

SERIOUS INCIDENT

Aircraft Type and Registration:	Tekever AR5 Evolution Mk 2, G-TEKV	
No & Type of Engines:	2 3W 2-stroke piston engines	
Year of Manufacture:	2019 (Serial no: E505)	
Date & Time (UTC):	17 January 2023 at 1346 hrs	
Location:	Temporary Danger Area EG D098, over English Channel	
Type of Flight:	Commercial operations (UAS)	
Persons on Board:	Crew - None	Passengers - None
Injuries:	Crew - N/A	Passengers - N/A
Nature of Damage:	None	
Commander's Licence:	Other	
Commander's Age:	31 years	
Commander's Flying Experience:	254 hours (of which 125 were on type) Last 90 days - 38 hours Last 28 days - 5 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

The unmanned aircraft encountered a loss of the communications link due to a fault in the Satcom antenna, such that it was not under the direct control of the remote pilot for a period of several minutes. In accordance with contingency procedures, the aircraft entered a holding pattern and the communications link was subsequently re-established. The remainder of the flight proceeded without incident.

As a result of this serious incident, the operator indicated that future variants of the aircraft will be equipped with a feature that automatically enables Satcom backup when fewer than two communications links are available.

History of the flight

The unmanned aircraft, G-TEKV, had taken off at 0538 hrs and was conducting a flight in Temporary Danger Area (TDA) EG D098 over the English Channel, in support of UK Border Force operations. Flight operations were conducted from a Ground Control Station (GCS) where the crew control the aircraft and operate the payload.

The aircraft was equipped with Satcom to enable Beyond Radio Line of Sight (BRLOS) operations. Satcom was selected as the primary command and control (C2) link, with a Satcom backup on standby. At approximately 1346 hrs the Satcom link dropped out. The

aircraft's Return to Home (RTH) flight mode activated and it followed a pre-defined lost link route, remaining within the TDA.

At approximately 1348 hrs the Satcom backup channel went from standby to online and the C2 link with the aircraft was regained. The remote pilot (RP) flew the aircraft closer to the home location to re-establish Radio Line of Sight (RLOS) in order to gain an additional communications link. The RP carried out the procedures for losing Satcom, including resetting the Satcom page on the GCS. Once the aircraft was within range, additional communication links were established using RLOS and 4G. At approximately 1416 hrs the primary Satcom link was re-established. The remainder of the flight was conducted as planned and the aircraft landed uneventfully at 1521 hrs.

Aircraft information

System description

The Tekever AR5 Evolution UAS (AR5) consists of a manned GCS and an unmanned aircraft (Figure 1). The aircraft has a maximum takeoff mass of 180 kg¹, a wingspan of 7.29 m, a length of 4.03 m and is powered by two 170 cc two-stroke boxer engines. It has an endurance of up to 12 hours.



Figure 1
Tekever AR5 Evolution

G-TEKV was manufactured and operated by the same organisation and, for this report, is referred to as the operator.

Footnote

¹ G-TEKV's maximum takeoff mass is limited to 165 kg by the operator's CAA Operational Authorisation.

Communications links

Depending on the range at which the aircraft is operating, command and control of the aircraft is achieved through the use of RLOS and BRLOS communication data links. The system has six data links in total, five of which carry primary and secondary RLOS and BRLOS capability. Depending on the phase of flight, multiple communication links may be simultaneously active.

The RLOS control system operates in one frequency band and has a maximum range of 3 km, the backup RLOS system operates at a different frequency and has a range of 4 km. For BRLOS the system uses 4G and Satcom channels to maintain communication with the aircraft. Satcom is a satellite communication system. The primary Satcom channel allows C2, telemetry and video data exchange with the GCS; the Satcom backup channel, which has a different service provider, prioritises the C2 function but cannot transmit data.

In the event of a loss of the C2 link, the aircraft can remain in a holding pattern to try and reestablish communications. If, after a defined period, the aircraft has not regained the link, it can automatically return to a designated safe location by following a pre-determined 'rally route' included in the flight plan. The pre-defined route is established by the operator prior to takeoff, in coordination with ATC, to avoid conflict with other traffic and can be changed in flight to account for changing variables such as weather or other traffic. Once the aircraft re-enters RLOS range the C2 link is re-established via the RLOS channels. In the event of a total loss of communication the aircraft can perform an automatic landing.

Operator and Satcom service provider's investigation

The operator reported the occurrence and sent the log files to the Satcom service provider for analysis. There were no pre-notified periods of planned maintenance or degradation to the satellite service which could have accounted for the Satcom dropout.

The analysis indicated that the Satcom terminal had appeared to perform as expected during the flight between 0558 hrs and 1346 hrs. At 1346 hrs the Satcom terminal logged out due to TRANSMIT BLOCK UPCONVERTER (TXB) faults reported to the antenna control unit from the antenna.

The Satcom service provider indicated that possible causes of TXB faults include excessive antenna temperature or the loss of a 10 MHz reference signal on a cable that runs between the antenna transmit interface and the satellite modem. Antenna temperatures were confirmed to have been well within the operating specifications and replacement of the cable did not solve the issue, with further TXB faults generated during subsequent ground testing. The Satcom antenna was therefore replaced.

A Satcom data analysis was conducted by the Satcom service provider following a flight by G-TEKV on 6 March 2023 and no faults were recorded. The operator monitored the Satcom data over five subsequent flights and no further Satcom dropouts occurred.

While its exact nature had not been determined at the time of publication of this report, a fault with the Satcom antenna was identified as the cause of the Satcom dropout.

Organisational information and Operational Authorisation

The aircraft was operating under a CAA Operational Authorisation for Beyond Visual Line of Sight (BVLOS) unmanned aircraft operations in the Specific category. A condition stated in the Operational Authorisation is that the UA must be equipped with a mechanism that will cause it to land in the event of a disruption to, or failure of, any of its control systems, including the C2 link.

The operator had submitted an Operational Safety Case (OSC) to the CAA to support its application for the Operational Authorisation. The OSC contained a risk assessment which identified the hazard 'Loss of C2 link', with the associated safety risk of 'mid-air collision'. The mitigations identified for a loss of C2 link included crew training and procedures associated with a loss of data link, the redundancy offered by multiple independent C2 channels, the fitment of a Mode S ADS-B transponder and the aircraft's automatic RTH flight mode.

Analysis

A fault with the Satcom antenna resulted in a temporary Satcom dropout which caused a loss of the CA link between the GCS and UA. For a period of several minutes, the aircraft was not under the direct control of the RP. During this time the automatic RTH flight mode activated and the UA flew a holding pattern. The UA subsequently acquired the Satcom backup, such that the C2 link was re-established. This enabled the RP to fly the aircraft to within RLOS range, to gain an additional C2 channel. The remainder of the flight proceeded without event, and the primary Satcom link was subsequently re-established.

Loss of the C2 link had been documented as a hazard that in the operator's risk assessment and technical and procedural mitigations were in place to ensure the UA would avoid conflict with other airspace users. The UA behaved as anticipated during the loss of link, in accordance with the identified mitigations and in compliance with the conditions of its Operational Authorisation.

Safety action

As a result of this occurrence, the operator indicated that all future variants of the Tekever AR5 will be equipped with a feature that automatically enables Satcom backup when fewer than two C2 links are available. It considered that this change will further mitigate the hazard associated with loss of the C2 link.

Conclusion

A fault in the Satcom antenna led the UA to encounter a temporary loss of the command and control communications link. Contingency procedures and redundancy within the UA's communications meant that the communications link was re-established and the flight proceeded without further incident.