

Boeing FDR data analysis and observations

Boeing conducted an analysis of the information recorded on the Flight Data Recorder (FDR) installed on N278EA and recovered from the airplane after the event. Boeing's analysis and observations were communicated to the NTSB in an email dated November 17, 2016, and the relevant portions of this email are presented below.

Content of Boeing email dated November 17, 2016

Attached are the preliminary FDR data plots with some data observations below. We have included a ground track plot that focuses on the landing and rollout. We believe that the data clearly shows what occurred during the landing sequence and why the airplane experienced an excursion. ...

Figures:

- Figure 1: Longitudinal parameter overview of the approach
- Figure 2: Lateral-Directional parameter overview of the approach
- Figure 3: Longitudinal parameter overview of the landing and rollout
- Figure 4: Lateral-Directional parameter overview of the landing and rollout
- Figure 5: Ground track plot focusing on the approach
- Figure 6: Ground track plot focusing on the landing and rollout

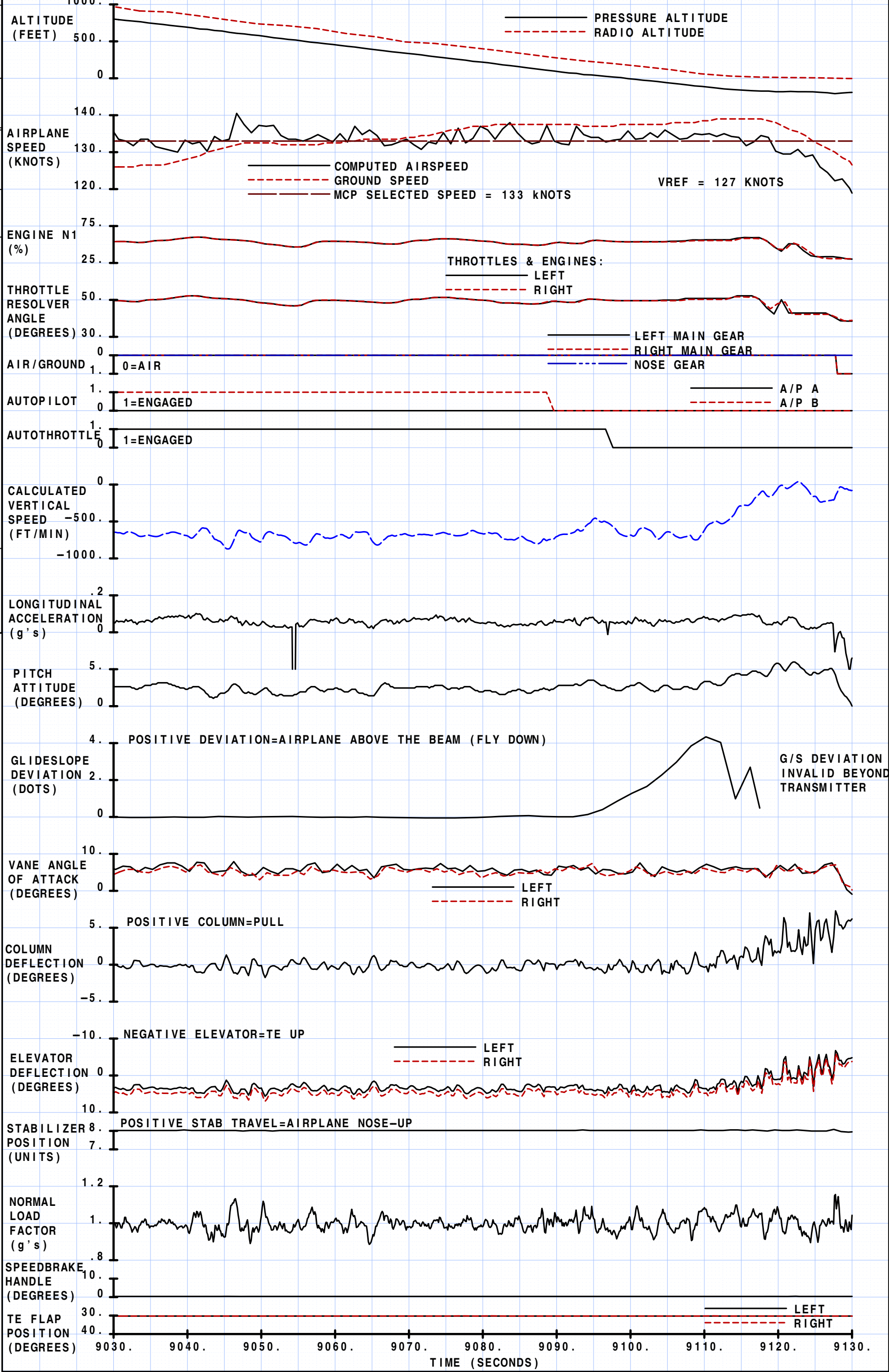
Preliminary Data Observations:

- F30 approach to Runway 22 at LaGuardia (LGA) with a runway length of 7001 feet, at a gross weight of 116,560 lb. at landing (Max Landing Weight [MLW]=129,200 lb.).
- Turbulent atmosphere with an increasing tailwind as the airplane approached the runway. At touchdown, the tailwind was approximately 10 knots.
- Autopilot was disconnected at approximately 300 feet radio altitude, with the autothrottle disconnected approximately 7 seconds later at 200 feet radio altitude
- Shortly after autopilot disconnect, the glideslope deviation began to increase indicating the airplane was deviating above the glideslope beam.
- The airplane crossed the runway threshold at a radio altitude of 66 feet with the glideslope deviation increasing beyond 4 dots and a descent rate (negative vertical speed) of approximately 750 ft/min.
- The descent rate was reduced to near zero by 2500 feet beyond the runway threshold, resulting in the airplane floating down the runway.

- The initial touchdown occurred at: 1) approximately time 9127.5 seconds, 2) a distance of 4242 feet beyond the runway threshold (~1900 feet beyond the recommended touchdown zone), 3) an airspeed of 123 knots (V_{ref-4}), 4) a ground speed of 130 knots, 5) a sink rate of 3.3 ft/sec.
- Upon main gear touchdown, maximum manual wheel brakes were commanded.
- The nose gear touched down approximately 2 seconds after main gear touchdown, but then rebounded back into the air due to commanded aft control column. The nose gear was held off the ground until it touched down a second and final time approximately 5 seconds after main gear touchdown.
- Speedbrakes were manually extended to full approximately 4.5 seconds after main gear touchdown (the speedbrakes were not armed for automatic extension upon landing). After initial touchdown, the airplane traveled approximately 1250 feet down the runway before the speedbrakes were extended to full deflection.
- Max reverse thrust was commanded by time 9135.5 seconds (8 seconds after initial touchdown). From initial touchdown to max reverse command, the airplane had traveled approximately 1650 feet down the runway.
- The airplane achieved good deceleration with speedbrake extension, maximum wheel brakes, and maximum reverse thrust, reaching 0.5 g's of deceleration (negative longitudinal acceleration).
- Preliminary calculation of airplane braking coefficient indicates that during the period of friction-limited braking (beginning when the nose gear touched down at time 9133.5 seconds, 5520 feet beyond the threshold and ending as the airplane entered the EMAS) the calculated airplane braking coefficient varied between 0.2 and 0.4.
- As the airplane decelerated, increasing left control wheel was commanded, reaching 50 degrees of left control wheel by time 9145 seconds. The increasing left control wheel reduced the spoiler deflections on the right wing, per design.
- The calculated in-air crosswind component indicated there was a left crosswind of 7 to 8 knots, reducing to 3 to 5 knots before touchdown. The winds that were present while the airplane was on the ground could not be calculated, but a left crosswind would typically result in a right rudder pedal input to maintain centerline (and left control wheel if the crosswind magnitude was large enough).
- Some left rudder pedal was commanded as the airplane rolled down the runway, until it was removed and right rudder pedal was commanded at 6650 feet beyond the threshold. The airplane responded to the right pedal by deviating right of the runway centerline.
- The airplane departed the end of Runway 22 while deviating right of centerline at a ground speed of approximately 40 knots.
- The airplane crossed through the right corner of the EMAS and came to rest to the right of the EMAS, approximately 7180 feet beyond the runway threshold, and 114 feet right of centerline.
- Preliminary analysis of the data indicates all systems were operating as designed. The automatic speedbrake functionality could not be verified as the system was not armed for landing and was reportedly on the Minimum Equipment List (MEL) as inoperative.

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PRELIMINARY DATA



EXPORT CONTROLLED ECGN: 9E991

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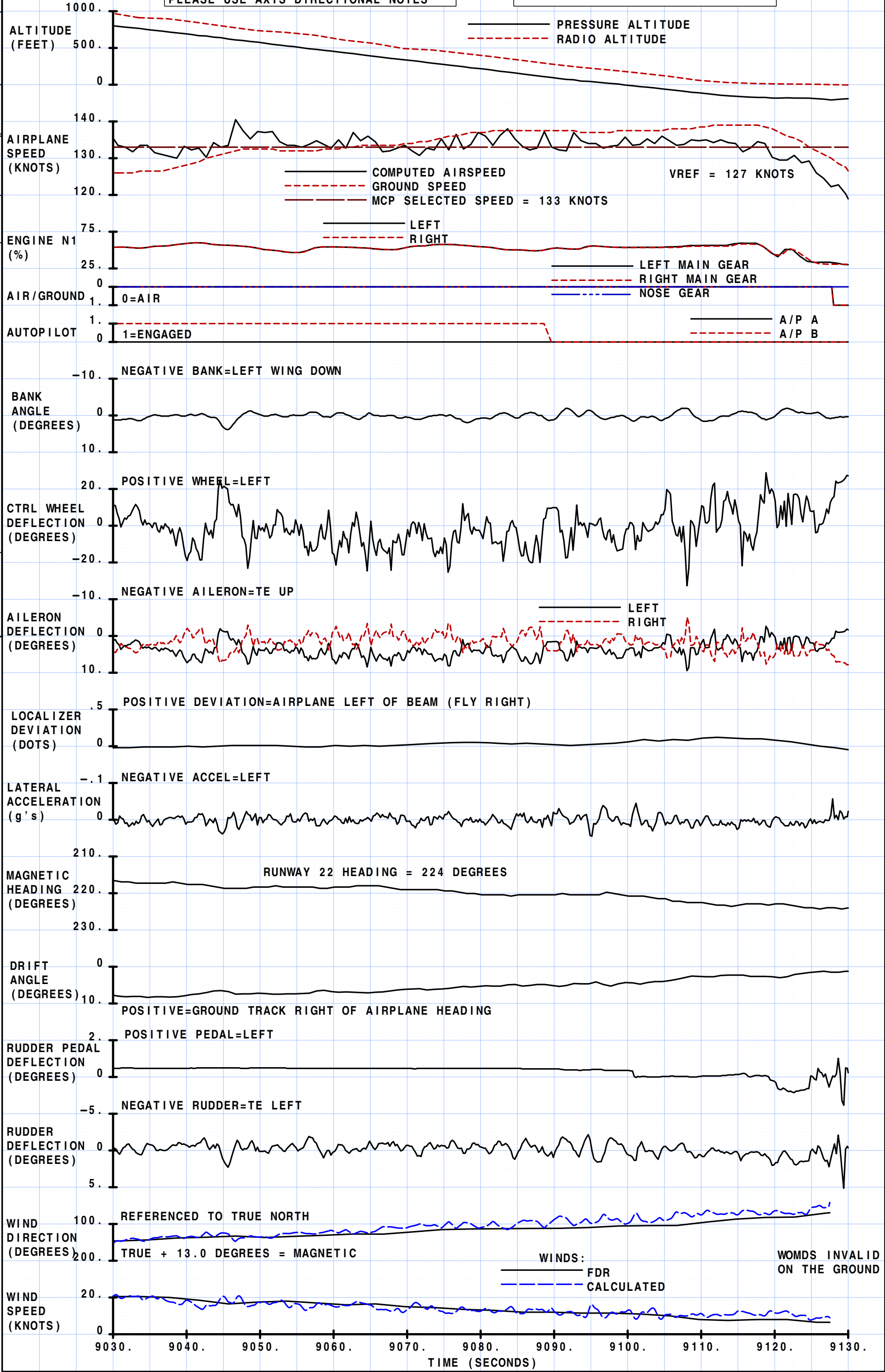
EKV 737-700 RUNWAY OVERRUN
 27OCT2016 -- TIME-ALIGNED FDR DATA
 LONGITUDINAL PARAMETERS

YA203/N278EA

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PRELIMINARY DATA



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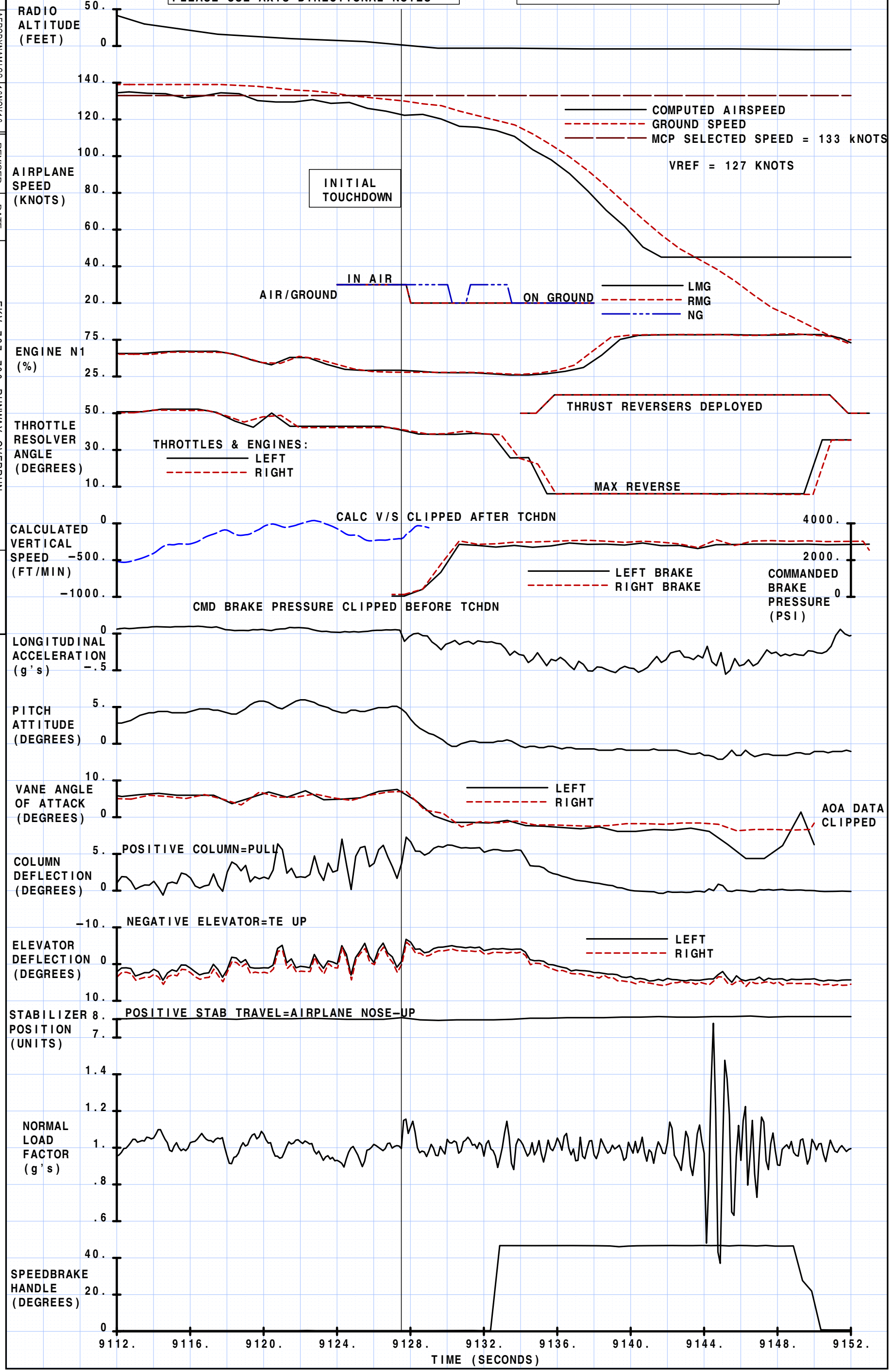
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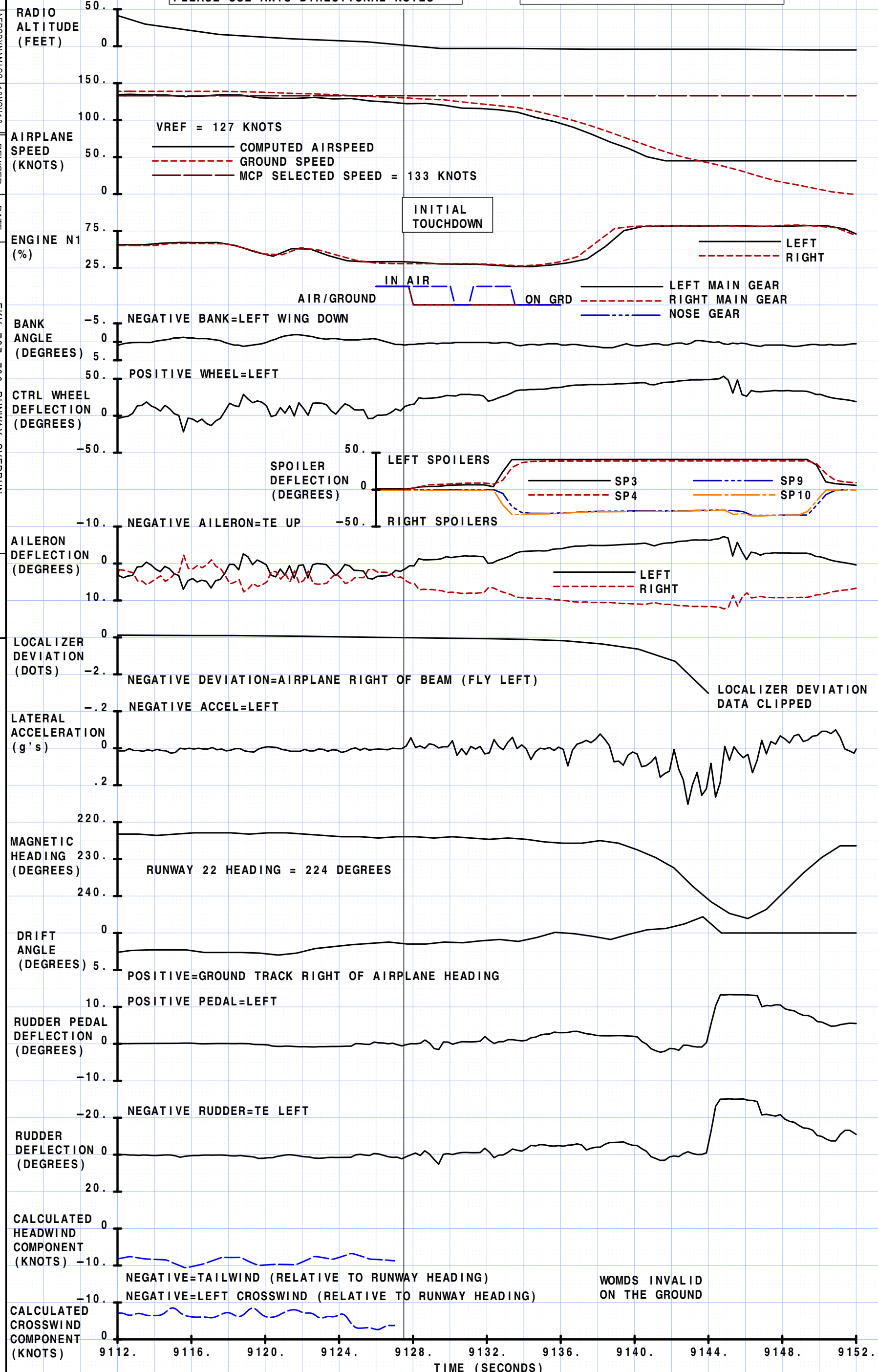
EKV 737-700 RUNWAY OVERRUN
27OCT2016 -- TIME-ALIGNED FDR DATA
LONGITUDINAL PARAMS - LANDING ROLLOUT

FIGURE 3

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PRELIMINARY DATA



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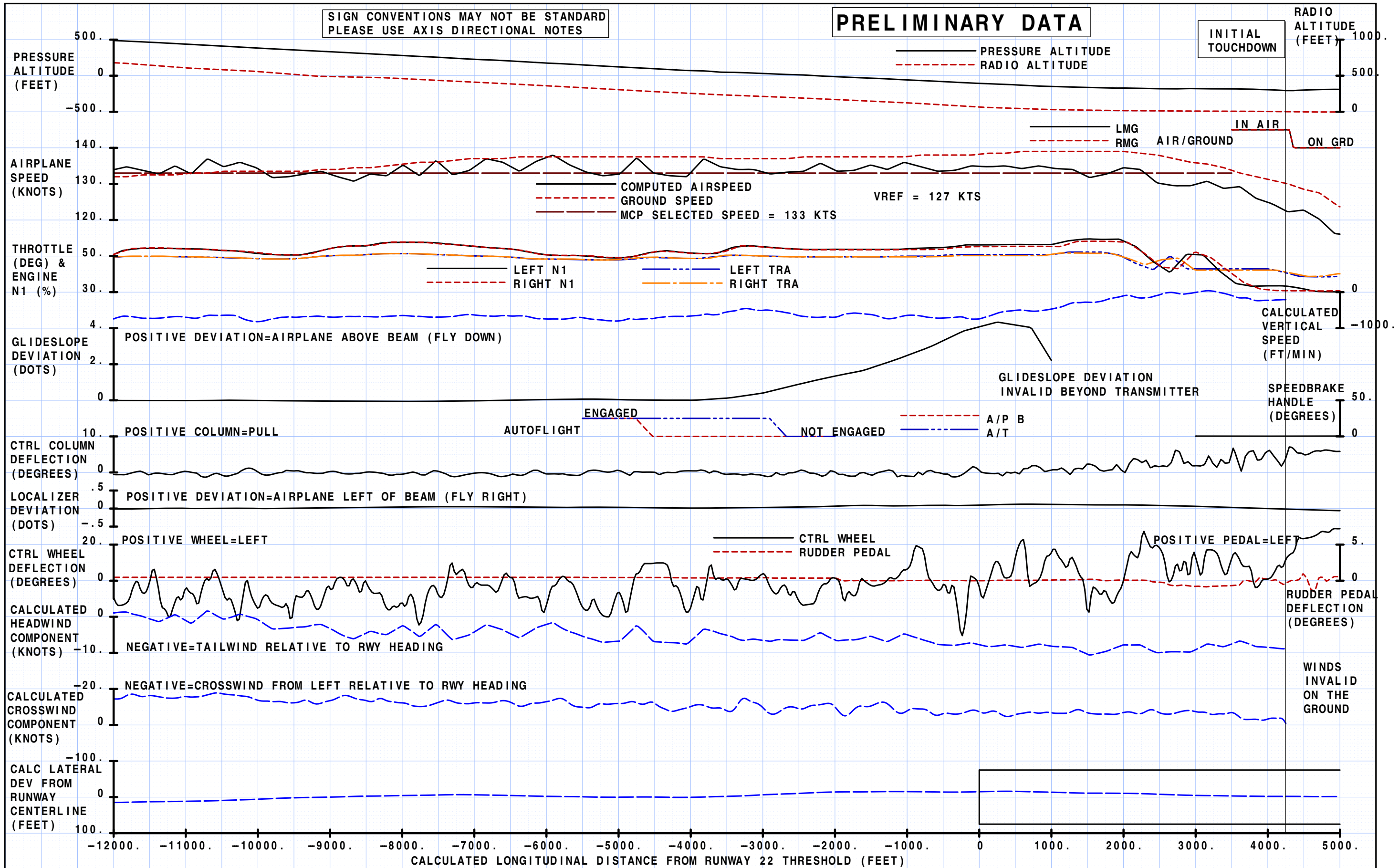
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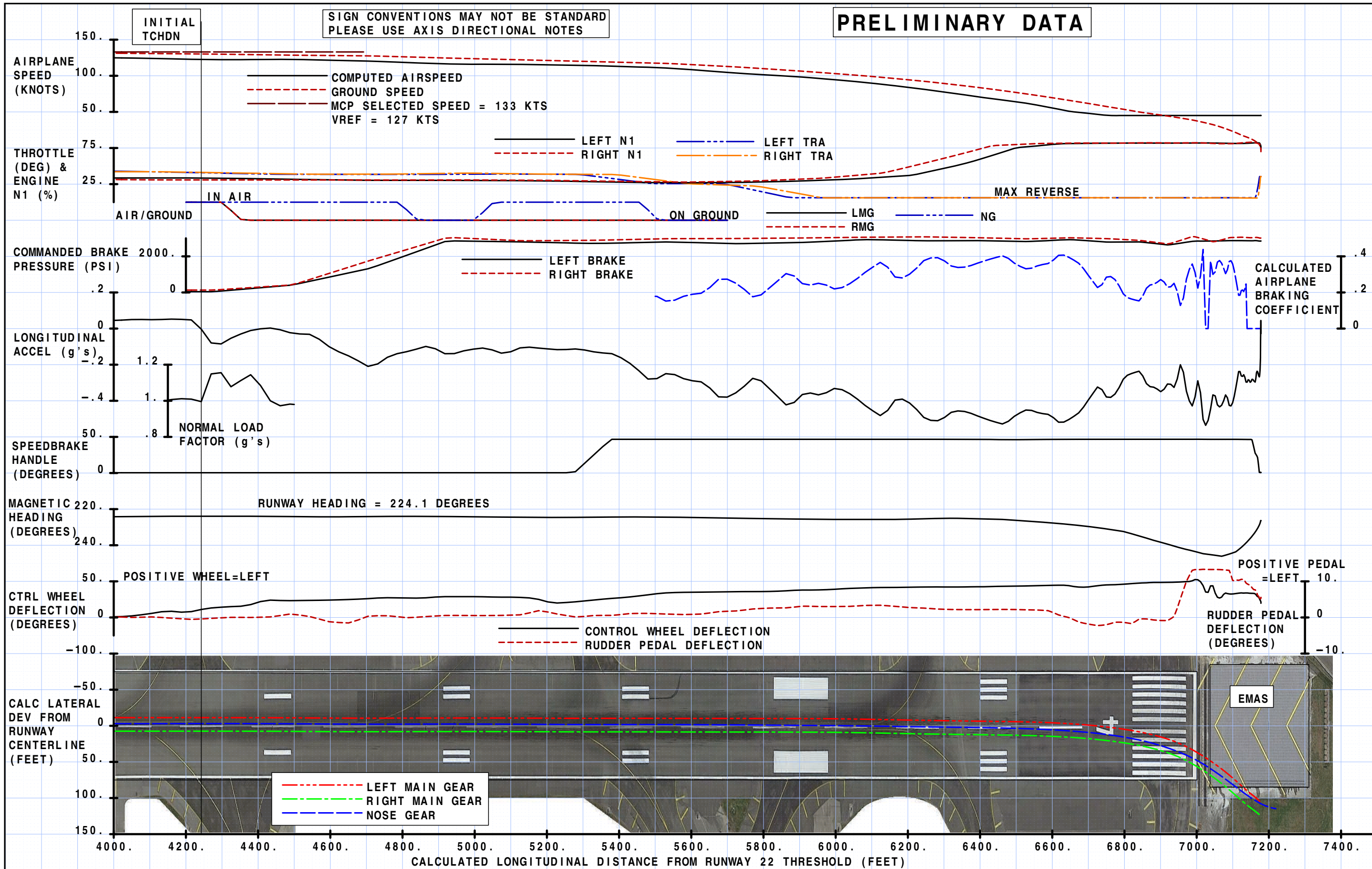
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