

DRS-M600 Parachute manual

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Warranty will be terminated if parachute is re-packed by yourself.



1 Specification

1.1 Operational and environmental limitations

Service life (before repack required)	1 year
Maximum altitude above sea level	6000 m (19700 ft)
Maximum UAV speed	$18 \frac{m}{s}$ ($64.8 \frac{km}{h}$, 40.3 mph)
Maximum wind speed	$9 \frac{m}{s}$ ($32.4 \frac{km}{h}$, 20.1 mph)
Temperature range	-10 C° to +40 C°
Overall weight	450 g (0.99 lbs)
Maximum number of deployments	10
Minimum deployable altitude	58.90 m

Results tested at 11.50 kg take-off weight:

Average descent rate	$3.92 \frac{m}{s}$ ($14.1 \frac{km}{h}$, 8.70 mph)
Average impact energy	88.3 J (65.0 ft-lb)

Results tested at 15.50 kg take-off weight:

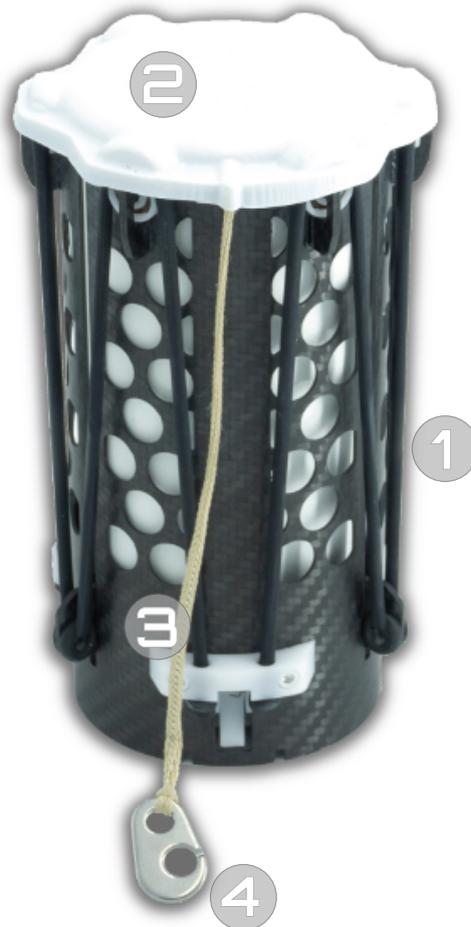
Average descent rate	$4.58 \frac{m}{s}$ ($16.5 \frac{km}{h}$, 10.2 mph)
Average impact energy	162.5 J (119.8 ft-lb)

1.2 Approved payloads

The DRS-M600 is approved for the DJI's M600 series including the professional version (M600 pro) with any additional payload as long as it is operated within the specifications provided by the manufacturer DJI.

2 Components

2.1 Deployment unit



Picture 1: Container to store and deploy the parachute

The deployment unit is shown in picture 1 and will store the parachute on the DJI Matrice M600/pro while flying. It is made out of carbon fiber composites and uses elastic rubber bands (1) to deploy the parachute automatically in case of an emergency. The parachute is stored inside the tube covered by a lid (2) at the top. Only the parachutes leash (3) and the connection hook (4) leads out of the container.

2.2 Mounting plate

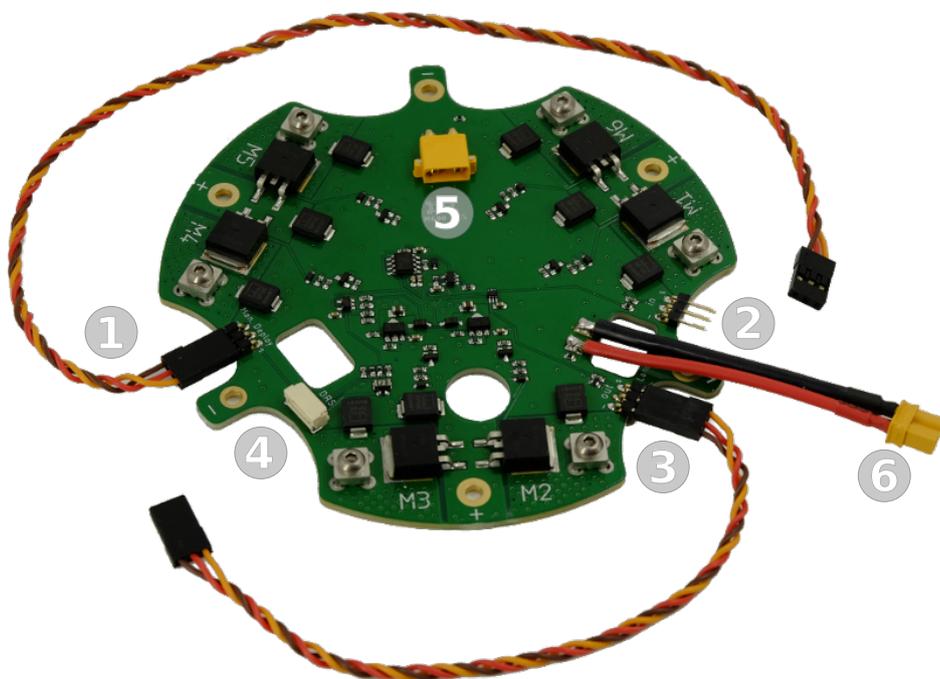


Picture 2: Mounting plate

The mounting plate is a part which has to get mounted onto the top of the DJI Matrice M600 /pro and acts as the connecting point between the deployment unit and the drone as shown in picture 2. On top of the mounting plate there is a bayonet joint ① including five golden stripes for the electrical connection between the deployment unit and the motor cut-off PCB. The wire ② coming out of the mounting plate has get passed through from top to bottom of the center plate. The connector ③ at the end of the wire needs to get plugged into the motor cut-off PCB.

The two engraved padlock symbols ④ indicate the correct open (left) and close (right) position when attaching the deployment unit.

2.3 Motor cut-off PCB



Picture 3: PCB to stop the motors from spinning

The motor cut-off PCB (Printed Circuit Board) is responsible for stopping the motors from spinning in the moment the parachute gets deployed. This safety feature reduces the risk of the parachute lines getting tangled in the propellers. The 3-pin connector on the left (1) is an input from the A3 flight-controller to deploy the parachute manually via the remote-controller from the pilot in command. This PCB also forces the landing-gear coming down after the deployment to safe the payload located underneath when touching the ground. Therefore the attached servo-cable (2) has to be connected to the servo of the landing-gear and the original cable for the landing-gear servo has to be connected to the input socket (3). The signal interface (4) has to be connected to the mounting plate and is the main interface to the deployment unit. The PCB gets power from the drone through the XT30 connector, which needs to get connected to (5). For additional payload the motor cut-off PCB provides the same connector at (6)

2.4 Parachute and accessories

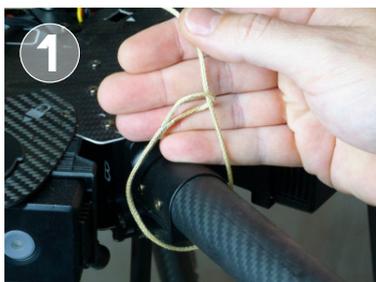


Picture 4: Deployment unit with accessories

As shown in figure 4 the parachute ① comes wrapped in a plastic cover to protect it from environment influences (secured by some rubber bands) and it is equipped with a leash. The plastic cover has to stay around the parachute canopy when getting loaded into the deployment container to secure a fast and reliable deployment. At the end of the leash is a metal hook to connect it to the UAVs frame. Also included are three additional leashes ② and an other metal hook. To store the leashes in a safe and clean way a plastic container ③ is part of the kit. This plastic container has to be placed in the middle of the drone in a way that the three cutouts point into the directions of the arms there the parachute is connected.

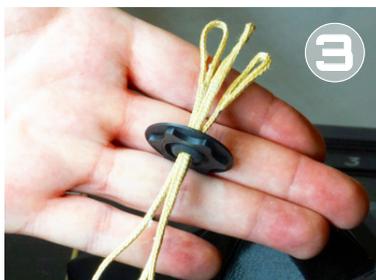
3 Installation

3.1 Connecting the parachute



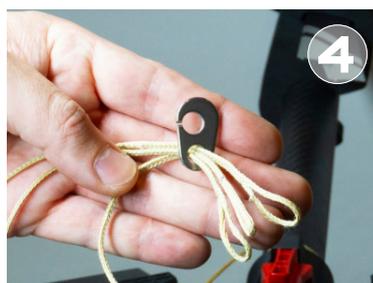
Use one parachute cord every second arm and pull it around close to the hinge. Thread one end of the cord through the other ends loop.

Tighten it well. Take care which three out of the six arms you will select depending of the location of anything mounted on top like the GPS antennas. After connecting all three arms continue with step 3.



After all cords are hooked up with the arms of the M600 pick up the small lid of the cords storage box and thread all three cords through the hole in the center.

Next step is to connect the metal hook with the three cords. First step is to loop them through the hole which doesn't have the opening.



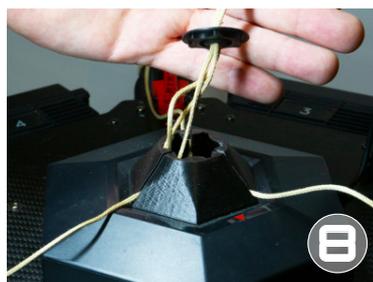
Go all the way through the hole until the three loops are close enough for the hook to go into it.

Run the hook all the way through the loops of each cord as shown in step 6.



When done the loops should get tightened to get a solid and strong knot.

Pull the hook close to the lid. At the end the push the cords into the storage container running through the slots at the side. The excess length of the cords can be placed inside the container.

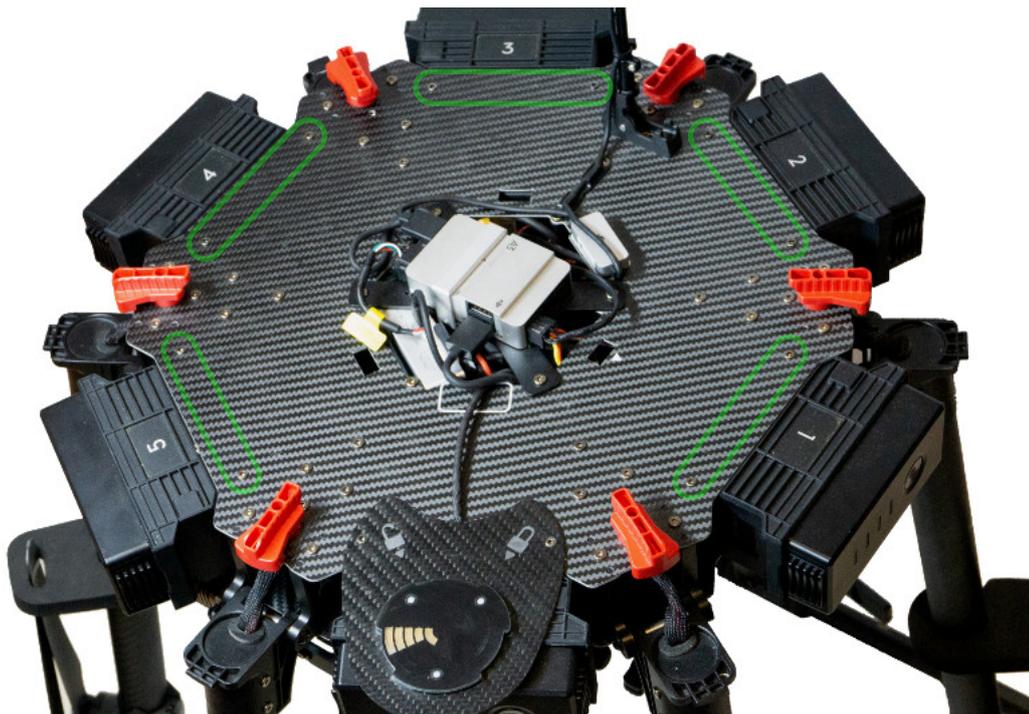


Push the lid on the plastic container to get a clean and safe installation on your M600. The finished setup should look like shown in step no. 9.

3.2 Installing the mounting plate

The installation of the mounting plate is quite straight-forward. First you need to find a position right above one of the batteries that fits best for your setup. If you are using the M600 pro version one of the position will not be available through the bigger top cover in the front. The mounting plate should be placed at a position with the greatest distance away from critical components like the GPS antennas. As shown in picture 5 the plate is mounted above battery number six because the antenna is located between battery two and three. In case of a parachute deployment the chance of ripping off the antenna gets minimized because of the positioning.

When mounting the plate you have to remove the two screws right above the battery. Place the plate above the screw-holes and put back in the screws.



Picture 5: Feasible positions for the mounting plate

After mounting the plate the signal wire coming out of the plate needs to run down to the bottom where the motor cut-off PCB will get installed.

3.3 Installing the motor cut-off PCB



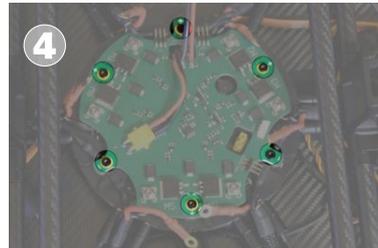
Place the DJI M600/pro in stable position upside down and move the landing gear manually up. This way you can easily access the bottom area. Unplug the XT30 socket which is powering the servo for the landing gear. Remove the bottom plastic cover.

Remove the six screws from the terminals which lock the red (positive) and black (negative) power supply cables for the motors. Only pull out the red wires while you leave the black ones at its original positions.



Place the motor cut-off PCB on the center with white arrow on the PCB pointing into the forward flight direction.

Put back in the six screws where three of them are still holding the black (negative) wires. The three other screws connect the PCB with the positive power supply terminals of the M600.

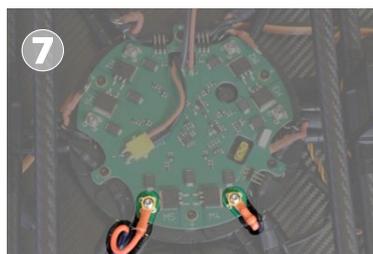


Connect the XT30 auxiliary power supply cable from the M600 to the motor cut-off PCB.



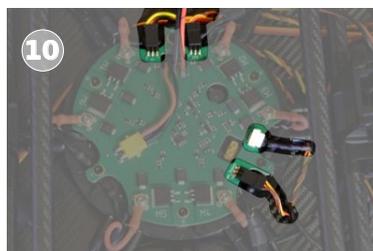
Connect the cables from motor 2 and 3 to the terminals labeled M2 and M3.

Connect the cables from motor 4 and 5 to the terminals labeled M4 and M5.



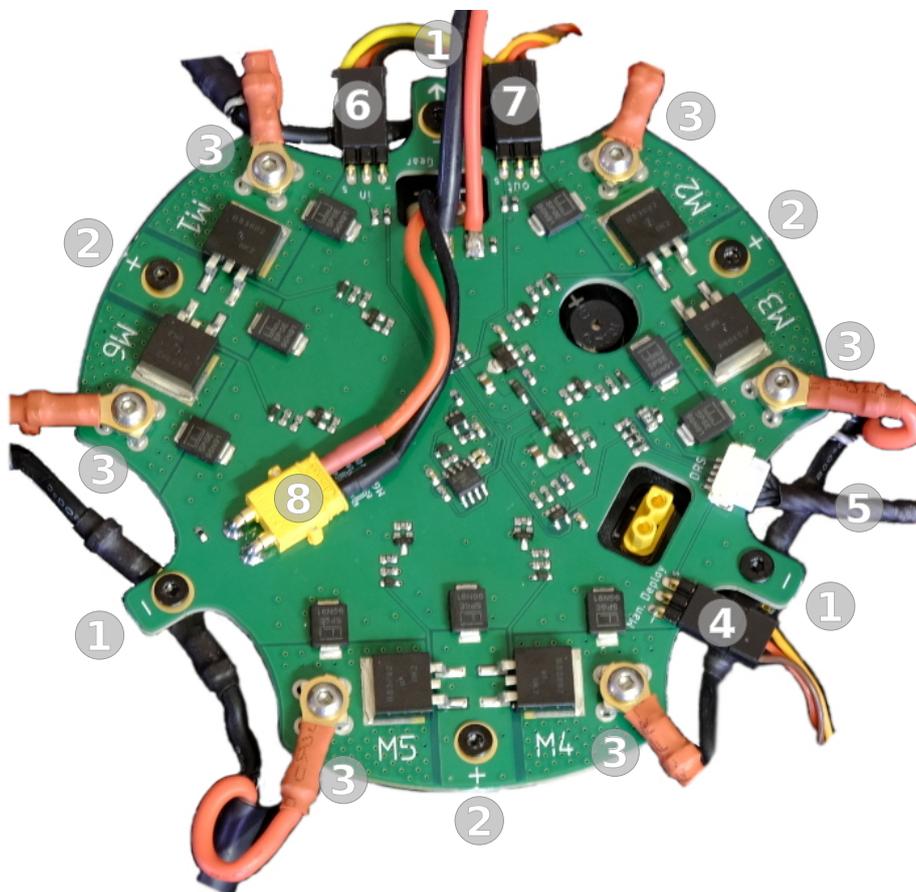
Connect the cables from motor 6 and 1 to the terminals labeled M6 and M1.

Disconnect the cable from the landing gear servo and connect it to the connector labeled with "Landing gear IN". Connect the other PWM signal cable from "Landing gear OUT" back to the landing gear servo.



Connect a PWM signal cable from the A3 flight controller (Port F3) to the connector labeled with "Man. Deploy". And connect the cable from the base-plate of the DRS unit to the corresponding socket (labeled "DRS") on the PCB.

An overall view of the motor cut-off PCB installation is shown in picture 6. ① are the ground and ② the positive power supply terminals from the M600. ③ are the positive power supply for the motors. ④ shows the PWM signal cable coming from one of the output channels of the A3 flight-controller to manual trigger the parachute. ⑤ shows the 5-pin connector coming from the mounting plate at the top. ⑦ is the PWM signal cable connected to the landing-gear servo and ⑥ is the original servo cable for the landing gear from the A3 flight-controller - now connected to the motor cut-off PCB. ⑧ is the connector for the auxiliary power supply from the M600 which is used to supply the motor cut-off PCB.

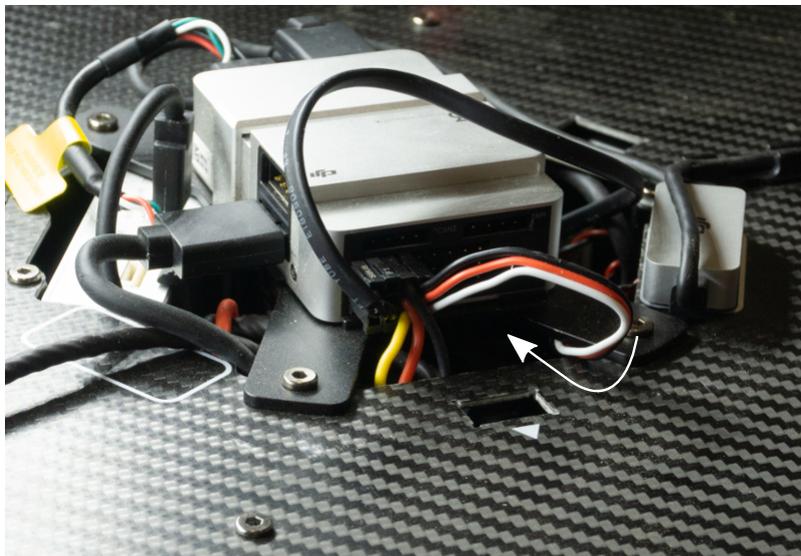


Picture 6: Overall view of the motor cut-off PCB installation

- ① Screws to connect to the negativ power supply
- ② Screws to connect to the positiv power supply
- ③ Positive power cables connected to the motors
- ④ PWM signal for manual triggering - connected to A3
- ⑤ Interface connection to DRS mounting-plate
- ⑥ PWM signal for landing gear servo
- ⑦ PWM signal connected to lending gear servo
- ⑧ XT30 Power supply from drone

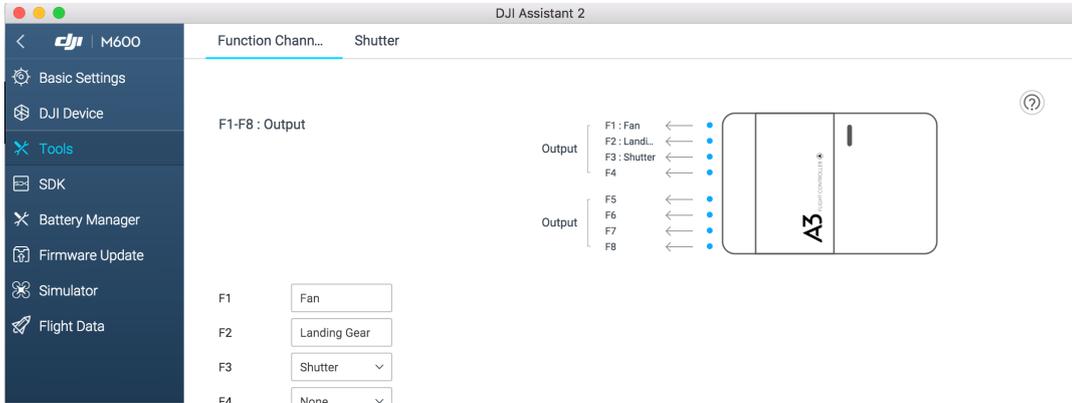
3.4 Connection to A3 Flight-controller

To manually deploy the parachute via the remote controller from the pilot in command a connection between the DJI A3 flight-controller to the motor cut-off PCB, as shown in picture 7, has to be installed. As an example the port F3 from the A3 flight-controller can be used. Therefor connect a standard PWM signal cable to this port. The cable has to get threaded from the A3 at the top to the motor cut-off PCB at the bottom. Beside the electrical installation the A3 has to get configured as well.

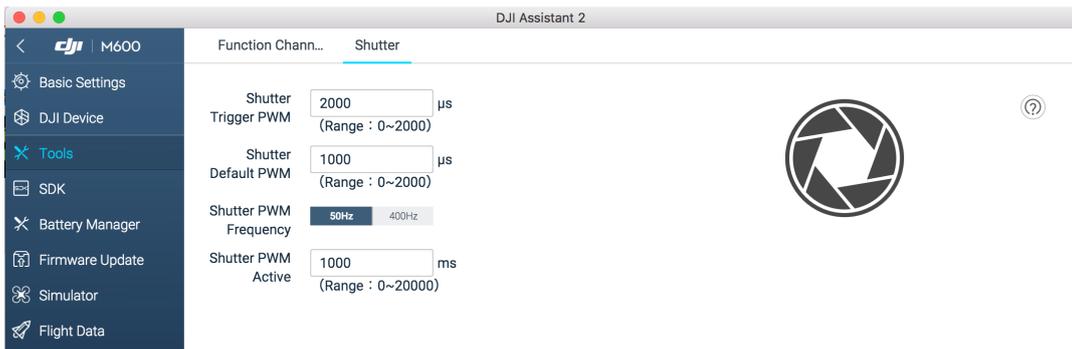


Picture 7: PWM wire to manually deploy the parachute

To enable the manual deployment via the standard DJI remote controller this feature needs to get enabled using the DJI Assistant software as shown in the pictures 8 and 9. Therefor the camera trigger feature is used to manually deploy the parachute. As shown in the pictures the output port F3 is used as the camera trigger. The PWM value of $1000\mu\text{s}$ represents the value where the parachute will not get deployed and a value of $2000\mu\text{s}$ will deploy the parachute immediately.



Picture 8: Assigning port F3 to the shutter trigger channel



Picture 9: Setting shutter default and trigger PWM value

3.5 Loading and unloading the parachute



1

First you need to open the release mechanism, which is the small shutter at the bottom. The easiest way to do so is to get underneath the shutter using your fingernail and swing it out till the stop. When open place it on a flat surface and keep the shutter in this position.

Use a solid object which fits the inner diameter of the deployment unit and is longer than the whole unit. A plastic pipe is very convenient but a small bottle of water should also work. Use it to push down gently the deployment mechanism until it reaches the bottom position. Release the shutter and slowly remove the force pushing down to feel if it get locked in its position.



2



3

Take care the shutter is fully back in, underneath the carbon fiber tubes surface. Don't try to pull it out manually because then the parachute will get deployed as well.

Remove the rubber bands from the parachute and use your fingers to pretend and accidentally opening of the plastic cover. You can only remove the one at the bottom which is closer to the spiky end and remove the other one when the parachute is half inside of the tube.



Push in the parachute covered by the plastic sheet with the spiky end first. The spikes are essential to prevent the parachute fabric from getting stuck in case of a deployment.

You should also pay attention that there is no fabric being not covered by the plastic sheet. Specially in the bottom area you should not be able to spot any parachute fabric.





Put on the lid to protect the parachute from sun light and other environmental influences. The parachute cord should lead out underneath the lid at its designated position pointing to the center of the M600.

Place the container on the mounting plate with the small pike (arrow) at the bottom pointing towards the open padlock symbol. After pushing it down a bit you should be able to twist it clock-wise until the arrow is pointing towards the closed padlock symbol - as shown in the bottom area of picture in step number eight.



At the end connect the metal hook from the parachute with the one where the three cords are connected to the M600 arms.



4 Application

4.1 Functional tests after installation

After finishing the installation of the DRS-M600 parachute rescue systems you should run some basic tests before taking-off. These tests ensure the installation was successful and all components operate properly. For these tests it is necessary to switch on the engines without actually taking off. Therefore we strongly recommend to remove the propellers to prevent any injuries.

Put the deployment container under tension as described in chapter "Loading and unloading the parachute" until you reached step number 3 - without loading the parachute into the tube. Instead you should put some dummy load (like a bottle filled with water) inside.

4.2 Visual status signal

The DRS-M600 system is equipped with a three-color RGB (Red, Green, Blue) LED (Light emitting diode) to inform the pilot about the internal system status as described in table 1.

Color	Type	Description
Blue	Flashing	System initializing.
Blue	Solid	System on, waiting for valid RC input signal.
Green	Flashing	System armed - ready for take-off. Manual deployment possible.
Green	Solid	System armed take-off detected. Automatic failure detection active.
Red	Flashing	System error.
Red	Solid	Parachute deployed.
Purple	Flashing	Firmware update in progress.

Table 1: LED status codes

If the status LED will not switch to solid green after taking off, the parachute will not get deployed in case of emergency and it is highly recommended to land the UAV and check signals between the RC-Receiver/Flightcontroller and the DRS system.

4.3 Acoustic status signal

Whenever the parachute will get deployed, the DRS system will inform the environment about the descending UAV using a loud acoustic signal. You will also hear a short beep when the take-off was detected.



4.4 Storage

If you don't use the parachute rescue system for a longer period of time we recommend to take out the parachute canopy and remove the tension from the deployment unit. Always store the system in a dry environment to prevent moisture accumulating inside of the parachute canopy which might increase the time for fully inflation in case of an deployment.

5 Firmware

The firmware is the embedded software operating on the DRS systems. It is responsible for automatic parachute deployment and is able to automatically detect the take-off and landing. The automatic parachute deployment is only active while flying and will be displayed to the pilot by a solid green LED color and a short acoustic signal. See table 1.

5.1 Updates

The DRS-M600 system is equipped with a slot to insert a micro SD memory card to store log-files as well as reading from the memory to perform firmware updates. The microSD card has to be formatted using the FAT32 file-system.

To update the firmware a file (.bin extension) will be provided from Drone Rescue Systems GmbH which has to be placed in the root directory of the micro SD card. When powering up the DRS system the file will be recognized and the update process will be performed automatically. While the updating process is running, the status LED will blink in violet color which will take about 5 to 10 seconds. After a successful update the LED will blink green. In case of any error the LED will blink red.

5.2 Configuration

The behavior of the firmware operating in the DRS parachute system is influenceable via some parameters described in table 2. The parameters can be placed in a configuration-file (ASCII text) named "config.txt" which has to be placed in the root folder on the micro SD card. Every time the DRS system boots up, this file will get processed and the values saved as the parameters will get taken into account. If the configuration-file can not get processed for any reason the LED will flash red for a short period of time after powering the DRS-M600. To set a parameter to a specific value the line has to start with the key-word "set" followed by a space, the name of the parameter you want to change, another space and the value at the end. As an example take a look at the following few lines which modify the values for the maximum banking-angle as well as the maximum sink-rate to values different from their defaults:

```
set MAX_BANK_ANGLE 45  
set MAX_SINKRATE 8
```



Parameter	Def.	Range	Unit	Description
AUTOMATIC_DISABLE	0	0 / 1	-	0 Deploy when enabled parameters exceed set value. 1 System will <u>not</u> deploy when enabled parameters exceed set value.
LOGGING_FROM_POWER_ON	1	0 / 1	-	0 Logging from takeoff until power off. 1 Logging from power on until power off.
MAX_BANK_ANGLE	55	20 - 90	deg	Deploy when roll or pitch angle exceeds set value. Set to zero to disable this feature.
MAX_SINKRATE	0	5 - 255	$\frac{m}{s}$	Deploy when vertical velocity exceeds set value. Set to zero to disable this feature.
MAX_YAWRATE	0	100 - 490	$\frac{deg}{s}$	Deploy when yaw rate exceeds set value. Set to zero to disable this feature.
MOTOR_OFF_DELAY	0	0 - 10000	ms	Delay parachute deployment for configured time. This refers to manual and automatic deployment.

Table 2: Available parameters to customize configuration

5.3 Time

The DRS-M600 is capable of naming the log-files based on the current date and timestamp. Therefor the systems time has to be set in advance. This is done once after fabrication but might be repeated if the system was not supplied with power for a very long time or you want to change it to your time-zone. In case of a time-loss this can be done via a file named "set_time.txt" which needs to be placed in the root directory of the micro SD memory card. As an example see the following content which can be used as a template:

```
#YY-MM-DD,hh:mm:ss  
19-12-02,11:36:00
```



6 Inspection

6.1 Before flight

To ensure a safe and reliable operation you should visually check the following components before each flight:

- The deployment container is fully under tension and the deployment base is at the bottom
- No visual damage to the rubber bands or any other component
- The parachute is packed in the plastic protection foil
- The parachute is fully loaded inside of the tube and no parachute fabric is protruding
- The deployment container is twisted to its locked position
- Proper connection of the parachute with the drone
- The LED indicator is blinking green and switched to solid green when airborne (around 3 meters off the ground)

6.2 After flight

After each flight it is recommended to do a short visual overall inspection to see if any part or component looks abnormal, worn out or broken. Replace damaged parts before using the DRS-M600 parachute rescue system the next time.



7 Maintenance

The DRS-M600 parachute rescue system needs to be maintained once a year which include the following steps:

- Repacking the parachute
- Replacing the plastic protection foil
- Replacing the rubber bands
- Replacing the four leashes which connect the parachute with the drone

The maintenance needs to be done by Drone Rescue Systems GmbH or an other certified partner of Drone Rescue Systems GmbH.

8 Packing the parachute



Place the parachute canopy on a flat surface and separate the cells in two parts - 6 cells on each side. The wires have to be in the middle.

Use a strip with a width of 140 mm which acts as a helping tool to fold the parachute to the correct size.



Pull the parachute fabric over the strip until the end is reached.

At the end of this folding the parachute has the shape of the strip matching the length of the deployment container.





Flip the fabric over multiple times starting at the end where no wires are. At the end you can roll the last part of the fabric to get nice tube.

Roll up the wires of the parachute using your pointing and little finger. You should start where the hook is connected and end close at the fabric.



Place the whole packet of wires into the last area of the parachutes fabric where it was rolled at the end.

Roll the plastic sheet around the parachute. This is important to prevent the parachute from getting stuck in the deployment container when getting ejected.



10



Take care the parachute is fully wrapped in the plastic foil and no fabric or wire is protruding. This is essential to preventing getting the parachute stuck when deployed.



9 Document revision

Revision	Date	Author(s)	Description
1.0	September 23, 2019	MMA, MMo	created
1.1	November 14, 2019	Manninger	New motor cut-off PCB v0.5