



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

January 31, 2024

### **Group Chairman's Factual Report**

# **SYSTEMS**

DCA23FA149

## **A. INCIDENT**

Location: Austin, TX  
Date: February 4, 2023  
Time: 0640 CST  
Airplane: Federal Express 767-32LF, FDX1432  
Airplane: Southwest Airlines 737-79P, SWA708

## **B. SYSTEMS GROUP**

|                |  |
|----------------|--|
| Group Chairman | Adam Huray<br>NTSB<br>Washington, DC             |
| Group Member   | Charles "Andy" Olvis<br>FAA<br>Washington, DC    |
| Group Member   | Jay Eller<br>Honeywell<br>Phoenix, AZ            |
| Group Member   | Ronald Scott<br>ACSS<br>Phoenix, AZ              |
| Group Member   | Scott Reeves<br>Federal Express<br>Memphis, TN   |
| Group Member   | Erin Carroll<br>Southwest Airlines<br>Dallas, TX |

## **C. SUMMARY**

On February 4, 2023, at about 0640 central standard time (CST), Federal Express flight 1432 (FDX1432), a Boeing 767-32LF, and Southwest Airlines flight 708 (SWA708), a Boeing 737-79P, were involved in a runway incursion with overflight that resulted in a loss of separation at the Austin-Bergstrom International Airport (AUS), Austin, Texas.

The Traffic Alert & Collision Avoidance System (TCAS) units for the two airplanes were removed and shipped to the manufacturers for examination of the

recorded data. On February 28, 2023, representatives downloaded the data from the Honeywell TCAS unit from the Southwest Airlines airplane. In March, Honeywell also performed a simulation for the Southwest Airlines TCAS unit. On March 7, 2023, representatives downloaded the data from the Aviation Communication and Surveillance Systems (ACSS, an L3 Harris & Thales Company) TCAS unit from the Federal Express airplane. The following summarizes those activities.

## **D. DETAILS OF THE INVESTIGATION**

TCAS is a family of airborne devices that function independently of the ground-based air traffic control system and provide collision avoidance protection for a broad spectrum of aircraft types. The TCAS units installed in both of the event airplanes were TCAS II Version 7.1 and met the requirements of FAA Technical Standard Order TSO-C119c. TCAS II units can provide traffic advisories (TAs) to assist the pilot in the visual acquisition of intruder aircraft and can also provide resolution advisories (RAs), i.e., recommended escape maneuvers, in the vertical dimension to either increase or maintain the existing vertical separation between aircraft.<sup>1</sup> Some TCAS features are purposefully inhibited if one or both aircraft are near to or on the ground, as described in later sections of this report.

### **1.0 Examination of the Southwest Airlines TCAS**

On February 28, 2023, representatives from the NTSB, FAA, Southwest Airlines, and Honeywell participated in a download of the non-volatile memory (NVM) of the TCAS computer which was installed on the Southwest Airlines Boeing 737-79P, registration N7827A, at the time of the incident.

The data plate on the unit identified it as the following:

- Model: TPA-100B
- Part Number: 940-0351-001
- Serial Number: TPA09458
- DMF: 042016 (Date of Manufacture April 20, 2016)
- Modifications Applied: 1-8, 11-13

The NVM data was successfully downloaded. The data was subsequently filtered to show only those alerts related to the Mode-S ID for the Federal Express B767, N297FE, as follows:

- Octal: 5060 7775
- 24-Bit: 101 000 110 000 111 111 111 101
- Hex: A30FFD

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<sup>1</sup> This systems description for TCAS was taken from the FAA booklet titled "Introduction to TCAS II Version 7.1", published February 28, 2011.

There was a single TA against the Federal Express airplane, but there were no RAs. The details of the TA associated with Mode-S ID A30FFD, were as follows:

- Own Altitude (feet) = 38.6ft: This indicates Southwest N7827A was at a barometric altitude of 38.6ft when the TA was triggered.
- Own Altitude Rate (feet/min) = 15.0 ft/min: This value is within the range of data error and does not indicate a climb.
- No Descent = TRUE: This indicates the TCAS was determining that Southwest N7827A should not descend. Note this is not a RA. This is simply the TCAS determining that the ownship should not descend which might become an RA eventually. The Minimum Operational Performance Standards requires this reporting for possible display information of intruders.
- TA Intruder Count = 1: This indicates the TCAS was only identifying 1 intruder when the TA was triggered.
- Range (nm) = 0.861 nm: This indicates the TCAS was calculating a distance of 0.861 nautical miles to the intruder when the TA was triggered.
- Relative Altitude (feet) = -332ft: This indicates the TCAS was calculating that Southwest N7827A was 332 feet below the intruder when the TA was triggered.
- Relative Altitude Rate (ft/min) = 882 ft/min: This indicates the TCAS was calculating the two aircraft were closing their vertical altitude between them at a rate of 882 ft/min when the TA was triggered.
- Bearing (deg) = -178 degrees: This indicates the TCAS had calculated that the intruder was at a bearing of -178 degrees to Southwest N7827A (behind the aircraft and slightly to the left). The bearing is between 0 to 180 degrees (from the nose of the aircraft, pointing forward) and around to the right is positive while around to the left is negative. As such, -178 degrees is around to the left 178 degrees which puts the intruder behind and 2 degrees off their left "shoulder".

## **2.0 Honeywell TCAS Simulation**

Honeywell performed a TCAS simulation in March 2023 using flight data recorder information provided by the NTSB. The simulation was performed with the "ownship" being that of N7827A (SWA) aircraft while the "intruder" is N297FE (FDX). The FDR data provided by the NTSB was input into a TCAS II simulation model derived from Honeywell's production software/hardware used in N7827A (SWA's) TCAS II unit. Honeywell's TCAS II product is defined by and certified to DO-185B. Positions obtained from the FDR data are transferred into the ownship (SWA) data (barometric and radio altitude, heading) and intruder (FDX) data (slant range, bearing, baro altitude). These two data files are inputs to the TCAS simulation while the outputs are relative to the "ownship" (N7827A, SWA). Simulation steps of 0.25 seconds corresponding to the data provided by the NTSB was used. No

interpolation was applied between the data points. Honeywell's simulation, having been generated from the functional software of the certified product, is thereby representative of certified unit behavior.

## **2.1 Summary of Honeywell Simulation Results**

The simulation showed that the two aircraft likely came within 216ft (direct line of sight) of one another at their closest point. In addition, a TA, without aural alerting, would have been issued within the flight deck of N7827A (SWA) at approximately time 24001.75s (estimated to be 06:40:01.75 AM local time) while the intruder was approximately 6400 feet behind and 400ft above N7827A (SWA).<sup>2</sup> In addition, N297FE (FDX) likely entered the Near Mid-Air Collision (NMAC) zone of N7827A (SWA) at approximately time 24032.75s, as defined by DO-185B. A NMAC is defined in DO-185B as two aircraft simultaneously coming within 100 ft vertically and 500 ft horizontally. However, because SWA708 and FDX1432 were both below 1000 ft AGL, there would be no RAs expected.

## **3.0 Examination of the Federal Express TCAS**

On March 7, 2023, representatives from the NTSB, FAA, Federal Express, and ACSS participated in a download of the NVM of the TCAS computer, which was installed on the FedEx Airplane, registration FDX1432, at the time of the incident.

The data plate on the unit identified it as the following:

- Model: TCAS3000SP
- Part Number: 9003500-10905
- Serial Number: TSE02856

The unit was connected to the test station and the data file was downloaded. The recorded TCAS event data was analyzed, and the Mode S ID for the Southwest aircraft was not recorded in the event data. According to ACSS, the absence of event data related to SWA708 could indicate that no advisories (either Traffic Advisories or Resolution Advisories) were generated, or that more recent events had filled the memory and overwritten the data from the subject event. While there is no date or time stamp in the recorded data, review of the recorded events revealed that the log was populated with approximately four hours of active TA alerts from the same intruder aircraft (not SWA708), consistent with TA alerts occurring while aircraft are in test on the ground at an airport.<sup>3</sup>

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<sup>2</sup> Aural alerts are inhibited below 500 +/-100 ft AGL.

<sup>3</sup> The data from the recorded TA alerts revealed that both aircraft were within 0.2nm and reported 0 to -100 ft uncorrected barometric altitude. In addition, review of the TCAS fault log showed no faults at the time of the event that would indicate a failure to write to the memory, and the event log recorded properly during the TCAS examination.

The booklet titled "Introduction to TCAS II Version 7.1", published by the FAA on February 28, 2011, states that "If TCAS determines the intruder to be on the ground, it inhibits the generation of advisories against this aircraft". The intruder's transponder is responsible for encoding the TCAS message with its air/ground status. The transponder will report in-air status when weight-on-wheels status is in-air. If the weight-on-wheels status is on-ground, the transponder will over-ride the weight-on-wheels status and report in-air status if the groundspeed or airspeed is greater than 100 kts, or if the radio altitude is greater than 50 ft. Using Flightradar24 data for position and timing, ACSS calculated that a visual only (no aural annunciation) TA would have been expected from the time the SWA708 TCAS first transmitted an airborne status at approximately 6:40:40 CST until the time that the vertical separation was greater than 850ft at approximate time 06:41:04 CST.<sup>4</sup> In addition, the TA would have been expected to remain displayed for an additional 8 seconds, as according to ACSS the TCAS model TCAS3000SP does not downgrade a potential threat to other traffic status until the TA has been inactive for 8 seconds.

ACSS further utilized Flightradar24 data to recreate the event in a lab session. To playback the event in question the data was interpolated to update from the provided 0.33Hz rate to 2Hz. A playback of the ADS-B data was performed, and a visual only TA was observed in the lab. The event data was then downloaded in an identical process to that performed on the FDX1432 unit. The data showed that during the simulation, the instant that SWA708 reported an airborne status the ACSS unit generated the expected TA.

Submitted by:

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<sup>4</sup> The Flightradar24 data was provided at 0.33Hz.