SOLID STATE FLIGHT DATA RECORDER

P/N 2100-4043-02, 00

Component maintenance manual No:
31-30-03

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Introduction: The flight data recorder (FDI) is a highly reliable recorder that is designed for ARINC 747 characteristics. The FA2100 FDI is designed as a maintenance free recorder. There is no special calibration, periodic or scheduled maintenance required for this recorder. It is considered an “install and forget it box”.

General Description: The FA2100 FDR is classified as a class -A flight data recorder. It receives data at 128, 256, 512 or 1024 words per second (wps). Each of these recorders is capable of storing a minimum of 25hrs of flight data that can be downloaded in less than six minutes.

This FDR consists of a chassis and front panel, an aircraft interface PWA and acquisition processor PWA and the crash survival memory unit (CSMU). The CSMU contains the solid state flash memory used as the recording media. An underwater locator device (ULD) is mounted horizontally on the front of the CSMU and is also used as a carrying handle for the recorder. The ULD is equipped with a battery that has an expected life of six years. The ground support equipment (GSE) connector is located on the front of the FDR. This connector provides the interface from the recorder to GSE for check out of the recorder, or to transfer data to a read out or analysis device.

System description: The model FA2100 FDR is housed in either a $\frac{3}{2}$-ATR, short or long, ARINC 404A style case. It weighs less than 11 pounds and don’t require external shock mounting. It operates from 28V-DC or 115V AC (400 HZ) aircraft power. The flight data stream is stored in a solid state memory consisting of a number of flash EEPROM devices.

Underwater Locator Device: The device is mounted in front of the model FA2100 FDR carrying an underwater acoustic beacon. Its expected battery life is 6 years, requiring cleaning and functional testing every 24 months with the batteries in the beacon being field serviceable.

Flight data interface: The FA2100 FDR is designed to accept a bi-phase serial data stream at a selectable data rate of 64, 128, 256, 512 or 1024 wps. Data recording is controlled by ground –strapping J1 gear connected pins.

<table>
<thead>
<tr>
<th>DATA RATE (wps)</th>
<th>J1-17</th>
<th>J1-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>128</td>
<td>Open</td>
<td>Ground</td>
</tr>
<tr>
<td>256</td>
<td>Ground</td>
<td>Open</td>
</tr>
<tr>
<td>512</td>
<td>Ground</td>
<td>Ground</td>
</tr>
<tr>
<td>1024</td>
<td>Open</td>
<td>Open</td>
</tr>
</tbody>
</table>

Ground support equipment (GSE) interface: It’s an interface to the GSE via a bi-directional high speed serial link available at the front panel of GSE connector, used primarily for retrieving stored data from CSMU to the GSE.

Circuit Boards: FA2100 FDR is comprised of three main hardware modules

- The aircraft interface board provides the connector signal conditioning, input protection and main power supply.
- The acquisition processor board provides a logic power supplies, micro processors, interface to the CSMU and interface to the GSE.
- Crash survival memory unit (CSMU).
### Specifications:

| Physical Characteristics | Size (nominal) | Height: 5.5 in  
width: 4.98 in  
depth: 12.6 in (short case)  
weight: 10.0±0.5 pounds (short case)  
Main (Rear Connector): Dual 57-pin connector, compatible with ARINC 747 |
|--------------------------|----------------|------------------------------------------------------------|
| Electrical Characteristics | Power Requirements | 115V AC @ 400 Hz or 28V DC  
Power Level | 7.5 Watts max when 28V DC  
8.5 watts max when 115V AC @ 400 Hz  
Power Factor | 0.58 (measured power)  
Recording time | 25 Hours minimum  
Input signal format | ARINC 747, 64, 128 or 256 wps. |
| Environmental Characteristics | Temperature (°C) | Operating: -55 to +70  
Non-operating: -55 to +85 |
| Crush and Fire Protection | Static Crush | 500lbs  
Fire Protection | 60 minute @ 1100°C  
10 hours @ 260°C  
Sea Pressure | Up to depth of 20,000 ft. |
Functional Description: The recorder interfaces with the aircraft fly data acquisition unit through the rear panel connector J1A and with the ground station equipment through the front panel GSE connector. The model FA2100 consists of three sub-assemblies: The aircraft interface printed wiring assembly (PWA), the acquisition processor PWA and CSMU.

- The Aircraft Interface (AI) PWA: The functional component blocks of the AI are:
  - **Input/output RF barrier blocks**: Provides RF suppression on all input and output signals.
  - **Input/output Lightning Protection**: Provides lightning protection on all input and output signals, that interface with the aircraft.
  - **Signal Conditioning Block**: Provides input and output signal conditioning for flight data signals and output signal conditioning for STATUS and MAINT_FLAG signals.
  - **Power Supply/ Filtering Blocks**: This supply conditions the applied AC or DC input power and charges a storage capacitor to provide the energy required to operate the FDR during power outages up to 200 msec.

- Acquisition Processor (AP) PWA: It performs data management of flight data and provides various command and control functions for the recorder as well as power management. It consists of two processors:
  - **Store manager processor (SMP)**: It gathers flight data from the flight data processor, packetizes and saves it into the Flash memory, contained in CSMU.
  - **Flight Data Processor (FDP)**: It performs various detection, synchronisation, and compression functions associated with processing flight data.

Software Consideration

CSMU flight data structure

The primary data structure used in the FA2100 solid state flight data recorder (SSFDR) is the organization of the crash protected flash memory contained in the CSMU. Each physical flash memory device in the CSMU contains 32 Mbit flash memory chips. The 32M bit chips operate at 5Volts while the 128 Mbit chips operate at 3Volts. The number of flash memory chips is determined by the data rate capability of the recorder.

<table>
<thead>
<tr>
<th>Data Rate (WPS)</th>
<th>Chip Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Volts memory</td>
<td></td>
</tr>
<tr>
<td>64/128</td>
<td>4X32-MEG</td>
</tr>
<tr>
<td>256</td>
<td>6X32-MEG</td>
</tr>
<tr>
<td>512</td>
<td>14X32-MEG</td>
</tr>
<tr>
<td>3 VOLTS memory</td>
<td></td>
</tr>
<tr>
<td>64/128/256/512</td>
<td>4X32-MEG</td>
</tr>
<tr>
<td>1024</td>
<td>6X128-MEG</td>
</tr>
</tbody>
</table>

The portioning of the CSMU memory chips supports the “erase ahead” process that is required by the Intel flash memory devices as part of the data storage process. Each 32 MEG( 2-M words x 16-Bits per word) chipset...
contains 64,32 K word erase blocks. The 128 MEG (8 M words x 16Bits per word) chipset contains 256,32 K words erase blocks. An erase block is the smallest physical block of a flash memory that can be erased at one time.

The FA2100 SSFDR software partitions each erase block into 512 logical pages of 64 words each. These pages are the fundamental units which are built and stored into the CSMU. The first two pages of the erase blocks contains header information and a bad page map. The header contains partition, channel, and block number information that can be used to re-align and reassemble the physical memory devices should they become detached from the printed wiring board during impact.

The remaining 510 pages in each blocks are used for storing flight data. At the end of each flight data page is the hamming code and page parity used for error detection and corrections.