical (no trim) | 3500 . A - 7 1 4 0 * 9 |
| 1 electronic engine (mA) and 1 gearbox mechanical (no trim) + neutral relay | 3500 . A - 7 8 4 0 * 9 |
| 1 PWM engine and 1 gearbox mechanical (no trim) | 3500 . A - 3 1 4 0 * 9 |
| 1 PWM engine and 1 gearbox mechanical (no trim) + neutral relay | 3500 . A - 3 8 4 0 * 9 |
| 2 electronic engines (V) and 2 gearboxes mechanical (no trim) | 3500 . A - 2 2 4 0 * 9 |
| 2 electronic engines (V) and 2 gearboxes mechanical (no trim) + neutral relay | 3500 . A - 2 9 4 0 * 9 |
| 2 engines CANBus and 2 gearboxes mechanical (no trim) | 3500 . A - 6 2 4 0 * 9 |
| 2 engines CANBus and 2 gearboxes mechanical (no trim) + neutral relay | 3500 . A - 6 9 4 0 * 9 |
| 2 electronic engines (mA) and 2 gearboxes mechanical (no trim) | 3500 . A - 8 2 4 0 * 9 |
| 2 electronic engines (mA) and 2 gearboxes mechanical (no trim) + neutral relay | 3500 . A - 8 9 4 0 * 9 |
| 2 PWM engines and 2 gearboxes mechanical (no trim) | 3500 . A - 4 2 4 0 * 9 |
| 2 PWM engines and 2 gearboxes mechanical (no trim) + neutral relay | 3500 . A - 4 9 4 0 * 9 |
| 1 electronic engine (V) and 1 gearbox mechanical (with trim) | 3500 . A - 1 1 4 1 * 9 |
| 1 CANBus engine and 1 gearbox mechanical (with trim) | 3500 . A - 5 1 4 1 * 9 |
| 1 electronic engine (mA) and 1 gearbox mechanical (with trim) | 3500 . A - 7 1 4 1 * 9 |
| 1 PWM engine and 1 gearbox mechanical (with trim) | 3500 . A - 3 1 4 1 * 9 |
| 2 electronic engines (V) and 2 gearboxes mechanical (with trim) | 3500 . A - 2 2 4 2 * 9 |
| 2 CANBus engines and 2 gearboxes mechanical (with trim) | 3500 . A - 6 2 4 2 * 9 |
| 2 electronic engines (mA) and 2 gearboxes mechanical (with trim) | 3500 . A - 8 2 4 2 * 9 |
| 2 PWM engines and 2 gearboxes mechanical (with trim) | 3500 . A - 4 2 4 2 * 9 |

| | |
|---|---|
| 1 mechanical engine and 1 gearbox solenoid driven (no trim) | 3500 . A - 0 3 4 0 3 9 |
| 2 mechanical engines and 2 gearbox solenoid driven (no trim) | 3500 . A - 9 4 4 0 3 9 |
| 1 mechanical engine and 1 gearbox solenoid driven (with trim) | 3500 . A - 0 3 4 1 3 9 |
| 2 mechanical engines and 2 gearbox solenoid driven (with trim) | 3500 . A - 9 4 4 2 3 9 |
| | |
| 1 electronic engine (V) and 1 gearbox solenoid driven (no trim) | 3500 . A - 1 3 0 0 3 9 |
| 1 CANBus engine and 1 gearbox solenoid driven (no trim) | 3500 . A - 5 3 0 0 3 9 |
| 1 electronic engine (mA) and 1 gearbox solenoid driven (no trim) | 3500 . A - 7 3 0 0 3 9 |
| 1 PWM engine and 1 gearbox solenoid driven (no trim) | 3500 . A - 3 3 0 0 3 9 |
| 2 electronic engines (V) and 2 gearboxes solenoid driven (no trim) | 3500 . A - 2 4 0 0 3 9 |
| 2 CANBus engines and 2 gearboxes solenoid driven (no trim) | 3500 . A - 6 4 0 0 3 9 |
| 2 electronic engines (mA) and 2 gearboxes solenoid driven (no trim) | 3500 . A - 8 4 0 0 3 9 |
| 2 PWM engines and 2 gearboxes solenoid driven (no trim) | 3500 . A - 4 4 0 0 3 9 |
| 1 electronic engine (V) and 1 gearbox solenoid driven (with trim) | 3500 . A - 1 3 0 1 3 9 |
| 1 CANBus engine and 1 gearbox solenoid driven (with trim) | 3500 . A - 5 3 0 1 3 9 |
| 1 electronic engine (mA) and 1 gearbox solenoid driven (with trim) | 3500 . A - 7 3 0 1 3 9 |
| 1 PWM engine and 1 gearbox solenoid driven (with trim) | 3500 . A - 3 3 0 1 3 9 |
| 2 electronic engines (V) and 2 gearboxes solenoid driven (with trim) | 3500 . A - 2 4 0 2 3 9 |
| 2 CANBus engines and 2 gearboxes solenoid driven (with trim) | 3500 . A - 6 4 0 2 3 9 |
| 2 electronic engines (mA) and 2 gearboxes solenoid driven (with trim) | 3500 . A - 8 4 0 2 3 9 |
| 2 PWM engines and 2 gearboxes solenoid driven (with trim) | 3500 . A - 4 4 0 2 3 9 |

(*) identifies the power supply voltage; (*) = 2 identifies actuators with only 24 Vdc; (*) = 3 identifies actuators which can work with both 12 and 24 Vdc.
All actuators with electronic gearbox interface have the neutral relay option already implemented.

# 6. Accessories and Options

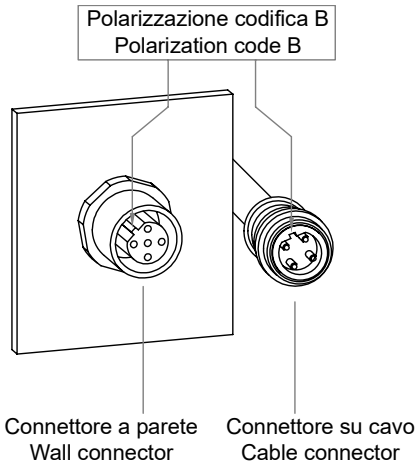



Cables reported here below are used in standard installations. For specific engines there are anyhow available cables with their proper connectors; in case you need cables for specific engines, please contact the supplier.

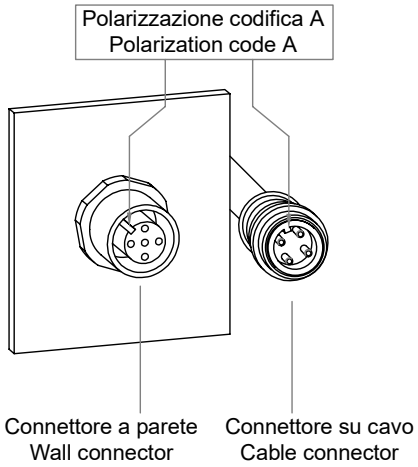
**For a correct mounting plug in the connector at 90° with respect to wall side of the actuator box. Rotate then the ring until the cable enters into the counterpart M12.**
If the cable has been inserted correctly, it must be possible to screw completely by hand the cable without too much efforts. The best electrical connection and the max water protection of this connector is reached when screwed with around six turns.

**Connector for throttle cables**

Engine cables must be installed as far as possible from heat generating sources. If the cable is running for some of its length nearby the engine, protect this part of the cable with a cover suitable to reflect the heat generated by the engine.

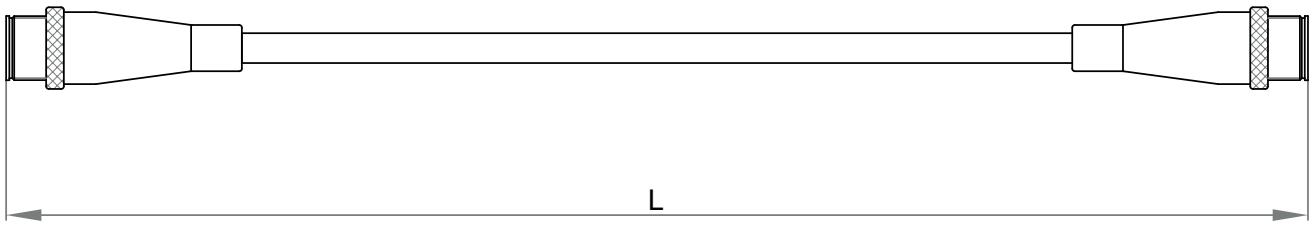



**Connector for CANbus data transmission cable**



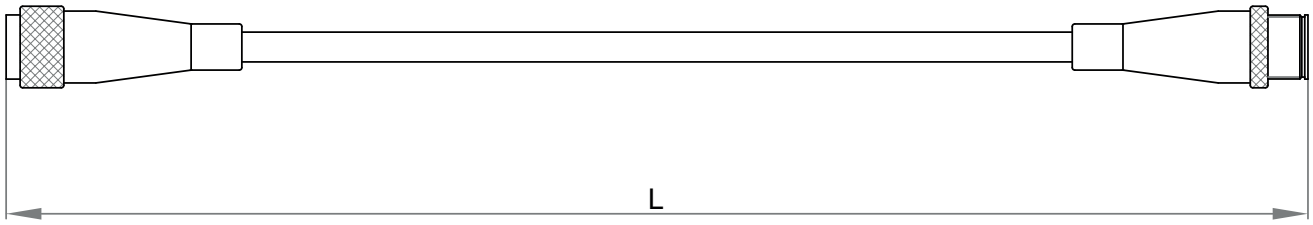
## 6.1. CANBus cable

### 6.1.1. CANBus data transmission cable




| Length | Code | Length | Code |
|---|---|---|---|
| L=3 m | 3500.33-03000 | L=15 m | 3500.33-15000 |
| L=5 m | 3500.33-05000 | L=20 m | 3500.33-20000 |
| L=7,5 m | 3500.33-07500 | L=25 m | 3500.33-25000 |
| L=10 m | 3500.33-10000 | | |

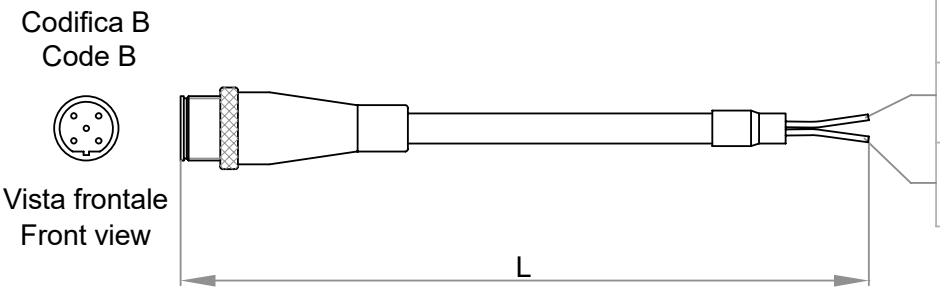
### 6.1.2. CANBus extension cable




| Length | Code |
|---|---|
| L=30 m | 3500.39-30000 |

## 6.2. Cable actuator - electronic engine

### 6.2.1. Cable actuator for electronic engine with 1 channel, voltage or current

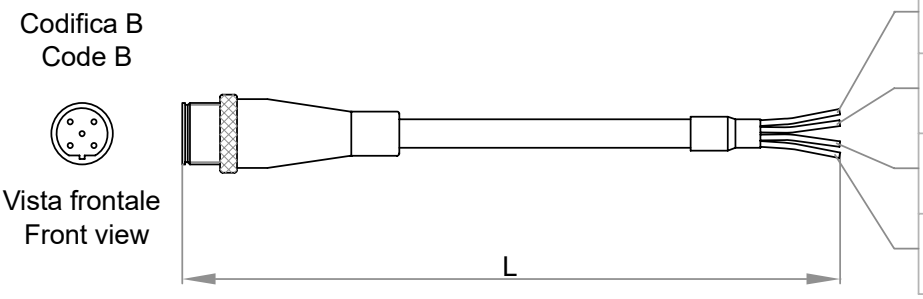



| Colore filo<br>Wire colour | Funzione<br>Function |
|---|---|
| Bianco<br>White | Segnale<br>Signal |
| Giallo<br>Yellow | GND |

| Length | Code |
|---|---|
| L=3 m | 3500.34-03000 |
| L=5 m | 3500.34-05000 |
| L=7 m | 3500.34-07000 |

► **Important:** this cable is without connector on engine side

### 6.2.2. Cable actuator – electronic engine (V) with 2 channels

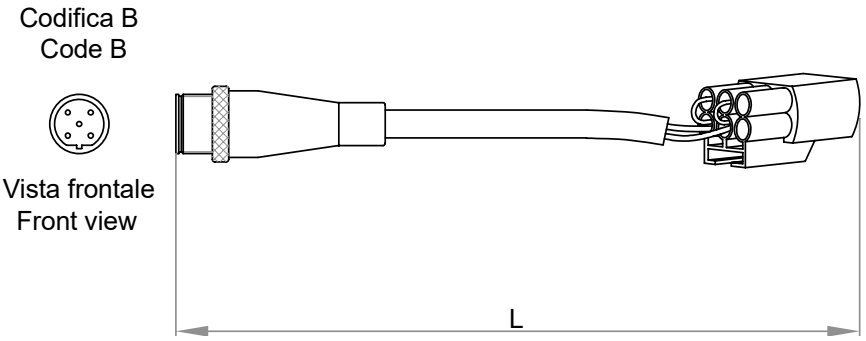



| Colore filo<br>Wire colour | Funzione<br>Function |
|---|---|
| Bianco<br>White | Ch.1 - Segnale<br>Ch.1 -Signal |
| Giallo<br>Yellow | Ch.1 - GND |
| Marrone<br>Brown | Ch.2 - Segnale<br>Ch.2 - Signal |
| Verde<br>Green | Ch.2 - GND |

| Length | Code |
|---|---|
| L=3 m | 3500.42-03000 |
| L=5 m | 3500.42-05000 |
| L=7 m | 3500.42-07000 |

► **Important:** this cable is without connector on engine side

### 6.2.3. Nanni Diesel – Throttle cable for Toyota ECU




| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Segnale<br>Signal | 2 - 5 |
| Giallo<br>Yellow | GND | 1 - 4 |

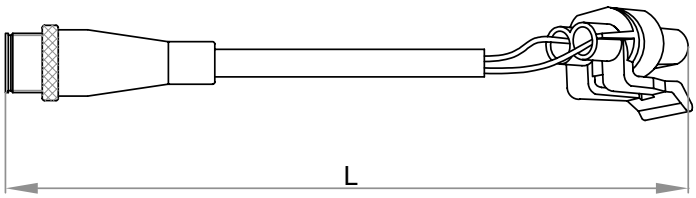
| **Length** | **Code** |
|---|---|
| L=3 m | 4665/34-03000 |
| L=5 m | 4665/34-05000 |
| L=7 m | 4665/34-07000 |

Engine side: Sumitomo connector, 6 poles

### 6.2.4. Nanni Diesel – Cable only for the inverter (hybrid engines)

Codifica B
Code B

Vista frontale
Front view




| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Segnale<br>Signal | A |
| Giallo<br>Yellow | GND | B |

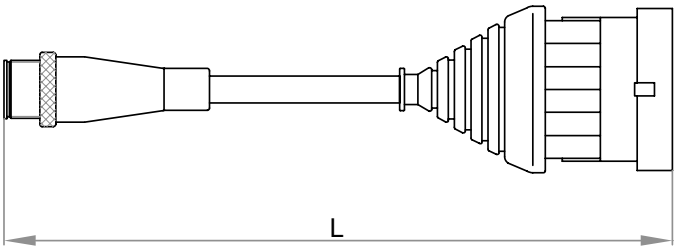
| Length | Code |
|---|---|
| L=3 m | 4665/41-03000 |
| L=5 m | 4665/41-05000 |
| L=7 m | 4665/41-07000 |

Inverter side: Delphi connector, 2 poles

### 6.2.5. Nanni Diesel – Command cable for throttle and inverter

Codifica B
Code B

Vista frontale
Front view



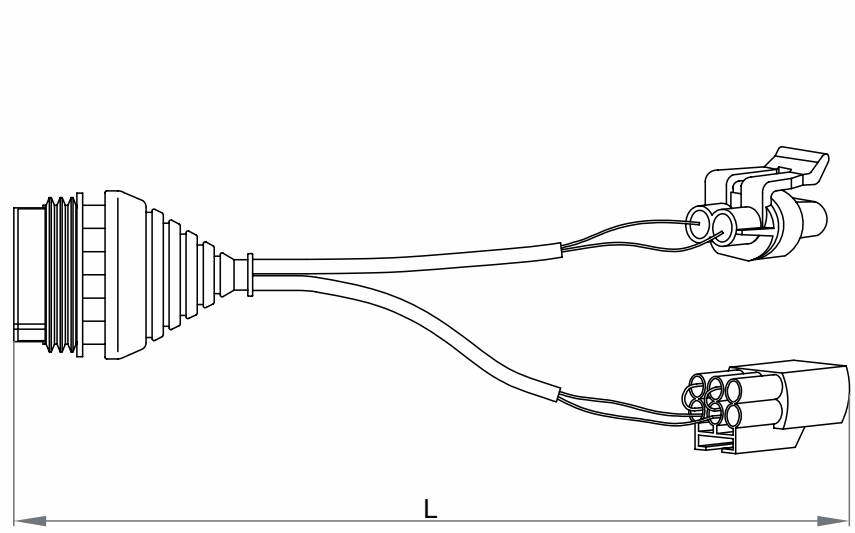

| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Ch.1 - Segnale<br>Ch.1 -Signal | 4 |
| Giallo<br>Yellow | Ch.1 - GND | 1 |
| Marrone<br>Brown | Ch.2 - Segnale<br>Ch.2 - Signal | 2 |
| Verde<br>Green | Ch.2 - GND | 5 |

| Length | Code |
|---|---|
| L=3 m | 4665/42-03000 |
| L=5 m | 4665/42-05000 |
| L=7 m | 4665/42-07000 |

Engine side: AMP Superseal connector, 6 poles

This cable is to be used between the actuator and Nanni Diesel cables codes 4665/44 and 4665/45.

### 6.2.6. Nanni Diesel – Y cable for Toyota engine base (V) + inverter (V)



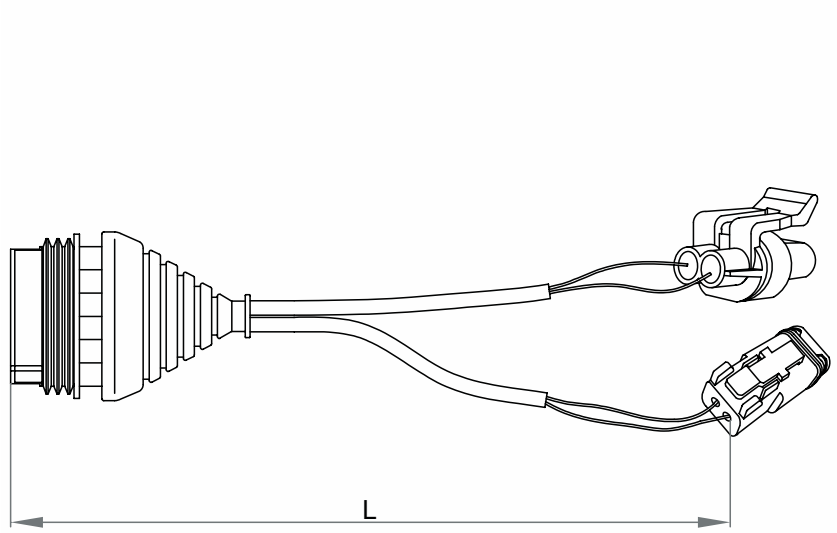

| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Marrone<br>Brown | Segnale<br>Signal | A |
| Verde<br>Green | GND | B |

| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Segnale<br>Signal | 2 - 5 |
| Giallo<br>Yellow | GND | 1 - 4 |

Engine side: Sumitomo connector, 6 poles
Inverter side: Delphi connector, 2 poles

| Length | Code |
|---|---|
| L=3 m | 4665/44-03000 |
| L=5 m | 4665/44-05000 |
| L=7 m | 4665/44-07000 |

### 6.2.7. Nanni Diesel – Y cable for VM engine base + inverter



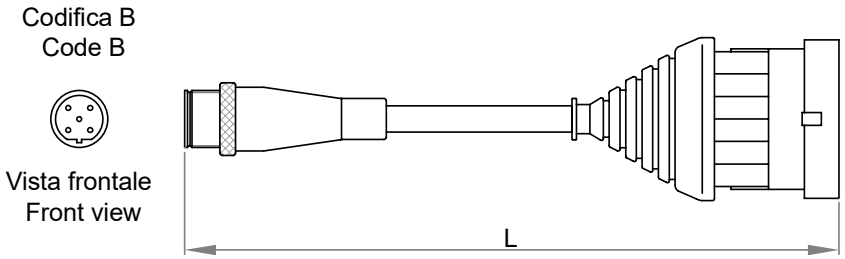

| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Marrone<br>Brown | Segnale<br>Signal | A |
| Verde<br>Green | GND | B |

| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Segnale<br>Signal | 2 |
| Giallo<br>Yellow | GND | 1 |

Engine side: Deutsch connector, 2 poles
Inverter side: Delphi connector, 2 poles

| Length | Code |
|---|---|
| L=3 m | 4665/45-03000 |
| L=5 m | 4665/45-05000 |
| L=7 m | 4665/45-07000 |

### 6.2.8. FPT – Throttle CANBus command cable

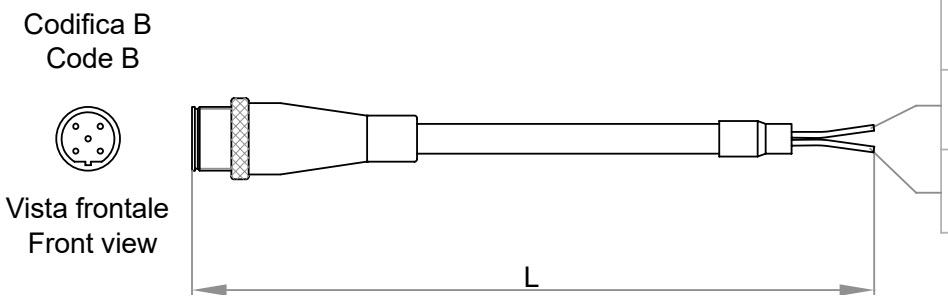



| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Marrone<br>Brown | Can H | 5 |
| Verde<br>Green | Can L | 6 |

Engine side: AMP Superseal connector, 6 poles

| Length | Code |
|---|---|
| L=3 m | 15/35-03000 |
| L=5 m | 15/35-05000 |
| L=7 m | 15/35-07000 |

### 6.2.9. Cable actuator – CANBus engine with free wire

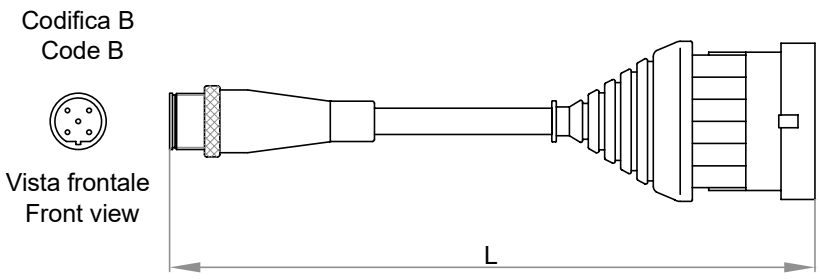



| Colore filo<br>Wire colour | Funzione<br>Function |
|---|---|
| Marrone<br>Brown | Can H |
| Verde<br>Green | Can L |

► **Important:** this cable is without connector on engine side

| Length | Code |
|---|---|
| L=3 m | 3500.56-03000 |
| L=5 m | 3500.56-05000 |
| L=7 m | 3500.56-07000 |

### 6.2.10. FNM – Throttle cable

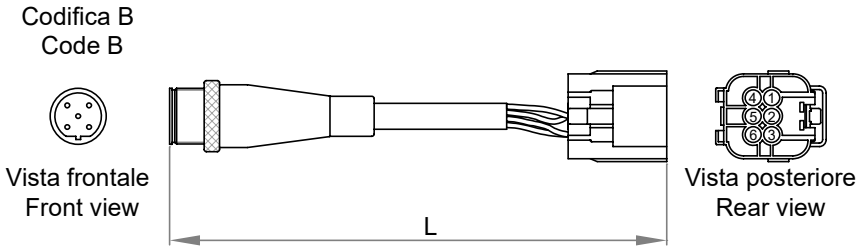



| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Ch.1 - Segnale<br>Ch.1 -Signal | 3 |
| Giallo<br>Yellow | Ch.1 - GND | 1 |
| Marrone<br>Brown | Ch.2 - Segnale<br>Ch.2 - Signal | 2 |
| Verde<br>Green | Ch.2 - GND | 5 |

Engine side: AMP Superseal connector, 6 poles

| Length | Code |
|---|---|
| L=3 m | 4649/EC3E3M |

### 6.2.11. Hyundai - Throttle cable

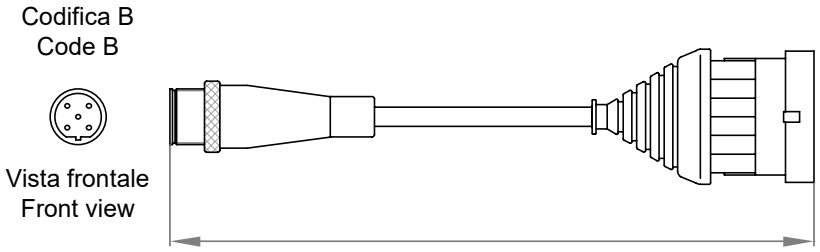



| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Ch.1 - Segnale<br>Ch.1 -Signal | 2 |
| Giallo<br>Yellow | Ch.1 - GND | 5 |
| Marrone<br>Brown | Ch.2 - Segnale<br>Ch.2 - Signal | 1 |
| Verde<br>Green | Ch.2 - GND | 4 |

Engine side: Tyco Econoseal J connector, 6 poles

| Length | Code |
|---|---|
| L=3 m | 3500.49-03000 |
| L=5 m | 3500.49-05000 |
| L=7 m | 3500.49-07000 |

### 6.2.12. Steyr - Throttle cable, type A (Ch2 = IVS signal)

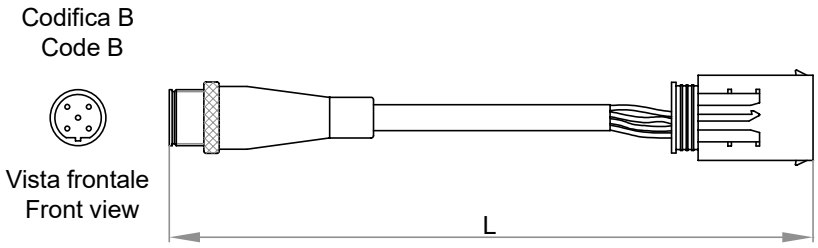



| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Ch.1 - Segnale<br>Ch.1 - Signal | 2 |
| Giallo<br>Yellow | Ch.1 - GND | 4 |
| Marrone<br>Brown | IVS - Segnale<br>IVS - Signal | 1 |
| Verde<br>Green | IVS - GND | 3 |

Engine side: AMP Superseal connector, 5 poles

| Length | Code |
|---|---|
| L=3 m | 3500.50-03000 |
| L=5 m | 3500.50-05000 |
| L=7 m | 3500.50-07000 |

### 6.2.13. Steyr -Throttle cable, type B, for engines series "SE"



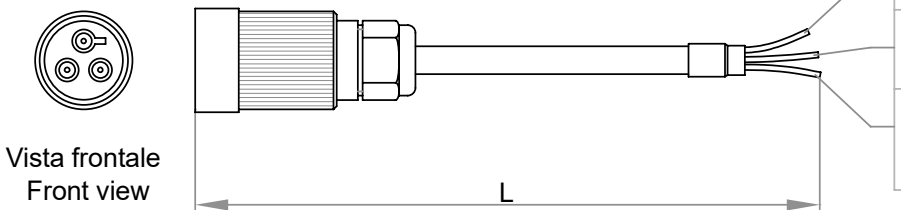

| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Bianco<br>White | Ch.1 - Segnale<br>Ch.1 -Signal | 3 |
| Giallo<br>Yellow | Ch.1 - GND | 2 |
| Marrone<br>Brown | Ch.2 - Segnale<br>Ch.2 - Signal | 4 |
| Verde<br>Green | Ch.2 - GND | 5 |

Engine side: Micro Quadlok connector, 6 poles

| Length | Code |
|---|---|
| L=3 m | 3500.51-03000 |
| L=5 m | 3500.51-05000 |
| L=7 m | 3500.51-07000 |

## 6.3. Cable actuator – gearbox solenoid driven

For the connection towards the gearbox solenoid driven, please refer to sections 10.2.1 and 10.2.3. of this manual.




| Colore filo<br>Wire colour | Funzione<br>Function |
|---|---|
| Nero 1<br>Black 1 | M. Avanti<br>Forward |
| Nero 2<br>Black 2 | M. Indietro<br>Reverse |
| Giallo-Verde<br>Yellow-Green | Alimentazione<br>Supply |

| Length | Code |
|---|---|
| L=3 m | 3500.36-03000 |
| L=5 m | 3500.36-05000 |
| L=7 m | 3500.36-07000 |

► **Important:** this cable is without connector on gearbox side

### 6.3.1. Nanni Diesel – Cable for gearbox solenoid driven

For drawing and pin-out refer to section 6.3

| Length | Code |
|---|---|
| L=3 m | 4665/36-03000 |
| L=5 m | 4665/36-05000 |
| L=7 m | 4665/36-07000 |

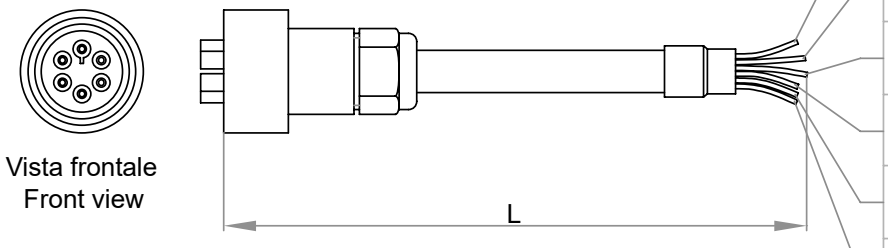
### 6.3.2. FPT – Cable for gearbox solenoid driven

For drawing and pin-out refer to section 6.3

| Length | Code |
|---|---|
| L=3 m | 15/36-03000 |
| L=5 m | 15/36-05000 |
| L=7 m | 15/36-07000 |

### 6.3.3. Cable actuator - gearbox solenoid driven + neutral relay signal

For the connection towards the gearbox solenoid driven, please refer to sections 10.2.2. and 10.2.4. of this manual.

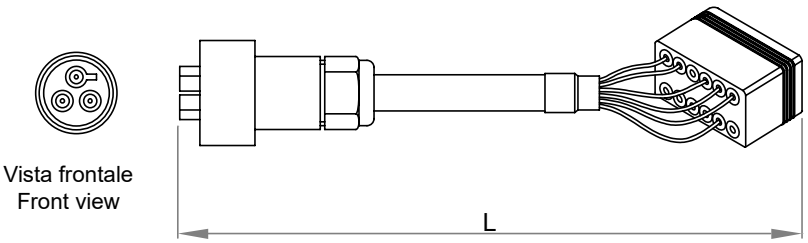



| Colore filo<br>Wire colour | Funzione<br>Function |
|---|---|
| Nero 1<br>Black 1 | M. Avanti - Signal<br>Forward - Signal |
| Nero 2<br>Black 2 | M. Indietro - Signal<br>Reverse - Signal |
| Nero 3<br>Black 3 | Relè di neutro<br>Neutral relay |
| Nero 4<br>Black 4 | M. Avanti - GND<br>Forward - GND |
| Nero 5<br>Black 5 | Relè di neutro<br>Neutral relay |
| Nero 6<br>Black 6 | M. Indietro - GND<br>Reverse - GND |

| Length | Flexball code |
|---|---|
| L=3 m | 3500.46-03000 |
| L=5 m | 3500.46-05000 |
| L=7 m | 3500.46-07000 |

► **Important:** this cable is without connector on gearbox side

### 6.3.4. Nanni Diesel – Cable for gearbox solenoid drive + neutral signal

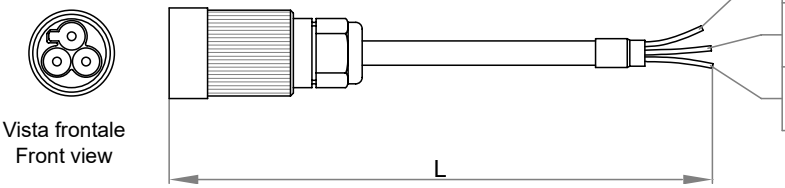



| Colore filo<br>Wire colour | Funzione<br>Function | Pin |
|---|---|---|
| Nero 1<br>Black 1 | M. Avanti - Signal<br>Forward - Signal | 1 |
| Nero 2<br>Black 2 | M. Indietro - Signal<br>Reverse - Signal | 2 |
| Nero 3<br>Black 3 | Relè di neutro<br>Neutral relay | 3 |
| Nero 4<br>Black 4 | M. Avanti - GND<br>Forward - GND | 5 |
| Nero 5<br>Black 5 | Relè di neutro<br>Neutral relay | 6 |
| Nero 6<br>Black 6 | M. Indietro - GND<br>Reverse - GND | 11 |

| Length | Code |
|---|---|
| L=1 m | 4665/46-01000 |
| L=3 m | 4665/46-03000 |
| L=5 m | 4665/46-05000 |
| L=7 m | 4665/46-07000 |

## 6.4. Cable actuator – trim/flap

For the connection to trim/flap, please refer to section 10.2.7. and 10.2.8. of this manual.




| Colore filo<br>Wire colour | Funzione<br>Function | |
|---|---|---|
| | Cablag. Trim<br>Trim Harness | Cablagg. Flap<br>Harness Flap |
| Nero 1<br>Black 1 | Trim - | Flap - |
| Nero 2<br>Black 2 | Trim + | Flap + |
| Giallo-Verde<br>Yellow-Green | Trailer | (Vdc Flap) |

| Length | Code |
|---|---|
| L=3 m | 3500.37-03000 |
| L=5 m | 3500.37-05000 |
| L=7 m | 3500.37-07000 |

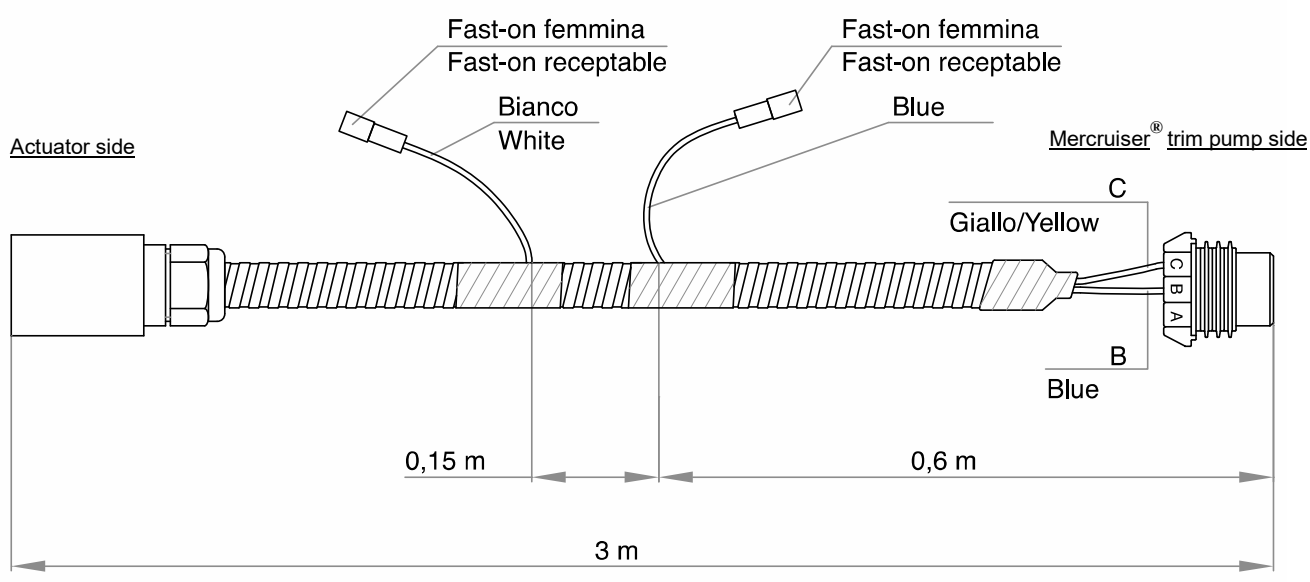
### 6.4.1. Nanni Diesel – Cable for the trim/flap command

For drawing and pin-out refer to section 6.4

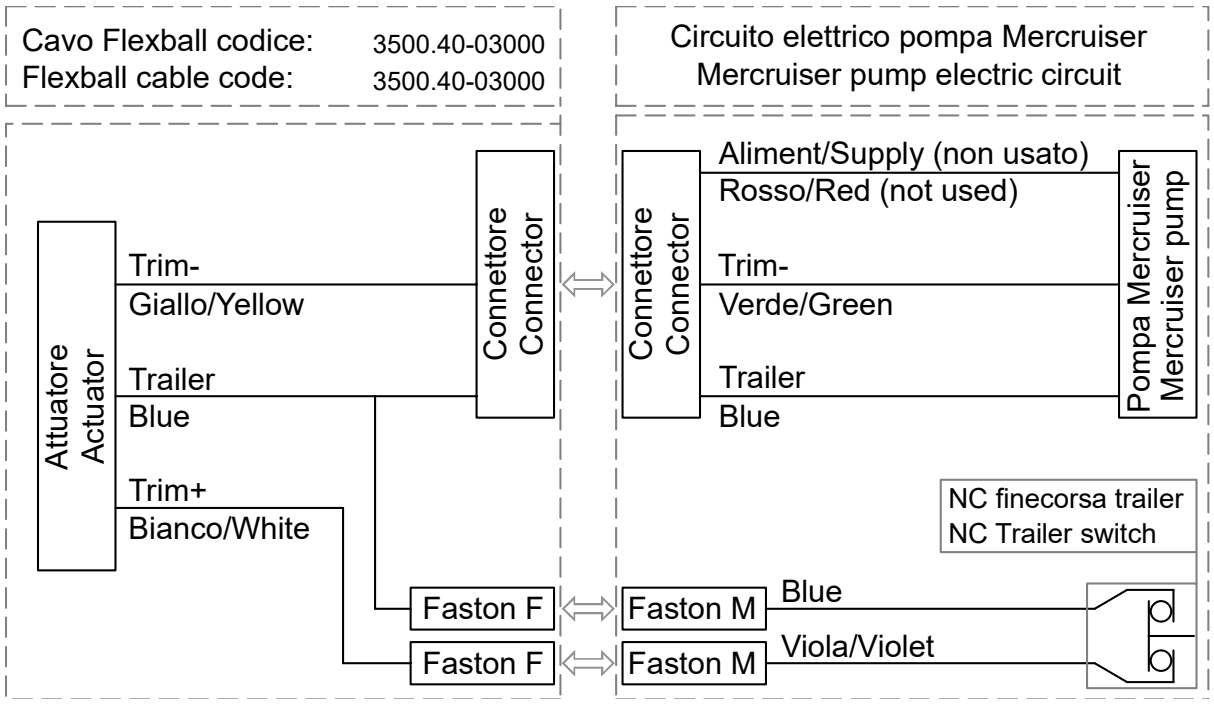
| Length | Code |
|---|---|
| L=3 m | 4665/37-03000 |
| L=5 m | 4665/37-05000 |
| L=7 m | 4665/37-07000 |

## 6.5. Cable actuator – Mercruiser® trim pump

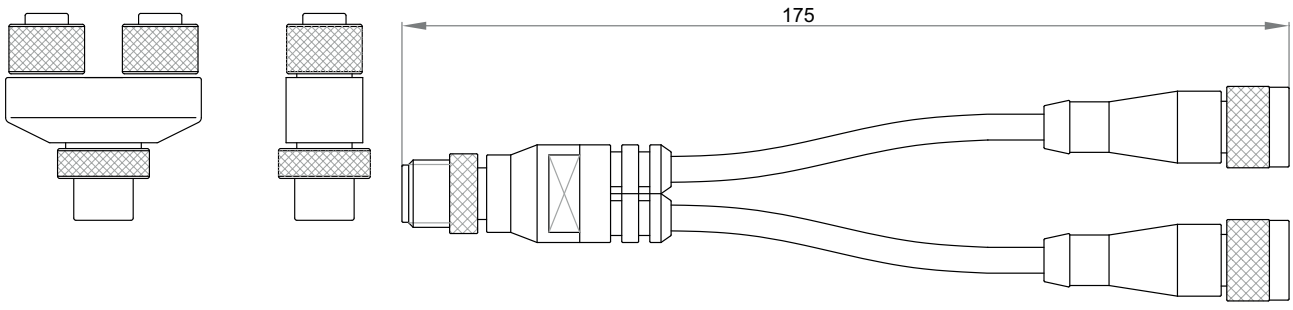
The cable for the trim pump of Mercruiser sterndrive has a length of 3 meters; in the cabling are included the fast-on connections to the microswitch for the end of stroke of the tilt.




| Length | Code |
|---|---|
| L=3 m | 3500.40-03000 |

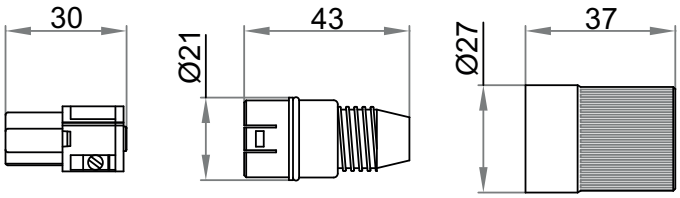


## 6.6. T-Splitter




Code: N-85E010003

## 6.7. Power supply connector




Code: 3500.38-00000

► **Important:** cabling instruction of power supply connector are at section 10.1.1. of this manual.

# 7. Configuration of the CANBus network

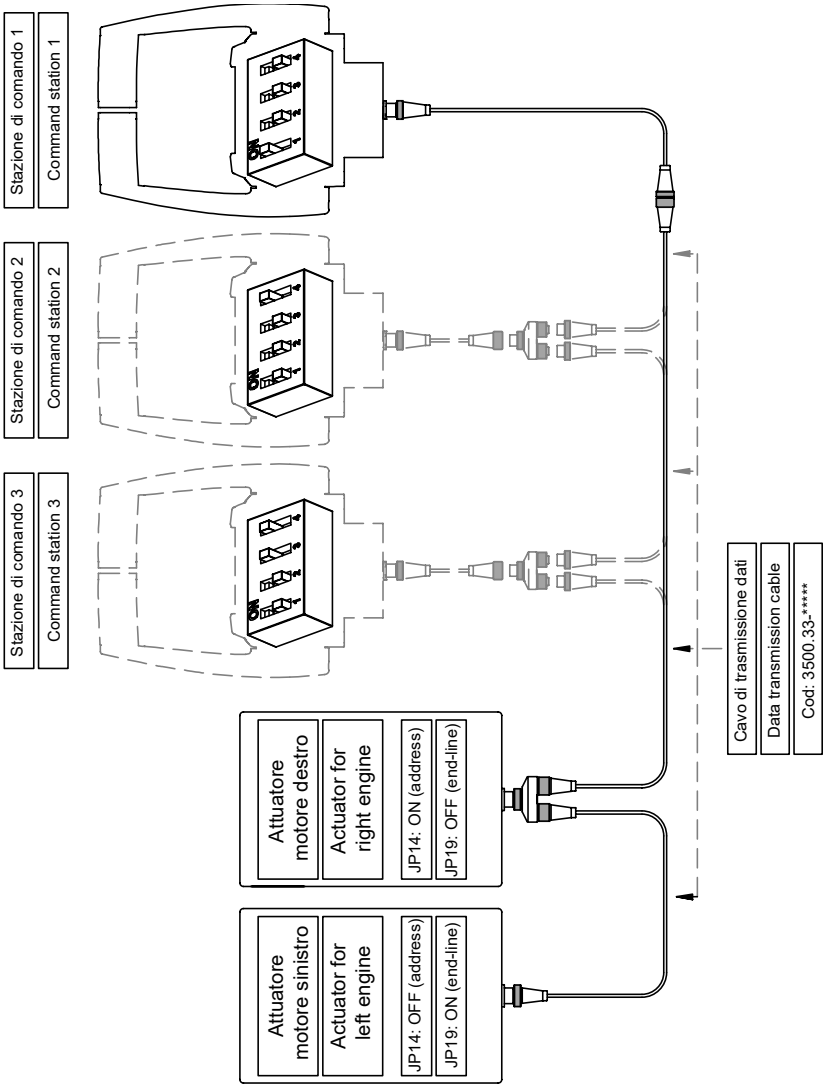
## System types, installation schemes and addressing for command stations and actuators

How to configure the installation depends from the quantity, type of engines and gearboxes and number of command stations. Actuators and command stations, which communicate together through the CANBus network, must be configured in relation to how they are connected to the CANBus network. In the following installation schemes you find:

- Components necessary to build an installation
- Configuration of actuators and command stations in relation of their position on the CANBus network

The following installation schemes cover the most common application cases.

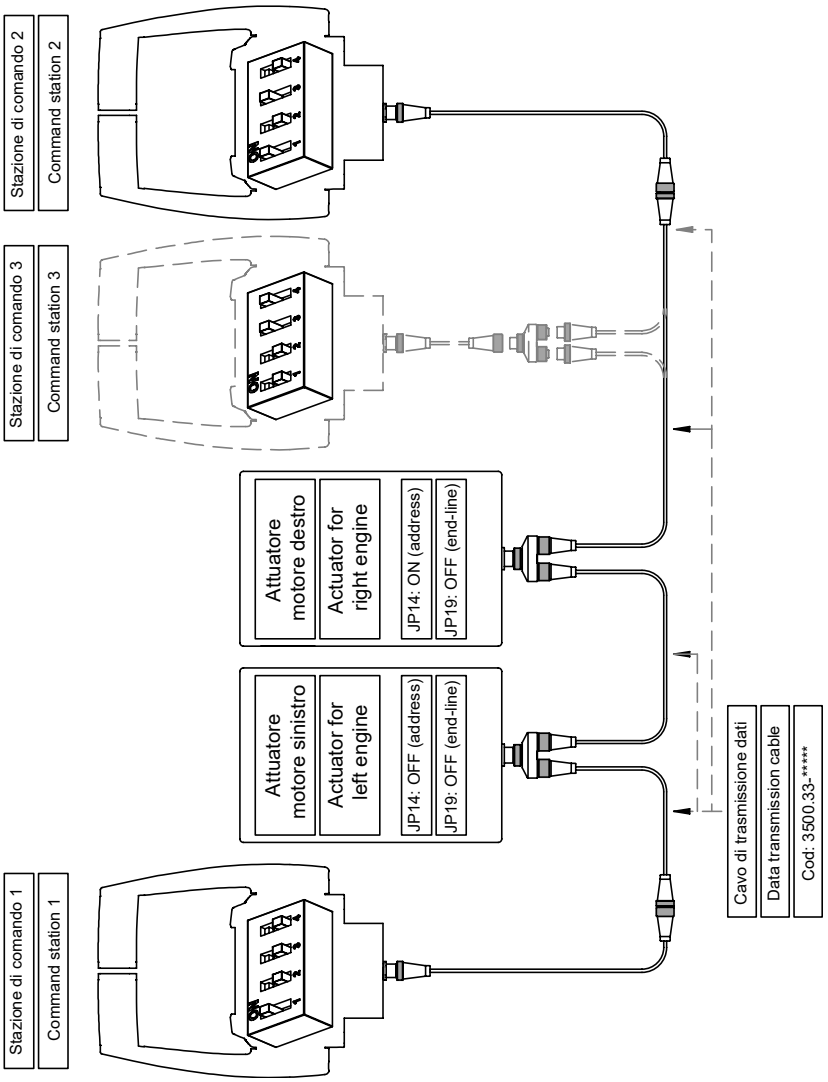
### 7.1. Installation with 2 mechanical actuators – solution A




This installation scheme is valid for systems with:

- Up to 3 command stations and 2 engines with mechanical throttle, mechanical gearbox, with/without trim;
- Up to 3 command stations and 2 hybrid engines with mechanical throttle, mechanical gearbox, analogue outputs for electric engine inverter driven, with/without trim.

## 7.2. Installation with 2 mechanical actuators – solution B

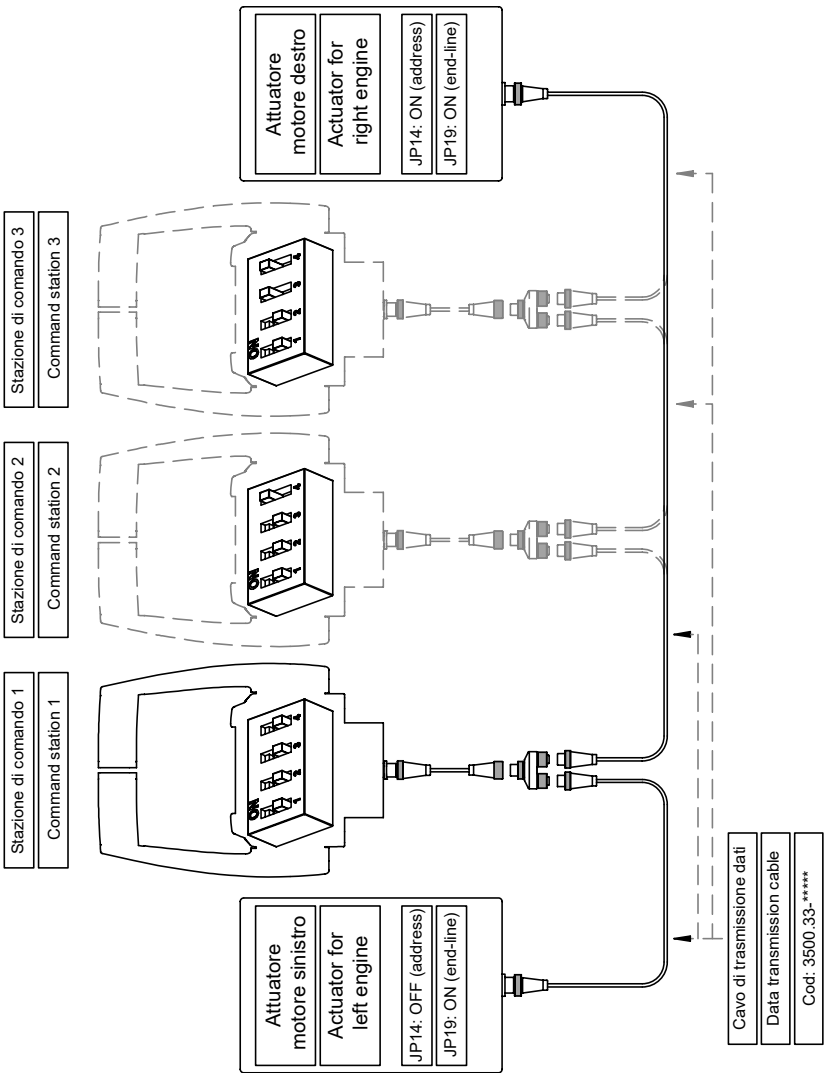



This installation scheme is valid for systems with:

- Up to 3 command stations and 2 engines with mechanical throttle, mechanical gearbox, with/without trim;
- Up to 3 command stations and 2 hybrid engines with mechanical throttle, mechanical gearbox, analogue outputs for electric engine inverter driven, with/without trim.

## 7.3. Installation with 2 mechanical actuators – solution C

Actuators are placed at the ends of the CANBus network

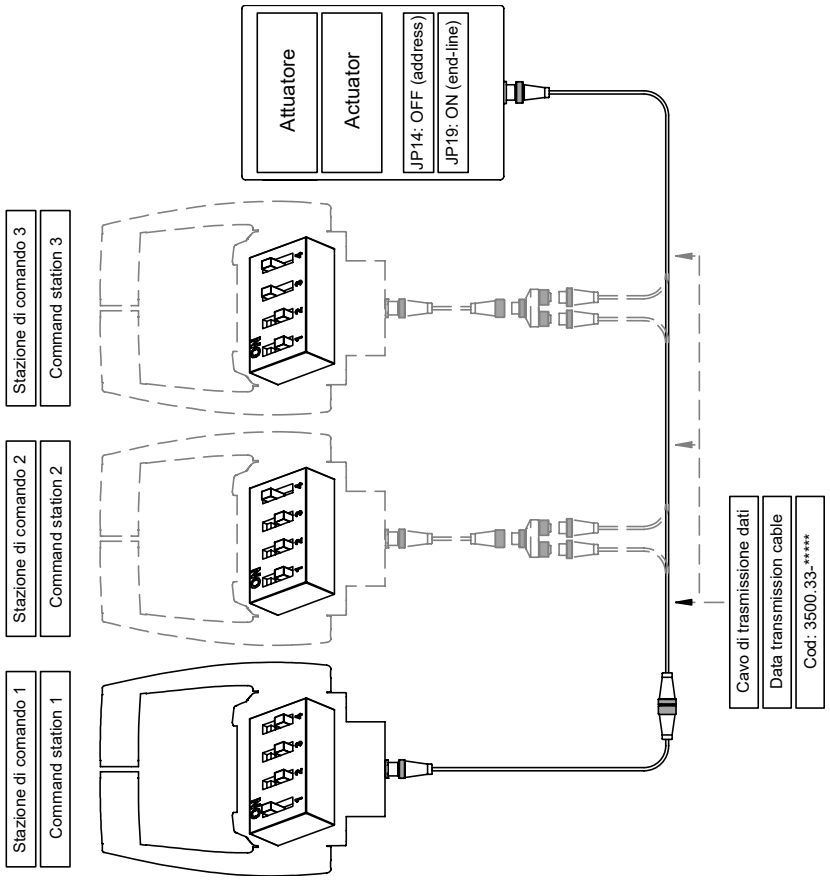



This installation scheme, typical for catamaran applications, is valid for systems with:

- Up to 3 command stations and 2 engines with mechanical throttle, mechanical gearbox, with/without trim;
- Up to 3 command stations and 2 hybrid engines with mechanical throttle, mechanical gearbox, analogue outputs for electric engine inverter driven, with/without trim.

## 7.4. Installation with 1 actuator – solution D

The actuator is placed at one end of the CANBus network.

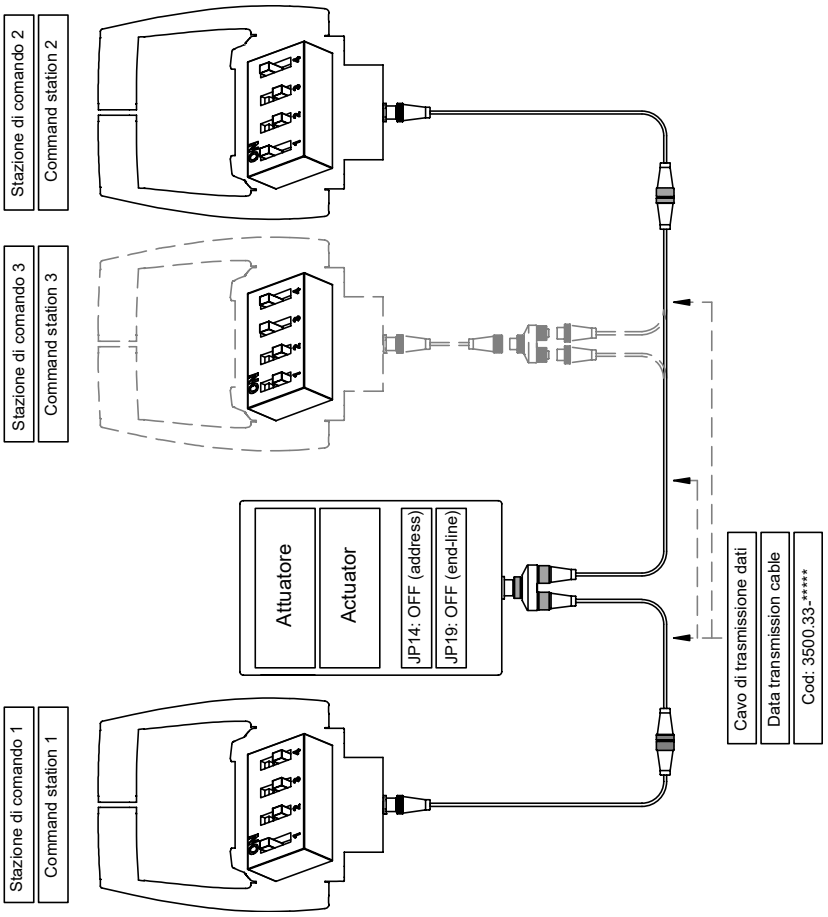



This installation scheme is valid for systems with:

- up to 3 command stations and 1 engine with mechanical throttle, mechanical gearbox, with/without trim (or flap);
- up to 3 command stations and 1 hybrid engine with mechanical throttle, mechanical gearbox, analogue outputs for electric engine inverter driven, with/without (or flap);
- up to 3 command stations with 1 or 2 mechanical throttles and 1 or 2 solenoid gearboxes, analogue outputs for electric engine inverter driven, with/without (or flap);
- up to 3 command stations and 1or 2 engines with electronic throttle (voltage or CANBus), mechanical gearbox, with/without trim (or flap);
- up to 3 command stations and 1 or 2 engines with electronic throttle (voltage or CANBus), solenoid driven gearbox, with/without trim (or flap);
- up to 3 command stations and 1 or 2 hybrid engines with electronic throttle (voltage or CANBus), mechanical gearbox, analogue outputs for electric engine inverter driven, with/without trim (or flap);
- up to 3 command stations and 1 or 2 hybrid engines with electronic throttle (voltage or CANBus), solenoid driven gearbox, analogue outputs for electric engine inverter driven, with/without trim (or flap).

## 7.5. Installation with 1 actuator – solution E

The actuator is placed in the middle of the CANBus line.




This installation scheme is valid for systems with:

- up to 3 command stations and 1 engine with mechanical throttle, mechanical gearbox, with/without trim (or flap);
- up to 3 command stations and 1 hybrid engine with mechanical throttle, mechanical gearbox, analogue outputs for electric engine inverter driven, with/without (or flap);
- up to 3 command stations with 1 or 2 mechanical throttles and 1 or 2 solenoid gearboxes, analogue outputs for electric engine inverter driven, with/without (or flap);
- up to 3 command stations and 1or 2 engines with electronic throttle (voltage or CANBus), mechanical gearbox, with/without trim (or flap);
- up to 3 command stations and 1 or 2 engines with electronic throttle (voltage or CANBus), solenoid driven gearbox, with/without trim (or flap);
- up to 3 command stations and 1 or 2 hybrid engines with electronic throttle (voltage or CANBus), mechanical gearbox, analogue outputs for electric engine inverter driven, with/without trim (or flap);
- up to 3 command stations and 1 or 2 hybrid engines with electronic throttle (voltage or CANBus), solenoid driven gearbox, analogue outputs for electric engine inverter driven, with/without trim (or flap).

## 7.6. Configuration: end of line termination resistor and address setting of command stations and actuators

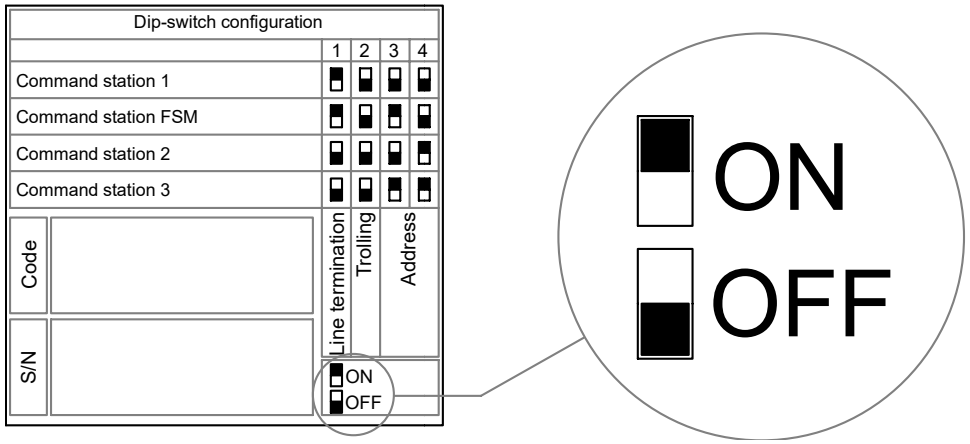
According to the number and to the position on the CANBus communication net, command stations and actuators must be properly configured to guarantee the correct functioning of the system. End of line termination resistor must be enabled, in case the device is placed at the end of the CANBus network.

### 7.6.1. Configuration of the command station

This operation allows to setup the command station in relation to its position on the CANBus net. Each command station must have a different address number and if the command station is connected at the end of the CANBus net, the end line dip-switch must be enable (ON).

Under the base of the command station there is a plastic cap. Unscrewing it, you have access to the dip-switches.
Operation:

- unscrew the plastic cap
- set the dip-switch position according to one of the configurations described in chapter 7
- screw again the cap




**Dip-switch 1:** OFF end-line resistance disabled
ON end-line resistance enabled

**Dip-switch 2:** trolling option

**Dip-switch 3 and 4:** identify the command station

The dip-switches configure the command station according to its position in the CANBus network. The selector of the dip switch is represented in the nearby label with the white square.

| | **Dip- switch 3** | **Dip- switch 4** |
|---|---|---|
| Command station 1 | OFF | OFF |
| Command station Fast Start-up Mode (this is alternative to command station 1) | ON | OFF |
| Command station 2 | OFF | ON |
| Command station 3 | ON | ON |

► **Important 1:** if there are more command stations connected to the same CANBus network, each command station must have a unique address. This unique address of the command station is defined by the configuration of the dip-switches.

► **Important 2:** “command station 1” and “command station Fast Start-up Mode” cannot co-exist in the same system: either you have a “Fast Start-up Mode” or “Command station 1”.

► **Important 3:** To configure the dip-switches of each command station, please refer to the installation schemes reported from section 7.1. to section 7.5.

► **Important 4:** two engines command is configured from the factory to be mounted in systems with only one actuator. This is the typical application where there are two engines and/or gearboxes with electronic interface (like it is described in sections 7.4 and 7.5). In case of systems with two propulsion systems equipped with mechanical engines and mechanical gearboxes, you need to use two mechanical actuators (installations described at sections 7.1, 7.2 and 7.3). If this is the case, the command station must be re-configured as described at section 4.4.

### 7.6.2. Configuration of the actuator

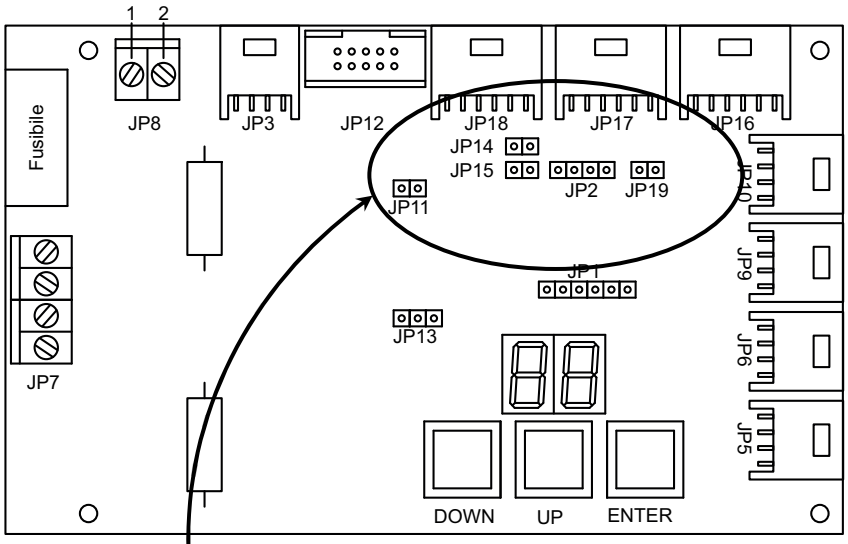
To configure the actuator it is necessary to:

- enable or disable the end of line resistor
- define the CANBus address

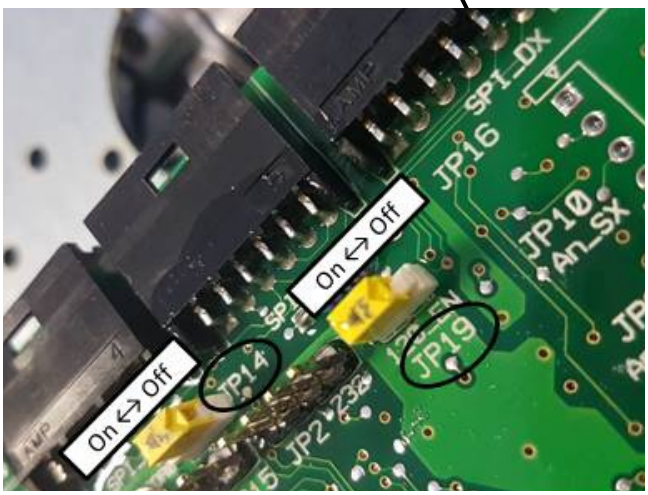
These operations must be according to the position of the actuator as described in the schemes of chapter 7.

**Actuator PCBoard version 3.1**

JP14 defines the CAN Bus address of the actuator. Factory setting is JP14 = OFF (address =0).
JP19 enables (ON) or disables (OFF) the line termination. Factory setting is JP19 = ON (line termination = ON).




In some documentation, alternative to ON or OFF are indicated YES or NO




If JP14 = ON, address = 1

If JP19 = ON, end of line is enabled

The actuator configuration changes according if the system is with one or two actuators:

| Installations with 1 actuator | Installations with 2 actuators |
|---|---|
| JP14 = OFF (address = 0) | Left actuator is with JP14 = OFF (address = 0) |
| | Right actuator is with JP14 = ON (address = 1) |
| The settings of JP14 and JP19 depend on the configuration of the CANBus network, as described from section 7.1 to 7.5 | |

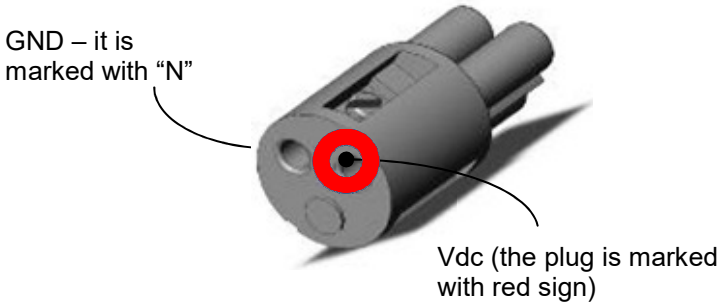
# 10. Electrical installation

**System's components involved:** actuator, supply connector, all the electrical cables

## 10.1. Wiring from the battery to the actuator (input cables)

### 10.1.1. The supply connector

**First of all you must wire the power supply cable, do not connect any other cable before having checked that this operation has been performed correctly!** Choose a cable with a cross section of at least 2,5 $mm^2$.
Each actuator is delivered with an external supply plug, identify the insert of the power plug:




- pay attention that the positive wire must be screwed to the clamp with the red mark
- insert the plug into the connector of the actuator box and power-up
- open the actuator box removing the 4 plastic screws

If the plug has been wired properly, after power up, the display shows a sequence of 2 codes: 'FI' and 'XX':
- 'FI' means Firmware;
- 'XX' is the firmware version.

… and after 2 seconds the display shows "_ _".

If the display on the actuator doesn't show any light, it means that there is no power supply on the actuator box.

**Causes:**
- the electrical connection is missing, check where
- the actuator has been supplied with inverse polarity, therefore:
  - swap plus and minus wires, in order to re-stablish the right polarity on the supply cable
  - replace the fuse of 6,3 Amps that you find on the front of the actuator box
  - insert again the plug into the connector of the actuator box and power-up

If the display is lighted, the cabling is correct and you see on the actuator's display the following sequence of digits reported here abow (FI XX _ _).
In case of installations with 2 actuators, repeat the same procedure on each actuator (check that both displays light on). Only after you have assured that the actuators have been powered up correctly, you can connect the CANBus cable between the actuators and all the other electrical cables.

| **Supply voltage** | **12 V** | **24 V** | **12/24 V** |
|---|---|---|---|
| Internal fuse (on the PCB) | | 5,0 A | |
| Wall fuse | 6,15 A | - | 6,15 A |
| Current absorbed in no loaded condition | 0,5 A | 0,25 A | 0,5 A (max) |

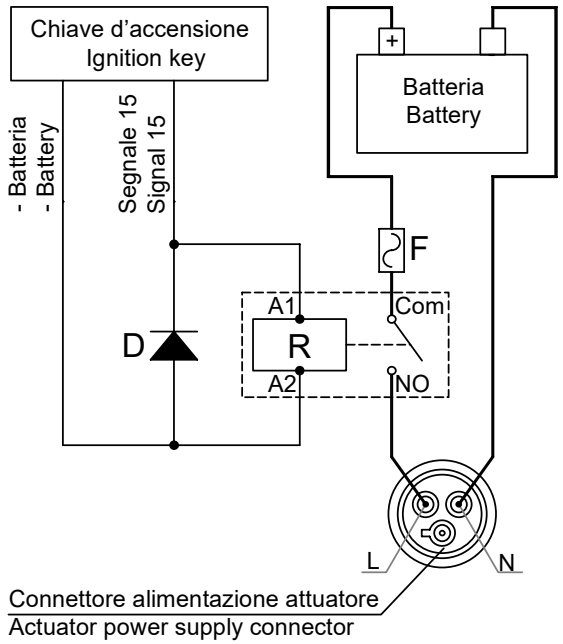
### 10.1.2. The ignition key switch

For the wiring of the actuator to the ignition key, refer to the installation schemes reported here below.

<table>
<tr><td colspan="3">Starter motors<br><br>The cables that connect the battery to the starter motors must have a cross-section of at least 50 mm$^2$ (both the “plus” and the “minus” cable). The “minus” cable of the actuator must be connected directly to the battery. It is vital that there is zero voltage between battery negative terminals.</td></tr>
<tr><td>Electronic system with 1 actuator<br><br>In case of 2 batteries, the actuator must be connected to both the batteries. The “plus” cables must be connected with a 10A decoupling diode. In this way the actuator will be supplied by the most charged battery. The minimum section of the cable must be of 2,5 mm$^2$.</td><td></td><td>Electronic system with 2 actuators<br><br>Each actuator must be supplied from its own battery.<br>The minimum section of the cable must be of 2,5 mm$^2$.</td></tr>
<tr><td>Refer to electrical installation scheme reported in section 10.1.3 for system with one ignition key and 10.1.4 for system with two ignition keys. This last scheme allows to power the actuator box activating at least one of the two ignition keys.<br><br>If your application has double deck (e.g. main deck and fly-bridge) refer to installation scheme reported in section 10.1.5.</td><td></td><td>Refer to electrical installation scheme reported in section 10.1.6.<br><br>If your application has double deck (e.g. main deck and fly-bridge) refer to installation scheme reported in section 10.1.7.</td></tr>
</table>

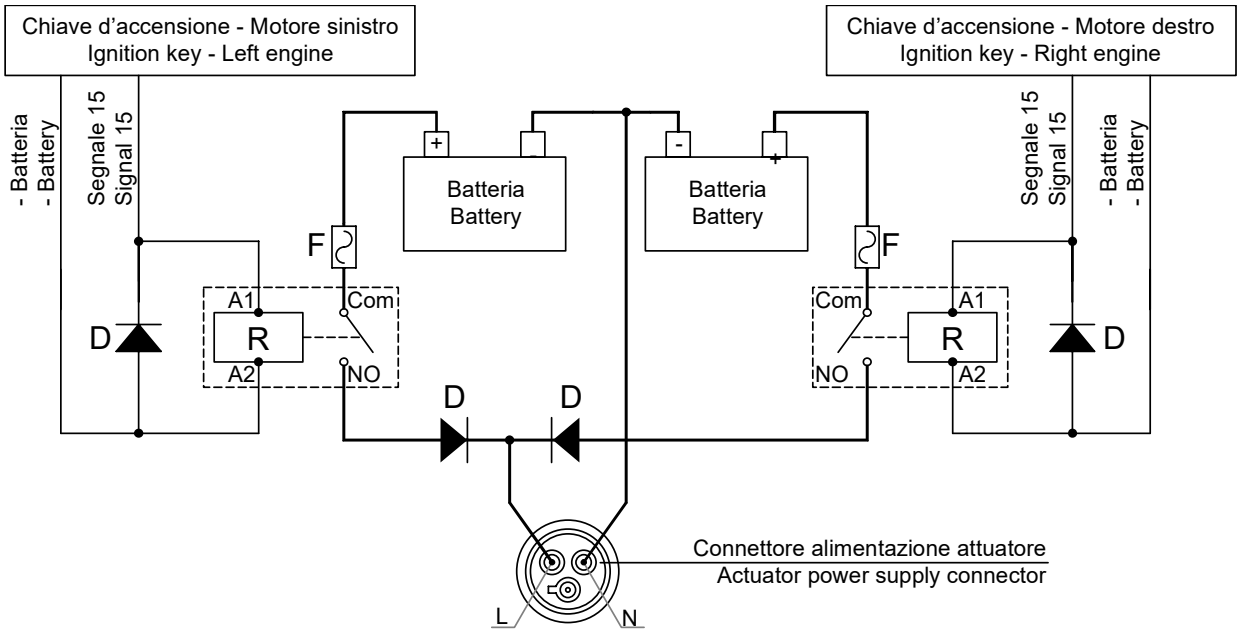
### 10.1.3. Electrical installation of systems with 1 engine, 1 actuator and 1 ignition key

It follows the electrical schemes to be used to make the connection to power supply, including rated values of the electrical components.



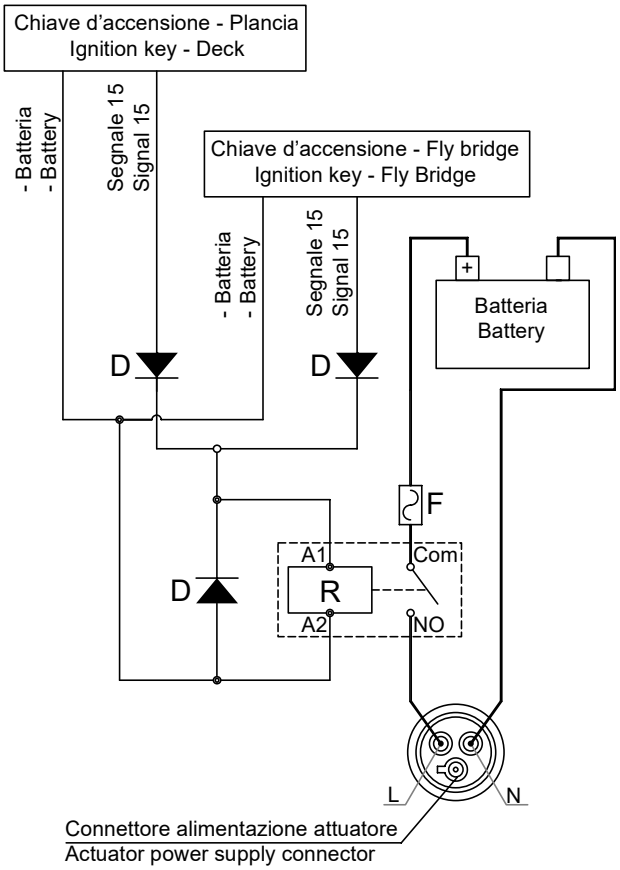

| Ref. | Description | 12 V power supply | 24 V power supply |
|---|---|---|---|
| D | Diode | 10 A, 20 V | 5 A, 24 V |
| R | Relay | 10 A, 12 V | 5 A, 24 V |
| F | Fuse | 10 A | |
| 15 | Terminal 15 is the signal coming from the ignition key block. When the ignition key is on its first detent, signal 15 is active. | | |
| | Supply cable cross section | 2,5 mm$^2$ | 1,5 mm$^2$ |

### 10.1.4. Electrical installation of systems with 2 engines, 1 actuator and 2 ignition keys



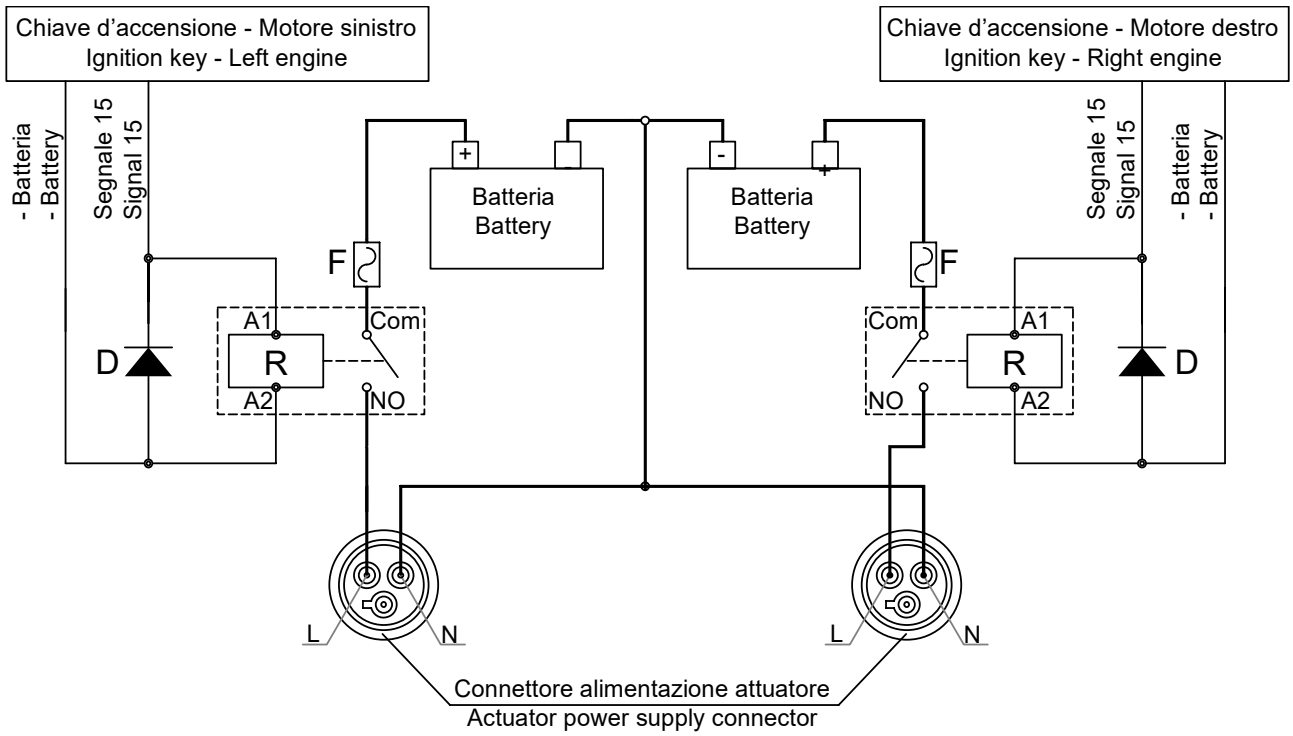

For the detailed list of components, please refer to the table at section 10.1.3.

### 10.1.5. Electrical installation systems with 1 engine, 1 actuator and 2 ignition keys.



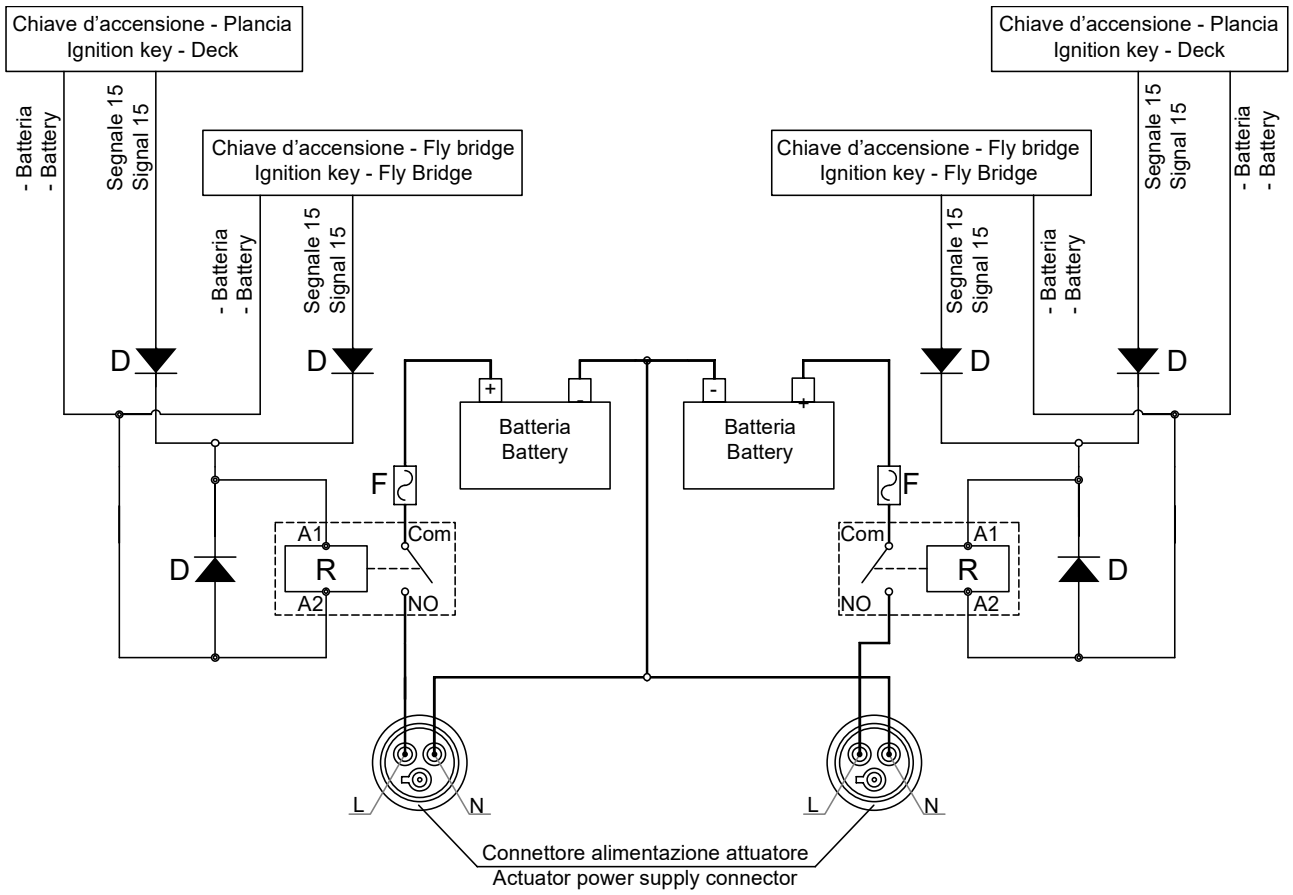

For the detailed list of components, please refer to the table at section 10.1.3

### 10.1.6. Electrical installation of systems with 2 engines, 2 actuators and 2 ignition keys




For the detailed list of components, please refer to the table at section 10.1.3.

### 10.1.7. Electrical installation of systems with 2 engines, 2 actuators and 2+2 ignition keys

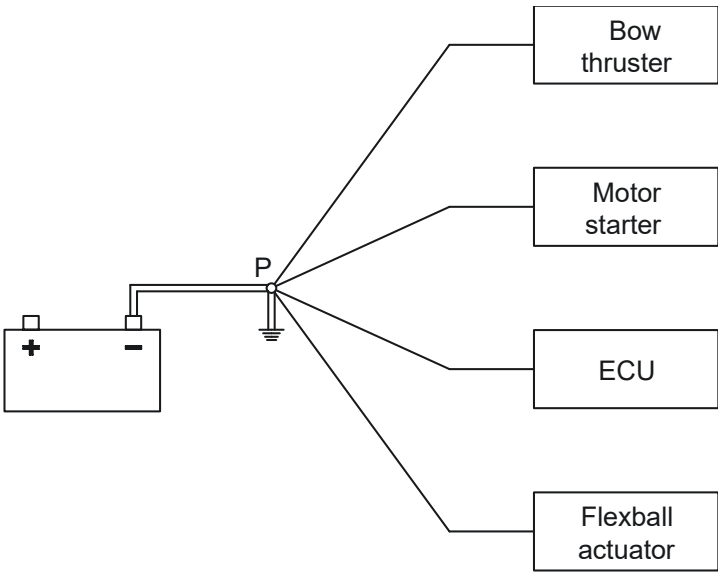



For the detailed list of components, please refer to the table at section 10.1.3.

### 10.1.8. Dimensional criteria of the power supply cables

For supply cabling respect the following conditions:

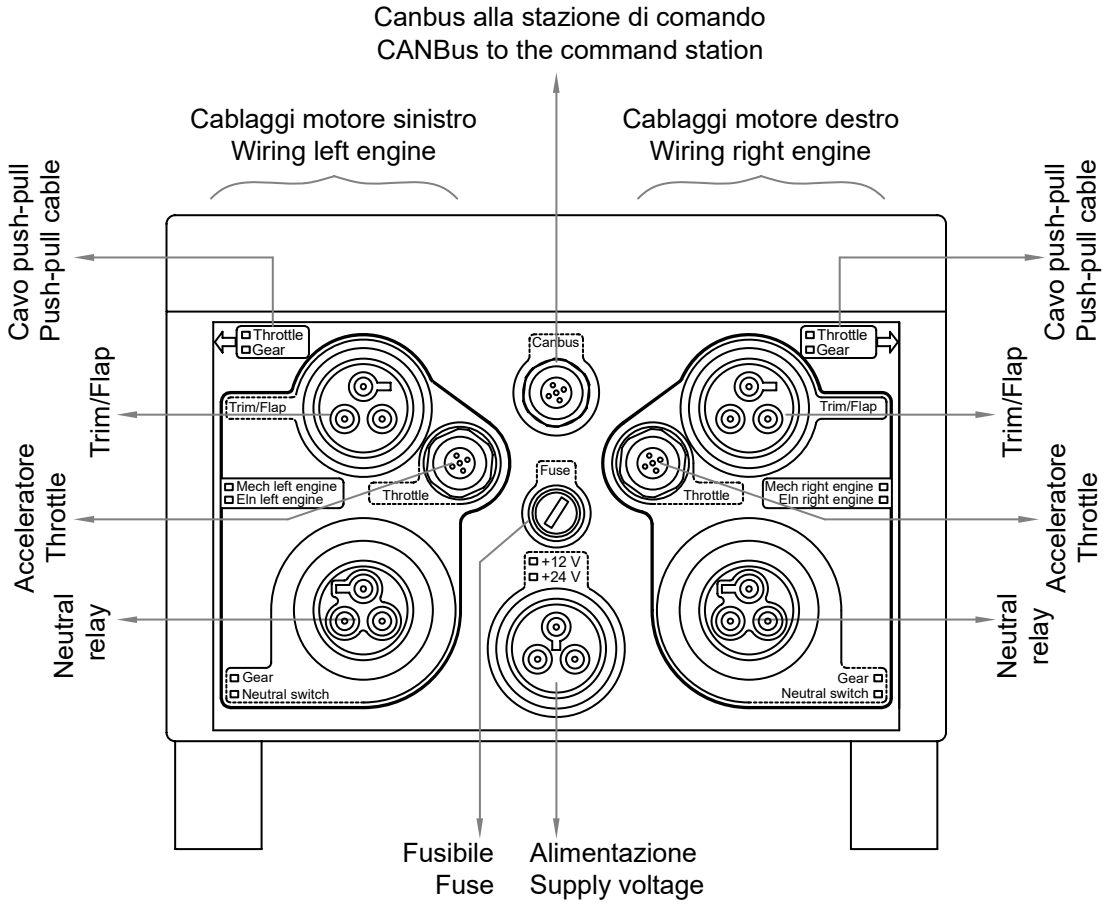
- Cables from the battery to engine starter (both positive and negative poles) must have a minimum cross section of 50 $mm^2$, if it is not specified a higher cross section by the engine supplier.
- The GND of the actuator must be connected directly to the negative pole of the battery. Minimum cross section is 2,5 $mm^2$.
- In case electronic throttle, it is very important to connect to a common GND point (either GND buss bar or common bonding conductor or hull) all the negative poles of each electronic device.



## 10.2. Wiring from the actuator to command stations, engines, gearboxes, trim/flaps, etc (output cables)

Almost every cable is provided with its unique connector, therefore it is easy to identify the cable type, its function and where to mount it. Each connector has a different polarization, therefore it is almost impossible to mount a cable in the wrong position. For the description of all the types of cables, look at chapter 6.
**When mounting the electronic engine cable on the actuator, align the polarization keys and insert carefully the M12 connector of the cable on the actuator M12 counterpart.** Rotate then the M12 ring until the cable enters completely into the counterpart. If the cable has been inserted correctly, it must be possible to screw completely by hand the cable without too much efforts (around 6 full rotations).
There are basically 4 types of actuators classified on the type of interface (mechanic or electronic) and on the type of connector placed on the actuator itself (with or without neutral relay).

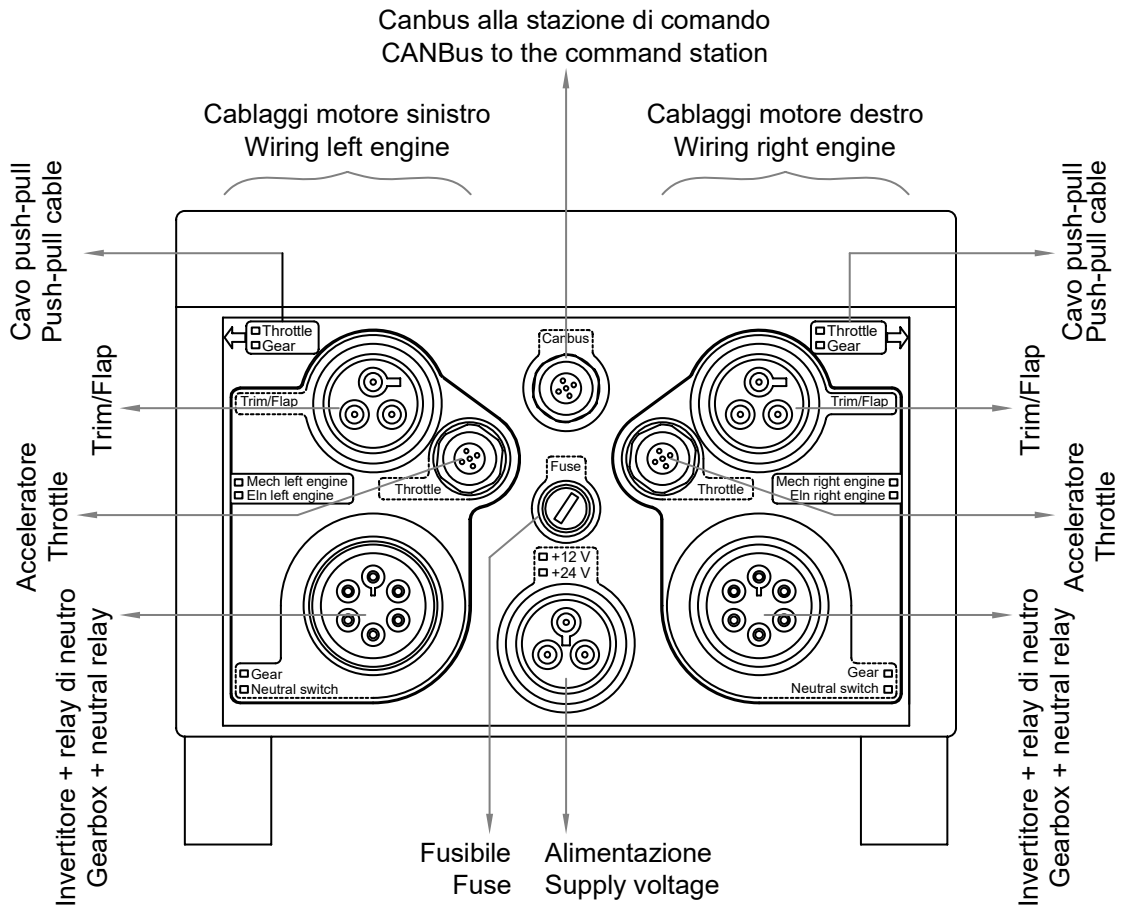
### 10.2.1. Actuator with mechanical interface without neutral relay




For better comprehension are depicted only the electrical connections and not the mechanical linkages. This actuator is available in versions with neutral relay, with or without trim and it is suitable for the following applications:

- mechanical engine and mechanical gearbox (only 1 propulsion group per actuator)
- mechanical engine and solenoid driven gearbox (up to 2 propulsion groups per actuator)
- electronic engine and mechanical gearbox (up to 2 propulsion groups per actuator)

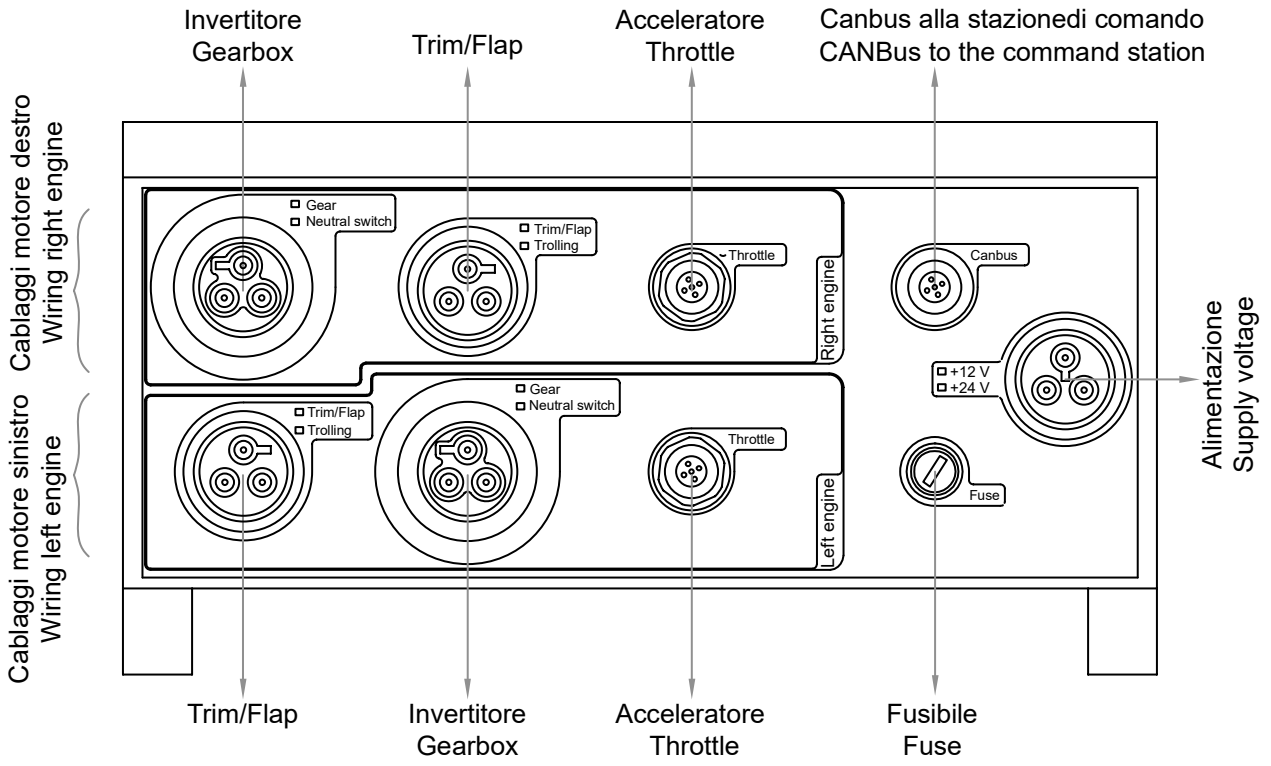
### 10.2.2. Actuator with mechanical interface and neutral relay




For better comprehension are depicted only the electrical connections and not the mechanical linkages. This actuator is available in versions with neutral relay, with or without trim and it is suitable for the following applications:

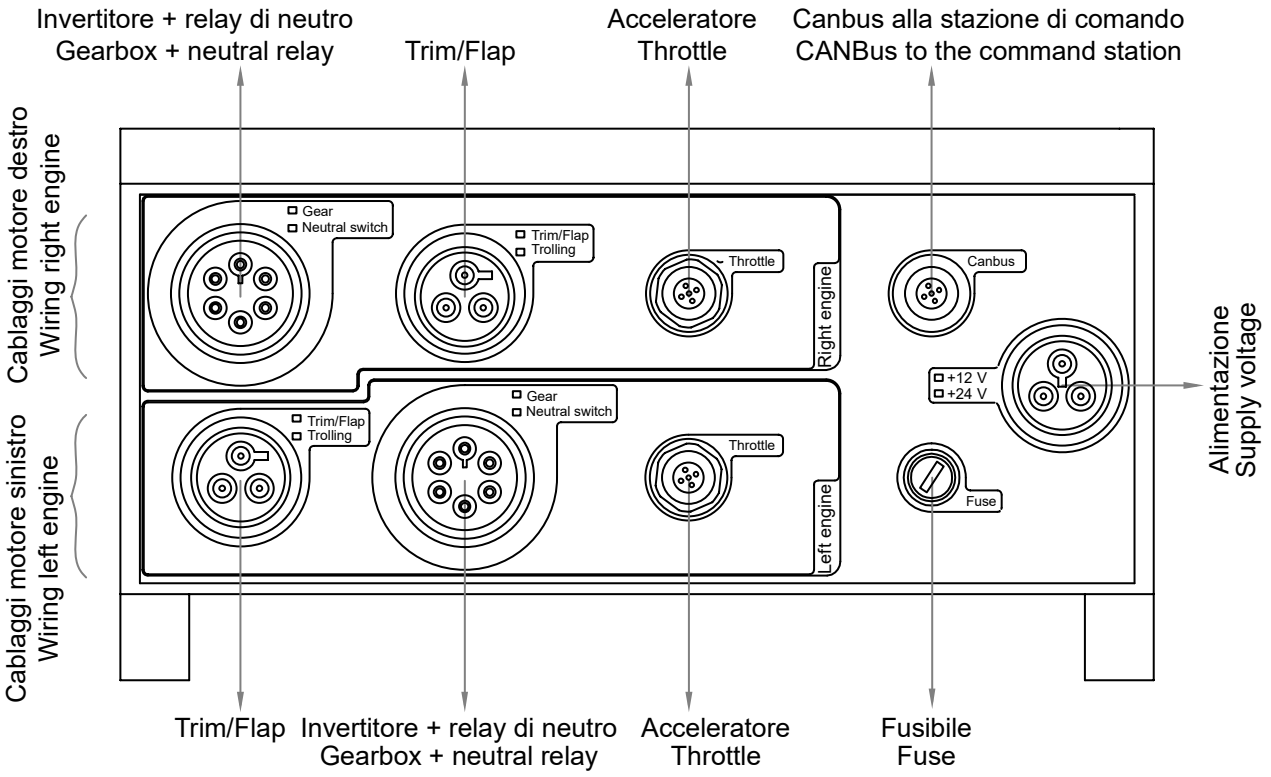
- mechanical engine and mechanical gearbox (only 1 propulsion group per actuator)
- mechanical engine and solenoid driven gearbox (up to 2 propulsion groups per actuator)
- electronic engine and mechanical gearbox (up to 2 propulsion groups per actuator)

### 10.2.3. Actuator with full electronic interface




► **Important:** in case of single engine installation, use only the connectors for the right engine.

### 10.2.4. Actuator with full electronic interface and neutral relay

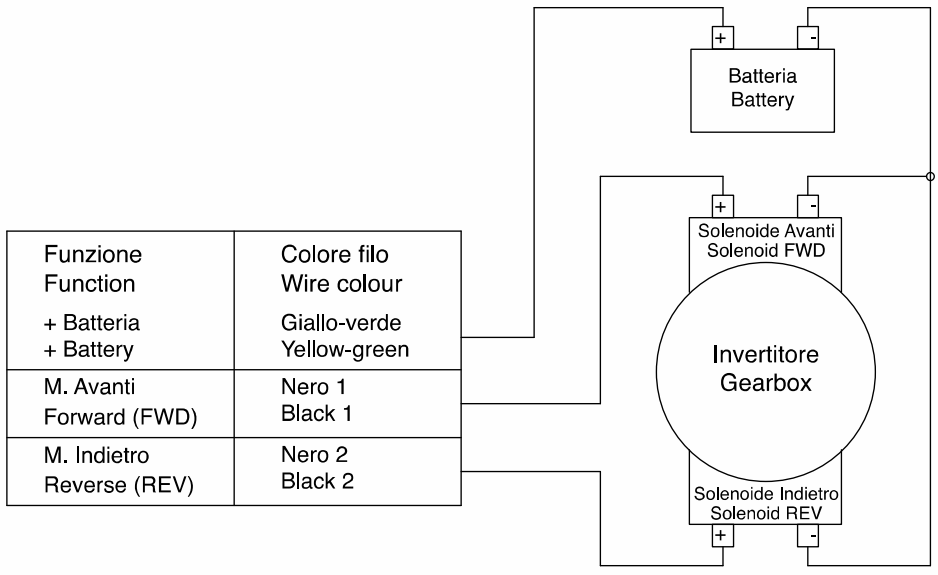



► **Important:** in case of single engine installation, use only the connectors for the right engine.

### 10.2.5. Wiring scheme to gearbox in case of actuator without neutral relay

This wiring scheme refers to:

- Actuators without neutral relay (see sections 10.2.1 and 10.2.3)
- Gearbox cable code 3500.36 (see section 6.3), gearbox cable code 4665/36 (see section 6.3.1) and gearbox cable code 15/36 (see section 6.3.2)



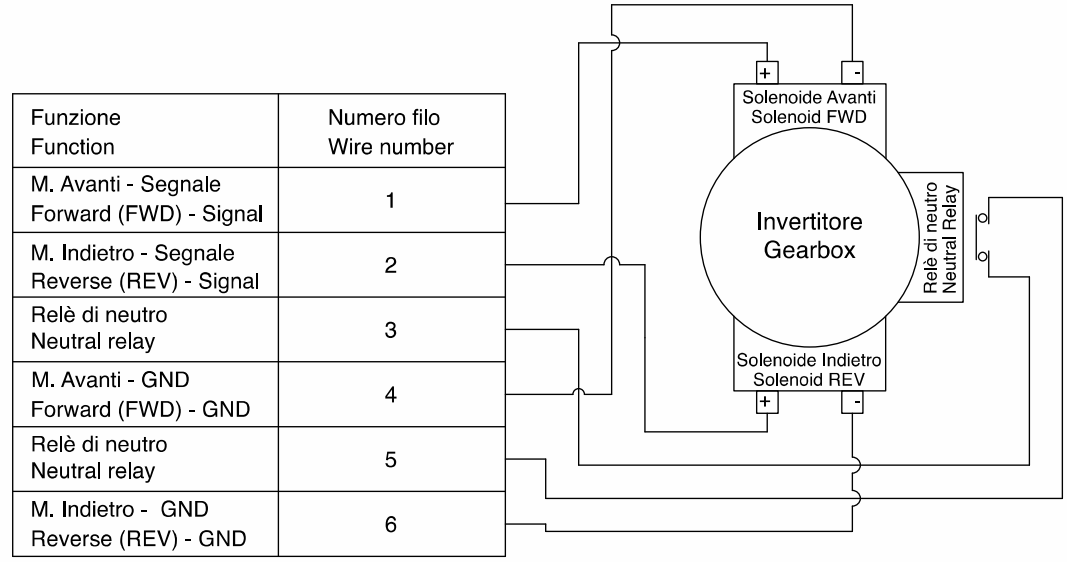

| Funzione<br>Function | Colore filo<br>Wire colour |
|---|---|
| + Batteria<br>+ Battery | Giallo-verde<br>Yellow-green |
| M. Avanti<br>Forward (FWD) | Nero 1<br>Black 1 |
| M. Indietro<br>Reverse (REV) | Nero 2<br>Black 2 |

► **Important:** this conceptual scheme shows how to connect the electrical cables; battery switch and protection devices (e.g. fuses) must be implemented according to local regulations.

### 10.2.6. Wiring scheme to gearbox in case of actuator with neutral relay

This wiring scheme refers to:

- Actuators with neutral relay (see sections 10.2.2 and 10.2.4)
- Gearbox cable code 3500.46 (see section 6.3.3.)



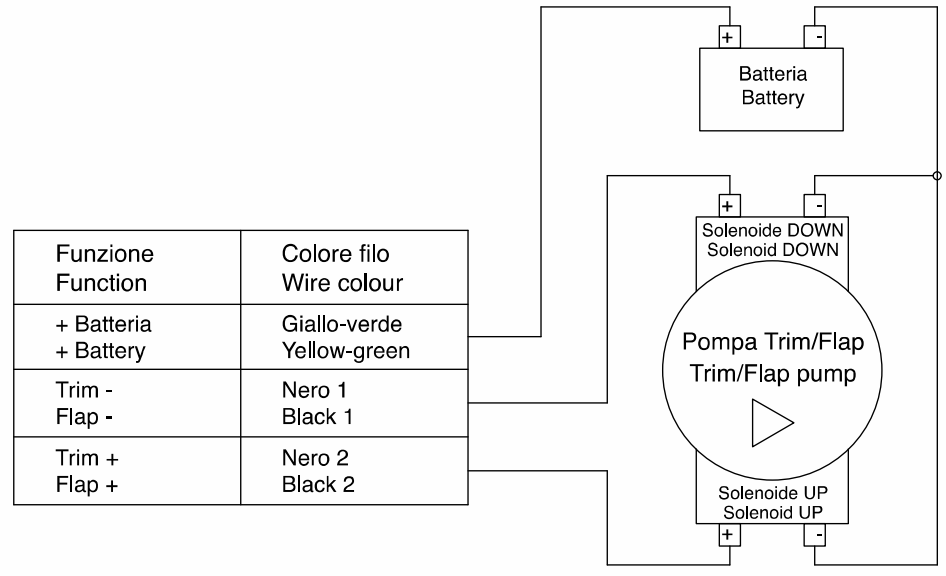

| Funzione<br>Function | Numero filo<br>Wire number |
|---|---|
| M. Avanti - Segnale<br>Forward (FWD) - Signal | 1 |
| M. Indietro - Segnale<br>Reverse (REV) - Signal | 2 |
| Relè di neutro<br>Neutral relay | 3 |
| M. Avanti - GND<br>Forward (FWD) - GND | 4 |
| Relè di neutro<br>Neutral relay | 5 |
| M. Indietro - GND<br>Reverse (REV) - GND | 6 |

► **Important:** this conceptual scheme shows how to connect the electrical cables; battery switch and protection devices (e.g. fuses) must be implemented according to local regulations.

### 10.2.7. Wiring scheme from actuator to trim/flap with external supply

This wiring scheme refers to:

- Any actuator with serial number before 16500
- Trim/Flap cable code 3500.37 (see section 6.4)




| Funzione<br>Function | Colore filo<br>Wire colour |
|---|---|
| + Batteria<br>+ Battery | Giallo-verde<br>Yellow-green |
| Trim -<br>Flap - | Nero 1<br>Black 1 |
| Trim +<br>Flap + | Nero 2<br>Black 2 |

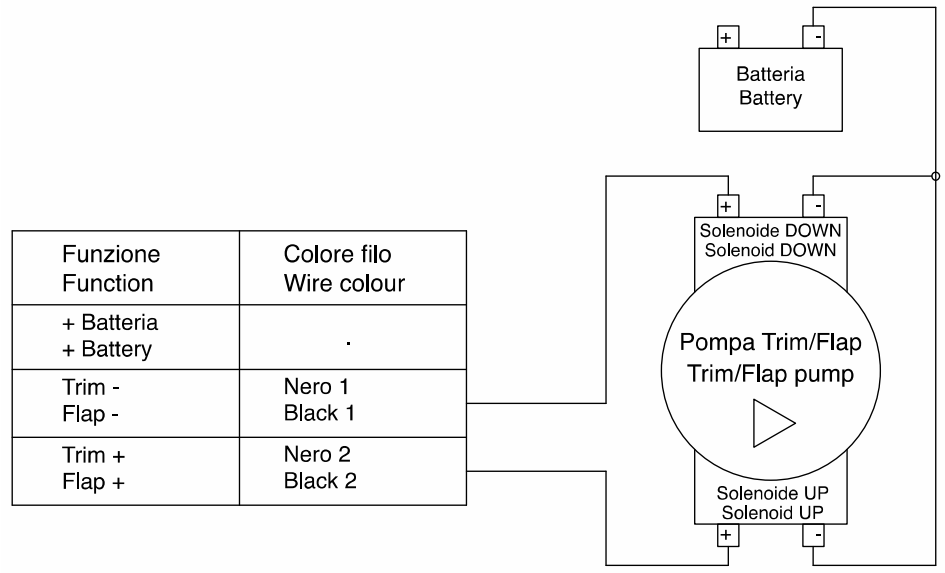
► **Important:** this conceptual scheme shows how to connect the electrical cables; battery switch and protection devices (e.g. fuses) must be implemented according to local regulations.

### 10.2.8. Wiring scheme from actuator to trim/flap with internal supply

This wiring scheme refers to:

- Any actuator with serial number equal or after 16500
- Trim/Flap cable code 3500.37 (see section 6.4)

Output signals are internally protected with 5A fuse.

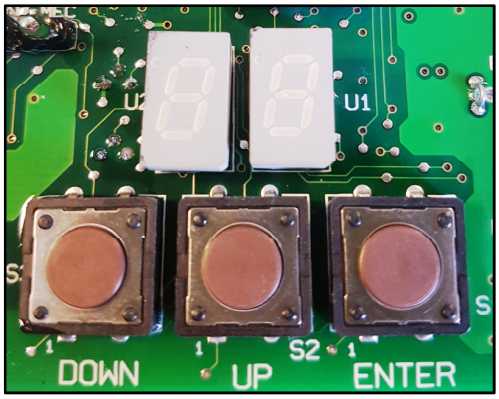



| Funzione<br>Function | Colore filo<br>Wire colour |
|---|---|
| + Batteria<br>+ Battery | . |
| Trim -<br>Flap - | Nero 1<br>Black 1 |
| Trim +<br>Flap + | Nero 2<br>Black 2 |

# 11. Programming of the actuator, general guidelines

## 11.1. Programming keypad

The keyboard has a display with two figures and three programming pushbuttons/keys.




Actuators are already programmed from the factory and it should not be necessary to make any change, but in case you want to modify their programming, follow this procedure.

## 11.2. Display and Parameters

After power up, the display shows a sequence of 2 codes: 'FI' and 'XX':
- 'FI' means Firmware;
- 'XX' is the firmware version.

… and after 2 seconds the display shows "_ _".

To enter into the parameter menu, press at the same time keys "UP" and "DOWN". It is now possible to move from one parameter to the other using the keys "UP" and "DOWN".
For the setting of the specific parameters follow this procedure:

1. with the actuator turned on (the display shows " _ _") press both keys "UP" and "DOWN" and the first parameter will appear on the display the message "A0"
2. pressing either "UP" or "DOWN", it is now possible to scroll the parameter lists
3. pressing the key "ENTER", the parameter's value will be shown on the display. The display is now blinking and it is possible to modify the parameter's value, using the keys "UP" and "DOWN"
4. press the key "ENTER" (↵) to store the parameter's value and immediately the display stops blinking
5. to set the other parameters, scroll the menu with the keys "UP" and "DOWN" and when you have pointed the parameter that you want to change, repeat this procedure from point 3.

## 11.3. Actuator parameters

Parameters are different in relation of the type of actuator and application. The detailed parameter list for each application is described in each specific section reported in the following pages. Here below are listed the parameters present in any type of actuator.

| Code display | Description | Values | Factory value | Value shown on display (factory value) | Note |
|---|---|---|---|---|---|
| A0 | Push-pull cable movement direction | 1 .. 4 | 4 | 04 | |
| dI | Delay before disengaging the gearbox | 0 .. 9,9 s | 0,0 s | 00 | |
| dA | Delay on the throttle | 0 .. 9,9 s | 0,0 s | 00 | |
| CC | To be used for the check-up of the internal CANBus communication | | | | |

**A0** is described in section 13.2

With parameters **dI** and **dA** it is possible to set a delay time measured in tens of seconds:

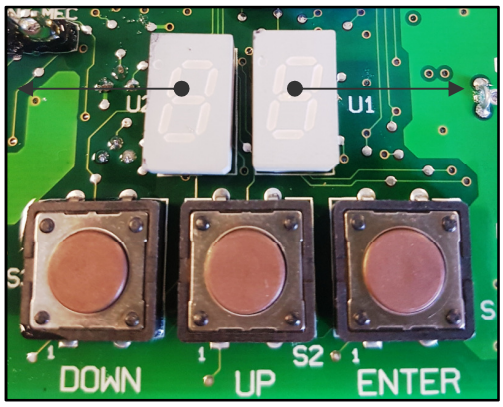
- **dI** is the delay that occurs when you move the lever from forward (or reverse) to neutral. The actuator goes to neutral only after the time set into **dI** expires.
- **dA** is the delay that occurs when you move the lever from neutral to forward (or reverse). The actuator starts to accelerate only after the time set into **dA** expires.

With parameter **CC** you can check if the communication between the command station and the actuator is correct. The value of the parameter corresponds to a precise physical position of the lever and it is described in the following table:

| Value shown on display | Description |
|---|---|
| N | indicates that the command station is in neutral position |
| F | indicates that the command station is in forward position |
| R | indicates that the command station is in rear position |
| 1-2-3-4-…..-9-A | indicates that the command station is in throttle condition: “1” is the position of minimum gas and “A” is the position of maximum gas |

Looking at the display from the front side, the left digit of the display shows the position of the left command station lever and the right digit of the display shows the position of the right command station lever.

It is shown left lever position according to the table above




It is shown right lever position according to the table above

# 12. Installation of the push-pull cable and stroke's programming on the actuator

**System's components involved:** push-pull cables, actuator

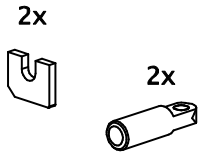
In this chapter will be presented the different types of push-pull cables and how to mount them.

## 12.1. Push-pull cables choice

It can be used 3 different types of push-pull cables. For the connection of the push-pull cable to the actuator, it is necessary to use its proper connection kit. The available kits are for Volvo® cable (E2, E3, C0, C3, C33…), Johnson® cable and Mercruiser® stern drive cable.

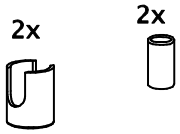
### 12.1.1. Connection kit

Connection kit for Volvo® cable, or cable type E2, E3, C0, C3, C33…



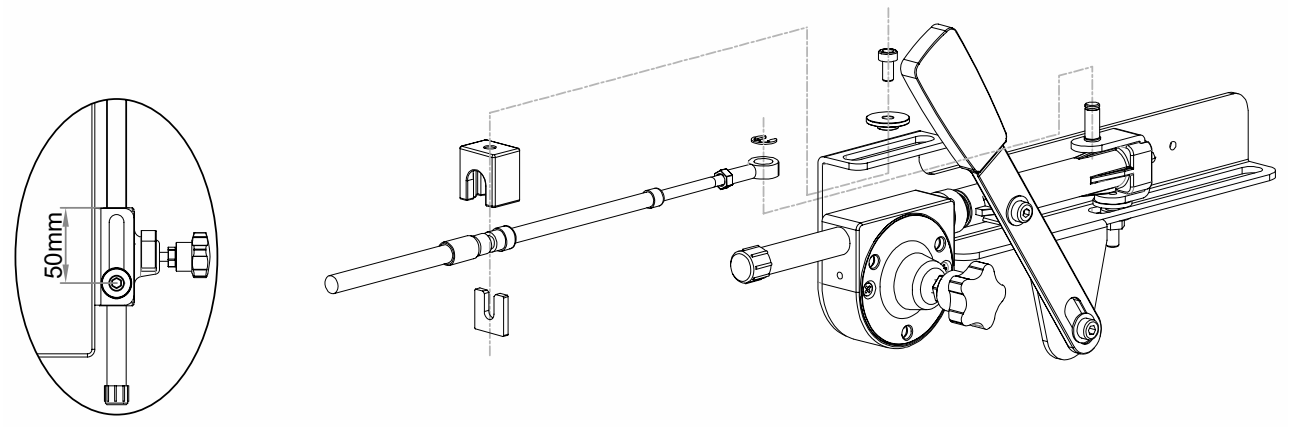

Connection kit for Johnson® cable


Connection kit for Mercruiser® cable



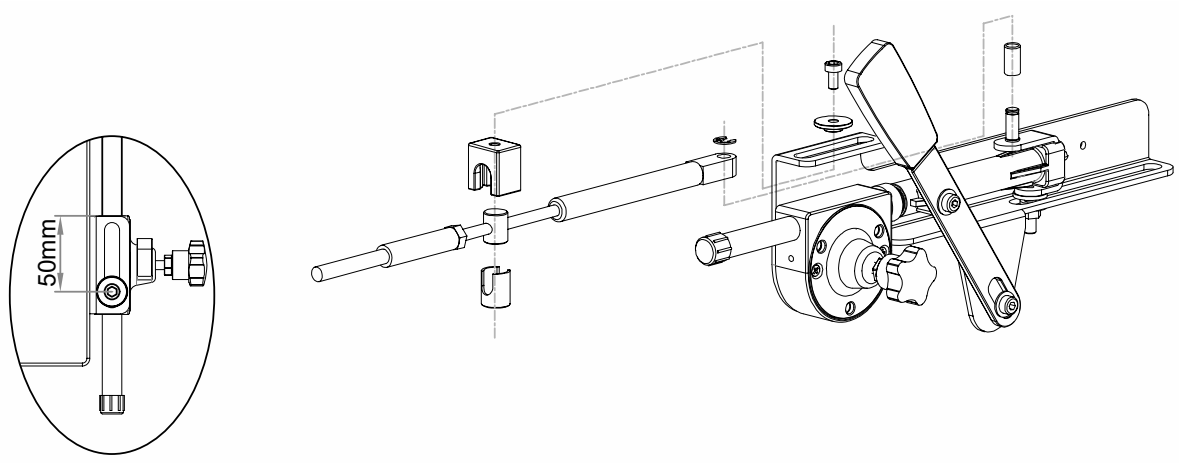

Each kit is enough to connect two push-pull cables.

### 12.1.2. Standard push-pull cable (E2, E3, Volvo®, C0, C3, C33…)

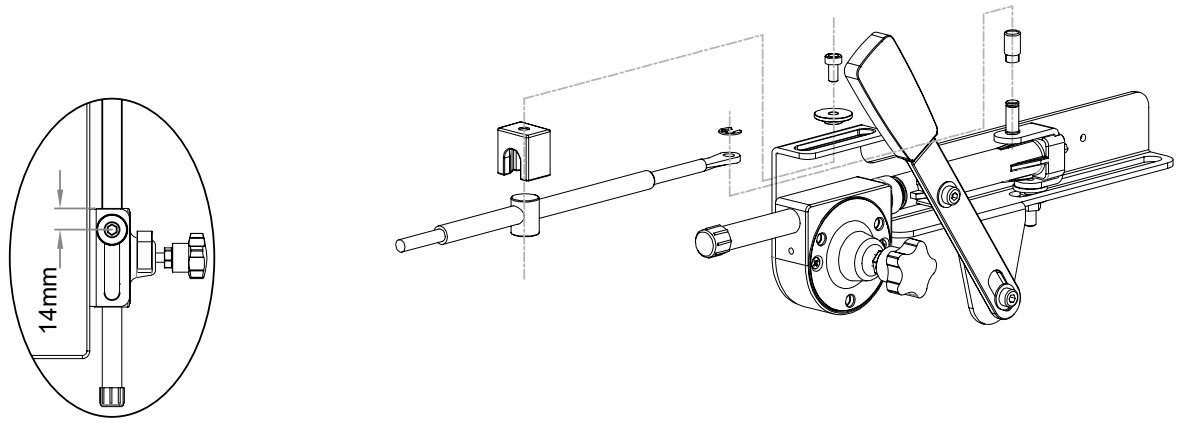


### 12.1.3. Mercruiser® stern drive push-pull cable

In case it is used the push-pull cable outgoing directly from the Mercruiser® stern driver, the plastic Mercruiser® bracket is not necessary.




### 12.1.4. Johnson® push-pull cable



## 12.2. Mounting of the push-pull cables between engine and actuator

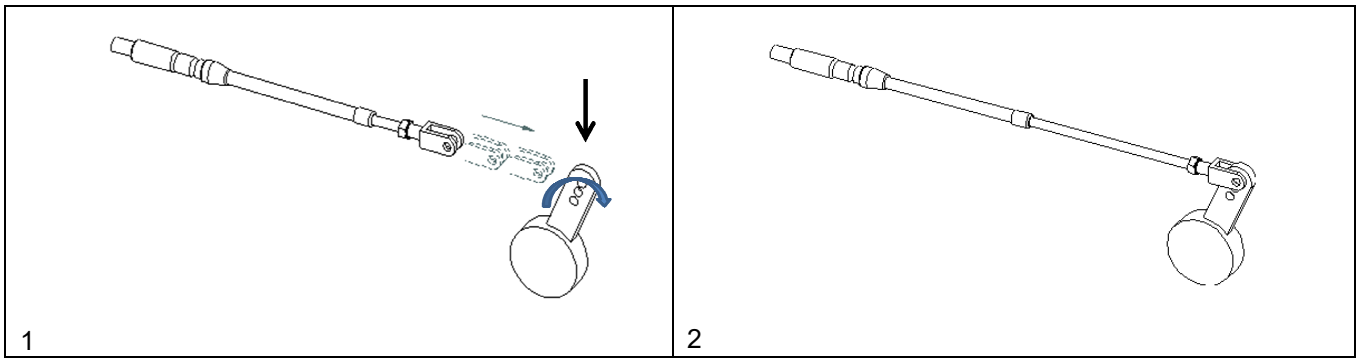
This example is referring to the mounting of a standard Volvo Penta push-pull cable. To mount the other types of cables, refer to the drawings at sections 12.1.3. and 12.1.4. For the assembly, the throttle must be in minimum position and the actuator must be turned off.

### 12.2.1. Connection of the push-pull cable to the engine

In this example it is assumed that if you pull the cable, the throttle speed increases.

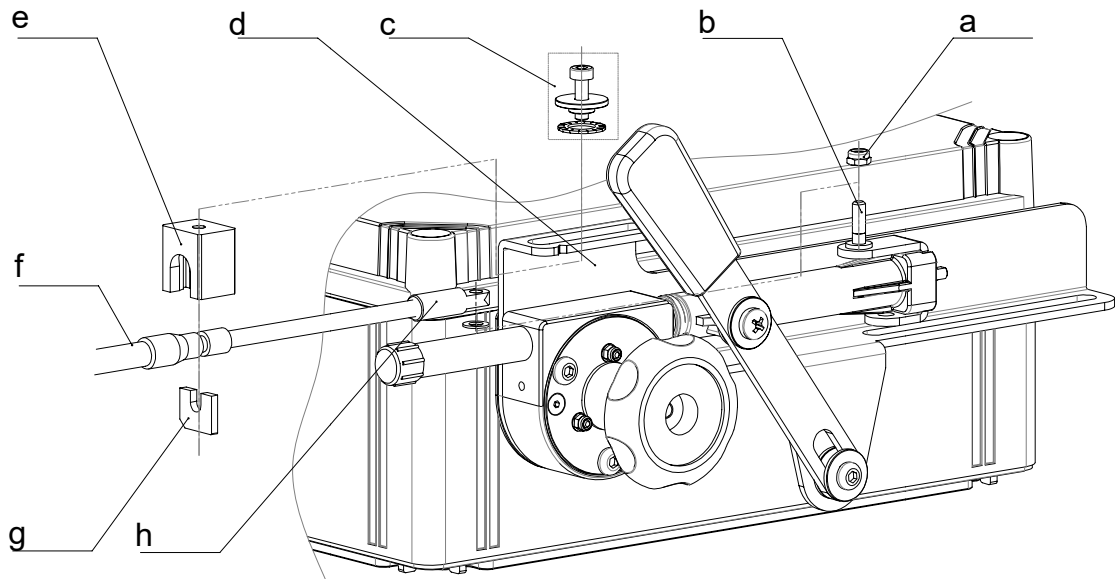
1. Adjust the fixing of the push-pull cable in such a way that when the lever (see arrow) is at the minimum position (engine idle), the rod of the cable is completely out (minimum engine speed).

2. Connect the push-pull cable to the engine throttle lever with the fork or the ball joint.




### 12.2.2. Connection of the push-pull cable to the actuator

Elements to be used for the connection



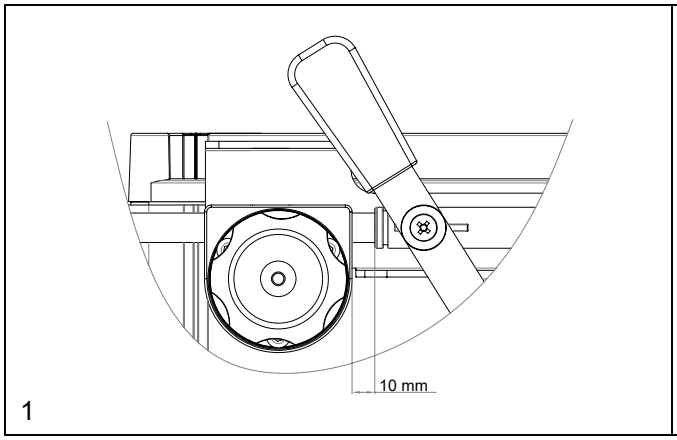

| | |
|---|---|
| **a** | Self lock nut (seeger in some cases) |
| **b** | Pin |
| **c** | Fixing screw (screw and washers) |
| **d** | Bracket slot |

| | |
|---|---|
| **e** | Black aluminium cube |
| **f** | Push-pull cable |
| **g** | Blade |
| **h** | Eyelet |

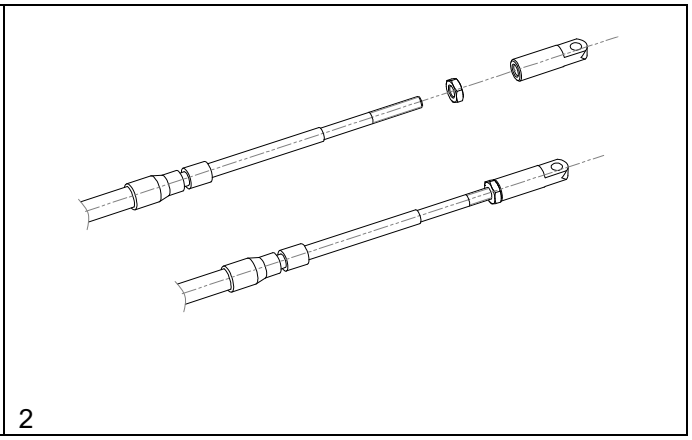
Follow the steps from 1 to 8 as reported here below:

1. Verify that the actuator's throttle lever is at minimum position, as depicted in the picture here below (1). The lever should be at 10 mm from the knob, otherwise enter into the jog programming mode and move the actuator's lever to this position. For this operation follow steps from 1 to 7 section 13.1. The minimum speed throttle position is parameter "UL".

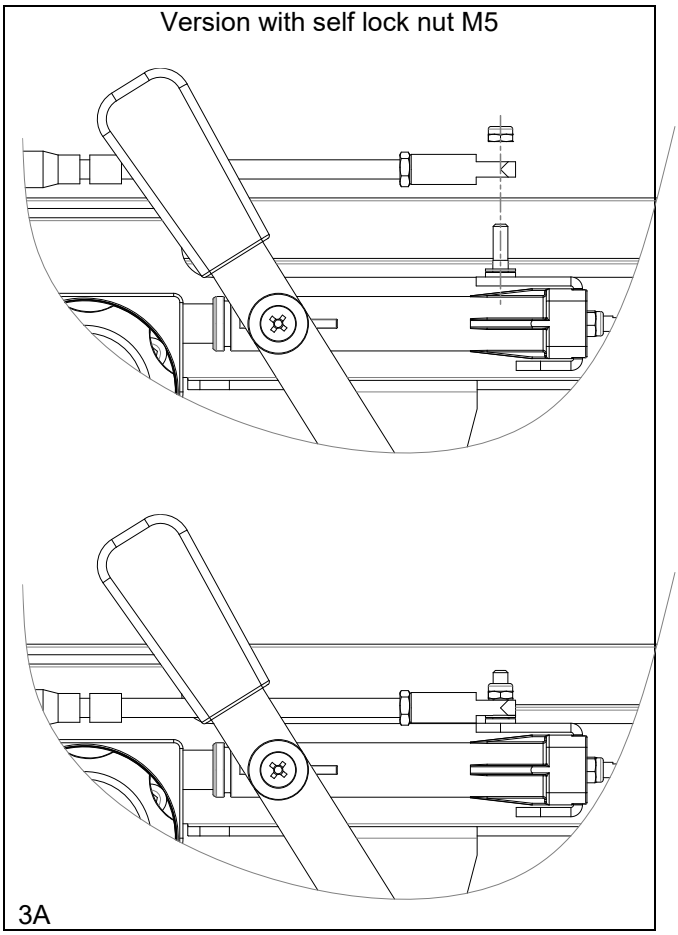
2. Verify that the position of the throttle lever is in idle position on the motor side as described at section 12.2.1. The push-pull cable must show its maximum stroke on the actuator's side. Then screw the eyelet (h) onto the cable's rod (2).



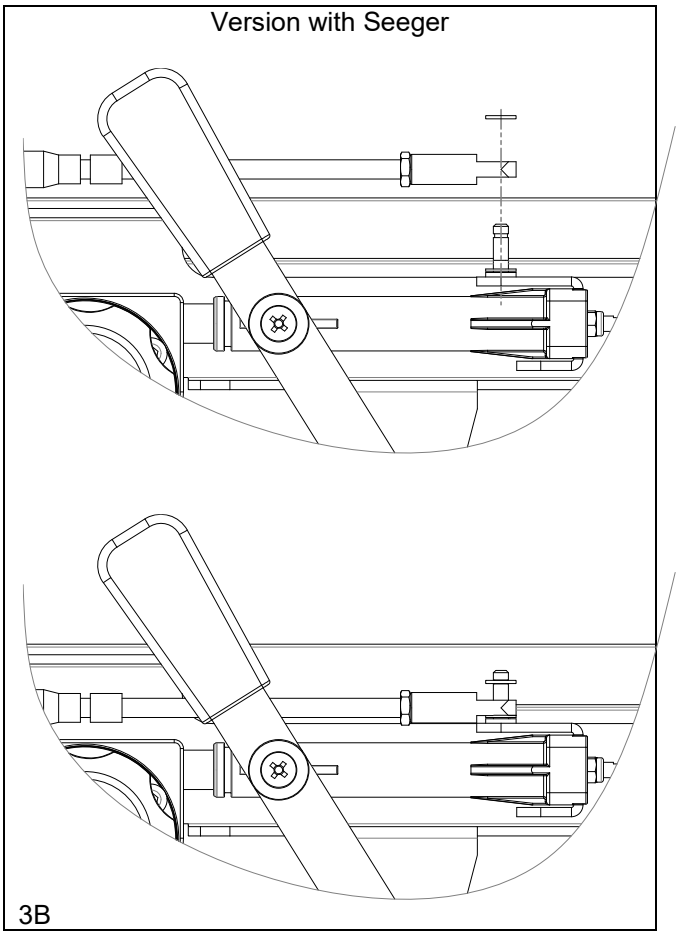
1


2

3. Insert the push-pull cable into the pin (b) of the actuator's sliding tube and fix it, either with the self lock nut M5 (3A) or with the Seeger (3B).

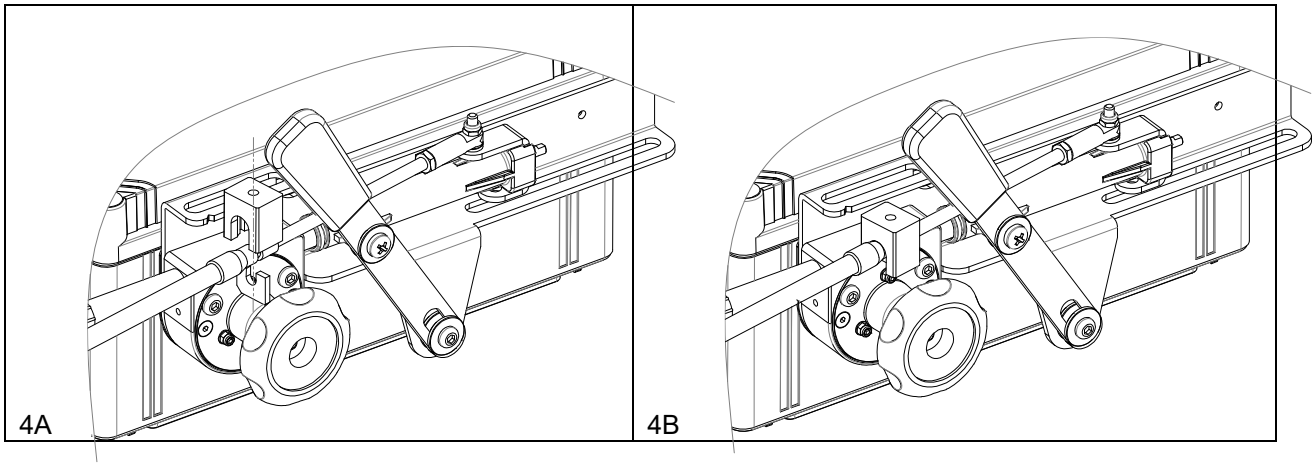


3A

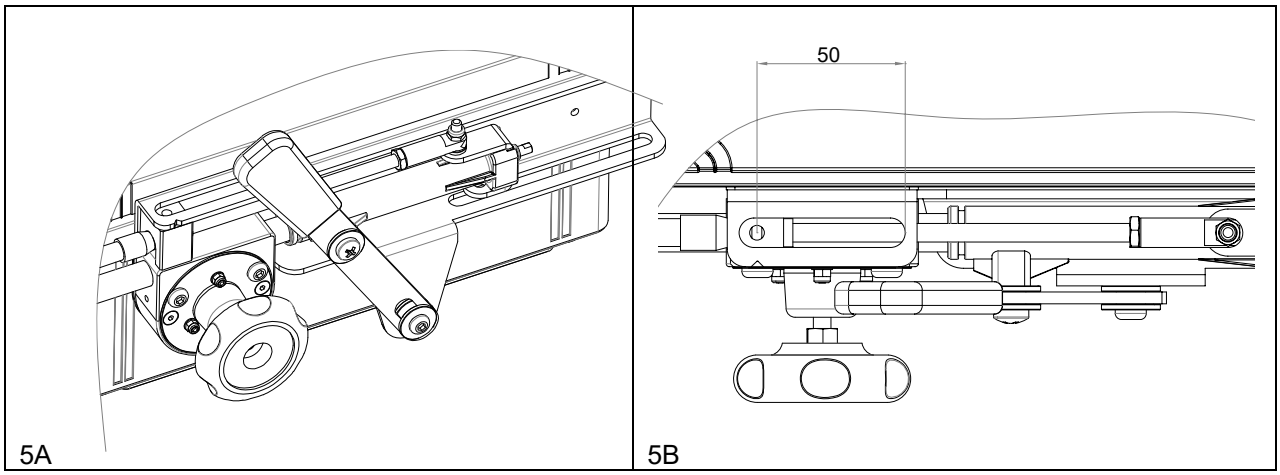


3B

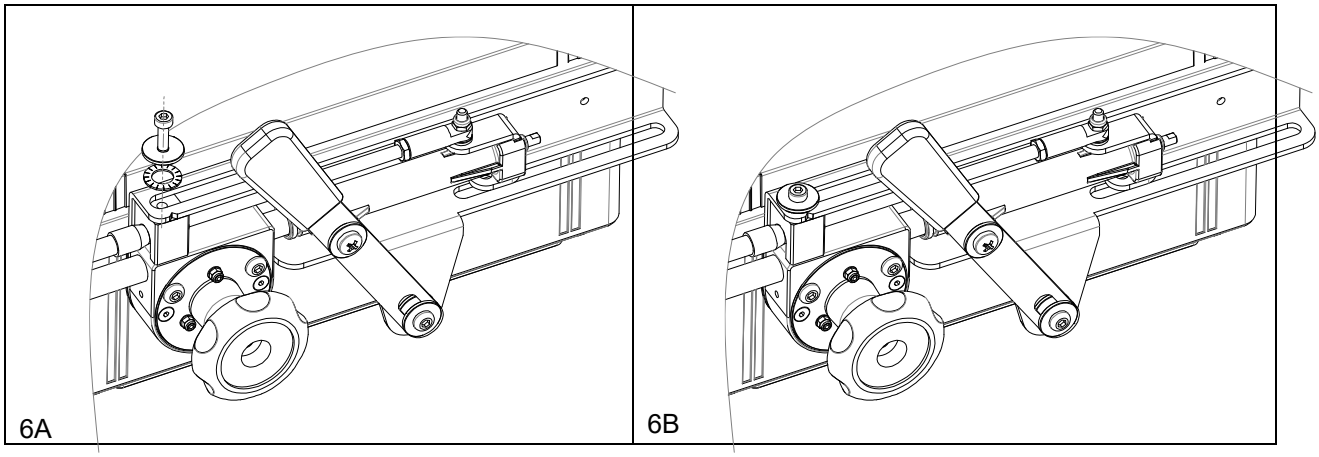
4. Connect the blade (g) and the black aluminium cube (e) onto the push-pull cable's hub.




5. Then insert the push-pull cable into the bracket slot (d), picture 5A. Verify that the fixing elements are positioned on the actuator as depicted in picture 5B. The black aluminium cube (e) should be positioned at 50 mm from the end of the bracket slot (d); alternatively you can verify if the fixing screw is aligned with the notch shown on the slot.




6. Fix the black aluminium cube (e) against the bracket (d) using the fixing screw (c).




7. If the fixing position is not correct, tune the push-pull cable in such a way that when the cable is at its minimum, the fixing screw is aligned with the notch on the slot.

8. Verify and eventually tune again minimum speed position (UL) and set maximum speed position (UH). For these operations look at section 13.1

## 12.3. Mounting of the push-pull cable between gearbox and actuator

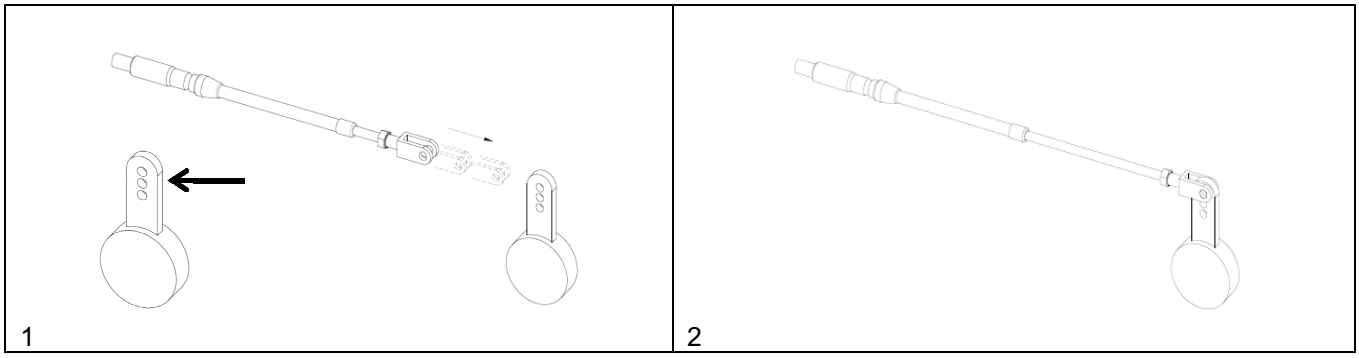
This example is referring to the mounting of a standard Volvo Penta push-pull cable. To mount the other types of cables, refer to the drawings at sections 12.1.3. and 12.1.4. For the assembly, the gearbox must be in neutral position and the actuator must be turned off.

### 12.3.1. Connection of the push-pull cable to the gearbox side

Position the gearbox lever in neutral (the lever must be vertical).

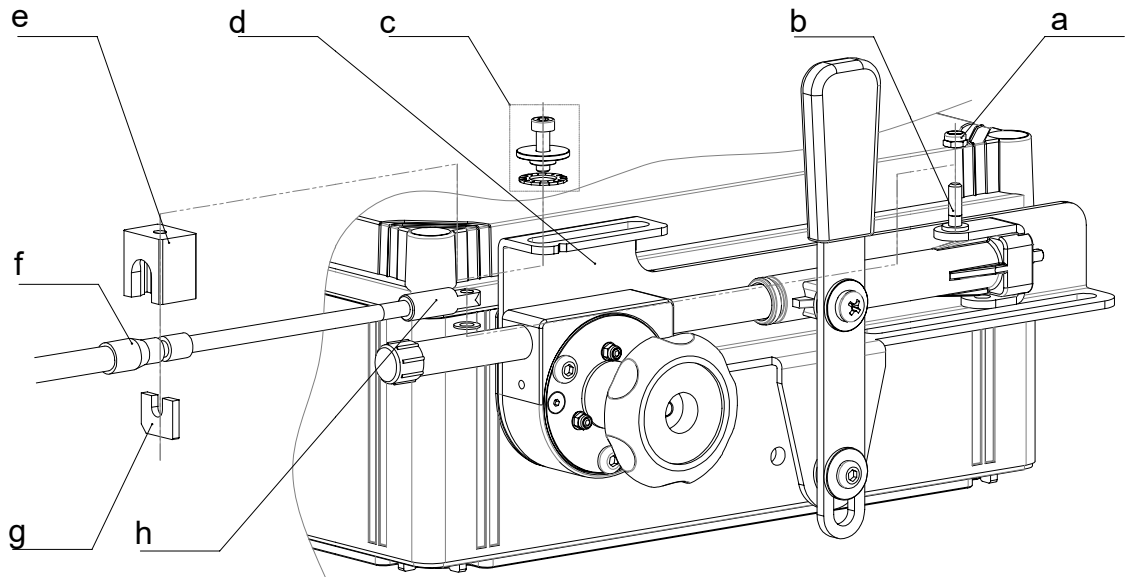
1. Adjust the fixing of the push-pull cable in such a way that when the lever is in vertical position, the cable must be at its half stroke

2. Connect the push-pull cable to the throttle lever using the fork.




**Connection of the push-pull cable to the actuator**

Elements to be used for the connection



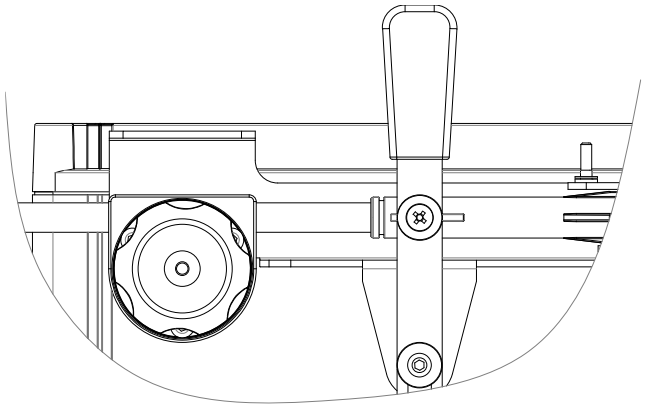

| | |
|---|---|
| **a** | Self lock nut (seeger in some cases) |
| **b** | Pin |
| **c** | Fixing screw (screw and washers) |
| **d** | Bracket slot |

| | |
|---|---|
| **e** | Black aluminium cube |
| **f** | Push-pull cable |
| **g** | Blade |
| **h** | Eyelet |

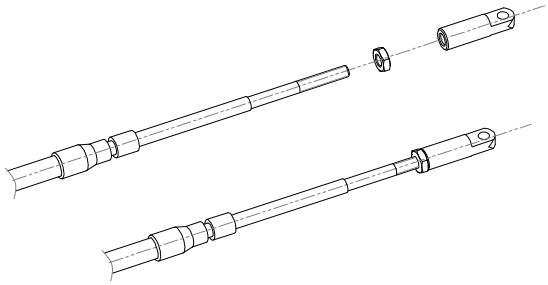
Follow the steps from 1 to 8 as reported here below:

1. Verify that the actuator's gear lever is in neutral position, as depicted in the picture here below (1). The lever should vertical, otherwise enter into the jog programming mode and move the actuator's lever to central position. For this operation follow steps from 1 to 7 of section 14.1. The neutral position is parameter "0F".

2. Verify that the position of the gearbox lever is in neutral on the motor side as described previously. The push-pull cable must be at its half stroke on the actuator's side. Then screw the eyelet (h) onto the cable's rod (2).



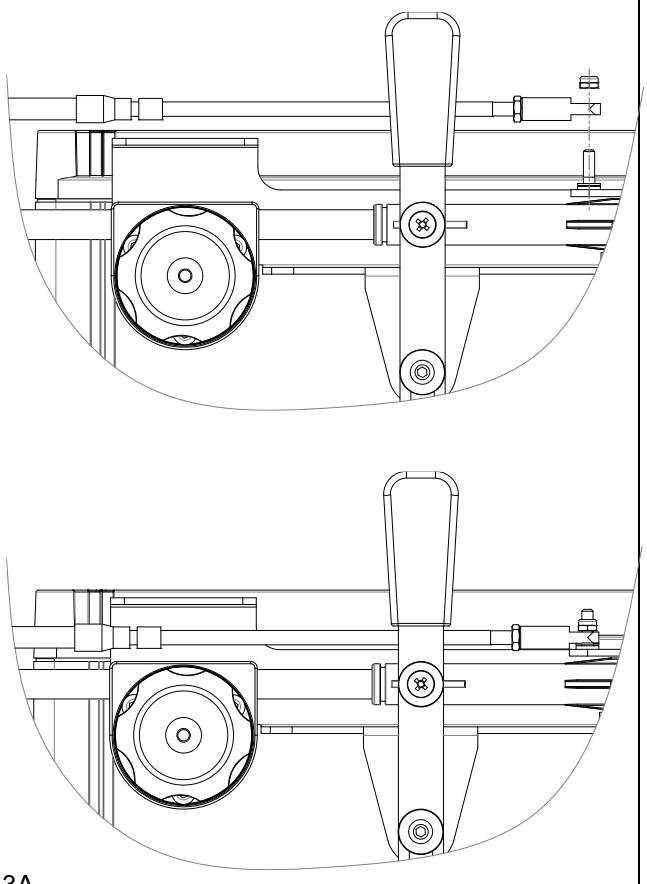
1



2

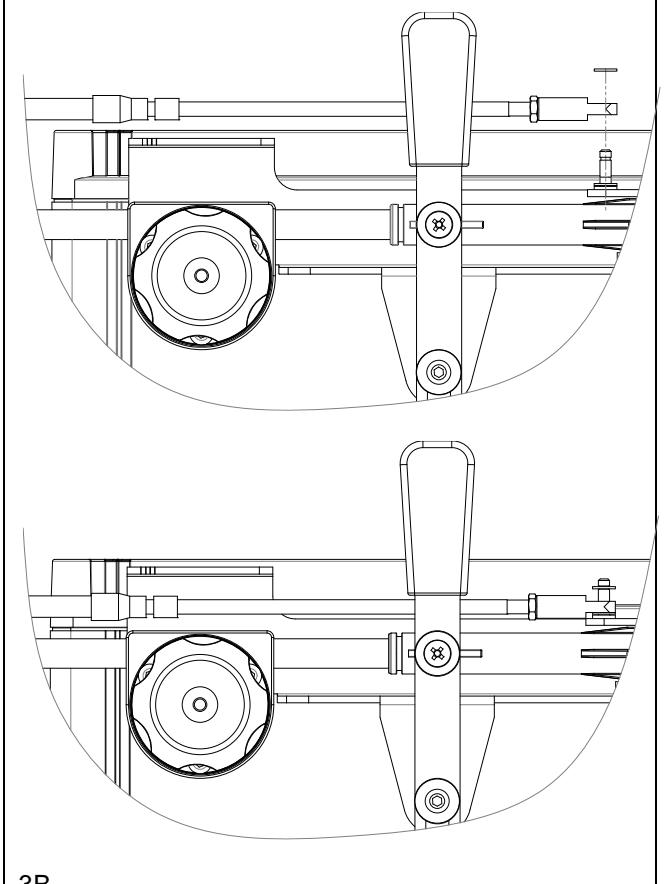
3. Insert the push-pull cable into the pin (b) of the actuator's sliding tube and fix it, either with the self lock nut M5 (3A) or with the Seeger (3B).

Version with self lock nut M5



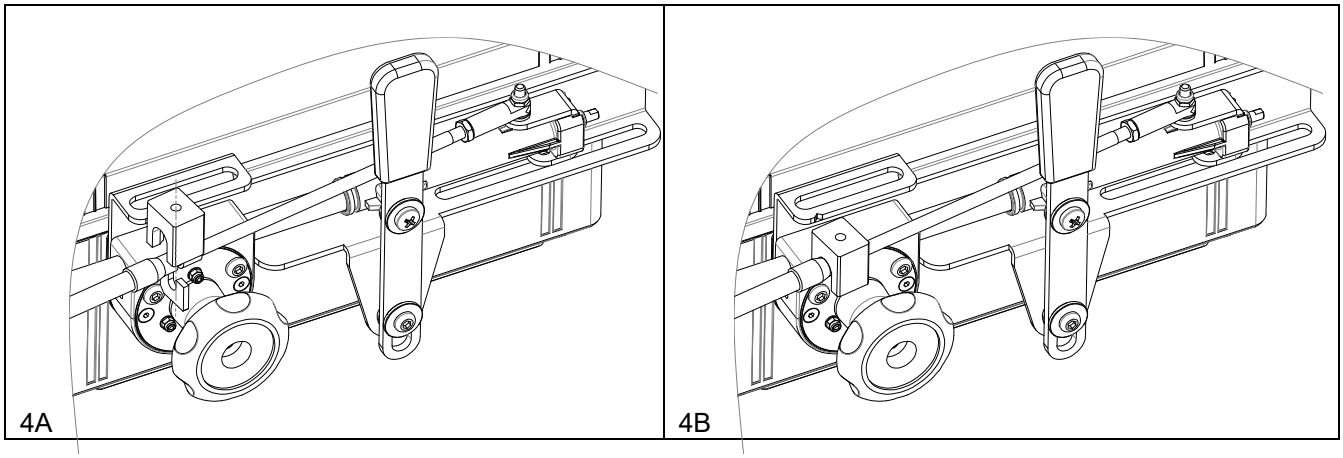
3A

Version with Seeger

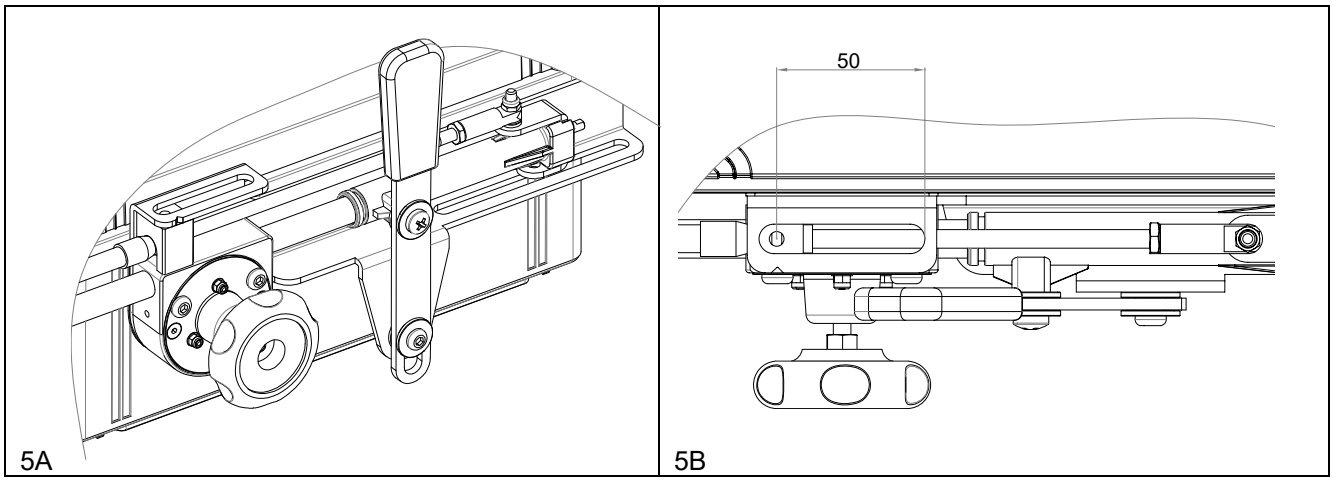


3B

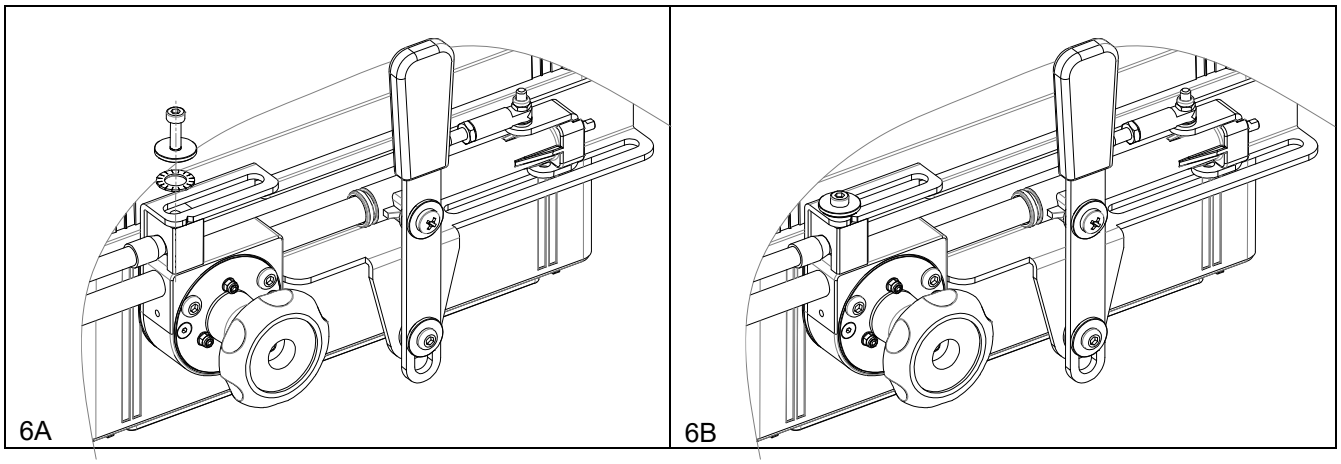
4. Connect the blade (g) and the black aluminium cube (e) onto the push-pull cable's hub.




5. Then insert the push-pull cable into the bracket slot (d), picture 5A. Verify that the fixing elements are positioned on the actuator as depicted in picture 5B. The black aluminium cube (e) should be positioned at 50 mm from the end of the bracket slot (d); alternatively you can verify if the fixing screw is aligned with the notch shown on the slot.




6. Fix the black aluminium cube (e) against the bracket (d) using the fixing screw (c).



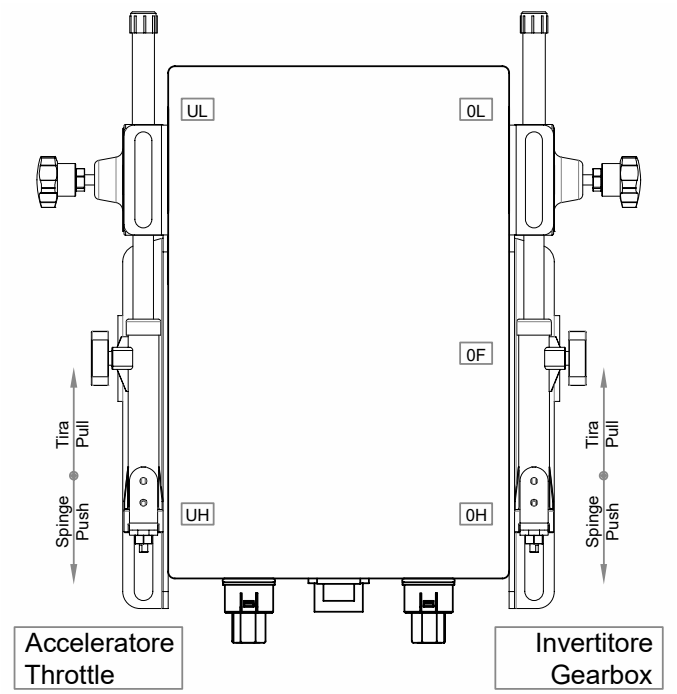

7. If the fixing position is not correct, tune the push-pull cable in such a way that when the gearbox's lever is in neutral, the push-pull cable is at its half stroke and the fixing screw is aligned with the notch.

8. Verify and eventually tune again the neutral position, set reverse (0L) and forward (0H) positions. For these operations look at section 14.1

# 13. Programming of the strokes on actuator with mechanical interface to engine and gearbox

**System's components involved:** push-pull cables, actuator

In this chapter it will be presented how to program the actuator, in order to obtain the correct strokes for engine and gearbox. The actuator looks according to the picture here below:




You must program 5 positions and therefore 5 parameters: 2 for the throttle and 3 for the gearbox. Gearbox and throttle positions have to be set according to the parameters of the above table.

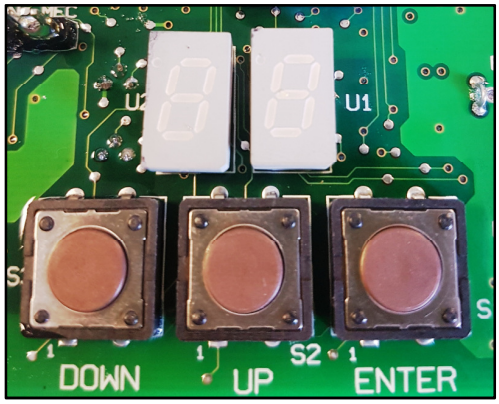
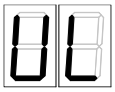
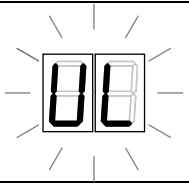
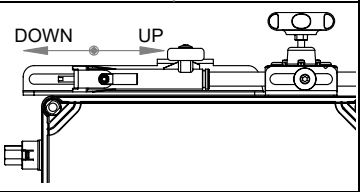
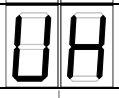
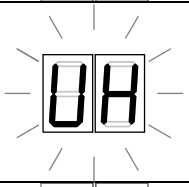
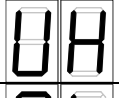
| Parameters to set | Value on display | Function |
|---|---|---|
| Throttle | UL | Minimum speed position |
| | UH | Maximum speed position |
| Gearbox | 0L | Gearbox Reverse |
| | 0F | Gearbox Neutral |
| | 0H | Gearbox Forward |

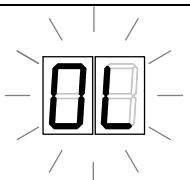
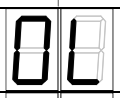
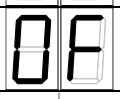
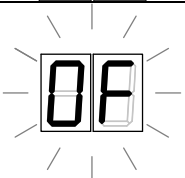
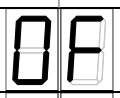
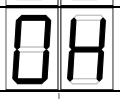
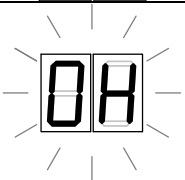
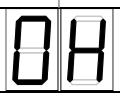
Actuators are delivered from factory with:

- No throttle stroke,
- Forward, Reverse and Neutral positions coincident in the Neutral position

In order to start-up correctly the system you must do the correct setting the cable strokes.

## 13.1. Programming of the push-pull cable strokes

| | | |
|---|---|---|
| **1** | Switch-off the power supply, either from the mains or unplug and plug-in again the supply connector | |
| **2** | Open the Actuator box and identify the programming keypad (3 push buttons) and the display (2 digits)<br>  | |
| **3** | Press at the same time key “UP” and “DOWN” and, keeping pressed both keys “UP” and “DOWN”, then turn on the actuator voltage supply | |
| **4** | On the 2-digit display shows up, with a steady light “UL”, which corresponds to parameter Minimum Throttle. If you don’t need to modify the minimum stroke, jump to step 8 of this procedure |  |
| **5** | Press the “Enter” push button and the display will start flashing |  |
| **6** | When the display is flashing you have entered into the jog mode and if you press either the “Up” or the “Down” push button, the left push-pull cable will move according to the picture on the right. Press “Up” or “Down” to adjust the position of Minimum Throttle |  |
| **7** | To store the position of Minimum Throttle, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **8** | With the arrows Press the “Down” push button and the display will move to “UH” (parameter of Maximum Throttle) |  |
| **9** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Maximum Throttle |  |
| **10** | To store the position of Maximum Throttle, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **11** | Press the “Down” push button and the display will move to “0L” (parameter of Gearbox Reverse) |  |

| | | |
|---|---|---|
| **12** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Reverse |  |
| **13** | To store the position of Gearbox Reverse, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **14** | Press the “Down” push button and the display will move to “0F” (parameter of Gearbox Neutral) |  |
| **15** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Neutral |  |
| **16** | To store the position of Gearbox Neutral, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **17** | Press the “Down” push button and the display will move to “0H” (parameter of Gearbox Forward) |  |
| **18** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Forward |  |
| **19** | To store the position of Gearbox Forward, press “Enter” again. When the display stops flashing it means that you have stored the position |  |

► **Important:**

- a not precise setting of the strokes may generate malfunctioning of the gearbox (delays in clutch-in, clutch-out) or an excessive current absorption on the actuator.
- in case of stern drive and outboard engines, if the engine isn’t running, it isn’t possible to set the strokes, because the clutch-in operation becomes very hard. In this is the case, actuate the rotation of the propeller manually, this will make easier the clutch-in of the gearbox.

## 13.2. Sea trials

Now your programming is finished!
In order to verify the settings you need to activate your electronic control system.
Switch-of the power supply and then switch on again.
If all the settings have been done correctly, the command station will look as follow:

**Command station series 4500**


To learn about how to command the boat go to chapter 3 (Pilot Instructions).

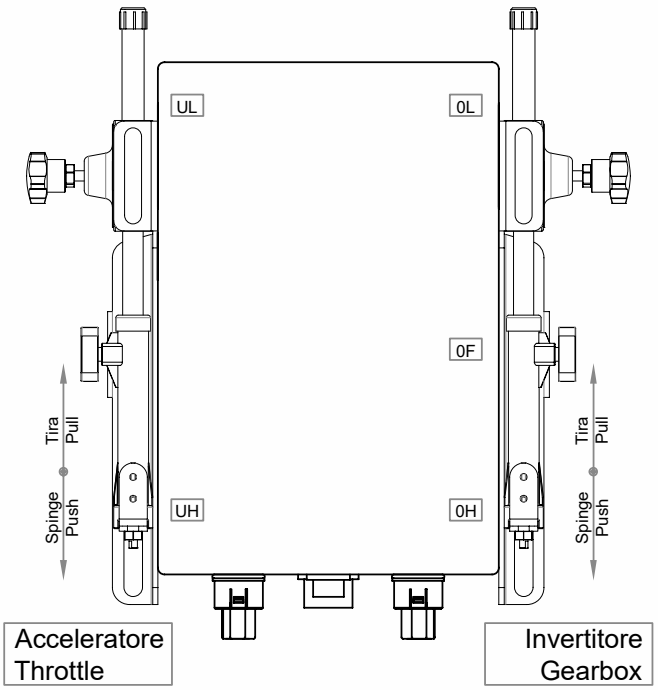
You must test now the correct functioning of the gearbox and the throttle in relation to the command lever. After having set the stroke positions, it might happen that there is not the right correspondence between the direction of the lever and the movement executed by the actuator (e.g.: you move the lever forward and the gearbox cable is pushing instead of pulling).
Changing the value of parameter A0 you can modify the correlation between the direction on the lever and the direction on the actuator. The table here below defines the directions of throttle and gearbox in relation to the 4 possible values of parameter A0, **with the assumption to move the command station lever in forward direction** (gearbox forward and engine accelerated).

| Value A0 | Throttle | Gearbox |
|---|---|---|
| 1 | Push (direction UL) | Pull (direction 0H) |
| 2 | Push (direction UL) | Push (direction 0L) |
| 3 | Pull (direction UH) | Push (direction 0L) |
| 4 | Pull (direction UH) | Pull (direction 0H) |

Factory setting A0 = 4

The following examples show how to operate in case there is not the exact correspondence between the command lever and the actuator.

**System with mechanical throttle and mechanical gearbox**




| Problem | Solution |
|---|---|
| The gearbox push-pull cable positions are inverted while the throttle push-pull cable works correctly (forward and backward positions are inverted) | Set A0=3 |
| The gearbox is working correctly while the throttle push-pull cable positions are inverted (min and max throttle positions are inverted) | Set A0=1 |
| Both gear or throttle push-pull cables positions are inverted | Set A0=2 |

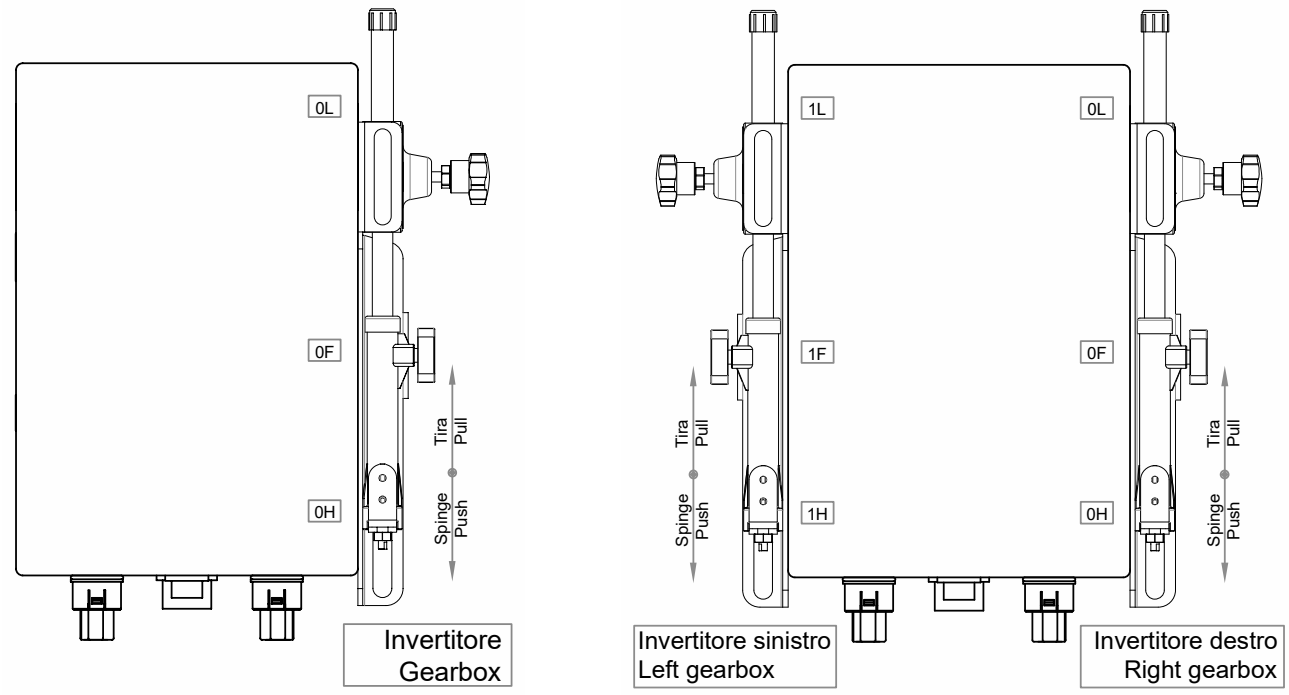
## 13.3. Specific parameters

| Display code | Description | Values | Factory value | Value shown on display (factory value) | Note |
|---|---|---|---|---|---|
| A0 | Push-pull cable movement direction | 1 .. 4 | 4 | 04 | |
| dI | Delay before disengaging the gearbox | 0 .. 9,9 s | 0,0 s | 00 | |
| dA | Delay on the throttle | 0 .. 9,9 s | 0,0 s | 00 | |
| PP | Proportional coefficient | 0 .. 99 | 40 | 40 | These parameters must not be modified |
| PI | Integral coefficient | 0 .. 99 | 0 | 00 | |
| CC | To be used for the check-up of the internal CANBus communication | | | | |

# 14. Programming of actuators for installations with electronic engine and mechanical gearbox

**System's components involved:** push-pull cables, actuator

In this chapter it will be presented how to program the actuator, in order to obtain the correct strokes of gearboxes. Depending if the boat is with 1 or 2 propulsion systems, the actuator looks according one of the pictures here below:

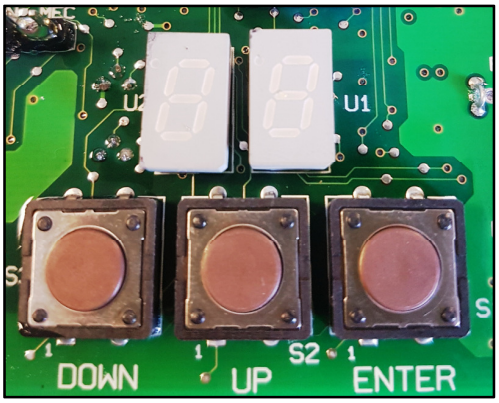
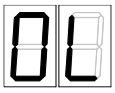
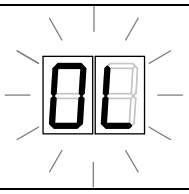
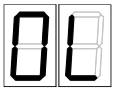
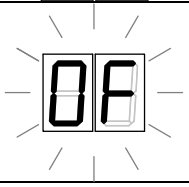
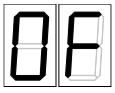
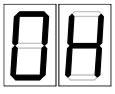
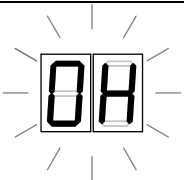
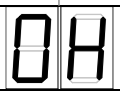


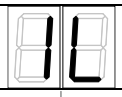
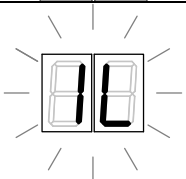
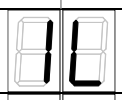
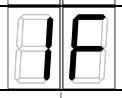
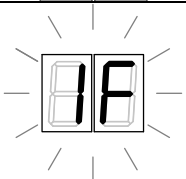
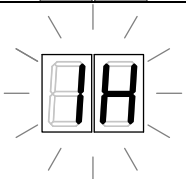
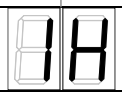

You must program either 3 or 6 positions and consequently 3 or 6 parameters: 3 for per each gearbox. Gearboxes positions have to be set according to the parameters of the above table.

| Parameters to set | Value on display | Function |
|---|---|---|
| Gearbox 1 (right) | 0L | Gearbox Reverse |
| | 0F | Gearbox Neutral |
| | 0H | Gearbox Forward |
| Gearbox 2 (left) | 1L | Gearbox Reverse |
| | 1F | Gearbox Neutral |
| | 1H | Gearbox Forward |

Actuators are delivered from factory with Forward, Reverse and Neutral positions coincident in the Neutral position. Therefore the installer must do the correct setting the stroke, in order to start-up correctly the system.

## 14.1. Programming of the gearbox strokes

| | | |
|---|---|---|
| **1** | Switch-off the power supply, either from the mains or unplug and plug-in again the supply connector | |
| **2** | Open the Actuator box and identify the programming keypad (3 push buttons) and the display (2 digits)<br>  | |
| **3** | Press at the same time key “UP” and “DOWN” and, keeping pressed both keys “UP” and “DOWN”, then turn on the actuator voltage supply | |
| **4** | On the 2-digit display shows up, with a steady light “0L”, which corresponds to parameter (right) Gearbox Reverse |  |
| **5** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Reverse |  |
| **6** | To store the position of Gearbox Reverse, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **7** | Press the “Down” push button and the display will move to “0F” (parameter of Gearbox Neutral) |  |
| **8** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Neutral |  |
| **9** | To store the position of Gearbox Neutral, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **10** | Press the “Down” push button and the display will move to “0H” (parameter of Gearbox Forward) |  |
| **11** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Forward |  |
| **12** | To store the position of Gearbox Forward, press “Enter” again. When the display stops flashing it means that you have stored the position |  |

| | | |
|---|---|---|
| **13** | Press the “Down” push button and the display will move to “1L” (parameter of left Gearbox Reverse) |  |
| **14** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Reverse |  |
| **15** | To store the position of Gearbox Reverse, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **16** | Press the “Down” push button and the display will move to “1F” (parameter of Gearbox Neutral) |  |
| **17** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Neutral |  |
| **18** | To store the position of Gearbox Neutral, press “Enter” again. When the display stops flashing it means that you have stored the position |  |
| **19** | Press the “Down” push button and the display will move to “1H” (parameter of Gearbox Forward) |  |
| **20** | Press the “Enter” push button and the display will start flashing. Press “Up” until the cable reaches the position of Gearbox Forward |  |
| **21** | To store the position of Gearbox Forward, press “Enter” again. When the display stops flashing it means that you have stored the position |  |

► **Important:**

- a not precise setting of the strokes may generate malfunctioning of the gearbox (delays in clutch-in, clutch-out) or an excessive current absorption on the actuator.
- in case of stern drive and outboard engines, if the engine isn’t running, it isn’t possible to set the strokes, because the clutch-in operation becomes very hard. In this is the case, actuate the rotation of the propeller manually, this will make easier the clutch-in of the gearbox.

## 14.2. Sea trials

Now your programming is finished!
In order to verify the settings you need to activate your electronic control system.
Switch-of the power supply and then switch on again.
If all the settings have been done correctly, the command station will look as follow:

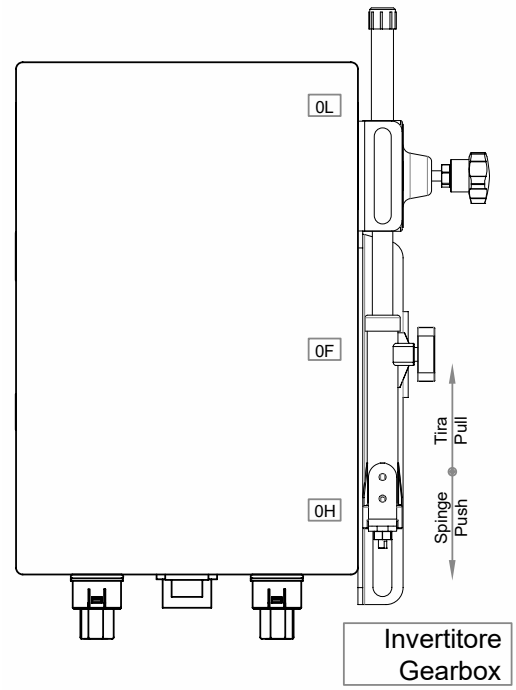
**Command station series 4500**


To learn about how to command the boat go to chapter 3 (Pilot Instructions).

You must test now the correct functioning of the gearbox and the throttle in relation to the command lever. After having set the stroke positions, it might happen that there is not the right correspondence between the direction of the lever and the movement executed by the actuator (e.g.: you move the lever forward and the gearbox cable is pushing instead of pulling).

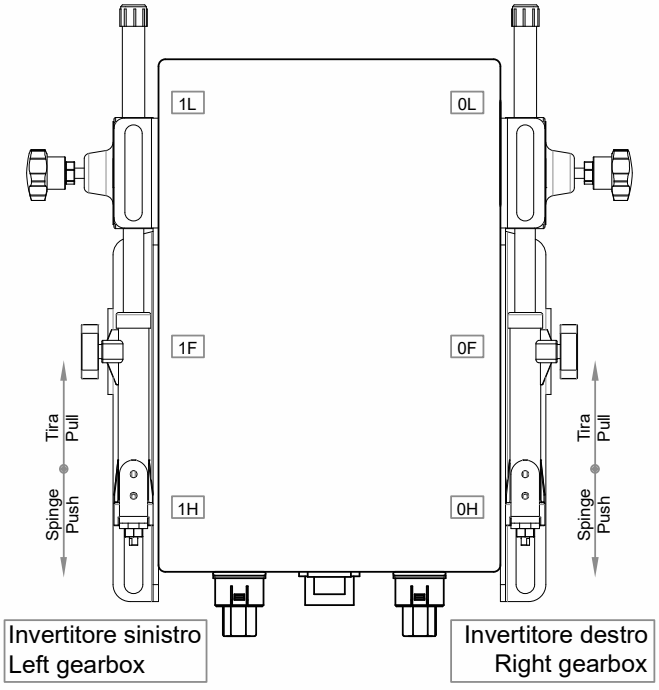
Changing the value of parameter A0 you can modify the correlation between the direction on the lever and the direction on the actuator. The table here below defines the directions of throttle and gearbox in relation to the 4 possible values of parameter A0, **with the assumption to move the command station lever in forward direction** (gearbox forward and engine accelerated). With the assumption that you have done all the stroke setting with A0 = 4 (factory setting), modify the correlation between lever and actuator as described in the schemes of the next page.

**System with one electronic engine and one gearbox mechanically driven**




| Problem | Solution |
|---|---|
| The gearbox push-pull cable positions are inverted | Set A0=3 |

**System with two electronic engines and two gearboxes mechanically driven**




| Problem | Solution |
|---|---|
| Positions of the right gearbox are inverted while the positions of the left gearbox are correct | Set A0=3 |
| Positions of the left gearbox are inverted while the positions of the right gearbox are correct | Set A0=2 |
| Positions of both gearboxes are inverted | Set A0=1 |

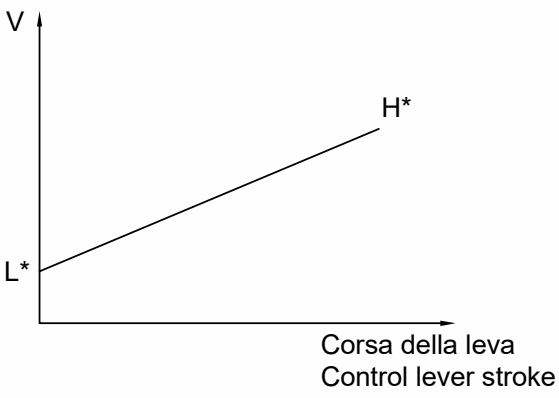
## 14.3. Specific parameters

| Display code | Description | Values | Factory value | Value shown on display (factory value) | Note |
|---|---|---|---|---|---|
| A0 | Push-pull cable movement direction | 1 .. 4 | 4 | 04 | |
| dI | Delay before disengaging the gearbox | 0 .. 9,9 s | 0,0 s | 00 | |
| dA | Delay on the throttle | 0 .. 9,9 s | 0,0 s | 00 | |
| PP | Proportional coefficient | 0 .. 99 | 40 | 40 | These parameters must not be changed |
| PI | Integral coefficient | 0 .. 99 | 0 | 00 | |
| CP | CANBus protocol | 1-99 | 0 | 00 | See 17.2.2. |
| L1 | These parameters are present only in systems with electronic engine (ECU) and/or electric with electrical engine inverter driven. Parameters to define the voltage output interface will be detailed in the following pages. | | | | |
| H1 | | | | | |
| L2 | | | | | |
| H2 | | | | | |
| L3 | | | | | |
| H3 | | | | | |
| L4 | | | | | |
| H4 | | | | | |
| CC | To be used for the check-up of the internal CANBus communication | | | | |

### 14.3.1. Parameters to configure the voltage output signal for electronic engines

For installations with electronic engine or hybrid engine (engine driven by a frequency converter), it is necessary to set the minimum and maximum voltage output. Voltage signal profile is defined through parameters L*, and H*, where “*” means 1,2,3,4.

► **Important:** the graphic on the right represents the voltage profile defined by parameters L, H. Changes of factory values could cause a system malfunctioning. Before making any changes, contact our technicians.



### 14.3.2. Parameters to configure the voltage output signal for for FNM - Vetus VF engines

It follows the list of parameters shown on the display

| Display code | Description | Field Range | Factory value (V) | Value shown on display (factory value) |
|---|---|---|---|---|
| L1 | Minimum output voltage ch. 1 - right engine | 0,0 – 5,0 V | 0,9 | 09 |
| H1 | Maximum output voltage ch. 1 - right engine | 0,0 – 5,0 V | 4,3 | 43 |
| L2 | Minimum output voltage ch. 2 - right engine | 0,0 – 5,0 V | 0,5 | 05 |
| H2 | Maximum output voltage ch. 2 - right engine | 0,0 – 5,0 V | 2,1 | 21 |
| L3 | Minimum output voltage ch. 3 - left engine | 0,0 – 5,0 V | 0,9 | 09 |
| H3 | Maximum output voltage ch. 3 - left engine | 0,0 – 5,0 V | 4,3 | 43 |
| L4 | Minimum output voltage ch. 4 - left engine | 0,0 – 5,0 V | 0,5 | 05 |
| H4 | Maximum output voltage ch. 4 - left engine | 0,0 – 5,0 V | 2,1 | 21 |

### 14.3.3. Parameters to configure voltage output for Nanni Diesel engines

It follows the list of parameters shown on the display

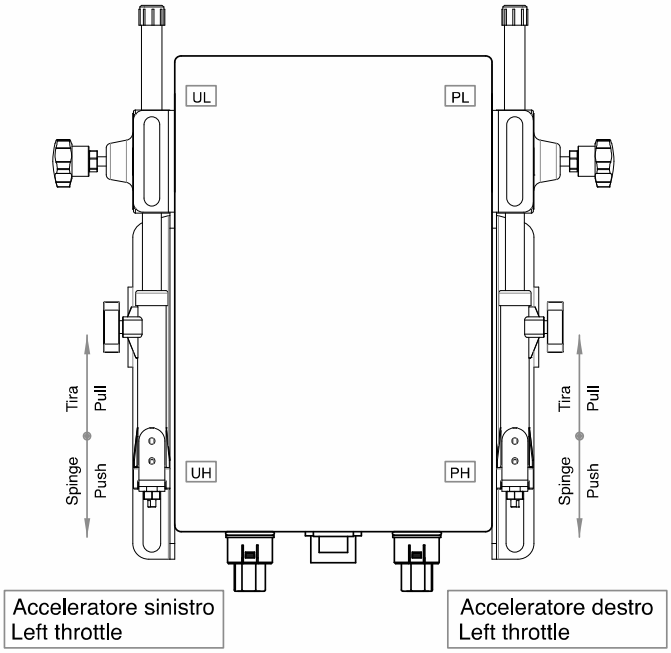
| Display code | Description | Field Range | Factory value (V) | Value shown on display (factory value) |
|---|---|---|---|---|
| L1 | Right diesel engine - Minimum ch. 1 | 0,0 – 5,0 V | 1,3 | 13 |
| H1 | Right diesel engine - Maximum ch. 1 | 0,0 – 5,0 V | 4,0 | 40 |
| L2 | Right electric engine inverter driven - Minimum ch. 2 | 0,0 – 5,0 V | 0,0 | 00 |
| H2 | Right electric engine inverter driven - Maximum ch. 2 | 0,0 – 5,0 V | 5,0 | 50 |
| L3 | Left diesel engine - Minimum ch. 3 | 0,0 – 5,0 V | 1,3 | 13 |
| H3 | Left diesel engine - Maximum ch. 3 | 0,0 – 5,0 V | 4,0 | 40 |
| L4 | Left electric engine inverter driven - Minimum ch. 4 | 0,0 – 5,0 V | 0,0 | 00 |
| H4 | Left electric engine inverter driven - Maximum ch. 4 | 0,0 – 5,0 V | 5,0 | 50 |

# 15. Programming of actuators for mechanical engines and electronic gearbox

## 15.1. Installation of engine the push-pull cable and programming of throttle mechanical strokes

For the connection of the push-pull cables please refer to chapter 12. To set strokes refer to 13. In case of actuators for 2 mechanical accelerators and 2 electronic gearboxes, the following parameters must be programmed.

| Parameters | Values on display |
|---|---|
| Left throttle | UL |
| | UH |
| Right throttle | PL |
| | PH |




## 15.2. Programming of the push-pull cable strokes

With this kind of actuator you must program 2 positions for each engine (minimum throttle and maximum throttle). For the general programming instructions please refer to chapters 12 and 13.

## 15.3. Electrical cabling of the gearbox

For each gearbox are available 2 output relays. For proper wiring please refer to sections 5.4.2, 5.4.3, 10.2.5 and 10.2.6. of this manual.

## 15.4. Specific parameters

Installations with electronic gearbox might require a delay time when you pass the lever directly from reverse to forward or from forward to reverse. Factory setting is 0,5 seconds.

| Code display | Description | Values | Factory value | Value shown on display (factory value) |
|---|---|---|---|---|
| dI | Delay in switching off the gearbox | 0 .. 9,9 s | 0,0 s | 00 |
| dA | Delay in start of throttle | 0 .. 9,9 s | 0,0 s | 00 |
| dF | Delay in neutral; it occurs any time you move directly from forward to reverse or from reverse to forward. This delay does not occur when from neutral you move to forward or reverse. | 0 .. 9,9 s | 0,5 s | 05 |

# 16. Programming of actuators with electronic engine and electronic gearbox

## 16.1. Electrical wiring

For electrical wiring please refer to chapter 10.

## 16.2. Specific parameters

Installations with electronic gearbox might require a delay time when you pass the lever directly from reverse to forward or from forward to reverse. Factory setting is 0,5 seconds.

Parameter list

| Display code | Description | Values | Factory value | Value shown on display (factory value) | Note |
|---|---|---|---|---|---|
| dI | Delay in switching off the gearbox | 0 .. 9,9 s | 0,0 s | 00 | |
| dA | Delay in start of throttle | 0 .. 9,9 s | 0,0 s | 00 | |
| dF | Delay in neutral; it occurs any time you move directly from forward to reverse or from reverse to forward. This delay does not occur when from neutral you move to forward or reverse. | 0 .. 9,9 s | 0,5 s | 05 | |
| L1 | These parameters are present only in system with electronic engine with ECU and/or electric engine inverter driven. Parameters for the voltage outputs are described at section 14.2.2. | | | | |
| H1 | | | | | |
| C1 | | | | | |
| L2 | | | | | |
| H2 | | | | | |
| C2 | | | | | |
| L3 | | | | | |
| H3 | | | | | |
| C3 | | | | | |
| L4 | | | | | |
| H4 | | | | | |
| C4 | | | | | |
| CC | To be used for the check-up of the internal CANBus communication | | | | |

# 17. Programming of actuators with electronic CANBUS engine and mechanical gearbox

## 17.1. Installation of the push-pull cable and programming of the cable stroke

Please refer to sections 12. and 13.1.

## 17.2. Specific parameters

| Display code | Description | Values | Factory value | Value shown on display (factory value) | Note |
|---|---|---|---|---|---|
| dI | Delay in switching off the gearbox | 0 .. 9,9 s | 0,0 s | 00 | |
| dA | Delay in start of throttle | 0 .. 9,9 s | 0,0 s | 00 | |
| dF | Delay in neutral; it occurs any time you move directly from forward to reverse or from reverse to forward. This delay does not occur when from neutral you move to forward or reverse. | 0 .. 9,9 s | 0,5 s | 05 | |
| CP | Canbus protocol | 1-99 | 0 | 00 | See 17.2.2. |
| CC | CANBus communication | - | - | - | |

### 17.2.1. CANBus protocol

Every CANBus interface card has one CANBus output. Communication starts automatically at power-up once the CP parameter has been set to a non zero value.
This document refers to SAE J1939 CANBus protocol. The electronic system can handle also other communication protocols.

| Bit rate | Repetition rate | Identifier | |
|---|---|---|---|
| | | 29 bit in according to CAN 2.0B | |
| | | | |
| default value | default value | description | n° byte |
| 250 Kbit/s | 10 ms | Priority | 1 |
| | | PGN | 2 |
| | | Address | 1 |

Data field:

The 8 bytes of the Can Data Link are completely programmable according to the profile used by the engine producer. In the data field you must write the engine speed reference. Necessary information for majority of the engines are **minimum speed** and **maximum speed without load**.
Byte 2 and byte 3 are used to transfer the speed reference. Bytes 1, 4, 5, 6, 7, 8 are commonly not used.

### 17.2.2. Setting of the CANBus parameter values

After the mechanical and electrical installation, it is necessary to set into the actuator the type of engine to command.

The procedure is the following:

1. when the actuator is powered up the display shows " _ _". Press at the same time keys "UP" and "DOWN" and automatically parameter A0 will appear on the display;
2. with keys "UP" and "DOWN" scroll the different parameters until you reach parameter CP;
3. after you have pressed "ENTER" , the display start blinking and with the help of keys "UP" and "DOWN" you can set the value which is correct for your specific engine. Each engine is defined by a specific value which is listed in the table here below.
4. press "ENTER" again to store the right CANBus profile value.

| Type of engine | Model | RPM at minimum | RPM at maximum (no load) | CAN identifier | Value |
|---|---|---|---|---|---|
| S30 230 | S30 ENTM 23 | 750 | 4400 | TSC1-AE | 01 |
| S30 230 | | | 3900 | | 02 |
| N40 250 | N40 ENTM 25 | 600 | 3200 | | 03 |
| N60 370 | N60 ENTM 37 | | | | |
| N60 400 | N60 ENTM 40 | | 3300 | | 04 |
| N67 450 | N67 ENTM 45 | | | | |
| N67 560 | N67 ENTM 56 | | 3300 | TSC1-VE | 05 |
| C78 300 | C78 ENTM 30 | | 2300 | TSC1-AE | 06 |
| C78 550 | C78 ENTM 55 | | 2900 | | 07 |
| C13 330 | C13 ENSM 33.10 | | 2300 | | 06 |
| C13 500 | C13 ENTM 50.10/30 | | 2300 | | 06 |
| C13 825 | C13 ENTM 83 | | 2700 | TSC1-VE | 08 |
| C13 330 | C13 ENSM 33.12 | | 2300 | | 09 |
| C13 500 | C13 ENTM 50.12 | | 2300 | | 09 |
| C13 500 | C13 ENTM 50.32 | | 2300 | | 09 |
| C90 620 | C87 ENTM 62 | | 2900 | | 10 |
| C90 650 | C87 ENTM 65 | | 2900 | | 10 |
| C90 380 | C87 ENTM 38 | | 2300 | | 09 |
| C90 240 | C87 ENSM 24 | | 2300 | | 09 |
| Nanni H4.40 VM | | 700 | 3700 | TSC1-TE | 30 |
| Nanni H4.78 VM | | | 3700 | | |
| Nanni H4.115 VM | | | 3100 | | 31 |
| Nanni H4.130 VM | | | 4100 | | 32 |
| Nanni H4.150 VM | | | 4100 | | |
| Nanni H4.170 VM | | | 4100 | | |
| Nanni V6.180 VM | | 600 | 3700 | | 35 |
| Nanni V6.200 VM | | | 3700 | | |
| Nanni V6.270 VM | | | 3920 | | 36 |
| Nanni V6.320 VM | | | 3920 | | |
| Nanni V6.350 VM | | | 3920 | | |
| Nanni T4.240 TOYOTA | | 650 | 4000 | | 38 |
| | | | | | |
| Speed reference % | | 0% | 100% | EEC2 | 50 |

If CP = 0 non message will be sent.

### 17.2.3. Technical data of the CANBus interface card

Maximum current which each channel can generate is 100 mA. Each channel output is protected against short circuit towards ground and towards voltage supply. Termination resistor is already mounted on the CANBus interface card but it can be removed, if necessary.
The CANBus interface card pin-out is described at section 5.4.4.

## 17.3. Wiring of the outgoing actuator cables

Please refer to section 10.2.

## 17.4. Connection to FPT engines through CANBus interface

Common-rail FPT engines with CANBus interface are equipped from factory with a 6 poles Superseal connector labelled JD. Standard procedure is to simply connect the throttle CANBus cable to connector JD.
In case the engine doesn't respond correctly to the command station, typical case is the engine that doesn't accelerate regularly, make the following controls:

- **Operation must be done with the electronic control switched off:** verify with a multimeter that the impedance between terminals JP4.4 and JP4.5 of the CANBus PCBoards on the actuator is = 60 ohm or similar (see section 5.4.4.). In case of different values, contact either Flexball or the FPT dealer.

- Verify that the setting of the CANBUS CONVERTER MODULE is correct. The CANBUS CONVERTER MODULE is part of FPT installation equipment and it is described by FPT Norm A049 and other FPT Norms. Please refer to FPT installation manual to set correctly the CANBUS CONVERTER MODULE according to the type of FPT engine.
  A wrong setting of dip-switches of the CONVERTER MODULE can cause communication problems between FPT ECU and Flexball control system.

# 18. Programming of actuators with electronic CANBUS engine and electronic gearbox

## 18.1. CANBus engine parameters

For parameter setting, please refer to section 17.2.

## 18.2. Electronic gearbox parameters

For parameter setting, please refer to section 16.

## 18.3. Wiring of the actuator outgoing cables

For wiring of the cables outgoing from the actuator refer to section 10.2.

# 19. System configuration in case of options

## 19.1. Commissioning of actuators for installations with Trim or Flap command option

Trim or flap options don't require any programming on the actuator.
Trim and flap cables are reported from section 6.4 to section to 6.5 included.
Sections 5.3.2 and 5.3.3 depict the pin-out of the electronic PCBs which perform the trim/flap commands.
Electrical installation schemes are at sections 10.2.7 and 10.2.8.

## 19.2. Commissioning of actuators for installations with Trolling option

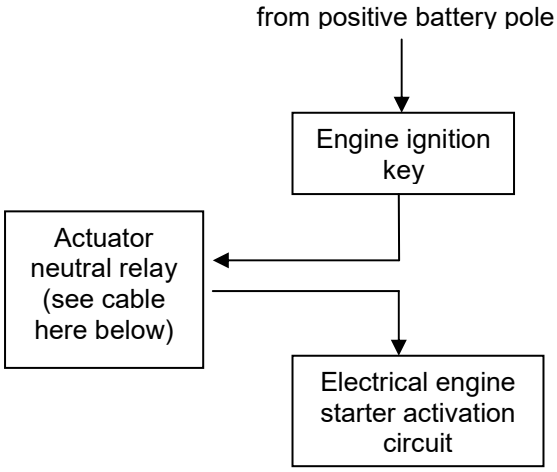
Refer to separate document "Trolling_Flap option for lever 3500 & 4500".

## 19.3. Commissioning of the actuators with Neutral Relay option

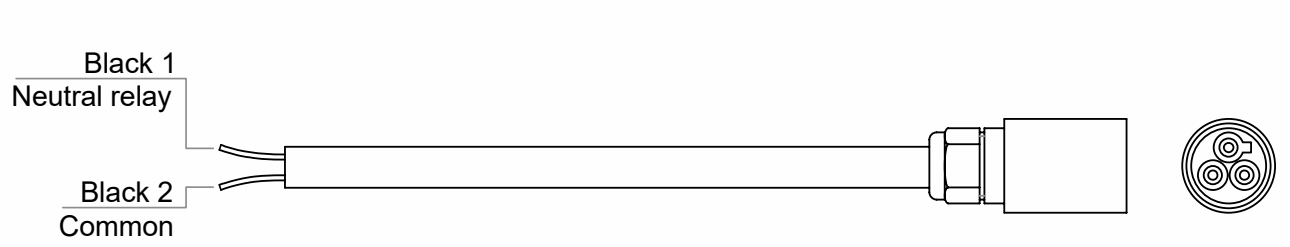
The mechanical actuator can provide a no contact signal when the gearbox is in neutral. This signal, if properly used in the engine starter safety chain, allows the start of the propulsion engine only in case the gearbox is in neutral position.

The neutral signal is given through a two pole wire, as depicted here below. The neutral relay is normally open and it closes only in case the gearbox is in neutral and the actuator is properly supplied (if the actuator doesn't receive the power supply the relay is switched off and its contact is open).

The block diagram here below shows the safety chain:




Specific neutral cable is described at section 6.3




| Length | Code |
|---|---|
| L=3 m | 3500.36-03000 |
| L=5 m | 3500.36-05000 |
| L=7 m | 3500.36-07000 |

**To be noticed:**

- the cable presents n. 3 wires: black 1, black 2 and yellow/green. In the application do not use the yellow/green wire
- maximum current which can be commutated by the neutral relay is 10 A
- in case the actuator is not supplied, you cannot start the engine unless you provide a by-pass electrical circuit for emergency situations
- actuator with mechanical interface is just giving the information that itself is in neutral position. The neutral position on the gearbox is to be considered valid only if the push-pull cable is mounted correctly.

Neutral relay option cables are depicted in sections 6.3.3 and 6.3.4. Installation schemes are at sections 10.2.5 and 10.2.6.

## 19.4. Programming of the actuators with Hybrid Engine option

The interface towards the hybrid engines is through a voltage signal produced by the actuator. The actuator can generate 2 voltage signals per each engine. Usually the second channel is used as speed reference for the frequency converter which drives the electrical engine.

This programming section is an addendum with respect to the programming instructions for the basic actuators described from section 13. to 18. included.

Description of the cables between actuator and frequency converter is reported at section 6.2. Wiring scheme connections are described at section 10.2

In order to produce the voltage profile as reported in the diagram here below, you need to define minimum and maximum voltage. These values are defined through parameters L*, and H*.

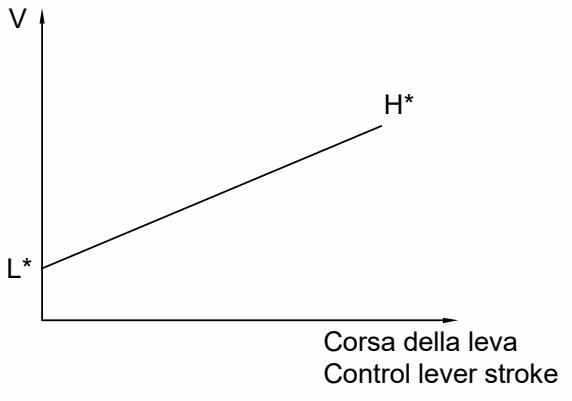
**Parameters setting for installations with 1 engine**

| | Display | Range | Factory setting | Value on display |
|---|---|---|---|---|
| Throttle minimum voltage channel 2 | L2 | 0 – 5 Vdc | 0,0 | 00 |
| Throttle maximum voltage channel 2 | H2 | | 5,0 | 50 |

**Parameters setting for installations with 2 engines**

| | Display | Range | Factory setting | Value on display |
|---|---|---|---|---|
| Throttle minimum voltage channel 2 right engine | L2 | 0 – 5 Vdc | 0,0 | 00 |
| Throttle maximum voltage channel 2 right engine | H2 | | 5,0 | 50 |
| Throttle minimum voltage channel 4 left engine | L4 | | 0,0 | 00 |
| Throttle maximum voltage channel 4 left engine | H4 | | 5,0 | 50 |

► **Important:** change of factory setting might cause a wrong functioning of the system. It is therefore recommended to do not make any change without previously contacting the producer.



# 21. Trouble shooting

## 21.1. What to do in case of system failure

Here below are described standard procedures to follow in case of faults. In case of vessel with 2 engines or of vessel with two or more command stations, the redundancy of the system can overcome the situation of a first failure and the electronic control system could continue to operate, but it is advisable to recover the boat and immediately find and solve the problem.

### 21.1.1. Behavior of the system in case of unforeseen shutdown

In case the engine switches off during navigation, the normal procedure requires to turn off the ignition key and then to turn it on again. At power-up, independently on the position of the command station, the actuator behaves as follows:

- Gearbox is moved to a the safety position (neutral)
- Engine throttle is moved to minimum

The command station that had the control of the vessel, has now lost the command. To take the command again, you must start again the following procedure:

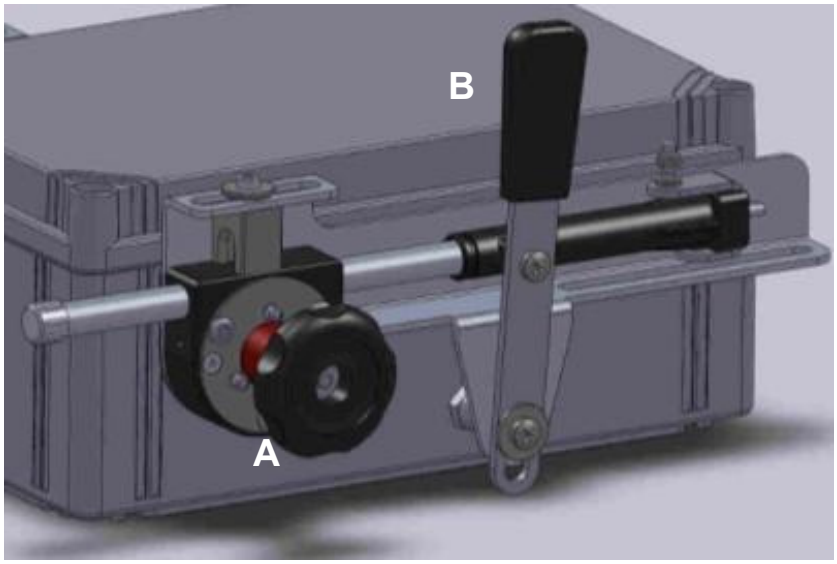
- move the lever to neutral
- press “Command” and then “Warm-up”.

This procedure is described in section 3 of this manual.

### 21.1.2. Emergency lever and how to overcome faults during navigation in case of system with mechanical interface

In case of system’s fault due to:

- missing power supply
- data transmission cables broken
- broken push-pull cables



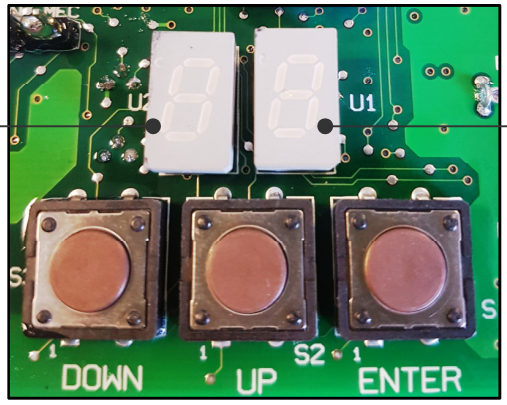

The electronic system can be quickly switched off and the engines can be operated directly with the mechanical emergency levers.
Emergency levers are fitted on the control box. It is sufficient to completely turn-on (clockwise) knob (A), then the gearbox can be operated manually using levers (B).
To enable again the control on the electronic system, turn-off completely (counter-clockwise) knob (A) and at the first movement of the command lever, the lever on the actuator will automatically come back to the position it had before the activation of the emergency mode.

### 21.1.3. Self-protection in case of overload or breakage of the push-pull cables

The 2 digit display on the actuator is a helpful instrument during trouble shooting. The actuator has a built-in control that generates a failure alarm in case the push-pull cable becomes “too hard” or in case the cable’s stroke is not set correctly (beyond the maximum stroke allowed by the actuator).
If one of the above mentioned cases occurs:

- the systems stops (no movements on the push-pull cables)
- on the display of the actuator appears an “E” on the side of the overloaded cable
- all the LEDs of the command stations start to blink.

An “E” will be shown on the side of the actuator with the cable overload




An “E” will be shown on the side of the actuator with the cable overload

In case this alarm is activated, turn off the system, verify the following causes that might have generated the alarm:

- strokes and bending radius of the push-pull cables
- performance of the push-pull cables and if they are not functioning correctly, replace them.

Restart the electronic control system only if you have removed the causes of the not correct functioning.

## 21.2. Analysis of the electronic system behavior

It follows a list of behaviours and errors and their possible remedies.

| Symptom | What to check | What to do | Where to look on the product manual |
|---|---|---|---|
| After power up, there is no light on command station or on actuators | Power supply is missing, check the causes:<br><br>Circuit breaker not correctly connected | Check and eventually replace the circuit breaker | |
| | Electrical cables from the battery to the actuator | Check and fix supply cables | |
| | The fuse on the actuator is blown-up | Verify that the power supply connector of the actuator is wired with the correct polarity. | Chapters 5 and 10 |
| The 4 LEDS blink twice at power on but then the green LEDS are off and the command station doesn't take the command | Check that end of line resistance terminations have been correctly activated both on actuators and on command stations. | Program dip-switches according to your installation scheme. | Section 4.4. and chapters 7 and 8 |
| LEDs on command station are never enlightened while the display on the actuator is enlightened | CANBus data transmission cable doesn't transmit power from actuator to command station | Check if the CANBus data transmission cable is correctly connected on the command station (connector nut requires 5.5 turns of the nut to be fully seated). If power supply is still missing, replace the CANBus data transmission cable. | Chapter 6 |
| Without moving any lever of the command station, the actuator generates changes of speed or unpredictable engagement of the gear | 2 command stations have the same CANBus address. | You must re-assign the CANbus addresses on the command station, set correctly the dip-switches positioned below the command station. | Section 4.4. and chapters 7 and 8 |
| Only one lever commands both the actuators, while the second lever is not active | Command station is in Synchro mode | De-activate the Synchro mode with the push-buttons on the command station. | Chapter 3 |
| | The two actuators might have the same CANBus address and receive the command from the same lever. | Program dip-switch JP14 according to the following:<br>JP14 = OFF for the left actuator<br>JP14 = ON for the right actuator<br>Verify also that JP19 is programmed according to the installation scheme that you have chosen (see from section 7.1 to section 7.5). | Section 4.4. and chapters 7 and 8 |
| LEDs have faint light or the reaction time to the command is very slow | Check battery voltage | | |
| The motor doesn't reach the correct minimum or maximum speed (installations with mechanical actuators) | Check if the stroke of the push pull cable is correct, both on the engine and on the actuator | Tune the push-pull cable on the engine and make a precise setting of the stroke on the actuator. | Chapter 12 |

| Symptom | What to check | What to do | Where to look on the product manual |
|---|---|---|---|
| The engine doesn't accelerate but it is possible to engage the gear (installations with mechanical actuators) | Check the stroke of the gearbox. If you set a stroke longer than necessary, the gear can be engaged but the actuator doesn't manage to reach the target position and therefore it doesn't activate the throttle. | Reprogram the gearbox stroke. | Chapter 13 |
| Minimum speed position of the command station corresponds to maximum motor speed (installations with mechanical actuators) | There isn't the right correlation between the position of the lever of the command station and the movement generated by the actuator. | Modify the setting of parameter A0. | Scheme at sections 13.2 and 14.2 |
| Lever is in forward or reverse position but the gear is not engaged (installations with push-pull cables) | Check the stroke of the push pull cable is correct, both on the gearbox and on the actuator | Tune the push-pull cable on the gearbox and make a precise setting of the stroke on the actuator. | Chapter 13 |
| The lever of the command station is forward but it is activated the reverse gear instead of the forward gear (installations with mechanical actuators) | There isn't the right correlation between the position of the lever of the command station the movement generated by the actuator. | Modify the setting of parameter A0. | Sections 13.2 and 14.2 |
| The engine doesn't accelerate (installations with FPT engines or engines with CANBus interface) | Check the setting of the dip-switches on the CANBUS converter module | | Section 17.4 |

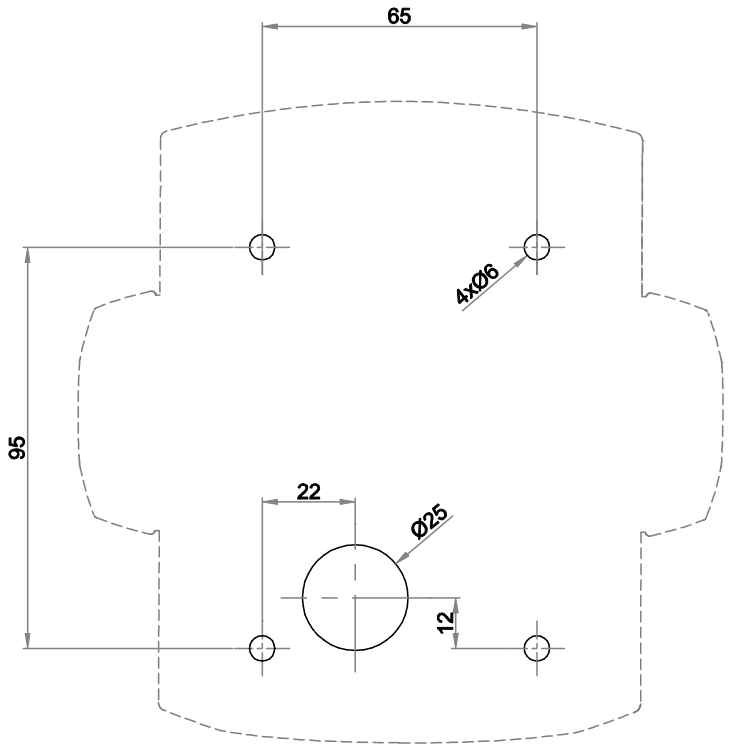
## 21.3. Diagnosis through the command station

LEDs of the command station produce flashes to show operating conditions, warning and failure conditions.

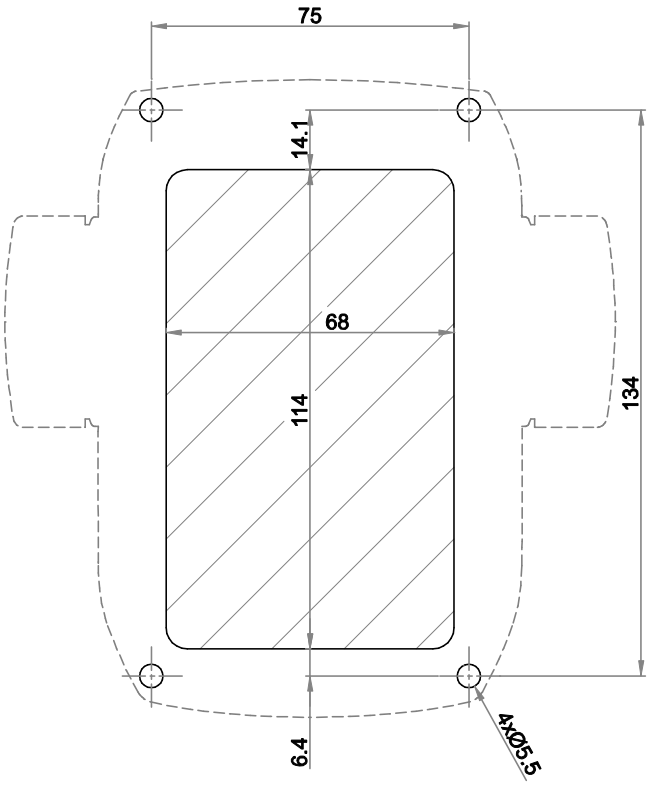
| LED indications | When it happens | Meaning/problem | What to do |
|---|---|---|---|
| All LEDs are blinking with 1° flash long and 2° flash long | At power up | Command station configured for installations with 1 engine | If you need to reconfigure the command station, see section 4.3 |
| All LEDs are blinking with 1° flash short and 2° flash long | | Command station configured for installations with 2 engines and 1 actuator | |
| All LEDs are blinking with 1° flash short and 2° flash short | | Command station configured for installations with 2 engines and 2 actuators | |
| The 2 green LEDs show a steady light when the levers are in neutral | After power up | Gearboxes are in neutral and the installation works correctly | - |
| The 2 green LEDs are switched off, even if the levers are in neutral | | Power supply is missing | Check if the display on the actuator is enlightened:<br><br>if YES, verify the connection of CANBus data transmission cable;<br><br>if NO, check the electrical installation (chapter 10). |
| The green LED is switched off, even if the lever is in neutral | | The push-pull cable of the gearbox hasn't come to the assigned neutral position (actuators with mechanical interface) | Check and remove the obstacle which doesn't permit the actuator to go to neutral position (see chapters 12 and 13) |
| Green LED is blinking with duty cycle: 90% On and 10% Off | | Command station is not configured correctly with respect to the type of installation; command station has been configured for installations with 1 actuator and it must be configured for installations with 2 actuators | Reconfigure command station as described at section 4.3. |
| Green LED is blinking with duty cycle: 50% On and 50% Off | | There might be a problem on the position measuring device of the command station | Contact Flexball |
| All 4 LEDs are blinking | | There is a failure on mechanical actuators, probably due to:<br><br>an extra load on push-pull cables<br><br>wrong setting of the push-pull cable strokes | Go to the actuator's display and check which is the cable which has generated the failure (see section 21.1.3), then:<br><br>replace the defective push-pull cable<br><br>re-program the strokes of the push-pull cables (see chapters 12 and 13). |

# 23. Drilling mask for command station

## 23.1. Command station series 3500

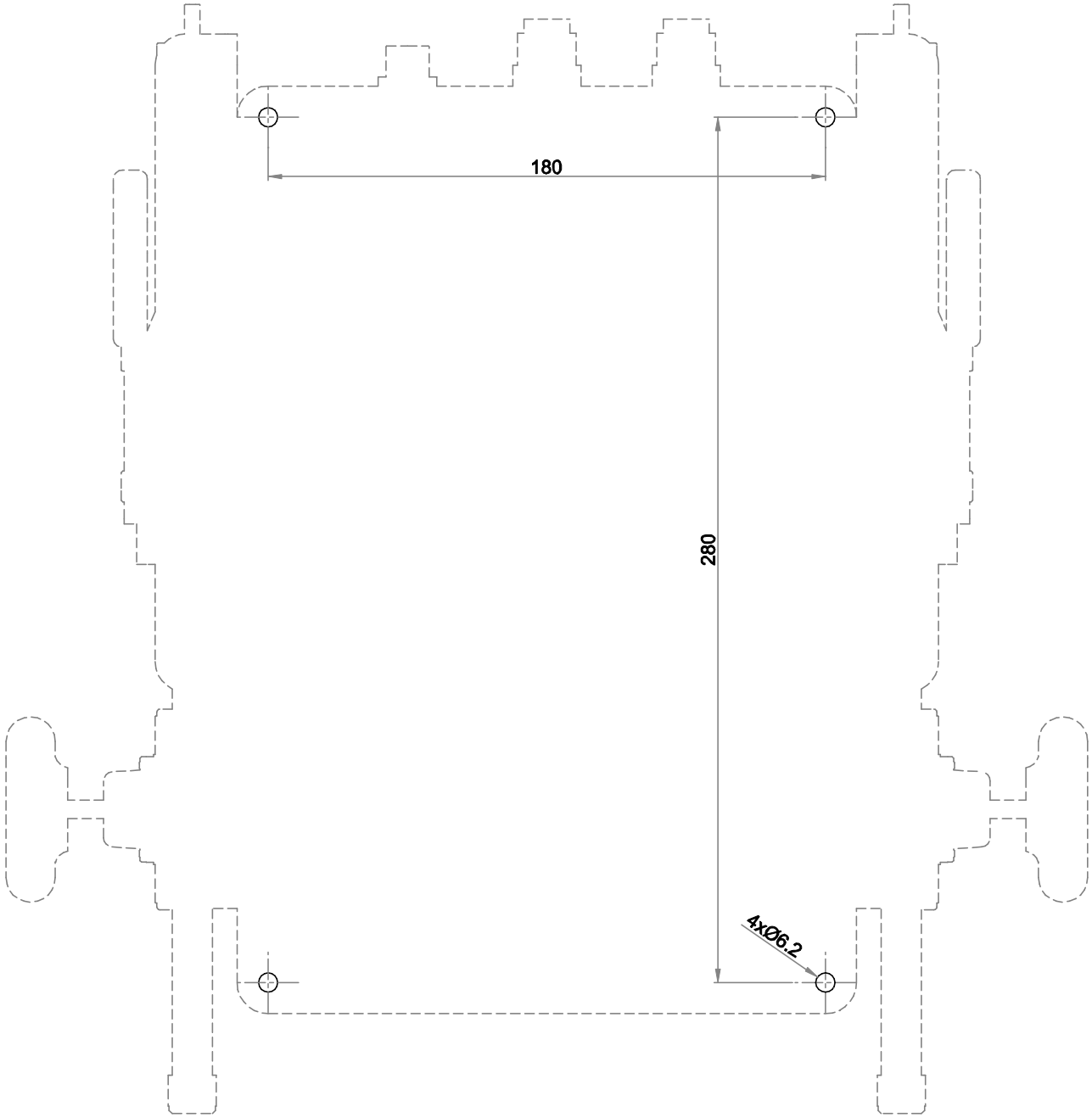



## 23.2. Command station series 4500




**Attention:** drawings here depicted are not corresponding to the object's real physical size

# 24. Drilling mask for actuator




**Attention:** drawings here depicted are not corresponding to the object's real physical size