no. 1584-TAE3

TAE 3

Electronic Switch Unit

HALL SENSOR

Static Depth Controller TAES

Installation & Operation

Please read the following instructions and safety warnings carefully BEFORE you commence with the assembly of this unit and installation of the dive system. For further safety instructions please refer to the instructions supplied with Piston Tanks.

Only operate Piston Tanks when switch unit is completely connected. Otherwise Piston Tanks will inevitably be damaged, resulting in total failure of the system.

During the charging period all batteries must be removed from the hull. **NEVER** charge batteries inside the hull as almost all battery types gas while being charged. Insufficient air circulation during the charging period may lead to a serious **EXPLOSION!**

Engel Dive Systems have been primarily designed for use in Engel model submarines. Therefore, we cannot guarantee satisfactory installation and/or operation in self-made models or kits of other brands.

We are not liable for any personal injury or damage of any kind incurred during the assembly and/or use of our products as we are neither able to delegate nor verify the assembly and/or use of these items. Please adhere to your country's safety guidelines during construction and operation of this item. This product is not suitable for persons under 16 years of age. Technical specifications are subject to change without notice.

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Since 1952

Switch Unit TAE3 offers enhanced functionality and safety. This unit can opterate Piston Tanks type EA (with AutoStop) as well as type TA (with AutoTrim).
Switch unit TAE3 can also be upgraded to proportional piston tank control by which the pistons are driven to a position set by the transmitter. Both Piston Tanks are equipped with magnets fitted to the middle gear wheel in combination with Hall Sensors connected to TAE3. This Hall Sensor version then allows proportional control of Piston Tanks. Installation, connections and operation of this version is described in the following manual.

With the TAE3 Piston Tanks can be operated as a pair (default setting) as well as individually. Separate operation offers more functionality. However, this feature makes operation of dive system more demaning, thus, more difficult.

Each Piston Tank is safeguarded by a self-resetting polymer fuse against electrical overload.
The TAE3 will automatically switch to empty the Piston Tanks not only if receiver signal is lost but even if the receiver itself or receiver power (Rx battery or BEC) is defective, thereby allowing the model to resurface safely.

In addition, the unit features 3 additional fail safe devices, such as loss of receiver signal, low battery monitor and limitation of operational depth by pressure switch (item no. 5029), included in the complete set of this unit. If transmitter signal is lost (e.g. by excessive depth) or main battery power has diminished the unit will also automatically switch the tanks to bail. Threshold voltage at which the automatic resurfacing mode is activated is adjustable by a rotary switch onboard of the unit (factory settings 4V for 6V operation, 9V for 12V operation). Operational and switching modes are indicated by LEDs.

The unit's main power circuit (ranging from 6 V to 12 V) is held separately from the control circuit 4.8 V to 8 V in order to eliminate disturbances caused by voltage swings in the main power circuit. The control circuit is supplied with power from the receiver (Rx) battery via the receiver. To avoid possible problems with interference it is best to implement this separate power supply and not use a BEC (Battery Eliminating Circuitry) system. The recommended NiMH3000 battery pack (item-no. 5528) will be sufficient for Rx operation time of several hours.

A pressure switch is also part of the fail safe system, acting as a peripheral safety device for limiting operational depth of the model to approx. 1.8 m (for standard ENGEL WTC volume).

The pressure switch incorporates a further safety function. If the over pressure of approx. 0.12 bar inside the hull (which develops by compressing the air within the hull when tanks are completely filled) decreases due to a leakage, the pressure switch will terminate the "submerge mode" allowing the model to "resurface" only. This feature ensures that no water can be drawn into the WTC (Water Tight Compartment). As long as the leakage remains the model cannot be submerged.
Therefore, the WTC must be hermetically sealed. Any leak will inevitably cause suspension of the submerge mode.

The TAE3 can be upgraded with a Static Depth Controller, so-called TAES. This auxiliary controller is equipped with a pressure sensor supporting the trim of the submerged, static (not moving) model. TAES measures the pressure differentials during submerging and resurfacing which are then equalized by water being sucked in and pressed out of the Piston Tanks. With this system no further manual trimming is necessary, thereby allowing the model to be held automatically within a desired depth range.

However, TAES is recommended for TAE3 with Hall Sensors, only.
Without Hall Sensors the TAES shows rather poor performance.

Static Depth Controller TAES with 25 cm long connection lead can be purchased as a separate item (item no. 1585-TAES).

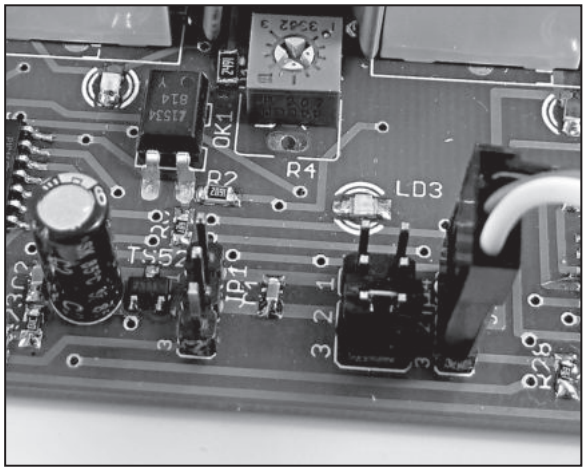
R/C CHANNEL(S)

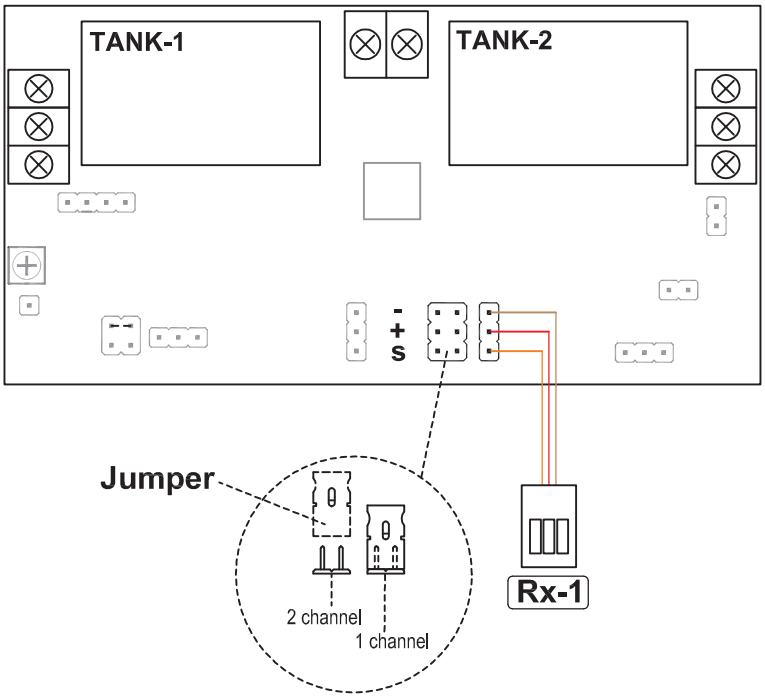
The TAE3 offers operation of Piston Tanks via a single or two R/C channels.

This proportional version of TAE3 requires a linear slider (alternatively a rotary switch) on the transmitter. Receiver signal must lie between 0.7 and 2.3 ms which is automatically detected by TAE3. Therefore, this switch unit is suitable for all conventional R/C systems.
Operation via 2 R/C channels will also require two of the above.

1. Single Channel

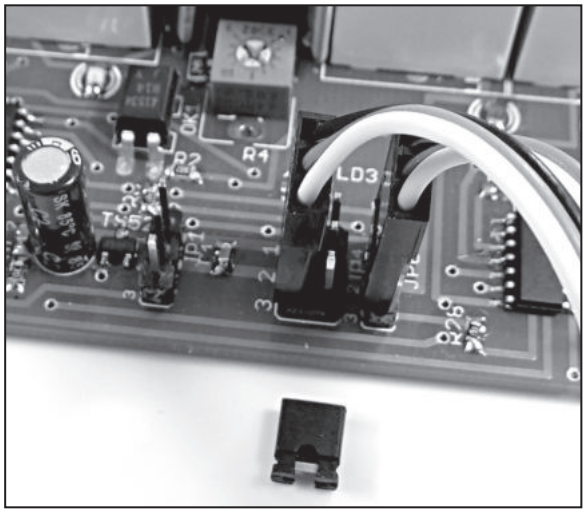
Operation via a single R/C channel
Jumper remains plugged (default setting) so that signal pins (S) on TAE3 prevail as „bridged“.

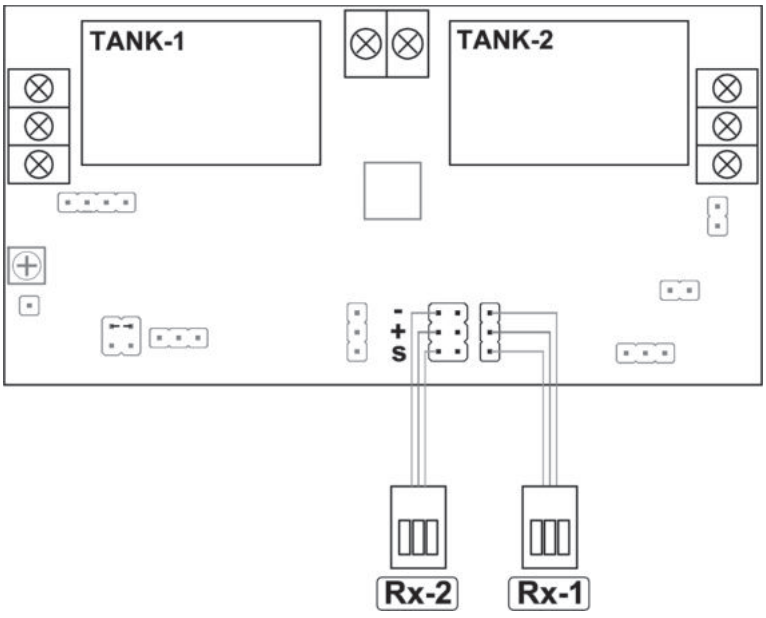




2. Dual Channel

Operation via two R/C channels
Remove (pull) jumper and connect a second wire lead to receiver (with patch cable no. 9118).





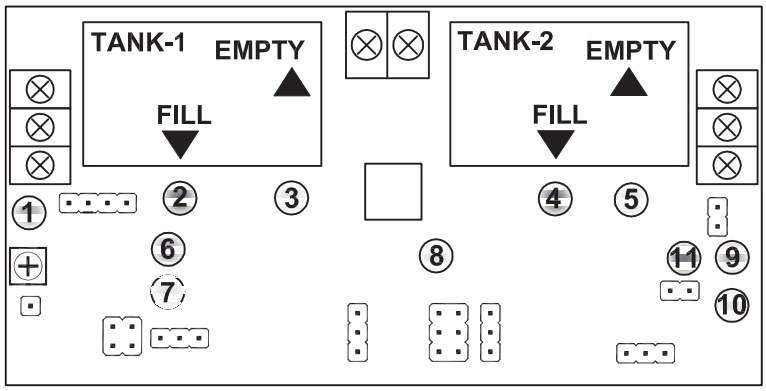
LEDs

The unit is equipped with 4 relais, one relay for every Piston Tank and function (fill and empty). Each function is indicated by a LED, red LEDs (2) and (4) for FILLING, yellow LEDs (3) and (5) for EMPTYING.
Green LEDs (6) and (9) indicate quality of receiver signal.

LEDs (7) and (10) show the impulses of Hall Sensors.

LED Indications:

(1) Pressure Switch activated
(2)(4) FILL
(3)(5) EMPTY
(6)(9) quality of receiver signal as well as blinking during setup of Hall Sensors
(7)(10) impulses of Hall Sensors
(8) TAES activated
(11) Low Battery Monitor activated



CONNECTION OF PISTON TANKS TYPE EA WITH HALL SENSORS

>> Please refer to Wiring Diagram HALL.

The optionally available Hall Sensors (no. 1585-H30) allow proportional piston tank control by which the pistons are driven to a position set by the transmitter. The exact position is detected by a so-called Hall effect sensor connected to TAE3 by three-core cables and pre-mounted on separate PCBs. To activate this mode the two contact pins on TAE3 marked MODE are connected by setting a jumper (see page 7 for details). This proportional version of TAE3 requires a linear slider (alternatively a rotary switch) on the transmitter. Operation via 2 R/C channels will also require two of the above.

The Hall sensor is switched through magnets mounted on to one of the piston tank gear wheels. The piston tank can then be operated in two different modes. In the first mode, called 20/80, the first 20% on the slider of the transmitter control the first 70% of piston movement. The last 80% on the slider control the last 30% of piston movement. This mode allows precise trim of the boat and is preferable for most piston tank volumes.
In the second, so-called linear mode the entire piston tank volume is controlled on the slider. This only makes sense for piston tank volumes with less than 300 ml, as resolution of the slider (or rotary switch) is otherwise too low to allow for exact trimming of the model.
Piston tanks used must feature end switches for safe termination of piston movement at its corresponding end positions (e. g. completely full or empty). All ENGEL piston tanks are equipped with such end switches.

Connecting the End Switches

The end switches (also called micro switches) of each Piston Tank are connected with wire leads (0.5 sq mm). It is important that all connections are made as per wiring diagram enclosed.

Leads are supplied in different colours for easy identification of the various connections to be made. Refrain from using thinner leads.

NOTE **+ (or RED dot)** marking on back plate of motor! Should one or both Piston Tank motors show incorrect direction of movement at first trial (see page 7), motor polarity must be reversed by interchanging the leads connecting to the motor tags (DO NOT reverse battery connections of the TAE3).

A single faulty connection can lead to a short circuit of the system which may result in destruction of the unit.

Connections to the micro switches should be soldered. Ensure that all connections are made with great care as a single bad connection can result in the loss of the model. Both end switches of each Piston Tank are connected with 3 leads to the switch unit. It is of important that all connections are made as per wiring diagram. The connection tags on the micro switches are numbered as 1, 2 and 4.

Cable ends connecting to the TAE3 should be tin-coated and screwed to their corresponding terminals on the TAE3.

Micro switches S1 and S2 are responsible for the *AutoStop* feature. As soon as the tank has reached its "empty" position, micro switch S1 is released and the motor stops instantly. With the tank filled at 100% micro switch S2 is activated and, again, the motor stopped instantly.

Connecting and Fitting Hall Sensor and Magnets

Position and attachment of sensor and magnets depends on the particular piston tank. Hall sensor upgrade (item no. 1585-H30) includes a total of eight neodymium magnets as well as two longer screws and two washers for mounting Hall sensors to the micro switches. Additional magnets in various sizes and shapes are optionally available.
In theory, precision of trim increases with amount of magnets used. This is only true to a certain extend, though. Neodymium magnets have very strong magnetic force. Therefore, when using such powerful magnets these should be positioned at a distance to one another. Otherwise their magnetic fields lead to mutual disturbances. This will result in less accuracy or even system failure. A pair of magnets mounted to the main gear wheel (spindle) allows an accuracy of half a rotation. Mounted to the middle gear accuracy is already multiple.

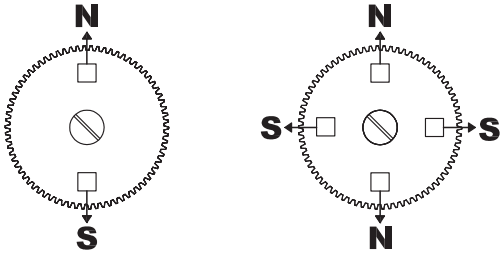
Using two pair of magnets on each Piston Tank will result in duplication of accuracy. For piston tanks in 6 V with 540 size motor as well as 12 V with 380 size motor the middle gear wheel is ideal for mounting up to three or two pair of magnets respectively. Hall sensor can be mounted directly to micro switch S1 (as shown on the next page).

The middle gear wheel of piston tanks in 12 V and 540 size motor is rather small. For this type of tank the main gear wheel (with spindle bushing) is a better alternative. Four pairs (= eight magnets) of disc shaped neodymium magnets 1.5 x 0.5 mm (item no. 5810-1510) will allow for accurate trim. The Hall sensor can be attached to micro switch S1.

Magnets are positioned so that north (N) and south (S) pole come by the sensor alternately. Magnets can be glued with Cyano ("Superglue"). Make sure to degrease surfaces to be glued thoroughly. Distance between magnet and sensor should be 2 mm or less.

Firstly, Hall sensor is mounted to micro switch S1 whereby only the outer screw lying is removed. The second micro switch screw should not be left untightened to avoid misalignment of the switch. Place Hall sensor's PCB with its bore onto the bore of the switch, place the washer onto the PCB and insert the longer screw (supplied with Hall sensor). The PCB should lie horizontal (aligned with micro switch) without touching the middle gear wheel of the piston tank.

Mark position of Hall sensor onto gear wheel. Remove bearing pin of middle gear wheel with appropriate screw driver. Magnets are positioned so that north (N) and south (S) pole come by the sensor alternately. Magnets can be glued with Cyano ("Superglue"). Make sure to degrease surfaces to be glued thoroughly. Distance between magnet and sensor should be 2 mm or less.
Re-grease bearing pin (with Q-Lube, item no. 9705) and fasten middle gear wheel to piston tank.



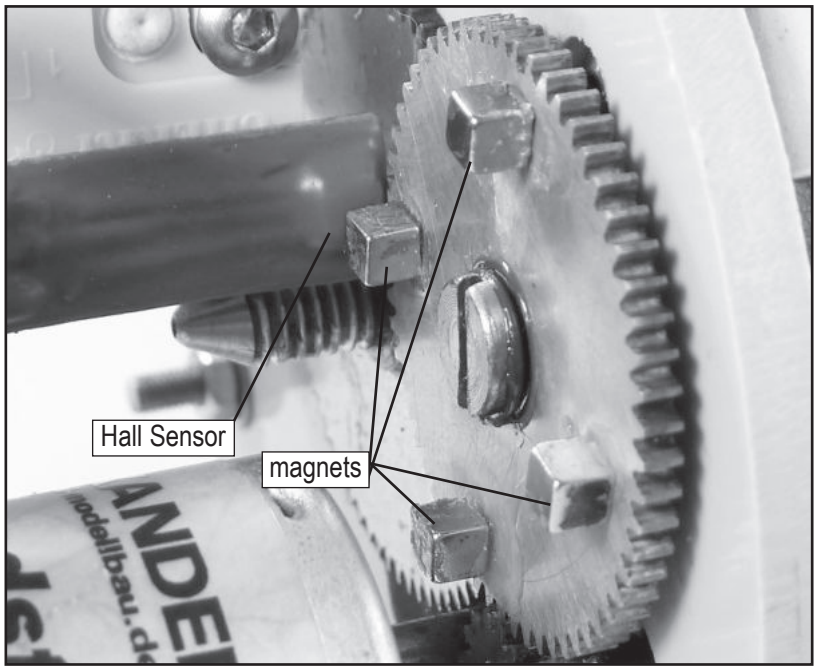
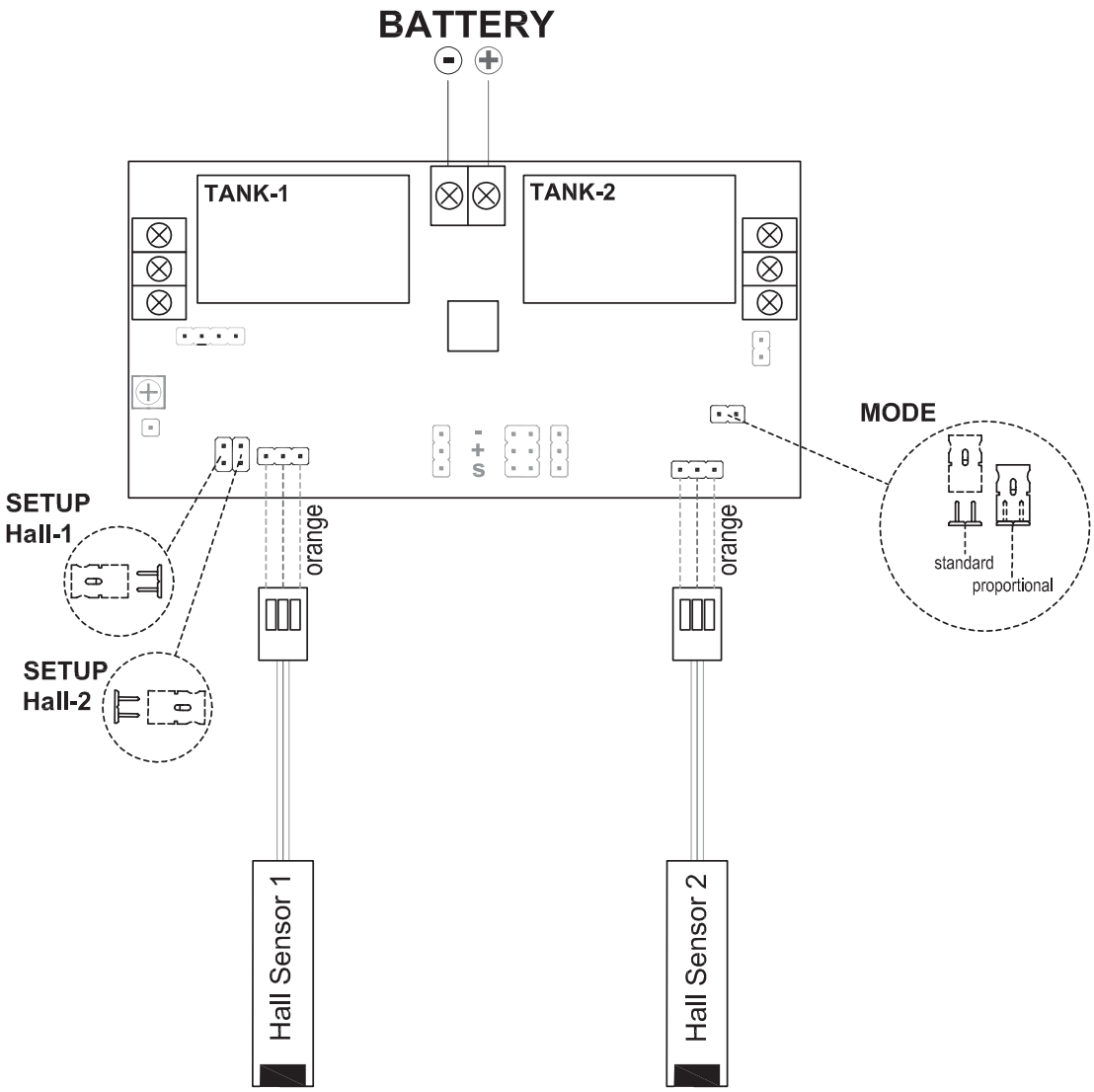
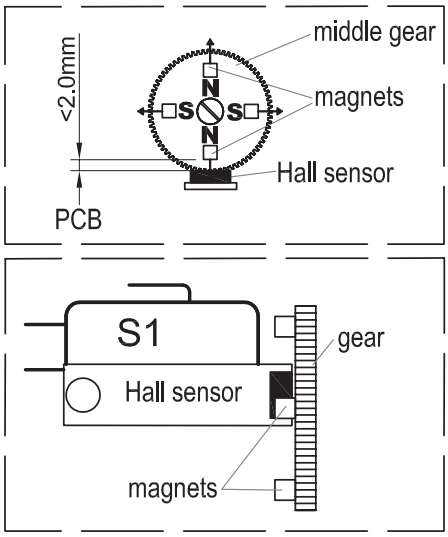
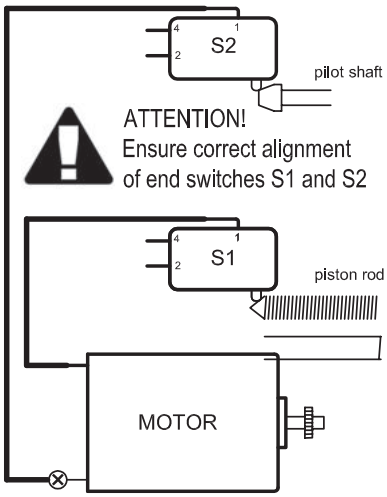


Photo shows Hall sensor (mounted to S1) as well as four magnets (mounted to middle gear wheel) on Piston Tank 12V motor size 380.







ATTENTION - ensure correct adjustment of end switches!

The actuator of micro switch S2 must be kept at the smallest possible distance to the conical part of the pilot shaft. Furthermore, it must be ensured that the actuator is pressed inwards and not sideways when the pilot shaft moves outwards. Otherwise the piston within the tank is likely to be moved over its most outer end position resulting in ultimate blocking of the tank mechanism!

SETUP OF TAE3 WITH HALL SENSORS

1. Hall sensors is fitted and connected to TAE3. MODE and SETUP jumpers are plugged onto TAE3. Receiver is ON and proportional slider is placed to BAIL (empty tank = resurface mode).

2. Switch receiver ON: LEDs (6) and (9) will light up indicating that receiver signal is good. Should piston rods not be fully retracted already piston tank drives will start and empty the tanks (i.e. piston rods will be driven to actuation point of micro switch S1) and stop instantly. Actuation of Hall sensor is indicated by LEDs (7) and (10). Due to high rotation of gears LEDs might not blink but be steadily lit.

3. LEDs (6) and (9) will start to blink: TAE3 measures receiver signal BAIL.

4. LEDs (6) and (9) will show a double blink: Push slider to FILL (fill tank = submerge mode). The unit now measures receiver signal FILL. Piston Tanks remain idle.

5. LEDs (6) and (9) show triple blinking. This indicates that the unit is ready for setting of mode, either to linear or 20/80.

6. With slider remaining in FILL position and pulling of jumper SETUP will switch TAE3 to linear mode. LEDs (7) and (10) are OFF.

7. By pushing the slider to BAIL (yellow LED is ON) and pulling of jumper SETUP will switch the unit to 20/80 mode.

8. Piston tanks now start running with the TAE3 measuring piston tank lengths. LEDs (7) and (10) should show actuation of the Hall sensors. Pistons are driven from their "empty" to their "full" position while Hall sensors count the switching operations required for that full piston stroke.

9. Finally, pistons are driven very shortly to BAIL in order to account for possible overrun whereby piston is briefly stopped. Pistons then travel to the set position. The system is now fully operational.

This setup procedure can be repeated simply by starting anew: Switch TAE3 OFF, plug jumper SETUP back onto TAE3 and switch unit ON again. Restart setup at step 1.

Both MODE jumpers remain plugged onto TAE3 as this activates Hall sensor mode. Jumper SETUP is required for programming only and is layed aside after successful setup of the unit.

HINTS ON INSTALLATION OF TAE3
The TAE3 is fixed onto the four spacers (plastic, 5 mm) with self-tapping screws (supplied with complete set only).

Piston Tanks must be fastened securely within the WTC. A bracket ("short" 18 x 18 mm, item no. 1589-942 or "long" 18 x 36 mm, item no. 1589-944*) can be bolted to the Piston Tank by the same screw fixing one of the straps on the bearing plate (connecting to the end cap of the cylinder). Be careful when re-screwing the bolt into the bearing plate of the tank; otherwise the threaded bushing within the bearing plate might be damaged. A single bracket for fastening each Piston Tank is in most cases sufficient. The water in/outlet of the Piston Tank should lie at its top position (preferably at "12:00"). This will ensure that no air remains after bleeding the tank (by filling and emptying the cylinder several times before trimming the finished model).

Keep in mind that installation of the Piston Tanks does not only require sufficient space for the tanks themselves but also for the spindles which are driven outwards when tanks are filling.

For connection of nozzles on the Piston Tanks PVC hose 9/6 mm is used. These connect to outboard tubing connectors made of brass tubing 8/6 x 16 mm.

Ensure that hoses are not kinked. The cross section of the hoses must be maintained fully. Do not use a thinner hose with smaller cross section. Insertion of filters is neither necessary nor advisable, as all material sucked in will eventually be discharged from the tank. Filters tend to decrease flow rate which in turn causes excess pressure within the tank and hose. This might cause the piston to leak or the hose to spall which inevitably will result in the loss of the model!

The Pressure Switch can be places somewhere within the WTC and connected to an outboard tubing connector (cut of brass tube 3/2 x 15 mm) through silicone hose (4/2 mm).

Outboard tubing connectors should be glued-in with 2-component adhesive, such as Epoxy.

In general, hoses must not be fixed with cable ties or similar as these are held securely down to a depth of 20 m (i.e. 2 bar).

PRESSURE SWITCH
The Pressure Switch is placed within the watertigh compartment (WTC) and connected to an outboard tubing connector (i.e. brass tube 3/2 x 15 mm) via Silicone tubing 4/2 mm (no. 3248-42).

Connect contacts 1 and 3 of Pressure Switch with two-core wire lead with JST jack (no. 9128) to 2-pin row of TAE3 marked as PS (see wiring diagram HALL).

Polarity of pins connecting to Pressure Switch on TAE3 is irrelevant.

Photo on the left shows connection of Pressure Switch to TAE3 via two-cord wire lead with JST jack (no. 9128, supplied with complete set TAE3).

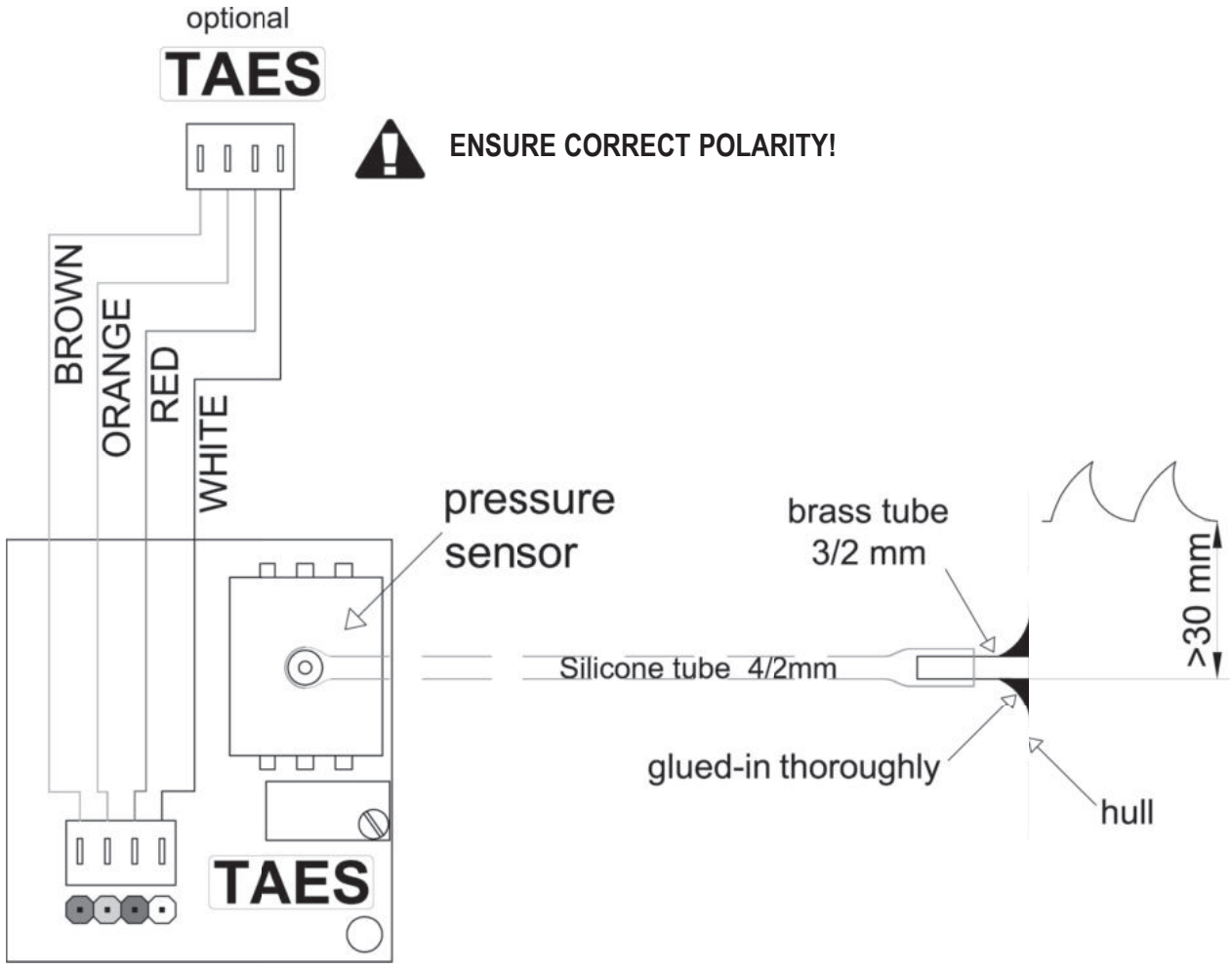
Photo on the right shows contacts 1 and 3 to be connected on Pressure Switch.

TATIC DEPTH CONTROLLER TAES (optional, no. 1585-TAES)

The Static Depth Controller supports the trim of the submerged, static (zero velocity) model. This separate unit measures the pressure differentials during submerging and resurfacing which are then equalized by water being sucked in and pressed out of the Piston Tank cylinders. With TAES activated, no further manual trimming via the transmitter is necessary, thereby allowing the model to automatically level itself off at a desired depth. However, the exact basic trim (with lead ballast) of the model is essential for the system to work effectively. The better basic trim, the less up- and downwards movement during TAES mode (automatic levelling).

TAES (no. 1585-TAES) includes an approx. 240 mm long cable with socket contacts on both ends. TAES is mounted separately from the main switch unit TAE3 on a spacer with a screw (thread M3). The vertical/horizontal position of the unit is irrelevant. The nozzle of the pressure sensor must be connected to an outboard connector (brass tube 3/2 x 15 mm) via a silicone tubing (approx. length 100 mm), both included in this option.

Static Depth Controller TAES does not act as a substitute for pitch controllers as TAES is not effective whilst the model is in forward motion. Automatic adjustment of depth and/or horizontal position of the model in forward motion can only be facilitated by so-called Pitch Controller (such as SPC2, no. 1574) or Pitch & Depth Controller (such as LTR6, no. 1575-6).

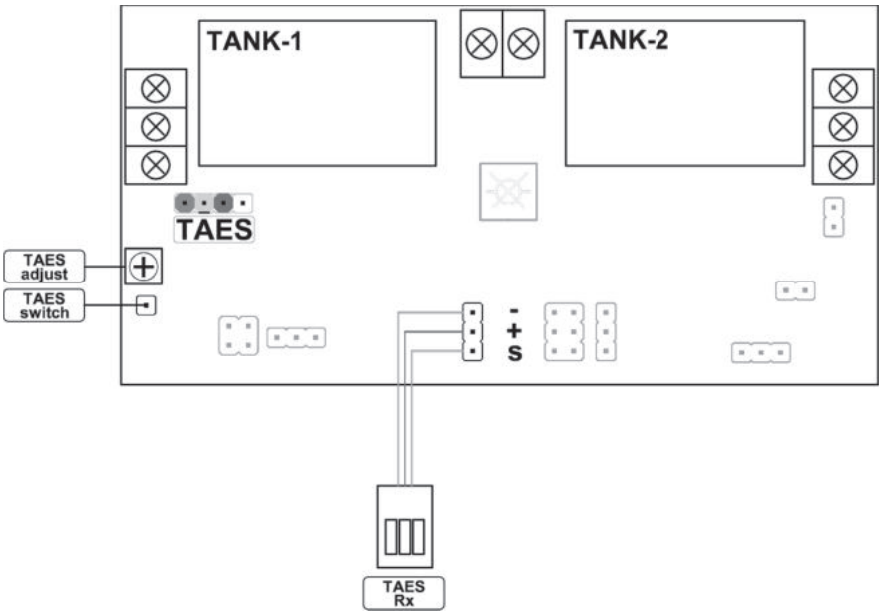


Activating TAES
TAES can be activated in two ways:

1. By an electronic switch (i.e. no. 8431) or module/decoder system (such as robbe Multi Switch).
   Connection is then made to the single pin on the TAE3, switched by „ground“ (negative polarity).

2. By a swich channel directly from the receiver (Rx).
   Connection is then made to the 3-pin row on the TAE3.

Activation of TAES is indicated by LED-8.



As each model submarine differs in terms of buoyancy and trim the TAES should be adjusted accordingly. This is achieved by regulating the response characteristic of the TAES pressure sensor via the smalle potentiometer located right next the 4-pin row on TAE3 connecting to TAES. Turning the potentiometer clockwise will make TAES less responsive to pressure differentials. At the right end-stop responsiveness is zero. Turning in anti-clockwise direction will make TAES more responsive to pressure differentials, which in turn will cause increased swinging of the submerged model.

Furthermore, erratic up- and downward swinging can also be caused because of poor basic trim.

A prerequesite for optimal fuctionality of static depth control is a good basic trim of the model. With TAES activated the pistons will oscillate from fill to empty and vice versa, thereby trying to bring the model to the depth given when TAES was activated. The better basic trim the less fluctuation. A stroke of about +/- 5 cm would be optimal but hard to achieve, +/- 10 cm will prove adequate. Such differences in depth will not show whilst the model is submerged anyways.

INITIAL TESTING

At this stage both Piston Tanks should be fully wired to the TAE3. BEFORE initial testing of this dive system draw the piston rods outwards by turning the gear wheels of the Piston Tanks in ANTI-clockwise direction. 3 to 4 cm will allow for sufficient travel of the rods for this first test.

Move piston rods “BY HAND” - DO NOT connect a battery directly to the motor tags. Otherwise you risk damaging the TAE3.

Connect the TAE3 to the main battery (6 or 12 V).

Please note: the unit has not been plugged-in to the receiver, yet!

Ensure correct direction of movement!
The fact that the main battery is connected but receiver power is NOT forces the TAE3 into fail safe status (as consequential no receiver signal can be detected by the TAE3). This should now result in the TAE3 to command the Piston Tanks to BAIL so that the spindles are drawn inwards (i. e. retract). If one (or both) of the Piston Tanks react inversely, i. e. SPINDLE(s) EXTRACT, SWITCH OFF MAIN POWER IMMEDIATELY.

In this case, direction of movement must be INVERTED by interchanging the leads connecting to the motor tags (DO NOT reverse battery connections of the TAE3).

Wrong motor polarity will consequently cause incorrect switching logic of end switches!
Therefore, actual end stops will not be detected by end switches as such causing the piston drive to jam.

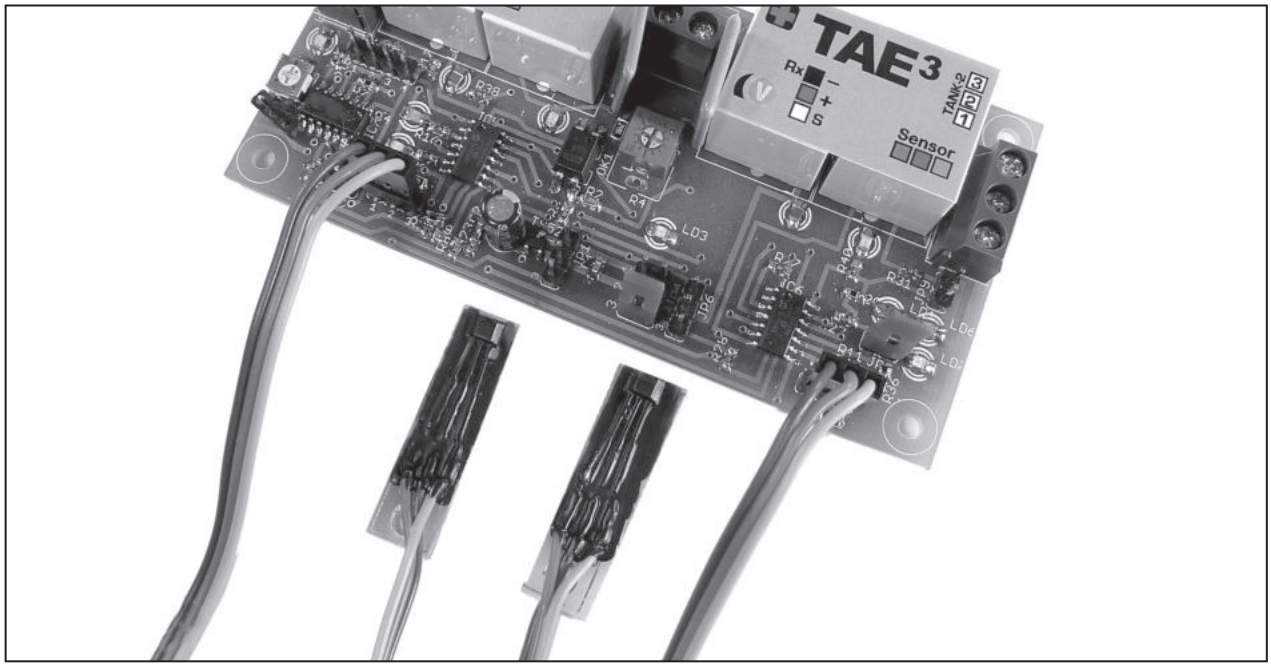
Once correct direction of movement has been assured, proceed with the ultimate functional checks.

CONNECTING TAE3 TO RECEIVER

With the TAE3 connected to main battery power but without connection to receiver or receiver power, will automatically force the TAE3 to switch to BAIL (empty). In conclusion, the model will resurface not just as a result of a missing R/C signal but also if receiver battery power has turned weak or is actually “off”. This is, in fact, an impressive safety feature as the model will resurface despite such “unfavourable” conditions.

Plug the TAE3 into the corresponding port of the receiver (Rx). Then power up transmitter and receiver (in this sequence).

Using an ampere-meter will prove preferable (up to 10A) in order to monitor current strength. This will also allow for fast detection of hook up errors or short circuits.



When switching to “fill” the RED LED of each relay block will light up. The “empty” mode is indicated by the YELLOW LED. Every time the Piston Tanks drives have reached their end positions, the motor must stop instantly. The ampere-meter must instantly turn to zero.

Trouble-free operation of the switch unit might only be possible in PPM modulation. In PCM modulation the unit may show dysfunctions (or not operate at all) due to non-standardized transmission signals in PCM. Ensure that your R/C system (transmitter and receiver) can be used in PPM. Please refer to the manual of your R/C for setting your system to PPM.

FUNCTIONAL TEST OF SAFETY DEVICES

1. Transmitter Signal Loss

If the signal is lost - due to excessive depth or transmitter failure - the unit will automatically switch to "resurface" (i.e. empty the tanks). If signal is picked-up again and "submerge command" is still given by the transmitter, the system will automatically switch back to "submerge". This fail safe function is preset to about 4 seconds so that not every twitch can ruin the model's trim. Default fail safe time is preset to approx. 4 seconds.
Testing this function is quite simple. Just turn off the transmitter. The unit will then switch to "resurface" after about 4 seconds. LEDs (6) and (9) will the be off.

2. Receiver Signal Loss

With LEDs (6) and (9) lit indicates good receiver signal.

Failure of receiver or receiver battery will command the TAE3 to switch automatically to “bail” (empty the tanks). Reaction time here is minimal. LEDs (6) and (9) will then turn off.

3. Pressure Switch

With LED (1) lit indicates activation of Pressure Switch.

By blowing into the tube of the pressure switch the "resurface mode" will automatically be activated even if the "submerge command" is given. If the "submerge mode" is activated and the Piston Tanks are running, the signal of the pressure switch will override this command and force the model to resurface. The pressure switch acts as a safety device which comes into action as soon as the model has submerged below a depth of approx. 1.8 meters, forcing the model to resurface.
If the "submerge command" is still given by the transmitter, the system will switch back to "submerge" as soon as the model has reached a depth above 1.8 meters.

4. Low Battery Monitor

As soon as LED (11) lightts up indicates that main battery power has dropped below threshold value. After low battery voltage has been identified further operation of the system will only be possible after having charged the battery. If low battery status sets in although battery voltage is adequate, threshold voltage needs to be decreased.
This so-called low battery monitor can be adjusted by turning of potentiometer on the TAE2:

- potentiometer turned **clockwise** = threshold voltage is **decreased** = low battery mode sets in **later**
- potentiometer turned **anti-clockwise** = threshold voltage is **increased** = low battery mode sets in **earlier**

For accurate adjustment a regulated mains unit is recommended. Alternatively, a battery with appropriate voltage can be used.

TRIMMING

The following hints on trimming the model are a general guideline. For trimming of an ENGEL submarine model please refer to the corresponding manual of the individual kit which describes the trim of the model in particular.

The model must be fully equipped and painted before attempting to trim the boat. Trimming can be a tedious task. However, a good trim is absolutely necessary for achieving proper operation of a fully functional model submarine.

You MUST check that the boat is completely watertight before beginning to trim.
Blow air into the WTC through the breather so that over-pressure is created.

DO NOT use a pump as the pressure should not exceed 0.1 bar.

This allows you to verify that really everything is absolutely "pressure proof".
Now press the model below water surface. Leaks are easy to spot, as a stream of bubbles will be seen. Any leaks found must be fixed before going forward with trimming.

After this test, any over-pressure must be released by opening the breather.
Do not forget to close breather again after equalization of pressure!

Ensure that Piston Tanks are in their "empty position" and place the model into the water.

The draft should correspond to the model's particular waterline. If this is not the case ballast weight (e.g. lead) must be added or removed from the hull. If no weight can be removed, the model can be "lifted" by floats cut of foam (e.g. Styrodur® / polystyrene panels) which are to be fitted within the hull. Please note, that foam floats will only affect the water line of the model if these are placed below water surface.

Next is the diving test. Prior to the first dive, Piston Tanks must be operated several times to bleed the tanks of air caught within the cylinders.

After this, tanks are to be filled completely to 100%. This position resembles the *AutoTrim* position ("neutral buoyancy") and should remain until trimming has been completed.
The model will now just barely be below water surface or fully submerged. If the model is too light, ballast (e.g. lead) must be added. If the model is too heavy (i.e. submerging too fast and/or too far down) weight must be removed or foam added.

Neutral buoyancy and horizontal trim of the model must be adjusted WITHOUT operating the Piston Tanks.
If foam is necessary for reaching an exact trim, these floats should be placed in a position which is above water level if the model is surfaced. In this position it will not affect the trim of the water line.
Foam can be attached with double-sided adhesive tape.

After trimming has been completed, Piston Tanks are emptied and the model resurfaces up to its correct waterline.
Good horizontal trim of the model will also ensure efficient control via the dive planes.

A good basic trim of the model is of vital importance for effective operation of Static Depth Controller TAES. In TAES mode Piston Tanks will oszillate between micro switch S2 and S3 whereby the model will be levelled out. However, up and downward movement will remain so that the TAE3 will permanently readjust the tanks. The better basic trim, the less deviation in terms of lifting movement during the TAES mode. A good value is +/- 5 cm (optimal) to 20 cm (still reasonable). Anyways, these ups and downs are at a very slow pace and barely visible on the submerged model.

Foam plates used as floats should be let to dry thoroughly and then sealed with Epoxy to avoid absorbance of water which will otherwise corrupt the formerly achieved trim of the model.

MAINTENANCE

ENGEL Piston Tanks are superior to other designs in terms of resilience to pollution.
Even slush will not cause a malfunction of the tank as all material drawn into the tank will eventually be discharged.

Standard servicing of the Piston Tank only requires lubrication of the middle cog wheel's retaining bolt with white oil (as used for fire arms or sewing machines). BALLISTOL Oil (item no. 9720) is ideal for this. Just place a drop between the bolt head and the cog wheel. After several turns the lubricant will be sucked-in by itself.

After operation in polluted water (e. g. algae) the piston tanks should be rinsed with fresh water. Please note, that further lubrication of the piston will only be necessary, if a leakage of the Piston Tank itself is obvious.
This might be the case if used in very sandy waters after a period of time. In this (very unlikely) circumstance, open tank (unscrew bolts at motor/gear cap), rinse cylinder and lubricate piston and inner spindle with a high performance grease such as Q-Lube (recommended, item no. 9705) or a similar dedicated lubricant.

FURTHER SAFETY GUIDELINES

Never operate Piston Tanks without completely connected Switch Unit!
Operation without completely connected switch unit will lead to damage of the Piston Tank and consequently result in the failure of the entire system.

Take care when charging batteries!
Batteries which indicate to be sealed can release gas even if handled and charged correctly (for example: excessive charging current or time, unsuitable charger in use). Batteries have a security valve to release any possible internal over-pressure. The gas produced is highly explosive and has an enormous destructive power.

For safety reasons batteries MUST NEVER be charged within sealed compartment!
The charger and the battery should be in an open well-ventilated space. Therefore, ALL batteries must be removed from the model during the charging period. Even so-called "sealed" batteries allow a build-up of hydrogen gas while being charged which in turn can cause a serious EXPLOSION, tearing the model into pieces and endangering its immediate environment.

The installation of charging sockets in either the hull or pressure proof compartment will result in the GUARANTEE being NULL and VOID!

If you have any questions regarding the assembly or functioning of the system, please do not hesitate to contact us by

phone: int.+49 (0) 7043 - 93520

email: info@engel-modellbau.de

Happy Sailings!

ALEXANDER ENGEL KG

This symbol indicates that after the service life of this electrical device has ended it must be disposed separately from domestic refuse at your communal waste collection.

Problems, possible causes and solutions

Problem	Description	Cause	Solution
When switching to FILL piston rod spins INWARDS, switching to EMPTY piston rod spins OUTWARDS.	Piston is driven over its actual end position and locks-up.	Incorrect direction of movement due to wrong polarity of motor.	Change direction of motor rotation by exchanging the wires soldered directly to the motor tags.
	Micro switches of Piston Tank react not analogously. Piston locks-up.	Wrong connection of micro switches or switch unit.	Verify wiring!
Dive system does not react to SUBMERGE command any more.	Significant difference between air and water temperature creates an under-pressure within the WTC.	Submerge command disabled by pressure switch.	Open breather so that pressure is equalized to normal atmosphere.
	The positive pressure generated within the WTC by filling the tanks has diminished due to a leak. Escape of air bubbles.	Emptying the tanks has now caused a negative pressure within the WTC. Therefore, submerge command has been disabled by pressure switch.	Locate leakage. Check WTC for water ingress. Leave to dry thoroughly. Seal leakage accordingly.
	LEDs (6) and (9) are off.	Transmitter or receiver not powered or defective so that no signal can be transmitted.	Check transmitter and transmitter battery. Alternatively check BEC.
Dive system does not react at all.	LED for fill and empty remain unlit at surface or dive command. LED (11) is off.	Power supply has been interrupted by self-resetting Polymer fuse due to overload.	Ensure free movement of Piston Tank drive and spindle. Fuse(s) will reset itself automatically.
		Battery power exhaused or battery defective.	Charge and check battery. Replace battery if in doubt.
	LEDs (6) and (9) are off.	Transmitter or receiver not powered or defective so that no signal can be transmitted.	Check transmitter and transmitter battery. Alternatively check BEC.
Shortly after switching to FILL Piston Tank(s) switch to EMPTY.	Battery voltage drops below preset threshold voltage, but threshold value is OK.	Battery capacity exhausted.	Immediately command model to shore. Charge or replace battery.
	Battery voltage drops below preset threshold voltage, but battery voltage is OK.	Battery voltage is lower than threshold value of battery monitor. FILL command deactivated due to assumed weakness of battery. Threshold voltage is too high.	Lower threshold value by slowly turning potentiometer of battery monitor a small step in CLOCKWISE direction.
	Piston rod drives outwards, then inwards. Piston Tank seems to function erratically.	Micro switch S1 is not properly adjusted.	Slightly open retaining screws. Carefully press BOTH switches against tank and downwards.
		Micro switch S1 dirty or worn.	Replace micro switch. NOTE: use genuine spare part no. 5024 ONLY. Other types or brands will suffer of extreme abrasive wear on the spindle!