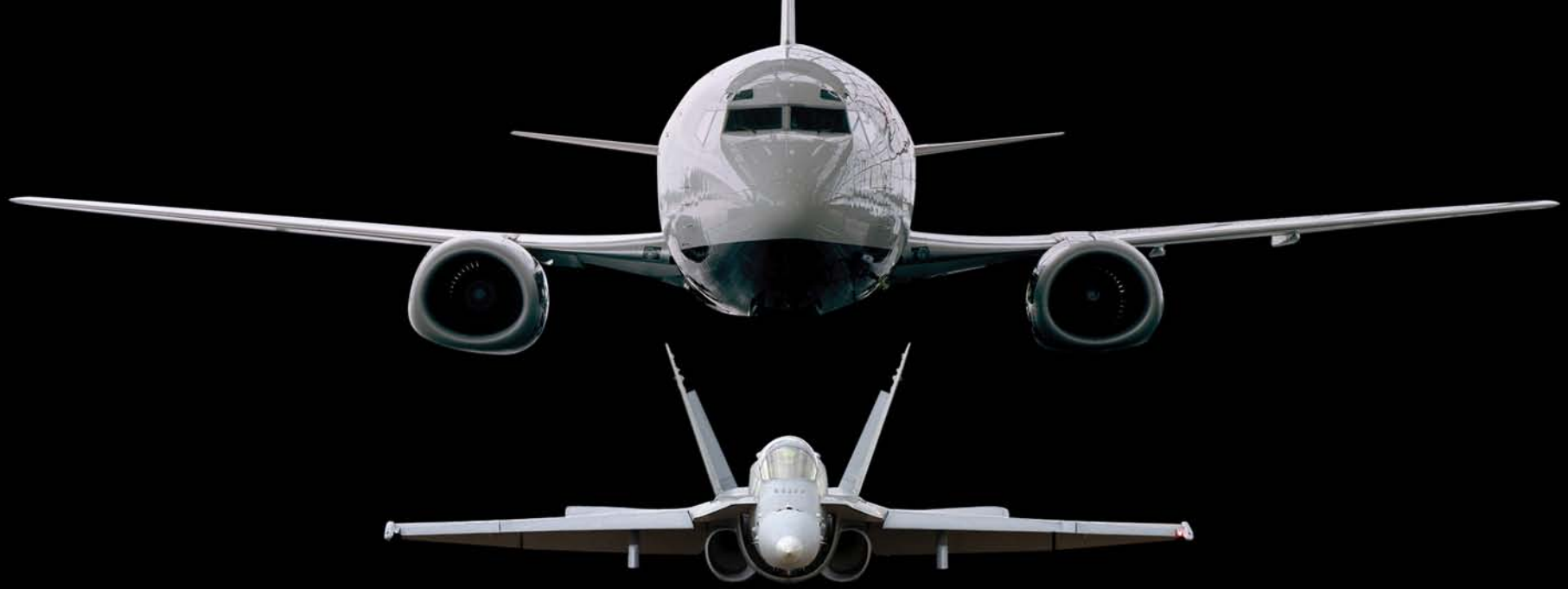
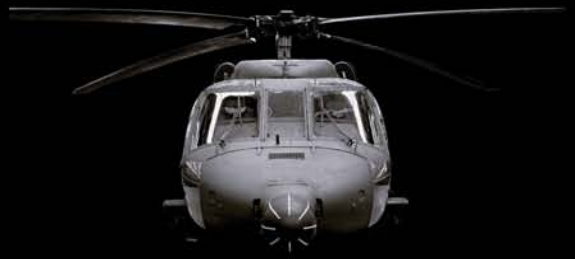


AS DIVERSE AS AVIATION ITSELF



L3 Aviation Products

Thomas R. Schmutz
Vice President, Engineering
L-3, Aviation Recorders

ACSS • Aviation Recorders • Avionics Systems • Display Systems • Electronic System Services

L-3 At A Glance

- Aerospace and Defense Contractor - 2013 Sales $12.6B
  - Fortune 200 Company
  - 48,000 Employees
- Prime for ISR, Aircraft Modernization, Logistics, Enterprise IT
- Supplier of Communication and Electronic Systems
- Attributes:
  - Broad/Diverse Technologies, Customers
  - High Earnings-to-Cash Flow Conversion
  - Efficient Capital Structure
  - Investment Grade Credit

C^3ISR

National Security Solutions

Platform & Logistics Solutions

Electronic Systems

Aviation Products Sector

Commercial and Military Aviation Solutions.

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Commercial Aviation

- Integrated Avionics
  - TCAS
  - TAWS
  - ADS-B
  - Transponders
  - Lightning Detection
  - Weather Mapping
  - Airborne Navigation
  - Standby Systems
  - Touch Screen Controllers
- Flight Displays
  - Displays & Processors
  - 3D Moving Map & Synthetic Vision
- Data Acquisition, Connectivity & Storage
  - Flight Data & Cockpit Voice Recorders
  - Iridium SATCOM
- Emergency Power Supplies
- Support Services
  - Aftermarket; MRO & Logistics

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Starting Point...Where we left off

- Triggered Transmission of Flight Data Working Group met following the AF447 WG
- BEA Report published 5/18/2011 (http://www.bea.aero/en/enquetes/flight.af.447/triggered.transmission.of.flight.data.pdf)
- Triggered transmission of flight data is essential to control the costs associated with real time transmission. This is an underlying assumption of the WG.
- Summary of Conclusions:
  - Developing reliable emergency detection criteria (triggers) is achievable
  - 85% of known cases would have allowed transmission of data prior to impact with surface given the detectable warning times
  - Two or more antennas may be necessary for satellite systems due to unpredictable attitude
  - A location radius of 4 NM by year 2020 is technically feasible to significantly reduce the search area by
    - Triggering the transmission of appropriate data via SatCom prior to impact
    - Automatically activating next generation ELT prior to impact
    - Increase frequency of position reports

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Real Time Monitoring: Key Points

- Standardization
  - Recorder MOPS has been very successful in driving worldwide standards for Flight Recording
  - Real time monitoring requirements should continue to be harmonized through international committees and added to ED-112A
  - Consider using all available aircraft communication means and use the recorder to trigger the transmission
- Privacy
  - ED-112A: Cockpit Voice Recorders are not downloaded while on aircraft
  - Pin strapping prevent download while installed
  - Ownership of flight data and audio varies according to country and situation
  - Important part of any discussion on real time monitoring
- Security
  - Transport methods should be encrypted and secure
  - Storage concepts should protect and secure data according to data owners wishes
  - Storage persistence should be clearly identified
- Reliability
  - Extremely high reliability of data transfer may not be necessary; existing recorder provides backup
  - High reliability could impede acceptance due to costs

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Goals for Real Time Monitoring

- Flight recorder data has always been considered only part of an overall investigation
- Investigators review all of the available data; information recorded prior to any “trigger” point may be important to the case and may not be transmitted due to warning time
- Even when flight recorders are found in an accident, as much of the wreckage as can be recovered is pieced together and evaluated
- Real Time monitoring will not change this fundamental approach
- Goals for Real Time Monitoring Could Be:
  1. Find the aircraft
  2. Alert authorities of a problem; try to prevent a mishap
  3. Have a data set to investigate if recorder cannot be found or is damaged

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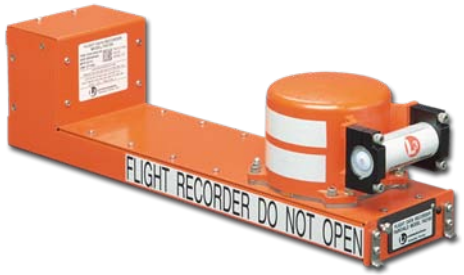
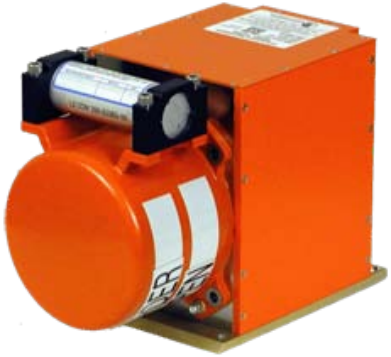
Background FDR/CVR Info for Record

FA5000 CVR/FDR
MADRAS



FA2100 FDR

SRVIVR® CVR/FDR



FA2500 CVR/FDR

FA2100 CVR/FDR

FA2300 MADRAS

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Flight Data Recorder Equipment

- Governing Minimum Operation Performance Standard
  - Standard published by EUROCAE (www.eurocae.org)
  - ED-112A published September 2013
  - Supersedes:
    - ED-112 published March 2003
    - ED-55 published May 1990
  - Reissued 4 times over 23 years
- Technical Standard Order (E/TSO)
  - TSO-124c effective 12/19/2013 (ED-112A requirement)
    - TSO-124b applications no longer approved after June, 2015
    - Existing authorizations to TSO-124b will stand
  - ETSO-124b effective 12/21/10 (ED-112 requirement)
  - ETSO-124c issue is expected

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Cockpit Voice Recorder Equipment

- Governing Minimum Operation Performance Standard
  - ED-112A published September 2013
  - Supersedes:
    - ED-112 published March 2003
    - ED-56A published December 1993
- Technical Standard Orders (E/TSO)
  - TSO-123c effective 12/19/2013 (ED-112A requirement)
    - TSO-123b applications no longer approved after June, 2015
    - Existing authorizations to TSO-123b will stand
  - ETSO-123b effective 12/21/10 (ED-112 requirement)
  - ETSO-123c issue is expected

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Changes in ED-112A

- ED-112A added detail to the flight recorder standard specifically addressing recent aviation investigations including:
  - Air France 447 in Atlantic
  - British Airways 38 engine incident at Heathrow
- Deployable Recorder Changes
  - Requirement for deployable recorders to be fitted with a dual frequency 406/121.5 MHz radio transmitter for detection
- Cockpit Voice Recorder Changes
  - Implemented additional classes of CVR's with longer recording durations
    - Current standard class is 2 hours
    - Added 10, 15 and 25 hours classes

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Changes in ED-112A: FDR

- Flight Data Recorder (FDR) additional parameters were added
  - Engine fuel metering valve position
  - Vertical speed
  - Flight director commands
  - Computed weight
  - Cabin pressure altitude
- Increased sampling rates on some existing FDR parameters
  - Control forces, Inputs and Surfaces
  - Attitude
  - Navigation data (lat and long)
  - Power level position
  - Accelerations
- FDR to also store the data frame layout information (FRED File) for investigators to decode the flight data.

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Changes in ED-112A: ULB

- Underwater locator beacon (37.5 kHz ULB) controlled by TSO-C121a
  - TSO-C121b established 90 day versus 30 day beacon
  - TSO-C121b will revoke TSO-C121/C121a in March 2015
  - 90 day beacons will become standard by attrition
  - ICAO has published in Annex 6 that recorders shall have 90 day ULB's in January 2018
- ED-112A adds a shear test to the ULB retention mechanism so that the beacons won't become detached
  - The BEA (French Safety Board) provided a study where many water incidents had recorders with beacons detached.

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8.8kHz Low Frequency Beacon

- ED-112A does not specify the operational performance of the ULB
  - Performance was discussed in the working group
  - Many of the same participants worked in the SAE group to develop the specification for the 90 day ULB on the flight recorders and a low frequency, greater range ULB for the airframe.
- Low Frequency Beacon spawned from the BEA organized AF447 Working Group
  - Described the Recorder ULB as a means to find a needle in the haystack
  - Described the Low Frequency Beacon as a means to find the haystack
- Transport aircraft operating over oceanic areas be fitted with the low frequency ULB by January 2019

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Data Rates For FDR Systems

- FDR essential parameters recorded from a 256 word per second ARINC 717 interface. Words are 12 bits.
  - Required Rate = 256 Words/Second * 12 bits/Word = 3,072 Bits/second
  - Duration = 25 hours
  - Image Size = 25 hours * 3600 seconds/hour * 3,072 bits/second = 276.480 MBit = 34.56 MB
  - Compression possible
- FDR typical parameters recorded from a 1024 word per second ARINC 717 interface.
  - Typical Rate = 12,288 bits/Second
  - Duration = 25 hours
  - Image Size = 1,106 Gbit = 138.24 MB
  - Compression possible

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Data Rates For CVR Systems

- 3 Pilot Audio Channels sampled at 8 kHz
  - 3 x 16 bits x 8 kHz = 384 kbps
- 1 Cockpit Area Microphone Channel sampled at 16 kHz
  - 1 x 16 bits x 16 kHz = 256 kbps
- Total Raw Audio Channel Rate = 640 kbps
  - Good compression techniques are available to compress these raw data rates
- CPDLC Messages are also required to be recorded on aircraft with Datalink installed
  - The message record rate is variable and small compared to audio rates

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End

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Aviation Products Sector

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