

DG200 15m/17m DG 202

Flight Manual



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II. Modelo DG-200/17. Aprobado el 25 de Febrero de 1.997.

Certificación Original	Certificado de Tipo LBA N° 323 emitido con fecha 18 de Enero de 1.980.
Categoría	Planeador Terrestre Normal (VFR Diurno)
Número de plazas	Una.

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(ver adjunto)

Type certificate data sheet

Type Certificate Holder

Glaser-Dirks Flugzeugbau GmbH
Im Schollengarten 19-20
7520 Bruchsal 4
LBA No. I-B 25

German Type certificate data sheet No. 323 issue: 5
6. Dez. 1984

Sailplane versions:

DG-200
DG-200/17
DG-200/17 C

I. Certification data of the basic design

1. Type: DG-200
2. LBA No.: 323
3. Manufacturer: Glaser-Dirks Flugzeugbau GmbH
Im Schollengarten 19-20
7520 Bruchsal 4
4. Category: U "Utility"
5. Airworthiness requirements:
 - a) Airworthiness Requirements for Sailplanes and Powered Sailplanes, LFSM issued 23.10.1975
 - b) Guideline for the stress analysis of glasfibre reinforced plastic structures for sailplanes, issued March 1965
6. Applicant for type certification: Glaser-Dirks Flugzeugbau GmbH
Im Schollengarten 19-20
7520 Bruchsal 4
7. Date of german type certification: 25. Nov. 1977

II. Engineering description and limitations of the basic design

1. Description: Mono place, self supporting midwing, constructed from GFRP, T-type tailplane, retractable central landing gear, wing flaps, airbrakes on upper wing surface, waterballast.

Span: 15,0 m

2. Equipment:

Required minimum equipment:

1 airspeed indicator (300 km/h) (162 kts)
1 altimeter
1 four piece safety belt and shoulder harness (symmetrical)
1 parachute or a back cushion 4 inches (10 cm) thick

3. Air speed limits:

VNE (never exceeded): 270 km/h 146 kts.
VB rough air: 190 km/h 103 kts.
VA manoeuvring: 190 km/h 103 kts.
VW winch launch: 130 km/h 70 kts.
VT aero - tow: 190 km/h 103 kts.

4. Weights:

Maximum weight:
15 m wing span 450 kg 992 lbs.
Max. weight of the non lifting parts: 250 kg 551 lbs.

5. C.G. Range:

datum: wing leading edge at wing root
leveling line: pattern 1000:36.7 on top of aft fuselage horizontal
most forward C.G.: 9.1 inch 230 mm
aft C.G.: 15.2 inch 385 mm

6. Tow hook:

C.G. position tow hook: Tost SH 72

7. Weak link:

Winch launch and aero tow: 500 + 50 daN
1100 + 110 lbs.

8. No of seats:

1

9. Control surface displacements:

Ailerons at wing-flap setting 0°
up: 42 ± 3 mm 1.65 ± 0.12 inch
down: 21 ± 3 mm .83 ± 0.12 inch
at 123 mm 4.84 inch from hinge line
Elevator
up: 57 + 1 mm 2.24 ± .04 inch
down: 48 + 1 mm 1.89 ± .04 inch
at 150 mm 5.9 inch from hinge line
Rudder
to both sides
243 ± 10 mm 9.57 ± .4 inch
at 460 mm 18.1 inch from hinge line
wing flaps:
setting: - 12°
up: 30 ± 3 mm 1.18 ± 0.12 inch
setting: 0°
0 mm
setting: + 12°
down: 30 ± 3 mm 1.18 ± 0.12 inch
at 145 mm 5.71 inch from hinge line

• III. Operating instructions

1. Aircraft manual DG-200 issued June 1980 (original issue 18.08.1977)
2. Maintenance manual DG-200
3. Operating and maintenance instructions for the release mechanism special release "S 72" and "SH 72" Edition Nov. 1977.

IV. Approved variantes of the basic design

Version DG-200/17

The data for the basic design is applicable with the following modifications:

- I. 7 Date of german type certification: 18. Jan. 1980

II. 1 Engineering description:

As the basic design but with wing tip extensions

wing span: 15 m

with extensions on: 17 m

II. 4 Weights:

Maximum weight of the non lifting parts: 232 kg 511 lbs. for 17 m wing span

III. Operating instructions

1. Aircraft manual DG-200/17 issued June 1980
2. Maintenance manual DG-200/17

Version DG-200/17C

The data for the basic design is applicable with the following modifications:

I. 5 Airworthiness requirements:

3. Preliminary guideline for the stress analysis of carbonfibre reinforced plastic structures for sailplanes and powered sailplanes, issue January 1980 (draft No. 5)

- I. 7 Date of german type certification: 1. December 1980

II. 1 Engineering description:

As the basic design but with wing tip extensions, wings and wing flaps in carbonfibre reinforced plastic construction

wing span: 15 m

wing extensions on: 17 m

II.4 Weights:	Max. weight	15 m span	480 kg	1058 lbs.
		17 m span	450 kg	992 lbs.
Max. weight of the non lifting parts				
		15 m span	240 kg	529 lbs
		17 m span	236 kg	520 lbs

III. Operating instructions

1. Aircraft manual DG-200/17 C issued October 1980
2. Maintenance manual DG-200/17C

V. Amendments and limitations of the certification

For the basic design and all versions:

1. Certified only for industrial production.
2. All external portions of the glider exposed to sunlight must be painted white except of the surfaces for the registration No's and anticollision paint as specified by the manufacturer.
3. Suitable for cloud flying and simple aerobatics as specified in the flight manual.

For the versions DG-200/17 and DG-200/17C:

With 17 m span aerobatics are prohibited.

manufacturer:

Glaser-Dirks Flugzeugbau GmbH
Im Schollengarten 19-20
7520 Bruchsal 4, West-Germany
Tel.: 07257/1071

Aircraft manual for the DG-200/17 sailplane
a variante of the DG-200 sailplane

This manual is to be kept with the sailplane

Serial no:

Year of construction:

Registration No:

Owner:

.....
.....
.....

Issued: June 1980 (original issue November 1979 and
amendment up to June 1980)

The original German Language edition of this manual has
been approved as operating instruction according to
"§ 12 (1) 2. of Luft- GerPO"

Anerkannt durch
Luftfahrt-Bundesamt

25. Juni 1980

Skov



Approval of translation has been done by best knowledge
and judgement - In any case the original text
in German language is authoritative.

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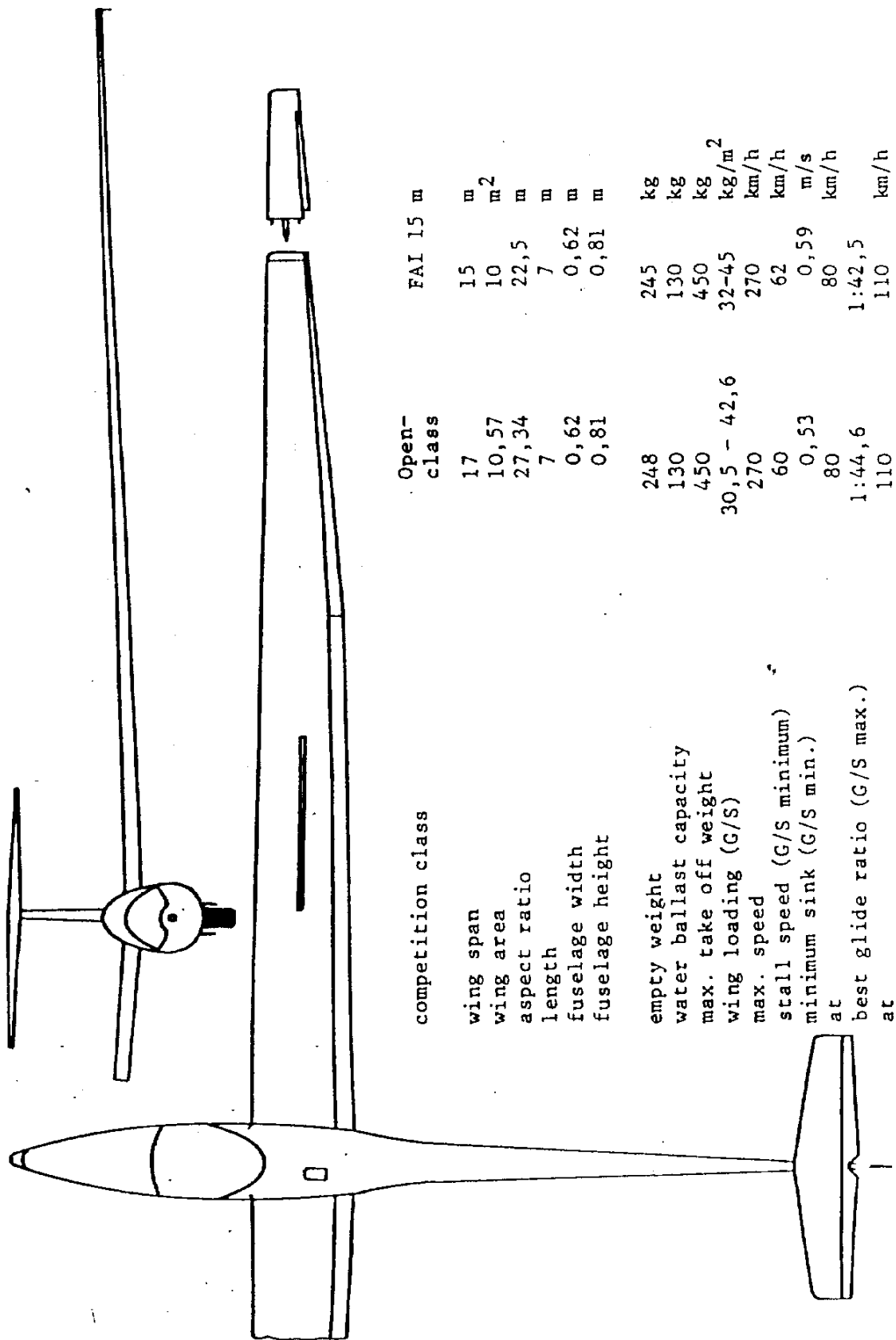
6. Additional

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Further information dealing with Inspection, Maintenance, Repair, C of G, etc. can be found in the Maintenance Manual for the DG-200.

Diagrams

- 1 ballast chart
- 17/2 calculated rate of sink polar DG-200/17
- 3 measured rate of sink polar DG-200 15 m
- 4 Mc Cready polars DG-200



competition class	Open- class	FAI 15 m
wing span	17	15 m
wing area	10,57	10 m ²
aspect ratio	27,34	22,5 m
length	7	7 m
fuselage width	0,62	0,62 m
fuselage height	0,81	0,81 m
empty weight	248	245 kg
water ballast capacity	130	130 kg
max. take off weight	450	450 kg
wing loading (G/S)	30,5 - 42,6	32-45 kg/m ²
max. speed	270	270 km/h
stall speed (G/S minimum)	60	62 km/h
minimum sink (G/S min.)	0,53	0,59 m/s
at	80	80 km/h
best glide ratio (G/S max.)	1:44,6	1:42,5
at	110	110 km/h
certified for simple aerobatics	no	yes

1. General Information

1.1 Three view drawing

1.2 Description

One-Place High Performance Sailplane in the 15 Meter Unrestricted Class, with insertable wing tips for open class flying with 17 m wingspan.

Construction

Wings and Control Surfaces: Fiberglass Foam Sandwich
Roving Spar Flange

Fuselage: Laminated Fiberglass

Landing Gear: Retractable

Tire: 5.00 x 5 362 mm dia.
drum brake

Completely enclosed gear well.

Cockpit:

In flight adjustable rudder pedals and adjustable seat back made for automatic or manual parachute.

Unusually large canopy allowing exceptionally good visibility.

Instruments mounted in a pedestal (easily removable).

Controls for landing gear, wing flaps, dive brakes and trim on the left side.

Parrallelogram control stick for the elevator. This eliminates PIOs in turbulence.

Dive Brakes:

Schempp-Hirth dive brakes on the upper surface.

Tailplane:

T-Tail with conventional stabilizer-elevator and spring trim.

Color:

White, registration numbers gray

2. Operating Limitations

2.1 Airworthiness Category "U" Utility (Airworthiness-requirements LFSM dated 10/23/75).

2.2 Approved Flight Regimes

1. Flights according to VFR (day light)
2. Cloud flying is permitted when properly instrumented (see below)
3. The following aerobatic maneuvers are approved:

Spins

Inside Loop

Stall turn

Lazy Eight

Chandelle

2.3 Required Equipment Airspeed Indicator Range 50-300 km/h 25-165 Kts 30-185 mph. The airspeed indicator is to be connected to the front static ports!

Green arc	90-190 km/h	48-103 Kts	56-118 mph
White arc	82-190 km/h	44-103 Kts	50-118 mph
Yellow arc	190-270 km/h	103-146 Kts	118-168 mph
Redline at	270 km/h	146 Kts	168 mph
Red "I," at	150 km/h	80 Kts	93 mph

Yellow triangle at 90 km/h (recommended approach speed)
48 Kts, 56 mph

Four piece safety belt and shoulder harness (symmetrical)

Altimeter

Automatic or manual parachute or a back cushion approximately 3 inches (8 cm) thick.

Required placards, check lists and this manual.

In addition for cloud flying

Radio

magnetic compass (compensated)

Variometer

Turn and bank or artificial horizon

Experience has shown that the installed airspeed system may be used for cloud flying.

2.4 Airspeeds

	km/h	kts	mph
Maximum permissible airspeed: V_{NE}	= 270	146	168
Maximum permissible in rough air: V_B	= 190	103	118
Maneuvering Speed: V_A	= 190	103	118
Maximum airspeed for flap settings + 4°, + 8° :	= 190	103	118
Maximum airspeed for flaps in landing position:	= 150	80	93
Maximum airspeed for operating landing gear:	= 190	103	118
Maximum airspeed for air tow:	= 190	103	118
Maximum airspeed for winch launch:	= 130	70	81

Remarks:

Rough air is air motion such as wave rotors, storm cloud turbulence, dust devils and turbulence that one often encounters near mountain tops.

Maneuvering speed is the highest speed at which one may give a full control deflection. At maximum airspeed only deflections of up to 1/3 full deflection are allowable.

Attention must be paid to the fact that at higher altitudes the true airspeed is greater than the airspeed indicates.

This fact has no influence on the strength and the aerodynamic loads on the sailplane. But for flutter prevention the following indicated airspeeds are not to exceed:

Altitude in meters	0-2000	3000	4000	5000	6000
V_{NE} indicated km/h	270	256	243	230	218
Altitude in Ft.	0-6600	10,000	13,000	16,000	20,000
V_{NE} indicated Kts.	146	138	131	124	117
V_{NE} indicated mph	168	159	151	143	135

2.5 Maximum G-Loadings

The following G-Loadings are not to be exceeded:

at Maneuvering airspeed V_A + 5.3 - 2.65

at Maximum airspeed V_{NE} + 4 - 1.5

2.6 Weights

Empty weight approx. 245 kg 540 lbs. 15 m
approx. 248 kg 546 lbs. 17 m

Maximum Gross Weight
without water ballast 370 kg 814 lbs.
with at least 90 kg water ballast 450 kg 990 lbs.
maximum weight for the non- 250 kg 550 lbs. 15 m
lifting parts: 232 kg 510 lbs. 17 m

2.7 Center of Gravity Locations

The in-flight center of gravity must lie between
230 mm to 385 mm behind the leading edge of the wing
or 33 % to 55 % of the wing chord.

Leveling fuselage: Slope of rear top surface of
fuselage 100 : 3.67 tail down

2.8 Record of Aircraft Weight

By following the diagram on the next page the center of gravity will be kept within the limits described on 2.7.

Weighed on:				
Mechanic:				
Equipment list dated:				
Empty weight:				
E.W.-Center of gravity behind reference point (leading edge)				
Minimum cockpit load	kg 70	154 lbs.		
Maximum cockpit load	kg 110	242 lbs.		

To determine the empty weight center of gravity and the limits thereof, consult the maintenance manual page 1.

The maximum gross weight is not to be exceeded. With pilots weighing less than 70 kg., the necessary lead ballast must be added on the seat or in the optional ballast holder on the right side of the instrument pedestal. A lack of 3,6 kg (8 lbs) weight can be replaced by a ballast weight of 2,2 kg (5 lbs) when placed in forward holder. Ballast put on the seat must be fastened at the connections of the safety belts so that it cannot slide or move in any way.

Baggage

Maximum 15 kg 33 lbs.

Water Ballast

Each wing tank holds 65 liters or 17.15 gal. USA

The permissible maximum water ballast quantity is dependent on the actual empty weight and the cockpit loading and must comply with the Diagram 1 limits.

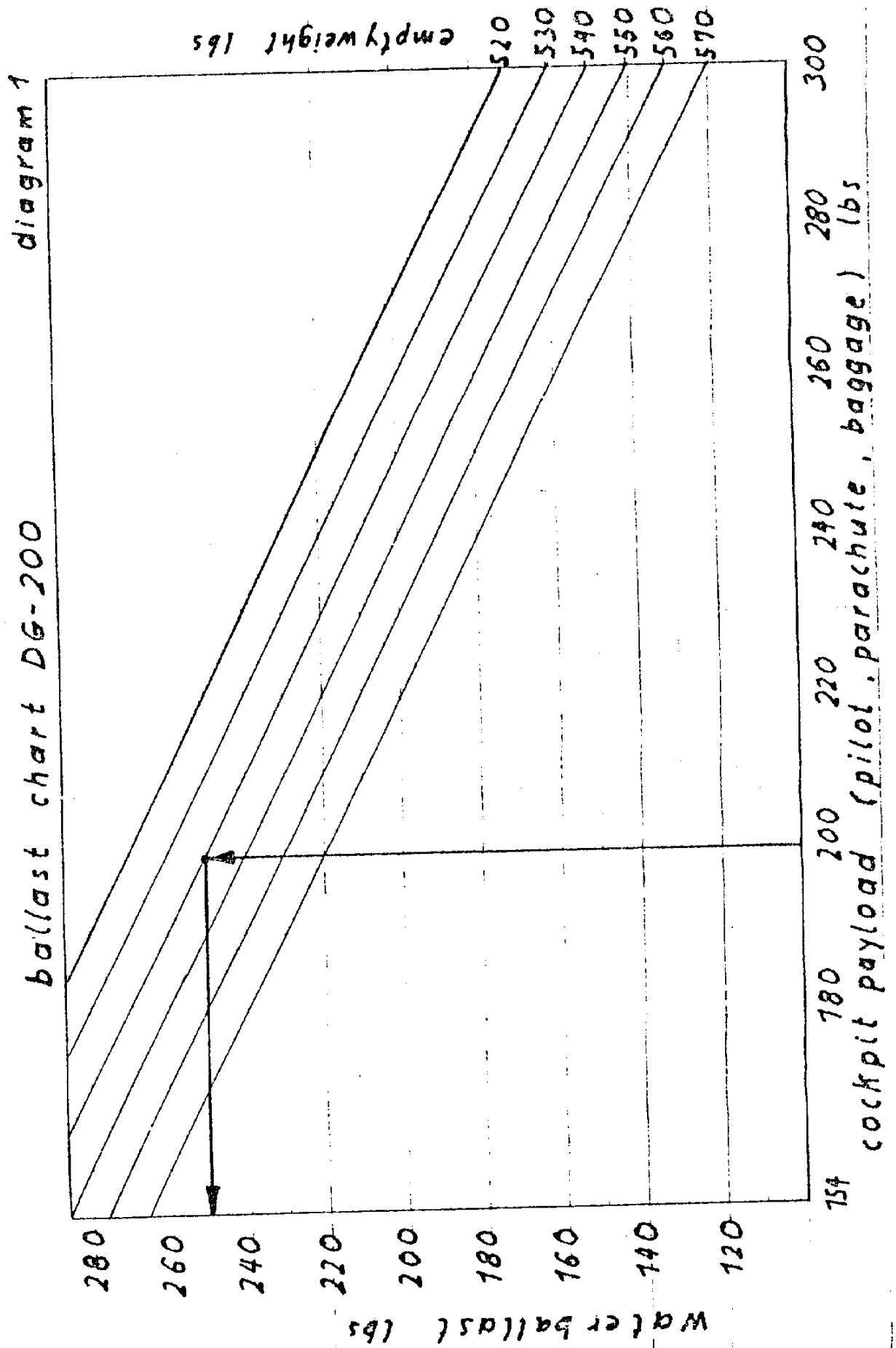
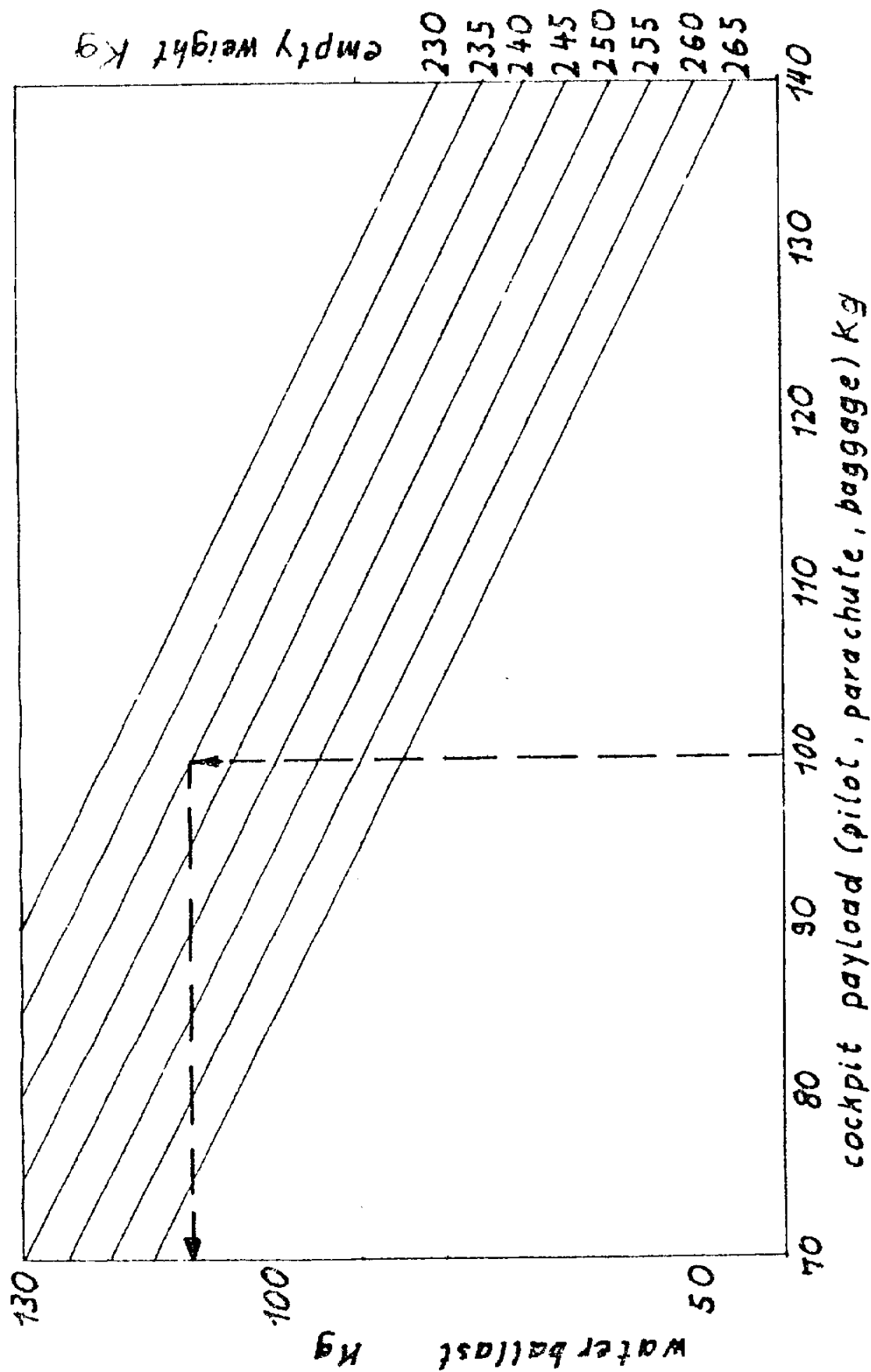


diagram 1a

ballast chart DG-200



2.9 Tow Release

C.G. release: Special tow release SH 72
additionally as an option: Nose release E 85 installed below
instrument console
only for aerotow

2.10 Weak Links

Winch launch and aero tow

5000.+- 300 N
500 +- 30 daN (kp)
1100 +- 66 lbs.

2.11 Tire Pressure

Mainwheel
Tailwheel

3 bar (ATÜ) (42 PSI)
2 bar (ATÜ) (28 PSI)

2.12 Crosswinds

The tested maximum crosswind component according to the
Airworthiness requirements for take-off and landing is 16 km/h 9 kts
10 mph. Use flap setting L 1 for strong crosswind landing.

3. Emergency Procedures

3.1 Spin Recovery

Apply rudder opposite to spin direction, pause, then ease stick forward, after rotation has stopped neutralize the controls and carefully pull out of the dive. The ailerons should be kept neutral during recovery. Pushing the flaps to -12° expedites spin recovery when spinning with positive flap settings. Waterballast in both wings does not influence recovery.

3.2 Canopy Jettison

Bail Out

a) Two piece canopy:

To bail out, open the canopy a few inches and it will be blown open and tear off in the airstream.

b) Single piece canopy:

Open the canopy - opening lever and pull then the emergency release knob.

The low sides of the cockpit allows for a quick push-off exit.

3.3 Recovery from unintentional cloud flying

Spins are not to be used to lose altitude. In emergency, pull out the spoilers fully before exceeding a speed of 190 km/h and fly at 190 km/h (103 kts) (118 mph) until leaving the cloud.

At higher speeds pull out the spoilers very carefully by reason of high aerodynamic and g-loads.

4 Landing with the gear retracted

Even on soft fields the DG-200 can be landed with the landing gear extended. With the stick pulled back during roll out there is no danger of nosing over. Only in the case of an extremely short landing field should the pilot choose to land wheel up.

After a gear up landing the tow release and its cable defectors must be checked for damage. All damaged parts must be replaced before the next take off.

3.5 Rain and Icing

1. Influence of flight characteristics

Rain and light icing raise the stall speed and best landing approach speed slightly. The sink speed is raised remarkable. Otherwise there are no noticeable changes in flight characteristics.

2. Water Ballast

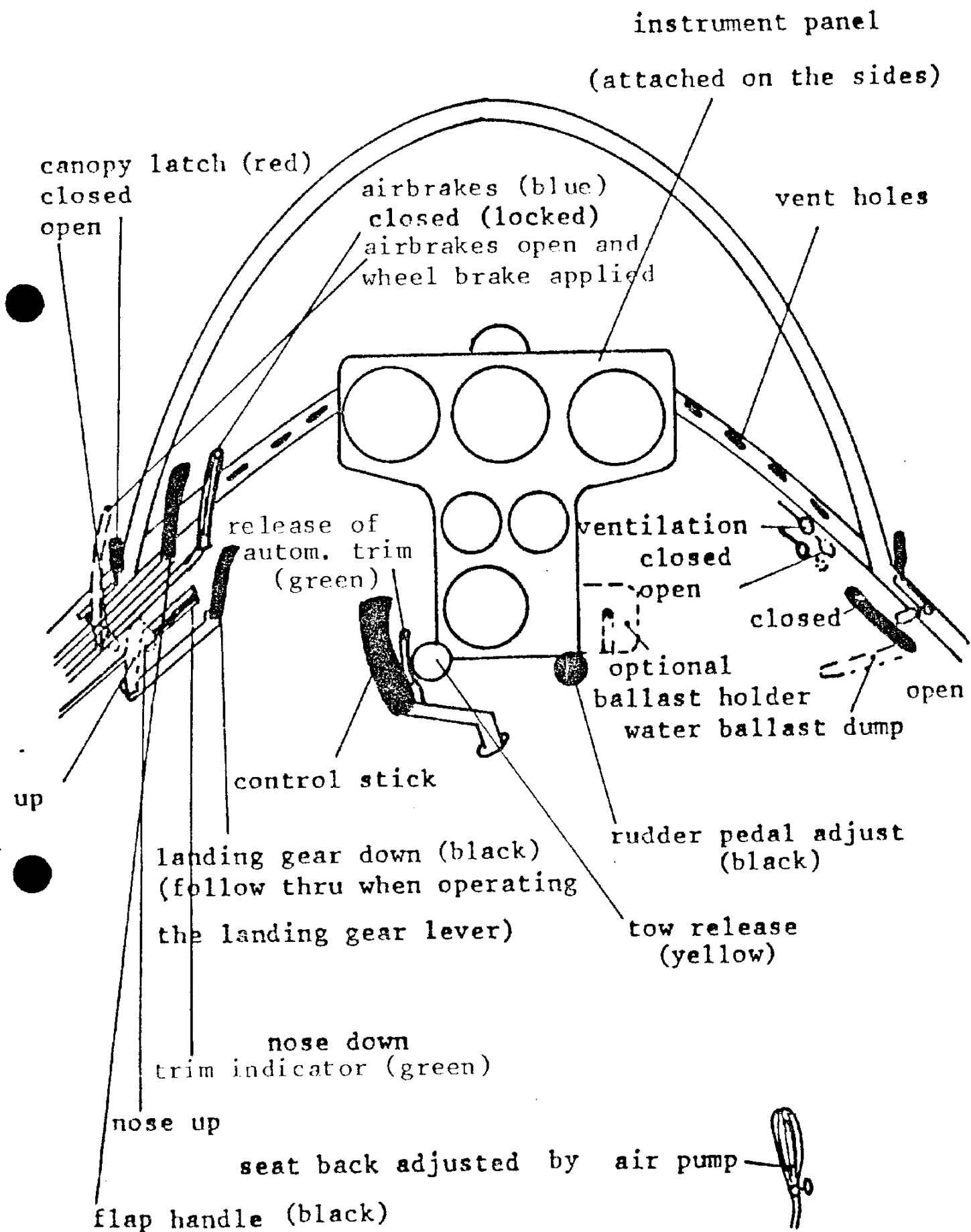
When the OAT outside air temperature dips under 0°C (32° F) there is a danger that the water ballast may freeze. Avoid flying for more than a few minutes with the ballast under 0°C. It must be dumped before possibly freezing and damaging the wings!

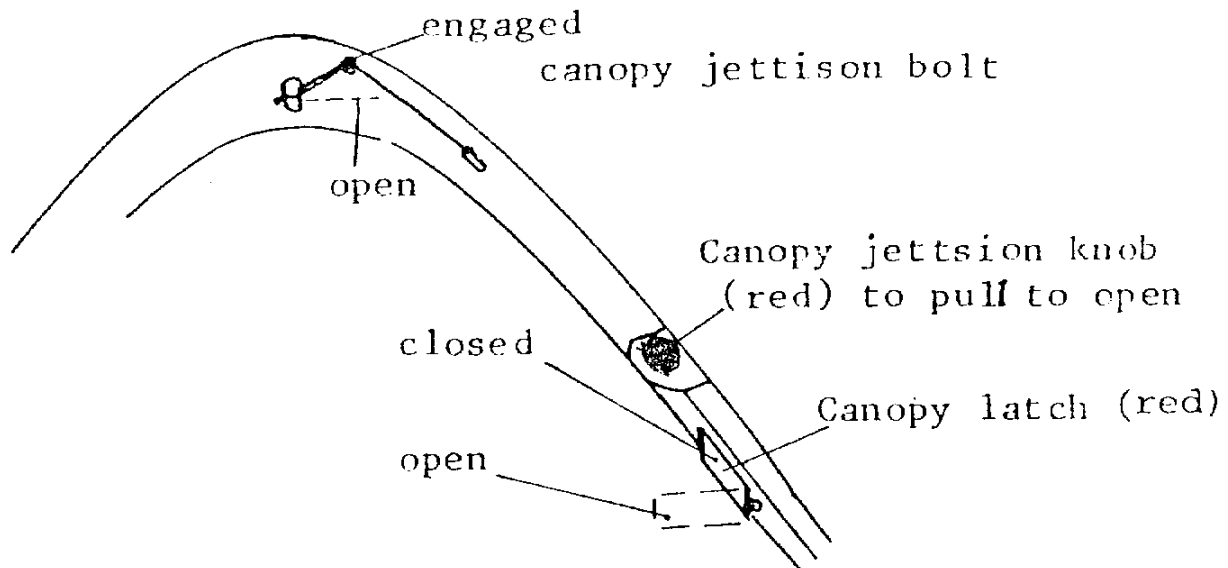
3.6 Landing with only one tank filled

If you suspect, that water did not flow out of one tank, you have to set the flaps to -12° after touch down. Approach should be done with +12° flap setting.

4. Normal operating procedures

4.1 Cockpit and Controls



Single peace canopyCanopy jettison

1. open canopy latch
2. Pull canopy jettison knob

The spiral spring installed in the front hinge will lift the canopy as far as necessary to be blown open by the airstream.

Ground function test of the canopy jettison

Pull canopy jettison knob. The spring must lift the canopy 1 to 2 cm in the front even if the canopy latch is in its closed position.

Reassembly of the canopy

Pull canopy jettison knob to fully opened position. Pull the canopy hinge to its opened position. Insert the jettison spring. Take the canopy, one person in front, one person at the rear.

Attach the canopy on the hinge and press it down. Push the canopy jettison bolt with one hand into its forward engaged position.

Trim:Automatic trim control

To adjust the trim you have to pull the small release handle at the control stick and to place the control stick in the desired position.

When you let go the release handle your aircraft is trimmed to the adjusted control stick position.

Airbrake handle/ Optional parking brake combined with an airbrake securing device (Piggott-hook):Airbrake handle - blue

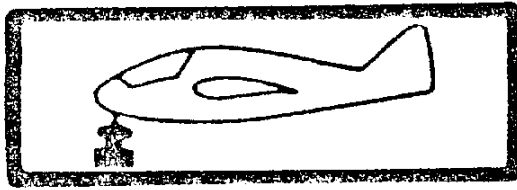
The wheel brake is operated at the end of the airbrake handle travel.

Optional parking brake combined with an airbrake securing device (Piggott-hook):

Pull the airbrake handle back to actuate the wheelbrake and push the handle to the cockpit wall. A detent will engage in one of 4 notches to hold the system in this position.

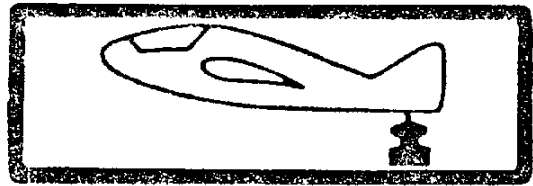
In case the airbrakes mistakenly haven't been locked, a detent engages in one of 4 notches to avoid inadvertent deployment of the airbrakes. To open and to close the airbrakes the operating handle must be rotated into the cockpit so far, that the detent passes the notches.

Cockpit placards

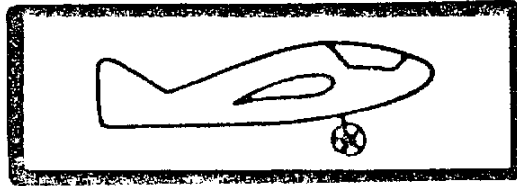


Nose down

Trim

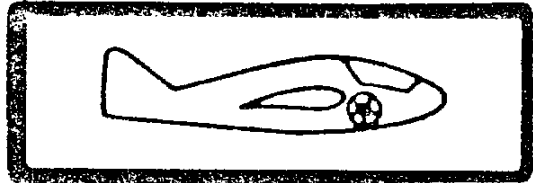


Nose up

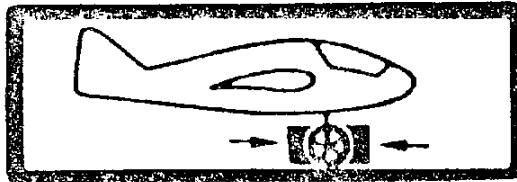


Down

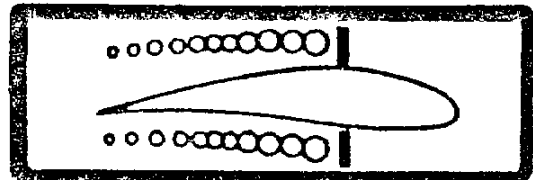
Landing gear



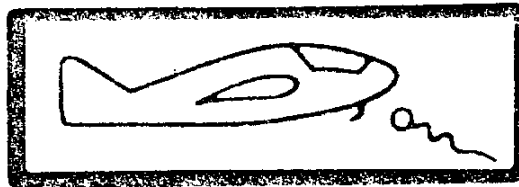
Up



Wheel brake



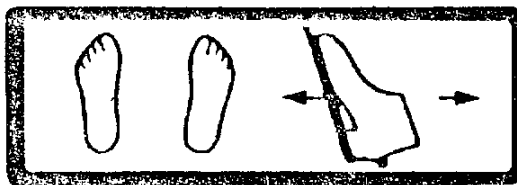
Airbrakes



Tow release



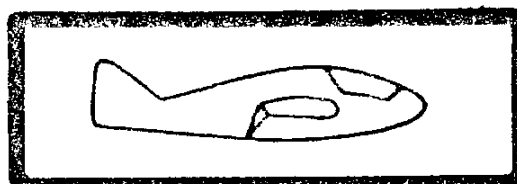
Canopy latch



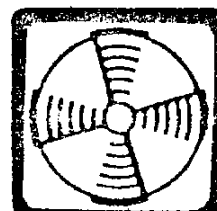
Rudder pedal adjustment



Water ballast dump



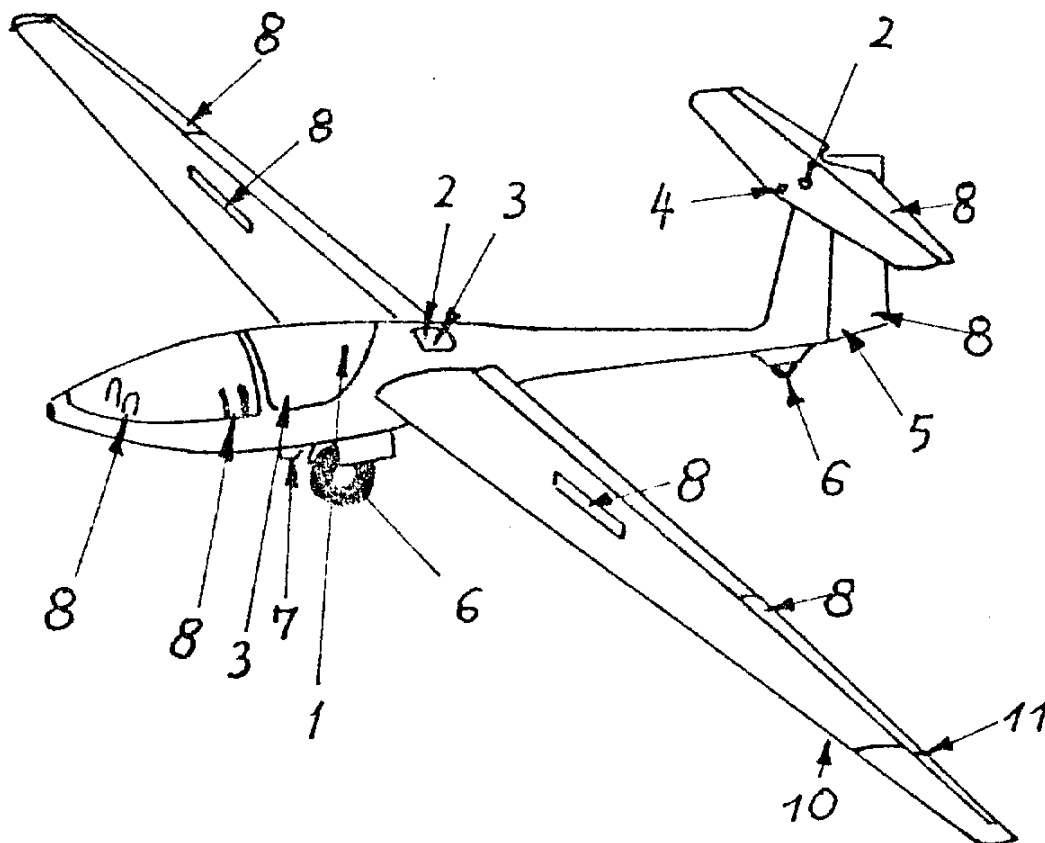
Flaps



Ventilation

4.2 Daily Inspection

1. Are the main wing pins in and safetied?
2. Are the control quick connects properly fastened?
3. Any foreign objects?
4. Is the stabilizer safetied?
5. Check the rudder for hinge play and proper saftycatch.
6. Check the tire and landing gear.
Dirt in the front strut can hinder the landing gear from locking over center the next time!
7. Hook-up check. Is the tow release clean?
8. Check all control surfaces for free movement and play.
9. Look for flaws such as bubbles, holes, bumps and cracks in the surface.
10. Are the insertable wing tips safetied with a split pin?



11. Are the wing tip ailerons connected correctly?

4.3 Cockpit check:

1. Lead ballast (for under weight pilot)?
2. Parachute worn correctly?
3. Pilot seat belts and shoulder harness fastened?
4. Seat back and rudder pedals adjusted?
5. All controls and instruments in reach?
6. Altimeter?
7. Spoilers checked for operation and locked?
8. Flight controls tested? (One man at the controls)
9. Trim set?
10. Canopy properly closed and locked?

4.4 Take – off

The location of the tow hitch in the fuselage centre line, the very effective ailerons and rudder supply ample control to avoid dropping a wingtip and to master a strong crosswind on take off.

Aero-tow:

- a) If only a C.G. release is installed, then the aerotow is to be executed with this release. Set trim full nose down.
- b) If an additional tow release for aerotow is installed, only this release should be used for aerotow. Adjust the trim for aerotow so that the indicator is 2 cm (0.8 in.) behind the forward position.
- c) General: Hold stick in resulting position and at 75-80km/h (38-43kts.) (44-50mph) ease stick back to lift off. On very rough surfaces keep a tight grip on the stick. After attaining safety altitude the landing gear can be retracted with a forceful operation of the gear handle. Normal tow speed is 100-120 km/h (54-65 kts.) (62-75mph). Cruising tow speed is 190 km/h (103 kts.) (118mph).

For starting the roll set the flaps on 0° , reaching the take off speed set $+4^{\circ}$ and keep them there for the remainder of the climb. When towing at higher speeds cross country the flaps may be set on 0° or to reduce drag on -8° .

Winch launch is only allowed at the C.G. release.

Winch launch: Set the trim on full nose down position for a winch launch. Use the normal winch launch procedure (consult SSA Training Manual). After reaching (60 m) 180 ft, gradually pull back some on the stick so that the glider will not pick up excessive speed. Recommended winch launch airspeed is 100-110 km/h (54-60 kts) (62-68 mph) not less than 90 km/h (49 kts) (56 mph) and not more than 130 km/h (70 kts) (80 mph). After reaching release altitude pull the tow release knob (do not wait for the automatic release to function)! Flap setting $+4^{\circ}$ or $+8^{\circ}$ with water-ballast and weak winch.

4.5 In Flight

Thermaling

Use flap settings $+4^{\circ}$ and $+8^{\circ}$ (6.1). Thanks to the long fuselage the DG-200 is directionally very stable.

Uneven lift can be optimized because of the excellent roll rate (45° to 45° in 3 seconds). The DG-200 is docile at slow speeds for centering in thermals.

Stall Characteristics

At stall speed the DG-200 begins to mush, there is no abrupt stall. The ailerons remain effective. Pulling up will induce the DG-200 to stall forward or over one side. A little forward stick and if necessary, opposite rudder will recover the sailplane with minimum loss of height. Rain influences these characteristics negligibly and stall recovery is accomplished without losing more than 40 m (130 ft) altitude.

Stall Airspeeds in Knots

Wing Loading

		flap setting											
lbs ft ²	kg m ²	L			+8			0 ^o			-12 ^o		
		km/h	kts	mph	km/h	kts	mph	km/h	kts	mph	km/h	kts	mph
6.6	32	61	33	38	63	34	39	66	36	41	75	40	47
7.4	36	65	35	40	67	36	42	70	38	43	80	43	50
8.2	40	69	37	43	71	38	44	74	40	46	84	45	52
9.2	45	73	39	45	75	40	47	78	42	48	89	48	55

4.6 High Speed flying: Flap settings 0° , -4° , -8° , -12°

The parallelogram stick configuration adds to the stable flight characteristics of the DG-200/17. It helps reduce the possibility of pilot induced oscillations. The DG-200/17 may be trimmed at any speed up to maximum. At high speeds the stick should be held at all times.

Do not exceed the maximum airspeed of 270 km/h (146 knots) (168 mph).

Do not exceed 190 km/h (103 knots) (118 mph) with the flaps in the $+4^{\circ}$ or $+8^{\circ}$ settings.

4.7 Cloud flying

Take care to fly cleanly. Do not induce a spin as a method for losing altitude in the clouds. In case of emergency, pull out the dive brakes fully before exceeding a speed of 190 km/h and dive at 190 km/h (103 knots) (118 mph) to leave the cloud. Set the flaps on 0° .

4.8 Simple acrobatics Flap setting 0°

Permissible only with 15 m wing span and without water ballast.

Execute only the approved figures. At the recommended entry airspeeds there is no need to pull up abruptly, unnecessarily stressing the aircraft. The following maneuvers are easy to execute.

Approved maneuvers

1. Spins
2. Inside Loop Entry Speed 92 knots (106 knots) 170 km/h
3. Stall turn Entry Speed 92 knots
4. Chandelle Entry Speed 92 knots
5. Lazy Eight Entry Speed 92 knots

Turn

The turn is especially graceful when the pilot uses a touch of aileron along with the rudder deflection to lead into the turn. At the top a little opposite aileron should then be deflected.

Spins

Water ballast in both wings does not influence spin characteristics but increases the nose down pitch during spin recovery. It is not necessary to deploy the dive brakes during spin recovery. The DG-200 shows a very large axial taper after leaving the spin. So you have to level out correspondingly.

Inducing a spin

With the CG position forward or in the middle of the CG limits the DG-200 will not remain in a spin regardless of stick position. Trying to induce a spin in the usual manner will result in a skid or a stall over one wing with the DG-200 recovering after a quarter turn.

With the CG further aft the pilot can induce a spin by the standard method. Inducing the spin: gradually bring the sailplane into a stall. When it starts to burble, pull the stick back completely and kick in full rudder in the spin direction.

Recovering from the spin:

Opposite full rudder, pause, then ease stick forward, after the spin has stopped neutralize the controls and carefully pull off excess speed. Pushing the flaps to -12° expedites spin recovery when spinning with positive flap settings.

4.9 Approach and Landing: Flap setting L 1 (12°)

Flap setting L 2 (16°) for very large angle of approach. It is recommended to jettison all water ballast before landing. In calm weather, approach at 90 km/h (48 knots) 56 mph. The very effective Schempp-Hirth dive brakes make a short landing possible. The DG-200 side slips well and the side slip may be employed as a landing technique, but is not necessary. While slipping the rudder is succed in its displaced position. So it is recommended to train the slip at higher altitudes. Strong crosswinds offer no problem, the use of flap setting L1 is recommended. In windy weather increase approach speed by 1/2 wind speed. When flaring out keep the airbrakes setting you were using, opening them further may drop the sailplane.

Clean the landing gear and tow release after landing in a muddy field. Dirt in the front strut can keep the landing gear from locking over center next time.

Simply hosing with water is the best cleaning method.

4.10 Using Water Ballast

A few tips for optimizing the wing loading.

No water: When the average rate of climb is under 1 m/sec (200 fpm) or in extremely weak weather and evening thermals.

Approx. 16 gallons 60 ltr. water:
When the average rate of climb is approx. 2 m/s (400 fpm).

Maximum water ballast:

When the average rate of climb is 3 m/sec (600 fpm) or more. Do not exceed the maximum gross weight when loading the water ballast. The maximum quantity of water allowed is dependent on the empty weight and the cockpit load. It must concur with Diagram 1.

Level the wings when filling the water tanks.

In flight the water drains at approx. 1 ltr/sec (2 lbs./sec). By timing the jettison the pilot can lighten the DG-200 as he needs. There is a danger of freezing water should the outside air temperature go under 32°F (0°C). Dump the ballast in time. Water ballast raises the approach speed, so it is recommended to dump the water before an incumbent out landing.

If you suspect a tank is leaking dump the water immediately.

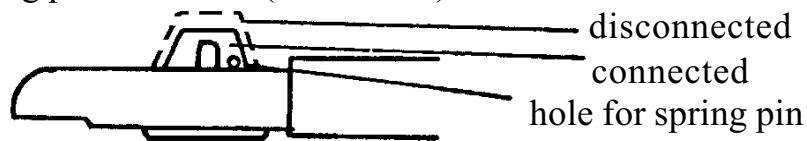
If you suspect, that water did not flow out of one tank, you have to set the flaps to -12° after touch down. Approach should be done with +12° flap setting.

5. Assembly and disassembly

5.1 Assembly

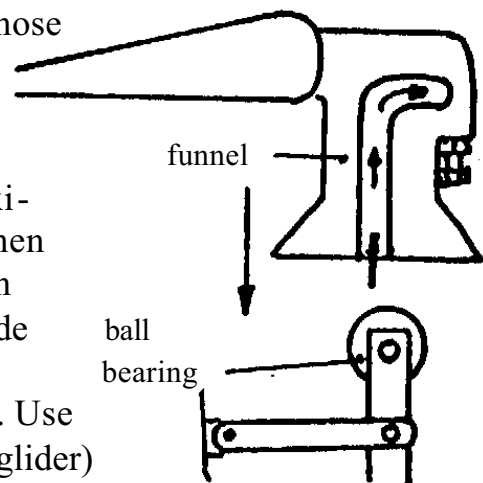
1. Open the canopy and open the access cover with a screwdriver.
2. Clean and lube the pins, bushings and the ball ends of the control rod quick connects.
3. With a helper on the wingtip, lead the wings into place. Sight thru the wing main pin bushings to determine alignment. Push the main pins in as far as possible. Turn the handles up to the fuselage wall. Therefore pull out the white securing knob. Set the knob back in its locking position. The wing flaps connect automatically. The best method for rigging is to set the flap handle on 0° and to hold the flap in the 0° position.
4. Connect aileron and spoiler controls. Spoilers are best connected in the closed but not locked position. To check the quick connects, insure that the sliding latch has returned as far as it can locking the ball end in place.

The hole must be visibly. It is recommended to fit a diameter 1 mm spring pin in the hole (500 30 771)



Attach the cover plate.

5. Rigging of the stabilizer with the automatic elevator control self connection mechanism. Set the trim nose down. Set the stabiliser on, so that the ball bearing at the fuselage side push road is inserted into the funnel at the elevator. Look through the plexi-glas disc to watch the procedure. When stabilizer is set down laying on the fin push it back. The ball bearing will slide forward in the funnel if you will hold the elevator in the pertinent position. Use an 8 mm wrench (supplied with your glider) to tighten the front mounting bolt. Turn it so that the securing spring engages into the slit of the bolt.
6. Control check..... Check tire pressures (3 bar 42 psi main, 2 bar 28 psi tailwheel). Check instruments.



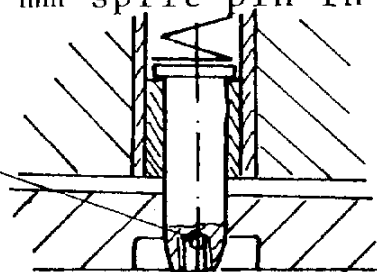
A. Rigging of the 17 m insertable wing tips

1. Disassemble the small 17 m wing tips. Use a $\varnothing 6$ mm pin for pressing in the locking pin on the wings bottom side.
2. Insert the 17 m wing tip into the wing. Press in the locking pin with your finger. Insert the wing tip as far as the aileron connector starts to slide into the ailerons slot.

Push the wing tip in vigorously, thus the locking pin engages.

If the locking pin will not engage, you can screw a M 3 screw into the pin to pull the pin out.

It is recommended to fit a $\varnothing 1,5$ mm split pin in the hole of the locking pin.



B. Disassembling of the wing tip

This has to be done analogous to the small 15 m wing tips.

The rigging of the small 15 m wing tips has to be done analogous to the 17 m wing tips, but no split pins have to be fitted in the locking pins.

5.2 Filling the Water ballast tanks

For filling the Water ballast pull back the lever (top-right tank, bottom-left tank) in the cockpit.

Place one wingtip on the ground. Attach the hose connection in the water outlet on the undersurface of the wing.

Fill with the desired amount of water, remove the hose and close the valve with the water ballast lever. Place the other wingtip on the ground and fill the other tank.

In case the valve leaks slightly, apply some grease to the valve surfaces.

After filling the tanks, check to see if the wings are balanced. If one wing is heavy, release enough water to balance the wings.

5.3 Tie Down, parking

There are holes in the wingtip skids for securing the sailplane. The fuselage should be tied down just ahead of the fin. Water ballast can be left in the wings, for short period storing.

On sunny days the cockpit should be covered. The magnifying glass effect of the canopy can overheat the simulated leather interior and possibly burn it.

5.4 Disassembly

Drain the water ballast. Disassembly follows simply in opposite order of assembly.

5.5 Trailering

It is recommended that this valuable fiberglass sailplane be carried in a factory approved trailer.

Approved fitting points:

- Wings:
1. Wing spar as close to wing root rib as possible or a rootrib wing cradle.
 2. A wing cradle where the aileron begins.

Stabilizer: Cradles as desired.

- Fuselage:
1. A felt lined fiberglass nose cap that does not extend over the canopy.
Secured to floor.
 2. Fuselage dolly in front of the tow hook or a support attached to the lift pins ϕ 16 mm (use plastic or brass bushings).
 3. Tail wheel well in trailer floor.
Secure fuselage with a belt in front of the fin or a pin thru the hollow tail wheel axle. Pin ϕ 8 mm.

5.6 Service and Care

You have chosen a sailplane made of fiberglass which, though elegant, is enormously strong and robust.

A few tips for care of the surface:

- o Wash the surface only with clear water using a sponge and chamois.
- o Never use gasoline, alcohol, or thinner for cleaning.
- o Do not use detergent too often.
- o The surface may be polished as often as desireable. When using a power buffer, care must be taken that the surface is not overheated.
- o This sailplane should be protected from moisture just like other sailplanes.
- o The surface should be protected from intense sunlight (heat) and ballast should not be retained for extended periods.

Intentionally Blank

6. Additional6.1 Proper use of flaps

To maximize the DG-200's performance, the flaps should be operated accordingly.

Flapsetting

L 2 (16°) for steep landing approach

L 1 (12°) for normal landing

+ 8° Thermaling in narrow lift and high wing loading

+ 6° Normal thermaling

+ 4° thermaling in narrow lift and airtow

0° Maximum LD flying

- 8° Fast cruising

- 12° High speed flying (ie Start & Finish gates)

Calculated performances

Wing-loading	kg/m ²	32	36	40	45
min. sink	m/s	0,57	0,6	0,62	0,66
at	km/h	73	79	83	89
best glide	ratio	1:40,3	1:41	1:41,5	1:42,1
at	km/h	100	106	112	118
Wing-loading	lbs/ft ²	6.6	7.4	8.2	9.2
min. sink	ft/min	112	118	122	130
at	kts	40	43	45	48
	mph	45	49	52	55
best glide	ratio	1:40,3	1:41	1:41,5	1:42,1
at	kts	54	57	61	64
	mph	62	66	70	73

A deviation in airspeed of ± 3 km/h (± 6 kts, ± 7 mph) from the given limits reduces the optimum L/D approx. $-.5$ and the minimum sink 2 ft/min (1 cm/s).

Diagram 2 is a rate of sink polar. The competition pilot should set up the DG-200 with the CG near the aft limit. This enhances thermalling performance, but be prepared for some pitch sensitivity.

Of course the wing fuselage gap and the stabilizer bolt should be taped. The sailplane must be clean to obtain the performance shown in diagram 2. Dirty surfaces and / or rain reduce flight performance.

6.2 Maintenance

Before every assembly all fittings should be cleaned and lubricated. Every 3 month all the bearings and hinges should be cleaned and greased, see the greasing program sect.7 of the maintenance manual. Also the emergency release of the single piece canopy should be greased and checked. At the annual inspection all displacements, weights, adjustments and general condition must be checked. See maintenance manual.

6.3 Repair

Minor damage may be repaired by a licensed airframe mechanic. Advises see DG-200 maintenance manual. Don't do any repairs without considering the maintenance manual!

6.4 Tow release

C.G. release: To be serviced as detailed in "SH 72" and "S 72" manuals, issued Nov.1977, LBA-approved.

and if installed:

Operating Manual for Tow Releases

Series: E 85 Nose Tow Release

Date of Issue: March 1989

6.5 Maximum total service time and concerning inspections

see maintenance manual section 6.

6.6 Performance polares

The rate of sink polars of the DG-200 were measured by the DFVLR.

These curves are plotted in Diagramm 3. The following air-speed (kts) ranges have been shown optimal for the various flap settings.

		km/h				
Wing loading	kg/m ²	32	36	40	45	
flap-setting	+ 8°	-75	-30	-85	-90	
	0°	75-95	80-100	85-105	-110	
	- 4°	95-140	100-145	105-155	110-160	
	- 8°	140-150	145-160	155-170	160-180	
	-10°	150-170	160-180	170-190	180-200	
	-12°	more than 170	> 180	> 190	200	

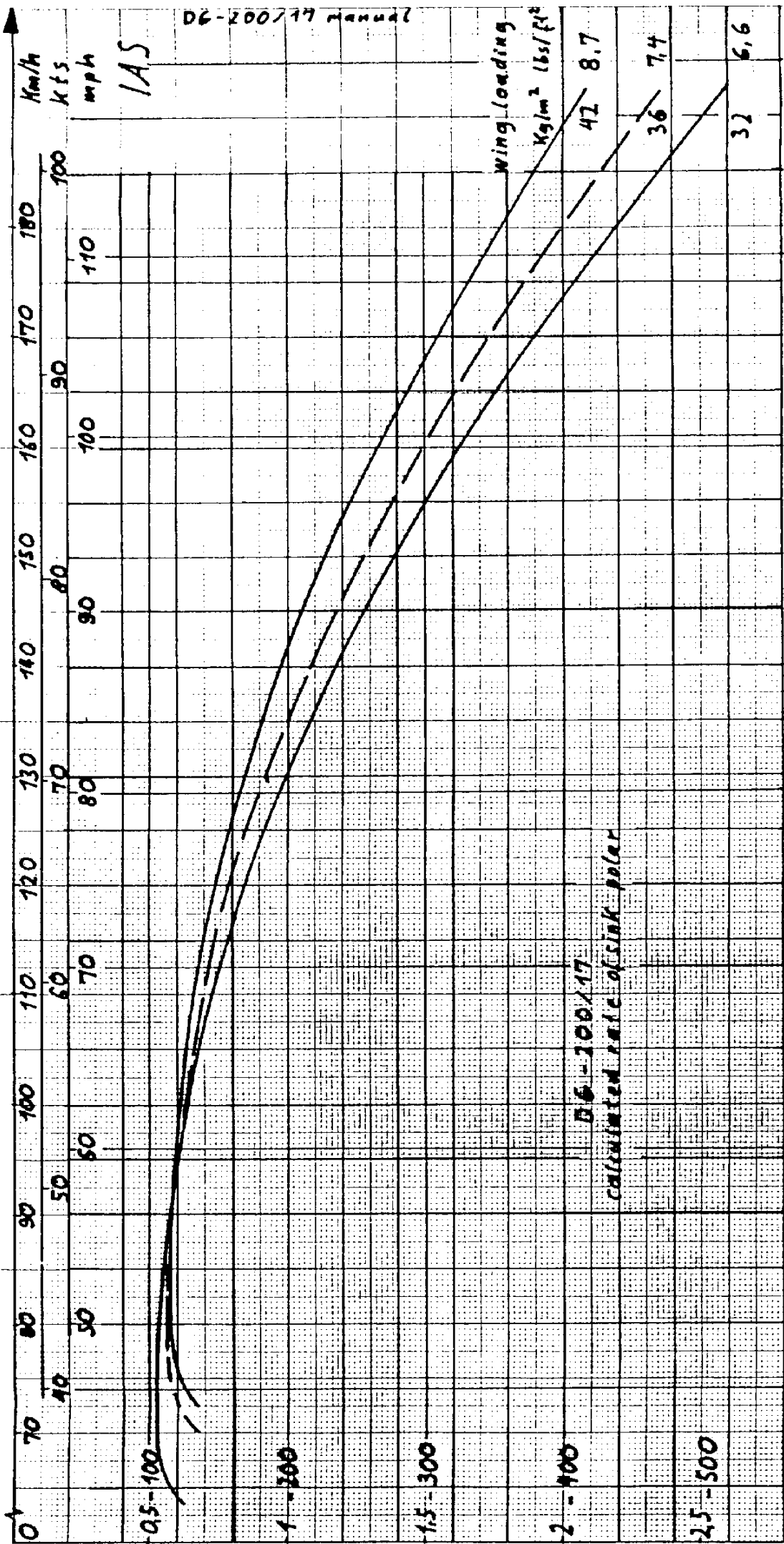
		kts				
Wing loading	lbs/ft ²	6,6	7,4	8,2	9,2	
Flap-setting	+ 8	- 40	- 43	-46	-49	
	0°	40 - 50	43-55	46-57	49-60	
	- 4°	50 - 75	55-78	57-84	60-86	
	- 8°	75 - 90	78-86	84-92	86-97	
	-10°	80 - 92	86-97	92-103	97-108	
	-12°	> 92	> 97	> 103	> 108	

		mph				
Wing loading	lbs/ft ²	6,6	7,4	8,2	9,2	
flap-setting	+ 8	-47	-78	-53	-56	
	0°	47-59	78-62	53-65	56-68	
	- 4°	59-87	62-90	65-96	68-99	
	- 8°	87-93	90-99	96-106	99-112	
	-10°	93-106	99-112	106-118	112-124	
	-12°	> 106	> 112	> 118	> 124	

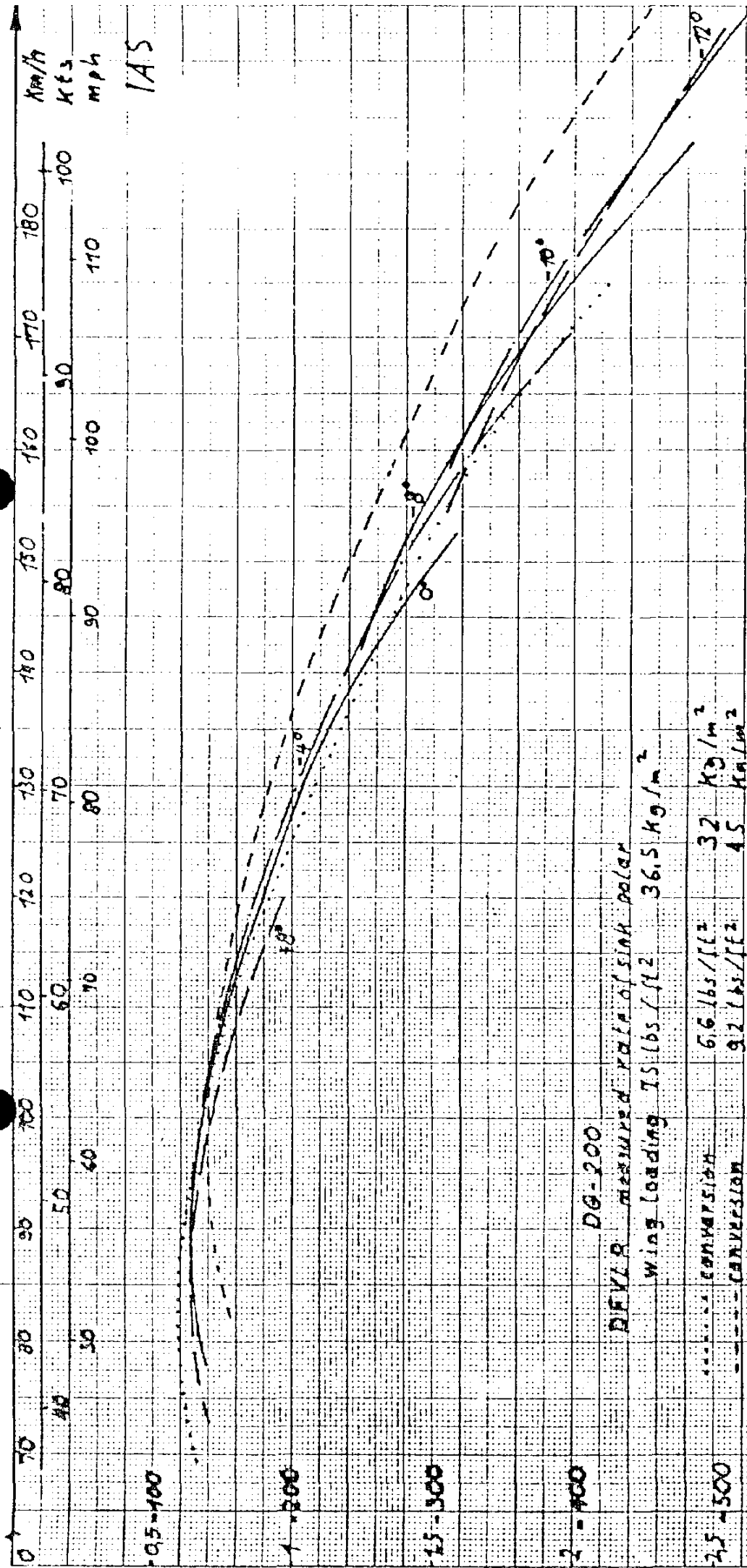
To accelerate or flatten out use always flaps and elevator simultaneous.

Set the flap earlier in its position as for the speeds listed above because flatten out raises the wings loading and speeding up lowers it.

Set the flaps earlier as higher the g-loads. Flatten out with 1.5 g or speeding up with 0,5 g changes the optimal speed approximately 15 km/h (8kts) (10 mph) at low speeds and 30 km/h (16 kts) (20 mph) at high speeds.

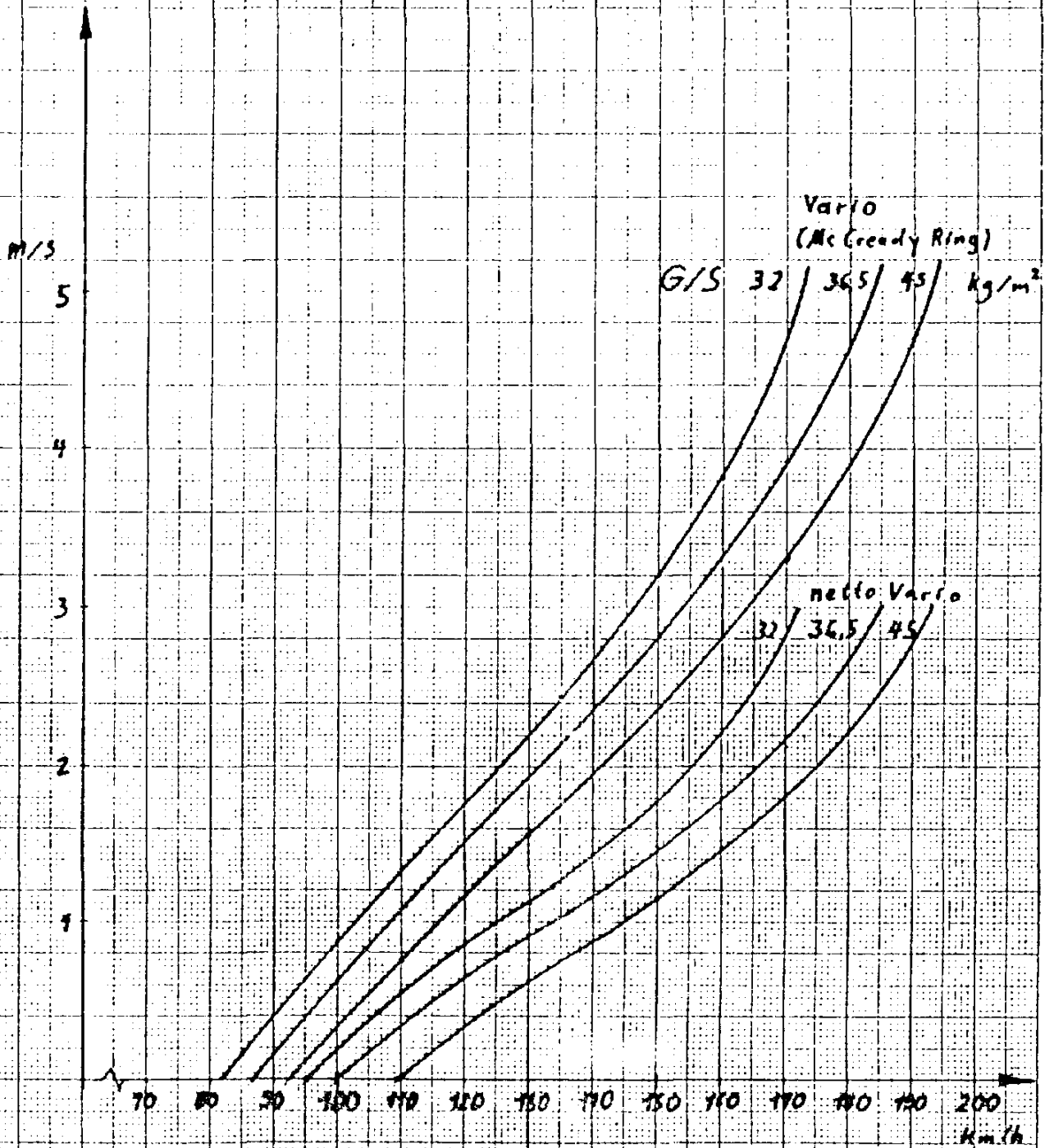


06-200/17
calculated rate of sink polar



Flughandbuch Diagramm 4

manual
diagram 4



McCready Kurven für die DG-200

McCready polars

DG200 15m/17m
DG 202

FLIGHT INSTRUMENTS



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DG200 15m/17m
DG 202

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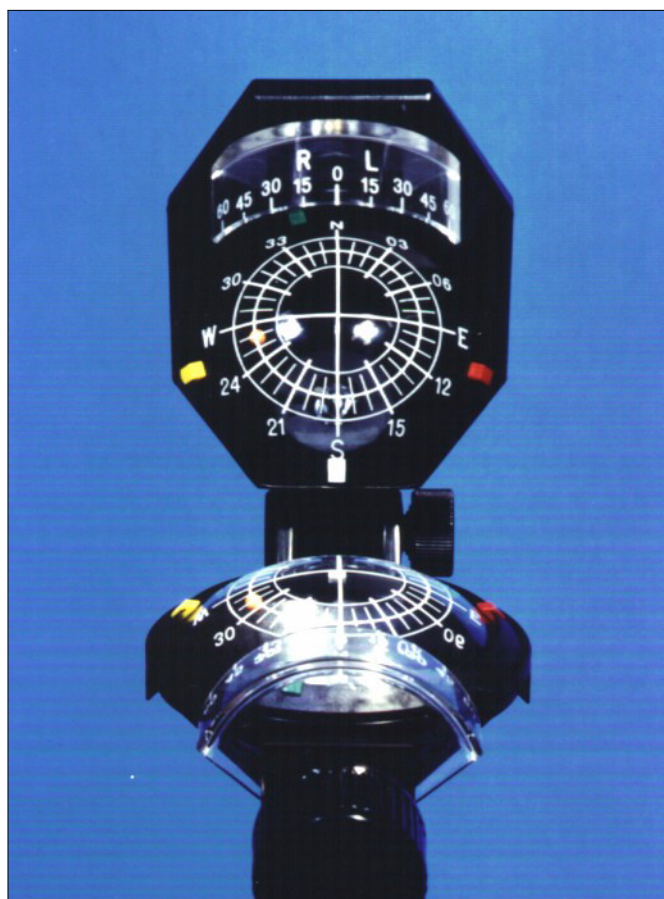
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Magnetische Messuhrhalter und Spannplatten
Instrumenten- und Bremsmagnete
Kleinst- und Miniaturmagnete
Segelflugzeugkompass und -Variometer

BOHLI COMPASS 46-MFK-1



Description

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Installation

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Description

Bohli compass for aerial navigation

A device, using the magnetic field of the earth for directional orientation, has been known in China as far back as 2000 B.C. It originally consisted of a magnetic iron splinter, floating on top of a small piece of wood in a water container. Added was a miniature human figure pointing South with an outstretched arm.

Similar designs of water compasses were used right into the Middle Age. They were improved for more accurate reading by painting a compass-rose onto the floating wooden disc and by centering the same with a pin. This type of instrument was known to all seagoing people.

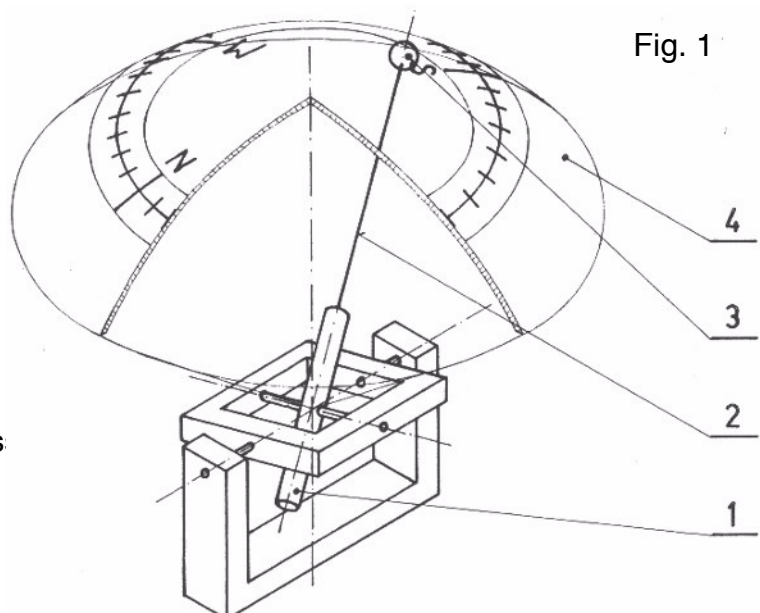
In the 15th to 16th Century a different type of compass became known, which had a "cap" (dab) that supported the magnetic needle on top of a pointed metal pin. The low center of gravity held the needle more or less horizontally; any remaining pitch, due to the magnetic inclination, was counter-balanced with weight. This principle, which uses the horizontal component of the earth's magnetic field, has undergone many refinements. It is widely used in aviation compasses today (Lit. 1. 2).

Unfortunately, this simple instrument fails during turns. Unless the axis of the needle is aligned perfectly vertical to the earth, it will start to swing. In a turn, when heading East or West, the needle does point correctly. But as soon as the aircraft turns towards South or North, the needle will be influenced by the magnetic inclination and will run ahead or behind, depending on the direction of turn. If the angle of bank exceeds 15°, the compass needle goes berserk. Any directional information is lost. The pilot has to fly on a straight heading for some time in order to allow the compass to calm down. Only then can he take a reading and initiate a further correction toward the desired heading, using very little bank (Lit. 3, 4, 5, 6).

The Bohli compass does not know such drawbacks (fig. 1). The magnetic needle of this instrument is hinged in a precision cardan joint and can move freely around two orthogonal axes (a narrow border range excepted). Independent of the aircraft position, the compass needle always points in the direction of the earth's magnetic inclination.

To make it insensitive to acceleration forces, the center of gravity of the magnetic needle with pointer has been positioned at the intersecting point of the two cardan axes.

- 1 magnet
- 2 extension
- 3 marker dot
- 4 spherical dial (calotte) with compass



The inclination varies with geographic latitude. Over the magnetic poles the needle would point down vertically; on the magnetic equator it would lie horizontally. One can notice this effect on long flights going North-South or vice-versa.

The effect shows on the Bohli compass in this manner: the imaginary circle, which the pointer mark describes on the dial during a circle on the plane, becomes wider in lower latitudes and narrower in higher latitudes. At a given inclination (latitude), the diameter of the imaginary circle (described by the red mark) can easily be visualized. Circles for three typical inclinations are painted on the dial. Directional indication is not influenced by a change of latitude. The local variation must, of course be accounted for, as with many other compasses.

Since the magnetic needle maintains its position like a platform, a damping device is superfluous. Directional indication is therefore immediate and without any noticeable oscillation. The chosen magnet exerts a high directional force; at European latitudes it is about 2.5 times stronger than for conventional "declination compasses".

There is very little deviation caused by interfering magnetic fields (inside the cockpit) which are moving around the compass needle during circling. If the source of such interference is more than 20 cm (8 in) away, it may be ignored. The off-center effect caused by such magnetic disturbances is automatically compensated when levelling the compass. The four main magnetic directions can therefore be established on the instrument with precision.

The use of this compass is limited to areas with a magnetic inclination between 40° and 75°. This includes Europe, Iceland, the USA (including part of Alaska), Mexico, southern part of Canada and all of Asia located between 30° and 65° northern latitude. A special model is available for the southern hemisphere, suitable in Australia, New Zealand and South Africa.

The first units of this compass were used during the 1972 World Gliding Championships in Vrsac (Yugoslavia) and have proved successful.

It is not surprising that the glider pilots, in particular, are showing great interest in this instrument. Navigation is more complex in gliding than it is in power flying. Gliding requires frequent transition between straight flight and narrow circling (for gaining altitude). In competitive soaring accuracy is imperative, for instance in maintaining an exactly determined wind correction angle, or when rolling out of a turn onto a precise heading (this problem will be treated in details in a separate article).

For this we need quick and accurate directional information. Furthermore it allows the pilot during circling to determine track radials towards special land marks, clouds or other circling gliders.

In addition, the compass can be utilized for centering thermals. After maximum climb, the pilot makes a 270° turn (3/4 circle), then flies straight for a short moment and continues circling. This will usually be a faster method for getting into the center than by guessing time, using land marks on the ground or other methods.

The instrument can serve the same purpose as a gyrocompass but it needs no energy, is always ready for use and does not drift off. It is equally suitable for visual and instrument flying.

Profound knowledge of the basic principle of this instrument is mandatory in order to fully benefit from its possibilities. For easier understanding, let's have a look at the compass as the pilot sees it.

An image of the dial is visible on the mirror (fig. 2).

Make sure you can see it when the instrument is banked at 60° . The width of the mirror (60 mm) is narrower than the distance between the pilot's eyes, thus the forward view is practically not obstructed.

The compass has been levelled for an average pitch angle of the fuselage (speed 100 - 110 km/h / 62 - 70 mph) and horizontal wings. If the plane makes a full 360° turn without banking, the red pointer mark would describe a circle around the center of the dial. The diameter of this circle depends on the local magnetic inclination (in reality the pointer mark is steady and the dial is rotating. Fig. 3).

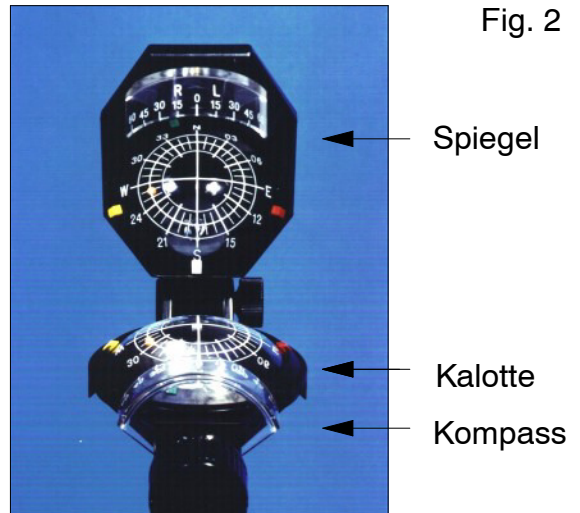
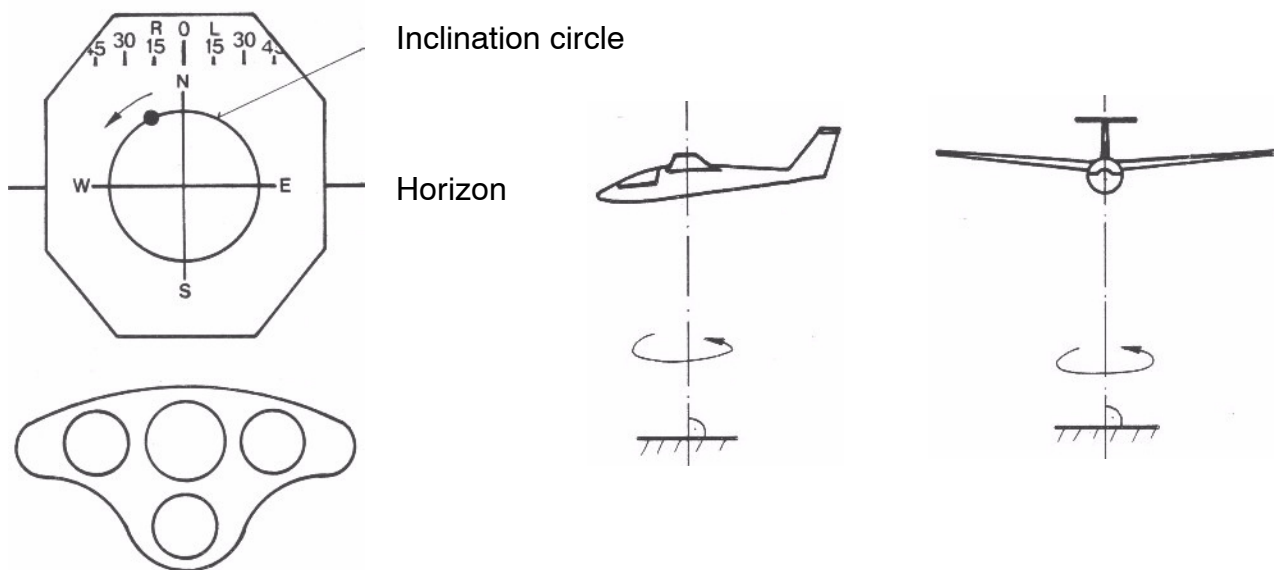


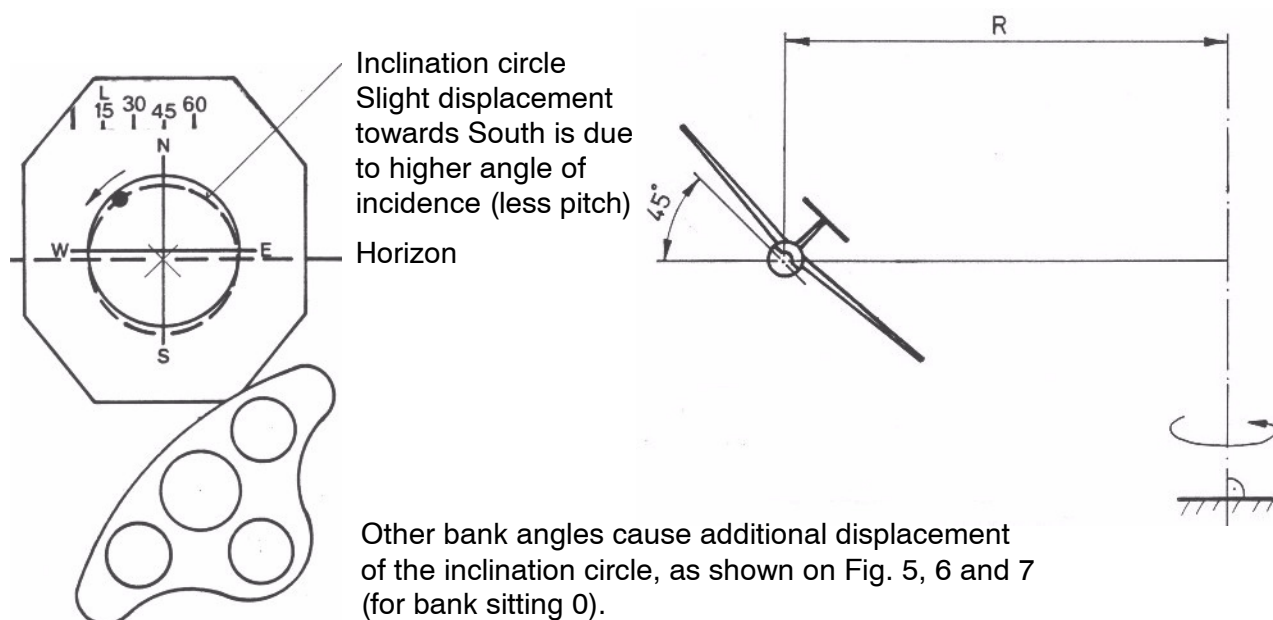
Fig. 2

Fig. 3



The same thing happens in actual circling flight, when the plane is banked but the compass is tilted so that it will remain parallel to the horizon (the bank angle is visible on the special scale which appears on top of the mirror image. Fig. 4).

Fig. 4: circling with 45° bank



If the pilot increases forward pitch, i.e. flies faster, the entire circle described by the red mark will be displaced towards "North" (fig. 5).

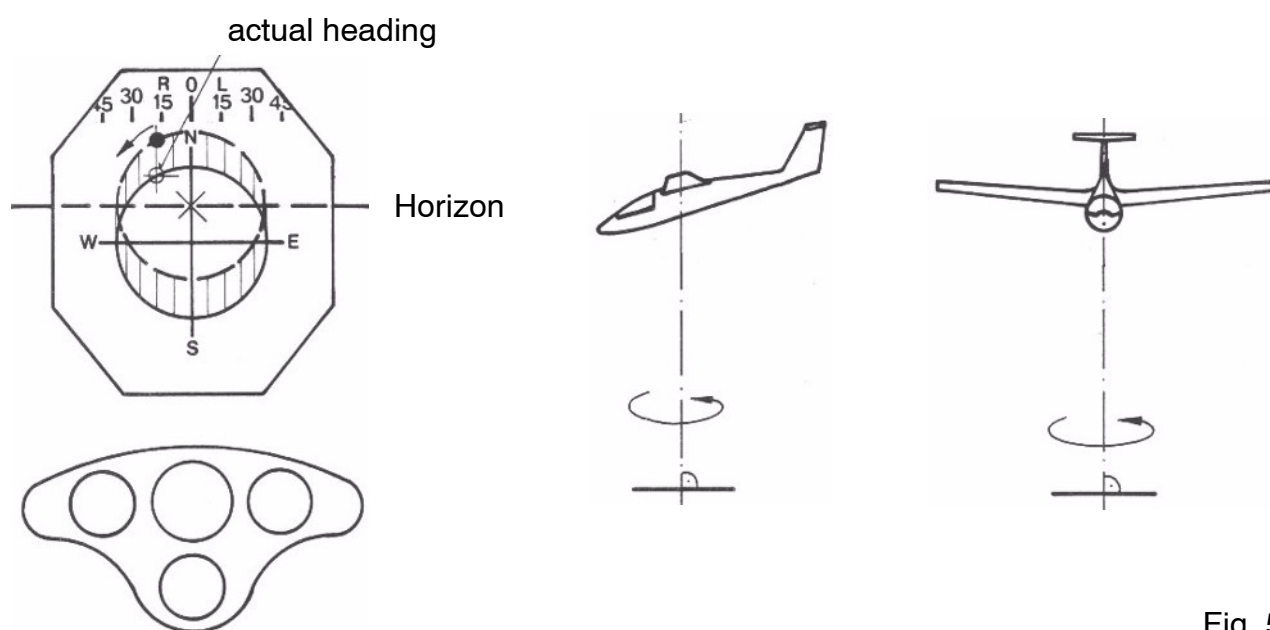


Fig. 5

Increasing the angle of incidence will displace the circle towards "South". Any change in pitch will merely move the red mark parallel to the N-S axis. Equally, banking (the compass) will move the red mark parallel to the E-W axis. Banking to the left will displace the circle towards East and vice versa (fig. 6).

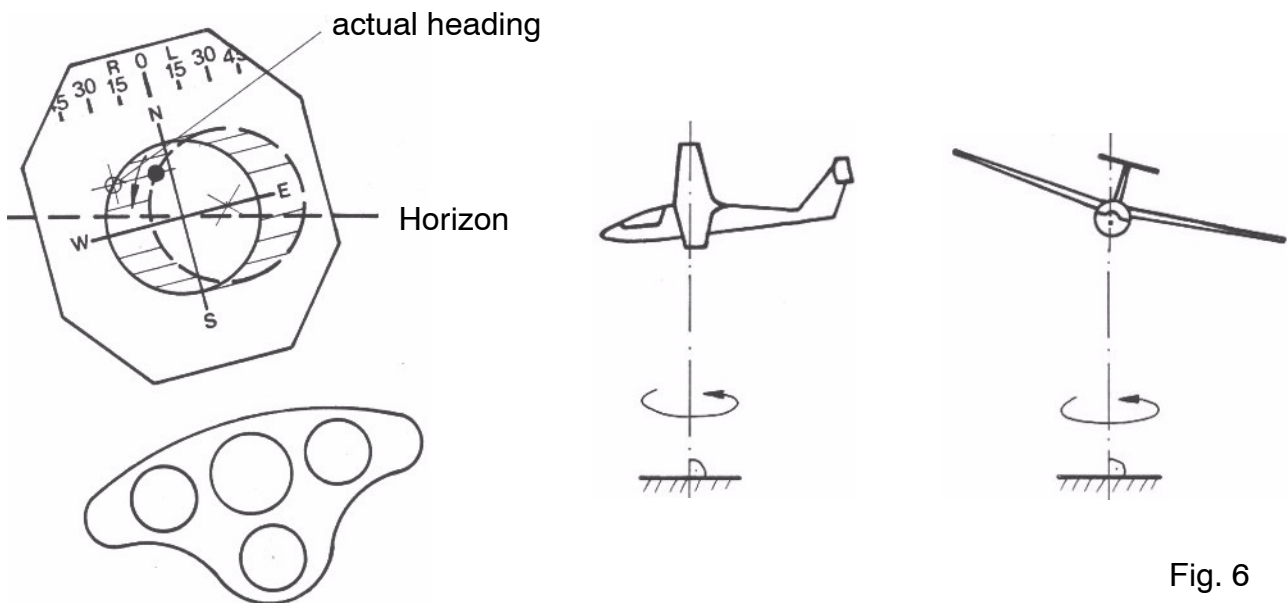


Fig. 6

Simultaneous pitch and bank movement will cause the red mark to move in a direction which is the resultant of both movements (fig. 7). In actual practice the displacement due to banking may be disregarded. During straight flight the compass is horizontal anyway; during circling in the thermals the bank angle applied by a pilot is usually the same or nearly so, thus permitting the use of a single compass bank setting for circling.

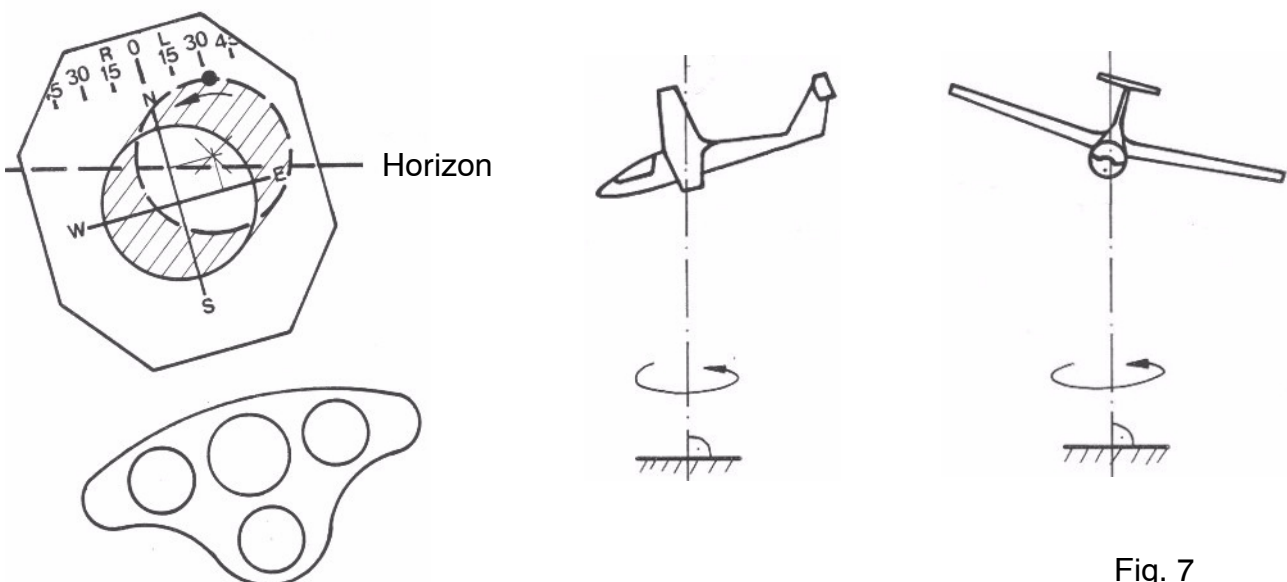


Fig. 7

Consequently, the pilot has to bother only with those displacements of the mark which are due to pulling and pushing the stick (dolphin flying) and he must learn to interpret them. The effect is minimized in gliders with flaps since the pitch angle of the fuselage changes little with different speeds.

Of course, it would have been possible to design a compass with adjustable forward pitch, or one which is hinged freely for fore and after movements. But the ensuing complications would offset the advantages. It is much easier to accept the effects of small pitch changes and to account for them by mentally understanding their geometrical effects. If you are flying at a different pitch angle from the one at which the compass was levelled, then think of a vertical line through the red mark dot (parallel to the N-S axis). At the point where this imaginary line intercepts the circle on the dial (with diameter according to the local inclination), this is the point where the red dot would be with correct pitch; consequently the heading is to be read at this point. On easterly and westerly headings the imaginary vertical lines will be tangent to the circle on the dial; reading will be inaccurate (compare fig. 5). Accurate headings in easterly and westerly directions can therefore only be obtained if the flying speed is maintained such as the compass has been levelled. Or, alternatively, corrections for different speeds should be established and memorized. For this purpose, the division on the compass-rose may be often varied (dolphin), so there are ample opportunities for reading off the correct heading (always then when the fuselage pitch is the same as when the compass was levelled).

What are the procedures for determining the magnetic radial (track) from one's own position towards another point? For the change of headings during straight flight? For leaving thermals on a precise heading? Or the 270° thermal centering method? All these procedures are fairly simple. They will briefly be described in that order.

If, during circling, the magnetic radial (track) towards another point is to be established, then it is merely necessary to adjust the compass to be parallel to the horizon. At the precise moment when the nose of the glider is pointing towards the relevant target, the heading (track) can be read on the compass. With a known wind correction angle (add or deduct), the target will be reached in the shortest possible time. The same method may be used for accurate turn point photographs which must be taken in a specific compass direction.

A precise change of direction in straight flight is done as follows. The turn is initiated with normal bank. The compass is set parallel to the horizon and observed. The roll-out manoeuvre must be initiated before the desired heading is fully reached. With a rolling time of 4 sec and bank angles of 45°, 30° or 15°, roll-out must be initiated in advance by 25°, 10° or 3° respectively. For small heading changes it is not necessary to tilt the compass. Several small corrections might be necessary; the accurate heading can immediately be read after every leveling-out. It is also possible to simply watch the red mark describe part of a circle, which now appears displaced to the E or W. This movement is mentally projected onto the equivalent circle on the dial and the turn is stopped when the desired angle is reached (deduct angle for roll-out). The latter method is possible with banks up to max. 15° only, as otherwise the pointer would hit against the stop, especially in low latitudes.

A special case is turning onto an E or W heading with little bank. Level flight is initiated in this case as soon as the edge of the red dot is touching the W-E axis.

The manoeuvre of leaving a thermal on a precise heading is done in the same manner as described for a change of direction. The preceding angle for roll-out must, of course, also be taken into account.

Some special reflections are necessary in order to correctly determine the angular advance to compensate time lags (fig. 8). Since different flying manoeuvres are applied for shifting towards the center, depending on personal preference and type of glider (levelling-out or sliding with opposite rudder, etc.), the amount of angular lag compensation is to be determined individually by each pilot. Point * is the location of strongest lift during the circle. With feeling alone it is hardly possible to determine this point exactly; the lift usually increases gradually and we cannot "feel" the peak. Due to its lag, the variometer will indicate maximum climb at point ●. The amount of turn that was flown during the variometer lag is shown by the angle α ; it represents the angle α by which the heading has changed from * to ● in direction of circling. When using a fast variometer, one must reckon with a time lag of approximately 3 sec. With a full-circle time of 16 sec (40 - 45° bank) this causes an angular lag of $\alpha = 67.5^\circ$ ($360^\circ : 16 \times 3 = 67.5^\circ$).

Fig. 8

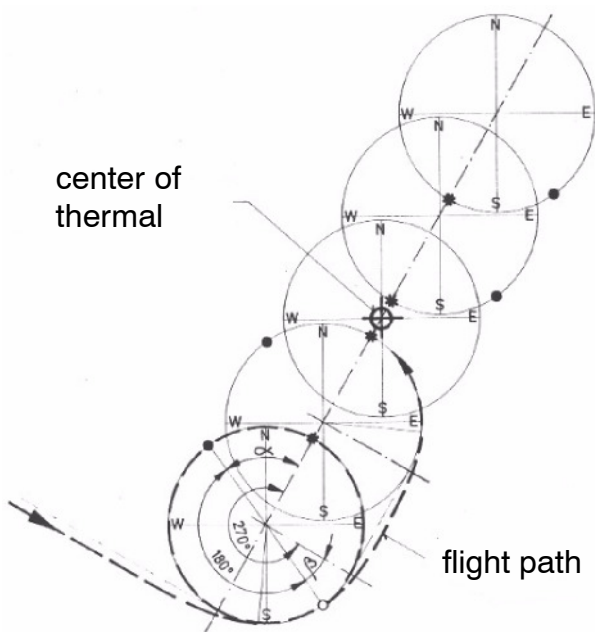
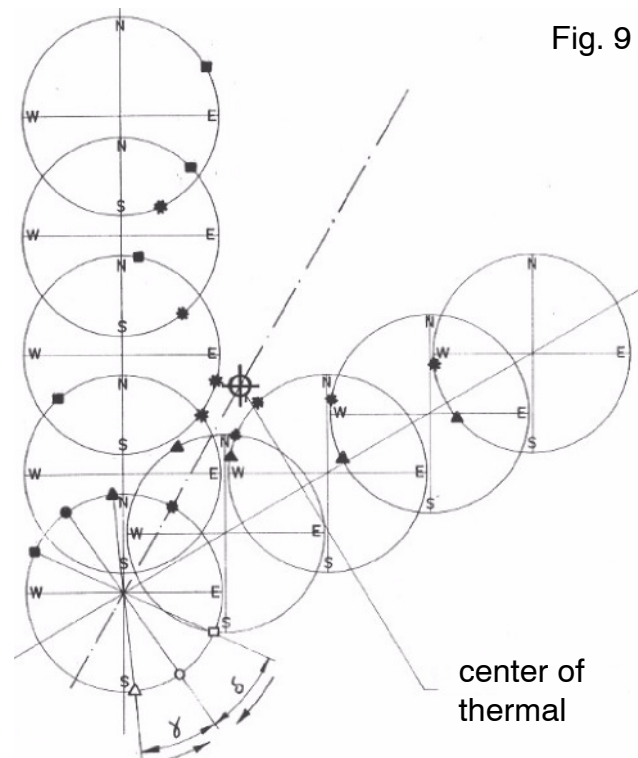


Fig. 9



If we add the angle b which is to counter-act the roll-out lag and if $b = 25^\circ$, we obtain 92.5° or approx. 90° total angular lag. In consequence, roll-out for shifting towards the center must be initiated $270^\circ - 90^\circ = 180^\circ$ after the moment of maximum climb indication. If we work with the compass it is not necessary to take readings of headings and make calculations; there is an easier way. At the moment of best climb indication, we mentally retain the position of the red mark and project it across the center of the dial into the opposite quadrant. Thus, the heading for initiating straight flight (roll-out) becomes evident at a glance.

If a 90° total angular lag was a correct assumption for a specific flying style, glider and variometer, then we are gradually shifting closer towards the center of the thermal. The reading of the heading at best climb ● should remain the same after every manoeuvre. If we have reached the center, there will be an almost identical climb indication on the variometer around the full circle. If we have overshoot the center of the thermal, then the heading at the moment of best climb will suddenly be 180° opposite from before.

If the indication of best climb occurs later after a shifting step, this is an indication that roll-out has been initiated too early as shown by ▲ in figure 9. On the other hand, if the relevant heading for best climb is encountered earlier after every step, then roll-out was initiated too late ■. Based on these observations an additional correction angle g or d may be introduced, where g is added to 180° and d is subtracted. The rough amount of these angles is easily determined by each pilot for his personal style, plane and instruments.

If, after the short straight flight, we want to quickly come back to the same bank as before (and thus the same radius of turn), we merely have to watch the mirror image of the E-W axis and get it aligned with the horizon. In clouds, the same bank is confirmed when the red mark travels on a concentric circle around the center of dial.

The aim of the Bohli inclination compass is purposely not an extremely high accuracy for reading headings. The instrument has been conceived, in the first place, to furnish information fast; information which is not blurred or distorted by movements or accelerations. It also does away with the complicated rules (lacking precise information) governing the interpretation of declination compasses.

This instrument certainly also offers advantages in power and helicopter aviation, provided the operating area is within the defined latitudes.

Literature

- | | |
|---------------------|---|
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(Sauerländer Verlag Aarau) |
| 2) Hine Alfred | Magnetic Compasses and Magnetometers
(Adam Hilger Ltd., London) |
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(Hans Reich Verlag, München) |
| 4) Simon Harro | Instrumentenkunde und Navigation
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| 5) Nietlispach Hans | Segelflug
(Fritz Marti, Buchbinderei, Bern) |
| 6) Löwe Karl F. | Flugzeugortung
(CJ. E. Volckmann, Berlin, 1934) |

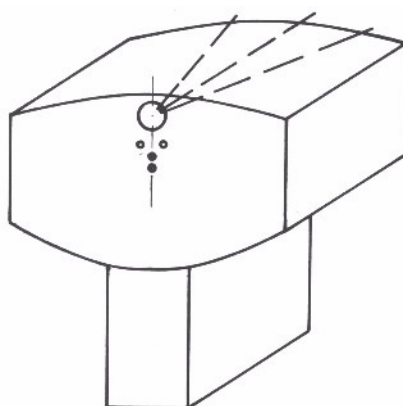
Installation

The specially developed compass 46-MFK-1 offers a number of important advantages over conventional types. In order to benefit fully from its unique information and presentation possibilities the following instructions must carefully be followed.

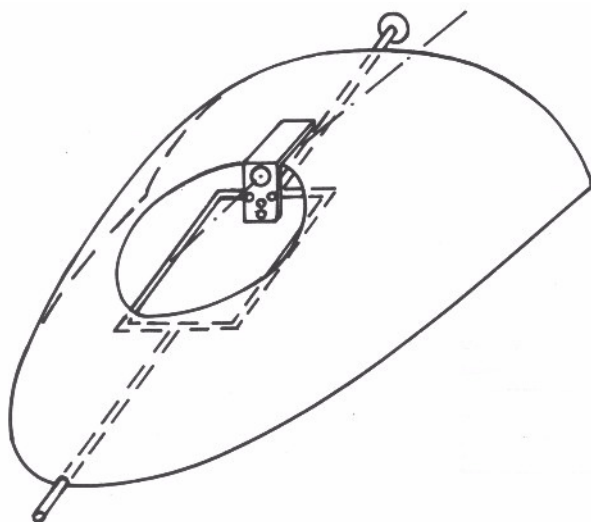
Mounting

The compass must be mounted at least 15 cm (6 in) away from any ferrous parts. If possible it should be even further away from moving coil instruments, loudspeakers or dynamic microphones. This is mandatory in order to reduce deviation. The best location is centrally on top of the instrument cover board (fig. 10). The compass may be sunk into the cover board so that merely the mirror remains in sight (also when banked in 60°). The width of the mirror is slightly less than the average distance between the two eyes of the pilot, thus giving an unobstructed forward view from a few yards in front of the fuselage onwards.

Fig. 10
Instrument cover boards



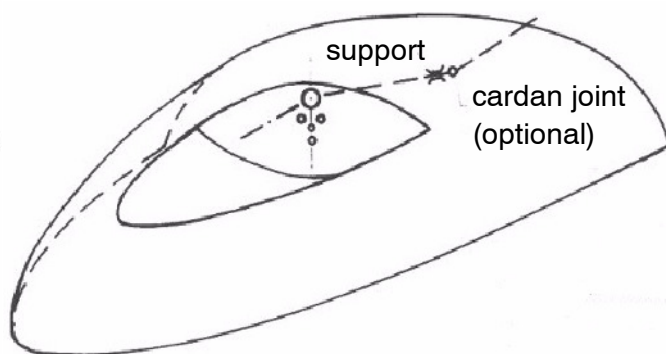
Instrument console
e.g. Kestrel 401, 604
Bank adjusting shaft
straight or at angle,
depending on
instrument arrangement



Central rod to canopy lock

e.g. ASW 17

Reshaping rod around compass,
cut-out hole in instrument cover
closed with textile bag, \varnothing 110 mm.
Use angular aluminium piece as support.



Bypassing instruments with shaft
e.g. LS 1

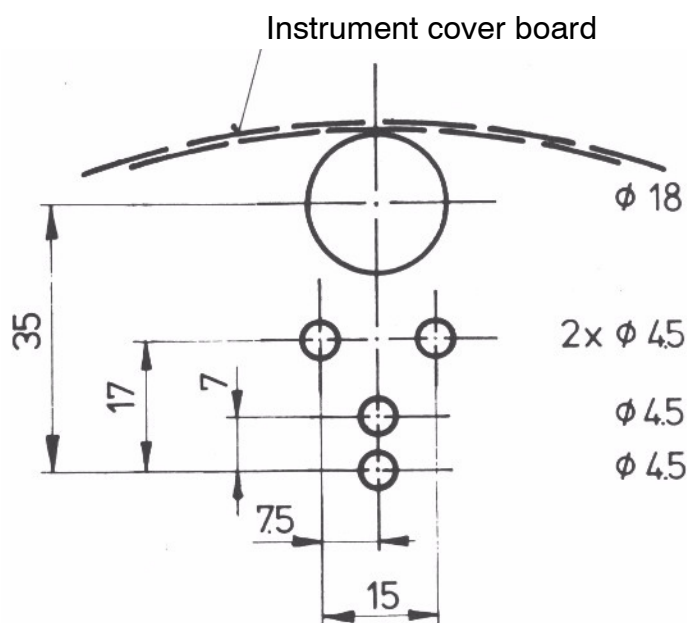
Cut out part instrument cover board turn
cut-out piece upside down and glue onto
vertical end plate. If necessary reinforce
lower drilling holes with aluminium sheet
(2 mm).

The compass may also be mounted off center, but in this case the pilot may have to slightly move his head to the side in order to see the entire dial when circling. In cockpits with central forward canopy locks, it pays to modify the knobs of levers, by-passing the compass. Use antimagnetic materials (aluminium, brass, etc.). The compass base plate is bolted against a surface which should be as vertical as possible in flight.

The drilling plan gives details on the three mounting holes and the holes for the shaft and central screw. The upper edge of the top hole for the shaft shall, if possible, be located just slightly below the instrument cover board. Examples of suggested installation possibilities are shown on enclosed sketches. The shaft with the bank adjusting knob may be brought through the instrument panel at the most suitable location. Drill a $\varnothing 5.2$ mm hole, or a slot of 5.2 mm width near the edge of the instrument cover board (thus the entire assembly may be taken off with the cover board). Should another deep instrument already occupy the top central space on the panel, then it may be necessary to install an additional (optional) universal joint and an additional support in order to by-pass said instrument with the bank adjusting shaft.

Fig. 11

Drilling plan 1:1



Levelling of compass

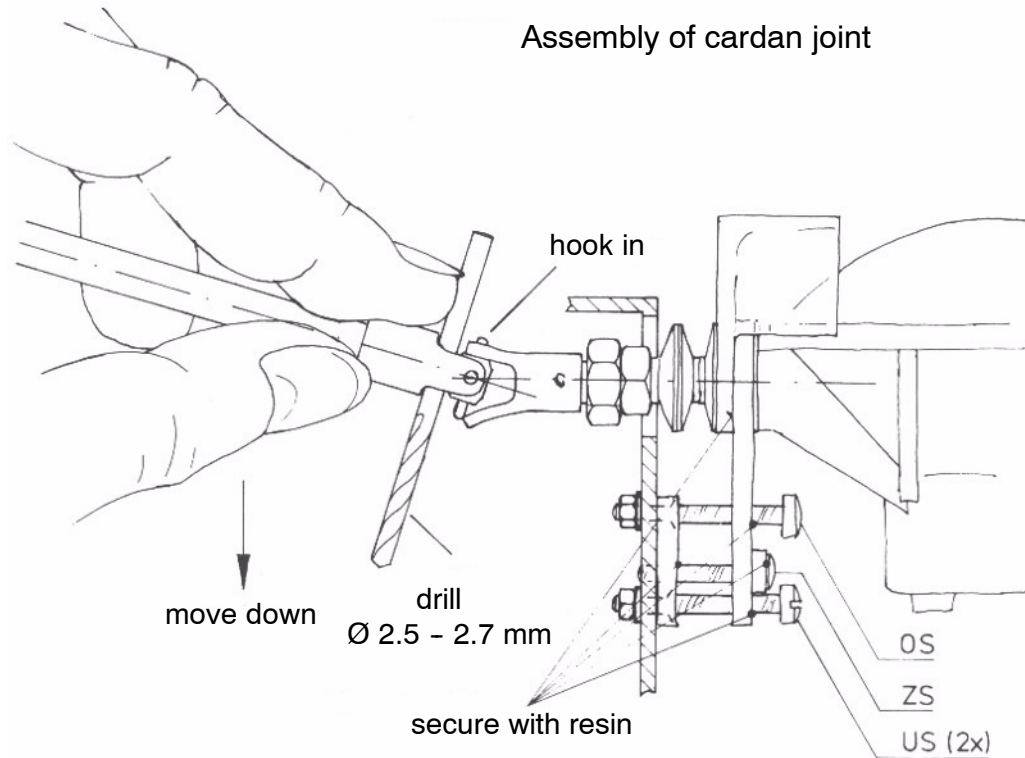
For levelling the compass it is important to know the fuselage pitch angle which corresponds to a flying speed of 100 to 110 km/h (62 to 70 mph). For gliders without flaps this will give the lowest average indication errors (over the entire speed range) on headings East and West.

In the case of gliders with flaps these errors are negligible since the pitch angle of the fuselage remains constant over a wide speed range. If the pitch angle of the fuselage at the above indicated speed is not known, it may be determined during a flight with the adjustable water-level supplied with the compass. This must be fixed somewhere in the cockpit (canopy frame, etc.) for this purpose. If desired, the water-level may remain mounted in the plane and can later serve to verify the pitch angle of the fuselage at which the compass always indicates correctly.

By turning the two lower adjustment screws (US), the N-S axis of the compass is now turned to be exactly in line with the center line of the fuselage. For turning the scale to the right screw (US) must be loosened and the left screw (US) tightened and vice-versa. After the sailplane has been prepared in this manner, it is moved to a compass compensation spot which is aligned to the magnetic pole. Levelling of the compass and, at the same time, compensation (swinging) are then a simple matter.

Fig. 12

Assembly of cardan joint



First, with the wings held horizontally, the sailplane is aligned to face exactly towards magnetic North. The fuselage pitch angle is not important here, as it only causes the indicator to move along the N-S axis. Using the turning knob, the compass is now adjusted so that the N-axis will cut centrally through the red marker dot. Slight tapping on the knob will eliminate friction on the compass needle. This tapping must be done during the entire compensation procedure (in flight, friction is automatically eliminated by the ever-present vertical and horizontal accelerations). Now the bank indication scale is adjusted so that its 0-mark is exactly aligned with the N-S axis.

The center point of this circle lies now exactly on the N-S axis of the scale. Now, the center point must also be brought onto the E-W axis.

The plane is turned to face exactly towards magnetic West. In this position the pitch angle of the fuselage is important. By unscrewing the upper screw (OS) and tightening the center screw (ZS), or vice-versa, the W-axis is moved exactly above the red mark. In order to have easier access to the screws, the compass may be banked to position 45° "R". The red mark is then somewhere near the E-axis and the centering adjustment may be completed by using this axis. Make sure to remove the screw-driver from the compass for every reading in order to eliminated interference. When bringing the compass back to level, the red mark must now be located exactly on the W-axis.

By this comparatively simple levelling procedure (which must be done accurately, however) the compass has been adjusted for zero bank and for a pitch angle of the fuselage corresponding to a flying speed of 100 to 110 km/h (62 to 70 mph). By the same procedure all stray magnetic fields within the glider have been compensated. A check may be done by taking other compass readings on different headings, e.g. from 30° to 30°. In most cases there will be no noticeable deviation. A special deviation or correction table is consequently superfluous. In an exceptional case only, when strong and uneven magnetic fields are influencing the compass, such a table may become necessary.

Due to the compensated stray magnetic fields the compass is not necessarily aligned with the vertical or cross axis of the plane. The mirror must now be adjusted, so that the N-S axis of the scale appears vertical on the image, and the E-W axis horizontal. Thus, when circling, the image of the E-W axis may always be set parallel to the horizon. The bank angle scale shall be visible along the top edge of the mirror, but it need not regularly be observed in flight. If the compensation area is aligned with the geographic (true) North, the local variation must be added or subtracted (if the red mark would be adjusted to the true North, the error when facing South would be twice the local variation).

If no calibration area is available, the compass may be levelled and compensated by lifting the tail to the proper height and, with the wings held level, rotating the whole plane around 360° several times in a row. By adjusting the upper center screw (ZS) and turning the knob, the compass is adjusted until the red mark describes a circle around the center point of the dial (and concentric to the circles marked thereon). Obviously, this must be done way out on a field, away from constructions, steel, cars, etc. The compass can then be checked in flight by flying parallel to known tracks, such as roads, railway lines, etc. The local variation and possible deviations must accurately be accounted for when using this last method of compensation.

Maintenance and care

The compass requires little maintenance. The maximum permissible shock acceleration is approx. 25 g. Care must be taken to avoid hitting the instrument against hard objects or letting it drop. A dusty or dirty mirror shall be cleaned by breathing against and using cotton-wool. The same applies for the two dials. Make sure never to come close to the compass with a strong magnet. When adjusting the screws with the screw-driver, turn gently and avoid swinging the needle against the stop with a jerk. If treated with care, the compass will function properly for years.

Technical data

Operating area:	Northern hemisphere in areas with approx. 75° - 45° inclination; this corresponds to latitudes between approx. 65° - 30° North.
Inclination on scale:	inner circle = 72,5°, center circle = 65°, outer circle = 57,5°
Scale division:	10°
Temperature range:	Minus 20°C to plus 60°C
Max. permissible acceleration:	25 g
Hysteresis:	on ground $\pm 3^\circ$, in flight practically nil

General hints

Experience has shown that after final adjustment the adjusting screws “US” and “OS” and the center screw “ZS” must be secured with lacquer or resin. This is to prevent them from becoming loose during trailer transports (which would require a new adjustment).

If there is any chance that the bank indication scale may be de-regulated (by inattention when cleaning the canopy or if access to the compass is possible to spectators) this scale should also be secured. This is done by glueing one of the edges against the aluminium support. Only resin may be used, since dissolvents such as acetone, nitro, petrol or benzine etc. will cause small cracks in perspex. The same applies to the spherical cap with the dial which must never come into contact with such a dissolvent.

If the water-level, which is supplied with the compass, shall remain installed, it is recommended to secure it with lacquer.

Before take-off, the compass, like other instruments, should be protected from direct sunlight in order to avoid excessive heating.

Information on the use of compass 46-MFK-1 model “South” for southern hemisphere

Generally, the mode “South” is suitable for use in Australia, New Zealand and South Africa.

Externally, the models “North” and “South” differ only by the design of the compass rose. On model “South” the “S” appears in the mirror on top, “W” on the right, and “E” on the left. With model “North” it is vice-versa: “N” in the mirror on top, “W” to the left and “E” to the right.

Installation is done exactly the same as for model “North”.

If a compass “North” is to be replaced by a model “South”, the center screw “ZS” must be unscrewed, whereupon the compass can be taken off and the other one inserted. Attention: Don't lose the concave washer!

Levelling of the model “South” is possible only in the Southern hemisphere. It is done in the same manner as for model “North”. A compensating spot with magnetic North indication is useful; otherwise the N-S and E-W axes may be established by other means (using an other, calibrated compass and marking the main directions with stretched strings).

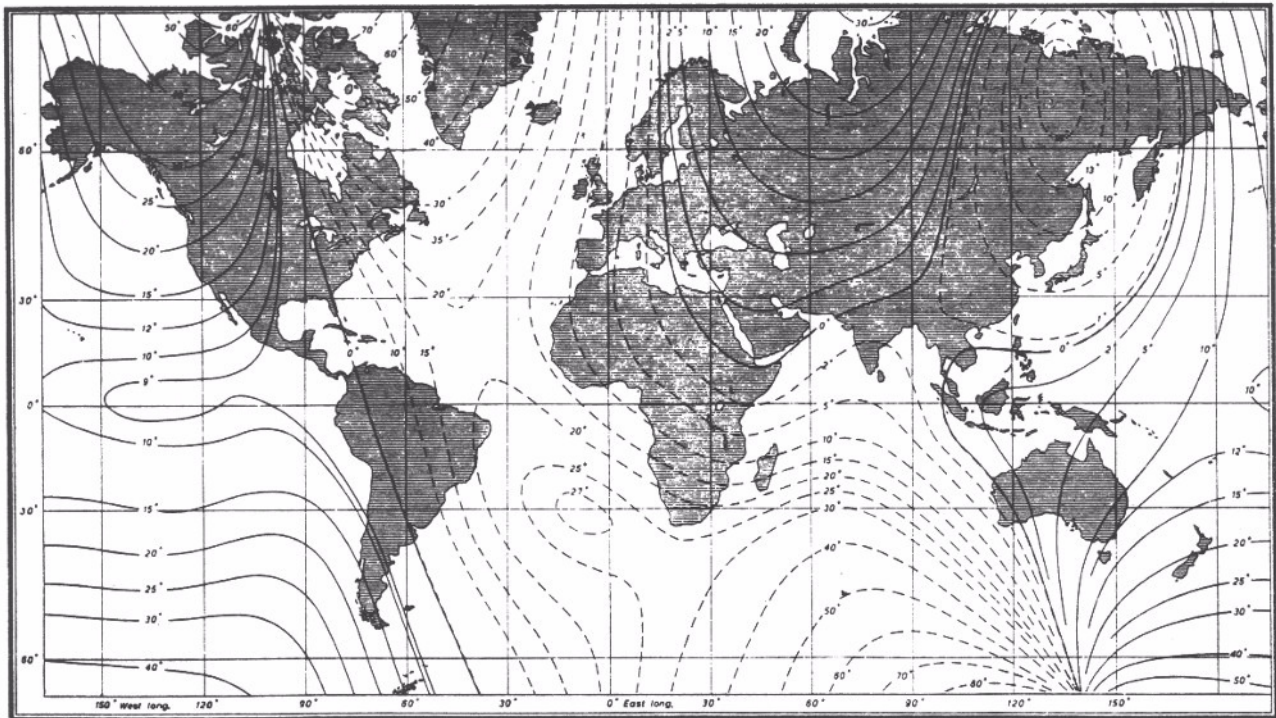


FIG. 2.6. Isogonic chart for 1965
The isogonal lines join places of equal magnetic variation.

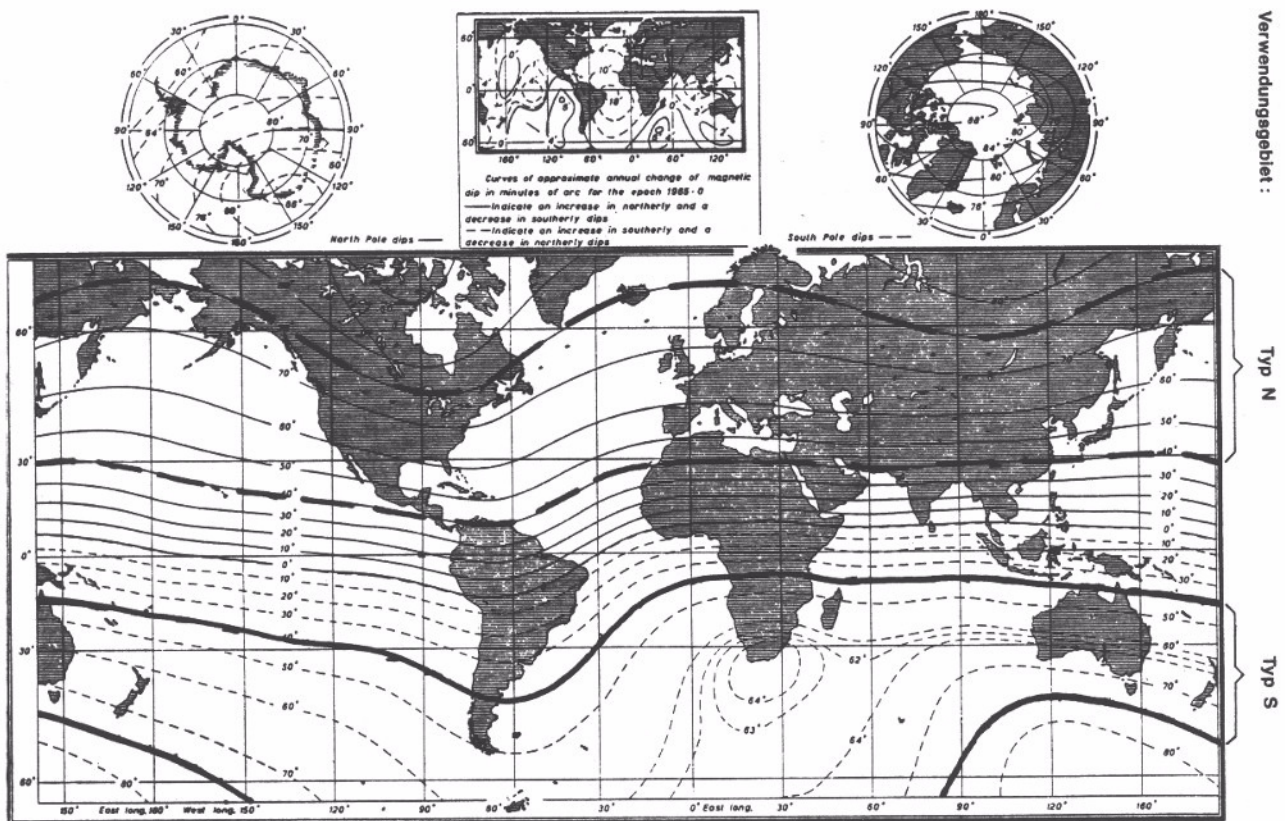


FIG. 2.8. Lines of equal dip for 1965

BOHLI manufacturing programme:



Standard program:

Magnetic holding devices

Dial test indicator holder

Selecting magnet

Demagnetizer for steel

Holding and sticking magnets

Rubber magnets

Sailplane instruments

Ask for our price list

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Telefax +41 32 622 14 82

stprod@bohli-magnete.ch

<http://www.bohli-magnete.ch>

STANDARD PRECISION ALTIMETER WINTER 4 FGH 10

Application

2-pointer altimeter for measuring absolute und relative altitudes in the

0-10 000 m or 0-20 000 ft range.

Indicating range:

item No. 4110: 0-1000-10 000 m

item No. 4320: 0-1000-20 000 ft

Gradations:

item No. 4110: large pointer 10 m, small pointer 100 m, 3rd pointer 5000 ft

item No. 4320: large pointer 20 ft, small pointer 200 ft, 3rd pointer 5000 ft



Technical data

Airtight, black plastic housing. Connection via hose from static pressure sensor to hose connector on rear. Kollsman window with millibar scale, reading from 940 to 1050 millibars. See scale drawing for installation dimensions. Weight 0,330 kg. Linear scale

The 4 FGH 10 altimeter can be fitted with a scale ring.

Scale Ring

Prior to a cross-country flight, the altimeter is usually set to field elevation.

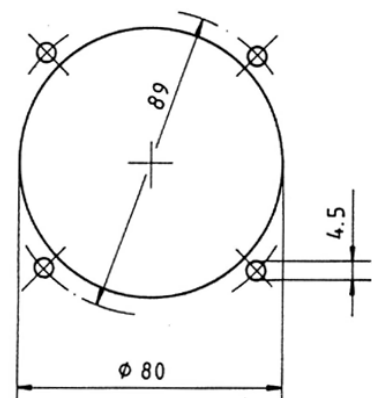
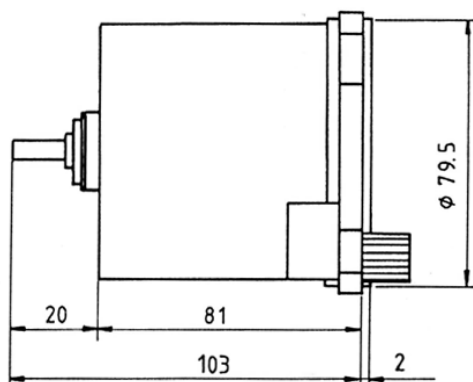
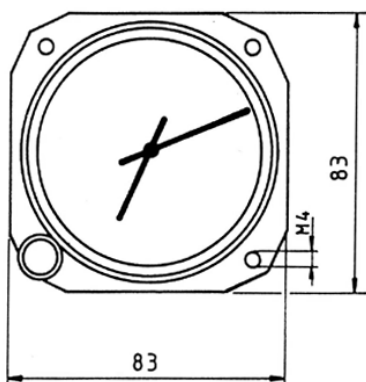
Atmospheric pressure reduced to pressure at sea level (QNH pressure) is then indicated in the Kollsman window. Throughout the flight, the altimeter reads height above sea level.

In many instances, it is also desirable to know one's relative altitude above a defined landmark, as well as height above sea level. On a final approach, for example, it is essential to know one's height above the landing field at any given time.

Once the arrow on the rotatable scale ring has been set to the elevation of the landing field, altitude above the field can be read off the gradations at any time until touchdown (reading corresponds to the QFE setting).

Further applications include the safe crossing of ground obstacles (mountain ranges) or control zones, cases in which the difference in altitude can be read directly once the ring has been correctly adjusted.

The scale ring has also proved particularly useful for destination approach calculations in performance gliding.



AIRSPEED INDICATOR WINTER 7 FMS 4 (300 KM/H)

Application

Developed especially for gliding, the instrument shows airspeed on a 510° spiral scale. Gradations for low and average speeds are greatly enlarged, in order to permit speeds in the ranges of primary interest to be read accurately and with ease.

Technical data

Black plastic housing, white scale on matt black background see scale drawing for installation dimensions, weight 0,205 kg 0 in 6 or 12 o'clock-position (only mph or knots-readings) ranges: see table

Application

An alternative to the 6 FMS 4 airspeed indicator in small standard housing for installation where space is at a premium.

Technical data

like 6 FMS 4
see scale drawing for installation dimensions
ranges: see table
weight 0,075 kg

Speeds frequently used in general aviation

V speeds are nearly always given as Indicated Airspeed (IAS), so that pilots can read them directly off the airspeed indicator (ASI). ASIs carry color-coded markings that give the pilot an immediate reference, as follows.

VNE Red line and top of yellow arc. The VNE, or the never exceed speed, of an aircraft is the V speed which refers to the velocity that should never be exceeded due to risk of structural failure, most commonly due to wing or tail deformation or failure and less commonly due to aeroelastic flutter (usually in faster aircraft). VNE is specified as a red line on many airspeed indicator. This speed is specific to the aircraft model, and represents the edge of its performance envelope.

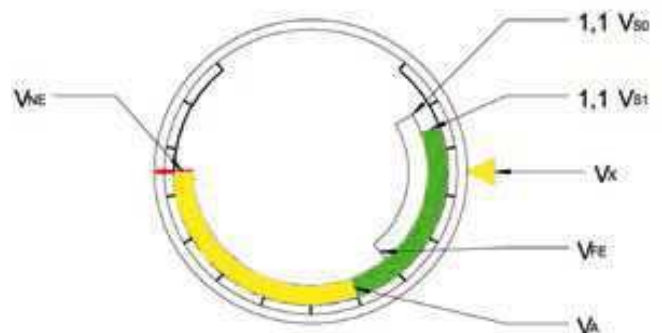
VA Top of green and bottom of yellow arcs. The yellow arc is caution, as speeds in this region may add dangerous stress to the aircraft, and are only to be used in smooth air when no turbulence or abrupt control inputs are expected. Design maneuvering speed (stalling speed at the maximum legal Gforce, and hence the maximum speed at which abrupt, full deflection, control inputs will not cause the aircraft to exceed its G-force limit). Maneuvering speed is limited by aircraft structural characteristics. With the Cirrus SR20 and SR22, this speed is also known as V0.

VFE Top of white arc. Maximum flap extended speed (a different maximum speed may be specified for partial flap extension).

VX Best angle of climb speed.

VS1 Bottom of green arc. The **stalling speed** or the maximum steady flight speed obtained in a specific configuration (usually a configuration "clean" of flaps, landing gear and other sources of drag).

VS0 Bottom of white arc. Stall speed in landing configuration.



Airspeed-indicator with Grosskinsky-variable-camberflap ring

Application

As is generally known, wing load and, in turn, the optimum flap positions for the various speed ranges of a variable-flap glider changes with take-off weight. Until now, selecting the right flap position has involved using special tables carried on board or observing a confusingly large number of marks on the airspeed indicator. The new adjustable ring for airspeed indicators makes these complicated methods things of the past.

Features

As the illustrations shows, the ring has a double scale for aircraft weight "G" and wing load "G/F". Four arrows can also be seen, showing the corresponding angles for the flap positions. The number of arrows depends on the number of flap positions for the type of glider in question – are shown here. Like the MacCready ring of the variometer, the rotatable ring is simply push-fitted over the airspeed indicator.



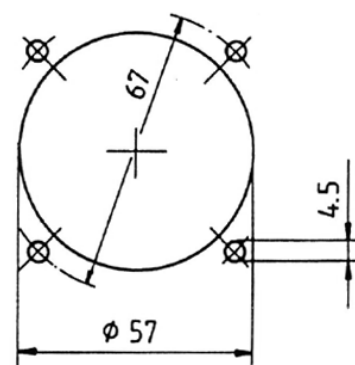
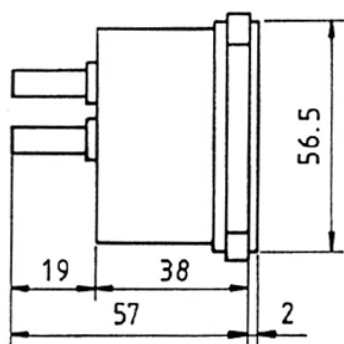
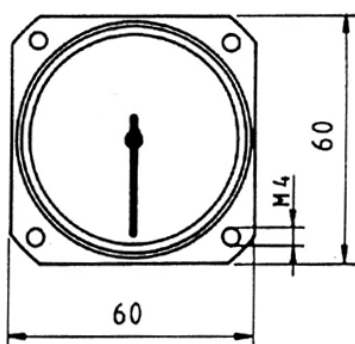
Use

Once the take-off weight has been calculated by adding the dead weight of the aircraft, the weight of the pilot and the weight of any water ballast on board, the "G" scale is simply turned until this figure is aligned with the 0 mark of the airspeed indicator. The arrows on the ring now automatically show the correct flap positions on the airspeed-indicator scale.

Furthermore, the correct wing load for the takeoff weight can be read from the "G/F" scale and entered in the electric variometer, if fitted. If wing load changes in the course of the flight, due to a reduction in ballast, for example, the ring need only be turned back to the new flying weight, and immediately, the arrows show the new, flight dependend flap positions.

The ring is calibrated for a standard preset acceleration of 1 g. If values as high as 1,3 g should occur, as they do in high-performance competition gliding, a second ring with the appropriate values can be fitted during the flight, or changed as required.

If the Großkinsky ring is not ordered along with a new airspeed indicator, please send us the airspeed indicator and state the type of aircraft in which it is installed, because the scales vary from model to model. Only the 6 FMS 4 or 7 FMS 4 series airspeed indicators with 510° scales are suitable.



VARIOMETER 5 STV 5

Vane type variometers measure the change in air pressure inherent to changes in altitude. The instrument consists of a cylindrical chamber with a precision-fit baffle plate (vane) rotating on shockproof jewel bearings and centered by a coil spring. The vane divides the chamber in two: one section is open to static pressure, while the other is connected to an expansion tank, in which a volume of air is insulated against the thermal effects.

Differences in pressure are compensated by the narrow gap between vane and chamber wall. There is a change in static pressure when an aircraft climbs or descends, and a differential pressure is established between the two sections of the chamber. The resultant deflection of the vane provides a measure of the vertical speed and this deflection is transferred to the pointer of the instrument.

The response rate of a variometer is important. In high-performance gliding, upcurrents can be identified all the quicker and used all the more efficiently if the variometer responds without delay.

Defined as the length of time the instrument takes to reach 65% of its final reading in response to a sudden change in vertical speed, the time constant serves as a standard for gauging speed of response. The faster a variometer responds, the smaller is its time constant.

Vane type variometers with large measuring ranges such as 5 StV 5 (± 10 m/sec. and ± 15 m/sec.) have small time constants. The volume of the expansion tank must be increased in order to achieve comparable figures with variometers having the most common measuring range (± 5 metres/second).



Application

Indicates the aircraft's vertical speed (rate of climb, rate of descent).

The variometer is the most valuable aid on all types of aircraft for pilots wishing fully to exploit the prevailing thermal conditions. The variometer with linear dial calibration can be used in conjunction with a MacCready ring. The separate 0,45 litre equalization reservoir is easy to install. responsive and exact display, linear dial calibration, shock-resistant shafts

Technical data

Black plastic housing see scale drawing indicating range see table for installation dimensions, see table of vane type variometers for time constants,
weight 0,260 kg
volume of expansion tank 0,45 litre
equalization reservoir dimensions□:
0,45 litre, 65 mm Ø, 280 mm long, 190 g
0,9 litre, 80 mm Ø, 350 mm long, 300 g

Maintenance

A leak test should be performed annually. Otherwise the instruments require no maintenance.

Test and repair

Normally the instruments remain serviceable and accurate over a long period of time. If test or repair become necessary, the instrument is to be sent to the manufacturer or a qualified repair station.

The instrument should be packed in shock absorbing material, and the connection fittings should be sealed.

We strongly advise against service by unqualified personnel. We recommend that variometers are retested after 5 years.

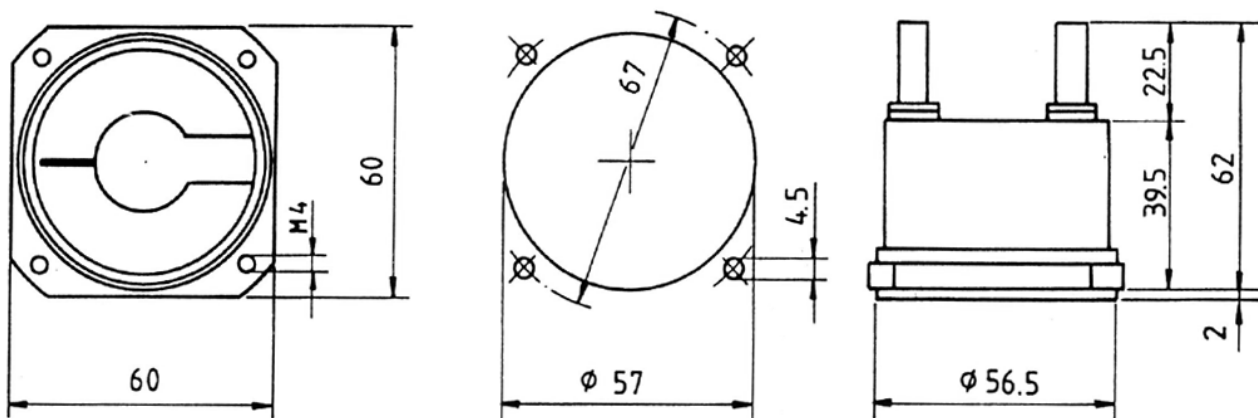
Vanetype variometer with MacCready ring (preselected flying speed ring)

Nowadays, the MacCready type ring is an indispensable aid in cross country flying. The ring is rotatable and is marked with speeds and a white triangle. The chief use of MacCready ring is to achieve the highest possible cruising speed (average cross country flying speed) on thermal cross country flights. This involves setting the white arrow to the anticipated rate of climb for the next upcurrent.

Optimum light performance is assured when the airspeed indicated by the airspeed indicator corresponds to the preselected flying speed to which the MacCready ring has been set. The MacCready ring allows gliding distance and final approach to be optimised. Please refer to the relevant literature for further details. When ordering, please do not forget to state the type of aircraft in which the ring will be used.



If the ring is retrofitted to a variometer of older design, the original threaded ring of the instrument must be removed and replaced by a grooved threaded ring onto which the MacCready ring can be fixed with ease.



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Section 1 GENERAL INFORMATION

1.1 Introduction

The following Handbooks describe the VHF-communications transceiver AR 3201 - ().
 The Handbooks DV 28110.03 („Installation and Operation“) and DV 28110.04 („Maintenance and Repair“) contain the following sections :

Section		DV 28110.03	DV 28110.04
1	General Information	X	X
2	Installation	X	X
3	Operation	X	X
4	Theory of Operation		X
5	Maintenance and Repair		X
6	Illustrated Parts List		X
7	Modification and Changes		X
8	Circuit Diagrams	X	X

1.2 Purpose of equipment

The VHF transceiver permits transceiver communication on 760 channels in the frequency range 118.000 MHz to 136.975 MHz with a channel spacing of 25 kHz. It can also be limited to 135.975 MHz = 720 channels by incorporating a different PROM. Extensions for additional modes such as temperature and operating voltage measurements, etc. are provided for.

The VHF transceiver is physically designed for unrestricted application in category II aircraft. In the environmental categories there is no limitation for application in the instrument panel and for use in

rigid fuselage mounting in all aircraft. The VHF transceiver is designed for compliance with RTCA and EUROCAE airworthiness requirements.

1.3 General description

The VHF transceiver is designed as a single-block unit with dimensions in keeping with 58 mm diameter standard instrument size. Mounting is by means of four screws (behind-panel fitting). All controls and indicators are located on the front panel. The rear panel locates the connector for connecting the transceiver to aircraft wiring, the antenna socket and a test connector.

The transceiver features a single superhet receiver. A squelch circuit suppresses noise and input signals below a specific field strength. The switching threshold is adjustable from without through the case. The squelch can be defeated with the squelch switch.

The transmitter has wideband tuning over the range 118.000 MHz to 136.975 MHz. Transmitter output power is greater than 5 watt. In transmitter operation sidetone is automatically on. In transceiver with serial No. of 4000 and above, an arrow flashes on and off in the upper left side of the LCD during transmission

The injection frequency of the receiver and the transmit frequency of the transmitter are generated by a voltage-controlled oscillator (VCO) which is signalled by a digital frequencysynthesizer in conjunction with a microprocessor.

The microphone input is designed for a dynamic microphone or for a standard microphone, the transceiver being infactory-set for a dynamic microphone. Conversion to a standard microphone is done in transceivers up to serial No. 86 by resoldering a jumper on the soldering side of the audio module. As of serial number No. 86 the conversion is made by reconnecting a wire jumper on the component side of the audio module. The microphone input is connected to a dynamic compressor which maintains the modulation depth constant over a microphone input voltage range of approx. 40 dB.

The frequency indication is a liquid crystal display (LCD). The MHz and kHz frequency selectors permit selection of the desired channel frequency. The MHz frequency selector indexes in steps of 1 MHz, the kHz frequency selector in 25 kHz steps.

The transceiver also contains a memory for storing four different channel frequencies, even when the transceiver is OFF. The stored frequencies are called up by the channel selector switch in positions 1 - 4. In switch position A a further channel frequency can be set which is, however, lost when the transceiver is switched off. In transceiver with serial No. fo 4000 or above, the channel frequency set in position A is also stored and not deleted when the unit is powerd down.

In addition, when the VHF transceiver is powered up, a self-test function is automatically activated to test the LCD. For a period of a few secounds, all of the segments in the LCD flash on (188.88). Aterwards, either the frequency 121.5 MHz appears (channel selector switch in position A), or one of the 4 stored frequencies (depending on the position of the channel selector switch). The VHF transceiver is now ready for operation.

In Transceiver with serial No. of 4000 or above, either the most recently set frequency in channel A appears, or one of four stored frequencies (depending on the position of the channel celector switch). When the self-test function is activated, an arrow flashes on and off in addition to the digits 188.88 (\Leftarrow 188.88).

The transceiver also contains a stage for monitoring the aircraft supply voltage. This stage is ON as soon as the transceiver is switched on. Should the aircraft supply voltage drop to 11 V - 10.5 V, the readout will commence flashing.

For operation on an 28 V aircraft system a voltage regulator (VR 2011) is necessary. In aircraft with no power circuit (gliders) the battery box (BK 5) is provided.

When using the emergency power unit EPU 400 the transceiver can be continued to be operated at reduced output power (12 V operating voltage) even when aircraft power is down.

When operating the IC mode, the transceiver can be used for intercommunications.

The auxiliary audio input permits input of audio signals from other equipment in the aircraft, however, these auxiliary audio input is standard as of module No. 471 . Up to module No. 470 this feature was only available as an option.

If LCD illumination is required, it can be connected either directly to the operating voltage or to a dimmer.

The standard version can be extened by optional voltage and temperature measuring facilities without affecting the airworthiness of the transceiver.

An optional voltage and temperature measurement circuit permits measurement of either two different voltages or two different temperatures or a single voltage and a single temperature with the aid of two corresponding sensors and two external pushbuttons. The LCD provides indication on pressing the external pushbuttons for approx. 4 seconds. Temperature can be indicated in Fahrenheit or Celsius.

1.4 Variants survey

Table 1 -1 surveys the variants of transceiver AR 3201 - (). The various variants are not different in appearance, i.e. dimensions, case depth, etc. being the same for all variants. The necessary accessories are given in the List of Accessories at the end of Section 1 for the various variants, all of which have no effect on airworthiness of the transceiver.

Transceiver AR 3201-()

Drawing No./ Order No	Type	Voltage measurement	Temperature measurement in deg Celsius	Temperature measurement in deg. Fahrenheit	760 channel	720 channel
28110-00000.000 389.528-910	AR 3201-()	no	no	no	yes	
28111 -00000.000 397.156-910	AR 3201-(1)	yes	yes	no	yes	
28112-00000.000 397.164-910	AR 3201-(2)	yes	no	yes	yes	
28113-00000.000 397.172-910	AR 3201-(3)	no	yes two different temperatures	no	yes	
28114-00000.000 397.180-910	AR 3201-(4)	no	no	yes two different temperatures	yes	
28120-00000.000 767.018-910	AR 3201-(10)	no	no	no		yes
28121 -00000.000 767.026-910	AR 3201-(11)	yes	yes	no		yes
28122-00000.000 767.034-910	AR 3201-(12)	yes	no	yes		yes
28123-00000.000 767.042-910	AR 3201-(13)	no	yes two different temperatures	no		yes
28124-00000.000 767.050-910	AR 3201-(14)	no	no	yes two different temperatures		yes

Table 1-1

1.5 Specifications

1.5.1 General data Transceiver

Operating voltage	12,4 V . . . 15,1 V
Emergency operation (10,0 V)	Intelligible communication
Current consumption 14 V without Panel illumination	
Receive „stand by “	typ. 70 mA
Receive „stand by “ with auxiliary input	typ. 90 mA
Transmit	typ. 1 .8 A
Panel illumination	13,8 V / 40 mA DC
Fuse	5A
Operating temperature range	D1 - 20° . . . + 55°C,
Env. Cat. RTCA DO - 160A	shorttime temperature + 70°C
Altitude max.	D1 50000 ft
Env. Cat. RTCA DO - 160A	
Vibration	MNO
Env. Cat. RTCA DO - 160A	
Dimensions	
Panel	60.6 mm x 60.6 mm
Mounting depth	212.5 mm
Weight	0.9 kg

1.5.2 Receiver specifications

Type Receiver	Single superhet
Frequency range	118.000 MHz . . . 136.975 MHz
Channels	760
Channel spacing	25 kHz
Sensitivity (mod. 1000 Hz/30%)	$\leq 5\mu\text{V}$ emf for 6 dB $\frac{S+N}{N}$
Bandwidth	$\geq \pm 8$ kHz at 6 dB down
Selectivity	≥ 40 dB at ± 17 kHz ≥ 60 dB at ± 25 kHz

Squelch	fixed in unit, defeatable with squelch switch
AGC characteristic from 5 μ V . . . 100 mV emf	≤ 6 dB
Undesired radiation	$\leq 4 \times 10^{-10}$ watt
Distortion / m = 85%	≤ 10 %
Frequency response audio channel relative to 1000 Hz / 0 dB	≤ 6 dB 350 Hz . . . 2500 Hz ≥ 18 dB at 5000 Hz
Intermediate frequency	21.4 MHz
Rated audio output	
Speaker	at 13.8 V operating voltage ≥ 2.5 watt into 4 Ω typ. 3 watt at 10.0 V operating voltage ≥ 1.5 watt into 4 Ω
Headphone	at 13.8 V operating voltage ≥ 40 mW into 300 Ω at 10.0 V operating voltage ≥ 30 mW into 300 Ω
Audio power output unregulated	100 mV/30% mod. $R_i \geq 10k\Omega$
Auxiliary input	1 V eff. / 600 Ω

1.5.3 Transmitter specifications

Transmitter output	at 13.8 V operating voltage ≥ 5 watt at 10.0 V operating voltage (Emergency operation) ≥ 2 watt
Mode of modulation	amplitude modulation A3E
Modulation depth	$\geq 85\%$ ≤ 100 % (dynamic compressing)
Input voltage for m = 85 %	
dyn. mike	no overmodulation at input voltages ca. 2mV Dynamic-Compressor
Standard mike	ca. 200 mV Dynamic-Compressor
Frequency deviation	$\leq 0.002\%$
Undesired radiation	$\leq 2.5 \times 10^{-5}$ watts
Spurious emissions within the 108 - 117.95 MHz range	$\leq 2 \times 10^{-7}$ watts

Frequency response	≤ 6 dB 350 Hz . . . 2500 Hz
Distortion / m = 85% / 1000 Hz	≤ 10%
m = 85% / 350 - 1000 Hz	≤ 20%
Carrier noise level	≥ 35 dB

1.5.4 Optional functions

Digital voltmeter (operating voltage indication)	7 V . . . 35 V DC ± 0.1 V
Digital thermometer	- 20°C . . . +100°C
Temperature sensor	Linear tolerance ± 1,5°C

NOTE

The VHF transceiver is designed for the frequency range 118 to 137 MHz. The frequency range between 136 MHz and 137 MHz may not be used for mobile aircraft radio communications until after January 1990, in accordance with the relevant regulations.

1.6 Certification

FTZ certification	LB 393/83
LBA certification	10.911/76
Specification	
RTCA DO - 156	
RTCA DO - 157	
RTCA DO - 160A	
EUROCAE ED 23 / ED 24 / ED 14A	
Performance classification	D1 / A/MNO/XXXXXXABABA

1.7 Accessories

The following connectors are necessary for connecting the transceiver without options :

1 Cable connector plug for transceiver	Order No. 430.722-277
Antenna connector plug UG 88/U for transceiver	Order No. 725.706-277
IC-Switch	Order No. 213.055-278

When the transceiver incorporates the temperature or voltage measurement option, the following items are required :

1 Cable connector complete

Order No. 431.036-950

Detail parts

1 Cable connector plug for option

Order No. 710.687-277

Temperature sensor - 65°C . . . 150°C

Order No. 431.044-955

Bounceless pushbuttons

Order No. 724.742-278

1.8 Scope of delivery

Screw block

Order No. 472.875-203

Spring washer

Order No. 213.126-213

1.9 Software

Frequency synthesizer, frequency storage and frequency display of the AR 3201 - () are controlled by a microprocessor. The software used has been categorized to Function Criticality Category

„ESSENTIAL“

according to the guide, lines of RTCA DO - 178.

Uses class was determined to be

„CLASS X“

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Section 2 INSTALLATION

2.1 General

Installation of the VHF communication transceiver and the battery box depends on the type of aircraft and equipment involved, the instructions given in this section thus being only generally applicable.

2.2 Pre-installation check

2.2.1 General

Prior to fitting the new system in the aircraft, the units must be checked according to the following procedure to establish whether they have been damaged in transit.

2.2.2 Visual inspection

Prior to commissioning the equipment, carry out a visual inspection to establish any of the following deficiencies.

1. Soilage, dents, scratches, corrosion, broken fasteners, damaged paintwork on enclosures and parts thereof.
2. Soilage and scratches on the nameplate, front panel and markings.
3. Soilage, bends or broken-off pins, cracked plug and socket inserts.
4. Soilage and mechanical damage to rotary switches, LCD elements, knobs and pushbutton.

2.3 Mechanical installation

2.3.1 Mechanical installation VHF transceiver

The VHF transceiver is designed for incorporating in an aircraft instrument panel in behind panel installation. The circular cutout and the fastener holes must be drilled in accordance with the standard for small size instruments. Location must be min. 30 cm away from the magnetic compass of the aircraft to avoid the compass being affected by the transceiver. Dimensional requirements are shown in Fig. 2-4. Four DUZ fasteners (supply) are used to secure the unit.

2.3.2 Mechanical installation of a temperature sensor

The VHF transceiver permits indication of temperatures in the range - 20° C to +100° C with the aid of an integral measuring circuit and a connected remote temperature sensor. The latter is located in accordance with the particular requirements and local conditions. The wiring can be seen from Fig. 2-5. Only use shielded flexed leads, noting the color coding of the connecting cables. The red lead must be connected to J 3101/8, the blue lead to J 3101/2. The shielding must be connected to pin 4 of J 3101.

The temperature measuring circuit in the VHF transceiver and the temperature sensor are calibrated in the factory together for optimum temperature measuring accuracy. Should the device or the temperature sensor develop a fault or should the transceiver need replacing, the device will need recalibrating according to the instructions as given in Section 5, Item 5.7.

2.4 Installation wiring

2.4.1 General

Fig. 2-5 illustrates the installation wiring of the VHF transceiver. In wiring the VHF transceiver the battery voltage feeder cable should be AWG 20.

NOTE

- a) Only use airworthy cable, i.e. self-extinguishing in suitable AWG for power supply and the other lines.
- b) Pull rubber sleeves over the solder junctions on the instrument connector.
- c) A 3 A fuse or circuit breaker must be incorporated in the power supply.
- d) Prior to switching on the unit, carefully check the wiring, particularly making sure that +ve and -ve are not confused.

CAUTION

The AR 3201 - () is only protected against wrong polarity when a fuse is incorporated in the power supply, i.e. so that the fuse blows, leaving the unit undamaged. If no fuse is provided, the unit can be ruined. In this case, the unit is not covered by our guarantee.

Suitable type cable sets are available for aircraft wiring (contact manufacturer).

CAUTION

Never tie any aircraft wiring into the connecting lines. In addition, the connecting cable must not be put down together with line carrying pulsed information (IFC's, DME, XPR, SLAVED GYRO) the same applying to autopilot supply and control lines.

2.4.2 Microphone connection

The VHF-transceiver features a microphone amplifier as standard which is compatible with both a dynamic microphone and a standard microphone. Unless stated otherwise, the transceiver is set in the factory for a dynamic microphone connection. By resoldering jumper Br 4001 on the audio module the microphone input can be changed from a dynamic microphone to a standard microphone. This jumper is accessible after unscrewing the case and removing the audio module. As of serial No. 86, conversion from dynamic to standard microphone has been simplified, jumper 4401 then no longer requiring resoldering but merely reconnecting, without requiring removal of the audio module.

View showing components side of audio module

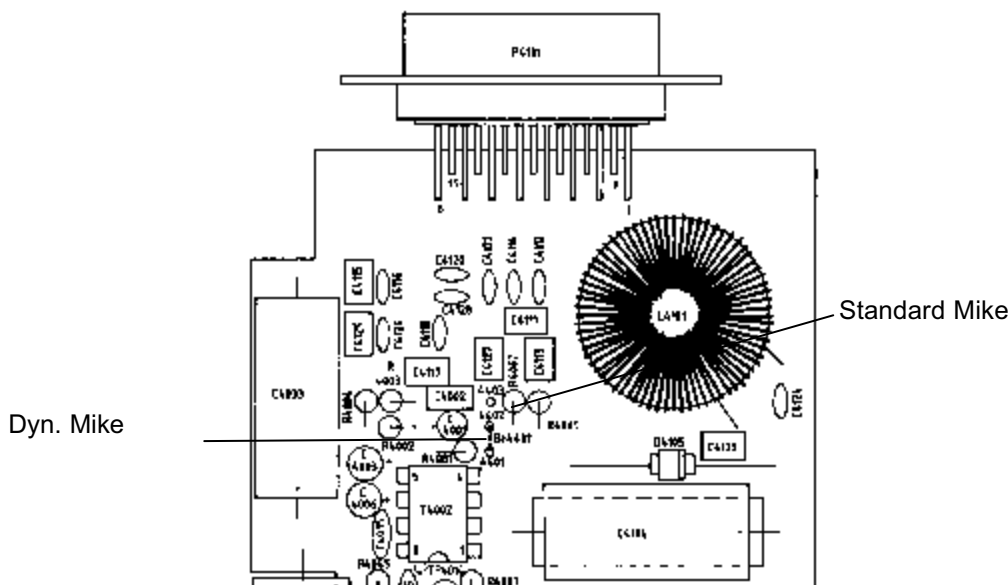


Fig. 2-1 Jumpers location for charging the microphone input from dynamic to standard microphone

2.4.3 Speaker/headphones connection

The audio output of the transceiver is compatible with a 4Ω speaker or headphone with an impedance of 300Ω - 600Ω or both in parallel without having to switch the transceiver over.

CAUTION

The magnetic field of the speaker will affect the compass, therefore, minimum spacing between speaker and compass must be 1.3 m when selecting speaker location.

2.4.4 IC connection

The IC connection is provided for aircraft with high ambient noise and requires use of the headset together with an IC switch in the unit connector for the additional wiring (see aircraft wiring Fig. 2-4). The normal communications position is the OFF position of the IC-switch, i.e. in the ON position communications operation is the same as before, however, with intercommunication between the two crew members without having to press the (PTT) button.

2.4.5 Panel lighting

The transceiver features a panel lighting circuit which must be connected to the + 14 V supply voltage by connection P 4101/7 or to a dimmer control. It is good practice to provide the lighting externally via a separate lighting switch to save current in aircraft having no power system, e.g. gliders.

CAUTION

The lighting is not switched off on operation of the ON/OFF switch.

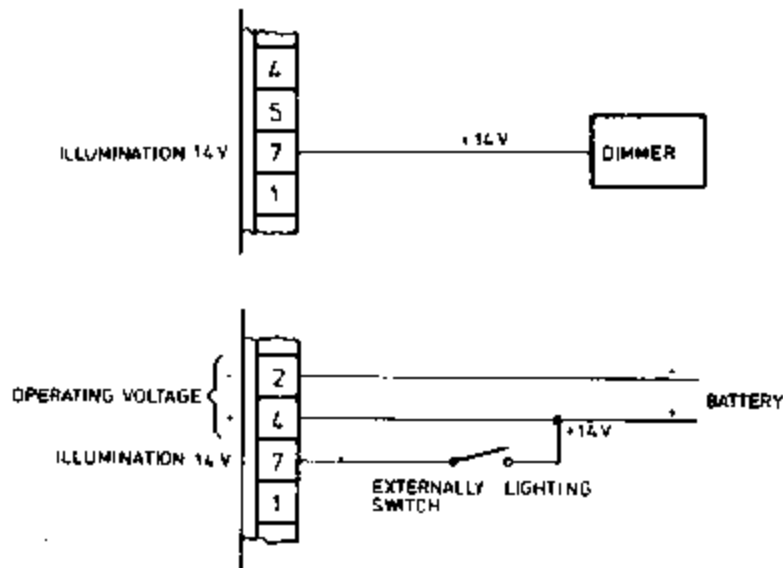


Fig. 2-2 Panel connection

2.5 Auxiliary audio input (optional) (standard as of module No. 471)

The auxiliary audio input permits audio input from other equipment in the aircraft. This input can only be heard, however, in the RX mode. The possibility of circuiting two units together finds application in aircraft having, for instance, only one transceiver and one NAV receiver. When using the auxiliary audio input, a 680 Ω resistor must be switched to GND. When circuiting units together, 100 Ω decoupling resistors must be included (see following diagrams). Output of the audio listening amplifier requires an audio input voltage of approx. 1 V/600 Ω .

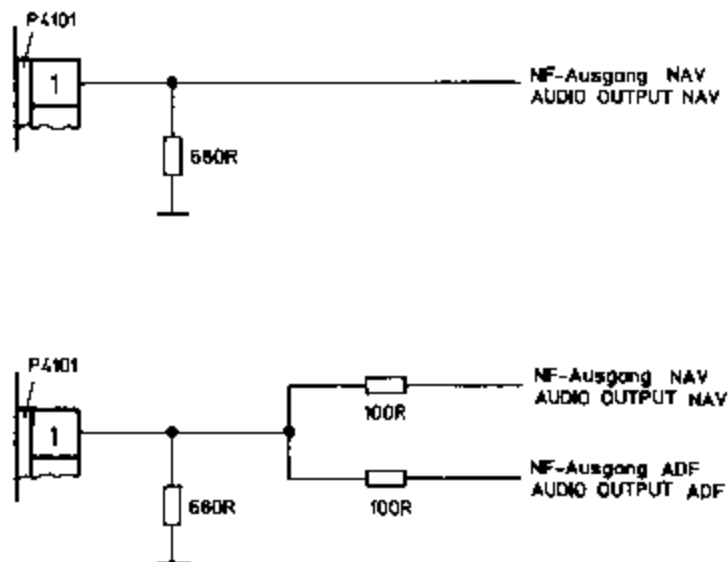


Fig. 2-3 Auxiliary audio input

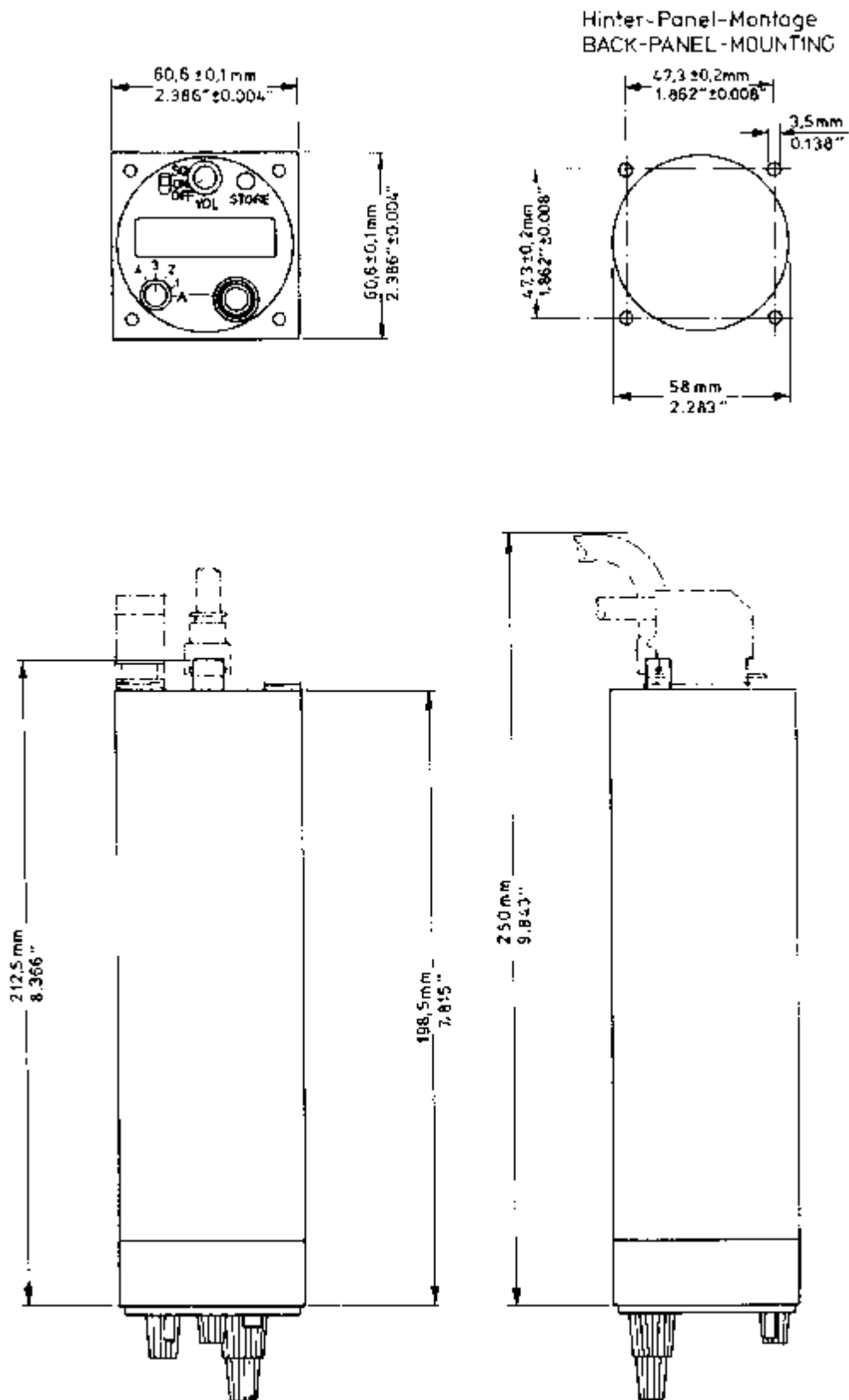


Fig. 2-4 Dimensions of VHF transceiver

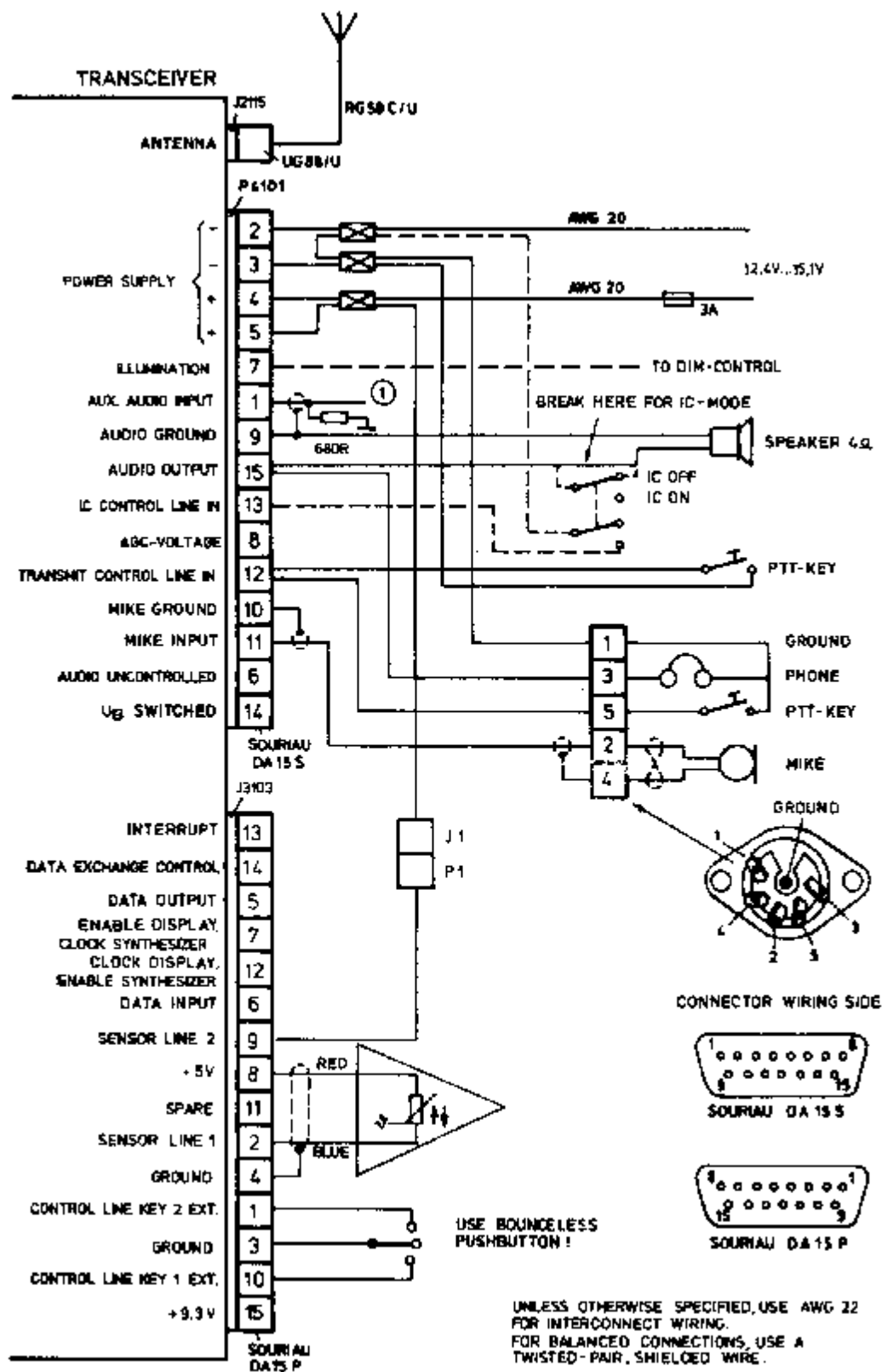


Fig. 2-5 Aircraft wiring

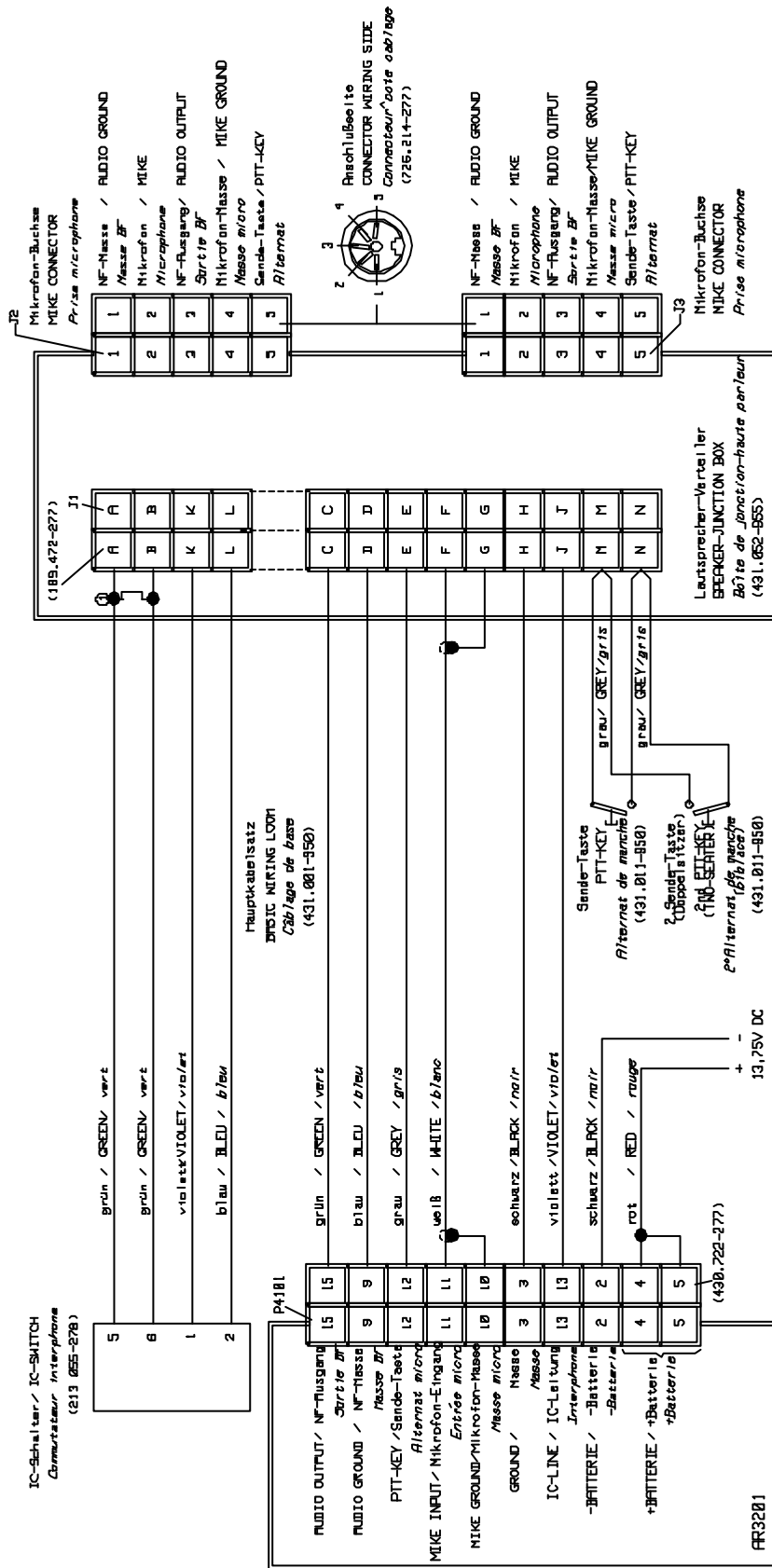


Fig. 2-6 Wiring diagram AR 3201 - () with Speaker - Junction

Bordverdrahtung AR3201 mit Hauptkabelsatz und Lautsprecher-Verteiler
WIRING DIAGRAM AR3201 WITH BASIC WIRING LOOM and SPEAKER-JUNCTION BOX
Câblage à bord pour le AR3201 avec câblage de base et jonction-haut parleur

Remarque / NOTE / Remark
① Brücke, falls kein IC-Schalter montiert. K und L frei.
JUMPER IF NO IC-SWITCH IS USED. NO CONNECTION AT K AND L.
Pont, au cas où le commutateur interphone n'est pas monté. K et L non occupés.

() Bestell-Nr. / STOCK NO. / No. de commande

2.6 Testing after installation

2.6.1 Ground testing with engine OFF

After installing the transceiver, measure antenna matching between antenna base and antenna feeder by means of a VHF reflection meter (voltage/standing-wave meter).

Over the complete frequency range of the transceiver, the voltage/standing-wave ratio must be within the value 3 : 1. Exceeding this value is an indication of mismatch, which can be due to a wrong or inadequate counterweight.

After antenna measurement, carry out a voice test with the ground station.

2.6.2 Ground testing with engine ON

With the engine running make sure that the aircraft voltage is within the permissible tolerances at approx. 14 V. Make the test at engine cruising speed. Carry out speech test at a long distance away from the ground station. At engine cruising speed the cabin noise of the aircraft must only be heard muted thus making for clear, intelligible conversation. Hold microphone close to lips when speaking. Switch on intercommunications by means of the IC switch (when provided) and carry out speech test at engine cruising speed.

If necessary, correct volume by means of IC control (see Fig. 2-7).

Apply squelch switch and check squelch function. The squelch threshold can be set from without by means of the squelch control.

CAUTION

In speaker operation no acoustic feedback should occur via the sidetone. If necessary, turn down sidetone by means of the SIDETONE control.



Fig. 2-7 Location of IC control

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Section 3 Operating Instructions

3.1 Control and Indicators

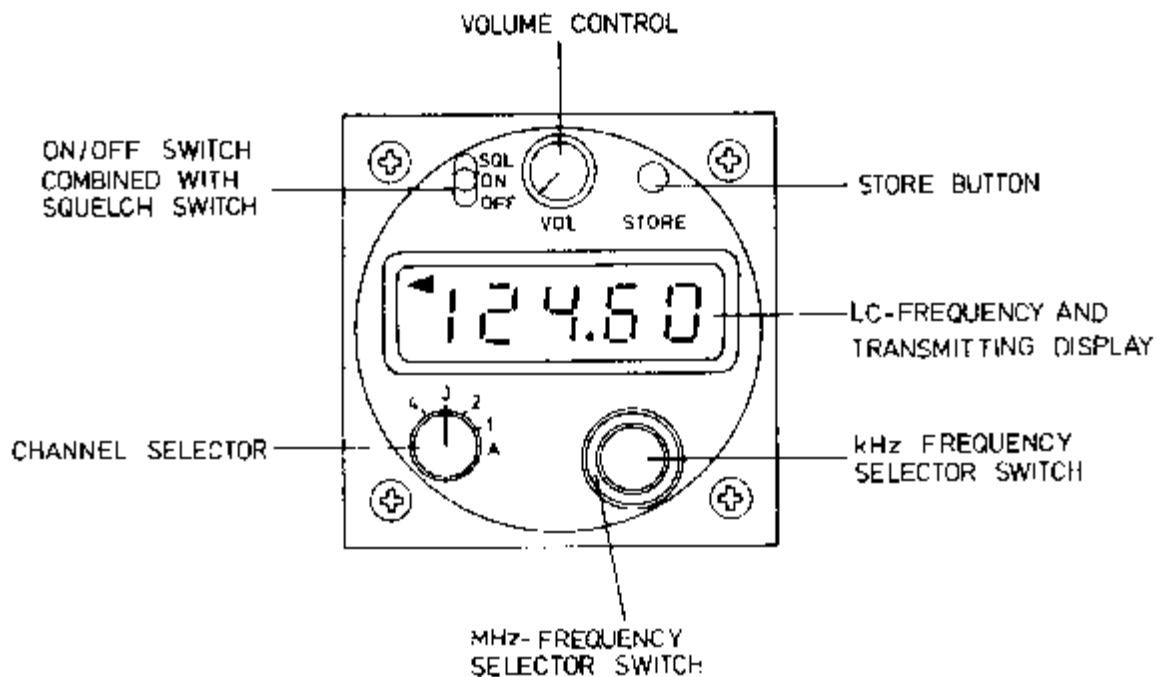


Fig. 3-1 Controls and indicators

Controls and indicators	Description	Function
Volume control	Potentiometer	Turning control clock-wise increases volume continuously.
ON/OFF switch combined with squelch	3-position rocker switch	Position OFF : VHF transceiver OFF. Position ON : VHF transceiver ON, squelch OFF (input noise audible). Position SQL : Transceiver ON, Squelch ON. Input limited to transmitters having a field strength exceeding the set squelch threshold

Controls and indicators	Description	Function
Channel selector	5-position rotary switch	<p>Position A : When the transceiver is powered up, a brief test routine is performed for the segments of the display. Afterwards the channel frequency 121,500 MHz appears in the display and the transceiver is ready for operation. In models with serial no. of 4000 or above, the most recently set frequency instead of 121,500 MHz.</p> <p>The setting of channel frequencies is performed with the channel selector switch in position A, regardless of the units serial number</p> <p>Position 1 through 4 : If it is wished to store a channel frequency in any one of the four memory locations, then channel frequency to be stored must first be set with the frequency selector switch in position A. Then the desired memory location is selected using the channel selector switch, and the Store button is pressed. Stored channel frequencies remain in the memory even, when the unit is powered down and can be immediately called up again after the unit has been switched on.</p>
MHz frequency selector switch	Rotary switch (continuous)	Switches the MHz steps indicated by the frequency readout.
kHz frequency selector switch	Rotary switch (continuous)	Switches the 25 kHz steps indicated in the frequency readout. The 3rd digit behind the point is not indicated, e.g. 125.52 = 125.525 MHz.
Frequency indication	LC display 5 digits	<p>When the unit switched on, following completion of the self-test routine the frequency appears in the display on which the unit is ready to operate. During transmission, in models with serial no. 4000 or above arrow also flashes on and off.</p>

Controls and indicators	Description	Function
Store button	Pushbutton	Briefly pressing the STORE button causes the display frequency to be stored in one of the four memory locations, provided that the channel selector switch is not in position A, but set to one of the four memory positions (1 - 4). In models with serial no. of 4000 or above the STORE button must be held depressed for approx. 2 seconds in order for the displayed channel frequency to be written into the selected memory location.

3.2 Operating instructions for serial no. 0 to serial no. 3999

NOTE

Switch off transceiver when engines are started or stopped.

1. Switch on VHF transceiver with ON/OFF switch. For a few seconds the LC display reads 188.88 (display test). The transceiver then automatically switches to 121.500 MHz (emergency frequency) when the channel selector is in position A. When it is positioned to one of the stored channel frequencies (switch position 1-4) the display reads the stored channel frequency. To select a channel frequency other than the stored channel frequencies, position channel selector to A and then set the desired frequency by means of the MHz and kHz frequency selector switches.
2. Set to frequency of local ground station and position VOL control to center position.
3. Operate PTT key and call ground station. For optimum intelligibility keep microphone almost touching lips.
4. On response from the ground station adjust for desired volume using VOL control.
5. Position ON/OFF switch to SQL to suppress weak input signals and input noise.
6. The sidetone volume can be adapted to the noise level of the aircraft by means of the sidetone volume control.

3.3 Operating instructions serial no. 4000 upwards

NOTE

Switch off transceiver when engines are started or stopped.

1. Use the ON/OFF switch to turn on the VHF transceiver. For a few seconds, the digits 188.88 will appear in the LCD (display test), as well as an arrow to indicate transmission mode. Afterwards the VHF transmitter automatically switches to the most recently set frequency, if the channel

selector switch is in position A. If the channel selector switch is set to one of the stored channel frequencies (any one of switch positions 1 through 4), then the channel frequency stored in that memory location will appear in that display. If any other channel frequency is desired other than those channel frequencies stored, then the channel selector switch should be set to position A whereupon the desired frequency can be set using the MHz and kHz frequency selector dials.

2. Repeat steps 2 through 6 of Section 3.2.

3.4 Storing frequencies

Four memory locations are available for channel frequencies; each of these can be used to store any channel frequency used for aircraft communications. They can be used in any desired order. To store, proceed as follows :

- a) Switch the channel selector switch to position A.
- b) Use the MHz and kHz rotary switches to set the desired channel frequency.
- c) Set the channel selector switch to the desired memory location.
- d) Press the store button. For models with serial nos. of 4000 or above, the STORE button must be held depressed for approx. 2 seconds.

NOTE

When overwriting a stored channel frequency, the same procedure as listed in steps a. through d. should be followed.

3.5 Setting the emergency frequency

3.5.1 Setting the emergency frequency on models with serial numbers up to 3999

As already described in the operating instructions, the transceiver automatically switches to the emergency frequency 121.500 MHz when the channel selector is positioned to A in switching the transceiver on. To quickly switch to the emergency frequency in an emergency situation best procedure is to switch the channel selector to A and to briefly switch the transceiver off/on, after which the transceiver operates on the emergency frequency of 121.500 MHz. Under normal operating conditions, this can be set by means of the frequency selector switches. Another possibility is to store the emergency frequency directly in one of the four available channels.

3.5.2 Setting the emergency frequency on models with serial numbers of 4000 or above

In models with serial numbers of 4000 or above, the emergency frequency 121.500 MHz does not automatically appear when the channel selector switch is in position A and the transceiver is powered up. It is recommended to store the distress frequency in one of the 4 memory locations.

In models with serial numbers of 4000 or above, an arrow flashes on and off in the LCD during transmission. This is activated by the microprocessor, which outputs the instruction for this along with the other data for the liquid-crystal display.

3.6 LC display blinking

As soon as the operating voltage for the transceiver drops to a value of 10.5 V to 11 V, the display starts blinking to signalize, e.g. in battery operation that the batteries need recharging. The display will start blinking in transmitter operation since this situation involves the highest current drain.

Since the discharge curves of batteries greatly depend on the type of batteries involved, e.g. lead-acid or nickel batteries and on the ambient temperature of the batteries, no accurate indication can be given as to how long the transceiver will remain fully functional on commencement of LC display blinking. After a few keying cycles, the batteries can be empty in transmitter operation. In receiver operation the instrument will remain functional for approx. 1-2 hours from commencement of blinking.

At an operating voltage of 10 V, the transceiver remains fully functional, but at reduced output power.

3.7 IC operation

1. Switch on IC switch.
2. Carry out speech test.
3. IC volume can be adapted to the noise level of the aircraft by means of the IC volume control see (Fig. 2-7).

3.8 Optional temperature, voltage measurement

When the standard version is supplemented by optional temperature and voltage measurement circuits, note:

Temperature or voltage is measured continuously, whereas display follows only after pressing the external pushbutton for approx. 4 sec, after which the previously set channel frequency appears.

NOTE

Independent of the temperature or voltage measurement, transceiver operation is available at the set channel frequency even when the instrument is displaying a temperature or voltage indication.

3.9 Auxiliary audio input (optional) (standard as of module No. 471)

Via the auxiliary audio input, other radio equipment (e.g. navigation receiver) can be monitored. When the system is wired up for this application, the volume control of the remote equipment must be set so that these inputs are intelligible and can be differentiated from each other.

During transmission the auxiliary input from the audio output amplifier is OFF.

3.10 No channel frequency storage

When the stored frequencies are lost when the transceiver is switched off, first measure the battery voltage at the two button batteries which must be 2.4 V. These batteries are automatically charged when the transceiver is switched on. When the unit is not switched on for a long time, or in lengthy storage, the batteries may become discharged. To recharge the battery, it is sufficient to simply connect the transceiver to the aircraft voltage for a couple of hours. The service life of a new battery is between 3 and 5 years.

3.11 Precautions

In order to secure a reliable transceiver operation, please note the following precautions:

- a) Before running-up the engines, ensure that the transceiver is switched off.
- b) Always conduct a verbal pre-flight check. Note that in the vicinity of a flight control, a broken or shorted antenna cable must not necessarily impair the function. At a distance of 5-10 km from the ground station, however, the connection will doubtlessly fail.
- c) Transceiver communication contact should always be conducted using a clear, loud voice and by speaking directly into the microphone. Otherwise, cabin background noise could predominate, making the message inaudible.
- d) Use suitable microphones or headset for aircraft only. With certain aircraft types (wood or fibre-glass aircraft, gliders and helicopters) the signals transmitted by the unit's antenna may be picked up and enhanced by the integrated microphone amplifier (feed back). As a result, the signal received by the flight control will be superimposed by whistles and/or strong distortion. This phenomenon may not necessarily remain constant for all channels.
- e) The PTT button of the microphone or control unit might jam, causing the system to remain in the transmission mode. In order to rule such cases out, please ensure that the arrow in the frequency display (from serial no. 4000 onwards) illuminates during the transmission mode, and extinguishes when the PTT button is released.

DX 50 FAI

DX 50

GPS-Flight information centre

User guide

LX navigation



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Introduction

DX-50 represents a GPS-Variometer system of the newest generation. The instrument is the combination of modern GPS technology and traditional Variometer system.

This manual will lead you to know the device, its functions and all the advantages. Please read it carefully through before you build in the device. The best way to learn basic and more advanced facts about the DX-50 is to turn it on at home and go step by step through this manual. We have made our best to achieve as little handling during the flight as possible, if the on-ground preparation has been optimal.

Please beware that the airfield data (frequency, altitude, etc.) can very easily lose their topicality. These data, as also the GPS-device itself, can only be helpful by the flight navigation. The appropriate on-ground preparation and the use of appropriate data is therefore indispensable.

The manufacturer doesn't take the responsibility for possible mistakes or misprints in this text and gives no guarantee for accuracy of this manual. Any possible technical alterations of the device itself or software are naturally excluded.

This manual has been written with all attention and we have made our best to avoid any mistakes but with all respect please check any doubtful statement and let us know. We would be very grateful and for any comment we thank you in advance.

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1 General description

1.1 Technical data

Voltage supply:	9 - 30 VDC
Current input (volume 0):	ca. 300 mA bei 12V
Operating temperature:	-20 to +60 °C
Storage temperature:	-30 to +80 °C
Dimensions:	96x190 mm
Total weight:	ca. grams
GPS receiver:	8-Chanel, parallel
Pressure probe:	1 silicium pressure probe for altitude meter (vario) and flight

1.1.1 The difference between the DX 50 FAI and DX 50

The DX 50 FAI is the official FAI logger which is accepted by the IGC (International gliding commission). All the inflight functions are the same by both instruments, the only difference is that the DX 50 has no logger menu and all its functions. Therefore the record flights or DMST flights can't be documented when you are flying with DX 50.

1.2 Variometer system

The variometer system consists of these functions:

- Total energy compensating variometer (TEC variometer)
- Netto relativ variometer
- Interval integrator
- Speed command
- Tone generator

The interval integrator calculates the average climbing rate with the time constant, which can be defined by user.

For the speed command calculation the polars are available for some of the more common glider types. For calculation of some other parameters the included PC program "POLAR.EXE" is available. The DX 50 enables you to put in these values.

The speed command signal is optically marked as SC on the main display and as an arrow on the LCD indicator (vario is marked with a circle on the same place). There is a special audio signal during the speed command (no beep in + and there is a dead area of audio around zero). The dead audio area can be adjusted in DX 50 SETUP program.

The following changable parameters influence on the speed command signal:

- the McCready value
- the wing load
- the glider polar
- the wind
- muddy wings (degradation of the polar in % of the best glide ratio, BUGS in SETUP)

The units for wing load can be selected (kg/m² or lb/ft²). It is also possible to enter the wing load as the percentage multiplier (overload) of the standard calculated wing load. The wing load value can be raised in 10% steps to maximum of 60% (= 1.6).

The BUGS value can be altered in 2,5%- steps to max. 30%, of the best glide ratio. This causes the deterioration of the glider polar.

There are several different filters available in SETUP program for the variometer. The lower the filter value entered, the lower the speed command dead area.

- the smallest filter for calm air
- the biggest filter for turbulent air

1.3 Electronic altitude meter

The electronic altitude meter in DX 50 operates with the newest temperature compensated pressure probe. All the altitudes shown in DX 50 are barometric altitudes and not GPS altitudes.

After you have turned on the DX 50 you will be asked to enter the current local altitude. The blinking altitude is the altitude of the last landing point from the database. After the altitude entry the current QNH should be entered. This pressure is shown on the barometric altitude meter after the local altitude entry in the hp- bzw. mb- window. The QNH entry is not necessary, but in DX 50 it is needed as a reference for the altitude meter, for during the flight the air pressure alterations could be entered.

During the flight the altitude meter alteration isn't possible without the previous QNH entry.

1.4 GPS-Navigation

By means of the integrated GPS navigation system the DX 50 is able to accurately calculate all position data. All courses respectively speeds calculated by the GPS are related to ground, that means that the indicated ground speed can deviate from the indicated airspeed. The largest deviations are caused by the altitude error of the airspeed indicator respectively by an existing wind component.

The following parameters are calculated by the GPS:

- Track (TRK)
- Bearing to the way pint (BRG)
- Groundspeed (GS)
- Distance to the way point (DIS)
- Estimated time of arrival at the way point (ETA)
- Estimated enroute time to the way point (ETE)
- Selected course to the way point (DTK, desired track)

1.5 Flight computer

The flight computer in DX 50 calculates the glider's course deviation drawn on the actual distance from the next way point under consideration of the security altitude entered in the SETUP program. On the display the digital value of the quantitive glider's course deviation is indicated (for instance - 320m).

For wind calculation (direction and speed) five different options are available, which can be selected in all navigational programs.

The wind component, which is necessary for the flight is automatically calculated and considered.

For the geknickte flights it is possible to enter the last turn point also as check point. In this case the glider's course isn't calculated to the next turn point, but over the check point to the finish line. This is necessary when the last turn point is very close to the finish line , and so the final glide altitude can be reached before the last TP.

When the glider departs from the finish line, the necessary altitude for the safe return is calculated considering the actual wind component and entered safety altitude.

When the GPS during the flight for 60 seconds or longer receives no signal, turns the computer automatically traditional distance calculation on. The last from GPS calculated distance to selected way point is then used as the starting point.

1.6 Flight path recording

The flight path recorder in the DX 50 automatically records all position data of the airplane (position, altitude, vario). The recording is repeated every 20 seconds by the DX 50, by the DX 50 FAI the recordings are repeated according to the preset interval in the LOGGER setup. The data can be read out by a PC or notebook, stored or even printed. Nach dem Einschalten wird die Speicherkapazität gezeigt die von Setup (DX 50 FAI) abhängig ist.

1.7 Airport and turning point database

The DX 50 is able to store up to 5000 airports, 600 turning points and 100 tasks with 10 turning points each. In the original version already several thousands airports (e.g. in Europe) are stored. These easily can be selected by the user and can be modified or deleted. This can be done either directly at the LX 5000 or leisurely at home if a PC is available. The delivery scope of the DX 50 contains a corresponding disc with the transfer and editing software.

Please beware that the manufacturer can not guaranty for the accuracy of the airport and TP data after the date of their publishing.

1.8 Coordinates

The DX 50 enables you to enter the coordinates in degrees, minutes and seconds or decimal minutes. The favoured format can be selected in SETUP program.

Latitude (LAT): N/S GG.MM.mm or GG.MM.SS (N= North, S= South)
 Longitude (LON): W/E GGG.MM.mm or GGG.MM.SS (W= West, E=East)
 GG= degree
 MM= minutes
 mm= decimal minutes
 SS = seconds

With the following formula seconds can be converted into decimal minutes:

$$\text{decimal minutes} = \frac{\text{seconds}}{0,6}$$

Before entering coordinates from already existing list please take note in which format these coordinates are given. The right coordinate format should be selected in SETUP program before the entry. If necessary the coordinates can be converted with the above mentioned formula.

1.9 Glider polars

Nowadays in the DX 50 some 30 glider polars are stored which can be selected in SETUP menu. For the gliders which polar is not included in this list it is possible to define your own two polars which can be added to the existing list.

These polars are defined by 3 coefficients (a, b and c). These coefficients can be calculated by the program POLAR.EXE which is included on the software support disc. Three pairs of values need to be selected out of the speed polar diagram of the glider and entered in the program mentioned above. The coefficients a, b and c can then be entered in the DX 50. According to our experience the values by these airspeeds should be used: 100, 130 and 160 km/h.

2 Installation

Please read the following installation instructions carefully through before mounting the device into the glider.

2.1 Mechanical fixing

For the DX 50 a new fixing method of the instrument in the instrument panel has been developed.

The whole instrument can be removed very simply from the front side of the instrument panel. There are special pneumatical connectors which allow to remove the instrument without disconnecting the plastic tubes. The same holds true for the electrical wiring. That means that the pilot needs only a few seconds to remove the instrument and bring it to the scoring office.

- prepare the instrument recess according to the drilling plan
- fix from behind the instrument holder
- mount the tubes on the Ptot, Pst and TE
- plug in the antenna

2.2 Antenna

The delivered GPS antenna has to be mounted in the airplane in such a way that the optical range to the sky is not obstructed. The cover of the instrument panel in the airplane is the best mounting position. It is also possible to mount it underneath the instrument cover provided it is not made of carbon fiber reinforced plastics or metal (e.g. aluminium). Please pay attention that the antenna is not shielded by metallic parts or by solar panels and that it is not mounted in the immediate vicinity of the magnetic compass.

It is recommended to test the receipt of the GPS signal with a provisionally mounted antenna first before mounting the antenna permanently. The antenna should only be mounted after an optimal mounting position has been found.

You can lay the antenna cable according to the following rules:

- the antenna cable should not be kinked
- it should be laid in as large radii as possible
- do not wind up extra antenna cable to a ball or wind it round the antenna
- the antenna cable should never be laid close to other current-carrying leads or antenna cables

The delivered antenna should not be mounted outside the airplane.

2.3 Pneumatic connection

On the back of the mounting frame there are three pneumatical connectors (static Pst, Pst TE, Total pressure Ptot).

Pst is always connected to the static source of the glider using TE probe for compensation connect Pst TE to the TE

probe. Ptot is allways connected to the total pressure source of the glider (Pitot). See Figure 1 for details.

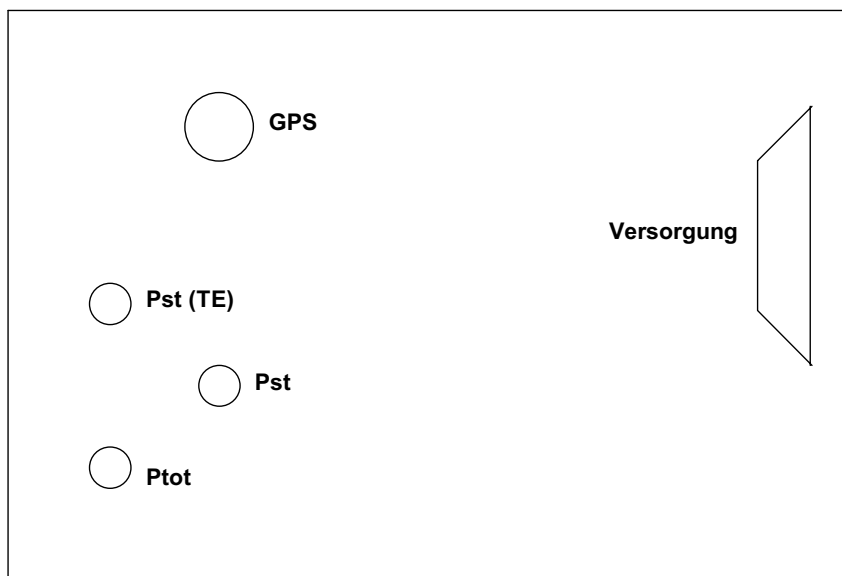


Figure 1: pneumatic connection

Attention:

Do not blow into the pressure connectors of the instrument, because the pressure sensors could be damaged.

2.4 Wiring

All the cables needed for the normal operating of the instrument are included in the package:

- All the cables are shielded

The two strided cable ends of the power supply cable have to be connected to the power supply in the glider. If possible use a supply cable with a large crossection and pay attention to a proper grounding.

The power supply (RED) should be protected with a fuse (1,0 Amp) in any case!!

red end = PLUS

blue end = MINUS/ground

The panel jack of the PC interface can be mounted in the instrument panel. If required the delivered interface cable to the PC COM port can then be plugged in the panel jack.

The speaker should be connected with the cinch jack to the cable set. The speaker should be as far from the magnetic compass as possible because of the possible disturbances of the compass.

The cable labeld SC is used for manual external speed command change over (switch on the stick or flaps).

The cable labeled **NMEA** will only be used when the external Moving-Map-System is run on the DX 50.

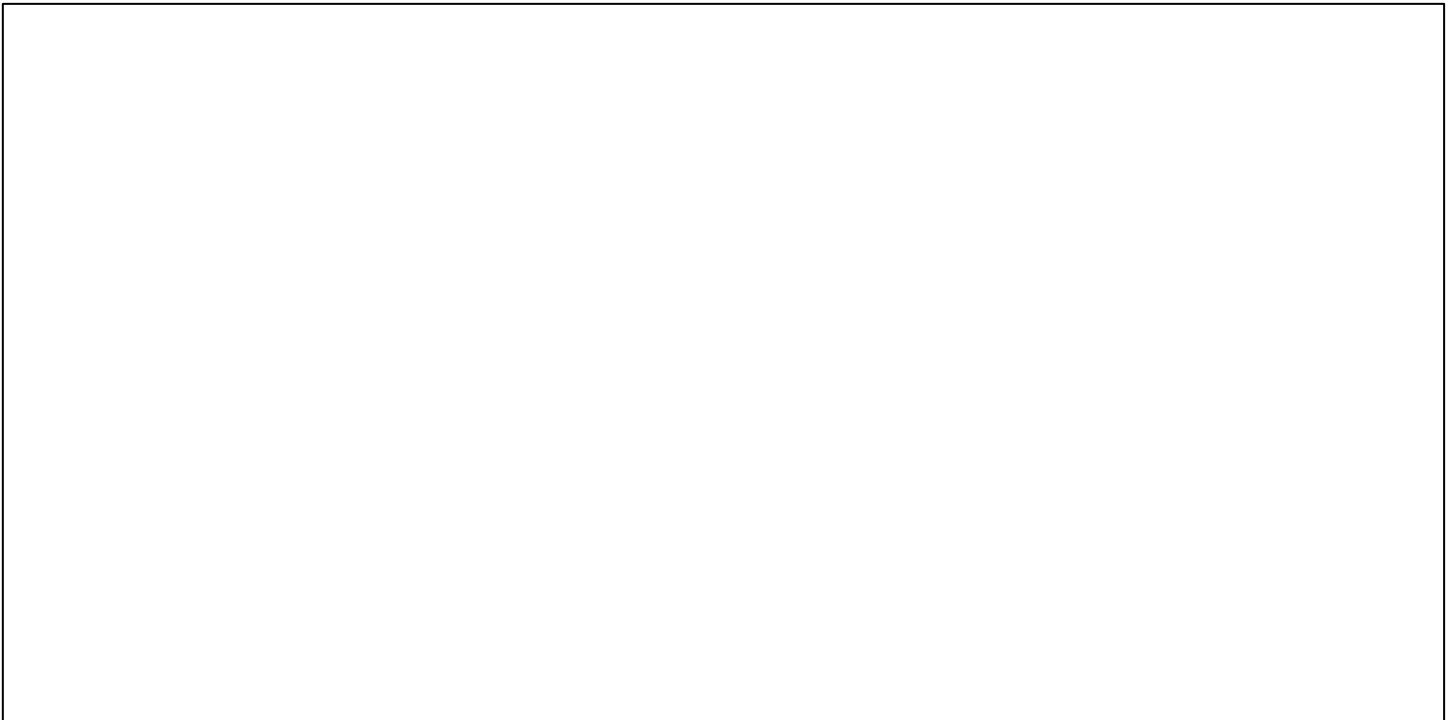
The accurate wiring plan is shown on the beginning of this manual.

3 Operation

The operation of the DX 50 was designed as user friendly and as simple as possible. Flying with the DX 50 is possible without a long familiarization.

3.1 Control elements

The control panel of the DX 50 is equipped with 14 key keyboard.



The control elements have the following functions:

	Function:
ON switch	used to switch the instrument ON
Mode selector	the device has 7 different modes, which can be easily selected with +/- keys
Up and down cursor keys	with this keys you can select the input data (e.g. to scan up and down the alphabet or the figures from 0 to 9)
Speaker	with the combination of this key and the +/- keys you can alter the speaker's volume
McCready switch	use MC key in combination with +/- keys to alter the McCready function
Ballast switch	use BAL and +/- keys to alter the ballast entry
ENTER button	with the ENTER-button the entered data are confirmed or activated and the menus are opened...
ESC button OFF	with the ESC button you can skip input data or return from already selected functions; if holded for a longer time (few seconds) the instrument will turn OFF
START button	to start the programmed tasks (only possible when fling), to store the curent position as way point (only in TP mode) and to operate the stop-watch (only in POS mode), as well as to return to the corresponding mode during the editing process. If you push the START button in the APT navigation program the full APT name will be shorty displayed in the upper line.

After any button is pushed a short beep is heard !

3.2 Data editing and selction

Editing as well as selcting of data are done the same way in all modes of the DX 50. To reach a high degree of comfort a simple and especially logical operation of the instrument is used to guarantee a quick familiarization and an unmistakable operation.

When the instrument is ready for the input of a letter combination, e.g. a TP name the cursor flashes on the first position of the input field. Now you can select the different letters of the alphabet or figures from 0 to 9 by pushing the up and down cursor keys. If you push the ENTER button the selcted letter or figure is stored and the cursor moves to the next position of the input field.

Using the START button the cursor can be moved one position to the left again to correct possible mistakes.

By pushing the ESC button the whole following data block can be skipped. This could be necessary e.g. if you do not want to push thr ENTER button 4 times to store already indicated signs.

Example:the input of the airfield altitude

After the turning ON the DX 50 the curent airfield altitude should be entered.

The different figures are then selected by up and down cursor keys; do not forget to confirm every chosen value by pushing ENTER. If the altitude displayed is correct, so you don't want to change it, then just push ESC to skip the whole figure block or confirm every figure by pushing thr ENTER button.

Again, here is a short summary:

- to confirm an input ⇒ ENTER button
- to skip an input ⇒ ESC button
- to move the cursor to the left: ⇒ START button

These procedure is the same by all the inputs made.

3.2.1 The wing load adjustment

The actual wing load can be entered in kg/m², lb/ft² or as an OVERLOAD in procentage (1.2 equals 20% overload). The wanted unit can be selected in the SETUP program.

Example:how to calculate the overload procentage:

The glider polar which should be entered in the DX 50 is based on the wing load of 35 kg/m². But the actual wing load is 42 kg/m². This calculation should be made:

$$\text{Overload} = \frac{\text{curent wing load}}{\text{standard wing load}} = \frac{42\text{kg/m}^2}{35\text{kg/m}^2} = 1,2$$

By this example the value 1,2 (that is 20% increased wing load) should also be put in. Independably of the selected wing load units the entered value apperas on display.

3.2.2 Input of the McCready values

The input of the McCready values is done by pushing the MC button and by pushing + or - key shortafter, the input value apperas on display.

4 DISPLAY presentation

The following figures show the display of the DX 50 and the indicated data:

4.1 Glider navigation display 1

The navigation display is the most needed information source of the DX 50. All required information for a precise navigation to a certain point are shown on this display. All calculated data are related to the way point that is shown in the first line.

- BRG indicates the bearing to the way point
- DIS indicates the distance of the glider to the selected way point
- GS indicates the ground speed of the glider
- TRK indicates the track of the glider

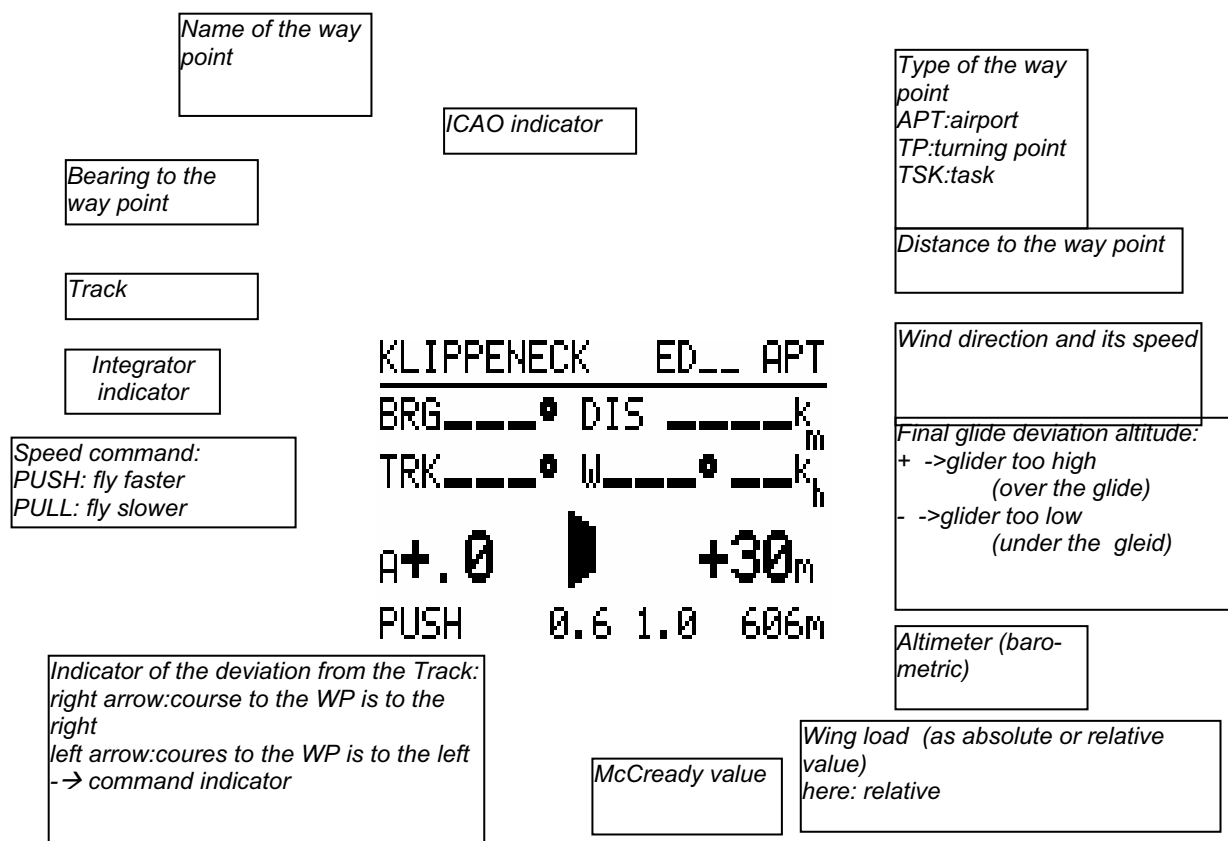


Figure 2: glider navigation display

4.2 Graphic display

The graphic display serves as a navigation support in a graphic and alphanumerical form in the APT, TP, und TSK modes.

The graphic display is second to the navigation display in the above mentioned modes. The graphic display is called by pushing the AB button.

The most important data as BRG(B), TRK(T), GS(G) and distance are shown on the right hand side of the display.

The name of the selected way point appears in the shortened form.

In the graphic part of the display the current position of the glider is shown in relation to the selected course or to the selected way point respectively.

The different air space structures are shown all together or related to their type fading in or out (see SETUP).

Two different glider symbols are available and are configured in the SETUP program.

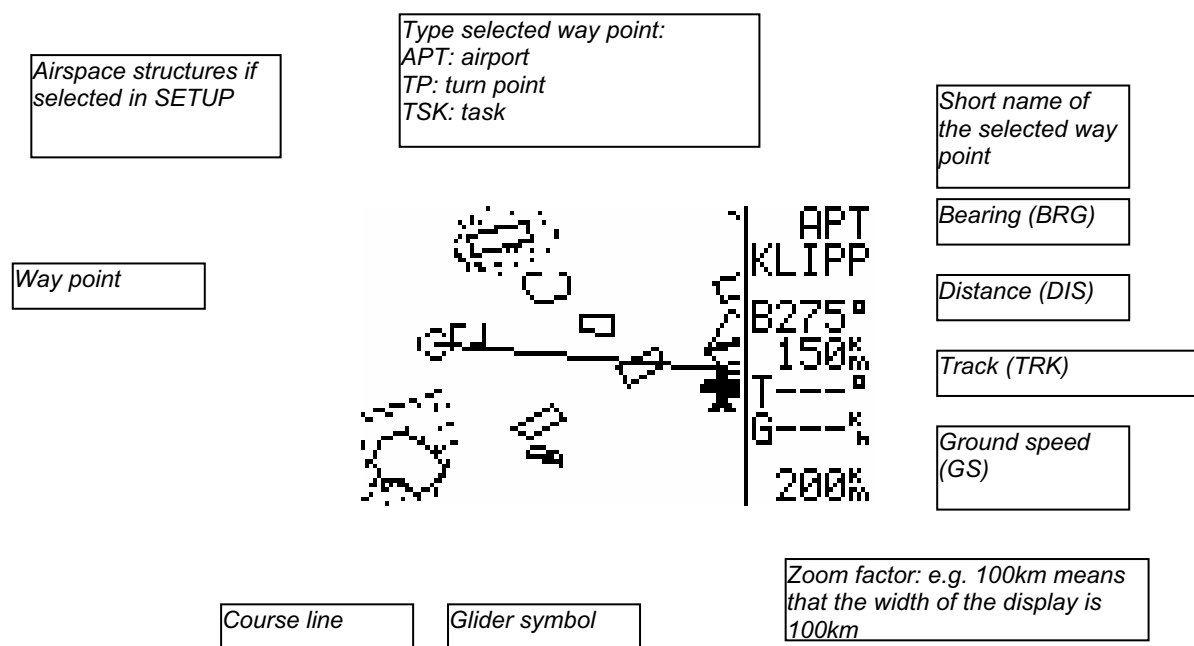


Figure 3: Graphic display

If there aren't enough satellites for the navigation in the lower part of the display the warning GPS BAD is displayed. **The ZOOM function ("+" or "-" button)** enables you to select the scale from 200 km to 100, 50, 20, 10, 5 and 2 km. The selected scale value is shown in the left bottom corner of the display. In the TASK mode 'Z' is displayed for ZOOM and the TSK, LEG or FS (photo sector) for the presented mode. By pushing the AB button the belonging navigation display is switched on.

4.5.3 Navigation display

All the required information for a precise navigation to a certain point are shown on the navigation display as well as on the glider navigation display described above. Some specific glider information are added to the bottom of a display as a scale which shows the lateral deviation from the selected course. The scale can be altered by pushing the + or - keys (only when the navigation display active is). The function can be compared with the OBS and CDI of a VOR receiver.

All calculated and displayed data are related to the way point or airfield that is shown in the first line.

- DTK This value can be selected by “+” or “-” button. It corresponds to the OBS of a VOR receiver. With a DTK a course can be selected. It is not adjustable in the TSK mode!!
- CDI indicates the lateral deviation from the selected course (DTK)
- XTE indicates the lateral deviation from the selected course (DTK) in km, nm or ml

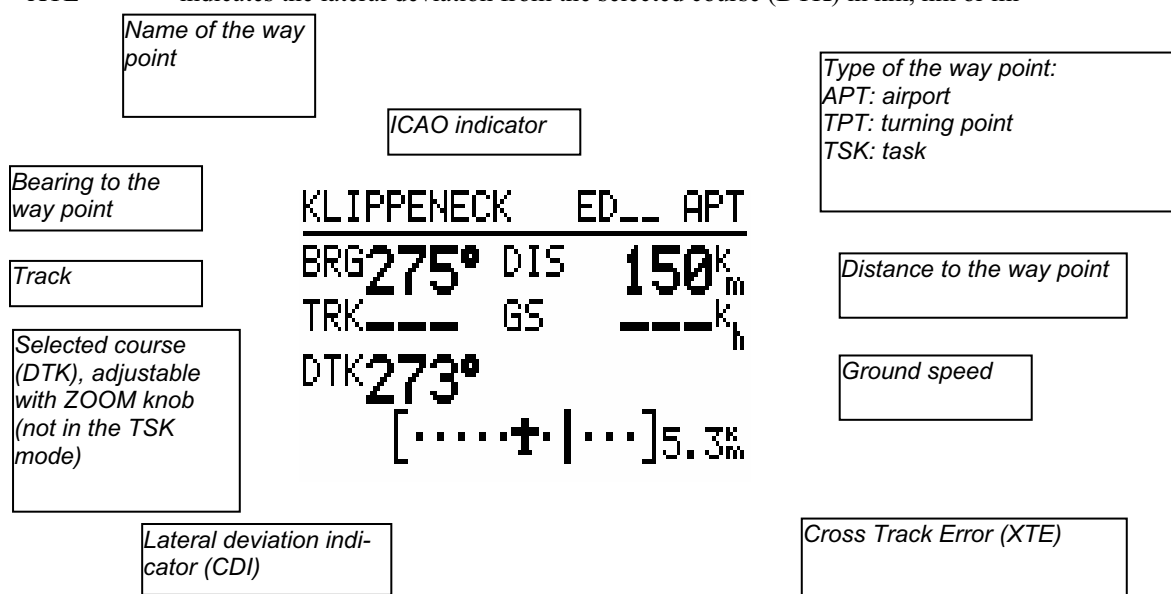


Figure 4: Navigation display

This display can be turned off in SETUP program with password (PAGE3) if not needed.

By pressing the AB button in the navigation menu the corresponding arrival display is shown.

4.3 Arrival display

The arrival display informs you about the arrival data of the currently approached way point in the APT, TP and TSK modes. The following data are displayed:

- ACT.T current time
- ETA estimated time of arrival
- ETE estimated time enroute
- W wind speed and direction
- V battery valtage
- TC Traffic Circuit altitude

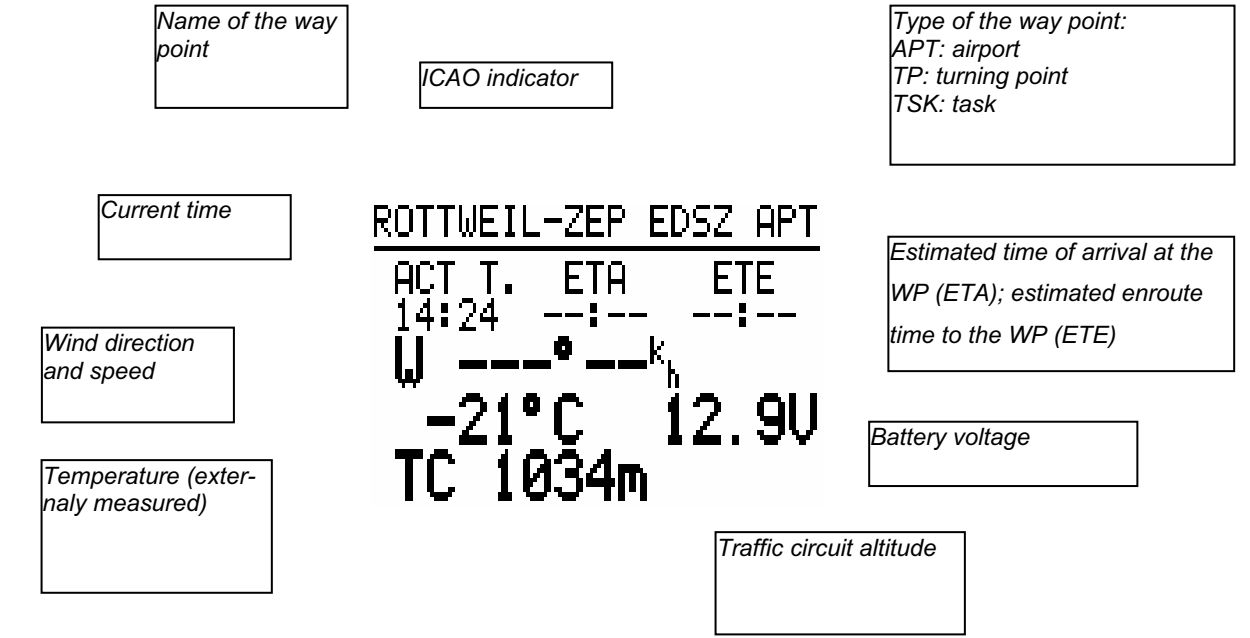


Figure 5: Arrival display

By pressing the AB button the INFO display is shown (holds true only if the airfield is selected as the next way point).

4.4 Info-Display

The INFO display shows all necessary data for the approach of an airport. If data for a certain airport are not published or if they are unknown minus signs (---) will be displayed at the corresponding positions.

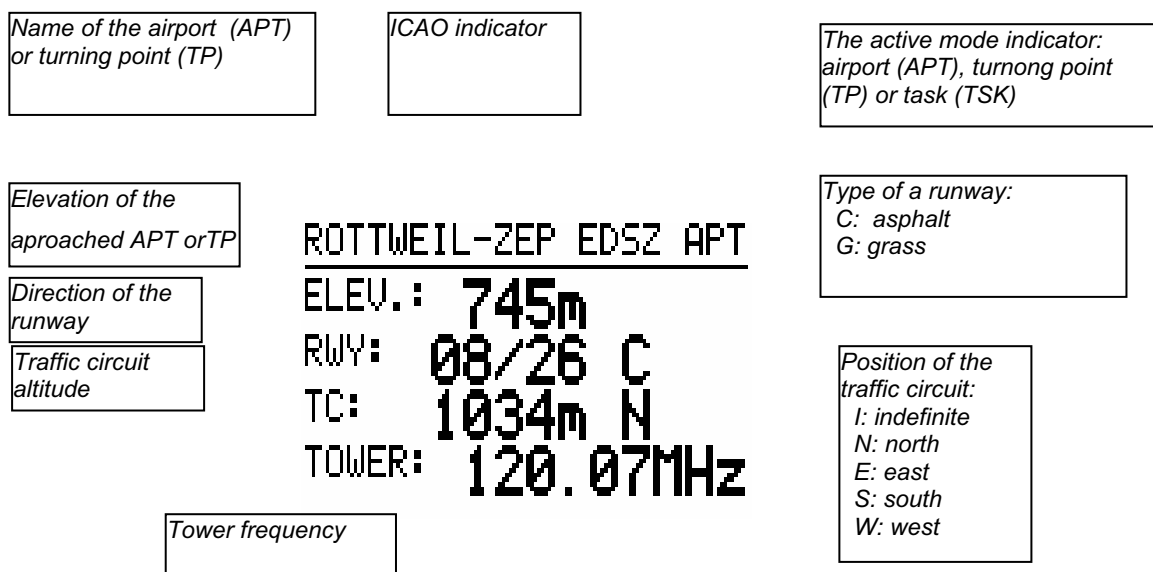


Figure 6: Info-Display

Attention:

The info display only appears if an airport (APT) is approached. If a turning point (TP) was programmed data such as tower frequency a.s.o. are not available.

5. Menu structure

The following figure shows the structure of the different program modes of the DX 50. The program modes can be selected by using the MODE button and short after the “+” or “-” key (regardless of which mode was selected before).

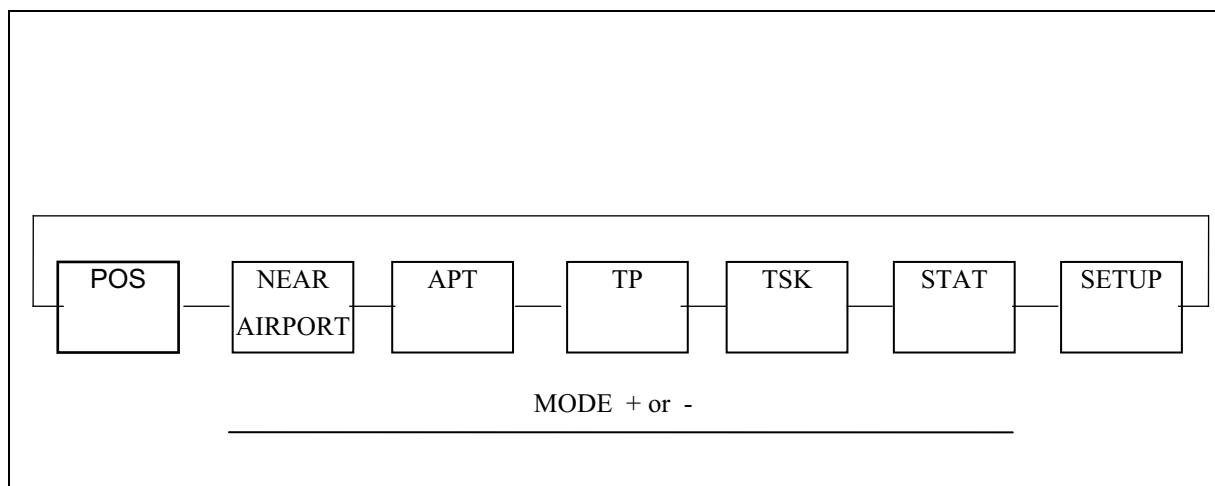


Figure 7: Structure of the program modes

The mode key stays active for a short time after it has been pushed, so you need to release the mode key and then press the + or - key to make the selection. It is also possible to skip some modes by pressing +/- keys repeatedly. The selected mode becomes active at once. There are seven different modes available:

POSITION	Indication of the current position (coordinates), current time, date and stop-watch.
NEAR APT	In this mode the distance and the course to the 10 most close airports is displayed.
APT	Used for the direct approach to the airport or to edit the airport database
TP	Used for the direct approach to the TP or to edit the TP database
TSK	Used to fly the previously programmed task as also to edit the task database
	In the APT, TP, and TSK modes the WIND calculations and TEAM function menus are available.
STATISTICS	The DX 50 offers you two different types of statistics: during the flight statistics and the statistics after the flight with the log book.
SETUP	In setup program the system setup is made.

The APT and TP modes are almost identical. The difference is that in the APT mode all the data relate to the programmed airport but to the programmed turning point in the TP mode (which can also be an airport).

5.1 Airport (APT) program

In this mode all the functions related to the airports can be used: the navigation to the airport, mapping, airfield information as also the editing of the APT database (e.g. if the frequency of the airport has changed). In the APT mode the type of wind calculation can be determined and it also contains the TEAM function. The both following functions are also integrated in TP and TSK modes.

The following Figure 8 illustrates the program structure of the APT mode:

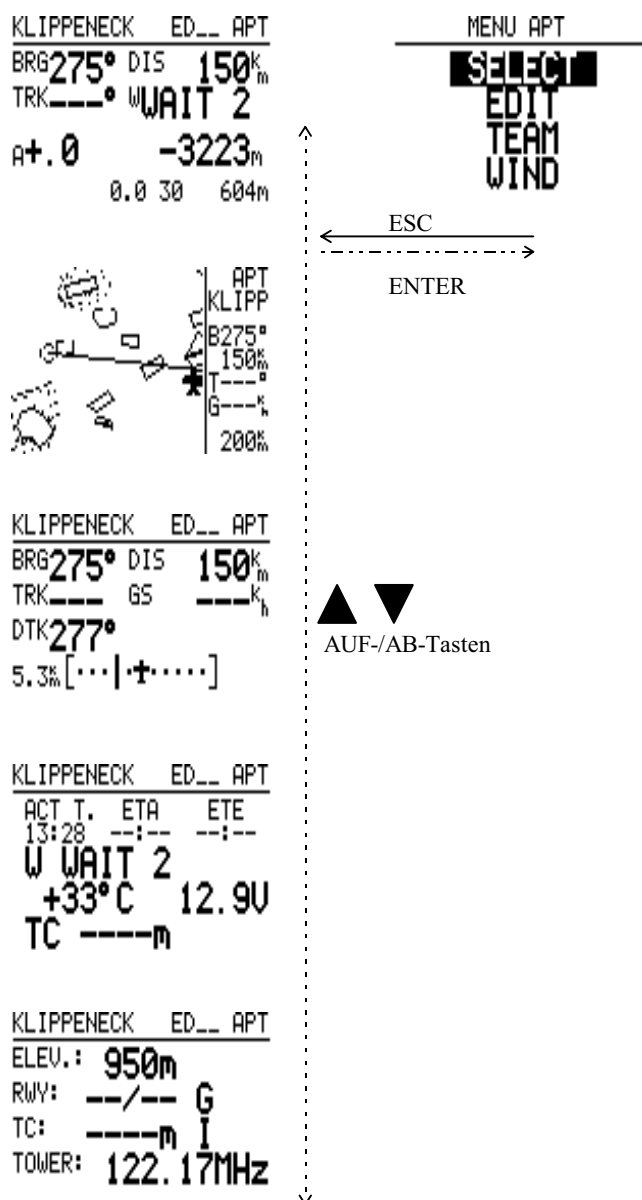


Figure 8: APT Mode structure

By pressing the “ ENTER ” key in the APT menu all the above shown submenus are available. The menus for selection and editing of the airports as well as the menus for the TEAM function and wind calculation selection (WIND) are part of the APT mode. Use UP and DOWN arrows to select the above mentioned menus and “ ENTER ” button to activate them.

Example: Selection of an APT:

After selcting the APT program with the MODE button the APT menu is activated by pressing the “ ENTER ” key. With the arrows keys the menu SELCT is selected and with ENTER key activated. Now there are two possibilities for search for the airfields:

a) Search for ICAO indicator	b) Search for name
Now enter the full ICAO indicator of the airport (every letter has to be confirmed by ENTER button).	Skip the input of the ICAO indicator by pushing the ESC button or pushing the ENTER button 4 times.
The DX 50 is searching the airport using the ICAO indicator and returns direct to the glider NAV display with the NAV data of the desired APT displayed.	Select the country of the disired airport by the UP/DOWN keys and push the ENTER button to confirm selection.
	Now you can enter the first four letters of the desired airport using the arrow key and ENTER key for confirmation.
	You will now find one or several airports in the bottom line of the display that start with the four entered letters. If more than one airport is indicated the desired can be selected by UP/DOWN keys and activated by pushing ENTER.
	The NAV data of the selected airfield are then displayed in the glider NAV menu.

5.1.1 TEAM

The TEAM menu enables group flights of two or more gliders; e.g. when you lose your partner out of sight or when you want to meet him on your way. With the TEAM menu you can follow your partners under condition that all the gliders are equiped with the GPS instruments (preferable with the DX 50) and are flying to the same way point.

Both partners have to select the same way point. The serched partner-B has to tell the partner-A his bearing and the distance to the selected way point by radio. These values are then entered by partner-A in the mode APT/menu TEAM of the DX 50. On the glider navigation display are then shown the navigation data directly to the partner-B.

5.1.2 WIND

The wind can be calculated (considered) in 4 different ways.

In the APT, TP or TSK menus the WIND menu can be selected. The following options are available:

FIX manual input of a fixed value (speed and direction)

	(in SETUP program you are able to select different units for wind's speed)
	The resulted wind component will be considered by all the calculations made.
GS	Here the wind is determined over the glider's ground speed. This enables you to circle with the constant speed (IAS).
POS	Works only by climbing (minimum six turns to get the wind)
COMB.	Special algorithm where TAS, GS, TRK are taken in calculation and the result is the wind. The 1 is functionig during the climbing as well as by straight flight where some track deviations are m

The pilot has to chose the desired wind calculation. The pilot is able to change the method whenever he wants, only one can be activated at the time.

Please take attention that the GS and POS methots can only be selected while circling and COMB only during the straight flight. If you select the FIX method your wind component is constant and isn't calculated.

5.2 Turning point (TP) program

In principle the TP function is identical to the APT mode. However the TP mode is only related to programmed TP's whereas the APT mode is only related to stored airports.

Turning points are (TP) selected and edited in the same way as in the APT mode.

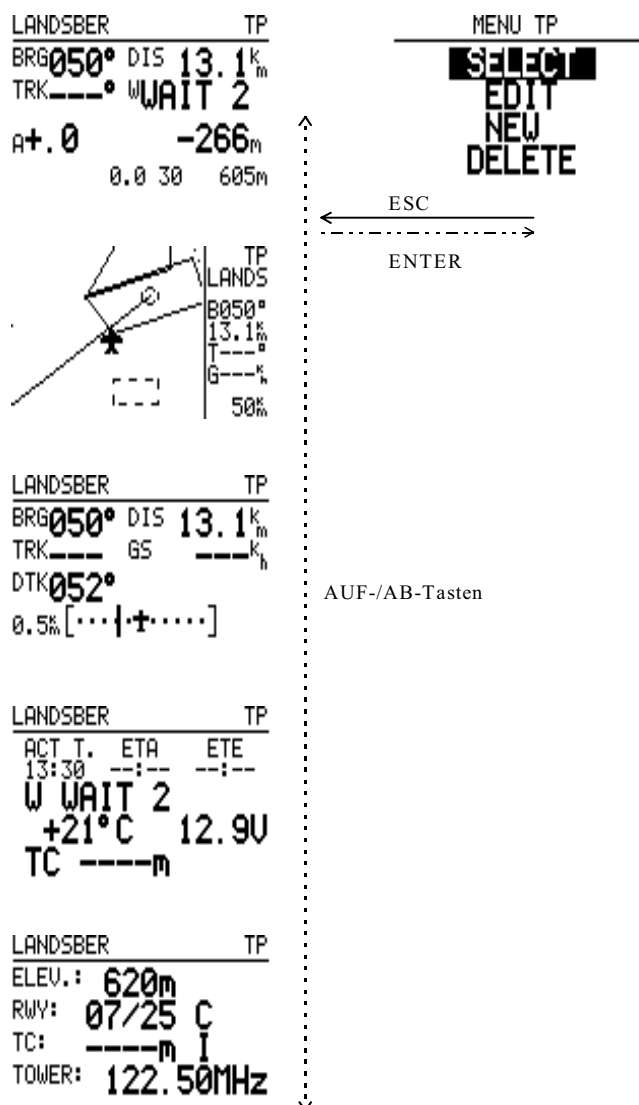


Figure 9: TP mode structure

After the selection of the TP mode with the mode selector switch the TP menu is opened by pushing ENTER. The submenus are then selected by using the arrow key.

SELECT is used to select the TP; EDIT enables you to edit the stored data; NEW is used when you want to add some new TP's; with DELETE the stored TP is deleted.

To enter a new TP you have to select NEW and confirm with ENTER. Now a question appears on the display whether an APT should be copied into the turning point memory:

If you answer the question “COPY APT DATA” with Y (yes) the same selection appears as in the APT menu when selecting an airport. A now selected and confirmed airport is copied into the TP memory and is then available as normal TP.

If you want to enter a new turning point the mentioned question should be answered with N (no). Now you can enter a new TP. After activating the input block by pushing ENTER button. Now the name, coordinates and elevation can be entered.

The TEAM and WIND functions can also be activated from the TP menu.

Attention:

- Only these airports which have previously been copied in the TP memory can be selected in TSK menu.
- By the coordinates input pay attention on the units selected in SETUP.

5.2.1 Quick TP

The function Quick TP offers you the possibility to store your current position as a turning point. This function is activated by pushing the START button (provided: GPS reception and TP mode active).

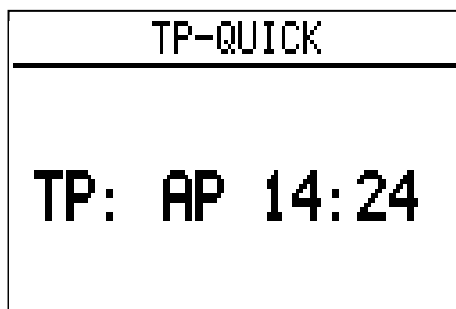


Figure 10: Quick TP

The message e.g. AP 14:24 appears on the display. This quick TP is then available under the name AP and current time it is stored by pushing the ESC button. It is possible to rename such a turning point the usual way.

5.3 Task (TSK) program

In the TASK (TSK) mode up to 100 tasks with 10 way point each can be stored in the DX 50. The stored tasks can be displayed graphically on the screen. All programmed turning points can be used as points for a task. If airports should be programmed into a TASK they have to be copied into the TP memory first.

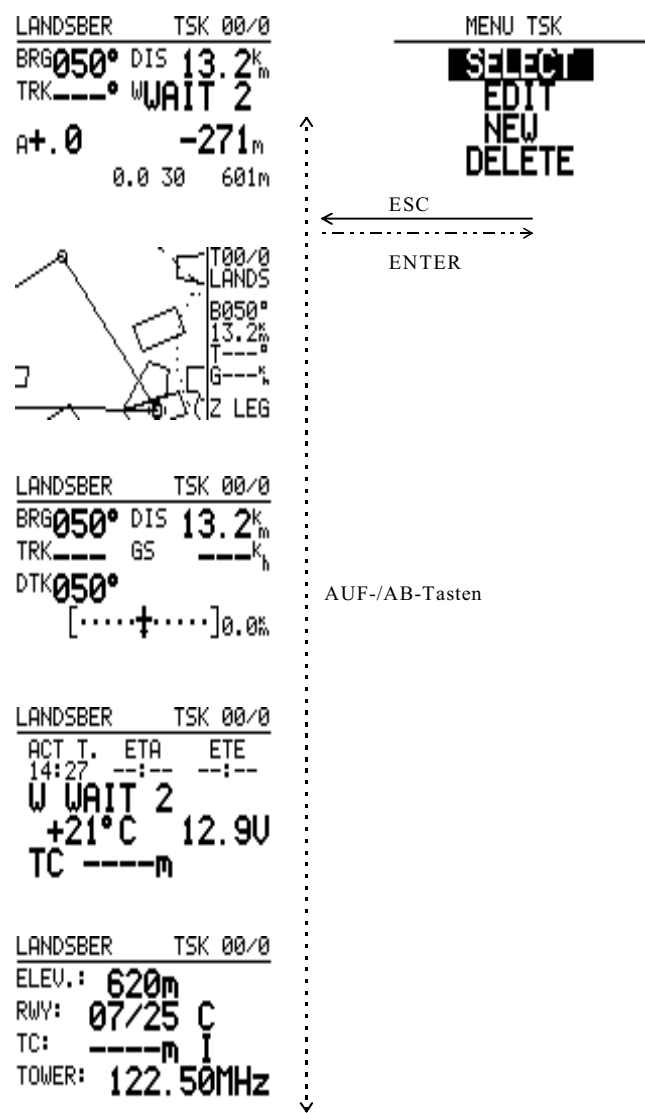


Figure 11: TSK Mode structure

There are three different possibilities to display the task graphically:

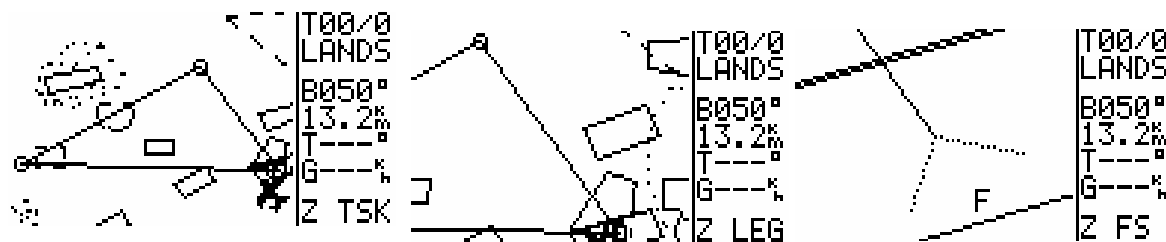


Figure 12: TSK graphic modes

By using thr + or - keys the above mentioned graphic modes can be selected as long as the instrument is in the TSK mode. The scale of these three graphic modes can not be changed as it is possible in the APT or TP mode.

Either the whole task, the whole active leg or the active pgoto sector can be shown on the display. Es kann entweder die gesamte Aufgabe (TSK), der gesamte aktive Schenkel (LEG), oder der aktive Fotosektor(FS), eingeblendet werden. The active photo sector means the next sector which will be flown to. The show glider indicates the current position related to the task.

5.3.1 Selection of a TASK

After selecting the TSK mode with MODE button the TSK menu is activated by pushing ENTER. The option SELECT should be selected and confirmed with ENTER. With UP and DOWN keys you can browse through all 100 possible tasks. The number of the current task is shown on the display with the programmed way points below. If points are not programmed within the task the message NOT PROG appers. If you want to activate the displayed task you have to push the ENTER button. The selected task is now active.

TSK SELECT				
TSK SELECT: 00				
0	LANDSBER	5	NOT	PROG
1	AALEN-HE	6	NOT	PROG
2	KLIPPENE	7	NOT	PROG
3	LANDSBER	8	NOT	PROG
4	NOT PROG	9	NOT	PROG

On the glider navigation display the first tuning point (normally designated Nr. 0) will be considered as a start point. That is normally the starting airfield but can also be a TP out of the airfield.

The information for approach to the first way point aren't shown until the start of the task.

5.3.2 Change of a TASK (TSK EDIT)

In TSK EDIT menu you can change already programmed tasks that means that you have the possibility to change TP's, to skip or delete one or more TP's or invert the task as well. The last way point before the finish can also be entered as a check point.

After selecting the task in the glider NAV menu the TSK menu has to be reopened by pushing ENTER. By UP/DOWN keys the EDIT menu has to be selected and confirmed by ENTER.

The DX 50 displays a question whether the task should be inverted or not. After answering Y or N the total distance of a task and the distances and courses of the single legs are displayed.

The last turning point before the final point can be programmed as a check point by using ENTER and UP/DOWN keys.

```

          TSK EDIT
-----
TSK 09:    40.3%  --
0 CELJE/AD
1 VELENJE
2 ZICE TUN
3 CELJE/AD
4 NOT PROG
SELECT
INSERT
DELETE

```

If you place the cursor by arrow key to the desired turning point and activate it by pushing ENTER, the submenu in which now SELECT, INSERT or DELETE can be selected opens.

By opening the SELECT menu you will be asked to enter the first four letters of the TP name. The matching turning points are displayed and are available for your selection. By using the UP/DOWN keys and ENTER the desired TP will be selected and activated.

By pushing the ESCAPE button you will be able to select between all the stored turning points in the alphabetical order.

a) Search for a name	b) Browsing through all TP's
Enter the first four letters of the TP in the usual way at the position of the four stars and confirm each time with ENTER.	Instead of entering the name push ESC button once. Now all the programmed TP's appear in alphabetical order in the line below. The selection is made by UP/DOWN keys and ENTER key.

In TP memory coded airports have to be searched by their names not by their ICAO indicator.

5.3.3 Programming of a new TASK

The programming of a new task can be made also in the TSK EDIT menu, but only with changing the previously programmed and stored task. The menu NEW prevents the overwriting of the programmed task.

Das Menü NEW schützt vor dem Überschreiben einer bereits programmierten Aufgabe.

As mentioned above by the TASK SELECT an empty task has to be selected and the submenu NEW should be opened. The question COPY TSK appears on the display, this is only needed to copy a task under the new TSK number e.g. to achieve a certain task order. So if you answer N (no) and confirm it with ENTER the empty task is displayed. After the answering INVERT N/Y and CP N/Y the cursor will place to the first turning point (0) which can be activated by pushing ENTER. As by editing the submenu SELECT, INSERT, and DELETE appears. Chose SELECT and you will be able to select TP's out of the TP's database and by pushing ENTER the selected TP will be displayed in the corresponding position.

a) Search for a name	b) Browsing through all TP's
Enter the first four letters of the TP in the usual way at the position of the four stars and confirm each time with ENTER.	Instead of entering the name push ESC button once. Now all the programmed TP's appear in alphabetical order in the line below. The selection is made by UP/DOWN keys and ENTER key.

The whole process is repeated as long as all desired turning points of the task are programmed. As soon as more than two points are entered in the task the DX 50 calculates the total distance of the task as well as the distances and courses of the single legs and displays them.

5.3.3.1 Declaration of a TASK (DECLARE only by DX 50 FAI)*****

The declaration of a task is a very important procedure which should be done on the ground before the flight. DECLARE is a submenu in the TSK mode. If the declaration of the task is not correct the recorded flights (badges) are invalid. There are two different ways how to declare a task:

- a) - with a PC by header transmission (see LXFAI manual)
- b) - by DX 50 as follows:

Select a task in a usual way.

```

      TSK DECLARE
-----
DISTANCE: 226.7%
0 CELJE TAKE OFF
1 CELJE
2 LJUBLJAN 58.9% 268°
3 AJDOVSCI 57.6% 229°
4 CELJE 110% 068°

```

With copy a selected task can be copied or after N (no) edited. The DX 50 task doesn't consider the TAKE OFF point as a start point so this should be entered. After pushing ENTER button appears a window with SELECT, INSERT and DELETE now you can edit the selected task if you want. The same holds true for LANDING.

```

      TSK DECLARE
-----
DISTANCE: 226.7%
0 CELJE
1 CELJE
2 LJUBLJAN
3 AJDOVSCI
4 CELJE

```

SELECT
INSERT
DELETE

After pushing ESC the window closes, the task is declared and a message TASK DECLARED appears. During the flight many different tasks can be selected and flown, but in FAI logger the only active task is the declared task.

If the task is already declared the following message appears after the selecting DECLARE:

```

      TSK DECLARE
-----
OVERWRITE
DECLARED
TASK ? N

```

If the answer is N (no) the previously in logger declared task is displayed and you can return to the TSK menu by pushing ESC. If the answer is Y (yes) the current selected task is displayed that means the last declared task has been altered.

IMPORTANT!

After every landing the task must be declared again although the task stays the same.

The LXFAI program enables you to declare task on your PC. The task should be correctly defined in FLIGHT INFO menu and then transmitted to the DX 50. It is then automatically declared and the TSK DECLARE is not necessary.

5.3.4 Deletion of a TASK (DELETE)

You can delete a task that has been selected as active before. To delete the whole task select DELETE menu. By choosing Y (yes) the deletion process is confirmed, by choosing N (no) the deletion process is terminated.

5.3.5 Flying with a TASK

When using the TSK mode note the following remarks:

- The corresponding task must have been programmed and activated.
- It is recommended to perform a task check before the flight. This can be done by using the TSK subprogram TSK EDIT. In this program all leg distances, all leg courses and the total distance of the task are calculated and displayed. Possible coordinate or programming errors of the turning points can now be recognized and corrected in time.
- A programmed task always has to be started manually when passing the start point by holding the START button at least for a second.
- However the instrument switches automatically to the next leg of the task when passing the way point sector.
- When flying in the TSK mode it can be quit any time to continue the flight in another mode (e.g. TP, APT, or Near Airport). However shortly before reaching the way of final point you have to return to the TSK mode because otherwise the statistic documentation is incomplete.

As long as the task is not started the DX 50 displays all flight data (course, distance etc.) related to the first entered point of the task.

5.3.6 Starting of a TASK

The photosector dimensions as also the size of a radius (Start, TP or Finish radius) and thus the dimension of the corresponding sectors can be selected in the SETUP TSK menu.

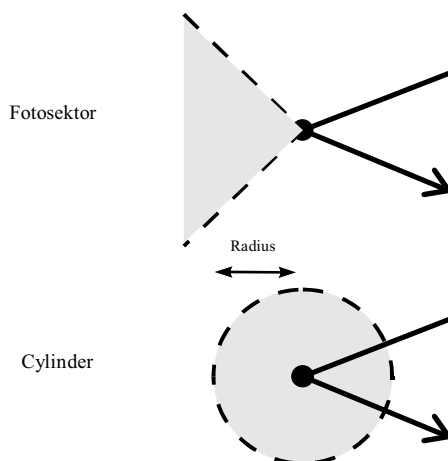


Figure 13: Rounding modes

To start a task or to change to the next leg of a task when rounding a way point the START button has to be pushed in the following manner:

Photosector/Cylinder

	inside	outside
starting a TSK	hold START button for 1 second	hold START button for 5 seconds
rounding a way point	automatic	hold START button for 5 seconds

After completing the task a TASK END message appears which is displayed until the glider stops (the total pressure is relevant factor for determining whether the glider is moving or not and not the calculated ground speed of the GPS receiver).

To delete the TASK END message (only during the flight) the task has to be restarted by selecting RESTART. Note that the statistic of the already flown task will be influenced when activating the first leg again.

5.3.7 Restart of a TASK (TSK Restart)

It could be necessary to restart an already activated task (for example a second start in a glider competition). By activating RESTART the statistic of the last flown task is deleted.



Figure 14: TSK RESTART MENU

The TSK RESTART display shown in figure 14 is activated by pushing ENTER button. Therefore the instrument has to be in the TSK mode. Now select the menu RESTART with the up and down switch and push the ENTER button. The following display will appear:



Figure 15: TSK RESTART confirmation

If you answer the question RESTART with Y (yes) your task will be reset, that means that first entered point of the task will appear as navigation point on the TSK navigation display. Now the task has to be restarted e.g. by second start when passing the start line or photosector by pushing ENTER button.

IMPORTANT: RESTART has no influence on the declared task in the FAI Logger.

5.3.8 Setup program

In the setup program all parameters that are necessary for the later use of the DX 50 can be programmed.

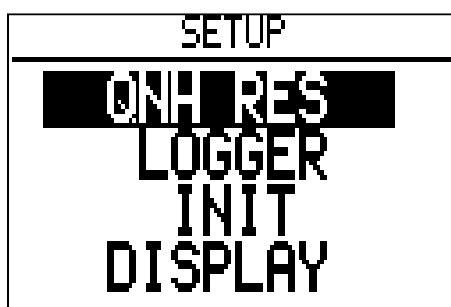


Figure 16: SETUP mode

The above figure shows the display which appears after selecting the SETUP menu. The following diagram shows the particular submenus of the SETUP mode and their meaning or their activation respectively:

QNH RES	ENTER → ← ESC	Input of: QNH (for altitude correction during the flight) ALT. R = reserve altitude for the final glide BUGS = the polar deterioration because of midges (BUGS) in % entered in 2,5% steps to max. 30%
LOGGER	ENTER → ← ESC	Input of the FAI Logger parameters (only by DX50 FAI)
INIT	ENTER → ← ESC	Input of: Vario Filter Vario integration time (10, 20 or 30 sec.) Vario range selection (2.5, 5 or 10 m/s) Speed command audio dead area (0 to +-2 m/s) Autom. Vario-/Speed command turn on: OFF / GPS or TAS
DISPLAY	ENTER → ← ESC	LCD contrast (0 to 100%)
PC	ENTER → ← ESC	PC communication
PASSWORD	ENTER → ← ESC	Input of the Password (96990), then skipping into the SETUP PASSWORD submenu

Figure 17: Structure of the SETUP menu

The following diagram shows the structure of the Setup Password menu. All the named functions can be altered only if the **password (96990)** is entered:

TSK	ENTER → ← ESC	TSK-Mode: selection of the photo sector, radius Start-Cylinder 0.1- 9.9 km TP Cylinder 0.1- 9.9 km adjustable Finish Cylinder 0.1- 9.9 km
GPS	ENTER → ← ESC	Selection of the geodethic system. Normally: WGS 1984 Input of the UTC offset related to the identical local time
UNITS	ENTER → ← ESC	Selection of the desired units: Coordination format Distance: km, nm, ml Speed: km/h, mph, kts Vert. Speed: m/s, kts Wind: km/h, kts, mph, m/s Altitude: m, ft Load: kg/m², lb/ft², OVERLOAD
SYMBOL	ENTER → ← ESC	Glider symbol in graphic display BIG/SMALL
AIRSPACE		Selection of the airspace for the graphic display
NMEA	ENTER → ← ESC	Activation or inactivation of the following NMEA messages: GPGGA, GPRMC, GPRMB, GPGLL, GPR00, GPWPL, GPLX1
PC	ENTER → ← ESC	PC communication: Selection of the communicating speed normally: 19200 bps
DEL TP / TSK	ENTER → ← ESC	Deletion of all in DX50 stored TP and programmed TSKS. Confirmed with Y (yes) or N (no)
POLAR	ENTER → ← ESC	Input of the glider polar and the glider type (USER1 or 2), activation of the stored polars
TE. COMP.	ENTER → ← ESC	Input of the electronic compensation rate and the electronic compensation filter from 1% to 150%. Attention: by TE probe compensation the TE= 0% must be entered!
AUDIO	ENTER → ← ESC	Adjustment of the tone for Vario or Speed command in negative and positive range: frequency, audio type, dead area and Audio Demo
Fortsetzung.....		
INPUT	ENTER → ← ESC	Inverting the ext. speed command switch Ext. temperature probe ON or OFF Temperature correction for the ext. temperature probe

INDICATOR		Function selection for the LCD vario indicator
PAGE 1	ENTER → ← ESC	Selection of the shown glider navigation display 1 or 2
PAGE 3	ENTER → ← ESC	Navigation display ON/OFF

Figure 18: Structure of the *SETUP PASSWORD* menu

5.3.8 QNH RES

Here the new **QNH** can be entered (when switching ON the DX 50 the actual QNH was entered) this is needed if during a long flight the QNH changes. After the input of the new QNH value the electronic altimeter automatically considers the new value in calculations so the correct altitude is displayed.

The input of the reserve altitude is needed to reach the selected airfield on a safe altitude. This altitude is added to the absolute airfield elevation.

5.3.9 LOGGER (only by DX50 FAI)

All the adjustments influence only the FAI Logger and have no influence on the flight.

The main menu has 4 submenus:

```

FLIGHT SETUP
-----
FLIGHT INFO
LOGTIME
(I) RECORD
(J) RECORD

```

FLIGHT INFO	Pilot and glider data
LOGTIME	Logging time interval selection
(I) RECORD	Adjustment of the extra parameters which are shown (not necessary)
(J) RECORD	Adjustment of the extra parameters which are shown (not necessary)

The shortenings for the (I) and (J) RECORD:

GSP	ground speed	
IAS	indicated air speed	
TAS	true air speed	
TRM	magnetic track	
HDT	true heading	
HDM	magnetic heading	

TRT	true track	
TEN	total energy	
WDI	wind direction	
WVE	wind velocity	

5.3.10 INIT

In the INIT menu you can enter the following parameters:

VARIO FILT.	Vario filter
VARIO INT.	The selection of the integration time of the interval integrator (normal value: 20 Sek.)
VARIO RNG.	Vario range adjustment (2.5, 5 and 10 m/s)
TAB	Audio dead area by SC (range from 0 to ± 2 m/s)
AUTO SC	Activation of the automatic vario/speed command switch
GPS	When circling switches the GPS from speed command to vario.
OFF	The switching on is achieved by an external switch (on stick or flaps)
100 kmh	The switching on depends on the speed (adjustable from 100- 160 km/h)

5.3.11 DISPLAY (graphic display)

Here you can select the display contrast (from 0 to 100%), the view angle and the light relation.

5.3.12 PC

In this menu you can transfer data from PC or notebook to the DX 50 or read it from DX 50. Therefor the LXFAI program should be installed and the right connect cable should be applied (see LXFAI manual).

On the PC the menu TRANSFER has to be opened and the menu PC in the DX 50. With ENTER the timeout from 0 to 9 seconds is counted. If in this time the connection is established the following note appears on the display:

CONNECT

The data transfer is now possible. All the operations are made on the PC. After the transmission has ended the ESC button on the PC has to be pushed to break the connection. The timeout appears again. The SETUP PC menu is automatically closed.

If the connection isn't possible the time will run out and the PC menu will be closed. For all other information about the data transfer see description of the LXFAI program.

5.3.13 PASSWORD

The menu PASSWORD enables you to adjust some other data which are placed in different submenus (glider and pilot data ...).

This data are secured with PASSWORD:

This password can not be changed:

96990

After the entry of this combination the submenus are displayed:

5.3.14 TSK

The selection of the mode of the task start and the radius around the way point inside of which the next leg of the task is started.

There are two different modes::

- Cylinder
- Fotosektor

The cylinder radius can be selected (from 0.1 to 9.9 km).

5.3.15 GPS

The GPS receiver operates allways with UTC (before GMT). In this submenu for the time dispaly a time offset can be entered. Example:

- UTC+0: the UTC is shown
- UTC+1: the c.e.t. during winter is shown (MEZ= UTC +1)
- UTC+2: the c.e.t. during summer is shown (MESZ= UTC +2) etc.

The GPS DATUM is standrdly shown in WGS 1984. This option enables to adapt the coordination system of the GPS to the Earth. This should not be changed in order to get the right position data.

5.3.16 UNITS

In the submenu UNITS the different forms and units for the fly data presentation can be selected:

- Coordinates of the TP's in dezimal minutes or seconds
- DISTANCE: km, nm, ml
- SPEED: km/h, kts, mph
- Climbing/descending (VER.SPEED): m/s, kts
- WIND: km/h, kts, mph, m/s
- ALTITUDE: m, ft
- WINGLOAD kg/m², lb/ft², OVERLOAD

5.3.17 SYMBOL

In this submenu the glider symbol size can be altered.

5.3.18 AIRSPACE

In the AIRSPACE submenu the airspace info which are shown on the graphic dispaly can be selected:

- AIRSPACE: DISABLE/ ENABLE
- CTR Zones
- R, P, D Zones
- TMA Zones
- TRA- Zones

-
- TIZ- Zones

All the declared airspace data can be displayed separately or together. The function AIRSPACE can be completely disabled.

5.3.19 NMEA

In the NMEA menu the NMEA0183 data string can be configured. This string is needed for the connection of special devices such as HandyMap. The NMEA data strings can be enabled or disabled. Which data strings are needed for the corresponding external device depends on the manufacturer. If on the NMEA interface no ext. devices are connected then all the NMEA data strings can be disabled.

5.3.20 PC (Adjustments)

In the submenu PC the communication baudrate is selected. The default value is 19200. The communication is possible only when the two devices don't differ in the baudrate value.

DEL TP/TSK

Within this submenu you are able to delete all the programmed TP's or TASKS. This happens if the question "DELETE ALL TP AND TSK:" is answered with Y (yes). The airport database stored in the DX 50 won't be altered.

POLAR

In the POLAR menu the speed polars of some 30 gliders are stored, which can be easily selected and activated.

It is also possible to enter the two user defined polars.

Under the "min. load" the wing load on which the polar is based should be entered.

5.3.21 TE COMP.

In this submenu the type of electronic compensation and its value can be selected. The default value is set at 0 %.

Please pay attention:

- By the TE probe compensation the compensation value of **000%** should be entered.
- If **electronic** compensation is wanted the desired values can be entered in TE COMP.

The preset of the TE values for the specific glider type is not possible, because the optimal electronic compensation depends on many different factors. The exact setup can be made only empirically during the test flight in calm air.

The following flight conditions are necessary for the optimal compensation:

- Absolutely calm air
- The DX 50 should be in the Vario mode (no SC automatic)
- Start the SETUP program and open the menu TE COMP.
- Accelerate to approximately 160 km/h and hold the speed constant for some 20 seconds.
- Then slowly pull up to reach 80 km/h. By the optimal TE compensation the variometer should display the polar descending. ????

If the vario shows higher descending then the variometer is over compensated (the TE value should be lowered).

If the vario by pull up a higher climbing (by under compensation) the TE value should be higher.

This procedure should be repeated till the optimal compensation is achieved.

The valid values range from 1 to 150 %.

The filter values can range from 0 to 9.

5.3.22 AUDIO

This submenu enables you to setup the audio signals for variometer and speed command. You are able to select the frequency, the type of the audio signals as also the dead area.

This selections are possible:

SC	The dead area by SC mode: SC Audio signal by positive and negative SC SC POS Audio signal only by positive SC SC NEG Audio signal only by negative SC
VARIO	Type of the audio signal in VARIO mode: LINEAR normal audio signal in whole range LIN/NEG normal audio signal interrupted by descending LIN/POS normal audio signal interrupted by climbing DIGITAL digital audio signal in whole range DIG/NEG digital audio signal interrupted by descending DIG/POS digital audio signal interrupted by climbing
0%	The input of the frequency in Hz by 0% deflection on the analog instrument
+100%	The input of the frequency in Hz by full positive deflection
-100%	The input of the frequency in Hz by full negative deflection

The **AUDIO DEMO** menu enables you to listen to the demonstration of the audio signals selected.

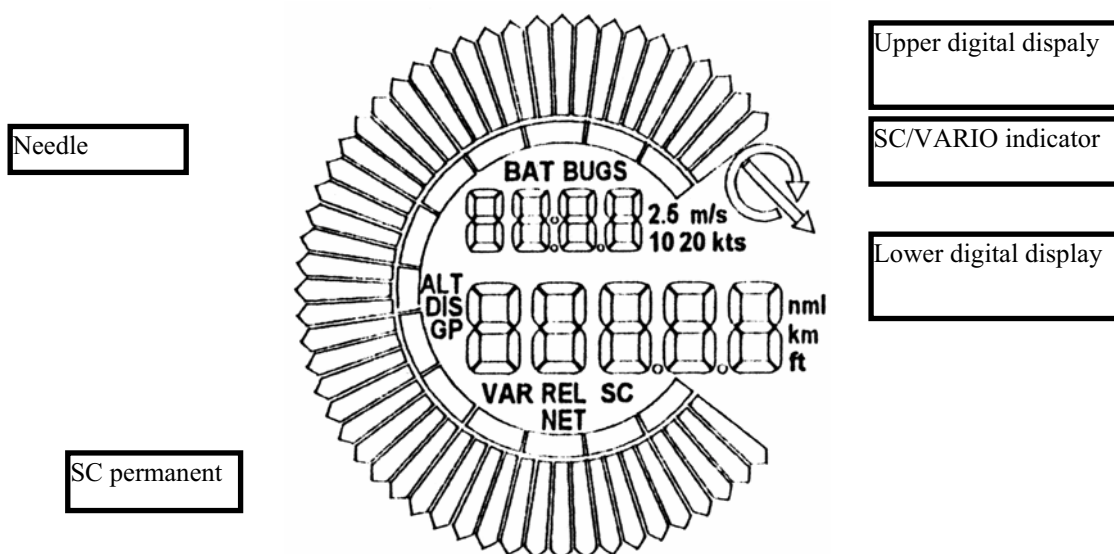
5.3.23 INPUT

In the INPUT menu some analog functions can be selected:

SC INPUT	The external SC switch setup: ON: if the switch is OFF → Speed command mode if it is ON → Vario mode OFF: if the switch is OFF → Vario mode if it is ON → Speed command mode
TEMPERATURE	With this option you can disable the temperature displaying (if there is no ext. temperature probe)
TEMP. OFF.	The external temperature probe can be compensated (for +/- 9°).

5.3.24 INDICATOR

In the Indicator menu the pilot is able to configure the vario indicator as desired.



The configuration is separated for the two flight phases: VARIO (circling) and Speed command (SC).

dist	Distance to the TP or APT
speed	TAS indication
legsp	Average speed in the current leg
alt	Altitude
gldpt	Glide deviation
flt.t	Flying time
leg.t	Leg time
aver	Integrator
time	Current time
rel	Relativ Vario
netto	Netto Vario
SC	Speed command

```

      SETUP INDICATOR
    _____
  Contrast:  HI
  Mode      VAR  SC
  Needle:   vario sc
  Lwr.nr:   speed alt.
  Upr.nr:   flt.t  leg t
  
```

From all the possible combinations the most convenient can be selected.

5.4 Near Airport program

The program NEAR AIRPORT continuously calculates the 10 nearest airports to your current position. These are indicated on the display with the following data (see figure 19).

- the abbreviated name of the airport (max. 6 signs)
- the bearing to the airport
- the distance to the airport

The number of the calculated airport (max. 10)

```

1/10  NEAR AIRPORT
-----
SHD WUERICH 282° 12%
LANDSBERG/LE 050° 13%
KAUFBEUREN 218° 19%
ALTENSTADT 157° 19%
SCHWABMUENCH 346° 21%
MINDELHEIM-M 305° 22%

```

Name of the
nearest airport

BRG to the air-
port

Distance to the airport

Figure 19: Near Airport

By UP/ DOWN keys the desired airport can be selected. If it should be activated, that means if you want to fly to this airport, the ENTER button has to be pushed. The program automatically returns to the APT mode where now the selected airport is active and is available for navigation.

Attention:

Please note that before using the Near Airport function the instrument only offers exact data after a good GPS receipt of at least 5 minutes (otherwise the message “GPS BAD” is displayed).

Any way only these airports are displayed which have been stored in the APT memory of the DX 50!!

5.5 Statistic program

The DX 50 has a very comprehensive statistic with the log book. There are two different modes:

- Statistic during the flight
- Statistic after the flight with graphical presentation of the barogram, flying route, photo sectors and PC interpretation

Statistic during the flight

The flight data can be read from the STATISTIC menu during the flight:

```

22073 3
FLIGHT:
12:30:05 - ---:---:
Duration: 0:12:47
Speed: 159%
Vario: 0.1% 0% 0
Engine: 12'47"

```

The following parameters are displayed:

- Start time
- Duration
- Variometer (digital averager and portion of circling)

After pushing the AB button the leg statistic is displayed

```

26873 3
TSK 00/1:
Time: ---:---:
Duration: 0:10:58
Speed: 108%
Vario: 0.1% 15% 0
Engine: 10'57"

```

TSK 00/1 means that the 1. leg statistic of task 00 is displayed.

Time The arrival time (time when the TP was reached). If the time isn't displayed the TP hasn't been reached yet (means that the current leg statistic is displayed).

Duration The duration of the leg.

Statistic after the flight

This statistic is official for the FAI regulations and is available some 5 minutes after the landing.

IMPORTANT!

The FAI regulations require a straight line by barogram flight and ending. ????? Therefor it is recommended to switch ON the DX 50 5 minutes before the start and not to switch it OFF for 5 minutes after the landing. All the procedures are surely finished when this message (only by DX 50 FAI) appears:

CALCULATING

SECURITY

After appearance of this message the statistic is available. If this procedure is not respected and the DX 50 is switched OFF immediadely, this procedure will be repeated after switching it ON again and the data will be stored.

In the DX 50 Statistic menu the LOGBOOK will be presented.

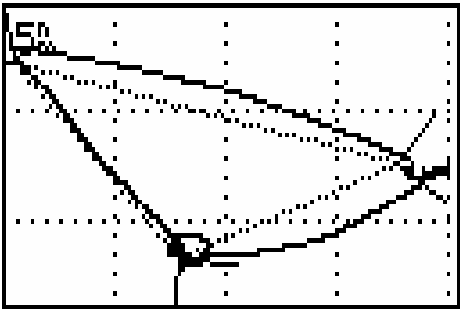
```
LOGBOOK
-----
25.12.97 12:30 13:07
24.12.97 8:58 9:03
```

By using the UP/DOWN keys you are able to select the desired flight. After pushing ENTER the message PLEASE WAIT is displayed and after pushing ENTER again the following data are displayed:

```
Flight: 1 31.12.97
-----
PILOT: John_Smith
GLIDER: DG-703
DURATION: 11:19:03 -
TASK: 40.3
```

ROUTE
HEIGHT
STAT

After selecting the ROUTE option the flight route is displayed (it may take few seconds)



The same holds true also for the barogram (ROUTE menu is closed by ESC and HEIGHT should be activated)

After the flight statistic is activated the DX 50 calculates the TASK (may last few seconds).

If no task is flown then the following message

```
Flight: 1 25.12.97
-----
PILOT: John_Smith
GLIDER: DG-703
DURATION: 12:30:05 -
TASK: 79.8
```

ROUTE
HEIGHT
STAT

also the task statistic is not available and appears:

Flight: 1 25.12.97
PILOT: John_Smith
GLIDER: DG-303
DURATION: 0:34:46
16:22:23 - 16:57:09
TASK: NOT SPECIFIED

TSK : NOT SPECIFIED means that the task hasn't been declared (DECLARE TASK) in TSK menu.
If the task has been flown but not declared the statistic is surely available but such flights are by FAI regulations not valid and should be announced before the start.

IMORTANT !

All the flights that require announcement must be declared. If the pilot forgets to start the task in the DX 50 that won't influence on the FAI scoring if the task has been declared.

After finishing the task the following data are available (this might take few seconds):

LOGBOOK
31.12.97 11:19:12:10

Flight: 1 31.12.97
PILOT: John_Smith
GLIDER: DG-303
DURATION: 0:51:22
11:19:03 - 12:10:25
TASK: PLEASE WAIT

Flight: 1 31.12.97
PILOT: John_Smith
GLIDER: DG-303
DURATION: 0:51:22
11:19:03 - 12:10:25
TASK: 40.3

ROUTE
HEIGHT
STAT

ENT

ENT

ENT

ENT

AB button

STATISTICS: TASK
TASK FINISHED OK!
Task dist.: 40.3%
Speed: 57.08%
Vario: 1.0% 6%
Track dist.: 45.0%

STATISTICS: LEG 1/3
CELJE/AD - VELENJE
11:21:31 - 11:33:46
Duration: 0:12:15
Distance: 11.7%
Speed: 57.34%

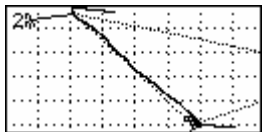
STATISTICS: LEG 1/3
CELJE/AD - VELENJE
2671% - 5046%
Vario: 2.0% 1%
Track dist.: 12.0%
XC speed: 112.99%

AB button

AB button

AB

button





The next legs can be selected by +/- keys. When the desired leg stat. is displayed the UP/DOWN keys are used to operate.

XC speed - if two TP's of the leg were not reached at the same altitude, the average speed is not realistic (especially by the final glide). **XC speed** is the value which shows how much you have lost or gained because of that. **XC speed** can be positive or negative.

To zoom the photo sector push ENTER button. The same holds true for the zooming in leg mapping. After pushing ENTER the cross appears in the lower left corner of the display. The +/- keys are used to change its position and after selecting the segment to be zoomed push ENTER to confirm the selection.

5.6 POS program

The program position informs you about:

- number of the GPS satellites that are momentarily tracked
- GPS receiver status (2D- or 3D navigation or LAST FIX)
- the current position (indication of coordinates)
- the altitude (barometric measured by DX 50)
- the time (UTC or configured time in the INIT menu)
- Stop watch (as soon as it was started by pushing the START button)

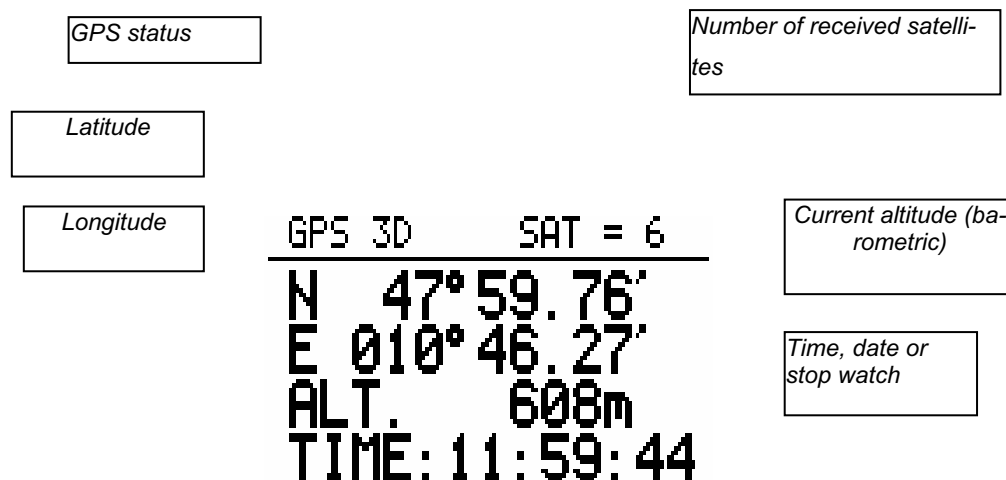


Figure 20: Positions display

To display the date instead of the time the ENTER button has to be pushed. The current date will appear as long the button is pushed.

The stop watch can be activated by pushing the START button:

- START stop watch selection
- pushing START again stop watch will start
- pushing START again stop watch will stop

-
- pushing START again the stop watch will reset

By pushing ENTER button the current time is displayed again.

Attention:

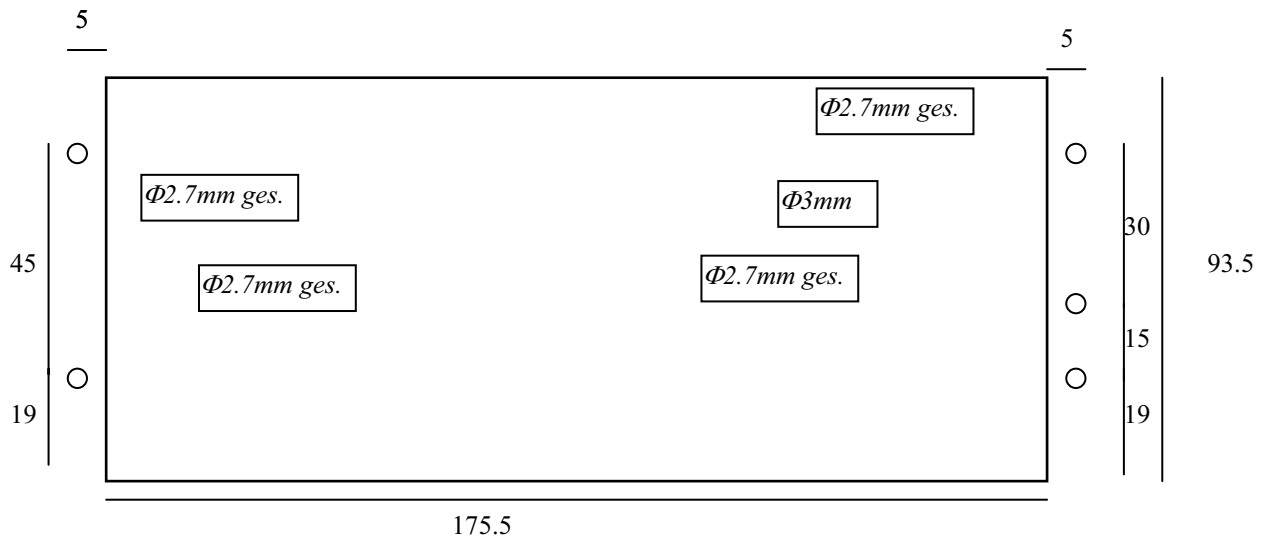
The indication “Last Fix” appears as long as the GPS is not ready for navigation. Meanwhile those coordinates are indicated which the GPS module has stored last. The current position coordinates are only indicated as long as the GPS is in the 2D or 3D mode.

6 Appendix

6.1 Cable connection

= - - - -

6.2 Drilling plan



6.3 Short notes

The keyboard:

Mode selection : “ Mode ” button plus “ + ” or “ - ” buttons

Selection of menus in current mode : UP/DOWN keys

ESC: to finish editing or to skip the whole line; to switch OFF the DX 50 (Timer)

ENTER: to start editing or to confirm the entered value

START: to start the task, one character back by editing, to start the stop watch

MC: after pushing “ MC ” and “ + ” or “ - ” the MC is altered

“ + ” and “ - ” : to zoom in Task menu

EVENT: Start of the faster logging

Volume adjustment: the speaker key and “ + ” or “ - ” key

FAI Logger:

TASK DECLARE: declares the task in the FAI Logger. Do not forget to record flights or glider competitions.

PASSWORD: 96990



OPERATING MANUAL FLARM COLLISION WARNING UNIT


Status
Software Version 4.04 (June 03, 2008)

This is a translation of the German manual.

© 2003-2008 FLARM Technology GmbH
Zurich-Switzerland
www.flarm.com
info@flarm.com

1. Welcome to the FLARM user community

Thank you for purchasing FLARM, a modern low-cost collision-warning unit for sailplanes and light aircraft. The main task for FLARM is to support the pilot, while he scans the airspace ahead with his own eyes. FLARM is simple to use and does not distract the pilot from the main business in hand.


 Sport flying is an activity that is associated with considerable risks for crew, passengers, third parties and other objects. **In order to make full and safe use of FLARM, it is absolutely essential to be fully aware of the risks, operating conditions, restrictions and limitations associated with the use of FLARM, ensure a proper installation and do regular software updates. This includes familiarity with and observance of this Operating Manual and the Installation Manual.** Additional configuration information can be found in the 'Data Port Specifications' document, e.g. how to suppress additional data at the serial port what might be required in international championships.

We welcome user feedback and reports, suggestions for improvements, and pictures that will help us make further improvements to FLARM. Feedback reports should give a detailed description of the situation, quoting the Hardware and Software versions used, plus the flight data records in IGC format with short time recording intervals.

The latest version of this handbook and other related documents can be found at the Website www.flarm.com. This Website also has answers to Frequently Asked Questions.

This Website also carries announcements when new software versions or functions become available. If you enter your name on the mailing list, you will automatically receive notification of changes as and when they happen: https://lists.flarm.com/mailman/listinfo/user-list_flarm.com

To use existing devices in April 2008 or later, it is required to update the software to version 4.00 or higher. Use the free PC installation software available at www.flarm.com. You need a PC with Windows 98 / ME / 2000 / XP with a serial port or a suited USB-serial converter plus a data-power cable like the one used for most IGC flight recorders. This cable connects the PC to FLARM and supplies FLARM with power. Ensure you have configured the correct PC COM-port, only use the Power/Data-port on FLARM (not the Extension-port) and know the printed device serial number. After completion of the software update, use the same PC software to load the most recent obstacle file to FLARM; this file is available on www.flarm.com as well. Then use the PC software to configure the flight recording functionality accordingly. In case of questions, contact your FLARM dealer.

 **Software-Versions 4.x will only remain operational until March 01, 2011.** Before this date, you must update the device in order to use it in the air. The update is available in October 2010.

2. How it works

FLARM receives position and movement information from an internal 16 channel GPS receiver with an external antenna. A pressure sensor¹ further enhances the accuracy of position measurements. The predicted flight path is calculated by FLARM and the information - including a unique identifier - transmitted by radio as low-power digital burst signals at one-second intervals. Provided they are within receiving range, the signals are almost at the same time received by further aircraft also equipped with FLARM. The incoming signal is compared with the flight path predicted by calculation for the second aircraft. At the same time, FLARM compares the predicted flight path with known data on obstacles, including electric power lines, radio masts and cable cars.

If FLARM determines the risk of dangerous proximity to one or more aircraft or obstacles, the unit gives the pilot warning of the greatest danger at that moment. The warning is given by a whistle sound (beep) and bright light emitting diodes (LED). The display also gives indication of the threat level, plus the horizontal and vertical¹ bearing to the threat. During circling flight different methods of calculation are employed to those used during straight flight.

The GPS and collision information received from other aircraft can also be made available for third party equipment (e.g. external display, speech synthesizer, PDA) via a serial data output. Such equipment is available from a number of manufacturers.

¹ Requires Hardware Version 2 or higher. However, the vertical bearing on the serial data output is also available to third-party equipment on Hardware Version 1.

The operating range is very dependent upon the antenna installation in the aircraft. The normal range is about 2 km. In individual cases the range may be up to 5 km, which can be valuable for fast sailplanes with a speed of up to 250 kt, providing the pilots in both aircraft with a warning enabling visual identification and reaction to the potential hazard. The effective range can easily be verified with an online tool². Warnings are given in order of the time remaining before a potential collision, not the geometrical distance. The first warning level for another aircraft or an obstacle is delivered when less than 18 seconds remain to the possible collision; the second warning level is delivered when less than 13 seconds remains; the third level when less than 8 seconds remains.

The warnings continue as long as FLARM calculates a threat of collision. The warning level may decline or be cancelled, depending upon the prediction. The warnings are selective; they are only issued if the calculation reveals a high probability of collision in the near future. The alarm sensitivity can be configured with the PC.

In addition, FLARM operates as an IGC-file compatible flight recorder including the G-record. Flight logs can be read out either via the SD-card or via the data port and a suitable cable. The SD card does not need to be carried on during the flight. FLARM is optionally also available as diamond-level IGC-*approved* Flight Recorder, optionally with Engine Noise Level sensor (ENL).

With the standard April 2008 obstacle databank there is memory for more than 50 hrs of flight recording at a 4s interval. Use the free PC-software to download flights to your PC and to properly configure your device for flight recording. Flight recording automatically starts when the aircraft is moving and ends when the unit is switched off. Switching off the device during the flight for a longer period results in separate flight record files. Allow at least 2 minutes (if the interval is 4s, our recommended value) after landing before you switch off the device else you lose the last part of the flight. Allow more time after landing if the interval is higher. When the memory is full, the oldest data is overwritten. Always download your flight data before you update the obstacle databank or the software.

FLARM applies for the radio communication between the units a proprietary patent- and copyright-protected protocol. It is not public, but FLARM Technology offers a license contract where it is accessible in the form of a compatible core design ready for integration into 3rd party systems. These systems are officially declared as FLARM-compatible. Any non-licensed use, dissemination, copying, implementation or reverse engineering of the FLARM radio communication protocol, the FLARM hardware and software or parts of it is forbidden by law and will be prosecuted. FLARM is a registered trademark and can not be used without license.



3. General Advice on Operation

This Manual must be carried on board the aircraft. When permanently installed in an aircraft, the 'AFM Supplement' must also be carried in the aircraft.

In flight the pilot must have direct sight of and immediate access to a switch or circuit breaker that disconnects FLARM from the aircraft electrical power supply, without affecting other essential aircraft systems. This might be necessary if the pilot suspects that FLARM may be interfering with another on-board system, the suspected presence of smoke, the smell of smoke, or flying in a country where the use of FLARM is not permitted.

FLARM must not be operated at night or with night vision systems.

FLARM will not operate without adequate GPS signal strength. Correct antenna installation has a great effect on the transmission/receiving range.

FLARM is not able to measure its own RF-receiver sensitivity. When the pilot detects that other aircraft are received only when very close or not at all and when the RF-antenna's positioning is clearly not the cause of it, the device must be checked by the manufacturer.

² www.flarm.com/support/analyze


Installation and operation must be on the basis of non-interference with and no hazard to the existing suite of other certified equipment necessary for safe flying operation, or installed to comply with official requirements. Installation and operation must comply with official regulations and requirements. It is recommended that the FLARM, GPS and radio antennae are all installed as far away as practicable - but at least 25 cm from - susceptible aircraft systems such as GPS antennae and the magnetic compass.



The unit must be protected from solid particles or liquids, should not be exposed in use to temperatures below -10 °C or above +60 °C, or stored at temperatures -20 °C or above +70 °C, because this may cause irreparable damage. On the ground, the unit should be protected from exposure to long periods of direct sunlight, because it is likely to be overheated. Also avoid static discharges to the radio antenna.



Details on correct installation will be found in the Installation Manual.

4. Operating Modes

FLARM operates in two modes, *Nearest* and *Collision*. The change from one mode to the other is effected by a two-second push on a button followed by a brief visual confirmation from the unit. After the change has been signalled, the current mode selected is not displayed. When switched on, the unit is in *Nearest* mode.

 The warnings given are identical in both modes, and generally relate to an immediate threat to which the pilot should make an immediate and appropriate reaction. The assumption has been made that following a warning it will take up to 12.5 seconds from the time that the other aircraft is seen, until a change in flight path has removed the threat³.

When operating in the *Nearest* mode, the unit also reports the presence of other aircraft operating in the vicinity, even though calculations indicate that they do not represent a threat. The information displayed is limited to a configurable radius (default is three kilometres) and a vertical separation of 500 m. When no aircraft was displayed so far but one is received now, this is signalled with a click-sound. Only one single aircraft is indicated, with Hardware Version 3 or later in green. The optical signal is static (no flashing); the threat intensity is not indicated and there is no sound warning. As soon as FLARM detects the risk of a collision it automatically switches to *Collision* mode, followed by automatic reversion to *Nearest*. The choice of mode is presented, such that immediately after pressing the key, the display presents a diverging pattern (Hardware Version 1 and 2: ; version 3: ).

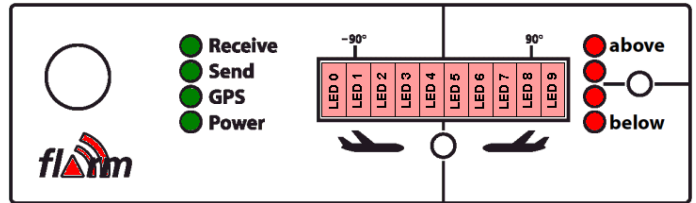
When operating in the *Warning* mode a red LED lights up only if the calculation predicts a threat. Warnings are always shown by flashing LEDs, the threat level being shown by the number of LEDs illuminated, by the frequency of flashes, and the simultaneous sound signal (beep). Selection of this mode is indicated by a upwards converging pattern (Hardware Version 1 and 2: ; Version 3: ) immediately after pressing the selector key.

In both modes the pilot can **suppress the display and the acoustic warning**: after a double push FLARM will suppress all visual and acoustic signals relating to traffic, obstacles or other threats. The act of selecting suppression is followed by a descending tone. A further double-push reinstates the *Collision* mode at once and is followed by a rising tone. While warnings are suppressed, FLARM nevertheless continues to transmit signals for reception by other aircraft.

³ These times were published in 1983 FAA Advisory Circular 90-48-C and were based on military data. They relate to fast jet pilots with no on-board warning systems for other traffic and hazards. The assumption was made that only one aircraft takes avoiding action. Of the 12.5 seconds, five seconds were to recognise the threat of collision and four seconds were required to decide upon avoiding action. No information is available as to whether these times are applicable to light aircraft, sailplanes or helicopters, when using a warning system.

5. Front Panel

The dark grey front panel of Hardware Versions 1 and 2 has a push-button, four green Status-LEDs, ten red collision warning LEDs and four red LEDs for vertical¹ position indication.



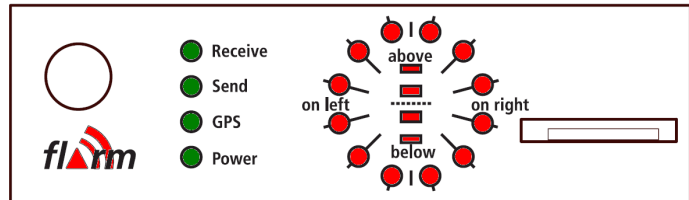
Push-button

4 green LED
(Status)

10 red LED
(horizontal)

4 red LED
(vertical¹)

The front panel of Hardware Version 3 has a push-button, four green Status-LED, twelve bicolour LED for horizontal and four bicolour LED for vertical position indication. Depending on the threat caused by other aircraft or obstacles the LED show up red or green. Also included is a microSD-reader which can be used for updates, downloads and configurations. microSD cards are not included, but widely available in electronic and mobile phone shops.



Push-button

4 green LED
(Status)

12 LED (horizontal)
4 LED (vertical)
all bicolour

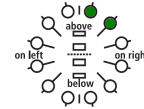
microSD
reader

6. Start-Up

FLARM is always switched on if the unit is connected to an adequate power supply.

Immediately after it has been switched on there follows a one-second long beep while a start-up pattern might be shown on the LED, followed by a binary presentation of the Hardware-Version installed during the system self-test. The self-test mode lasts from two to 20 seconds, depending upon the size of the obstacle data bank. The April 2008 data bank takes about twelve seconds.

- 0x01 Hardware Version 1 (only red)
- 0x02 Hardware Version 2 (only red)
- 0x03 Hardware Version 3 (only green)

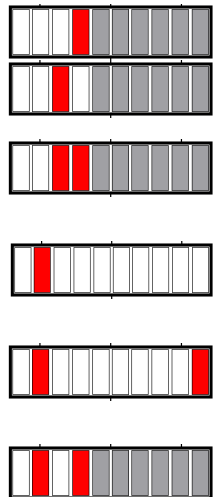
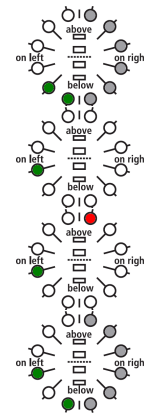


This is followed by another one-second beep, followed by a brief binary presentation of the Software-Version:

- Hardware Versions 1 and 2: LED0 to LED3 represent the major versions, LED4 to LED9 the minor versions. Everything is shown in red.
- Hardware Version 3 and later: The first six LEDs clockwise represent the minor version in red, the other LEDs clockwise the major version in green.

If the Software Version is not indicated and the beep sound is not emitted, the unit is not ready for operation.

- *Software Version 1.xx (operational only to April 2005)*
- *Software Version 2.xx (operational only to Feb. 2006)*
- *Software Version 3.xx (operational only to March 2008)*
- 0x100 Software Version 4.00 (operational till March 01, 2011)
- 0x101 Software Version 4.01 (operational till March 01, 2011)
- *Software Version 5.xx*
(available in October 2010, mandatory on March 02, 2011)



Then FLARM shifts to normal operation and waits until it has acquired an adequate GPS position fix. When switching on, this procedure can take *several minutes*. Without a proper GPS position fix, the unit is not ready for operation. Before departure the pilot must ensure that at least the Power-, GPS- and Send-LED are all continuously on. This state must be preserved during the whole flight to ensure correct operation.

7. Fault Finding

If a fault should occur during start-up self-test or subsequent operation, then all four green status LEDs will flash in unison for 30 seconds, while the red collision LEDs will give a binary indication of the most serious fault. The fault display can be stopped before 30 seconds has elapsed by pushing the button.

For safety reasons FLARM will not start up if there is a fault. FLARM may not be used if a fault has been reported or indicated. Limited operation is possible if there is an indication of a problem with the obstacle data bank or data recorder.



0x11	Fault: Software out of date (needs GPS reception)	No operation	
0x12	Fault: Software integrity violation	No operation	
0x21	Fault: Low Voltage	No operation	
0x31	Fault: Internal GPS communication	No operation	
0x32	Fault: Faulty GPS configuration	No operation	
0x41	Fault: Internal radio communication	No operation	
0x51	Fault: General internal communication	No operation	
0x61	Fault: Flash memory	No operation	
0x71	Fault: Pressure sensor	No operation	
0xF1	Fault: Other fault	No operation	
0x81	Indication: No obstacle data bank	Operation possible	
0x91	Indication: Flight recording not possible	Operation possible	
0xA1	Indication: Error with SD-card configuration file	Operation possible	

The communications faults itemised above indicate if internal modules within FLARM are not communicating correctly with each other. For reasons associated with the system, reduced radio range cannot be detected by a single unit alone.



Software-Versions 4.x will only operate until March 01, 2011. Before this date, you must update the device in order to use it in the air. An update with the same functionality can be downloaded free of charge, and will be available in October 2010. Users will be able to load the software with the aid of a suitable power supply/data cable (not supplied). This operation requires the user to have the unit Serial Number to hand. Software validity has to be time-limited to ensure that all FLARM units are mutually compatible and that updates include the latest obstacle data.

8. Status-Display

The green Status Display LEDs operate as follows; normal operating mode is underlined:

- **Receive:** Lights up when a signal is detected from another aircraft less than the configured range (default is 3 km) away, with a height separation of less than 500 m; otherwise the LED is dark. If the warning is temporarily suppressed (see below) but signals are still received from other aircraft, then the LED flashes.
- **Send:** Lights constantly during operation and indicates that the on-board FLARM is transmitting. Transmission requires GPS reception.
- **GPS:** Lights constantly during operation (with very brief interruptions once per second). If the LED is constantly dark and flashes briefly once per second, then there is no GPS reception. When switching on this condition can take several minutes.
- **Power:** Lights constantly during operation. If the LED flashes, then the power supply has dropped below 8 V. FLARM will not operate below 8 V DC.

The 'Receive' and 'Send' LEDs give no indication of FLARM's transceiver range.

9. Push Button⁴

The push button can be used to select the following functions:

- **Brief Push** (<0.8 s) changes the volume from *<loud>* to *<medium>* to *<quiet>* to *<silent>* (and *<loud>* again). A short sound is emitted at the new volume selected. The default setting is *<loud>*.
- **Longer Push** (2 s) changes mode between *<Nearest>* and *<Collision>* when airborne. Visual confirmation. Default setting *<Nearest>*.
- **Longer Push (5 - 8 s, only on the ground)** activates the receiver self-test: Two seconds after the button is released, FLARM will show how many other FLARM are received with reduced sensitivity (50% of the normal range). It will then emit a long beep and light one vertical LED for every 10 and a short beep and one horizontal LED for every single received aircraft (e.g. 14 received FLARM is: "beeeeeep bep bep bep bep", with one vertical and 4 horizontal LED's). After the self-test, FLARM switches back to normal operations. Note that for other units to be displayed these must be running.
- **Double Push** suppresses optical and acoustic warnings for five minutes. Suppression is followed by declining melody, normal setting followed by a rising melody. A double push terminates the suppressed operation at once.
- **Long Push** (>8 s): Re-boot. This procedure is recommended if a fault is apparent. No confirmatory sound signal.
- **Very long push** (>20 s) brings FLARM back to the factory settings. The very long push deletes all configurations that have been loaded by the user. No confirmatory sound signal.

⁴ Activate the external display update by pushing the button four times in rapid succession. For details see the Installation Manual.

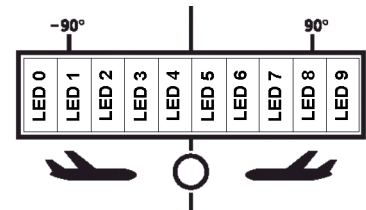
10. Aircraft Anti-Collision Warnings

An illuminated red LED indicates the approximate bearing to an aircraft currently posing the biggest threat of collision. The bearing is *relative to the track*. This indication is inaccurate if there is a strong wind, if the aircraft is in a sideways yaw, or if ground speed is very low (e.g. when a helicopter is in the hover). The display is refreshed every second.

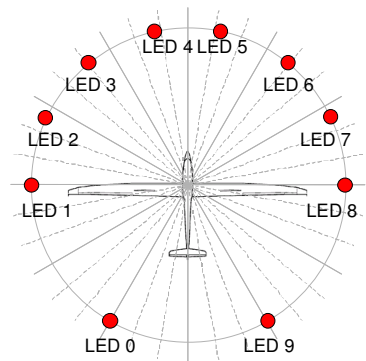
The unit emits an audio warning (beep) tone at the same time as the flashing red optical warning. The time between the warning and possible collision is brief, just a few seconds. Warnings of fixed obstacles are given slightly earlier.

Horizontal bearing indicated on Hardware Versions 1 and 2

Each red LED is allocated to a sector of sky around the aircraft horizontal plane in a side view. The aircraft centreline is indicated by a white line above and below the mid point (between LED4 and LED5). A short white line is located above LED1 and LED8, marking 90° left and right.



- LED 0 ~210° quadrant rear left
- LED 1 270° hard left 9 o'clock
- LED 2 296° left 10 o'clock
- LED 3 321° left 10-11 o'clock
- LED 4 347° front left 11-12 o'clock
- LED 5 13° front right 12-1 o'clock
- LED 6 39° right 1-2 o'clock
- LED 7 64° right 2 o'clock
- LED 8 90° hard right 3 o'clock
- LED 9 ~150° quadrant rear right



Horizontal bearing indicated on Hardware Version 3 and later

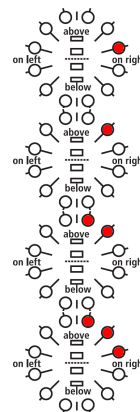
The twelve bicolour LED show a compass rose, i.e. the birds view on the traffic situation. 'Top' is track-up according the own aircraft. Each LED covers an equal-sized horizontal sector of 30°.

Danger from the front or side

If the threat of collision with another aircraft is from the front or side, but not from the rear, then the threat level will be flagged up by the display. If the threat is moderate (less than 18 seconds to possible collision), a single LED lights up; in the case of a medium threat (less than 13 seconds) then two diodes light up; if the threat is imminent (less than 8 seconds) three LEDs. The threat is at the centre of the illuminated block. The flash and beep frequency increases with the threat.

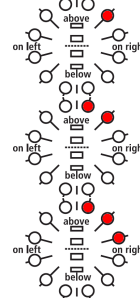
Moderate threat from ca. 3 o'clock
(less than 18 seconds to calculated collision)

Slow flash at 2Hz



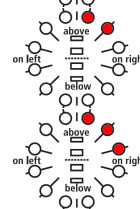
Moderate threat from 1 to 2 o'clock
(less than 18 seconds)

Slow flash at 2Hz



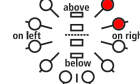
Medium threat from 1 o'clock
(less than 13 seconds)

Medium flash at 4Hz



Immediate threat from 1 to 2 o'clock
(less than 8 seconds)

Rapid flash at 6Hz

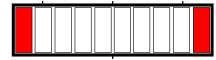
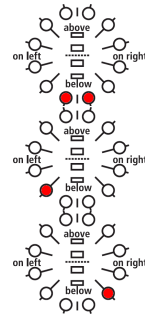


Danger from the rear

If the threat is from behind, then the threat level on Hardware Version 1 and 2 is given only by the frequency of LED flashes, not the number of LEDs activated.

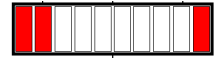
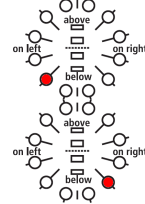
Danger from the rear, 5 to 7 o'clock

Flashing
(H/W Version 3 example shows
medium threat from 6 o'clock)



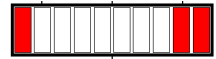
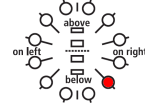
Danger from the rear left, 8 to 7 o'clock

Flashing



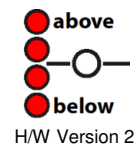
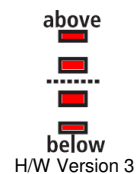
Danger from the rear right, 4 to 5 o'clock

Flashing



Vertical indication

The vertical bearing is indicated by a vertical¹ line of four red LEDs and show the bearing relative to a horizontal plane. This is independent of the aircraft's climb angle. The uppermost or lowest LEDs illuminate when the bearing exceeds 14°. The LED flash frequency is identical and synchronous with that of the horizontal display.

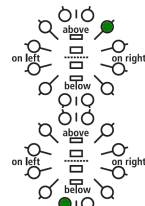


Traffic indication (only in Nearest-mode)

In Nearest-mode the closest aircraft is shown as long as no warning is necessary. Traffic indications don't flash, there is no sound and the distance is not shown. Hardware Version 3 and higher show traffic indications in green.

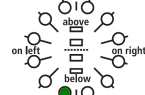
Traffic around 2 o'clock

No flashing



Traffic around 7 o'clock

No flashing



11. Obstacle Warnings

The standard obstacle data bank (as of April 2008) has about 33,000 coordinates locating about 11,000 Alpine obstacles⁵. This data bank is loaded by FLARM at manufacture; subsequently the user may upload but not alter up-dated information via a PC. Special data banks, corrections and amendments can be reported to us.

The FLARM display flashes when there is warning of obstacles. The warning always relates to obstacles straight in-line with the current flight heading. In other words there is no horizontal or vertical bearing given to the obstacle. The threat level depends upon the time remaining to impact; the flash and beep frequency increases with reducing distance from the obstacle. The display is refreshed every second.

A warning is given if an aircraft flies under a cable or power line.

An acoustic warning (beep) is given at the same time as the flashing fixed obstacle warning. The time between warning and possible collision is brief, just a few seconds. However, warnings are given of fixed obstacles earlier than those for other aircraft.

Hardware Versions 1 and 2 show obstacles as follows:

Moderate threat

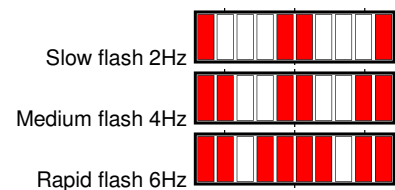
(less than 18 seconds to calculated collision)

Medium threat

(less than 13 seconds)

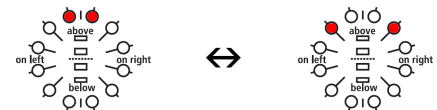
Immediate threat

(less than 8 seconds)



Hardware Versions 3 and later show obstacles as follows:

A toggling pair of two LED's is shown, with the toggle frequency depending on the threat.



⁵ For details on the data sources and status, consult the 'Obstacle Data Format Specifications' manual.

Neither FLARM Technology nor these organisations accept any responsibility for the accuracy, completeness or up-to-date status of the data or any direct or indirect damage resulting from using such data. Official data sources only collect data which have been reported by those who own, construct or operate constructions which represent an obstacle, and do not check these reports.

12. Operating Limitations



FLARM is designed and built as a non-essential 'situation awareness only' unit to only support the pilot, and cannot always provide reliable warnings. In particular, FLARM does not give any guidance on avoiding action. Under no circumstances should a pilot or crewmember adopt different tactics or deviate from the normal principles of safe airmanship. Even with FLARM installed, you remain responsible for flying the aircraft and ensure the safety of passengers and other traffic. The use of FLARM is solely at the discretion of the commander and his delegated crew member. Operation must be preceded by thorough familiarisation by the commander or his delegated crew member with the Operating Manual.

FLARM will only give warnings of other aircraft that are likewise equipped with a compatible unit. FLARM does *not* communicate with Mode A/C/S transponders and is not detected by ACAS/TCAS/TPAS or Air Traffic Control. Likewise FLARM does not communicate with FIS-B, TIS-B or ADS-B.

Compatible FLARM units must be within range in order to provide a warning. The range is very much determined by the type, installation and position of the radio antennae, plus the relative positions of the two aircraft. Under *optimum* conditions the internal antennae can give a head-on range of up to 5 km; normally, range is about 2 km, which is adequate for light aircraft and sailplanes. The radio signals can only be received by *line of sight*. There is no FLARM signal between two aircraft on opposite sides of the same mountain.

FLARM has to know its *current* position in order to operate. For this reason, FLARM will only operate in the presence of good quality three-dimensional GPS reception. GPS reception is greatly influenced by the installation and position of the antenna, and aircraft attitude. This is particularly true during turns, when flying close to mountain slopes and in areas known for poor reception. If the installation is poor the GPS signal quality may be reduced. In particular, there can be rapid degradation of height calculations. FLARM resumes operation as soon as the GPS reception quality is adequate.

Movements calculated by the GPS relate to a fixed system of *terrestrial* coordinates. In strong wind there may be a substantial difference between aircraft heading and track, leading to a distortion of the threat bearing. If the wind speed is one third of True Airspeed (TAS) and the yaw-free aircraft Heading is 90° out of wind, then the threat indication displayed has an error of about 18°. If the wind is very strong, the Track can deviate up to 180° from Heading. Under such circumstances and when circling, the calculation and warnings given are unusable.

When close up, when two aircraft are at the same or similar height, or GPS reception is poor, the vertical bearing indication is imprecise and fluctuates.

FLARM calculates the predicted flight path of the aircraft to which it is fitted for less than the next 20 seconds. This prediction is based on immediate past data, current position- and movement data, plus a movement prediction model that is *optimised for the respective user*. This forecast is associated with a number of uncertainties that increase with an extension of the forecast time. There is no guarantee that an aircraft will actually follow the predicted flight path. For this reason, the warning issued will not be accurate in all cases. In sport flying flight path predictions of more than 30 seconds are *unusable*. This is particularly true for sailplanes and hang gliders. For this reason, the radio range is generally adequate.

Warnings are given at *very short notice*, i.e. the warning is given within a time frame of from a few seconds to 18 seconds, depending upon the closest predicted proximity, as calculated. The threat intensity (pitch of the warning tone, LED block width, flash interval) flags up the threat (collision time point), but not the geometric distance. FLARM only issues a warning if the calculation forecasts a *considerable* threat. For this reason, it is usual - depending upon the mode selected - that no warning is given about the presence of other aircraft, in spite of the fact that signals have been correctly received.

When a number of moving threats or fixed objects are within range, then FLARM gives warning *only* of the most dangerous in accordance with the threat calculation algorithm. The pilot is unable to confirm receipt of this warning, nor is he able to call for presentation of further threats. In spite of the warning issued for one other aircraft or fixed objects, it is quite possible that there are several further aircraft or fixed objects that represent a greater threat than that which has been signalled. When the unit simultaneously detects a threat from moving and fixed obstacles, then the warning issued relates to the earliest likely collision.

FLARM indicates the rough position of the aircraft or obstacle that currently represents the biggest threat, in accordance with the algorithmic calculation; FLARM Hardware Version 2 (and onwards) also displays a vertical bearing. In the case of fixed obstacles, the unit does not signal a bearing. FLARM does not indicate where the closest proximity may occur, nor does it signal avoiding action. Whether and how avoiding action is taken is solely a matter for the pilot, who must base his decision on his own observation of the airspace. In taking his decision, he must comply with the Rules of The Air and ensure that no additional hazard is caused by his action. Depending upon the phase of the flight, FLARM uses different forecasting methods, movement models and warning calculations, to provide the pilot with the best possible support without causing a distraction. For example, when a sailplane is circling, the system sensitivity is reduced. These models and processes are optimised, but are nevertheless a compromise. As seen by the pilot these models are the source of 'false alarms'; i.e. FLARM would give warnings of 'threats' that would not subjectively be regarded as a real danger. It is quite possible that FLARM will not give warning of the highest threat, or will give any warning at all.

Obstacle warnings (e.g. cables, antenna masts, cable cars, avalanche dynamite wires, power lines) are dependent on the information having been stored *correctly* in the internal data bank. The unit cannot give warning of any fixed object that has either been incorrectly stored, or not stored at all. No data bank is complete, up-to-date and correct. Obstacle information stored has usually been simplified; for example, FLARM assumes that a power wire is slung absolutely straight between two fixed points with no sag. Likewise, data for power lines and cable cars does not include all intermediate masts. In addition, FLARM data does not include terrain data and no such warnings are possible.

FLARM radio communications take place in a license-free band in which there is general freedom to transmit and receive. This means that the band is also available to a number of other uncoordinated users. FLARM has no exclusive right to the use of this band and there is no guarantee that FLARM will not be subject to interference by third parties.

There are national differences in frequency allocation and operating conditions between countries. The aircraft commander and user are solely responsible for ensuring that their use of FLARM conforms with local regulations. No radio licence is required for FLARM in Switzerland, Germany and France.

The radio transmission protocol employed places *no limit* on the number of units that may be operated within a given range. However, an increasing number of units within range is associated with a reduction in the probability that a single coded signal will be received ('graceful degradation'). The probability is small that subsequent signals will not be received from the same transmitter. FLARM is designed to receive and process signals from up to 50 aircraft within range. A high number of FLARM units within range has no effect on range.

The transmitter has **no effect** on what the receiver in the other aircraft does with the data. It is possible that this data may be captured and stored by other aircraft, or by ground stations, or used for other purposes. This opens up a range of possibilities, some of which may be in the pilot's own interest, (e.g. automated generation of an sailplane launch logging system, aircraft tracking, last position recovery), while others may not be (e.g. detecting tailing of other aircraft, airspace infringements, failure to take avoiding action prior to a collision). When FLARM makes a transmission, the signal also bears a unique identification code that can trace to the pilot or aircraft registration. The user can - even though this is not recommended - configure the unit so that identification is generated randomly and alters at one-minute intervals, making a back-trace difficult.

Operation of FLARM is limited to non-commercial day VFR flights. FLARM may not be used for navigational purposes or aerobatics.

At present FLARM has not been certified or tested in line with the usual aviation procedures (e.g. DO-160E). The FLARM software development is *roughly* in-line with Level E of DO-178B; i.e. a partial or total failure of FLARM will have no effect upon the safe operation of the aircraft, nor does it increase crew workload.

Operation of FLARM is forbidden in the USA or Canada or in aircraft registered in the USA or Canada.

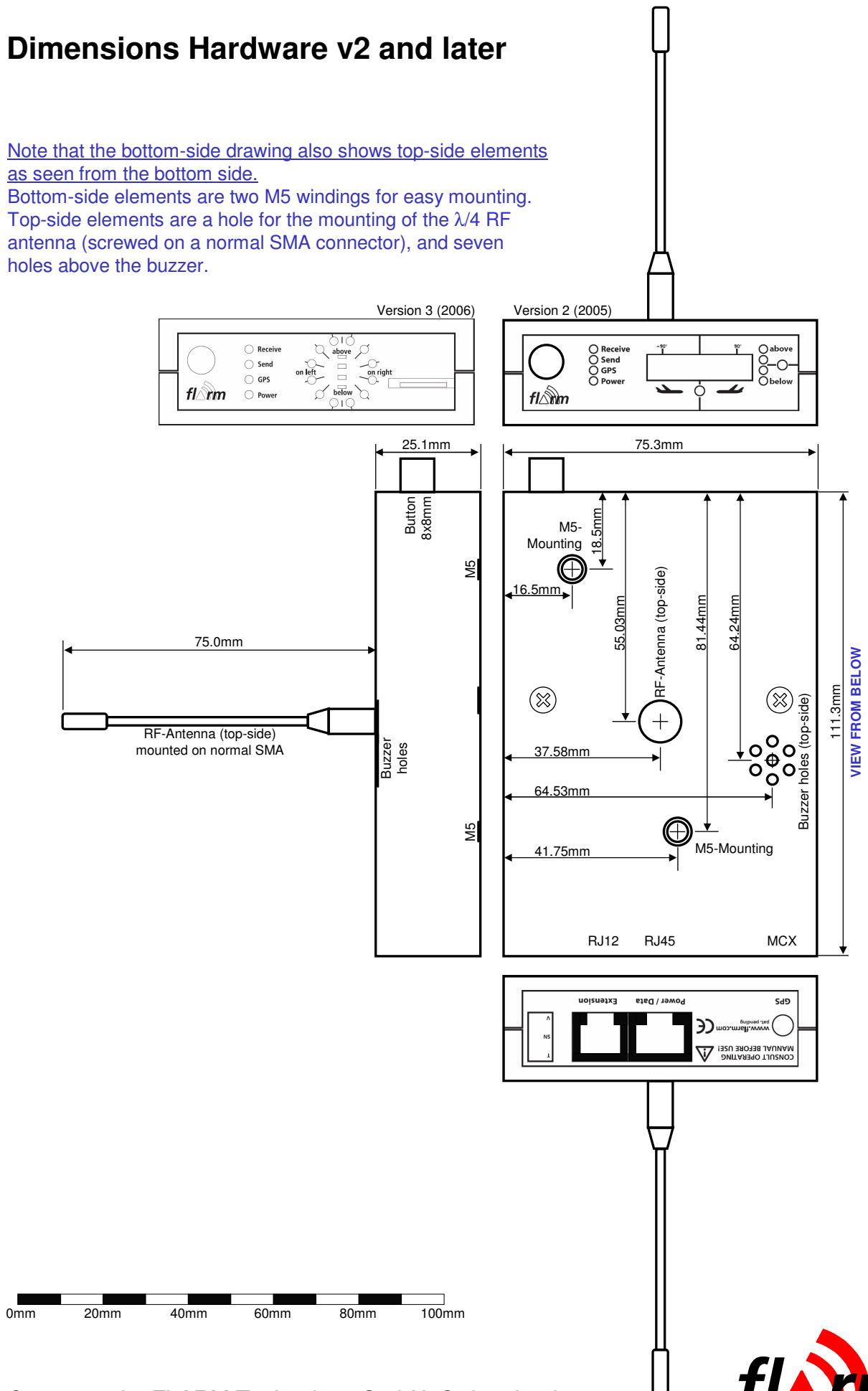
The association FLARM Technology, FLARM Technology GmbH, its associates, owners, staff, management, development team, suppliers, manufacturers and data suppliers accept no responsibility for any damage or claims that may arise from use of FLARM.

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Dimensions Hardware v2 and later

Note that the bottom-side drawing also shows top-side elements as seen from the bottom side.

Bottom-side elements are two M5 windings for easy mounting.
Top-side elements are a hole for the mounting of the $\lambda/4$ RF antenna (screwed on a normal SMA connector), and seven holes above the buzzer.

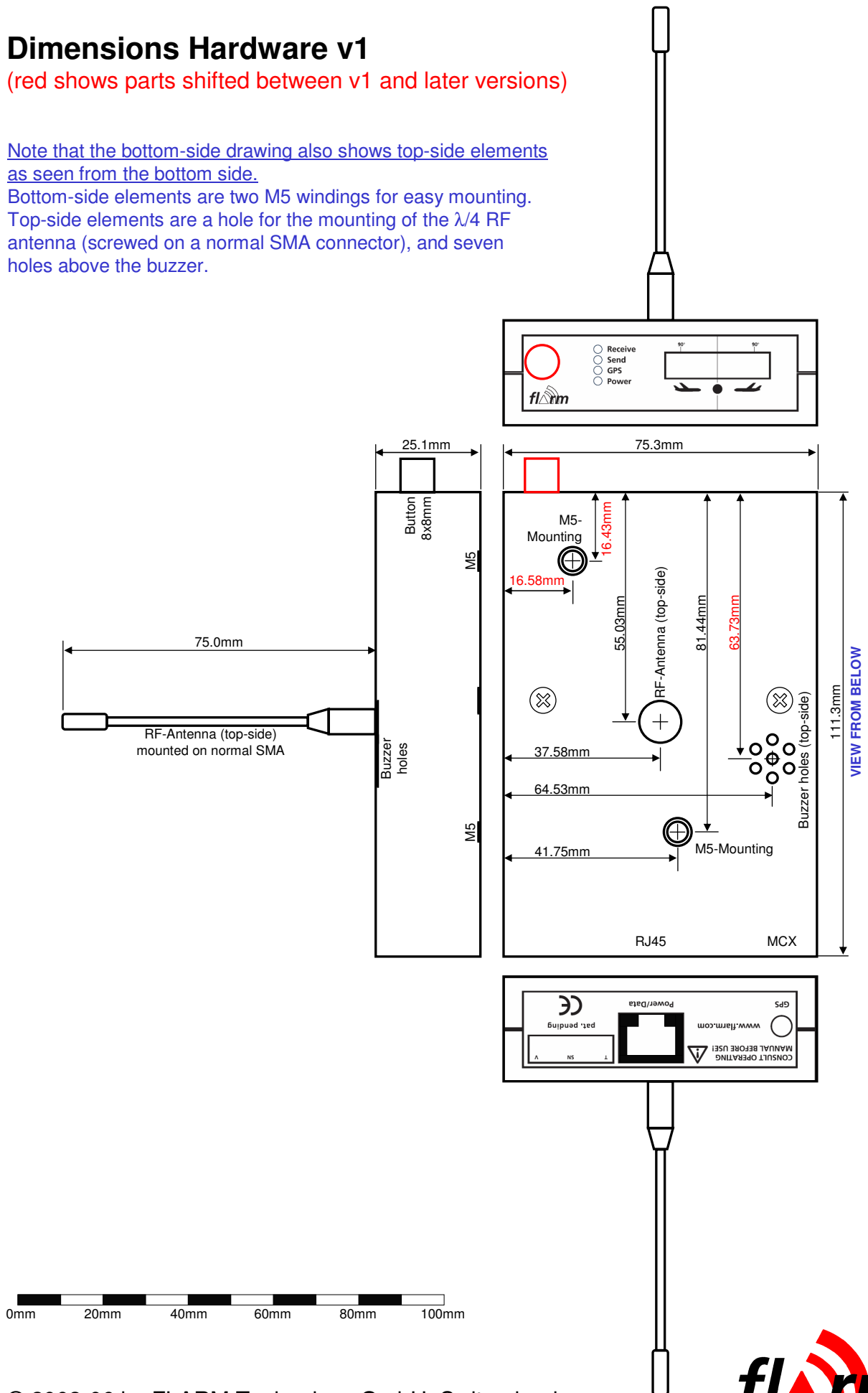


Dimensions Hardware v1

(red shows parts shifted between v1 and later versions)

Note that the bottom-side drawing also shows top-side elements as seen from the bottom side.

Bottom-side elements are two M5 windings for easy mounting.
Top-side elements are a hole for the mounting of the $\lambda/4$ RF antenna (screwed on a normal SMA connector), and seven holes above the buzzer.



DG200 15m/17m DG 202

Maintenance Manual



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Maintenance and Inspection

1. Weight and Balance

Method of weighing your DG-200:

1. Assemble the glider completely with gear down.
2. Place a scale under the tailwheel.
3. The fuselage must be leveled so that the top of the aft fuselage boom has a tail-down slope of 100 : 3.67.
4. Water ballast tanks should be empty.
5. Read weight of tail wheel. W_2 .
6. Be certain the wings are level.
7. Measure the distance between perpendiculars through points a and b. (see figure, next page).

Using the Empty Weight and the values determined above, calculate the C.G. as follows:

$$\text{C.G. Empty: } X_{s \text{ empty}} = \frac{W_2 \text{ empty} \times b}{\text{Gross Weight empty}} + a$$

Weight includes all accessories but excludes pilot and parachute. Remove loose objects from cockpit.

$$\text{C.G. In Flight: } X_{s \text{ gross}} = \frac{W_2 \text{ flight} \times b}{\text{Gross weight flight}} + a$$

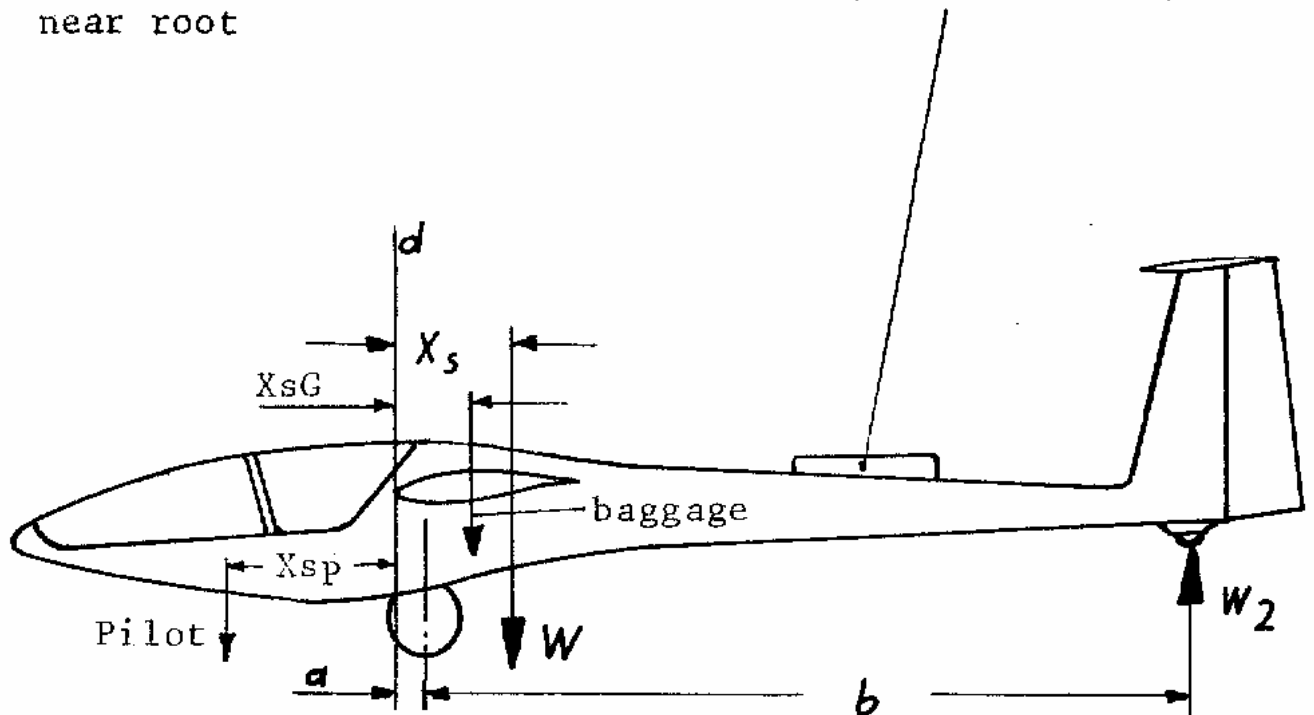
The flight weight includes empty weight items plus pilot, parachute, and all items needed in flight (barograph, camera, cushions, etc.). In addition, the rudder pedals and seat back should be adjusted as in flight.

Datum (d)

Wing leading edge
near root

Leveling line:

Aft fuselage boom slope
100 : 3,67 (tail down)



$X_{sp} = 560 - 580 \text{ mm (22 - 23 inches)}$

$X_{sG} = 180 \text{ mm (7 inches)}$

Repairs or alterations

After the addition or deletion of equipment or accessories, repairs, painting, or any change in the aircraft that could influence the weight and balance; a new weight and balance must be carried out. Aircraft certificated as Standard Category must have the weight and balance certified by a licensed Airframe Mechanic. Empty weight C.G. range is determined by reference to diagram no. 1. If the C.G. is out of limits, adjustments may be made by ballasting or by relocating equipment or accessories.

The result has to be entered on page 9 of the flight manual.

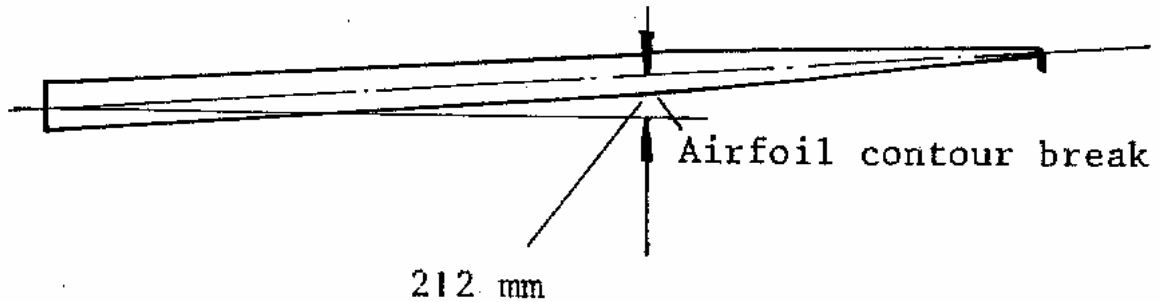
Weight and balance must be carried out at least every four years.

2. Reference Data

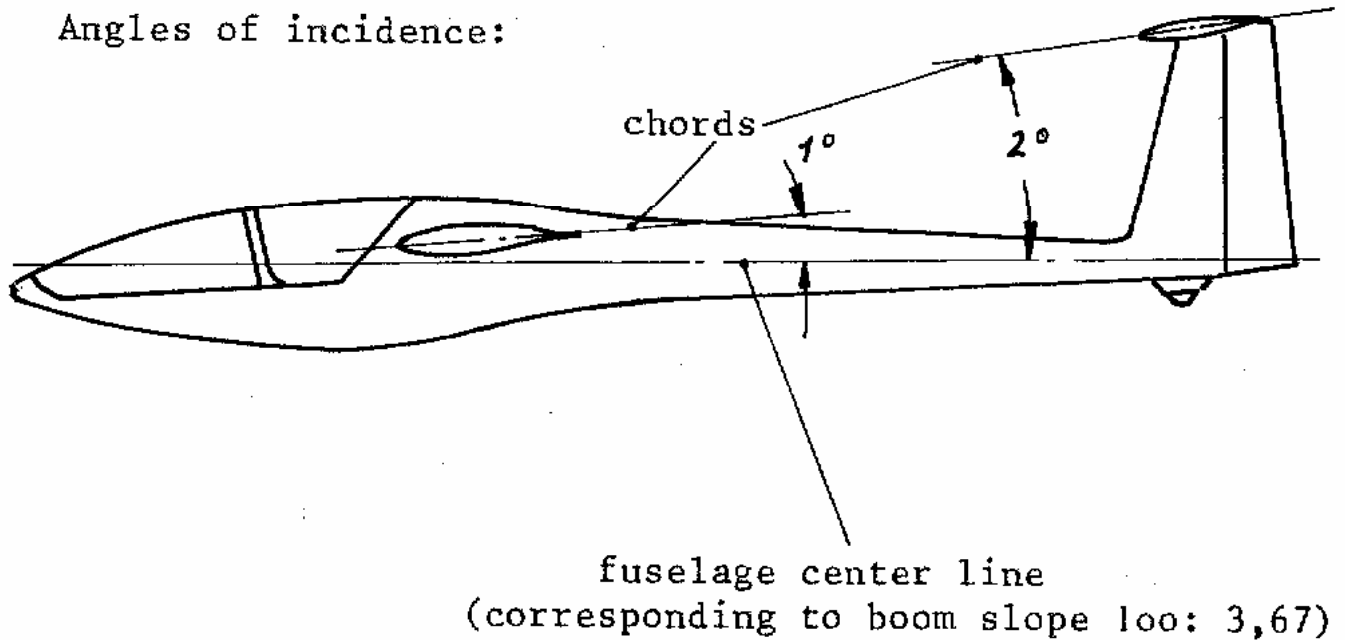
Wing:

Sweep Back (Leading Edge) = 100 mm - 10 mm + 0 mm
at wing tip

Dihedral (Leading Edge, Line) = 3°



Angles of incidence:



Wing oscillated frequency: / min.

Aircraft should rest on the wheels during the frequency measurements.

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Control displacements and tolerances

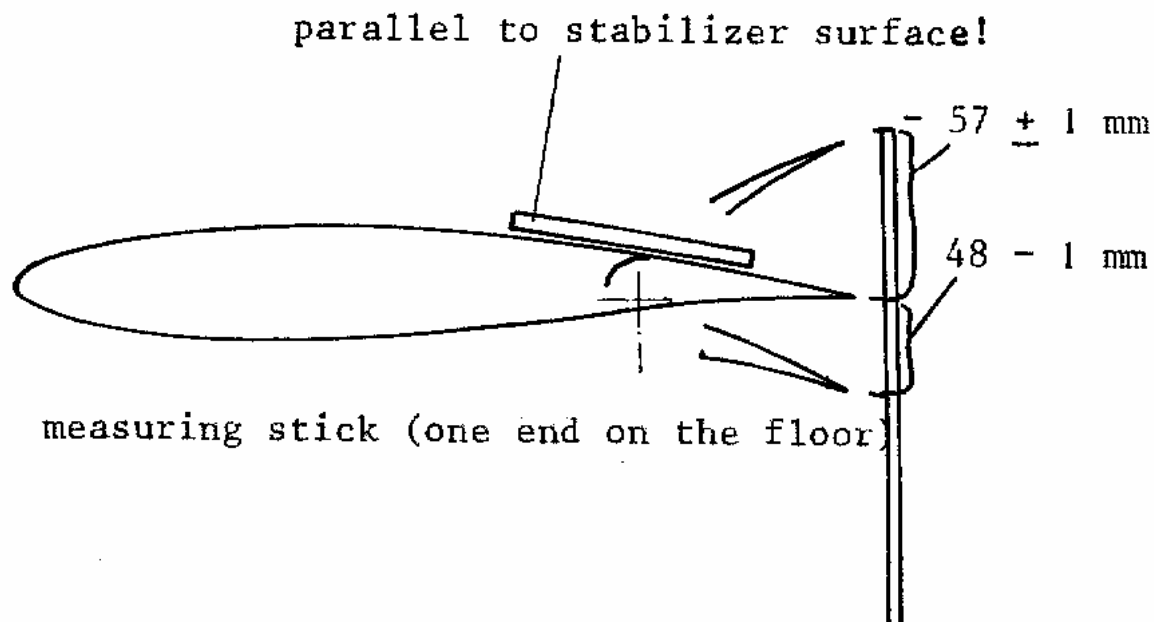
Rudder

+ 243 mm + 10 mm tolerance
measured 460 mm from hinge axis

Elevator

Up travel 57 mm + 1 mm
Down travel 48 mm - 1 mm
measured 150 mm from hinge axis

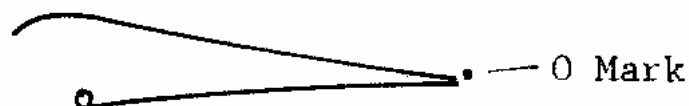
The adjustment is made at the stick. To measure the displacement lay a straight edge over the elevator and trailing surface of the stabilizer. The surface is flat in this area. The straight edge must lie parallel to the stabilizer surface. Holding a measuring stick with one end on the floor mark the 0 point on the stick. Then measure the up and down displacements from this "0" point.



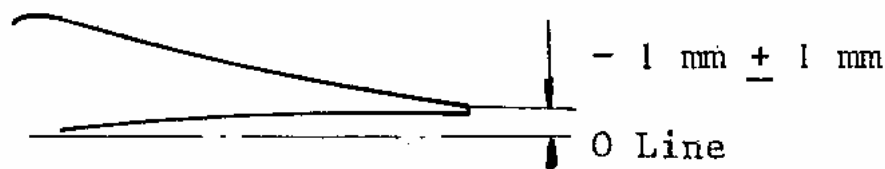
Aileron and Flaps

Glue the pattern from Diagram 4 onto a piece of thin plywood and cut it out. Place it in the gap between the flap and aileron. Set the flaps on 0° . Centralize the control stick.

There is a mark on the fuselage where the trailing edge of the flap should line up when the flaps are set on 0° .



The ailerons must have the position from the zero line of the pattern: $-1 \text{ mm} \pm 1 \text{ mm}$



If this is not the case, the ailerons are adjusted on the control rod coming out of the wing in the fuselage.

Aileron displacements:

up $-42 \pm 3 \text{ mm.}$ measured

down $+21 \pm 3 \text{ mm.}$ (123 mm. from the hinge axis)

Measured from the aileron "0" point. The displacement stops are found under the side cover panel in the cockpit.

Flap displacements

Set the flaps in the $+12^{\circ}$ and -12° positions and measure.

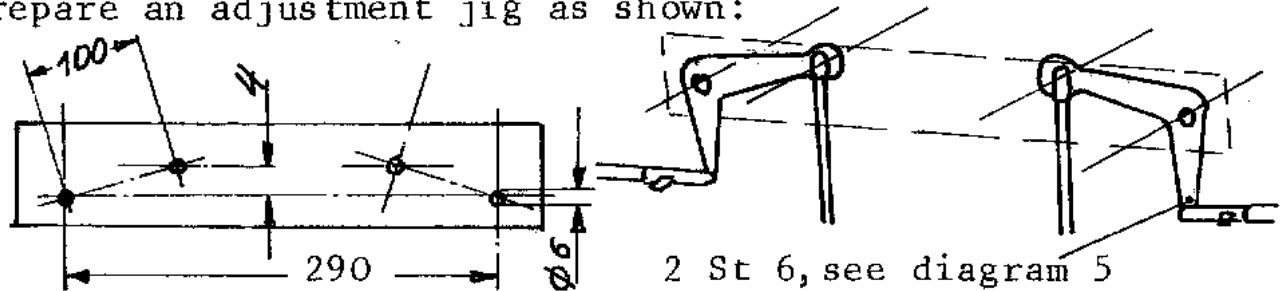
up -12° 30 mm. $\pm 3 \text{ mm.}$

down $+12^{\circ}$ 30 mm. $\pm 3 \text{ mm.}$ measured 145 mm. from the
 0° 0 mm hinge axis.

The displacement are not adjustable.

Should it be necessary to completely reset the flaps and ailerons because of a repair proceed as follows:

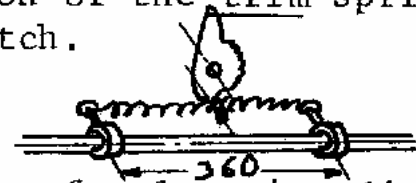
Prepare an adjustment jig as shown:



This jig is attached to the controls in the fuselage. It centralizes the control rods.

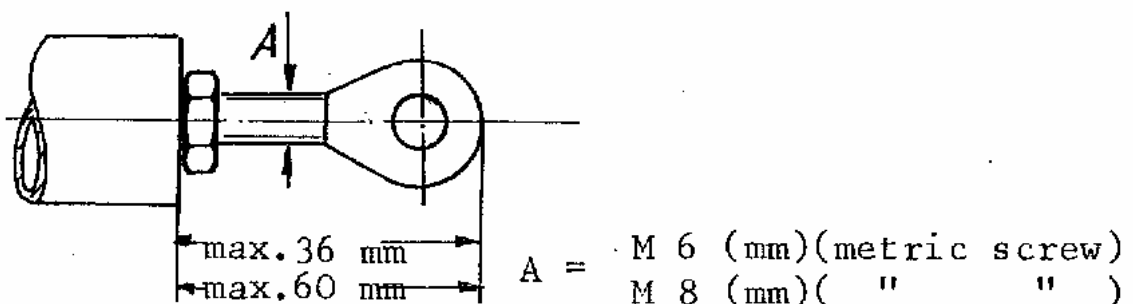
1. Adjust the control stick so that it is perpendicular (for ailerons)
2. Set the flap handle on 0°.
3. Adjust the flaps on the two short control rods in the interconnect mechanism.
4. Zero the ailerons by adjusting the quick connects.
5. Adjust the aileron displacements as above (page 5)

Trim: The automatic trim is to adjust so that the control stick is 1 to 1,5 cm behind its forward position in the nose down trim position. The tension of the trim springs is to adjust concerning to the sketch.



Spoilers: The short push rod in the fuselage is adjusted so that the spoilers are extended evenly and are easily locked closed. Extension out min. 140 mm, in 0 mm. It is important that the control rod ends are not unscrewed too far.

Important: With every adjustment of a control rod for the flaps, airbrakes, elevator, trim and ailerons make sure that the universal joint ends have not been unscrewed too far!



3. Inspections

A Every 200 flight hours and at the Annual inspection

1. Rudder cables for wear especially near the S-shaped tube guides of the pedal adjustment mechanism. Replace worn cables with the following hardware:
Steel wire cable 3,2 mm diameter LN 9374 with copper NICROPRESS sleeve 28-3-M. Cable is equivalent to 1/8" MIL-W-1511 A Cable. For further information (e.g. tool, number of grooves) see Aircraft Inspection and Repair FAA AC 43.13-1 A
2. The aileron and flap play (see page 18).

B Annual inspection

Control mechanism: Every year check all screwed connections and safety devices. Check controls for sufficient lubrication and rust prevention (see page 9, par 7).

Check control displacements (see page 4).

Check control system for free play (see page 18)

Check the tangential play of the wings (see page 19)

Tow Release: To be serviced as detailed in "SH 72" and "S 72" manuals, issued Nov. 77. Weight and balance must be carried out at least every four years (see page 1).

C Every 3 month

Detailed inspection and lubrication (see page 9, par 7).

Check of the emergency release of the single piece canopy according to flight manual sect. 4.1 page 13 a.

D Occasionally

Wheel Brake: If the braking effect is insufficient adjust the wheel brake at the adjustment screw on the front gear street. Check that you can open the spoilers as far as to allow a slot of min. 38 mm between spoilers and wing surface when the wheel brake starts to operate.

Landing Gear: Clean after soft field landings.

Tow Release: Clean tow release. After a gear up landing check cable deflectors. Damaged parts must be replaced before the next take off.

E. Inspection Procedure For Increase Of Service Time

1. General

The results of fatigue tests of wingspar sections have demonstrated recently that the service time of GFRP gliders may be extended to 6000 hours, if for each individual glider (in addition to the obligatory annual inspections) the airworthiness is demonstrated according to a special multi-step inspection program particularly with regard to the service life. CFRP components are already certified for 6000 hours service time.

2. Dates

When the glider has reached a service time of 3000 hours, an inspection must be done in accordance with the inspection program mentioned under point 3.

If the results of this inspection are positive or if any defects found have been duly repaired, the service time of the glider is extended by another 1000 hours to a total of 4000 hours (first step).

The above inspection program must be repeated when the glider has reached a service time of 4000 hours. If the results of this inspection are positive or if any defects found have been duly repaired, the service time of the glider is extended to 5000 hours (second step).

When the glider has reached a service time of 5000 h the above inspection program again must be repeated. If the results of the inspection are still positive, or if any defects found have been duly repaired, the service time may be extended to a total of 6000 hours (third step).

For a possible service time exceeding 6000 hours procedures will be evaluated in the future.

3. LBA-approved Glaser-Dirks Flugzeugbau GmbH document No.XXXX (to be issued and approved in the future) contains the structural inspection procedures and limitations to be used for extending the service life above 3000 flight hours.
4. The inspection must only be done by the manufacturer or by a licensed repair station or inspector.
5. The results of the inspections have to be recorded in an inspection test report wherein comments are required for each inspection instruction. If the inspections are done outside the manufacturer's facilities, a copy of the records must be sent to the manufacturer for his evaluation and information.
6. The annual inspection is not affected by this inspection program.

F. Exchange of the waterbags

Tie a piece of nylon cord (3 mm) diameter and at least 5 m long, to the nylon cord sticking out of the wing root rib. Unscrew the screw cap of valve. Pull the valve body with the tank out of its suspension in direction of the wing tip. Then pull the valve body and tank out of the wing through the opening in the root rib. Unknot the nylon cords from the tank and open the hose clamp at the valve. Attach the new tank and install it analogous. Fill the tank and check for watertightness.

Inspections

In addition to the inspections listed in item 3 the following inspections have to be accomplished:

Airbrake torque tube in the fuselage

On every annual inspection the airbrake torque tube in the fuselage must be inspected according to TN 323/9, working instruction no.2.

Airbrakes

On every annual inspection the airbrakes must be inspected according to TN 323/9, working instruction no.1.

5. Repair of Damage

Before every flight and especially after a period of nonuse, a thorough ground check should be carried out. Visually check the surface for small depressions, bubbles, and other unevenness. This could be a signal that something is not right.

Contact the manufacturer immediately and, if possible, send a photo of the damage and a report by a licensed airframe mechanic. The manufacturer will be able to supply the correct advice and a repair program saving you the time and troubles of guesswork and bad tries.

Minor surface damage such as scratches, gouges, and cracks in the finish may be repaired by a licensed airframe mechanic, (See also page 15). Knowledgeable advice can also be found in the Petite Plane Patch Primer. A list of materials for the DG-200 and a check list for postaccident inspection is found on pages 12 - 14.

Repairs by the owner should not be attempted if:

the spar flange is damaged.

the main fittings on the wings, fuselage, or tail are torn out or if in the immediate vicinity there are white areas in the laminations.

the parts are torn in such a way as to make repairs uncertain without the use of jigs or appliances.

the damage is so extensive that the original shape or contour is obscured.

Cut away undamaged areas as necessary to gain access to damaged areas.

You are not allowed to repair or repaint the ailerons and flaps.

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6. Service and Care

You have chosen a sailplane made of fiberglass which, though elegant, is enormously strong and robust.

A few tips for care of the surface:

- o Wash the surface only with clear water using a sponge and chamois.
- o Never use gasoline, alcohol, or thinner for cleaning.
- o Do not use detergent too often.
- o The surface may be polished as often as desirable. When using a power buffer, care must be taken that the surface is not overheated.
- o This sailplane should be protected from moisture just like other sailplanes.
- o The surface should be protected from intense sunlight (heat) and ballast should not be retained for extended periods.

7. Lubrication

Every 3 month make a detailed inspection of the sailplane and lube all bearings, Especially the ball bearing univers joints should be cleaned and lubed (Molycote Long-life). These areas are involved:

- o Aileron drive directly accessable at the wing contour break.
- o Spoiler drive in the spoiler box. In this location are the spoiler bearings which should be lubed.
- o Unscrew the push rod fairing on the left bulkhead and lube the guides.
- o Remove the baggage compartment bottoms. Stabilizer, aileron, trim, and flap control rods should be lubed.

- o Open fuselage access cover. Lube spoiler control and flight control quick-disconnects.
- o Remove stick mechanism cover. Lube stick mechanism.
- o Lube guide of rudder adjustment mechanism.
- o Oil bearing points of gear struts in wheel well.
- o Clean and lube all hinges (elevator, rudder, ailerons, flaps)
- o Take off the canopy and clean and grease the locking mechanism. After reinstalling the canopy, check the pilot force needed for emergency release with the red ball handle using a spring balance.
The force should not exceed 200 N (44 lbs.).
- o Check the canopy emergency release referring to flight manual sec. 4.1.

8. Material List

List of materials used in the DG-200:

Resin: Shell Epikote 162

Catalyst: BASF Laromin C 260

Mixing proportions 100 parts resin: 38 parts catalyst by weight or 2 parts resin: 1 part catalyst by volume.

Fiberglass Fabric:

Interglas No.	US No.	Weave	Weight (grams/sq. meter)
90070	1610	Linen	80
92110	-	Twill	163
92125	-	Twill	280
92130	-	Linen	390
92140	-	Twill	390
92145	181-150	Unidirectional	220

All fabrics - finish I 550

Rovings:

Gevetex EC-10 -2400 K 92 with Silanschlichte

Foam:

Continental Conticell C 60 Colour brown

Röhm GmbH Rohacell 51 Colour white

Lacquer:

Lesonal PE Schwabbellack 0369120

Mixing ratio 100 : 2 with hardener 0720510

Filler:

The resin catalyst mixture may be thickened with chopped cotton fibers. Non-thickened resin and catalyst mixture is applied to the area first as a bonding layer then the thickened mixture may be used.

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9. Check List After crash landing

Entire Aircraft:

Inspect the general alignment along the longitudinal axis (vertical and horizontal tail surfaces).

Wing-flex characteristics normal, wing angles and measurements in agreement with previously mentioned specs.

Wings:

Spar pins: Check for deformation in main pins and bushings and also white spots around bushings.

Wing root rib: Separation between rib and wing shell or between rib and main spar?

If necessary, remove paint and putty to determine if cracks extend into FRP.

Check for white spots and delaminations around bushings.

Shell: Compression fractures, cracks, blisters?
Spanwise, hair-line cracks in the leading-edge near the stagnation point can be ignored.

Ailerons and flaps:

Compression fractures, cracks, blisters?
Check hinges and drives.

Check listFuselage:

Fuselage to wing connections:

White spots, excessive play, bent tubes (hard assembly)?

Torsion check:

Hold fuselage steady and attempt to move vertical stabilizer - does it move easier than usual?

If so, are the cracks visible?

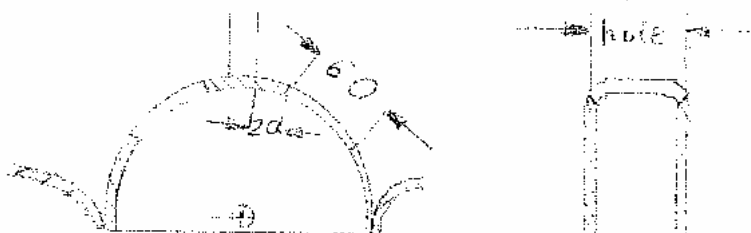
Fuselage and vertical stabilizer intersection:

Cracks? Scrape away paint and putty. While moving vertical stabilizer side to side and fore and aft, check for cracks extending into FRP.

For inspecting the controls and the bulkheads etc. in this area disassemble the tailwheel and cut 2 holes into the tailwheel box (see sketch).

Close the holes after inspection or repair with 3 layers of 92 125 glassfibre fabric. Overlap length 2 cm. Sand at minimum 3 cm around the holes with 80 grit sand paper.

You can use the original Epoxy resin (see page 11) or a polyester resin, as the tailwheel box is a non supporting part.



Stabilizer mounting:

Excessive play? Check top rib of vertical stabilizer for cracks especially near fittings.

Rudder bearings:

Excessive play, spots in FRP, bent fittings, cracks in finish?

Tail wheel:

Enlarged axle hole? If so, fill with thick filler.

Fuselage shell:

Outside: Cracks, creases, nicks?

Inside: White spots, sharp white zig-zag lines, cracks?

Any loose ribs?

Has any bulkhead become loose? To check this remove also the control column boot, instrument panel cover and the access cover of the tow hook compartment and check the bulkheads in this areas carefully.

Landing gear:

Check for straight axle, bent struts, alignment, ease of operation, over center locking? Is dirt in the forks of the forward strut?

White spots or cracks in the wheel well bulkheads.
Remove deck of storage area and inspect wheel well.
Gear lever condition?

Tow hook:

Especially after a belly landing check for dirt, function, and if housing loosened or separated from fuselage.
After a gear up landing check cable deflectors.
Damaged parts must be replaced before the next take off.

Seat back rest bulkhead:

Cracks? Shoulder strap connection?

Seat belt:

Check for white areas near fuselage attachments.

Stick:

Check suspension. Excessive play?

Controls:

Condition and proper operation of all flight controls and all other operating devices

Instruments:

Function? Dirt in the pitot plenum?

For further checks see page 7.

Check safety harness.

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10. Repair instructions

I. The following can be repaired:

1. All damage to paint and putty.
2. Holes on the belly of the fuselage if the maximum diameter does not exceed the following:

Forward fuselage 80 mm

Aft boom 40 mm

Cracks in the belly maximum length:

Forward fuselage 120 mm

Aft boom 80 mm

The blind glue joints of the fuselage boom should not be damaged.

3. Holes, cracks, blisters in the wings, tail, and control surfaces not in excess of the following dimensions:

	Diameter	Length
Wings	100 mm	150 mm
Stabilator	50 mm	80 mm
Rudder	50 mm	80 mm

The parts may not be damaged in the spar area.

4. Replacement of bent fittings.

II. Method of FRP repairs (2,3 above)

1. Remove damaged fabric, bevel edges and roughen surface around hole. The scarf length corresponds to the overlap length (see page 16).
2. All repairs must follow the procedure of wet over dry.

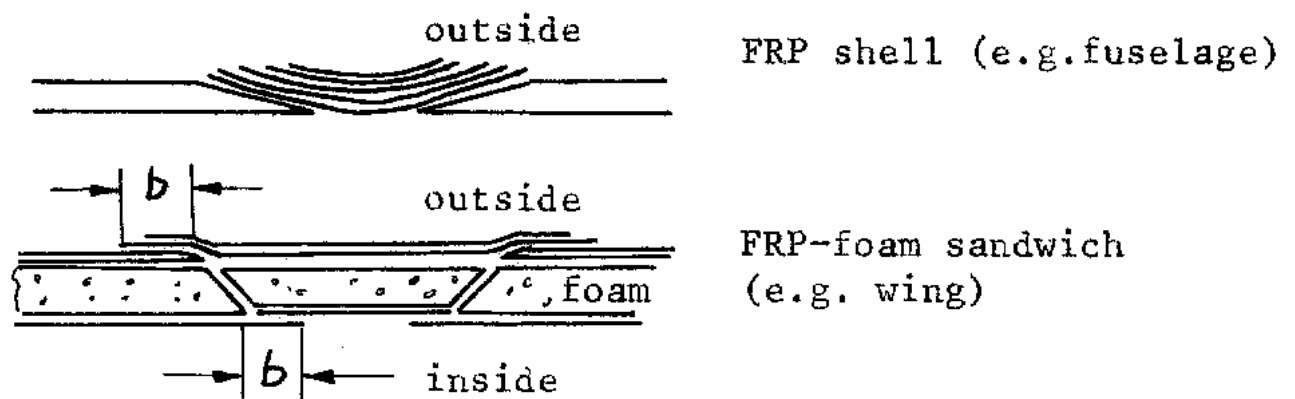
Special tips for handling FRP repairs are found in the Petite Plane Patch Primer.

3. The following overlap dimensions are to be maintained.
 These dimensions apply to all phases of the repair work.

Part	Overlap b (cm)	Fabric Layers and Type
Wing shell outside	2	1 x 92 110 ✕ + 1 x 92125 ✕ or 3 x 92 110 ✕
Wing shell inside	2	1 x 92 130 ✕ or 3 x 92110 ✕
Stabilator outside	2	1 x 92125 ✕
inside	1	1 x 90070 ✕
Elevator	2	1 x 92110 ✕ + 2 x 92125 ✕
Rudder outside and inside	1	1 x 90070 ✕
Forward fuselage belly	6	1 x 92110 ✕ outside + 3 x 92125 ✕ + 7 x 92125#
Fuselage boom belly	5	1 x 92110 ✕ outside + 3 x 92125 ✕ + 3 x 92125#

You are not allowed to repair or paint the ailerons and flaps.

4. Method of beveled repair



Outside fabric layers may be pressed into foam slightly before new layers are applied.

11. Control Surface Mass Balances

After the repair or painting of any control surface, the weight and the mass balancing must be checked.

Control surface	weight (kg)		mass balancing moment (kg.cm)	
	max.	min.	max.	min.
Rudder (with mass compensation)	4,4	3,9	8,0	4,0
Elevator (without control tube)	2,2	1,6	8,7	6,7
Aileron (with mass compensation)	3,1	2,5	4,5	3,0
Wing tip aileron	0,4	0,25	0,53	0,35
Wing flap	5,8	4,9	21,6	16,9

Remark:

Please contact the manufacturer before changing the mass balancing.

Methods of measuring the mass balancing momentsRudder:

Disconnect control cables and place fuselage on its side so that the fin is horizontal. At a point of 200 mm (7.87 in.) from hinge line at the rudders bottom side of the rudder lift rudder with a small scaled spring balance.

Elevator:

Suspend the elevator freely at hinge line and lift 150 mm (5.9 in.) (elevator centre) from hinge line with a small scaled spring balance.

Aileron:

Suspend the aileron freely at hinge line and lift 100 mm (3.94 in.) (2 nd bearing) from hinge line with a small scaled spring balance.

Wing flap:

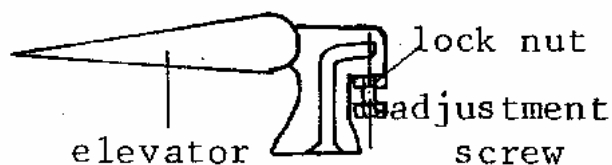
Suspend the wing flap freely at hinge line and lift 135 mm (5.31 in.) (2 nd bearing) from hinge line with a small scaled spring balance.

12. Play in control systemsAileron play:

Measured with the ailerons neutral and the opposite aileron fixed in position. The maximum allowable play in the ailerons is 2 mm (measured 123 mm from the hinge axis). When there is too much play the bearing (part no. 2 F 7/1) must be replaced. Hold the other aileron firmly in place when conducting this measurement. With both ailerons held neutral firmly, the play at the top of the control stick must not exceed 3 mm.

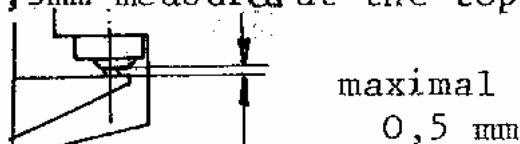
Elevator play:

The play at the top of the control stick must not exceed 3 mm, when the elevator is firmly held neutral position. There shall be no play in the automatic elevator control self connection mechanism. If necessary you can reduce the play by turning in the adjustment screw.

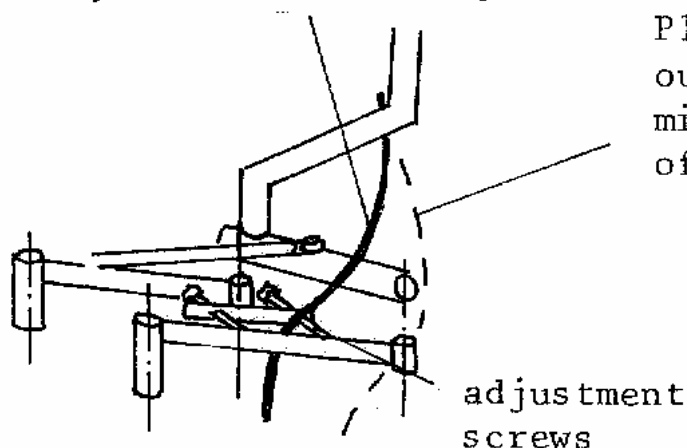
Flap play: (measured 145 mm from hinge axis)

The maximum allowable play measured at the trailing edge of the flap is 3 mm. If the play exceeds this amount the pin in the flap drive ball must be replaced with an oversize pin. (part no. 2 St 14/3). Hold the other flap firmly in place when conducting this measurement.

Rudder play: The maximum allowable vertical play in the rudder hinges is 0,5 mm measured at the top hinge.

13. Repair of the bowden cable in the parallelogram stick mechanism

In case of replacement it is of importance that the cable should be placed between the two parallelogram arms of the stick system (see drawing).



Placement of the cable outside the parallelogram might lead to a blockation of the steering mechanism

14. Tangential play of the wings

Rigg your glider.

Pull the wings forward and backward and observe at which lift pin you can find the maximum tangential play.

Derigg the glider.

Sand the flange of the lift pin and glue a thin washer inner diameter 16,5 mm 0,25 mm of thickness with a suitable metal adhesiv (Stabilit Express, Decon etc.) to the flange.

Mark the thickness of this washer at the fuselage side near the lift pin. Rigg the glider again and check if tangential play is eliminated.

15. Tangential play of the insertable wing tips

See wing.

Washer inner diameter 10,5 mm 0,25 mm of thickness.

Mark the thickness of this washer at the rib of the wing tip.

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16. Instrument- and equipment list1. Airspeed indicators

<u>Manufacturer</u>	<u>Type</u>
Winter	6 FMS 4 (10.210/10)
Winter	6 FMS 5-2 (10.210/3)
PZL	PSO 6
PZL	PR-400 S

The airspeed indicator must have the speed range markings see Flight manual page 6.

2. Altimeters

<u>Manufacturer</u>	<u>Type</u>
Winter	4 FGH 10
PZL	PW 12

3. Four piece safety belt and shoulder harness (symmetrical)

<u>Manufacturer</u>	<u>Type</u>
Gadringer	BAGU IV-B (40.070/16)
	SCHUGU II-c (40.071/05)
Autoflug	SCHUGU FAG-7 D/O (40.070/30)
	BAGU FAG-7 H/O (40.071/21)

In addition for cloud flying

4. Radios

<u>Manufacturer</u>	<u>Type</u>
Dittel	FSG-40 S (10.911/45)
Becker	AR 2008/25 (10.911/48)

5. Compass

<u>Manufacturer</u>	<u>Type</u>
Bohli	46 MFK 1
PZL	B-13 KJ
Ludolph	FK 16

The compass is to be compensated in the glider.

6. Variometer

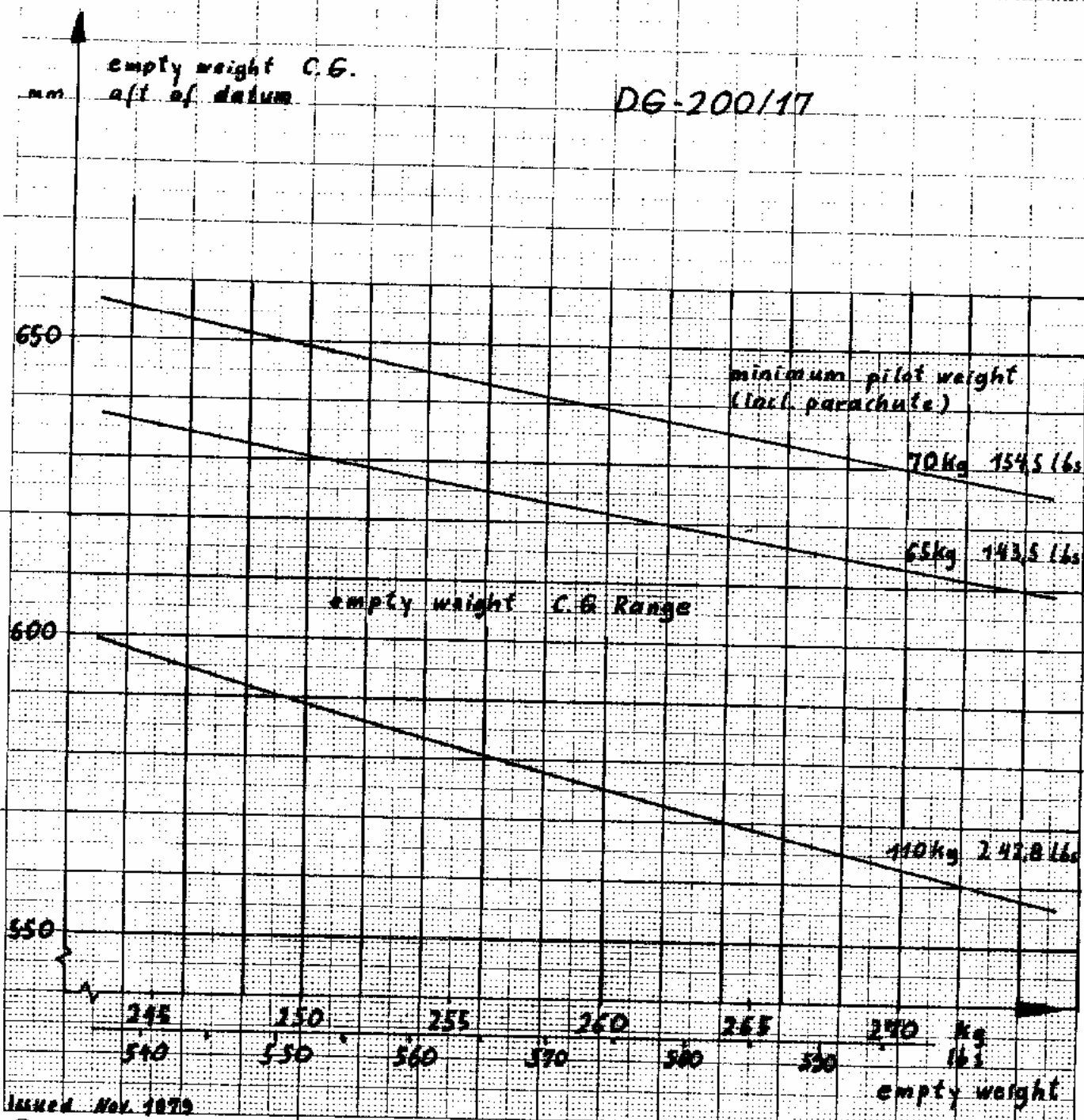
<u>Manufacturer</u>	<u>Type</u>
Winter	StV 55 (Ø 58)
Winter	StV 5 (Ø 80)
Winter	5 StVL (10.230/11)
Winter	5 StVLM (10.230/12)
Winter	5 StV (10.230/13)
Winter	5 StV M (10.230/14)
PZL	PRO 4 (Ø 58)
PZL	PRO 03 (Ø 80)

7. Turn and bank indicators

<u>Manufacturer</u>	<u>Type</u>
Apparatebau Gauting AOA	WZ-402/31 12 V (10.241/8)
PZL	EZS-3
or a certified artificial horizon	

diagram 17/1

DG-200/17



Issued Nov. 1979



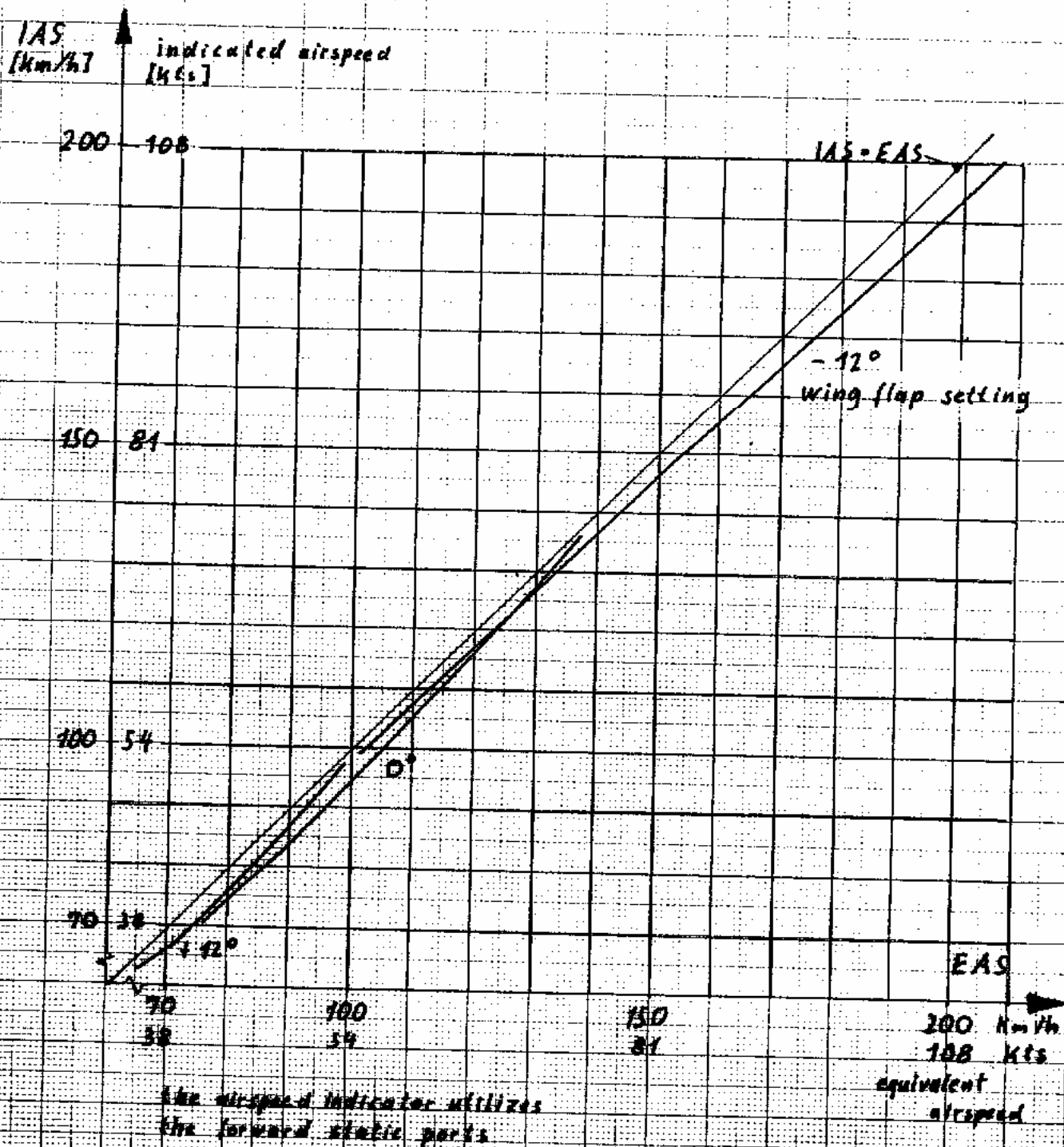
A 4 210x297 mm



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diagram 17/2

Airspeed Calibration DG-200/17



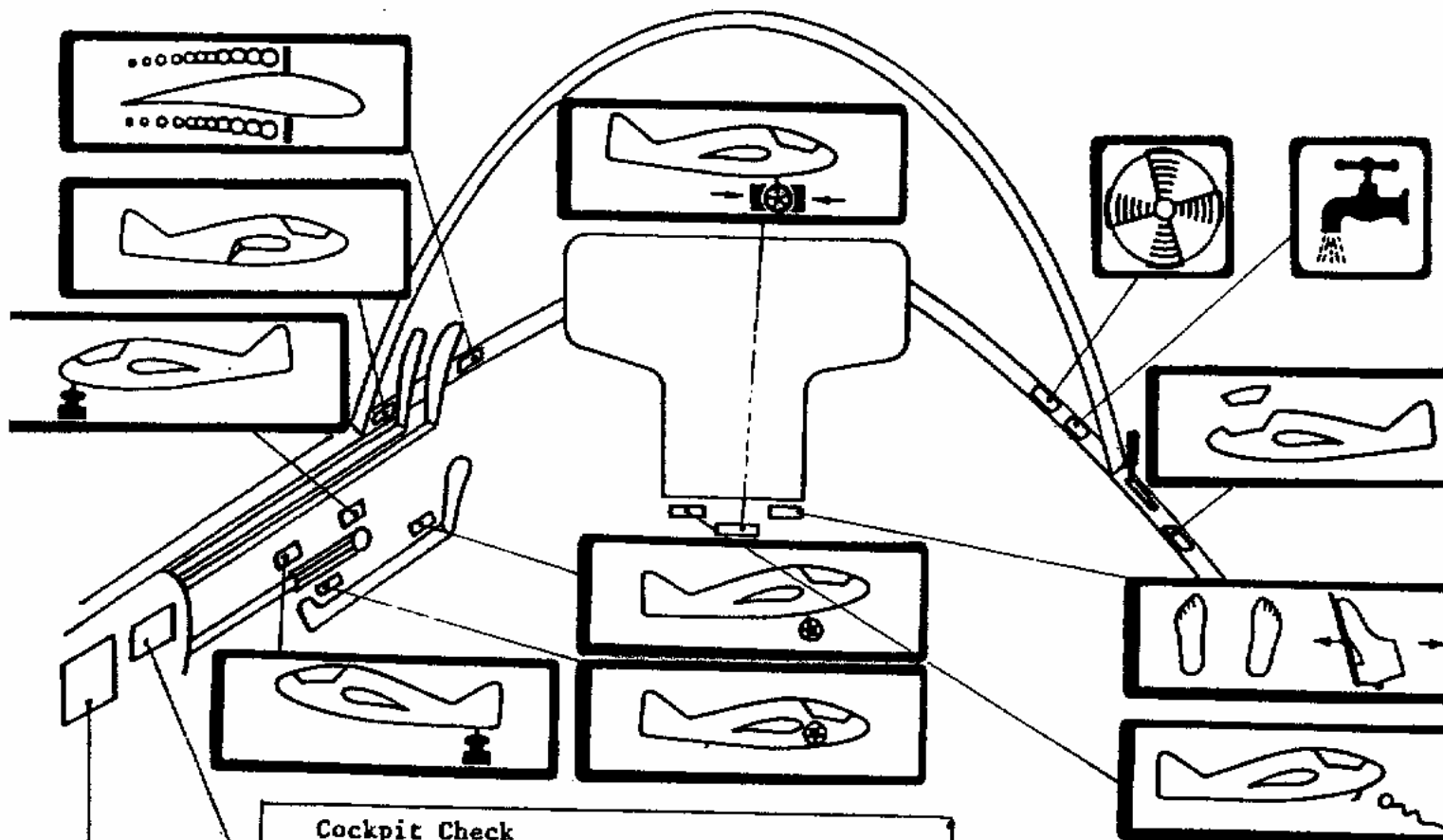
Issued Nov. 1999



A 4 210:297 mm



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Cockpit Check

1. Lead ballast (for under weight pilot)?
2. Parachuteworn properly?
3. Safety harness buckled?
4. Seat back and pedals adjusted?
5. All controls and knobs in reach?
6. Altimeter?
7. Dive brakes cycled and locked?
8. Control check? (one man at the control surfaces)
9. Trim?
10. Canopy locked?

Glaser-Fries Flugzeugbau GmbH

Model: DG-200/17 Serial No:

Maximum Airspeeds

Never exceed (V_{NE})	270 km/h	168 mph	146 kts
In rough air (V_R)	190 km/h	118 mph	103 kts
Maneuvering (V_A)	190 km/h	118 mph	103 kts
On aero-tow (V_T)	190 km/h	118 mph	103 kts
On winch tow (V_W)	130 km/h	81 mph	70 kts
Landing gear extended	190 km/h	118 mph	103 kts
Spoilers	270 km/h	168 mph	146 kts
Flaps (I.)	150 km/h	93 mph	80 kts

Gross weight 450 kg (992 lb.) including water ballast.

If the pilot's weight with the parachute is below 70 kg. (154 lb.) ballast weight must be installed in the trim weight fastener or in the seat. (see Flight Manual).

Operating Limitations

The sailplane must be operated in compliance with the operating limitations as stated in the form of markings, placards and Flight Manual.

Cloud flying is only permitted when the following instruments are installed: airspeed indicator, altimeter, magnetic compass, turn and slip indicator and variometer, radio.

Approved aerobatic maneuvers

permissible only with 15 m wing span and without water ballast

Maneuver	Recommended entry speed
Inside Loopings, chandelle, stall turn, spin, lazy eight	170 km/h, 106 mph, 92 kts Use slow deceleration

Maximum load factor - at maneuvering speed: + 5.3/-2.65
at never exceed speed: + 4.0/-1.5

All aerobatic maneuvers including spins must be accomplished in accordance with the approved DG-200/17 Flight Manual.

Night flying is prohibited.

Further placards
on the left gear door:

rated load 1100 lbs. (5000N)

42 psi (3 bar)

over the tailwheel:

28 psi (2 bar)

on the rear bulkhead:

baggage 33 lbs. (15 kg)

fire proof placard
RU 2 /

stabilizer:
HL 2 /

Rudder gusset:
SR 2 /

Wing root rip:
FL 2 / (left) FR 2 / (right)

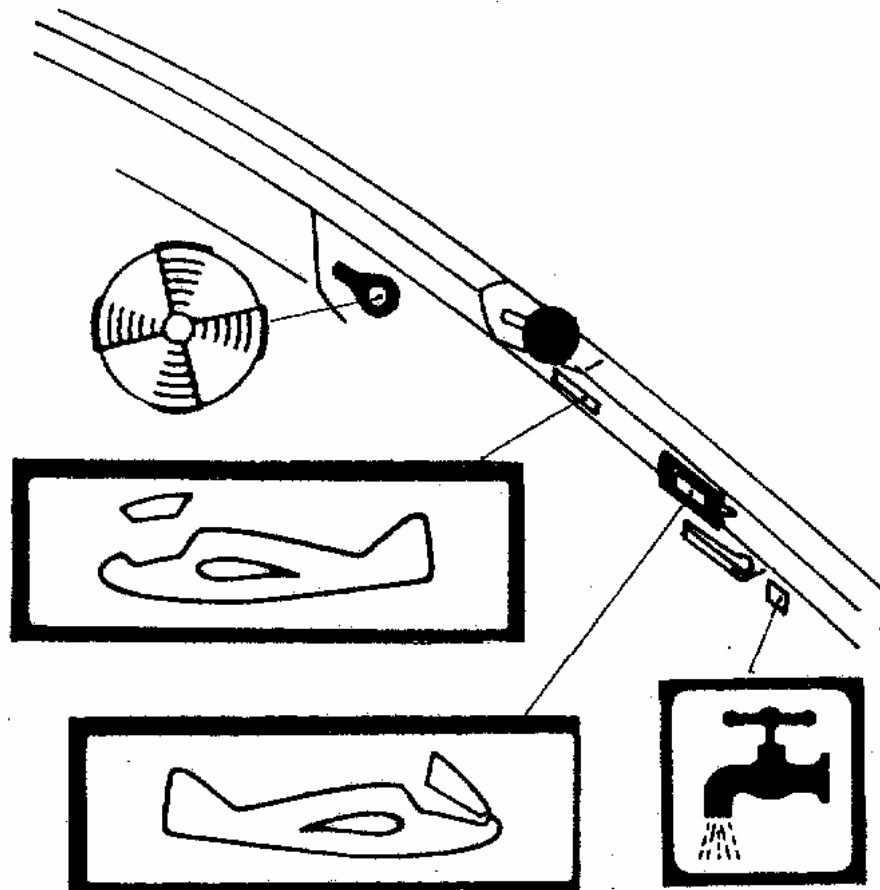
Flaps inner root rip:
WL 2 / (left) WR 2 / (right)

Aileron inner root rip:
AL 2 / (left) AR 2 / (right)

Placard locations
DG-200/17

diagram 17/3

Difference in placarting for single piece canopy.



DG-200

pattern for aileron displacements

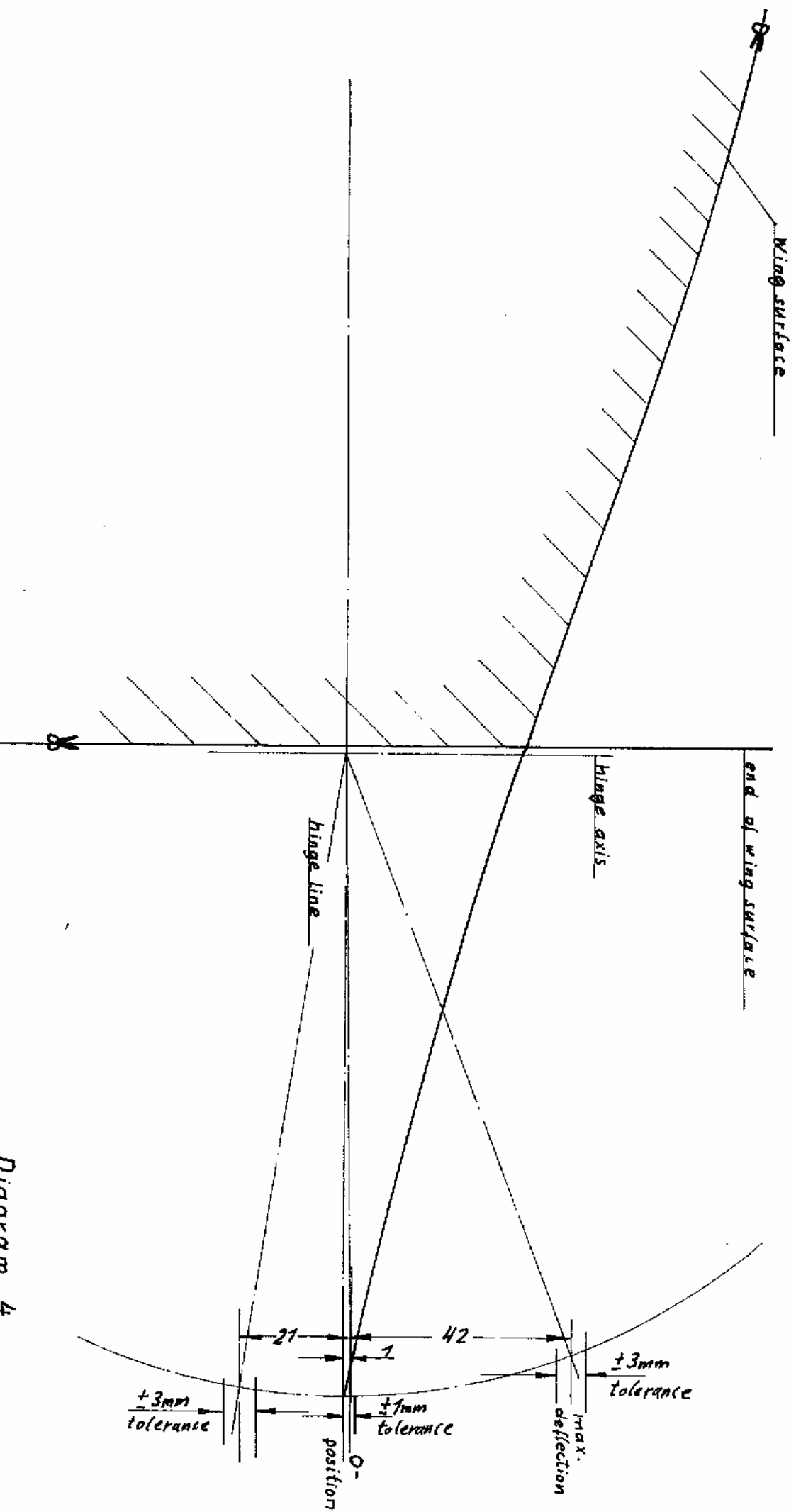
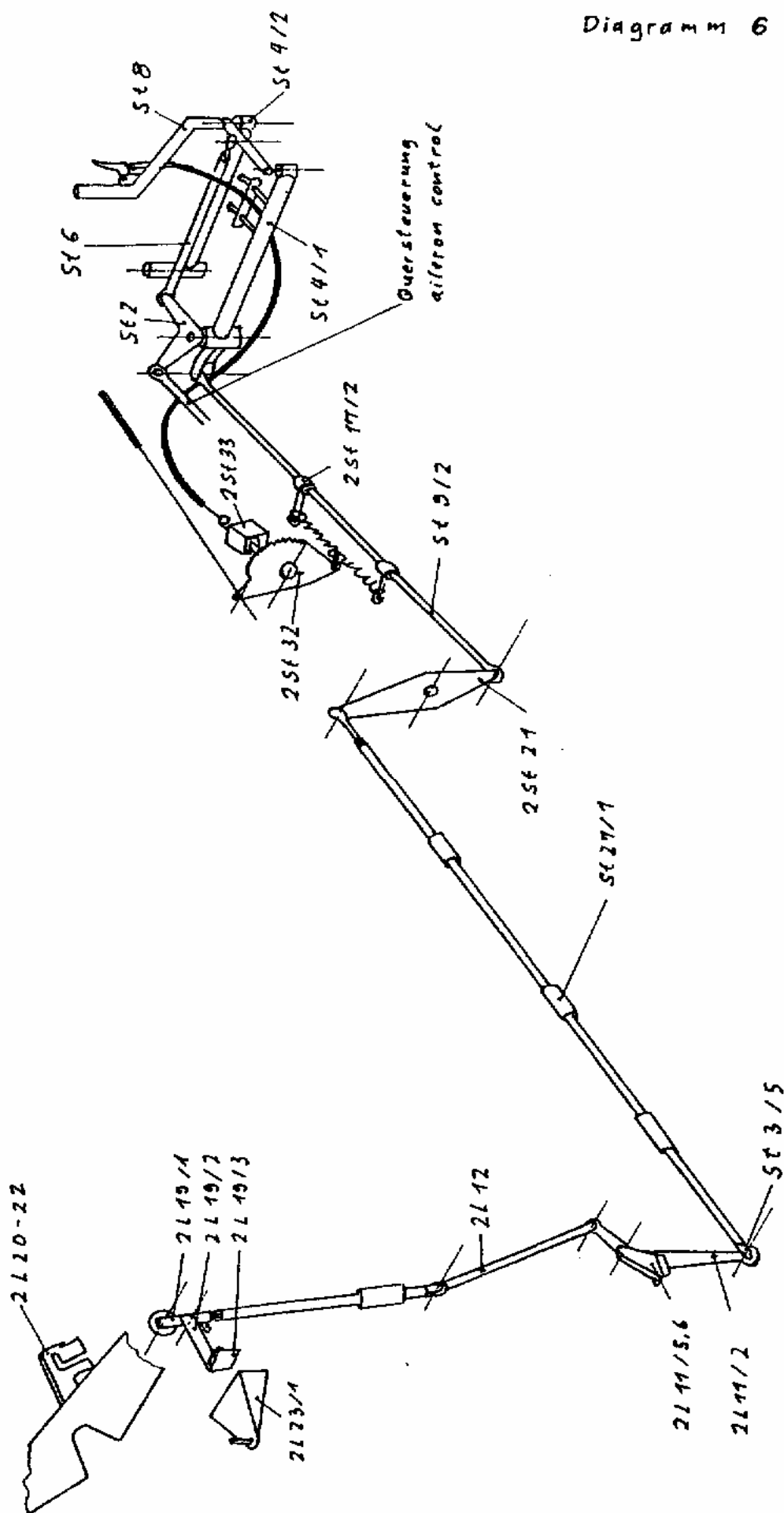


Diagram 4

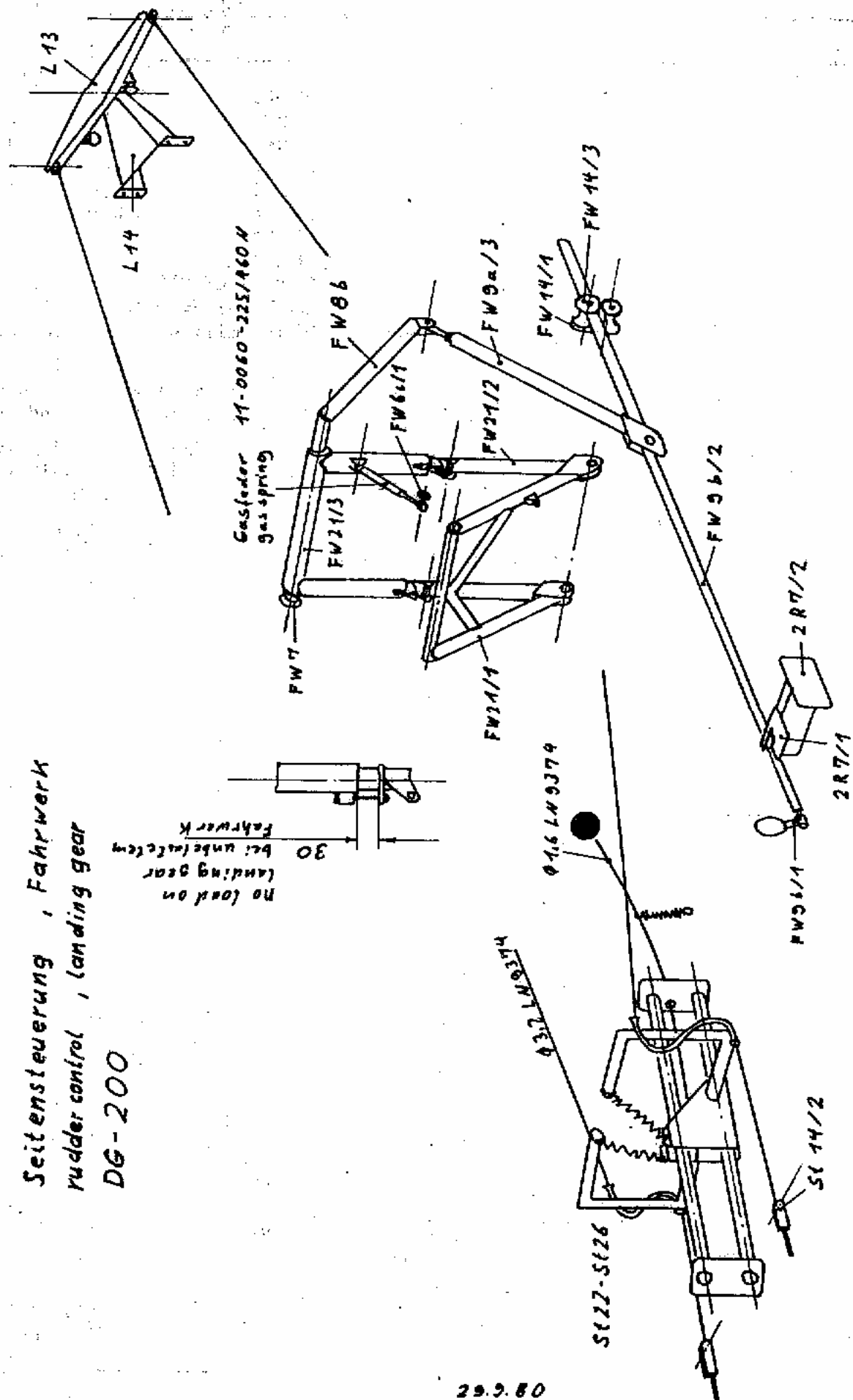
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 cm

Höhensteuerung
elevator control
DG-200

Diagramm 6

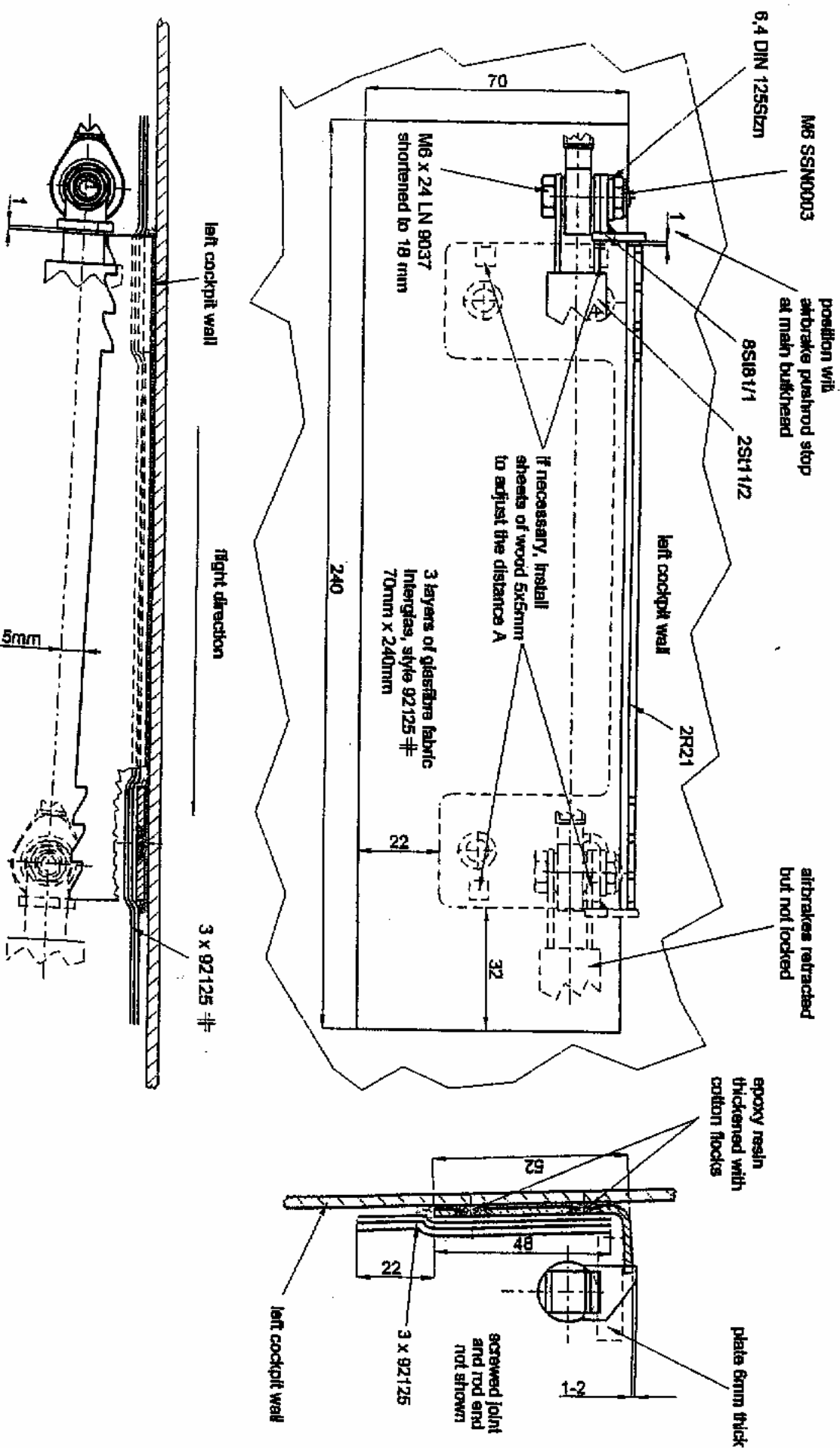


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Seitensteuerung , Fahrwerk
rudder control , landing gear
DG-200

29.9.80



Technische Zeichnung / Technische Zeichnung DG 1				Technische Zeichnung / Technische Zeichnung DG 1			
Schriftliche Notizen / Schriftliche Notizen DG 1				Schriftliche Notizen / Schriftliche Notizen DG 1			
Zeichn.	Titel	Tag	Rev.	Zeichn.	Titel	Tag	Rev.
1:1	parking brake combined with Piggott-hook DG-200 / DG-400 installation			1:1	parking brake combined with Piggott-hook DG-200 / DG-400 installation		
Flugzeugbau GmbH				Flugzeugbau GmbH			
2R20				2R20			

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