

Description of Aircraft System:

UAV Platform

The UAV platform is based on the Maxi Joker 3 RC electric helicopter. The Maxi Joker 3 is the latest model in a long line of field tested Joker helicopters built by [Minicopter](#). Minicopter has many years of experience producing industrial standard, high quality models. What began in 2000 with the Joker 1, the first high-end 90 class electric helicopter, has evolved over the years to become one of the most popular and universal models ever developed. The Maxi Joker 3 has become the workhorse of the radio controlled aerial photography world. Being electric, the Maxi Joker 3 offers exceptionally smooth and vibration-free performance. The Maxi Joker 3 helicopter is designed for carrying payload and scale flying. Due to this nature, the components are built to extremely high tolerances as not to wear out.



Fig 1. Maxi Joker 3

The main features of the Maxi Joker 3 are:

- Extremely stable and rigid chassis
- Integrated host of Flybarless electronics in a well protected chassis.
- Compartments for components above the flight battery as well as optimum antenna position.
- Integrated battery slot for up to 12s/5000 mAh Battery
- Engine mount acts as a cooling plate for the ESC, a small buffer battery can be mounted above the esc.
- Additional freewheel clutch between main-and tail rotor
- An easy to mount and remove torque tube drive
- Easily removable tail boom for transportation and maintenance purposes
- Precision scissor linkage on the tail rotor featuring 9 bearings

- Precision swashplate with double ball raced swash holder and swash drive with 8 bearings.
- Direct CCPM linkages to the swashplate without the old push-pull linkages.
- Robust flybarless rotor damping with different hardnesses
- Rotor diameter: 2.16 m
- Weight without battery: 15-18 lbs
- Tail rotor diameter: 330 mm

Maxi Joker Assembly and Pre-Shipping Testing

Our aircraft is a variant of the Maxi Joker 3 with flybar and a torque tube driven tail. It was assembled and flight tested by [ChopperShots](#), the sole distributor of Maxi Joker 3 in the United States. Choppershots is based in Jupiter, Florida and specializes in aerial photography using remote controlled helicopters like the Maxi Joker 3. Choppershots has many years of experience in building and customizing helicopters for aerial imagery needs.

The following steps are followed during assembly and flight testing:

- Make screws are secured using loctite so that they do not come loose
- Make sure the rotor blades are tracking correctly using pitch gauges to eliminate vibration and to fly smoothly
- Test the radio range up to a 1/4 mile to make sure there is no interruption of the signal

Once assembled and all the electronics tested, the helicopter is flight tested several times. The following steps are followed during flight testing.

- Make sure the main rotor blades are tracking evenly
- Make sure the tail rotor is equal so that the helicopter does not yaw unnecessarily
- Once the helicopter is tracking correctly, do numerous flying circuits to make sure we have the correct pitch and throttle percentages. This includes forward, backward, sideward and vertical flights
- After numerous test flights, check the gear mesh of the main gear to make sure it is correct.
- Inspect the entire helicopter and check all electronic connections, and make sure all bolts and screws are tight.

Once the helicopter is found airworthy after rigorous flight testing, it is made ready for shipping.

Primary Flight Control System (PFCS)

[Adaptive Flight FCS20](#) autopilot is the primary flight control system. The FCS20 Flight Control System is designed to enable advanced behavior in small UAVs. The FCS20 systems has been integrated into a wide range of vehicles and proven itself as a reliable and highly capable flight control solution



Fig 2. The avionics box housing the FCS20 and camera system

The system comprises an avionics unit on-board the aircraft and a ground control station (GCS). The system allows manual flight control, via an R/C-style control unit, through the autopilot's 900 MHz spread-spectrum link. The system also enables the UAV to navigate GPS waypoints while providing the GCS operator real-time motion telemetry. The unit includes 3-axis gyros and accelerometers to provide measurements of tilt attitude and angular rate. Differential GPS (DGPS) hardware provides position and course angle measurements. A static pressure sensor provides barometric altitude and a pitot-static pressure sensor provides airspeed. A magnetometer module provides magnetic heading (in addition to the DGPS heading measurement).

Safety Pilot for Increased Safety

The primary control system is the FCS20 autopilot, which provides control through a 900MHz link. The secondary control system, the backup R/C receiver, operates on a 72 MHz R/C channel. The 72 MHz receiver has a dedicated channel that allows the safety pilot to switch from 900MHz to 72MHz control at any time. This is achieved via **RxMUX**, a servo control signal multiplexer which permits the integration of a redundant, manual flight control system. The RxMUX takes signal inputs from two sources inputs (in our case, the 900 MHz and 72 MHz) and selects one set of signals according to the state of a binary switch.

Fully Autonomous Capability

The Maxi Joker 3 UAV is capable of autonomous operation – an entire mission, including auto take-off, can be flown without a human. However, during any flight operation, the safety pilot shall always have the manual control device in hand, in case the safety pilot detects the need to take manual control. Landings are done manually by the safety pilot.

Maintenance

Basic maintenance, pre- and post-flight checks, and assembly/disassembly will be performed by qualified UCONN personnel. We will follow a maintenance schedule for the Maxi Joker 3 and keep a log. UCONN has a comprehensive inventory of kits, tools and supplies needed for repair and maintenance of Maxi Joker 3.