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# Self Launch System Sequencing Unit

## Operating Manual (v2.07)

# 1.  The Idea

With large scale gliders, we always run into the same situation: where three to five control surface servos are used in each wing halves, then you use dual elevator servo setup, retract, and tow release. So you run quickly in receiver channel output shortage.

Now if someone wants now to add a scale Self Laucnh System (SLS) in his glider, then we need up to four additionnal channels to achieve this: one for the unit itself, one or two for the unit doors, and an additionnal for motor throttle.

In addition to the problem of channel shortage, we have also the situation where the power up and shutdown process of the SLS goes always through the same process. For instance SLS doors open, arm folds up, door closes, motor on. All this to be controlled from the transmitter by different switches/control levers.

For that purpose we built this microprocessor based unit to take over the complete SLS control, the opening and closing, as well as the startup and shutdown of the motor. And to avoid the need of an additionnal channel, the unit will be connected to the tow release channel, where the control unit will take over the control of the tow release servo as well..

Thus:  The SLS control unit will drive the complete SLS without the need of an
         additionnal channel!


# 2.  What can the control unit do?

▶ Control of up to 5 servos:
 - Arm actuating servo
 - Right door servo
 - Left Door servo
 - Motor (esc)
 - Tow release servo

▶ Fully automatic unfolding and forlding of SLS arm with a three position toggle switch on transmitter, inclusiv control of motor esc (motor on, motor off)

▶ Slow scale operation of SLS arm.

▶ Gear safe power up and brake of motor.

▶ Control of optic prop sensor, before closing SLS, SLS will only fold back when prop is fully and safely stopped at right position.

▶ Additionnal evaluation of two limit switches, to avoid a false startup of motor in any case (for ex. If a servo fails).

▶ User programmable servo travel and direction, which are automatically and permanently stored in EPROM.

▶ At first motor startup, esc will throttle up to predermined level and after 6 seconds will go full throttle. This to avoid nose tipping of model at startup ground rolling and so have a smooth progressive start. (see page 11).

▶ Possibility to choose doors open or closed during the climb or power on.

# 3.   How to install the unit into the model

## 3.1.  Self Launch System & Arm Switch

Install the Self Launch System (SLS) exactly as per manufacturers recommendation. Make sure that the unit is ridgidly installed and that the arm is well locking into each end position.
The arm limit switch is required to avoid any motor startup as long as arm is not fully deployed. Not using this limit switch would not permit detection of the arm servo failure or its related linkage, and then would let you start the motor when the arm is still within the fuselage…

For that reason the arm swicth is a necessity. The switch is installed in such a manner that once the arm is fully deployed, the switch is closed. By this mean will the electronic detect a failure and not allow motor startup. **Within the electronic the signal wire stays open till the switch is closed**. Is the limit switch closed, can the motor startup with its throttle up sequence .

The SLS normally comes with this limit switch installed. This switch needs to be wired with an extension and connected to the sequencing unit:
-   Minus wire (brown or black) is not required
-   Plus (red)- and/or signal wire (orange or white) needs to be soldered to the switch. There is no polarity involved, because only one contact will be closed. Don't forget tto protect with shrink tubing.

*Install this switch with greatest care, and check it regularly.*

Adjust the switch, so that it still will realibely close, even if a backward force is applied to the arm, like when opening the unit at higher flight speed. So test by applying a slight back force by hand.


## 3.2.  SLS Doors **&** Door Switches

The SLS sequencing unit is designed to control two seperate door servos. Obvously it is also possible to actuate the doors by only one servo (in that case use either right or left servo output only) or none by using rubber bands to close the doors, in any case the easiest way to mechanically control the door is by using two servos. Because low torque is needed to actuate the doors, sub micro servos of the 9g category are well suited.

**The door servos will actually actuate the back part of the doors, which will be again closed once the unit is fully deployed. For that mean the doors need to be made in two parts, where the shortest part is pushed open by the arm and then remains open. These two small doors are best hoocked up to the arm by means of rubber bands or springs, so they close aagin when arm is folded back into fuselage.**

Operation without door servos:

Operation of the SLS sequencing unit without door servos is also possible without any problem, the doors are pushed open by the SLS arm and maintained open during climb.
**For this purpose we need a jumper to be plugged onto the doors limit switch output of the unit or the unit must be programmed for open doors during climb. If this is not done the SLS sequencing unit would wait till the doors are closed again before to proceed to next step. In this case the limit switches are not installed. Jumper is included.**

Typical doors servo installation:
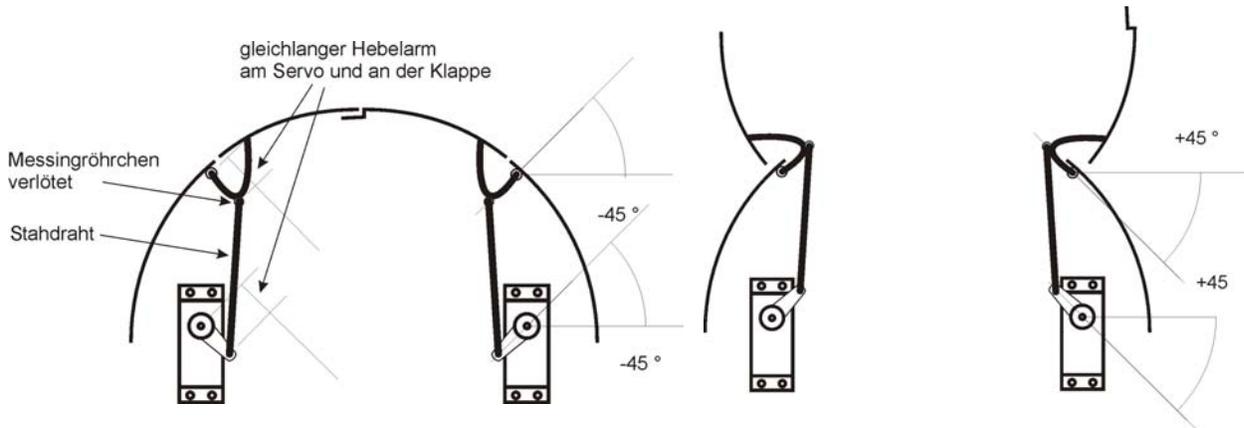


When controlled by two seperate servos, the sequencing unit will always operate and close the <u>right door first</u> followed by the left door.

⇒    This will permit to add a lip to the right door, against which the left door will rest (if you already have such a lip on your left door, you still have the ability to swap left and right servo on the sequencing unit and at programmation)

For safety, door limit switches are installed, which will close once the doors are closed. These door limit switches will avoid, like the arm limit switch, any operation if a door servo fails.

Typical door limit switch installation:
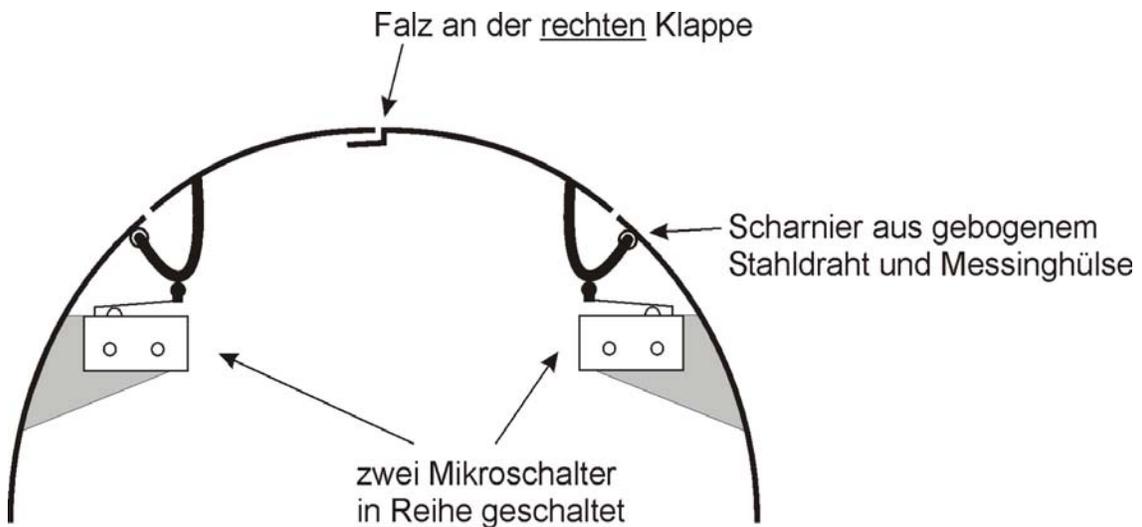
## 3.3. Propsensor

The propsensor, thanks an infrared reflective sticker, will detect correct stop position of the prop.
This will avoid closing the unit with a prop that would not be inline with the fuselage.
The propsensor ist installed dierctly to the SLS arm with two small M2 srews.
**As infrared reflector, two supplied stickers need to be installed on the back side of both the prop blades.**
For inspection of sensors proper operation, a light emitting control led is part of the sensor.
**This control LED lights off, as soon as the prop (actually the infrared reflector) stays at the correct position.**
The sensor range is about 30 mm (1.125"). Distance between prop ←→ sensor shall be between 10 and 15 mm for proper operation. Please do not install sensor too close to prop balde, because due to some kind of vibration, the blade could destroy the sensor.

Propsensor installation dimensions:
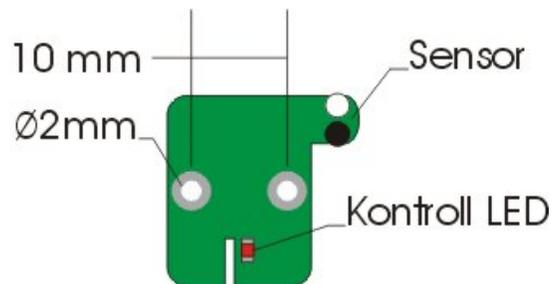


Example on 12,5 in. SLS:
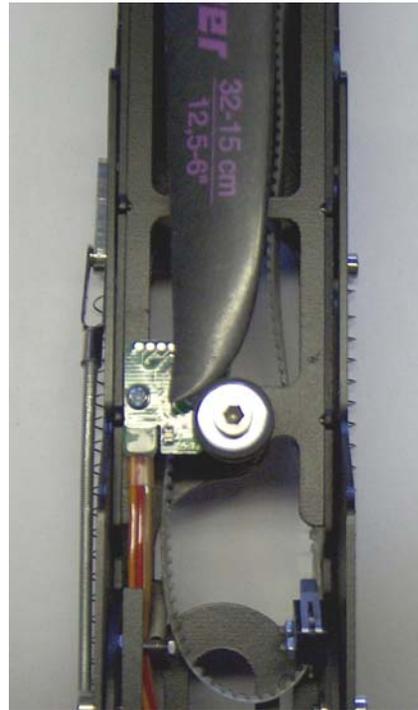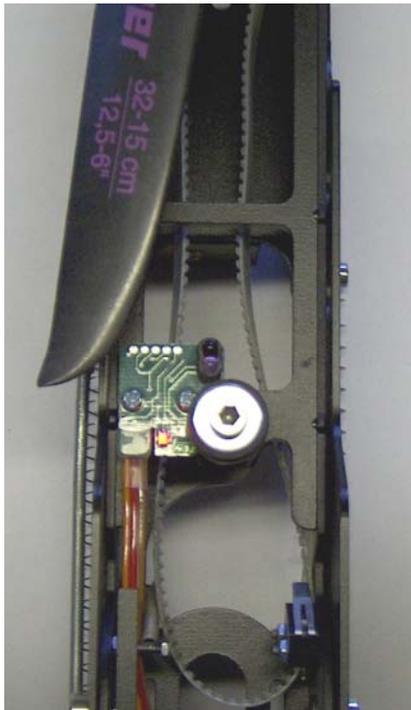
## 3.4. Installation of control unit

The best way to install the sequencing control unit, is to do it the same as with a receiver. Protect well the unit with padded foam, cushionning and double sided tape. Install and secure unit at least 10cm away from receiver.
The sequencing unit shall stay accessible from the cockpit, to allow easy connection of the programming adapter. Possibly you will need to extend some servo lead wire.

# 4. Transmitter programmation and sequencing

The control takes places by means of one single channel, which on the transmitter will be set to three predefined  values (preferably a three position toggle switch).

This means following on the three position switch:

Position 1 (back):                            SLS folded into fuselage (motor off) & towrelase closed
                                                       ⇒ situation during tow

Position 2 (middle):                         SLS folded into fuselage (motor off) & towrelase open
                                                       ⇒ end of tow, line released

Position 3 (forward):                       SLS open (motor on) & towrelase open
                                                       ⇒ power on climb

## 4.1. Transmitter programmation

The three position of the toggle switch needs to correspond to predefined servo positions, because the switch values are factory set in the control unit as follow:

▶ switching from position 1 ⇒ position 2  at 1,2 ms transmitter signal

▶ switching from position 2 ⇒ position 3  at 1,8 ms transmitter signal

These values are usually reached, when the toggle switch reaches following values at corresponding channel, when switching between the following
     -100%  at position 1 (back)
      0%  at position 2 (center)
    +100%  at position 3 (forward)

Please verify these values in your transmitter programming menu.
Correct the values if the direction and travel are not reached!
Make also sure that there is no mix function associated to the channel dedicated to control the SLS control unit, to avoid any uncontrolled operation of the SLS by means of any other channel.

## 4.2. Opening sequence

▶ Doors open
▶ Arm folds up (speed adjustable – see Point 5.4)
▶ Test of the arm limit switch: only if this switch is closed, which means that the arm is really fully open, unit will porceed.
   <span style="color:red">Following only if doors will be closed during climb (see 5.4):</span>
   ▶ Doors close (first right, then left door)
   ▶ Test of the door limit switches: only if these are closed, which means only when the door are really closed, unit will proceed.
▶ Motor on (throttle up adjsutable - see Point 5.4)

## 4.3. Closing sequence

▶ Motor off (throttle down adjustable – see Point 5.4)
▶ Doors open
▶ Folding arm back till stopper gets active (speed adjustable – see Point 5.4)
▶ Fold slowly arm further back as soon as propsensor was able to read prop at rest for at least one second – only when prop is fully stopped aligned, unit will proceed
▶ completely forlding arm into fuselage
▶ Closing the doors (first right then left door)

# 5. Programmation

The SLS sequesning unit will store all adjsuted values into its EPROM.
These values will not be stored immediately, but only once the programmation steps have been completed. If you made a mistake, just disconnect the control unit and start over the programmation.

Programming is done by means of the enclosed programming adapter. It has to be connected to the sequencing unit at the former crystal location. The connector is false polarity portected, by means of a missing pin.

Following is adjustable: endposition of the arm servo in both dierction, door left, door right and towrelease.

The signal values on motor output, to which the motor controller is connected, are also factory preset. These correspond to –100% travel for motor off und +100% for motor on (like on JR/Graupner transmitter) (pulse width from 1.1ms to 1.9ms).

This means:    The controller needs to be programmed on a free channel with these preset values on the transmitter. As alternate you may use of course a servo tester.
⇒ please follow your controller instructions!

Warning:    Depending on the brand of transmitter used (like Multiplex), the signal values may not correspond to the sequencing unit, thus not giving full throttle or controller will not initialize. So adjust values so they correspond to JR/Graupner values.

If you want to set all values of your sequencing unit back to factory setting, it is possible to perform a reset (see 5.5).

## 5.1. Typical Wiring schematic
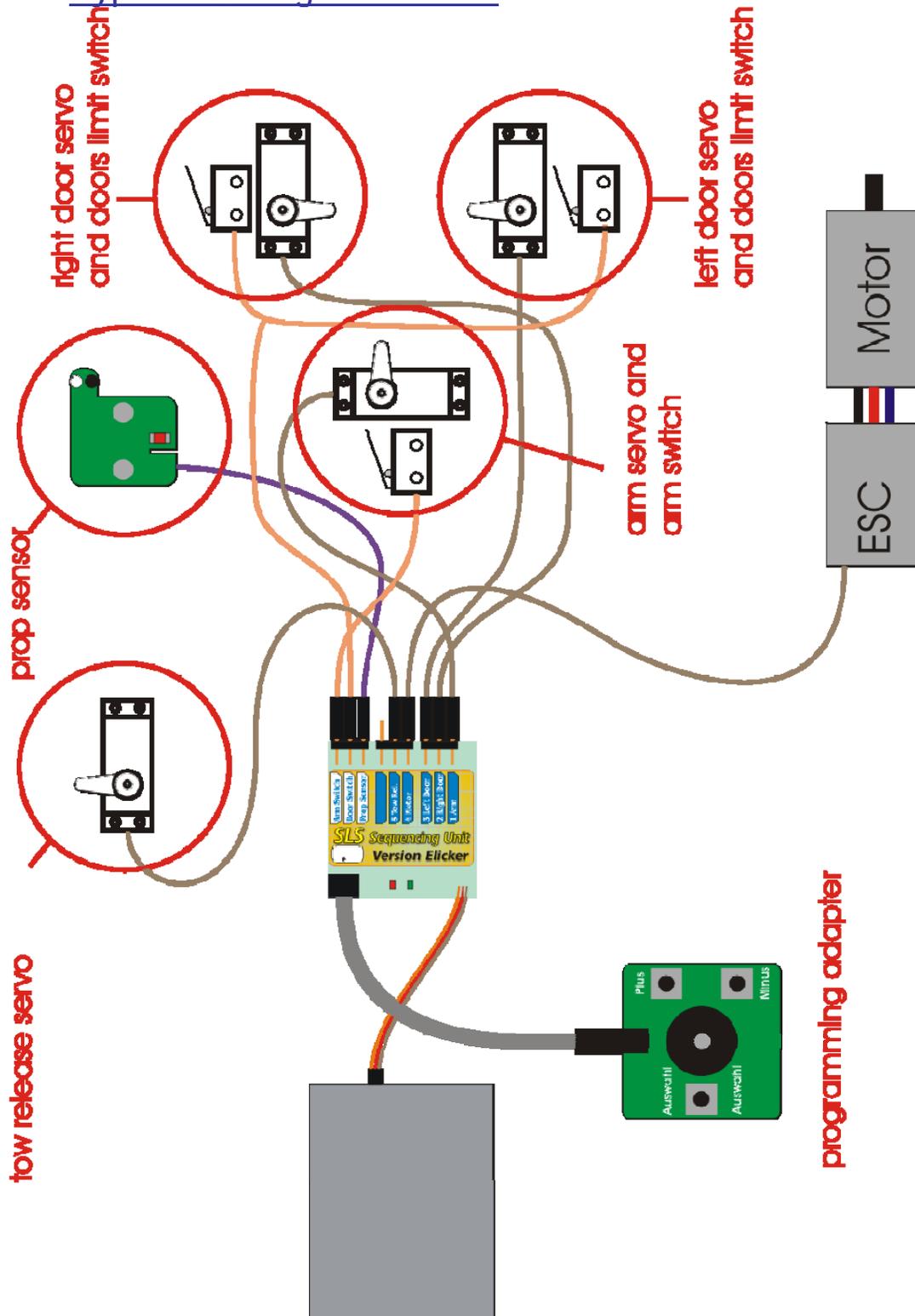
## 5.2. How to programm

To adjust the servo values the programming adapter needs to be connected to the sequencing unit. The sequencing unit is then connected to the corresponding channel of the receiver. This is mostly the channel used for the towrelease, because the sequencing unit also takes care of the two release. Connect as first (and for the moment sole) servo, the towrelease servo to the corresponding output on the sequencing unit.

**Already in programmation mode all limit switches (arm switch and door switches) need to be connected to the sequencing unit!**

Programmation mode activation:

To activate the programmation mode, the selection („Auswahl") button of the programing unit needs to be pressed when switching the receiver on (transmitter already on of course). The green LED will light on, at the sequencing unit. After switching on release the selection button and long double beep will confirm the programmation mode activation:
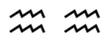
〰〰 〰〰　⇒ Programmation mode

Now with the selection („Auswahl") button, it is possible to select the desired servo to adjust. Servos are numbered and the selected servo will be confimed by the number of beeps. The green LED will also blink the number of time. The arm servo is active as soon as the programmation mode has been activated:

❏　　　　　　　　Arm servo

❏ ❏　　　　　　Right door

❏ ❏ ❏　　　Left door

❏ ❏ ❏ ❏　　　　　　　　　　　　　　Motor throttle

❏ ❏ ❏ ❏ ❏　Towrelease servo

As a practice, we will first adjust the towrelease (we are aleardy in the programmation mode, as described above):

▶ Press the selection („Auswahl") button as many times needed to reach the four beeps.
▶ With toggle switch in back position (position 1) you shal have the tow release closed.
⇒ Adjust the servo travel with the „Plus" and „Minus" button to achieve proper servo position.
**TIP: verify first travel direction and if required reverse by pressing „Plus" and „Minus" together!**
▶ With toggle switch in center position (position 2) and forward (position 3) the tow release shall open.
⇒ Adjust the servo travel with the „Plus" and „Minus" button to achieve proper servo position.

Now you can do all other the servos in the sequence.
But, please, respect the suggested sequence to avoid unexpected problems. As if, for example, you would programm the doors servos first then connect the arm servo, it could be well possible that this servo would move around unexpectively and may move up with closed doors…

*Though:*
*Respect the servo sequence during programming, connect only one servo at a time, programm it and then connect the next servo.*

## 5.3. Step by step

Step 1:
- connect only the Arm-Servo and the Propsensor (**and the limit switches!**)
- do not connect esc and door servos!
- the propsensor needs to be activ (LED shall be red), to be able to move arm up and down
- the doors <u>needs to be open</u> (move door servbos by hand or disconnect linkage)
- Activate programmation mode ⇒ see **Error! Reference source not found.** (Press selection („Auswahl") button during switch on of receiver)
- press once the selection („ Auswahl") button to select Arm-Servo
- move toggle switch between position center (position 2) and forward (position 3) back and forth
    ⇒ is travel direction correct? ⇒ <u>arm up with switch in forward position</u>, <u>arm closed with switch in center and back position</u>? (reverse servo travel by pressing „Plus" and „Minus" together)
- now in both position, adjust the travel end point
    ⇒ verify that the arm locks properly into position!
    ⇒ if necessary adjust the arm switch again so that it will properly close once the arm up and that it closes easely!
- the arm servo adjustement is now terminated

Step 2:
- connect now (during the current programming session) the right door servo
- the Arm-Servo remains connected
    ⇒ **here we have a particularity in the door mode <span style="color:red">„doors closed during climb":</span>**
    **in contrast to normal operation, the door will remain open during programming mode when the arm is folded back in position (this at toggle switch position back and center), to actually be able to programm the open position**
- select the right door servo by pressing twice the selection „Auswahl" button
    (if for any reason the receiver was switched off, you will forst need to activate the programmation mode as described under 5.2  and then you may select by pressing twice the selection „Auswahl" button)
- move toggle switch between position center (position 2) and forward (position 3) back and forth
    ⇒ is travel direction correct? (reverse servo by pressing „Plus" and „Minus" together)
- now in both position, adjust the travel end point
- the right door servo adjustement is now terminated

Step 3:
- <u>disconnect</u> now (during the current programming session) the right door servo, with <u>doors open</u>,  and connect the left door servo
- the Arm-Servo remains connected
- select with the selection „Auswahl" button the left door servo
- repeat adjusment procedure as described for the right door servo

By pressing an other time the selection „Auswahl" button, we will <u>activate the **Motor throttle up:**</u>.

❑ ❑ ❑ ❑                                                  Motor throttle

With the "Plus" and "Minus" button, we can adjust here the throttle power level which will be used for the 6 first seconds of take off. The standard level is 80 %. It can be modified by 5 % increments (one beep) between 60 % and 100 %. Bei pressing the „Plus" and „Minus" button together it will reset to the initial 80 % level.
This motor power adjsutement as well as the soft start and throttle down delay, are normally only needed when you will make your first take off tests with your model. Of course you can get familiar to it during the installation by connecting a servo instead of the speed control, to see and test the behaviour of this option.

Adjust the start take off throttle power to a level so that your model will start rolling without tipping the nose into the ground. After 6 seconds, the model has taken enough speed so that that the esc can go full power for take off.
This procedure take places only once, after the unit has been switched on. After take off the next climb will get directly into full throttle. At start it will only be taken into account when after switching on, the motor has reaches full throttle afirst time. Though you may test the SLS by briefly switching on and off before motor reaches ful throttle. If you interrupt the process before motor reaches full throttle, you still have the take off procedure available.

**By pressing the „Auswahl" button for the sixth time, you will get to the towrelease, which was already programmed as a practice:**
❑ ❑ ❑ ❑ ❑  Towrelease servo

**Now by pressing an other time the „Auswahl" button, you reach the motor speed control adjustment and door mode selection. Even if you don't whish adjust anything further, you need to go to the end of the programmation (three long beeps) to store your programmed values.**

## 5.4. Travel speed and doors setting

Besides the servo travel end points, you can adjust the travel speed of the arm servo and how the motor will throttle up and also brake.
The same way it is possible to define the door mode: doors closed during climb (standard) or dorrs open.
Programmation is made in the similar way to previous steps by means of the programming adapter.
To clearly differenciate the procedure, you will see the red LED blinking at the selected menu position.

Now with the selection „Auswahl" button it is possible to choose between arm travel speed, motor throttle and door mode:

❑                    Arm travel speed      (red LED blinks!)
❑ ❑                Motor throttle          (red LED blinks!)
❑ ❑ ❑            Door mode               (red LED blinks!)

By means of the „Plus" and „Minus" button you may adjust the respective travel speed.
„Plus" will increase the speed, and „Minus"  will slow down.

To adjust the travel speed of the opening arm        ⇒    Close SLS
To adjust the travel speed of the closing arm         ⇒    Open SLS

To adjust the throttle up speed          ⇒   Close SLS (motor off)

To adjust the throttle down speed (brake)    ⇒   Open SLS (Motor is on; better to use servo instead of esc!)

**TIP:**   **By pressing the „Plus" and „Minus" button simultaneusly the travel speed will be reset to factory setting.**

Under doors setting, by pressing once the :
- **„Plus" button, you will select doors open during climb**
- **„Minus" button, doors will close during climb (standard)**

By depressing an other time the selection „Auswahl" button, you will leave the programmation mode and store the adjustement you just made.
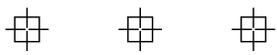
⊞      ⊞      ⊞   ⇒ **Programmation mode left**

Now you can disconnect the programming adapter.
Close the right door and verify the complete operation.
Adjustement may be modified at any time.

## 5.5. Reset

You can reset all adjustment to factory setting, by holding the selection „Auswahl" button during at least 10 seconds, when switching on the receiver. Five long beeps will confirm the reset. The selection of the door mode (doors open or closed during climb) is not affected:
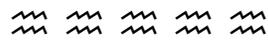
〰 〰 〰 〰 〰 ⇒ Reset, all values reset to factory setting

## 5.6. Motor controller connection and adjustment

The travel for the motor control output is not adjustable on the sequencing unit. It is factory set at 1,1ms signal for <u>motor off</u> (shall correspond to <u>-100%</u> on transmitter) and 1,9ms signal for m<u>otor on</u> (shall correspond <u>+100%</u> on transmitter).
The controller needs to be programmed to these values, in order to operate adequatly.
Proceed as follow (**<u>please use only JR/Graupner transmitter or compatible or servo tester to adjust!</u>**):

▶ Use a free model memory to test the throttle stick travel end points. These shall move between -100% with stick in back position to +100% with stick in forward position.
⇒ is it not the case, adjust end points!
⇒ if you use a different brand transmitter the signal may be verified by means of a servo tester connected to the receiver throttle output, adjsut the throttle endpoints to get the 1.1ms to 1.9ms travel

▶ Connect the esc (motor controller) to throttle channel of your receiver and programm it so it will work with these set values (throttle stick back = -100% = motor off, throttle stick forward = +100% = motor on). How to do it is explained in your controller user manual.

▶ Now test the controller with the sequencing unit, use an almost empty battery and remove the prop.
With the toggle switch in the forward position the motor will progressively throttle up after the arm has moved up and the door closed again.
Now when closing the SLS by switching the toggle switch to center or back position, the motor will throttle down to stop, then after a short break, the doors open, the arms folds slightly back to activate the prop stopper, when prop has stopped in position (led lights up red at propsensor), the arm will fold completely back in place and doors will close.

# 6.  Tips for Fail-Safe adjustement

These tips have nothing to do with the SLS sequencing unit, but are suggestions from erpsonnal experience.

If you use a PCM receiver, please take your time and adjust your transmitter with reasonable Fail-Safe values.
Basically, in the current transmitter, the Fail-Safe function is deactivated and the hold function is on. This is for sure the worst choice and means no safety increase against PPM receiver!

A meaningfull basic Fail-Safe adjsutment which increases safety:
- Close SLS!!! (this is the most important, to avoid the motor to keep running)
- Landing gear open, to avoid that your model falls on the belly, in case you have a short interference on ground
- all control surfaces to neutral, possibly little elevator with airbrakes/flaps to slow down your model

An other time:
Please activate Fail-Safe!
A PCM receiver with Hold Mode activated means additionnal safety risks, in Fail-Safe Mode brings you improved safety.


# 7.  Safety recommendation

Please keep in your eye all the dangers such a high power electric system can lead to.

Don't allow any other pilot or spectator reach the vicinity of the rotating propeller.

Maintain the Self Launch System periodically to ensure proper operation.

Do you whish to test your SLS before a take off. Do it only on the take off strip, not between the spectators.

Plug on the power pack only at take off strip.

Any questions, comments, improvement suggestion or special whishes?
    Just give us a call or e-mail, we are always thanksfull for your ideas!