ACCIDENT

Aircraft Type and Registration:	DJI Matrice 210 RTK (UAS, registration n/a)
No & Type of Engines:	4 electric motors
Year of Manufacture:	2018 (Serial no: 0N4DF6L021005)
Date & Time (UTC):	20 October 2018 at 1340 hrs
Location:	Manchester Piccadilly Gardens
Type of Flight:	Emergency services operations
Persons on Board:	Crew - N/A Passengers - N/A
Injuries:	Crew - N/A Passengers - N/A
Nature of Damage:	Extensive damage to the airframe, batteries and cameras
Commander's Licence:	N/A
Commander's Age:	44 years
Commander's Flying Experience:	19 hours (of which 1 was on type) Last 90 days - 14 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The operator deployed the DJI Matrice 210 RTK unmanned aircraft system in the City Centre of Manchester. Whilst the aircraft was in a static hover at 260 ft above the takeoff point with an estimated remaining flight time of 12 minutes and 9 seconds displayed on the controller, the aircraft suddenly descended and slewed sideways uncontrollably. It hit the ground causing extensive damage to the airframe, batteries and cameras. No persons or other property were hit by the aircraft.

Analysis confirmed that one of the batteries was indicating an erroneously high state of charge (SOC) and the aircraft had initiated automatic landing due to critically low battery voltage. It subsequently lost all power less than 2.5 seconds later, which resulted in an uncontrolled descent followed by impact with the ground.

The cause of the erroneously high SOC is discussed in the report on the accident to DJI Matrice 210 on 4 September 2018 (ref EW/G2018/09/04, AAIB Bulletin 11/2019).

History of the flight

On 20 October 2018, the operator deployed to Manchester City Centre to operate a series of flights above the rooftops, using the Matrice 210 RTK. The weather at the time was dry, with a wind speed of about 5 kt, and visibility in excess of 10 km. The takeoff mass

was 6.14 kg. During the series of flights, the pilot landed the aircraft and changed out the batteries for a fresh pair of fully-charged TB55 batteries and, on carrying out the pre-flight check, the pilot did not receive any error messages; the voltage displayed by the DJI Pilot app on the tablet computer linked to the remote controller (RC) at start-up for the accident flight was 26.0 VDC, with an estimated flight time of 29 minutes.

Figure 1

Plot of flight path of the flight

The accident flight started at 1325 hrs. The pilot was operating the aircraft up to heights of 79.2 m (260 ft) above the takeoff point. At 1340 hrs, while the aircraft was in a static hover at a height of about 168 ft (51.2 m) above the takeoff point, it started suddenly to descend and slew uncontrollably sideways, and hit the ground. The pilot briefly noticed the solid green battery indicator switch to flashing red; the observer noticed a BATTERY SYSTEM ERROR which flashed up on the RC. At the time of the sudden descent, the RC indicated that the battery voltage was 21.9 VDC with an estimated flight time remaining of 12 minutes and 9 seconds. The airframe and batteries, as well as both cameras incurred extensive damage. The aircraft did not hit any other persons or property on impact.

The operator sent the damaged aircraft, batteries and cameras to the manufacturer for repairs and analysis of the recorded on-board data.

Recorded information

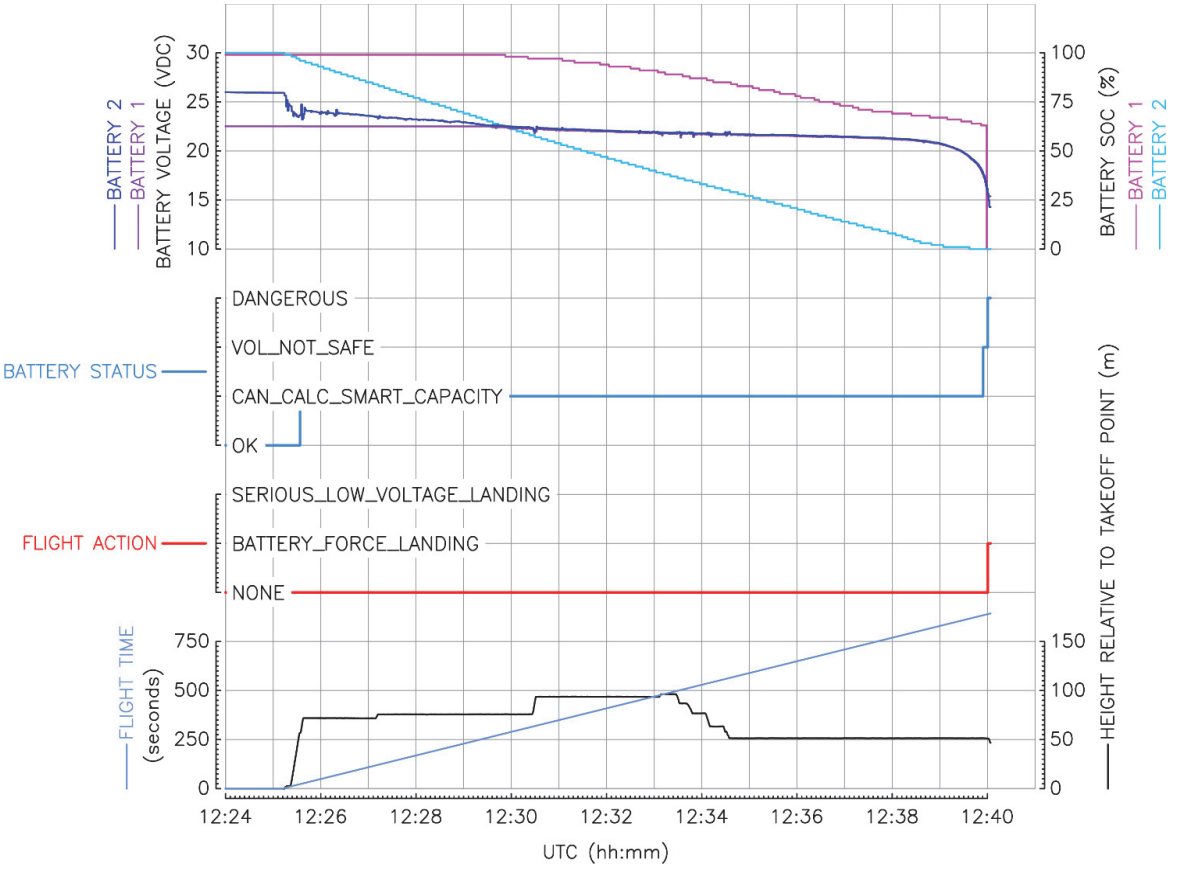

Figure 2

Plot of salient recorded data for the flight

The initial analysis by the manufacturer confirmed that the battery firmware was the latest version (v01.00.00.71). The log file from the aircraft recorded the battery voltages at the start of the flight as 22.5 VDC for battery 1 and 26.0 VDC for battery 2, yet, the SOC was 99% for battery 1 and 100%[1] for battery 2. Once airborne, the aircraft only drew current from battery 2 until the voltage matched that of battery 1; both batteries then discharged uniformly (Figure 2).

9.5 seconds before the end of the data, both batteries had a recorded voltage of 17.6 VDC. However, battery 1 had an SOC of 68% and battery 2 had an SOC of 0%. Seven seconds later, when battery 1 was fully discharged with an SOC recorded of 0% at 15.4 VDC, the aircraft initiated an automatic landing while at a height of 51.2 m (168 ft) above the take-off point.

The end of data, at 1240:03 hrs, with the aircraft at a height of 46.7 m (153 ft) above the takeoff point, marks the time at which the aircraft lost all power and it descended uncontrollably to the point of impact.

Footnote

[1] Battery SOC of 100% is normally associated with a battery voltage of 26.3 VDC.

Analysis

The manufacturer's initial analysis confirmed that the battery firmware was the latest version v01.00.00.71; it concluded that the aircraft had initiated landing automatically '*due to critically low voltage'* and the subsequent uncontrolled descent, which resulted in impact with the ground, occurred once the aircraft had lost all power. The manufacturer identified that the firmware of one of the batteries was reporting an erroneously high SOC for the voltage. The cause of the erroneous SOC is discussed in the report on the accident to DJI Matrice 210 on 4 September 2018 (ref EW/G2018/09/04, AAIB Bulletin 11/2019).