

AR-SERIES

ADVANCED RECORDER

PRODUCT DESCRIPTION

Solid-State Voice, Data & Combined Recording Systems
for
Military and Helicopter Applications



The Honeywell, Inc. Solid State Advanced Recorder (AR) family is designed specifically for use in military aircraft, helicopters, and other weight sensitive installations. The Solid State technology combines the extremely high reliability of integrated circuit technology with the most advanced protective enclosure and is based on more than 45 years experience in the industry, including the mature Air Transport Solid State Cockpit Voice (SSCVR) and Flight Data Recorder (SSFDR) products. The AR-Series is a small, lightweight recorder that requires no mounting rack or cockpit mounted control panel.

AR Recorder Product Family

The AR-Series Recorder is available in several configurations, as shown below:

- Cockpit Voice Recorder only (AR-CVR)
- Flight Data Recorder only (AR-FDR)
- Combined Digital Voice and Data Recorder (AR-DVDR)

Model Type	VOICE		DATA	
	# Channels	Record Duration	Data Rate Input	Record Duration
AR-30	3 crew + 1 Area	30 Minute		
AR-120	3 crew + 1 Area	120 Minute		
AR-64			64wps	25 Hour
AR-128			128wps	25 Hour
AR-256			256wps	25 Hour
AR-301C	3 crew + 1 Area	30 Minute	64wps	25 Hour
AR-302C	3 crew + 1 Area	30 Minute	128wps	25 Hour
AR-304C	3 crew + 1 Area	30 Minute	256wps	25 Hour
AR-601C	3 crew + 1 Area	60 Minute	64wps	10 Hour
AR-602C	3 crew + 1 Area	60 Minute	128wps	10 Hour
AR-604C	3 crew + 1 Area	60 Minute	256wps	10 Hour
AR-201C	3 crew + 1 Area	120 Minute	64wps	25 Hour
AR-202C	3 crew + 1 Area	120 Minute	128wps	25 Hour
AR-204C	3 crew + 1 Area	120 Minute	256wps	25 Hour
AR-501C	3 crew + 1 Area	120 Minute	Mil-Std-1553	25 Hour

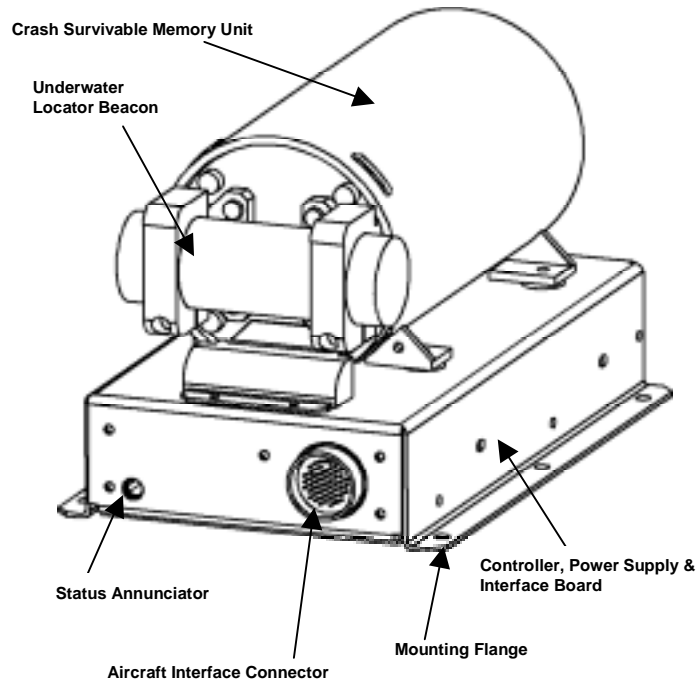


Figure 1: AR-Series System, Major Features

This equipment satisfies the most recent FAA and EUROCAE Minimum Operational Performance Specifications (MOPS) for Cockpit Voice and/or Flight Data Recorders. These specifications are:

- **EUROCAE Documents ED-56a/ED-55**
- **FAA Technical Standard Order TSO C-123a and C-124a**
- **ARINC-747 and ARINC-757**

In addition, the AR Series includes provisions in anticipation of future legislation:

- **Recording of digital data linked air traffic control messages**

Interface provisions include:

- One wideband and two or three narrow-band audio channels
- ARINC 717, ARINC 429, or Mil-Std-1553 data input
- Rotor tachometer input
- GMT (ARINC-429) optional input
- Two, spare ARINC 429 inputs (for future CNS/ATM recording)
- Analog and digital maintenance and status outputs

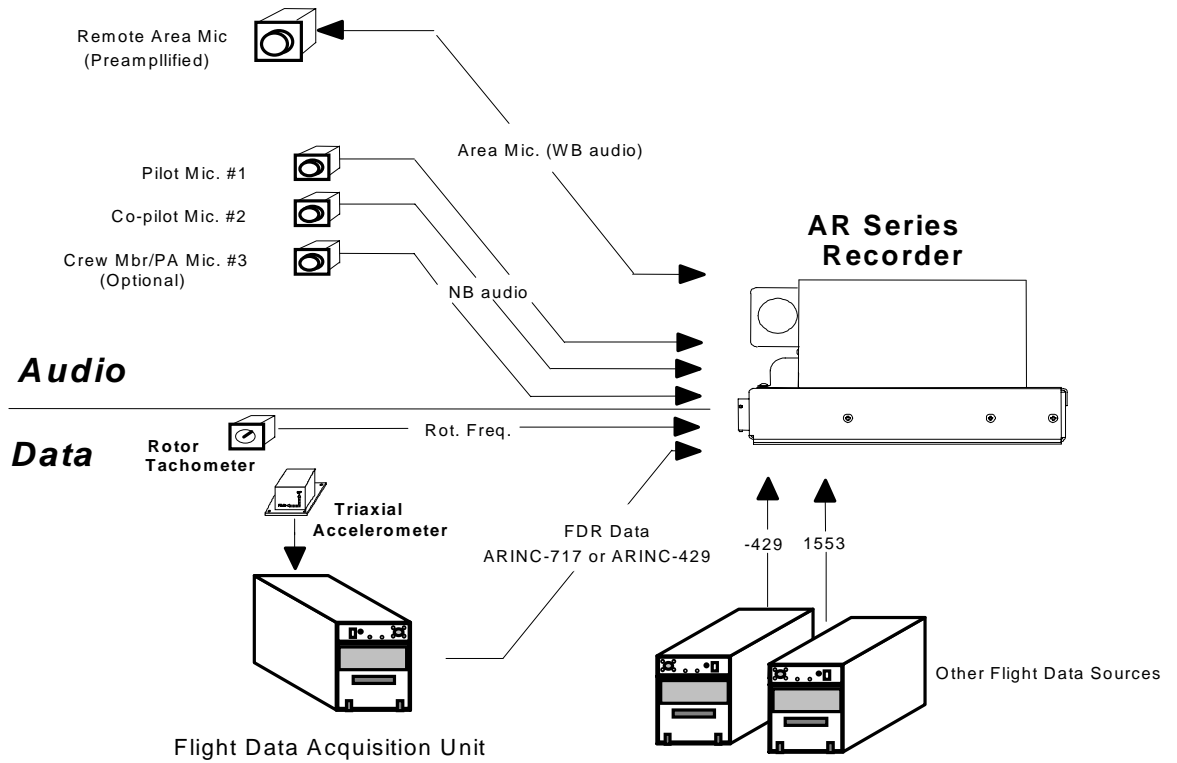


Figure 2: AR- Series Recorder, Major Aircraft Interfaces

1.0 AR-SERIES DESIGN OVERVIEW

All AR-Series Recorders are of non-ARINC form factor in order to minimize the total installation cost and weight. In addition the Pre-amplification and Signal Conditioning functions of the Microphone Monitor (Control unit) have been incorporated within the recorder Chassis, which includes three (3) Shop Replaceable Units (SRU's), as depicted in Figure 3:

- ◆ Interface and Controller Board (ICB)
- ◆ 28Vdc Power Supply (PS)
- ◆ Crash Survivable Memory Unit (CSMU)

The AR-Series Recorders utilize a small, lightweight, modular crash survivable memory unit (CSMU) for protection of the solid state memory. State of the art high-density FLASH memory devices are combined with the use of mature industry standard audio digitization and encoding integrated circuits (ICs). The CSMU may be removed from its mounting shelf by simply removing four bolts and releasing its mating connector. In addition to the described SRUs, an Underwater Locating Beacon (ULB) is attached to the CSMU by four (4) mounting, to avoid separation in the event of an incident. The mounting of the ULB also facilitates easy access for replacement of its battery.

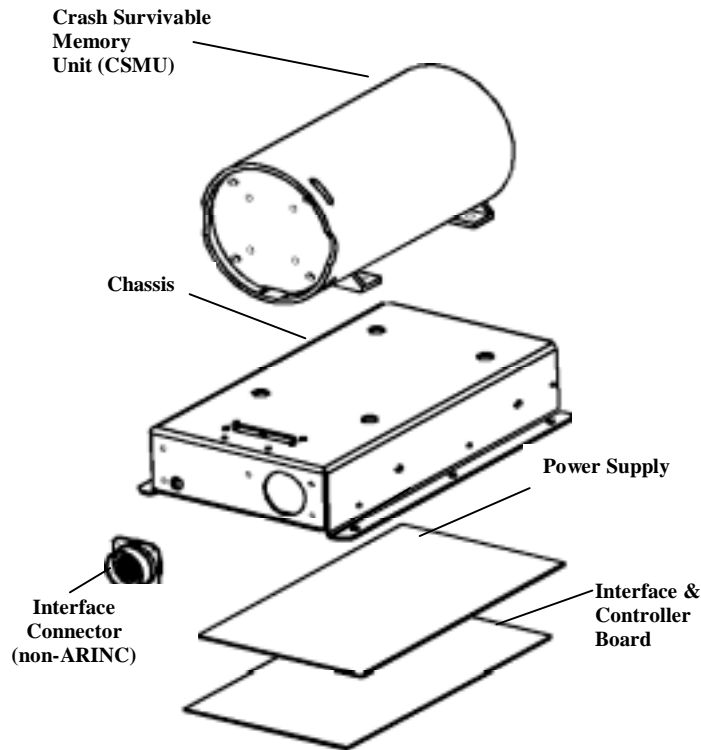


Figure 3: AR-Series Exploded View Showing Major SRUs

Low Cost of Ownership

Honeywell’s AR-series recorders provide high quality, performance, reliability and support.

- ◆ High Reliability (MTBF)
In excess of 50,000 hours field operation anticipated – based on mature SSCVR/SSFDR.
- ◆ Useful life in excess of 20 years, not including the ULB
- ◆ “On demand” maintenance only – no calibration requirements
- ◆ Low weight – 8.8 pounds (no mounting rack required)
- ◆ Field repair - only 3 SRUs allow for simple repair
- ◆ Five-year warranty – standard

No scheduled periodic maintenance or servicing is required during the life of AR products (except for the TSO C-121 approved ULB, which requires battery replacement approximately every 6 years). The AR series has been designed to detect and isolate errors to the Shop Replaceable Unit (SRU) level, and its modular fashion allows SRU replacement for ease of repair with an estimated Mean Time to Repair (MTTR) of 30 minutes.

2.0 AR-SERIES OPERATIONAL OVERVIEW

All AR-Series 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, audio signal digitization and encoding, control of all states and modes of the system, and performing functions such as record, erase, and test. Figure 4 provides a simplified block diagram of the ICB.

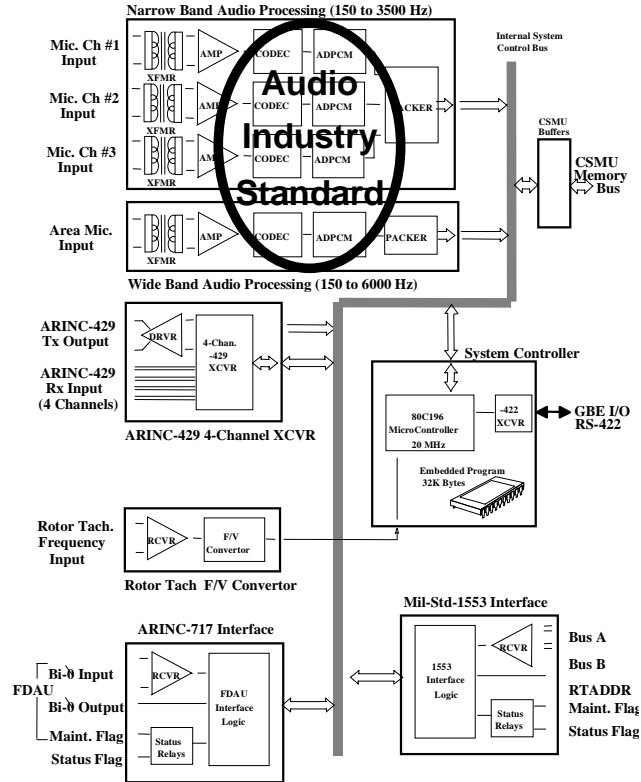


Figure 4: Interface Controller Board Block Diagram

A key element of the AR-Series design is that the audio recording uses an industry standard encoding method (G.723 CCITT, 24kbs). This approach provides several advantages to the user:

- The audio digitization and encoding have been matured through widespread use in consumer equipment, and in current Honeywell SSCVR units.
- The encoding algorithm is extensively used in personal computer based high quality audio systems, thus decoding/playback tools are inexpensive and commercially available .

The audio circuits, digitization/compression process, and memory resolution meet the improved audio performance requirements of ED-56a, thereby assuring the highest level of audio recording fidelity.

FDR/DVDR Data recording is accomplished in the same manner as previous Honeywell Solid State FDRs, that is, **without** data synchronization or compression, thereby providing 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.
- Recording duration does not vary with aircraft flight profile, nor is a specific aircraft database required.

The flight data input circuits meet ARINC-717/747 interface requirements with the FDAU and Mil-Std-1553 redundant buss requirements.

3.0 AR-SERIES PHYSICAL CHARACTERISTICS

Recognizing that the AR-Series will be installed on aircraft where space and weight is at a premium. The AR-Series 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, allows more latitude in mounting location on the aircraft. The physical characteristics of the unit are:

- **Mounting:** Direct to shelf/Structure, no tray required
- **Dimensions:** 9.49" L x 5.88" W x 5.75" H
- **Connector:** Circular, not rack type MS27508E16F35A (55 pins) (mates with MS27473T16F35S)
- **Weight:** 8.8 Pounds typical
- **Power Dissipation:** 8 Watts typical, +28VDC only
- **Cooling Method:** Convection and Radiation to Ambient Air

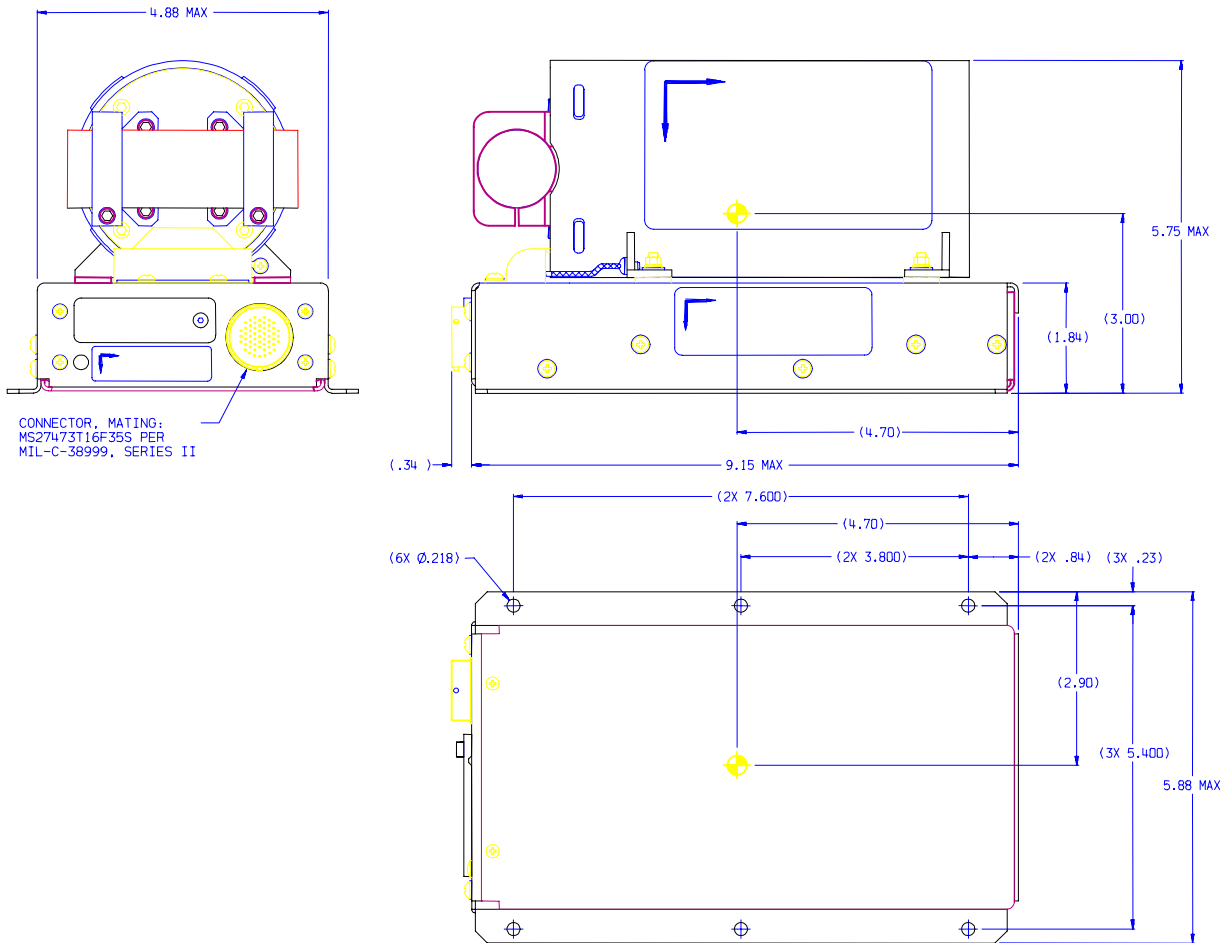


Figure 5: AR-SERIES Mechanical Interface Features (AR-FDR/DVDR shown)

4.0 AR-SERIES ENVIRONMENTAL CHARACTERISTICS

The AR-Series 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 virtually on all aircraft and helicopters which require use of a CVR, FDR or DVDR.

Environmental Test Condition	DO-160C Category / Limit
Temperature: Operating Short-Term Operating Non-Operating	-55°C to +70°C, Category D2 +70°C, Category D2 -55°C to +85°C, Category D2
Altitude	+50,000 Feet MSL, Category D2
Humidity	Severe Environment, Category B
Vibration: Aircraft Helicopter	Curves B, C, L, and M Curves N and V
Shock	Operational: 6g Peak, 11 msec. duration Crash Safety: 15g Peak, 11 msec. duration
Explosion Proofness	Category E1
Waterproofness	Category X
Fluids Susceptibility	Category X, (Meets ED-56a Requirements)
Sand and Dust	Category X
Fungus Resistance	Category F
Salt Spray	Category X
Magnetic Effect	Category A
Power Input	Category A (22 to 29.5 VDC)
Voltage Spike	Category A
Audio Frequency-Conducted	Category A
Induced Signal Susceptibility	Category Z
RF Susceptibility	Category V
Emission of RF Energy	Category Z
Lightning Induced Transients	Category A2C2
Lightning Direct Effects	Category X
Icing	Category X
Crash Survivability Testing per ED-56 Revision A, TSO-C123a /C-124a	
Impact Shock	3400g's, 6.5 msec. duration (half-sine)
Penetration Resistance	500 lbs. drop from 10 feet
Static Crush	5000 lbs., 5 minute duration
High Temperature Fire	1100°C, 50,000 BTU's, 60 Minutes
Low Temperature Fire	260°C, 10 Hours
Deep Sea Pressure	20,000 Feet, 30 Days
Salt Water Immersion	10 Feet, 30 Days
Fluid Susceptibility / Immersion	Per ED-56a
Performance Characteristics	
Recording Duration	Cockpit Voice – 30, 60 or 120 minutes Flight Data - 10 or 25 Hours
Audio Input Channel Impedance	> 10K Ohms
Audio Output (Monitor) Impedance	< 600 Ohms
Channel Frequency Spectrum	3 Narrow Band (150-3500 Hz) 1 Cockpit Area Microphone (150 – 6,000 Hz)
Audio Quality	Per ED-56a:- (S/N+D) - 24.0 dB minimum (full bandwidth) Speech Transmission Index (STI) - 0.75 min (voice) 0.85 min (area)
Cockpit Area Microphone Preamplifier	Integrated Into Recorder

5.0 AR-SERIES CRASH PROTECTION DESIGN

The AR Series Recorder has a crash survivable memory unit (CSMU) designed to ensure complete data recovery when subjected to the crash survivable requirements of ED-56A, as shown below. The superior performance of the CSMU is the result of 45 years experience with designing and producing protective enclosures

- **Impact shock of 3400Gs**
- **500 lbs. dropped from 10 feet**
- **High temperature fire exposure in excess of 60 minutes**
- **Low temperature fire exposure of 260°C for a period of 10 hours**
- **Deep water immersion at a depth of 20,000 feet for a period of 30 days**
- **Salt water immersion at a depth of 10 feet for a period of 30 days**

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.

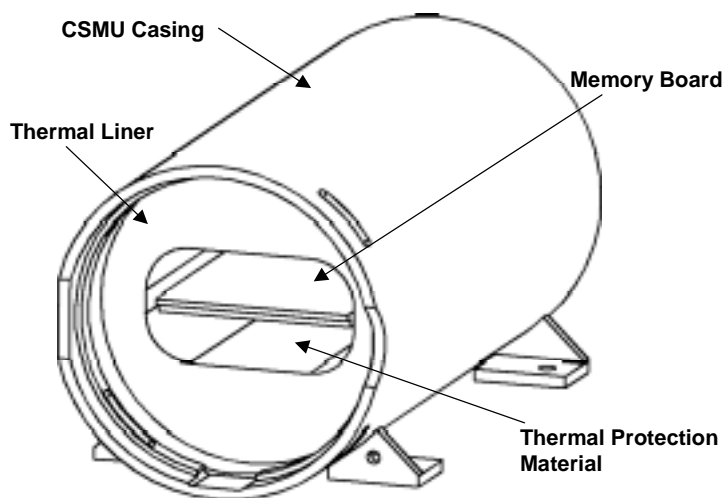


Figure 6: CSMU Cutaway View Showing Major Features

The CSMU is easily removed from the top of the AR-Series chassis without having to disassemble the remainder of the unit.

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 jells or special insulating fluids.

6.0 REMOTE AREA Microphone Design Overview

In order to reduce weight and cockpit panel space requirements the AR-Series recorders have incorporated the Pre-amplification and Signal Conditioning functions of the Microphone Monitor (Control unit) **within the recorder chassis**. Therefore the optional Erase, Test, Headphone and Status functions may be provided on a separate Status Panel, at the installers' discretion.

The area microphone, which meets the requirements of ED-56A and TSO C-123a, is a small device intended for location in the cockpit ambient audio environment, and is provided with flying leads, as shown in Figure 7.

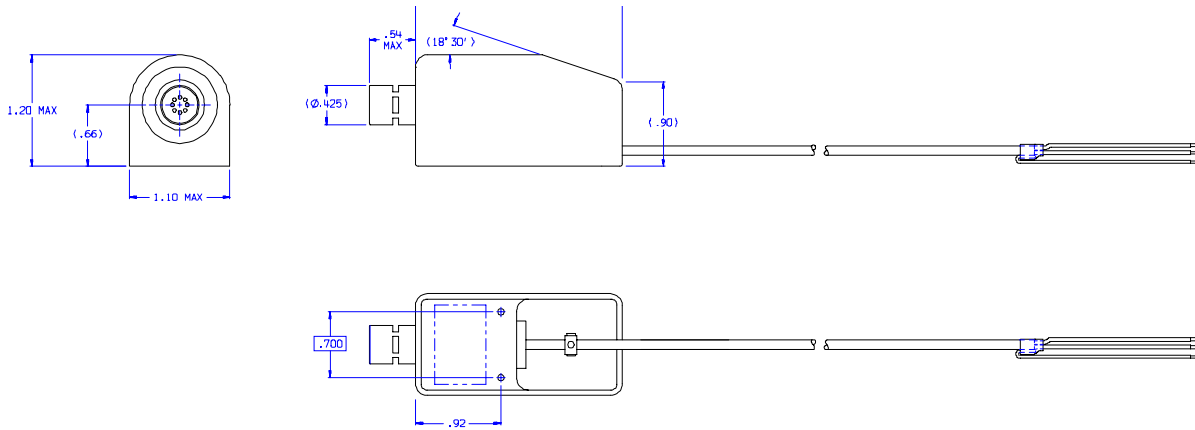


Figure 7: Area Microphone – Flying Leads

- **Input Power (supplied by Recorder)** +5 Vdc ± 1 Vdc
- **Current:** 300µA maximum
- **Audio Characteristics:**

Frequency Response	150 Hz to 10,000 Hz
Signal to Noise Ratio	48dB, 95 - 120dB SPL
Harmonic Distortion	< 5% at 90dB SPL over 150 to 8,000 Hz <10% at 120dB SPL at 10,000 Hz
- **Weight** **3.5 ounces maximum**

7.0 AR-SERIES SYSTEM SUPPORT EQUIPMENT

The same family of Ground Support Equipment as their Air Transport predecessors (the SSCVR and SSFDR) supports the AR-Series recorders.

Playback and Test Station (PATS)

The PATS is a PC-based workstation which includes Windows®-based acceptance test, return-to-service and diagnostic software for the AR-CVR, AR-FDR, AR-DVDR and SSCVR. Full audio playback of all recorded information is provided, including data display of the optional Rotor Speed indication.

The PATS is configured with a GBE Interface Board containing the high speed RS-422, discrete interfaces, ARINC-429, and Mil-Std-1553 interface channels necessary to test the AR-Series functions. The PATS also contains up to 3 commercial dual-channel digital-audio boards. These are used for audio input/output during CVR audio tests, and for audio output (to speakers) during playback.

Since the "TEST" function does not preserve the data contained in the recording memory, the PATS operations are segmented into two distinct applications; "Playback" and "TEST". This provides a level of protection against unintentional erasure or re-write of recorded audio.

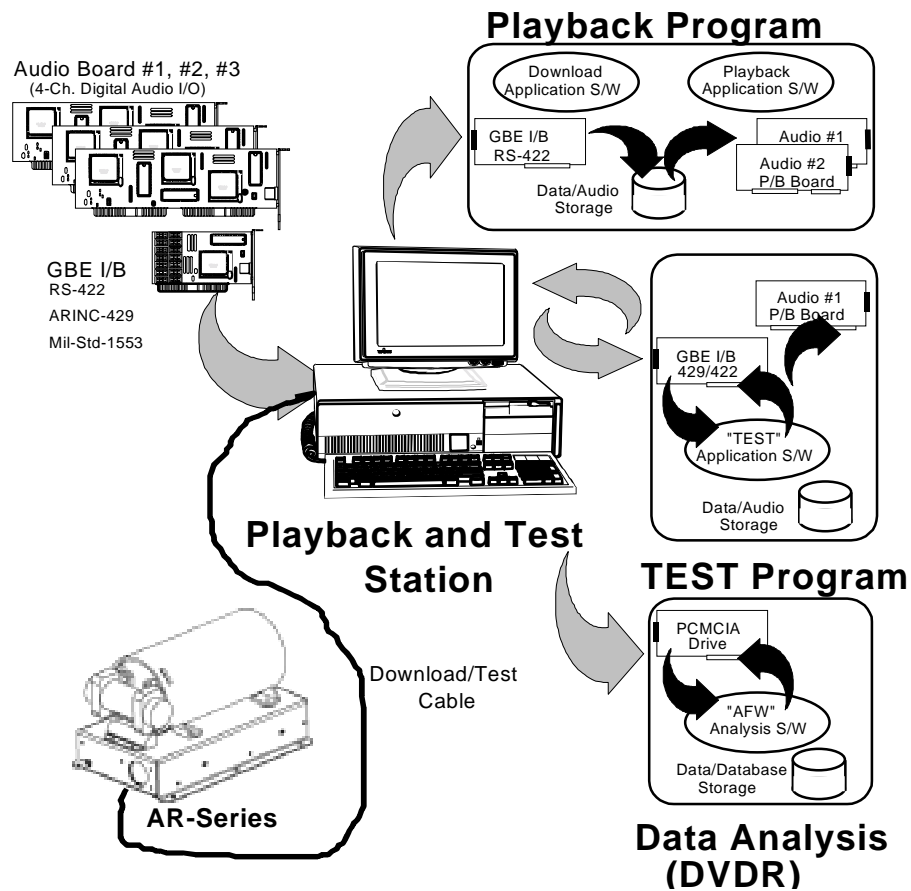


Figure 11: AR-Series Playback and Test System Configuration

Hand-Held Download Unit (HHDLU)

On-aircraft data download of the AR-FDR, AR-DVDR and SSFDR may be accomplished via the RS-422 interface located on the front face of the unit using a PCMCIA memory cartridge as the data transfer medium; in less than 5 minutes for 64-words/second, 25-hour memory capacity models.

8.0 AR-SERIES INSTALLATION RECOMMENDATIONS

MECHANICAL INSTALLATION

The Honeywell Solid State Advanced Recorder (AR) family was designed specifically for use in weight sensitive aircraft and helicopters and has the following installation advantages over standard Recorders

- **small,**
- **lightweight**
- **no mounting rack required**
- **no cooling required**
- **may be mounted in any orientation**
- **cockpit mounted control panel not required**
- **Status panel optional .**

The AR-Series is sufficiently robust that it may be hard mounted (i.e. a shock/vibration isolation tray is not required) in any orientation . This, combined with the small form factor, allows more latitude in mounting location on the aircraft.

AUDIO INTERFACE

The area microphone, part number 980-6113-010, is a small device intended for location in the cockpit ambient audio environment, and is provided with flying leads. This is a pre-amplified device and allows for a greater distance from the Microphone to the AR-Series Recorders.

The Area Microphone is installed using a bracket screwset and requires a simple mounting bracket, which may be manufactured by the installer.

DATA INTERFACE

The AR-Series data recording is in accordance with ARINC-573/717, ARINC-429, or Mil-Std-1553 and can be interfaced to a Flight Data Acquisition Unit (FDAU).

STATUS PANEL

In order to reduce weight and cockpit panel space requirements the AR-Series recorders have incorporated the Pre-amplification and Signal Conditioning functions of the Microphone Monitor (Control unit) within the AR-Series chassis. Therefore the optional Erase, Test, Headphone and Status functions may be provided on a separate Status Panel, at the installers' discretion.

To minimize the cockpit real estate requirements it is recommended that the operator design (per space requirements) a panel that includes CVR and FDR Fault Status lamps as well as a Headset jack.

FAULT and STAUS INDICATIONS

The AR-Series Recorders provide the following outputs to an optional cockpit indicator.

CVR MAINTENANCE FAULT OUTPUT

This output is normally short circuited (using a relay) to chassis ground (500 mA max, 1 VDC max), but if any CVR section(s) of the DVDR malfunction, if the DVDR is removed from the aircraft, or if the system power is off, this output will toggle to an "open" state (>100,000 ohms).

FDR MAINTENANCE FAULT OUTPUT

This output is normally short circuited (using a relay) to chassis ground (500 mA max, 1 VDC max), but if any FDR section(s) of the DVDR malfunction, this output will toggle to an "open" state (>100,000 ohms).

FDR STATUS OUTPUT

When the DVDR is functioning properly, the FDR Status output is in an "open" state (>100,000 ohms). If an internal FDR related error occurs, the output will toggle to chassis ground (500 mA max, 1 VDC max).

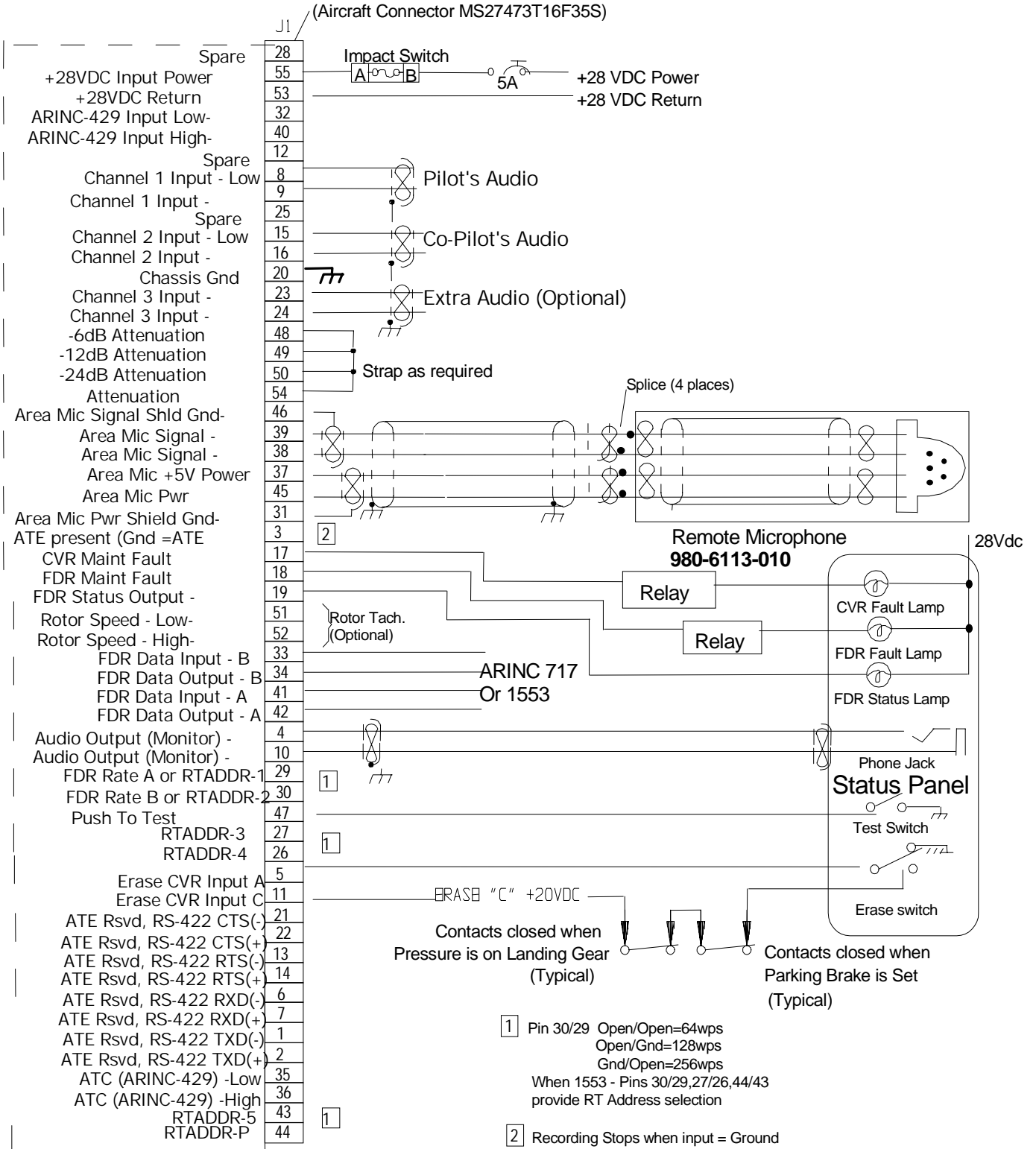


Figure 9-- System Interconnection Diagram for DVDR with optional Status Panel