National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594

ERA22LA169

ENGINE CONTROL UNIT

Specialist's Factual Report

September 12, 2022

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A. EVENT SUMMARY

Location: Smithfield, North Carolina
Date: March 25, 2022
Time: 1613 eastern daylight time (EDT)
Airplane: Diamond Aircraft DA-40NG, N471BL

B. ENGINE CONTROL UNIT SPECIALIST

Specialist: W. Deven Chen
National Transportation Safety Board (NTSB)
Washington, DC

C. DETAILS OF THE INVESTIGATION

A recorder group was not convened. The NTSB Vehicle Recorder Division received the following engine control unit:

Recorder Manufacturer/Model:	Austro Engine 300 EECU
Part Number:	E4A-92-100-000
Recorder Serial Number:	3625

1.0 Austro Engine 300 EECU Description

The Austro Engine 300 EECU is the electronic engine control unit of an Austro Engine 300 (known as AE300). The EECU encloses two engine control units (ECUs), ECU A and ECU B. Each ECU contains non-volatile flash memory[1] which is used to store 16 channels of signals. These signals are sampled at an interval of 1 second as long as the ECU is powered on. Both ECUs perform this task independently. These signal channels are connected to operational data parameters including Engine Oil Pressure, Coolant Temperature, Intake Air Temperature, Battery Voltage, Power Level Position, Gearbox Oil Temperature, etc. The unit can record these 16 channels at a 1 second sampling rate for about 90 hours of flight time, depending on the number and duration of flights. The oldest data will be overwritten when the memory reach full. The unit records in Coordinated Universal Time (UTC). In addition, the unit saves failure information into a non-volatile Fault Code Memory (FCM). This FCM can hold up to 20 different faults detected, including 9 environmental conditions (e.g., timestamp, voltage, temperatures, pressures, etc.) which are specific for each possible failure and are sampled and stored at the time the failure occurred. The full contents of the FCM will be included in the engine log file download.

[1] Non-volatile flash memory – electronic memory device that does not need external power for data retention.

1.1 Recorder Condition and Data Recovery

The device was undamaged upon arrival at the Vehicle Recorder Division, as shown in Figure 1. The manufacturer was contacted and provided hardware and software to facilitate data recovery. The software provided by the manufacturer could view the recorded data and export raw data but could not export engineering unit data. The manufacturer stated that there was a data conversion software that could convert the raw data into engineering unit data, but that software could only run on the manufacturer's server at that time. The recorded raw data was then exported and sent to the manufacturer, and the manufacturer sent back the converted engineering unit data.

Figure 1. Austro Engine Electronic Engine Control Unit as received.

1.2 Recording Description

The converted engineering unit data sent back from the manufacturer contained 75 sessions of recording, ranging from February 16, 2022, to March 25, 2022. There were three sessions recorded on March 25, 2022, started at 12:33, 17:00, and 20:07 UTC, respectively. The session recorded at 20:07 UTC, the last session of the recording, was determined to be associated with the event. This session's duration was 7 minutes and 56 seconds, with sampling frequency of 1Hertz.

1.2.1 Parameters Provided

Table 1 lists the recorder parameters verified and provided in this report.

Table 1. AE300 EECU Data Parameters Provided.

Parameter Name [units]	Parameter Description
PosPL [%]	Power lever position in percentage
rTrq [%]	Output torque in percentage
nProp [1min]	Engine speed in revolutions per minute (RPM)
tIntakeAir [degF]	Intake air temperature in degrees Fahrenheit
tOilEng [degF]	Engine oil temperature in degrees Fahrenheit
tOilGBX [degF]	Gearbox oil temperature in degrees Fahrenheit
tCoolant [degF]	Coolant temperature in degrees Fahrenheit
pBoost [inHg]	Boost pressure in inches of mercury
pOilEng [PSI]	Engine oil pressure in pounds per square inch
pAmbient [inHg]	Ambient air pressure in inches of mercury (measured inside the EECU enclosure)
pRail [PSI]	Common rail pressure in pounds per square inch
pFuel [PSI]	Fuel pressure in pounds per square inch
|v|OliEng [mm]	Engine oil level in milliliters (not calibrated, use only for trend analysis)
uBatt [V]	Battery voltage in volts

1.3 Time Correlation

The data was recorded in UTC and converted to eastern daylight time (EDT), the local time of the event, for the rest of the report.

D. FIGURES AND TABULAR DATA

Figures 2 and 3 show parameter plots of the data recorded during the event on March 25, 2022.

The corresponding tabular data used to create Figures 2 and 3 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

W. Deven Chen
Electrical Engineer – Recorder Specialist

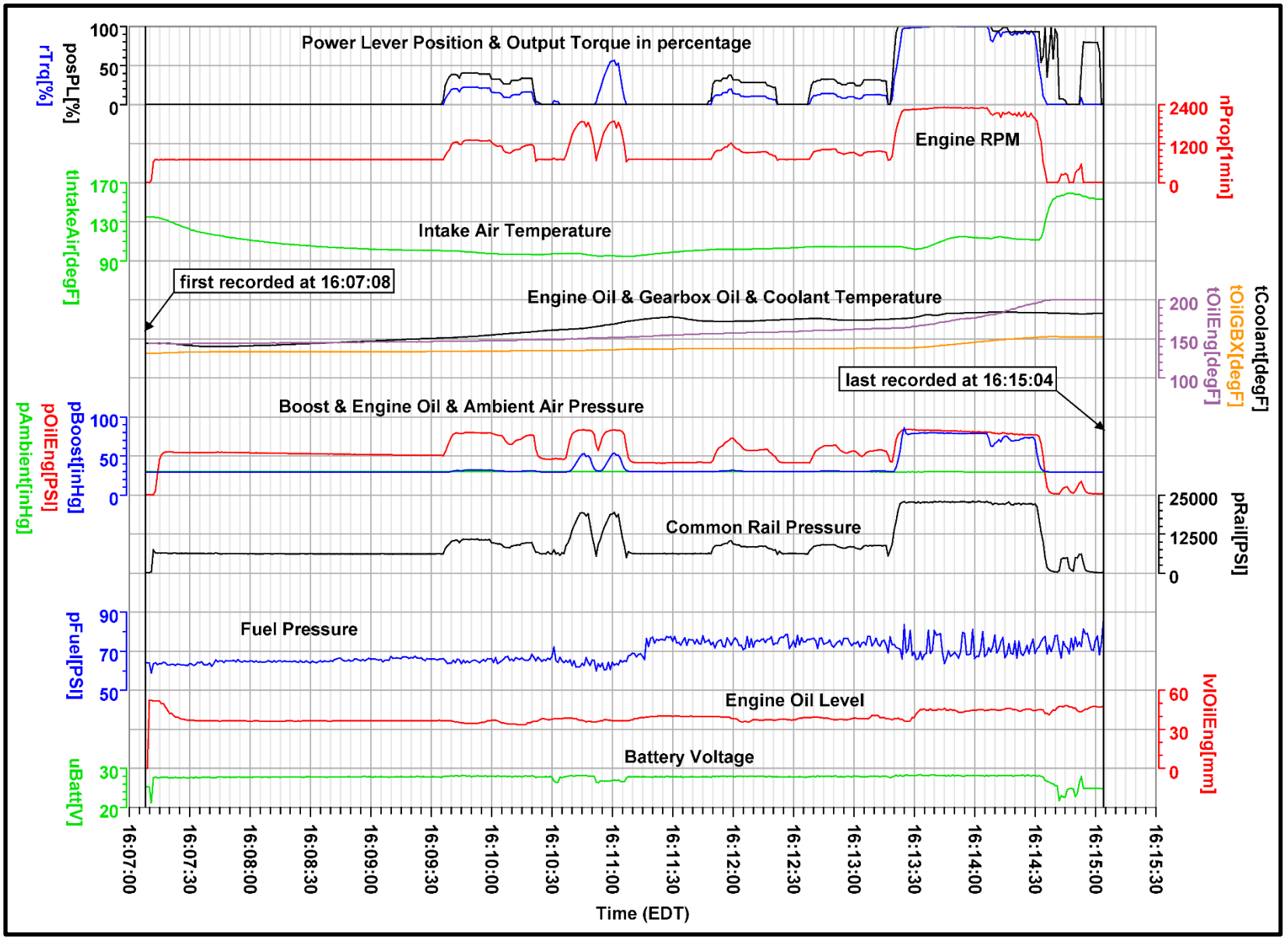

Figure 2. Plot of data parameters for the entire event recording.

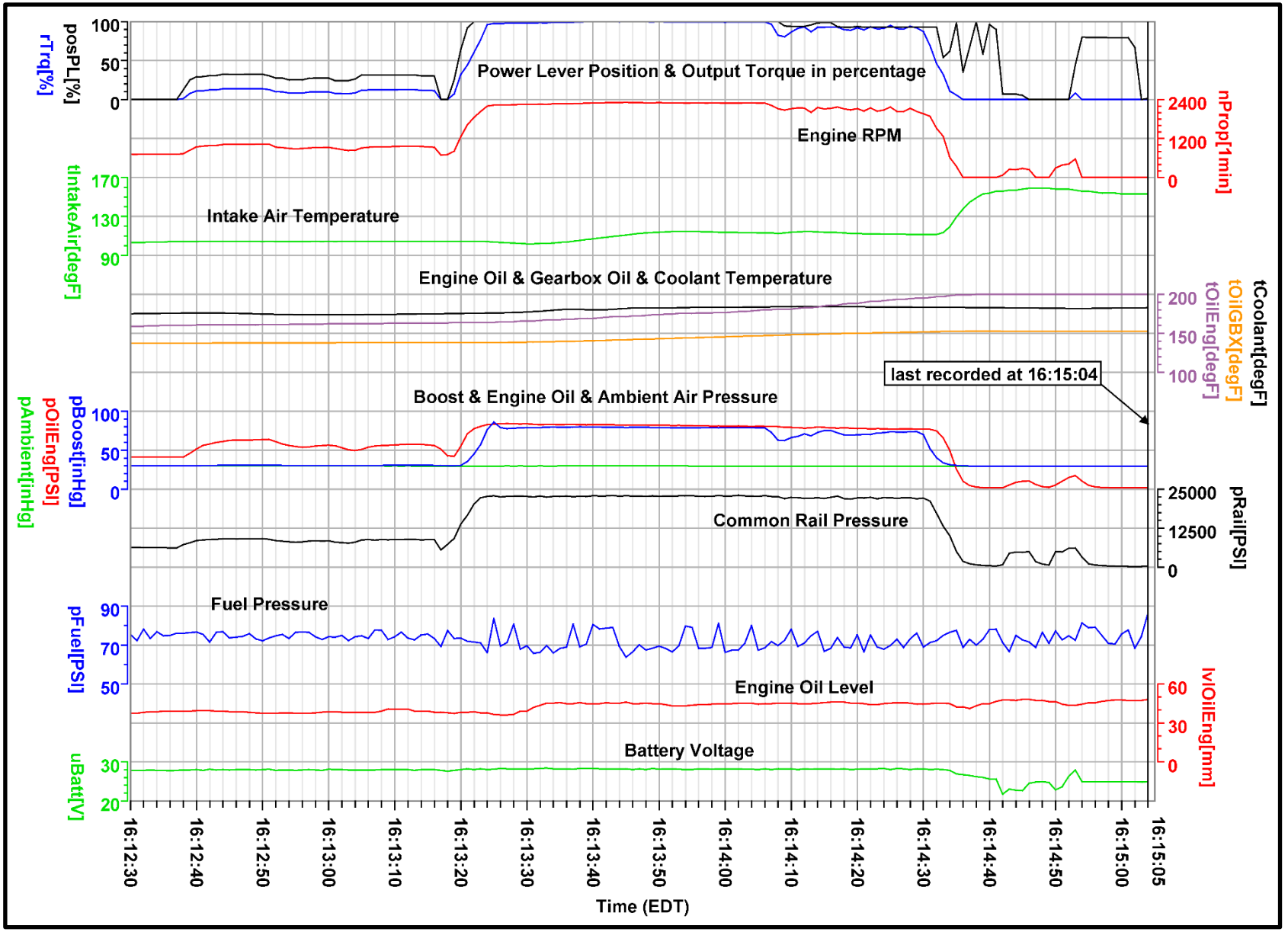

Figure 3. Plot of data parameters for the final portion of the event recording.