General Aviation Accidents Investigative Challenges

2nd Meeting of the AIIG, 13-15 SEP 2022

Jeddah, Saudi Arabia

Small and LSA aircraft

in Small Sentences

ICAO

In general A light aircraft is **an aircraft that has a maximum gross takeoff weight of 12,500 lb (5,670 kg) or less**

FAA

LSA are defined as simple, low-performance, low-energy aircraft that are limited to- 1,320 pounds maximum takeoff weight for aircraft not intended for operation on water; or. 1,430 pounds maximum takeoff weight for aircraft intended for operation on water.

EASA

Light Sport Airplane (LSA) is a simple two-seater with a maximum take-off weight of 600kg. Commission Regulation (EC) No 748/2012 (Part 21) issued on August 2012, introduced a new process for the European Light Aircraft (ELA) that, together with the certification specifications CS-LSA published in 2011, create a lighter regulatory regime for the EASA certification of LSA aircraft..

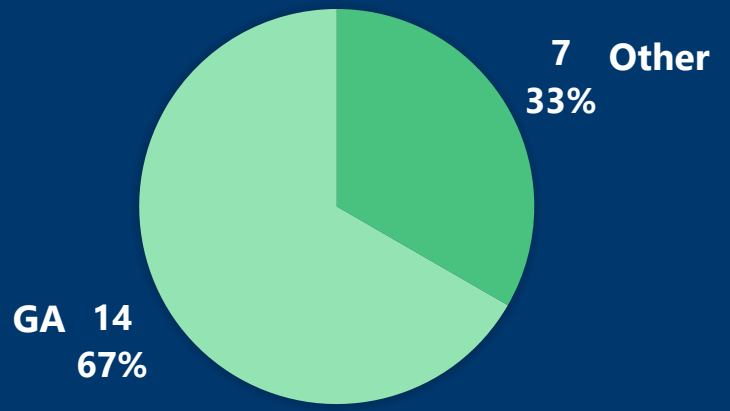
Industry

There are 6 categories -- **(A) Heavy, (B) B757, (C) Large Jet, (D) Large Commuter, (E) Medium, (F) Small**

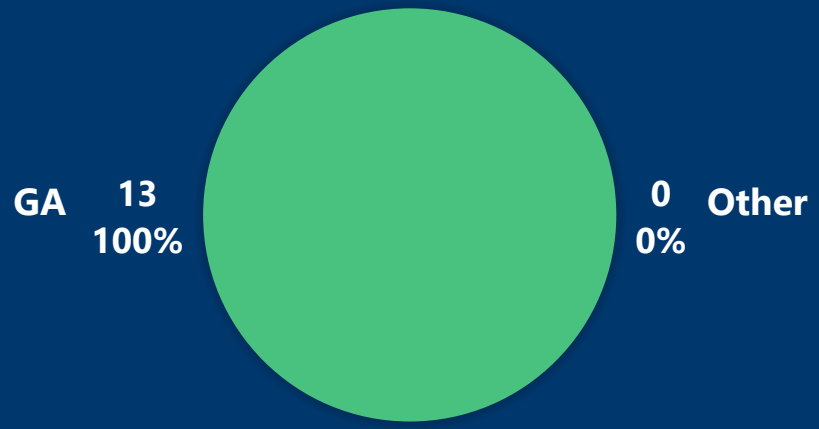
For Investigators it simply means NO DFDR nor CVR are required and searching for evidence is much more difficult

Statistics

Ratio of General Aviation Accidents 2015-date



Ratio of fatalities of General Aviation from other operations 2015-date



Sampling of Non-Volatile Data sources

PFD G1000

EMS-D10

G695 -ND

Dynon SV-700

G-500

Non-Volatile Memory

Installed within display systems contain critical Flight information data.

Numerous related parameters such as: time, latitude, longitude, altitude attitude, speed, thrust…etc are extracted to recreate a flight profile.

Process Outline

1. Checking manuals for data availability
2. Physical search to locate and retrieve media
3. Condition of the media and Decoding Requirements
4. Data Analysis: Sampling of Case Studies
5. Sensible Steps for the Future

Checking if there is something Available

Search to locate and retrieve media

Where is my media? Is the data retrievable?

Which component within the wreckage to take?

- There is always an element of uncertainty. Advisable to collect “more –than- less” of damaged components.

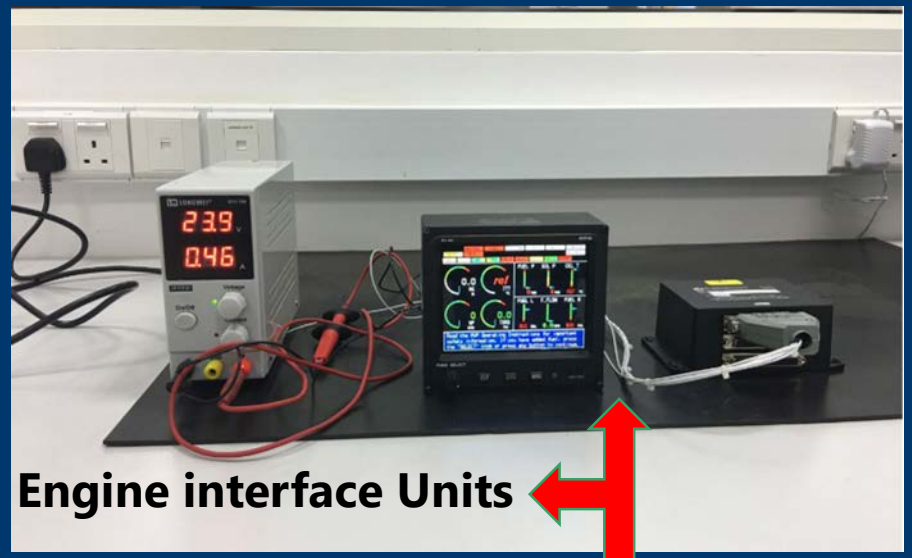
Which units are relevant?

- Refer to the manuals.
- Contact the manufacturer.

Connectivity Inconsistency makes it difficult to extract data

Powering & Communicator connectivity

- Decide? USB/RS232/Serial Ports etc…
- Necessity of “Inhouse Cable fabrication” is real.

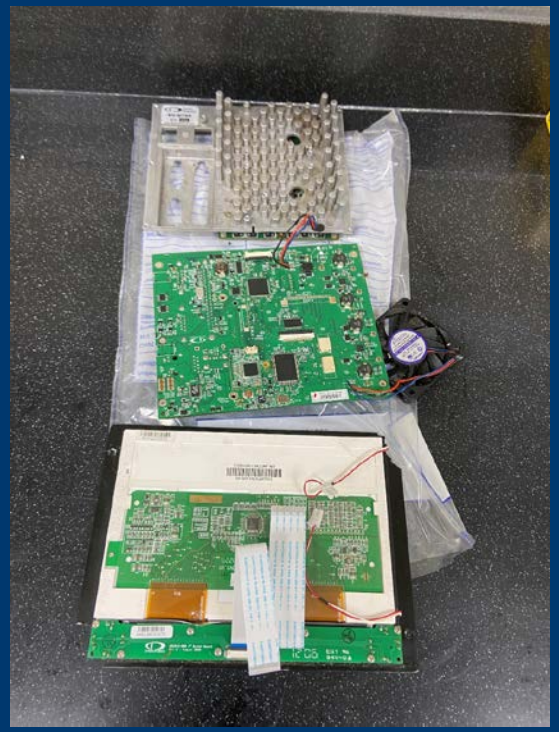


Media Condition
&
Decoding Requirements

Skills in extracting data out of the NVM Chip

Top Knowledge

- In applied electronics
- Evaluating unit condition and extreme care not to cause inadvertent removal/recovery related damage



Delicate Handling skills with:

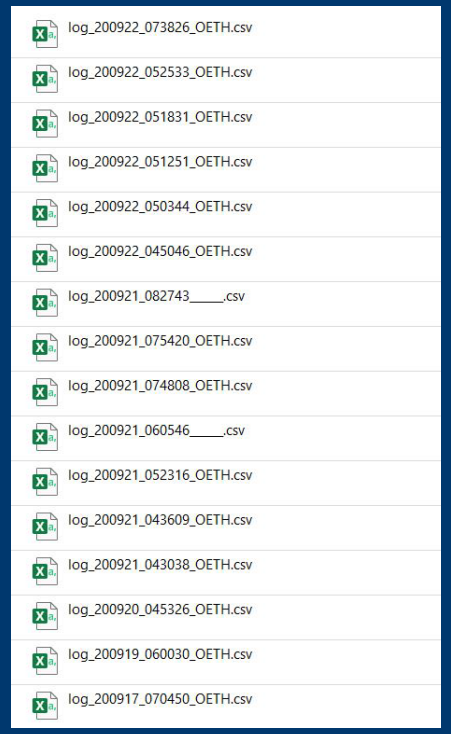
- Fragile components
- Cable Fabrication and Software Applications

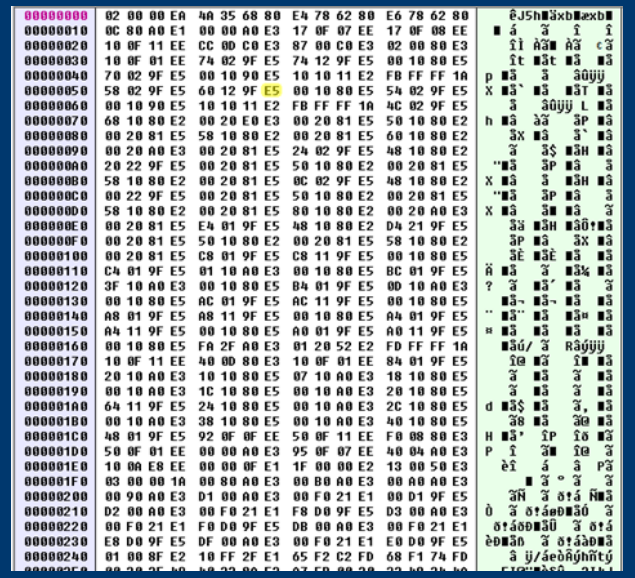
Lack of Parts/References/Vendor support

Data Decoding

Formats of Raw Data

- CSV format
- Specific proprietary format





Decoder

- Normally supplied by manufacturer
- Always “Proprietary Software”

Data Analysis: A Sampling of Case Studies

Cessna 172S

Al Thumamah (OETH)

CASE 1

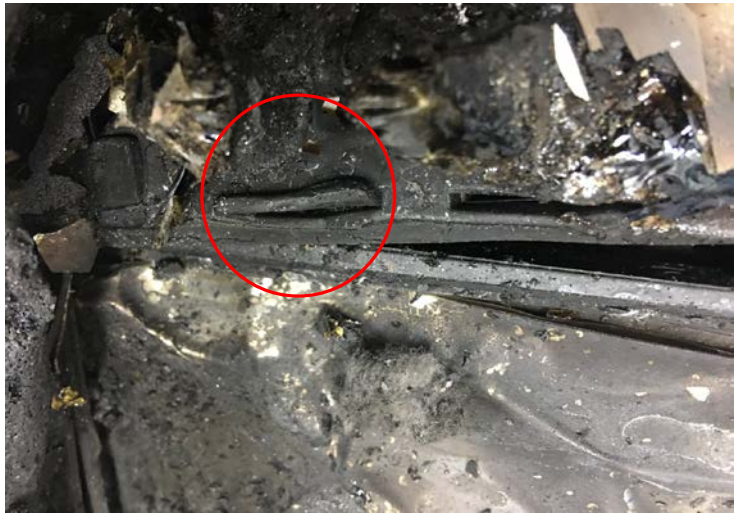
Brief

On 02 FEB 2020, a Cessna 172 S, lost control and stalled shortly after takeoff from Al-Thumamah airport (OETH, near the city of Riyadh). The impact destroyed and burned the airplane killing the pilot who was the only occupant. The AIB investigators looked for NVM sources and found them.

1

Complete burned panel transported to AIB lab

2



SD Card located

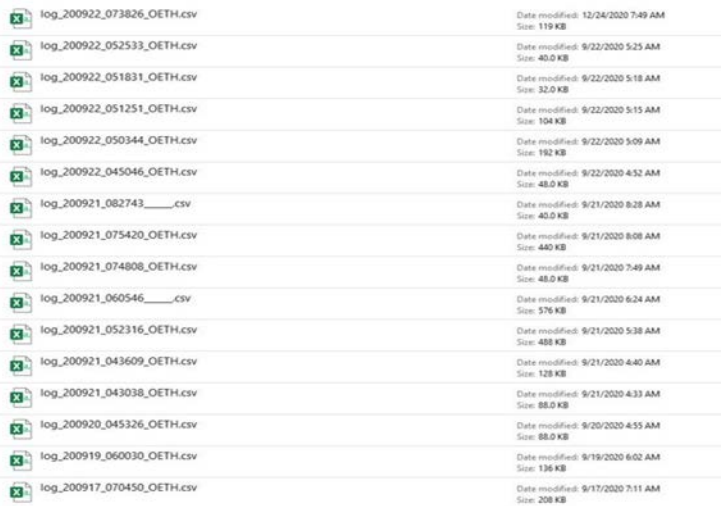
3

SD Card Recovered

Steps 1-3 for retrieving Garmin G1000 from crash site

Garmin G1000

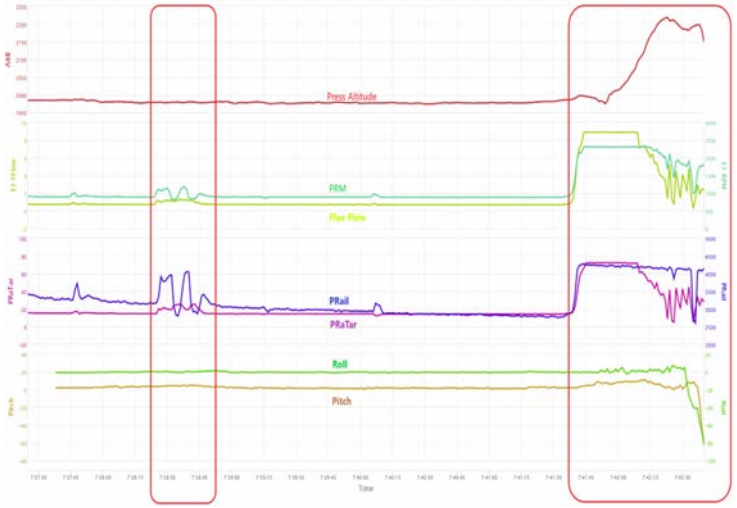
4



CSV Files

Managing Garmin G1000 - Steps 4 for accessing "Data Log" in CSV format and plotting for selected data.

5



Data Analysis

6

Tecnam Astore

Al Thumamah (OETH)

CASE 2

Brief

16 AUG 2022, a Tecnam Astore crashed shortly after takeoff from Al-Thumamah airport (OETH, near Riyadh). The impact destroyed the airplane killing the pilot who was the only occupant.

1

Unit Disassembly

2

DB37 harness Pin#	Dynon Harness Wire color	Function	Details
1	Red	Master Power (10-30V)	Page 4-1
2	Yellow	Keep Alive (10-30V, low current)	Page 4-1
3	Black	Master Ground	Page 2-2
4	Purple/blue	GP 1 (general purpose resistive)	Page 3-13
5	Black	Ground	Page 2-2
6	White/yellow	Oil pressure	Page 3-6
7	White/brown	Oil temperature	Page 3-6
8	Brown	Fuel pressure	Page 3-7
9	Brown/blue	Contact 1	Page 3-18
10	Brown/yellow	Contact 2	Page 3-18
11	Orange	EMS-D10 Transmit / PC Serial Receive (RS-232)	Page 4-2
12	Yellow	EMS-D10 Receive / PC Serial Transmit (RS-232)	Page 4-2
13	Black	Ground (Fuel Flow)	Page 3-9
14	Yellow	Fuel flow input	Page 3-9
15	Red	Fuel flow power (12V)	Page 3-9
16	Black	Ground	Page 2-2
17	Black	Ground	Page 2-2
18	White/red	5V excitation circuit	Page 2-2
19	White/black	Auxiliary Serial Receive (RS-232)	Page 4-2
20	Orange/brown	Fuel level 1	Page 3-11
21	Orange/blue	Fuel level 2	Page 3-11
22	Purple/yellow	GP 2 (General Purpose Resistive)	Page 3-13

Guide to connect power and fabricate interface Cable

3

Memory module Data Extraction

Steps 1-3 for retrieving EMS-D10 from crash site

EMS-D10 Data Retrieval

4

EMS-D10_sn1947_20220823_datalog.csv
EMS-D10_sn1947_20220823_datalog.xlsx
EMS-D10_sn1947_20220823_datalog_min_max.csv
EMS-D10_sn1947_20220823_datalog_snapshot.csv
EMS-D10_sn1947_20220823_datalogFAS.csv

CSV Files

Managing EMS-D10 - Steps 4 for accessing "Data Log" in CSV format and plotting for selected data.

5

Data Analysis

Tecnam P2002 SIERRA

Al Haridhah (Sport Flying strip)

CASE 3

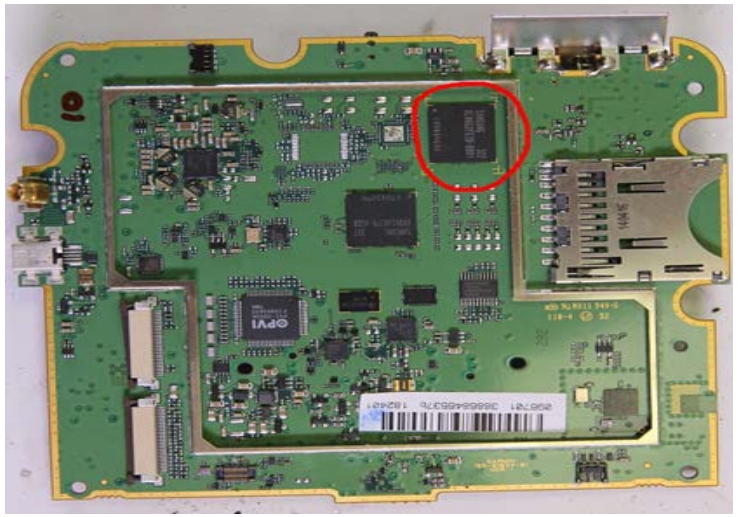
Brief

05 AUG 2022, a Tecnam P2002 Sierra crashed into sea shore shortly after go around from Al Haridhah (Sport Flying strip) south of Kingdom of Saudi Arabia. The two occupants were injured.

1

Disassemble the unit

2



Locate memory NVM chip

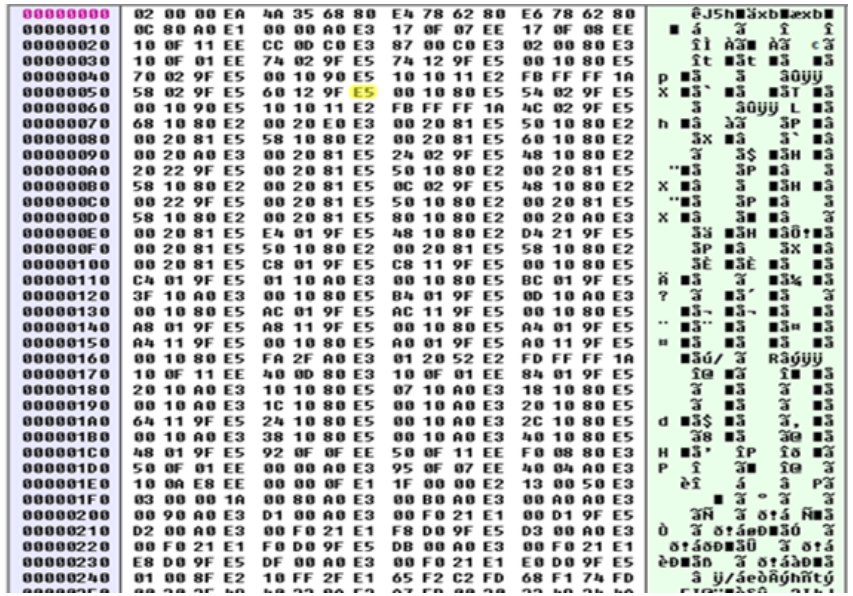
3

Special tool download

Steps 1-3 for retrieving Garmin695 ND from crash site

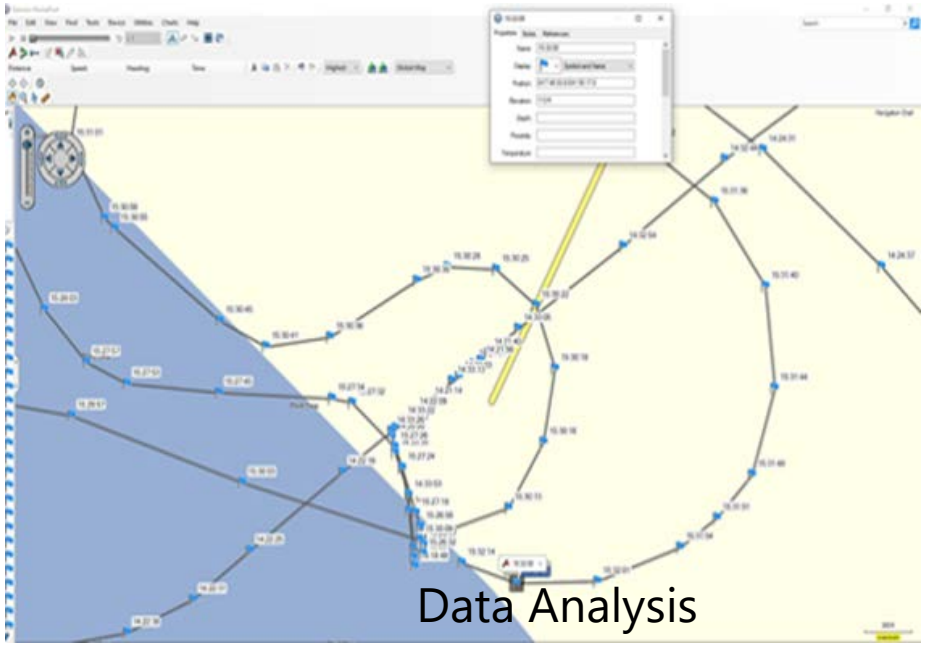
Garmin695 ND

4



Data Decoding

5



Data Analysis

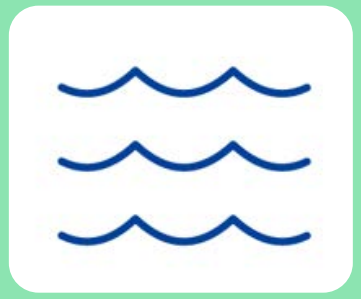
Managing Garmin 695 - Steps 4 for accessing "RAW Data " format and analysis for selected data

Fire

- Melted equipment
- Risk of damage while extracting

Damage

- Risk of overheat
- Cable fabrication



Water Submerge

- Salt & Corrosion
- Risk of damage when powered up

Sensible Steps for the Future

Recommendations & Practices

Previous recommendation

Safety Recommendation AIB-2019-0191-SR-01 issued to a local flight academy

- to install SDs on all operational Garmin G1000/G950 units.

- to notify GACA Airworthiness PMI and POI of the added SD to the operating units.

Good practice

To activate and utilize any data recording capability that is installed onboard the aircraft

This simple to active the systems

Thank You
for your attention