

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

December 16, 2020

Electronic Devices

Specialist's Factual Report
By Gerald Kawamoto

1. EVENT SUMMARY

Location: Billings, MT
Date: January 11, 2020
Aircraft: Cessna TR182
Registration: N736YU
Operator: Marginal Aviation LLC
NTSB Number: WPR20FA063

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic devices:

Device Manufacturer/Model:	Garmin GTN 750
Serial Number:	1ZA022071
Device Manufacturer/Model:	JPI EDM-900
Serial Number:	07369

3.1. Garmin GTN 750 Device Description

The Garmin GTN 750 is a panel-mounted navigator featuring an 800 x 600 pixel, 6.9 inch color liquid crystal (LCD) display. It has a GPS/SBAS engine and is TSO-c146c certified for primary domestic, oceanic, and remote navigation including enroute, terminal, and non-precision approaches, and approaches with vertical guidance, such as LPV and LNA/VNAV. The unit can simultaneously give aviators vital approach information and weather and traffic data in relation to their position on a large, color moving map display. Its color moving map features a built-in database that shows cities, highways, railroads, rivers, lakes, and coastlines. The unit has a slot on the front for a Jeppesen database containing all airports, VORs, NDBs, Intersections, FSSs, Approaches, DPs/STARs and SUA information. A flight plan composed of multiple waypoints, including user-defined waypoints, can be programmed in the unit. The GTN 750 also includes a TSO approved airborne VHF communications transceiver and TSO approved airborne VOR/Localizer and Glideslope receivers. The unit contains an internal SD card storing flight log data, which can be accessed through the slot in the right side of the unit. If the unit is equipped

with a firmware v6.50 or later, the internal SD card will store a limited set of flight data information.

3.1.1. Garmin GTN 750 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an external examination revealed the device had sustained impact damage, as shown in Figure 1, rendering it inoperable. The device was received without the touchscreen display. An internal SD card was extracted from the device and historical data was downloaded normally using a functioning surrogate device.

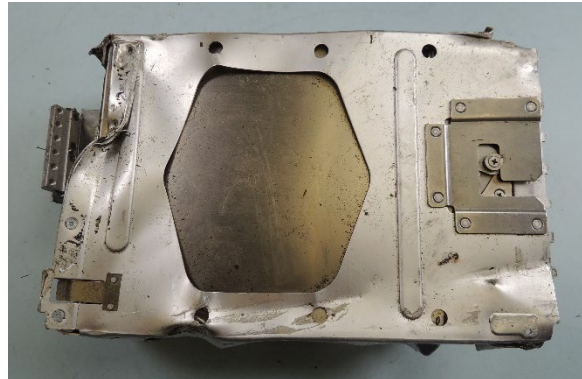


Figure 1. Garmin GTN 750 as received.

3.1.2. Garmin GTN 750 Data Description

The data extracted included 75 logs from July 12, 2019, through January 12, 2020.¹ The accident flight was recorded starting at 00:31:47 UTC and ending at 01:01:22 UTC on January 12, 2020. In addition, a Google Earth overlay of the first leg of the flight starting January 11, 2020, at 23:47:36 UTC and ending January 12, 2020 at 00:19:29 UTC is included in this report. The data were sampled at a one sample per second rate.

3.1.3. Garmin GTN 750 Parameters Provided

Table 1 describes basic data parameters provided by the GPS device.

¹ All dates and times are referenced to Coordinated Universal Time (UTC).

Table 1. Garmin GTN 750 Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (UTC) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
AltB (ft)	Barometric Altitude ² (feet)
AltGPS (ft wgs)	Recorded GPS Altitude (feet)
AltMSL (ft msl)	MSL Altitude ³ (feet)
AltPress (ft)	Pressure Altitude ⁴ (feet)
GndSpd (kt)	Average derived groundspeed (knots)
TAS (kt)	True Airspeed (knots)
HDG (deg)	Magnetic Heading (degrees)
TRK (deg)	Average derived true course (degrees)
VSpd (fpm)	Vertical Speed (feet per minute)
FQtyC (gals)	Fuel Quantity (gallons)

3.2. JPI EDM-900 Device Description

The J. P. Instruments EDM-900 is a panel mounted gauge that the operator can monitor and record up to 24 parameters. Depending on the installation, engine parameters monitored can include: Exhaust Gas Temperature (EGT), Cylinder Head Temperature (CHT), Oil Pressure and Temperature, Manifold Pressure, Outside Air Temperature, Turbine Inlet Temperature, Engine Revolutions per Minute, Compressor Discharge Temperature, Fuel Flow, Carburetor Temperature, and Battery Voltage. The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory for data storage of the parameters recorded and calculated.⁵ The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The data can then be downloaded by the operator using the J.P. Instruments software.

² Baro-corrected altitude (or indicated altitude) is derived by adjusting the altimeter for local atmospheric conditions.

³ GPS altitude is converted to a Mean Sea Level based altitude (GSL altitude). GSL altitude accuracy is affected by factors such as satellite geometry, but is not subject to variations in pressure and temperature.

⁴ Received by pressure altitude source in the aircraft.

⁵ Non-volatile memory (NVM) is semiconductor memory that does not require external power for data retention.

3.2.1. JPI EDM-900 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an external examination revealed the device had sustained impact damage, as shown in Figure 2, rendering it inoperable. An internal examination revealed that the circuit boards and non-volatile memory chip were undamaged. The device was sent to the manufacturer and data were downloaded normally.



Figure 2. JPI EDM-900 as received.

3.2.2. JPI EDM-900 Data Description

The data extracted included 92 sessions recorded from November 27, 2018, through January 11, 2020, JPI Time. The last session was determined to be the accident flight and was recorded on January 11, 2020. The recorded time on the JPI was found to be offset 7670 seconds from the time recorded on the Garmin device. Altitude data was used to correlate the data sets and the offset was applied to JPI data plot. The data were sampled once every six seconds.

3.2.3. JPI EDM-900 Parameters Provided

Table 2 describes data parameters provided by the EDM device.

Table 2. EDM Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	JPI Time for recorded data point (HH:MM:SS)
EGT # (degF)	Exhaust Gas Temperature Cylinder # (degrees Fahrenheit)
CHT # (degF)	Cylinder Head Temperature Cylinder # (degrees Fahrenheit)
CLD (degF/min)	Shock Cooling Rate (degrees Fahrenheit per minute)
FF (gph)	Fuel Flow (gallons per hour)
USD (gal)	Fuel Used (gallons)
OilP (psi)	Oil Pressure (pounds per square inch)
OilT (degF)	Oil Temperature (degrees Fahrenheit)
HP (%)	Horsepower (Percent)
RPM (rpm)	Engine Revolutions per Minute
MAP (inHg)	Manifold Pressure (inches of Mercury)
FP (psi)	Fuel Pressure (pounds per square inch)
OAT (degC)	Outside Air Temperature (degrees Celsius)
CRB (degF)	Carburetor Temperature (degrees Fahrenheit)
ALT (ft)	MSL Altitude (feet)
SPD (kts)	Ground Speed (knots)

3.3. OVERLAYS AND TABULAR DATA

Figure 3 is a graphical overlay generated using Google Earth for the accident flight. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The first leg of the trip departed BIL at approximately 23:55 UTC and arrived at 00U at approximately 00:16 UTC. The accident flight departed 00U at approximately 00:39 UTC and the last data point was recorded at 01:01:22 UTC.

Figure 4 is a graphical overlay generated using Google Earth zoomed in on the end of the accident flight and the reported wreckage location.

Figure 5 is plot of basic parameters recorded on the Garmin GTN 750 during the accident flight. The time plotted is 00:30:00 UTC to 01:03:00 UTC.

Figure 6 is plot of parameters recorded on the JPI EDM-900 during the accident flight. The time plotted is 00:30:00 UTC to 01:03:00 UTC.

Tabular data from the Garmin used to generate figures 3 through 5 are included as Attachment 1. Tabular data from the JPI used to generate figure 6 is included as Attachment 2. These attachments are provided in electronic comma-delimited (.CSV) format.

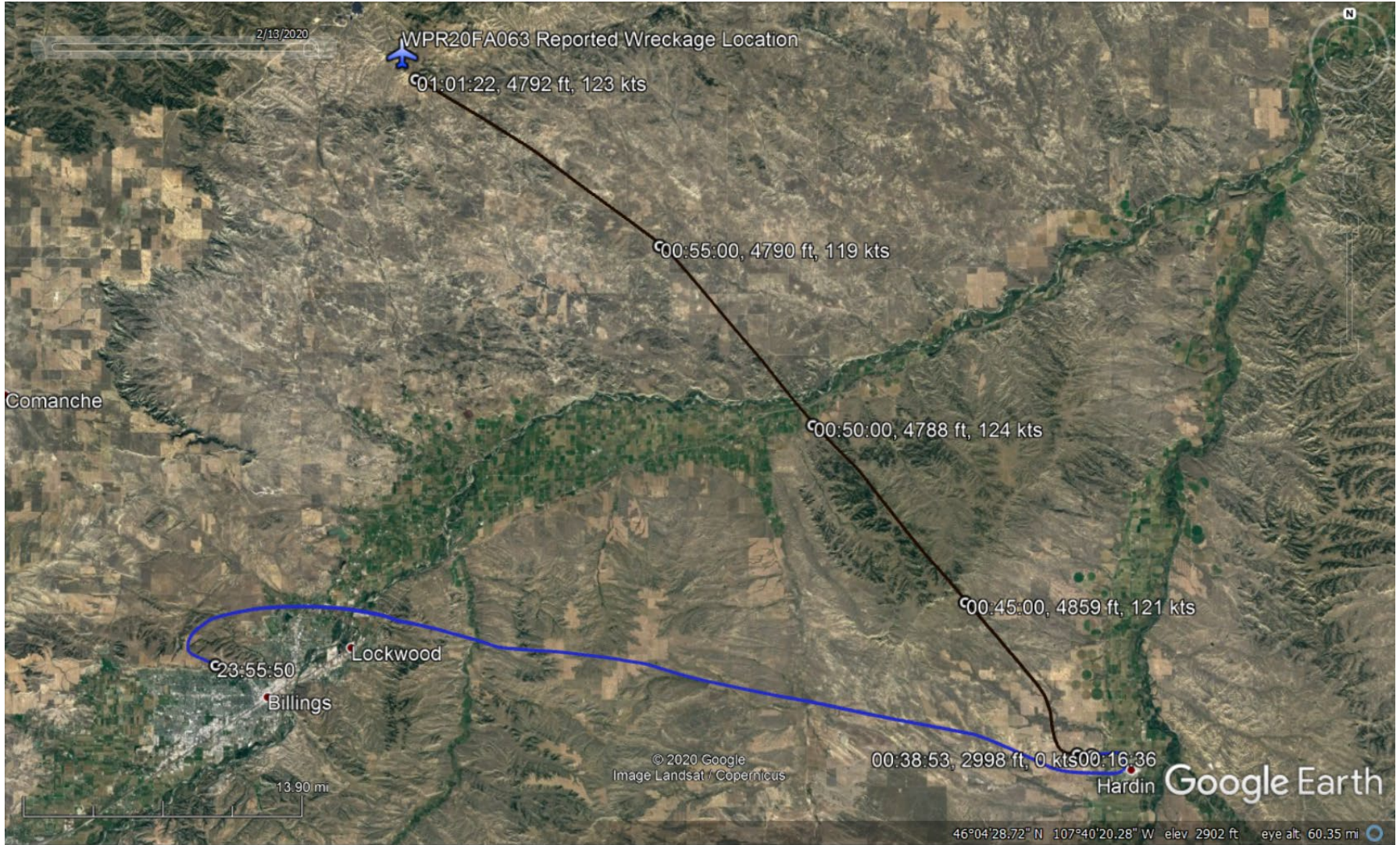


Figure 3. Google Earth overlay of the first leg of the trip departing from BIL and the accident leg departing from 00U.



Figure 4. Google Earth overlay end of the accident flight and the reported wreckage location.

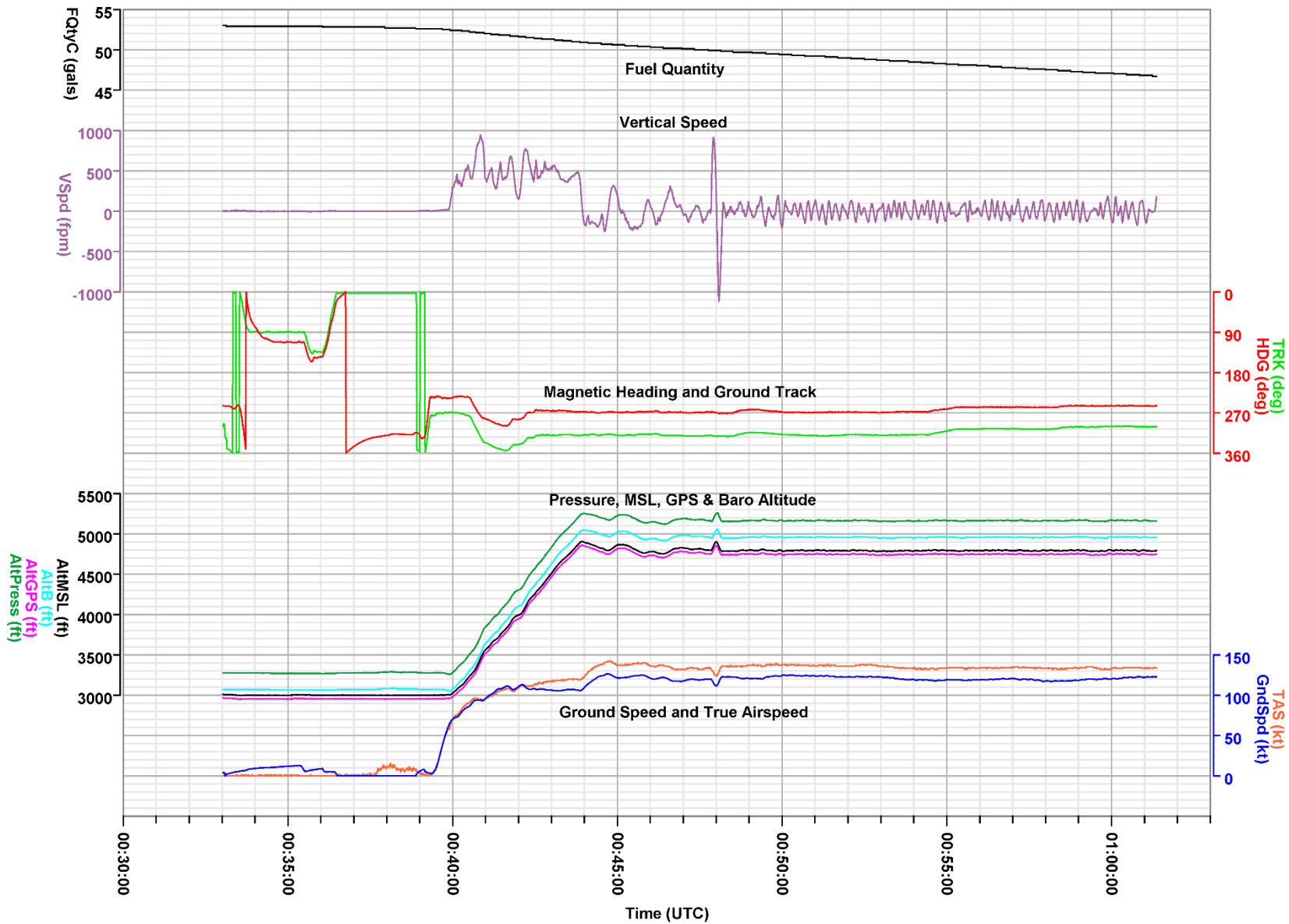


Figure 5. Plot of basic parameters recorded on the Garmin GTN 750 during the accident flight.

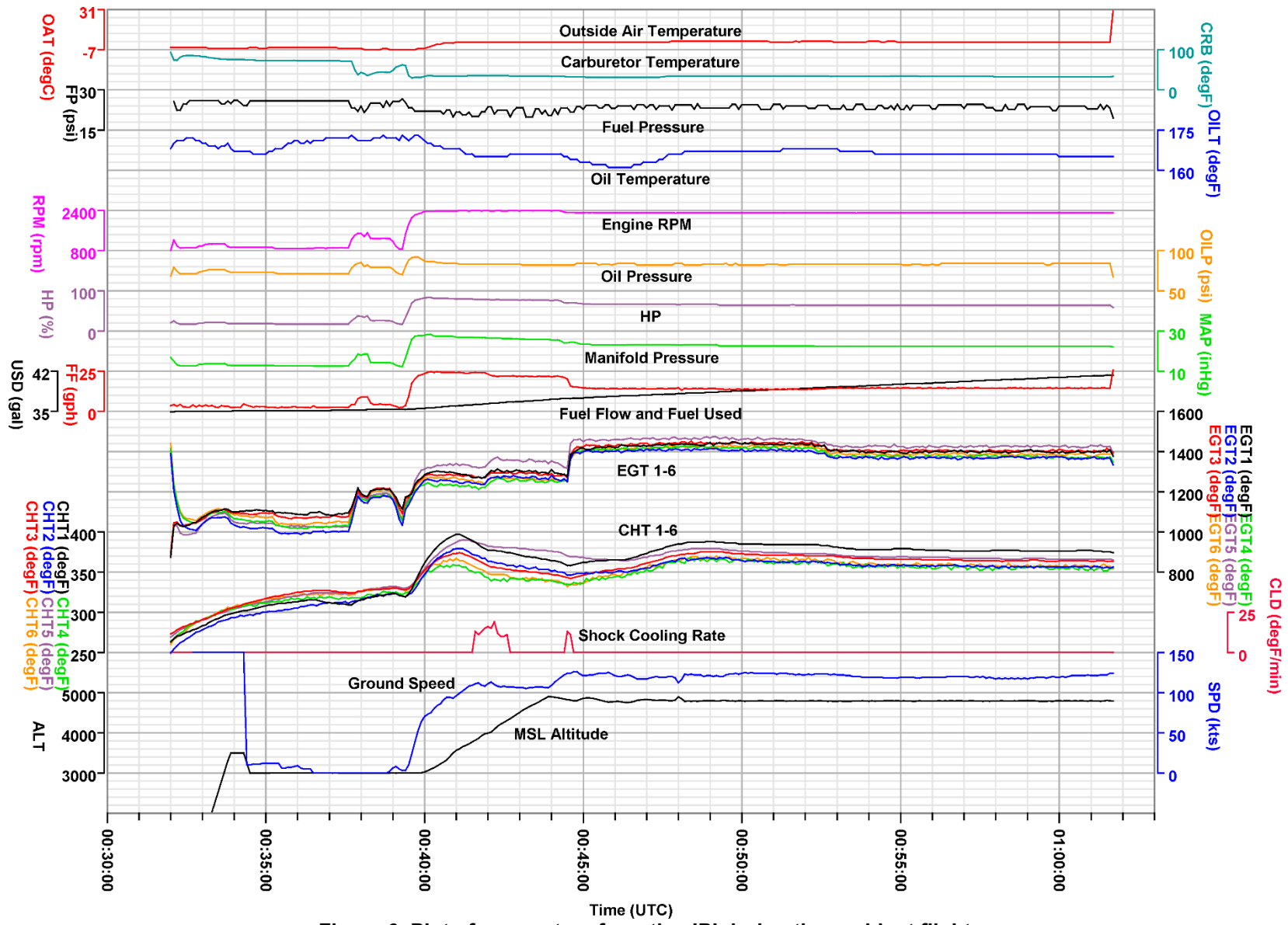


Figure 6. Plot of parameters from the JPI during the accident flight.