SKLANDITA

WDU - WIPERS DRIVE UNIT MANUAL

"ALL IN ONE" and "SPLIT" versions

Rev.1.0 2023-03-01

OPERATION AND INSTALLATION MANUAL

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General Information

This manual has been prepared to provide users with information for the safe and efficient operation of the *WDU – Wipers Drive Unit* system. Before start using *WDU – Wipers Drive Unit*, users must read this manual carefully and make themselves familiar with the proper system operation. The installation and operation of the *WDU – Wiper Drive Unit* system is done at the user's own risk and responsibility. The producers don't take any liability for any damages caused by faulty installation or inadequate operation. Improper operation might damage the system and the glider, and may cause loss of cleaning blade.

To avoid collisions and other hazardous situations during the whole cleaning cycle, the users must keep an eye on the other traffic in close environment. Avoid operations in turbulent air, especially when flying in close proximity with other traffic. Don't operate the system when flying close to the terrain. The operation of the unit is always done at user's own risk and responsibility.

The following definitions apply to **WARNING**, **CAUTION** and **NOTE** signs used in this Manual:

→ **WARNING** means that non-compliance with the corresponding procedure leads to an immediate or important degradation of the flight safety.
→ **CAUTION** means that non-compliance with the corresponding procedure leads to a minor or a more or less long-term degradation of the flight safety.
→ **NOTE** draws attention to any special item not directly related to safety, but which is important or unusual.

1. System description

The *WDU – Wipers Drive Unit* is a DC 12v electrical system designed to slide bug wipers in/out along the glider wing's leading edge during the flight in different wingspans. The system operates when manipulating particular switches and knobs. One wing cleaning possible at the time. The system has an integrated screen and push buttons to set up to 10 multiple parameters according to requirements based on glider performance or user needs (for more information see ***Settable Parameters*** on Page 5). Depending on space availability in different glider fuselages, the system was designed in two concepts: "ALL IN ONE" and "SPLIT".

The rope spool is driven by an electric motor via gearbox. This ensures self-locking in any position, additional brakes and locks not necessary. The rope tension level is sensed with micro switch via sensor lever, with "friction friendly" designed eyelet mounted at the end. This ensures that the unit motor stops if the rope is too loose and is not wound up or unwound in an uncontrolled manner. The most common reasons are when the wiper gets stuck in the wing-wing tip junction or crossing a poorly taped wing-junction area. When tension is lost, the system will stop operating. When tension is regained, the winding process will proceed in the direction the control toggle switch is set.

When bug wiper comes back to the side of the fuselage, controller detects a stationary spool with increased electrical current which corresponds to the pre-set load (see ***Settable Parameters*** *No. 6 and 7*), automatic shut-off of the system initiated, as indicated by green bright LED signal light illumination.

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2. Technical Specifications

Dimensions:

Main body (ALL IN ONE) 145 x 145 x 75 mm (distance between mounting ∅ 6 mm holes, 175 mm)

Motor bay (SPLIT) 145 x 48 x 78 mm (dimensions of plunger and mounting brackets are not included)

Electronics bay (SPLIT) 145 x 55 x 79 mm (dimensions of sockets, and mounting brackets are not included)

Control console 60 x 40 x 20 mm (dimensions of switch toggle levers and knob are not included)

Weight: 1600 grams (entire system without power supply source and bug wiper blades)

Power supply: 10 – 14 v DC

Current consumption: Approx. 9 A (at the maximum possible load)

Current consumption at normal operation: Approx. 2.5 – 4.5 A (at the speed of 120 km/h)

Internal fuse rating: 10 A

→ NOTE: Despite power supply wrong polarity protection (P600 diode), we recommend to avoid incorrect battery polarity connection

Operating speed:

Approx. 25 sec. at 8 m. cleaning length both sides (fuselage – wingtip – fuselage), at speed of 120 km/h, power consumption: approx. 2.5 – 4.5 A (retraction force corresponds to approx. 3.0 kg)*

Operating speed:

Approx. 40 sec. at 8 m. cleaning length both sides (fuselage – wingtip – fuselage), at speed of 160 km/h, power consumption: approx. 6 A (retraction force corresponds to approx. 6 kg)*

**Flexi bug wiper blade was used to measure these parameters, fixed diameter bug wipers produce much more drag, therefore power consumption and operating speed may differ!*

→ NOTE: *Battery must be fully charged to ensure proper system operation*

Coiled rope capacity: 20 m.

Recommended rope type: Braided Teflon coated fishing line of 0.38 mm in diameter;

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3. WDU - Wipers Drive Unit Illustration

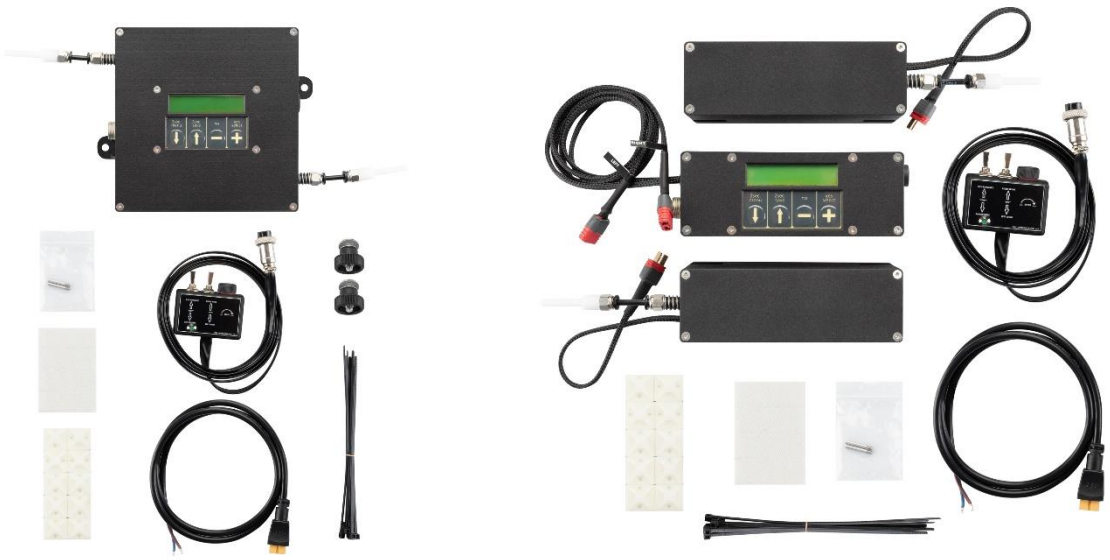

Fig. 1 (ALL-IN-ONE and SPLIT entire system illustration)

4. Installation of WDU System

The unit should be mounted as close as possible to the fuselage - wing junction area, to keep the friction in the rope guide tube low. Mounting in the baggage compartment or behind the seat rest could be achieved by drilling holes and screwed using M6 bolts (ALL IN ONE) concept and M4 bolts (SPLIT). Each bay of (SPLIT) concept has it's own mounting brackets (2 pcs.) per bay. The length of the rope guide tube with the corresponding bends has a significant influence on the friction of the system. The higher the friction, the larger power consumption and system wear, and also the greater the negative aerodynamic influence of the cleaning blades on the glider.

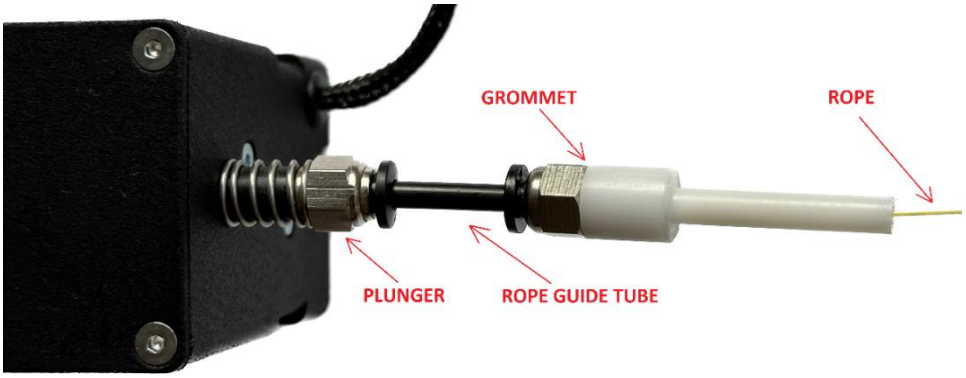

Fig. 2 (Plunger, rope guide tube, grommet)

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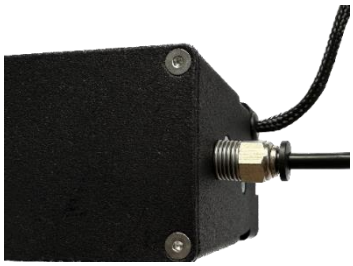
The rope guide tubes are prepared accordingly and do not require any special components for the hull penetration. Installation is very easy and straightforward. Drill a 5 mm hole through the fuselage wall, push the plastic grommet through and out. Cut off the excess with a sharp knife or another appropriate tool. Glue in the plastic grommets by quick hardening epoxy adhesive or suitable two components glue. By the hole drilling, of course, the structure of the aircraft must be considered at the point, if necessary, look for recommendations of the manufacturer. Depending on length of rope guide tube, enclosed fastening adhesives would be necessary. Avoid S-loops, bending or any other superfluous loops as much as possible.



CAUTION Make sure that rope guide tube is of appropriate length, especially when plunger spring is completely depressed.

NOTE Proper operation of plunger can be ensured when rope guide tube has one turn of up to 90 degrees.

Fig. 3 (Depressed plunger illustration)

The control console is designed and suitable to mount on either side of the wall in the cockpit. Make sure that control console is mounted in such an ergonomic position, where it easily could be reached by hand. Information label and LED signal light should be clearly visible.

→ CAUTION Adjust the rope length according to the wing span, (approx. 20 cm from the wing tip). If few wings span tips are available, rope length should be adjusted for a highest span.

5. System Settable Parameters

Settings and Monitoring

Settings can be set with push buttons located on the top of the unit. The unit is made for adjusting and monitoring driver's dynamic values during operation. The unit also enables the searching of the right settings and adjustments for proper and smooth running.

When the driver unit is powered, the display wakes up and after some announcements it is ready to adjust the **Load & Edit** parameters of the driver**.** If it is necessary to edit some parameters, the values can be changed with **+** and **-** buttons. The parameters can be saved by pushing and holding the **2 sec save** button for 2 seconds.

For **Saving** – **Load & Edit** window, press the **2 sec save** button. The displayed parameters (*edited or not*) will be sent to the driver device and saved. The **Copy to Device** window will send the parameters that are in the control unit's active slot to the driver memory. In all other situations, pressing the **2 sec save** button will send the parameters from active slot to driver unit. If you make a mistake, leave the **Load & Edit** window without saving the edited parameters. The edits will stay there if you do not do any saving or copying, or you do not switch the unit to **OFF**. To save edited parameters, you have to go back to the **Load & Edit** window and push the **2 sec save** button. Then, the edited parameters are saved to active slot and sent to the driver unit.

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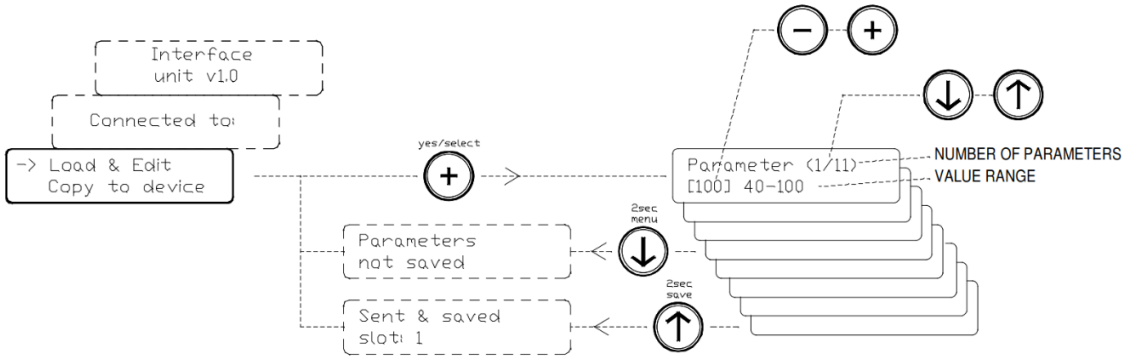

Fig. 4 (Parameter adjustment and saving schematics)

Load & Edit: this option will pick up the parameter from the driver unit. Parameters will be displayed on the screen, and you can scroll and edit them. When editing a value, it will blink **three times** before it becomes valid. Edited parameter list is stored in the RAM until you save it. By pressing the **2 sec save** button (*the button must be pressed for at least 2 seconds*), the new edited parameters will be sent to driver unit and stocked into the selected memory slots of the wiper's drive unit.

Settable Parameters

The **Load & Edit** menu allows parameter adjustments depending on individual user's needs. This section describes how to achieve it. Green parameters are adjustable by the user according his/her requirements. Red parameters are manufacturer's default settings. **NOTE!** Do not change these the default settings; otherwise, settings will not match the operational requirements and the unit will stop working! (Default settings in brackets)

SETTABLE PARAMETER LIST	
1 Command mode: (0) continuous = 0, impulse = 1 direction change with stop impulse 2 = 2 direction change without stop	**12** Load compensation: 0-255 / 0-255 (0) If this feature is needed, please set the value to (**33**) and hold the 2 sec save button for 2 seconds. For detailed "load compensation" function explanation, see **Appendix**. → **CAUTION** higher values then (**33**) will cause twitch and unstable unit running.
2 Start condition combinations: 0-3 (0) 0= start both direction after I-trip and Stop 1= start only opposite direction after I-trip 2= start only opposite direction after Stop 3= start only opposite direction after I- and Stop	**13** Timeout: 0-255s. / 0-255 (0=not in use) (0)
3 Input logic combinations 0-7 PNP/NPN (0) 0= cont. PNP, limits PNP 1= cont. NPN, limits PNP 2= cont. PNP, limits NPN N.C. 3= cont. NPN, limits NPN N.C. 4=cont. PNP, limits PNP N.C. 5=cont. NPN, limits PNP N.C. 6=cont. PNP, limits NPN 7=cont. NPN, limits NPN	**14** Reset for start and hour-counter 0/1 (0) selecting 1 and push save = reset counters
4 Running speed-1: 0-100% / 0-100 (100) If analog speed input mode is select with parameter 5, then parameter 4 work analog input range adjust	**15** Start ramp: 0-5s / 0-500 (100) Setting value to 100 means start ramp 1 second. For detailed "ramp" function explanation, see **Appendix**.

5 Control mode / running speed-2 preset 0-100% / 0-100 (0) 0= Analog speed mode-1 "speed 2-input" is used as analog 0-5V speed control input. 1= Analog speed mode-2 as above but FW direction is automatically "on" and FW input works as direction change input. BW input works as pause input 2-100 = 2-speed mode, two digitally settable speed (speed-1 preset with param. 4 and speed-2 with param. 5)	**16** Stop ramp: 0-5s / 0-500 (50) Setting value to 50 means stop ramp 0.5 second. For detailed "ramp" function explanation, see **Appendix**.
6 Current limit FORWARD: 0.1-25A / 1-250 (30) Setting value 30 = 3A current, limit value for controller, when detected, I – trip (automatic shut off) occurs. → **CAUTION** Wrong setting may cause unit damage. → **CAUTION** Settings No.: 6 and 7 must have the same values!	**17** Start kick 0-200ms / 0-200 (0) gives short 0-200ms full drive pulse for start
7 Current limit REVERSE: 0.1-25A / 1-250 (30) Setting value 30 = 3A current, limit value for controller, when detected, I – trip (automatic shut off) occurs. → **CAUTION** Wrong setting may cause unit damage. → **NOTE** If both 6 & 7 is set = 0, then I-limit input is enabled, and works as current limit adjust input. → **CAUTION** Settings No.: 6 and 7 must have the same values!	**18** - I-trip auto reversing 0-5s / 0-500 (0) Change automatically run direction when I-trip occurs, the maximum reversing time 5 seconds. → **NOTE** Value 20 – 0.2 seconds reversing; This feature assist to reduce rope stretch, when wiper gets folded before automatic shutdown. Value – 0 means, function is switched-off.
8 Trip (automatic shut off) combinations: 0-3 (1) 0= no I-trip, no zero-current-trip 1= only I-trip 2= only zero-current-trip 3= both I-trip and zero-current-trip	**19** - Freewheel options 0-3 (0) 0= freewheeling when overvoltage 1= freewheeling when overv. or stopped 2= freewheeling when overv. or during stop ramp 3= freewheeling when overv. or when stopped or during stop ramp
9 I-trip (automatic shut off) delay: 0-255ms/0-255 (20) Setting value to 20 means I-trip (automatic shut off) delay of 0.2 sec.	**20** - Pwm frequency 1=2kHz / 2=16kHz (1)
10 LED green signal light output combinations: 0-5 (1) 0= I-trip and zero current won´t cause LED light signal 1= only I-trip causes LED light signal 2= only zero current causes LED light signal 3= both I-trip and zero current causes LED light signal. 4= overcurrent indication = pull down 5= "run" indication = pull down when unit motor run	**21** Serial port configuration, speed, parity, and number of stop bits (1) 1 =9600bps 8N1 6 =19200bps 8N2 2 =9600bps 8N2 7 =19200bps 8E1 3 =9600bps 8E1 8 =19200bps 8O1 4 =9600bps 8O1 5 =19200bps 8N1
11 Overvoltage limit: 15-60V / 15-60 (16) Overvoltage can be caused by load driving the motor or when braking the speed down but supply cannot accept the current back from driver. Exceeding the limit will cause the power stage set to free-wheel state. The brake current is charging the battery and the voltage will not normally rise.	**22** Modbus address 1-247 (1)

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Monitor Values will enable user to monitor some dynamic values during operation of the driver. Monitorable values can be scrolled with arrow buttons.

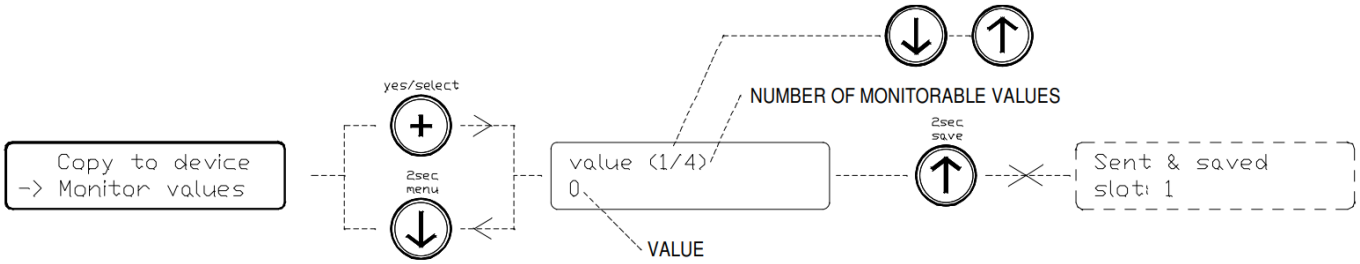

Fig. 5 (Monitoring option schematics)

1 Motor current 0-2.0A (0-200)
2 PWM-level-% 0-100% (0-100)
3 Hour counter (max.65535h)
4 Start counter (max.65535)
5 Carry counter for start counter
Settings parameter No. 14 could be used to reset these counters.

Copy to Device: this option is not in use for operation.

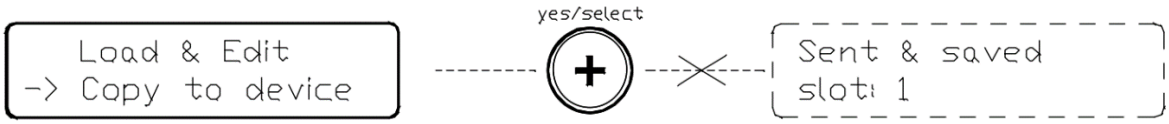

Fig. 6 (Copy to device option schematics)

Memory – Show Selected: here, you can see the parameters list which is stored in the slot and is selected at the time. This function could be used when user wishes to have few different options with different parameters stored in the memory. First you get a message, which slot is selected and for what type of driver the parameters are valid. Then, you can see displayed parameters, which can be scrolled trough, but not edited until those are saved. **Select Slot:** here, you choose which one of the 5 memory slots could be active. Choose save, copy or go to **Show Selected**. The operation is referred to the slot you have chosen here.

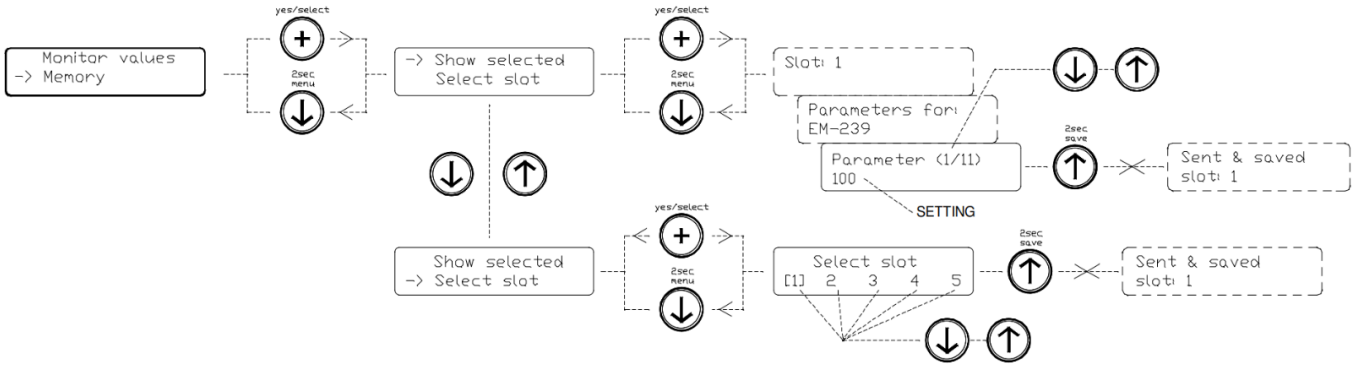

Fig. 7 (Memory option schematics)

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6. WDU Operation Control

Fig. 8 (Control console: front view)

WARNING: Before starting operation of the WDU system, the user must ensure that there is no other traffic and terrain in close environment. The cleaning cycle should commence without possible flight safety disruption. Perform the cleaning in straight flight, make sure abrupt deflections of flight controls are not needed during cleaning. Avoiding turbulent air areas are highly recommended.

Operation sequence:

1. Make sure the rotary knob is set to the MAX position.
2. Decide which wing you want to get cleaned first by using the toggle switch RIGHT WING / OFF / LEFT WING. To clean, for instance, the right wing, set the toggle switch from OFF to the RIGHT WING position. Green LED signal light illuminates GREEN DIM, this means power supply meets operational requirements and system is ready to operate.
3. Adjust stable and straight flight at the constant speed.
4. Operate RUN FORWARD / STOP / RUN REVERSE toggle switch and set it from STOP to the RUN FORWARD position. This way, the system is turned on and starts operating without delay.
5. Try to keep an eye on sliding wiper.
6. The right wiper goes out, if the toggle switch is in the RIGHT WING position, then, the motor and spool of the right winch starts to run and to wind off the rope. The wiper slides off along the wing leading edge to the wing tip until the user decides to wind up the rope and sets the toggle switch to the STOP position.
7. Set the toggle switch into the RUN REVERSE position. The rope now starts to wind up and this way to pull back the bug wiper to the fuselage, where it is collapsed and folded against the fuselage.
8. When the wiper is folded to the side of the fuselage, the LED signal light is lit up in GREEN BRIGHT. This is an indication that the pre-set value is reached (SETTABLE PARAMETERS No.: 6 and 7) and automatic shut off is initiated.
9. Position the toggle switch from RUN REVERSE to STOP. The GREEN BRIGHT LED signal light remains illuminated.
10. Position the toggle switch from RIGHT WING to OFF. The GREEN BRIGHT LED signal light goes off and the system powers off. This toggle switch position protects any electrical power consumption.
11. Cleaning other wing: repeat the sequence from step 1 to 10 except at step 2, set the toggle switch from OFF to the position LEFT WING.

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The rotary knob is installed for 2 purposes:

1. To reduce the risk of cleaning filaments getting stuck in the gap between the outer and inner wing, these gaps must be sealed in the proper manner. When the bug wiper slides through these gaps, we highly recommend to reduce the sliding speed by turning the rotary knob anticlockwise. The wiper will pass the sealed gaps more slowly than usual and minimize the chances of getting caught. This feature also could be beneficial when operating on the wing of the given span, sweeping along it from root to tip (Schempp-Hirth).
2. The rope has a tendency to stretch when coiled, especially at the last centimeters when bug wiper comes back to fuselage into folded position. This could cause an uncontrolled behavior of bug wiper when starting the next cleaning cycle (bug wiper has a tendency to slide out, then change the sliding direction instantly and slide out again). To avoid this unpleasant behavior of the bug wiper, we recommend to adjust the sliding-in speed of the bug wiper just before it folds up (approx. 20 – 50 cm.) There is no standard speed; it depends on the flying speed, other settable parameters (ex. No.:12) and should be established by the user individually, attempting several speeds before the wiper folds.

→ **NOTE.** Speed adjustment using the rotary knob during operation also adjusts the shut off pre-set value (SETTABLE PARAMETERS No.: 6 and 7). The lower the speed, the lower the load where automatic shut off will initiate.

→ **NOTE.** To meet the pre-set load values at the low speed operation of the system, low speed load compensation should be applied. For details, refer to (SETTABLE PARAMETERS No.: 12).

7. Non-Normal Operation

If a mechanical or electrical failure occurs or the batteries supplying the WDU System have insufficient capacity to operate the system, an extended bug wiper cannot be retracted. The flight may continue with the bug wiper extended but a loss in performance may be observed.

Electrical fire

In case of fumes or smoke, suspect electrical fire and take the following recommended actions:

1. Switch off the master switch supplying the circuits.
2. If a circuit breaker “pops”, reset once only. If “pops” again, don’t reset the circuit breaker.
3. Land at Pilot-in-command discretion.
4. Ensure the aircraft is serviceable before next flight.

Motor gliders

→ **WARNING:** Do not install the WDU components close to fuel supply hoses and fuel tank. Operating WDU system may interfere with other electronic components of glider electric propulsion system: FES, RES, etc. If you smell glider engine fuel vapors, do not operate the WDU system. Ensure effective ventilated airflow is provided in the cockpit. If in doubt, land at Pilot-in-command discretion.

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8. Replacement of the rope

The rope must be replaced when it becomes worn. Rope replacement sequence:

1. Move the bug wiper out as much as all the rope winds off the spooler.
2. Remove the rope guide tube by depressing the “push to fix” black ring at the end of grommet and at the end of the plunger.
3. Cut the rope close to the plunger.
4. Remove the main WDU body (ALL IN ONE) from the fuselage, or motor bay (SPLIT).
5. Unscrew M3 bolts to remove the top cover.
6. Use circlip plier to remove circlip (DIN471) from the top of spooler.
7. Remove spooler from the shaft, by pulling it up.
8. Use the negative screwdriver from the top of the spooler to remove the rope fixing pin.
9. Remove the remains of the old rope.
10. Put the rope fixing pin back in place but do not tighten it. The new rope goes through the plunger, then via microswitch lever “eyelet” and finally around the rope fixing pin. To do this, you might need to move the rope fixing pin slightly up. Tighten the rope fixing pin with a negative screwdriver.
11. Make a “Grinner” or appropriate knot and tighten the rope properly. *For details, see* **Appendix**.
12. Put the spooler back in place and fix circlip (DIN471) from the top of the spooler.
13. Put the top cover back and tighten the M3 bolts.
14. Put the WDU main body (ALL IN ONE) or motor bay (SPLIT) back in place.
15. Fix the rope guide tube with one end back to the plunger, the other to the grommet, by simply pushing them via a hole (rope guide tube should slide in the hole for approx. 7 mm).
16. Adjust the new rope length according to the wing span (approx. 20 cm from the wing tip).
17. Fix the rope end on the bug wiper.
18. Put the wiper back to the fuselage in a folded position.

Fig. 9 (Spooler, rope fixing pin, “eyelet”)

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9. Rope length adjustment for different wing span

If your glider equipped with different wing span tips, WDU rope length should be adjusted for highest wing span. If the owner of the glider wishes to fly other wing span configuration, please follow the sequence for rope length adjustment without shortening the rope:

1. Move the bug wiper out as much as all the rope winds off the spooler.
2. Unscrew M3 bolts to remove the top cover.
3. Use the negative screwdriver from the top of the spooler to remove the fixing pin which is not fixing the rope.
4. Wind up the wiper when it gets approx. 20 cm from the tip of the wing of the new span.
5. Tighten the fixing pin with a negative screwdriver.
6. Put the top cover back and tighten the M3 bolts.
7. Put the wiper back to the fuselage in a folded position.

10. Pre-Flight Inspection

A pre-flight inspection of the WDU system should be done before the flight.

- Make sure the system power source is fully charged.
- Perform the function check of the toggle switches and the rotary knob.
- Extend the wiper by holding it with one hand for approx. 1 meter.
- Check the quality of the rope, especially of the knots in the area of the bug wiper.
- Fold bug wiper back to fuselage and check whether the automatic shut off operates properly together with the LED signal light.

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Appendix

Detailed Explanation of Ramp (Parameters No. 15 and 16)

A **ramp** is a function generator that increases its voltage output up to a specific value. Usually, supplying the power directly to the motor will cause a surge of current as the motor accelerates up to the designed speed during start. This results in the motor been driven rapidly to reach its nominal RPM value immediately. For example, if the nominal running current of the motor is 1 Ampere, it may reach up to 15 Ampere current during the start. This stresses the device mechanics and its power supply eventually may cause damage. When **ramp** is applied, the motor accelerates at the control phase and deaccelerates without experiencing a sudden current surge by applying time in seconds delay (For ex.: 2 seconds ramp = full designed speed or stop is reached within 2 seconds when start/stop has been initiated). Using the **ramp** is especially important when the motor changes rotation direction. Acceleration and deacceleration becomes much smoother without experiencing a surge of current.

Detailed Explanation of Load Compensation (Parameter No. 12)

Load compensation (RxI) improves low speed and start torque. Load compensation focuses on improving the motor's load tolerance. This is especially important when having a heavy load on low speed. For example, wiper driving speed is reduced by round knob (see Fig.8). Without the **load compensation,** the running motor's RPM drops drastically when load is applied and the current increases. With **load compensation**, the motor is able to keep the reduced RPM when load is applied.

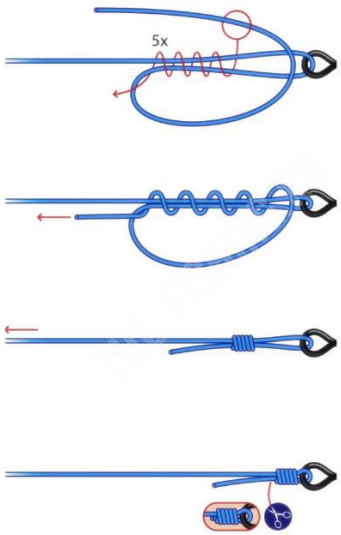

Fig. 10 (Grinner Knot)

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