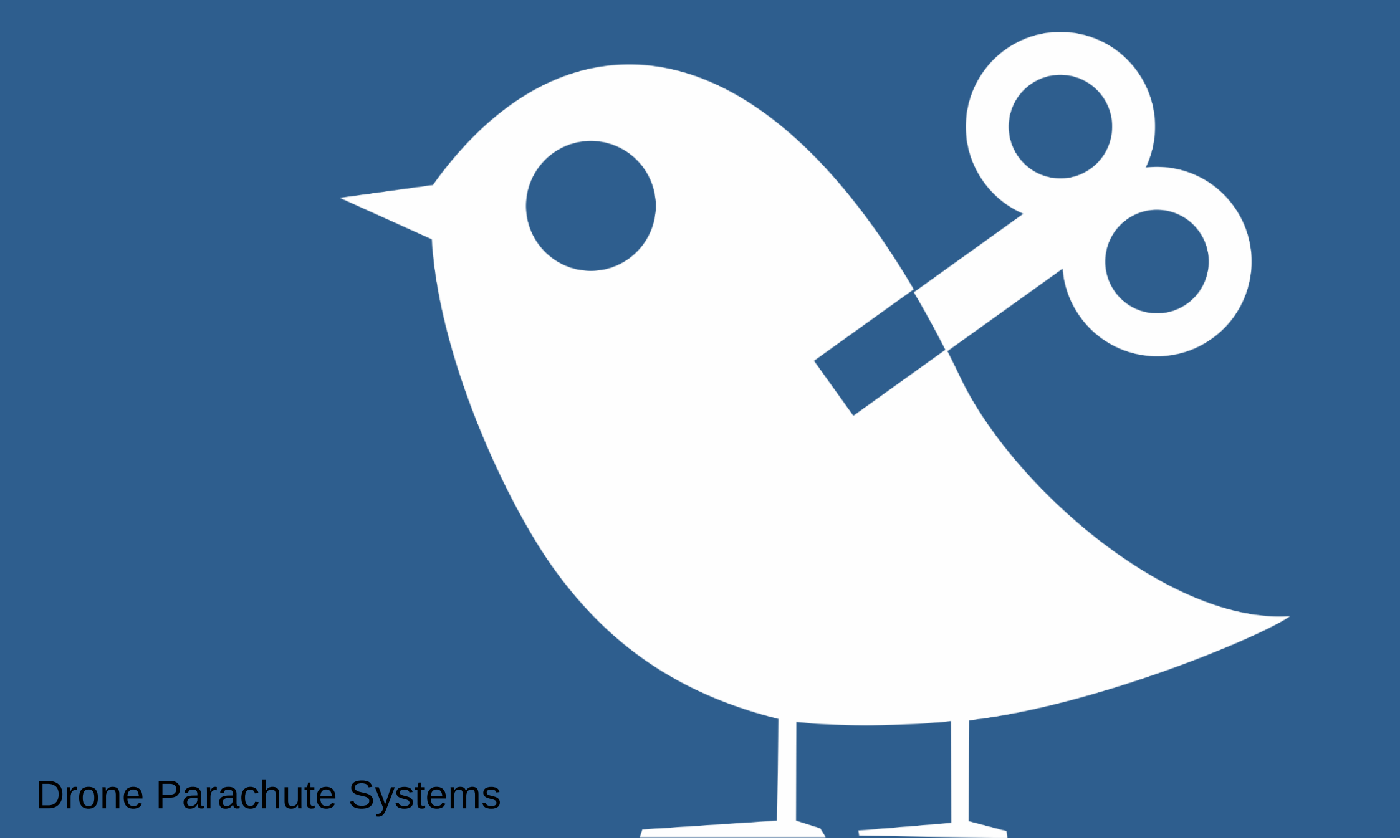


Drone Parachute Systems

www.uavos.com

The user of this system must read this manual all the way through! Please read this manual carefully before using, for any reason, the parachute system built by UAVOS. This manual describes how to safely use the parachute system without endangering you and your surroundings, and how to set up the system so that it operates correctly. You will also be informed in what situations and how to use the parachute system.

List of abbreviations used

UAV – unmanned aerial vehicle

AC – aircraft

PS – parachute system

ERS – emergency rescue system

SPL – system of standard parachute landing

PROHIBITIONS

1. Read this manual carefully before using the parachute system. This manual describes the purpose, composition, principle and sequence of the PS, the safety of using the parachute system. Any manipulations with the parachute system other than those specified in the manual is prohibited. It is forbidden to add, disassemble, or change the quantitative composition of the parachute system.

2. Before installing the ballistic emergency rescue system of the UAV, it is forbidden to aim at people nearby or at yourself. The parachute system must be handled like a pyrotechnic device or like a weapon with the safety off! No one is allowed to stand in the direction of PS deployment.

3. It is forbidden to install and use the parachute system that has been in service for more than 6 months without repacking.

4. In case of the UAV failure, the owner of the parachute system must inform the manufacturer, who will take the necessary measures for possible use on the same type of UAV.

5. The owner of the parachute system must notify the manufacturer prior to any transportation, such as transporting the system to the manufacturer for repair or inspection.

6. It is prohibited to store the parachute system at temperatures below –10 °C or above + 30 °C and humidity less than 30% or above 80%.

7. It is forbidden to expose the parachute system to high temperatures, strong shocks, mechanical damage and damages by acids, harsh chemicals, long-term storage in high humidity or dusty conditions.

8. It is forbidden to mount the parachute system on parts of the UAV that are not approved by the manufacturer, or other types of UAVs.

9. The parachute system should only be attached to the UAV strictly in accordance with the manufacturer's instructions to prevent accidental activation and/or weakening of the rescue system structure.

10. Connecting slings for attaching the parachute system to the UAV are installed in such a way that they do not interfere with the going out of the parachute system from the container, and are protected from harmful effects during the operation of the UAV.

11. In case of a single actuation of the ballistic rescue system, the pyrocartridge must be replaced; in case of triple actuation – a liner of an expelling charge and a protective cover with a protective washer of a ballistic parachute, in case of a five-time actuation – a container of a ballistic parachute. The entire parachute system is rechecked and put into service by the manufacturer after 50 uses – for another 50 uses or 5 years.

12. The connector of the expelling charge of the ballistic emergency rescue system is connected before the launch of the UAV and is disconnected immediately after the landing of the UAV.

Table of contents

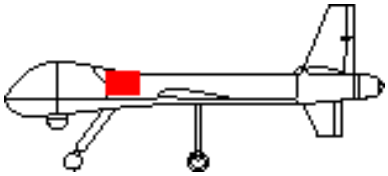
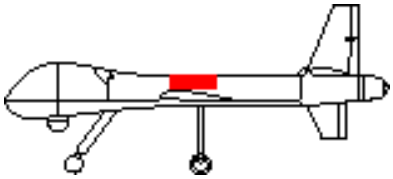
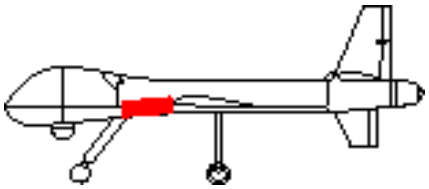
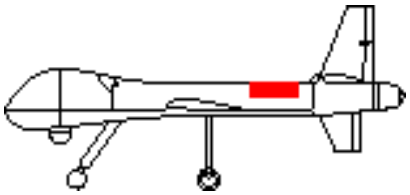
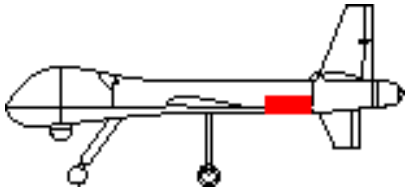
Parachute Systems configuration

Parachute Systems configuration depends on the type of UAV and the placement of RS on board the UAV

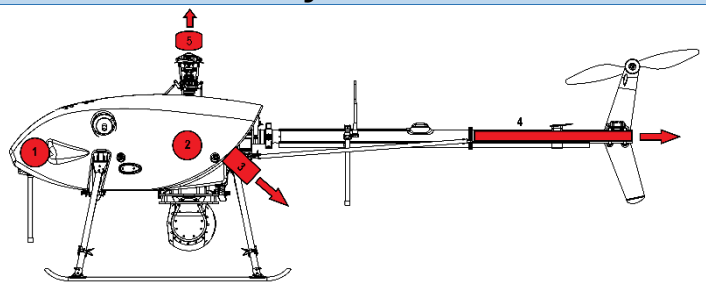
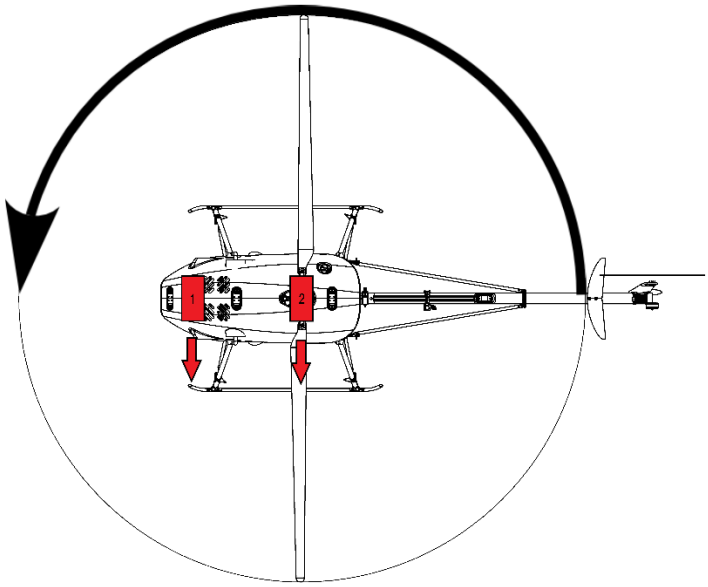
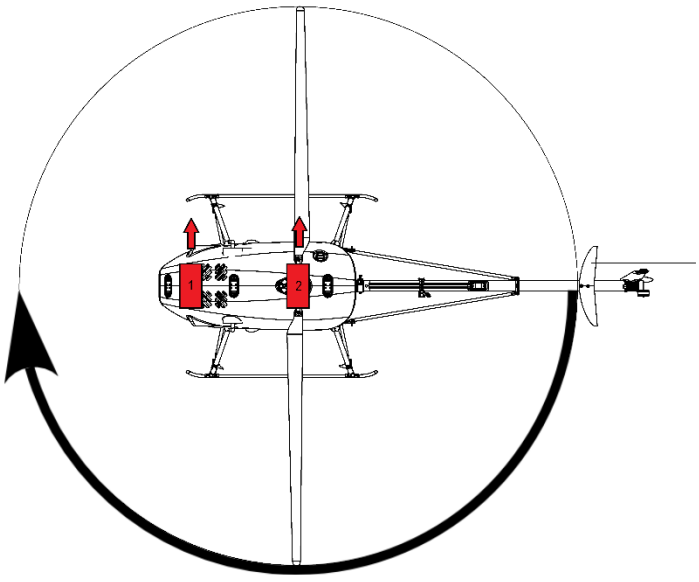
Fixed wing-type
Rotary-type
Multi-rotor-type

Parachute Systems configuration can be changed for any customer needs!

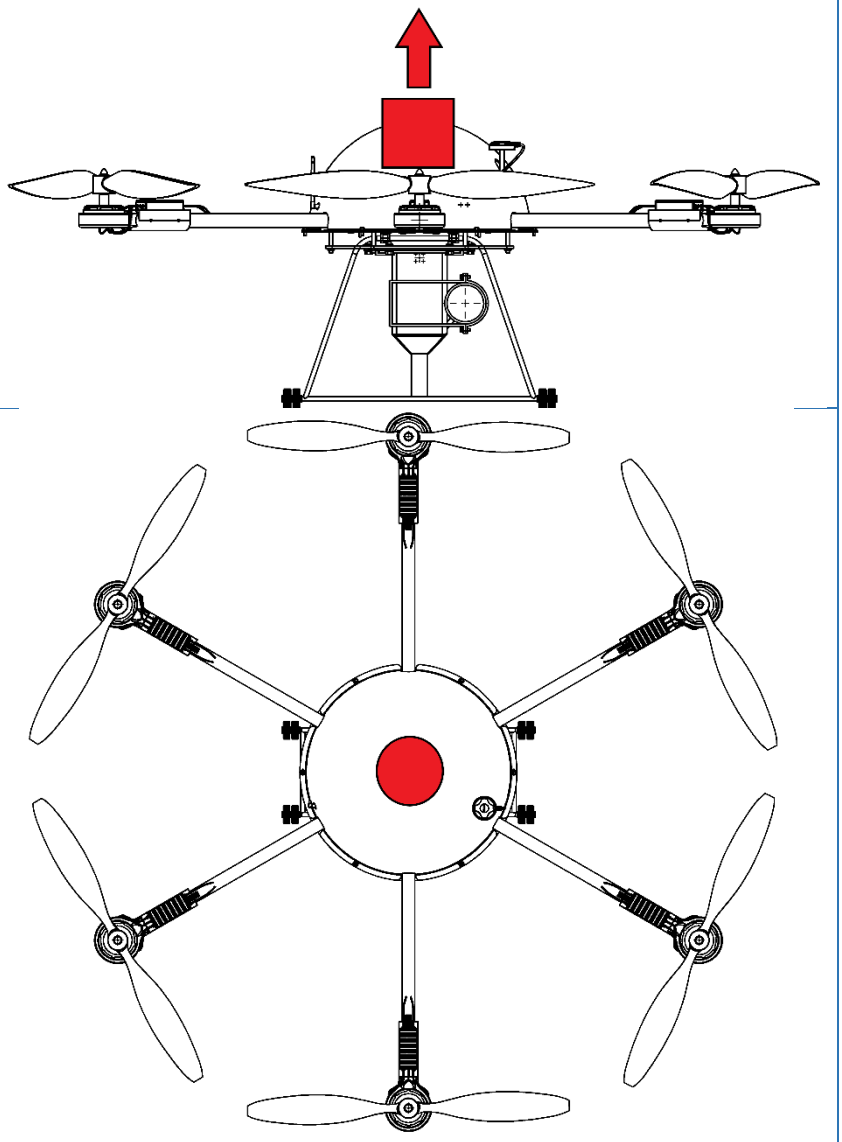
Recommended options for installing parachute systems on a fixed wing UAV.

No.	Installation options for parachute systems	Description
1		Option for placing a parachute system with fuel tank in the center of gravity and the center of pressure.
2		The best option of placing an emergency rescue system (above the center of gravity, above the aircraft's center of pressure).
3		Option of placing a regular landing system (under the center of pressure of the aircraft).
4		Option of placing a parachute system if it is impossible to install it according to options 1-3.
5		Option of placing the standard landing system with the design features of the UAV.

Recommended options for installing parachute systems on a rotary wing-type UAV.

Installation options for parachute systems	Description
	Front mounting Central mounting Under-mounting Rear mounting Upper mounting
	The direction of PS release of placement options 1 and 2 depends on the direction of rotation of the CCW rotor then the direction of PS release on the left side of the UAV.
	The direction of PS release of placement options 1 and 2 depends on the direction of rotation of the CW rotor, then the direction of PS release on the right side of the UAV.

Recommended options for installing parachute systems on a multi-rotor-type UAV.

Installation options for the parachute system	Description
	Option for installing the parachute system on a multi-rotor UAV in the center of mass.

Types of Drone Parachute Systems

Parachute systems are classified into two types of application:

1. **The standard parachute landing system** (hereinafter – SPL) is intended for landing (flight completion) at a given point of the terrain at a given altitude and at a given speed, safe for all elements of the UAV structure and payload.
2. **Emergency rescue systems** (hereinafter – ERS) is intended for emergency landing and rescue of the UAV in cases of destruction, failure of the autopilot, as well as cases when normal flight is impossible.

Parachute systems are classified into three types by design:

1. Self-extracting system. This system is used for regular UAV landings. SPL is located in the UAV niche closed with a hatch. The hatch is opened by a lock. When the hatch is opened in flight, the extraction parachute is thrown out (blown out), which is filled due to the incoming air flow, and the main canopy is pulled out. The advantages of this system are – that it is simpler in design and faster and easier during installation in the field conditions. It does not require replacement of expelling charges.

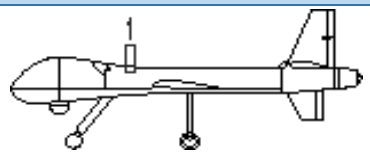
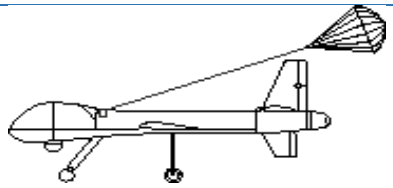
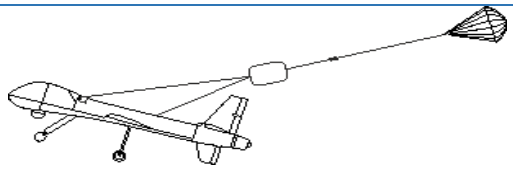
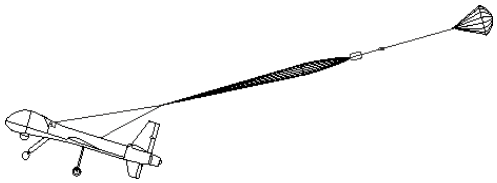
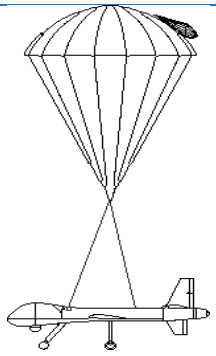
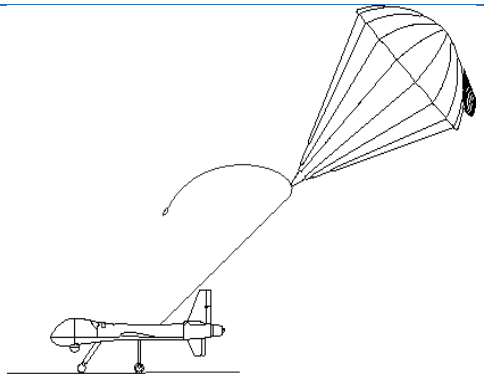
The function of the UAV deceleration and the parachute canopy deflation on the ground using a lock is possible.

2. Ballistic and exhaust system. It is applied for both regular and emergency use. The main difference from the self-extracting system is that the exhaust canopy is fired from the shell with an expelling charge. This allows the system to be installed in different layouts on the UAV. The ballistic pilot chute provides guaranteed and quick deployment and the exhaust of the main canopy. The function of UAV braking and canopy deflation on the ground using a lock is possible. These systems can be manufactured for any UAV weight.

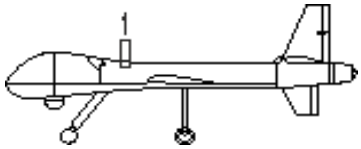
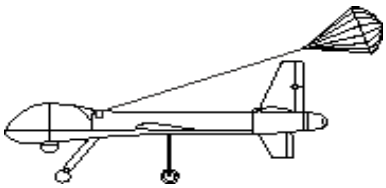
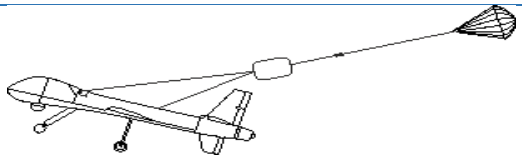
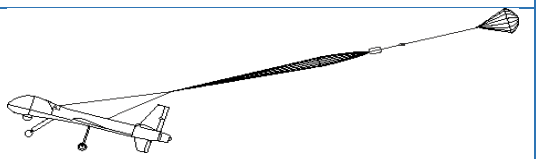
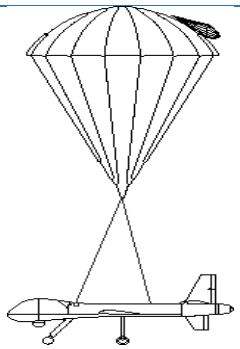
3. Ballistic system. Used for UAV emergency rescue. It is used for UAVs weighing up to 500 kg. The parachute is packed into a carbon fiber tube, from which it is fired with an expelling charge or a gas generator. The parachute is protected by a Kevlar cover. The advantage of this system is its ability to be used at extremely low altitudes and speed. Among disadvantages are strong overloads during deployment and UAV weight restrictions.

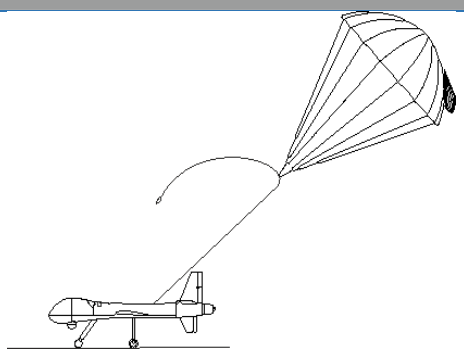
Commissioning principle	
Self-extracting	
Ballistic-exhaust	
Ballistic	

Procedure of the use of ERS and SPL on an UAV with a flight speed of less than 35 m/s

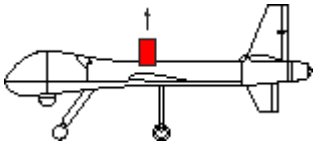
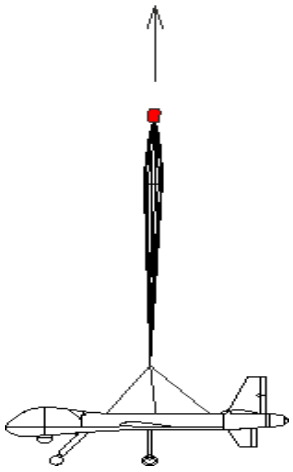
No.	Procedure	Description
1		Types: 1) Self-extracting. 2) Ballistic-exhaust.
2		When the system is activated, the pilot chute goes out.
3		The pilot chute pulls out the main canopy and load-bearing lines. Filling and opening of the canopy take place.
4		
5		Descent and landing on the main canopy.
6		After landing, actuation of the lock and release of a lug of a group of lines – to prevent the destruction of the UAV structure in the presence of wind and its possible dragging along the land surface.

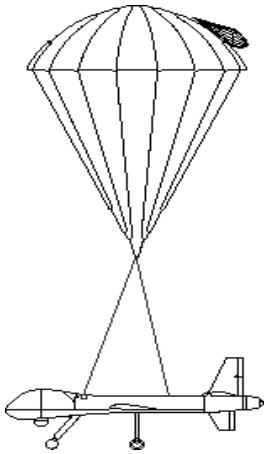
Procedure of the use of ERS and SPL on an UAV with a flight speed of more than 35 m/s. In this case, a braking-pilot chute system is used to reduce overloads when opening the main canopy. The brake parachute release lock is applied.

No.	Procedure	Description
1		ERS types: 1) Self-extracting, 2) Ballistic-exhaust.
2		When the system is activated, the braking-exhaust parachute goes out, the UAV decelerates.
3		Actuation of the first stage of the lock, release of a lug No. 1, after which there is a further exhaust, filling and opening of the main parachute occurs.
4		
5		Descent and landing on the main canopy.

6		Actuation of the 2nd stage of the lock and release of the lug No. 2 of the line group occurs, after landing – to prevent the destruction of the UAV structure in the presence of wind and its possible dragging along the land surface.

Procedure of the use of ballistic ERS.

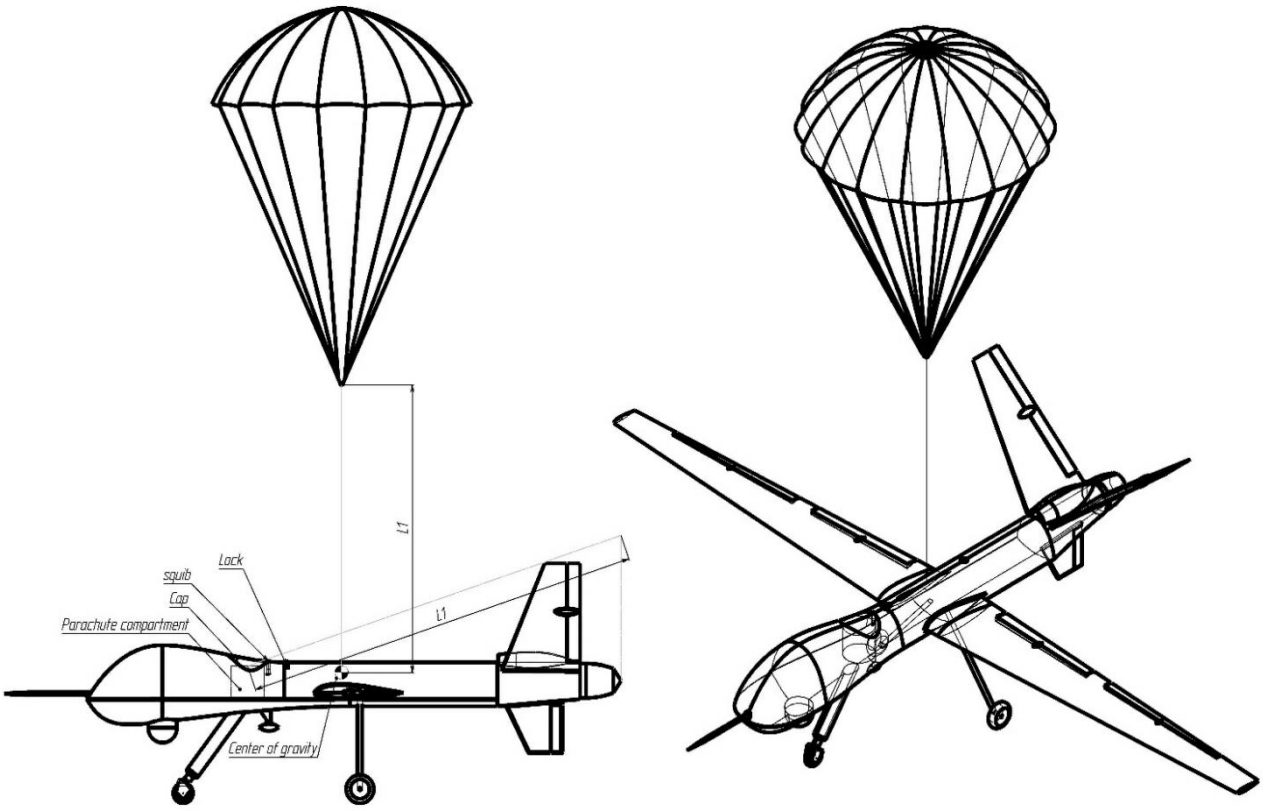
No.	Procedure	Description
1		ERS type: 1) Ballistic.
2		System activation. Ejection of the parachute, its opening and filling of the canopy occurs.

3		Descent and landing on the main canopy.

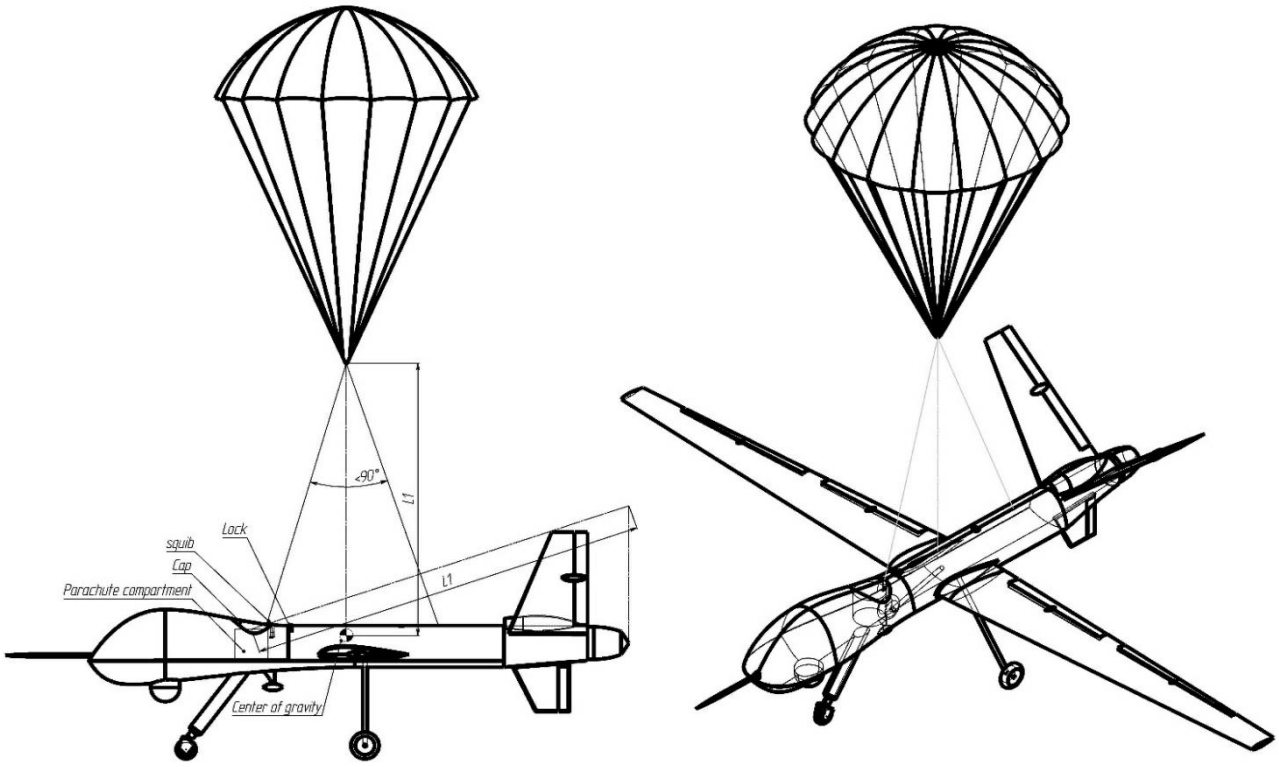
It is possible to use a one-step lock to deflate the parachute canopy on the ground.

Type of pilot parachute	
Self-extracting is meant to pull out the main canopy of the parachute and stabilize its opening.	
Braking-exhaust is meant to reduce the speed of the aircraft to the allowable speed for opening of the main parachute.	
Stabilizing is meant to stabilize the position of an object during free fall.	

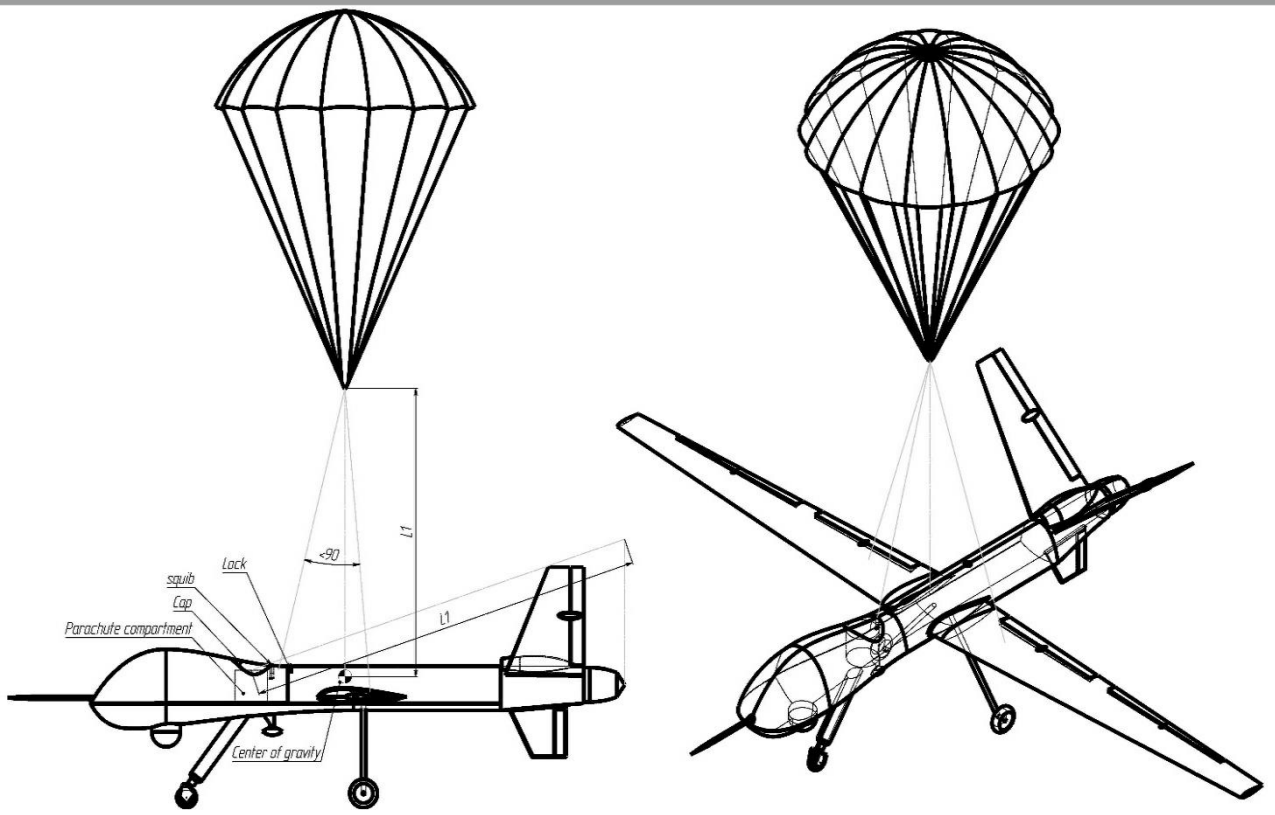
Attachment scheme of connecting lines and the number of attachment points on an aircraft-type UAV



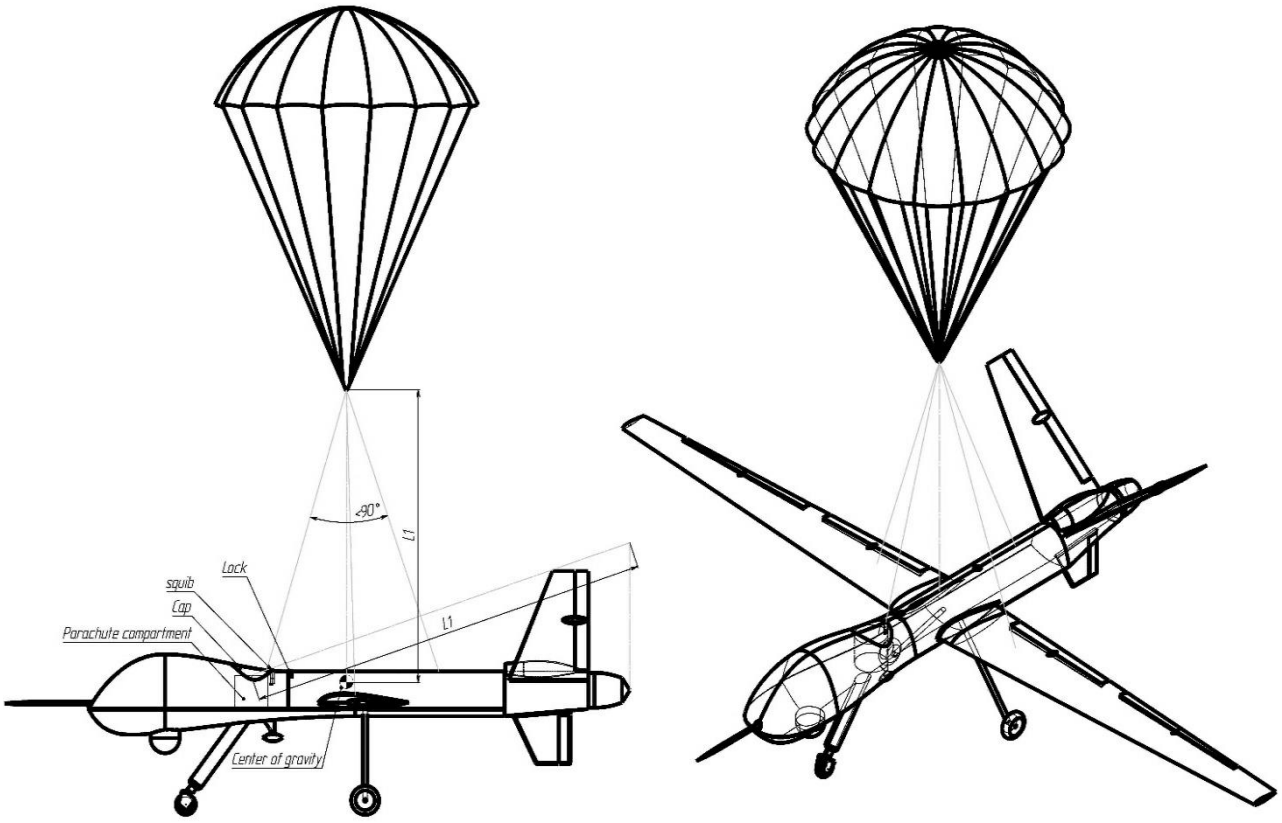
1-point attachment of connecting lines



2-point attachment of connecting lines

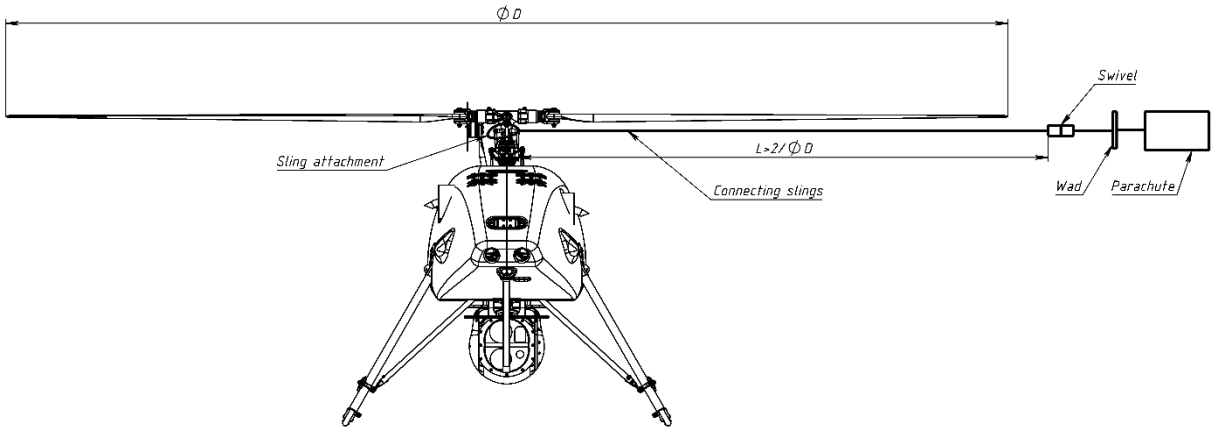


3-point attachment of connecting lines



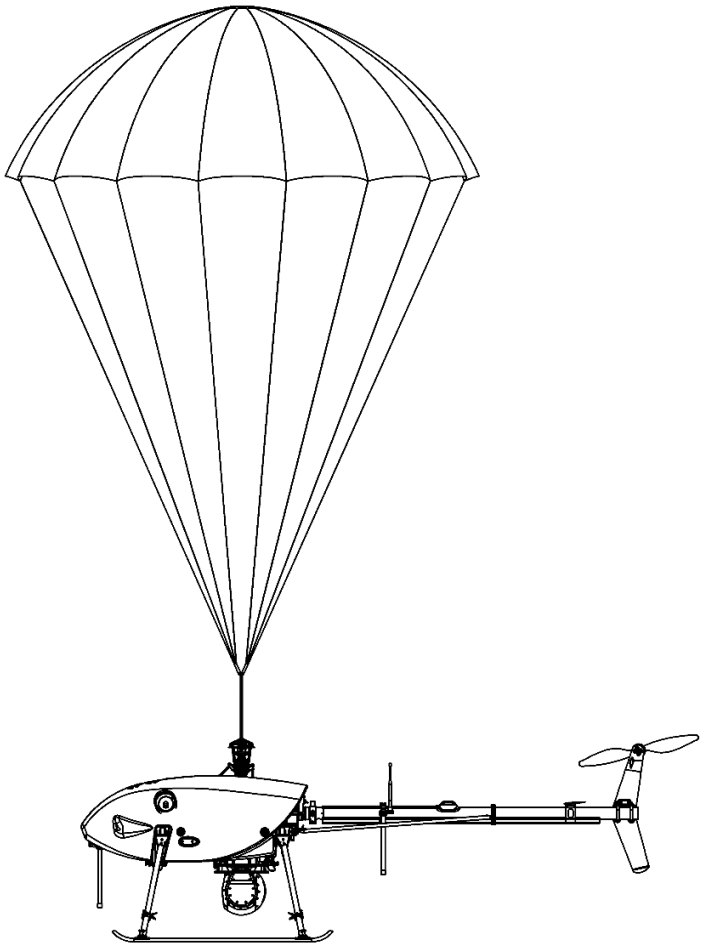
4-point attachment of connecting lines

Attachment scheme for connecting lines on a helicopter-type UAV



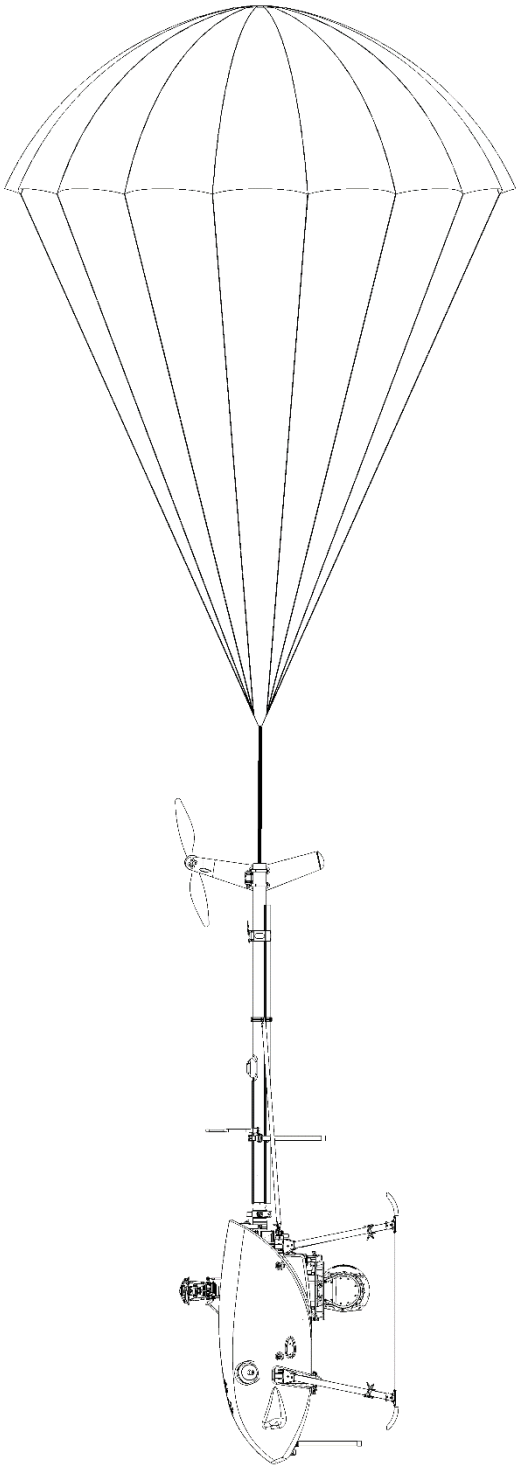
Attachment scheme for layout option No. 1, No. 2, No. 5 of the parachute system

The connecting lines are attached to the swashplate of the helicopter, and landing takes place on the landing gear.



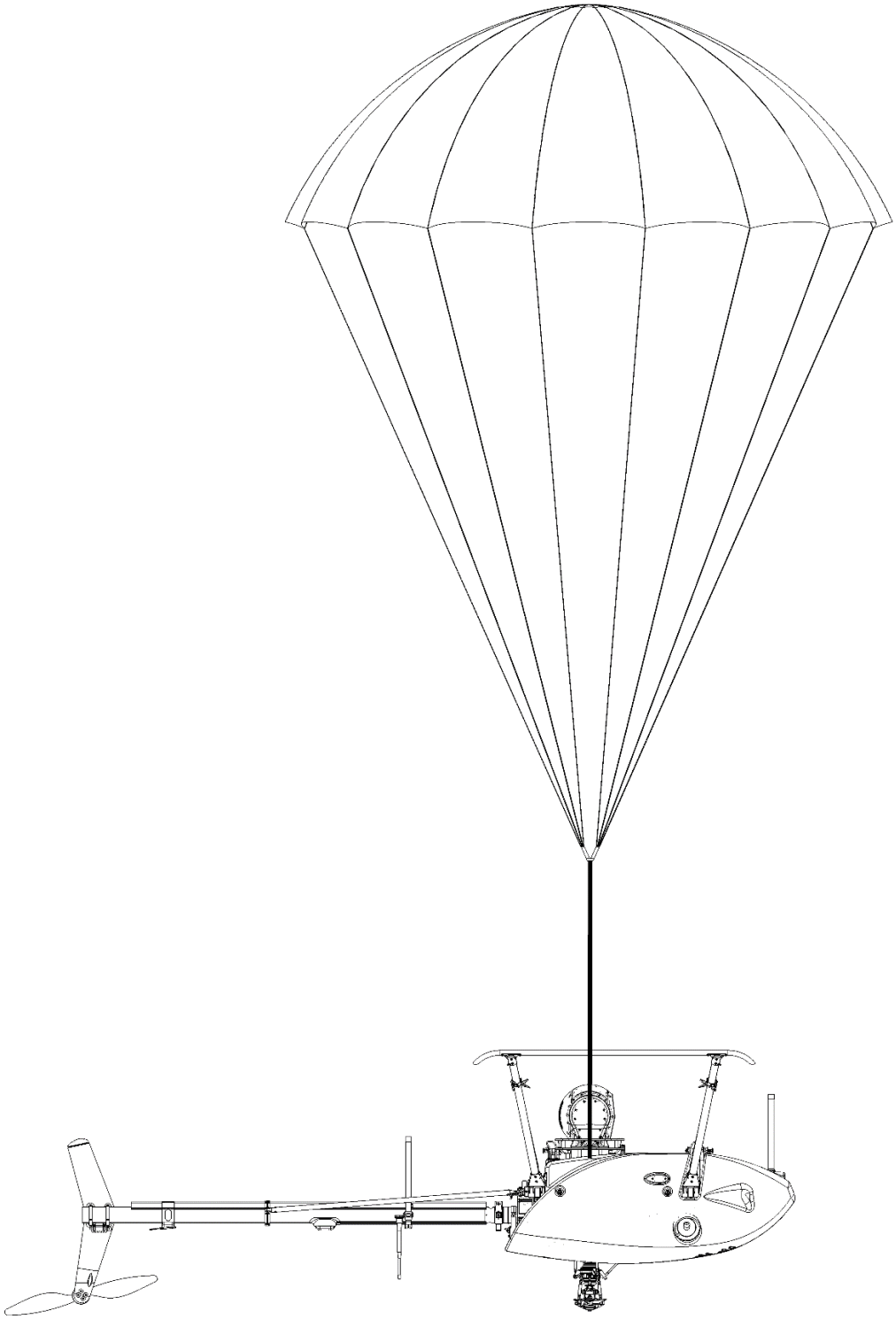
Attachment scheme for option No. 4 of the parachute system

The connecting lines are attached to the helicopter's PS body, and landing takes place on the helicopter nose section.



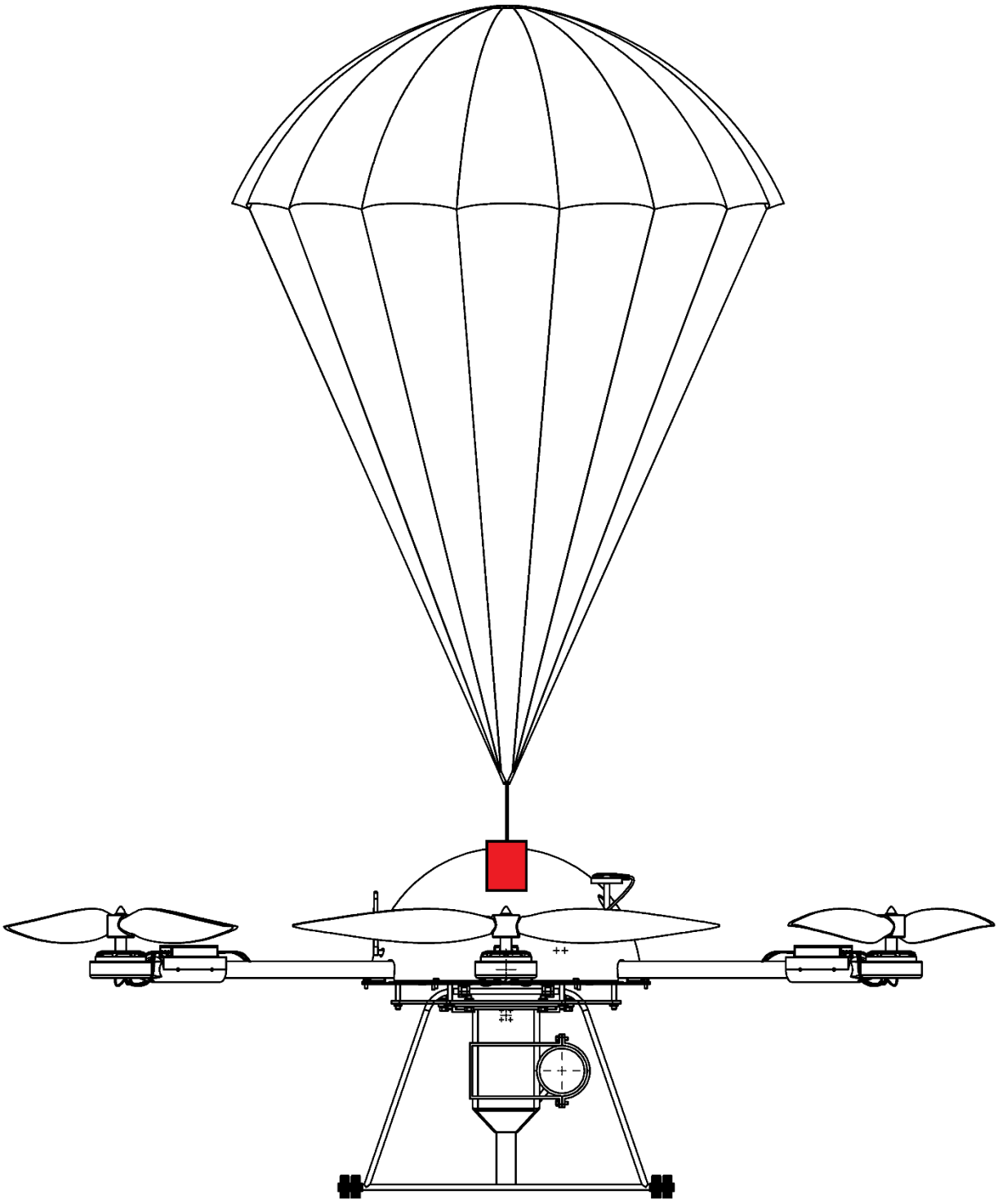
Attachment scheme for layout option No. 3 of the parachute system

The connecting lines are attached to the helicopter PS body, and landing takes place on the helicopter blades.



Attachment scheme for connecting lines on a multi-rotor UAV

The connecting lines are attached to the PS body of the quadcopter, and landing takes place on the landing gear.



Picture							
RS name		10 System of Standard Parachute Landing	10 Parachute Systems	15 Parachute Systems	25 Parachute Systems	50 System of Standard Parachute Landing	50 Parachute Systems
UAV type (aircraft, helicopter, multi-rotor)	type	airplane	airplane / helicopter / multi-rotor	airplane / helicopter / multi-rotor	airplane / helicopter / multi-rotor	airplane	airplane / helicopter
RS type (standard, accident, emergency)	type	standard	standard / emergency	standard / emergency	standard / emergency	standard / emergency	standard / emergency
Commissioning principle (self-extracting, ballistic, ballistic-exhaust)	type	self-extracting	ballistic	ballistic	ballistic	self-extracting	ballistic-exhaust
Type of the pilot chute (exhaust, brake, stabilizing)	type	stabilizing	-	-	-	exhaust / brake / stabilizing	exhaust / brake / stabilizing
The number of attachment points for the lanyard on the UAV	pcs	4	1	1	1	1-4	1
Maximum allowable load	kg	15	15	20	35	60	60
The maximum speed of the UAV when the RS is triggered, without a braking parachute	m/s	up to 16	up to 33.3	up to 20	up to 33.3	up to 33.3	up to 33.3
The maximum speed of the UAV when the RS is triggered, with a braking parachute	m/s	-	-	-	-	up to 300	up to 300
The maximum speed of the UAV when the RS is triggered	km/h	20	0	0	0	5	5
Min. RS response time	s	3	2	1	3	3	2
Minimum altitude when the RS is triggered at minimum speed	m	50	50	10	50	50	50
Operating temperature	°C	-20°C/+30°C	-40°C/+50°C	-40°C/+50°C	-40°C/+50°C	-20°C/+30°C	-40°C/+50°C
Technical resource of the parachute, number of applications	times	50	30	30	30	30	10
Technical resource of the charge	times	-	1	1	1	-	1
Technical resource of the cartridge tube	times	-	3	3	3	-	3
Service life	Mos.	12	12	12	12	12	12

Overall dimensions LxWxH of the parachute compartment	mm	300x120x40	142x130x130	100x100x180	136x136x175	260x220x80	260x220x80
Overall dimensions LxWxH of the ballistic compartment	mm	-	-	-	-	-	214x80x70
Weight	kg	0.3	0.8	0.7	1.3	2,5	3
Maximum overload with max. Load	g	1.2	6	6	6	6	6
Descent rate with max. Loading	m/s	up to 4	up to 6	up to 6	up to 6	up to 6	up to 6
Slider		no	no	no	no	yes	no
Container type (soft/hard)	soft/hard	-	hard	hard	hard	soft/hard	soft/hard
Actuation		-	application of power supply	application of power supply	application of power supply	-	application of power supply
Operating supply voltage	V	-	5	5	5	-	5
Operating current of charge actuation, not less	mA	-	500	500	500	-	500
Possibility to install a lock	No.	No. 1	No. 2 - No. 3	No. 2 - No. 3	No. 2 - No. 3	No. 3	No. 3
Square	m²	6.3	6.5	7	15	35	35
Repacking interval	Days	60	60	60	60	60	60

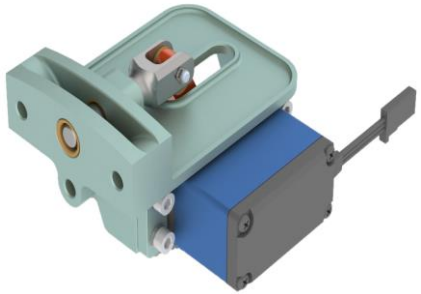
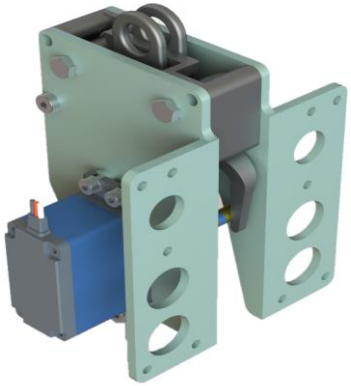
Parachute Systems 5-50 KG

Parachute Systems 75-1000 kg

Picture							
RS name		75 System of Standard Parachute Landing	75 Parachute Systems	100 Parachute Systems	200 Parachute Systems	350 Parachute Systems	1000 System of Standard Parachute Landing
UAV type (aircraft, helicopter, multi-rotor)	type	airplane	airplane	airplane / helicopter	airplane / helicopter	airplane / helicopter	airplane
RS type (standard, accident, emergency)	type	standard / emergency	Standard / emergency	emergency	emergency	emergency	emergency
Commissioning principle (self-extracting, ballistic, ballistic-exhaust)	type	self-extracting	ballistic-exhaust	ballistic-exhaust	ballistic	ballistic	Ballistic-exhaust
Type of the pilot chute (exhaust, brake, stabilizing)	type	exhaust / brake / stabilizing	exhaust / brake / stabilizing	exhaust / brake / stabilizing	-	-	exhaust, brake, stabilizing
The number of attachment points for the lanyard on the UAV	pcs	1-4	1-4	1	1-4	1	1-4
Maximum allowable load	kg	80	80	120	220	360	1300
The maximum speed of the UAV when the RS is triggered, without a braking parachute	m/s	up to 10	up to 33,3	up to 33,3	up to 97	up to 97	up to 100
The maximum speed of the UAV when the RS is triggered, with a braking parachute	m/s	up to 300	up to 300	up to 110	-	-	up to 300
The maximum speed of the UAV when the RS is triggered	km/h	20	20	5	0	0	50
Min. RS response time	s	1.5	1.5	3	3	4	5
Minimum altitude when the RS is triggered at minimum speed	m	70	70	80	50	200	500

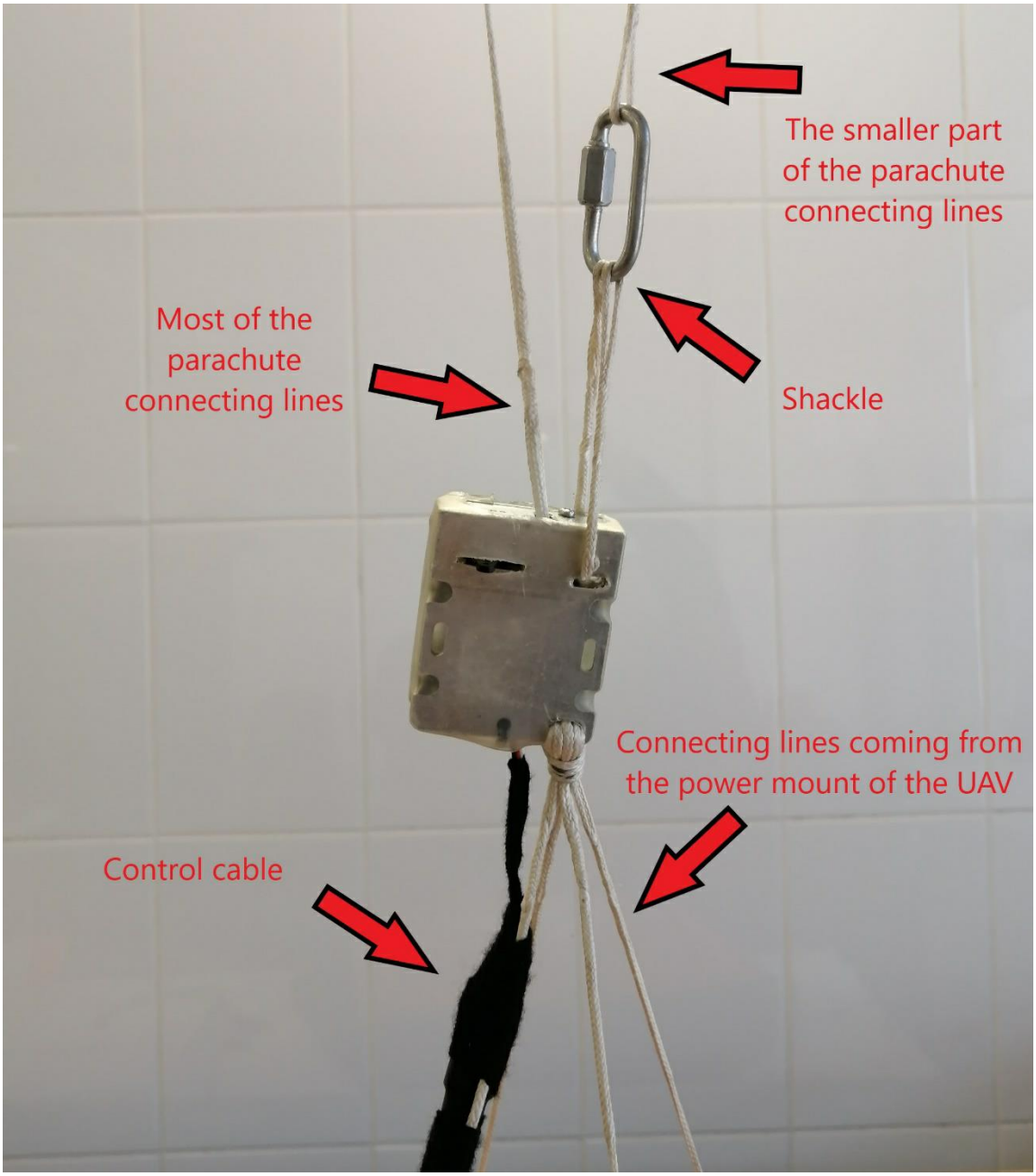
Operating temperature	°C	-20°C/+30°C	-40°C/+50°C	-40°C/+50°C	-40°C/+50°C	-40°C/+50°C	-50°C/+60°C
Technical resource of the parachute, number of applications	times	30	10	10	10	10	5
Technical resource of the charge	times	-	1	1	1	1	1
Technical resource of the cartridge tube	times	-	3	3	-	-	3
Service life	Mos.	12	12	12	12	12	12
Overall dimensions LxWxH of the parachute compartment	mm	300x240x80	300x240x80	350x300x100	300x300x275	210x210x510	x
Overall dimensions LxWxH of the ballistic compartment	mm	-	214x80x70	214x80x70	-	-	x
Weight	kg	2,7	3	3.5	4.5	5.7	x
Maximum overload with max. Load	g	12	12	10	5	5	16
Descent rate with max. Loading	m/s	up to 6	up to 6	up to 6	up to 6	up to 6	up to 6
Slider		no	no	no	yes	yes	yes
Container type (soft/hard)	soft/hard	soft	soft	soft	hard	hard	soft
Actuation		-	power supply	power supply	power supply	power supply	power supply
Operating supply voltage	V	-	5	5	5	5	5
operating current of charge actuation, not less	mA	-	500	500	500	500	500
Possibility to install a lock	No.	No. 3	No. 3	-	-	-	-
Square	m²	35	35	42	0	56	280
Repacking interval	Days	60	60	60	60	60	60

PARACHUTE SYSTEM LOCKS

Characteristics		No. 1	No. 2	No. 3
Picture				
Item		UV01.6402.07.50	UV01.1120.01.00.00	UV01.1120.02.00.00
UAV type	Type	Airplane	Airplane	Airplane
Number of actuation levels	Num.	1	1	2
Max. load on the lanyard	N	200	1500	3600
Overall dimensions LxWxH	mm	42x16x51	73x70x40	63x70x100
Interface		PWM	PWM	PWM
Operating supply voltage	V	DC 6V - DC 7.4V	DC 6V - DC 7.4V	DC 6V - DC 7.4V
Maximum current	A	5	6	6
Technical resource	times	100 applications	100 applications	100 applications
Weight	g	50	132	360

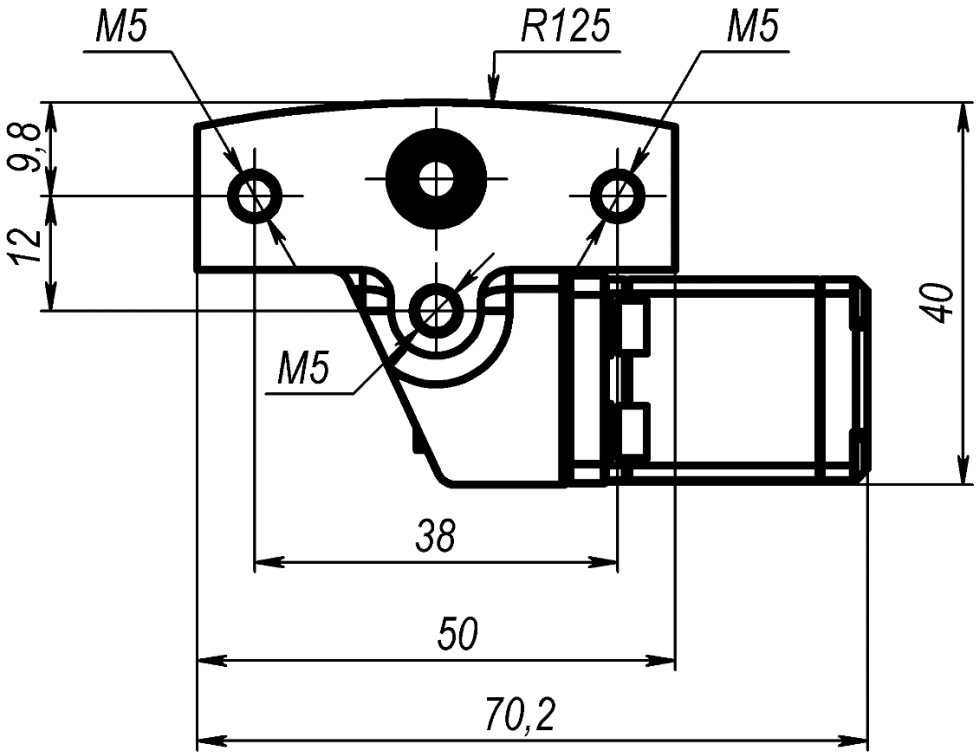
Parachute system lock №1

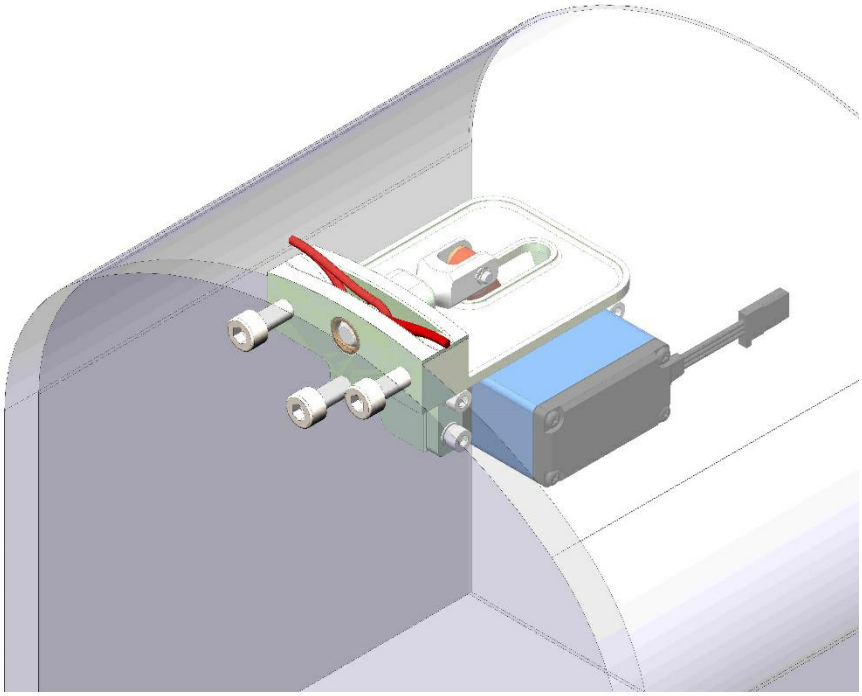
Lock No. 1 is meant to deflate the UAV parachute canopy. The lock is fixed on the connecting lines running from the load-bearing connection of the UAV to the lock; the lock control cable is laid along one of the connecting lines. A smaller part of the parachute connecting lines is attached through the shackle, which is attached to the lock, and most of the parachute connecting lines are attached through the load-bearing rod of the lock.



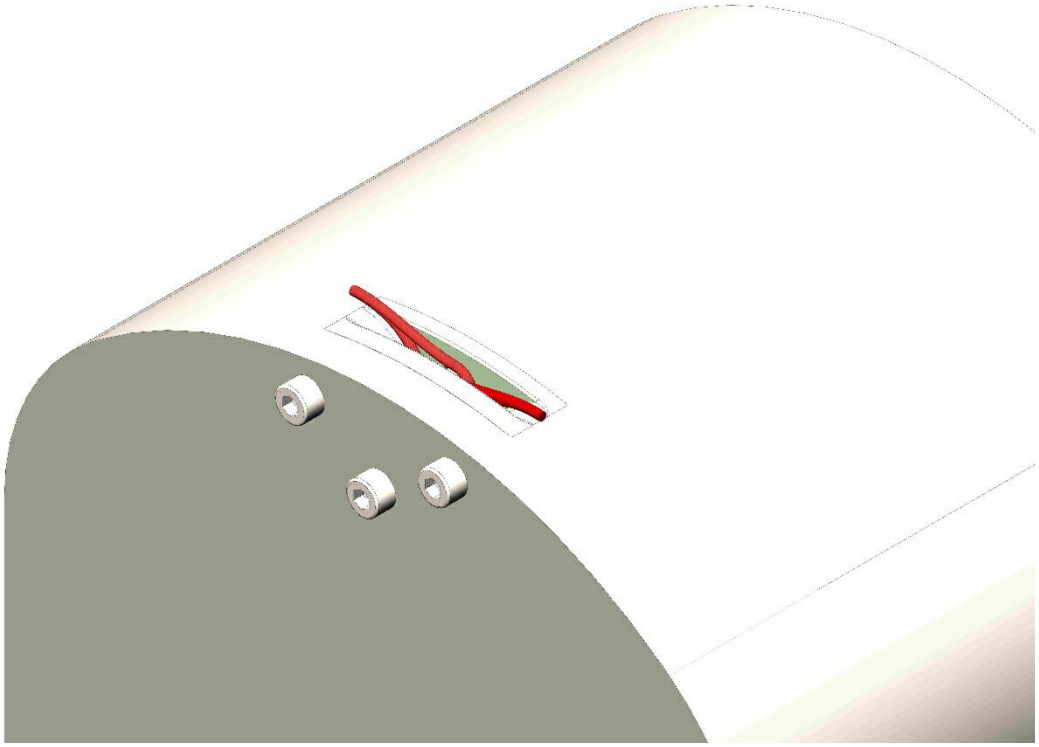
Parachute system lock No. 2

Lock No. 2 is meant to deflate the UAV parachute canopy. The lock is attached to the load-bearing frame of the aircraft using 3 screws with M5 thread.





To install the lock, cut a rectangular hole in the upper fuselage shell so that the lock is flush with the upper surface of the fuselage.



Connecting lines coming from the parachute are attached with one part of the lines to the aircraft, the other part to the lock rod (the number of lines depends on the PS configuration).

Parachute system lock No. 3

Lock No. 3 has 2 stages of actuation. It is meant to release the braking parachute when the first stage is actuated and to deflate the UAV parachute canopy when the second stage of the lock is actuated. The lock is attached to the aircraft load-bearing frame using 6-8 M4 screws in the holes (1) in the corners of the lock load-bearing arm. It is possible to manufacture a lock with a 3rd breather for opening the ERS hatch.

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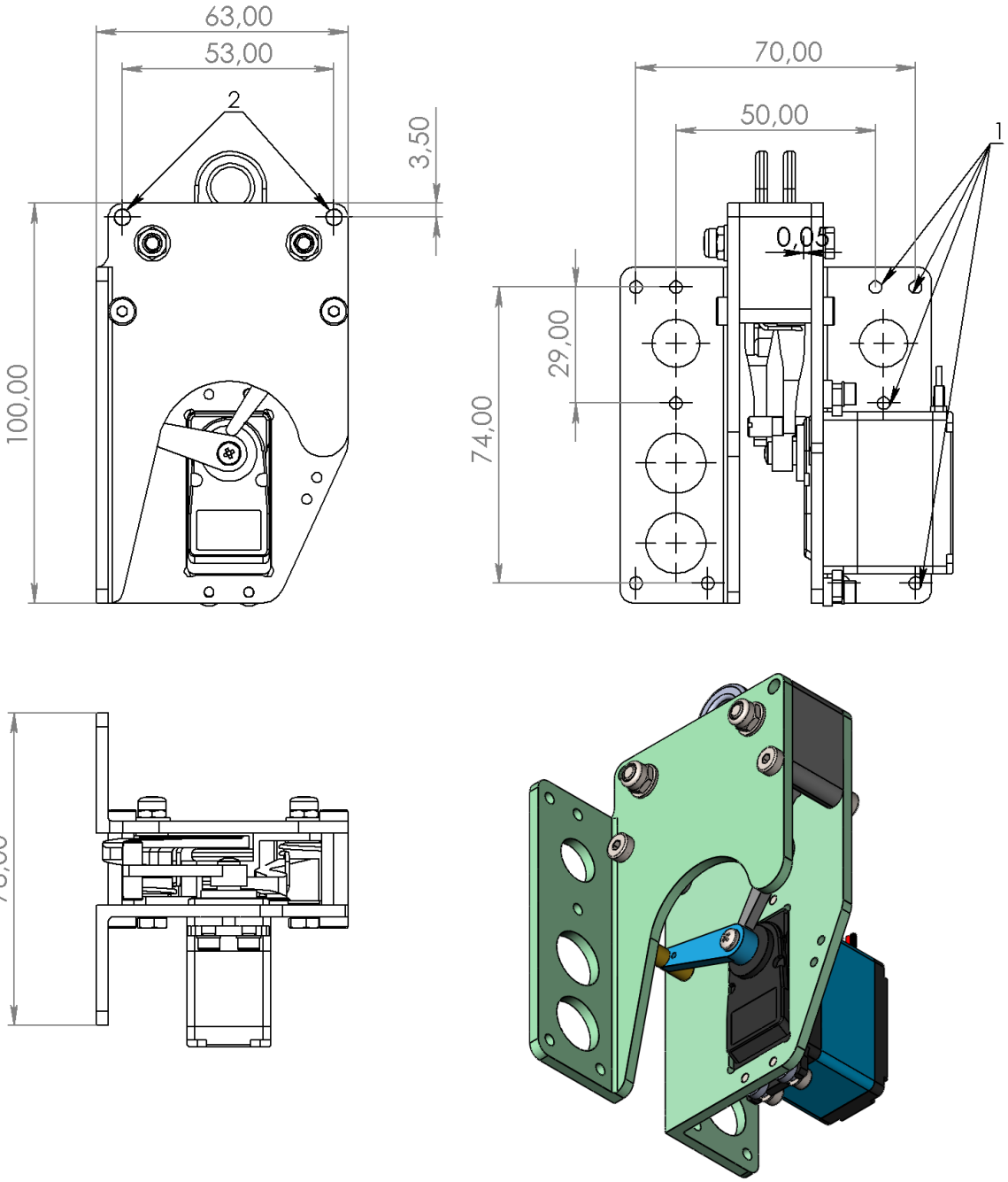
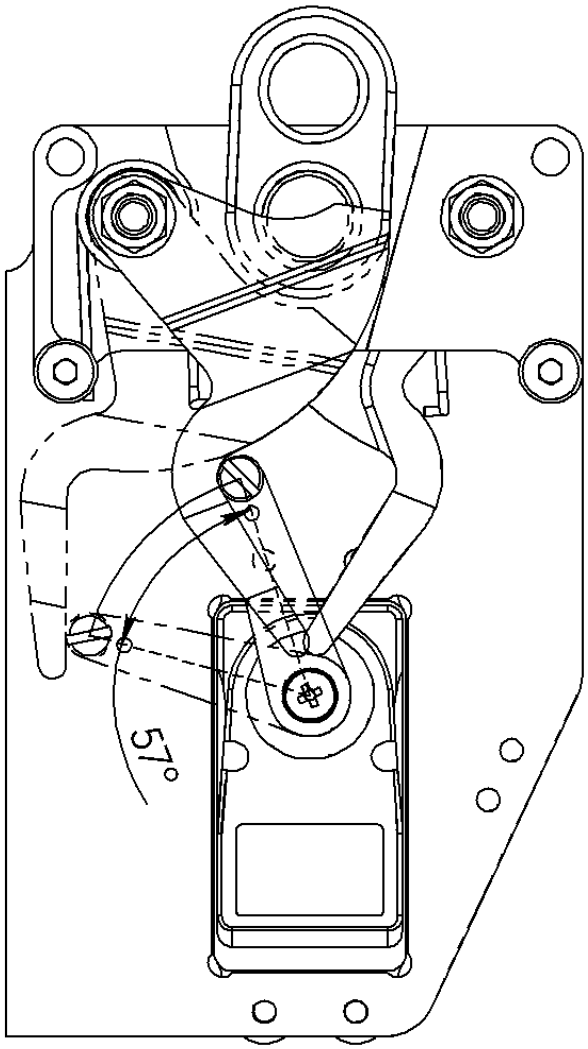


The deflection angle of the servo arm from the neutral position to the full opening of one stage is 75 degrees. The actuation speed without load is 0.15 sec.



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