

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



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ELECTRONIC DEVICES

Specialist's Factual Report

September 18, 2024

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A. ACCIDENT

Location: St. Augustine, Florida
Date: March 25, 2024
Time: 1154 eastern daylight time (EDT)
1554 coordinated universal time (UTC)
Airplane: Mooney M20K, private operator, N4387W

B. ELECTRONIC DEVICES SPECIALIST

Specialist: Steven Smith
Mechanical Engineer (Recorder Specialist)
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

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

Recorder Manufacturer/Model: Garmin aera 760
Part Number: GMN-02303
Recorder Serial Number: 6HC004769

Recorder Manufacturer/Model: JPI EDM-730
Part Number: EGT-701-6C
Recorder Serial Number: 37089

1.0 Garmin aera 760 Description

The Garmin aera 760 is a battery-powered portable multi-function display and GPS receiver with a sunlight readable 7-inch diagonal touch screen operation display. The unit includes a built-in Jeppesen database and can receive XM satellite radio for flight information including NEXRAD radar, lightning, METARs, TAFs, and TFRs. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and Safe Taxi Airport Diagrams are included for selected fields. The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 250 feet and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed track log including latitude, longitude, date, time, and GPS altitude information is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information overwrites the oldest information or

recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory and 15 saved track logs can be maintained in addition to the current track log. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory (NVM).¹ The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information to a PC via built-in USB port. An internal button-battery is used to back-up power to the internal memory and real-time clock during those periods when main power is removed.

1.1 Garmin aera 760 Data Recovery

The NTSB Vehicle Recorder Laboratory received a damaged Garmin aera 760. The Garmin aera 760 device was opened and the memory chip was dislodged from the circuit board. The chip was examined under a microscope and significant damage was observed, as shown in figure 1. Examination of the chip revealed damage that precluded normal recovery procedures; thus, no data were recovered.

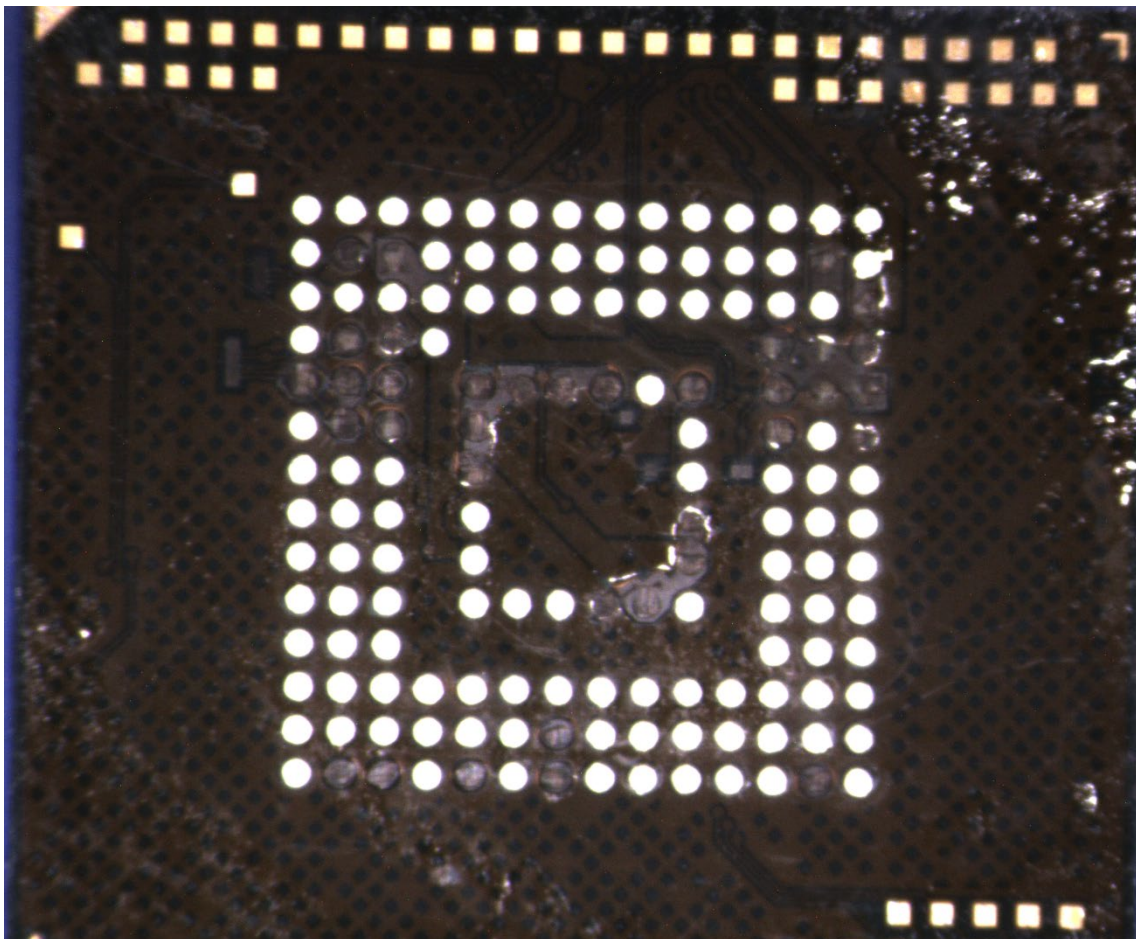


Figure 1. Garmin aera 760 damaged memory chip.

¹ Non-volatile memory is a semiconductor memory that does not require external power for data retention.

2.0 JPI EDM-730 Description

The J. P. Instruments (JPI) EDM-730 is a panel mounted LCD display that the operator can monitor and record up to 24 parameters related to engine operations. Depending on the installation engine parameters monitored can include:

- Battery Voltage
- Carburetor Temperature
- Compressor Discharge Temperature
- Cylinder Head Temperature (CHT)
- Engine Revolutions per Minute
- Exhaust Gas Temperature (EGT)
- Fuel Flow
- Manifold Pressure
- Oil Pressure and Temperature
- Outside Air Temperature
- Turbine Inlet Temperature

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 NVM for data storage of the parameters recorded and calculated. The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The memory can store up to 20 hours of data at a 6 second sample rate. For a non-damaged unit, the data can then be downloaded by the operator using a USB flash drive and following the instructions on the unit.

2.1 JPI EDM-730 Data Recovery

The JPI EDM-730 was encased in the avionics panel, which was damaged, as shown in figure 2. The panel was cut away and the device was removed. The device was cleaned and the connectors were removed. Figure 3 shows the device removed from the panel and cleaned. Power was then applied to the JPI EDM-730 and the device powered up normally. The data were downloaded using the manufacturer's procedure.

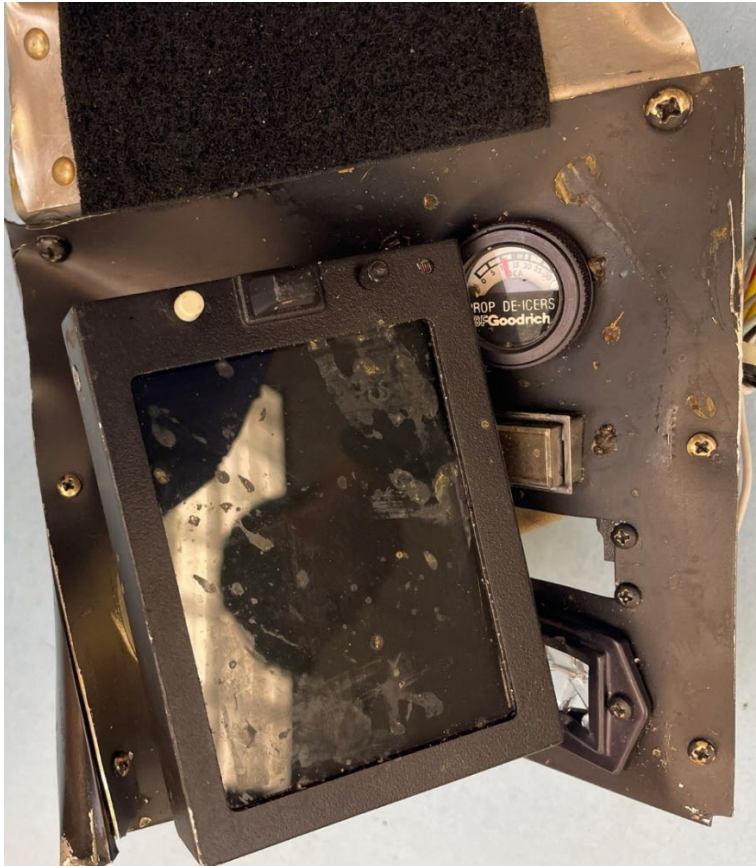


Figure 2. JPI EDM-730 as received by the NTSB Vehicle Recorder Laboratory.



Figure 3. JPI EDM-730 removed and cleaned from the avionics panel.

2.2 JPI EDM-730 Data Description

The EDM recording contained approximately 221 power cycles. The event flight was the last recording and its duration was approximately 36.6 minutes. Only data from the event flight is provided and referenced in this report.

2.2.1 JPI EDM-730 Parameters Provided

Table 1 lists the JPI EDM-730 parameters verified and provided in this report. In table 1, # represents the number of cylinders. In the data plots, the # is replaced with the appropriate cylinder ID.

Table 1. JPI EDM-730 parameters verified and provided.

Parameter Name (unit)	Parameter Description (unit)
CHT# (degF)	Cylinder Head Temperature (degrees Fahrenheit)
CLD (degF)	Shock Cooling (degrees Fahrenheit)
EGT# (degF)	Exhaust Gas Temperature (degrees Fahrenheit)
OILT (degF)	Oil Temperature (degrees Fahrenheit)
TIT (degF)	Turbine Inlet Temperature (degrees Fahrenheit)
VOLTS (V)	Volts from Essential Bus (Volts)

2.3 JPI EDM-730 Time Correlation

The JPI EDM-730 records time with the first data sample based on the unit's internal clock. This clock is set and updated by the operator. A time correlation of the JPI EDM-730 data to local time was not conducted. Instead, the times in the report are kept in JPI Elapsed Time (seconds).

D. FIGURES AND TABULAR DATA

Figures 4 and 5 contain JPI EDM-730 data recorded during the event on March 25, 2024. All the parameters listed in table 1 are plotted.

Figures 4 and 5 are time history plots displaying the same JPI EDM-730 recorded parameters. Figure 4 presents the entire recording, from 0 to 2200 seconds. Figure 5 presents the approximate start of takeoff rollout through the entire accident flight, from 1920 to 2200 seconds.

The corresponding tabular data used to create figures 4 and 5 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:
Steven Smith
Mechanical Engineer (Recorder Specialist)

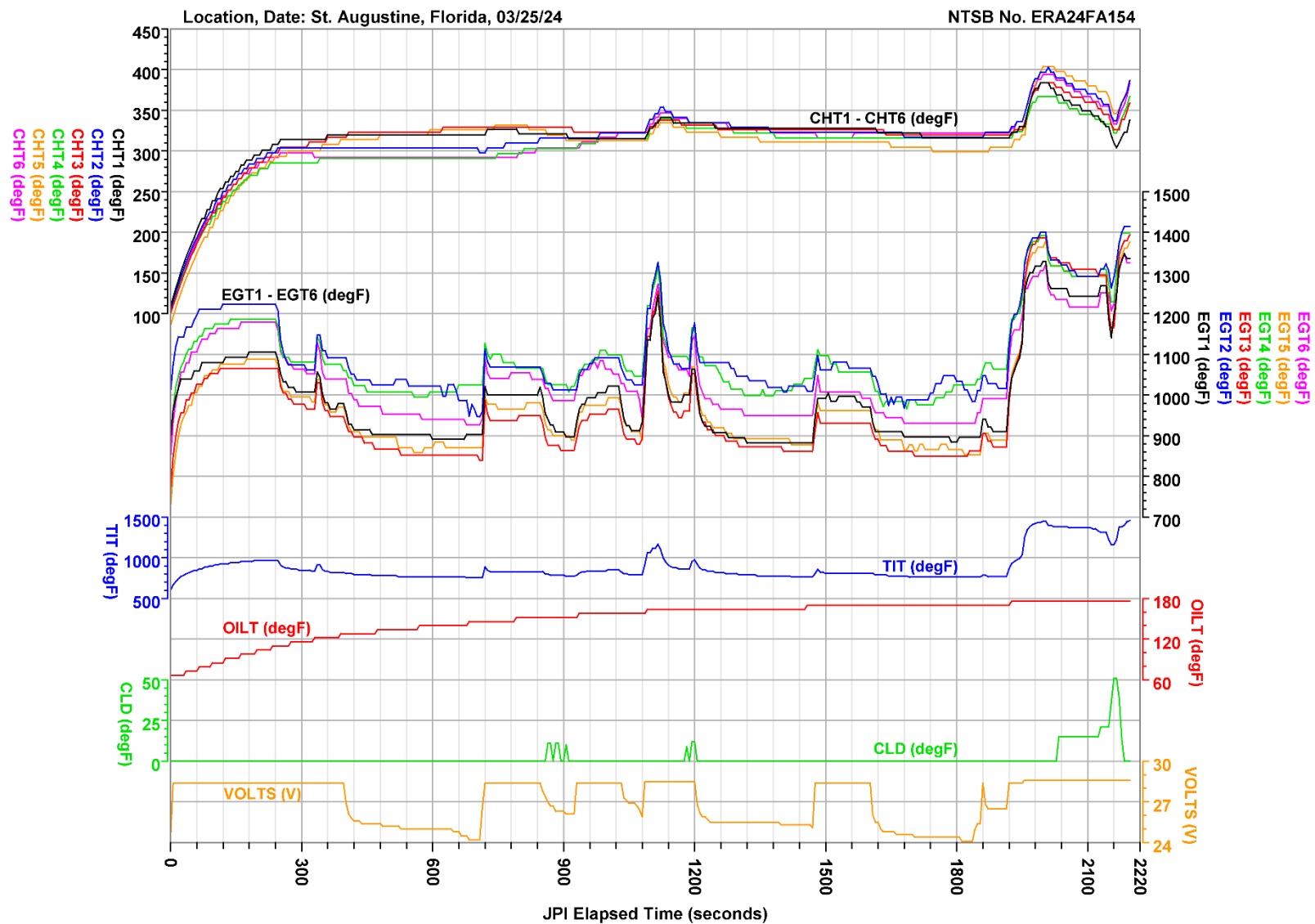


Figure 4. Time history plot of the entire JPI EDM-730 recording for the event flight.

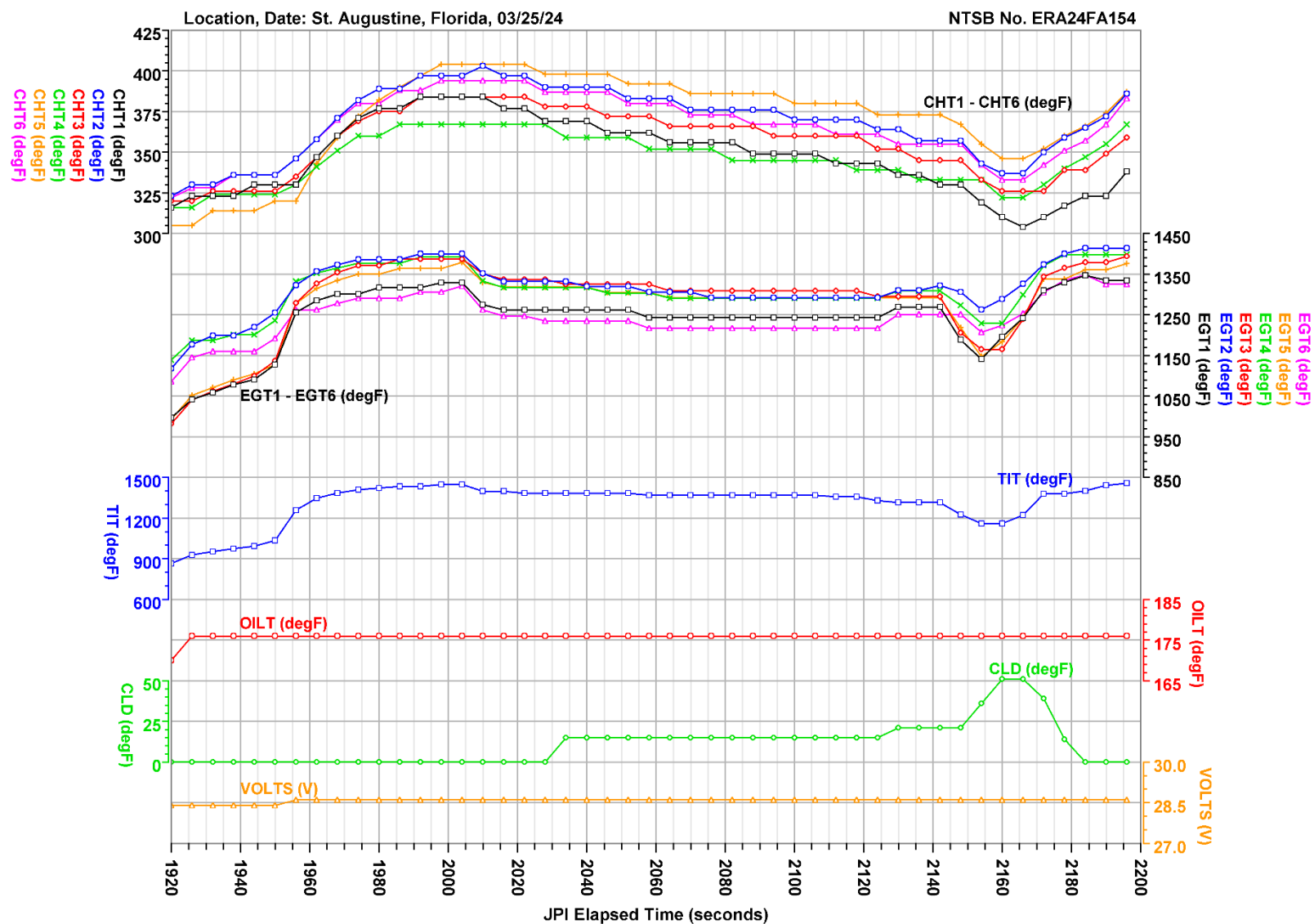


Figure 5. Time history plot of the takeoff and accident sequence.