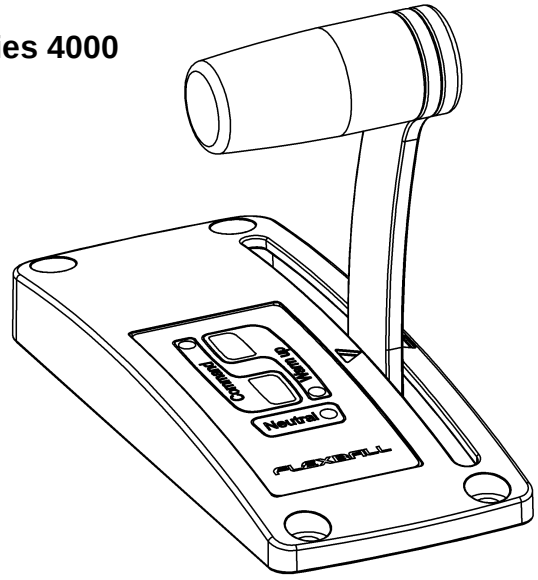
FLEXBALL

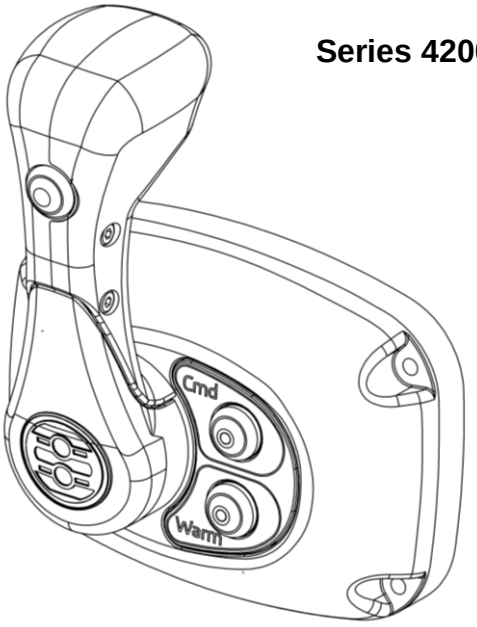
FLEXBALL ITALIANA
WR CONTROLS GROUP

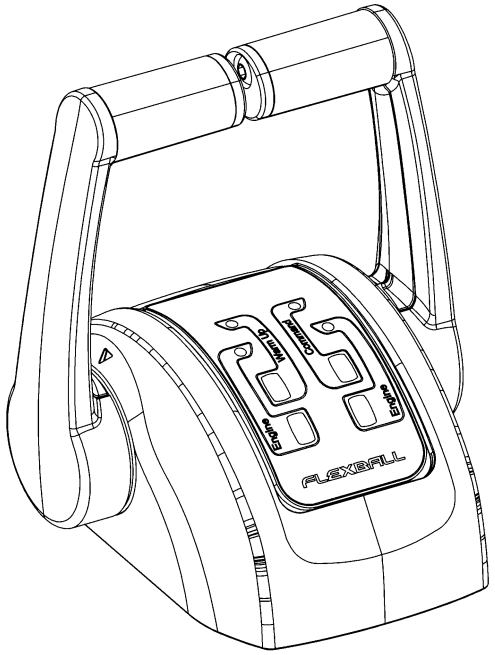
Electronic command system for marine engines

Series 4000

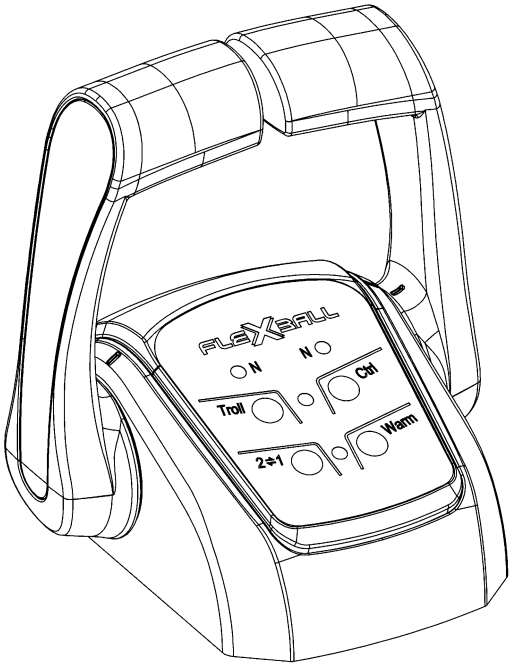


Series 4200





Series 4500



Series 5000

Operating manual & mounting instructions

WARRANTY

The Electronic Command Systems Flexball series 3500, 4000, 4200 and 4500 are guaranteed to have a good performance in case they are operated according to the instructions mentioned in the referring product manuals.

Flexball Italiana srl warrants as follows.

1. SCOPE OF WARRANTY

Warranty is limited to repair or supply with new one against Flexball Electronic Command Systems or their parts which are occurred by defective materials or workmanship within warranty period.

2. WARRANTY PERIOD

Flexball Italiana srl warrants against defective materials or workmanship for a period of twenty-four (24) months from the date of original shipment by Flexball Italiana srl to original customer or twelve (12) months from the first sea trial, whichever occurs first.

3. WARRANTY NON EFFECTIVE (Flexball Italiana srl does not warrant)

a. The parts that are not produced by Flexball Italiana srl or genuine parts which are lost.
b. The cost or the breakdown that occurs for repairing before contacting Flexball Italiana srl
c. The breakdown which is occurred due to any modification of Electronic Command Systems or their parts without previous consent of Flexball Italiana srl.
d. The breakdown that is occurred due to the customer's negligence, faulty maintenance, misuse or non-observance recommended in this instruction manual.

4. OBLIGATIONS OF USER

a. Electronic Command Systems should be inspected and repaired according to the instructions mentioned in the manuals.
b. Use of unsuitable parts, inspection or repair can cause a fatal damage. In case the Electronic Command System should be repaired in a workshop, use a workshop that is appointed by Flexball Italiana srl.

5. WARRANTY REPAIR

This warranty letter is accompanied by the product and Users should summit this warranty letter to warranty repairman when warranty repair or periodic inspection.

6. PRODUCT UPGRADE

Flexball Italiana srl does have no obligation to apply new specifications to the Electronic Command Systems that was supplied before changing specifications.

7. WARRANTY SUCCESSION

In case that owner is changed because the Electronic Command System is resold to another customer within warranty period, Flexball Italiana srl warrants the rest of warranty period. In order to do that, this warranty letter should be accompanied with the Electronic Command System.

Index

January 2024

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 is unlimited
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 3500	IP 66
Command Station series 4000	IP 54
Command Station series 4200, 4500, 5000	IP 67
Actuator (4500 and 4600 series)	IP 54

Mechanical features – 4500 and 4600 series

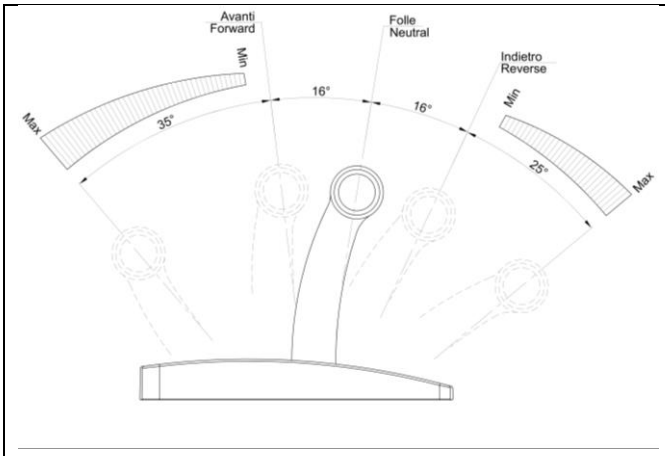
Nominal load when actuator is providing a pushing force	>150 N (15 kg) @12V
Max load when actuator is providing a pushing force	>450 N (45 kg) @12V for less than 1 s
Stroke of gearbox – forward	Stroke can be set at least between 15 and 40 mm
Stroke of gearbox – reverse	
Throttle stroke	Stroke can be set at least between 30 and 80 mm

Electrical features – both 4500 and 4600 series

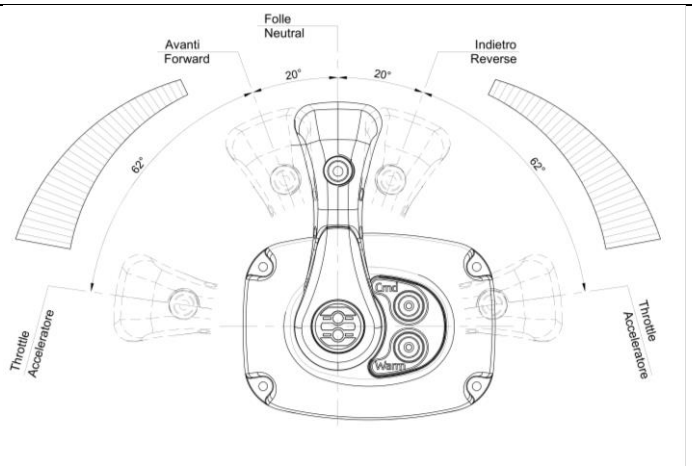
Power supply	from 9 to 30 V_{dc} (standard installations) from 20 to 30 V_{dc}(24V installations)
Max. current absorbed (for max 5 seconds)	15A@12V
Current absorbed when the system is in standby	Max 0,2A@12V each Command Station Max 0,5A@12V each Actuator Box

3. Pilot instructions

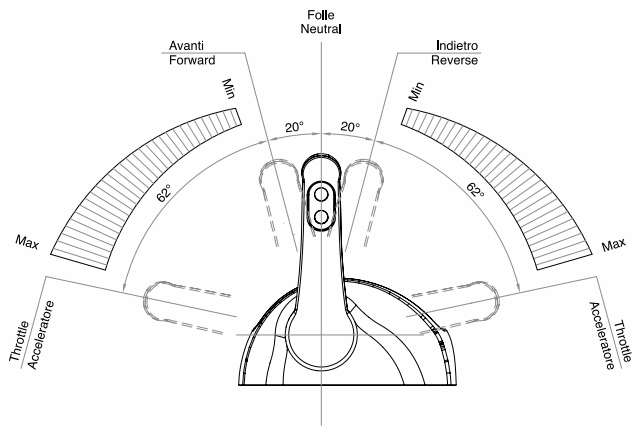
In the Flexball electronic control system can be mounted any of the following command stations: 3500 - 4000 - 4200 - 4500. Depending on the system configuration and on the type of command station, the latter can be used for the command of one or two engines. Here below are reported the instructions for some types of levers: although the functions are the same, due to the command station's construction, push buttons, LEDs and keypads might look slightly different. For more detailed information look at the specific command station product instruction.
Each command station repeats the functionality of a traditional mechanical lever. Moving the lever from the neutral position, after an angle between 16° and 20° forward or reverse (it depends on the lever's type), automatically the electronic system clutches-in respectively the forward or reverse gear. It follows then the lever's stroke in forward and backward direction for the throttle control.



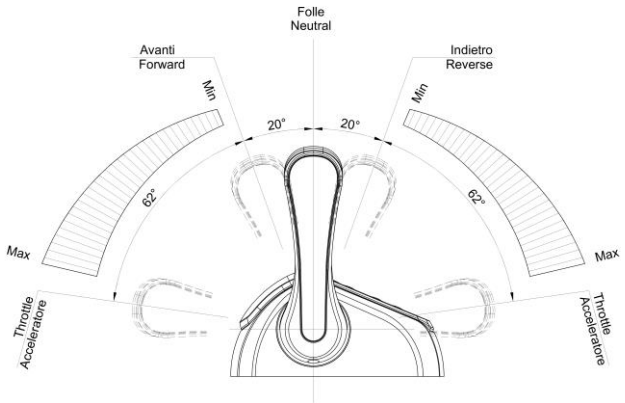
Command station series 4000



Command station series 4200



Command station series 4500



Command station series 5000

3.1. Control keypad

On each command station are mounted an electronic keypad, push-buttons and LEDs.
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.

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

Command station series 4000

Command station series 4200

To engage the gear you must keep pressed the push button on the lever in the movement from neutral to forward or reverse position.

Command station series 4500

Command station series 5000

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

Command station series 4500		
Push-button	**LED**	**Description**
	“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. 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. 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 accelerated without clutching-in the gear. If the LED is steady on, the system is in Single lever 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 Warm-up function.
Command		If you press Command for 1,5 seconds the station takes the command, only if one of these two conditions are respected: • both the lever of the station are in neutral • 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 (see chapter 19, page 113)

Command station series 5000		
Push-button	**LED**	**Description**
	Top position, labelled “N” Green	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, the corresponding gearbox is in neutral position. 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
	Central position Red	If it is switched off, the Station has not the command. If is switched on, the Station has the command. If fastly blinking, trolling mode is enabled and active, if rarely blinking trolling mode is enabled but not active
	Bottom position Yellow	If it is blinking, the navigation system is in Warm-up mode; this means that the engines can be accelerated without clutching-in the gear. If the LED is steady on, the system is in single lever mode.
“Ctrl”		If you press “Ctrl” for 1,5 seconds the station takes the command, only if one of these two conditions are respected: • both the lever of the station are in neutral • both the lever are synchronized with respect to the levers of the station that at the moment has the command (green led blinking)
“Warm”		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 or deactivated the Warm-up function.
“2↔1”		In dual engine applications, when both the levers of the station that has the command are aligned, if you press for 1,5 seconds the “2↔1” button the single lever mode is activated: you can drive both drivelines with only one lever. See 4.2.3, page 17 to know how to change the default driving lever in this case.
“Troll”		If you press “Troll” for 1,5 seconds with levers in neutral on a station with the command taken, trolling mode will be enabled or disabled.
All LEDs are blinking		The control system isn’t working correctly (see chapter 19, page 113)

3.2. Acquisition of the command

It is possible to take the control of the boat from any command station in the following cases:

- **Case 1: none of the command stations has the command**
  1. Move both levers in neutral and press “Command” or “Ctrl” pushbutton for 1,5 seconds.
  2. Red led is now lighted-on while the yellow LED is blinking. You are in warm-up mode: throttle command is enabled but clutch command is disabled.
  3. To enable the command of the gearbox you must press for 1,5 seconds the “Warm/Sync” or “Warm” push-button with all levers in neutral position

- **Case 2: one command station has already the command**
  1. Synchronize the 2 levers of the station which wants to acquire the command with respect to the station which has the command: move the levers until green LEDs will blink
  2. Press the pushbutton “Command” or “Ctrl” 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. Single lever mode

In dual engine applications, 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 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 (4500 series) or the “2↔1” (5000 series). Now, the control of both engines is on the left lever (default). In single lever mode, the yellow LED will be lighted on.

From single lever mode, if you move both levers in neutral and press contemporaneously for 1,5 seconds the two “Engine” or “2↔1” push buttons, the command of each engine is again assigned to the respective lever and yellow LED is switched off.

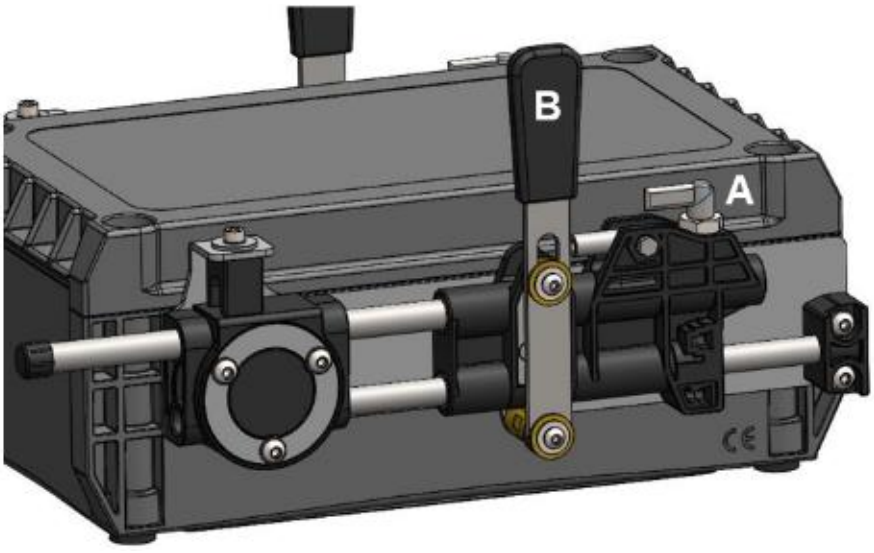
Single lever mode enable and disable can be performed on the station which has the command not only on neutral position, but also in case the two levers position don’t differ more than 10%.

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 this function is enabled on a command station, it will take automatically the command at power on **if both its levers are in neutral position**.
If the station is not in neutral position, it will take the command **as soon as** the neutral position will be reached by both its levers.

3.6. Emergency lever

In case of emergency, the electronic system can be switched off quickly and the engines and gearboxes can be operated directly by the mechanical emergency levers.
If you have the connector panel in front of you, the right emergency lever is for gearbox, the left emergency lever is for engine.



Emergency levers are fitted on the control box. During the normal functioning, the indexing plunger device “A” is positioned as shown in the picture on the left. In emergency situation, to unlock the mechanism it is enough to rotate of 180° the plunger “A” from its working position. After this operation, the mechanism (and the related push-pull cable) can be operated manually using lever (B).

In order to engage again the system you must:

1. Rotate or assure that the mechanical indexing plunger device “A” is in lock position (like in the picture)
2. Place the emergency lever “B” in the centre of stroke and move it back and forward until you hear a “click”.
3. Verify that after the “click” the lever is engaged (you cannot move it freely by hand). In case the emergency lever is still free, repeat operations from point 1 to 3.

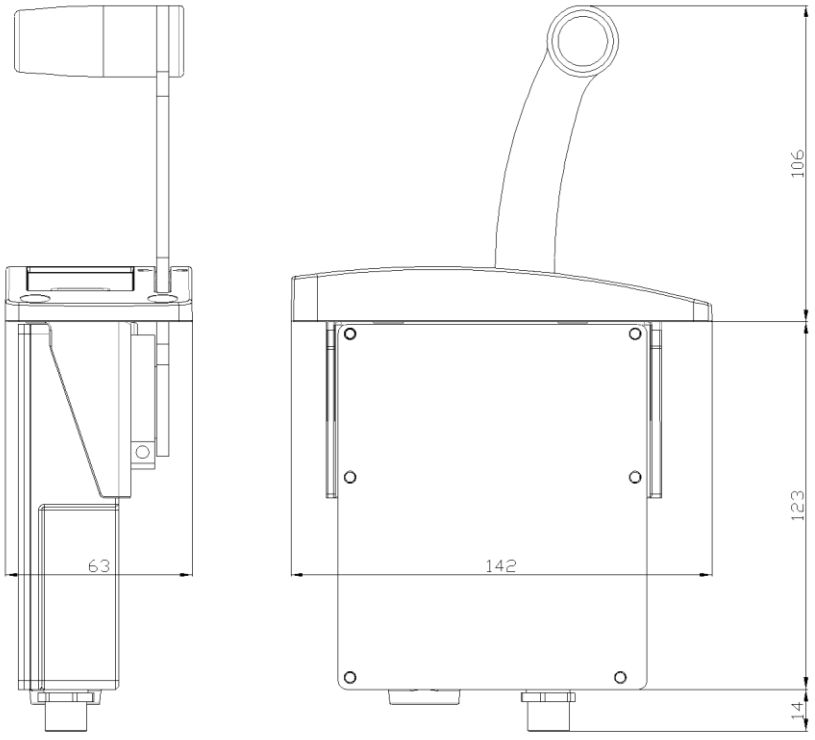
4. Command Station

Command stations are classified as devices for the control of one or two engines, with or without trim/flap command. After serial number 18500 an unlimited number of command stations can be mounted in the same installation; before serial number 18500 the number of command stations in the same installation is limited to 3. For detailed information look at section 7.7.
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.

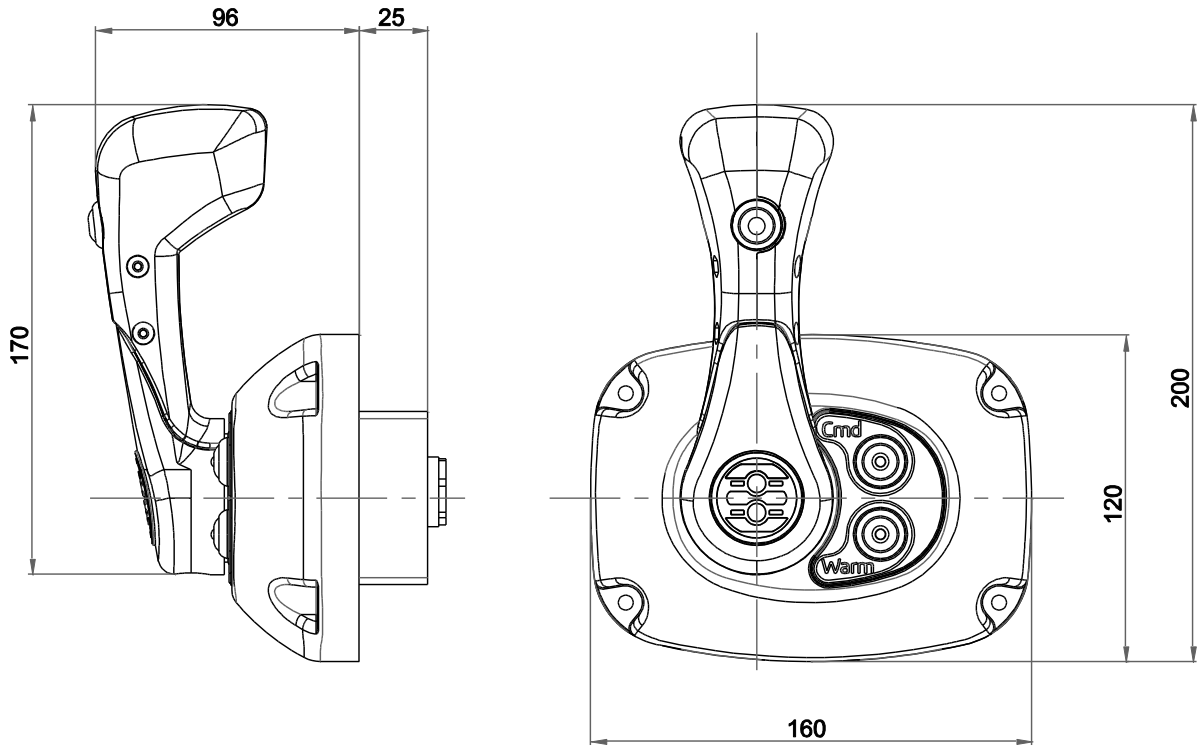
Command stations cannot be directly or indirectly mounted onto sources of vibrations. At chapter 23 of this manual, you find the suggested drilling mask drawings.

4.1. Dimensions

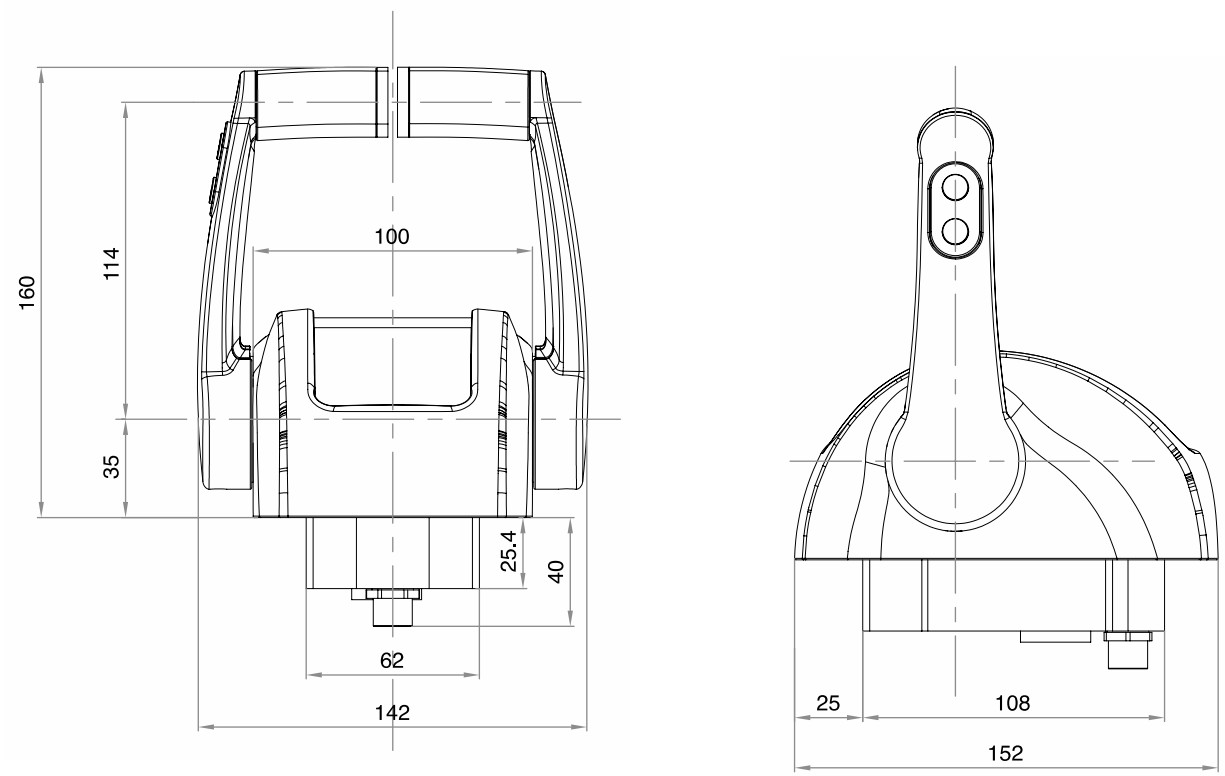
4.1.1. Command station series 4000



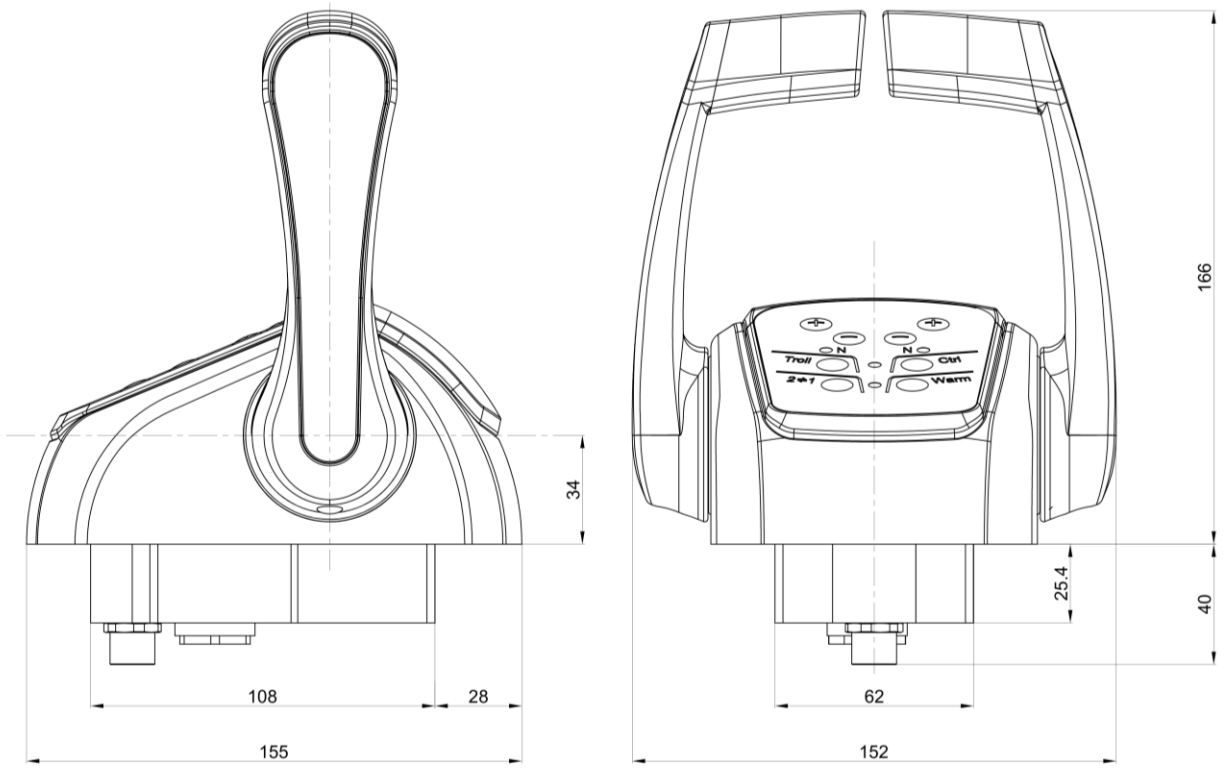
4.1.2. Command station series 4200



4.1.3. Command station series 4500



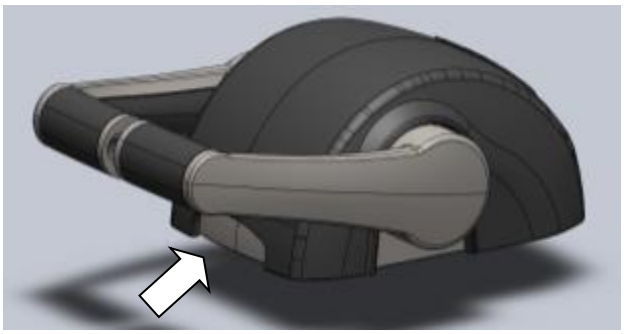
4.1.4. Command station series 5000



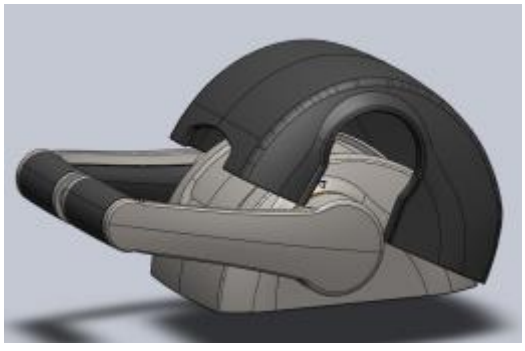
4.1.5. Removal of the protective cover (when present)

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:** max water protection of this cover is obtained when both levers are placed in full forward throttle position. Similar procedure has be followed for 5000 series command station.

4.2. Programming of the command station

4.2.1. For command stations before serial number 18500

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 (identifies the number of engines)	2° flash (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.

4.2.2. For command stations after serial number 18500

At power-up, the command station emits a sequence of flashes that depends on the type of station (single or double) and on the status of the DIP-SWITCH2. The possible behaviours of the command station are the following:

Step 1: if the station is single lever all the LEDs remain ON for 2s before moving on to the next state; if the station is double lever, all the LEDs remain ON for 0.25s before moving on to the next state

Step 2: if the DIP-SWITCH 2 is ON, there is this further sequence of flashes: the two central LEDs (Command and Warm-Up) are turned on for 0.25s and then the two side LEDs (Engine) stay ON for another 0.25s. Otherwise the station goes to the next state

After step 1 and step 2 the station will perform with the normal LEDs management, based on station and system status.

	Step 1	Step 2 (only if dip-switch 2 = ON)	
	1° flash (identifies the number of engines)	2° flash	3° flash
Installation with 1 engine	Long (2 seconds)	CMD and WARM-UP light on (0,25 seconds)	ENGINES light on (0,25 seconds)
Installation with 2 engines	Short (less than 0,25 second)	CMD and WARM-UP light on (0,25 seconds)	ENGINES light on (0,25 seconds)

Note: the number of flashes corresponding to the number of actuators present in the system (as depicted in section 4.3.1.) is no longer executed.

4.2.3. 4500 and 5000 two-engine stations: how to assign the single lever function to the operating lever (after serial number 18500)

By default, the single lever function is assigned to the left lever. It is possible to change or assign the Single lever function either to the left or to the right lever, following the instructions here below:

1. activate the Single lever mode as usual
2. bring both levers in neutral
3. press the two push-buttons on the side of the lever that you want to use for the Synchro:
    - 4500 series command station:
        - "Engine" left and "Syncro / WarmUp" for the left lever
        - "Command" and "Engine" right for the right lever
    - 5000 series command station:
        - "Troll" and "2↔1l" for the left lever
        - "Ctrl" and “Warm” for the right lever
4. keep the push buttons pressed for at least 10s
5. if the operation is successful, the LEDs pair corresponding to the push buttons pressed will flash

The programming is then stored in the device memory. The operation must be repeated for all the control stations of the system.

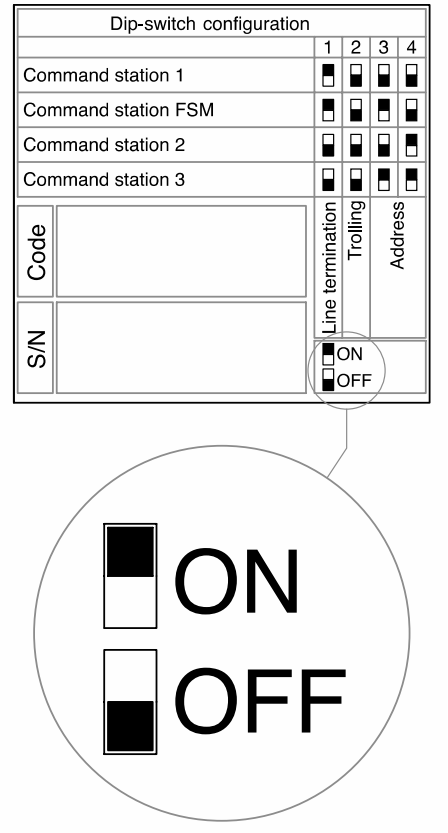
4.4. Command station label

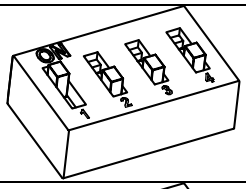
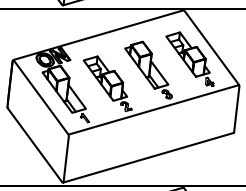
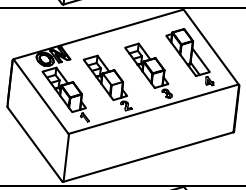
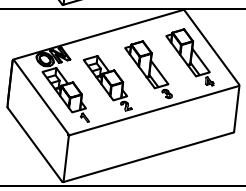
There is a label under the base of the command station. This label shows the code and the serial number of the command station. The dip-switches configure the control station on the base of its position in the CANBus network. The dip switch selector is represented with a small black square.

“Command station 1”, “Command station 2”, “Command station 3” and “Command station FSM” are different addresses on the CANBUs network.

If there are multiple stations in the same system, each one must have a different address (with the exception of the Command Station 3 from SN 18500). "Command station FSM" and "Command station 1" cannot coexist in the same installation: "Command station FSM" is an alternative to "Command station 1" and vice versa.

Chapter 7 lists the most common types of systems, which can only be configured with a correct dip-switch setting.



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

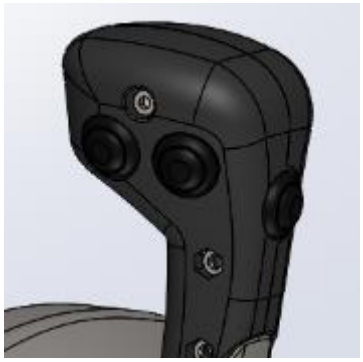
4.5. Trolling option

To activate the Trolling function, dip-switch 2 must be set to ON. For specific information refer to the document “Trolling_Flap option for lever 3500 & 4500”.

4.6. Trim/Flap option

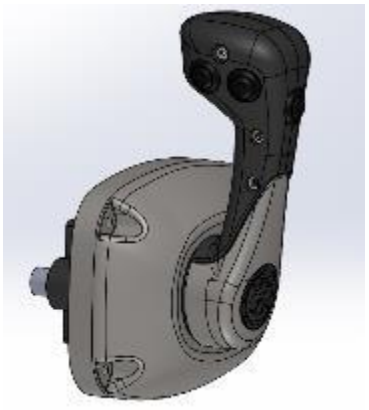
Trim/flap command can be activated directly from the command station with the buttons '+' and '-'. The commands are sent to the actuator from the command station. The relay card fitted on the actuator activates the hydraulic pump of the trim/flap.
For installations with two engines, in case of "Synchro" mode operation, the buttons on the right-hand side operate the both the trims (or the flaps) simultaneously.
This option is not available for the 4000 series command station.

Command station series 4200



Push buttons are placed in the back side of the control lever.

Press with finger 2 to lift up the TRIM
Press with finger 3 is to move down the TRIM



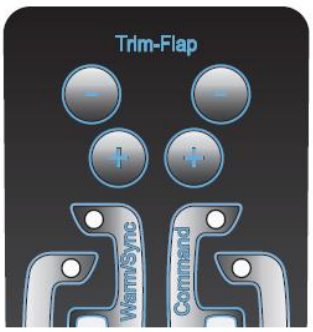
Command station series 4500

1 engine version

Trims/flaps 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

+



Trims/flaps are tuned with "+" and "-" pushbuttons placed on the keypad (a couple for each engine).
It is also possible to command both trims/flaps together with the "+" and "-" push buttons placed on the left lever.

Command station series 5000

1 engine version

Trims/flaps can be activated directly from the command station with the push buttons. These pushbuttons are placed on the side of the left lever.

2 engines version

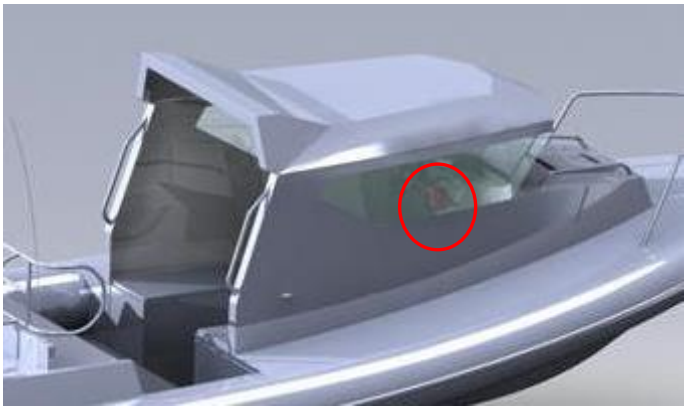
+

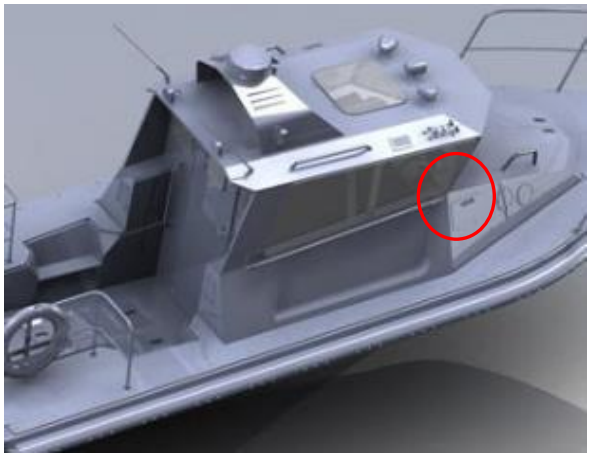
Trims/flaps are tuned with “+” and “-” pushbuttons placed on the keypad (a couple for each engine).
It is also possible to command both trims/flaps together with the “+” and “-“ push buttons placed on the left lever.

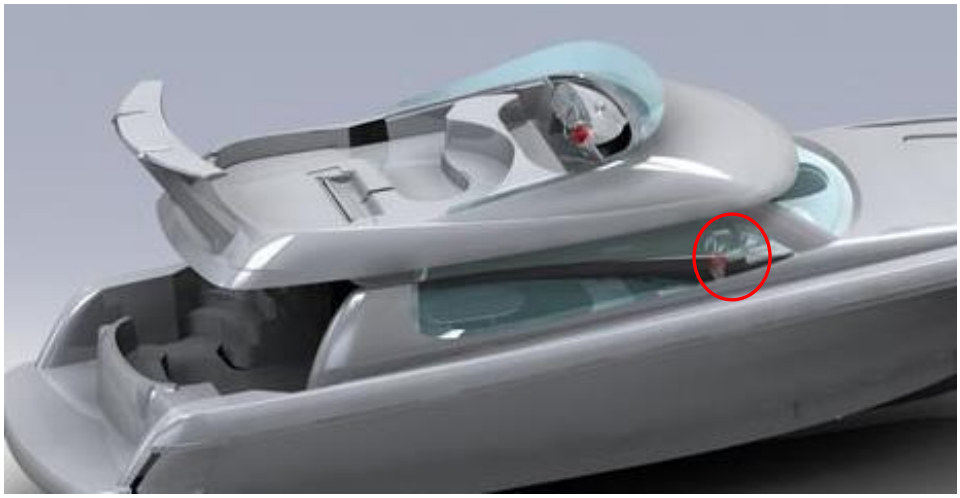
4.7. Classification of indoor and outdoor installation

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.

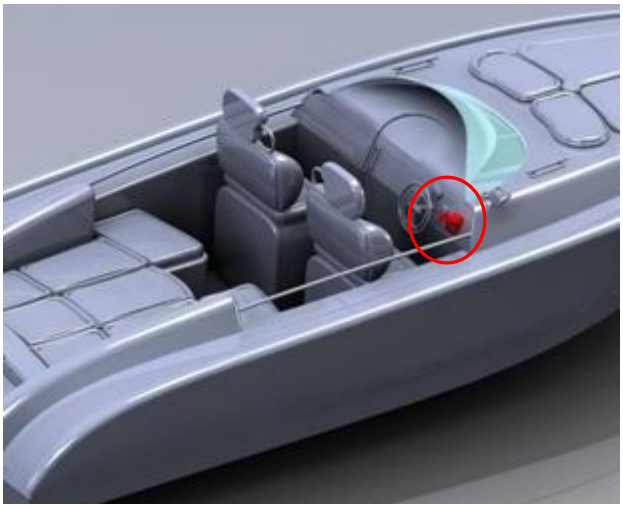


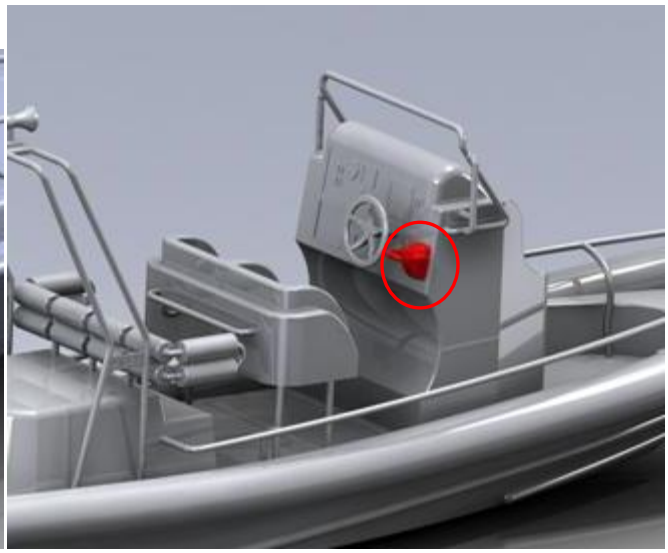


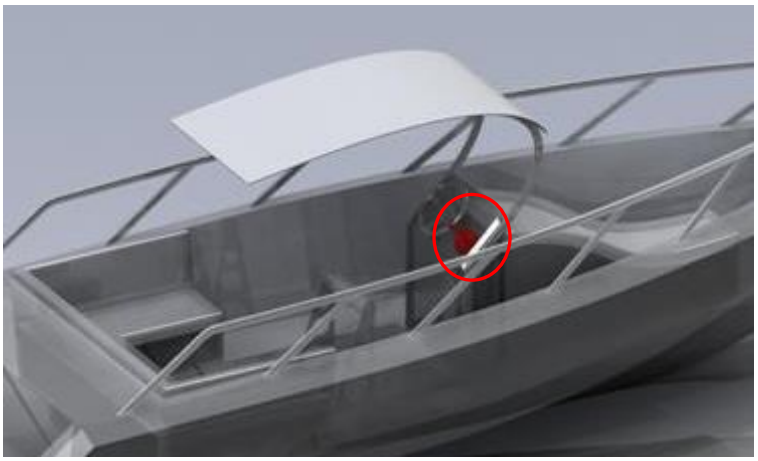


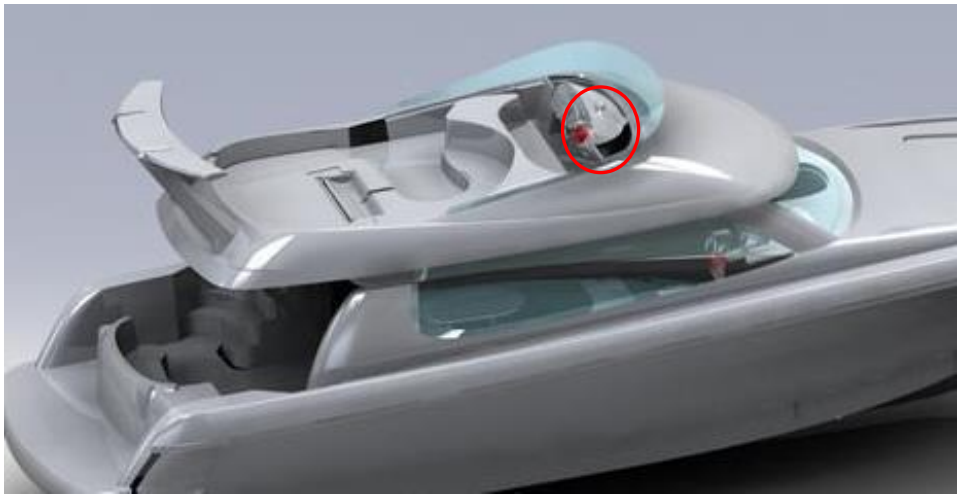
Outdoor installation

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





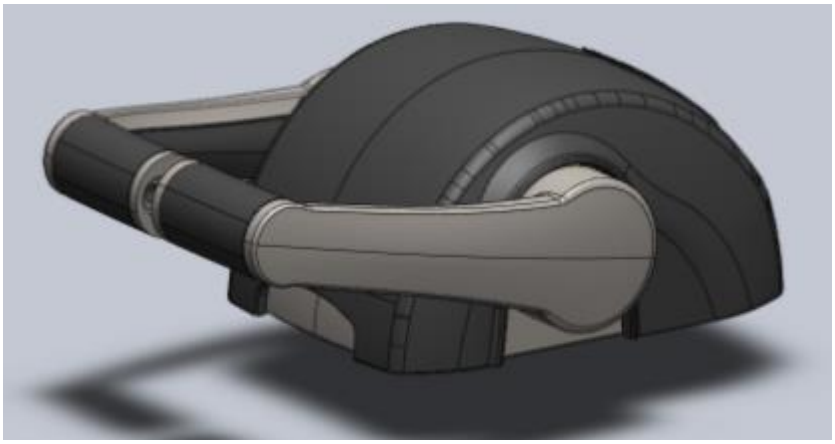




4.8. Advices about the mounting and preservation of the command station

In case of outdoor installation 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.
- Command stations are made of materials resistant to marine environment; in any case, it is essential to remove periodically salt deposits on the external surfaces to avoid corrosion and consequentially system inefficiency.
- It is not allowed to clean the command station with hydro-cleaner or any high-pressure watering/stem system directly to the command station.
- Do not use aggressive chemicals for cleaning the command station.
- When not in use, put on the command station the protection cover. In case the cover is not included into the supply, it is possible to order it separately.



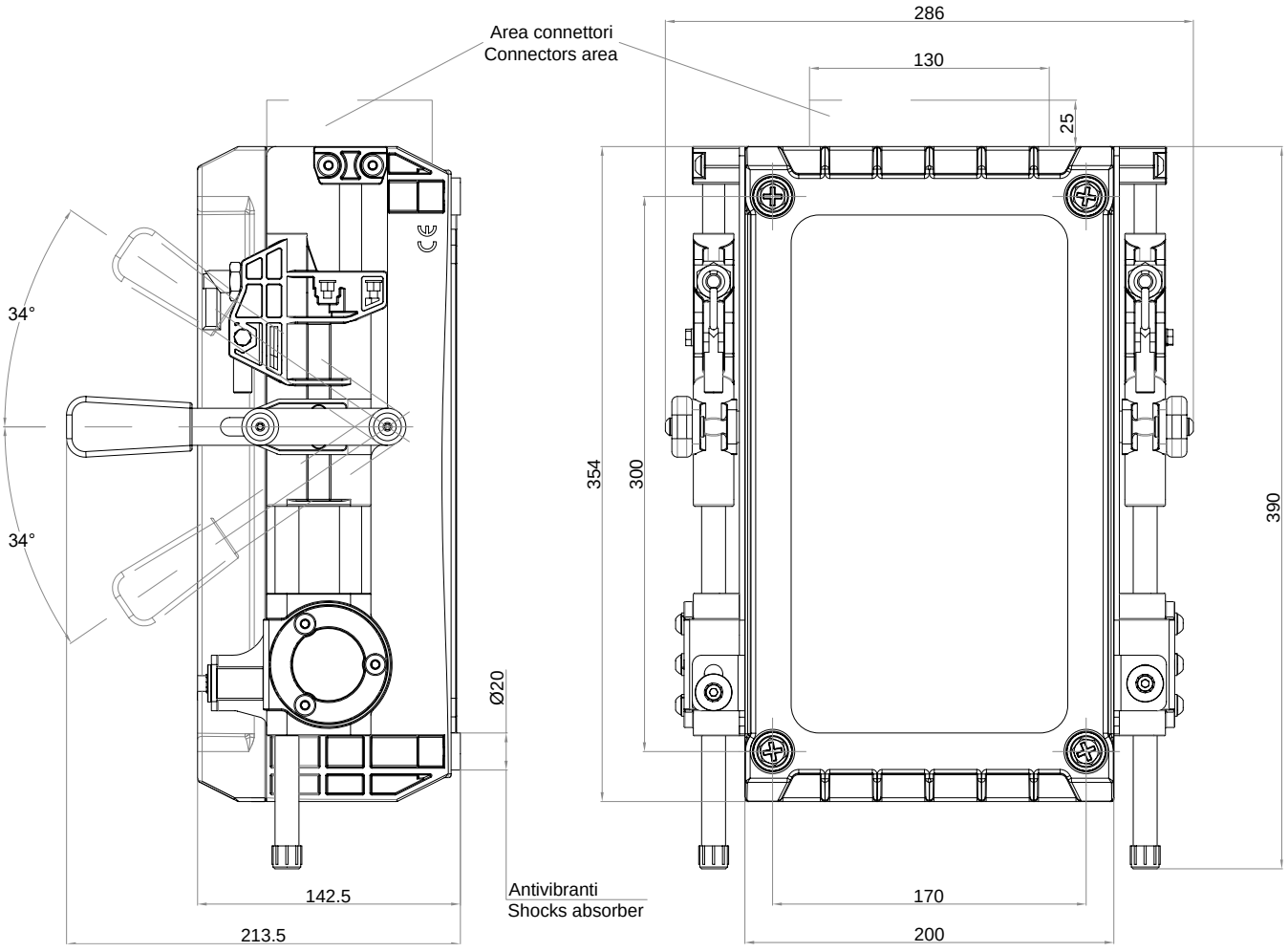
5. Actuator

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

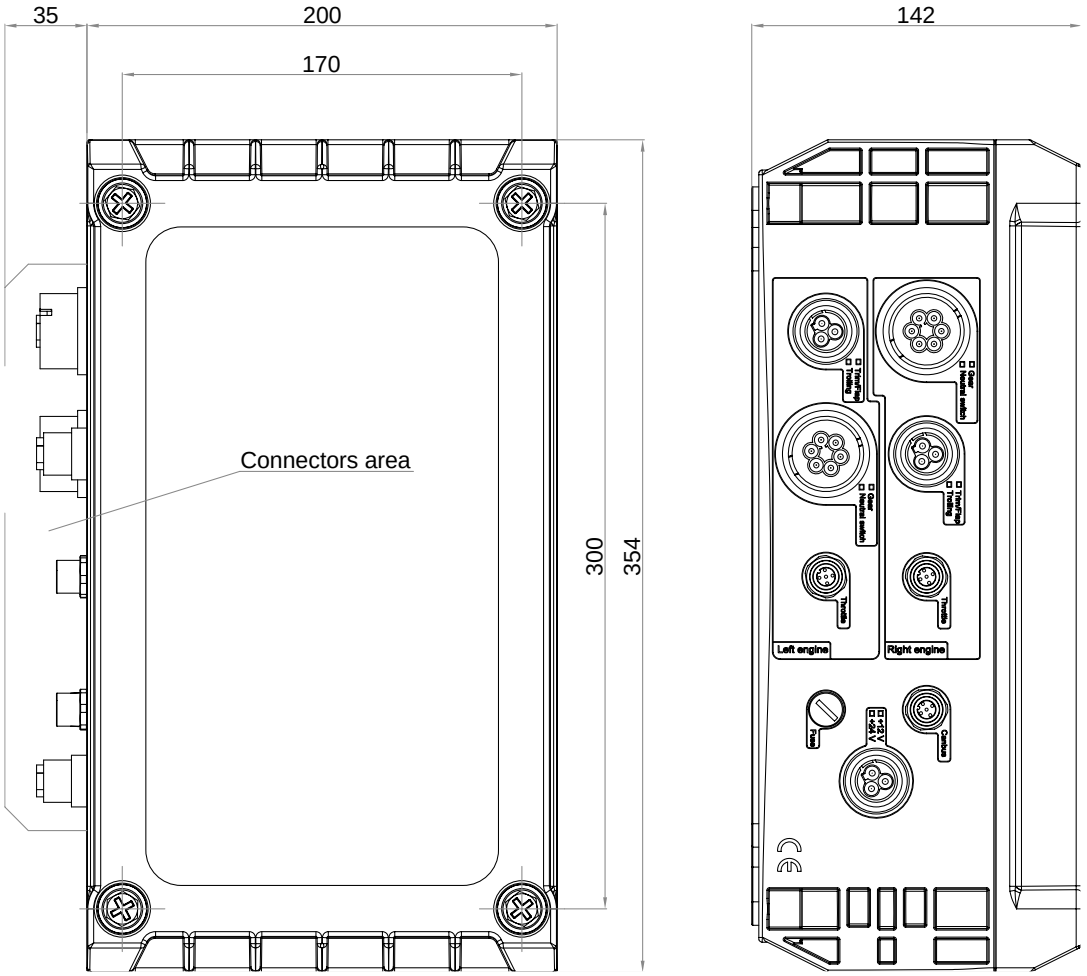
- mechanical
- electronic
- mechanical & electronic (hybrid)

It follow the 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

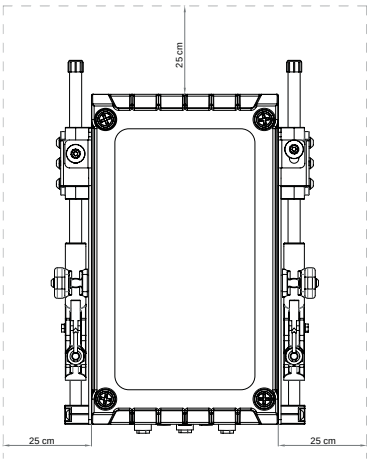
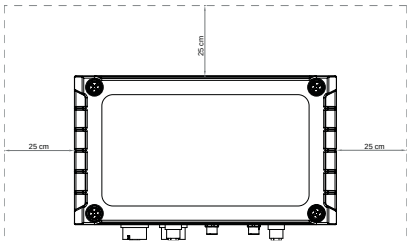
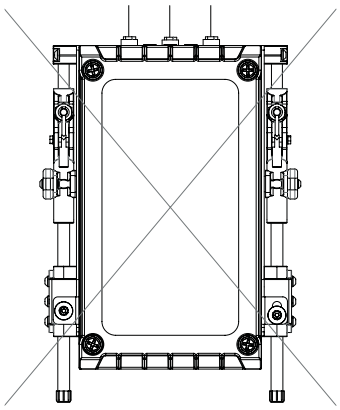


5.2. Drawing of full electronic actuator



5.3. How to mount the Actuator

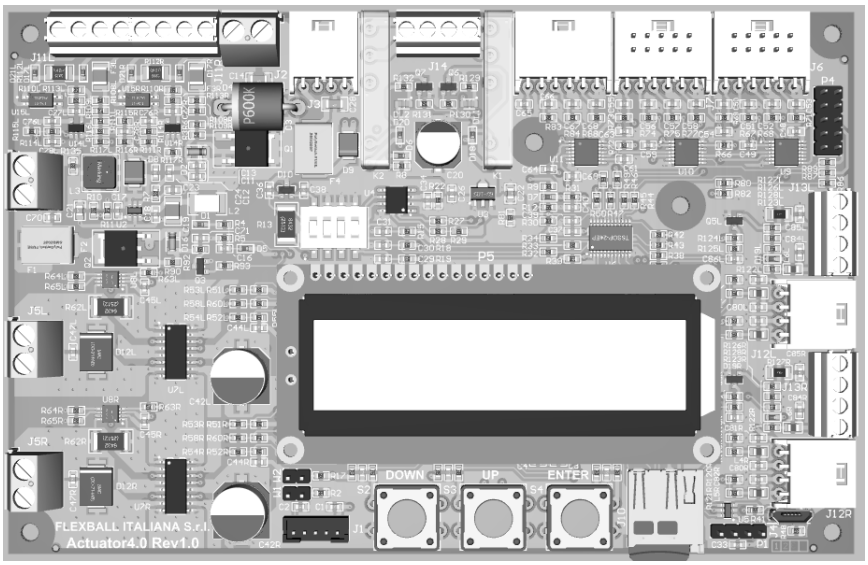
The Actuator must be mounted in the engine room in a safety place and as near as possible to the propulsion engine. The actuator cannot be exposed directly to the source of vibrations, e.g. it cannot be mounted directly on the engine, on the gearbox or on the engine's basement.

Leave a space of at least 25 cm on each side		Do not install the actuator with the connectors upwards
		

5.4. Electronic actuator boards

Please note that pictures may differ from the real boards depending on version or application

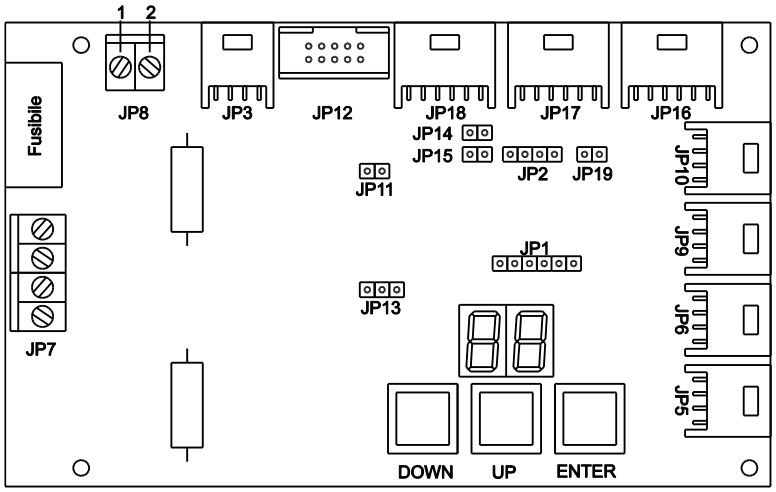
5.4.1. Actuator 4.0 (4600 series)



Position on board	Pin	Description	Output cable
J2 Supply	2	Vdc	Wall connector or DCDC
	1	GND	
J14	1	Neutral Switch Right Engine	2 poles wall connector
	2		
J14	3	Neutral Switch Left Engine	2 poles wall connector
	4		

The actual board installed can be different from the picture above since not all components are always mounted: it depends on application.

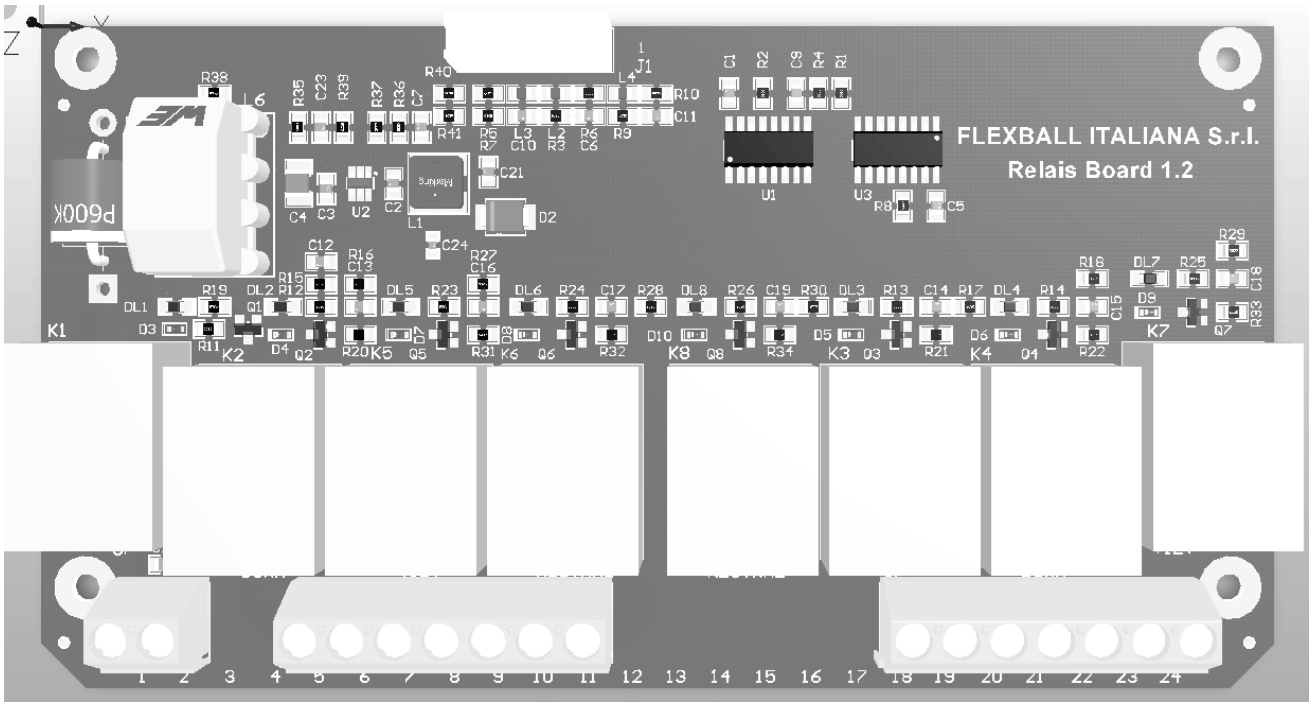
5.4.2. Actuator 3.1



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

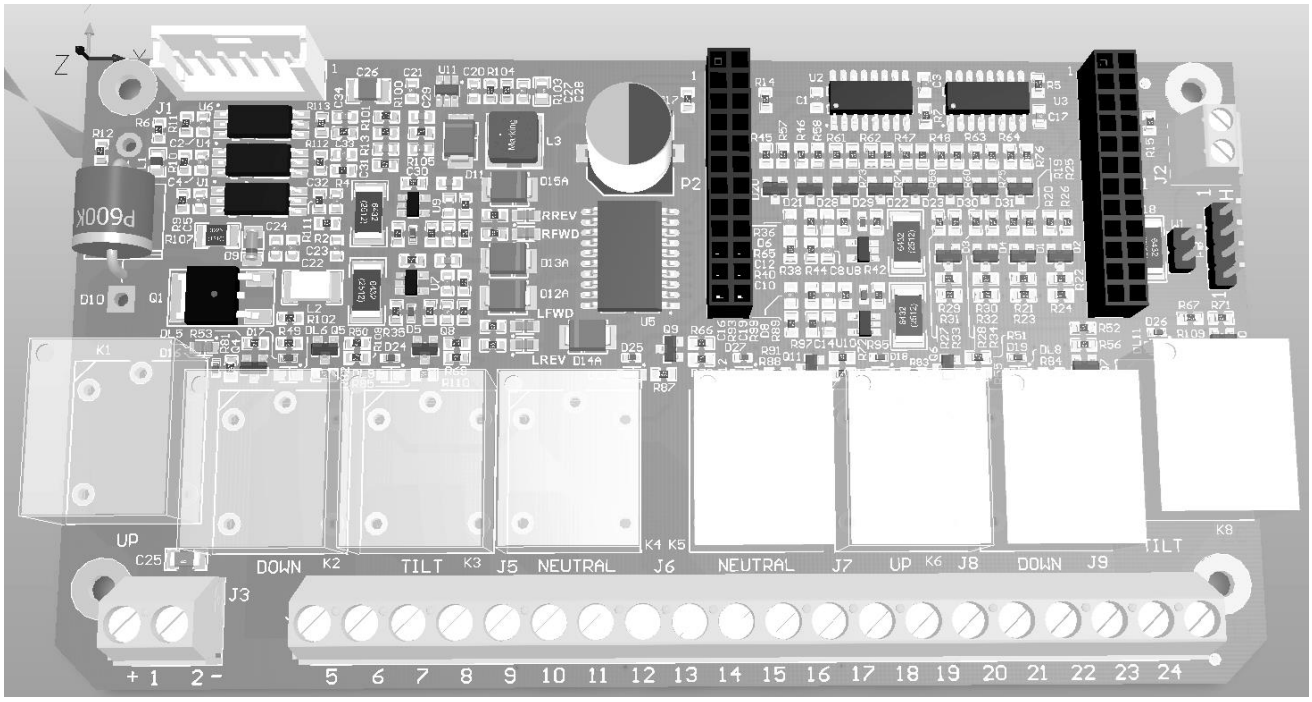
Connectors JP9 and JP10 are dedicated to the electronic control engine device (ECU); in case of hybrid engine application, channels 1 and 3 of each connector are dedicated to the inverter of the electric engines.

5.4.3. RB 1.X for TRIM-FLAP and neutral relays



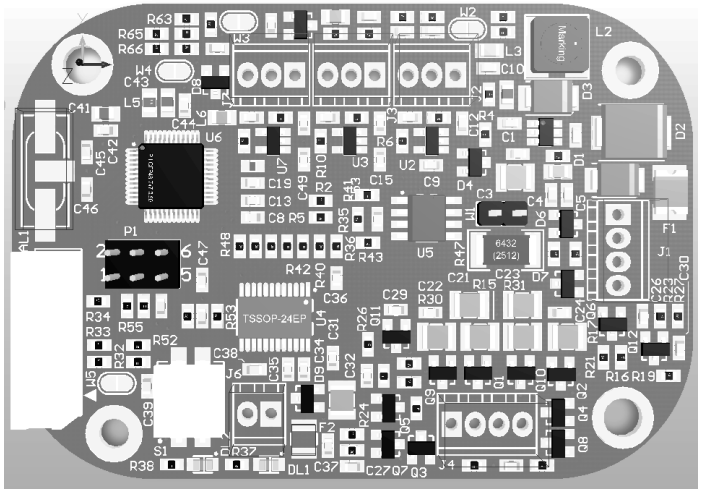
Pin	Description	
1	Vdc	
2	GND	
3	(Not used)	
4	(Not used)	
5	Left engine	Trim common contact
6		Trim +
7		Trim -
8		Trailer
9		Common neutral relay contact
10		NO contact neutral relay
11		NC contact neutral relay
12	(Not used)	
13	(Not used)	
14	(Not used)	
15	(Not used)	
16	(Not used)	
17	(Not used)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

5.4.4. PSBv2.0 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 relay contact
10		NO contact neutral relay
11		Forward gear
12		GND
13		Reverse gear
14		GND
15	Right engine	Forward gear
16		GND
17		Reverse
18		GND
19		Common neutral relay contact
20		NC contact neutral relay
21		Common trim contact
22		Trim +
23		Trim -
24		Trailer

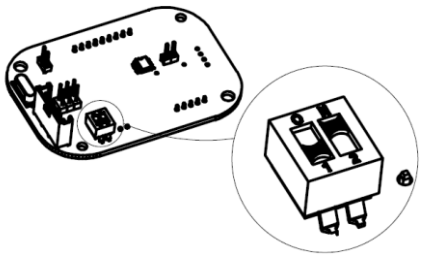
5.4.5. VANCONV-PCB: CAN Bus, PWM or 4-20mA interface towards engine



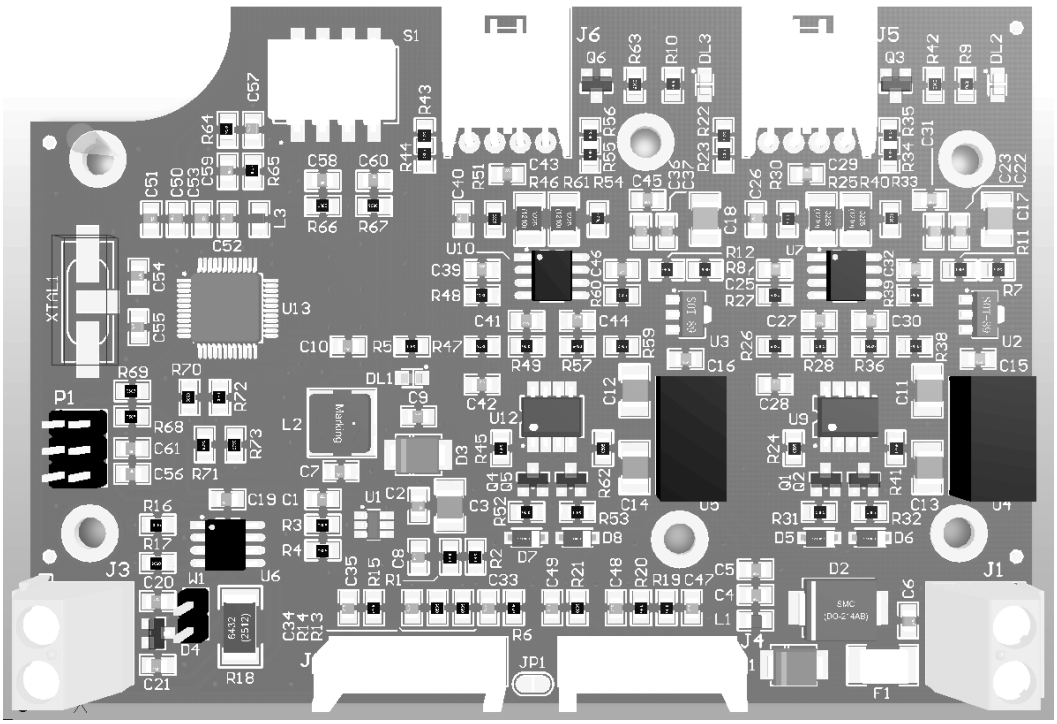
Note: you need a VANCONV-PCB board per each engine

Terminal block	Terminal n°	Description	Wire colour	Notes
J1	1	VSUPP	Red	Always connected
	2	CANH	Yellow	
	3	CANL	Green	
	4	0V	Black	Always connected
J2	1	Not used	-	
	2	+VKEY	Brown	Used in case of CAN Bus output
	3	0V	White	
J4	1	PWM0	White	
	2	0V	Brown	
	3	PWM1	-	
	4	0V	-	
J6	1	4-20mA	Brown	
	2	0V	White	

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 electronic circuit: if necessary, it can be enabled or disabled adding or removing jumper J1.
In case of CAN Bus engine control, the KEY signal is required: in order to enable the board also if KEY signal is not available, move switch n°2 on S1 to ON position:



5.4.6. ISOv2.1 PCB



This board has two functions:

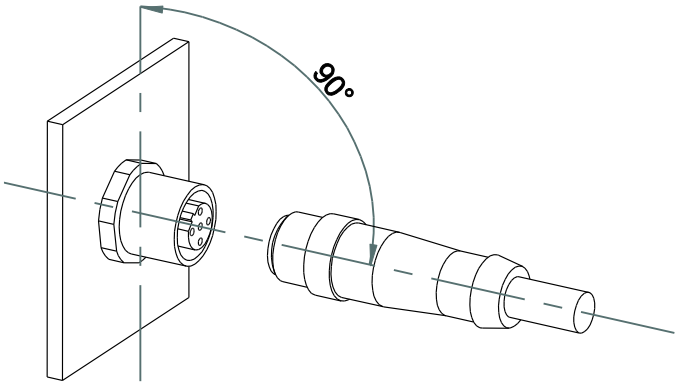
- Generates insulated control voltages for engines
- Manages CAN Bus signals (in some applications)

Position on board	Pin		Description	Output cable
J1 Supply	1		GND	Internal connections
	2		VDC	
J3	1		CANH	2 poles
	2		CANL	
J5 Engine right	2	MOD2 (Rev.3)	V_out CH1	4 poles
	3		V_out CH2	
	1		GND CH2	
	4		GND CH1	
J6 Engine left	2	MOD2 (Rev.3)	V_out CH3	4 poles
	3		V_out CH4	
	1		GND CH4	
	4		GND CH3	

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.

6. Accessories and Options

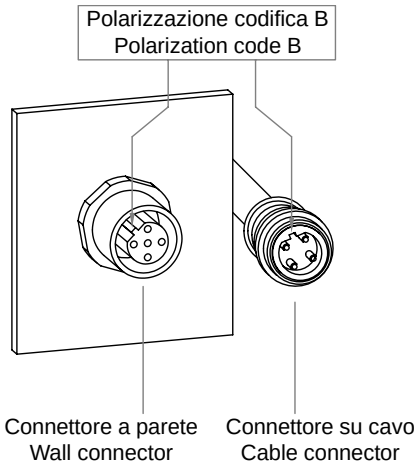


Cables reported here below are used in standard installations. For specific engines there are anyhow available cables with their proper connectors; in case you need cables for specific engines, please contact the supplier.

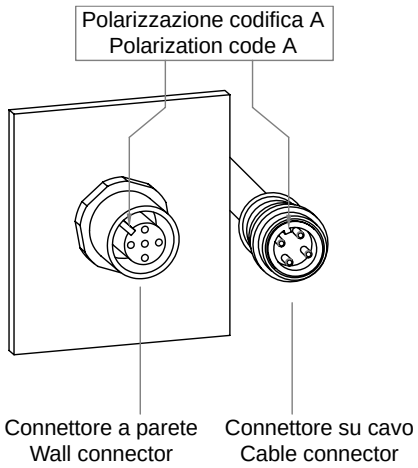
For a correct mounting plug in the connector at 90° with respect to wall side of the actuator box. Rotate then gently the ring until the cable seems to enter into the counterpart M12.
If the cable has been inserted correctly, it is possible to screw in completely by hand the cable without too much efforts. 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 reject the heat generated by the engine.

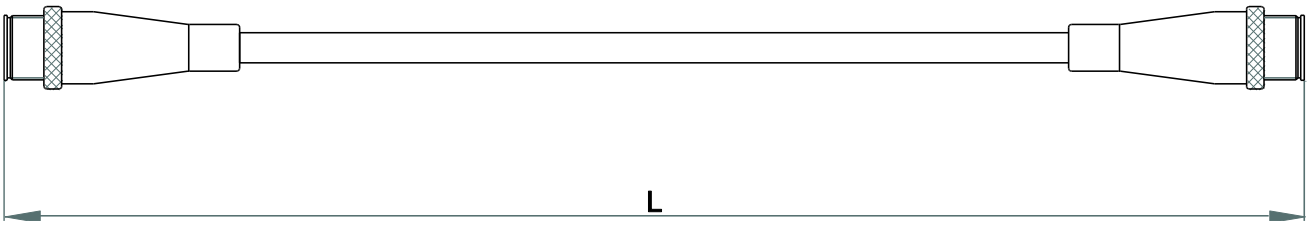


Connector for CANbus data transmission cable



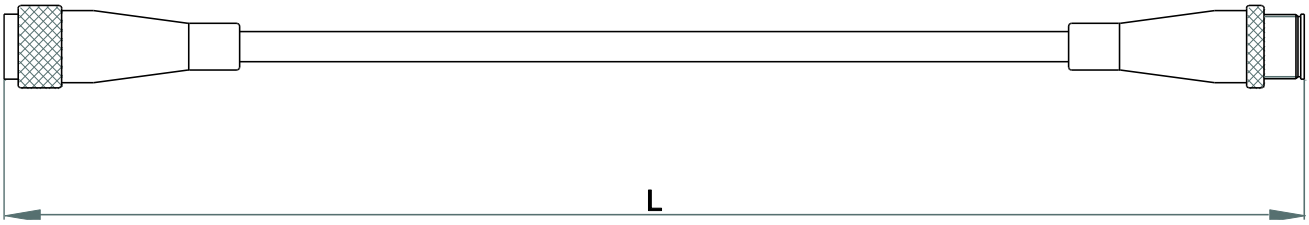
6.1. CANBus cable

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		

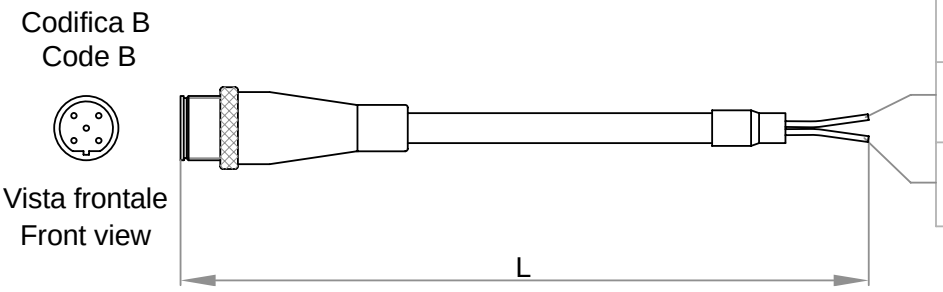
6.1.2. CANBus extension cable



Length	Code
L=30 m	3500.39-30000

6.2. Cables for electronic engine

6.2.1. Cable for 1 electronic enginewith 1 channel: voltage, PWM, 4-20 mA



Colore filo Wire colour	Funzione Function
Bianco White	Segnale Signal
Giallo Yellow	GND

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

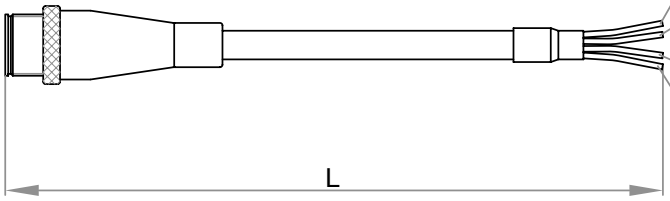
► **Important:** this cable is without connector on engine side

6.2.2. Cables for 1 electronic engine (V) with 2 channels (standard and ratiometric)

Standard

Codifica B
Code B

Vista frontale
Front view

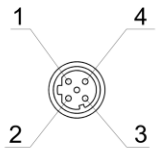


Colore filo Wire colour	Funzione Function
Bianco White	Ch.1 - Segnale Ch.1 -Signal
Giallo Yellow	Ch.1 - GND
Marrone Brown	Ch.2 - Segnale Ch.2 - Signal
Verde Green	Ch.2 - GND

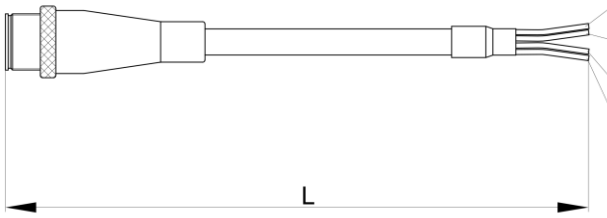
Length	Code
L=3 m	3500.42-03000
L=5 m	3500.42-05000
L=7m	3500.42-07000

Ratiometric

Codifica D
Code D



Vista frontale
Front view



Colore filo Wire colour	Funzione Function	Pin
Bianco White	0V	4
Giallo Yellow	Ch.1 - Segnale Ch.1 -Signal	2
Marrone Brown	+5V	1
Verde Green	Ch.2 - Segnale Ch.2 - Signal	3

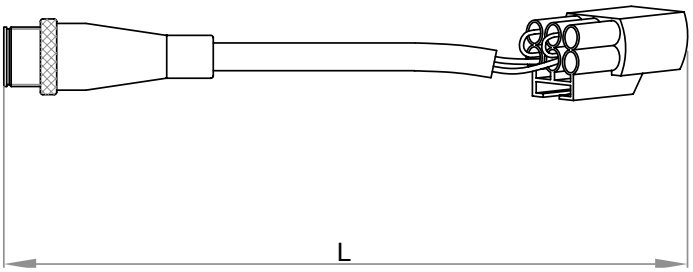
Length	Code
L=3 m	3500.74-03000
L=5 m	3500.74-05000
L=7m	3500.74-07000

► **Important:** these cables are without connector on engine side

6.2.3. Nanni Diesel – Throttle cable for Toyota motor version

Codifica B
Code B

Vista frontale
Front view



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

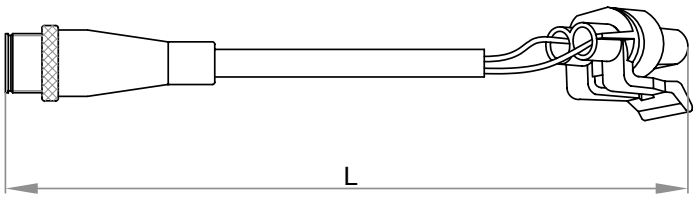
Length	Code
L=3 m	4665/34-03000
L=5 m	4665/34-05000
L=7m	4665/34-07000

Engine side: Sumitomo connector, 6 poles

6.2.4. Nanni Diesel – Cable for the inverter (hybrid propulsion)

Codifica B
Code B

Vista frontale
Front view

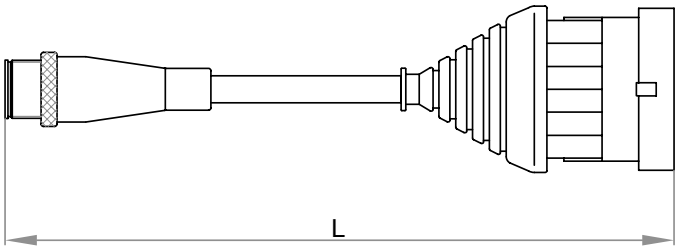


Colore filo Wire colour	Funzione Function	Pin
Bianco White	Segnale Signal	A
Giallo Yellow	GND	B

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

Inverter side: Delphi connector, 2 poles

6.2.5. Nanni Diesel – Command cable for throttle and inverter



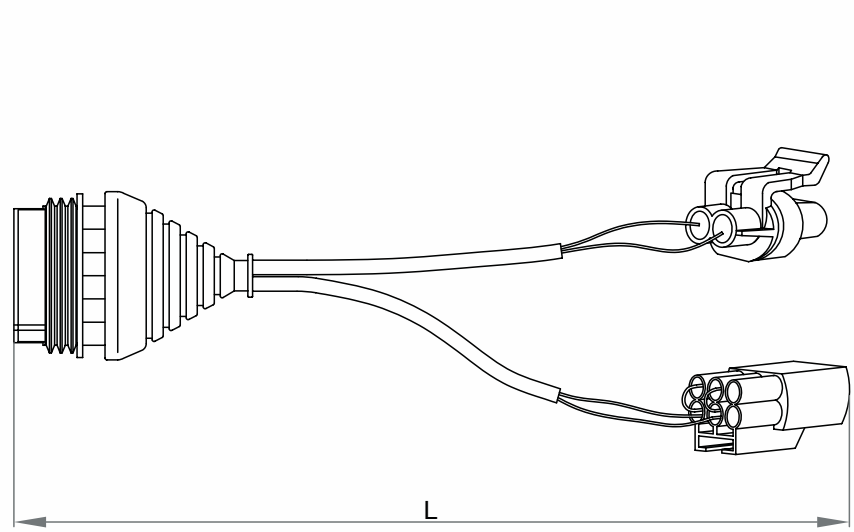
Colore filo Wire colour	Funzione Function	Pin
Bianco White	Ch.1 - Segnale Ch.1 -Signal	4
Giallo Yellow	Ch.1 - GND	1
Marrone Brown	Ch.2 - Segnale Ch.2 - Signal	2
Verde Green	Ch.2 - GND	5

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 electronic Toyota engine(V) + inverter (V)



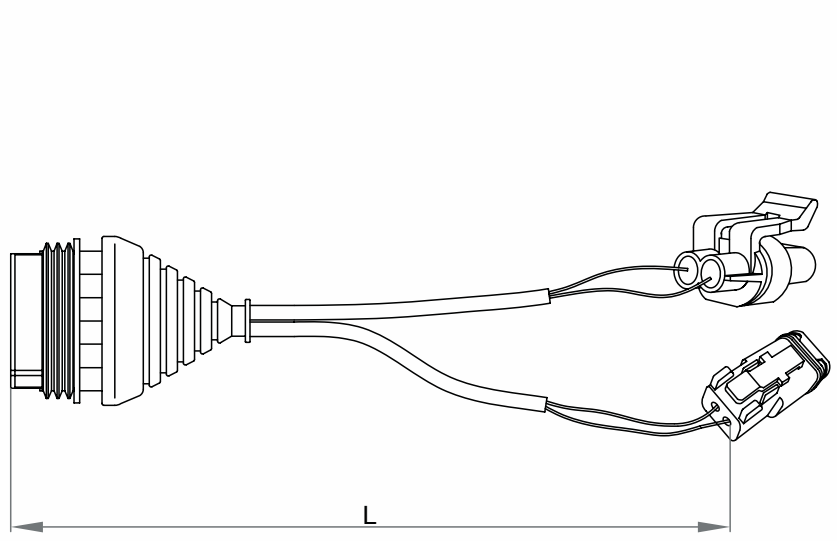
Colore filo Wire colour	Funzione Function	Pin
Marrone Brown	Segnale Signal	A
Verde Green	GND	B

Colore filo Wire colour	Funzione Function	Pin
Bianco White	Segnale Signal	2 - 5
Giallo 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 electronic engine (V) + inverter (V)



Colore filo Wire colour	Funzione Function	Pin
Marrone Brown	Segnale Signal	A
Verde Green	GND	B

Colore filo Wire colour	Funzione Function	Pin
Bianco White	Segnale Signal	2
Giallo Yellow	GND	1

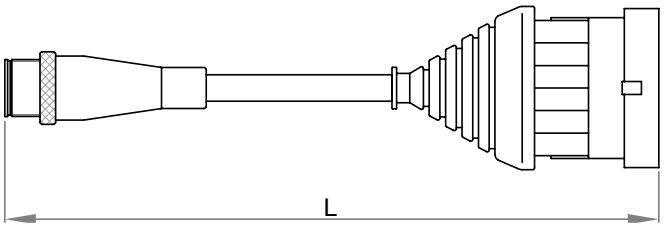
Engine side: Deutsch connector, 2 poles
Inverter side: Delphi connector, 2 poles

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

Codifica B
Code B

Vista frontale
Front view

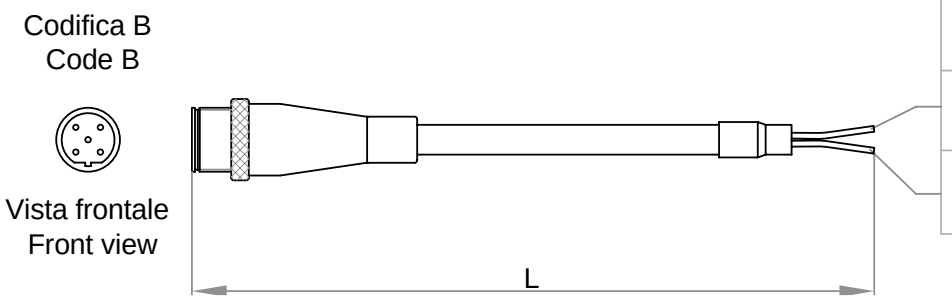


Colore filo Wire colour	Funzione Function	Pin
Marrone Brown	Can H	5
Verde Green	Can L	6

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

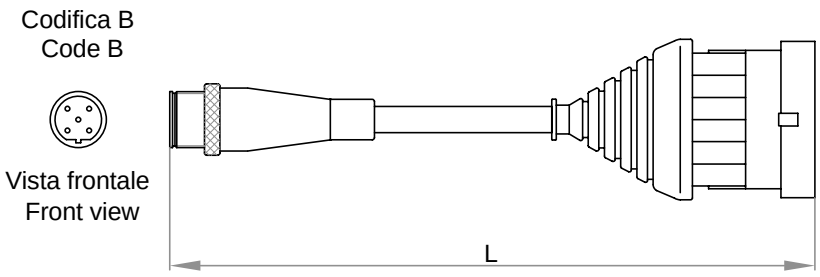


Colore filo Wire colour	Funzione Function
Marrone Brown	Can H
Verde Green	Can L

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

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

6.2.10. FNM – Throttle cable

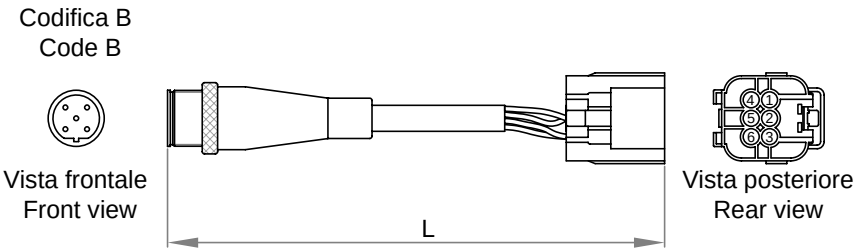


Colore filo Wire colour	Funzione Function	Pin
Bianco White	Ch.1 - Segnale Ch.1 -Signal	3
Giallo Yellow	Ch.1 - GND	1
Marrone Brown	Ch.2 - Segnale Ch.2 - Signal	2
Verde Green	Ch.2 - GND	5

Engine side: AMP Superseal connector, 6 poles

Length	Code
L=3 m	4649/EC3E3M

6.2.11. Hyundai - Throttle cable

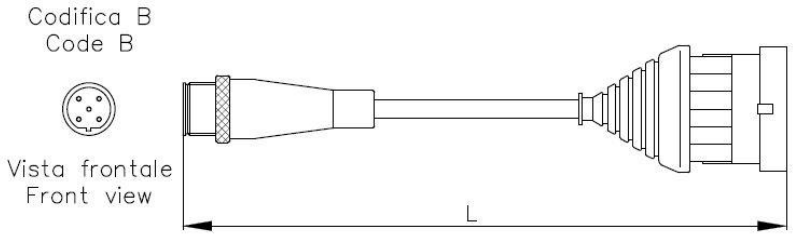


Colore filo Wire colour	Funzione Function	Pin
Bianco White	Ch.1 - Segnale Ch.1 -Signal	2
Giallo Yellow	Ch.1 - GND	5
Marrone Brown	Ch.2 - Segnale Ch.2 - Signal	1
Verde Green	Ch.2 - GND	4

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)

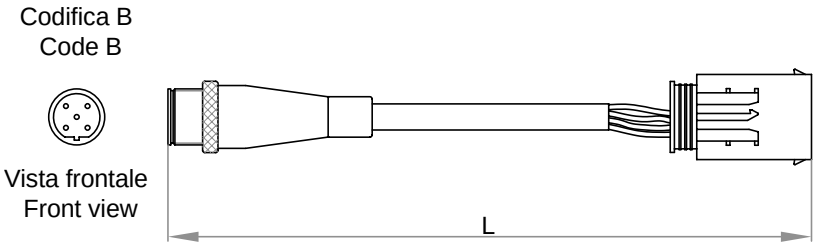


Colore filo Wire colour	Funzione Function	Pin
Bianco White	Ch.1 – Segnale Ch.1 –Signal	2
Verde Green	Ch.1 – GND	4
Marrone Brown	IVS – Segnale IVS – Signal	1
Giallo Yellow	IVS – GND	3

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"



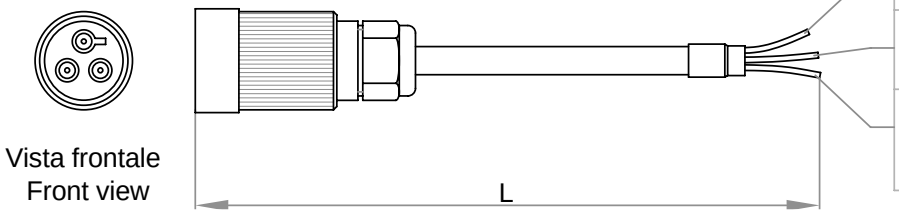
Colore filo Wire colour	Funzione Function	Pin
Bianco White	Ch.1 - Segnale Ch.1 -Signal	3
Giallo Yellow	Ch.1 - GND	2
Marrone Brown	Ch.2 - Segnale Ch.2 - Signal	4
Verde Green	Ch.2 - GND	5

Engine side: Micro Quadlock 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 8.2.5 and 8.2.6 of this manual.



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

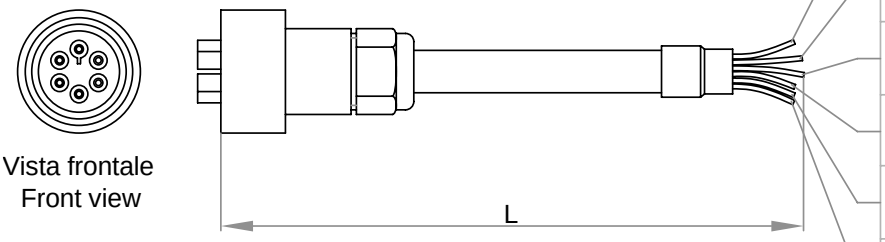
6.3.2. FPT – Cable for gearbox solenoid driven

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 8.2.5 and 8.2.6 of this manual.

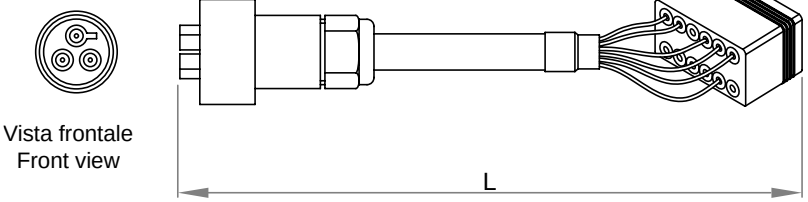


Colore filo Wire colour	Funzione Function
Nero 1 Black 1	M. Avanti - Signal Forward - Signal
Nero 2 Black 2	M. Indietro - Signal Reverse - Signal
Nero 3 Black 3	Relè di neutro Neutral relay
Nero 4 Black 4	M. Avanti - GND Forward - GND
Nero 5 Black 5	Relè di neutro Neutral relay
Nero 6 Black 6	M. Indietro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

Length	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

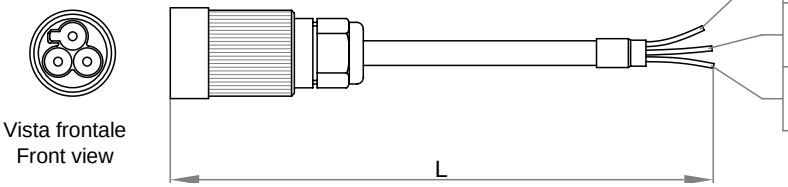


Colore filo Wire colour	Funzione Function	Pin
Nero 1 Black 1	M. Avanti - Signal Forward - Signal	1
Nero 2 Black 2	M. Indietro - Signal Reverse - Signal	2
Nero 3 Black 3	Relè di neutro Neutral relay	3
Nero 4 Black 4	M. Avanti - GND Forward - GND	5
Nero 5 Black 5	Relè di neutro Neutral relay	6
Nero 6 Black 6	M. Indietro - GND 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 sections 8.2.7 and 8.2.8 of this manual.



Colore filo Wire colour	Funzione Function	
	Cablag. Trim Trim Harness	Cablagg. Flap Harness Flap
Nero 1 Black 1	Trim -	Flap -
Nero 2 Black 2	Trim +	Flap +
Giallo-Verde 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

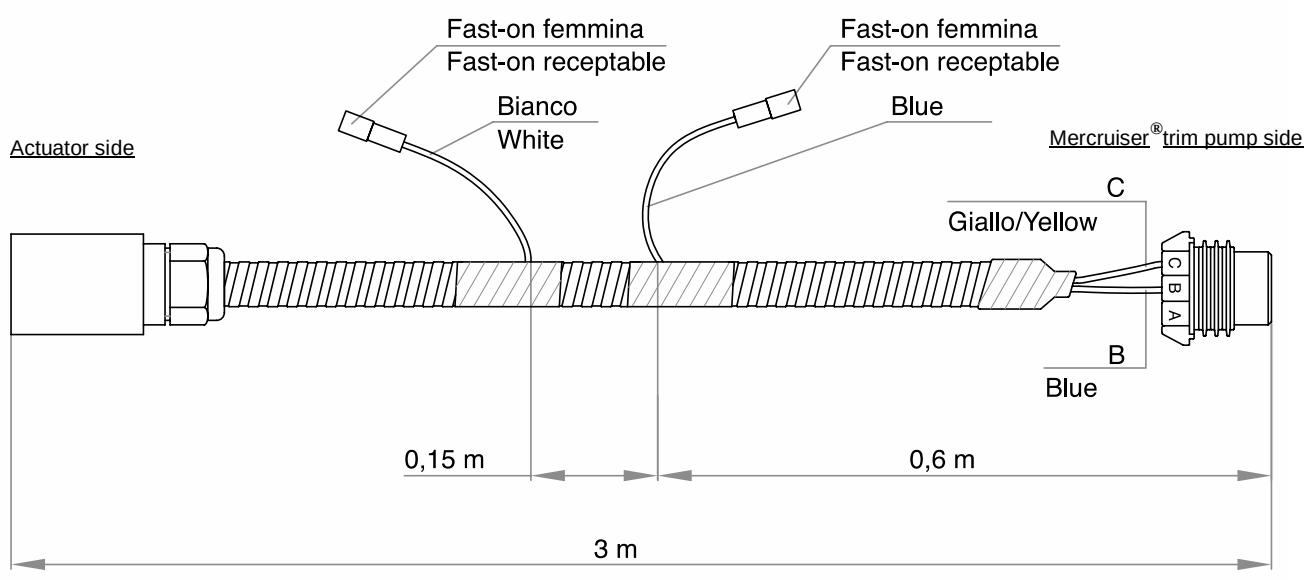
6.4.1 Nanni Diesel – Cable for the trim/flap command

For drawing and pin-out refer to section 6.4

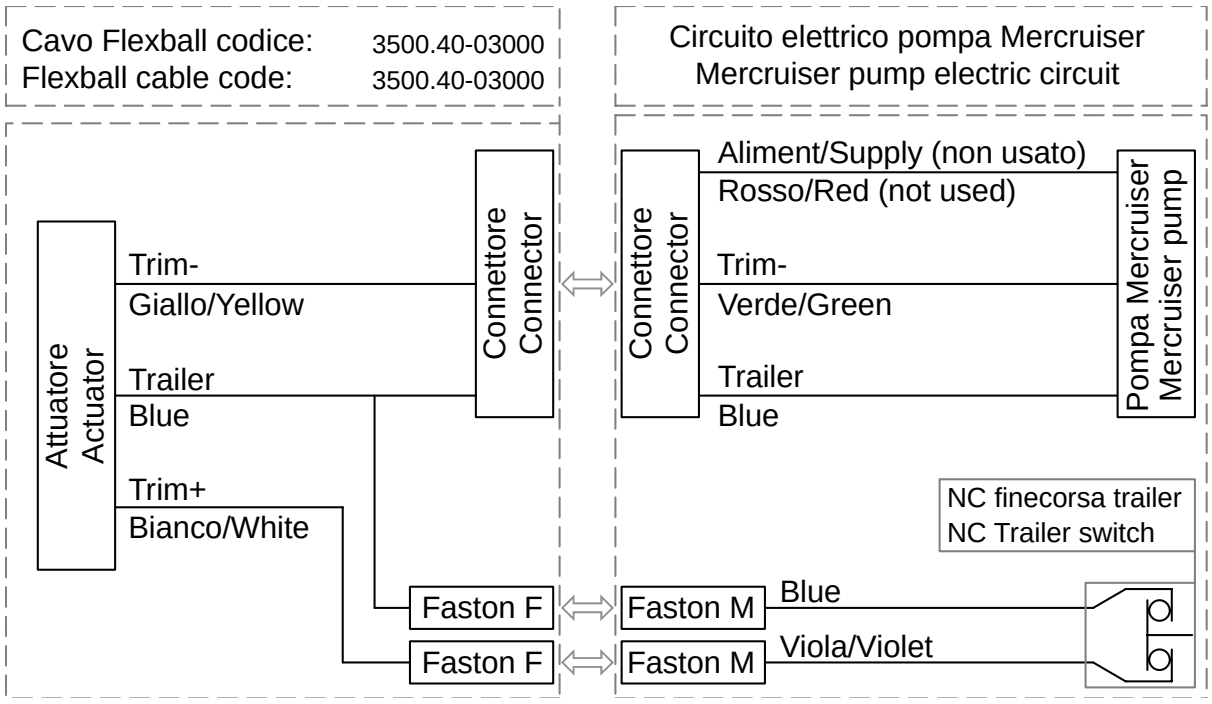
Length	Code
L=3 m	4665/37-03000
L=5 m	4665/37-05000
L=7 m	4665/37-07000

6.5. Cable actuator –Mercruiser® trim pump

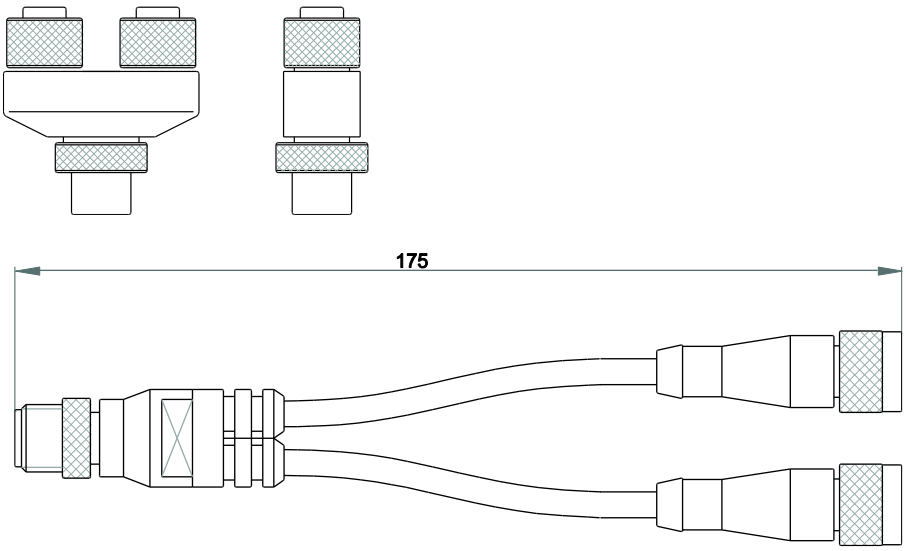
The cable for the trim pump of Mercruiser sterndrive has a length of 3 meters; in the cabling are included the fast-on connections to the micro-switch for the end of stroke of the tilt.



Length	Code
L=3 m	3500.40-03000

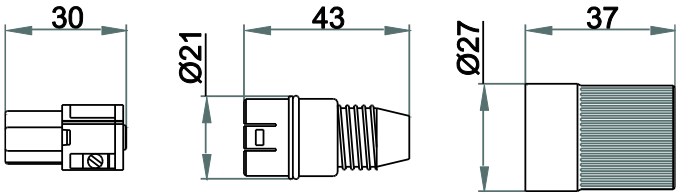


6.6. T-Splitter



Code: N-85E010003

6.7. Power supply connector



Code: 3500.38-00000

► **Important:** cabling instruction of power supply connector are at section 8.1.1 of this manual.

7. Configuration of the CANBus network

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

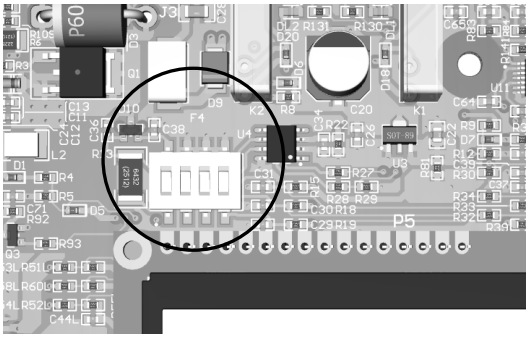
How to configure the installation depends on the quantity and type of engines, gearboxes and command stations needed. Actuators and command stations - which communicate together through the CANBus network - must be configured in relation to how they are connected to the CANBus network. In the following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

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

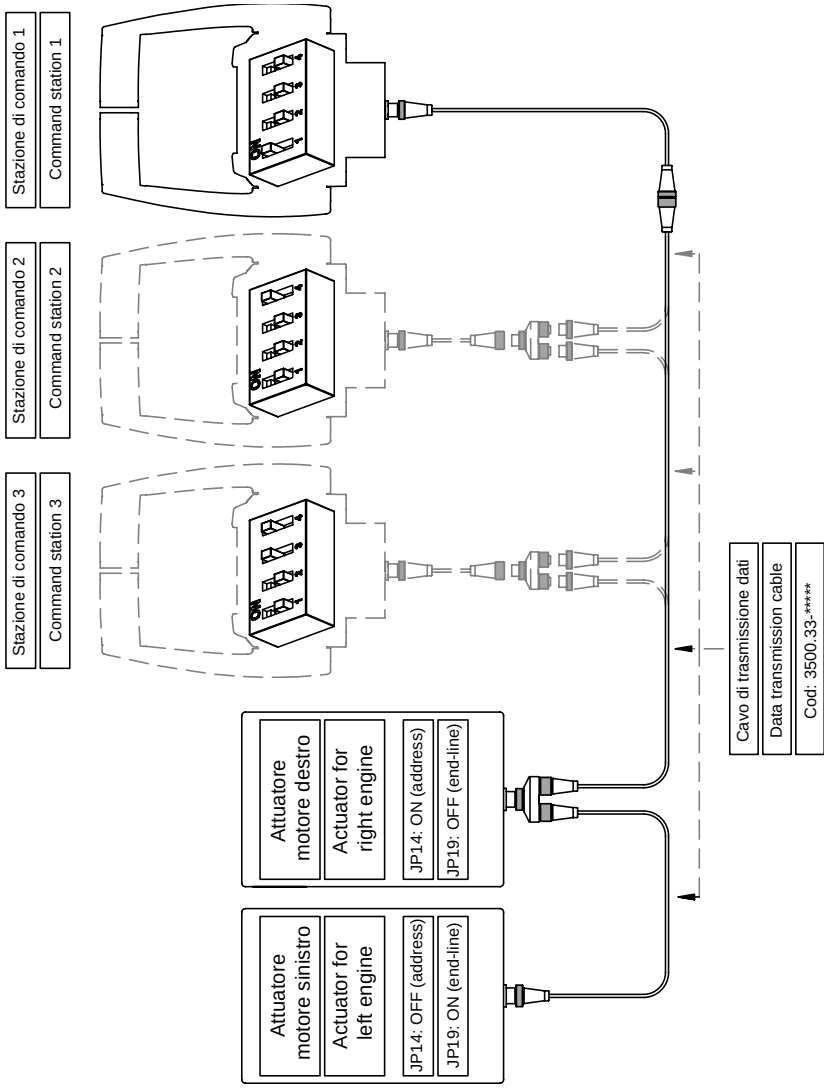
The following installation schemes cover the most common application cases.

► **Note for 4600 series:** here below pictures refer to actuator boxes having the Actuator 3.1 board installed. In case your system has the new Actuator 4.0 board, please refer to the following table in settings DIP switches:

Actuator 3.1	Actuator 4.0 (DIP switch S1)	Description
JP19	Switch number 1	CAN Bus Termination JP19 OFF is equivalent to SW1 OFF JP19 ON is equivalent to SW1 ON
JP14	Switch number 4	Actuator Address JP14 OFF is equivalent to SW4 OFF JP14 ON is equivalent to SW4 ON



7.1. Installation with 2 mechanical actuators – solution A

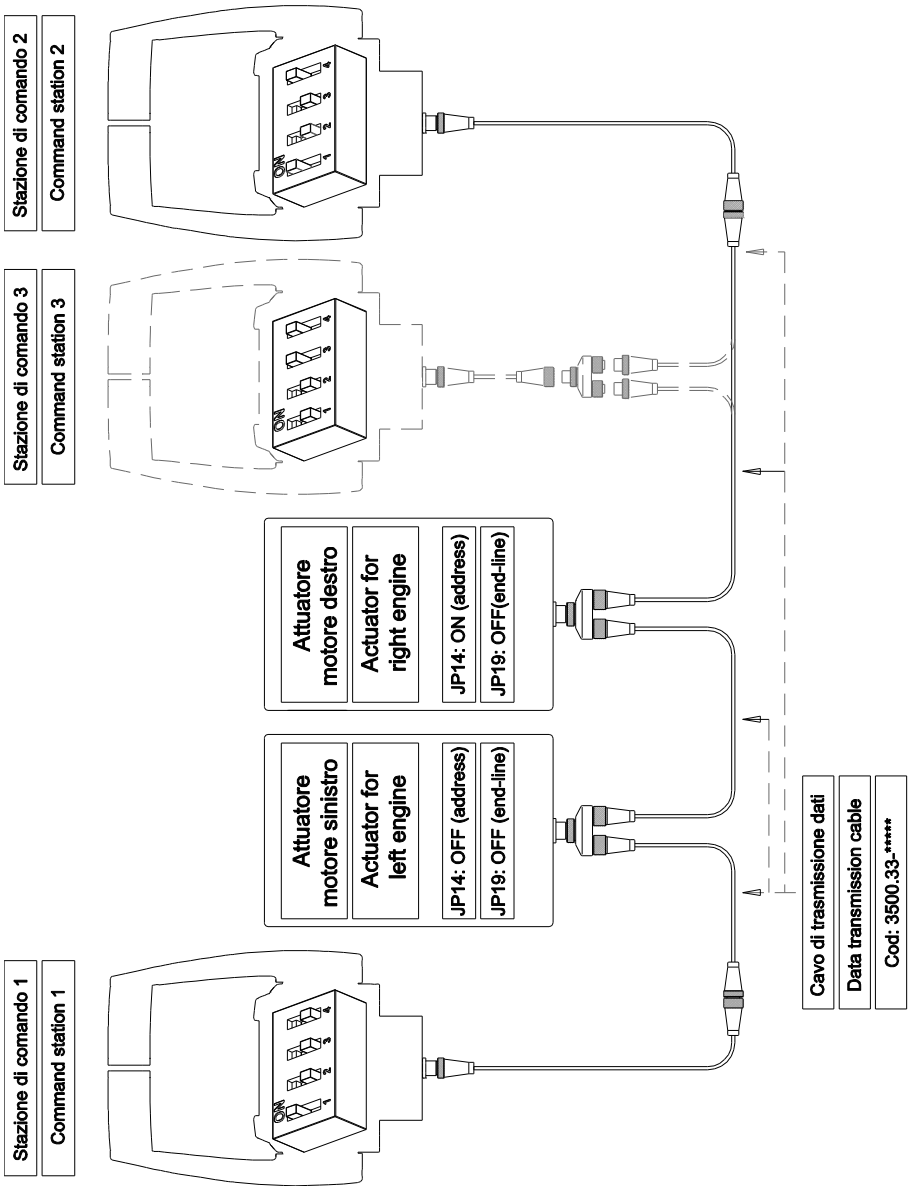


This installation scheme is valid for systems with:

- 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.

► **Note for 4600 series:** see page 47 for equivalence jumpers - DIP- switch position

7.2. Installation with 2 mechanical actuators – solution B



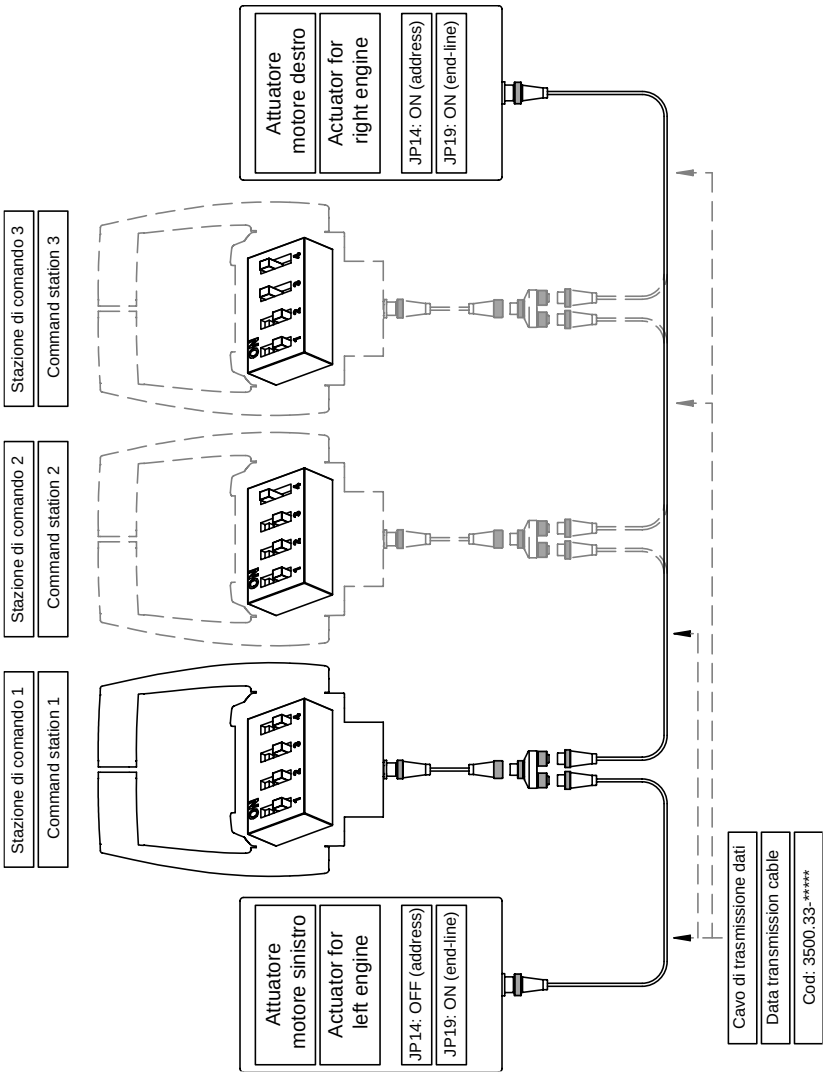
This installation scheme is valid for systems with:

- 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.

► **Note for 4600 series:** see page 47 for equivalence jumpers - DIP- switch position

7.3. Installation with 2 mechanical actuators – solution C

Actuators are placed at the ends of the CANBus network.



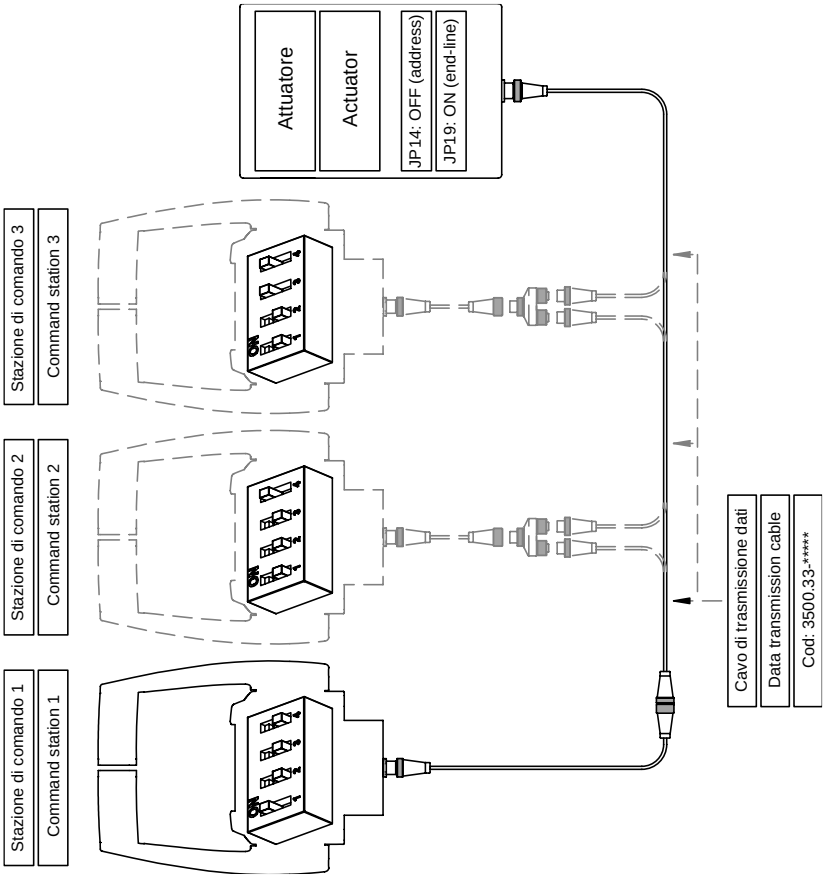
This installation scheme, typical for catamaran applications, is valid for systems with:

- 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.

► **Note for 4600 series:** see page 47 for equivalence jumpers - DIP- switch position

7.4. Installation with 1 actuator – solution D

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



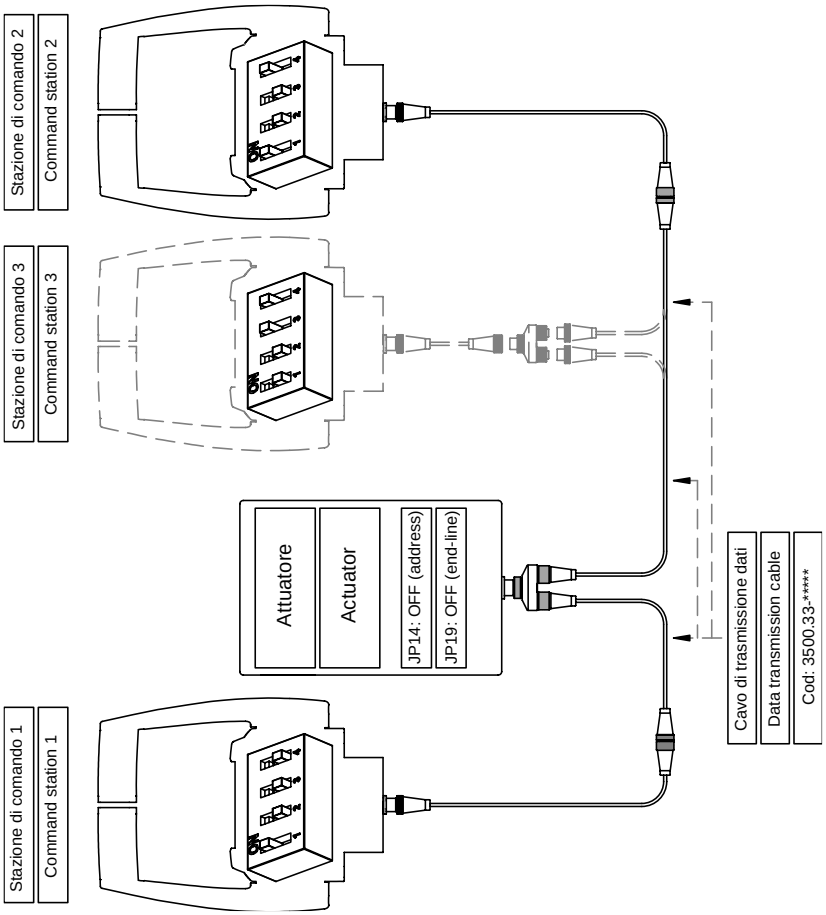
This installation scheme is valid for systems with:

- 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).

► **Note for 4600 series:** see page 47 for equivalence jumpers - DIP- switch position

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).

► **Note for 4600 series:** see page 47 for equivalence jumpers - DIP- switch position

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

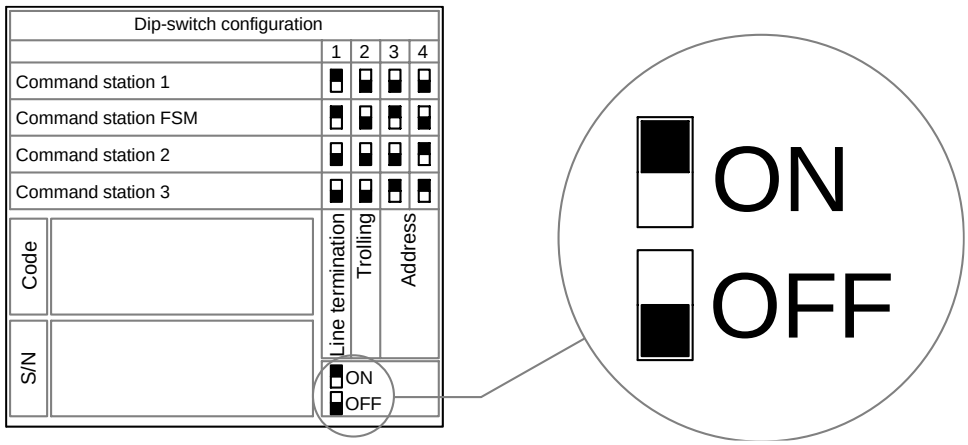
According to the number and to the position on the CANBus communication net, command stations and actuators must be configured to guarantee the correct functioning of the system. End of line termination resistors must be enabled on the devices placed at the beginning and at the end of the CANBus network.

7.6.1. Configuration of the command station

It is mandatory to setup the command station in relation to its position on the CANBus network. Each command station must have a different address number (except for the third command station from SN 18500) and if the command station is connected at the end of the CANBus network, the end line dip-switch must be enabled (ON).

Under the base of the command station there is a inox cap. Unscrewing and removing it, you have access to the dip-switches.
Operations:

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



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

Dip-switch 2: trolling option activation

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 black 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 The address of the command station is defined by the configuration of the dip-switches. If you are dealing with command stations with a higher SN with respect to 18500 you can add as many “Command station 3” as you want.

► **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, refer to the installation schemes reported from section 7.1. to section 7.5.

7.6.2. Configuration of the actuator

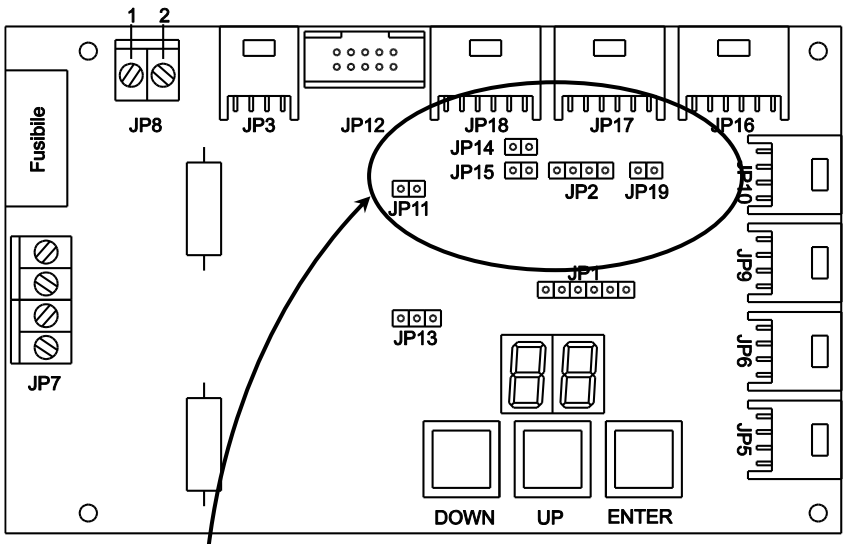
To configure the actuator, it is necessary to:

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

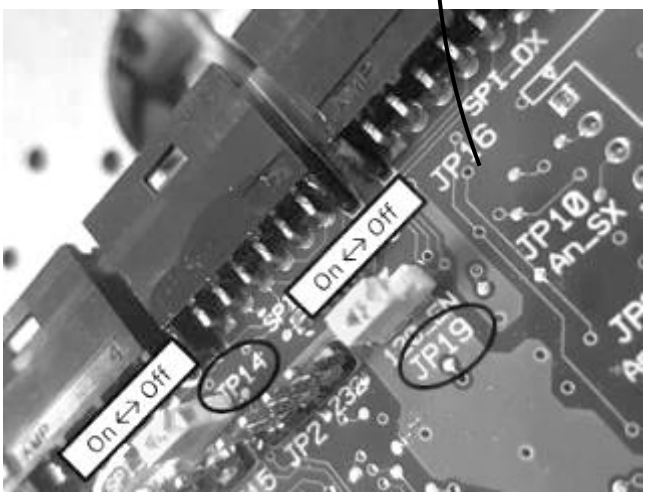
These operations must be related to the position of the actuator as described in the schemes of chapter 7.

Actuator 3.1 (4500 series)

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

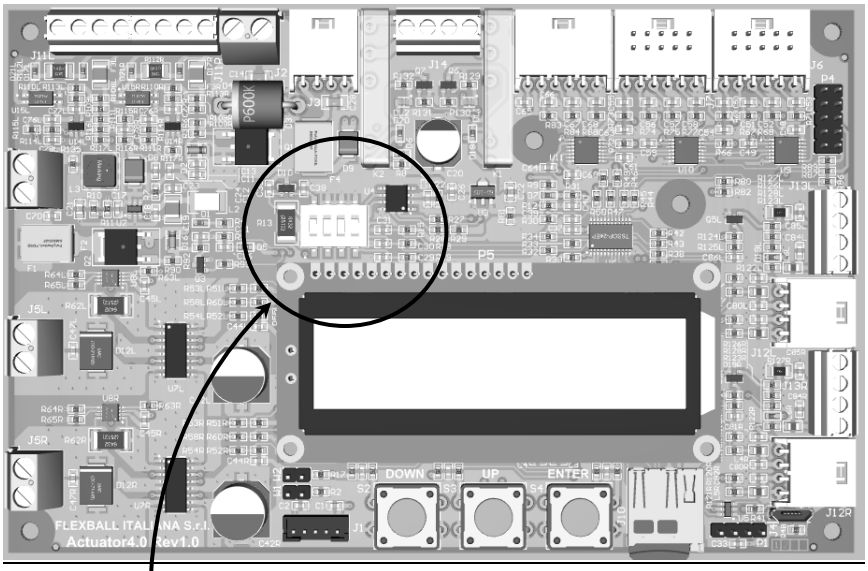
The actuator configuration changes according if the system is with one or two actuators:

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 setting of JP14 and JP19 depends on the configuration of the CANBus network, as described from section 7.1 to 7.5	

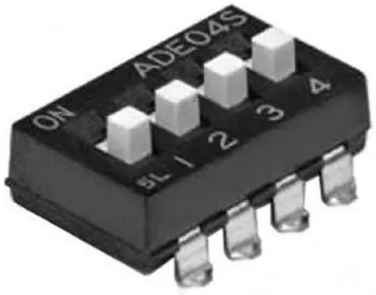
Actuator 4.0 (4600 series)

Component S1 contains 4 switches, numbered from 1 to 4.
Switch 1 activates the CAN Bus line-termination while switch 4 defines if the actuator will drive the left or the right engine.
Factory setting is:

- switch 1 ON (CAN Bus termination is activated)
- switch 4 OFF (left engine).



In some documentation, ON or OFF are indicated as YES or NO.

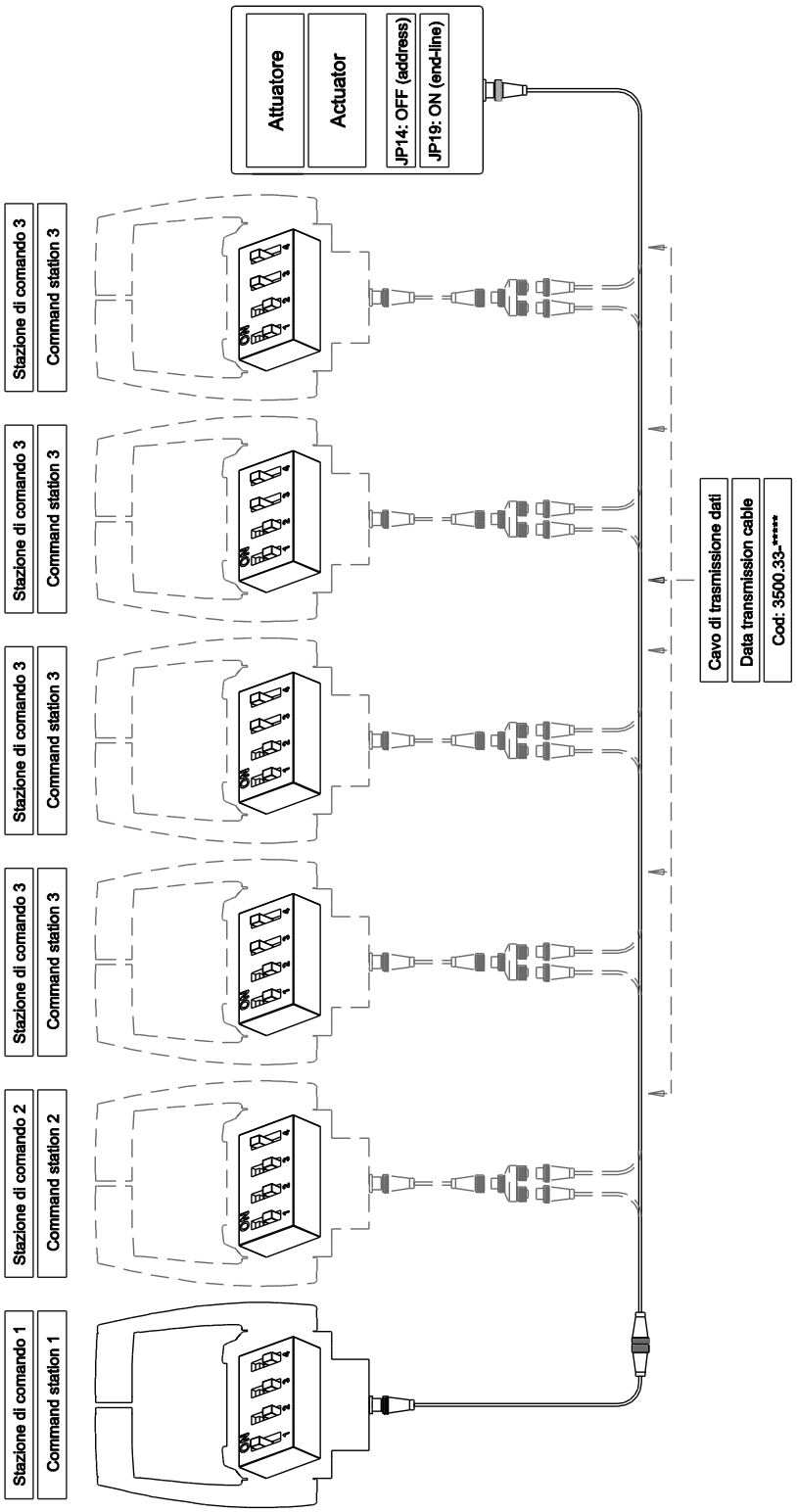


The actuator configuration changes according to the number of actuators:

Installations with 1 actuator	Installations with 2 actuators
Switch 4 = OFF (address = 0)	Left actuator must have switch 4 = OFF (address = 0)
	Right actuator must have switch 4 = ON (address = 1)
DIP-switches setting depends on the CANBus configuration, as described from section 7.1 to 7.5	

7.7. Configuration with more than 3 command stations

In case more than three command stations are required, command stations 3 must be with serial number greater than 18500. In this case it possible to add to the CANBus network a greater number of command stations, which must have all the CANBus address n° 3.
Command stations with CANBus address = 3 can be physically placed anywhere in the CANBus network, but the CANBus must have at its ends the end-of-line terminations (see sections from 7.1 to 7.6).
Here below an example of a single actuator installation with more than 3 command stations.



7.8. 4600 series switch settings

On Actuator 4.0 board there are some new features that can be activated through switch 3 and 4 on component S1. Settings are explained in the table below:

Switch number	Function
Switch 1	*CANbus 120Ohm Termination Management* OFF – No termination ON – Termination activated
Switch 2	*Listen Only Mode* Actuator will not emit messages on CAN Bus network except for fault messages. Useful for more than 2 engine installations
Switch 3	*Listen Only Third Command Station* Actuator will react only to settings done on the third command station. Useful in some hybrid applications
Switch 4	*Controlled Engine Side Setting* OFF – port engine (or single engine application) ON – starboard engine on dual engine application

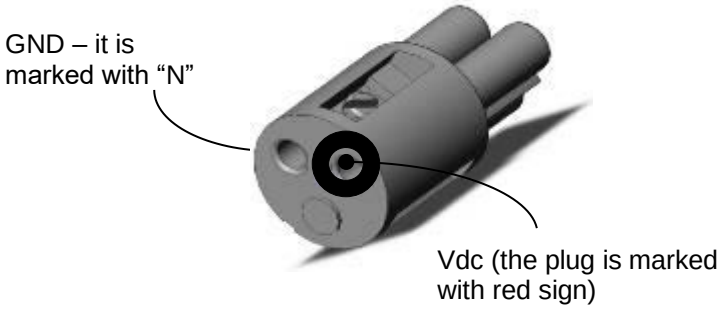
8. Electrical installation

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

8.1. Wiring from the battery to the actuator (input cables)

8.1.1. 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 supplyplug, 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 cables and power source
- the actuator has been supplied with inverse polarity, therefore:
  - swap plus and minus wires, in order to re-establish the right polarity on the supply cable
  - replace the fuse of 6,3 A 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 above (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.**

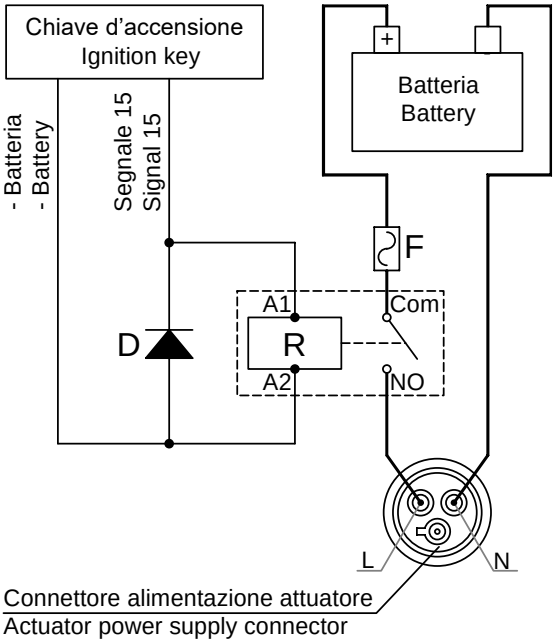
Supply voltage	**12 V**	**24 V**	**12/24 V**	**12 V**	**24 V**	**12/24 V**
	4500 series			**4600 series**		
Internal fuse (on the actuator PCB)	5,0 A			Not present		
Wall fuse	6,15 A	-	6,15 A	8A	8A	8A
Current absorbed in no loaded condition	0,5 A	0,25 A	0,5 A (max)	0,5 A	0,25 A	0,5 A (max)

8.1.2. The ignition key switch

Starter motors
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.

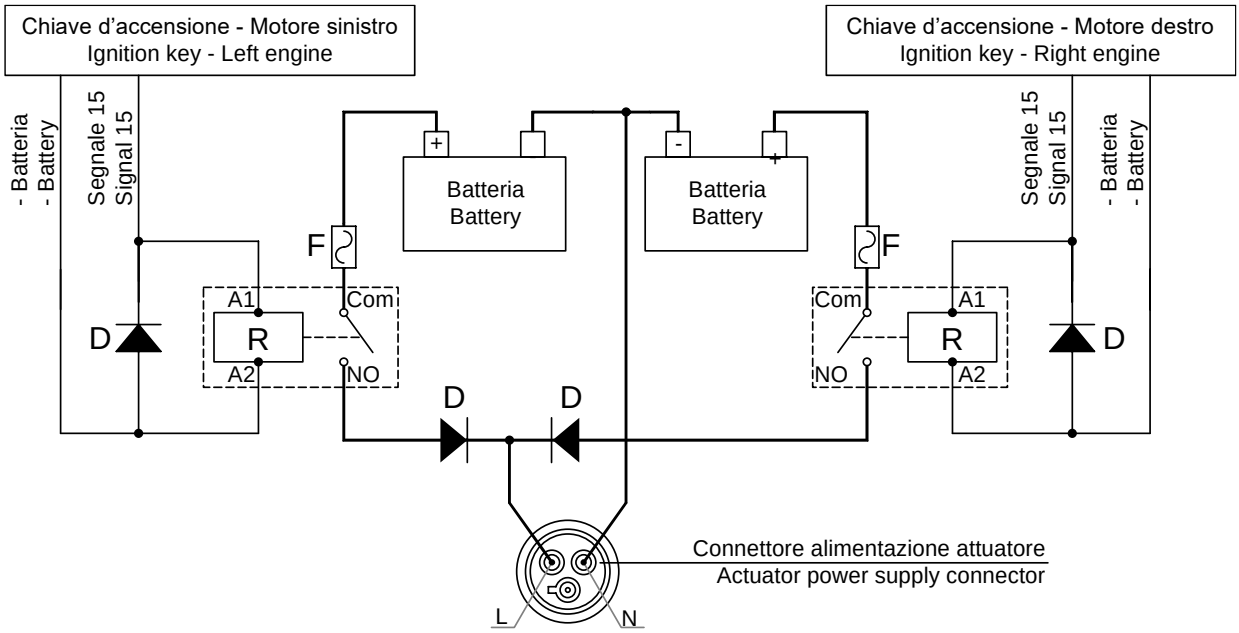
Electronic system with 1 actuator	Electronic system with 2 actuators
In case of 2 batteries, the actuator must be connected to both the batteries. The “plus” cables must be connected with a 10A decoupling diode. In this way the actuator will be supplied by the most charged battery. The minimum section of the cable must be of 2,5 mm^2.	Each actuator must be supplied from its own battery. The minimum section of the cable must be of 2,5 mm^2.
Refer to electrical installation scheme reported in section 8.1.3 for system with one ignition key and 8.1.4 for system with two ignition keys. This last scheme allows to power the actuator box activating at least one of the two ignition keys. If your application has double deck (e.g. main deck and fly-bridge) refer to installation scheme reported in section 8.1.5	Refer to electrical installation scheme reported in section 8.1.6. If your application has double deck (e.g. main deck and fly-bridge) refer to installation scheme reported in section 8.1.7.

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



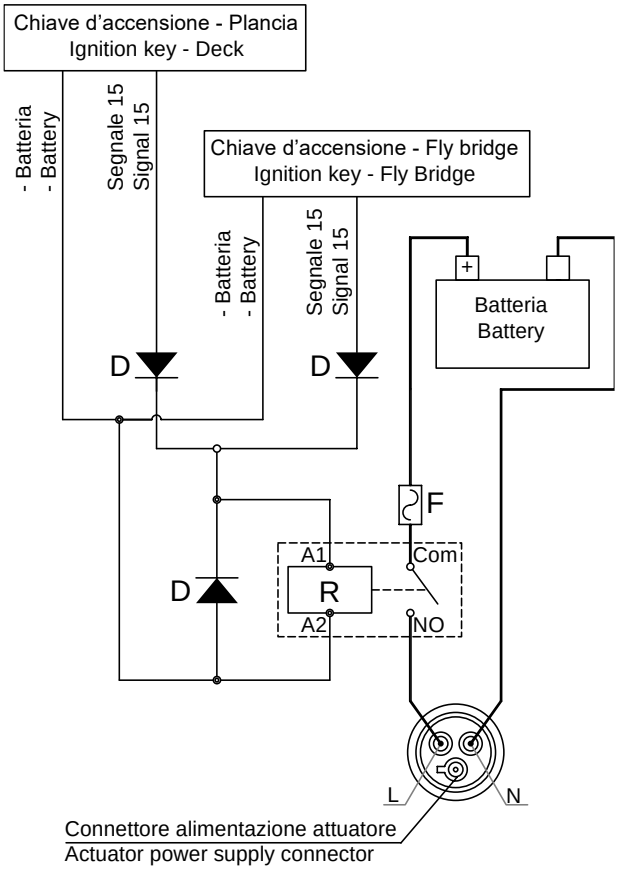
Ref.	Description	12 V power supply	24 V power supply
D	Diode	20 A, 20 V	10 A, 24 V
R	Relay	20 A, 12 V	10 A, 24 V
F	Fuse	16 A	
15	Terminal 15 is the signal coming from the ignition key block. When the ignition key is on its first detent, signal 15 is active.		
	Supply cable cross section	2,5 mm^2	1,5 mm^2

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



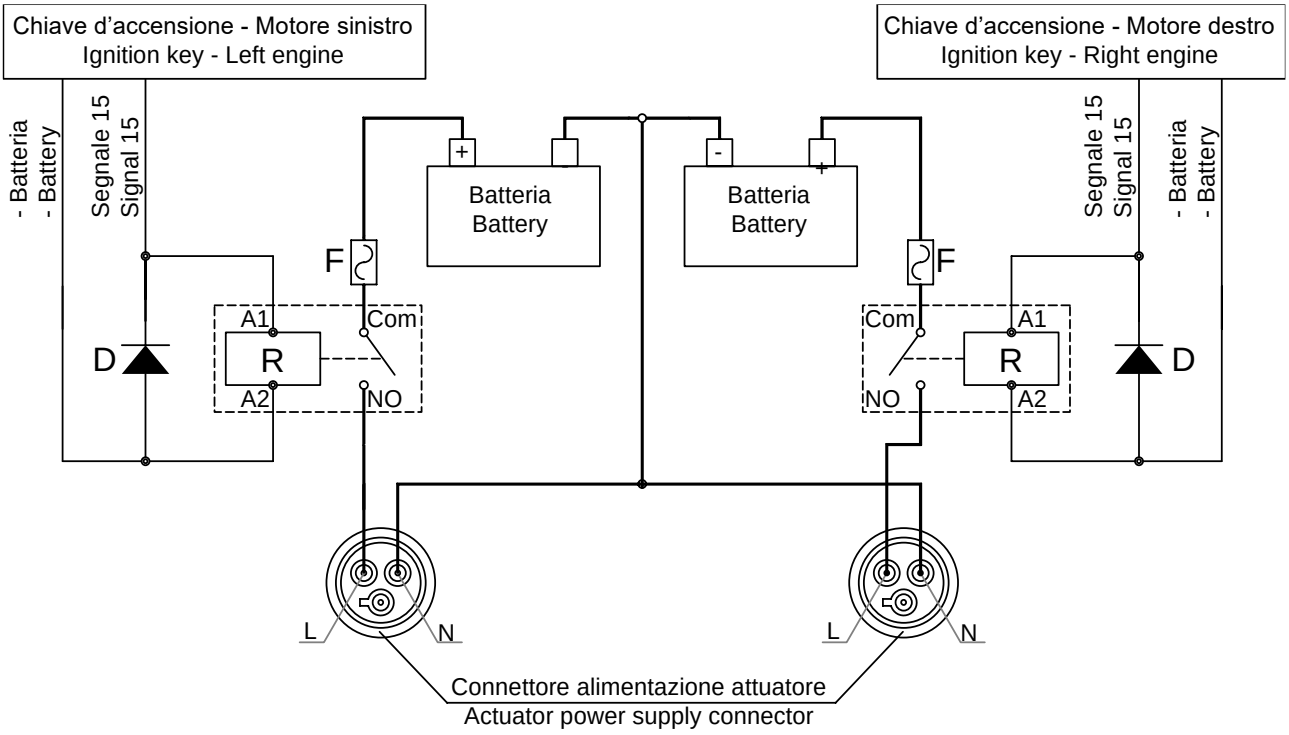
For the detailed list of components, please refer to the table at section 8.1.3.

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



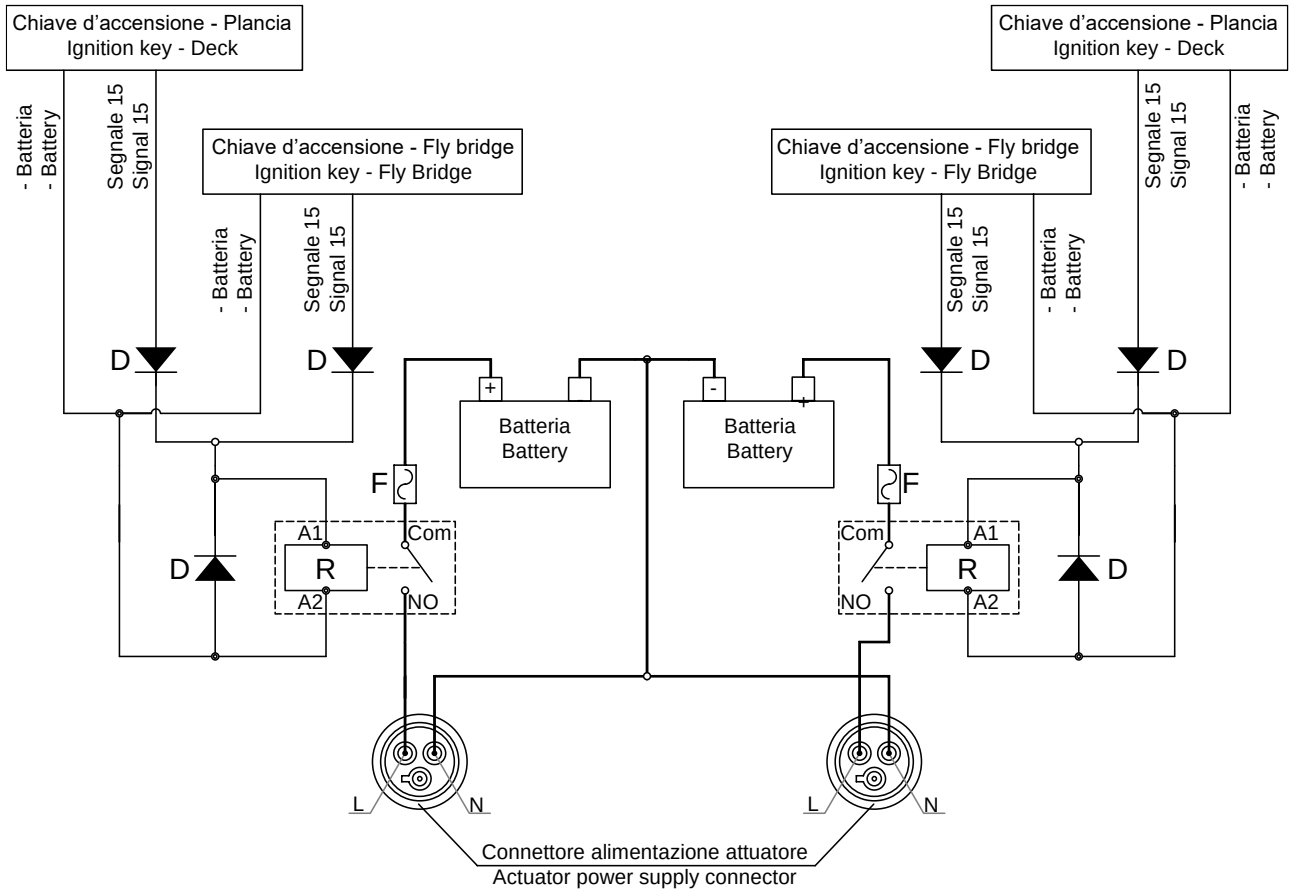
For the detailed list of components, please refer to the table at section 8.1.3.

8.1.6. 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 8.1.3.

8.1.7. Electrical installation of systems with 2 engines, 2 actuators and 4 ignition keys

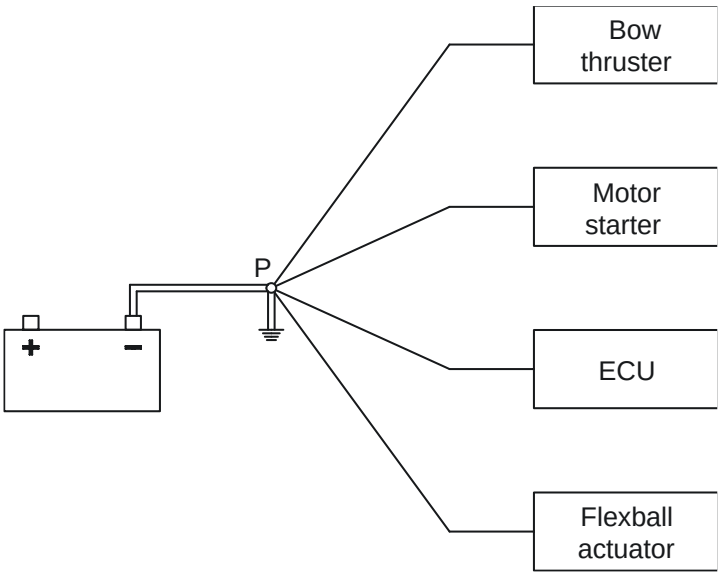


For the detailed list of components, please refer to the table at section 8.1.3.

8.1.8. Dimensional criteria of the power supply cables

For the supply cables respect the following provisions:

- Cables from the battery to engine starter (both positive and negative poles) must have a minimum cross section of 50mm^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 2,5mm^2.
- In case electronic throttle, it is very important to connect to a common GND point (either GND bus bar or common bonding conductor or hull) all the negative poles of each electronic device.

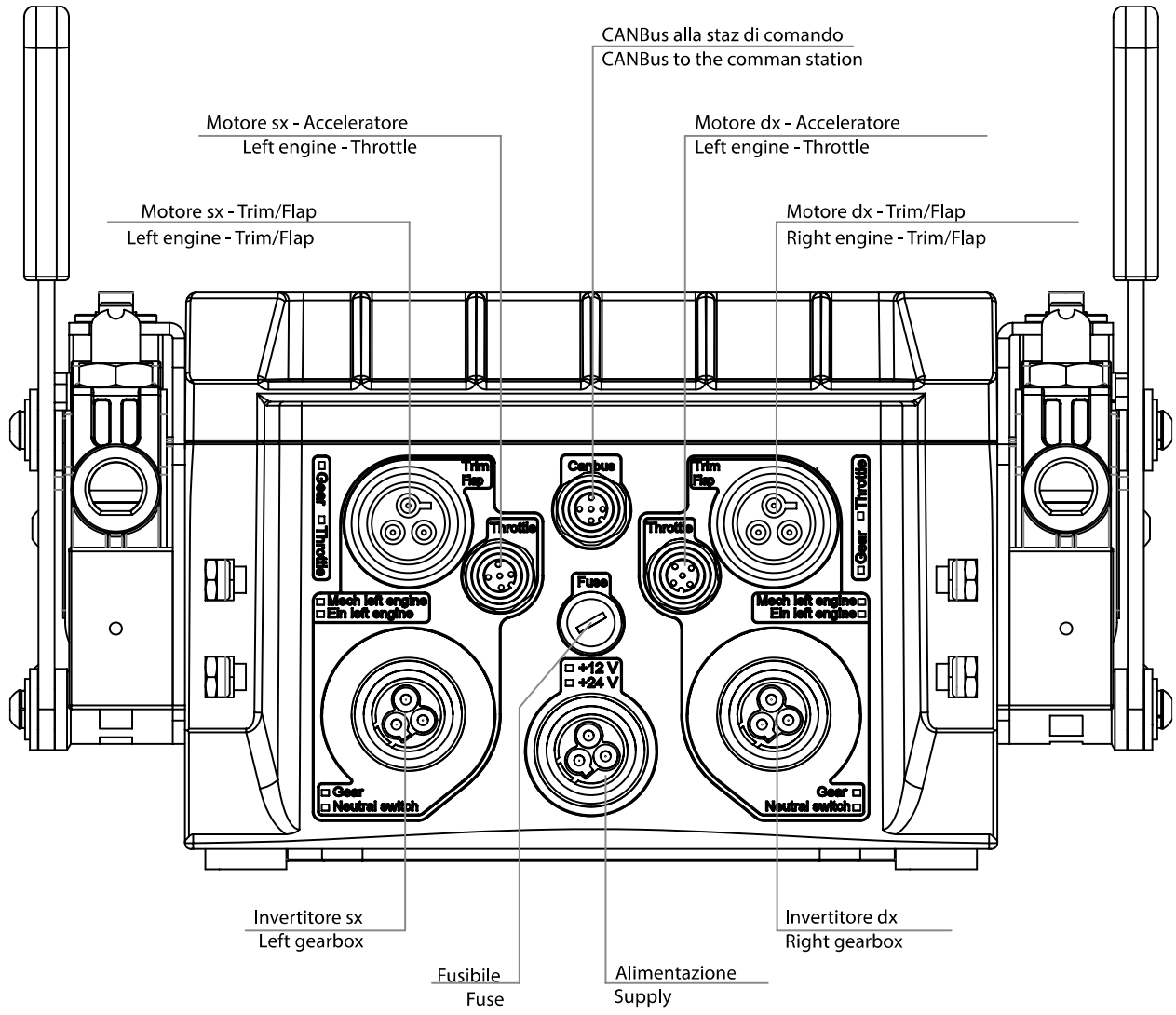


8.2. Wiring from the actuator to command stations, engines, gearboxes, trim/flaps, etc (output cables)

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, so 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). For more info look at chapter 6.

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).

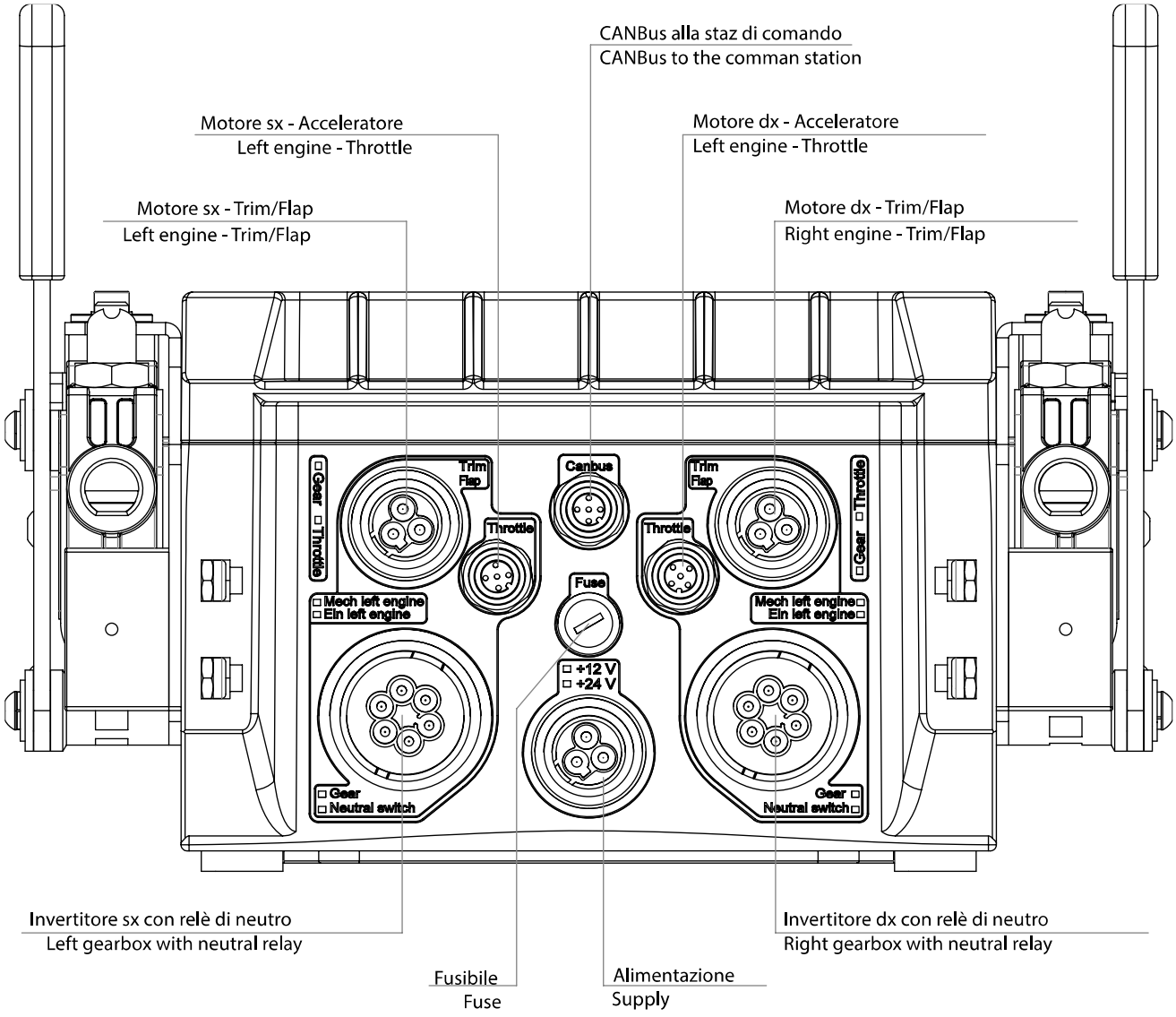
8.2.1. Actuator with mechanical interface without neutral relay



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 (2 propulsion groups per actuator)
- electronic engine and mechanical gearbox (2 propulsion groups per actuator)

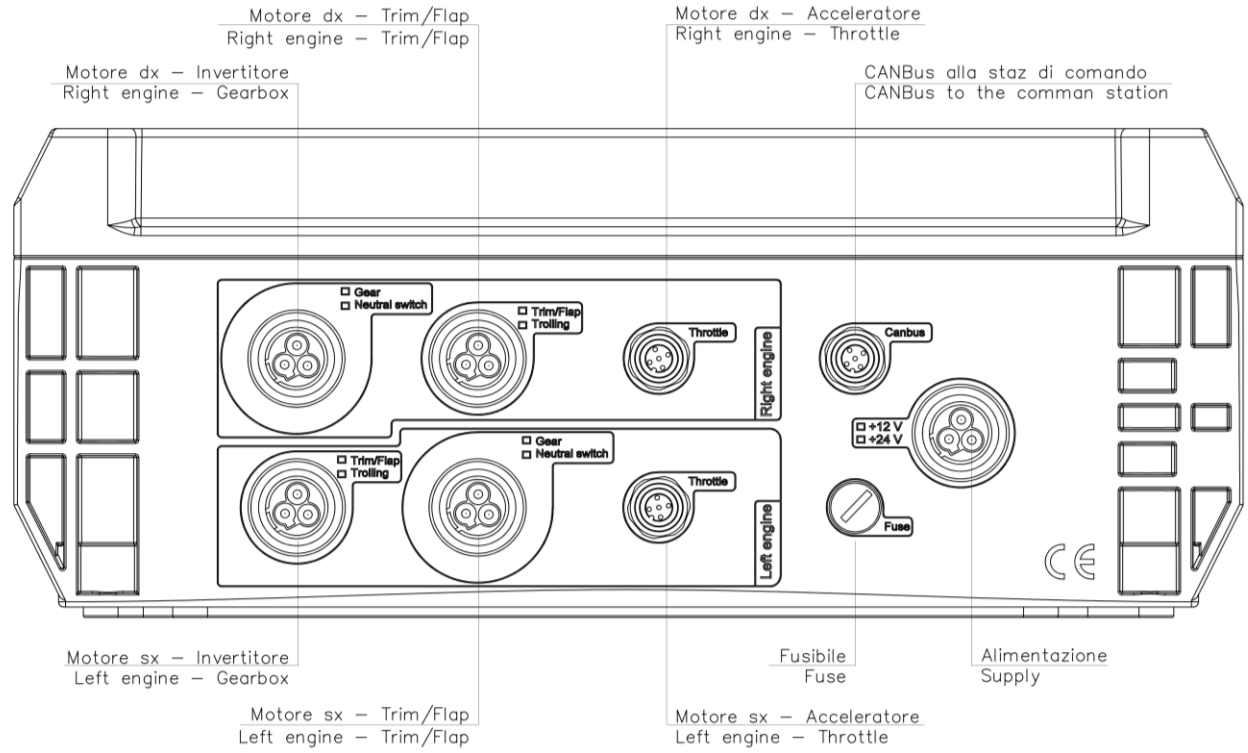
8.2.2. Actuator with mechanical interface and neutral relay



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:

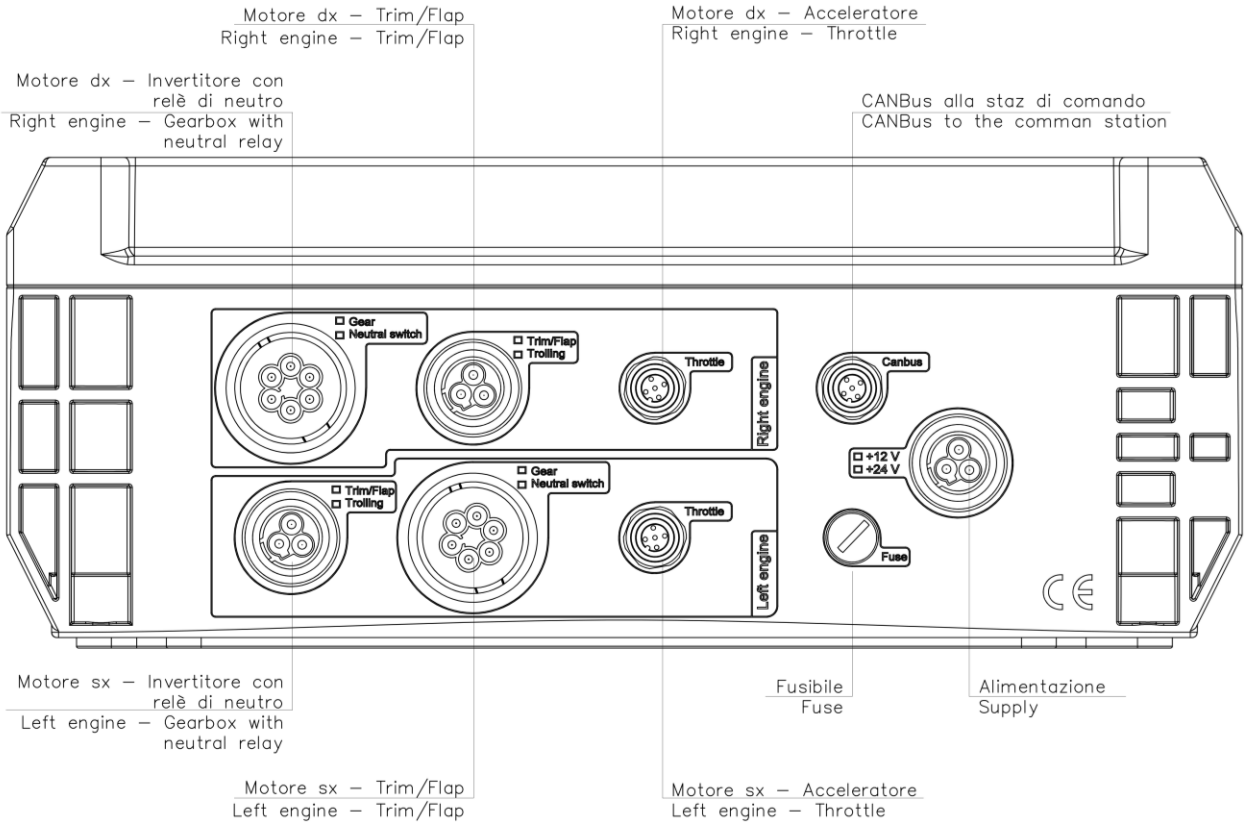
- mechanical engine and mechanical gearbox (only 1 propulsion group per actuator)
- mechanical engine and solenoid driven gearbox (2 propulsion groups per actuator)
- electronic engine and mechanical gearbox (2 propulsion groups per actuator)

8.2.3. Actuator with full electronic interface



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

8.2.4. Actuator with full electronic interface and neutral relay

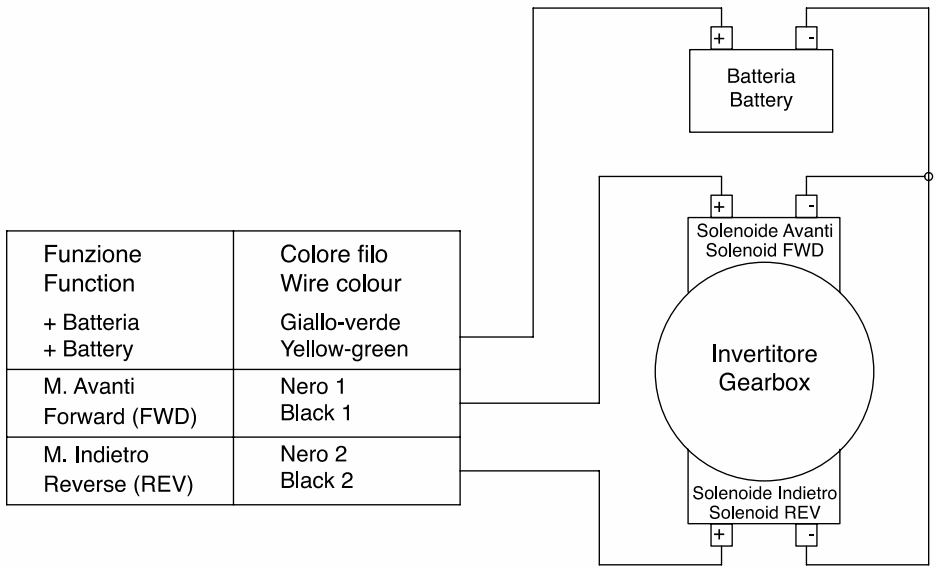


► **Important:** in case of single engine installation, use only the connectors for the right engine.

8.2.5. 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)



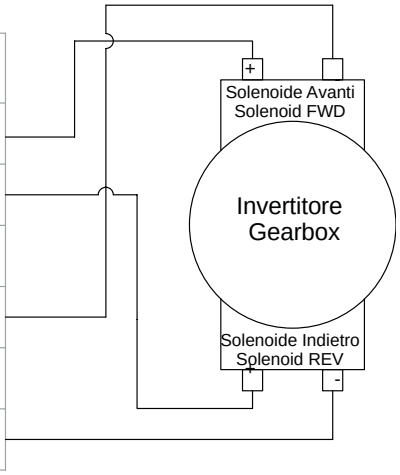
Funzione Function	Colore filo Wire colour
+ Batteria + Battery	Giallo-verde Yellow-green
M. Avanti Forward (FWD)	Nero 1 Black 1
M. Indietro Reverse (REV)	Nero 2 Black 2

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

8.2.6. 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.)



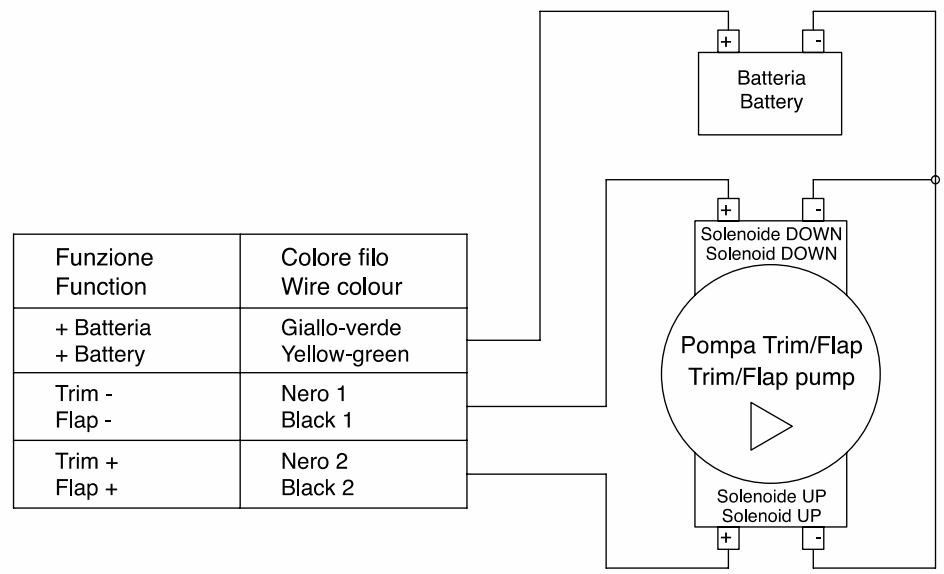
Funzione Function	Numero filo Wire number
M. Avanti - Segnale Forward (FWD) - Signal	1
M. Indietro - Segnale Reverse (REV) - Signal	2
Relè di neutro Neutral relay	3
M. Avanti - GND Forward (FWD) - GND	4
Relè di neutro Neutral relay	5
M. Indietro - GND Reverse (REV) - GND	6

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

8.2.7. 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 Function	Colore filo Wire colour
+ Batteria + Battery	Giallo-verde Yellow-green
Trim - Flap -	Nero 1 Black 1
Trim + Flap +	Nero 2 Black 2

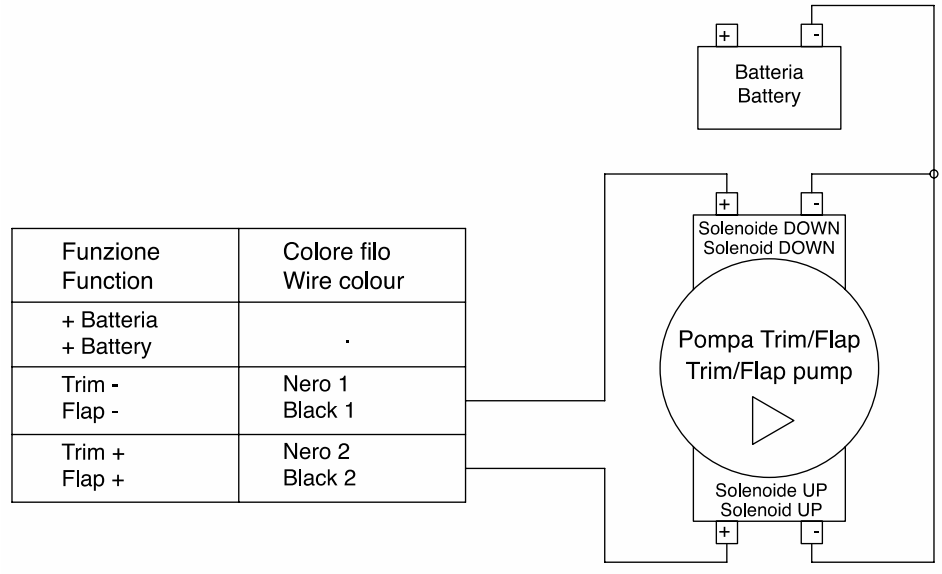
► **Important:** this scheme shows how to connect the electrical cables; battery switch and protection devices (e.g. fuses) must be implemented according to local regulations.

8.2.8. 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.

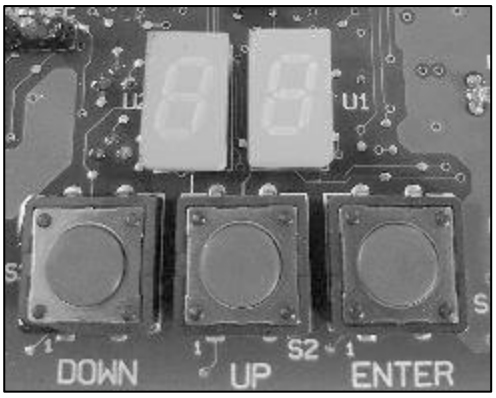


Funzione Function	Colore filo Wire colour
+ Batteria + Battery	.
Trim - Flap -	Nero 1 Black 1
Trim + Flap +	Nero 2 Black 2

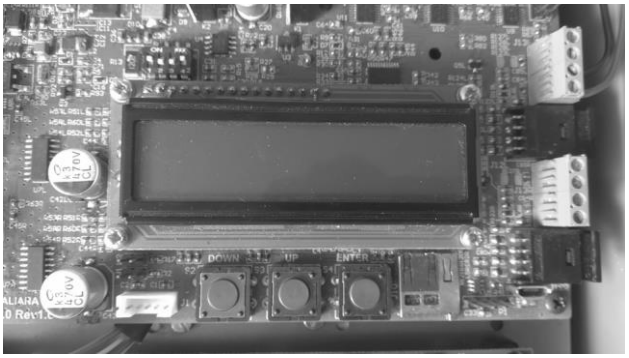
9. Programming of the actuator, general guidelines

9.1. Programming keypad

Actuator 3.1: the keyboard has a display with two figures and three programming pushbuttons/keys.



Actuator 4.0: the board has an LCD display and three programming pushbuttons/keys.



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

9.2. Display, menus and parameters

Actuator 3.1 (4500 series)

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 possible to scroll the parameter’s list
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.

Actuator 4.0 (4600 series)

At power on, the display shows in sequence
- “FLEXBALL ITALIANA S.R.L.”
- “4500 ELECTRONIC CONTROL SYSTEM”;

and then “SYSTEM OK (<UP&DW> for HELP”). This remains visible until an error comes out or the user presses “ENTER” or “UP” and “DOWN” together.

In general, to enter in a menu press “ENTER”, to return one level up press “UP” and “DOWN” together, to scroll the menus use the “UP” or “DOWN” buttons.

To enter into the parameter menu, press “ENTER”, select the “PARAMETER” menu, and then press again “ENTER”. It is now possible to move from one parameter to the other using the keys “UP” and “DOWN”.
For setting a parameter value, scroll the PARAMETER menu until you see it on the display and press “ENTER”: its value is now blinking and it is possible to modify the parameter’s value, using the keys “UP” and “DOWN”. Press the key “ENTER” to store the parameter’s value and immediately the display stops blinking.

See section 18 for more details.

9.3. Actuator parameters

► **Note for Actuator 4.0:** in the following sections the description is made for the Actuator 3.1 display. It is also useful for the new Actuator 4.0 board since in parameter and strokes setting menus there is always reference to the original parameter's code used in the Actuator 3.1 display.

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

Code display	Description	Range	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:

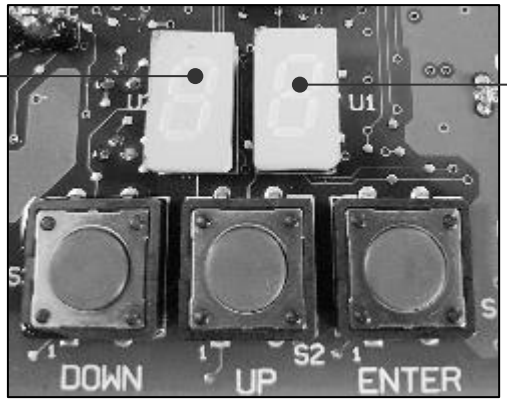
- **dI** is the delay that occurs when you move the lever from forward (or reverse) to neutral. The actuator goes to neutral only after the time set into **dI** expires.
- **dA** is the delay that occurs when you move the lever from neutral to forward (or reverse). The actuator starts to accelerate only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

With parameter **CC** (present only in Actuator 3.1, see section 20.2.1 for Actuator 4.0) 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 like in the picture herebelow, the left digit of the display shows the position of the left command station and the right digit of the display shows the position of the right command station.

It is shown left lever position according to the table above



It is shown right lever position according to the table above

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

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

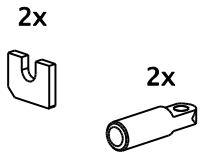
In this chapter will be presented the different types of push-pull cables and how to mount them.

10.1. 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.

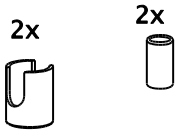
10.1.1. Connection kit

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



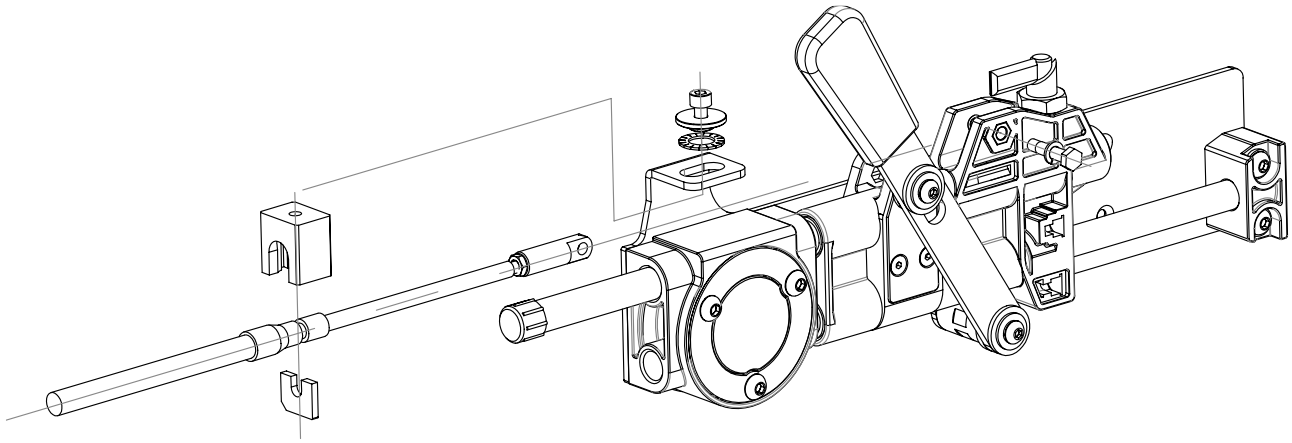
Connection kit for Johnson®cable

Connection kit for Mercruiser®cable



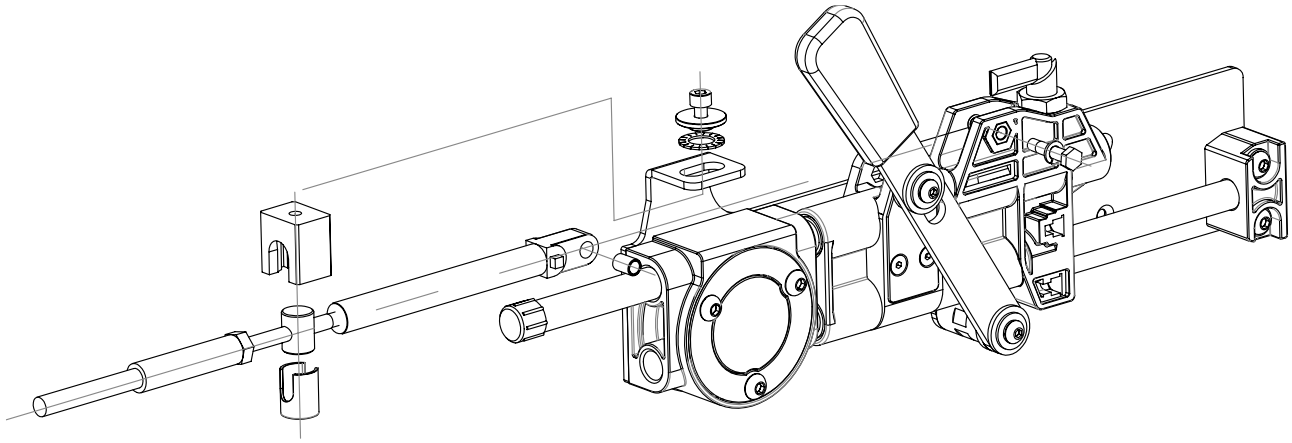
Each kit is enough to connect two push-pull cables.

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

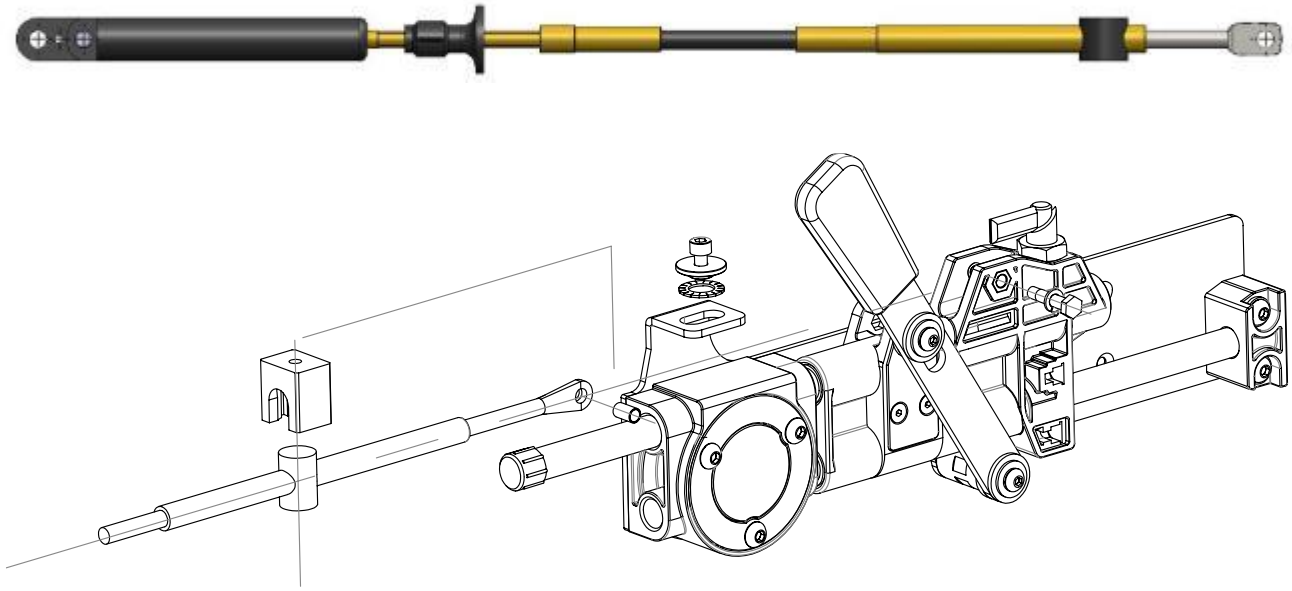


10.1.3. Mercruiser® stern drive push-pull cable

In case it is used the push-pull cable to connect directly the actuator to the Mercruiser® sterndrive, the plastic Mercruiser® bracket is not necessary.



10.1.4. Johnson® push-pull cable



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

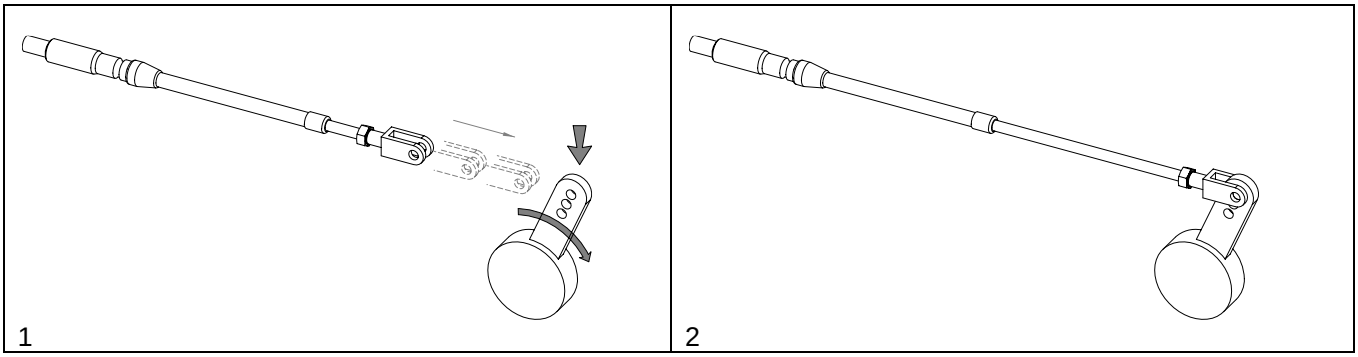
This example is referring to the mounting of a standard Volvo Penta push-pull cable. To mount the other types of cables, refer to the drawings at sections 12.1.3. and 12.1.4. For the assembly, the throttle must be in minimum position and the actuator must be turned off.

10.2.1 Connection of the push-pull cable to the engine

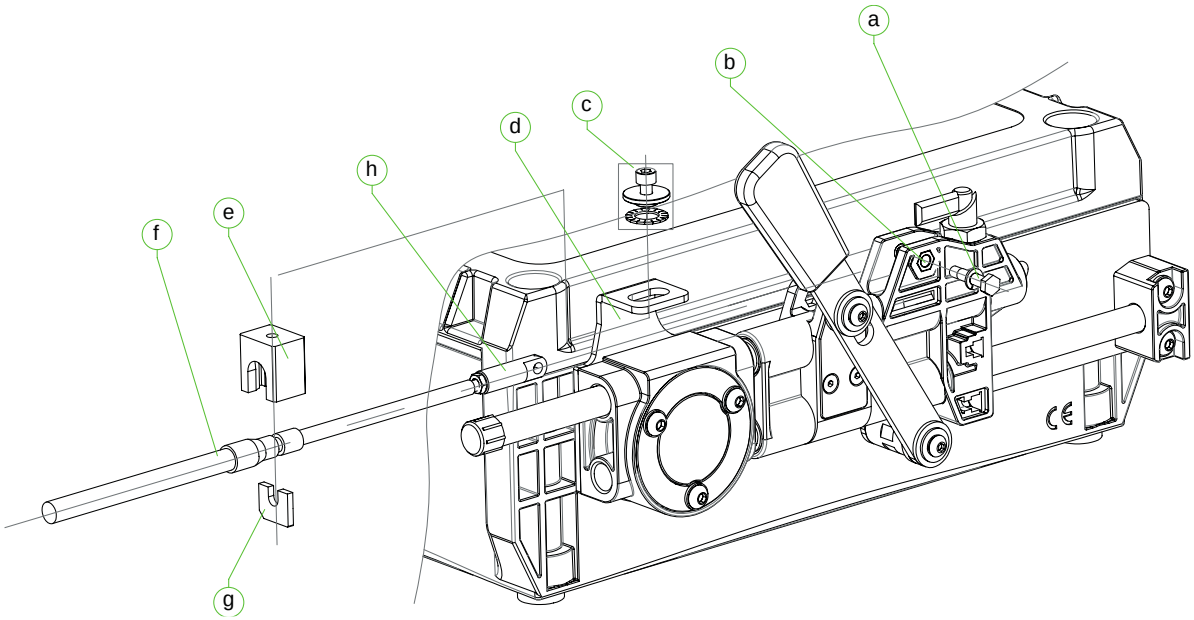
In this example it is assumed that if you pull the cable, the throttle speed increases.

1. Adjust the fixing of the push-pull cable in such a way that when the lever 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.



10.2.2 Connection of the push-pull cable to the actuator



Elements to be used for the connection

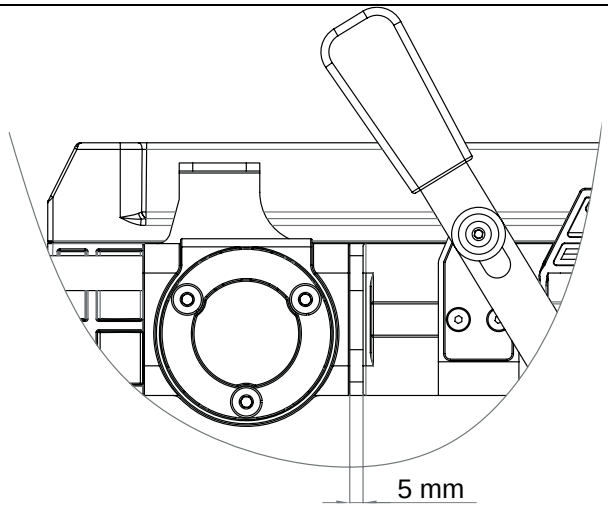
a	Screw + elastic washer to connect the eyelet
b	Hole where to fix the eyelet
c	Fixing screw (screw and washers)
d	Bracket slot

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

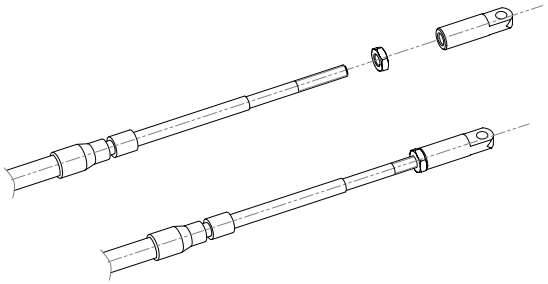
Follow the steps from 1 to 8 as reported here below:

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 eyelet, 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.If this is the case, at the actuator side the rod should be inside the push-pull cable (minimum stroke cable condition). Then screw the eyelet (h) onto the cable's rod (2).

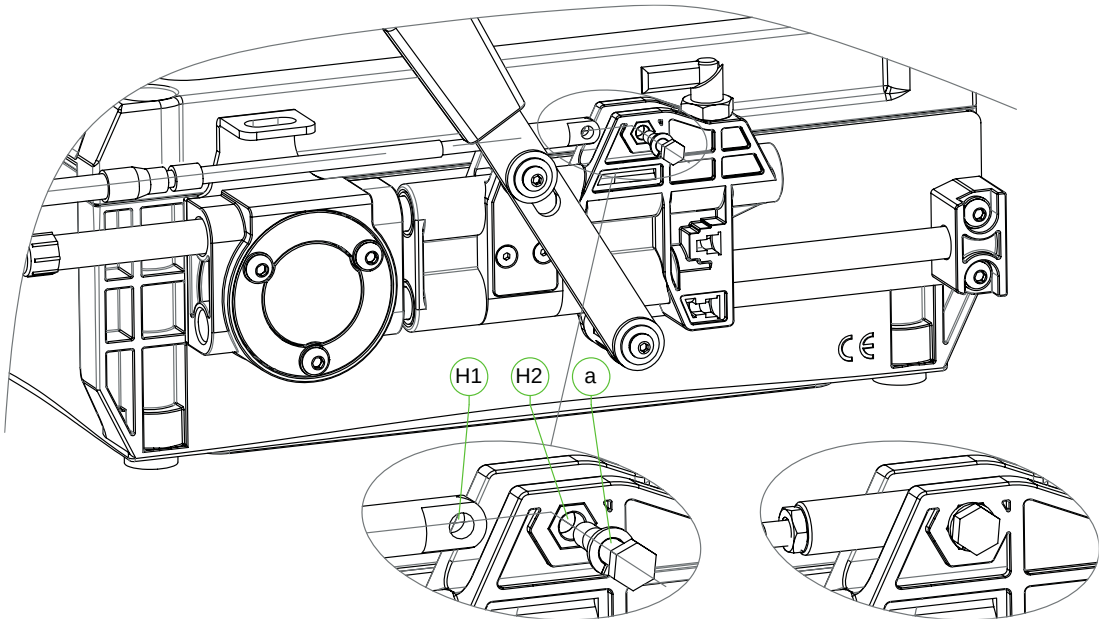


1



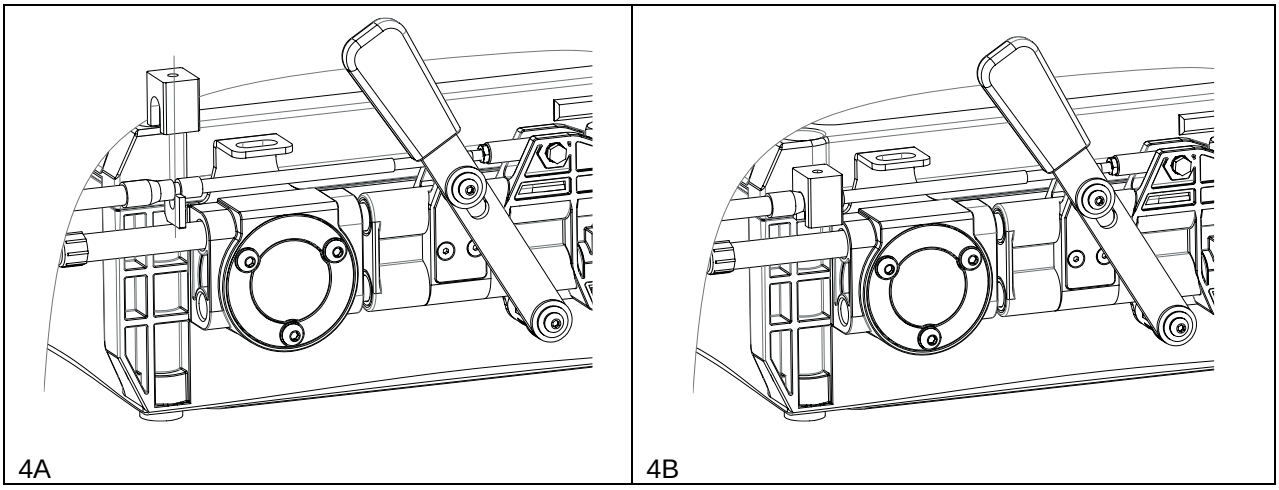
2

3. Align the eyelet on the push-pull cable (H1) with the hole of the plastic slider (H2).Insert the screw (+ elastic washer) and fasten it.



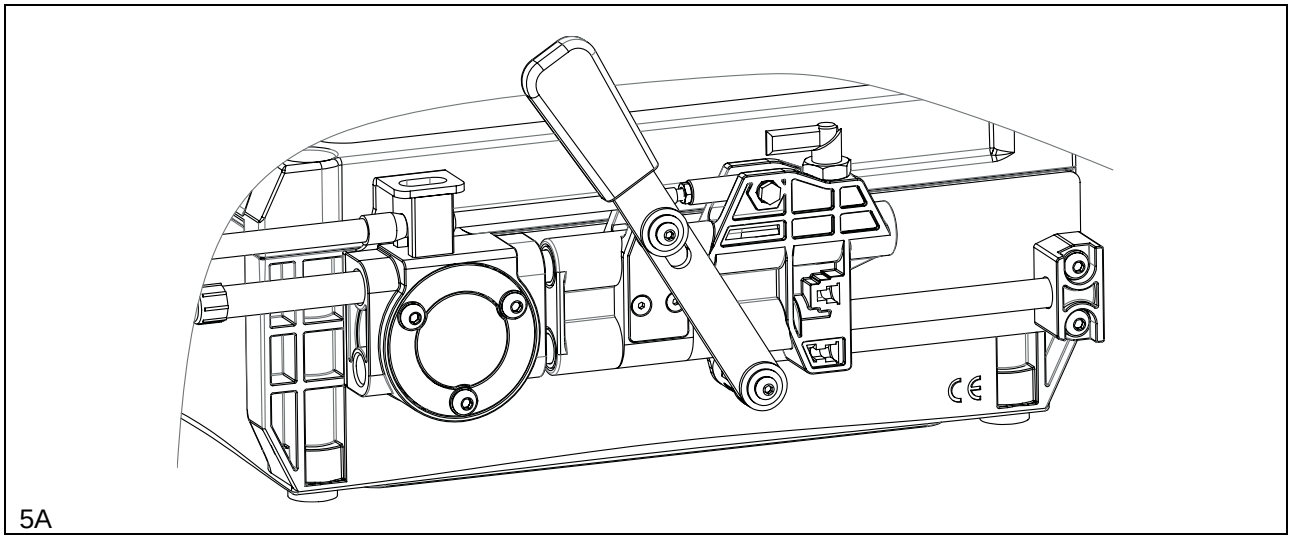
3

4. Insert the groove of the push-pull cable fitting between the blade (g) and the black aluminium cube (e).



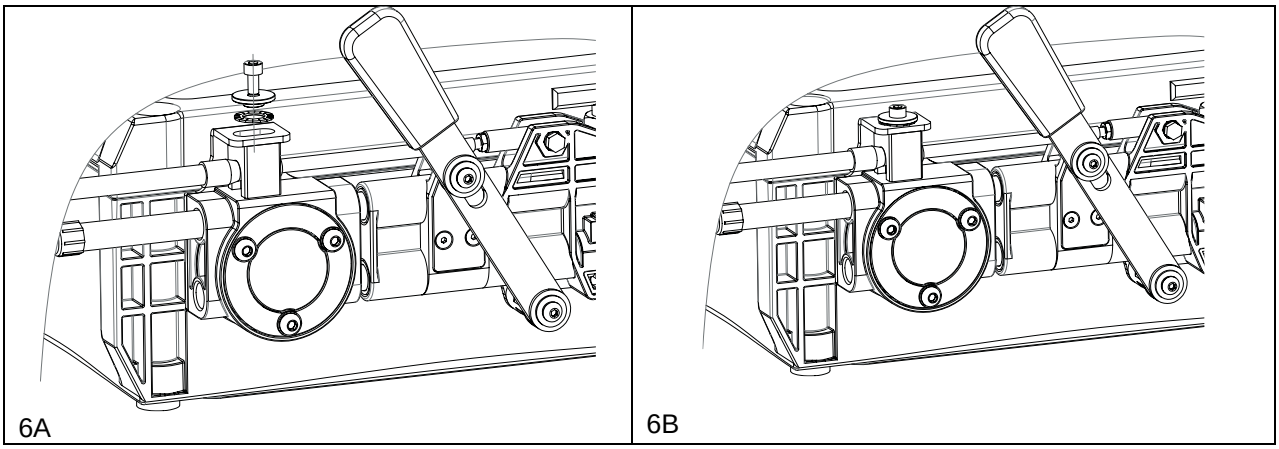
4A 4B

5. Insert the push-pull cable into the slot of the bracket (d). Check that the fixing cube is centred with respect to the slot on the bracket.



5A

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



6A 6B

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

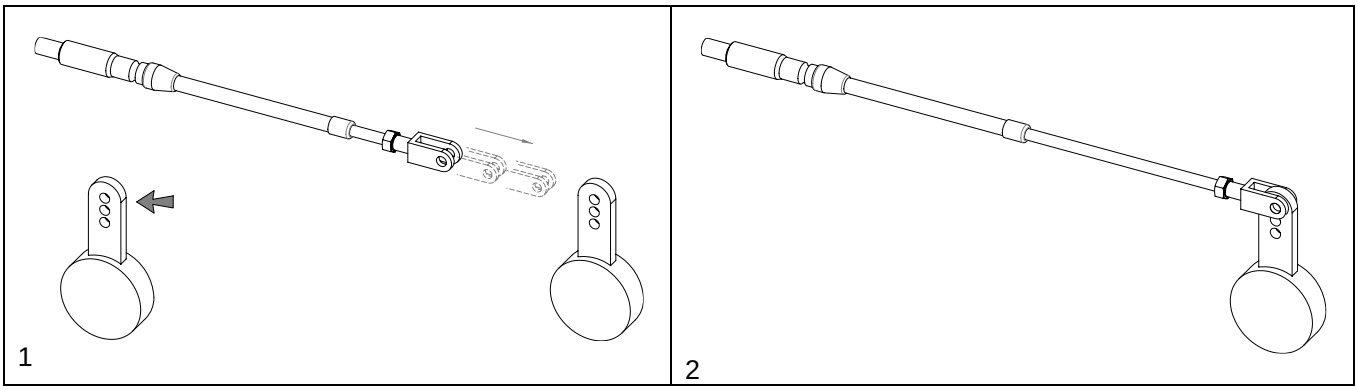
10.3. Mounting of the push-pull cable between gearbox and actuator

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.

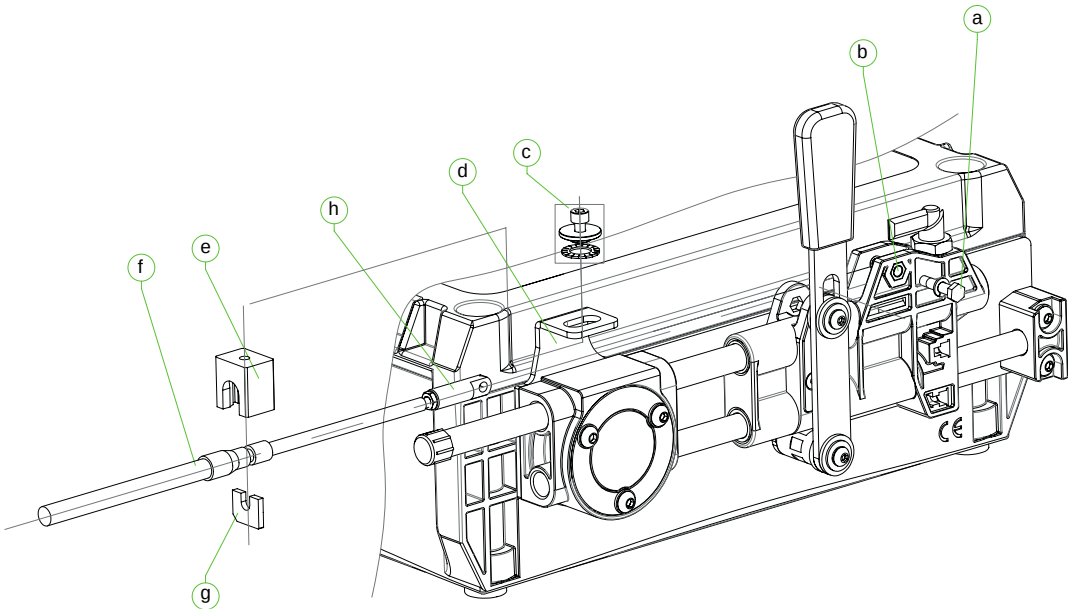
10.3.1. Connection of the push-pull cable to the gearbox side

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.



10.3.2. Connection of the push-pull cableto the actuator



Elements to be used for the connection

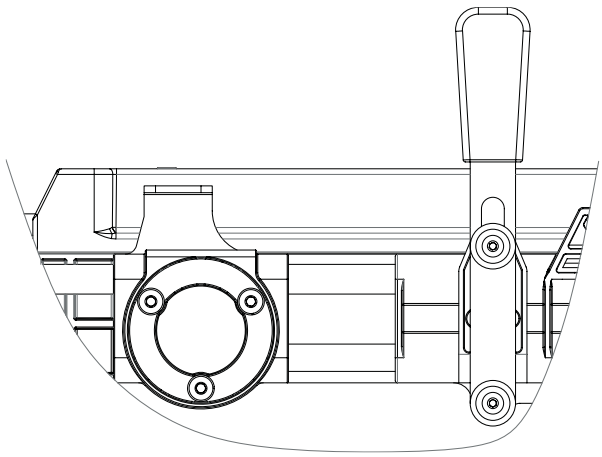
a	Screw + elastic washer to connect the eyelet
b	Hole where to fix the eyelet
c	Fixing screw (screw and washers)
d	Bracket slot

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

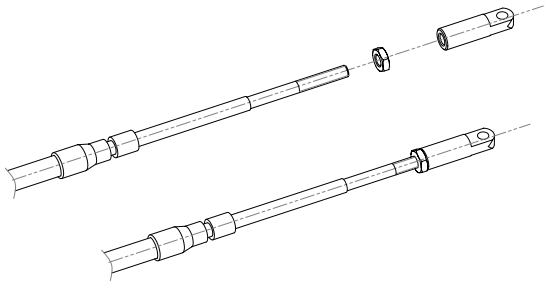
Follow the steps from 1 to 8 as reported here below:

1. Verify that the actuator's gear lever is in neutral position, as depicted in the picture here below (1). The lever should be vertical, otherwise enter into the JOGMODE 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 gearbox side as described previously. The push-pull cable must be at its half stroke also on the actuator's side. Then screw the eyelet (h) onto the cable's rod (2).

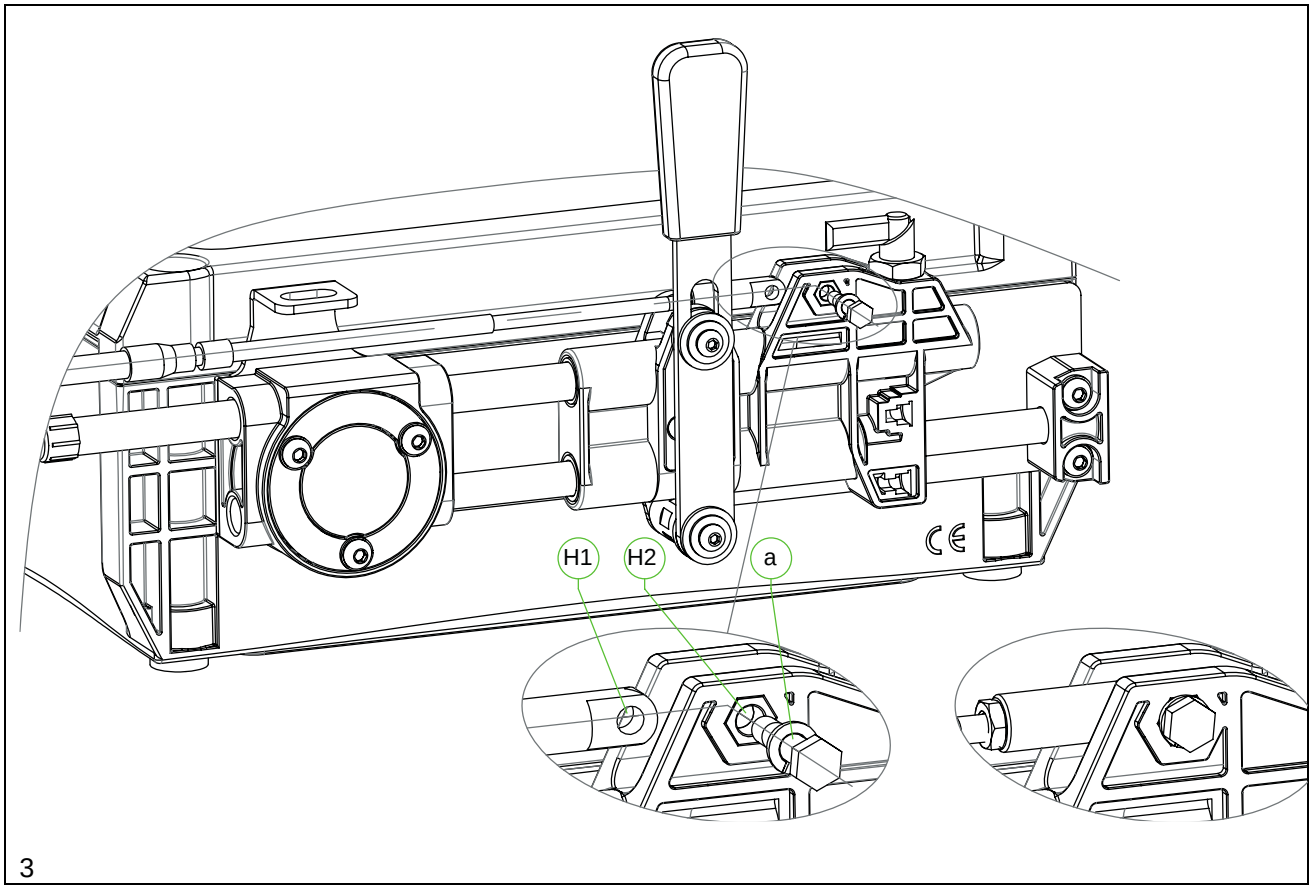


1



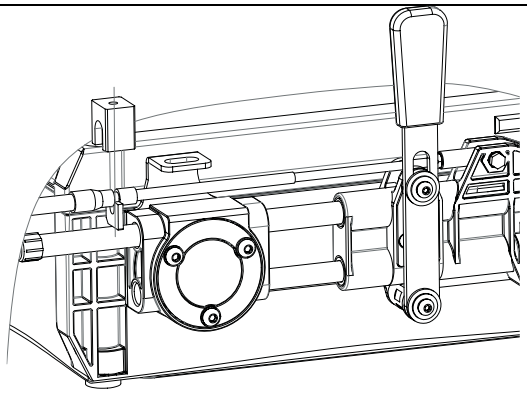
2

3. Positionthe push-pull cable with the hole on the eyelet (H1) aligned with the hole of the plastic slider (H2). Insert the screw (+ elastic washer) and fasten it.

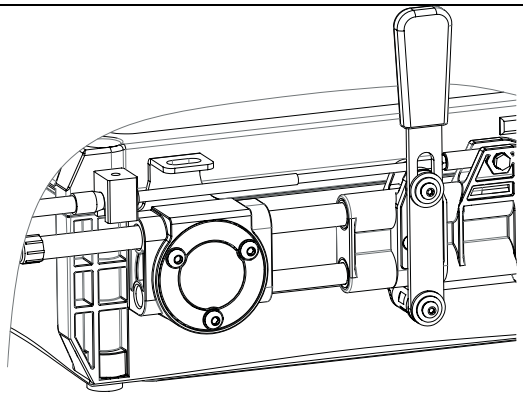


3

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

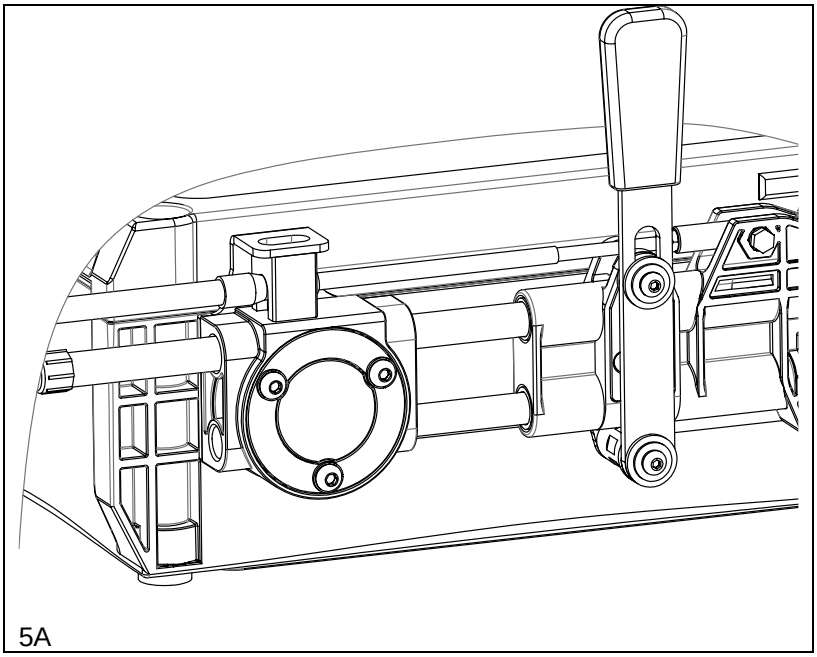


4A



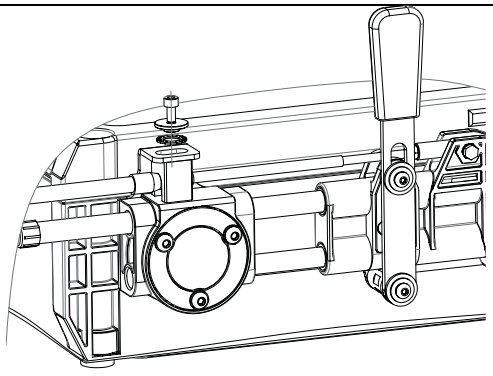
4B

5. Then insert the push-pull cable into the bracket slot (d), picture 5. Verify that the fixing element is centred into the bracket slot.

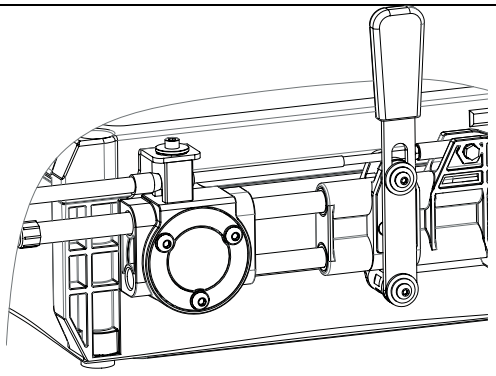


5A

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



6A



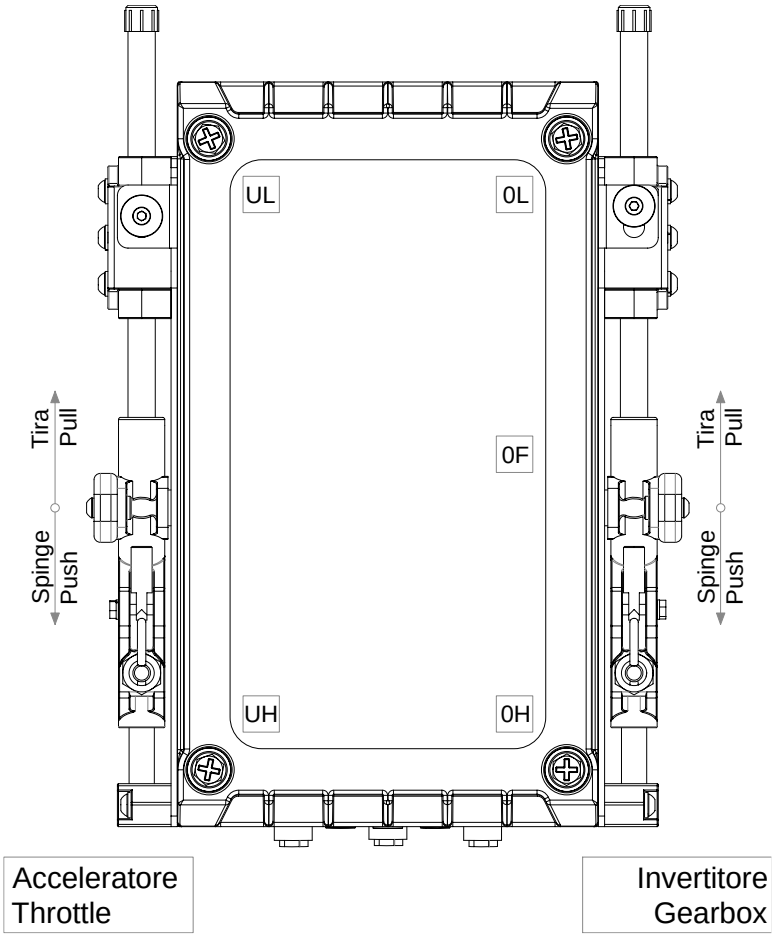
6B

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

11. 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 here below 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

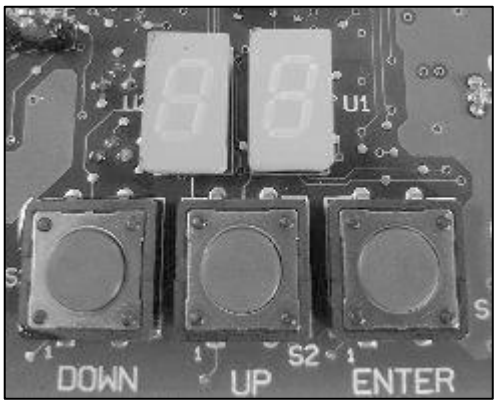
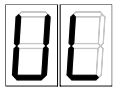
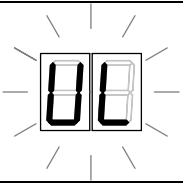
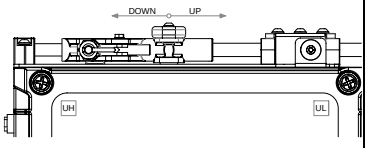
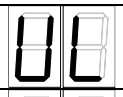
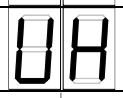
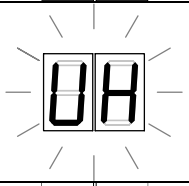
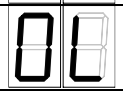
Actuators are delivered from factory with:

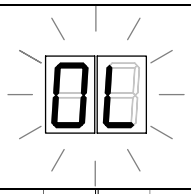
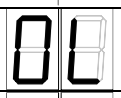
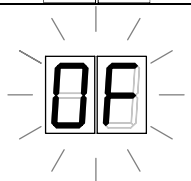
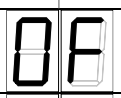
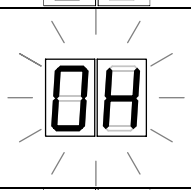
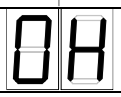
- No throttle stroke,
- Forward, Reverse and Neutral positions coincident with the Neutral position

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

11.1. Programming of the push-pull cable strokes

► **For Actuator 4.0 users:** in the following section the description is for Actuator 3.1 board's display. It is also valid for Actuator 4.0: in the parameters and lever settings menu there is a reference to the code of the original parameter used in the Actuator 3.1 display.

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) 	
3	Press at the same time key "UP" and "DOWN" and, keeping pressed both keys "UP" and "DOWN", turn on the actuator's 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 needto 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 here beside. 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	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 to flash. 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 and 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.

11.2. 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

Command station series 5000

Command station series 4000

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

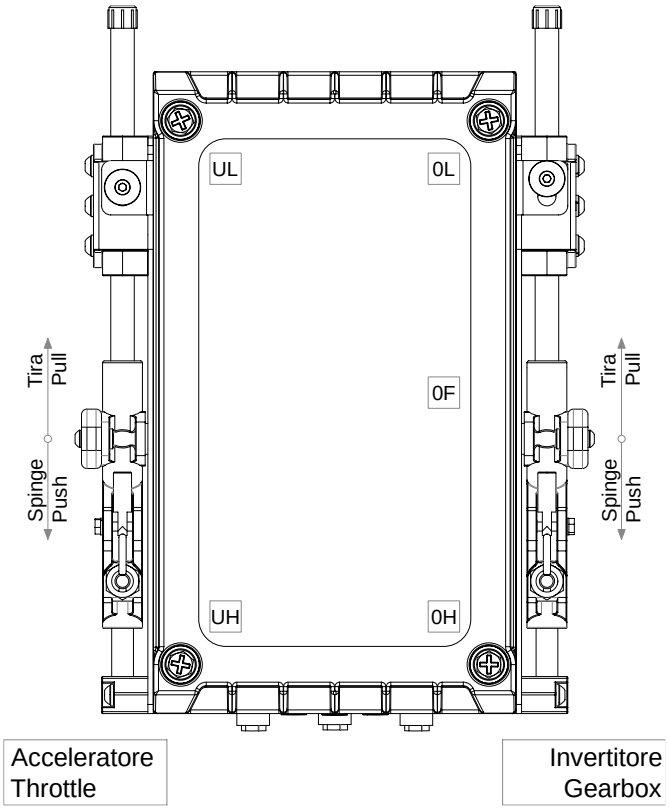
You must test now the correct functioning of the gearbox and the throttle in relation to the command lever. After having set the stroke positions, it might happen that there is not the right correspondence between the direction of the lever and the movement executed by the actuator (e.g.: you move the 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 (forward and backward positions are inverted) while the throttle push-pull cable works correctly	Set A0=3
Both gear and throttle push-pull cables positions are inverted	Set A0=2
The gearbox is working correctly while the throttle push-pull cable positions are inverted (min and max throttle positions are inverted)	Set A0=1

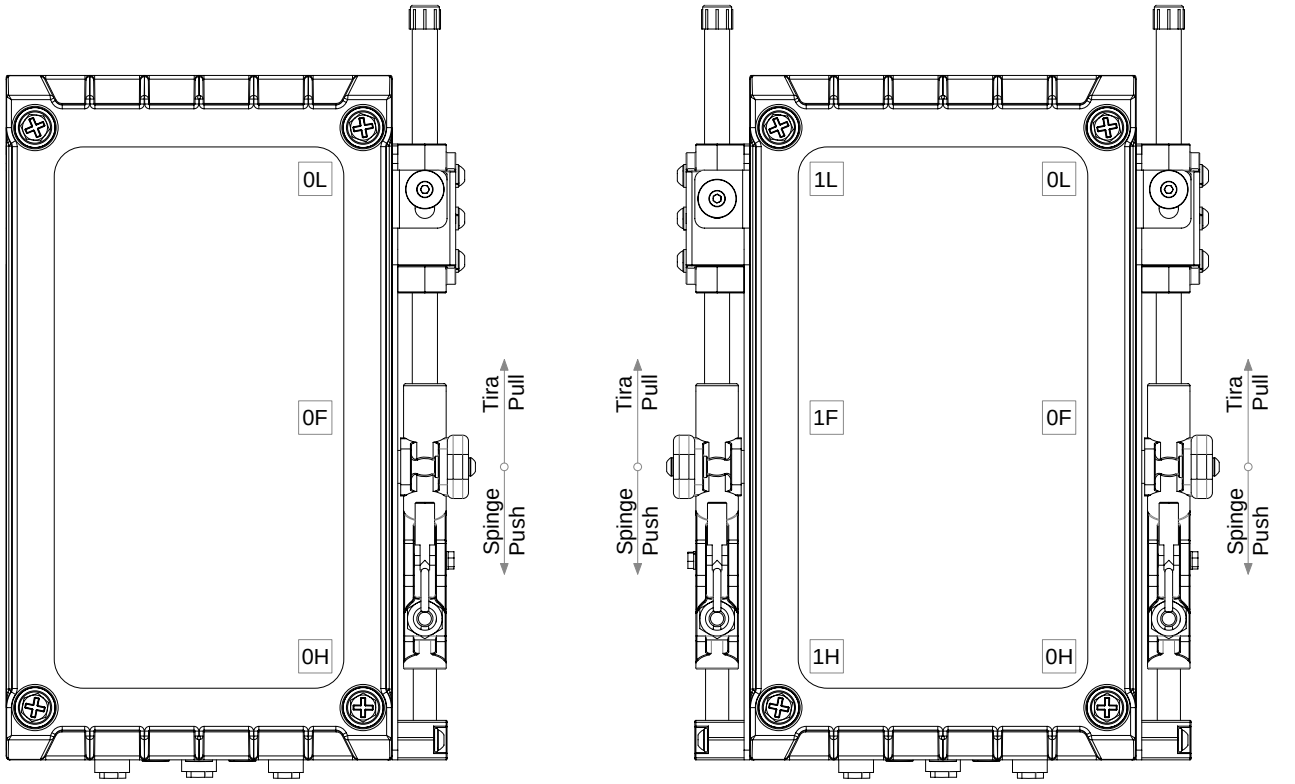
11.3. Specific parameters

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				

12. 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:



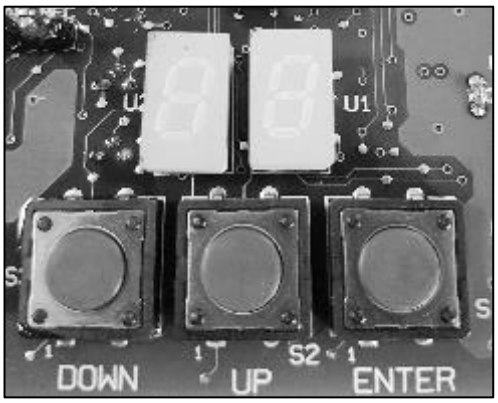
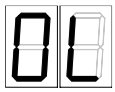
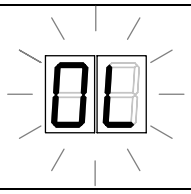
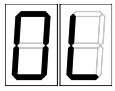
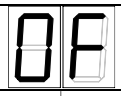
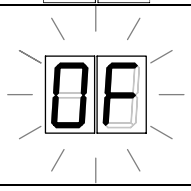
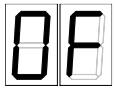
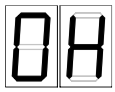
You must program either 3 or 6 positions and consequently 3 or 6 parameters: 3 for per each gearbox, according to the parameters of the above table.

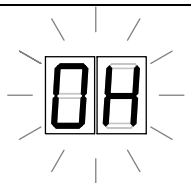
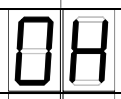
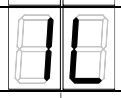
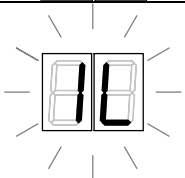
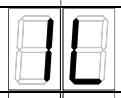
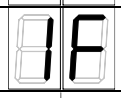
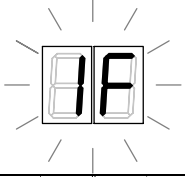
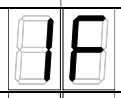
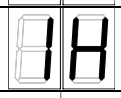
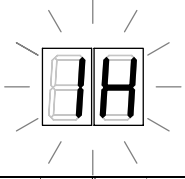
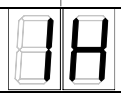
Parameter	Value on display	Function
Gearbox 1 (right)	0L	Gearbox Reverse
	0F	Gearbox Neutral
	0H	Gearbox Forward
Gearbox 2 (left)	1L	Gearbox Reverse
	1F	Gearbox Neutral
	1H	Gearbox Forward

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.

12.1. Programming of the gearbox strokes

► **For Actuator 4.0 users:** in the following section the description is for Actuator 3.1 board's display. It is also valid for Actuator 4.0: in the parameters and lever settings menu there is a reference to the code of the original parameter used in the Actuator 3.1 display.

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) 	
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 displaystops flashing it means that you have stored the position	
19	Press the “Down” push button and the display will move to “1H” (parameterof 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.

12.2. 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

Command station series 5000

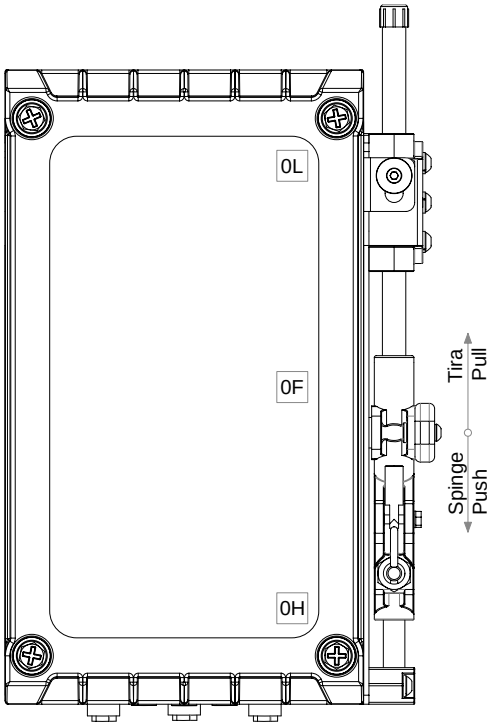
Command station series 4000

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

You must test now the correct functioning of the gearbox 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).

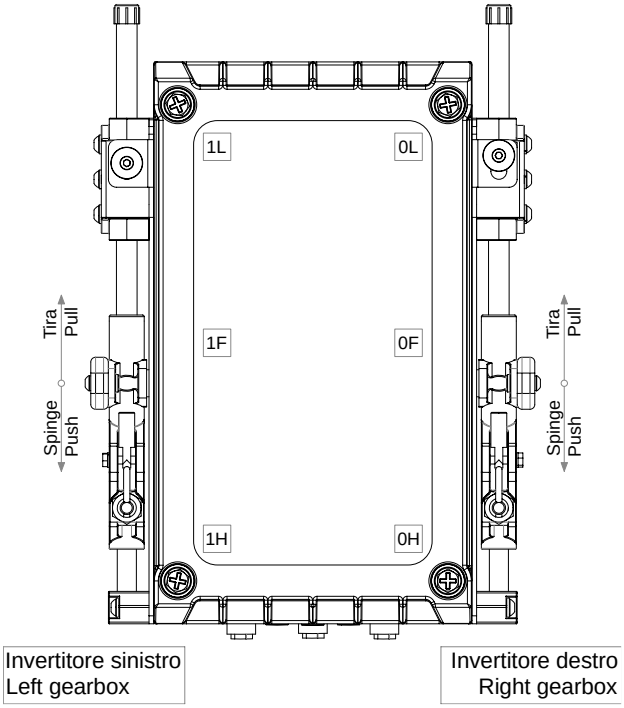
Changing the value of parameter A0 you can modify the correlation between the direction on the lever and the direction on the actuator. The table here below defines the directions of throttle and gearbox in relation to the 4 possible values of parameter A0, **with the assumption to move the command station 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 both gearboxes are inverted	Set A0=2
Positions of the left gearbox are inverted while the positions of the right gearbox are correct	Set A0=1

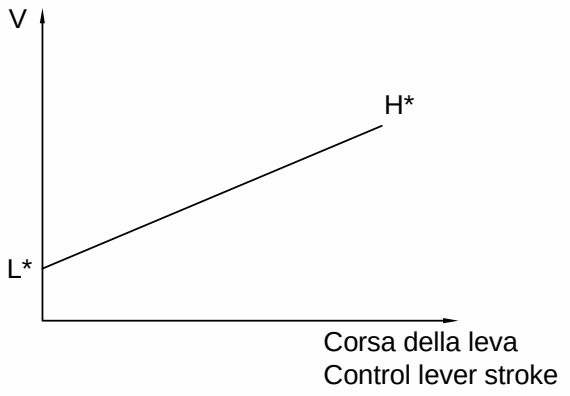
12.3. Specific parameters

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 electrical engine inverter driven. Parameters to define the voltage output interface will be detailed at section 14.3.2.				
H1					
L2					
H2					
L3					
H3					
L4					
H4					
CC	To be used for the check-up of the internal CANBus communication				

12.3.1. Parameters to configure the voltage output signal for electronic engines

For installations with electronic engines or hybrid propulsion systems (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.



12.3.2. Parameters to configure the voltage output signals

Parameters		FNM Vetus	NanniDiesiel (Toyota)		Hyndai	Steyr		Mercury		John Deere	Cummins	FPT	Scania
			T4.270	Others		IVS	2 Ch	Others	QSD 2.8 VM				
L1	Motor DX	9	10	13	8	5	7	8	8	6	8	5	5
H1		43	38	40	42	43	37	48	44	45	42	45	28
P1		NA	NA	NA	NA	10	NA	NA	NA	NA	NA	NA	NA
L2		5	0 *	0 *	4	0	43	4	4	NA	NA	NA	NA
H2		21	50 *	50 *	21	50	13	24	22	NA	NA	NA	NA
L3	Motor SX	9	10	13	8	5	7	8	8	6	8	4	5
H3		43	38	40	42	43	37	48	44	45	42	45	28
P3		NA	NA	NA	NA	10	NA	NA	NA	NA	NA	NA	NA
L4		5	0 *	0 *	4	0	43	4	4	NA	NA	NA	NA
H4		21	50 *	50 *	21	50	13	24	22	NA	NA	NA	NA

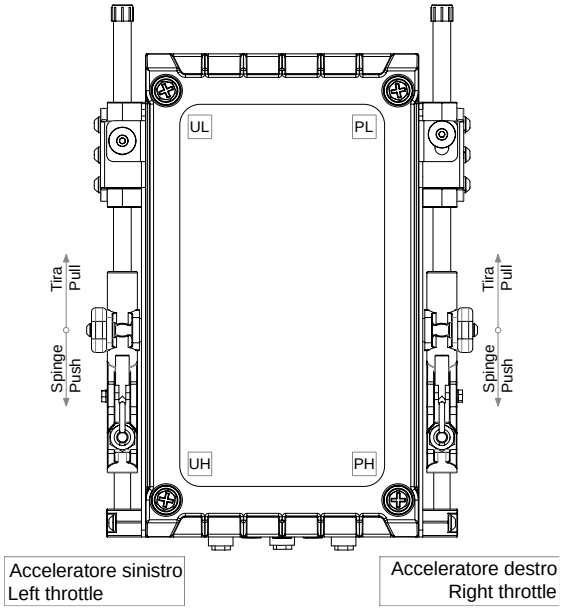
* For Nanni Diesel / Toyota, L2, H2, L4, H4 must be programmed only if the diesel motor is combined with the electrical motor. For further information see section 19.4, Programming of actuators with Hybrid engine option.

13. Programming of actuators for mechanical engines and electronic gearbox

13.1. Mounting of the 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 chapter 13.In case of actuators for 2 mechanical accelerators and 2 electronic gearboxes, the following parameters must be programmed.

Parameter	Value on display
Left throttle	UL
	UH
Right throttle	PL
	PH



13.2. 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.

13.3. 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.

13.4. 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

14. Programming of actuators with electronic engine and electronic gearbox

14.1. Electrical wiring

For electrical wiring please refer to chapter 8.

14.2. 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.

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 12.3.				
H1					
C1					
L2					
H2					
C2					
L3					
H3					
C3					
L4					
H4					
C4					
CC	To be used for the check-up of the internal CANBus communication				

15. Programming of actuators with electronic CANBUS engine and mechanical gearbox

15.1. Installation of the push-pull cable and programming of the cable stroke

Please refer to sections 12 and 13.

15.2. 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	-	-	-	

15.2.1. 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 value different from zero.
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.

15.2.2. Setting of the CANBus parameters

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. After power-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 CANBus profile selected.

Engine	ECM TYPE	RPM at min	RPM at max (no load)	CAN identifier	CP Value	CAN CONVERTER CONFIGURATION
S30 ENTM 23 *	EDC16	750	4400	TSC1-AE	1	Switch B4 in OFF
		750	3900	TSC1-AE	2	Switch B4 in OFF
N40 ENTM 25	EDC7C1	600	3200	TSC1-AE	3	Switch B4 in OFF
N60 ENTM 37	EDC7C1	600	3200	TSC1-AE	3	Switch B4 in OFF
N60 ENTM 40	EDC7UC31	600	3300	TSC1-AE	4	Switch B4 in OFF
N67 ENTM 45	EDC7C1	600	3300	TSC1-AE	4	Switch B4 in OFF
N67 ENTM 56	EDC7UC31	600	3300	TSC1-VE	5	Switch B4 in OFF
N67 ENTMW55.11	EDC17CV41	600	3350	TSC1-VE	11	Not Applicable
N67 ENTMW57.10	EDC17CV41	600	3150	TSC1-VE	12	Not Applicable
C78 ENTM 30	EDC7UC31	600	2300	TSC1-AE	6	Switch B4 in OFF
C78 ENTM 55	EDC7UC31	600	2900	TSC1-AE	7	Switch B4 in OFF
C13 ENSM 33.10	EDC7UC31	600	2300	TSC1-AE	6	Switch B4 in OFF
C13 ENTM 50.10/30	EDC7UC31	600	2300	TSC1-AE	6	Switch B4 in OFF
C13 ENTM 83	EDC7UC31	600	2700	TSC1-VE	8	Switch B4 in OFF
C13 ENSM 33.12	EDC7UC31	600	2300	TSC1-VE	9	Switch B4 in OFF
C13 ENTM 50.12	EDC7UC31	600	2300	TSC1-VE	9	Switch B4 in OFF
C13 ENTM 50.32	EDC7UC31	600	2300	TSC1-VE	9	Switch B4 in OFF
C87 ENTM 62	EDC7UC31	600	2900	TSC1-VE	10	Switch B4 in OFF
C87 ENTM 65	EDC7UC31	600	2900	TSC1-VE	10	Switch B4 in OFF
C87 ENTM 38	EDC7UC31	600	2300	TSC1-VE	9	Switch B4 in OFF
C87 ENSM 24	EDC7UC31	600	2300	TSC1-VE	9	Switch B4 in OFF
C16ENTMP94	MD1CE101	550	2700	TSC1-VE	13	Not Applicable
		600	2700	TSC1-VE	8	Not Applicable
		650	2700	TSC1-VE	14	Not Applicable
		700	2700	TSC1-VE	15	Not Applicable

C16ENTMP100	MD1CE101	550	2500	TSC1-VE	16	Not Applicable
		600	2500	TSC1-VE	17	Not Applicable
		650	2500	TSC1-VE	18	Not Applicable
		700	2500	TSC1-VE	19	Not Applicable
C16ENTMP60	MD1CE101	550	2100	TSC1-VE	20	Not Applicable
		600	2100	TSC1-VE	21	Not Applicable
		650	2100	TSC1-VE	22	Not Applicable
		700	2100	TSC1-VE	23	Not Applicable
C90ENTMW65	EDC17CV41	550	2900	TSC1-VE	24	Not Applicable
		600	2900	TSC1-VE	10	Not Applicable
		650	2900	TSC1-VE	25	Not Applicable
		700	2900	TSC1-VE	26	Not Applicable
N67 ENTM 45	EDC7C1	600	2250	TSC1-AE	27	Switch B4 in OFF
VM	-	0%	100%	EEC2	50	Not Applicable
STEYER	-	0%	100%	EEC2	51	Not Applicable

* CANBUS interface for SOFIM engines is not available yet and has to be considered for future developments. If CP = 0 no message will be sent.

15.2.3. 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.

15.3. Wiring of the outgoing actuator cables

Please refer to section 10.2.

15.4. 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:

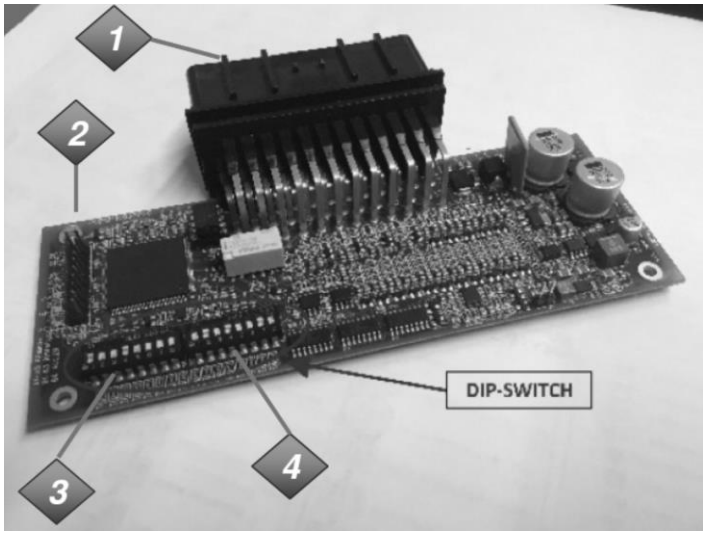
- **With the actuator switched off:** verify with a multimeter that the impedance between terminals JP4.4 and JP4.5 of the CANBus PCBoards on the actuator is @ 60 ohm (see section 5.4.4.). In case of different values, contact either Flexball or the FPT dealer.

- **Verify that the setting of the CANBUS CONVERTER MODULE is correct.** The CANBUS CONVERTER MODULE is part of FPT installation equipment and, depending on the type and on the age of the FPT motor, it is described by:

    1. FPT Norm A0XXfor new engines with ECU - EDC7UC31
    2. FPT Norm A049for all the other engines

    Refer to one of the two installation schemes reported in the following page and more specifically to the FPT installation manual to set correctly the CANBUS CONVERTER MODULE.
    A wrong setting of dip-switches of the CONVERTER MODULE can cause communication problems between FPT ECU and Flexball control system.

1. Voltage - CANBus converter box 580212464,according to FPT Norm A0XX (new engines)



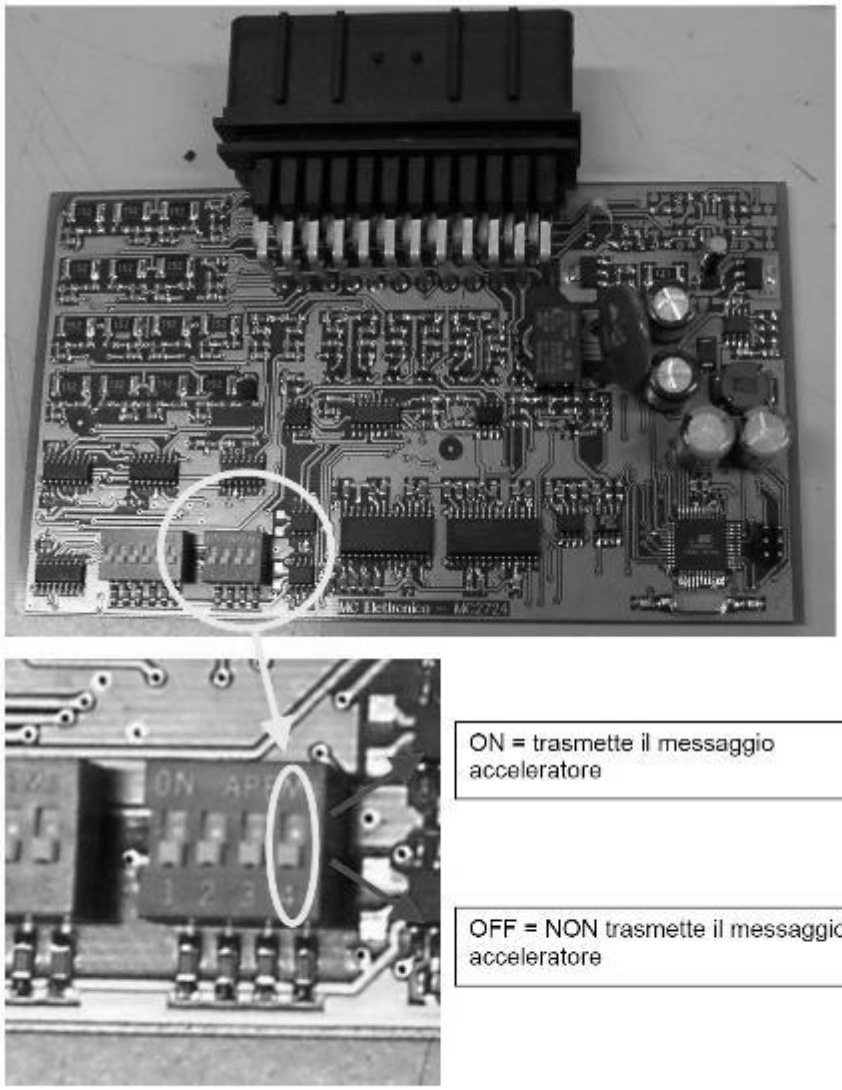
Dip-switch B4, here shown with tag “4”, must be switched in OFF position in order to allow CANBus communication between Flexball Electronic Command System and FPT engine.

Engines equipped with this module “Voltage - CANBus converter” are:

NEF
N60ENTM40.11 - N67ENTM45.11

CURSOR
C87ENTM38 - C87ENSM24 - C87ENTM62 - C87ENTM65
C13ENTM - C13ENSM-C13ENAM-C13ENTM83- C87ENAM13

2. Voltage - CANBus converter, according to FPT Norm A049 (all the other engines)



ON = trasmette il messaggio acceleratore

OFF = NON trasmette il messaggio acceleratore

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

16.1. CANBus engine parameters

For parameter setting, please refer to section 17.2.

16.2. Electronic gearbox parameters

For parameter setting, please refer to section 16.

16.3. Wiring of the actuator outgoing cables

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

17. System configuration in case of options

17.1. 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.

17.2. Commissioning of actuators for installations with Trolling option

The command station must be configured by setting dip-switch 2 to ON (see section 4.5 of this manual). The actuator is specific for this type of system. For its programming, refer to the document "Trolling_Flap option for lever 3500 & 4500".

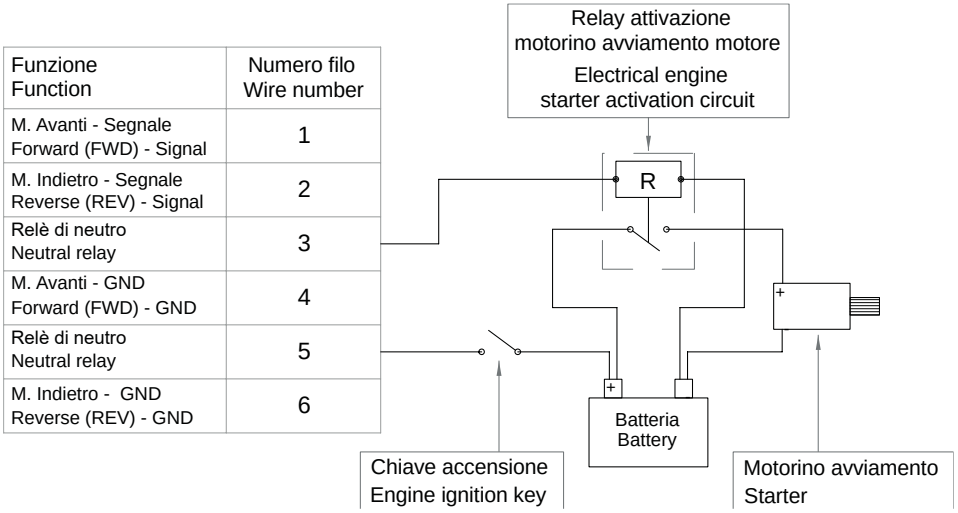
17.3. Commissioning of the actuators with Neutral Relay option

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.

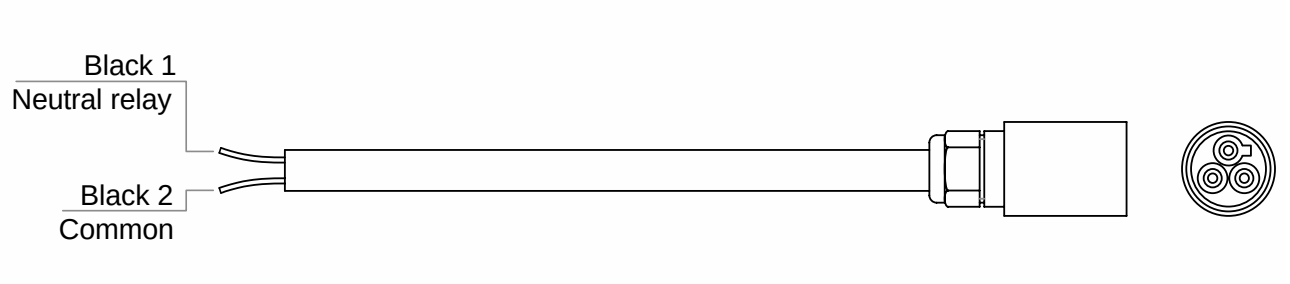
The neutral signal is given through a two-pole wire, as depicted here below. The neutral relay is normally open and it closes only in case the gearbox is in neutral and the actuator is properly supplied (if the actuator doesn't receive the power supply the relay is switched off and its contact is open).

The block diagram here below shows the safety chain:

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



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 has 3 wires: black 1, black 2 and yellow/green. For this 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.

17.4. Programming of the actuators with Hybrid Engine or Electric Engine option

The interface towards either the electric or to 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 can be set through parameters L*, and H*.

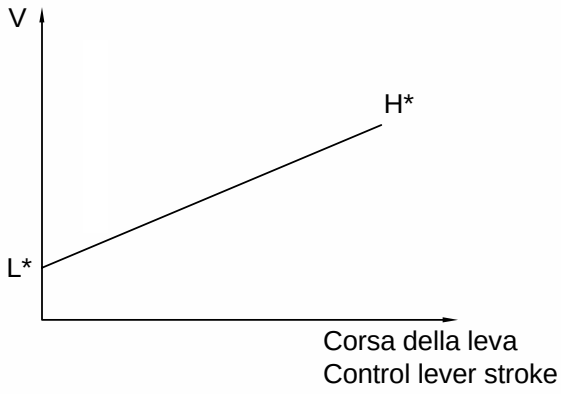
Parameters setting for installations with 1 engine

	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.



18. Actuator 4.0 menu description (4600 series)

18.1. Menu level 0 – Start UP

At power on, on the display is presented the following sequence:

				F	L	E	X	B	A	L	L				
		I	T	A	L	I	A	N	A		S	R	L		

4	5	0	0			E	L	E	C	T	R	O	N	I	C
	C	O	N	T	R	O	L		S	Y	S	T	E	M	

			S	Y	S	T	E	M		O	K				
(	U	P	&	D	W		F	O	R		H	E	L	P	)

This is page at menu level 0 in case there are no faults.
With “UP” and “DOWN” you get a short help on how to navigate through the menus:

<	E	N	T	E	R	>		M	E	N	U		I	N	
<	U	P	&	D	W	>		M	E	N	U		O	U	T

Use this keys combination:

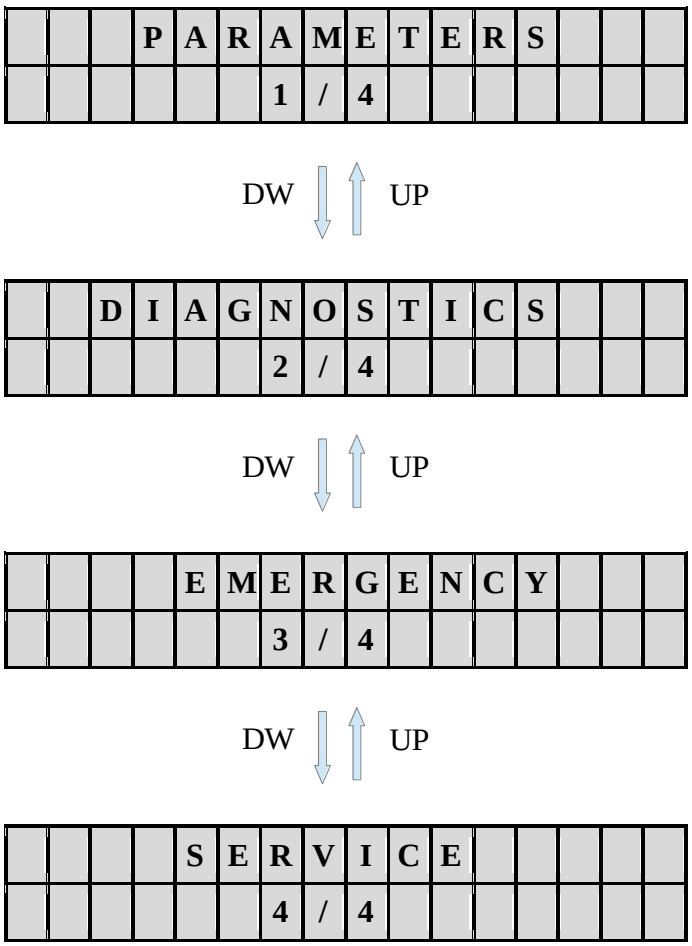
- “ENTER” to enter into the menu
- “UP” and “DOWN” to scroll menu items
- “UP” plus “DOWN” to exit from the current menu (up one level)

In case of faults the display will show its type with a short suggestion on what to do. See the following table. In case of multiple faults, they will be shown in sequence. Menu navigation is always possible pressing “ENTER”.

Detected fault	First visualization (4s)	Next visualization (4s)
Left Hall sensor fault	FAULT HALL LEFT	CALL SERVICE
	<<<----	<<<----
Right Hall sensor fault	FAULT HALL RIGHT	CALL SERVICE
	--->>>	--->>>
Overload left electrical motor	OVERLOAD LEFT	CHECK CABLE/LOAD
	<<<----	<<<----
Overload right electrical motor	OVERLOAD RIGHT	CHECK CABLE/LOAD
	--->>>	--->>>
Missed positioning for left actuator	FAILED POS LEFT	CHECK CABLE/LOAD
	<<<----	<<<----
Missed positioning for right actuator	FAILED POS RIGHT	CHECK CABLE/LOAD
	--->>>	--->>>
Fault left electrical motor driver	BRIDGE LEFT FLT	BRIDGE LEFT FLT
	<<<----	<<<----
Fault right electrical motor driver	BRIDGE RIGHT FLT	BRIDGE RIGHT FLT
	--->>>	--->>>
Open load left electric motor	OPEN LOAD LEFT	CHECK WIRES
	<<<----	<<<----
Open load right electric motor	OPEN LOAD RIGHT	CHECK WIRES
	--->>>	--->>>
No command station detected	MISSING COMMAND	CHECK CAN BUS
	STATIONS	CHECK STATIONS
Command station is faulty	FAULTY COMMAND	CHECK COMMAND
	STATION	STATION
A too fast power off – power on sequence	UNSTEADY SUPPLY	CHECK SUPPLY
	DETECTED	CABLE WIRING
Supply voltage is <9V	VOLTAGE <9 VOLTS	CHECK BATTERY
	DETECTED	AND ITS WIRING
Supply voltage is >30V	VOLTAGE >30 VOLTS	CHECK SUPPLY
	DETECTED	SYSTEM

18.2. Menu level 1

With the “ENTER” key from the Menu Level 0 you can reach the Level 1



Press “UP” & “DOWN” to return to Menu Level 0.

18.3. Menu level 2.1: PARAMETERS

This menu permits to change parameters values to set or tune actuator ‘s behaviour.

The following table reports the complete list of parameters: only a subset of these items will be available, depending on the actuator P/N.

Mnemonic symbol	Display indication
A0	SWAP STROKES
	- A0 - <VALUE> s
dI	GEAR OUT DELAY
	- dI - <VALUE> s
dA	THOTTLE DELAY
	- dA - <VALUE> s
dF	NEUTRAL DELAY
	- dF - <VALUE> s
PP	P PARAMETER
	- PP - <VALUE>
PI	I PARAMETER
	- PI - <VALUE>
PD	D PARAMETER
	- PD - <VALUE>
CP	CAN PROFILE
	- CP - <VALUE>
Cm	CAN MIN RPM
	- Cm - <VALUE>
CM	CAN MAX RPM
	- CM - <VALUE>
CID	CAN ID
	- CID - <VALUE>
L1	LEFT ENGINE CH1
	- L1 - <VALUE>
H1	LEFT ENGINE CH1
	- H1 - <VALUE>
L2	LEFT ENGINE CH2
	- L2 - <VALUE>
H2	LEFT ENGINE CH2
	- H2 - <VALUE>
L3	RIGHT ENGINE CH1
	- L3 - <VALUE>
H3	RIGHT ENGINE CH1
	- H3 - <VALUE>
L4	RIGHT ENGINE CH2
	- L4 - <VALUE>
H4	RIGHT ENGINE CH2
	- H4 - <VALUE>
Pm	PWM MIN
	- Pm - <VALUE>

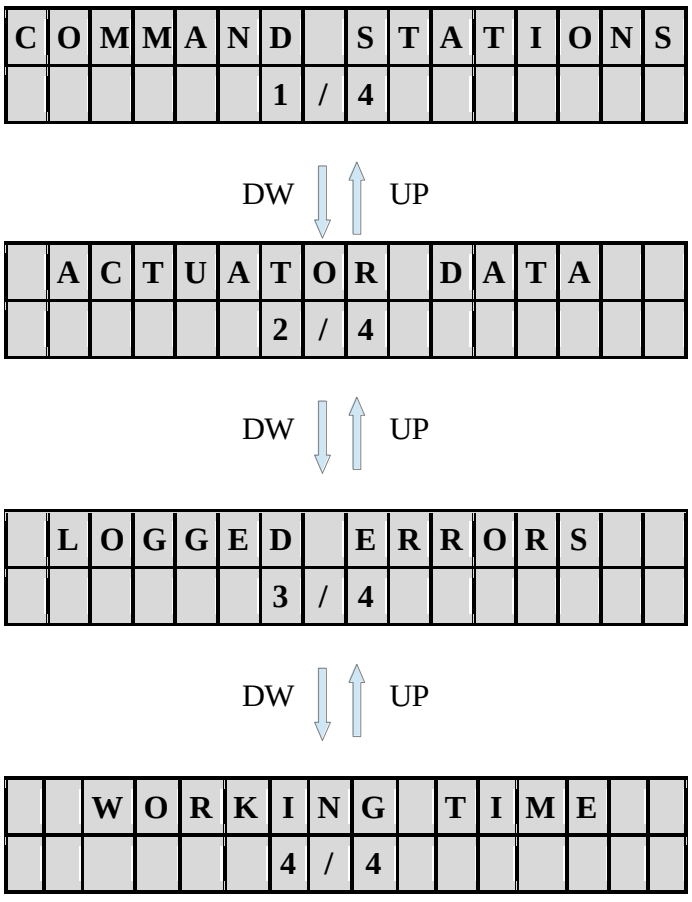
PM	PWM MAX
	- PM - <VALUE>
Im	4-20mA MIN
	- Im - <VALUE>
IM	4-20mA MAX
	- IM - <VALUE>
THR	THR CHANGE GEAR
	- UT - <VALUE>

Use “UP” or “DOWN” to select the parameter you want to change, then press “ENTER”. Current value will blink and you can change its value using again “UP” and “DOWN”. Press “ENTER” to set a new value.

Press “UP” & “DOWN” to go up one level.

18.4. Menu level 2.2: DIAGNOSTICS

This menu permits access to diagnostic data relative to the system and actuator itself.
It has 4 sub-menus that group diagnostic information.



18.5. Menu level 2.2.1: DIAGNOSTICS -> COMMAND STATIONS

This sub-menu shows data relative to command stations available on the CAN Bus network. There are up to three sub-sub-menus that can selected by “UP” and “DOWN” keys, one for each command station having address one, two or three (see chapter 3).
For each command station you will see the following display structure:

C	**S**	**#**	**1**		**<**	**S**	**T**	**A**	**T**	**U**	**S**	**>**		
G		**X**	**X**	**X**	**%**	**T**		**G**		**X**	**X**	**X**	**%**	**T**

<STATUS> field can be:

- “ABSENT” -> not present on the network
- “UNACTIVE” -> does not have the command
- “ACTIVE&WU” -> Command station has the command and warm up is active
- “ACTIVE” -> Command station has the command
- “FAULTY” -> Command station is faulty

<G> field can be:

- <no strings if command station is absent >
- “B” -> backward is requested
- “N” -> neutral is requested
- “F” -> forward is requested

<XXX> field -> requested throttle, 0 to 100%, no strings if command station is not present

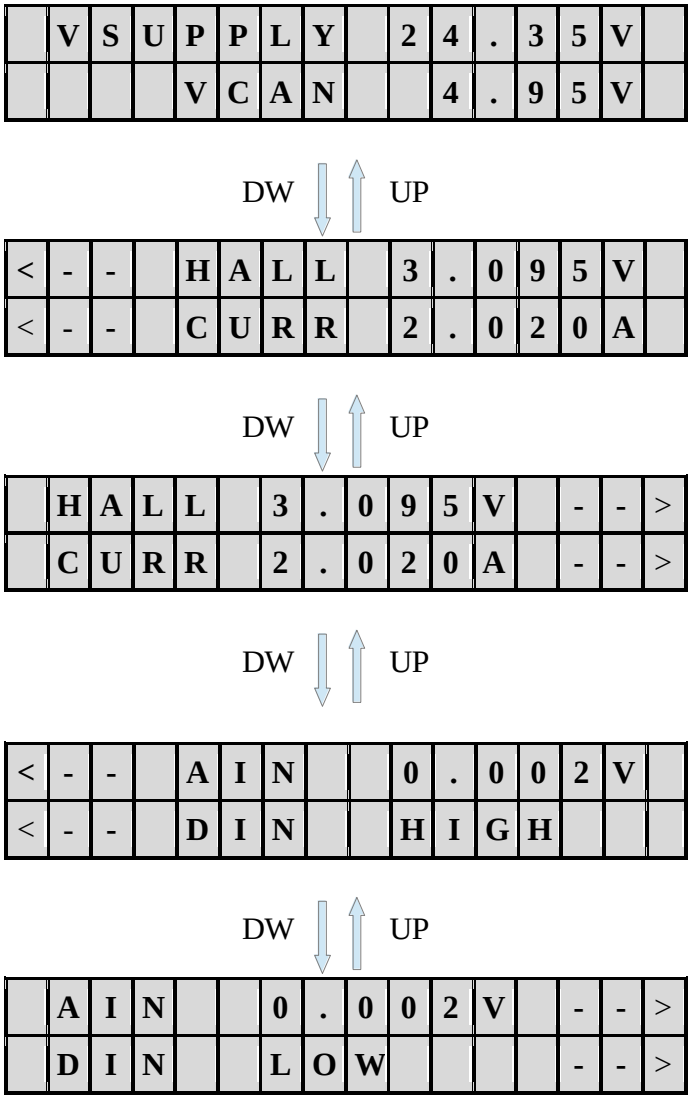
<T> field is the Trim/Flap command, normally off. In case of trim is commanded it will become:

- “U” for Trim Up command
- “D” for Trim Down command
- “T” for Trailer command

Press “UP” & “DOWN” to go up one level.

18.6. Menu level 2.2.2: DIAGNOSTICS -> ACTUATOR DATA

This sub-menu shows data relative to actuator itself. There are five sub menus:



Press “UP” & “DOWN” to go up one level.

18.7. Menu level 2.2.3: DIAGNOSTICS -> LOGGED ERROR

Actuator 4.0 has the ability to record faults that happens on the system. The registered events are readable back in the “LOGGED ERRORS” menu, which is structured this way:

	<	E	R	R	O	R		L	A	B	E	L	>		
1	/	X	X								Y	Y	Y	Y	Y

<ERROR LABEL> field contains the type of error logged, that can be one of the “Detected Fault” labels shown in Menu – Level 0 in case of faults.

<YYYY> is the number of errors of type <ERROR_LABEL> that occurred during the lifetime of the actuator

Press “UP” & “DOWN” to go up one level.

18.8. Menu level 2.2.4: DIAGNOSTICS -> WORKING TIME

This menu shows the total time in hours and minutes the system has been on.

		W	O	R	K	I	N	G		T	I	M	E		
		X	X	X	X	h		Y	Y	Y	m	i	n		

Press “UP” & “DOWN” to go up one level.

18.9. Menu level 2.3: EMERGENCY

This menu is reachable only under these conditions:

- actuator cannot find any control station in the CAN Bus network
- all the stations are faulty

This menu permits to drive garbox and throttle using the actuator’s keypad .

L	E	F	T						R	I	G	H	T		
G		t	t	%					G		t	t	%		

Through “UP” or “DOWN” it is possible to select the lower line fields (an arrow will point to the selected field), with “ENTER” it will be possible to change these values:

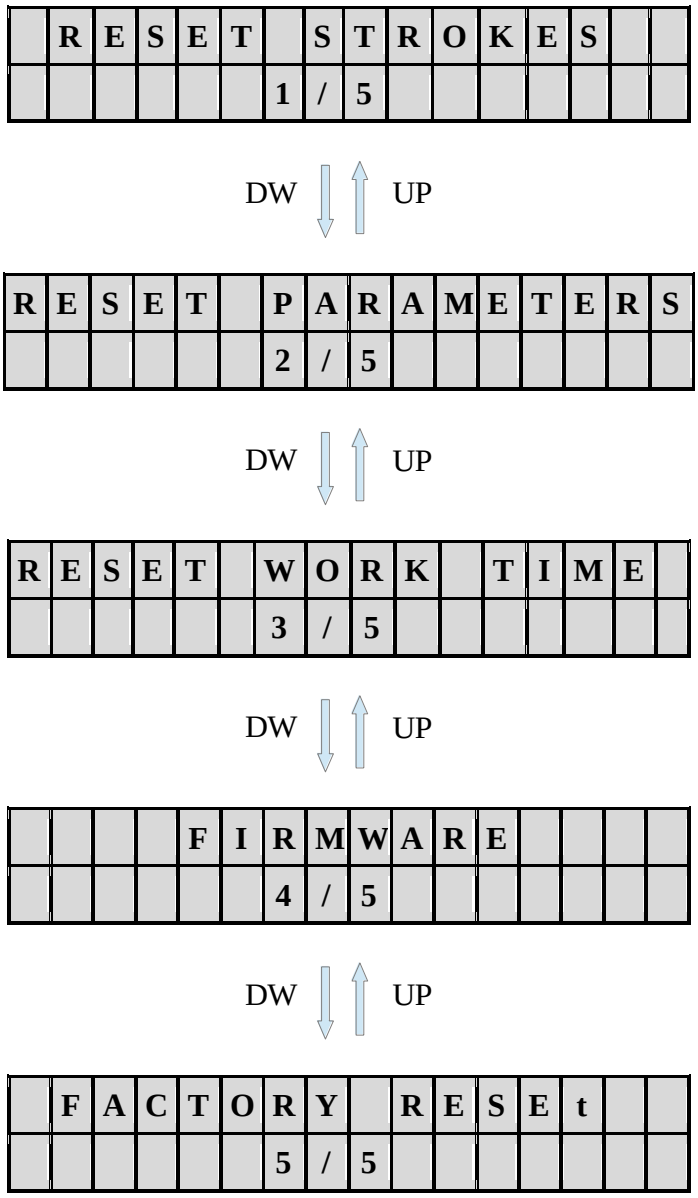
<G> field -> gearbox value, N (Neutral), B (Backword), F (Foreward)

<tt>% field, throttle level, limited to 50%

With “UP” plus “DOWN” you can return to menu 2.2, resetting gear and throttle settings to default.

18.10. Menu level 2.4: SERVICE

This menu can be used to make maintenance on the system. There are five sub-menus, which are:



Press “UP” & “DOWN” to return to menu level 1.

18.11. Menu level 2.4.1: SERVICE -> RESET STROKES

Used to reset mechanical strokes (if present) to their default values.

	R	E	S	E	T		S	T	R	O	K	E	S	?	
				N	O			Y	E	S					

By default, “NO” is selected and blinking. Using “UP” or “DOWN” user can select “NO” or “YES” Selecting “YES” and pressing “ENTER”, mechanical strokes will be set at the production default, otherwise system will return to level 2.4

18.12. Menu level 2.4.2: SERVICE -> RESET PARAMETERS

Used to reset parameters to their default values.

R	E	S	E	T		P	A	R	A	M	E	T	E	R	S
P	R	O	C	E	E	D	?		N	O					

DW UP

R	E	S	E	T		P	A	R	A	M	E	T	E	R	S
P	R	O	C	E	E	D	?		Y	E	S				

DW UP

R	E	S	E	T		P	A	R	A	M	E	T	E	R	S
					D	O	N	E	!						

Using “UP” or “DOWN” user can select “NO” or “YES” Selecting “YES” and pressing “ENTER”, all parameters will be set to default values. Menu level 2.4 will be reached automatically.

Press “UP” & “DOWN” to return to level 2.4

18.13. Menu level 2.4.3: SERVICE -> RESET WORK TIME

Used to reset working time counter. This function is password protected as it should not be used by a a normal service user.

Press “UP” & “DOWN” to return to level 2.4

service user.

18.14. Menu level 2.4.4: SERVICE -> FIRMWARE

Firmware version & actuator P/N codes.

					X	.	Y	.	Z					
<	A	C	T	U	A	T	O	R		C	O	D	E	>

<X.Y.Z> firmware release (ex. 1.2.3)

<ACTUATOR CODE> is the actuator's P/N (see "Actuator labels and codes")

Press "UP" & "DOWN" to return to menu 2.4

18.15. Menu level 2.4.4: SERVICE -> FACTORY RESET

Used to reset completely the actuator. This function is password protected as it should not be used by a normal service user.

Press "UP" & "DOWN" to return to level 2.4

19. Troubleshooting

19.1. 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.

19.1.1. Behaviour 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:

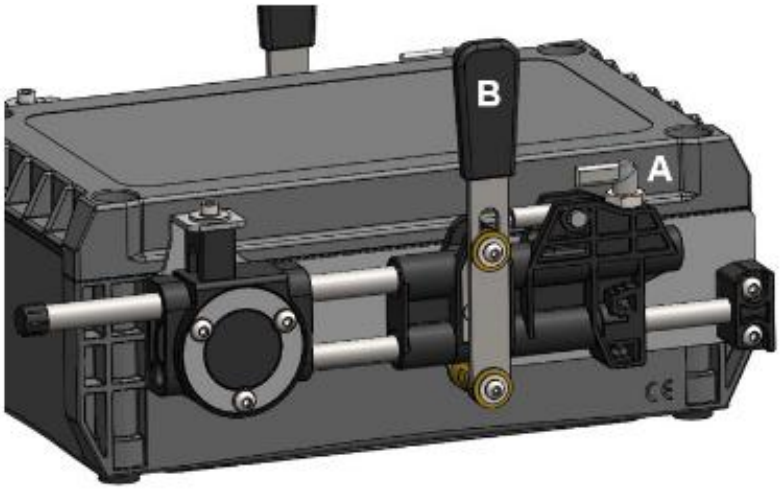
- Gearbox is moved to a the safety position (neutral)
- Engine throttle is moved to minimum

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.

19.1.2. 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 switched off quickly and the engines and gearboxes can be operated directly by the mechanical emergency levers.
If you have the connector panel in front of you, the right emergency lever is for gearbox, the left emergency lever is for engine.
Emergency levers are fitted on the control box. During the normal functioning, the indexing plunger device “A” is positioned as shown in the picture on the left. In emergency situation, to unlock the mechanism it is enough to rotateof 180° the plunger “A” from its working position. After this operation, the mechanism (and the related push-pull cable) can be operated manually using lever (B).

In order to engage again the system you must:

1. Rotate or assure that the mechanical indexing plunger device “A” is in lock position (like in the picture)
2. Move the emergency lever “B” towards the centre of stroke and move it back and forward until you hear a “click”.
3. Verify that after the “click” the lever is engaged (you cannot move it freely by hand). In case the emergency lever is still free, repeat operations from point 1 to 3.

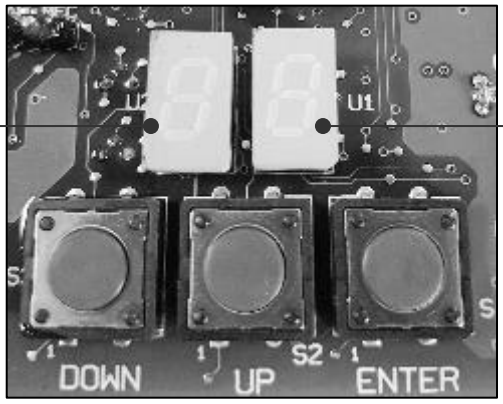
19.1.3. Self-protection in case of overload or breakage of the push-pull cables

Actuator 3.1 board

The 2 digit display on the actuator is a helpful instrument during trouble shooting. The actuator has a built-in control that generates an alarm signal 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” or a “P” on the side of the overloaded cable
- all the LEDs of the command stations start to blink.

An “E” or “P” will be shown on the side of the actuator with the cable overload error or the cable positioning error



An “E” or “P” will be shown on the side of the actuator with the cable overload error or the cable positioning error

“E” stands for overload failure.
“P” stands for position failure (missed position target).

In case one of the two alarms occurs, turn off the system and verify the causes that might have generated the alarm:

- errors in stroke setting, bending radius of the push-pull cables too small or push-pull cable “squeezes”
- performance of the push-pull cable too low or control cable degenerated over time: if push pull cables are not performing correctly, they must be replaced.

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

Actuator 4.0 board
See section 20.1 in case of failure to understand the actuator’s fault messages. In case reset again the mechanical cables strokes as described in sections 12 and 13.

19.2. Analysis of the electronic system behaviour

It follows a list of behaviours, error messages 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: 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 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 CAN address	Re-assign the CAN 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 Single lever mode	De-activate the Single lever mode with the push-buttons on the command station	Chapter 3
	The two actuators might have the same CAN address and receive the command from the same lever	Program dip-switch JP14 according to the following: JP14 = OFF for the left actuator JP14 = ON for the right actuator 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 setting of the strokes has been done successfully (chapter 13) but the actuator doesn't respond to the commands during normal operation	Verify that parameter PP = 40	Set PP = 40	Chapters 11 and section 13.3
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, the actuator doesn't manage to reach the target position and therefore it doesn't activate the throttle	Reprogram the gearbox stroke	Chapter 13
With the control station lever at minimum, the engine is fully accelerated (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	Schemes 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 again the push-pull cable both on the gearbox and 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 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

Actuator 4.0 board "EMERGENCY" menu.
In case actuator box is functional and you need to drive gearbox and throttle directly from actuator, you can use the "EMERGENCY" menu: it may be useful in case all control heads are faulty or CAN bus is not working in such a way heads are not reachable from the Actuator.
To activate the "EMERGENCY" menu and to drive in safety using the "EMERGENCY" menu**, it is strongly recommended to disconnect the CAN Bus cable directly from the actuator BOX**.
See section 20.9 for more details.

► **Important:** In case of mechanical actuators, keep hands and body away from the moving parts!

19.3. Diagnosis through the command station

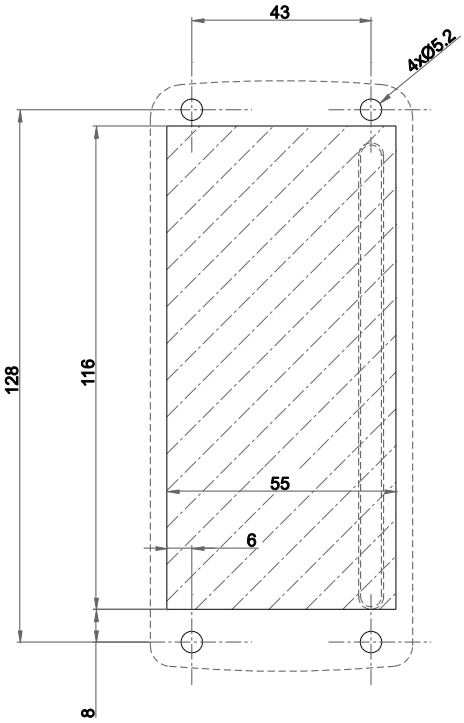
LEDs of the command station produce flashes to show operating conditions, warning and failure conditions.

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 2green 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: • if YES, verify the connection of CANBus data transmission cable; • if NO, check the electrical installation (chapter 10)
One of the green LEDs is switched off, even if its corresponding 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.
The green LED is slowly blinking (2 s period) with duty cycle: 50% On and 50% Off		There might be a problem on the position measuring device of the command station	Contact Flexball
LEDs are blinking according to the following combinations: • Engine_left (green) + Wrm/Sync(yellow) • Cmd (red) + Engine_right (green) • All the 4 LEDs together		There is a failure on mechanical actuators, probably due to: • an extra load on push-pull cables • wrong setting of the push-pull cable strokes	Go to the actuator's display and check which is the cable that has generated the failure. On the display is shown the message "E" or "P"on the side where it has occurred the failure (see section 21.1.3), then: • replace the defective push-pull cable • re-program the strokes of the push-pull cables (see chapters 12 and 13)

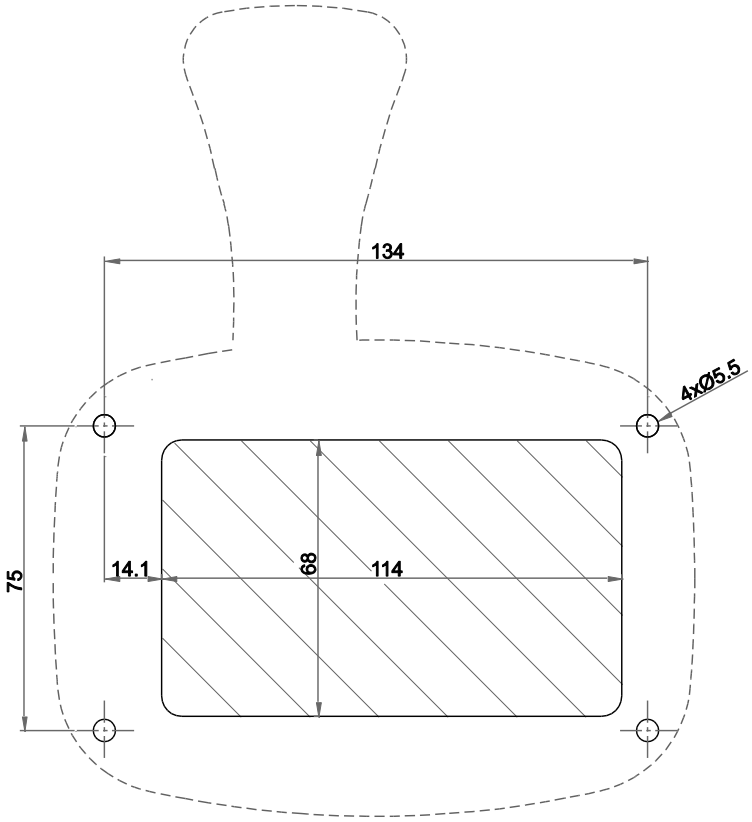
20. Dimensions for drilling masks (command stations)

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

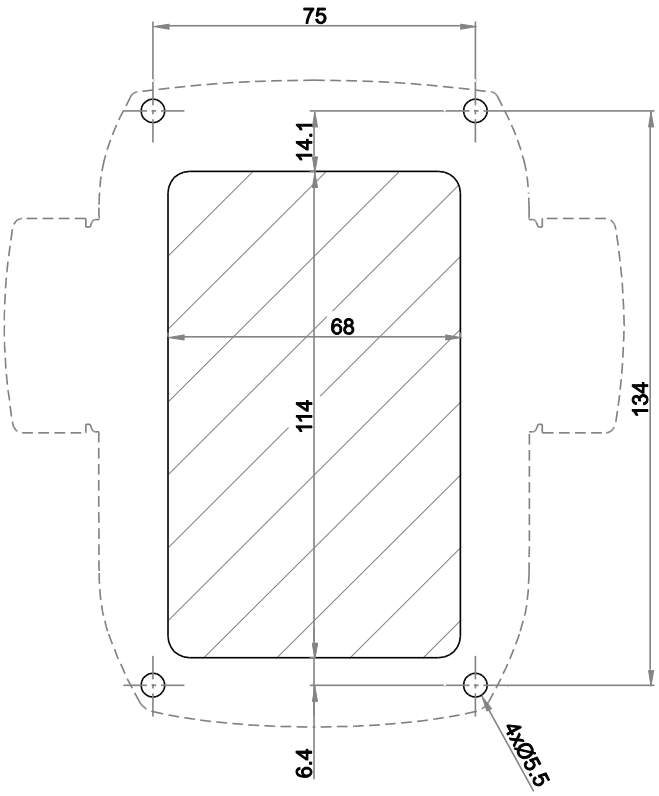
20.1. Command station series 4000



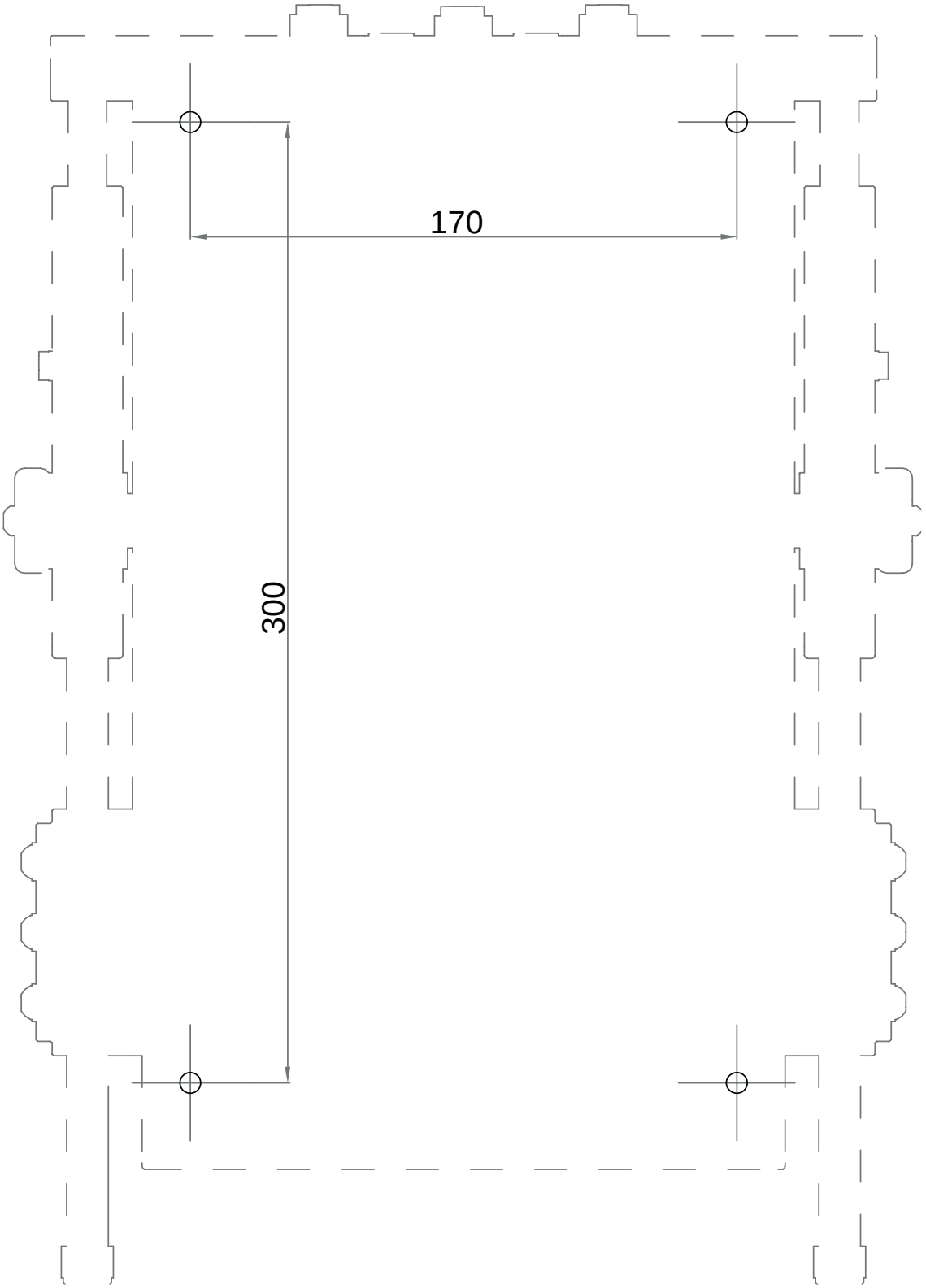
20.2. Command station series 4200



20.3. Command station series 4500 and 5000



21. Dimensions for drilling mask (actuator)



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