

L-3 Communications

Flight Data Monitoring (FDM) and ED-155

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Agenda

How Do We Leverage FDM And EUROCAE ED-155?

- Introduction To L-3 Flight Recorders
- EUROCAE ED-155 Working Group Overview
- L-3AR Lightweight Data Recorder (LDR) Overview





L-3 Aviation Recorders Division

- World Leader For Crash Protected Flight Recorders
 - 70% World Market Share; Shipped > 74,000 Flight Recorders
 - Deployed On Aircraft Ranging From Pilatus PC-9 to the Airbus A380
- World Leader For Protective Voyage Recorder Capsules
 - 80% World Market Share; Shipped > 11,000 Voyage Recorders
- Last Year, L-3AR Shipped More Than 5,000 Crash Protected Recorders
- We've Also Shipped Several Thousand μ QAR's





L-3 Aviation Recorders: Recorder Products



Cockpit Voice Recorder



Flight Data Recorder



MADRAS
Modular Airborne Data Recorder/Acquisition System



All Purpose Recorder



Maritime
Voyage Data Recorder



Micro Quick Access
Recorder



Hard Landing
Indication System





Micro Quick Access Recorder and FDM

- Light Weight , 6 oz. and small (1.8" x 2.2" x 1.4")
- Up To 2 GBytes Storage Capacity
 - Fixed Or Removable Media
- Input Signal Characteristics
 - ARINC 573/717/747
 - ARINC 429, Multi-Channel (High or Low Speed)
- Output
 - Via USB 2.0 Interface
 - Optional Ethernet Adapter For TCP/IP Download
- STC's or EASA Minor Mods For Virtually All Part 121 A/C
 - Others As Opportunities Arise





Why Mandate Recorders For Currently Non-Mandated A/C?

- Recent high profile accidents involving aircraft which are not required to carry cockpit voice or data recorders are bolstering accident investigators desires to have standardized recorders on that class of aircraft.
- The International Civil Aviation Organization, Flight Recorder Panel recently submitted a proposal to require ED-155 recorders to be fitted to new turbine aircraft weighing less than 5700 kg starting January 2016. (proposed update to ICAO Annex 6.)
- Are mandated flight recorders inevitable for GA? If so, what does ED-155 compliant recorders mean for FDM?





EUROCAE ED-155 / Working Group 77

- The purpose of ED-155 Working Group:

“MINIMUM OPERATIONAL PERFORMANCE SPECIFICATION FOR LIGHTWEIGHT FLIGHT RECORDING SYSTEMS”

- This working group is now complete, and the findings will be published for inclusion in ICAO Annex 6 by the end of 2009.
- The working group consisted of:
 - Accident Investigators, Regulatory Agencies, OEM’s, System Manufacturers, Industry Groups.





Purpose and Scope Of ED-155

- Define the minimum specification to be met for aircraft required to carry lightweight flight recording systems which may record:
 - aircraft data
 - cockpit audio
 - airborne images
 - data-link messages
- in a robust recording medium primarily for the purposes of the investigation of an occurrence (accident or incident) and
- which may be also used for or other purposes such as flight training, **flight data monitoring**, etc.





General Aspects of ED-155

- Reduced crash protection as compared to ED-112 for reduced cost and weight goals.
 - ED-112: Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems
- Both Fixed and Deployable recorders addressed.
- No underwater beacon required.
- No physical size or weight specification.
- Orange color.
- “FLIGHT RECORDER” marking as large as possible.
- Industry standard GSE interface, i.e. Ethernet, USB, etc.
- Hold-up times are specified: Audio, Image, A/C Data, Data Link





Audio (CockpitAudioRecordingSystem)

- Cockpit area microphone with increased fidelity over ED-112
- One or more audio channels such as combined crew audio. Also with increased fidelity over ED-112.
- Export in uncompressed .WAV or industry standard music file format. No psycho-acoustic or predictive data compression methods allowed, i.e. MP3
- Most recent 2 hours of audio stored.
- The general assumption is that two channels will be recorded; the area microphone audio and combined crew audio in a stereo .WAV file format. However, the requirement to record a specific audio channel is not dictated by ED-155. This is left to the regulatory authority. ED-155 only specifies the performance of the audio channels.





Image (Airborne Image Recording System)

- General cockpit view with emphasis on instruments and controls is most desired by investigators. Class C as a potential substitute for flight data.
- Resolution is not specifically described. Per ED-112 with test target.
- Image compression techniques allowed, however the loss of one image (frame or equivalent) shall not result in the loss of more than one second of images.
- Export in industry standard file format.
- Most recent 2 hours with minimum frame rates as specified by the AIRS class:

AIRS Class	Description	Minimum Frame Recording Rate	
		<i>Recording Period Most Recent 30 mins</i>	<i>Recording Period 30 mins - 2 hour</i>
A	General Cockpit View	4 per second	1 per second
B	CPDLC Message Display	1 per second	1 per 2 seconds
C	Cockpit Displays	4 per second	1 per second
D	Head Up Display	1 per second	1 per 2 seconds
E	Other Camera Images when presented to the pilots	1 per second, or the rate provided to the pilots, whichever is lower	1 per 2 seconds, or the rate provided to the pilots, whichever is lower
F	External view	4 per second	1 per second





Aircraft Data (A_{ircraft}D_{ata}R_{ecording}S_{ystem})

- The most recent 25 hours of data is recorded.
- Data compression not allowed.
- File format as described by required documentation. The desire is to have self-documented formats in a manner similar to FRED
 - ARINC 647A Flight Recorder Electronic Documentation (FRED)
- Essential and recommended parameters, recording rates, and accuracies are defined in a table according to aircraft type.





Data Link (D_{ata}L_{ink}R_{ecording}S_{ystem})

- Most recent 2 hours recorded (minimum 5 standard messages and acknowledgements per minute with timestamps).
- Data compression not allowed.
- File format as described by required documentation.





Survivability Compared With EUROCAE ED-112

Survivability Requirement	CVR TSO-C123b FDR TSO-C123b (ED-112)	Lightweight Flight Recording Systems (ED-155)
Impact	3400 Gs, 6.5 ms	1000 Gs, 5ms, All Axes
Pin Penetration	500 lb., 10 ft. 1/4 in. Pin	N/A
Static Crush	5000 lb., 5 min., All Axes	1000 lb, 5 min All Axes
Low Temp Fire	260° C, 10 Hrs.	N/A
High Temp Fire	1,100° C, 1 Hr.	1,100° C, 15 Min.
Sea Water Immersion	30 Days	N/A
Deep Sea Pressure	20,000 ft., 24 Hrs.	N/A
Fluid Immersion	Various Fluids, 48 Hrs.	N/A





L-3 Aviation Recorders

Lightweight Data Recorder (LDR)



- Crash protected, audio, image & flight data recorder
- Designed to meet, or exceed EUROCAE ED-155
- Targeted for General Aviation Airframes
- Ideal For Flight Data Monitoring





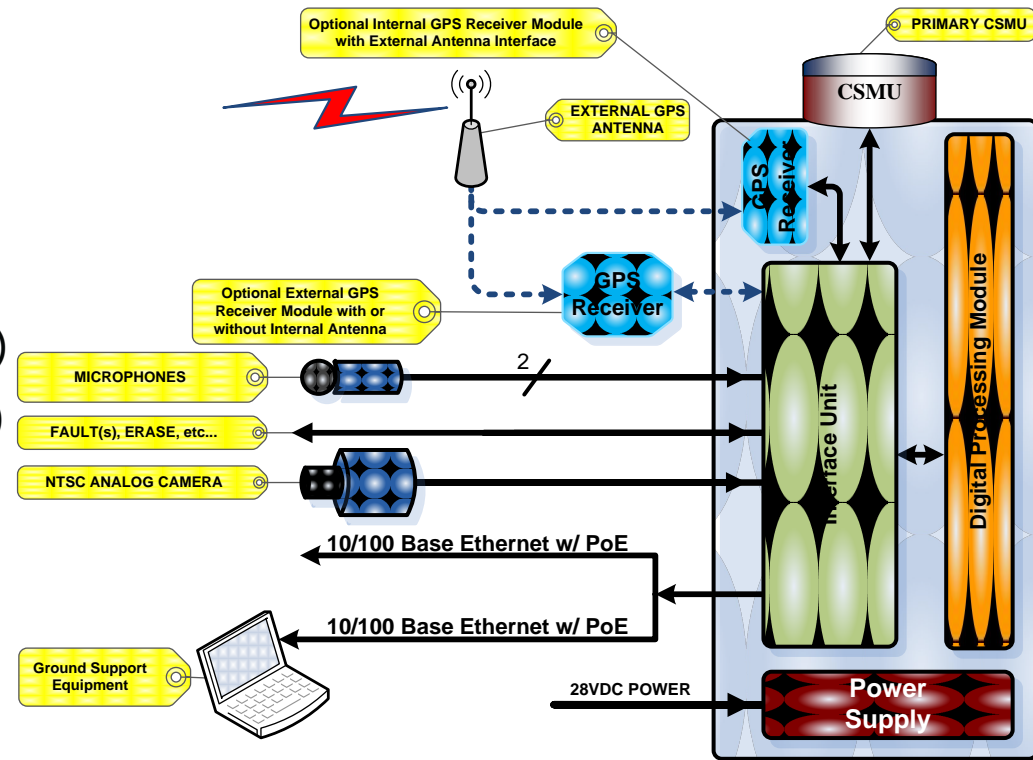
L3AR LDR Simplified Block Diagram

- LDR Supports:

- Audio inputs (2)
- Image input (1)
- Flight data input (1)
- GPS input (1) (or internal)
- Ground Support Connection (2)
- I/O (2) (Series Discrete/Shunt)

- Connectors:

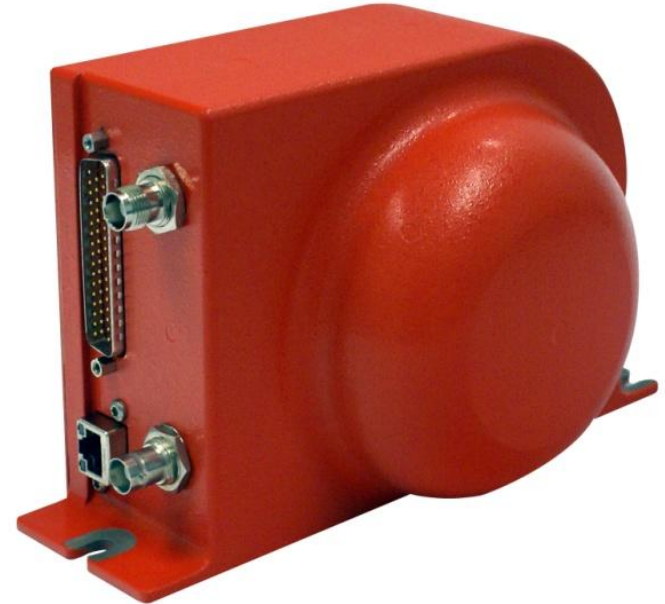
- DD-50: Signals/Power
- TNC: GPS Antenna
- BNC: NTSC Video
- RJ 45: Ethernet





L3AR LDR HW Specifications

- Standards:
 - EUROCAE ED-155
 - RTCA-178B Level D
 - RTCA-254 Level D
 - RTCA DO-160F
- Supply Voltage:
 - 28v DC Nominal
- Dimensions: (Flange Mount).
 - 3in (77mm) H x 5in (128mm) W x 4in (102mm) L
- Weight:
 - < 5 lbs nominal (2.3kg)





L3AR LDR Survivability & Environmental Qualification

Survivability Requirement	CVR TSO-C123b FDR TSO-C123b (ED-112)	Lightweight Flight Recording Systems (ED-155)	L-3 AR Lightweight Data Recorder (LDR)
Impact	3400 Gs, 6.5 ms	1000 Gs, 5ms, All Axes	1000 Gs, 5ms, All Axes
Pin Penetration	500 lb., 10 ft. 1/4 in. Pin	N/A	250 lb., 10 ft. 1/4 in. Pin
Static Crush	5000 lb., 5 min., All Axes	1000 lb, 5 min All Axes	1000 lb, 5 min All Axes
Low Temp Fire	260° C, 10 Hrs.	N/A	260° C, 5 Hrs.
High Temp Fire	1,100° C, 1 Hr.	1,100° C, 15 Min.	1,100° C, 15 Min.
Sea Water Immersion	30 Days	N/A	30 Days
Deep Sea Pressure	20,000 ft., 24 Hrs.	N/A	20,000 ft., 24 Hrs.
Fluid Immersion	Various Fluids, 48 Hrs.	N/A	Various Fluids, 48 Hrs.





L3AR LDR Functional Overview

- Video
 - NTSC Analog compressed @ 4 Frames/Sec in JPEG format
- GPS Data Acquisition
 - Internal GPS Option or external interface via RS-232
- Audio Acquisition
 - 2 Channels uncompressed 44.1 Ksps
- ARINC 717 Flight Data
- CSMU Data Recording
 - 2,4 or 6 GB standard USB Flash Disk
 - Non-volatile, crash protected storage of Video, Audio, GPS & Flight Data, Data Link





Ethernet Support Interface

- 10/100 Ethernet
- Web Server Accessed With Web Page Browser
 - Status
 - Configuration
 - Image
 - Setup
 - Download
- Non-proprietary
- Password Protected





LDR Web Server Home Page

LDR Ground Support Interface



[\[Home\]](#) [\[LDR Status\]](#) [\[LDR Config\]](#) [\[LDR Image\]](#) [\[LDR Setup\]](#) [\[LDR Download\]](#)





LDR Web Server Configuration Page

L3 LDR Configuration

LDR Time (UTC)	Saturday, 01 August 2009 03:33:24 AM
CSMU Size	1912 MBytes
Firmware Version Number	0000
FPGA HW Part Number	40-6790-1422i
FPGA FW Part Number	aSamCyrartgii
FPGA FW Version Number	Vth, Created 03/70/0290
Serial Number	000000000000
Part Number	000000000000
Aircraft ID	000000000000
Ethernet MAC Address	12:34:56:78:90:0
DHCP State	DHCP DISABLED
Ethernet IP Address	192.168.0.102
Ethernet Network Mask	255.255.255.0
Ethernet Gateway Address	0.0.0.0
GPS Overlay State	Overlay Enabled
GPS Selection	Internal
Internal GPS State	Running
Audio Power	AUDPOW
Audio Configuration	Microphone Channels 1 & 2 Enabled
Streaming Configuration	Streaming Stopped
ARINC 717 Configuration	ARINC 717 RX Disabled

Set LDR UTC Time and Date. **WARNING**, All CSMU Data will be erased after pressing the Update Time/Date Button:

Time (Hr:Min:Sec): 3 :33 :24 Date (Day/Mon/Year): 1 /8 /2009

Set LDR GPS Video Overlay:

Enable Disable

Set LDR Data Streaming:

Audio Streaming Video Streaming Stop Streaming
Streaming Client UDP/IP Address (xxx.xxx.xxx.xxx): 192 .168 .000 .100
Streaming Client UDP/IP Port Number: 2506



LDR "Image" Camera Via Web Server

LDR Image



STOP UPDATE

Home

LDR Status

LDR Config

LDR Image

LDR Setup

LDR Download




LDR Web Server Download Page

LDR Download Page - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://192.168.0.102/download.asp

CoreMemCtrl Most Visited



LDR Download

Video FileName	Last Modified	FileSize(Bytes)
▪ v1249097489.avi	Aug 01 2009 03:31:15	7460752

Audio FileName	Last Modified	FileSize(Bytes)
▪ a1249097489.wav	Aug 01 2009 03:31:15	3274028

GPS FileName	Last Modified	FileSize(Bytes)
▪ g1249097489.txt	Aug 01 2009 03:31:13	8178

Fault FileName	Last Modified	FileSize(Bytes)
▪ faultLoq1.txt	Aug 01 2009 03:31:29	0

[Home] [[LDR Status](#)] [[LDR Config](#)] [[LDR Image](#)] [[LDR Setup](#)] [[LDR Download](#)]





Discussion Summary

- Safety groups will continue to push for crash protected recorders on all aircraft
- EUROCAE ED-155 has outlined the objectives for a GA recorder
- Objectives of ED-155 and FDM recording can be met with the same device
- L-3 has designed a compliant recorder that is low cost, small, light, and easy to use
 - Requires no specialized ground support equipment or software
- L3AR product support network well-positioned to ensure 24/7 global coverage.

