

TEXTRON AVIATION INC.  
ONE CESSNA BOULEVARD  
WICHITA, KS 67215

MODEL NO: 680A

REPORT NO: PR-680A-022

TITLE: ENGINEERING REVIEW OF DATA FROM  
680A-0010 ON AUGUST 15, 2019

REVISIONS

Rev	Date	By:	Approved By:
-	10/14/2019	Christopher Horst	See Separate Electronic Signature Sheet
ECR No: N/A			

Section	Description
All	Initial Release

Rev	Date	By:	Approved By:
A	02/21/2020	Christopher Horst	See Separate Electronic Signature Sheet
ECR No: N/A			

Section	Description
2	Added cross-references to the figures for each sub-section.
Figure 4-5 Figure 4-6 Table 4-1	Added vertical speed data

TABLE OF CONTENTS

Section	Title	Page
	Revisions.....	i
	Table of Contents .....	ii
	References.....	iii
	List of Tables .....	iv
	List of Figures .....	iv
	Acronyms, Abbreviations, and Symbols .....	v
1.	OBJECTIVE .....	1
1.1	Data Sources and Processing .....	1
2.	FLIGHT SUMMARY.....	2
2.1	Takeoff, Cruise, Initial Descent .....	2
2.2	Initial Approach for Landing .....	2
2.3	Interruption of Initial Approach.....	2
2.4	Resumed Approach for Landing.....	3
2.5	Touchdown .....	5
3.	OBSERVATIONS .....	7
4.	SUPPORTING DATA.....	9
5.	DATA AND CALCULATIONS .....	17
5.1	Landing Weight .....	17
5.2	Ambient Conditions at Elizabethton, TN (0A9).....	17
5.3	Landing Distance .....	17
6.	RELATED DATA .....	18
6.1	Comparison of August 15, 2019 and April 6, 2019 flights to Elizabethton, TN.....	18

REFERENCES

The following are used in this document. Unless a specific revision of one of these documents is specified, the revision in effect at the time of original issue of this document or a later revision shall apply.

Textron Drawings and Reports

68AFM-02                    FAA APPROVED AIRPLANE FLIGHT MANUAL  
                                 CITATION LATITUDE MODEL 680A

Other Data

00000A5B                    AReS data file downloaded from 6918236-20 ARES II REC  
                                 UNIT, 24-CH on 680A-0010 from April 6, 2019

00000B5C                    AReS data file downloaded from 6918236-20 ARES II REC  
                                 UNIT, 24-CH on 680A-0010 from August 15, 2019

log\_190406\_08213            MFD log file from April 6, 2019  
5\_KSVH.csv

log\_190815\_14551            MFD log file from August 15, 2019  
9\_KSVH.csv

N8JR Flight Track            Google Earth Flight Path created with ATSB KML Creator  
4-6-19.kml                    v3.4.2 using data from MFD log file

N8JR Flight Track            Google Earth Flight Path created with ATSB KML Creator  
8-15-19.kml                   v3.4.2 using data from MFD log file

LIST OF TABLES

Table 4-1: AReS Parameters Exported To FTReader.....15

LIST OF FIGURES

Figure 4-1: Flight Path – Entire Flight.....9

Figure 4-2: Flight Path - Approach .....10

Figure 4-3: Flight Path - Touchdown.....10

Figure 4-4: FTReader Data – Entire Flight.....11

Figure 4-5: FTReader Data – Approach .....12

Figure 4-6: FTReader Data – Touchdown .....13

Figure 4-7: FTReader Data – Thrust Reversers .....14

Figure 6-1: Flight Path Comparison – Entire Flight .....19

Figure 6-2: Flight Path Comparison – Approach.....20

Figure 6-3: FTReader Data – Approach – April 6, 2019 .....21

Figure 6-4: FTReader Data – Approach – August 15, 2019.....21

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AFM	Airplane Flight Manual
AGL	Above Ground Level
A/P	Autopilot
AReS	Aircraft Recording System
ATSB	Australian Transport Safety Bureau
CAS	Crew Alerting System
CPCalc	Cessna Citation Performance Calculator
EICAS	Engine Indicating and Crew Alerting System
FADEC	Full Authority Digital Engine Control
fpm	Feet per minute
FLTA	Forward Looking Terrain Avoidance
G	Conventional Value of Gravitational Acceleration
KIAS	Knots of Indicated Airspeed
KML	Keyhole Markup Language (XML notation for geographic visualization)
LH	Left Hand
MFD	Multi-Function Display
RH	Right Hand
SD	Secure Digital Memory
TAWS	Terrain Awareness and Warning System
T/R	Thrust Reverser

## 1. OBJECTIVE

The purpose of this report is to provide an engineering review of data recorded on 680A-0010 (N8JR) on August 15, 2019.

### 1.1 Data Sources and Processing

The data used in this report was downloaded from a compact flash card pulled from the AReS Recording Unit and an SD card pulled from the Multifunction Display (MFD) on the airplane.

The AReS data in log file 00000B5C was processed using Textron Aviation program AReS View version 3.0.0.1 BETA, exported as a .csv file, and imported into Textron Aviation program FTReader version 4.0.0.4302 for plotting and annotation. Display names used in FTReader, data sources, sample rates, and AReS parameter ID numbers are listed in Table 4-1.

Flight path data from the MFD SD card was processed using ATSB KML Creator version 3.4.2 and imported into Google Earth Pro. Sample rate for the MFD data is 1Hz.

Altitudes listed in the following sections are pressure altitudes as recorded in AReS, with no barometric pressure compensation applied. The flight path data imported into Google Earth Pro uses altitudes with compensation applied. All listed times are in Coordinated Universal Time (UTC); local time for the flight data in this report is UTC minus 4 hrs.

## 2. FLIGHT SUMMARY

### 2.1 Takeoff, Cruise, Initial Descent (Refer to Figure 4-1 and Figure 4-4)

The data files began with aircraft power on at 18:53:39UTC. Takeoff from Statesville Municipal Airport (KSVH) was at 19:19:56UTC, with an expected flight duration of approximately 18 minutes. The aircraft climbed direct to 12,500ft on a magnetic heading of 307°, direct to Elizabethton Municipal Airport (0A9). Autothrottles were engaged and maintaining 250 KIAS, but autopilot was not engaged. Pitch trim inputs suggest the left-seat pilot was the pilot flying. Approximately 8 minutes after takeoff, the aircraft began a descent from 12,500ft to 5,400ft and turned right to a magnetic heading varying between 325° and 342°.

### 2.2 Initial Approach for Landing (Refer to Figure 4-2 and Figure 4-4)

At 19:32:44UTC, descent from 5,400ft resumed, and airspeed began to decrease toward 200 KIAS with autothrottles engaged. A left turn began 16 seconds later, the aircraft leveled off at 5,150ft for 12 seconds, then resumed descending.

### 2.3 Interruption of Initial Approach (Refer to Figure 4-2 and Figure 4-4)

At 19:33:51UTC, left bank increased from 13° to 20° and the aircraft leveled off at 4,100ft. At 19:34:01UTC, the aircraft was on a heading toward the destination airport, but the left turn continued. At 19:34:06UTC, the left turn stopped, and at 19:34:24UTC, a right turn and climb began. At 19:35:02UTC, descent resumed, and ten seconds later TAWS ECR (Excessive Closure Rate) Caution and Warning alerts sounded as the aircraft crossed a ridge at 4,600ft with 710ft clearance.



#### 2.4 Resumed Approach for Landing (Refer to Figure 4-2 and Figure 4-5)

At 19:35:27UTC, a shallow left turn to extended final was initiated, and at 19:35:45UTC, descent rate increased. As the approach to landing resumed, airspeed was 201 KIAS, at 4,320ft, 7.9 miles (6.9NM) from the airport. The average glide slope between this point and the first touchdown point was 3.8°, and the initial glide slope was 4.1°. As descent rate increased, autothrottle positioned the throttles to minimum (6° TLA). Flaps 1 (7°) was selected, but airspeed continued to increase, reaching a maximum of 220 KIAS.

Throttles were manually pulled to 0° TLA, disengaging autothrottle. The throttles were not moved above idle during the rest of the approach; total time at idle was one minute, fifty-two seconds. Speed brakes were partially extended (33° lever angle), and TAWS EDR (Excessive Descent Rate) Caution alert sounded a few seconds later. Speed brakes were extended further (41° lever angle) before being retracted after 21 seconds total as airspeed decreased below the maximum extend speeds for landing gear and Flaps 2.

Gear down was selected as airspeed decreased through 205 KIAS, and Flaps 2 (15°) was selected as airspeed decreased through 195 KIAS.

As flaps were extending, TAWS FLTA RTC (Rate of Terrain Closure) Caution alert sounded twice before changing to an FLTA RTC Warning alert. Following these alerts, descent rate decreased from -1700 fpm to -500 fpm before resuming its previous rate. Full Flaps (35°) was selected as airspeed decreased through 174 KIAS. A few seconds later, speed brakes were partially extended (22° lever angle) for 5.0 seconds. With aircraft weight above 27,000 lbs,  $V_{REF}$  was 108kts. Actual airspeed at the runway displaced threshold was 127 KIAS. Five seconds before touchdown, the aircraft was descending at over -1,500 fpm, which was reduced to -250 fpm two seconds before touchdown. The aircraft crossed the runway displaced threshold at 3 ft AGL.

## 2.5 Touchdown (Refer to Figure 4-3, Figure 4-6, and Figure 4-7)

The first touchdown, at 19:37:49.6UTC on the runway numbers, was at 126 KIAS, -600 fpm, and 1.4 Gs, and lasted 0.6 seconds. All three gear registered on-ground simultaneously. Speed brakes were not extended after touchdown. 0.4 seconds after gear-on-ground, thrust reverser deployment was commanded by moving throttles to the reverse idle position, but the aircraft was airborne again before the command could be executed. The throttles were left in the reverse idle position. The aircraft touched down a second time 1.2 seconds later for 0.4 seconds, nose first, then right main gear, at 1.6 Gs, but the left main gear did not register on-ground. The aircraft touched down a third time 1.8 seconds later for 0.6 seconds, at 1.7 Gs, on the runway thousand-foot marker. All three gear registered on-ground, the still-active thrust reverser deployment command was executed, and the thrust reversers unlocked 0.4 seconds after touchdown. The throttles were advanced to idle, sending a thrust reverser stow command nearly immediately after thrust reversers were unlocked, but aircraft gear status changed to in-air nearly simultaneously.

As the aircraft went airborne, the in-air status triggered a cut in hydraulic power to the thrust reverser actuators, which allowed the unlocked thrust reversers to be pulled open by aerodynamic forces. The amber T/R UNLOCK CAS message posted and the Emergency Stow switches began flashing. Throttles were advanced to Max Takeoff 0.7 seconds later, but the thrust reversers reached full deployment 0.4 seconds after that, and the FADECs prevented an increase in engine thrust. The red T/R DEPLOY CAS message posted, and the Emergency Stow switches continued to flash.

The aircraft remained airborne for 9.6 seconds, reaching a maximum altitude of 24ft AGL. Flaps 2 were selected four seconds after throttles were advanced, and flaps began retracting as airspeed decayed from 119 KIAS to 91 KIAS. The throttles were pulled back partially (not to idle), then pushed forward again with no effect, then pulled back to idle. Aircraft pitch was reduced and the aircraft leveled off, then pitch increased as the aircraft descended, and the stick-shaker activated half a second before the aircraft touched down for the final time. The aircraft touched down with a peak force of 3.2 Gs vertically, first on the right main gear, then on the left main gear with a bounce. The aircraft rolled right 7.5° as the left main gear contacted the ground again, which is consistent with the aircraft being supported by the left inboard tire and the right wingtip. Left inboard brake pressure increased to near maximum after the left main gear touched down, but the left outboard and right brake pressures did not increase significantly. This indicates only the left inboard tire was firmly contacting the ground. The nose gear contacted the ground one half-second later. With all three gear on ground, the thrust reverser system was re-energized. With throttles at idle, the thrust reversers stowed as commanded.

Eight seconds after the final touchdown, the aircraft crossed the end of the runway, on centerline. Four seconds after that, the aircraft experienced an impact measuring 3.4 Gs vertically and the fuselage began rolling left. The aircraft continue to move for five more seconds, then came to rest with the fuselage rolled 42° left. MFD data cut off six seconds later, and AReS data cut off eight seconds later.

### 3. OBSERVATIONS

Airspeed management was a significant issue during the approach. As the descent was initiated, airspeed was 201 KIAS; gear, flaps, and speed brakes were retracted; and partial thrust was applied. Airspeed increased to 220 KIAS over the following 30 seconds, which precluded the extension of landing gear and Flaps 2, which would have provided additional drag to aid in slowing the aircraft. The need for speed reduction was evidently apparent to the crew throughout the descent, as seen by the partial extension of speed brakes and by the extension of landing gear and flaps immediately after each of their maximum extension speeds was reached. Awareness of the high touchdown speed also likely contributed to the decision to deploy thrust reversers immediately after touchdown. A contributing factor was likely distraction due to terrain and navigation. The turn and descent to initiate the approach began while one ridge remained ahead. The subsequent course correction and terrain avoidance maneuvers created a distraction from speed management and configuration control as the approach resumed.

The misuse of thrust reversers was also a significant factor in the outcome of the flight. Thrust reverser deployment was commanded before the aircraft was firmly on the ground, and the command was still in place through the subsequent bounces. The Model 680A AFM prohibits the use of thrust reversers during touch-and-go landings. The unlocking of thrust reversers on the third bounce and their full deployment in air prevented application of forward thrust for a go-around attempt. If the throttles had been pulled back to idle then advanced again, the FADEC would have reset the idle latch, and reverse thrust would have been applied in air.

As shown in the landing distance calculations in section 5.3, extension of speed brakes on touchdown has a significantly greater effect on total landing distance than thrust reverser use. Even at  $V_{REF} + 19$  kts, a landing within the available runway length was possible given a touchdown with no bounce followed by use of speed brakes and wheel brakes.

4. SUPPORTING DATA

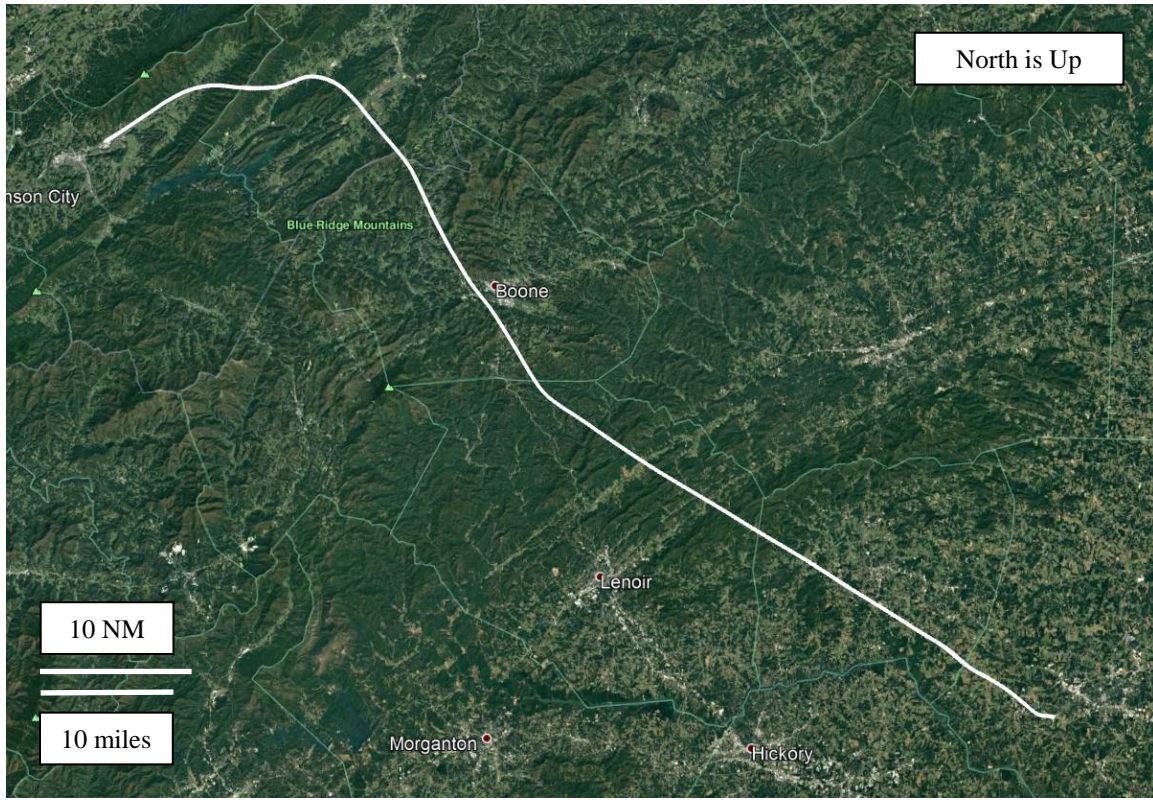


FIGURE 4-1: FLIGHT PATH – ENTIRE FLIGHT

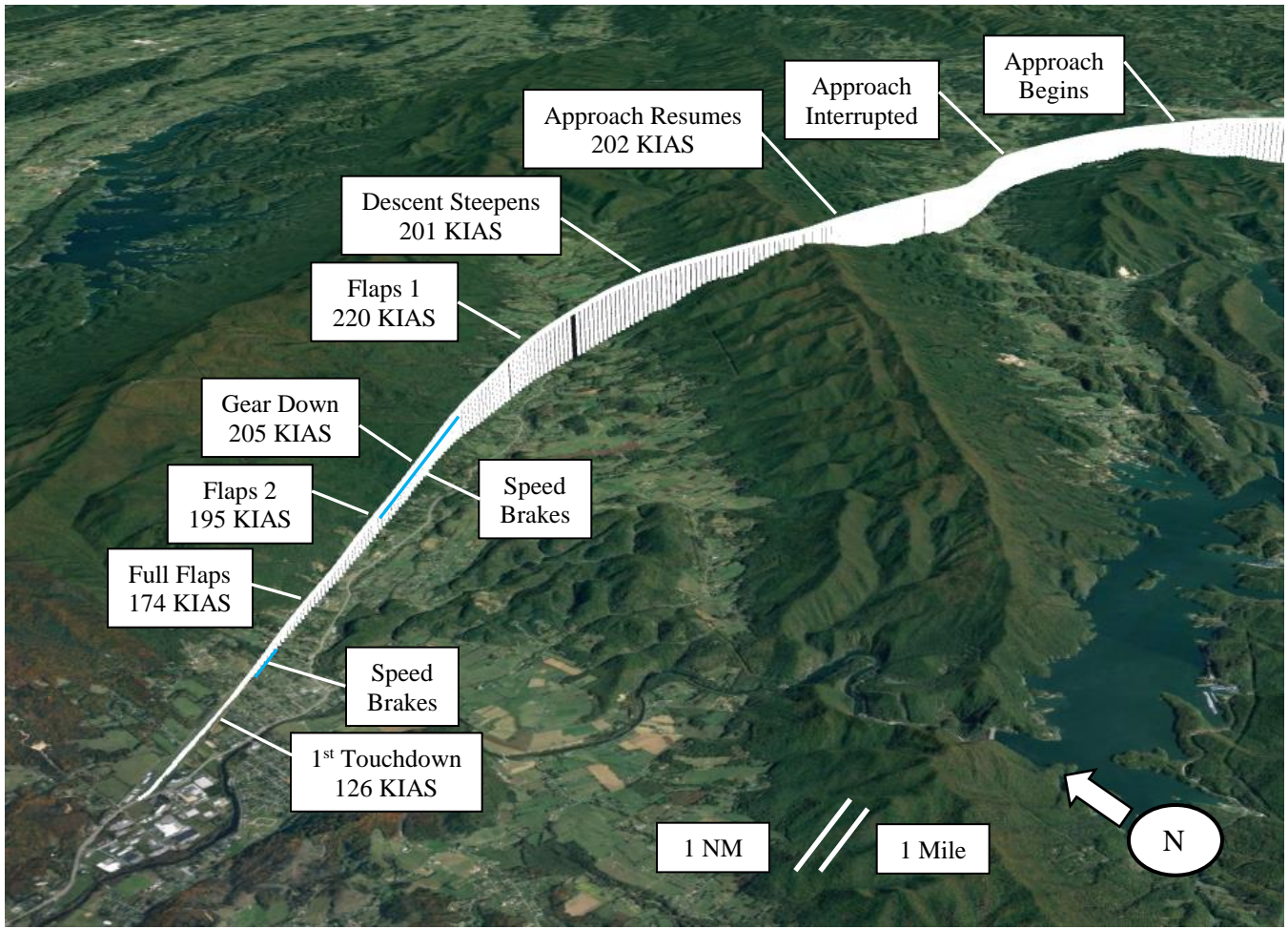


FIGURE 4-2: FLIGHT PATH - APPROACH

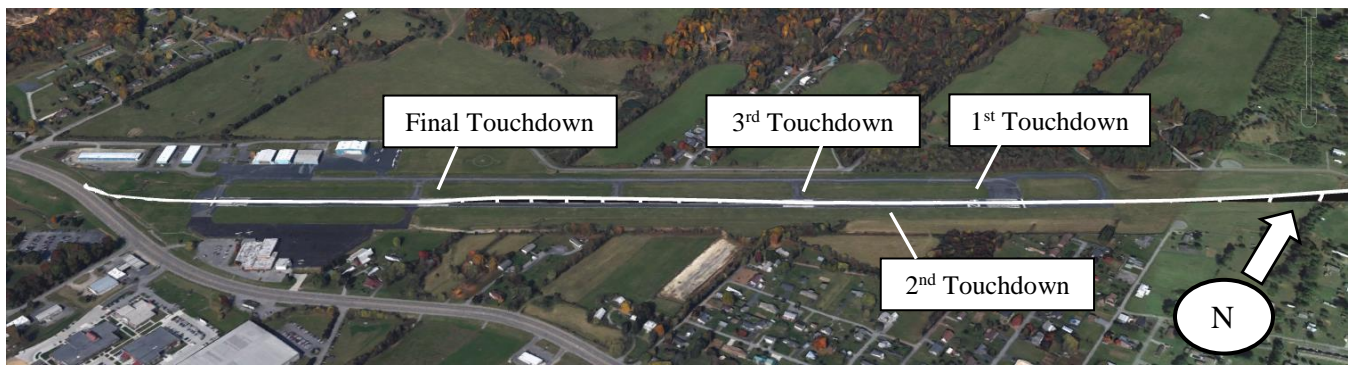


FIGURE 4-3: FLIGHT PATH - TOUCHDOWN



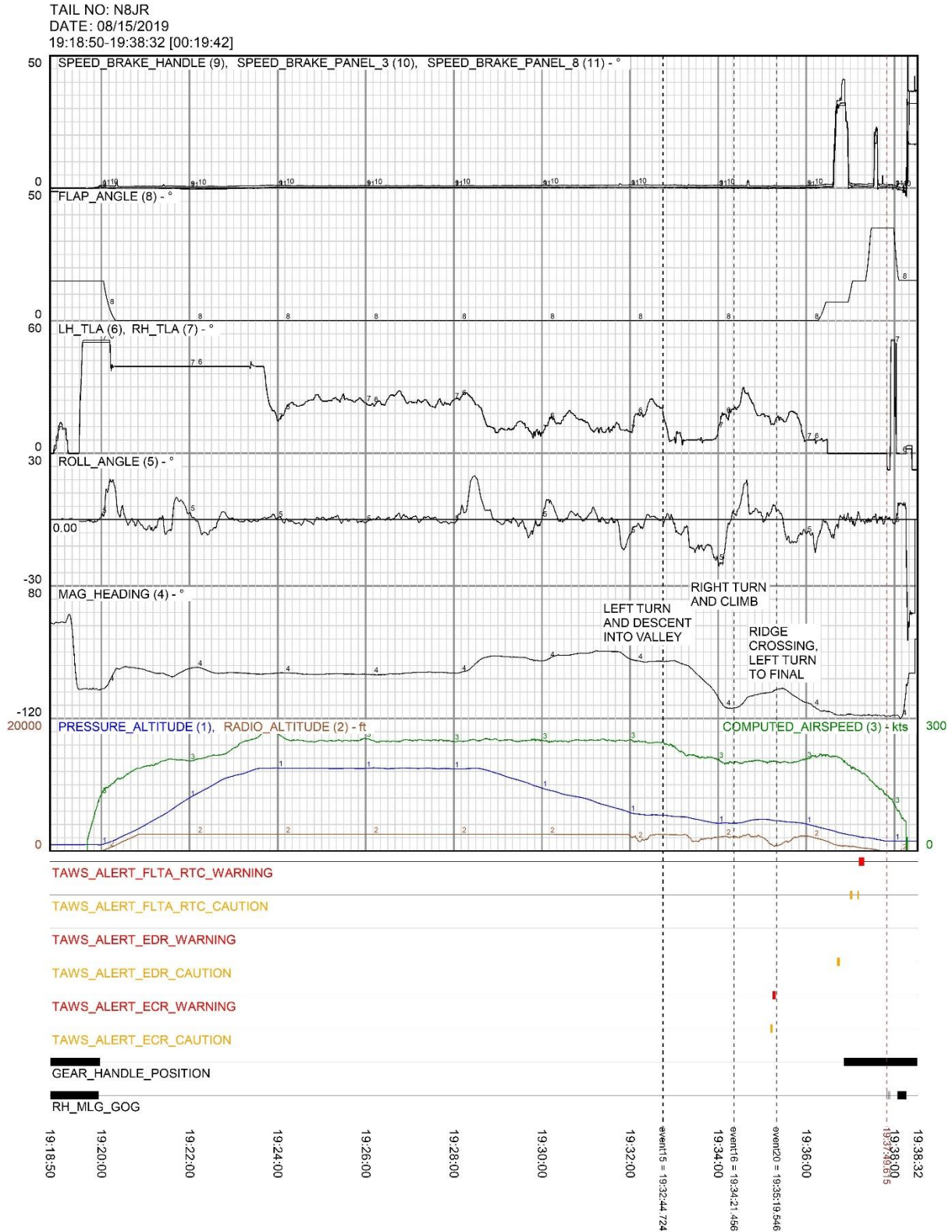
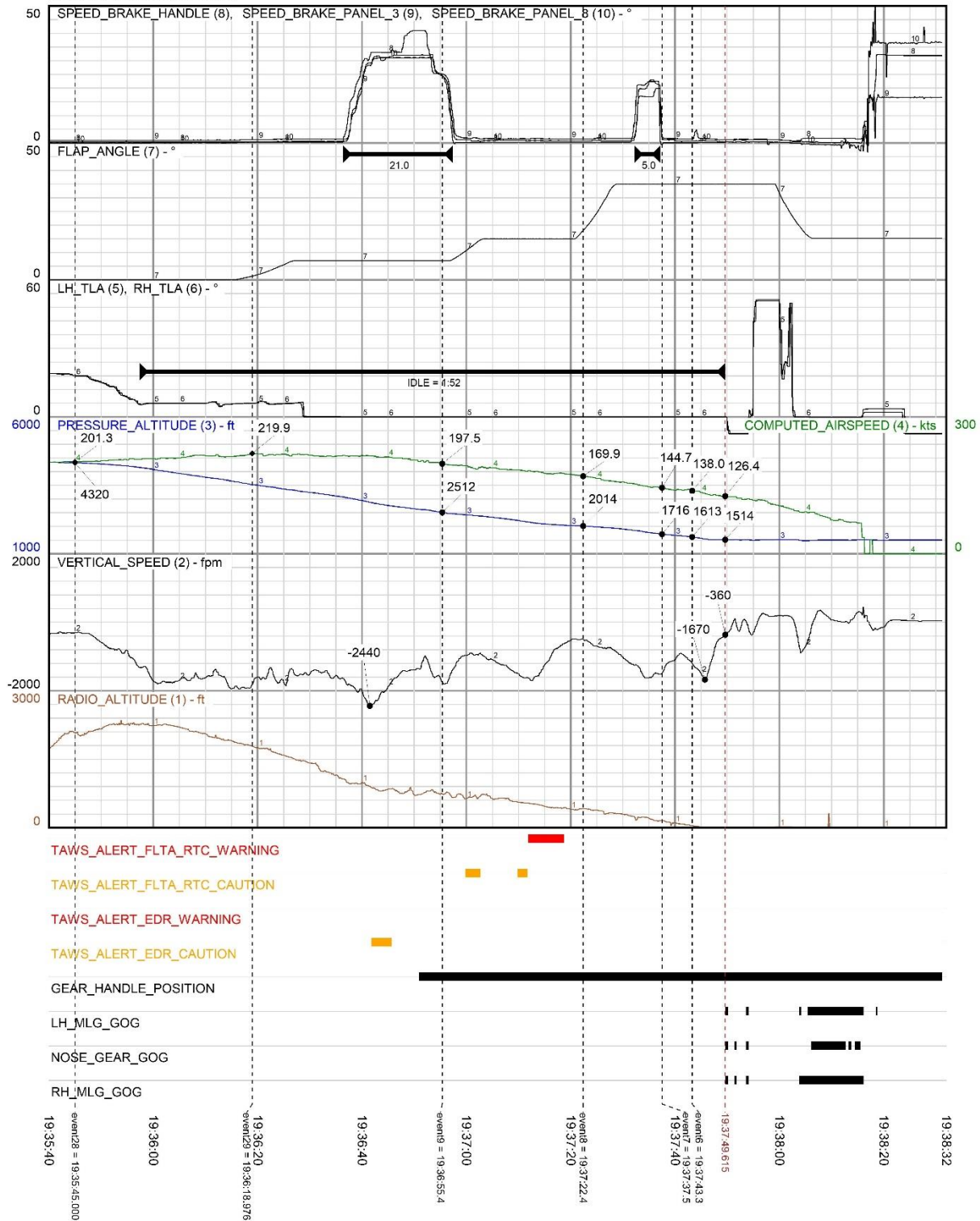


FIGURE 4-4: FTREADER DATA – ENTIRE FLIGHT

TAIL NO: N8JR  
 DATE: 08/15/2019  
 19:35:40-19:38:32 [00:02:52]



**FIGURE 4-5: FTREADER DATA – APPROACH**

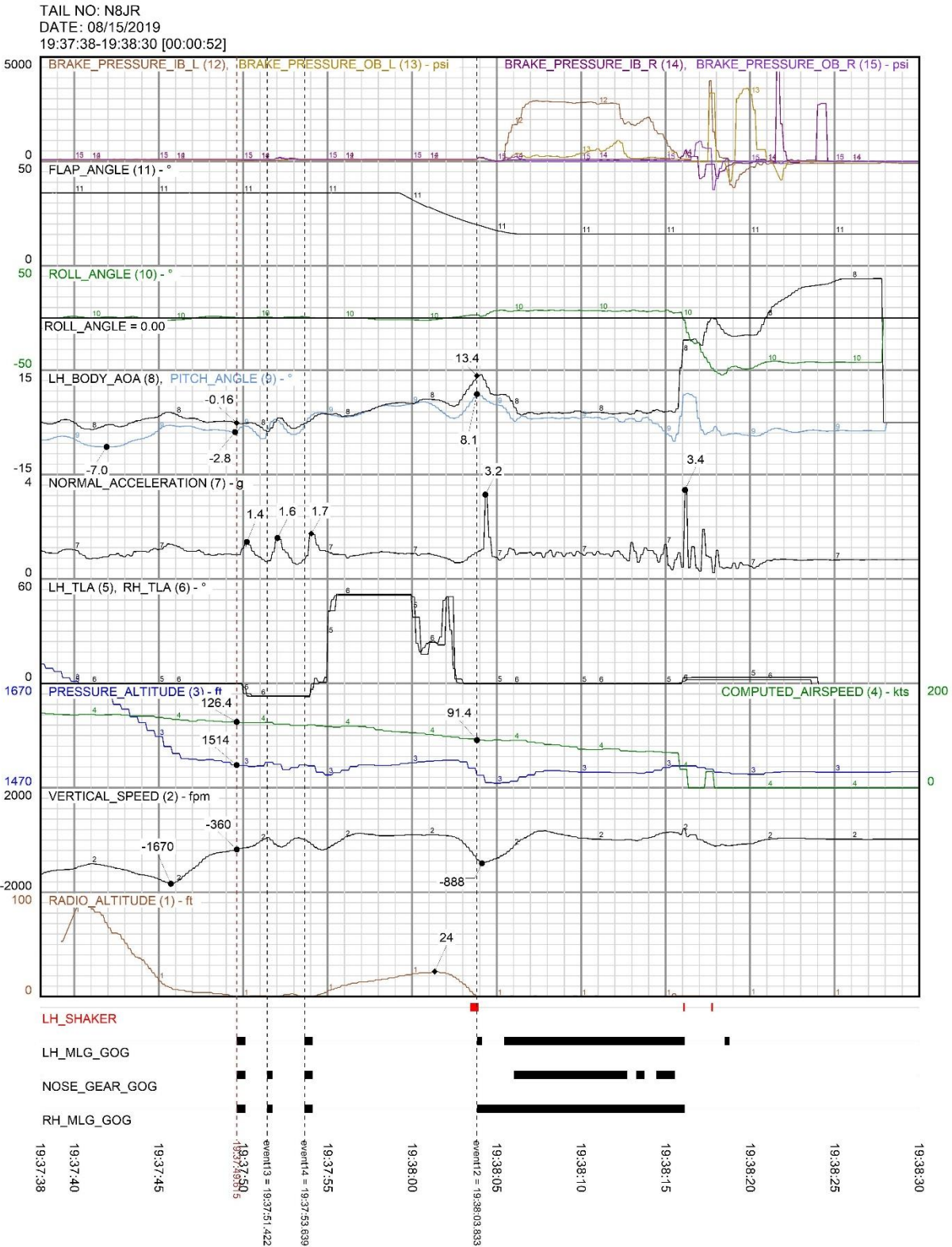


FIGURE 4-6: FTREADER DATA – TOUCHDOWN

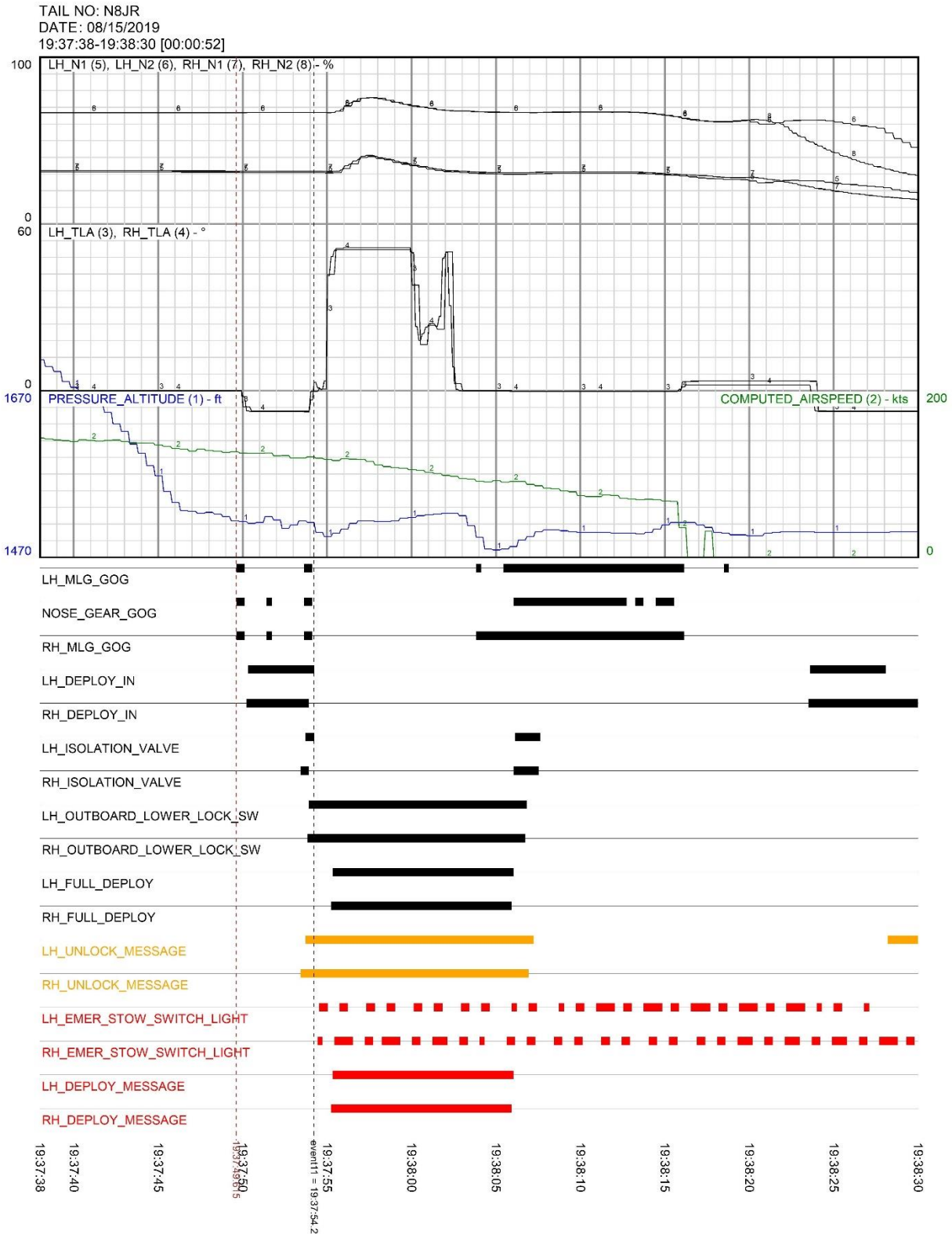


FIGURE 4-7: FTREADER DATA – THRUST REVERSERS

**TABLE 4-1: ARES PARAMETERS EXPORTED TO FTREADER**

Parameter	Source	Sample Rate (Hz)	AREs ID
Brake Pressure IB L	Garmin GEA2	5	70261000-110
Brake Pressure IB R	Garmin GEA3	5	70252000-110
Brake Pressure OB L	Garmin GEA2	5	70311000-110
Brake Pressure OB R	Garmin GEA3	5	70272000-110
Computed Airspeed	L Air Data Computer	2	120041000-140
Flap Angle	Flap controller	10	11379000-140
Gear Handle Position	Garmin GIA1	5	70010000-110
Lateral Acceleration	Garmin GEA3	5	70362000-110
Latitude	Garmin	5	72000000-110
LH Body AOA	L Angle of Attack	5	120350000-140
LH Deploy In	L Thrust Reverser PCB	5	40019000-250
LH Deploy Message	L Thrust Reverser PCB	5	40029000-240
LH Emer Stow Switch Light	L Thrust Reverser PCB	5	41449000-140
LH Full Deploy	L Thrust Reverser PCB	5	40029000-210
LH Isolation Valve	L Thrust Reverser PCB	5	40029000-220
LH ITT	L Engine Data Unit	1	93459000-180
LH MLG GOG	L Weight on Wheels PCB	5	30219000-130
LH N1	FADEC LA	2	123061000-150
LH N2	FADEC LA	2	123141000-150
LH Outboard Lower Lock Sw	L Thrust Reverser PCB	5	41439000-250
LH Shaker	L Angle of Attack	5	120420000-160
LH TLA	FADEC LA	5	123231000-170
LH Unlock Message	L Thrust Reverser PCB	5	40029000-250
Longitude	Garmin	5	72010000-110
Longitudinal Acceleration	Garmin GEA2	5	70431000-110
Mag Heading	L Inertial Reference System	5	80551000-110
Normal Acceleration	Garmin GEA3	5	70352000-110
Nose Gear GOG	L Weight on Wheels PCB	5	30219000-150
Pitch Angle	L Inertial Reference System	5	80561000-110
Pressure Altitude	L Air Data Computer	2	120021000-120
Radio Altitude	L Radio Altimeter	5	120311000-130
RH Deploy In	R Thrust Reverser PCB	5	180019000-250
RH Deploy Message	R Thrust Reverser PCB	5	180029000-240
RH Emer Stow Switch Light	R Thrust Reverser PCB	5	181449000-140
RH Full Deploy	R Thrust Reverser PCB	5	180029000-210
RH Isolation Valve	R Thrust Reverser PCB	5	180029000-220

Parameter	Source	Sample Rate (Hz)	ARes ID
RH ITT	R Engine Data Unit	1	23459000-180
RH MLG GOG	L Weight on Wheels PCB	5	30219000-140
RH N1	FADEC RA	2	83061000-150
RH N2	FADEC RA	2	83141000-150
RH Outboard Lower Lock Sw	R Thrust Reverser PCB	5	181439000-250
RH Shaker	R Angle of Attack	5	120421000-160
RH TLA	FADEC RA	5	83231000-170
RH Unlock Message	R Thrust Reverser PCB	5	180029000-250
Roll Angle	L Inertial Reference System	5	80571000-110
Speed Brake Handle Position	Garmin GEA1	5	71410000-110
Speed Brake Panel 3/8 Position	Garmin GEA2	5	71501000-110
Speed Brake Panel 3/8 Position	Garmin GEA3	5	71502000-110
Speed Brake Pressure	Garmin GEA2	5	70141000-280
TAWS Alert - ECR Caution	Garmin	1	81231000-140
TAWS Alert - ECR Warning	Garmin	1	81241000-110
TAWS Alert - EDR Caution	Garmin	1	81231000-150
TAWS Alert - EDR Warning	Garmin	1	81241000-120
TAWS Alert - FLTA RTC Caution	Garmin	1	81231000-240
TAWS Alert - FLTA RTC Warning	Garmin	1	81231000-280
Vertical Speed	L Air Data Computer	5	120071000-150

## 5. DATA AND CALCULATIONS

### 5.1 Landing Weight

Inputs:

- Empty Weight = 18,251 lbs (from airplane weighing form on Sept 28, 2015)
- Fuel: LH = 4,255 lbs, RH = 4,233 lbs, Total = 8,488 lbs
- Crew (2) + Adult Passengers (2) = 680 lbs

Estimated Landing Weight = 27,419 lbs

NOTE: This estimate uses standard weights for adults, and does not include younger passengers, baggage, or any aircraft weight changes since Sept 28, 2015.

### 5.2 Ambient Conditions at Elizabethton, TN (0A9)

- Temperature: 28.5°C (85°F)
- Wind: 245 @ 3 kts
- Gradient: -0.8%
- Barometric Pressure: 29.97 In-Hg

### 5.3 Landing Distance

Inputs:

- Flaps – Full
- Airport Elevation = 1,592.5 ft (rounded up to 2,000 ft)
- Aircraft Weight = 27,419 lbs estimate (rounded up to 27,570 lbs)
- Wind = 3 kts (rounded down to 0 kts)
- Temp = 28.5°C (rounded up to 30°C)
- Gradient = -0.79% (rounded up to -1%)

Outputs:

- $V_{REF} = 108$  KIAS
- Landing Distances (assume 50ft AGL at runway threshold):
  - Per AFM at  $V_{REF} = 2,710$  ft x 1.17 gradient multiplier = 3,171 ft
  - Per CPCalc at  $V_{REF} = 2,862$  ft
  - Per CPCalc at  $V_{REF} + 19$  kts with SB and T/R = 3,560 ft (1,590 ft in air)
  - Per CPCalc at  $V_{REF} + 19$  kts with SB, w/out T/R = 3,640 ft (1,590 ft in air)
  - Per CPCalc at  $V_{REF} + 19$  kts w/out SB, with T/R = 4,340 ft (1,590 ft in air)
  - Per CPCalc at  $V_{REF} + 19$  kts w/out SB or T/R = 4,580 ft (1,590 ft in air)

Available Runway = 4,100 ft

## 6. RELATED DATA

### 6.1 Comparison of August 15, 2019 and April 6, 2019 flights to Elizabethton, TN

Another flight from Statesville to Elizabethton was conducted on this aircraft on April 6, 2019 as recorded in AReS log file 00000A5B. While the aircraft was approximately 5,000lbs lighter on the earlier flight, a comparison between flights may provide some insights. The glide slope on the April 6 flight was steeper than on the August 15 flight ( $4.3^\circ$  vs.  $3.8^\circ$ ), but the airspeed when the approach began was much slower (160 KIAS vs. 201 KIAS). The deployment of Flaps 2 before descent allowed the aircraft to maintain a steady airspeed, which allowed for selection of Full Flaps and landing gear down at the pilot's discretion. On the August 15 flight, the clean configuration at the beginning of descent led to an airspeed increase of 19 KIAS, which restricted flap and landing gear extension. On both flights, the aircraft crossed the runway displaced threshold at approximately 3-4 ft AGL. On the April 6 flight, the aircraft was at the  $V_{REF}$  speed of 99 kts at the displaced threshold, gradually flared to  $4.2^\circ$  pitch angle, then extended speed brakes and touched down at the 1,000ft marker with no use of thrust reversers. On the August 15 flight, the aircraft was at 127 KIAS (19 kts above the  $V_{REF}$  speed of 108 kts) at the displaced threshold, nosed over to  $-2.8^\circ$  pitch angle, and bounced at the runway numbers with no use of speed brakes.



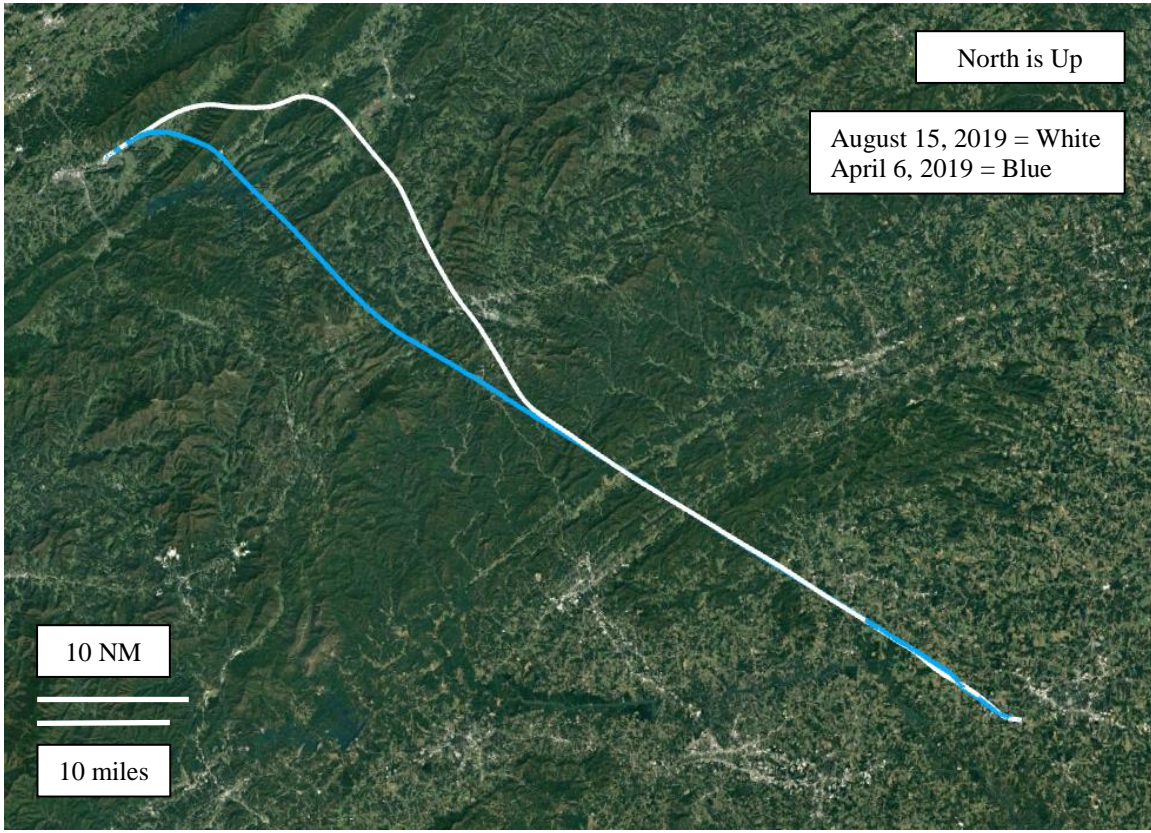
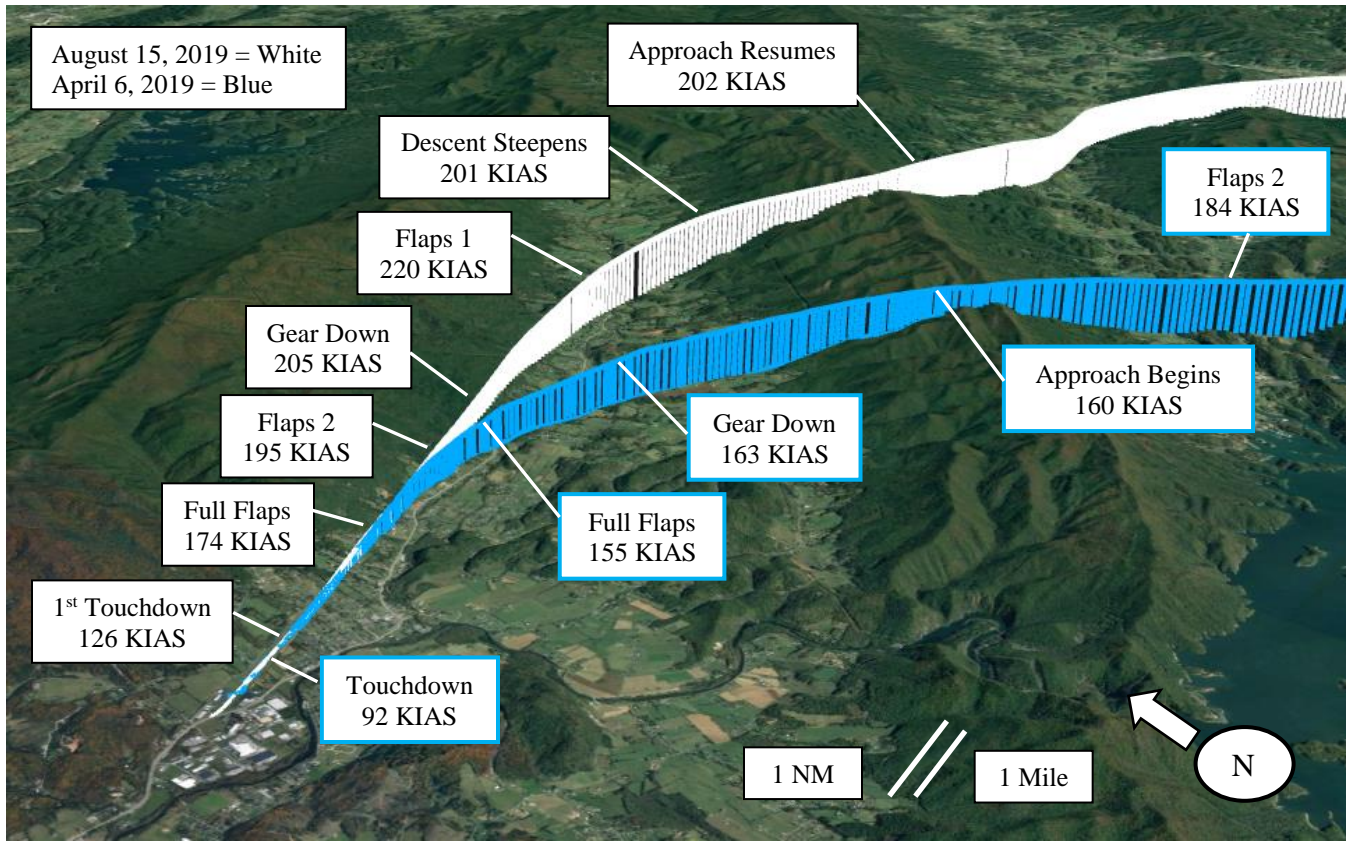


FIGURE 6-1: FLIGHT PATH COMPARISON – ENTIRE FLIGHT



**FIGURE 6-2: FLIGHT PATH COMPARISON – APPROACH**

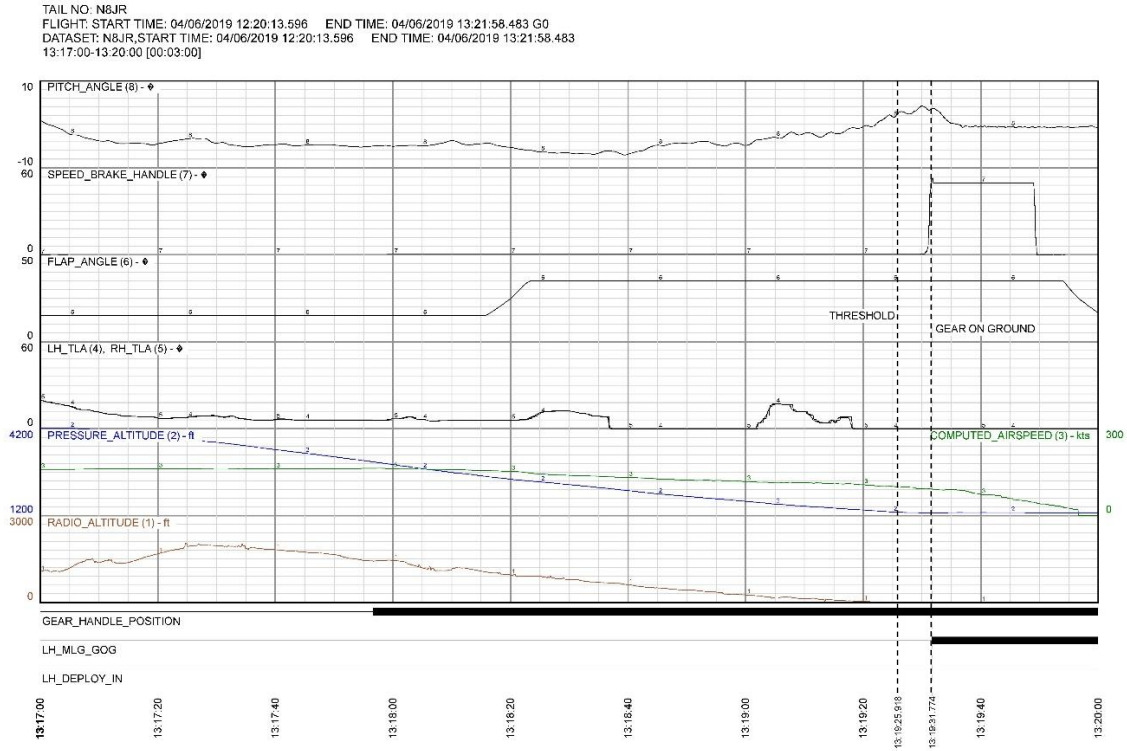


FIGURE 6-3: FTREADER DATA – APPROACH – APRIL 6, 2019

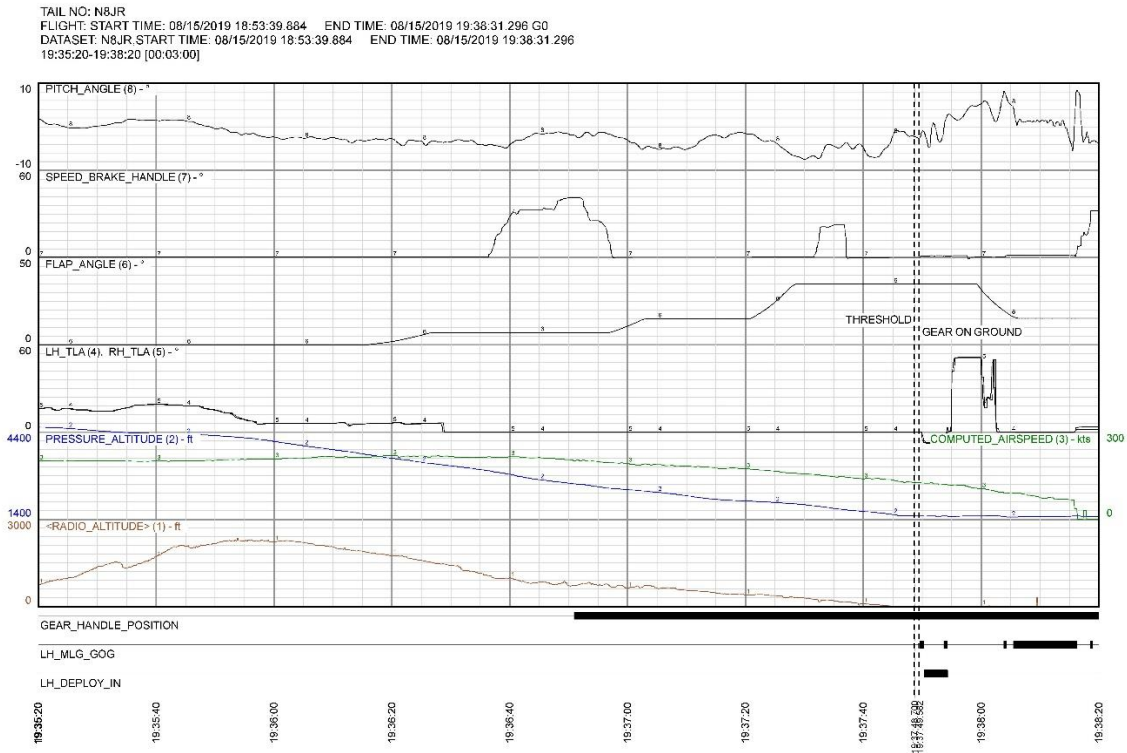


FIGURE 6-4: FTREADER DATA – APPROACH – AUGUST 15, 2019