National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

CEN21FA215

RECOVERABLE DATA MODULE & COCKPIT DISPLAYS

Specialist's Factual Report

July 14, 2022

A. ACCIDENT

Location: Englewood, Colorado
Date: May 12, 2021
Time: 10:23 mountain daylight time (MDT)
Airplane: Cirrus SR22

B. RECOVERABLE DATA MODULE & COCKPIT DISPLAYS SPECIALIST

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National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A data group was not convened. The NTSB Vehicle Recorder Division received the following devices:

Recorder Manufacturer/Model: Heads Up Technologies RDM
Part Number: RDM100-02
Recorder Serial Number: unknown

Recorder Manufacturer/Model: Garmin Perspective SD Card
Part Number: N/A
Recorder Serial Number: unknown

1.0 Heads Up Technologies RDM Description

The Heads Up Technologies RDM is a data recording device located in the SR22 tail. It incorporates limited crash and fire protections but does not meet any standard for crash protected flight recorders.

1.1 Recorder Condition

The RDM cable was severed during recovery. A replacement cable was fabricated and the data were extracted normally from the recorder (see figure 1).

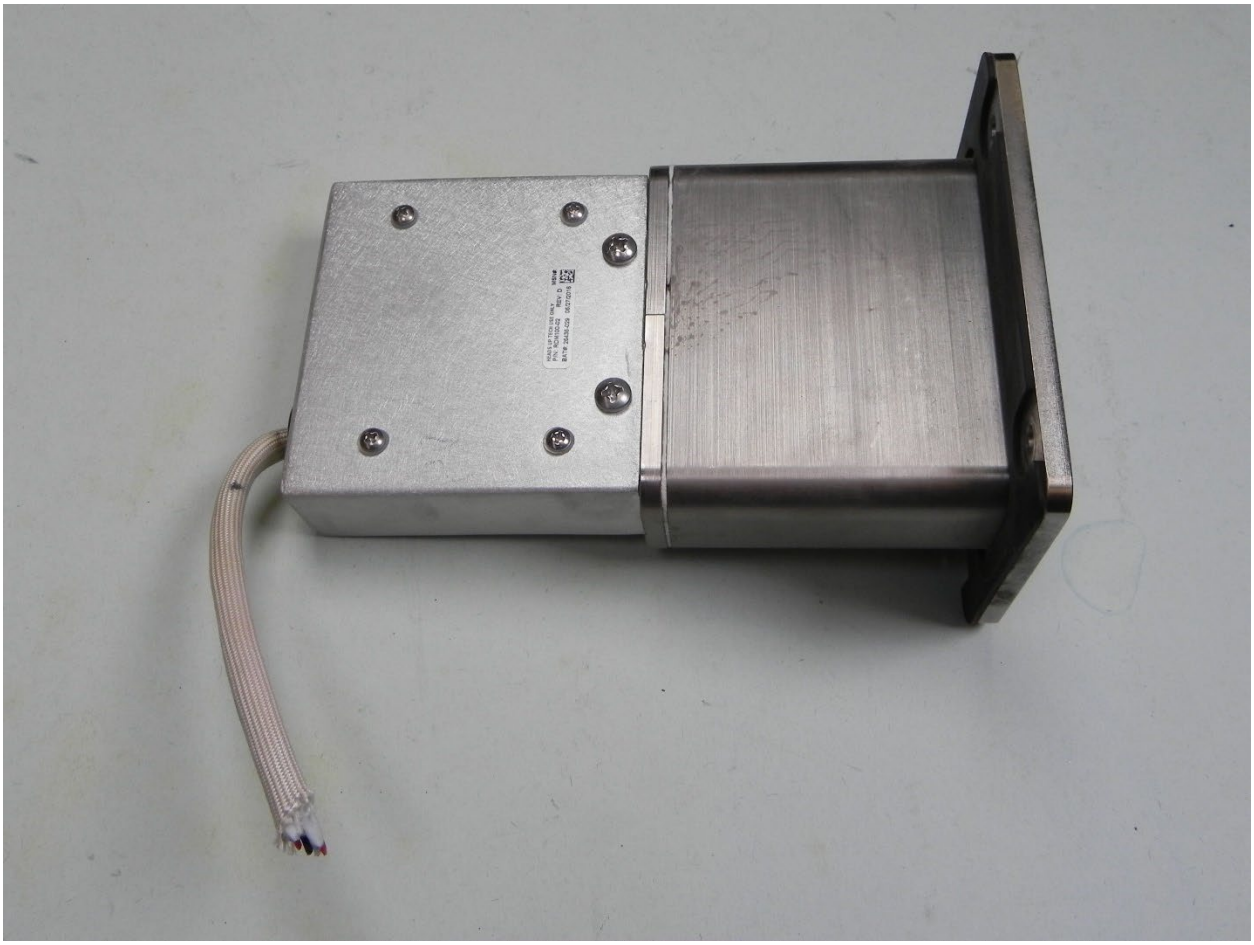

Figure 1. RDM condition, as received.

1.2 Recording Description

The RDM recording contained approximately 94 hours of data. Timing of the RDM data is measured in universal coordinated time (UTC). The accident flight was the last flight of the recording, and its duration was approximately 63 minutes.

1.2.1 Engineering Unit Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from Garmin. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).[1]

[1] CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

1.3 Time Correlation

Correlation of the RDM data from UTC to the local MDT was established by subtracting 6 hours.

2.0 Garmin Perspective SD Card Description

The Garmin Perspective Integrated Flight Deck is a collection of multiple avionics units which include flight displays, air data computers, attitude/heading reference system (AHRS), communications and other systems. A typical installation includes a primary flight display (PFD) and a multi-function display (MFD). Each display includes two secure digital (SD) card slots, an upper and a lower slot. The lower SD card slot is used by the system for software updates and various databases.

Depending on the display unit software, the aircraft can include a data logging feature. The data logging feature must be enabled by the aircraft operator. If the data logging feature is available and enabled, a SD card must be installed in the upper slot of the MFD. Depending on the airframe and engine combination as many as 64 parameters can be stored at a rate of one sample per second (1Hz). According to the manufacturer of the display unit, one flight hour can be stored in approximately 2 megabytes (MB). The SD card typically used is 2 gigabytes (GB) in size and can store over 1,00 flight hours.

2.1 Recorder Condition

The Garmin Perspective SD flight data card was undamaged. Data were extracted normally (see figure 2). Two other SD cards were recovered but they only contained various aeronautical databases and did not contain flight data.

Figure 2. SD card containing flight data (left, circled).

2.2 Recording Description

The SD card contained 1,683 data logs dating back to September 2016. Not every data log was associated with a flight, some were ground power cycles. Timing of the data is provided in UTC. The accident flight was the last data log on the card, and its duration was approximately 63 minutes.

2.2.1 Engineering Unit Conversions

Data on the SD card is provided in plain text with included engineering units, so no further conversion was necessary.

2.3 Time Correlation

Correlation of the SD card data from UTC to the local MDT was established by subtracting 6 hours.

D. FIGURES AND TABULAR DATA

Figures 3 and 4 show basic flight data from the last 13 minutes and last 3 minutes of the accident flight, respectively. Figure 5 shows engine related data from the last 13 minutes of flight. Where similar data parameters exist between the RDM and SD card, the RDM data is plotted. Figure 6 displays Google Earth imagery of the accident approach of the Cirrus along with the accident approach of the Metroliner.[2]

These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page. Google Earth imagery does not represent the weather or lighting conditions on the day of the accident.

The SR22 departed Centennial Airport (KAPA) at about 9:21 MDT. The flight departed the airport environment to the west and then north. At about 9:54 MDT, in the vicinity of Fort Collins and about 8,500 feet (ft) Mean Sea Level (MSL) pressure altitude, the SR22 turned back to the south. At 10:18:53 MDT, the autopilot was switched off and remained off for the rest of the flight. At about 10:21 MDT, the SR22 entered a right downwind for runway 17R at KAPA. The SR22 began a turn to right base for runway 17R at about 10:22:50 MDT. At this time, the SR22 was at about 7,400 ft MSL pressure altitude and 125 knots indicated airspeed (IAS). SR22 began descending and accelerating at about 10:22:55 MDT. At 10:23:17 MDT, the SR22 Garmin Perspective avionics generated a traffic alert that persisted until after the collision with the Metroliner. The SR22 began turning final for runway 17R at about 10:23:40 MDT. The RDM data indicate flaps were extended to 50% at 10:23:49 MDT.

[2] Flight data from the Metroliner is FAA provided ADS-B data. See Air Traffic Control Specialist's Factual Report for more information.

At this time, the SR22 was at about 6,300 ft MSL pressure altitude and 134 knots IAS. The SR22 also crossed the runway 17R extended centerline at this time. The data indicate that the aircraft collided at about 10:23:52 MDT while the SR22 was about 6,360 ft MSL pressure altitude and 130 knots IAS along the extended centerline for runway 17L. The RDM data indicate that the Cirrus Airframe Parachute System was deployed at 10:23:55 MDT.

Table 1 lists the RDM parameters verified and provided in this report. Additionally, table 2 describes the unit abbreviations used in this report. The corresponding tabular data used to create figures 3 to 6 are provided in electronic comma separated value (CSV) format as attachment 1 to this report.

Submitted by:

Christopher Babcock
Sr. Aerospace Engineer

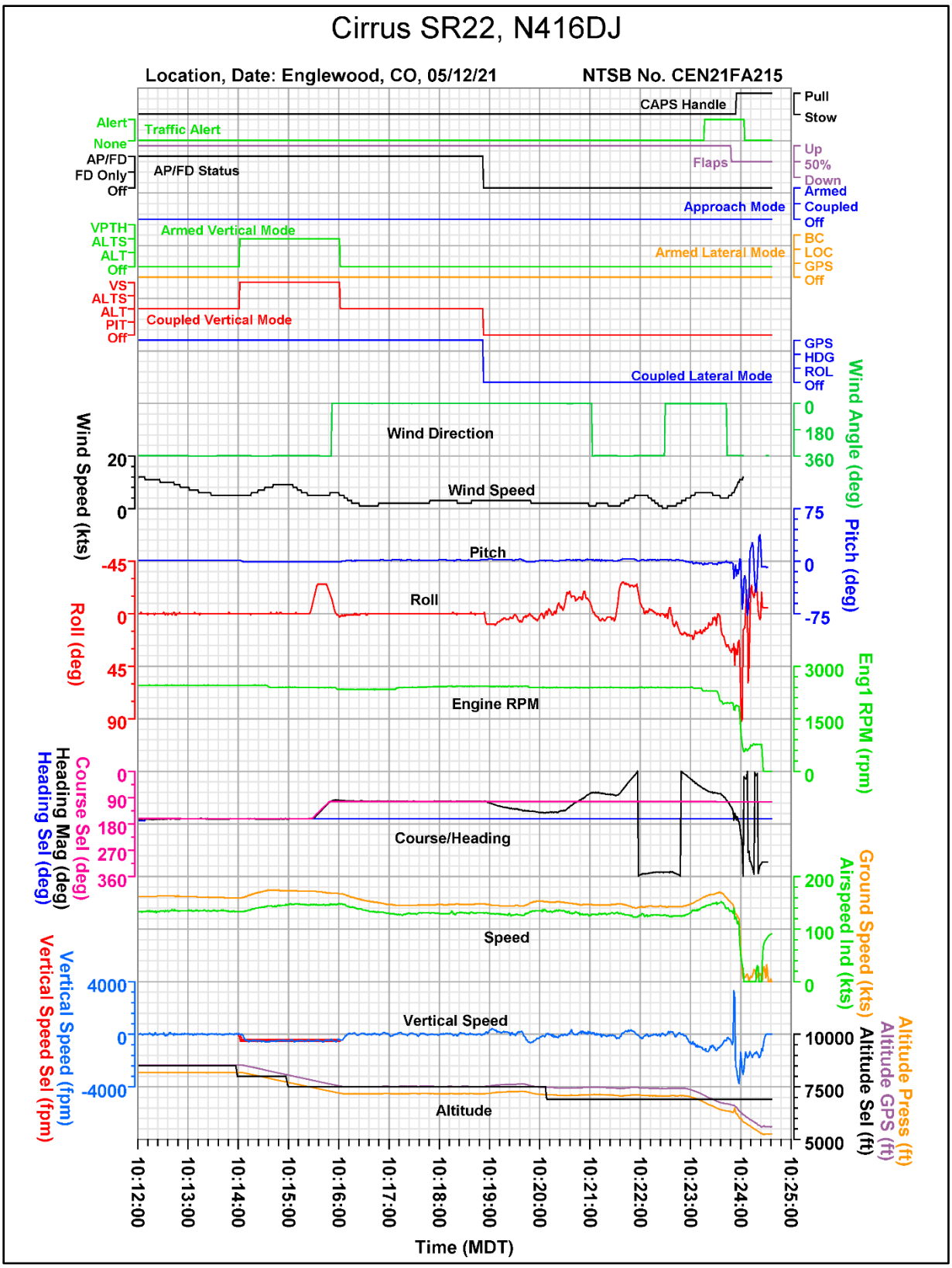

Figure 3. Plot of SR22 basic parameters for last 13 minutes of flight.

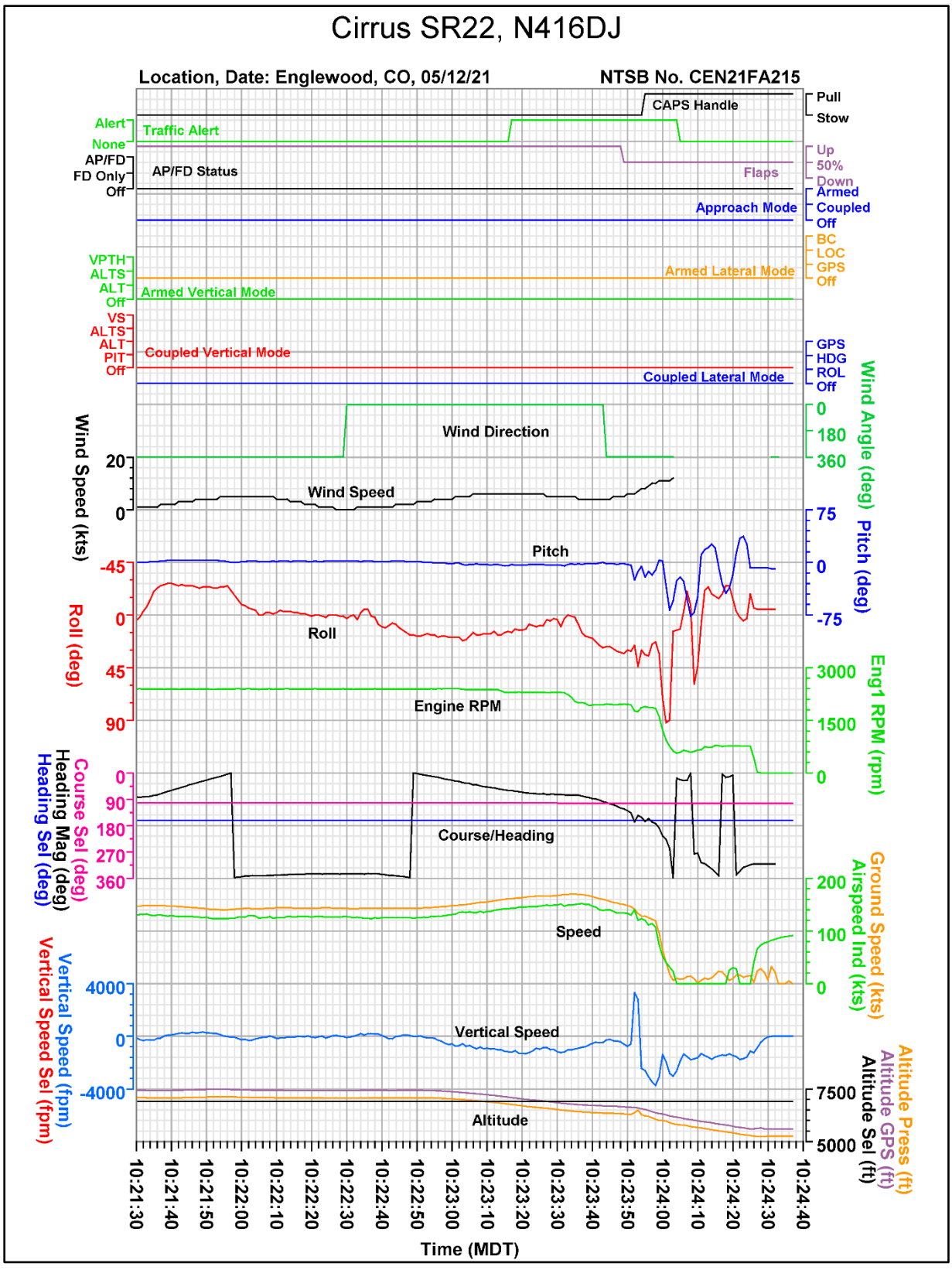

Figure 4. Plot of SR22 basic parameters for last 3 minutes of flight.

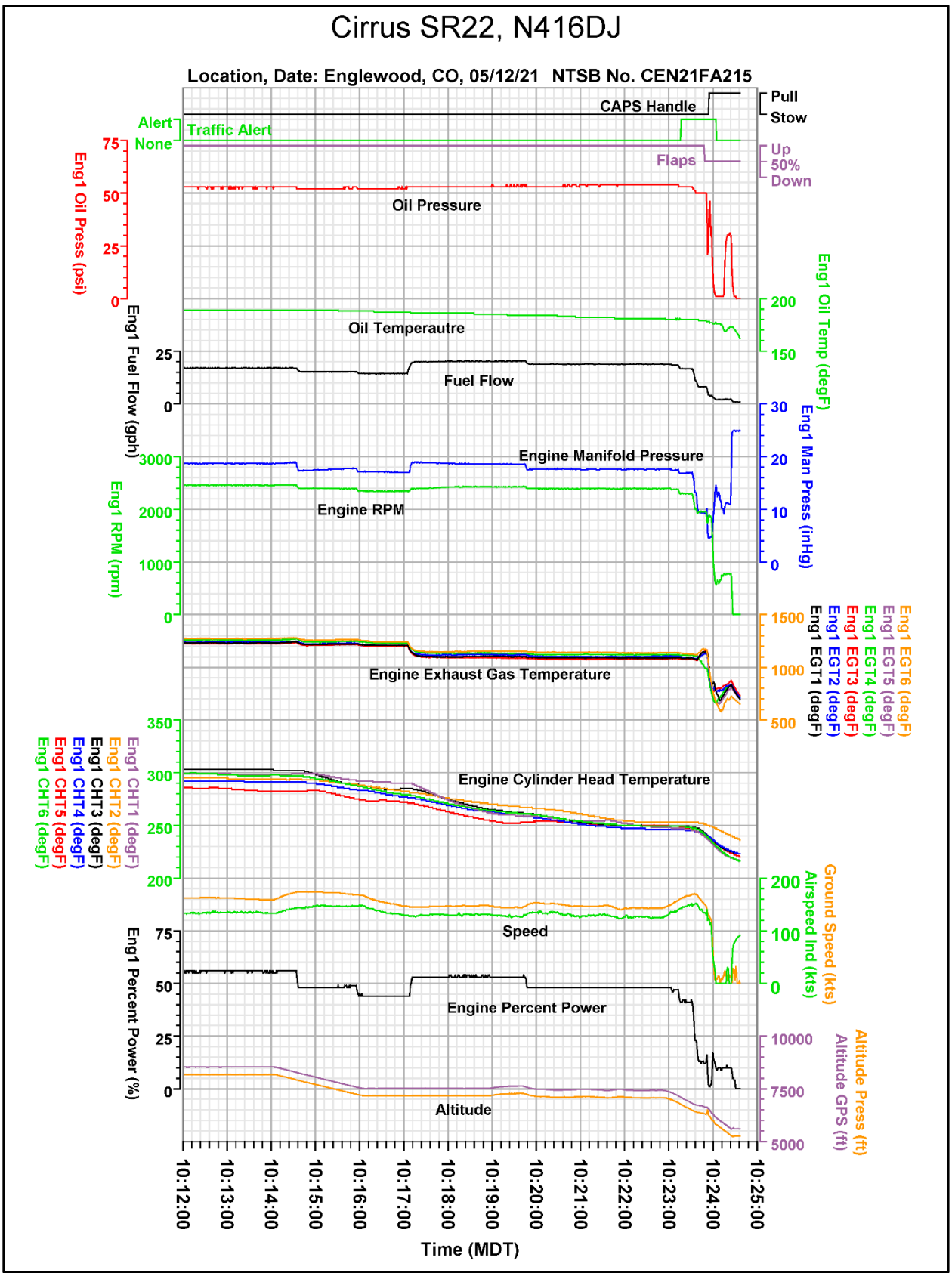

Figure 5. SR22 Engine data during last 13 minutes of flight.

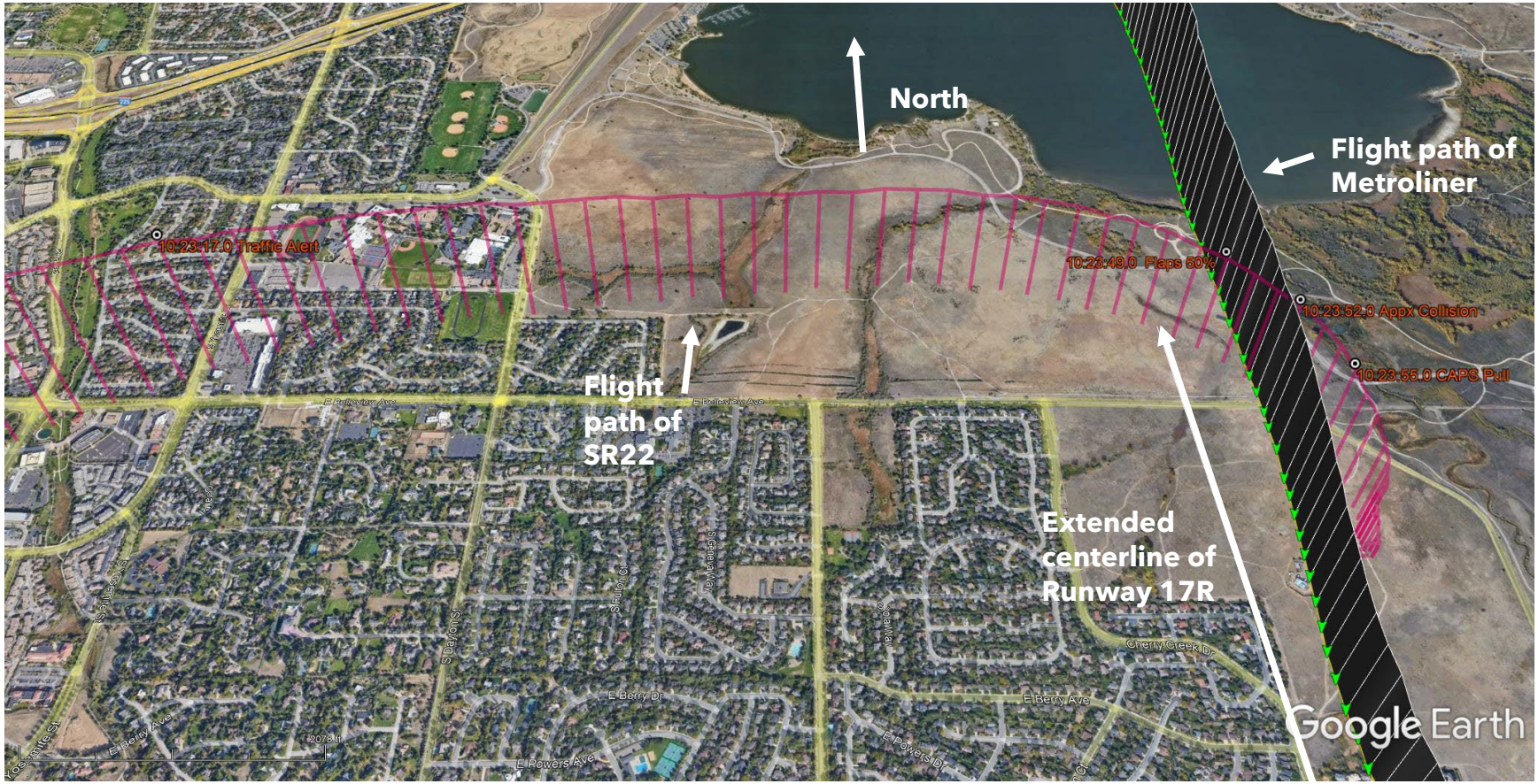

Figure 6. Flight paths of SR22 and Metroliner.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 1 lists the plot/table labels, parameter names, and units. Additionally, table 2 describes the unit abbreviations used in this report.

Table 1. Verified and provided RDM parameters

Plot/Table Labels	Parameter Names	Units
Airspeed Ind	Indicated Airspeed	kts
Altitude Press	Pressure Altitude	ft
Altitude Sel	Selected Altitude	ft
Altitude GPS	GPS Altitude	ft
AP/FD Status	Autopilot/Flight Director Status	
Approach Mode	Autopilot Approach Mode Status	
Armed Lateral Mode	Autopilot Lateral Mode Arming Status	
Armed Vertical Mode	Autopilot Vertical Mode Arming Status	
CAPS Handle	Cirrus Airframe Parachute System Handle Position	
Coupled Lateral Mode	Autopilot Lateral Mode Coupled Status	
Coupled Vertical Mode	Autopilot Vertical Mode Coupled Status	
Eng1 CHT#	Engine Cylinder Heat Temperature	degF
Eng1 EGT#	Engine Exhaust Gas Temperature	degF
Eng1 Fuel Flow	Engine 1 Fuel Flow Rate	gph
Eng1 Man Press	Engine 1 Manifold Pressure	inHg
Eng1 Oil Press	Engine 1 Oil Pressure	psi
Eng1 Oil Temp	Engine 1 Oil Temperature	degF
Eng1 Percent Power	Engine Percent Power	%
Eng1 RPM	Engine 1 RPM	rpm
Flaps	Flap Setting	%
Ground Speed	Ground Speed	kts
Heading Mag	Magnetic Heading	deg
Heading Sel	Selected Heading	deg
Latitude	Latitude Coordinate	deg
Longitude	Longitude Coordinate	deg
Pitch	Pitch Angle	deg
Roll	Roll Angle	deg
Traffic Alert	Traffic Alert Status	
Vertical Speed	Vertical Speed	fpm
Vertical Speed Sel	Selected Vertical Speed	fpm
Wind Angle	Wind Direction	deg
Wind Speed	Wind Speed	kts

Note: This RDM records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (inHg). The pressure altitude information presented in the plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Note: Parameters with a blank unit description in table 1 are discretes. A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.

Table 2. Unit abbreviations

Unit Abbreviations	Descriptions
%	percent
rpm	percent revolutions per minute
deg	degrees
degF	degrees Fahrenheit
fpm	feet per minute
ft	feet
gph	gallons per hour
inHg	inches of Mercury
kts	knots
psi	pounds per square inch