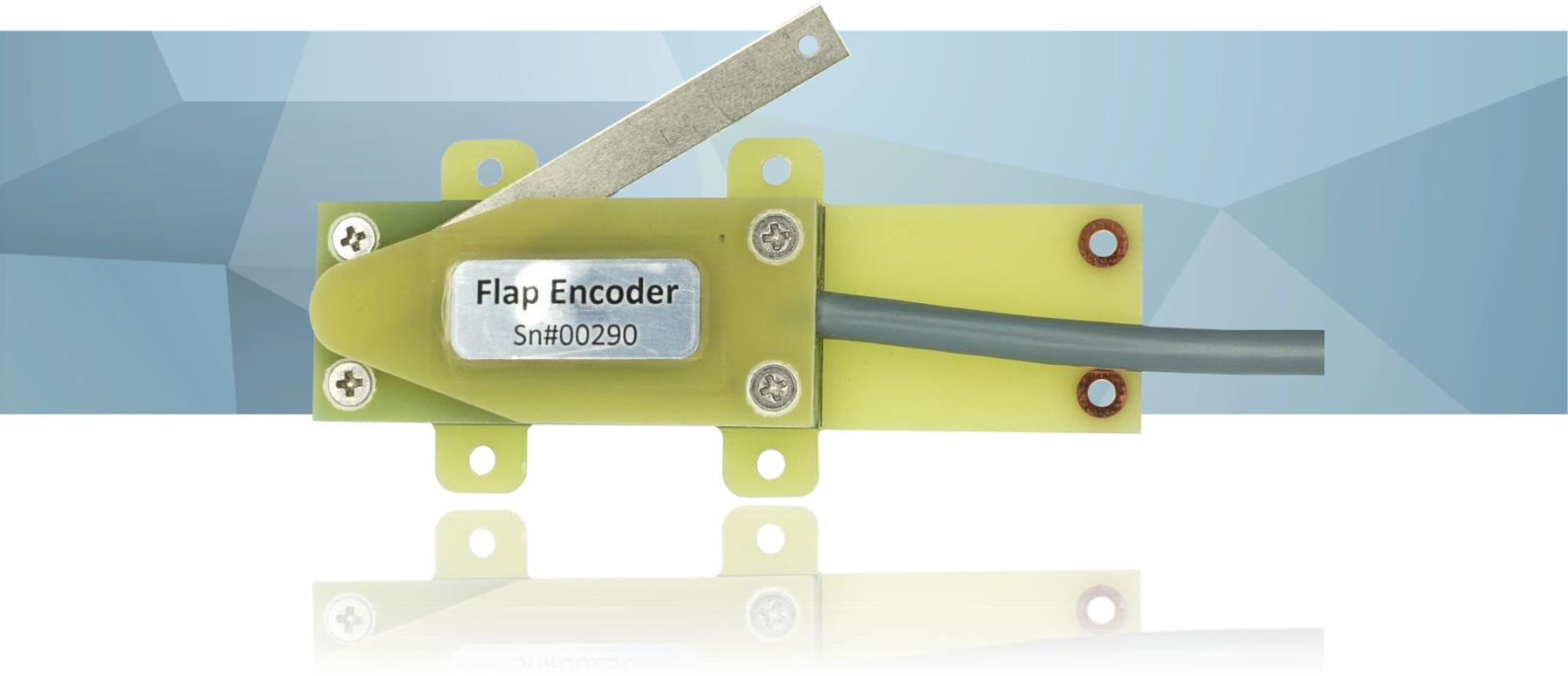
INSTALLATION MANUAL

Flap Encoder

Version 1.5



December 2022

www.lxnav.com

1 Important Notices

The LXNAV FLAPENCODER system is designed for VFR use only as an aid to flap management. All information is presented for reference only. It is ultimately the pilot's responsibility to ensure that the aircraft is being flown in accordance with the manufacturer's aircraft flight manual. The flap encoder must be installed in accordance with applicable airworthiness standards according to the country of registration of the aircraft.

Information in this document is subject to change without notice. LXNAV reserves the right to change or improve their products and to make changes in the content of this material without obligation to notify any person or organisation of such changes or improvements.

A Yellow triangle is shown for parts of the manual which should be read carefully and are important for operating the LXNAV FLAP ENCODER system.

Notes with a red triangle describe procedures that are critical and may result in loss of data or any other critical situation.

A bulb icon is shown when a useful hint is provided to the reader.

1.1 Limited Warranty

This LXNAV FLAP ENCODER product is warranted to be free from defects in materials or workmanship for two years from the date of purchase. Within this period, LXNAV will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts and labour, the customer shall be responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident, or unauthorised alterations or repairs.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL LXNAV BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT. Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you. LXNAV retains the exclusive right to repair or replace the unit or software, or to offer a full refund of the purchase price, at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

To obtain warranty service, contact your local LXNAV dealer or contact LXNAV directly.

August 2022

2 Description

The Flap sensor is designed to measure the position of flaps. It is very useful to direct pilot with correct flap settings that are programmed by the user over main unit. It is designed to communicate with RS485 or CAN devices. Currently there are two versions of Flap Encoders:

- Version 1 is the early version, which had to be ordered separately with RS485 or CAN bus, depending on the installation where it was used, either LX80/90x0 or S8x/10x system.
- Version 2 is however universal and compatible with both communication buses at the same time and it does not require special attention while ordering. In order to speed up the installation of the device, this type has also detachable cable, which makes Flap Encoder easier to install when customer has to pull cable through the already narrow tubes in gliders.

Versions 1 and 2 can be identified by the label on cable. Version 1 has label with either *RS485* or *CAN*, while version 2 has label *Universal*.

3 Packing list

Version 1 - RS485 or CAN Flap Encoder

- LXNAV Flap Encoder

Version 2 - Universal Flap Encoder – possible to connect either on RS485 or CAN

- LXNAV Flap Encoder (SKU:FLAP_ENC-UNI)
- Detachable universal cable for Flap Encoder (SKU:UNI-CA)

Optional:

- Universal CAN-485 splitter cable with which is possible to connect RS485 and CAN devices simultaneously. Only for version 2 - Universal Flap Encoder. SKU:UNI-485-CAN-SPLITTER

4 Technical data

Parameter	Condition	Min	Typ	Max	Unit
Operating supply voltage(1)		8	12	18/36(2)	V
Current consumption(1)			30		mA
Operating temperature		-20		+65	°C
Storage temperature		-40		+85	°C
Recommended humidity		0		95	RH
Weight		25g			g
Ingress Protection		IP4X			

Note1: Supplied via CAN or 485 BUS
Note2: New model of the unit since 2022.

5 Installations

Currently there are two versions of Flap Encoders:

- Version 1 of the Flap Encoder can be connected to LX90x, Lx80xx via the RS485 bus or to CAN devices such as S8x and S10x, depending on version which was ordered.
- Version 2 has universal connector that can be connected either to RS485 or to CAN bus.

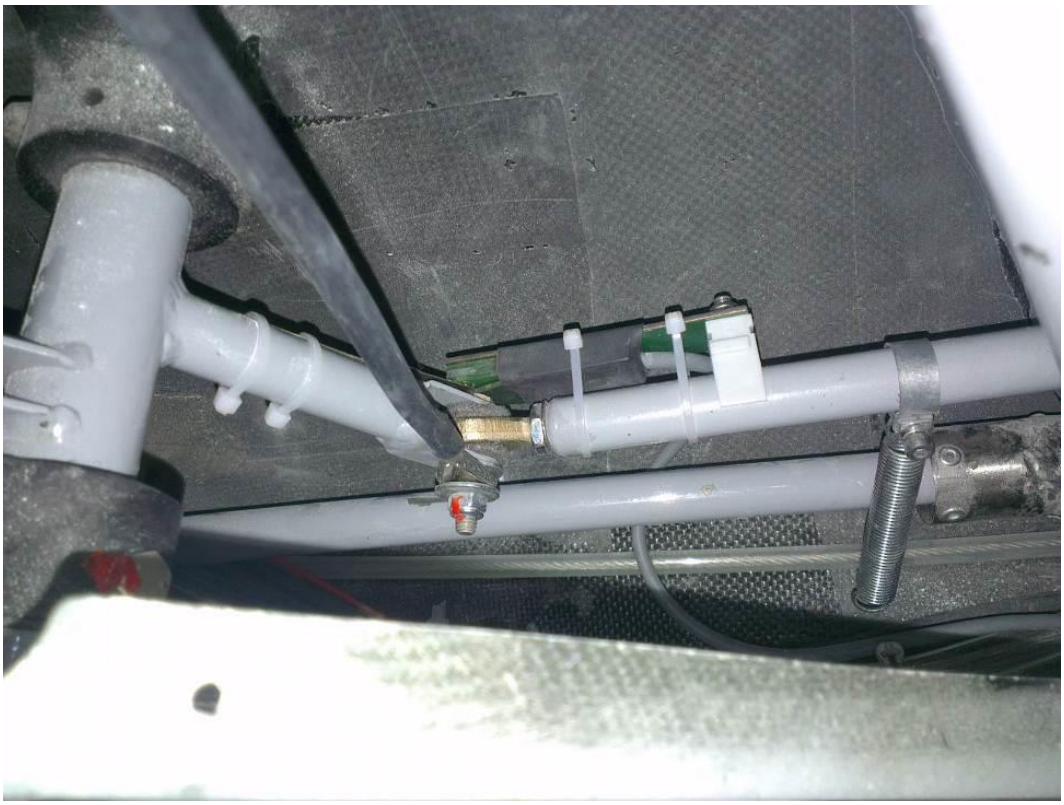
It is physically mounted near the flap mechanism. The flap encoder is very sensitive and accurate and can detect very small movements.

5.1 Installation examples

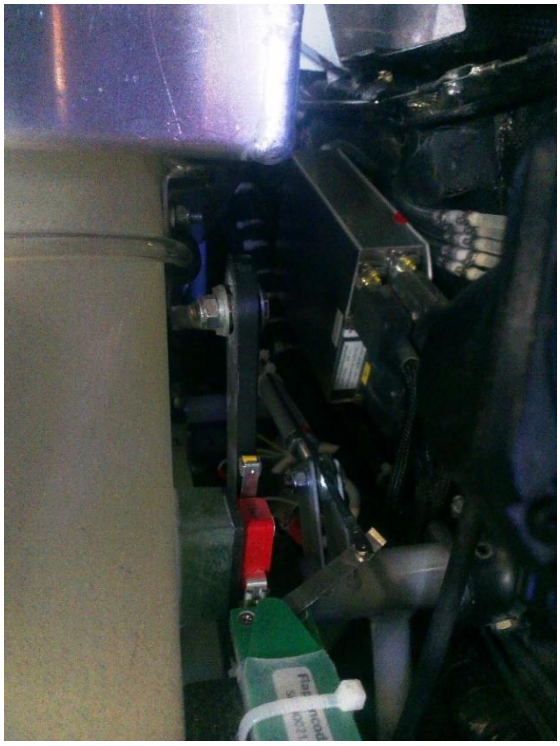
Following chapters show some examples of the Flap sensor installation. There are multiple working ways to install the sensor to every glider.

The following installations are made by end users of the product and are displayed here just as an example. LXNAV does not carry and responsibility for the correctness of the installation of the Flap sensor in the examples shown below.

5.1.1 Ventus 2a



5.1.2 Ventus 2cxm

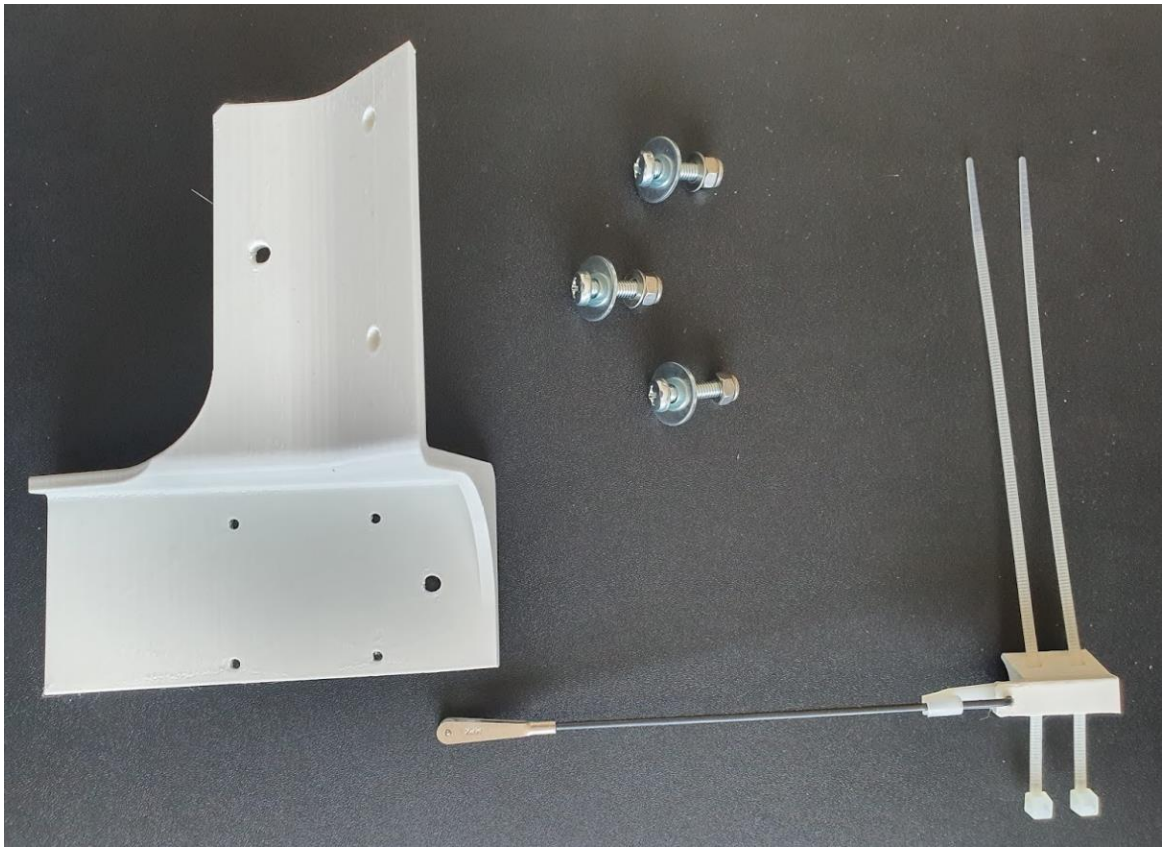


Another installation in a Ventus

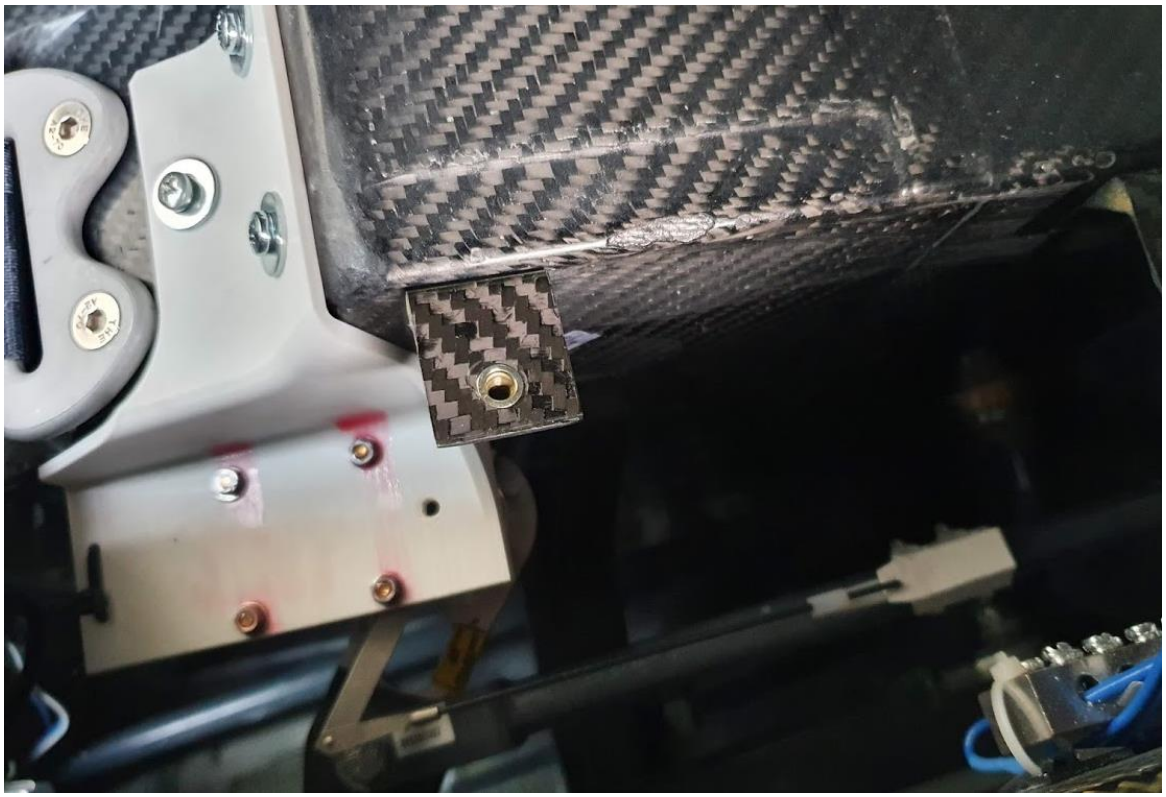
5.1.3 Jonker JS1

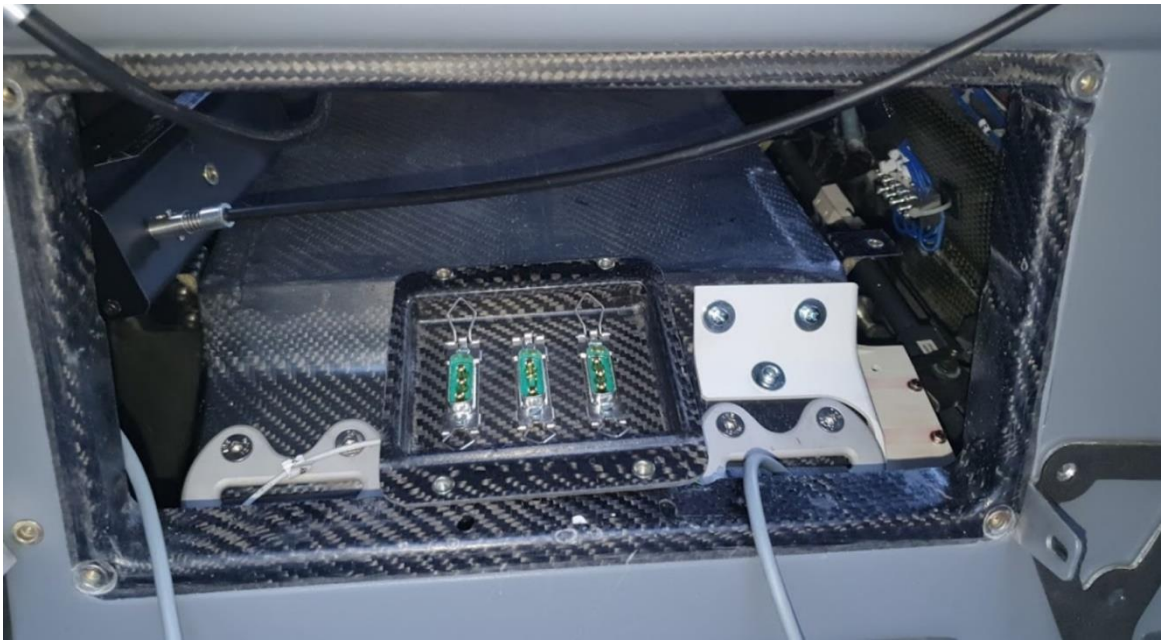
5.1.4 Jonker JS3

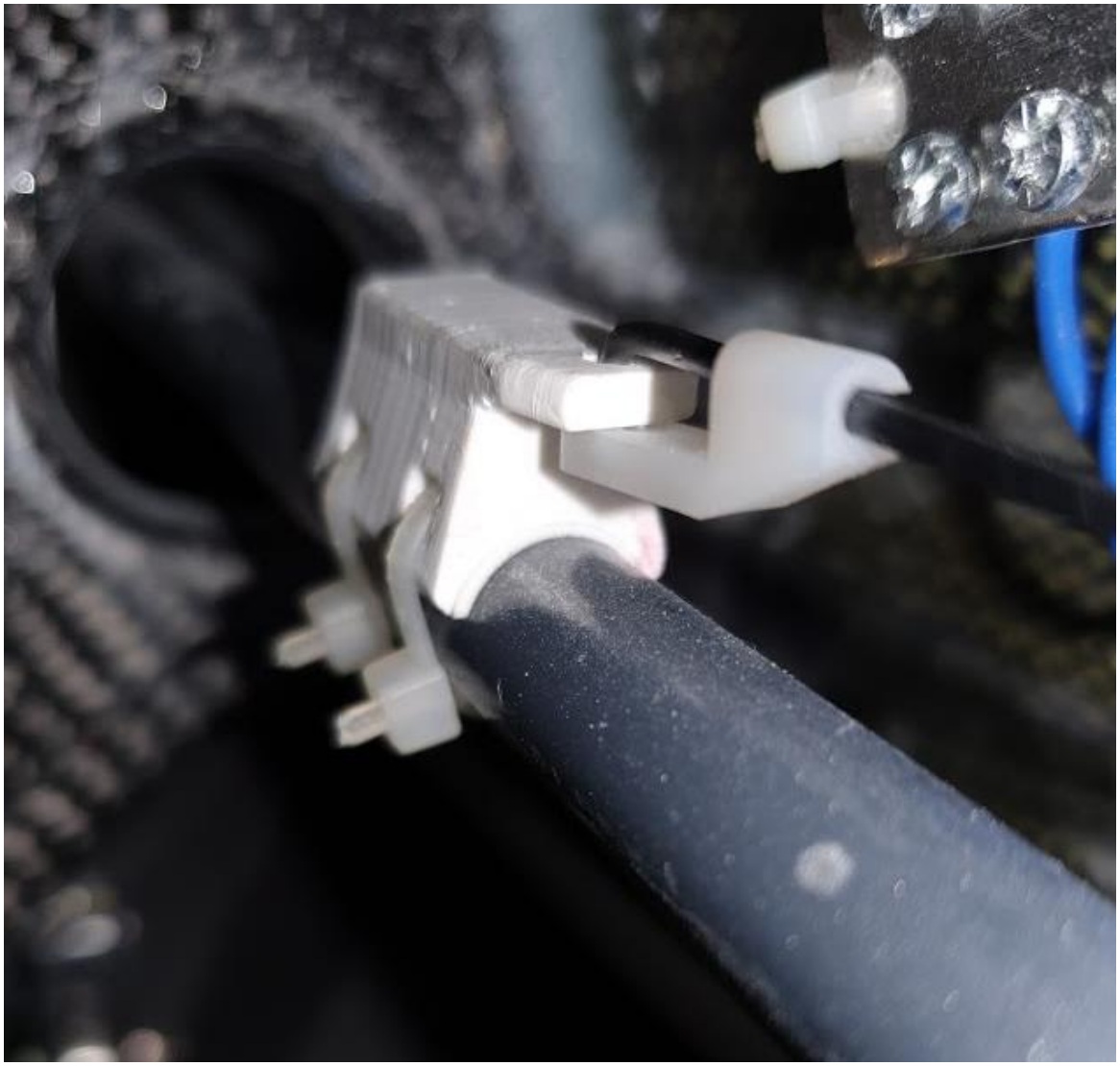
A special mounting bracket is required. For more information, please write to info@lxnav.com




Threadlock

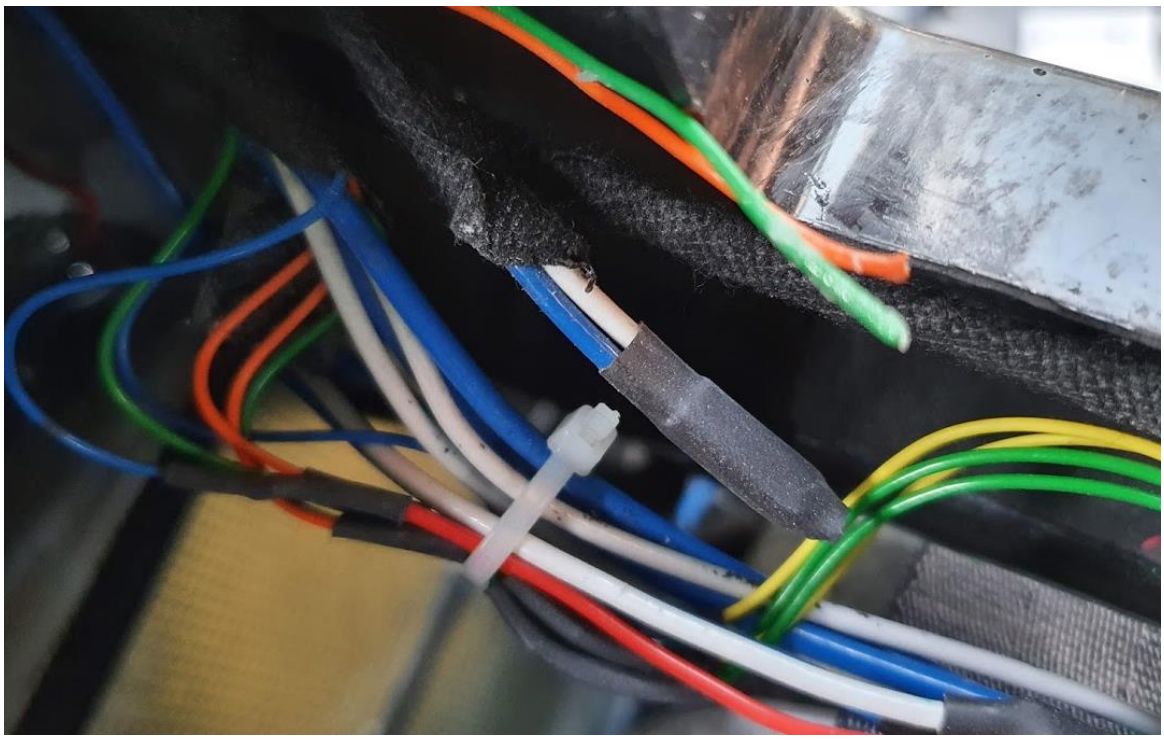






5.1.4.1 JS3 wiring

Use the pre-wired cable. For more information, please read the aircraft's manual.



Wire Harness Routing

Figure 92-4 illustrates the wire harness schematic layout and routing through the left-hand side of the fuselage.

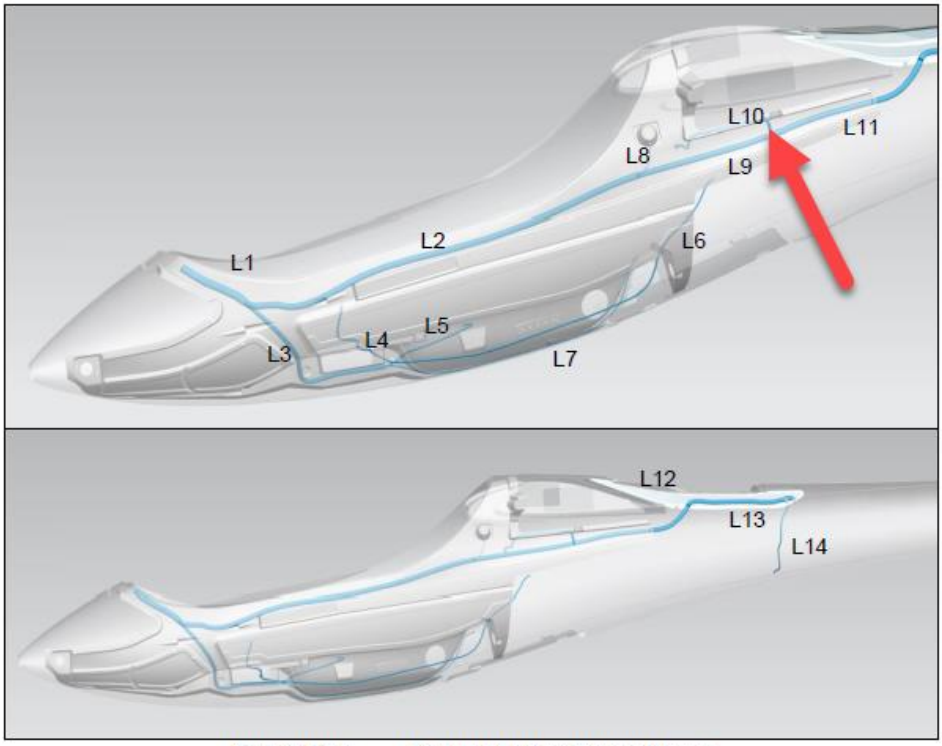
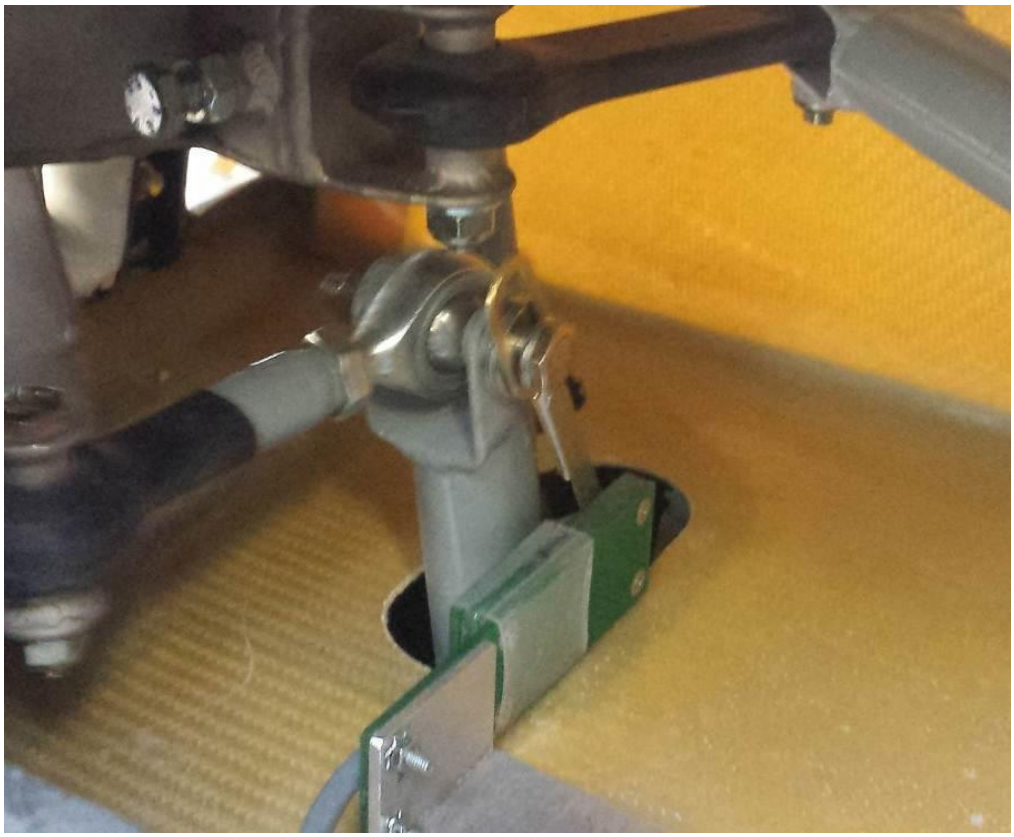


Figure 92-4: JS-MD 3 Left side wiring loom

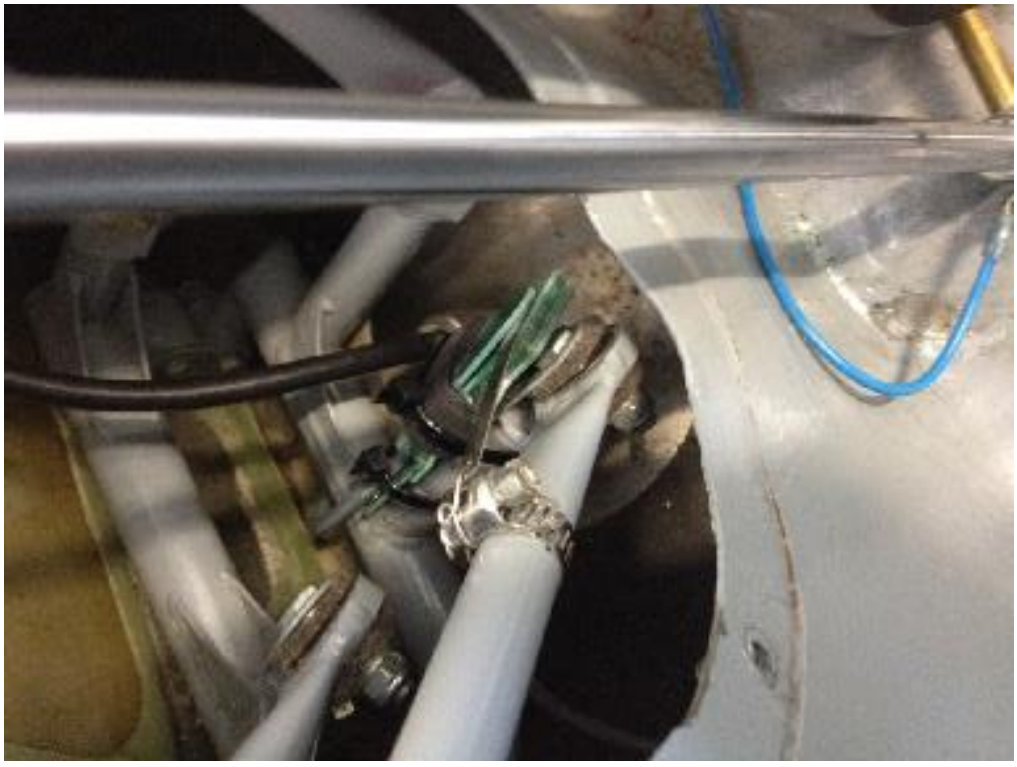
From		Wire			To		
Plug / Comp.	Pin	Marking	Gauge	Loom path	System	Plug / Comp.	Pin
ICC-S	3	Black	22	R1, R4	Landing gear	L/S	c
ICC-S	4	Red	22	L1, L2, L9, L10, L10b	Airbrake system	L/S	c
ICC-S	5	Red	22	R1, R4	Landing gear	L/S	c
ICC-S	6	Yellow	22	L1, L3, L4	Control stick	Unit	Yellow
ICC-S	7	Blue	22	L1, L3, L4	Control stick	Unit	Blue
ICC-S	8		22	L1, L3, L4	PTT	Unit	
ICC-S	9		22	L1, L3, L4	PTT	Unit	
ICC-S	10	Green	22	R1, R4	ELT	Unit	TX
ICC-S	10	Green	22	L1, L2, L9, L10, L10e	Flap sensor	Unit	TX
ICC-S	11	Blue	22	R1, R4	ELT	Unit	GND
ICC-S	11	Blue	22	L1, L2, L9, L10, L10e	Flap sensor	Unit	GND
ICC-S	12	Green	22	L1, L2, L9, L10, L11, L13, L14	MOP	Unit	TX
ICC-S	13	Blue	22	L1, L2, L9, L10, L11, L13, L14	MOP	Unit	GND
ICC-S	14	White	22	R1, R2, R9, R11, R12	Jet relay box	Unit	White
ICC-S	15	Orange	22	R1, R2, R9, R11, R13	Jet relay box	Unit	Orange
ICC-S	16	Black	22	L1, L2, L9, L10, L11, L13, L14	Jet instruments	Unit	
ICC-S	17	Green	22	L1, L2, L9, L10, L11, L13, L14	Jet instruments	Unit	
ICC-S	18	Yellow	22	L1, L2, L9, L10, L11, L13, L14	Jet instruments	Unit	
ICC-S	19	Orange	22	L1, L2, L9, L10, L11, L13, L14	Jet instruments	Unit	
ICC-S	20	Red	22	L1, L2, L8	Left speaker	Unit	-
ICC-S	21	Red	22	R1, R2, R8	Right speaker	Unit	-
ICC-S	22	Red	22	R1, R2, R3	Water system	L/S	c
ICC-S	23	Red	22	L1, L2, L9, L10, L10e	Flap system	L/S	c
ICC-S	24	Red	22	L1, L3, L4	Control stick	Unit	Red
ICC-S	25	White	22	L1, L3, L4	Control stick	Unit	White
ICC-S	26		22	L1, L3, L4	SC	Unit	
ICC-S	27		22	L1, L3, L4	SC	Unit	
ICC-S	28	Orange	22	R1, R4	ELT	Unit	RX
ICC-S	28	Orange	22	L1, L2, L9, L10, L10e	Flap sensor	Unit	RX
ICC-S	29	White	22	R1, R4	ELT	Unit	White
ICC-S	29	White	22	L1, L2, L9, L10, L10e	Flap sensor	Unit	White
ICC-S	30	Orange	22	L1, L2, L9, L10, L11, L13, L14	MOP	Unit	RX

5.1.5 Arcus

5.1.6 Alexander Schleicher



5.1.7 ASG 29



5.1.8 Another more detailed example for ASG 29

Required materials:
Aluminum sheet metal

- .040-.060 for mount
- ¼" thick phenolic block
- Aluminum sheet metal .020 or similar to extend the sensor arm.
- Small machine screws and nuts 2-56
- WDG-9 Adel clamp
- AN526-632r4 machine screws x2
- AN526-832r6 machine screw x 1
- AN365-832 nylon lock nut
- RC Airplane pushrod kit with connector ends
- Blue threadlocker
- Epoxy Resin
- Double sided tape for test fitting

Tools:

- Files
- Hacksaw
- tap/die set
- Tin snips
- Drill and bits
- Sandpaper
- Permanent marker
- C-clamp

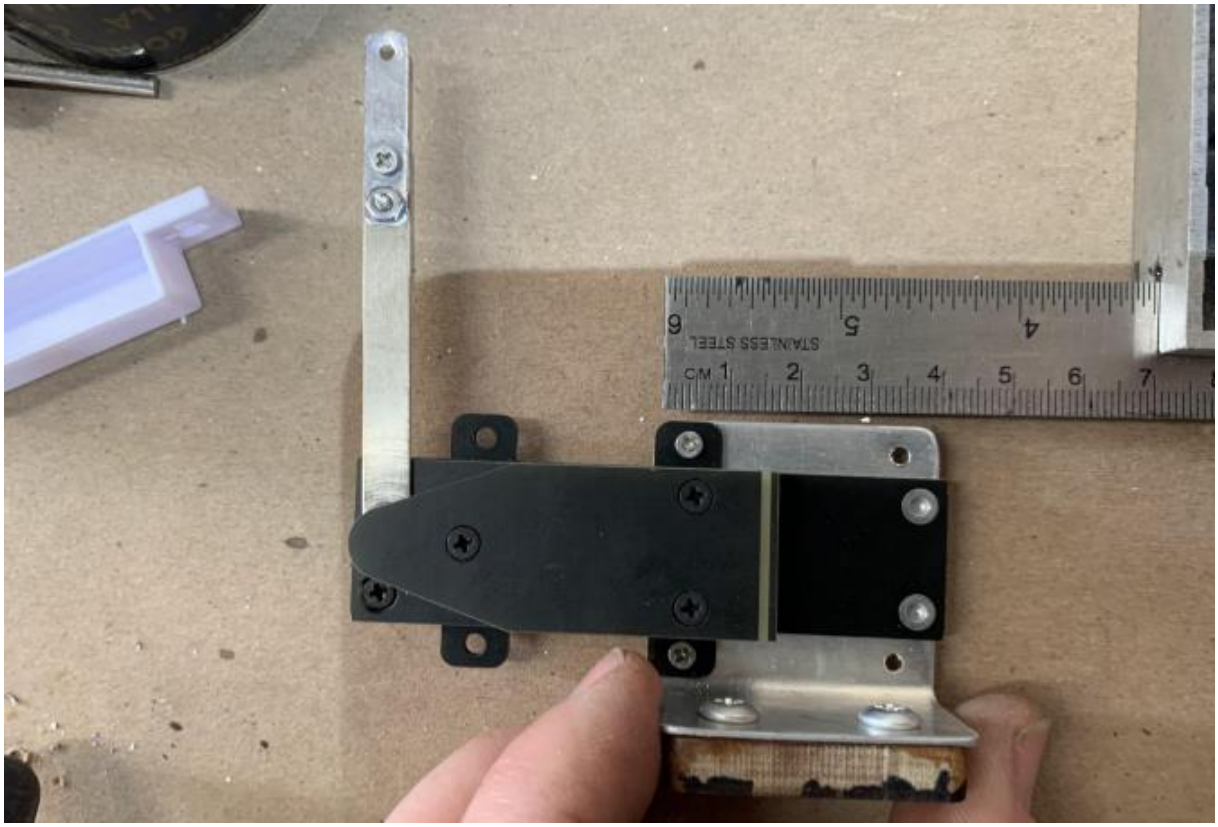
The Flap Sensor installation guide shows the mounting of the sensor in the bottom of the fuselage where a bell crank allows for the sensor to read the angle change. While this works, it is a very difficult location to reach and accurately install the sensor. It also places the sensor on/over a connection that should be lubed at inspection time and I'm not sure that's a good thing for the sensor. After exploring a lot of options and iterating through some design ideas with a friend we came up with the following solution which I am quite happy with. It does not block any controls or lubrication points. It's clear of the baggage shelf and it is easy to fabricate and install. If needed, it can be removed easily or adjusted and most of the components are things you may have around your shop/hangar already. If not, it's not terribly expensive to buy what you need. You can substitute screws and nuts as desired.

The solution consists of a phenolic mounting block tapped to receive 6-32 machine screws. An aluminum bracket is used to mount the sensor to the phenolic block. The arm of the sensor must be extended by about 15mm. This is connected to a pushrod from a model airplane that has a z-bend connecting it to an aluminum tab. That tab is connected to the flap pushrod using an adel clamp. The sensor and block assembly are bonded to the aft bulkhead at an angle that aligns with the general angle of the flap pushrod in its most common positions

5.1.8.1 Phenolic Block and Aluminum Mount

Cut a rectangle of ¼" phenolic sheet approximately 20mmx35mm. This block will get bonded to the aft bulkhead to provide a mounting block for the aluminum bracket. This allows the bracket and sensor to be removed if needed for service or adjustment. Cut a 40mmx65mm rectangle out of thicker aluminum. .040 - .060" thickness works well to provide a rigid mount

while still being easy to work with. Dress the edges of the Bend the aluminum into an L bracket that is about 40mm on one side and 20+ on the other. The bend will take up a few extra mm. This can be done in a bending brake or using a vice if that's all you have. Align the phenolic block with the smaller side of the L bracket and drill two 1/16" pilot holes about 10mm in from the outer edges all the way through the aluminum and the phenolic. Drill out the phenolic with a #36 drill bit and then tap for 6-32 threads. Drill out the Aluminum with a #28 bit to open the holes up enough for a 6-32 machine screw to pass through. On the larger side of the L bracket, mark two holes about 5mm in from what the lower edge of the bracket will be using the Flap sensor mounting holes as a guide. Drill these out with a bit appropriate to the machine screws you'll be using. For 2-56 screws a #42 bit worked well.



5.1.8.2 Sensor Arm Extension

Due to the throw of the flap pushrod, the arm of the sensor must be extended by about 15mm to have adequate range of motion. Cut a small rectangular strip from a thin aluminum sheet. .018-.020" sheet works well. Dress the edges with a file to remove sharp edges and round the corners. Clamp to the sensor arm and drill a #42 hole through the existing sensor arm hole and the extension. Drill a new hole through both the sensor arm and the extension about 7-10mm in from the original hole. Drill one more hole in the tip that will be about 15mm beyond the original hole. Debur all the holes. Mount the extension to the existing sensor arm using a couple of 2-56 screws and nuts. Apply a bit of blue thread locker to each screw prior to assembly.

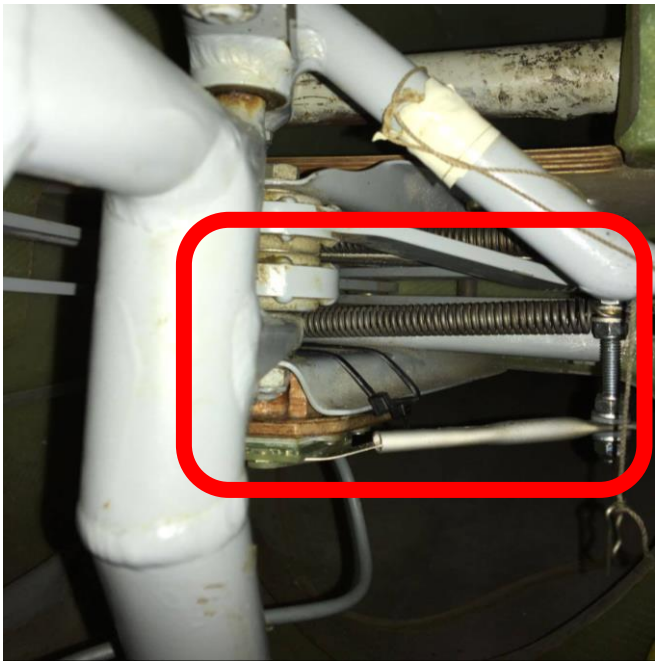
5.1.8.3 Pushrod attachment

Cut a small 10mm x 20mm rectangle from a thin aluminum sheet. Drill a large hole near one end and a small hole at the other. A #42 bit worked for the small hole and the size of the pushrod that I had. You want the hole just large enough to pass the Z bend through the hole without much additional room. The large hole should be enough for whatever size screw you are using. A #8 screw worked with a #24 bit if I remember right. Debur the holes and dress the edges to remove any sharp edges or points. I rounded the ends as well. Install the WDG-9 adel clamp onto the flap pushrod with the "flat" side inboard and the pushrod tab you made on the inboard side. Tighten the nut until the clamp grabs the tubing well but will still allow you to move the clamp around with reasonable amounts of force. Install the RC airplane pushrod into the connecting tab by feeding the Z bend through the tab on the pushrod clamp. The quick connect on the other end of the RC pushrod will connect to the sensor arm.

Temporarily position the sensor on the aft bulkhead using a clamp or double-sided tap. Adjust the angle to align generally with the angle of the flap pushrod near the upper limits of its travel (1-5 flap settings.) Slide the Adel clamp down the flap pushrod until the RC pushrod will position the sensor in the upward direction and connect the quick link. Confirm the angle of the sensor by running the flap handle through its full range of motion from 1 to L. Adjust the angle and position of the sensor as needed to ensure no interference between the components and the internal structures. With the position determined, mark the outline of the phenolic block on the bulkhead with a permanent marker. Rough up the surface of the bulkhead inside the outline of the block with sandpaper. Rough the bonding face of the Phenolic block as well. Bond the sensor to the bulkhead. If using a laminating resin like MGS, thicken the resin with cabosil prior to bonding. Clamp in place while it cures.

5.1.9 ASW20

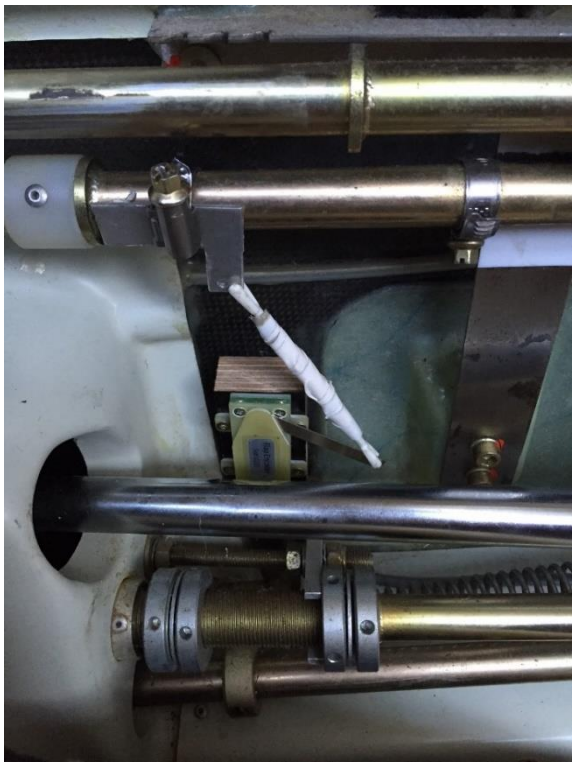

Flap Encoder
#00409



Instructions:

- Replace the bolt that holds the flap springs at the mixer.
- With: M6 x 80 (better is 100mm) 8.8
- Make a bracket for the flap sensor from multiplex as attached.
- Place this bracket centred to the main mixer bolt
- We used a 6mm aluminium tube, wall thickness 1mm to lengthen the sensor arm.
- Formed it in the right shape by heating it slightly.
- Drill a 6mm hole on the flattened side
- This was attached to the 80mm bolt with two self-locking nuts, 2 washers and two Teflon washers.

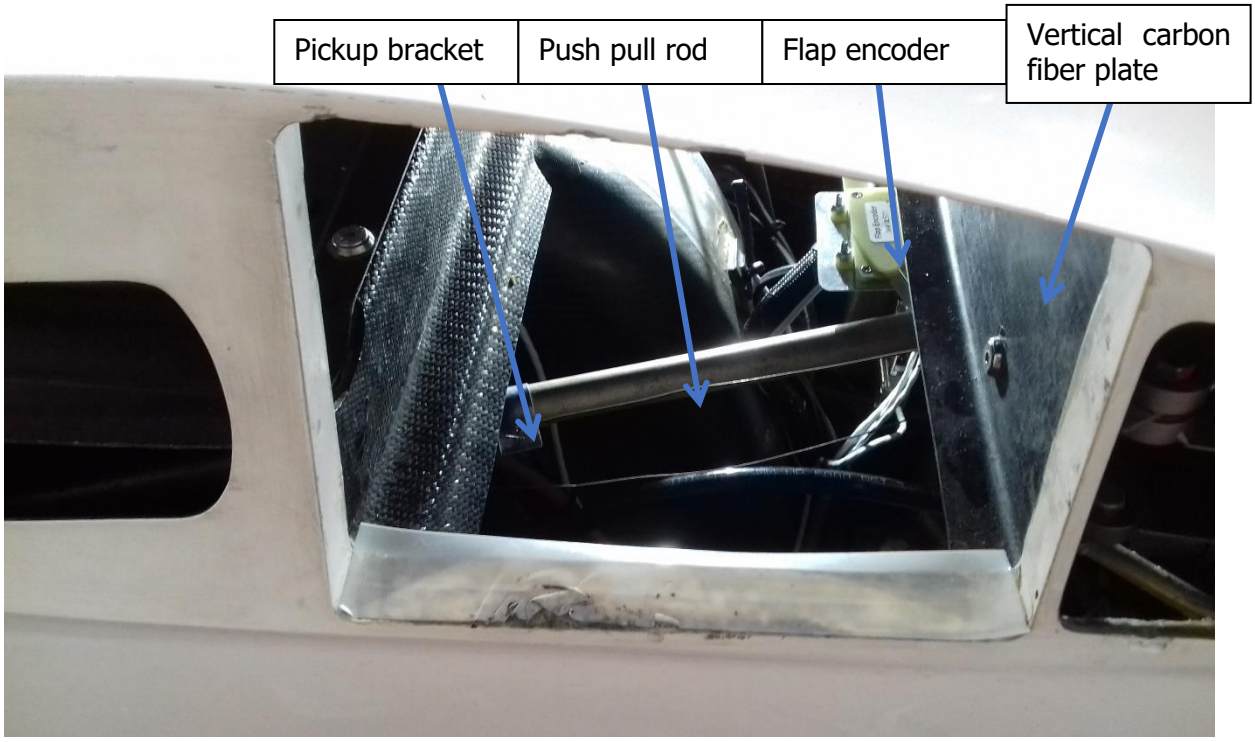
5.1.10 DG800



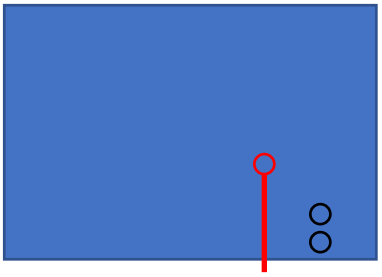
5.1.11 Ventus Ct

5.1.12 Antares

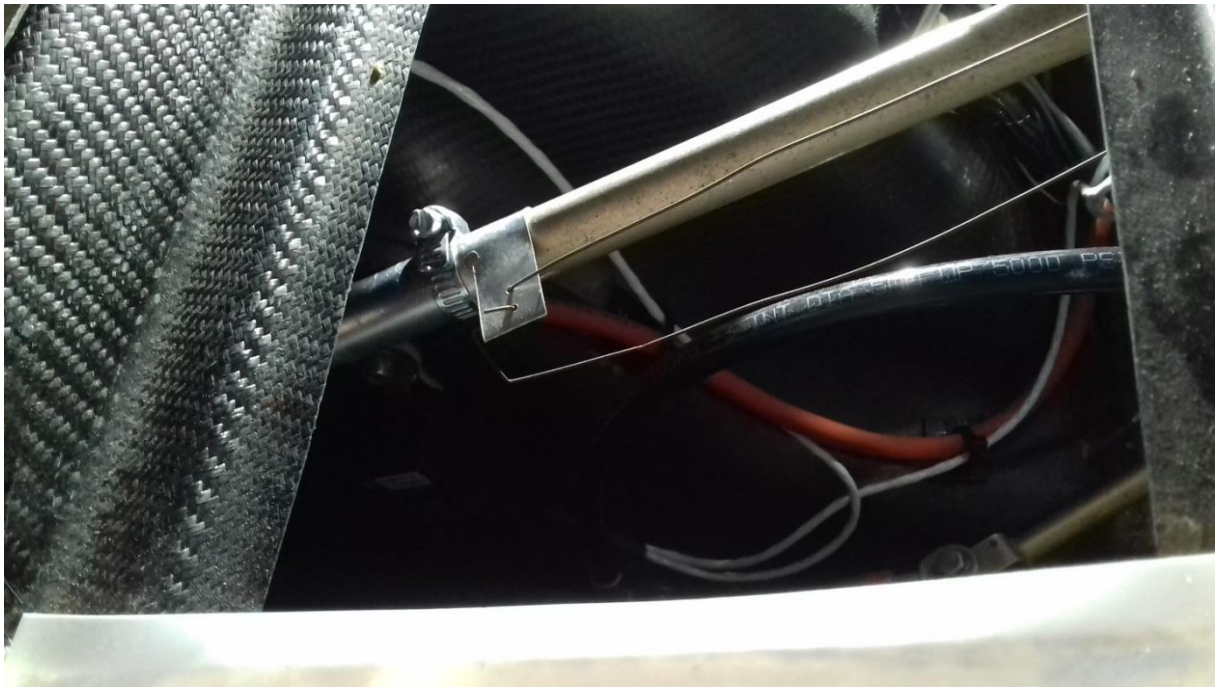
On the left side of the fuselage there is an opening where normally the left-wing spar is inserted. On the bottom of that space, there is a glass fiber plate that can easily be removed. Close by is a diagonal push-pull rod that commands the flap position. On the left side of this rod an aluminum bracket has been mounted that serves as a position pickup point. On the right side there is a vertical carbon fiber plate to which the sensor bracket has been mounted.



The pickup bracket is made from 0.5 mm aluminum plate, and it has the shape a given below. The red circle is a 3 mm diameter hole, and the red line needs to be cut. The black circles are 1 mm holes, roughly 5 mm apart. The area with the black holes remains flat; the rest is pre-bent in cylindrical shape (e.g. around a 15 mm water pipe) before mounting.



The pickup bracket is held in place with a screw-on clamp of nominal 16 mm diameter. See picture below.

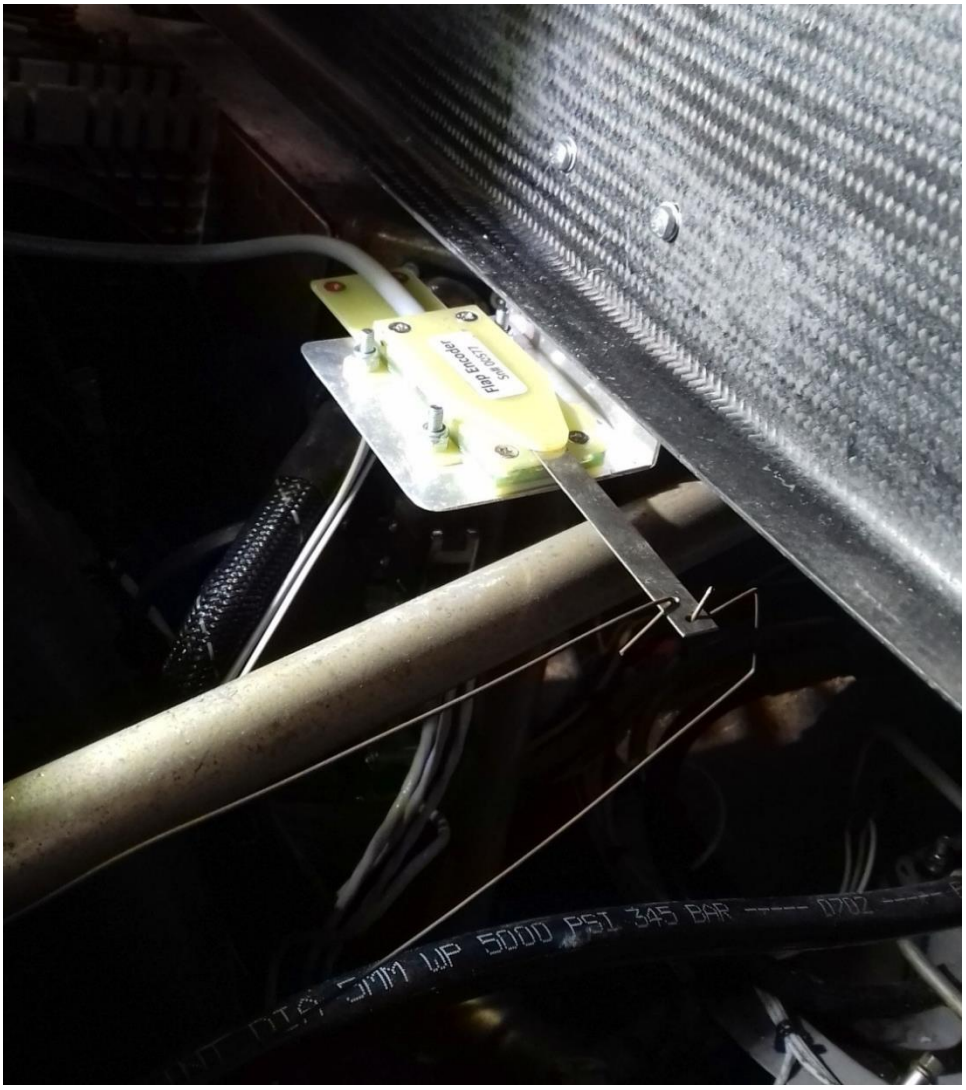


The Flap encoder comes with a pre-drilled hole. Drill an extra hole next to this existing hole. The sensor is then mounted on an L-shaped bracket.

Mounting the L-shaped bracket to the carbon plate is a bit tricky. See last picture below. Drill small holes (3mm) in the carbon plate and use m3 bolts and self-locking nuts (those with a bit of plastic on one end). Choose the height such that the distance of moving part to other objects is maximized (the arm of the sensor moves, and the push-pull rod moves). Bend the L-shaped bracket (to slightly more or less than 90 degrees) such that the arm movement is parallel to the rod so that the distance is constant. If the alignment is not perfect, increase the holes size in the bracket towards the desirable position. Use washers that are sufficiently big to cover the enlarged holes. Temporary fix the washer and nut to the bracket with tape and insert the bolt as shown in the picture. Mounting it in the other direction would be easier but then there will be increased chance of damaging the main spar of the wing.

The connection between the pick-up bracket and the senor arm is done with two thin rods of spring steel. I took 0.6 mm. One rod is straight and of the ideal length, the other one has extra bends and is a slightly too long (5mm). This one need to be compressed a bit to fit. The advantage is that the rod with ideal length will determine the exact distance between the sensor and the pickup bracket. The other rod will apply a pre-tension in the system such that there is no backlash AND such that the spring steel rods cannot fall out. If one of the rods is missing the other could, with sufficient amount of shaking, work its way out.

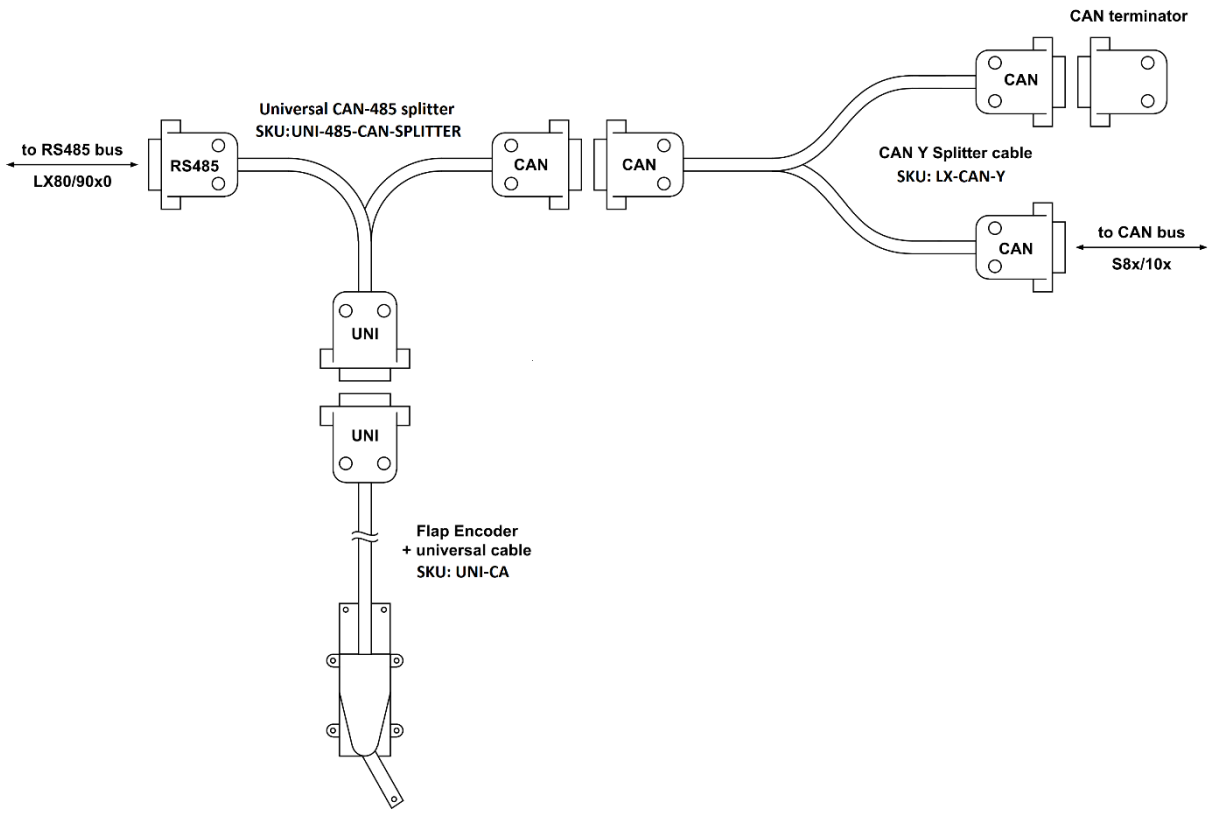
After mounting, the wire end can be bent further to make it even less likely for one of them to fall out (not shown in the picture). This also helps to further increase the distance to stationary parts.



The whole assembly is deliberately made of fragile materials. If anything goes wrong, human force can easily overcome the material strength so that the sensor and the sensor drive connections could get damaged, but without ever compromising the safety of operating the aircraft. Nothing is attached permanently so if there is something in the way for maintenance or upgrades, then that can be accommodated.

5.2 Connecting LXNAV Flap Encoder to communication BUS

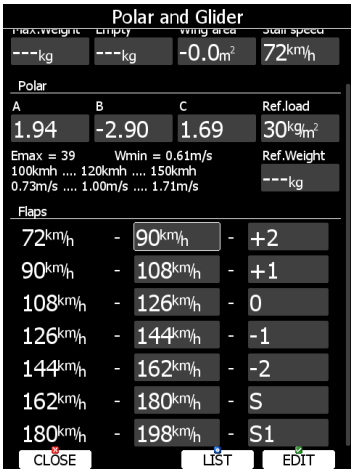
LXNAV Flap Encoder is connected to main unit through RS485 or CAN bus – depends on version and/or communication used.
If the Flap Encoder is version 1 and RS485 compatible then it should be connected to RS485 bus. Similarly to RS485 is CAN, that goes to the CAN bus.
If the Flap Encoder is universal (version 2) then it can be connected either to RS485 or CAN with the same connector. In a case, the glider has both, LX80/90x0 and S8x/10x instruments, the Flap Encoder can be connected to both of them with *RS485 CAN splitter cable*. Example of this connection can be seen in a figure bellow:



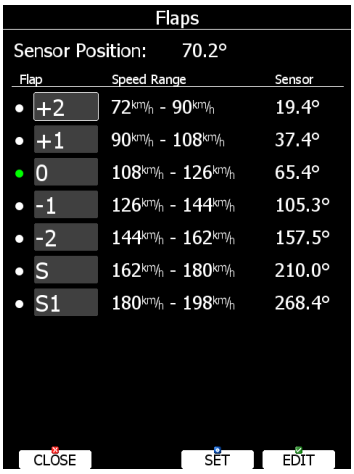
When *RS485 CAN splitter cable* is used, customer must take special care not to connect the connectors to opposite communication protocol. RS485 and CAN connectors have different pinouts and they can damage Flap Encoder, LX80/90x0, S8x/10x or even all of the connected devices.

5.3 Configuration

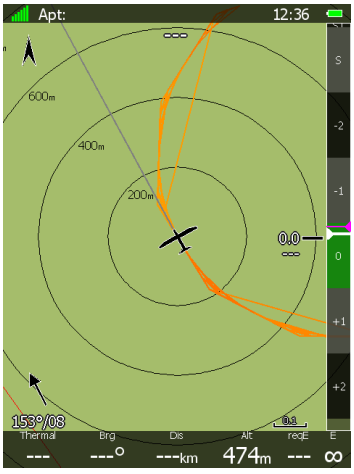
The first step is to enter all flap positions in the LX90XX/80XX. This can be done under the Setup Menu->Polar and the Glider's menu. The information required to complete this step can be found in the aircraft flight manual.



The second step is to program the flap positions under the Setup-Hardware-Flaps menu.



After configuring the flap encoder in the previous steps, the last step is to use LXstyler to display the flap tape on the main screen.



5.4 Updating firmware

Firmware updates can be performed either from the LX80/90x0 or S8x/10x device. Update procedure is similar on both types. In the next chapter is described update procedure via RS485 with LX80xx/90xx.

5.4.1 Updating via RS485 from LX80xx/90xx

Start the LX80xx/90xx and go to the Setup Menu->Password option. Enter password **89891** and press **ENTER**. The LX80xx/90xx will automatically search for an update file. If more than one update file is found, a selection dialogue will appear. Select the appropriate update file, and wait until the update has finished.

6 Cable pinout

- **Version 1 (separated version, either RS485 or CAN)**

Pin	Function
1	RS485-A
4	RS485-B
5	ground
7	power
9	ground

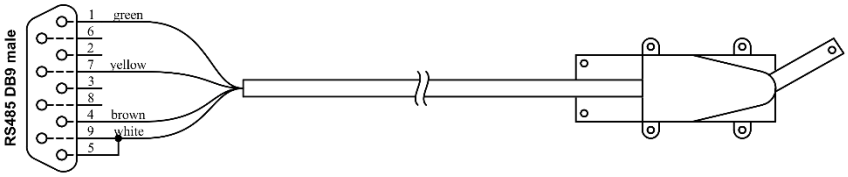


Figure 1: RS485 connector wiring

Pin	Function
2	CAN-L
3	ground
5	ground
7	CAN-H
9	power

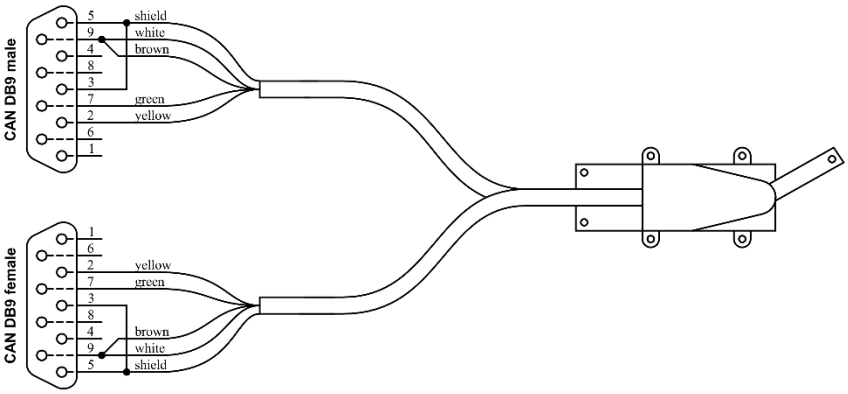


Figure 2: CAN connector wiring

- **Version 2 (universal version)**

Pin	Function
1	RS485-A
2	CAN-L
3	ground
4	RS485B
5	ground
6	power
7	CAN-H
9	power

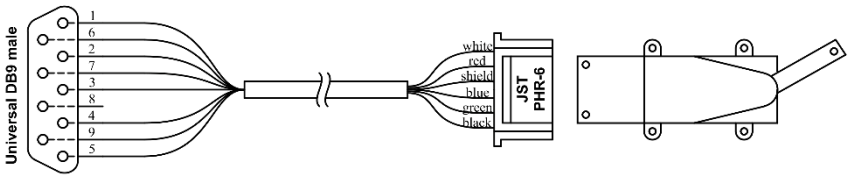
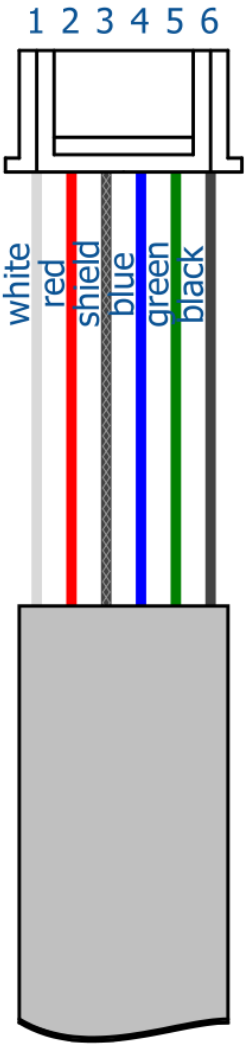
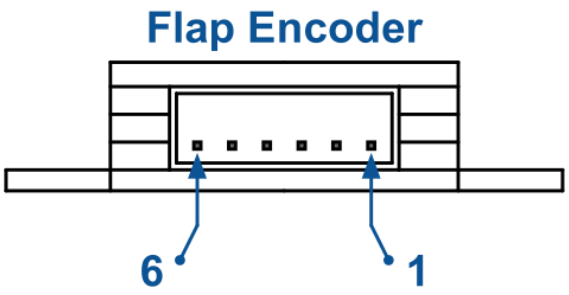


Figure 3: Universal connector wiring DB9





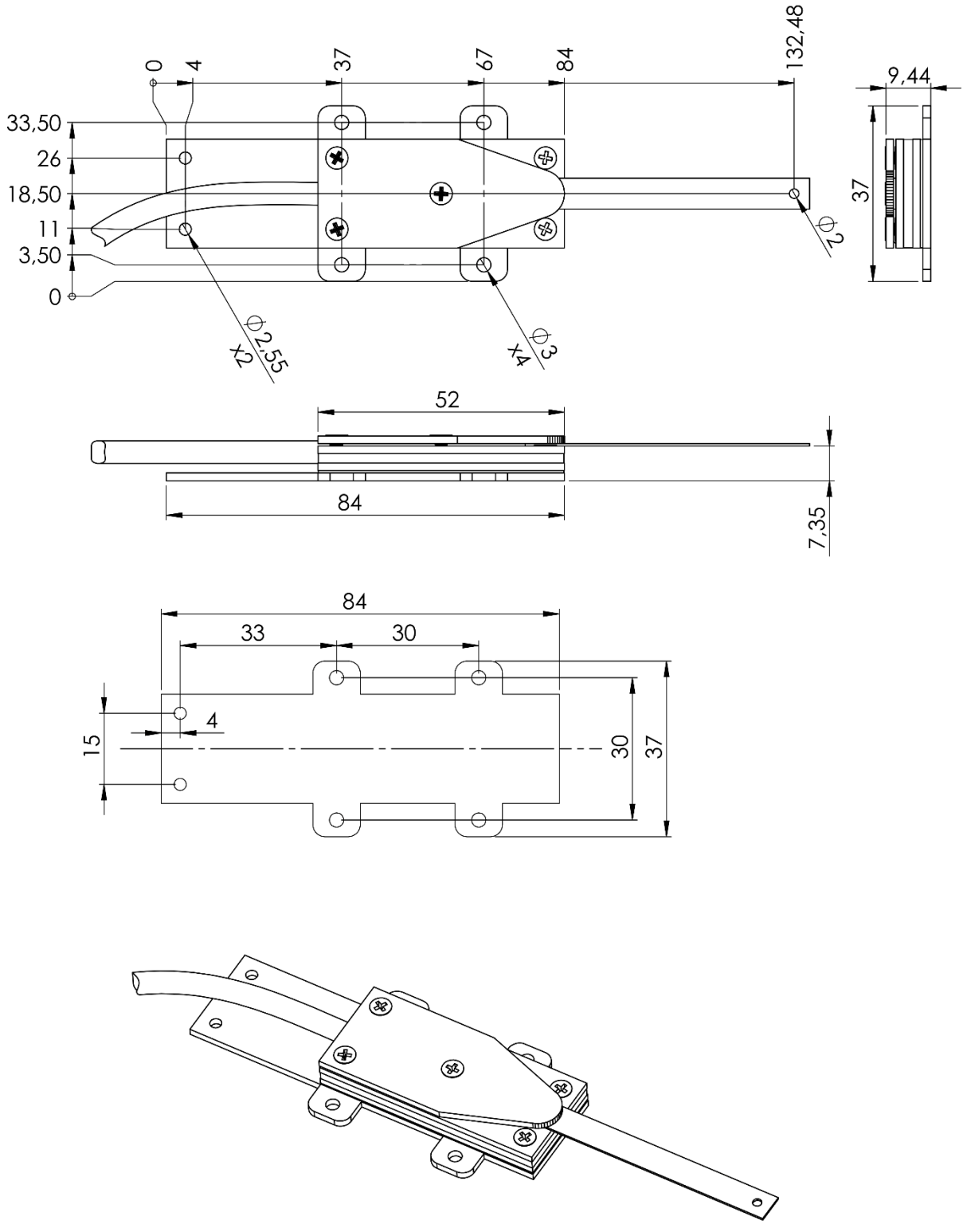
Pinout

Pin	Color	Function
1	white	RS485-B
2	red	RS485-A
3	shield in heatshrink	ground
4	blue	power
5	green	CAN-L
6	black	CAN-H

Cable connector type: JST PHR-6

Drawing is not to scale

7 Dimensions and mounting pattern



Not to scale

8 Revision history

Rev	Date	Comment
1	January 2015	Added installations in DG800, Ventus Ct
2	December 2016	Added installations in ASW20
3	August 2018	English correction done by JR
4	December 2019	Added chapter 7 with dimensions of Flap Encoder
5	July 2020	Added chapter 3.5 (JS3)
6	January 2021	Style update
7	February 2021	Style fix
8	August 2022	Style fix Added chapters: 2, 4, 6 Modified chapters: 3, 5
9	October 2022	Updated chapters 6
10	December 2022	Updated chapter 5.1

The pilot's choice

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