



Parachute Manual DRS-M600

Version 1.1-EN-Draft B

Drone Rescue Systems GmbH
Austria – Stremayrgasse 16/4
8010 Graz

www.dronerescue.com
office@dronerescue.com



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2 Disclaimer

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We recommend that you do not fly prior to purchasing liability insurance. This helps cover costs in the event that persons are hurt or property is damaged as a result of your use of DRONE RESCUE technology. In general, RC aircrafts are not covered by standard liability insurance.

Your safety is your own responsibility, including proper use of equipment and safety gear, and determining whether you have adequate skill and experience. Our products may be dangerous, unless used properly and with adequate precautions, including safety gear. Our products are not intended for use by hobbyists or non-professional users.

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

3 Introduction

The DRS-M600 is approved for the DJI 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. It provides the following advantages:

- **UAV-independent sensors**
- **Very light-weighted**
- **Easy to reuse** within minutes
- **Visual and acoustical indication signals**
- **No use of pyrotechnics/explosive components** to deploy the parachute
- **No use of compressed gas cartridges** to deploy the parachute
- **Bayonet mechanism** to simply attach and detach the whole system

This document will guide you through the system components, installation, configuration and pre-flight checks as well as possible firmware updates, storage and maintenance recommendations.

4 Components

Table 1 lists all system components. Within the document, parts are linked by their short ID e.g., [container](#) for the carbon container.

Short ID	Picture ¹	Quantity	Description
Container		1	Carbon container of the DRS system
Container Lid		1	Lid of the container
Parachute		1	Parachute (wrapped in a plastic cover secured by some rubber bands)
Parachute cord		3	Cords that link the UAV with the parachute
Hook and loop fastener		3	Long Hook and loop fastener
Hook		1	Brummel hook
Hook protection sleeve		1	Protection sleeve for the Brummel hook
Cord box		1	Cord box

¹ Depending on the actual DRS configuration, the component pictures in Table 1 may slightly differ from your system.

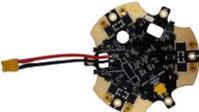
Short ID	Picture ¹	Quantity	Description
Cord box lid		1	Lid of the cord box
DRS M600 connector		1	M600 connector with mounting plate for the DRS system
Motor cut-off PCB		1	PCB which cuts the motor's power supply when the parachute is deployed
Short RC cable		1	Short signal cable for the motor cut-off PCB
Long RC cable		1	Long signal cable for the motor cut-off PCB
Connector-screw		2	2.5x10mm Torx screw (used to mount the DRS M600 connector)
PCB-screw		12	3x8mm cylinder head screws (2.5mm hexagon socket)
Flat washer		6	Flat washers (used to mount the motor cut-off PCB)
Safety washer		6	Safety washers (used to mount the motor cut-off PCB)

Table 1 System components

5 Installation

Unmount all propellers and detach all batteries and other power supplies before starting the installation!



Caution:
Mounted propellers may cause injuries or damages.



Caution:
It is mandatory to verify the correct operation with an assembly test right after the installation! See chapter 5.6 Assembly test for details.

5.1 Install the M600 connector

First, you need to install the [DRS M600 connector](#), which will carry the [container](#) later, in one of the five possible positions. There is no general rule which one to use because the arrangement of superstructural parts like GPS antennas and other equipment can vary between the different drone models. The key is to find a spot with enough space around it so that neither the [container](#) nor the attached [cords](#) will interfere with drone parts. Note that all [cords](#) will rapidly be tautened when the [parachute](#) is deployed. No drone parts should be ripped off in this case.

Each possible spot is right above a battery slot as shown in Figure 1.



Figure 1: Feasible positions for the DRS M600 connector, marked in yellow

Secondly, you need to install a communication cable which is required to allow the remote pilot in command to manually deploy the parachute via the remote controller. Therefore, a connection between the DJI A3 flight-controller and the [motor cut-off PCB](#) has to be installed. As an example the port F3 of the A3 flight-controller can be used, but you may choose another port which is appropriate for your application.

Execute the following steps to install the [DRS M600 connector](#):

- Remove both caps at the top and the bottom of the UAV.
- Choose a position to mount the [DRS M600 connector](#) and remove the two screws within the green marking (see picture below).



- Remove the protection sheet from the adhesive tape on the bottom of the [DRS M600 connector](#)
- Place the [DRS M600 connector](#) into the chosen spot and use the two [connector-screws](#) included in the DRS accessory to install it. Do not use the original screws because they are too short.
- Press the [DRS M600 connector](#) on the drone to facilitate a good adhesion.
- Install the [long RC cable](#) included in the DRS accessory from the A3 flight controller's port of your choice (e.g. port F3) through the openings in the center to the bottom of the UAV (see Figure 2 and Figure 3).

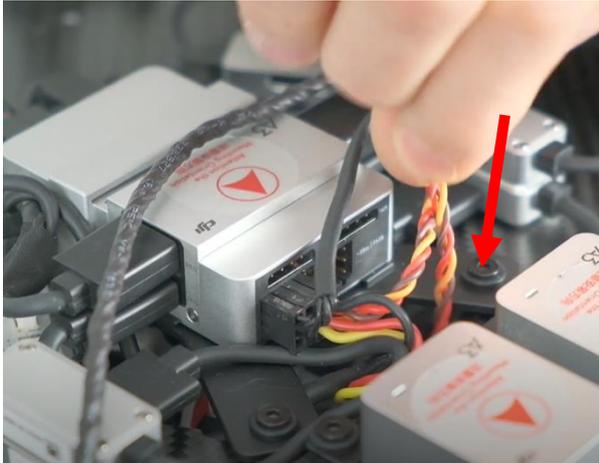


Figure 2: Long RC cable for manual deployment

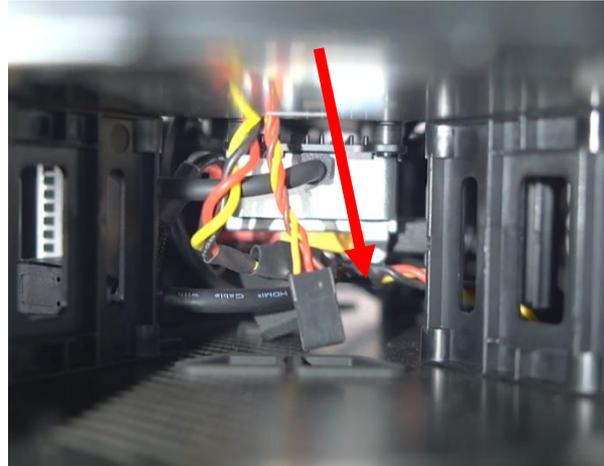
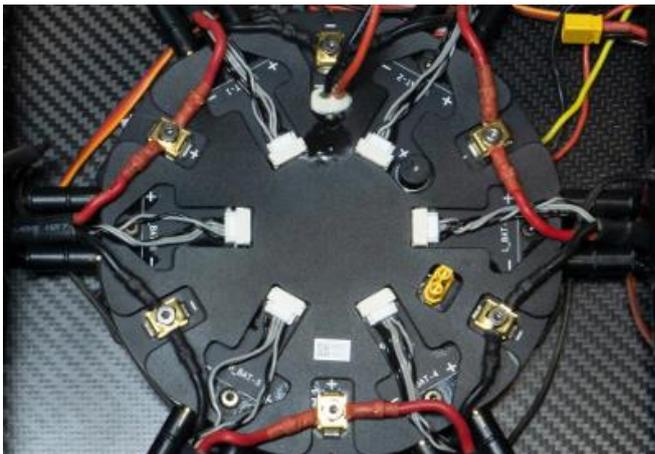


Figure 3: Thread the long RC cable all the way through the drone

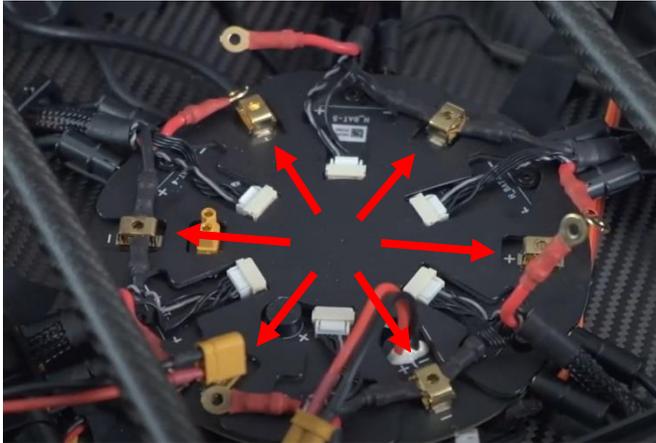
- Feed the cable of the [DRS M600 connector](#) through a nearby slit in the M600's top cap in order to prevent it from being crimped when the cap is reattached. Then feed it through the openings in the center to the bottom of the UAV.
- Reattach the top cap.

5.2 Install the motor cut-off PCB

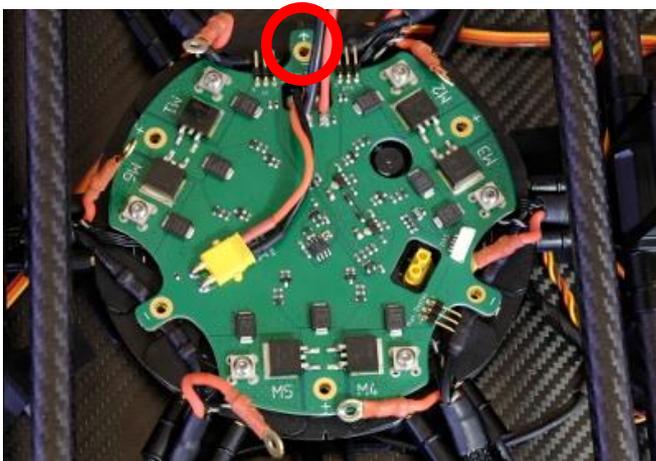
The [motor cut-off PCB](#) is installed at the UAV's bottom and is best done with the UAV flipped over. Consider how to place the UAV without breaking any equipment like GPS antennas.



Place the M600 in a stable upside-down position and move the landing gear up manually in order to easily access the bottom area. Unplug the XT30 socket which powers the landing gear's servo. Remove the bottom cap if not already done yet.

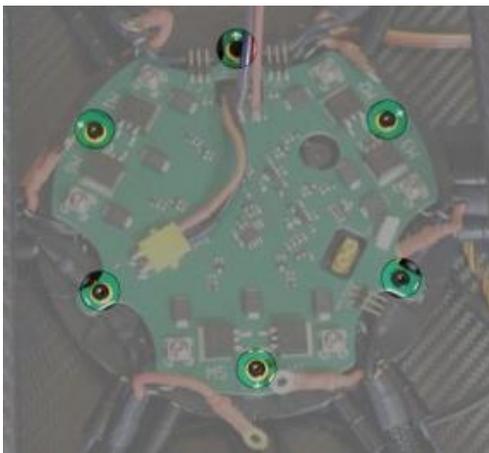


Remove the six screws from the terminals which lock the red (positive) and black (negative) power supply cables for the motors as indicated by the red arrows. Unplug only the red wires and leave the black ones at its original position.



Place the [motor cut-off PCB](#) in the center with the white arrow (next to one of the screw holes) facing into the forward flight direction. Feed the landing gear servo's power supply cable through the intended hole in the PCB when doing this. Pay attention not to crimp any cables between the [motor cut-off PCB](#) and the UAV. All six red power supply cables, the cable coming from the [DRS M600 connector](#) on the top, and the [long](#)

[RC cable](#) from the A3 flight controller need to stick out from under the PCB.



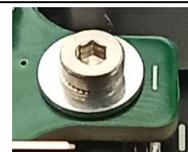
Ensure that the screw holes of the PCB and the UAV's power distribution board are aligned. Screw the PCB on and fix the black wires (negative supply) in their original positions in doing so. Use six of the [PCB-screws](#) included in the DRS accessory instead of the original screws.

Also use the delivered [flat washers](#) to prevent damages to the PCB as well as the [safety washers](#) to prevent the screws from loosening through vibrations.



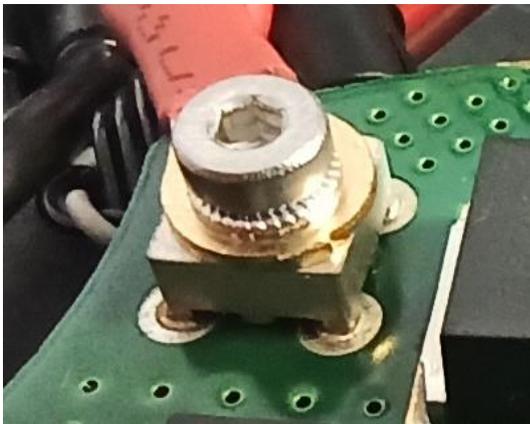
Caution:

The [safety washer](#) must be put between the cylinder head of the screw and the [flat washer](#)! Ensure a clean surface of the flat washer's bottom and the PCB.



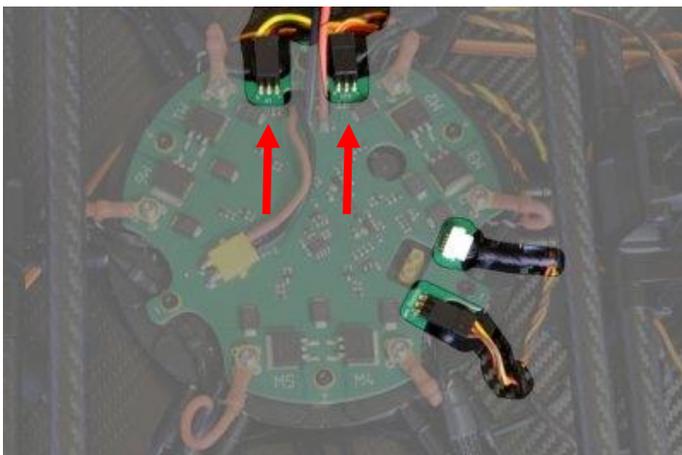


Plug the auxiliary power supply cable coming from the UAV into the motor cut-off PCB.

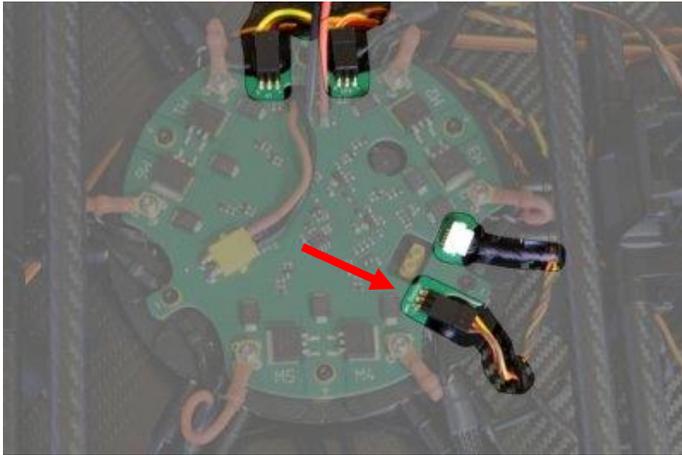


Connect the red cables to the appropriate terminals (cable from motor 1 to M1, motor 2 to M2, and so on). Use the six remaining PCB-screws and safety washers included in the DRS accessory to keep them locked even under heavy vibrations.

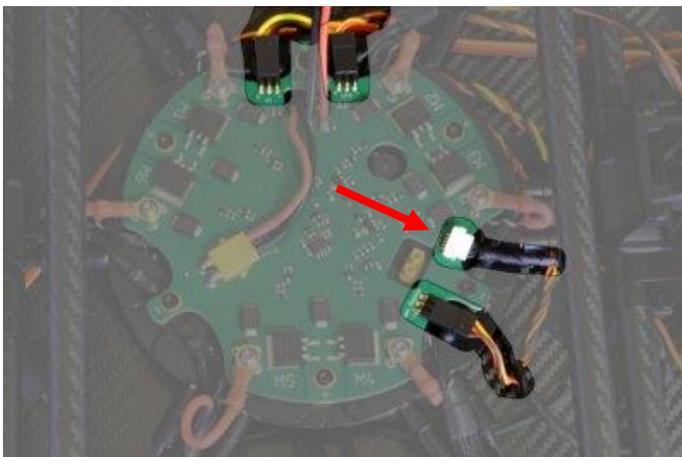
You do not need flat washers this time. Place the safety washers between the screw's head and the cable lug as shown in the picture.



Find the RC cable which is installed between the UAV and the landing gear servo. Unplug it from the servo and instead plug it into the motor cut-off PCB connector labeled with "Landing gear IN". Take the short RC cable included in the DRS accessory and wire it from the PCB's "Landing gear OUT" connector to the landing gear servo.



Take the loose end of the [long RC cable](#) which was installed in chapter 5.1 and plug it into the connector labeled with "Man. Deploy".



Take the loose end of the [DRS M600 connector's cable](#) and plug it into the corresponding socket (labeled "DRS").

Figure 4 shows the [motor cut-off PCB](#) after the installation

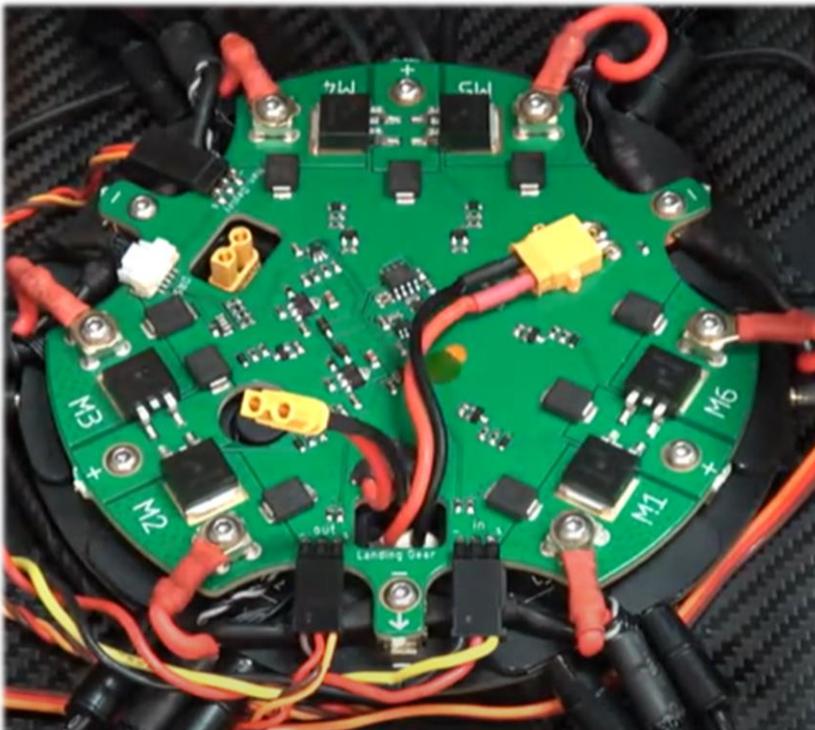
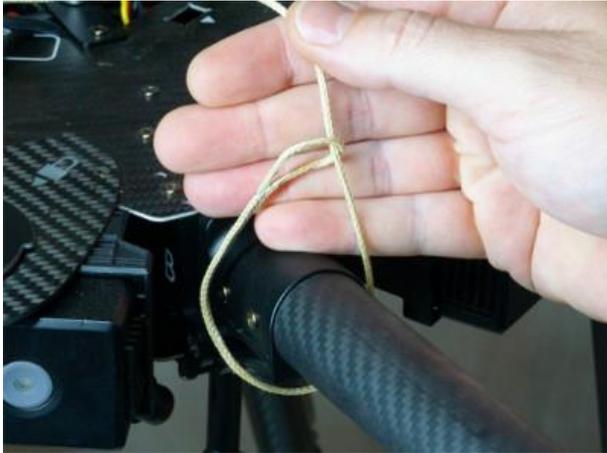


Figure 4: Overview of the installed M600 motor cut-off PCB

Finally, the landing gear's servo must be powered by the short cable with the XT30 socket which is soldered on the [motor cut-off PCB](#). Feed this cable through the bottom cap and reattach the cap. Pay attention not to crimp any cables. Connect the XT30 sockets of the landing gear's servo power supply.

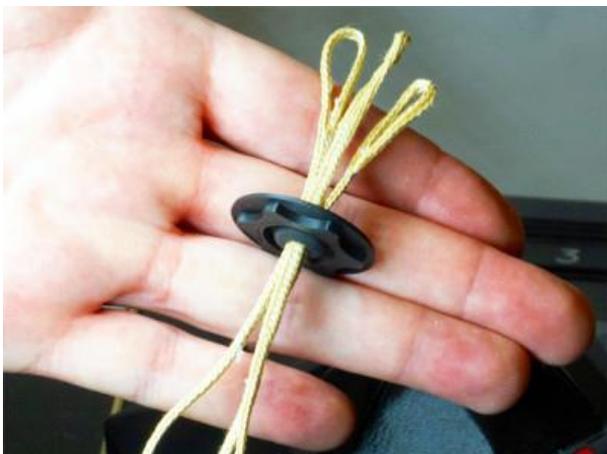
5.3 Mount the cords



Make sure the drone is in a stable upside position. Select three of the six available arms applying the same consideration as in chapter 5.1 when the spot for the [DRS M600 connector](#) was chosen. Make sure to select arms, where the [cords](#) will not interfere with mounted GPS antennas or other equipment. Mount one parachute cord to every second arm and pull it around close to the hinge. Thread one end of the cord through the other end's loop.



Put a [hook and loop fastener](#) over each [cord](#), then fasten it.



After the [cords](#) have been tied correctly to the arms of the M600, thread the ends of all three [cords](#) through the central hole in the [cord box lid](#). Then push the lid downwards.



Thread the ends of the [cords](#) through the [metal hook](#)'s small hole (without the opening).



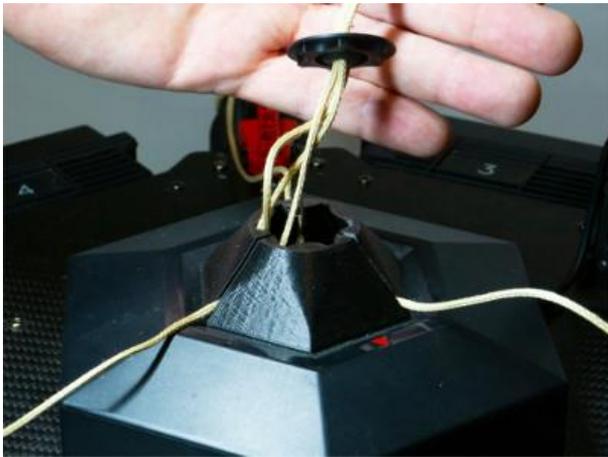
Push the [cords](#) far enough through the [metal hook](#) to wrap the loops of the cords over the hook.



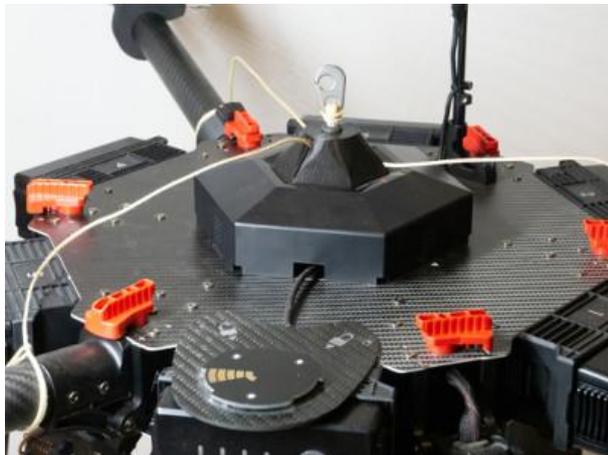
Make sure to push the [metal hook](#) through all three loops of the [cords](#).



Pull the [metal hook](#) in order to firmly tighten the knot.
Then pull the [lid](#) close to the knot.



Use the adhesive tape to affix the [cord box](#) to the center of the drone with the slots pointing to the arms with the cords. Push the [cords](#) through the slots of the [cord box](#) and stuff the remaining [cords](#) inside. Then clip the [lid](#) on to the [cord box](#).

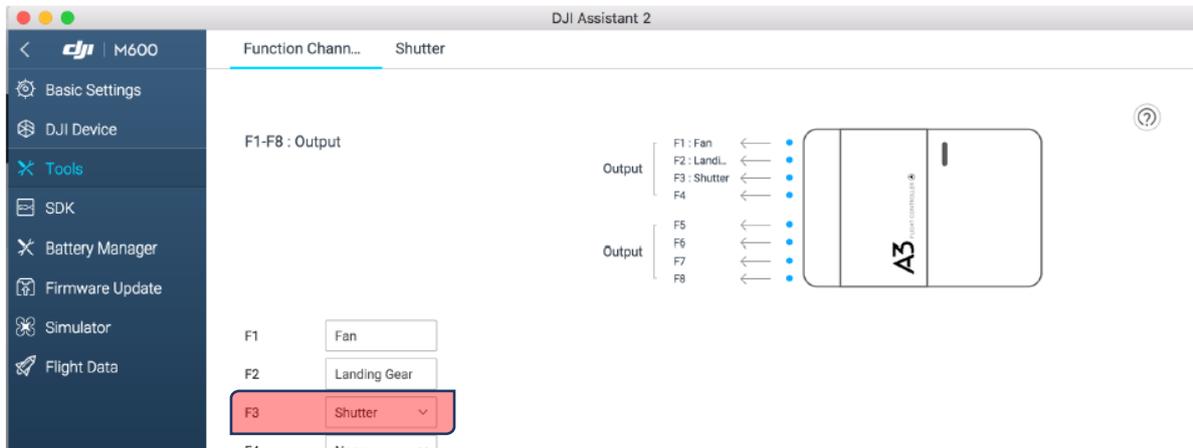


The finished setup should look like this.

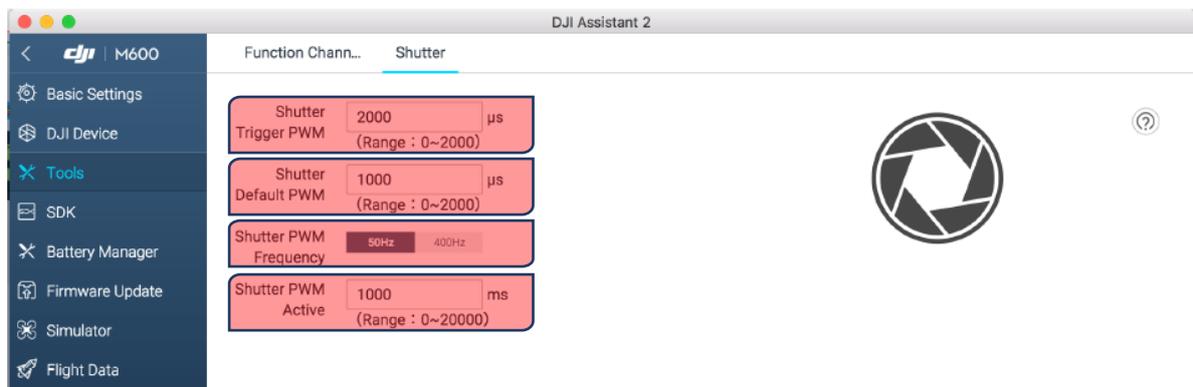
5.4 Configure the DJI M600

A PWM signal is used to deploy the parachute manually. The A3 flight controller has to be configured to generate this signal. The camera trigger on output port F3 is used here as an example, but you may choose another configuration appropriate for your application.

- Connect the M600 with a PC and use DJI Assistant 2 to configure the output (see DJI M600 user manual for details).
- In the "Tools" > "Function Channel" menu select "Shutter" as F3 output function.



- In the "Tools" > "Shutter" menu set the "Shutter Trigger PWM" value to 2000 microseconds (this is the PWM level to deploy the parachute).
- Set the "Shutter Default PWM" value to 1000 microseconds (the parachute will not deploy at this PWM level).
- Set the "Shutter PWM Frequency" to 50 Hz.
- Set the "Shutter PWM Active" to 1000 milliseconds.



5.5 DRS Configuration

The DRS System is pre-configured for DJI M600 standard use case application. Fit the configuration to your specific usage. Configuration is described in chapter 7.2.

5.6 Assembly test

Perform this assembly test right after the installation (before the first flight) and after every 50th flight to verify the proper operation of the parachute system. The intention is to test the engine shutdown and the deployment mechanism without a parachute actually being loaded in the [container](#). It is necessary to switch on the motors but keep the UAV on the ground during this test.

Carefully read this chapter to become familiar with the procedure, and execute the steps afterwards!

- Unmount the propellers

**Caution:****Mounted propellers may cause injuries or damages**

-
- Verify that all screws that fix the [DRS M600 connector](#) are pulled tight.
 - Place the UAV in an upright position in a way that the landing gear is free to move.
 - Move the landing gear up (flying position).
 - Attach the [container](#) and put it under tension as described in chapter 6.2.1. The system should be strained but not loaded with the parachute after this step.
 - Insert a dummy load into the [container](#) (e.g., an appropriate bottle filled with water).

**Caution:****Triggering (Deploying) an empty container will cause damage to the device!**

-
- Turn on the UAV and perform the usual takeoff procedure until the motors are spinning but without taking off.
 - Verify the correct status of the DRS by observing the LED and the buzzer signals. The DRS should be in the [ARMED MANUAL](#) state.
 - Prepare to catch (or at least dodge) the dummy load and trigger the manual deployment

**Caution:****The dummy load might be shot out to some extent, depending on its shape and mass. Take precautions to prevent it from causing any harm or damage!**

-
- Verify that
 - the motors have been switched off,
 - the dummy load has been deployed,
 - the landing gear has moved down to landing position,
 - the DRS's buzzer and LED indicate the [DEPLOYED](#) state.

All these conditions must be met for a positive test result.

- Turn off the UAV afterwards

Perform these checks after every 50th flight:

- Remove the bottom cap of the DJI M600.
- Verify that all cables are connected tightly.
- Verify that all 12 screws that fix the [motor cut-off PCB](#) are pulled tight.
- Verify that all 6 screws that fix the red cables on the sockets M1 to M6 are pulled tight.
- Reattach the bottom cap.

6 Flight

6.1 Pre-Flight Inspection

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

- No visual damage to the elastic rubber springs of the [container](#) or any other component.
- The screws that fix the mounting plate of the [DRS M600 connector](#) are pulled tight.
- The [container](#) is fully under tension and the deployment base is at the bottom.
- The [parachute](#) is packed in the plastic cover and the rubber bands which secure it have been removed.
- The [parachute](#) is fully loaded inside of the [container](#) and no parachute fabric is protruding.
- The [container](#) is rotated to its locked position.
- The [parachute](#) is properly linked to the drone with the cords and the [hook](#), and the link is covered with the [hook protection sleeve](#).
- The [cords](#) are stashed inside the [cord box](#) and the [cord box lid](#) is clipped onto it.
- The [container lid](#) is tightly clipped onto the top of the [container](#).

6.2 Loading and unloading the Parachute

6.2.1 Put the container under tension



First open the release mechanism of the [container](#), which is the small shutter at the bottom. The easiest way to do so is to get your fingernail underneath the shutter and lift it as far as it will go. When lifted, place the [container](#) on a flat surface and keep the shutter in this position.



Use a solid object which fits the inner diameter of the [container](#) and is longer than the whole unit. A plastic pipe is very convenient, but a small bottle of water works as well. Use it to gently push down the deployment base until it reaches the bottom position while holding the shutter. Then release the shutter and gently push it inside. Now slightly decrease the pressure on the deployment base until the shutter snaps into place.

Gently push the shutter back in place until it does not stick out of the container tube.



Caution:

In case the shutter is not fully back in place or is manually pulled out, the parachute will get deployed and might cause injuries or damages!

6.2.2 Load the Parachute



Remove the rubber bands from the [parachute](#) but keep the plastic cover shut or the parachute will unfurl.



Completely insert the [parachute](#) into the [container](#) with the jagged edge first.



Check if the parachute fabric is fully covered by the plastic cover. Pay special attention to the bottom side.



Caution:

Protruding parachute fabric at any side might impede a proper parachute deployment!

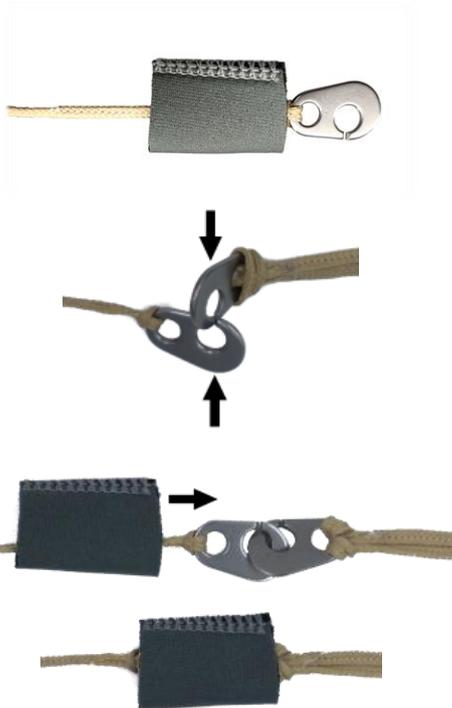


Clip on the [container lid](#) to protect the parachute from sunlight and other environmental influences. The cord of the [parachute](#) should lead out underneath the [container lid](#) at its designated position pointing to the center of the UAV when mounted.



Place the [container](#) onto the [DRS M600 connector](#) with the [small pike](#) (arrow) at the bottom pointing towards the open padlock symbol.

After pushing it down a bit, rotate it clock-wise until the arrow points towards the closed padlock symbol.



Pull the [hook protection sleeve](#) over the [hook](#) of the [parachute](#).

Fit the two hooks into each other (i. e. link the [parachute](#) to the UAV).

Afterwards slide the [hook protection sleeve](#) over both hooks.



Caution:

The protection sleeve prevents an unintentional detachment of the hooks, thus always has to be in place!

6.3 Takeoff

Observe the LED and the buzzer during takeoff and thus verify that the DRS is in the correct system state (see chapter 7.1 Device states and signals).

After initializing you must wait for the [ARMED MANUAL](#) state before you may take off. Right after the takeoff you must check if the DRS has correctly detected the takeoff. Hover the UAV above approx. 3 m over the ground for a few seconds and wait until the status LED switches its mode according to [ARMED AUTOMATIC](#) state and the buzzer beeps once. Only then the automatic failure detection is active.

**Caution:**

If the DRS does not detect the takeoff, you must land the UAV because the automatic deployment function is inactive. Switch the power off, wait 10 seconds and repeat the start procedure. If the failure persists, inform Drone Rescue Systems GmbH or it's reseller and provide the logfile for failure analysis.

6.4 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 UAV the next time.

If you don't use the parachute rescue system for a longer period of time, we recommend to take out the [parachute](#) and remove the tension from the [container](#) as described in chapter 9.

7 Device

The DRS-M600 is equipped with a micro SD memory card slot. The SD card is FAT32 formatted and is used to store logfiles, perform firmware updates, and load configuration parameters.

7.1 Device states and signals

An indication light and a buzzer are used to inform the pilot about the DRS-M600 internal system states as described in Table 2.

State	Visual Signal	Acoustic signal	Description
INITIALIZE	Breathing* Blue		System initializing.
ON	Solid Blue		System on, waiting for valid PWM input signal. Manual deployment not possible.
ARMED MANUAL	Blinking** Green		System armed - ready for take-off. Manual deployment possible.
ARMED AUTOMATIC	Solid Green	Short Beep	System armed - take-off detected. Automatic failure detection active.
ERROR	Blinking Red		System error.
DEPLOYED	Solid Red	Beeping till power off	Parachute deployed.
UPDATE	Blinking Purple		Firmware update in progress.

Table 2 Device states and indication signals

* Breathing smoothly fades the LED in and out in an interval of about 1 second.

** Blinking immediately switches the LED from off to on and vice versa.

7.2 Device Configuration

The DRS-M600 parachute system's behavior can be configured with the parameters described in Table 3. A configuration-file (ASCII text) named "config.txt" contains the parameter values. It must be placed in the root directory of the micro SD card. At boot time this file is processed and the values are stored for internal use. If the configuration-file cannot be processed for any reason, the LED flashes 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 the parameter's name and the value, all separated with a space. 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 800
```

Table 3 shows a list of available parameters.

Parameter	Def.	Range	Unit	Description
MAX_BANK_ANGLE	55	20 - 90	deg	Deploy when bank angle exceeds set value. Set to zero to disable this feature.
MAX_SINKRATE	700	500 - 2550	$\frac{cm}{s}$	Deploy when vertical velocity exceeds set value. Set to zero to disable this feature.
MAX_YAWRATE	300	100 - 490	$\frac{deg}{s}$	Deploy when yaw rate exceeds set value. Set to zero to disable this feature.
MIN_FREEFALL_ACC	300	5 - 500	$\frac{cm}{s * s}$	Deploys when the norm of the acceleration vector drops below this value. Set to zero to disable this feature.
DISABLE_POWER_BAD	0	0 / 1	-	0: deploy when a power loss is detected 1: Power loss detection is disabled
AUTOMATIC_DISABLE	0	0 / 1	-	0: Deploy when enabled parameters exceed their set value. 1: System will NOT deploy when enabled parameters exceed set value. Only manual deploy works.
LOGGING_FROM_POWER_ON	1	0 / 1	-	0: Logging from takeoff until power off. 1: Logging from power on until power off.
MOTOR_OFF_DELAY	0	0 – 10000	ms	Delay parachute deployment for configured time. This refers to manual and automatic deployment.
SERIAL_INTERFACE	0	0 - 4	-	Must be set to 0 for DRS-M600.

Table 3 Available parameters to customize configuration



Caution:

Be careful when choosing the values. Use proper values for your UAV and application. Using improper parameter values may cause the parachute to fail from deploying as well as unwanted deployments.

7.3 System Time

The DRS-M600 is capable of naming the log-files based on the current date and timestamp. Therefore, the system's 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.

To set the system time, place a file named "set_time.txt" 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
```

Lines starting with a '#' are ignored and can be used as comments.

The firmware will find and parse this file at startup, and if a valid entry is found, it sets the system time accordingly. The file will then be renamed to "set_time_ok.txt" on success or "set_time_fail.txt" if the entry cannot be parsed. This way, the user does not need to manually remove the file after setting the time.

7.4 Firmware Update

Store a file (.bin extension), provided by Drone Rescue Systems GmbH, in the root directory of the micro SD card to perform a firmware update. When the DRS powers up, the file will be found and the update process will start automatically. The status LED blinks violet during the update process which takes about 5 to 10 seconds (see 7.1 Device states and signals). After a successful update the LED blinks green for a few seconds. In case of any error the LED blinks red. The *.bin-file will be deleted after the update to prevent the system from being updated again at the next power-up.

8 Specifications

Service life (before repack required)	1 year
Maximum altitude above sea level	6000 m (19685 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	58.90m

*not including manual deployment within chapter 5.6 Assembly test.

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)

9 Storage

If you don't use the parachute rescue system for a longer period of time, we recommend to take out the [parachute](#) and remove the tension from the [container](#). Be careful not to unfold the [parachute](#) when you take it out. It is best to fix it with rubber bands. Use a solid object (e.g., pipe or water bottle), like the one you used when you loaded the parachute, to smoothly release the tension from the deployment mechanism.

Always store the [container](#) in a dry environment to prevent moisture accumulating inside of the [parachute](#) canopy because it will increase the inflation time in case of a deployment.

10 Maintenance

The parachute rescue system needs to be maintained once a year. The maintenance includes the following steps:

- Repacking the [parachute](#)
- Replacement of the [parachute's](#) plastic cover
- Replacement of the elastic rubber springs (part of the [container](#))
- Replacement of the [parachute cords](#)

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