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Ref : N EX NO 09 01

MCR ULC ECOLIGHT

Aircraft Flight Manual

3rd Edition – 2009/08/20

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THIS PLANE MUST ALWAYS BE USED IN ACCORDANCE WITH THE INFORMATION AND LIMITATIONS CONTAINED IN THIS DOCUMENT.

THE USER IS RESPONSIBLE FOR THE USE OF THE AIRCRAFT , ENSURING THAT IT COMPLIES WITH REGULATIONS AND INFORMING ANY PASSENGER OF THE LIMITATIONS OF THE AIRCRAFT WITH RESPECT TO ITS AIRWORTHINESS LIMITATIONS.

BUILDERS: DYN'AERO FRANCE

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THIS MANUAL BELONGS TO THE AIRCRAFT: HB-WAZ S/N: 363

0.1. REGISTRATION OF THE REVISIONS

All amendments to this document must be entered in the table below, except weighing data, and all cases of approved sections, aimed and approved by the Authority responsible for Airworthiness.

Revision N°	Affected section	Affected pages	Date	Approval	Date	Date of insertion	Signed

0.2. TABLE OF CONTENTS

1. GENERAL

1.1. INTRODUCTION

The flight manual for the aircraft was designed to provide pilots and instructors with the information necessary to efficiently and safely fly this very light aircraft.

This manual contains information's that are imperative to be given to the *MCR ULC ECOLIGHT* pilot. It also contains supplementary information given by the builder.

1.2. CERTIFICATION BASIS

This aircraft was approved by _____

Category of Airworthiness: ECOLIGHT

Basis of acceptance: LTF UL 2003

Noise certification basis: ICAO Annex 16, Chapter 10

1.3. WARNINGS, CAUTIONS AND NOTES

The following definitions apply to **Warnings, Alarms & Notes** used in the flight manual.

WARNING:
Means that a failure to observe the corresponding procedures will lead to an immediate or important deterioration of the flight safety.

CAUTION:
Means that a failure to observe the corresponding procedures will lead to a minor or major deterioration of the long term flight safety.

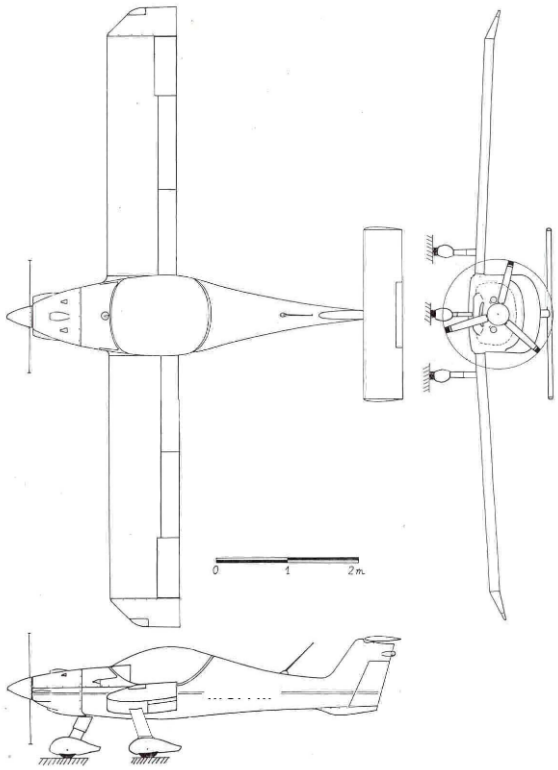
NOTE:
Draws attention to a condition which although not particularly related to the flight safety is important or unusual.

1.4. DESCRIPTIVE DATA

Kit aircraft of the type : *Dyn'Aéro MCR ULC*
Cantilever low-mounted wing, fixed gear.
Flying tail.
2 seats.
Carbon structure.
Engine: From Rotax 912 to 914 (Only 914 will be described here, each other engine (912 and 912S) will be added as soon as it equips an aircraft.)
Propeller: Dyn'Aero-Prop two/three-blades, fix or variable pitch.

Span	8.62	m
Wing surface	8.31	m²
Aspect ratio	9.02	
Wing loading	54.5	kg/ m²
Cabin width	1.12	m
Fuel capacity	72	l
Overall Length	5.53	m
Height	1.53	m
MAC	22/40	%

1.5. THREE VIEW DRAWING



2. LIMITATIONS

2.1. INTRODUCTION

This section includes operating limitations, reference marks of instruments and placards necessary for the safe use of the aircraft, its engine, standard systems and equipment.
The limitations included in this section are approved by _____.

2.2. AIRSPEED

Airspeed limits and their operational significance.

	Airspeed	(IAS)	Remarks
VNE	Never exceed speed	315 km/h	Velocity you must Never Exceed, in any case
VNO	Maximum structural cruising speed	210 km/h	Do not exceed this Velocity in Normal Operations, except in calm air, and then, only with great cautions.
VA	Manoeuvring speed	180 km/h	Do not apply abrupt or full-range control deflections beyond this speed, because under certain conditions, the Aircraft might be exposed to excessive loads.
VFE	Maximum speed allowed with flaps extended	140 km/h	Do not exceed this Velocity with Flaps Extended

***Note** : The maximum speed of the safety parachute deployment is 270km/h*

2.3. AIRSPEED INDICATOR MARKINGS

Marking	(IAS)	Significance
White segment	(70/140 km/h)	Speed range allowed with flaps extended
Green segment	(99/210 km/h)	Speed range for normal operational flight
Yellow segment	(210/315 km/h)	Manoeuvres must be carried out with caution and only in conditions of calm air
Red line	(315 km/h)	Maximum speed for all operations
Red triangle and red "P"	(270 km/h)	Maximum speed for the safety parachute deployment

2.4. POWER PLANT

2.4.1. Rotax 914

Engine manufacturer		Rotax
Engine model		914 UL4
Power		
Maximum:	Take-off, max. 5 minutes	115 HP
	Continuous:	100 HP
Manifold pressure		
Maximum:	Take-off, max. 5 minutes	39.9" Hg / 1350 hPa
Continuous		35.4" Hg / 1200 hPa
Engine RPM		
Maximum:	Take-off, max. 5 minutes	5800 RPM
Continuous		5500 RPM
Cylinder Head Temperature		
Maximum		135 °C
Oil Temperature:		
Maximum		130 °C
Oil pressure		
Minimum:		0.8 Bar
Maximum:		7 Bars
Fuel pressure		
Minimum:		0.15 Bar
Maximum:		0.35 Bar
Octane grade of fuel:		Automotive Gasoline unleaded min. 95 RON or AVGAS 100LL
Oil quality:		Motorcycle oil of a registered brand with gear additives, API classification SF or SG
Reduction gear with overload clutch		1:2.43

2.4.2. Propellers

Engines / Propellers	ROTAX 912 UL/A/F *Max Power :* -Take Off : 80HP (59.7 kW)/5800 RPM -Continuous : 77.8 HP (58.0 kW)/5500 RPM	ROTAX 912 ULS/S *Max Power :* -Take Off : 98.6HP (73.5 kW)/5800 RPM -Continuous : 92.5 HP (69.0 kW)/5500 RPM	ROTAX 914 UL/F *Max Power :* -Take Off : 113.3HP (84.5 kW)/5800 RPM -Continuous : 98.6 HP (73.5 kW)/5500 RPM
DYN'AERO MKIHE10() 3 bladed Diameter: 156 cm Fix Pitch		**x r** **O-STOL**	**x r**
DYN'AERO MKIHE11() 2 bladed Diameter: 156 cm Variable Pitch	**x**	**x** **O-C**	**x**
DYN'AERO MKIHE12() 2 bladed Diameter: 156 cm Variable Pitch	**x**	**x** **O-C**	**x**
DYN'AERO MKIHE13() 3 bladed Diameter: 156 cm Variable Pitch	**x**	**x r** **O-STOL**	**x r**

x : possible combination

r : optimized for towing

O-C : optimized for cruise

O-STOL: optimized for STOL performances

2.5. POWER PLANT INSTRUMENT MARKINGS

2.5.1. Rotax 914 UL

Instrumentation markings and their significance

ROTAX 914

a Instrument	Units	Red line Minimum Limit	Yellow sector Warning Range	Green sector Normal Range	Yellow sector Warning Range	Red Line Maximum Limit
Tachometer Model1 (S/N 326, 349, 351)	RPM	1400	1400 - 3500	3500 to 5500	5500 to 5800	5800
Tachometer Model 2 (S/N 362, 363 and next)	RPM		0 to 1400	1400 to 5500	5500 to 5800	5800 and over
Tachometer model 3 (S/N 328 only)	RPM	0 to 1500	1500 to 1800	1800 to 5500	5500 to 5800	5800
Oil temperature	°C	50°C	50 to 90°C	90 to 110 °C	110 to 130 °C	130 °C
Cylinder Head Temperature	°C	60°C	60 to 80°C	80 to 110 °C	110 to 135 °C	135 °C
Manifold pressure	In. HG			0 to 35.4 in Hg	35.4- 39.9 in. Hg	39.9 in. Hg
Oil Pressure	Bar	0.8 Bars	0.8 to 2 Bars	2 to 5 Bars	5 to 7 Bars	7 Bars

2.6. MISCELLANEOUS INSTRUMENT MARKINGS

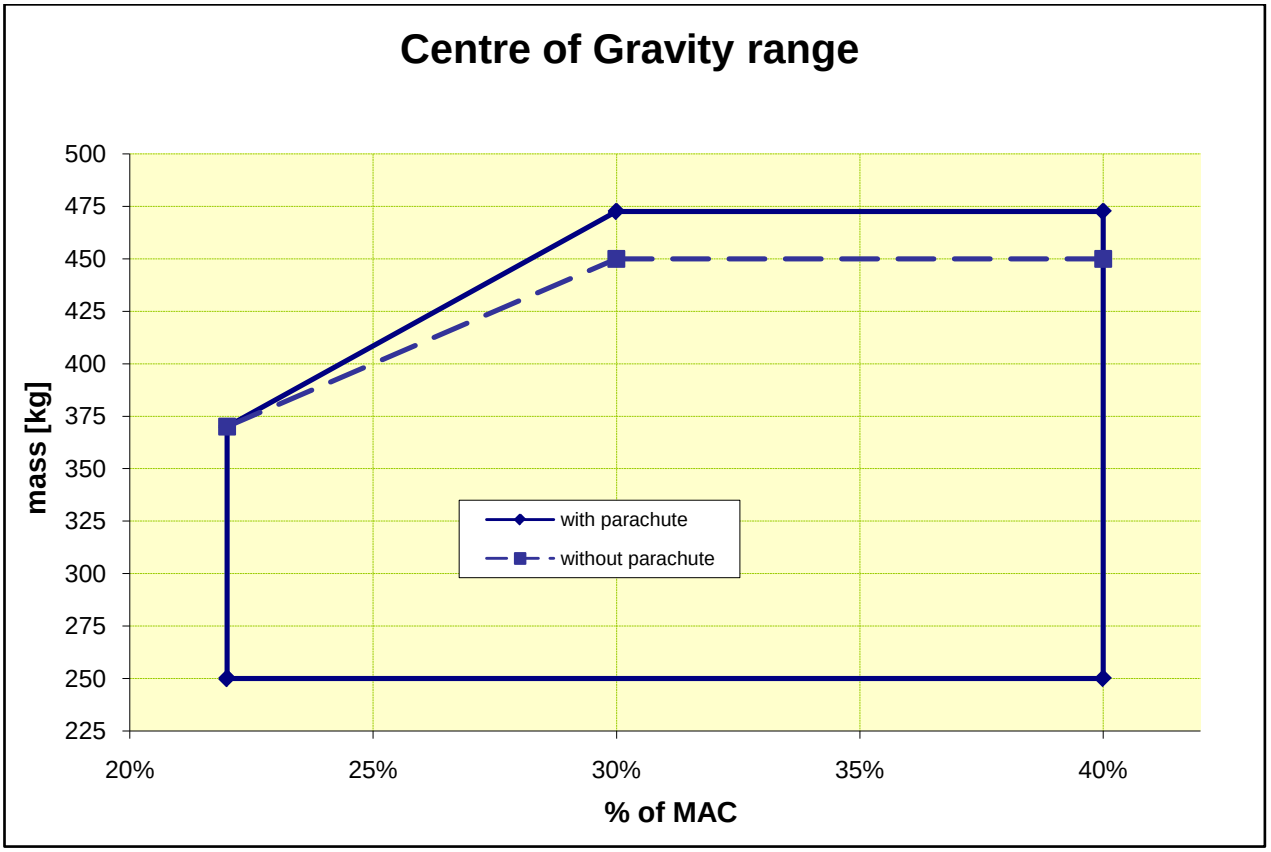
Fuel quantity indicator: placard of the usable fuel quantity: see 2.13

2.7. WEIGHT

Basic Empty Weight	see Chapter 6.2.3
Maximum take-off weight :	472.5. kg (450 kg without parachute)
Maximum landing weight :	472.5 kg(450 kg without parachute)
Maximum allowed baggage weight	15 kg

2.8. CENTRE OF GRAVITY

Centre of Gravity range	22 / 40% M.A.C.
Datum	M.A.C.



M.A.C. = 960 mm ; reference datum : 13.5 mm ahead of left wing leading-edge.

2.9. APPROVED MANOEUVRES

NORMAL CATEGORY
AEROBATIC FLIGHT IS PROHIBITED.
INTENTIONAL SPINS ARE PROHIBITED.

2.10. MANOEUVRING LOAD FACTOR

+4 / -2 g
+2.0 / 0 g (with flaps down)

2.11. FLIGHT CREW

Minimum flight crew is one pilot.
Two people onboard maximum.

2.12. KINDS OF OPERATION

VFR / DAY.

2.13. FUEL

	For S/N 326, 328, 389	For S/N 349, 351, 362, 363
Total fuel:	73 L	81 L
Usable fuel:	72 L	80 L
Unusable fuel:	1 L	1 L

Fuel Octane grade approved: Unleaded Automotive Gasoline min. 95 RON or avgas 100LL

2.14. MAXIMUM NUMBER OF SEATS

Two

2.15. OTHER LIMITATIONS

2.15.1. Tire pressure

Nose landing gear:	260 mm diameter wheel	2.5 bar
Main landing gear:	280 mm diameter wheel (11X4.00)	2.2 bar

2.16. PLACARDS

Minimum 3 cm high placard "ECOLIGHT AIRCRAFT" must be placed next to each cabin opening.

2.16.1. Flight limitations and airworthiness placards:

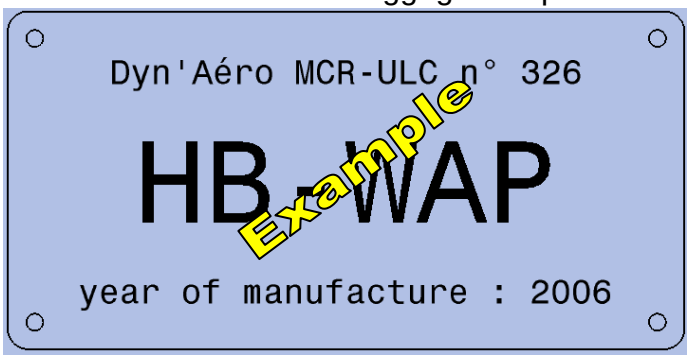
Sized 100*20mm and so that both pilots can easily read it, the following placard :

AEROBATIC FLIGHTS AND INTENTIONAL SPINS ARE PROHIBITED
NEVER EXCEED SPEED : VNE = 315 KM/H
MANOEUVRING SPEED : VA = 180 KM/H

Sized 75*35 and so that both pilots can easily read it, the following placard

Un certificat de navigabilité de la catégorie spéciale, sous-catégorie Ecolight, a été établi pour le présent avion. Le dit certificat ne correspond que partiellement aux normes internationales reconnues.
Für dieses Luftfahrzeug wurde ein Lufttüchtigkeitszeugnis der Sonderkategorie, Unterkategorie « Ecolight » ausgestellt. Dieses Dokument entspricht nur beschränkt den international vereinbarten Normen.

ID Plate: 100*50mm, 100*50mm (Inox)
"HB-XXX" : Height: 15mm Depth: 1mm
In the back frame of the luggage compartment.



2.16.2. Air speed indicator

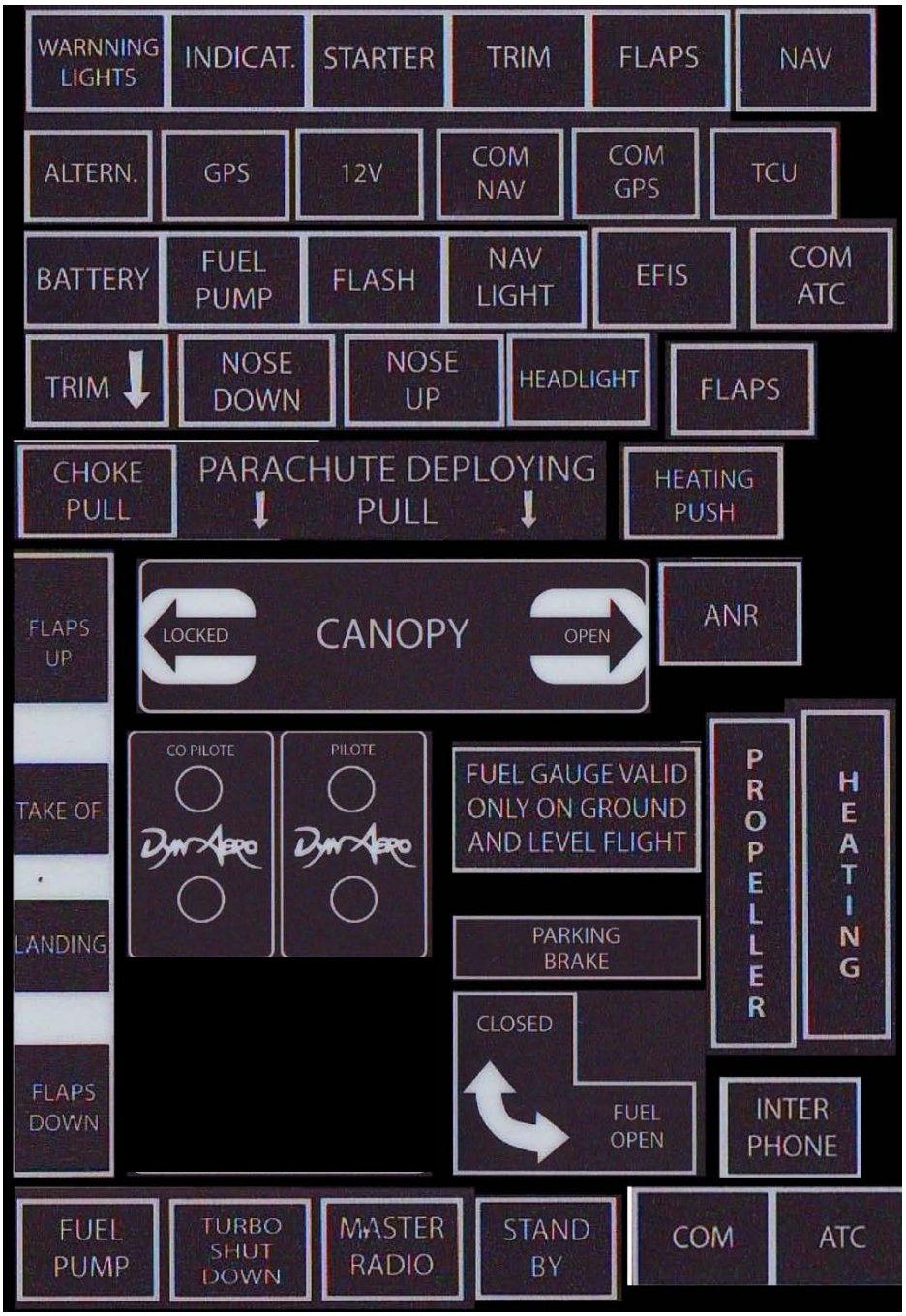
See paragraph 2.3.

2.16.3. Engine installation instruments

See paragraph 2.5.1.

2.16.4. Control system markings

Each control system other than main flight control systems is marked in order to explain its function and operation mode. This is an overview of the markings you should have on your aircraft if it is equipped with the corresponding device. It includes: lights, switches, breakers, handles and levers markings.

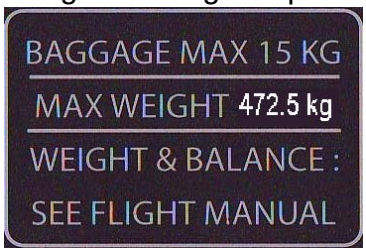


2.16.5. Fuel

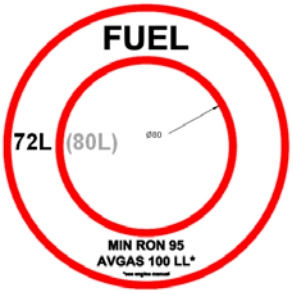
See paragraph 2.13

2.16.6. Miscellaneous placards and markings

In luggage compartment : MTOW 472.5 kg or 450 kg w/o parachute.

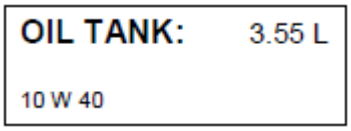


Fuel tank filler :



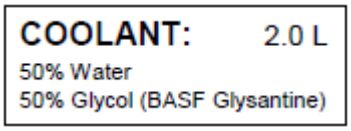
To be stuck around the fuel hole filler. Either with 72 or 80 L depending on the aircraft S/N. Inside diameter: 80 mm

Oil tank filler:



To be stuck on the hidden side of the oil filler door.

Water tank filler:



To be stuck on the hidden side of the coolant filler door.

Placards and Markings for Aerotow:

See section 10

3. EMERGENCY PROCEDURES

3.1. INTRODUCTION

This section provides a list of appropriate actions in the event of certain emergencies. Providing that the aircraft is well maintained and proper pre-flight inspections are made, emergencies due to failure of the aircraft, aircraft engine or other systems is very rare.

However, should an emergency occur, the procedures described in this section of the manual should be adopted.

3.2. ENGINE FAILURE

3.2.1. Engine failure on take-off run

If there is enough runway length remaining :

- Fully reduce power and apply brakes.

If there is insufficient runway length remaining :

- Fully reduce power
- Brake hard
- Fuel valve ..... **closed**
- Magnetos .....**OFF**
- Master .....**OFF**

3.2.2. Engine failure immediately after take-off

- Airspeed ..... **134 km/h**
- Fuel valve ..... **closed**
- Magnetos .....**OFF**
- Flaps .....**as required**
- Master .....**OFF**

Never attempt to turn back to the runway.

3.3. AIR START

3.3.1. Starter motor restart

If the altitude is sufficient to attempt to restart the engine :

- Airspeed ..... **134 km/h**
- Fuel valve ..... **open**
- Electric fuel pump ..... **on**
- Throttle setting **1/2**
- Magnetos ..... **"BOTH"**
- Starter ..... **on**

If the motor does not start, plan to make a forced landing.

3.3.2. Dive restart

If the altitude is sufficient to attempt to restart the engine (minimum altitude lost 1500 feet) :
Nose dive as explained :

- Airspeed ..... >**250 km/h**
- Fuel valve ..... **open**
- Electric pump ..... **on**
- Throttle setting **1/2**
- Magnetos ..... **"BOTH"**

If the motor does not start, plan to make a forced landing.

3.4. SMOKE AND FIRE

3.4.1. Fire on engine start

Continue starting the engine (or leave it running if it is has already started)
- Throttle setting ..... **fully open**
- Electric fuel pump ..... **off**
- Fuel valve ..... **closed**

If the fire persists :

- Magnetos ..... **off**
- Master ..... **off**

EVACUATE THE AIRCRAFT

3.4.2. Airborne engine fire

- Fuel valve ..... **closed**
- Full throttle until the engine stops
- Electric fuel pump ..... **off**
- Cabin heating and ventilation ..... **closed**
- Airspeed ..... **134 km/h**

Prepare for a forced landing with an engine inoperative.

3.4.3. Cabin fire

Extinguish the fire
Open ventilation to eliminate the smoke.

In case of an electrical fire (recognised by the smell of burning insulation) :

- Reduce cabin ventilation
- Master ..... **off**
- Charge breaker ..... **pulled**

LAND QUICKLY

3.5. GLIDE

Recommended air speed ..... **134 km/h**
Flaps ..... **0°**
Glide ratio **16**

3.6. LANDING EMERGENCIES

3.6.1. Planned forced landing with engine stopped

Choose a suitable site and report your position by radio

- Best glide ratio airspeed ..... **134 km/h**
- Flaps ..... **retracted / as required**
- Belt / Safety harness ..... **tight**
- Electric fuel pump ..... **off**
- Throttle setting ..... **closed**
- Magnetos ..... **off**
- Fuel valve ..... **closed**
- Canopy ..... **unlatch**
- Master ..... **off**

3.6.2. Planned forced landing with engine running

- Proceed as for a normal landing
- Best glide ratio speed ..... **134 km/h**
- On final approach, unlock the canopy
- Approach speed on final ..... **85 km/h**

Prior to touchdown:

- Magnetos ..... **off**
- Master ..... **off**

3.7. RECOVERY FROM UNINTENTIONAL SPIN

- Throttle ..... **reduce**
- Flaps ..... **retract**
- Rudder ..... **opposite spin direction**
- Elevator ..... **to neutral**
- Aileron ..... **to neutral**

3.8. PARACHUTE RESCUE SYSTEM OPERATION (IF FITTED).

Please read the scenarios described in the manufacturer's manual before flying to understand the situations that can justify the use of the safety parachute within the best conditions.

If necessary :

- Minimum altitude of parachute deployment ..... **200m (656 ft) above flight surface**
- Maximum speed of parachute deployment ..... **270 km/h**
- Safety pin ..... **removed**
- Engine ..... **off**
- Pilot and copilot ..... **check safety harness attaches**
- Parachute handle ..... **take with full hand and pull firmly**
- Pilot and copilot ..... **protect faces and group members against the body**

After landing and analysis of damage and possible injuries, evacuate the plane as soon as possible.

3.9. OTHER EMERGENCIES

3.9.1. Vibrations and erratic engine behaviour : likely causes.

- Contaminated fuel ..... **switch on the electric fuel pump**
- Ignition : magneto switch ..... **"L", then "R", then return to "BOTH"**

Select the position that gives the smoothest running and land as soon as possible on the closest runway.

3.9.2. Oil feed malfunction

If the oil pressure is low, look at the oil temperature

If the oil temperature rises (into the red), reduce engine power to setting to the minimum necessary and carry out precautionary landing. Prepare to make a forced landing.

3.9.3. Low voltage (red lamp)

Switch off all non-essential electrical equipment and fly to the nearest airfield and land.

Remark: The engine has electrical fuel pumps only. With a failed generator the engines fuel supply depends on the battery. The remaining flight time with running engine depends on the charge state of the battery. With a battery in good conditions and switched off consumers expect a remaining flight time of 30 minutes.

3.9.4. Sudden drop of boost pressure and speed

- Loud noise or bang:
A fracture of the turbo is likely.

Look for landing possibility. Flight with reduced performance may be possible. **Monitor oil pressure**.

- The orange caution lamp of TCU (turbo control unit) is blinking.

Limited flying operation as possibly wastegate does not close any more

NOTE: A minimum performance of approx. 66 kW remains available.

Any exceeding of the max. admissible operating limits and/or blinking of orange caution lamp must be recorded by the pilot in the logbook, stating the duration, exact time and extent of exceeding.

3.9.5. Sudden rise of boost pressure and speed

- Orange caution lamp of TCU is blinking:

Immediately reduce engine speed until boost pressure and speed are within operation limits.

Limited flying operation as wastegate may be fully closed and control of the boost pressure is only possible via throttle lever.

- Bowden cable(s) for actuation of throttle valve(s) broken:

Due to spring pressure the throttle valve(s) will be fully open – **full throttle**!

Limited flying operation as wastegate may be fully closed and control of the boost pressure is only possible via throttle lever.

Any exceeding of the max. admissible engine speed or boost pressure has to be recorded by the pilot in the logbook, stating the duration, exact time and extent of exceeding.

3.9.6. Periodical rise and drop of boost pressure and speed (boost pressure control is surging)

Orange caution lamp of TCU is not blinking.

Switch off servo motor **for a moment** (max. 5 sec.). After a short regulating time operation should stabilize.

ATTENTION: If this action does not stabilize operation, switch off servo motor completely. If needed, reduce engine speed until boost pressure and speed are within the operating limits again.

Limited flying operation, as boost pressure control is no more possible.

Switching off the servo motor momentarily or permanently, has to be recorded by the pilot in the logbook, stating the duration, exact time and duration of switching off.

3.9.7. Red boost lamp of TCU permanently illuminating

The maximum admissible boost pressure was exceeded.

Reduce speed and boost pressure manually to be within the operating limits.

Limited flying operation, as boost pressure control is no more or insufficiently possible.

ATTENTION: The boost pressure will not be reduced automatically

In case of exceeding the max. admissible boost pressure, this has to be recorded by the pilot in the logbook, stating the duration and exact time of exceeding of limits.

3.9.8. Red boost lamp of TCU blinking

The maximum "take-off" time limitation was exceeded.

Reduce speed and boost pressure at least to maximum continuous speed.

ATTENTION: The boost pressure will not be reduced automatically.

In case of exceeding the "take-of" time limits, this has to be recorded by the pilot in the logbook, staring the duration and exact time of exceeding of limits.

3.9.9. Orange caution lamp of TCU blinking

Indicates a failure of a sensor, sensor wiring, TCU, or leakage in the airbox.

Reduce speed and boost pressure manually the be within the operating limits.

Limited flying operation,as this may indicate that boost pressure control is no more or insufficiently possible and may affect engine performance.

In case of blinking of the orange caution lamp of TCU, this has to be recorded by the pilot in the logbook, starting the duration, exact time and extent of exceeding limits.

4. NORMAL PROCEDURES

4.1. INTRODUCTION

This section provides with a list of standard checks and procedures to be used in normal flight conditions. Procedures applicable to the use and check of optional equipment should be found in the "Supplementary systems and equipment" section.

4.2. DAILY INSPECTION

1 CABIN

- Seats ..... adjusted, locked
- Safety harness attachments ..... checked
- Primary wing attachment pins..... in place, safety pinned
- Front wing fixings..... in place, secure
- Rear wing fixings ..... in place, secure
- Controls ..... free
- Magneto contacts ..... off / cut
- Master switch ..... on
- Fuel level ..... checked
- Fuel filler cap ..... in place, locked
- Master switch ..... off
- Documentation ..... all present and correct
- Weight and balance (including baggage) ..... checked
- Canopy condition (clean)..... checked

2 FUSELAGE, LEFT SIDE

- Static vent ..... clean, unobstructed
- Antennas mounting..... checked

Watch out not to hurt yourself with antennas

3 TAIL

- Smooth, non-blemished surfaces ..... checked
- Rudder.....mounting / fixing / movement / cables / absence of play
- Tail plane.....mounting / fixing / movement / absence of play

- Control rod .....in place, secure
- Anti servo tab control..... in place

4 FUSELAGE, RIGHT SIDE

- Static vent .....clean, unobstructed
- Antennas mounting..... checked

Watch out not to hurt yourself with antennas

5 RIGHT WING

- Aileron and flap conditions and hinges..... checked
- Tightness to fuselage ..... checked
- Tightness & safety of front wheel and main undercarriage fairings ... checked
- Wing tip condition and safety..... checked
- Main undercarriage.....brakes / tyre inflation checked

6 ENGINE COWLS

- Cowl fixing screws..... checked
- Air vents .....clean, unobstructed
- Propeller spinner .....screws checked, no play or looseness
- Propeller .....clean, good condition
- Oil level* ..... checked
- Fuel drain : Check for absence of water and impurities..... operate and check
- Exhaust pipe ..... fixings checked
- Fuel tank air vent (beneath fuselage) .....clean, unobstructed
- Manually turn the engine …… until you hear a "blurp"

* To correctly determine the oil level it is necessary to remove and clean the dip stick before dipping and reading the level. (dif. Min./max.=0.45 l)

7 LEFT WING

- Main undercarriage (left) .....mounting, brakes, tyre inflation checked
- Pitot .....clean, unobstructed
- Wing tip condition and security..... checked
- Flaperons conditions and hinges..... checked
- Tightness to fuselage ..... checked
- Tightness & security of front wheel and main undercarriage fairings.. checked
- Stall warning …….. tested

4.3. PRE-FLIGHT INSPECTION

Repeat the daily inspection

4.4. NORMAL PROCEDURES AND CHECK LIST

4.4.1. Cabin check prior to engine start

- Parking brake ..... **on**
- Flaps..... **retracted**
- Seats ..... **adjusted and locked**
- Rudder pedals ..... **adjusted and locked**
- Safety harness .....**tightened**
- Flight controls .....**full and free**
- Pitch trim operation..... **full fwd / aft range checked / take-off position**
- Canopy .....**closed not locked**

Be careful, bridging the battery to another one may harm the system.
Therefore, the battery has to be fully charged before flying.

4.4.2. Cold engine start (ROTAX)

- Master ..... **on**
- Function Test TCU (2 lamps illuminated 1-2 sec)..... **checked**
- Fuel valve .....**check function / open**
- Electric fuel pump ..... **on**
- Throttle setting .....**idle**
- Choke ..... **pull fully**
- Propeller area ..... **clear**
- Magneto contacts .....**BOTH**
- Starter ..... **operate when ready**

As soon as the motor starts :

- Choke ..... **push**
- RPM ..... **1 600 rpm**
- Avionic switch ..... **on**
- Oil pressure ..... **checked**
- Canopy ..... **locked / checked**

4.4.3. Hot engine start

- Master ..... **on**
- Function Test TCU (2 lamps illuminated 1-2 sec)..... **checked**
- Fuel valve ..... **open**
- Fuel quantity .....**noted**
- Throttle ..... **1-2 cm**
- Magnetos .....**BOTH**
- Propeller area ..... **clear**
- Starter ..... **operate when ready**

Then follow the procedure for starting when cold.

4.4.4. Before Taxi and Taxiing

- Strobe ..... **on request**
- Parking brake ..... **off**
- Brakes ..... **checked**

4.4.5. Engine ground run

- Parking brake ..... **on**
- Oil temperature and pressure ..... **within green sector**
- RPM set to ..... **4'000 rpm**
- Magneto (max drop 300 rpm, max dif. 120 rpm)..... **"L", BOTH, "R", BOTH**
- Battery charge (red lamp) ..... **checked**
- Min rpm (1'400) ..... **checked**
- Throttle ..... **2'000 rpm**

4.4.6. Pre-take-off checks

- Magneto contacts ..... **BOTH**
- Controls ..... **full and free**
- Cabin (canopy, harness)..... **checked**
- Oil pressure and temperature ..... **within green sector**
- Trim ..... **checked**
- Altimeter ..... **checked**
- Fuel valve ..... **open**
- Fuel quantity ..... **checked**
- Electric fuel pump ..... **on**
- Flaps..... **Check full extension, and set to take-off position**
- Compass ..... **checked**

4.4.7. Take-off

- RPM at full throttle ..... **5 500 rpm checked**
- MP ..... **39.9" HG**
- Rotation speed ..... **80 km/h**
- Initial climb airspeed ..... **Vx : 105 km/h**
- Climb airspeed when clear of obstacles ..... **Vy : 120 km/h**
- Flaps ..... **Retracted**
- Electric fuel pump @ 300 ft AGL ..... **off**
- Engine readings..... **checked**
- Prop **5500**

4.4.8. Climb

MP 35.4" , prop max.5500 rpm, maintain 165 km/h

4.4.9. Cruise

See paragraph 5.3.1

4.4.10. Descent

- Engine minimum rpm ..... **2 400 rpm**

4.4.11. Approach

- Cabin (harness) ..... **tight**
- Electric fuel pump ..... **on**
- Flaps (under 140 km/h) ..... **extended**
- Altimeter ..... **set**

4.4.12. Final

- Flaps ..... **30°**
- Park Brakes ..... **off**
- Airspeed ..... **85 km/h**

4.4.13. Go-Around

- Airspeed ..... >**85 km/h**
- Flaps ..... **retracted**
- Climb airspeed ..... **120 km/h**

4.4.14. Post-landing checks

- Flaps ..... **retracted**
- Electric fuel pump ..... **off**

4.4.15. Engine Stop

- Parking brake ..... **on**
- Avionic switch ..... **off**
- Strobe light ..... **off**
- Magneto (2'000 rpm) ..... **off**
- Master ..... **off**

5. PERFORMANCES

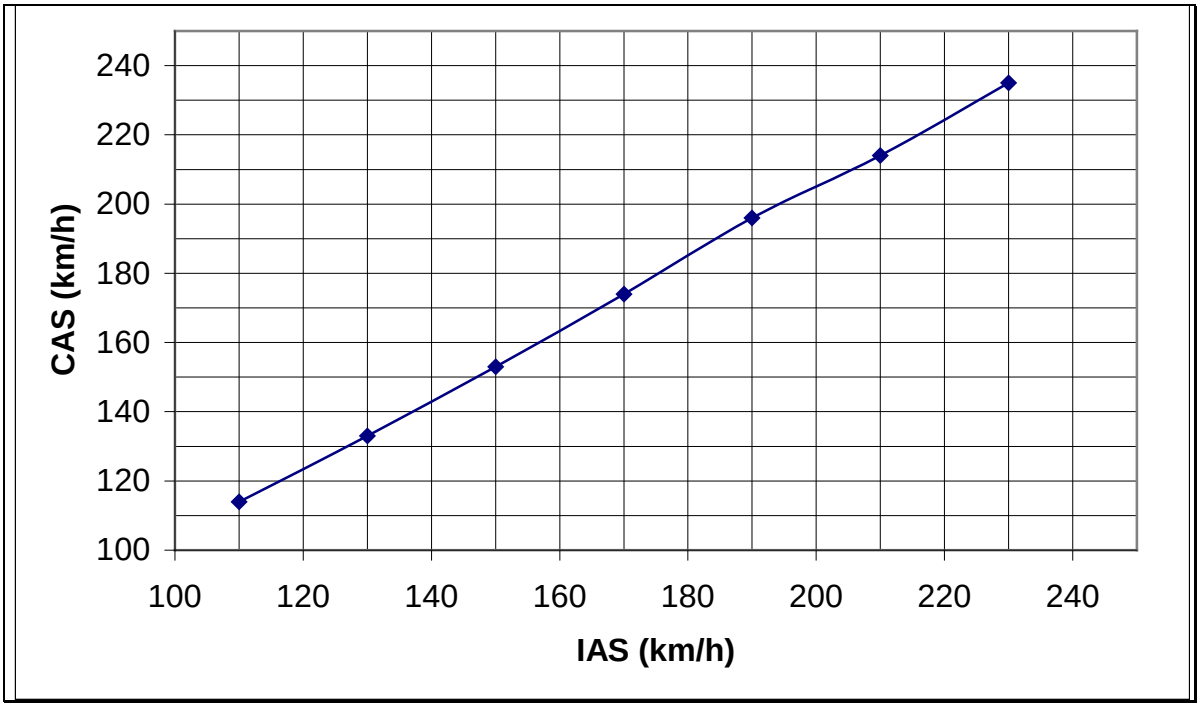
5.1. INTRODUCTION

This section provides approved information relating to standardised air speeds, stall speeds, take-off performance and supplementary non approved information.

The information given in the diagrams was obtained from flight tests with an aircraft and an engine in good condition and in the hands of an average pilot.

5.2. APPROVED DATA

5.2.1. Airspeed indicator system calibration



5.2.2. Stall speeds (km/h)

m = **472.5** Kg

	Flaps	0°	17°	30°
Bank angle				
0 °		86	73	69
30 °		92	79	74
60 °		121	105	98

5.2.3. Take-off performances (ROTAX 914)

TAKEOFF PERFORMANCE

ROTATION SPEED IAS: 85 km/h WEIGHT: 472.5 kg
CLIMB SPEED IAS: 100 km/h Apply full power then release brakes
Hard runway surface

	0°C		10°C		20°C		30°C		40°C	
Pressure Altitude feets	Ground Run m	Distance over 15 m obstacle m	Ground Run m	Distance Over 715 m obstacle M	Ground Run m	Distance over 15 m obstacle m	Ground Run m	Distance over 15 m obstacle m	Ground Run M	Distance over 15 m obstacle m
0	138	206	149	221	160	235	169	248	178	260
2000	166	252	181	275	195	296	208	317	221	337
4000	200	307	219	338	237	369	255	399	272	429
6000	240	373	264	414	288	456	311	467	333	539
8000	290	454	321	509	351	565	381	620	410	676

Performance measured with flaps in T/O position.

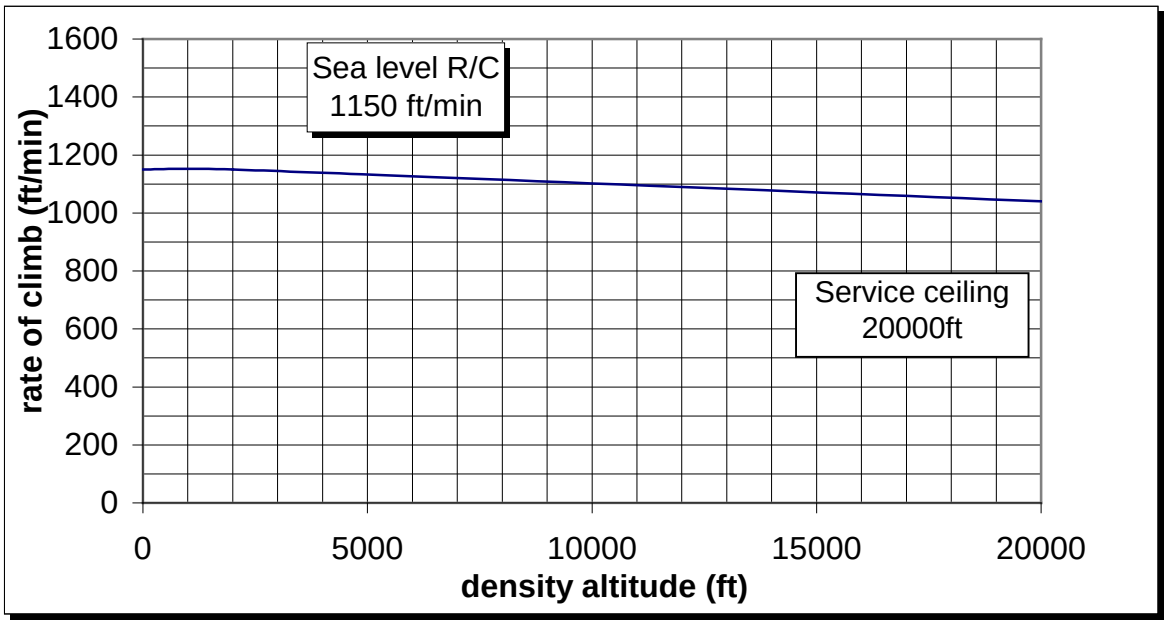
For every knot of headwind, reduce distances by 1%
For every 2 knots of tailwind, increase distances by 10%
For dry grass surface, add 15% to ground run
For soft grass surface, add 50% to ground run

5.2.4. Landing distances

LANDING PERFORMANCE										
TOUCHDOWN SPEED: 75 km/h WEIGHT: 472.5 kg APPROACH SPEED: 90 km/h Hard runway surface										
	0°C		10°C		20°C		30°C		40°C	
Pressure Altitude feet	Ground Run m	Distance over 15 m obstacle m	Ground Run m	Distance over 15 m obstacle M	Ground Run m	Distance over 15 m obstacle m	Ground Run m	Distance over 15 m obstacle m	Ground Run M	Distance over 15 m obstacle m
0	208	430	225	459	240	485	255	510	268	533
2000	250	526	272	569	294	611	314	652	333	691
4000	300	640	329	701	357	761	384	821	410	879
6000	361	776	398	858	433	941	468	1023	502	1104
8000	436	946	483	1055	528	1165	573	1275	617	1386

Flaps position : 30°
For every knot of headwind, reduce distances by 1%
For every 2 knots of tailwind, increase distances by 10%

5.2.5. Climb performance Vy 127 km/h CAS



5.3. ADDITIONAL INFORMATION

5.3.1. Cruise and endurance

					Power setting	**75%**
Altitude (ft)	Power MF	Power RPM	IAS (km/h)	TAS (km/h)	Fuel flow l/h	Endurance without res.
3000	31	5000	215	229	20	3h 10'
6000	31	5000	210	233	20	3h 10'
9000	31	5000	208	242	20	3h 10'

					Power setting	**55%**
Altitude (ft)	Power MF	Power RPM	IAS (km/h)	TAS (km/h)	Fuel flow l/h	Endurance without res.
6000	28	4300	195	217	16	4h 00'
9000	28	4300	195	227	16	4h 00'

5.3.2. Effect of rain and insects on aircraft performance, flying and handling qualities.

Decrease the performances by 4%

5.3.3. Cross-wind demonstrated performances

35 km/h

5.3.4. Noise data

This airplane is certified according ICAO Annex 16 Chapter 10.
The category and noise value measured are found in the noise certificate.

6. WEIGHT & BALANCE

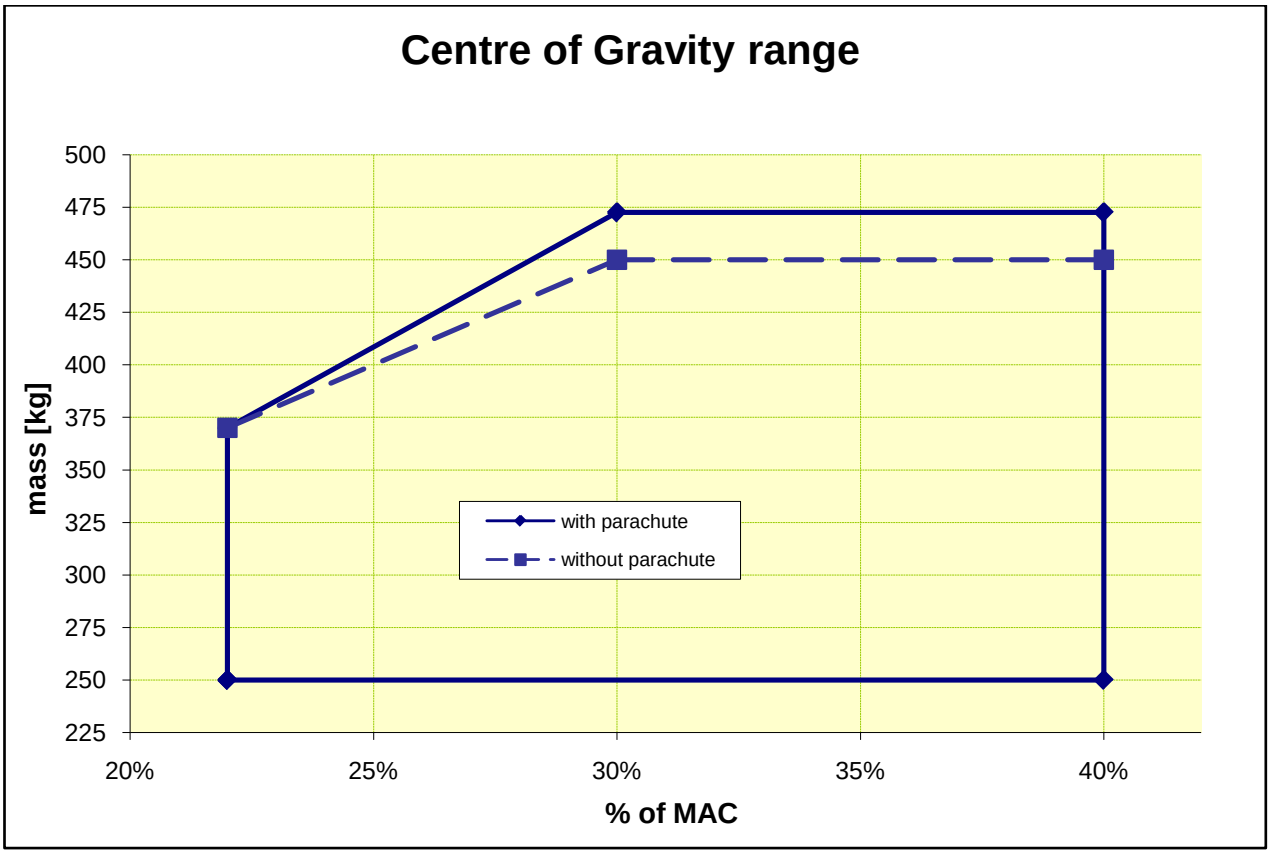
6.1. INTRODUCTION

This part presents loading cases where the aircraft can be safely operated.

Weight and balance calculation procedures and a complete list of the equipment available on the aircraft are included in last section of this Chapter.

6.2. WEIGHT & BALANCE REGISTRATION AND LOADING ENVELOPE

6.2.1. Loading envelope



M.A.C. = 960 mm ; Reference datum : 13.5 mm ahead of left wing leading-edge.

6.2.2. Weight & balance procedure

	Weight	Moment arm			Moment
	kg		M		m.Kg
Empty weight	**292**	x	**0.200**	=	**58.4**
Pilot		x	**0.700**	=	
Co-pilot		x	**0.700**	=	
Luggage		x	**1.150**	=	
Front fuel tank		x	**0.002**	=	

Total Weight		**Moment sum**	

Example

Note :
The above chart shows MCR mean moment arms. It must be completed with the actual empty weight and moment arm of the Aircraft. Also update if possible the actual moment arms of movable weight by weighing your Aircraft (refer to MBENOPP Weighing procedure).

Calculation method

- Note movable weights in fill above chart
- Compute total mass
- Multiply weights and corresponding moment arms and note the results in "Moment" column.
- Compute the moment sum.
- Divide the moment sum by the total weight. The result gives the location in meter of the actual Aircraft centre of gravity.
- Check the computed moment arm is within the weight and balance envelope shown on previous.

6.2.3. Weight & balance record & examples

Weight and Balance Record

Date	Item in (+) out (-)	Description	Weight change			Running basic empty weight	Arm	Running basic empty Moment
			Weight	Arm	Moment			
			(kg)	(m)	(mkg)	(kg)	(m)	(kg)
		Initial basic empty weight record				292	0.200	58.4

Example

Examples

Far forward C.G. (one light pilot, fuel)

	Weight [kg]	Arm [m]	Moment [kgm]
Empty Weight	292	0.2	58.4
Pilot	70	0.7	49
Passenger	0	0.7	0
Baggage	0	1.15	0
Fuel	56	0.02	1.1
Total	**418**		**108.5**

Example

Far rearward C.G. (heavy crew, max luggage and near empty tanks)

	Weight [kg]	Arm [m]	Moment [kgm]
Empty Weight	292	0.2	58.4
Pilot	78	0.7	55
Passenger	78,5	0.7	55
Baggage	15	1.15	17,3
Fuel	9	0.02	0.18
Total	**472,5**		**186,9**

Example

Fiche de pesée

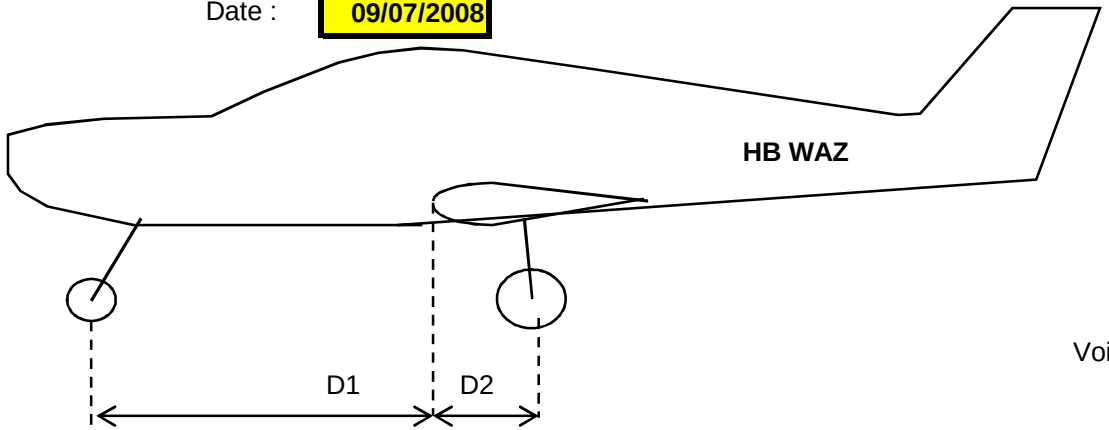
MCR type / n°série / propriétaire : **MCR R100 Ecolight R914**

type / S/N / owner ***363***

code identification (ULM Français) **HB WAZ**

immatriculation */ Call sign* **HB WAZ**

Date : **09/07/2008**



Voie du train 2010 mm

L/G track

Sieges en position basses, verrière fermée

Seats in lowest position, canopy closed

Référence mesure *measure datum* = Bord d'attaque gauche *left leading edge*

Référence calcul *calc. datum* = Bord d'attaque moyen *avg leading edge*

Géometrie		Cote droit		Coté gauche	
	mm	627	mm	D1=	**********
	mm	522	mm	D2=	517

Pesée

		TRAIN AVANT *Nose wheel*	TRAIN PRINCIPAL *Main L/G* ROUE GAUCHE *L*	TRAIN PRINCIPAL *Main L/G* ROUE DROITE *R*	TOTAL	
1/	**Masse à vide** *Empty*	**78**	**111**	**113,5**	**302,5**	kg

						Centrage
Calcul masse maxi	65	203,7	203,7		472,5	37,8%

VOIR EGALEMENT

DEVIS DE CENTRAGE : page 2/4

INVENTAIRE DETAILLE : page 3/4

PHOTO TABLEAU DE BORD : page 4/4

Visa Norbert LEOTTE

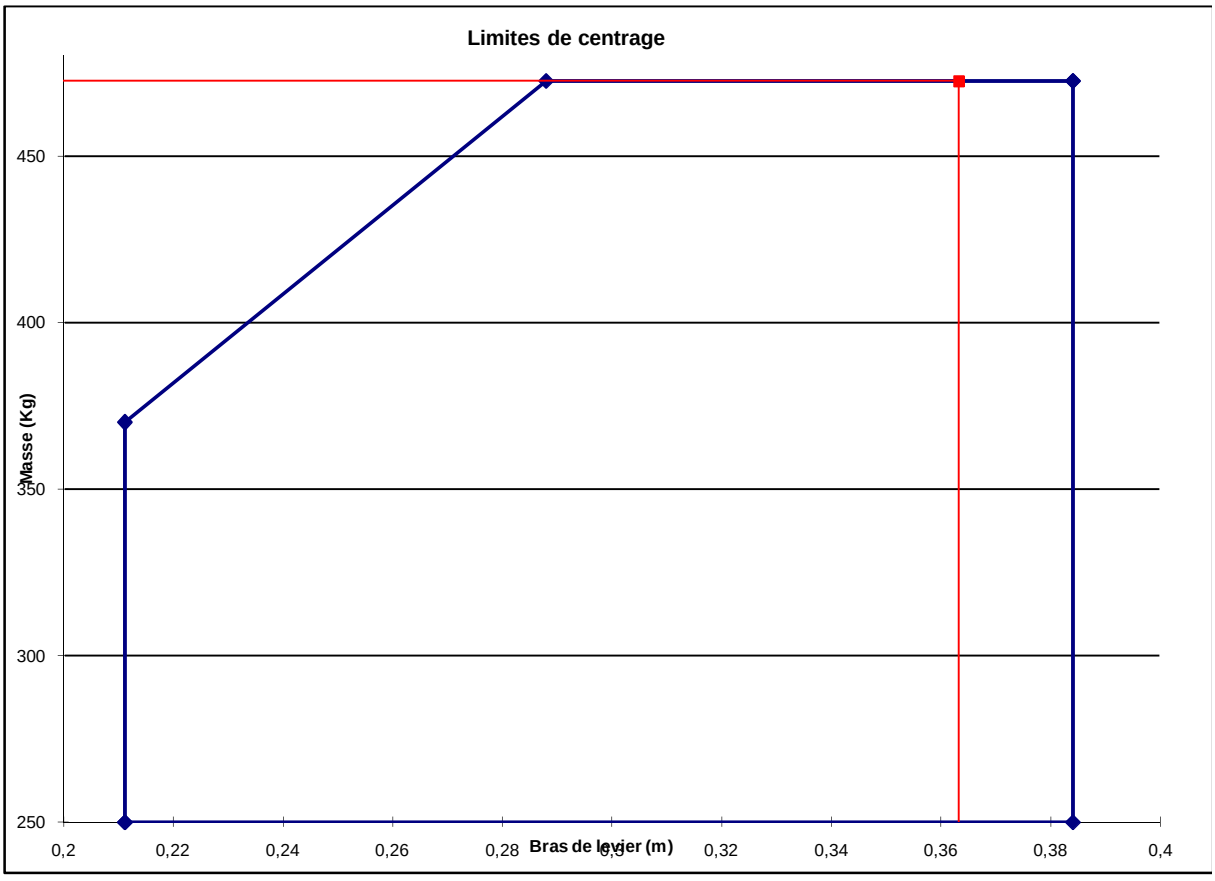
annexe à la fiche de pesée

p

N°de série	S/N 363		date	09/07/2008	
	Masse		Bras de levier		Moment
	kg		m		m.Kg
Masse a vide	**302,5**	*	**0,227**	=	68,7
Plomb quille	**0**		3,25		0,0
Pilote	**70**	*	**0,700**	=	49,0
					0,0
Copilote	**68**	*	**0,700**	=	47,6
Bagage	**5**	*	**1,150**	=	5,8
Essence avant	**27**	*	**0,020**	=	0,5

Masse totale	**472,5 kg**	**Somme des moments**	**171,6 kg.m**

Somme moments / Masse totale =	**0,363 m**	**37,8%**



Ref = BA moyen voilure

6.3. EQUIPEMENT LIST

Item #	Description	Manufacturer	Type
A	**Powerplant & Accessories**		
	Engine	Rotax	914 UL
	Drive gear	Rotax	887'708
	Starter	Rotax	293'152
	Alternator	Rotax	887'254
	Propeller	Dyn Aéro	MKIHE10/11/12/13
	Oil Thermostat	Dyn Aéro	ZMAIN6P00
	Spinner Installation	Dyn Aéro	
	Muffler stainless steel	Dyn Aéro	ZMAEMB100
	Oil Cooler	Dyn Aéro	ZMAEQ1500
	Ignition	Rotax	
	Water Thermostat	Dyn Aéro	ZMAIN6Q00
	Water cooler	Dyn Aéro	
B	**Landing Gear and Accessories**		
	Nosegear (optional)	Dyn Aéro	-
	Nosewheel (optional)	Dyn Aéro	ZMAEQ5W00
	Maingear	Dyn Aéro	-
	Mainwheel	Dyn Aéro	ZMAEQ5W00
	Brakes hydraulic	Dyn Aéro	ZMAEQ9Q00
C	**Electrical Systems (12V)**		
	Voltage regulator	Dyn Aéro	ZMAEL4P00
	Batterie	Dyn Aéro	ZMAEMB800
	Batterie relay	Dyn Aéro	ZMAEM4200
	Starter relay	Dyn Aéro	ZMAEM1400
	Flap electric motor	Dyn Aéro	ZMAEQJ800
	Elevator trim motor	Dyn Aéro	ZMAEQ9R00
	Fuse Breakers	ETA	
	Switches	ETA	-
	Strobe lights	Dyn Aéro	ZMAIN7A00
D	**Instruments**		
	Air speed indicator	Winter	6 EMS 441
	Altimeter	China	BG-3E
	Vertical speed indicator	China	BC-2S
	Compass module	Airpath	C 2400
	Tachometer	VMA	19.515.70B
	Manifold pressure indicator	VMA	7-100-16.5
	Engine Monitor	Rotax	Flydat
	Hour meter	Distrelec	
	Fuel pressure	Warning light	
	Low voltage lamp	Dyn Aéro	
	Flight timer / clock	VOGEL	
	EFIS	Dynon	D10A
	FLARM	EDIATec	ECW100
E	**Cabin Accomodation**		
	Pilot seat	Dyn Aéro	-
	Co pilot seat	Dyn Aéro	-
	Seat belts 4 point harnesss	Dyn Aéro	ZMAEQHD00

	Cabin heat assembly	Dyn Aéro	-
	Fresh air vents	Dyn Aéro	-
	Dual control, dual brake	Dyn Aéro	-
F	**Placards, Warnings and Manuals**		
	Pilot Operation Handbook V1.0		
G	**Auxiliary Equipment**		
	Tow winch	Dyn Aéro	ZMAEQWA00
H	**Avionics & Autopilot**		
	Com	Dyn Aéro	ZMAIN2G00
	Com Antenna	Dyn Aéro	ZMAINR000
	Transponder Mode S	Dyn Aéro	ZMAIN5L00
	Transponder Antenna	Dyn Aéro	ZMAINRX00
J	**Fuel System**		
	Maintank 80 l	Dyn Aéro	
	Fuel gauges	Dyn Aéro	ZMAIN6700
	Fuel selector	Dyn Aéro	ZMAEQF700
	Fuel gascolator	AC2	10564
	Main fuel pump	Dyn Aéro	ZMAEM0400
	Aux fuel pump	Dyn Aéro	ZMAEM0400

7. AIRCRAFT AND SYSTEMS DESCRIPTION

7.1. INTRODUCTION

This Chapter provides description and operation of the airplane and it's systems.

7.2. AIRFRAME

7.2.1. Fuselage

The carbon fibre fuselage is composed out of two halves, upper and lower body. The fire protection on the fire wall is made from special fire retarding fleece, that is covered by a stainless steel plate on the engine side. The main bulkhead is of a wood/carbon/foam sandwich construction.

7.2.2. Wings

The two main spars consist of wood /carbon sandwich construction, with foam ribs, glued to a carbon fibre sheet, serving as wing skin.
The ailerons and flaps are constructed the same way.
The wing-fuselage connection is made with six bolts. The two main bolts hold both wings in the spar tunnel. Each wing has two fixings, one on the leading and one on the trailing edge.

7.2.3. Tail plane

The Rudder and Elevator are built the same way as the flaps/ailerons.

7.3. FLIGHTS CONTROLS

Ailerons and elevator are actuated via push rods, the rudder is controlled using control cables. The flaps are electrically operated.

7.3.1. Trim System Elevator

The buttons are located on both sticks. The button control an electrical actuator moving a rubber band forward or backward balancing the elevator forces. There is no trim tab.

7.3.2. Flaps

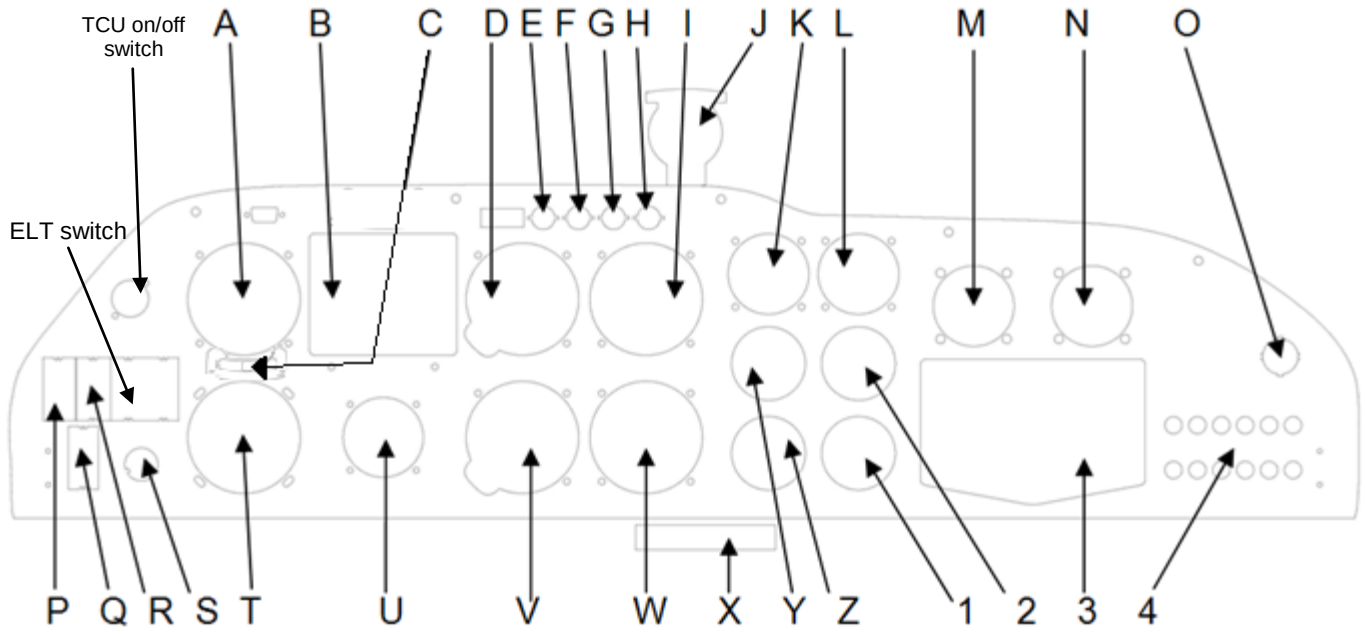
The flaps are driven by an electric motor. There are now three positions (up 0°, 17°,30°).

Please note that the 45° flaps position is not available yet: the lever range had been limited to 30°.

7.3.3. Pedal Adjustment

The pedals for rudder are unlocked by a pin at the rudder pedal.

7.4. INSTRUMENT PANEL



A	Airspeed indicator	P	Electric Fuel pump switch
B	EFIS Dynon D10A	Q	Master switch
C	Slip Indicator	R	Flash Switch
D	Altimeter	S	Ignition switch
E	Oil Pressure and Hour meter to the left	T	Fligt Time Counter
F	Low voltage warning lamp	U	FLARM ECW100
G	Boost warning lamp	V	VSI
H	TCU caution lamp and Fuel pressure warning light to the right	W	Flaps switch
I	Winch	X	Parachute handle
J	Compass	Y	Oil temperature indicator
K	RPM indicator	Z	Oil pressure indicator
L	Manifold pressure indicator	1	Fuel level indicator
M	Transceiver	2	Water temperature indicator
N	ATC	3	Glove box
O	12V plug	4	Breakers

7.5. LANDING GEAR SYSTEM

7.5.1. Landing gear

Hydro pneumatic main gear.

7.5.2. Brakes

Hydraulic disk brakes, hand operated

7.5.3. Parking brake

The parking brake can be locked by locking the brake system.

7.6. SEATS AND SAFETY HARNESS

Each seat is attached with 2 hinges in the front. To accommodate different body sizes, the back can be adjusted in height and secured with spring loaded pins.
Harness are 4 points type.

7.7. BAGGAGE COMPARTMENT

The baggage compartment is located behind the 2 seats.
Secure baggage's and respect weight & balance. Max. shelf load is 15 kg.

7.8. CANOPY

7.8.1. Lock and unlock CANOPY from inside

The CANOPY is locked by pulling the levers on each side of the fuselage. To unlock, push the levers.

7.8.2. Lock and unlock CANOPY from outside.

Lock CANOPY by turning outside knob in OPEN direction.

7.9. POWER PLANT

7.9.1. Engine

Refer to the Engine Operating Manual Rotax 914 Series

7.9.2. Propeller

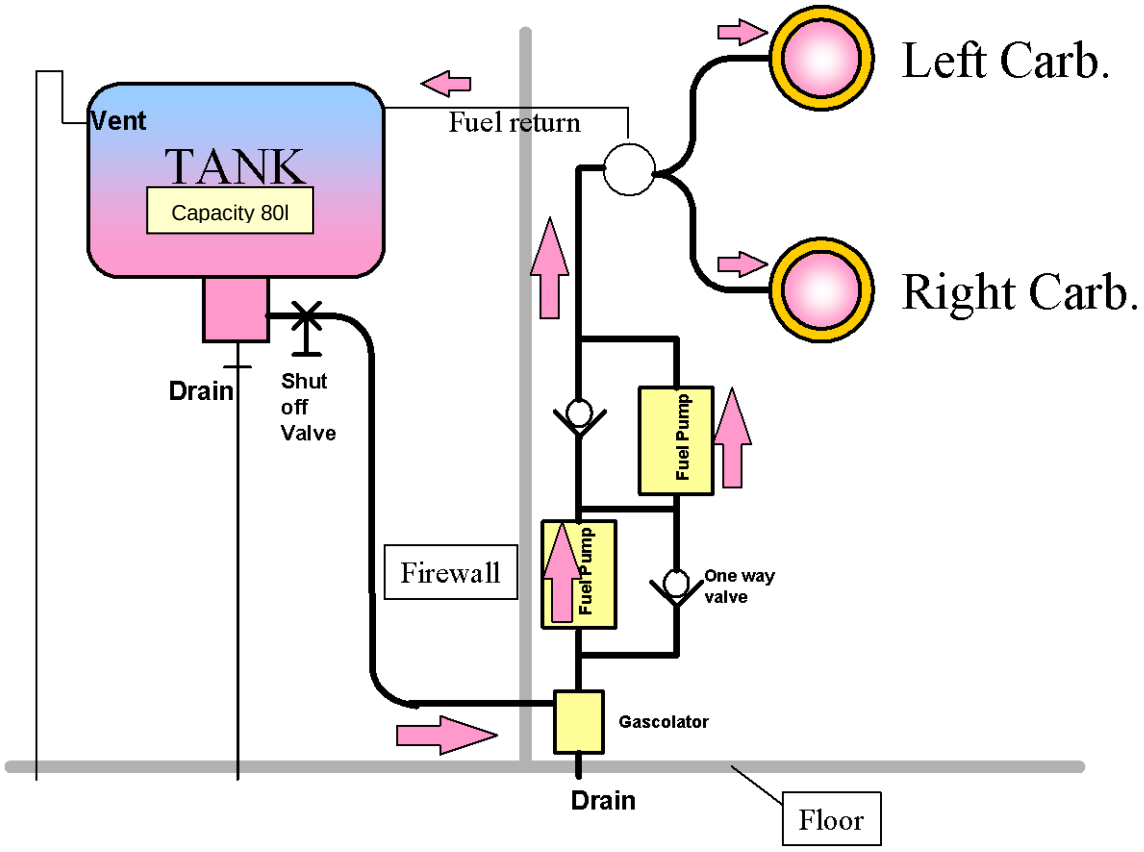
Refer to the Propeller Operating Manual

7.10. FUEL SYSTEM

Location: The Fuel Tank is located between the firewall and the instrument panel.

System: From the tank to the carburetors, the fuel takes the following way: (see next picture)
Tank - Shut off Valve – Gascolator – Electric auxilary pump – Electrical main pump – float chamber of carburetors.
Before the carburetor, a return line leads to the top of the tank and a pressure switch is installed.
Ventilation and overflow: The tank ventilation is on the front top of the tank.

7.10.1. Fuel schema



7.10.2. Unusable fuel

Unusable fuel is about 1 liter.

7.10.3. Fuel quantity

Measured by a vertically installed float sensor in the fuel tank and shown on the fuel gauge in the cockpit.

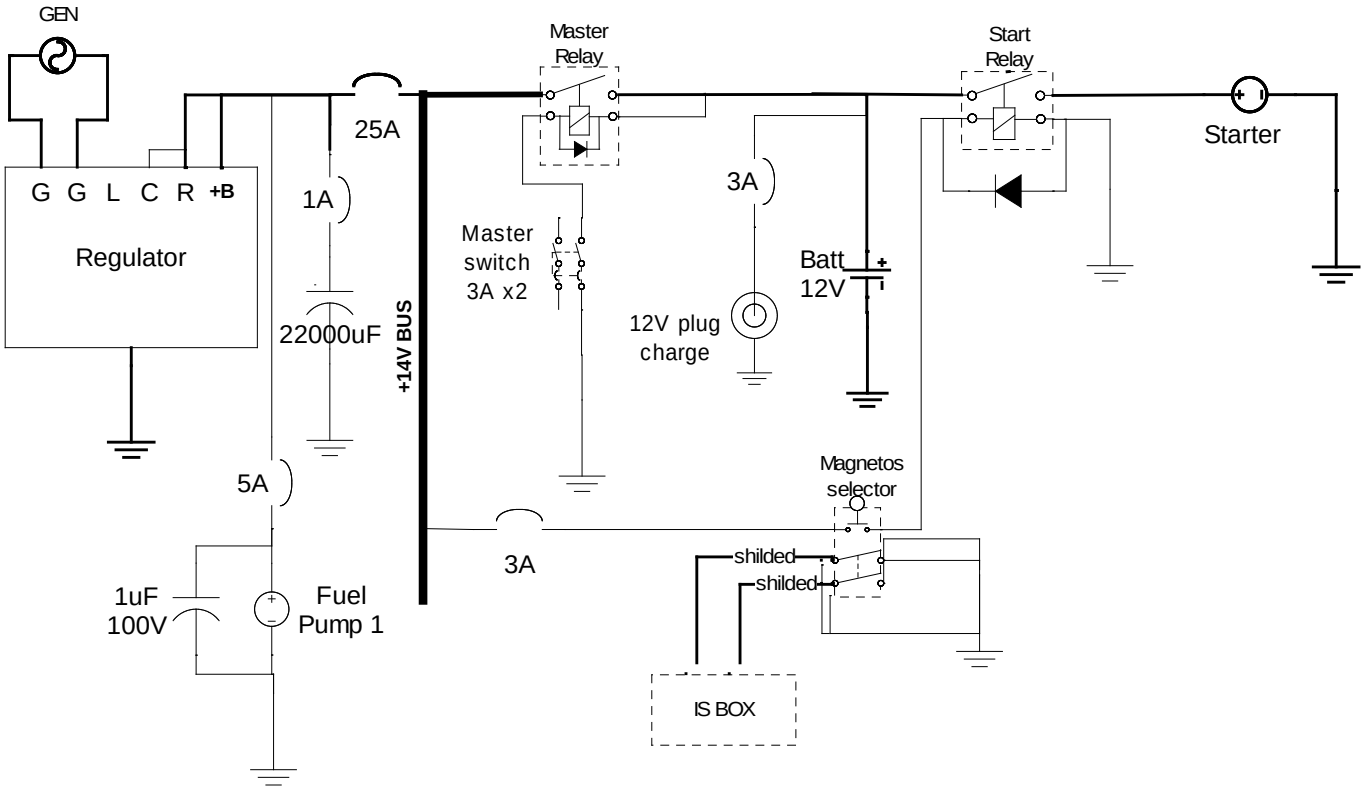
7.10.4. Fuel pressure

A fuel pressure probe is installed forward the carburetors.

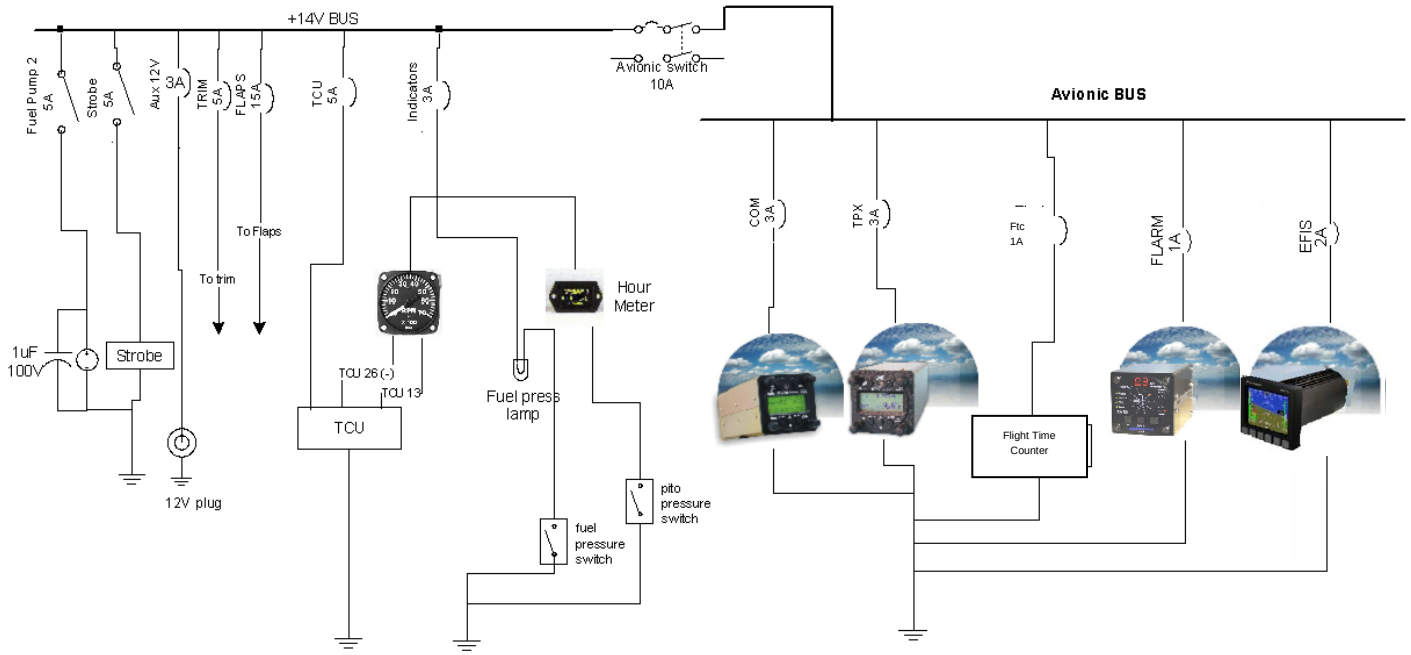
7.11. ELECTRICAL SYSTEM

7.11.1. Electric schematic with circuit protection

7.11.1.1. Alternator, Voltage regulator, Ignition



7.11.1.2. Electrical components diagram



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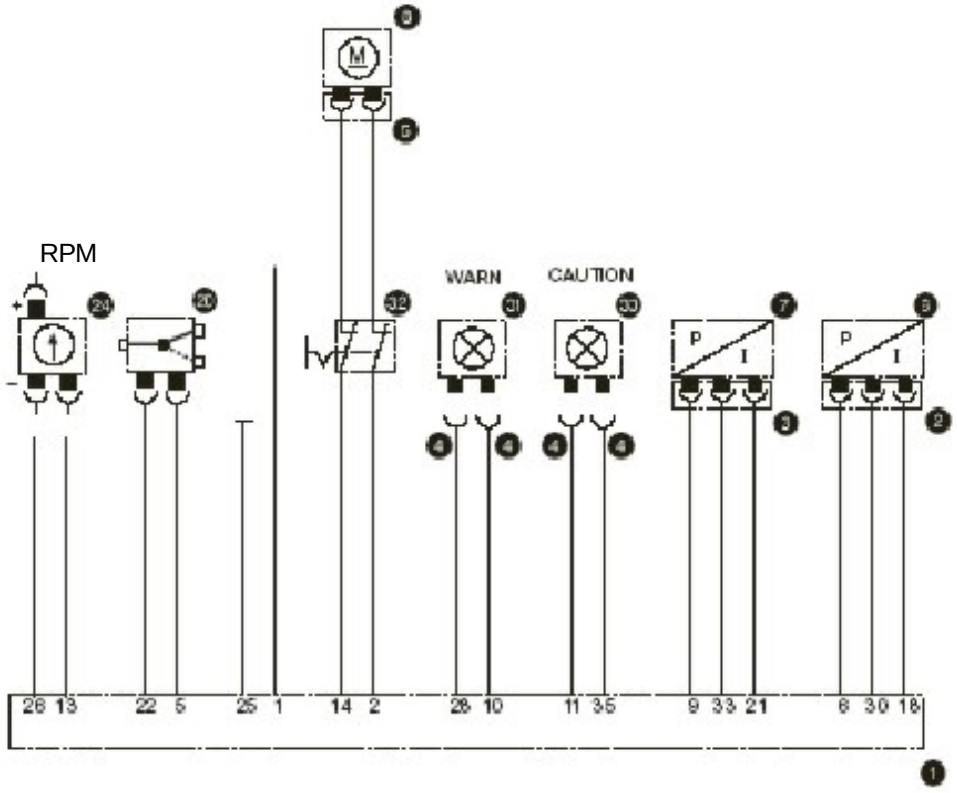
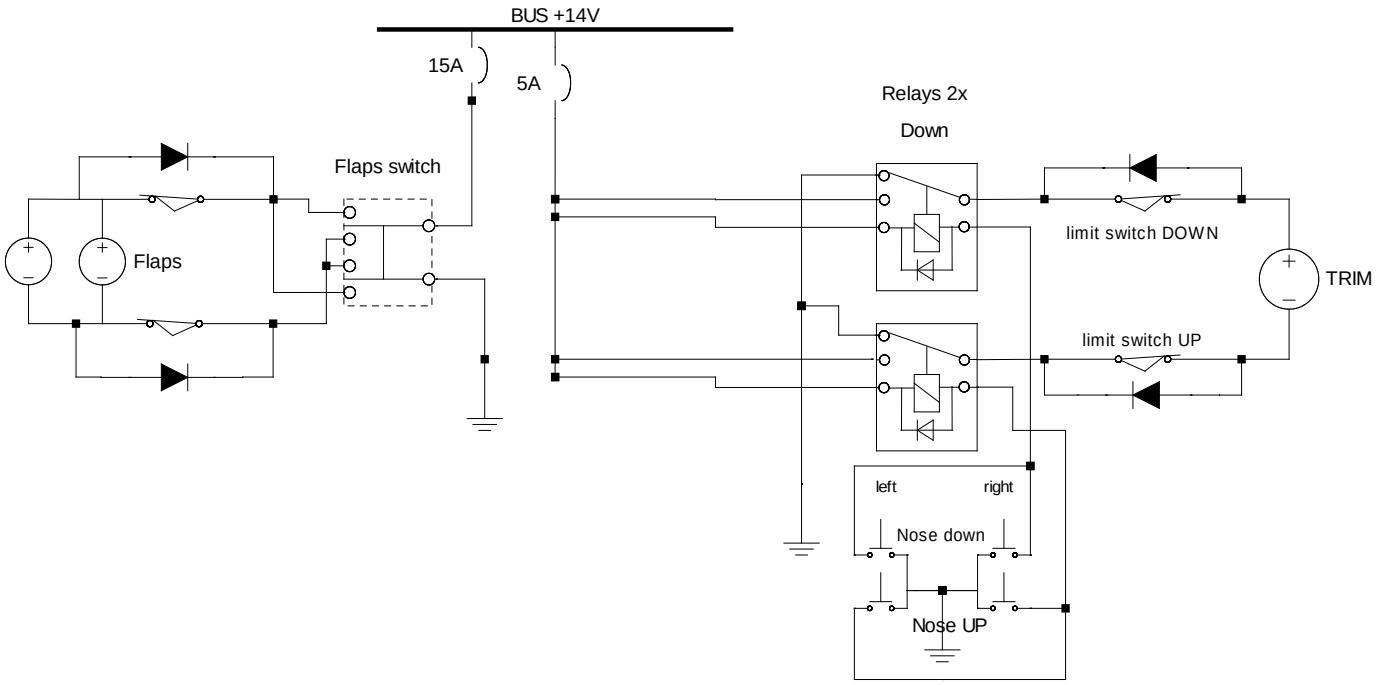


7.11.1.4. TRIM and FLAPS electric diagram



7.12. PITOT AND STATIC PRESSURE SYSTEMS

The total pressure is measured below the left wing. The static pressure is measured by the two static holes, one on each side of the fuselage behind the seats.

7.13. MISCELLANEOUS EQUIPMENT

N/A

7.14. AVIONICS

See schema "Electrical components diagram"
For details: Manual Filser ATR 500
Manual Filser TRT 800
Manual Dynon EFIS D100

Manual EDIATec ECW100 and FOCA approved AFM Supplement (included)
Manual of the Tow Cable Retractable Winch TOST (included)

8. AEROPLANE HANDLING, SERVICING AND MAINTENANCE

8.1. INTRODUCTION

This section provides the procedures required by the manufacturer for the handling and the maintenance of the aircraft. It also shows a few maintenance and inspection requirements which must be fulfilled in order to ensure performance and reliability of a new aircraft. According to the environment and flight conditions, a lubrication and maintenance schedule must be applied.

8.2. RIGGING AND DERIGGING

Wings assembly

- keep ready the two bolts and the security pins and a screw driver
- keep ready all 4 fittings
- Insert right wing first
- Right wing spar goes in front of left wing spar
- Support right wing
- Mount flaps control bar and secure
- Insert left wing with same procedure as above
- Support left wing
- Insert bolts through both spars and secure with pins back of spars
- Complete to fix all fittings and secure
- Mount ailerons control bars
- Connect dynamic pressure
- Connect brake lines

Disassembly

- Set park brakes
- Disconnect flaps and ailerons
- Release dynamic pressure
- Disconnect brake line
- Support right wing
- Hold left wing
- Dismount pins and bolts
- Pull left wing completely
- Same procedure for right wing

8.3. AIRCRAFT MAINTENANCE SCHEDULE

Advised inspections:

50 hours
100 hours / 1 year
1 000 hours
2 000 hours
5 years

RESPECT THE MAINTENANCE MANUAL SCHEDULE M EX NO 03 02

8.4. AIRCRAFT MODIFICATIONS AND REPAIRS

The Airworthiness authorities and the manufacturer must be informed before all modification or repair, which can change the aircraft Airworthiness.

8.5. GROUND HANDLING

Towing:
The aircraft is most easily maneuverd by pulling it by its propeller near the center

Parking:
Parking brake on, (off for hangaring)
Canopy locked,
Canopy cover advised,
Main landing gear wheels choked.

8.5.1. Ground fixing

Wing attach fittings using 6 mm diameter captive nut can also be installed.

8.6. CLEANING AND TREATMENT

Regularly clean all control surfaces and the inside of the aircraft.

Cleaning products must be suitable for surfaces to be cleaned. Check product before each canopy cleaning.

9. SUPPLEMENTARY SYSTEMS AND EQUIPMENTS

9.1. INTRODUCTION

This section presents the appropriate supplementary elements to safely and properly use the aircraft with the following optional systems and equipment that are not delivered with the standard aircraft (list to be completed by the assembler).

9.2. LIST OF THE SUPPLÉMENTARY SYSTEMS AND EQUIPMENTS

Date	Document N°	Title of the supplementary element

9.3. SUPPLEMENTARY ELEMENTS DESCRIPTIONS

Tow winch: See Manual: Flug- und Betriebsanweisung für die Schleppseil-
Einziehwinde mit Kappvorrichtung

Further Instructions for Handling of the Winch and Glider towing will be developed and added in the AFM after the initial flight testing.

10. SUPPLEMENT AEROTOW

10.1. PRELIMINARY LIMITATIONS:

Aerotow is allowed under the following conditions

- no visible moisture

Outside these limits the operation of the aircraft is allowed within the limits of the AFM without aerotow.

10.2. GENERAL

This supplement provides all necessary information for a safe and efficient aerotow.

10.3. LIMITATIONS

Towing Gear
- The strength of the rope must be limited to 4000 N.
- The length of the rope should be between 35 m and 60 m.

Mass of Gliders
- Gliders up to 820 kg MTOW are permitted with one person in the towplane
- Gliders up to 650 kg MTOW are permitted with two persons in the towplane (instruction)

Towingspeed / Flaps Setting

- Modern plastic gliders are best towed at 110 km/h and flaps retracted or T/O position
- Water loaded gliders in turbulent air should be towed at 120 km/h and flaps retracted
- Wooden gliders are best towed towed at 90 km/h and flaps in T/O position
- Maximum towing speed is limited to … km/h.

Additionally the speed specific limits of the towed glider have to be observed.

10.4. EMERGENCY PROCEDURES

Unusual flight characteristics

Towed Glider cannot be released

In case a towed glider is not able to release the rope repeatedly the towpilot can cut the rope, preferable towing the glider above an airfield before.
With experienced pilots both aircrafts may land still connected with the towcable.

Tow rope cannot be retracted

If repeated attempts to retract the rope are not successful the pilot has to perform a landing with the rope. The final approach should be chosen high enough to clear any obstacles even with a rope hanging down behind the aircraft.

10.5. NORMAL PROCEDURES

Pre-flight Inspection

Aerotow

The aircraft might lift off before the glider. It is mandatory for the aircraft pilot to accelerate close to the ground until the glider is well above its minimal speed and not to initiate the climb earlier.

10.6. PERFORMANCES

Take-off

Take-off distance (s_1 rolling distance, s_0 distance over the 15 m obstacle) on a level, shortcut and dry grass runway is (meters):

Mass of Glider 650 kg									
Density Altitude		0 ft / 1013 hPa		1000 ft / 977 hPa		2000 ft / 941 hPa		3000 ft / 906 hPa	
Head wind		s_1	s_0	s_1	s_0	s_1	s_0	s_1	s_0
0 kts	0 °C	236	504	248	524	261	546	276	570
	15 °C	264	561	277	583	292	608	309	634
	30 °C	293	621	309	646	325	673	343	702
5 kts	0 °C	224	479	236	498	248	519	262	541
	15 °C	250	533	263	554	277	578	294	602
	30 °C	278	590	294	614	309	639	326	667

Mass of Glider 820 kg									
Density Altitude		0ft / 1013 hPa		1000ft / 977 hPa		2000ft / 941 hPa		3000ft / 906 hPa	
Head wind		s_1	s_0	s_1	s_0	s_1	s_0	s_1	s_0
0 kts	0 °C	275	588	289	611	304	637	321	665
	15 °C	307	654	323	680	340	709	359	739
	30 °C	342	724	359	753	378	784	399	818
5 kts	0 °C	261	559	275	580	289	605	305	632
	15 °C	292	621	307	646	323	674	341	702
	30 °C	325	688	341	715	359	745	379	777

An uneven, soft runway, high cut grass, tail or cross wind or gusts, wet or dirty wings may increase the take-off distance significantly or prevent a safe take-off.

Climb

The following values had been established : -Weight of the towing plane: 420kg -Vi=120km/h

At T=ISA and Zp=450m

Glider Weight (kg)	350	400	450	500	550	600	650	700	750	800	820
Towplane+Glider Weight (kg)	770	820	870	920	970	1020	1070	1120	1170	1220	1240
Vz (m/s)	3.4	3.2	3.0	2.9	2.7	2.6	2.5	2.4	2.3	2.2	2.1

At T=ISA+23°C and Zp=450m

Glider Weight (kg)	350	400	450	500	550	600	650	700	750	800	820
Towplane+Glider Weight (kg)	770	820	870	920	970	1020	1070	1120	1170	1220	1240
Vz (m/s)	2.8	2.6	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.7

10.7. AIRCRAFT AND SYSTEMS DESCRIPTION

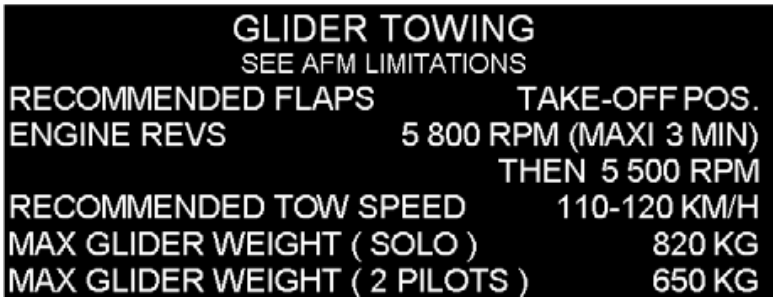
The TOST tow cable with retractor is firmly installed behind the passengers seat and will allow to retract the tow rope during the flight descend after the glider pilot has released the cable. The rope is retracted by the pilot pushing a switch located on the panel. A green light below the switch indicates a fully retracted cable. In an emergency the rope can be cut with a yellow handle situated left of the pilot at the console.
For a detailed description see the Operating Manual for the TOST Cable Retractor Winch in the annex of this manual.

10.8. CARE AND MAINTENANCE

For a detailed description see the Operating Manual for the TOST Cable Retractor Winch in the annex of this manual.

10.9. PLACARDS

Sized 100*40mm and in sight of crew:



Winch command:

13*18mm & 13*40mm near the green light (for "Cable in") and close to the button ("retraction")

Rope cutter:

100*18mm, along the cutter handle
Either in black or red

11. SUPPLEMENT EDIATEC FLARM ECW 100

This document is up to date on November 2008. Nonetheless, it is provided for information only and any new amendment should be considered.

SECTION 1 – GENERAL

The gliding scene has been confronted since years to dramatic mid air collision accidents. With the extreme fine shape and relatively high cruise speed of modern gliders, the human vision has reached its limit of detection. Another aspect is the airspace restrictions to VFR that creates an augmentation of traffic density in certain areas and the associated airspace complexity that request more pilot attention on the navigation material. These have a direct impact on the probability of collision also affecting powered aircraft or rotorcraft operations.

These equipments in the general aviation are not required by technical specifications or by operation regulations, but are recognized by the regulators as an important step toward improved aviation safety. Therefore they are not considered as essential for flight and may be used for "situational awareness only" on basis of non interference to certified equipment necessary for safe flight/landing and no hazard to the persons on board.

Correct antenna installation has a great effect on the transmission/receiving range. The pilot shall care that no masking of the antenna occurs especially when the antennas (GPS + COM) are located in the cockpit.

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 systems.

The software version must be regularly updated as per the instructions given in the installation manual. If a version mismatch exists, error information is displayed during the equipment power ON and the system will not become operational.

A unique switch provides ready disconnection of all equipments connected to the Collision Avoidance function (FLARM, TR-DVS and other parts used with the installation) from the electrical bus in case of fume, fire, interferences or when flying over territories where the SRD frequency is not available for air-air communication. This switch is labeled adequately.

Important Note:

Operation of FLARM is forbidden in aircraft in which one or more of the occupants resides in or is a citizen of the USA or Canada. Likewise, use of FLARM is forbidden if the aircraft concerned takes off from, makes an intermediate or final landing in the USA or Canada

SECTION 2 - OPERATING LIMITATIONS

1. **This FLARM installation is compliant for "situation awareness only".** The following placard must be installed on the instrumental panel, at the proximity of the display:

For Situation Awareness only

2. **Maneuvering must not be based solely on the use of the information presented on the FLARM displays or aural annunciations.** FLARM does not give any guidance on avoiding action. The azimuth and height accuracy of the computed traffic cannot always provide reliable warnings and only the most threatening traffic is announced. Therefore it is the pilot responsibility to evaluate by any means the real traffic position and altitude, the obstacle shape, the terrain and the meteorological situation prior executing any evasion maneuver.

   Under no circumstances should a pilot or crewmember adopt different tactics or deviate from the normal principles of safe airmanship.

3. **It is the pilot's responsibility to verify prior entering any states territory that the SRD frequency is permitted for use in air-air communication.** When such an acceptance does not explicitly or implicitly exist, the equipment shall be turned OFF. This verification is part of the flight planning.

4. **The pilot shall not intentionally generate uncoordinated warnings that might frighten other aircraft's pilot.** Any intentional maneuver of this kind has to be carefully coordinated and agreed in advance. Unexpected reactions might be especially hazardous when lateral, vertical or time separations are small.

SECTION 3 - EMERGENCY PROCEDURES

In case of **Fire, Smoke, electrical burning smells or Electromagnetic Interferences** follow the Emergency procedure of the basic AFM.

FLARM is normally installed on a non-essential bus. But on ancient aircraft it is possible that only an avionics bus or even only a main bus is available for all electrical consumers. The basic Emergency procedure might require this bus disconnection that will generate a total loss of Navigation, Communication and ATC detection. This is classified as a catastrophic failure condition under IMC condition.

The dedicated FLARM switch will help to rapidly determine if the FLARM installation is faulty or not, allowing to resume essential equipments as per the Emergency procedure of the basic Aircraft Flight Manual.

SECTION 4 - NORMAL OPERATING PROCEDURES

4.1 General

It is recommended to carry the FLARM Operating Manual version 3 or later on board the aircraft. To make good use of the information contains in this manual the pilot should know the hardware version, the software version, the serial number and the obstacle database name currently installed in the FLARM.

4.2 Self-test

To switch on the FLARM, the aircraft electrical power shall be available on the corresponding bus and the dedicated FLARM switch must be turned ON.

After switching on, the unit performs a self-test routine, quickly lights up all LED and displays either error codes or version numbers. The Operating Manual describes how errors and version numbers are being shown. If an error is being shown, the unit is not ready for operations.

When FLARM shifts to normal operation it waits until it has acquired an adequate GPS position fix. When switching on the unit after a long break or in a totally new location, 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 the LED status is "operational" (refer to the Operating Manual).

4.3 Operation Modes

FLARM operates in two modes, *Nearest* and *Collision*. 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 have an immediate and appropriate reaction.

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. As soon as FLARM detects the risk of a collision it automatically switches to *Collision* mode, followed by automatic reversion to *Nearest*.

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. While warnings are suppressed, FLARM nevertheless continues to transmit signals for reception by other aircraft.

4.4 Airborne and Alerts

In case other compatible units are within range, also the Receive LED is ON. The horizontal and vertical indicators show the direction of the most imminent thread with a flashing red display. The first warning level for another aircraft is delivered when less than **18 seconds** remains 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.

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 call for presentation of further threats. The warning indicates the earliest likely collision that could happen.

Depending upon the phase of the flight, FLARM uses different movement models, forecasting methods 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 have been optimised, but are nevertheless a compromise.

The thread might also be an obstacle (e.g. cables, antenna masts, cable cars, avalanche dynamite wires, power lines). In the case of fixed obstacles, the unit does not signal a bearing. Obstacle warnings 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.

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.

4.5 Line of sight

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. 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.

4.6 GPS signal quality

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.

4.7 Pressurized cabin

FLARM use an internal pressure sensor to determine the pressure altitude. This is an important element to verify the GPS positioning quality and to ensure an accurate and smooth altitude processing. When installed in a pressurized aircraft the FLARM system will not operate correctly until it is properly connected to an external static port.

4.8 Predicted flight path and accuracy

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 30 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.

4.9 Effect of wind

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 warnings given are unusable.

4.10 Data protection

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 identification. 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.

SECTION 5 – PERFORMANCE

No Change to basic flight manual

SECTION 6 – WEIGHT AND BALANCE

No Change to basic flight manual

SECTION 7 – SYSTEM DESCRIPTION

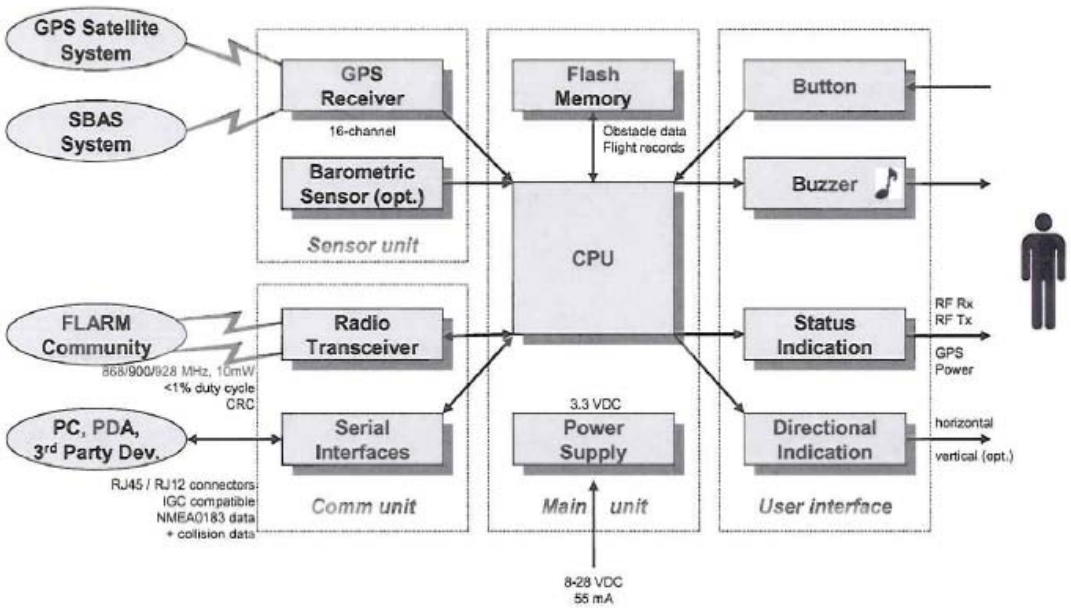
7.1 System description

FLARM receives position and movement information from an internal GPS receiver with an external GPS antenna. An optional pressure sensor further enhances the accuracy of position measurements. The predicted flight path is calculated by FLARM and the information transmitted by radio. Provided they are within receiving range, the signals are received by further aircraft also equipped with FLARM or compatible devices. 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 stored in an internal database.

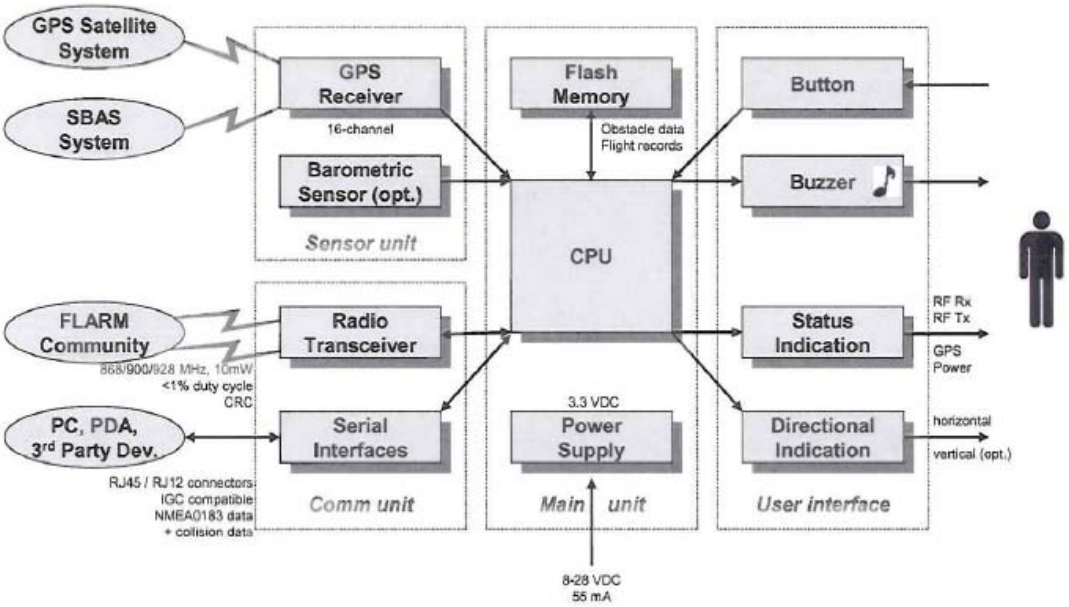
The GPS and collision information received from other aircraft can also be made available for third party equipment (e.g. external display, speech synthesizer, PDA) via a serial data output.

Obstacle information stored has 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 does not include all intermediate masts.

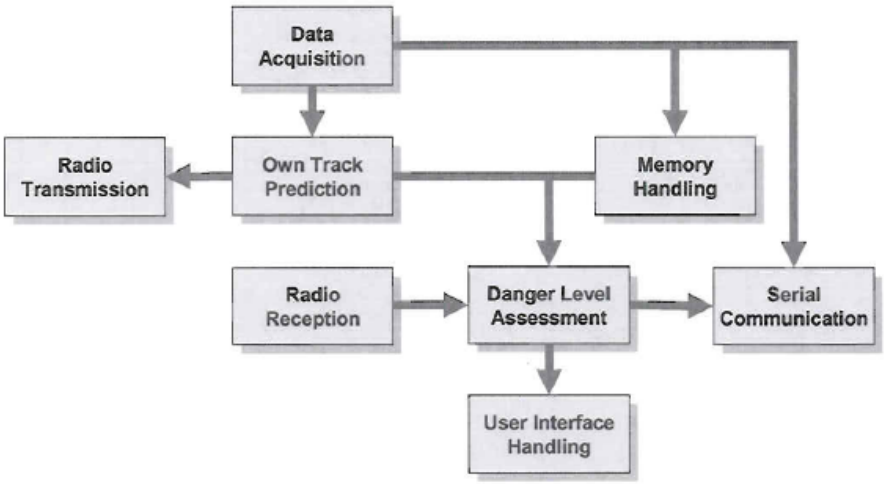
7.2 Hardware scheme



7.2 Hardware scheme



7.3 In-flight software scheme



7.4 Radio transmission

The FLARM system uses a data communication frequency in the free Non-Specific Short Range Device (SRD), sub band f, between 868.0 – 868.6 MHz and with an ERP power of less than 10 mW (duty cycle 1%). This band is ruled for European applications in the documents ERC/REC 70-03 annex 1(f) and ERC/DEC/(01)04. The band is free for any ground-ground applications and gets no official protection against external interferences. ITU's recommendation for this band in region 1 is "mobile except aeronautical mobile". **FLARM is not considered as aeronautical mobile radio.**

There are national differences in frequency allocation and operating conditions between countries. To be used for air-air application some countries require an authorization to be granted by each national communication authority. In Switzerland, BAKOM/OFCOM has granted this authorization for the FLARM application on the 23 March 2004. On the 29 May 2005 FOCA confirmed to BAKOM/OFCOM that no Radio License will be required for FLARM. The aircraft commander is solely responsible for ensuring that their use of FLARM conforms to local regulations.

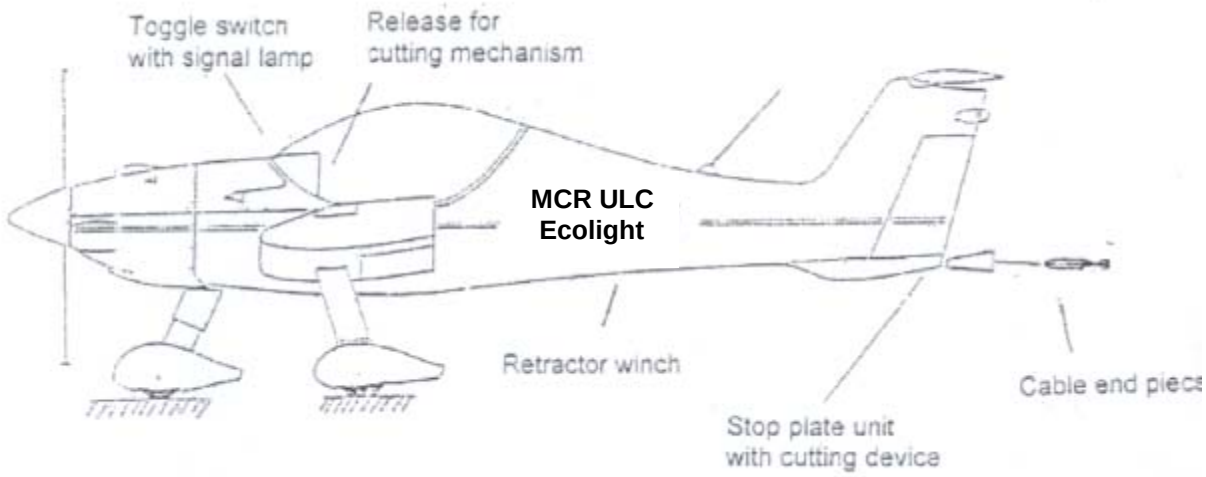
The radio transmission protocol employed places no limit on the number of units that may be operated within a given range. However, an increasing number of units within range is associated with a reduction in the probability that a single coded signal will be received ('graceful degradation'). The probability 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.

7.5 Electrical installation

FLARM is requested to be installed on a non-essential bus. This is not always possible as certain older aircraft got only one avionics bus that is essential when flying under IFR rules. The FLARM installation is protected with a C/B. A dedicated power switch is provided with this installation to readily disconnect the FLARM installation when required by Emergency or operational needs. The pilot must be confident with his electrical bus topology and the FLARM installation.

12. SUPPLEMENT TOW CABLE RETRACTOR WINCH TOST

This document is up to date on November 2008. Nonetheless, it is provided for information only and any new amendment should be considered.



The tow cable retractor winch with guillotine (CRG)

is firmly installed in the ultralight and will allow to retract the tow cable during the flight (descent), after the sailplane pilot has released the cable.

The ultralight can land directly, without additional cable-drop curve. In this way, the towing operations are more safe and economically. The flight time as well as the aircraft noise will be reduced.

The cutting mechanism allows to detach the tow cable also with hazardous flight attitudes: In an emergency, pull the operating lever for the cutting device with a jerk to the stop.

Description of the system

The tow cable retractor winch with guillotine consists from two components:

1. Traction unit and cutting system (guillotine) are integrated in the towing support, which will be mounted to the tail of the ultralight. The incorporated stop plate unit takes up the cable load (load input) via a sleeve screwed over a knot in the tow cable.

2. The retraction winch will be installed in the fuselage, close to the centre of gravity (see diagram). The cable drum is operated by an electric engine with a friction clutch. The engine is charged via the aircraft's electrical wiring system.

The effective cable length is max. 50 meters. The tow cable will run in a protection tube from the cable drum to the guillotine at the aircraft's tail.

Feeding the tow cable through the guillotine and the protection tube will be done with an auxiliary cable wind-up-wire, included in the ship set.

Instruction for feeding the tow cable:

⇒ Lay out the tow cable in full length behind the tow plane

⇒ Pass auxiliary cable wind-up-wire through stop plate unit and protection tube towards the aircraft front. Hang tow cable onto the rear end and pull up to the front to the cable drum. From there, pull the cable about further 4 meters.

⇒ Mark the tow cable at the rear end of the stop plate unit by a felt-type pen and pull up the cable until this marking appears at the drum.

⇒ Now, slip the half of the cable sleeve with exterior thread onto the cable to the marking (thread showing to the glider). Make an overhand knot into the cable, close to the marking. Tighten the knot with a jerk and pull it into the sleeve's interior. Slip the other sleeve half over frontal cable end (open sleeve halves showing towards each other) and screw firmly to the already fitted sleeve half, see drawing at the end of the Manual.

⇒ Pull the tow cable to the rear again, till the sleeve stops at the stop plate (load entry). Place the free tow cable end onto the cable drum at the drum fillet (drum edge). Only fix the cable end with adhesive tape on the drum surface.

⇒ **Do not fix the cable end at the motor side of the drum and do not make a knot!**

⇒ Wind up some coils of tow cable by hand onto the drum. Make sure that the windings are well distributed. This will ensure accurate rewounding of the cable during retracting operation.

⇒ Demount the „end piece" by **only** removing the special bolt M 6x32. Slip the aluminium part (with transparent protective tube) over the rear end of the tow cable. Make an overhand knot (the same as in the cable sleeve) at the end of the tow cable. Weld/seal cut cable ends immediately to prevent fraying. Pull the knot into the borehole of the aluminium end piece. Fit again the weak link with shackle and connecting ring pair into the aluminium piece and screw with the kspecial bolt M 6 x 32.

⇒ The transparent PVC tube (stabilizer) serves as protection of the weak link and as stabilization of the cable during cable retraction. For better visibility, cover the protection tube with **red** adhesive tape.

The special bolt M 6 x 32 of the end piece is placed off centre. The weak link can thus only be fitted in one position, see drawing at the end of the manual.
If it is necessary to replace the tow cable, proceed as described. It is recommended to replace to cable after about 1000 tows or depending on the condition of the cable.

Use only plated PVC or PA ropes with a diameter of 6.3mm maximum.

➔ Attention ←
Tow cables must not be spliced. A spliced point would prevent the full retraction of the cable.

The breaking strength of the tow cable must range below the trailer load of the tow plane! (see Flight Manual of the aircraft).

Attention must be paid to the use of the correct weak link, specified for the cable end.

About 1 m from the point the cable comes out of the guillotine there are visible 2 black markers of about 5 cm length on the cable (when the tow sleeve is close to the stop plate).

Cable retraction will be started by a toggle switch. A red signal light in the toggle switch indicates the operation of the retraction winch. When the end piece has run up, the toggle switch cut off automatically.

Cable retraction can be visually checked by a mirror, that is mounted lefthand on the canopy cabin's frame.

The release lever serves to actuat the cutting device.

➔ Attention ←
In an emergency pull this lever with a jerk up to the stop!

Towing Instruction:

The power for the Tow Cable Retractor Winch is charged via the aircraft's electrical wiring system, by operating the circuit breaker. In this manner, the retracting system can be switched out of service during normal flight operations of the tow plane.

The ultrlight should be taxied in a suitable distance in front of the sailplane. A member of the towing crew will draw the tow cable by hand to the sailplane, where it is connected properly. After take-off clearance, the pilot of the tow plane will pull tight the cable slowly, until the cable sleeve stops perceptibly at the traction block of the stop plate unit.

➔ Attention ←
Only start the towing operation, after the cable sleeve had been stopped at the traction block.

The aero tow has to be performed in accordance with the flight instructions of the ultralight manufacturer.

After the cable had been released from the glider pilot, switch on the retraction winch be pushing the toggle switch. The red signal light in the toggle switch indicates the cable retracting operation.

A short glance into the mirror will show, wether the red marked end piece has fully run up, that means the cable is completely retracted.

The ultralight should descend according to the instructions of the aircraft manufacturer. Attention must be paid to the flight level and position for a most noise-abating descent. Descent during retracting operation with max. 140 km/h.

The landing can be performed directly. If the cable had not been retracted completely, landing can be done with hanging cable if the runway has a sufficient length. Only in an emergency or in case of obstacles in the flight path the tow cable should be cut for safety reasons.

Malfunctions:
It may happen that the tow cable curls. Then it is only possible to retract the tow cable up to this point and the toggle switch will cut off automatically at the knot. Land as described and remove the curls.

➔ **Attention** ←
Do not tow with loops in the cable!

In order to prevent loops or knots in the cable, the glider pilot **may not release under load** or zoom the glider, just before releasing the cable. For a better introduction into this method of towing, the engine power should be reduced first at the end of the tow, and then the sign for releasing should be given.

When taxiing have a look from time to time into the mirror: check if the end piece is correctly inside the rubber funnel or hanging out of it. In this case actuate the toggle switch and pull in the cable completely. Otherwise the cable could damage the tail unit or jam in the tail wheel.

Maintenance Instructions
Proper function of the system can only be warranted if attentive maintenance is performed.

1. Daily Checks prior to the towing operation

-- Check proper fastening of the unit and secure all connections
-- Check free running ability of the cable drum
-- Check proper seat and fastening of the cable sleeve
-- Check proper function of the cutting device. Just press the knife slightly with a finger, to check wether it works
-- Check terminator for damages, grooves etc., to avoid damage or jamming of the cable during retracting operation
-- Unreel full length of the tow cable in starting position and check for defects, especially near to the end piece.
-- Check the weak links and the connecting ring pair
-- Check proper adjustment of the mirror.
-- Pay attention to the fact that the tow cable may freeze in winter operation

2. Checks and maintenance work to be performed with the 100-hour-check-up of the airframe of tow plane

-- Remove knife from the cutting device and check for cutting ability and possible defects
-- Clean the interior space of the cutting device
-- Clean protection tube and pay attention to chafe marks
-- When re-installing the knife, the engraved arrow must show backwards - to the cable outlet - (rebord part backwards). Screw down the crown nut - not too tight - and secure with locking pin.
-- Check the tension spring at the cutting lever
-- Check the cable drum for firm seat and defects. Replace the drum, if necessary
-- Check electric connections.

3. Check with the annual inspection of the tow plane

Perform cutting test with fully retracted cable

Spare parts and tow cables should be purchased from the manufacturer.