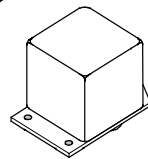
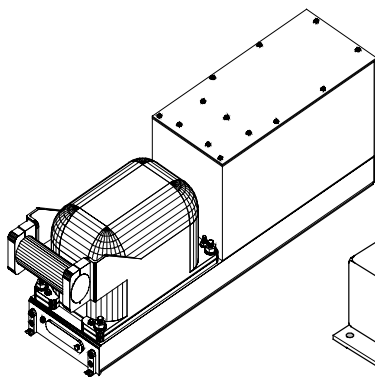


SSFDR

SOLID-STATE FLIGHT DATA RECORDER

PRODUCT DESCRIPTION



Tri-Ax Accelerometer

SSFDR

Solid-State Flight Data Recorder
1X, 2X, 4X Models

ED-55 Flight Data Recording System

SOLID-STATE FDR PRODUCT DESCRIPTION

The Solid-State Flight Data Recorder (SSFDR) combines the extremely high reliability of integrated circuit memory technology with the most advanced protective enclosure in the industry. This equipment fully satisfies the most recent FAA and EUROCAE Minimum Operational Performance Requirements (MOPR) for Flight Data Recorders used on commercial air transport aircraft. These specifications are:

- **EUROCAE Documents ED-55 Class A1**
- **FAA Technical Standard Order TSO C-124**
- **ARINC-747, and is retrofittable to existing ARINC-573/717 installations**
- **In addition, the SSFDR meets the extended low temperature fire test of ED-56a**

The SSFDR utilizes a modular crash survivable memory unit (CSMU) for protection of the solid-state flight data recording memory. The CSMU retains the most recent 25 hours of digital flight data and timing information. The SSFDR can be configured for 64 words per second (1X), 128 words per second (2X), or 256 words per second (4X) data recording. *Honeywell's new 4X Solid State Flight Data Recorder has the capability of receiving serial data at all data rates of 64, 128, or 256 Words/sec, in a format consistent with ARINC 573/717, from an external Digital Flight Data Acquisition Unit (DFDAU).* (See section 8.0 for additional details on the 4X SSFDR.)

- **The 2X SSFDR may also be used to provide 50 hours recording in 1X installations.**
- **The 4X SSFDR may also be used to provide 50 hours recording in 2X installations or 100 hrs in 1X installations.**

“State of the art” high density FLASH memory devices have enabled the SSFDR to be implemented without need of data compression, thereby providing very high recording integrity.

- **Unlike many competing designs, the SSFDR has avoided the risk and complexity of maturing and maintaining proprietary data compression algorithms. ALL data, including synchronization words, are recorded in their original form.....without necessity of decoding special FDAU formats or decompressing the information.**

The SSFDR has been designed to achieve a high degree of reliability, as well as facilitating simplified maintenance and minimal component sparing over competing models.

- **Actual Mean Time Between Failure in excess of 20,000 hours.**
- **No Scheduled or Periodic Maintenance is required.**
- **Consists of only (3) three Shop Replaceable Units.**
- **Dual voltage power supply available for fleet wide commonality.**

Figure 1 shows the SSFDR and its major features, while Figure 2 provides a simplified diagram showing its major aircraft interfaces.

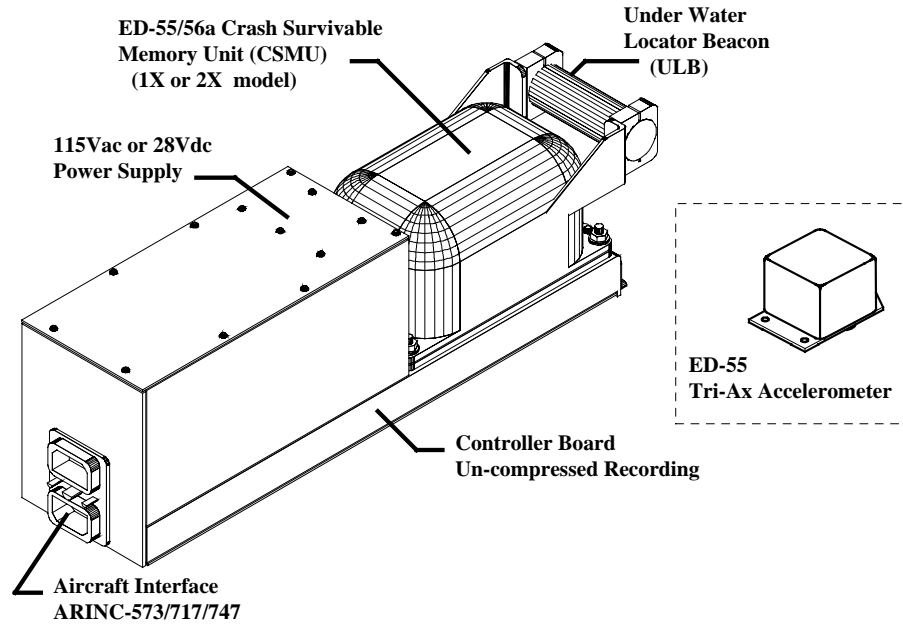


Figure 1: Solid-State FDR System, Major Features

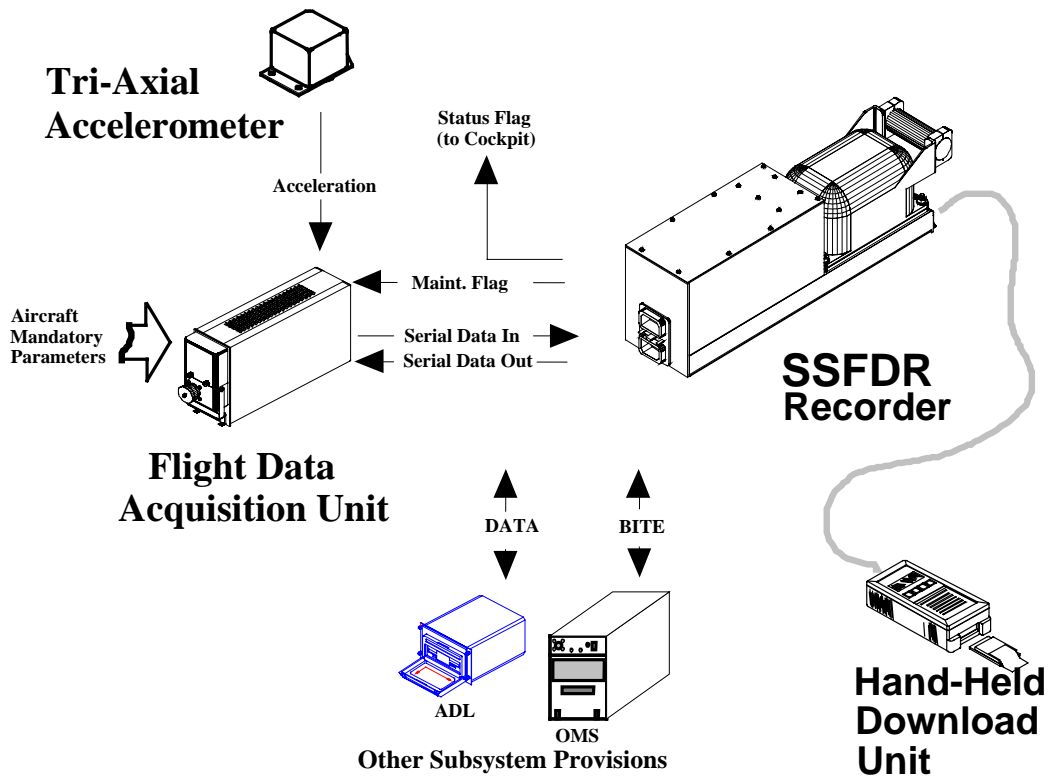


Figure 2: Solid-State FDR, Major Aircraft Interfaces

The SSFDR is the most modern available, incorporating the latest interface characteristics defined in ARINC Project Paper 747. Aircraft interfaces include one (1) ARINC-717 Harvard Bi-Phase input for receiving flight data from the aircraft's Flight Data Acquisition Unit (FDAU).

The SSFDR also includes provisions for two ARINC-429 interfaces as defined in ARINC-747; one is reserved for future copying of the FDR's recorded data to an Airborne Data Loader, and the second is provided for new generation aircraft equipped with Onboard Maintenance Systems.

Extensive micro-processor based built-in-test greatly simplifies test and trouble shooting, thereby minimizing technician training and support equipment costs.

The SSFDR provides an interface for high speed readout of its memory while onboard the aircraft. Readout time is under 5 minutes for the 1X model, under 10 minutes for the 2X model, and under 20 minutes for the 4X model.

1.0 SSFDR DESIGN OVERVIEW

The SSFDR is a single Line Replaceable Unit (LRU) in a standard ARINC-404A form factor. The SSFDR chassis includes three (3) Shop Replaceable Units (SRU's) and an optional underwater locating device. SRUs include:

- a) **Interface and Controller Board (ICB)**
- b) **115Vac or 28Vdc Power Supply (PS)**
- c) **Crash Survivable Memory Unit (CSMU)**
- d) **Under Water Locator Beacon (ULB) - optional**

The breakdown of major components and SRU accesses are summarized in Figure 3.

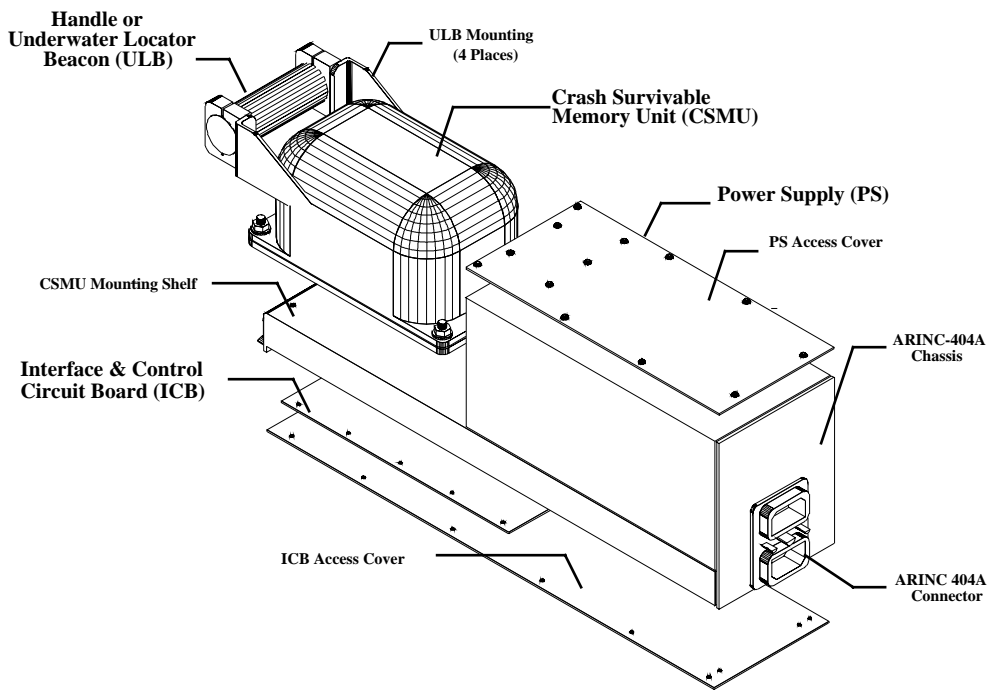


Figure 3: SSFDR Exploded View Showing Major SRUs

All three SRUs are readily accessible without requiring major disassembly. The CSMU may be removed from its mounting shelf by simply removing four bolts and releasing its mating connector. The plug-in power supply may be accessed by removing the top (power supply) access panel. Access to the plug-in interface controller board is accomplished by removing the bottom cover panel from the SSFDR chassis.

An optional under water locator beacon (ULB), per TSO C-121, is mounted on the front of the unit and also serves as a handle. Four (4) mounting bolts firmly attach the ULB directly to the front of the CSMU to avoid separation in the event of an incident. The mounting of the ULB also facilitates easy access for replacement of its battery. If the SSFDR is purchased without the ULB, a hollow metal tube is mounted in its place.

2.0 SSFDR OPERATIONAL OVERVIEW

All SSFDR processing and control is performed on a single plug-in circuit board, the Interface and Control Board (ICB). ICB functions include: front end data conditioning, control of all states and modes of the system, and performing record, monitor and test.

Figure 4 provides a simplified block diagram of the ICB.

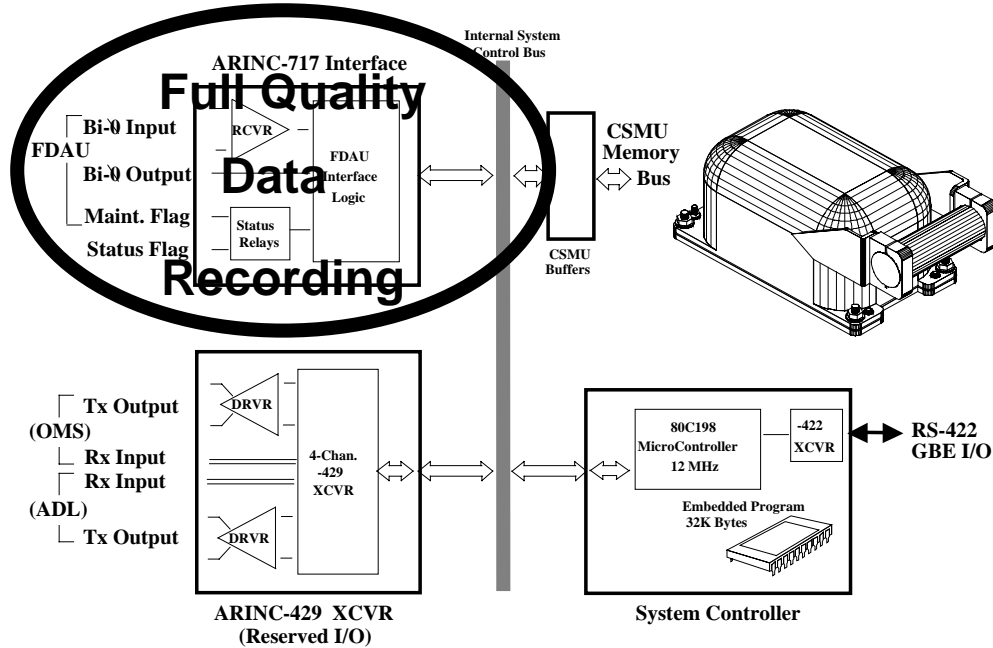


Figure 4: Interface Controller Board Block Diagram

A key element of the SSFDR design is that the flight data recording is accomplished in the same manner as previous tape-based FDRs, that is, without data synchronization or compression. This simplified recording approach provides several advantages to the user:

- The equipment will work identically without regard to special FDAU sync patterns.
- Maintenance and troubleshooting of complex compression algorithms are avoided.
- By eliminating synchronization and data compression, recording duration does not vary with aircraft flight profile, nor is a specific aircraft database required.
- There is no question about meeting the 25 hour minimum recording duration!

The flight data input circuits meet ARINC-717/747 interface requirements with the FDAU. Serial data input is decoded from the FDAU's bi-phase transmission format into a bit-for-bit binary form, which is then recorded in CSMU memory.

The system controller provides a direct high speed RS-422 serial link for interface with Ground Based Equipment via a connector on the front of the SSFDR. The GBE interface supports access to incoming FDAU data, and built-in-test fault history memory, as well as high speed readout (download) of the CSMUs recording memory.

3.0 SSFDR PHYSICAL CHARACTERISTICS

The SSFDR fits the half-ATR-long mounting requirements of ARINC-404A.

Recognizing that the SSFDR will be applied on small-aircraft and new generation aircraft, where space and weight are at a premium, the SSFDR is also offered in a half-ATR-short model. Height, which is a non-critical mounting dimension, is also reduced somewhat.

The SSFDR is sufficiently robust that it may be hard mounted (i.e. a shock/vibration isolation tray is not required). This, combined with the small form factor of the "short" version, will allow more latitude in mounting location on the aircraft. The physical characteristics of the unit are:

- **Mounting:** ARINC-404 1/2-ATR-Long (or Short) Tray Mount
- **Dimensions:** 6.1"H x 4.8"W x 19.62"L (or 12.62"L), plus ULB
- **Connector:** DPX2MA-57P00P-34-0001
- **Weight:** Less than 15 Pounds max. (13.5 lbs. Typical) - 1/2-ATR-Long
or less than 13 Pounds max. (11.5 lbs. Typical) - 1/2-ATR-Short
- **Power Dissipation:** Less than 15 Watts max. (6.5 W typical) for AC models
or less than 8 Watts max. (4 W typical) for DC models
- **Cooling Method:** Convection and Radiation to Ambient Air

Figure 5 illustrates the mechanical interface aspects of the unit.

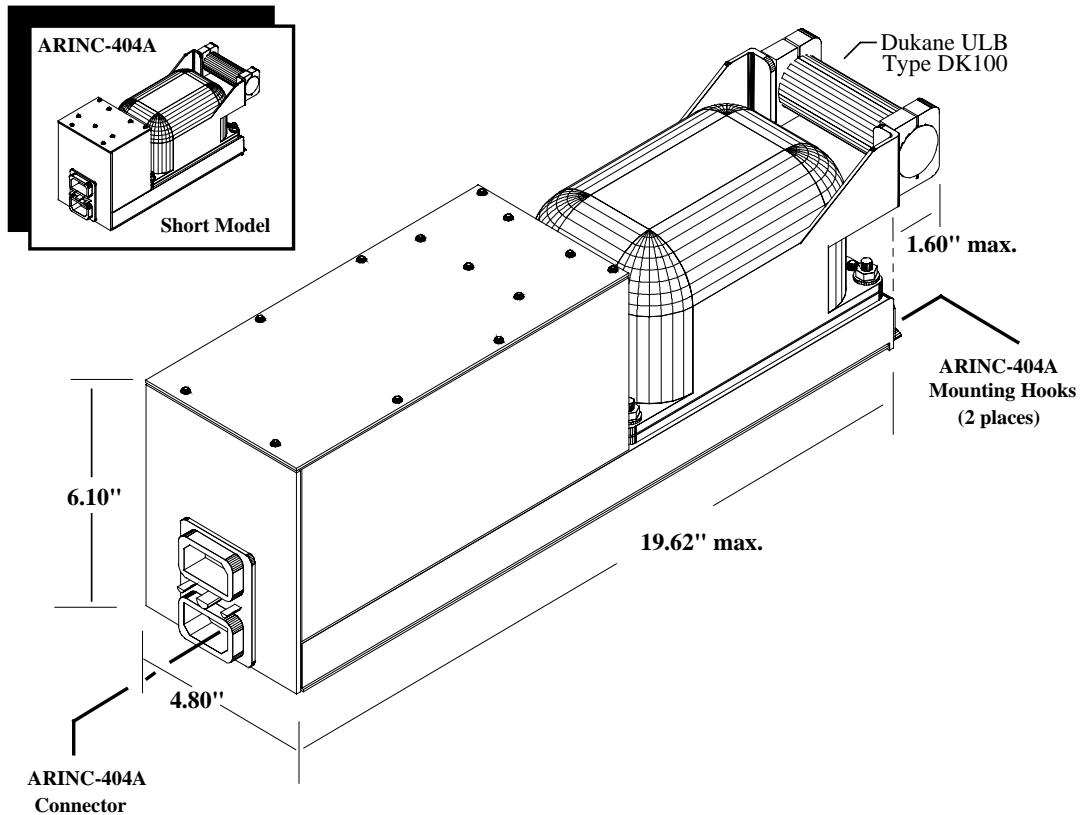


Figure 5: SSFDR Mechanical Interface Features

4.0 SSFDR ENVIRONMENTAL CHARACTERISTICS

The SSFDR has been fully qualified to meet the environmental service conditions for rack mounted equipment per DO-160C as outlined below. These conditions have been selected to assure its failure-free use in virtually all commercial transport aircraft which require use of a FDR.

Temperature		Per DO-160C Section 4, Category D2
Operational Limits:	Continuous -55°C to +70°C	
Non-operational Limits:	Continuous -55°C to +85°C	
Altitude		Per DO-160C Section 4, Category D2
Altitude:	Sea Level to +50,000 feet	
Temperature Variation		Per DO-160C Section 5, Category B
Humidity		Per DO-160C Section 6, Category B
Mechanical Shock		Per DO-160C Section 7
Operating Shock:	Up to 6G over 11 msec half-sine	
Crash Safety:	Up to 15G over 11 msec half-sine	
Vibration		Per DO-160C Section 8
Fixed Wing Aircraft:	Per Test Curve B, C, L, M	
Helicopter Vibration:	Per Test Curve N, Y	
Explosion Proofness		Per DO-160C Section 9, Category E1
Waterproofness		Per DO-160C Section 10, Category X
Fluid Susceptibility		Per DO-160C Section 11, Category X
Sand and Dust		Per DO-160C Section 12, Category X
Fungus Resistance		Per DO-160C Section 13, Category F
Salt Spray		Per DO-160C Section 14, Category X
Magnetic Effect		Per DO-160C Section 15, Category A
Magnetic Deflection:	0.3-1.0m Distance allowed	
Power Input		Per DO-160C Section 16, Category E
Input Power:	Category B for DC models	
Power Interruptions:	200 msec. without upset.	
Voltage Spikes		Per DO-160C Section 17, Category A
Audio Frequency Conducted Susceptibility		Per DO-160C Section 18, Category E
	Category B for DC models	
Induced Signal Susceptibility		Per DO-160C Section 19, Category Z
Radio Frequency Susceptibility		Per DO-160C Section 20, Category V
Emission of Radio Frequency Energy		Per DO-160C Section 21, Category Z
Lighting Induced Transient Susceptibility		Per DO-160C Section 22, Category L
Lighting Direct Effects		Per DO-160C Section 23, Category X
Icing		Per DO-160C Section 24, Category X

5.0 SSFDR CRASH PROTECTION DESIGN

The SSFDR's crash survivable memory unit (CSMU) provides for complete data recovery when subjected to the crash conditions stipulated in ED-55 and ED-56a:

- **Impact Shock** 3400G, 6.5 milliseconds
- **Penetration Resistance** 500 lb. weight from 10 feet
- **Static Crush** 5000 lbs., 5 minutes
- **High Temperature Fire** 1100°C, 30 minutes
- **Low Temperature Fire** 260°C, 10 hours (per ED-56a)
- **Deep Sea Pressure and** 20,000 feet, 30 days
- **Sea Water/Fluids Immersion** Per ED-55

The CSMU design has been fully qualified to these requirements and, in fact, exceeds them by considerable margin in key survival areas:

- **Impact shock has been successfully demonstrated at 4800 G's**
- **High temperature fire exposure has been tested to 60 minutes**
- **Low temperature fire was tested immediately after exposure to 1100°C fire**

The superior performance of the CSMU is the result of 30 years experience with designing and producing protective enclosures. As shown in Figure 6, a very simple package design has been achieved, which not only contributes to its industry leading survivability characteristics, but also assures a high degree of maintainability. Compared to competing models, requirements for specialized repair knowledge and support equipment have been greatly reduced.

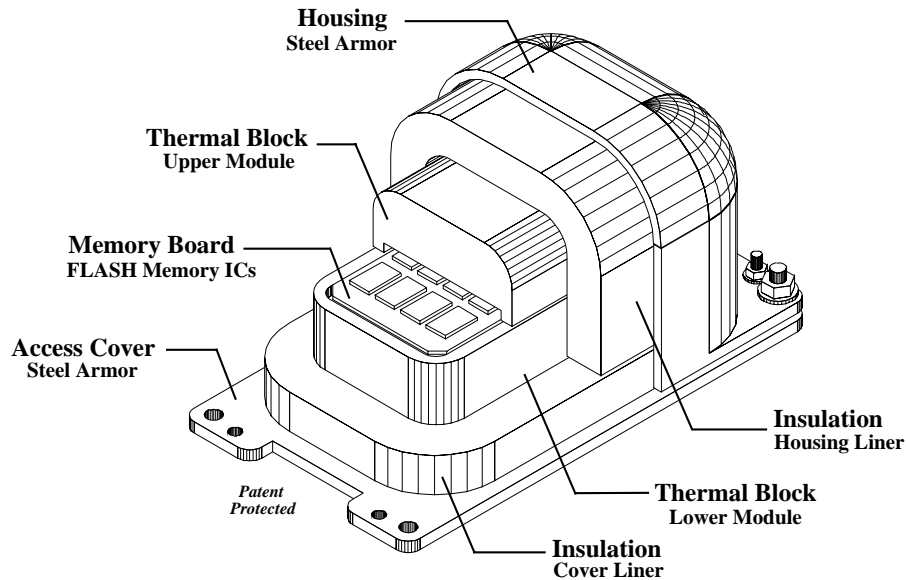


Figure 6: CSMU Cutaway View Showing Major Features

The CSMU is easily removed from the top of the SSFDR chassis without having to disassemble the remainder of the unit. A steel bottom cover provides easy access to the Memory Board. Since the CSMU uses modular "dry-block" materials for both the insulating liner and thermal mass, there is no need to deal with the sticky thermal gels or special insulating fluids. The Memory Board design is very simple, consisting of only a single small circuit card assembly.

6.0 TRI-AXIAL ACCELEROMETER

A tri-axial accelerometer meeting the requirements of the FAA TSO C-51a for measurement of acceleration at the aircraft center of gravity can also be provided. The flight data acquisition unit (FDAU) typically provides interface inputs for operation in conjunction with a tri-axial accelerometer as defined in ARINC-717. The FDR accelerometer measures *vertical, lateral, and longitudinal* acceleration values experienced by the airframe. The FDAU processes acceleration values and outputs these along with all other flight parameters in the serial data stream to the FDR.

The standard ARINC-717 Triax, shown in Figure 7 can be provided as part of the SSFDR recording system package. This device has a well-earned reputation for being the most reliable in the industry. The following briefly summarizes the characteristics of this device.

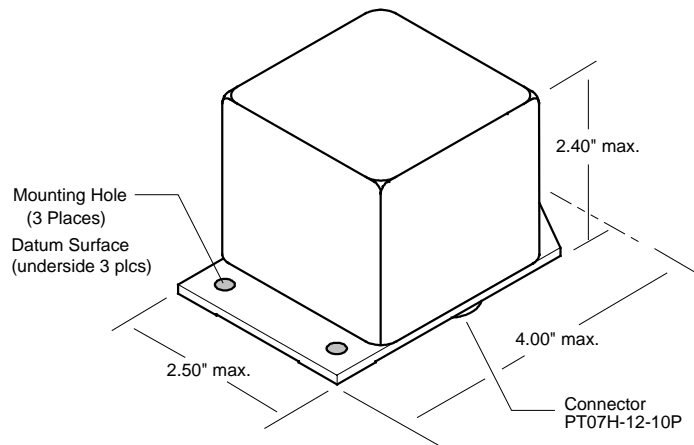


Figure 7: Triax-Accelerometer Mechanical Interface Features

- **Input Power:** **+28 Vdc ± 4 Vdc, 100ma maximum load**
Stabilization within 0.5 seconds

- **Range:**

Lateral Axis (x)	±1g	0g Null = 2600mv ± 25mv
Longitudinal Axis (y)	±1g	0g Null = 2600mv ± 25mv
Vertical Axis (z)	-3g to +6g	0g Null = 1800mv ± 25mv

- **Signal Output:**

Maximum Positive g's	5000 milli volts
Maximum Negative g's	200 milli volts
Peak to Peak Noise	less than 15 milli volts
Static Error Band:	±37.5mv from ideal endpoints
Null Offset:	<0.01% FS per °F, ±60mv max.
Temperature Coefficient	0.01% per °F, -65°F to +165°F
Dynamic Response:	3db down at 4 Hz

- **Mechanical Alignment:** **±1 degree of case reference surface**

- **Weight** **1.1 Pounds maximum**

7.0 SSFDR SYSTEM SUPPORT EQUIPMENT

The SSFDR is supported by an integrated set of Ground Based Equipment (GBE). The GBE consists of the following products:

- **Hand Held Download Unit**
- **Acceptance Test Unit**
- **Aircraft Data Recovery and Analysis Software**

7.1 Hand Held Download Unit (HHDLU).

The HHDLU is a compact, highly portable flight line support tool for accomplishing on-aircraft tasks such as SSFDR memory readout, SSFDR built-in-test fault history readout, and selective monitoring of incoming parameters from the FDAU. The HHDLU connects via the SSFDR's front panel connector, enabling easy access to the SSFDR while installed in its aircraft mounting rack.

The HHDLU is primarily intended for convenience where customers perform periodic on-aircraft readout of flight data and provides high speed download of the contents of the recording memory via an RS-422 interface. The HHDLU contains a removable mass storage device which is capable of storing the entire recording memory contents of the SSFDR. Figure 8 provides a diagram of the download function showing the HHDLU connected to the SSFDR's front panel GBE interface.

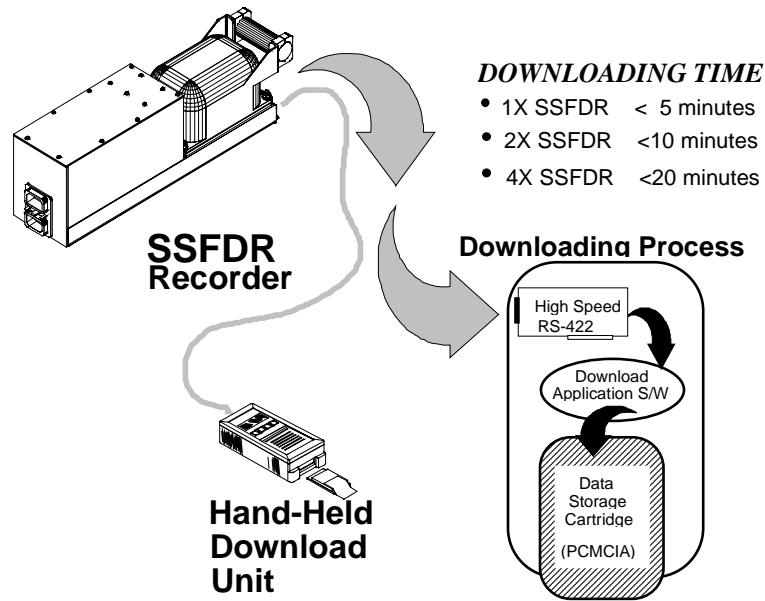


Figure 8: Hand-Held Download Unit Configuration

The HHDLU contains a "credit card" sized removable memory cartridge for storing the downloaded flight data. This cartridge provides sufficient capacity to enable the operator to download several aircraft before replacing/erasing the cartridge. Download files may be selectively erased. The cartridge is compatible with commercially available personal computer cartridge drives, thereby providing an efficient and cost effective method of transferring data from the HHDLU to other ground based tools, such as the SSFDR's test station or a dedicated analysis computer.

Recognizing that users will possess varying levels of sophistication, the operator interface has intentionally been kept very simple to minimize the need for extensive training. Four entry keys control operation and a 4-line display indicates progress.

7.2 Acceptance Test Unit

The Acceptance Test Unit (ATU) is a cost effective shop level personal computer (PC) based system with associated software which can perform download of SSFDR recording memory, processing of downloaded data, acceptance testing and return to service testing of the SSFDR. Because the "TEST" function does not preserve the data contained in the recording memory, the PATS operations are segmented into two distinct applications; "READOUT" and "TEST". This provides a level of protection against unintentional erasure or re-write of recorded flight data. Figure 9 shows the ATU in its SSFDR test configuration.

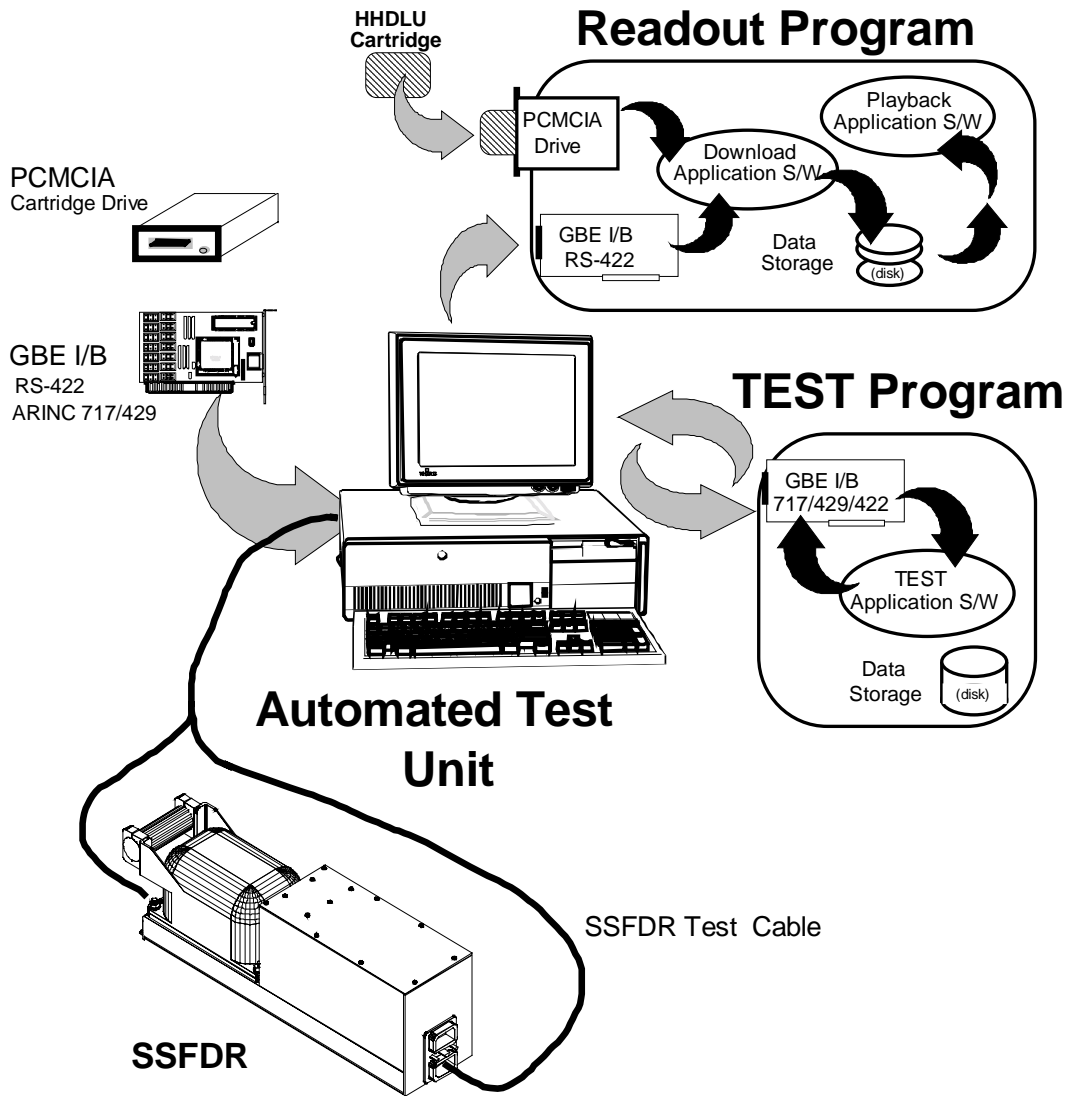


Figure 9: SSFDR Playback and Test System Configuration

The ATU is configured with a GBE Interface Board containing the high speed RS-422, ARINC-717, and ARINC-429 interface channels necessary to test the SSFDR functions. A PCMCIA cartridge drive enables flight data cartridges downloaded on the HHDLU to be transcribed onto hard disk for playback into other processing software programs. A 486-33MHz PC provides the necessary computing capability to support all SSFDR TEST and READOUT tasks.

7.3 Aircraft Data Recovery and Analysis Software (ADRAS)

ADRAS is a software package which enables the airlines to perform their own analysis of flight data removed from the solid state FDR products. This program operates on a 486 class personal computer in a MS Windows® operating environment. The Windows user interface provides an easily understood menu driven readout and analysis tool that requires minimal operator training. ADRAS is a full featured analysis tool which performs readout of the flight recorder data, as well as reconstruction of the data into formats which are useful in the analysis process.

- Display formats include both tabular listings and analog (strip chart) presentation.
- Results may be viewed on the computer screen, printed, and/or stored as a disk file.
- Logical search features enable the operator to search for and display specific events.
- Control features enable the operator to zoom in on details or switch display formats.
- A database construction and editing tool enables operator modification of parameter tables.

As examples of the ADRAS capability, Figure 10 shows both tabular and plot presentation formats where the operator selected GMT, Altitude, Airspeed and the AIR/GROUND switch as parameters. The ADRAS can very quickly search the entire 25 hours of flight data and trigger on such an event. The operator could have set the search logic to trigger on the air/ground switch, or altitude, or a combination of both. The operator has the ability to move between these displays or zoom in on the specific area of the event for a closer look.

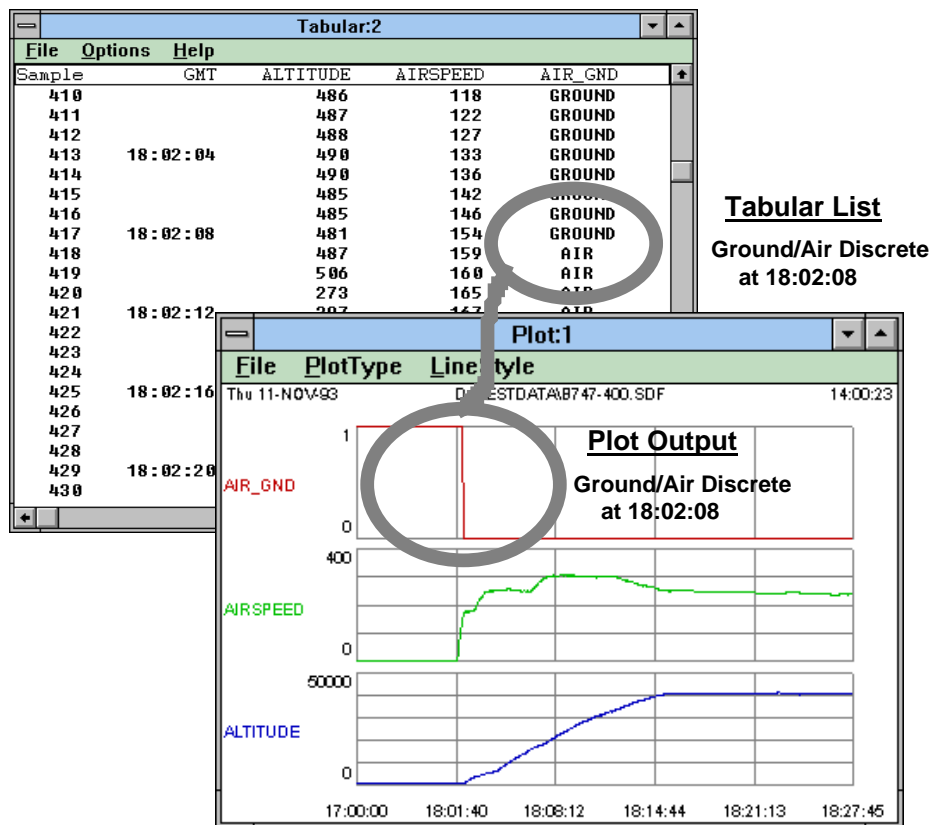


Figure 10: Examples of Tabular and Plot Display Formats

8.0 4X SOLID-STATE FLIGHT DATA RECORDER

Aircraft installation compatibility

The new 4X SSFDR (identified as part number 980-4700-04X) is form and fit compatible with existing aircraft ARINC 573/717/747 FDR installations. The data rate settings (64, 128 or 256 words per second) are pin programmable via jumpers on the aircraft connector.

The SSFDR provides an interface for high speed readout of its memory using a Hand Held Download Unit (HHDLU) while onboard the aircraft. **Readout (data transfer) time for the entire 4X model memory contents is less than 20 minutes.**

Initially developed for installation on the next generation Boeing 737 aircraft scheduled for roll-out in 3Q96, the 4X SSFDR is equally applicable to any FDAU equipped aircraft (forward fit or retro-fit), either to accept the higher data rate (256 words per second) or record the same data rate for an increased time period (e.g., in excess of 100 hours for 64 words per second data rate).

Qualification

The 4X SSFDR will be qualified to the categories of DO 160C

(D2-BB[BCLMNY]E1XXXFXA(E/A)A(E/A)ZVZLXX) as shown on the attached summary specification.

Approvals

The 4X SSFDR is approved to TSO C124 and CAA Spec 10a. The new configuration is considered a minor change in accordance with FAR 21.611.

Test Equipment Impact

The Automatic Test Unit (ATU) 964-0434, used for existing SSFDR products, will require an interface upgrade, in order to accommodate the faster 256 words per second data rate. Alternatively, two new dash numbers -042 and -044 will be available to accommodate CSMU testing only and all FDR testing respectively.

The HHDLU 964-0446, will also require modification from -001 to -002 to operate with the increased 256 words per second data rate.

SOLID STATE FLIGHT DATA RECORDER 4X SPECIFICATIONS	
Honeywell Part Number	980-4700-04X
Packaging	ARINC 404, 1/2 ATR Short & Long
Weight	16 or 18 Pounds, Nominal
Power	115 V _{AC} , 400 Hz, 15 W; 28 V _{DC} , 8 W
Connector & Mounting	DPX2MA-57P00P-34-0001 (Mates with DPX2MA-57S00S-33-0001) Front Panel: AMP Connector 749649-3 (Mates with AMP Connector 749621-3) ARINC 404 1/2 ATR Long or Short Tray Shockmounts not Required
Survival	TSO C124A / C123A
Environmental	RTCA DO16C Category

D2-BB[BCLMNY]E1XXXFXAEAEZVZLXX

Approvals	FAA: TSO C124 [<i>Pending</i>] CAA: Specification 10a [<i>Pending</i>]
Data Capacity	25 Hours @ 256 Words/Sec (3,072 bits / Sec) 50 Hours @ 128 Words/Sec (1,536 bits / Sec) 100 Hours @ 64 Words/Sec (768 bits / Sec)
Data Storage Medium	36 Mbyte, Flash EEPROM
Performance	ARINC 573/717/747 DFDR
Options	Underwater Locator Beacon
Download	<20 Minutes onboard using HHDLU

4X SSFDR Available Options

Part number	Input Pwr	Form Factor	with or without ULB
980-4700-041	AC/DC	1/2 ATR Short	with ULB
980-4700-042	AC/DC	1/2 ATR Long	with ULB
980-4700-043	AC/DC	1/2 ATR Short	w/out ULB
980-4700-044	AC/DC	1/2 ATR Long	w/out ULB

All Available SSFDR Options

ASAI Part Number	Input Power	Form Factor	Integral ULB	Memory Des	Memory Size (Mbytes)	Wgt (lbs)
980-4700-001	AC	Long	Yes	1X	9	17.4
980-4700-003	AC	Long	Yes	2X	18	17.4
980-4700-005	AC	Long	No	1X	9	17.4
980-4700-007	AC	Long	No	2X	18	17.4
980-4700-009	AC	Short	Yes	1X	9	15.5
980-4700-011	AC	Short	Yes	2X	18	15.5
980-4700-013	AC	Short	No	1X	9	15.5
980-4700-015	AC	Short	No	2X	18	15.5
980-4700-017	AC/DC	Long	Yes	1X	9	17.4
980-4700-019	AC/DC	Long	Yes	2X	18	17.4
980-4700-021	AC/DC	Long	No	1X	9	17.4
980-4700-023	AC/DC	Long	No	2X	18	17.4
980-4700-025	AC/DC	Short	Yes	1X	9	15.5
980-4700-027	AC/DC	Short	Yes	2X	18	15.5
980-4700-029	AC/DC	Short	No	1X	9	15.5
980-4700-031	AC/DC	Short	No	2X	18	15.5
980-4700-033	AC	Long	Yes	2X	18	17.4
980-4700-034	AC	Long	Yes	1X	9	17.4
980-4700-035	AC	Long	Yes	2X	18	17.4
980-4700-041	AC/DC	Short	Yes	4X	37	15.5
980-4700-042	AC/DC	Long	Yes	4X	37	17.4
980-4700-043	AC/DC	Short	No	4X	37	15.5
980-4700-044	AC/DC	Long	No	4X	37	17.4

Table Definitions

Input Power: AC 115 VAC, 400 Hz, 1 Phase AC/DC 115 VAC, 400 Hz, 1 Phase, or 28 VDC

Form Factor: Long 1/2 ATR Long / ARINC 404 Short 1/2 ATR Short / ARINC 404

Integral ULB: Yes - Equipped No - Not Equipped (Shipped with handle)

Memory Size: 1X > 25 Hr @ 64 Words/sec
 2X > 25 Hr @ 128 Words/sec
 4X > 25 Hr @ 256 Words/sec

