Item-No. 1575-6

Pitch & Depth Controller

LTR6

Installation Operation & Adjustment

Please read the following instructions and safety warnings carefully BEFORE you commence with the installation of the unit.

24 Month Limited Warranty
The manufacturer of this unit warrants this product to be free from defects in material and workmanship for a period of 24 (twenty-four) months from the date of purchase. During that period, we will repair or replace, at our option, any unit supplied through us that does not meet these standards. You will be required to provide proof of purchase (receipt or invoice). Defects caused by abuse, misuse, or accident, etc. are not covered under this warranty. Under no circumstances will the purchaser be entitled to consequential or incidental damages. If you attempt to dissassemble, modify, or repair this unit in any way yourself it may void the warranty. For service to your MiniPitchController send it post paid and insured to the address stated on the front page of this manual (please ensure adequate and safe packaging).

WARNING!
This item is not a toy and therefore not suitable for persons under 16 years of age.
Please adhere to your country's safety guidelines during construction and operation of this item.
We are not liable for any personal injury or damage of any kind resulting with 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.

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Engel Since 1952

A pitch and depth controller's main function is to keep the model whilst running submerged at a set level. Running his sub steadily at periscope depth is really an achievement for any model submariner.
The LTR6 is an automated system to succeed in this kind of manoeuvre. The LTR6 does not only offer a combination of pitch and depth controller but an interactive system of the two devices in a single unit.
Compared to gyro systems for model airplanes an auto leveller for model submarines must operate in a much narrower spectrum as subs do not have 100 meters (as model aircraft) but only about 1 meter of vertical space for movement.
Surely, even the most sophisticated controller will still demand initial manual adjustment due to the variety of models and their operational behaviour.
Good performance of the LTR can only be achieved if the model itself is well trimmed meaning that it is trimmed to buoyancy.
The closer the trim to perfect buoyancy the better the performance of the LTR.

As with their original counterparts model subs can also be graded in "well to manoeuvre" (i.e. German type 206) and "obstinate" (i.e. German type XXI). Therefore, the LTR will work better in a well manoeuvrable model rather than in a less handy type.

Unfortunately, such a unit is not self-adaptive (yet). Therefore, the unit must be adjusted to the individual sub to reach a perfect match (adjustment will be discussed at a later stage).

The LTR6 requires data from two inputs. Firstly, the depth sensor giving the relative depth as a result of the pressure surrounding the WTC (Water Tight Compartment). Secondly, the inclinometer shows the momentary horizontal position of the model.
The depth sensor is easily identified by the nozzle protruding the unit. The inclinometer is an internal part and not really visible.
Furthermore, the automatic system must also incorporate the manual commands given via the transmitter by the captain.

The control circuit of the depth controller consists (from a technical standpoint) of two individual but interleaving circuits. The "inner" circuit includes the inclinometer which is responsible for keeping the model in a horizontal position. The inclinometer determines the stability of the moving model during the dive mode and can be adjusted by a potentiometer to operate with the individual sub.

Its nominal value for the model's horizontal position is provided by the "outer" circuit, incorporating the actual depth controller with pressure sensor. The regulating properties of the "outer" circuit are uncritical and must, therefore, not be adjusted.

The desired depth is given via the transmitter whereby the control stick in neutral corresponds to approx. 0.4 meters (distance between pressure sensor and water surface); at this level most models are at periscope depth. The model will dive deeper by pushing the control stick forwards, or vice versa, emerge further by pulling the stick below neutral.

Installation

The LTR6 is mounted onto a solid machined base which must be properly fastended with the four self-tapping screws (recommended) or double-sided tape within the WTC. NOTE that the longitudinal axis of both, model and LTR, must coincide. Furthermore, the main pin row (connecting to the servos) must face towards the bow. Otherwise pressure changes would result in the dive planes turning in the opposite direction which would cause improper operation by the unit. However, it is irrelevant if the LTR is mounted lying flat or sideways.

Electrical connection is quite simple. The pre-soldered JR-type leads (brown/red/orange) are compatible with robbe/Futaba, Graupner/JR, Multiplex (new) as well as Hitec and other major brands. The LTR is pre-adjusted to suit robbe/Futaba control sticks and will match most other types with servo throw set to 100% without additional trim.

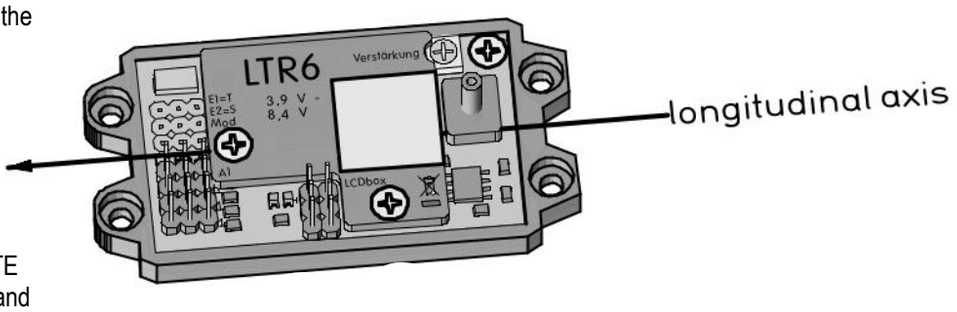
The upper connection lead is plugged into the Rx channel corresponding to dive plane operation. The lead in the middle is implemented for models with X-rudder and connects to the rudder channel. The lower lead is connected to a Rx channel directed by a 3-position switch on the transmitter; this channel controls the operating mode. If this lead remains unconnected the LTR will permanently be switched on. The order of receiver outputs is irrelevant. The signals can even have different sources without any impact on the functionality of the LTR.

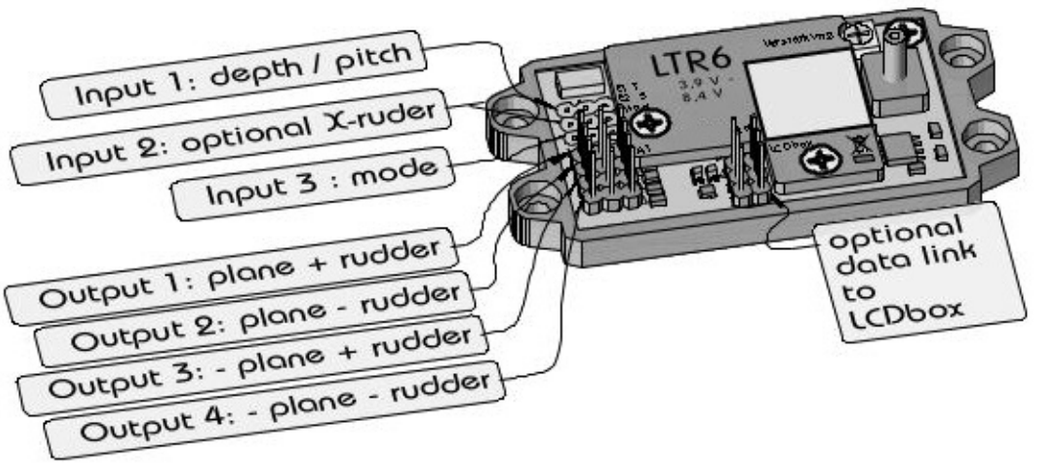
The servos connect to the four 3-pin rows with wire lead colours matching the Rx connection leads with "ground" (brown, robbe/Futaba black) on the outer pin of the LTR.

For submarines with normal cross-shaped tailplane and a single pair of dive planes only output 1 is used. Output 2 offers the same signal. Outputs 3 and 4 offer inverted signals so that servos connected to these outputs will operate in reverse direction. Therefore, the LTR6 offers connectivity of up to four servos in all variations of movement. This proves advantageous especially for models with X-rudders operated by four individual servos.

The nozzle on top of the pressure sensor is connected via silicone tube 3.5/1.5 mm to an outboard connector (brass tube) both included in this kit. The outboard connector should be located in a position at which no built-up (ram pressure) is generated when the model is either in forward or reverse movement. The most preferable location is towards a free-flooding space within the hull as here the current will be minimal.

The direction of servo movement as a result of change in pressure or position is adjustable. When pressure increases (model submerges) or the aft of the hull is lifted upwards the dive planes must turn to "surface". This will be, in fact, the servo's correct direction of movement. If this should not be the case turn potentiometer "P" to the opposite direction of its neutral position. NOTE that urning the LTR by 180 degrees will not solve the problem! Even though that direction of movement will be correct when horizontal position changes, the unit's reaction to a pressure change will remain false.





Operating Modes

The LTR6 offers three operating modes which are set on the transmitter by a 3-position switch (on/off/on):

• Off

Depth as well as pitch control are deactivated with full servo control via transmitter. LEDs are off. If the X-rudder input is used the X-mixer will remain active, of course.
Deactivating the LTR will proof helpful for various manoeuvres such as "emergency resurfacing" which is much more impressive with manual control. Also when model is moving in reverse as the LTR will then turn the dive planes inversely and, hence, in the wrong direction.

• Depth control relative (switch in centre position)

As soon as this standard mode is activated the LTR6 will memorize the actual depth and tries to hold the model at it. Target depth can be adjusted by moving the control stick slowly of its neutral position. Target depth is limited to 1 metre. Pushing the control stick by more than about 50% of stick travel, dynamic passivation sets in, thereby reducing automatic and increasing manual control. Pushing the control stick fully in either direction will fully deactivate automatic control with dive planes turning to full throw. This ensures that you will always have full control of the sub should an emergency manoeuvre should become necessary. As soon as the control stick is back to neutral the target depth will be set to this new value.
The two LEDs will now light-up depending on the model's pitch.

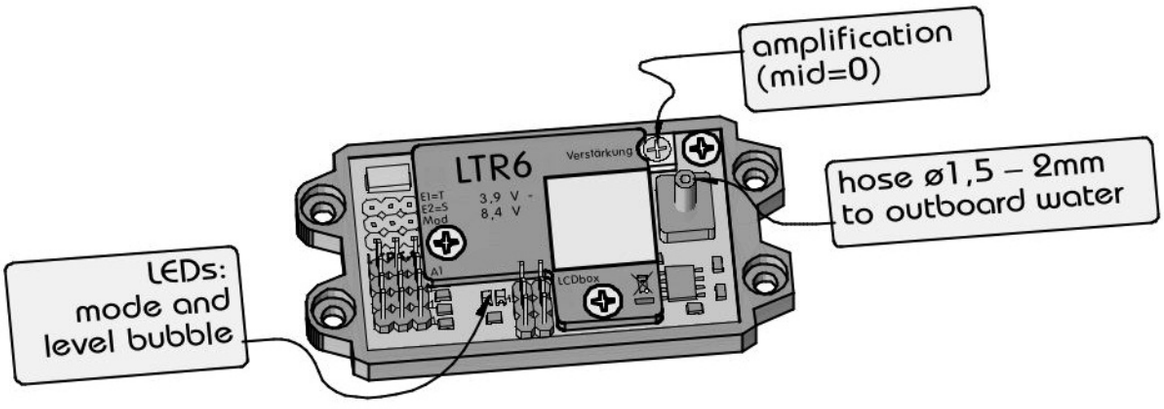
• Depth control absolute

Target depth is now set directly by movement of the control stick. Neutral stick position corresponds to a depth of about 40 cm which is the same as with former LTR versions 4.x and 5.x.
Dynamic passivation of the LTR at more than 50% stick travel also remains active in this mode.
Both LEDs are on.

Servo and Rudder

The dive plane servo must fulfil two main criterias: It must have minimal slip and strong enough to withstand permanent stress caused by steady operation.
Hence, low cost micro servos are not recommended. As reference choose a servo approved for operation in helicopter models. A good standard size servo will do the job. If the servo's transit speed is slower than 0,15ms there might be a problem with fast model submarines, though. In this case a faster servo is preferable.
Keep in mind that operation of the model with permanently activated LTR will also put a strain on battery capacity.
If you are using a BEC system instead of an individual receiver battery pack the BEC should have sufficient potential (refer to specifications of the servos used).

The minimal slip criteria is not just valid for the servo itself but also for the linkage between servo and dive planes. Higher slip will result in servo movements not being fully delivered to the dive plane which consequently results in a loss of efficiency achieved by the LTR.



Moreover, the unit will then not only work less exact but proper adjustment might not be possible.

Bow and aft dive planes

The LTR6 has been designed for submarine models with single as well as multiple pairs of control planes. There are various methods for operating aft and bow dive planes.

Firstly, the two pairs of dive planes can either be operated by a single servo via a common linkage. Secondly, the LTR6 can govern a servo for each pair of dive planes should technical setup of the boat require two individual servos.

In both cases the dive planes must interact in the opposite sense, meaning that aft planes tilt downwards, bow planes turn upwards (or vice versa). This setup has proven to be a good choice for IX, VII, GATO and similar type of models.

There is also a third alternative: Only one pair of dive planes (normally aft planes) is actually operated by the LTR. The other pair is then left to manual control. This will require a Y-cable (also called V-cable such as no. 9115). The Y-cable plugs in to the corresponding receiver channel. The LTR is then connected to one end of the Y-cable, the bow dive plane servo to the other end. Therefore, only a single channel will be occupied. However, manual operation of the bow dive planes should be limited to "emergency manoeuvres"; otherwise automatic control will be hampered.
This might be the right choice for models that have dive planes with highly differentiated effect on the actual movement of the vessel.

The choice to be made here really depends on the individual model and its operation.

Adjustment

Adjustment of sensitivity is made by turning rotary switched "P" on the LTR. Exact adjustment for the individual model can only be achieved by trial. Factory setting suits most models in general.
Individual setting must first be determined "on land" by lifting the aft upward. The dive planes must turn adversely to the tilt of the model. If this is not the case, rotary switch "P" must be turned in the other half of its adjusting range. Neutral setting of the rotary switch is marked at "3-o'clock" of the switch.

The higher the sensitivity the more exact the adjustment. However, this does also increase the possibility of "dolphin-like" behaviour with the model swinging up and down. The optimal sensitivity adjustment lies therefore just below the point at which the model starts swinging.

Technical Specifications

• Type:	plug-in-between device, powered by receiver battery, internal sensors and microprocessor
• Dimensions:	65x33x16 mm, milled plastic base
• Weight:	approx. 20 g
• Voltage:	3.9-8.5 V (receiver power)
• Consumption:	0.5 mA (idle)
• Impulses:	positive, 0.75-2.25 ms works with all R/C systems

LCDbox (optional, item no. 1575-LCD)

This box allows various parameter readings and configurations of Pitch and Depth Controller LTR6 such as complex mixers, filters, servo throw etc.

The LCDbox is connected via a 6-pole wire lead to LTR6. The black marking of the connector faces the middle of LCDbox; on the LTR6 the black marking faces the bottom.
Connect LCDbox to LTR6. Immediately after receiver is switched on the display of LCDbox will show the LTR's firmware version. If nothing shows either the connection has been setup improperly or display contrast needs to be adjusted.

For navigating through the menue the LCDbox is fitted with four buttons:
and change value of parameter.

opens" a parameter so that value can be adjusted; this is indicated by „=". Then press „RETURN" to save change in parameter and terminate change mode („=" dissappears).

Press „ESCAPE" for terminating change mode without saving changes made in parameter.

The following example illustrates how to change parameter