Bug Wiper Drive System

Operation and installation

Revision 1.4 July 2022
System-Version 1.1 and 2.1

Table of contents

Revision overview

Version	Who	When	What
1.0	HJR/MB/CB	Nov. 2020	Creation
1.1	HJR	Feb. 2021	Small I panel option
1.3	HJR	May 2022	Introduction of an over the air (OTA) firmware update
1.4	HJR	Jul. 2022	Sequence feature

Updated versions can be found at the dealer, or at www.designed-for-use.de.

1. General

The **jumbo putzi** is a drive for glider bug wipers. It was developed with the aim of not demanding any attention from the pilot and not distracting him during the cleaning process through the simplest operation and highest operational safety.

Furthermore, the drive handles the available battery power economically through its economical design, and thus minimizing the energy consumption for a wiper run. The drive principle has already proven its design in use for over ten years on many gliders.

The wiper run is controlled by a compact micro-controller. Only the rope length has to be adjusted once to the wing span. The controller adjusts itself during operation, many errors are detected automatically, manual configuration is not necessary.

Any wiper wings can be connected to the system, no restrictions are known here.

2. System overview
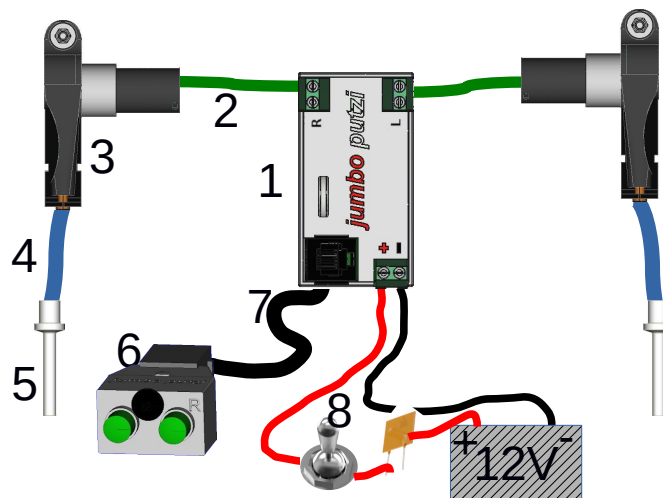
- ● **Components**

1) Control
3) Cable winch
5) Fuselage sleeve
7) RJ12 6P6C telephone cable

2) Power connection AWG20 or $1.0mm^2$
4) Bowden spiral/rope guide
6) Control panel with LED button
8) Wiring harness with switch and fuse

- ● **Functionality**

The winch controlled through continuous measurement of the current delivered to the DC motor. The current measurement enables
- • the detection of the winding direction when starting a wiper run
- • the regulation of the rope slack for the first seconds of the wiper run
- • the detection of the reversal point at the wing tip
- • braking and shutdown when approaching the parking position at the fuselage.

Short-circuiting the DC motor, together with the reduction gear, gives sufficient holding force in the parking position. The special design of the drive unit with seat on a rubber foot ensures that the holding force is maintained even if the rope settles on the drum over time.

The spindle runs without reversing the direction of rotation throughout a wiper run, i.e. the rope length must fit to the wing span. The controller preserves the rotation sense of the last run and starts in the correct direction for the following run.

A configuration for the actual rope length is not required. After approx. five uninterrupted wiper runs, the system has detected and stored the rope length and adjusted to the friction of the rope guides.

- ● **Interfaces**

The system boundary to the drive are completely described with the sleeve diameter, the motor support and the power connection. In the event of an

jumbo putzi drive
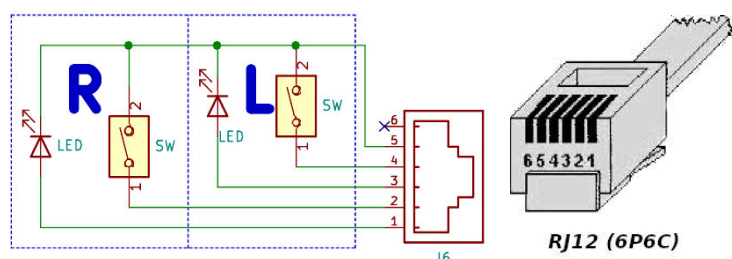
individual installation, the RJ12 assignment for the control panel is explained here. The LEDs are optional, the buttons do not need de-bouncing (handled on controller side).

3. Operation

The control panel provides a pushbutton with integrated status LED for each wing wiper. The system can operate both drives simultaneously. However, it is recommended to clean one wing after the other so that the onboard network is less loaded.

● Button commands

Each wiper is operated by the respective pushbutton in the control panel.

- One push of a button starts a wiper run on the corresponding side.
- After pressing the button again, the drive stops.
- Another button press retracts the wiper.
- Further button presses stop and start the winch.
- If the pushbutton is held down, the winch retracts at half power. As soon as the button is released, the drive stops. Referred to as "manual retract" in this manual.

● Button status LEDs

Each button on the control panel has an integrated green LED. It signals the status during operation:

- Ready for operation, e.g. after switching on, is signaled with a single flash. After that the LEDs remain off.
- Ready for operation and fully trained, e.g. after switching on, is signaled with a double flash.
- During normal operation of a wiper run, the corresponding LED flashes slowly.
- Rapid flashing indicates that operation was stopped manually by the user or aborted by the controller. The wiper run can be retracted by pressing the button.
- During "manual retraction", the LED lights up continuously.
- "Controller over heating" is indicated by a repeated signal consisting of one short and a long flash.

● Standard procedures

The system is intuitive to use. As a help for all cases, a "cheat sheet" is available in the appendix, which can be carried in the cockpit.

1) Wipe the bugs

A short button press starts the wiper run. The run is controlled automatically, and the winch stops as soon as the wiper is back against the fuselage.

2) Wing separation point

If the wiper gets stuck at a wing separation point or tape during fly out, the wiper run should be stopped by pressing the button. Press the button again to retract the wiper.
The problem can often be overcome by flying a bit faster, then the wiper usually makes it over the separation point.
Recommendation: *Ensure that the tape used for masking a wing separation does not pull into the gap causing the cleaning thread of the wiper to get caught in it.*
Note: *When running out, the wiper is driven solely by the airstream.*

3) Restart during pull in

If the wiper stops during retraction, the load was most probably too high. If possible, fly a little bit slower and restart the wiper with another short button press. The controller parks the wiper as usual.
This can occur during the first couple wipe runs, but should not occur thereafter, as the controller continuously learns the load and adapts to it.

4) Rig/unrig of the glider

The wipers are to be placed in the cockpit for de-rigging.

- Start the wiper, guide it by hand and cancel it after about one meter by pressing the button again. The wiper can then be stowed in the cockpit and does not interfere with wing assembly.
- The "manual retract" (see Chapter 3) is suitable for manually parking the wiper on the fuselage. If the controller runs the wrong direction it's internal state can be reset by switching off and on again the system. The wiper can then be parked with a single button press.

5) Tighten the wiper properly to the fuselage

If the wiper moves off from the fuselage and no longer sits properly in its parking position, the holding force and thus the parking position can be restored by pressing and holding the button down.

4. Configuration, firmware update, and rope length

All parameters for controlling a wiper run are collected during operation and refine with each run. Different behavior may be observed during the first couple runs. Especially slowing down in time before the parking position of the wiper at the fuselage will only be adjusted after some wiper runs in flight based on the rope length, rope guidance and wiper size.
The adjustment of the parameters cannot be influenced and takes place automatically during operation.

● Configuration Mode

Starting from firmware revision 1.3 the controller has a so called configuration mode, and OTA update has been introduced.
To enter into the configuration mode: Keep both buttons pressed when powering the system with the toggle switch. As a first response LEDs will read back the firmware revision. The Wifi configuration page is now accessible, which opens up further configuration options, including firmware updates. The wiper operation is reduced to empty the rope spindle entirely.
The configuration mode is indicated with a LED flash every four seconds. After 15 idle minutes in this configuration mode the controller restarts silently into normal operation.

● Determine the firmware version

When booted into configuration mode the firmware version number can be read out by counting the flashing of the LEDs.
The major version number on the left LED, the minor version number on the right LED, and the fix version number again on the left LED.

Example :   Left LED flashes 1x -- Right LED flashes 3x -- Left LED flashes 1x

> ➔ Software version: 1.3.1

● Smart phone access to the jumbo configuration

In configuration mode, an embedded web server is active. Any smartphone can connect to the WLAN access point with the SSID "jumbo putzi" (no password required).

Note: A smart phone *will warn about not getting an internet connection through the jumbo access point. It is just a local network.*

Then use a web browser and point it to the site http://192.168.4.1. The presented web page offers the sections:

> ➔ Cable Setup, Configuration, Info and Upgrade.

● Rope length

The correct rope length is fundamental and must be adjusted to the wing span before the first flight. The system spins in one direction and does not reverse the spindle when the wiper reaches the outermost position.

The documents of the respective wiper used should give an indication of how far the wings can be cleaned up to the wing tip. The geometry of the wing and the fit of the wiper on the outer wing also plays a role. As a safe minimum distance 30cm should be left from the reversal point of the wiper to the wing tip or winglet.

For reasons of operational safety, the spindle has to provide just enough rope to reach to the reversal point of the wiper. Without change of the spin direction at the reversal point the rope flips and pulls in automatically. The system stores the rope length and the direction of rotation of the last wiper run and starts accordingly for the next wiper run. A possible start in the wrong sense is nevertheless detected and corrected immediately.

● **Trimming the rope length**

The rope length should be trimmed that the wiper runs up to just before the wingtip, but in no case comes into the immediate vicinity of the wingtip or winglet.

The procedure to adjust the pull rope to the proper length is described step by step below. The cable setup of the configuration page does help on this task.

1. Enter configuration mode, hold the end of the rope in case the wiper drive starts pulling, instead of unwinding.
2. Empty the rope from the winch entirely. Start with a button press, you might use the virtual buttons on the embedded configuration page as a remote control.
3. Guide the end of the rope away from the fuselage under moderate pull force until the spindle is completely emptied. The controller detects the little "all-out" jerk and stops the motor.
4. Cut the rope to the length required by the wiper.
   Note: Leave enough reserve for mounting the wiper.
5. Attach the wiper according to the instructions of the wiper manufacturer.
6. Pulling in the rope to the parking position. Restart by pressing the button (still configuration mode).
   Note: The winch will pull with a minimum speed and detect the blocking wiper when reaching the fuselage. Power-cycle and park the wiper as described above in Chapter 3.

● **Wipe sequence**

This activated the second wiper does start automatically, when the first one has turned at the outermost position.

● **Wipe reminder**

The jumbo reminds you after a period of time to clean the bugs of the wings by flashing the LEDs "ready" sign. The "Configuration" section of the config page shows a field to set an amount of minutes for the reminder period. Set to zero disables this feature.
Other grayed out fields show just a preview of upcoming features, most significantly the support of two wing spans.

● **OTA firmware update**

New firmware for the jumbo wiper will be published on www.designed-for-use.de.
To upload a new firmware binary:
1. Select the downloaded binary with the "Browse" button on the last section on the configuration page.
2. Press the upload button. The upload progress is shown as percentage.
When the upload is finished successfully the message: "Wait for jumbo to reboot" shown up. Then you have to wait about 20 seconds until flashing of the new firmware is complete and the wiper reboots. The system should be continuously powered throughout this update procedure.

5. Mounting

Installation and routing of the Bowden cable guide for the rope is of crucial importance for the fault-free and robust functioning of the system. The rope guide should have as little curvature as possible; under no circumstances should the cable guide be kinked!

It is best to mount the wiper drive for the right wiper on the left side of the fuselage, so that the Bowden cable runs from the fuselage bushing to the drive with just little curvature.

When fastening parts (here: drive, control panel) in the cockpit area of the aircraft, the minimum loads to be taken into account must be in accordance with EASA CS22.561 General:
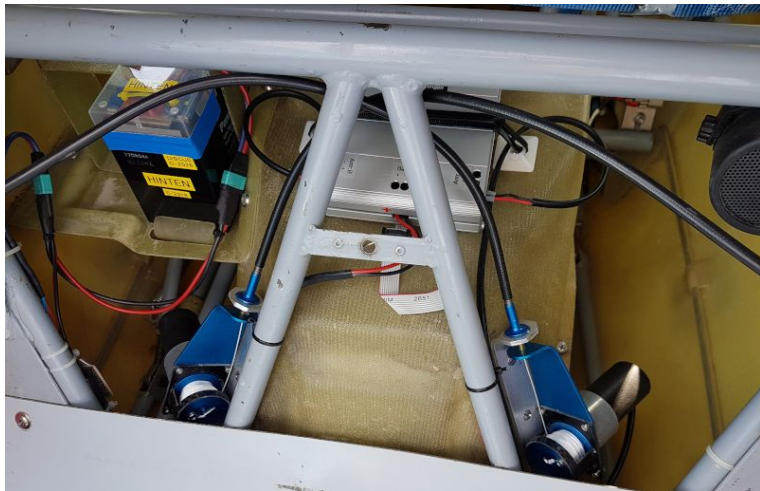
Upward: 7,5g
Forward: 15,0g
Sideward: 6,0g

Down: 9,0g

- **Examples**
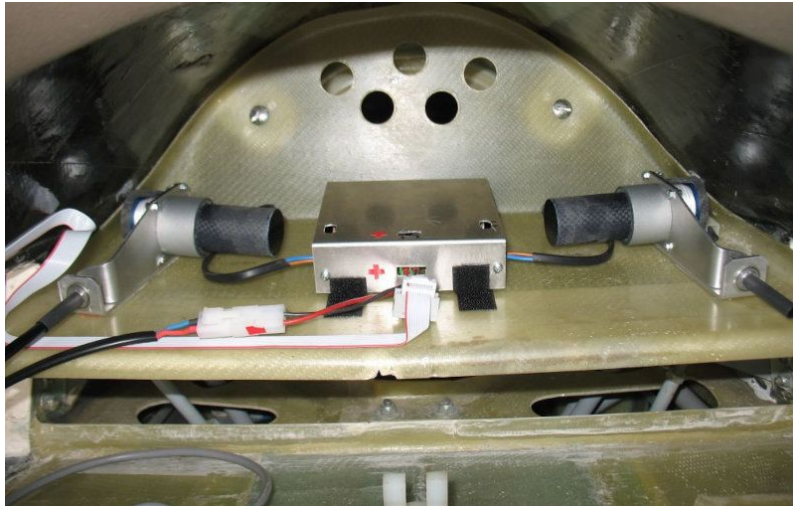 - 1) **Schempp-Hirth, Discus and Ventus**
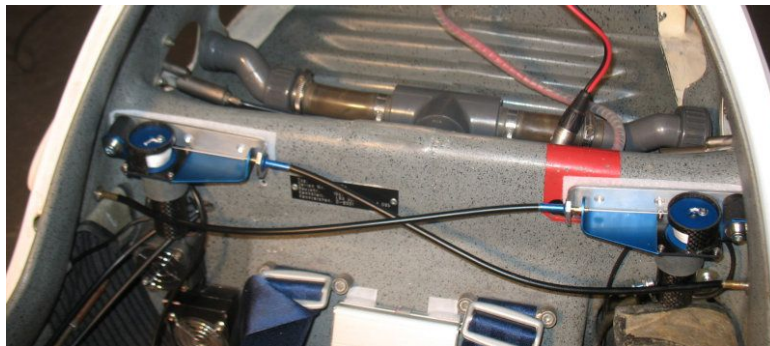

  - 2) **Schempp-Hirth, Arcus (under rear seat)**

  - 3) **DG-Flugzeugbau**

4) Schleicher


5) LS glider types

Note: Most of the pictures show assembly examples with the dimensionally and functionally identical predecessor models. The aluminum control box also shown is no longer needed. The current micro controller unit sits on one of the drives.

● Cable winch

The operating wiper puts no extra forces on the winch and its attachment. To full fill the 15g requirement of the winch attachment, the mount needs to resist a force equivalent of about 5kg. The mounting holes are 4mm in diameter. Two M4 screws are a sufficient fixation.

The aluminum base plate has two 4mm counter-bored holes for mounting the winch to the airframe. Dimensions and hole positions can be taken from the sketch. These are to be used for mounting. There are 1:1 installation models in the appendix chapter 9.
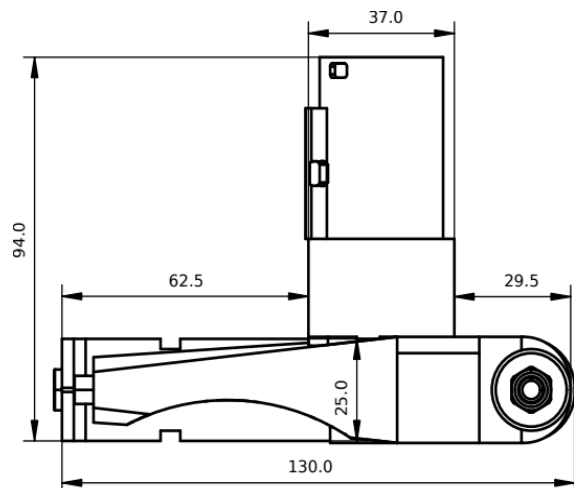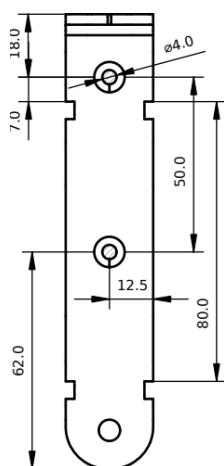

Dimensions in millimeters.

● Control panel

The first choice when installing the control panel is the instrument panel.

Three holes are required for this as shown in the adjacent sketch.

If there is no more free space on the panel, the rectangular design of the control block still leaves plenty of room for other mounting options.

Note: "upside down" mounting is also possible. In this case, the motor connections on the controller would have to be reversed in order to set the right/left assignment correctly.
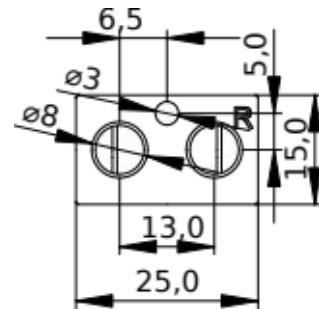
Dimensions in mm.

● Wiring harness

The wiring harness for connection to the on-board battery is prepared for a connection point located at the front of the cockpit. It must be adapted for a battery located behind the pilots seat.
Cable extensions must be made with at least AWG20 cable (approx. 0.55mm2 cross-section, or 0.97mm diameter, aka MIL-W-22759/16-20).
Alternatively, the system can be connected to the appropriately fused on-board power supply or free circuit breakers.
Important: *The connection must be able to deliver at least 5A exclusively for the bug wiper. If the connection is equipped with insufficient cable cross-sections, this will directly reduce the performance of the winch and can slow down pulling in the wiper or to undesirable effects on other electronic devices in the aircraft.*

● Rope guide, Bowden cable

Recommendation for routing: Deviate max. 90° from the rope direction into the fuselage, avoid loops.

Note: It is *best to cut the Bowden spiral to length using a grinder and a thin cutting disc.*

The red inlay must be 2mm longer on both sides. This protects the rope from contact with sharp edges of the outer spiral. The fuselage sleeve and the brass sleeve at the winch have corresponding cavities. The recess for the red inlay is 2mm deep and the recess for the spiral is 9mm deep.
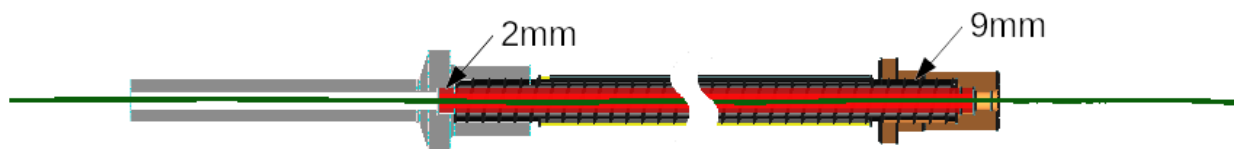
When cutting the Bowden cable spiral to length, make sure that no sharp edge remains. Otherwise the pull cable could be damaged and the wiper could be lost.
Important: *The red inlay of the Bowden cable must protrude 2mm.*

● Fuselage sleeve

The installation of the fuselage sleeve has to match the used wiper, because the pull rope should exit the fuselage precisely and without kinking at the attachment point of the wiper in its folded parking position.
Important: *To do this, first determine the appropriate position according of the wing manufacturer's specifications.*
A 5mm hole is required at the appropriate location. The fuselage sleeve is inserted from the inside through the hole in the fuselage shell with the thin end first. It can be held in place on the inside with a drop of epoxy. Trim the outer protruding end carefully.
Important: *Drilling on the glider structure only in accordance with the specifications from the manufacturer of the glider. Reinforcing layers of GFRP or CFRP fabric may need to be applied to the holes.*
Note: *The hat brim inside can be used to give lateral support. It can be trimmed to fit.*

Note: *Fuselage sleeve and Bowden cable can be held together well with a heat shrink tube.*

● **Position of the guide rope - Linkage of the wipers**

In principle, the rope can be routed above or below the wing. Since the rope can blow out considerably over the half wing span, the position of rudder horns, wing wheels, or other things on which the rope of the wipers could get caught must be taken into account in the decision.
Some wipers are designed to allow only one particular side for rope attachment. The manufacturer's specifications must be respected.
Often, the contour of the fuselage-wing transition also gives a clear preference for rope routing.

Examples of preference for rope guidance below the wing:
All DG`s, Hornet, HpH aircraft, Jantar, Kestrel, Jonker, all LS types, LAK, Libelle, PIK20, SZD55.

Examples of preference with rope guide above the wing:
All Schleicher aircraft, EB28, EB29.

6. Rope replacement and access to the winch

For rope replacement, open the M6 stop nut and removed the winch from the base plate. This allows access to the winch and makes it easier to thread the rope.

A threading loop is included in the set for threading on the spindle. With a Phillips screwdriver on the rope fixation screw, the spindle can easily be turned and the rope entry positioned towards the opening.

The rope fixing screw is 10mm long. It can be loosened far enough (approx. 3 turns) to ensure space for the threading loop under the washer.
Important: Place the *rope around the retaining screw twice in a clockwise direction. Keep the rope taut when tightening the screw so that it is clamped under the washer and rope retaining screw without swelling out.*
Note: The spindle *is firmly fixed on the axle, removal for maintenance or troubleshooting is not intended.*
Tip: *The workshop vacuum cleaner is a good aid for pulling the rope through the rope guide.*

Recommendation: Purchase the replacement rope from the ***jumbo putzi*** sales partner and you are sure to get the right material. No guarantee is given for the function of other traction ropes.
The material pairing of Bowden cable inlay and cable has been optimized for minimum friction.
The use of metal or steel ropes is strongly discouraged. The resulting rope curls cause too much friction in the rope guide.

7. Behavior and measures in case of errors

● **Rope breaks**

The wiper will inevitably be lost. Tip: If your address is written on it, there is a small chance that you will get it back.
Important: *Even though Dyneema ropes have up to 80kg breaking load, they still wear out, especially beyond the actual wiper operation and break one day. Their condition should be checked regularly, in case of loss there are no claims for compensation.*

● **Control panel goes „offline"**

➔ Buttons show no reaction, the LEDs no longer light up.

If the system is powered, each wiper run will complete without interaction. In addition, the controller also switches off the motors if the end of a wiper run is overdue.

The reason for the buttons not responding is probably a broken cable or loose contact.

● **Wipers gets stuck on the way out**

Stop the wiper run, then restart the wiper by pressing the button; the wiper then gets retracted. If the wiper is back in the parking position, the wiper run can be restarted.
Note: The wiper riding on its cleaning-thread causes typically more friction on the wing edge as compared to sliding on its frame. For the way out it might be crucial and potentially the cause for the wiper getting stuck.

● **Wipers gets stuck on the way back**

Press the button to restart the wiper.

● **Stranded**

➔ The wiper got parked, but the controller did not recognize it and signals "abort".

Either switch off the system briefly or wait until the controller automatically resets to "park". This is then indicated by the "Ready" LED flashing.

- **Battery weak**

  ➔ When pulling in the wiper no longer reaches the expected speed.

Relieve the winch by slowing down the flying speed and complete the wiper run if possible. Then do not run the wiper again until the battery is sufficiently recharged.

- **Controller overheated**

  ➔ As soon as a too high temperature is detected at the control unit, both motors are stopped. This can be recognized by the special blink code of both LEDs (see chapter 3).

As soon as the temperature lowers again, the LEDs go off and the wipers are ready for operation again.

8. Technical data

Winch size:	132 x 94 x 44mm (length x width x height)
Winch weight:	0,3kg
Controller size:	68 x 36 x 22mm (length x width x height)
Control panel size:	25 x 15 x 37mm (width x height x depth behind the panel).
Weight of the drive system ca.:	0.8kg (without battery and wiper)
Hold force in park position:	approx. 20N
Supply voltage:	10V to 17V DC
Standby current:	approx. 20mA
Fuse:	5A (integrated in the switch)
Power supply wires:	AWG 20 (approx. 1mm conductor diameter)
Current per winch:	Fly out: approx. 0.5A Pull in: approx. 2A (at 150km/h)
Maximum rope length:	15meters with 0.65mm rope diameter
Wiper speed:	approx. 0.5m/sec.
Wipe time (standard class):	30 seconds wiper run for one side
Max. flight speed while wiper run:	up to 200km/h

- **Airworthiness**

In a letter dated May 1990, the LBA classified bug wipers as "aeronautical equipment not subject to approval within the meaning of the LuftVZO". However, it is pointed out that the installation must not impair the safe operation of the glider. If there is any doubt about this, the manufacturer of the glider should be consulted in any case.

9. Appendix

- **Cheat Sheet**

jumbo putzi	
Commands	
short button press	Start - Stop - Retract - Stop - Continue - Stop - Continue - etc.
hold button pressed	Slowly retract as long as button is held down.
Status LED Code	
●	once — System is ready.
●—●	once — System is trained and ready.
●---●---●-----	etc. — Wiper operating.
●-●-●-●-●--	etc. — Abort or stop the wiper run.
●--●▬▬—●--●▬▬---	etc. — Over temperature.

● Installation trial templates

The printout on A4 with a laser printer should result in a true to size 1:1 model. Select "Print at original size" in the print menu and check the output size against the given dimension in millimeter.

Falt-
linie