

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

July 1, 2016

Engine Control Unit

Specialist's Factual Report
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1. EVENT SUMMARY

Location: Buckeye, Arizona
Date: February 16, 2016
Aircraft: Evolution Revo Trike
Registration: N107SB
Operator: Private
NTSB Number: WPR16LA071

On February 16, 2016, about 1452 mountain standard time, an Evolution Revo light sport weight-shift control "trike," N107SB, impacted terrain shortly after takeoff from Buckeye Municipal airport (BXK), Buckeye, Arizona. The pilot, who was the sole person on board, received fatal injuries, and the aircraft was substantially damaged. The personal flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and no Federal Aviation Administration (FAA) flight plan was filed for the flight.

2. DETAILS OF INVESTIGATION

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

Device Manufacturer/Model:	Rotax Engine Control Unit (ECU)
Serial Number:	12.0412

2.1. Rotax ECU Device Description

The Rotax ECU's primary function is to control engine functions to reduce pilot workload such as automatically adjusting air/fuel mixture, and control exhaust gas temperature. The ECU has two channels, also known as lanes, which are used for engine feedback and monitoring; the primary lane "A", and a secondary lane "B". The ECU will automatically detect failures and switch to the secondary lane seamlessly when necessary.

In addition to its primary function, the ECU contains a data logging feature that captures the last one hour of data from engine parameters. Data is recorded at two rates depending on the parameter, 10 times a second and once a second. Additionally, the ECU captures fault codes at the time of occurrence. The data is time stamped based on device operating time.

2.2. MoTec M48 ECU 'A' Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed no significant damage to the device (figure 1). The device was powered on and the data was extracted using the manufacturer's recommended procedures.



Figure 1. Rotax ECU, as received.

2.2.1. Rotax ECU Data Description

The accident flight was identified by observing engine performance parameter trends and the length of recording was compared to witness statements. The last engine start was identified from an ECU operating time (hour:minutes:seconds) of 102:30:21 to 102:39:28. The device operating time could not be correlated to local time.

A gap in data existed from 102:37:04 to 102:37:08, where the operator briefly changed the active ECU lane from "A" to "B", as indicated by the recorded fault. This operation is enumerated in the aircraft pilot operation handbook, before takeoff checklist.

The ambient air pressure parameter measures the air pressure going into the air filter. A correlation to pressure altitude could not be established.

Table A-1 lists the parameters verified and provided in this report along with their respective sample rate.

3. PLOTS AND CORRESPONDING TABULAR DATA

The following figure contains ECU data recorded during the February 16, 2016, event flight.

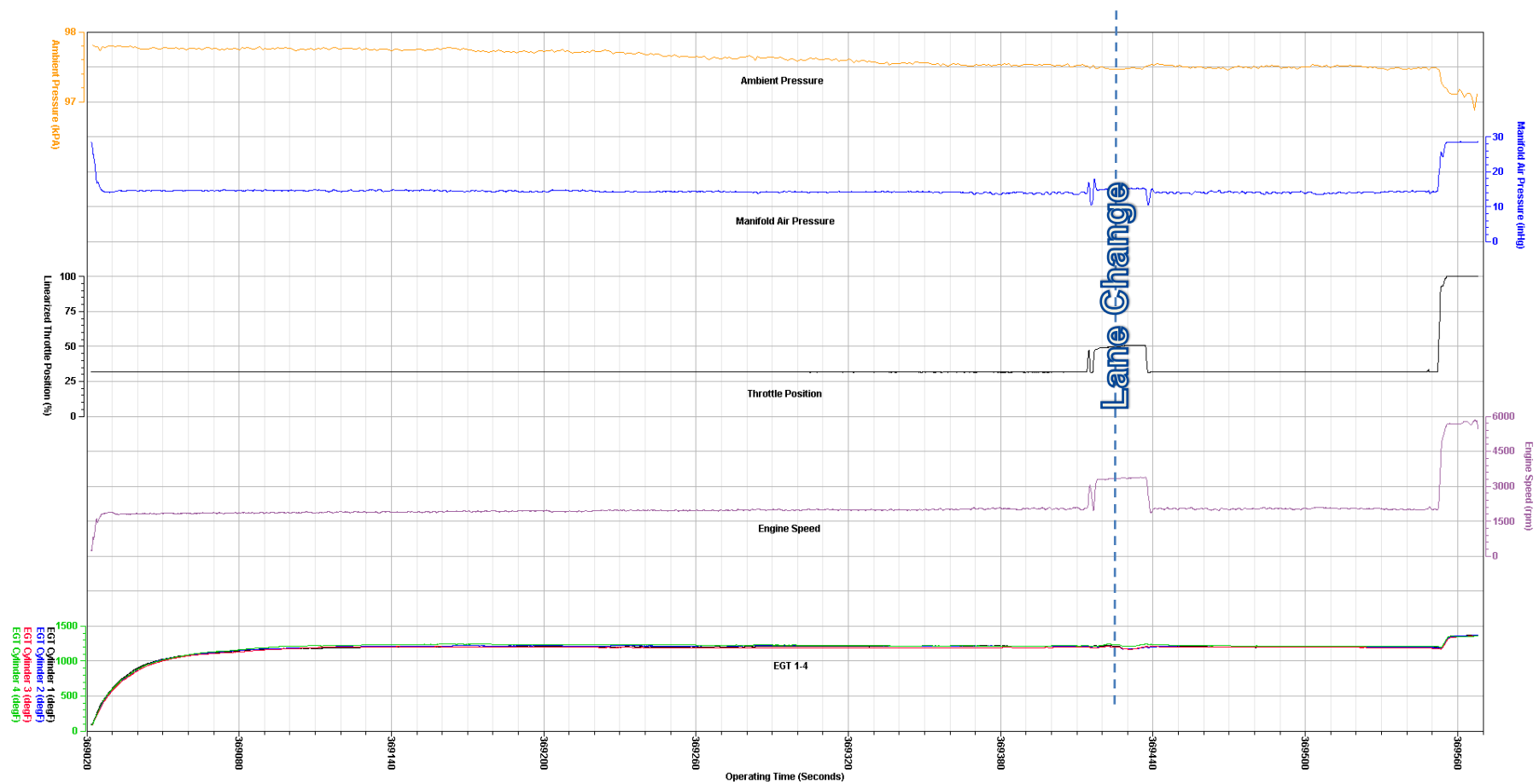
Figure 2 is a plot of the identified event flight spanning from 369020 seconds, to the last recorded data point at 369568 seconds. Figure 3 is a plot of the last 40 seconds of

recorded data. A dashed line was drawn to show where the temporary lane change occurred.

After the recording began, the EGT's settled to an average of 1200 degF, with a throttle setting of about 31 percent. At about 369552 seconds, the throttle position advanced to 100 percent, with a corresponding increase in EGT, Manifold Air Pressure, and engine speed.

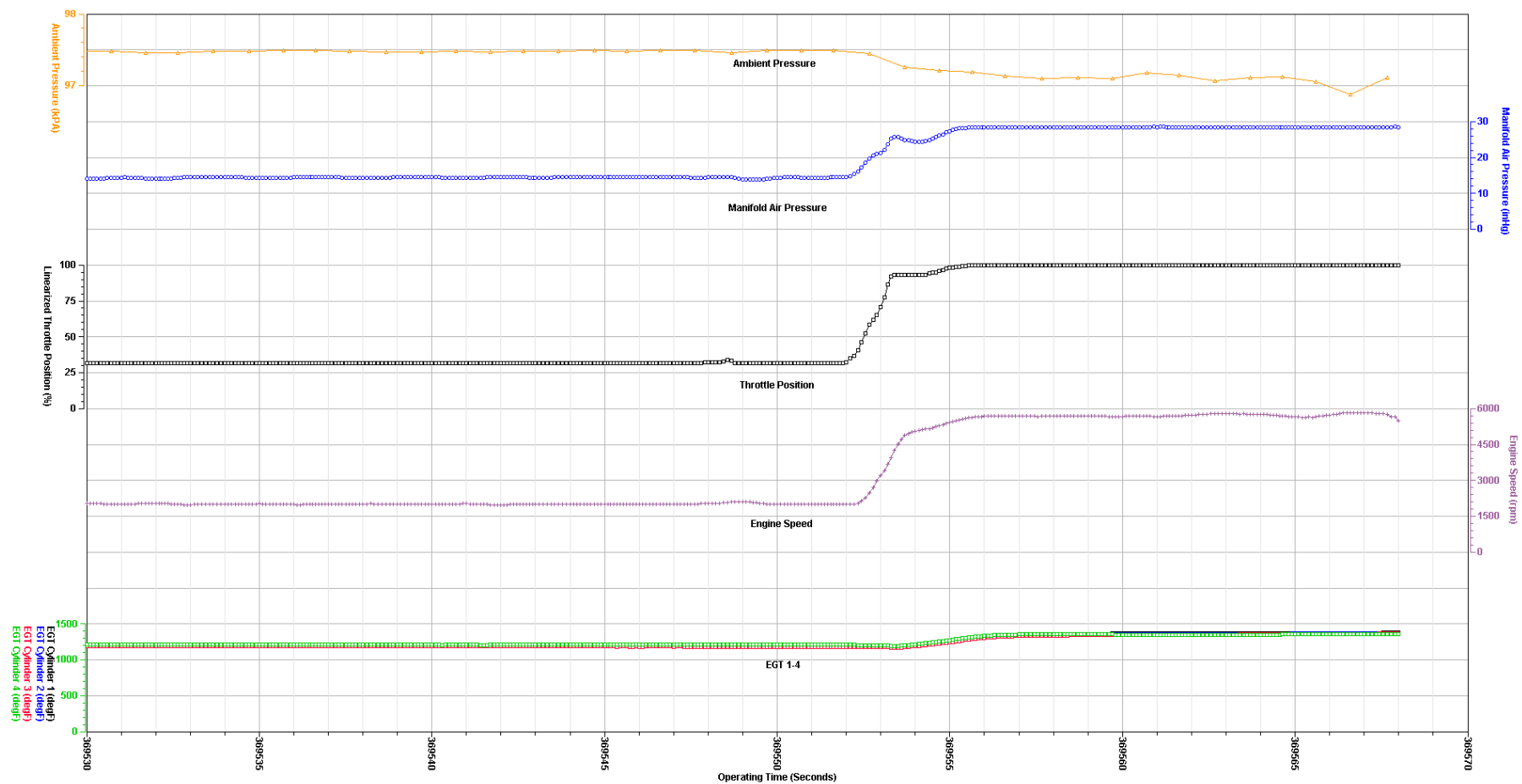
The corresponding tabular data used to create the plot are provided in electronic (*.csv¹) format as Attachments 1 to this report.

¹ Comma Separated Value forma



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Figure 2. Plot of Engine parameters during event flight.



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Figure 3. Plot of Engine parameters during last recorded data points.

APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided parameters.

Parameter Name	Parameter Description	Sample Rate (Hz)
1. Ambient Pressure (kPA)	Ambient Pressure Sensor	1
2. Manifold Air Pressure (inHg)	Manifold Air Pressure	10
3. Linearized Throttle Pos (%)	Throttle Position	10
4. EGT Cylinder # ² (degF)	Exhaust Gas Temperature	10
5. Engine Speed (rpm)	Engine RPM ECU A	10
6. Calculated Fuel Flow ³ (gph)	Calculated Fuel Flow	10
7. Fuel Injection Mass for Cylinder # ^{2,3} (pps)	Fuel Injection Mass	10

NOTE: ²# denotes Cylinder 1 through 4

³ Not plotted but included in the attached tabular data.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
degF	degrees Fahrenheit
inHg	inches of Mercury
%	percentage
rpm	rotations per minute
kPa	kiloPascals
pps	particles per second