

CTS₂

Compact Tank SWITCH

for Piston Tanks type EA in 6 and 12V

item no. 1584-CTS2

The CTS2 is the latest generation control device forming a compact unit with the piston tank. CTS2 is designed for a single piston tank type EA with AutoStop. The standard version (without Hall sensor) can be operated either via a control stick or a 3-position switch (on/off/on) on the transmitter. Control commands are FILL-STOP-EMPTY of piston tank (meaning: submerge-stop-resurface of model).

CTS2 with Hall sensor (optional, item no. 1585-H05S)

Switch unit CTS2 can also be upgraded to proportional piston tank control by which the piston is driven to a position set by the transmitter. The exact position is detected by a so-called Hall effect sensor connected to CTS2 by a three-core cable and pre-mounted on a separate PCB. To activate this mode the two contact pins on the back side of CTS2 marked MODE are connected by setting a jumper. This proportional CTS2 version 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 CTS2. Therefore, CTS2 is suitable for all conventional R/C systems.

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 tank 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.

The control current for the unit is fed in by the wire lead connecting to the receiver. Receiver current should be 4.8 to 6 V as common for most R/C components. CTS2 can take currents up to 8.4 V. However, most servos and receivers cannot bear such high voltage. Operating current depends on piston tank used (6 or 12 V) and supplied by the main battery.

With the optional pressure switch (item no. 5029) connected, maximum depth is limited to approx. 1.8 meters (about 5.9 ft). If the model dives below this level, CTS2 will automatically switch to BAIL and empty the tank. The model will then resurface if the slider is still set to BAIL. Otherwise, with the slider left in its initial position the model will emerge to a depth above 1.8 meters after which the tank will start filling again until the piston has reached the position according to the slider.

Furthermore, the pressure switch (DS) acts as a second security device. Should the overpressure which builds-up within the hull while submerging (by filling the tank) be lost due to a leakage, the "submerge" mode will be terminated. In this case, the yellow LED flashes steadily and the system does not allow the model to submerge again until leakage has been cured. Furthermore, CTS2 offers another fail safe device. If the transmitter signal is lost - due to increased depth or other circumstances - CTS2 will also automatically switch to BAIL. Automatic resurfacing will also be initiated if receiver battery or receiver itself fails. CTS2 also offers a so-called Battery Voltage Monitor. The voltage of the main battery is permanently verified. Should voltage fall below a specific threshold value for more than 5 seconds, the unit will switch to BAIL. Threshold value is factory set to approx. 4.5 V for 6 V operation or about 9 V for 12 V operation (adjustable). Low battery mode is indicated by the red LED.

It is highly recommend to always making sure all batteries are fully charged before your model commences its journey!

Connecting Piston Tank and Pressure Switch to CTS2

Before mounting CTS2 to Piston Tank, make up cables connecting motor poles to tags of micro switches from wires, yellow and violet (each. about 120 mm long) as well as blade receptacles and heat shrink tube supplied with CTS2. Skin each wire end and tin coat with soldering iron. Crimp one receptacle onto each wire. Cut heat shrink tube supplied in half (to about 20 mm), push over receptacles and shrink with heat gun (about 130°C). Solder other wire end directly onto connection tag of motor.

Connection between micro switches S1 and S2 with corresponding motor poles is made as illustrated. Install wires accurately around spindle and motor.

CAREFULLY widen the four blade receptacles (pre-soldered to CTS2's back side) with a small screwdriver. Coat contact tags of micro switches with contact spray in order to prevent oxidation. Slide receptacles of CTS2 CAREFULLY onto micro switches. This will require some pressure but must be done with GREAT CARE to avoid damaging the circuit board.

The optional pressure switch connects to the 2-pole pin row of the CTS2 marked DS. BEC connector cable no. 9128 is ideal. On the pressure switch only contacts 1 and 3 are employed. **Polarity is irrelevant.**

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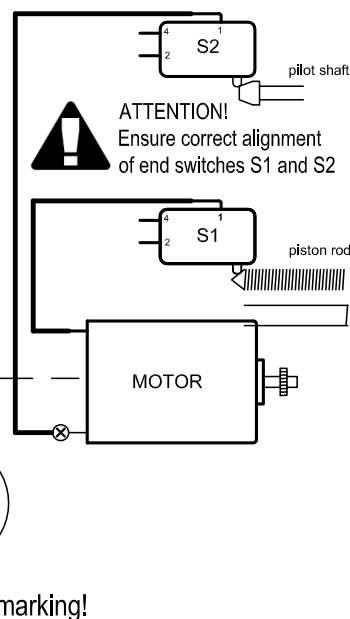
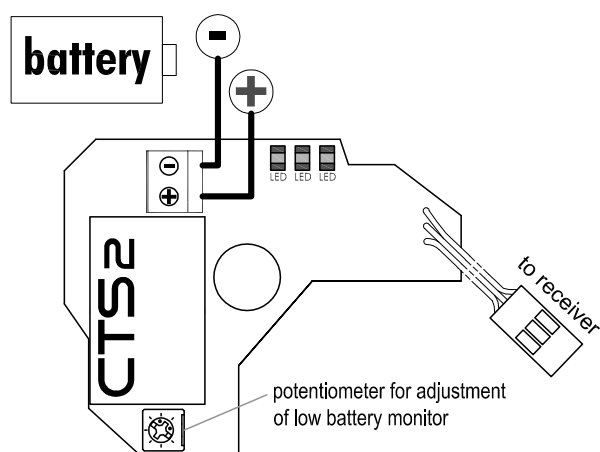
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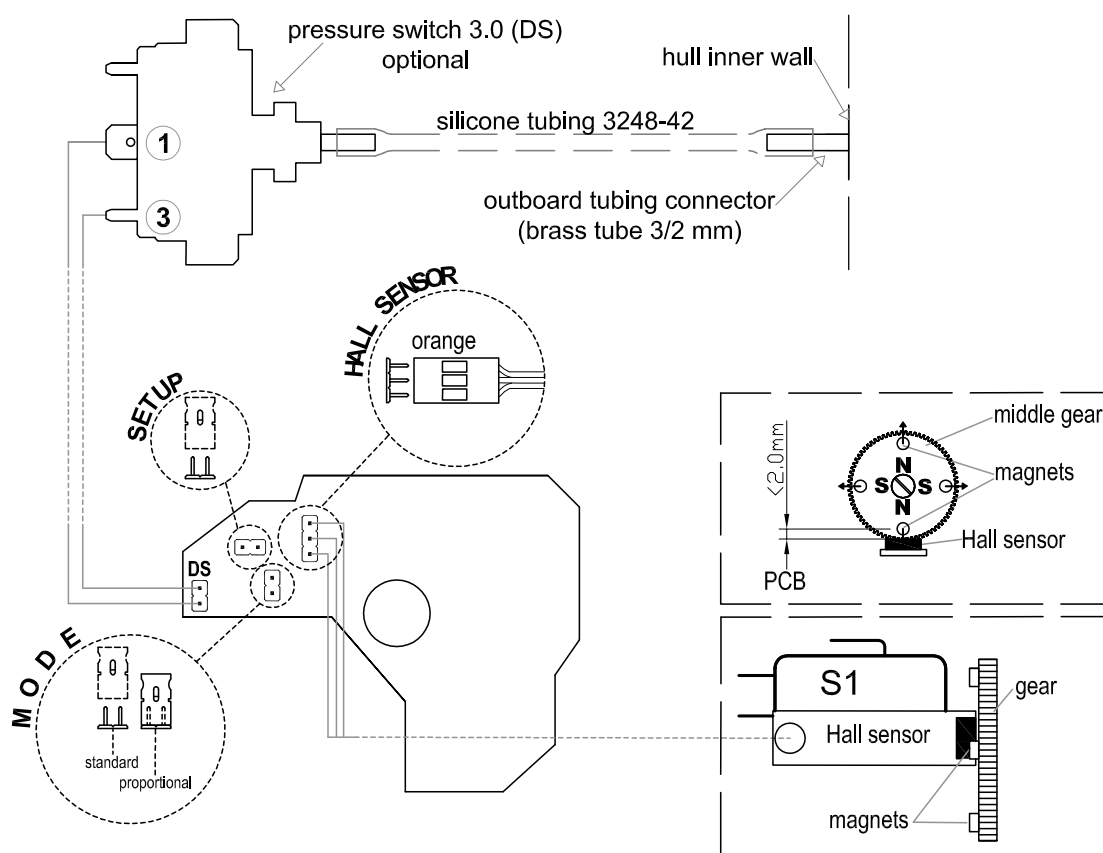
connections FRONT SIDE



Ensure correct polarity!



connections BACK SIDE



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-H05S) includes four neodymium magnets as well as a longer screw and washer for mounting Hall sensor to a micro switch. 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 extent, 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 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.

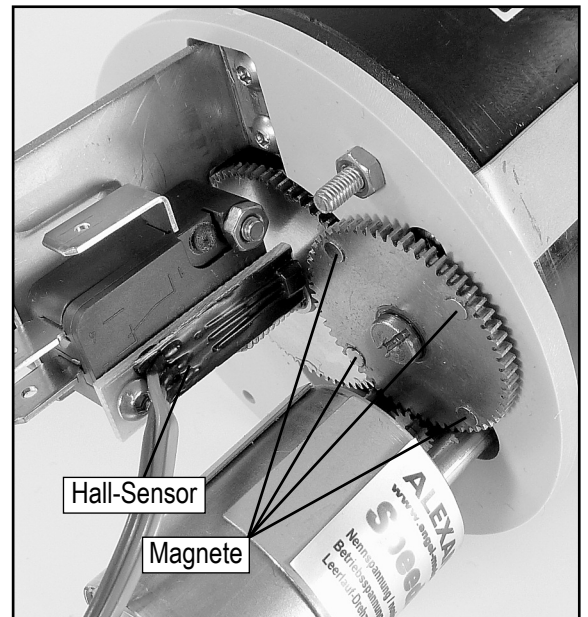
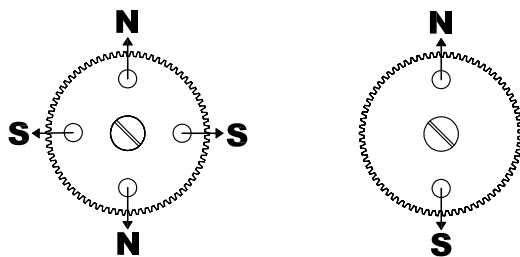
Firstly, Hall sensor is mounted to micro switch S1 whereby only the screw lying directly at the CTS2 is removed. The second micro switch screw should not be left untightened to avoid misalignment of the switch. Place Hall sensor's PCB with its bore onto the bore of the switch, place the washer onto the 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.

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!



Picture shows Hall sensor (mounted to S1) as well as four magnets (mounted to middle gear wheel) on piston tank 12V with motor size 380.

Proportional Control (with Hall sensor)

- 1 Hall sensor is fitted and connected to CTS2. Both jumpers MODE and SETUP are plugged onto CTS2. Receiver is ON and proportional slider is placed to BAIL (empty tank = resurface mode).
- 2 Switch receiver ON: green LED will light up indicating that receiver signal is satisfactory. Should piston rod not be fully retracted already piston tank drive will start and empty the tank (i.e. piston rod will be driven to actuation point of micro switch S1) and stop instantly. Actuation of Hall sensor is indicated by the CTS2's yellow LED.
- 3 Now the green LED will start to blink: CTS2 measures receiver signal BAIL.
- 4 The green LED shows a double blink: Push slider to FILL (fill tank = submerge mode). The unit now measures receiver signal FILL. Piston tank remains idle.
- 5 The green LED shows 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 CTS2 to linear mode. Yellow LED is 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 tank now starts running with the CTS2 measuring piston tank length. Yellow LED indicates actuation of the Hall sensor. Piston is driven from its "empty" to its "full" position while Hall sensor counts the switching operations required for that full piston stroke.
- 9 Finally, piston is driven very shortly to BAIL in order to account for possible overrun whereby piston is briefly stopped. Piston then travels to the set position. Lighting of the green LED indicates that the system is now fully operational.

This setup procedure can be repeated simply by starting anew: Switch CTS2 OFF, plug jumper SETUP back onto CTS2 and switch unit ON again. Restart setup at step 1.

Jumper MODE remains plugged onto CTS2 as this activates Hall sensor mode. Jumper SETUP is required for programming only and is layed aside after successful setup of the unit.



Ensure correct direction of flow! Connect CTS2 to the main battery BUT leave the receiver switched OFF. CTS2 must switch to BAIL (empty). If piston tank runs in the opposite direction (i.e. piston rod extends outward) tank must IMMEDIATELY be stopped by switching off main power. Reverse polarity on the motor (NOT on CTS2). Otherwise piston tank will not stop at its end position (micro switch) and stall!

RED LED indicates low battery voltage. This consequently requires the main drive battery to be charged. If red LED is lit although battery voltage is sufficient threshold voltage might be set too high. This can be adjusted with potentiometer on CTS2.

CLOCKWISE rotation of the potentiometer DECREASES threshold value, meaning that low battery mode will set-in later (e.g. at a lower voltage). ANTI-CLOCKWISE rotation will INCREASE this value; the battery monitor will activate resurfacing at higher battery voltage. For accurate adjustment a regulated mains unit is recommended. Alternatively, a battery with corresponding voltage can be used.

Adjustment of threshold voltage: Set power supply to desired voltage. Connect CTS2 to power supply. Pull off jumper from pins marked MODE. Connect CTS2 to receiver. Turn potentiometer on CTS2 until RED LED lights up. When red LED is lit means that desired threshold voltage has been reached and properly adjusted.

Blinking of YELLOW LED indicates activation of pressure switch. CTS2 will remain in BAIL (resurfacing) mode as long as pressure switch remains actuated.

GREEN LED indicates good signal quality. If transmitter signal is too weak or lost the GREEN LED will be off. A lost or faulty signal will cause CTS2 to automatically switch to BAIL. CTS2 will only react to transmitter commands after signal has reached acceptable strength. Other than that the unit will remain in RESURFACING mode.

During transport and storage main drive battery should be separated from the unit as otherwise battery will be discharged over time.

The fail safe system of CTS2 might not function properly if your receiver already features such a device. Please refer to manual of your R/C system or consult the manufacturer if in doubt.

Possible Failures and Probable Causes

During setup:

Green LED always blinks once (or twice) and setup does not progress.

- Signal received is either not continual (e. g. interference) or shows negative values which can be either too low, too high or too close to midpoint (1.3 - 1.7 ms).
- Differential between "fill" to "bail" signal is too small.

Yellow LED does not blink. Green LED blinks hectically.

- Check Hall sensor and magnets. Probably disturbance caused by other magnets (i. e. motor).
- Distance between sensor and magnets too large.
- Length of piston tank incompatible, i. e. more than 65,500 impulses.
- Override too large, larger or equal to 200 impulses.

During operation:

Green LED is off but unit is still functional.

- Receiver signal is weak or disturbed.

Green LED is off and Piston Tank switches to BAIL.

- Magnet impulses false, probably disturbance caused by other magnets (i. g. motor).
- Receiver signal shows major disturbances or is totally lost.
- Piston Tank is mechanically blocked.
- Drop in voltage of receiver battery.

Technical Specifications

Control voltage	4.0 to 8.4 V (receiver power)
Operational voltage	6 to 24 V (main battery)
Switching load	max. 10 A
Ascertainable impulses	65,500 (Hall effect sensor)
Weight	switch unit 35 g Hall sensor 7 g

CTS2 includes

- 1 Compact Tank Switch CTS2
- 1 wire and connector set

Optional Hall sensor upgrade includes (item no. 1585-H05S):

- 1 Hall sensor on PCB, rubber-coated, with connection cable
- 2 jumpers
- 4 neodymium disc-shaped magnets 3 x 1 mm
- 1 screw M3 x 40 mm stainless steel
- 1 washer stainless steel



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.

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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. 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! 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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