# NASA DEMONSTRATION ADVANCED AVIONICS SYSTEM

# (DAAS)

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The Demonstration Advanced Avionics System (DAAS) integrates a comprehensive set of general aviation avionics functions into an advanced system architecture for demonstration in a Cessna 402 aircraft. This paper presents a cursory functional description of the DAAS complex.

Several years ago the NASA Ames Research Center initiated a program to improve avionics for general aviation by applying, whenever possible, new developments in computing and sensing devices. The overall objective was to improve the safety and dependability (schedule adherence) of general aviation IFR operations without increasing the required pilot training/experience by exploiting advanced technology in computers, displays and system design. Earlier studies in the program provided a data base in computer technology potential, air traffic control environment, and system configuration possibilities. These studies also indicated that to bring advanced avionics benefits to general aviation at an affordable price, changes should not merely be those of improving existing devices and adding a few new "aids" to an already crowded cockpit, but should take the form of a rather sweeping change in the approach to combining sensors, computers and displays into systems which will meet the overall objective. The current Demonstration AdvancedAvionics System (DAAS) is the culmination of this effort and is intended to demonstrate the feasibility of the approach by designing, building, and flying a set of demonstration equipment.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

### DAAS PROGRAM

- **PROGRAM OBJECTIVES**
  - PROVIDE CRITICAL INFORMATION FOR THE DESIGN OF INTEGRATED AVIONICS FOR GENERAL AVIATION
  - USE DATA BUSSING, DISTRIBUTED MICROPROCESSORS, SHARED ELECTRONIC DISPLAYS
  - PROVIDE IMPROVED FUNCTIONAL CAPABILITY
- **DESIGN CONSIDERATIONS**
  - COST
  - RELIABILITY
  - MAINTAINABILITY
  - MODULARITY

The DAAS program go ahead was awarded to Honeywell, Inc. and King Radio Corp. in August 1978. The system was installed in the Cessna 402 aircraft in June of 1981. Flight testing begun in July 1981 and concluded with NASA acceptance in October of 1981.

# NASA
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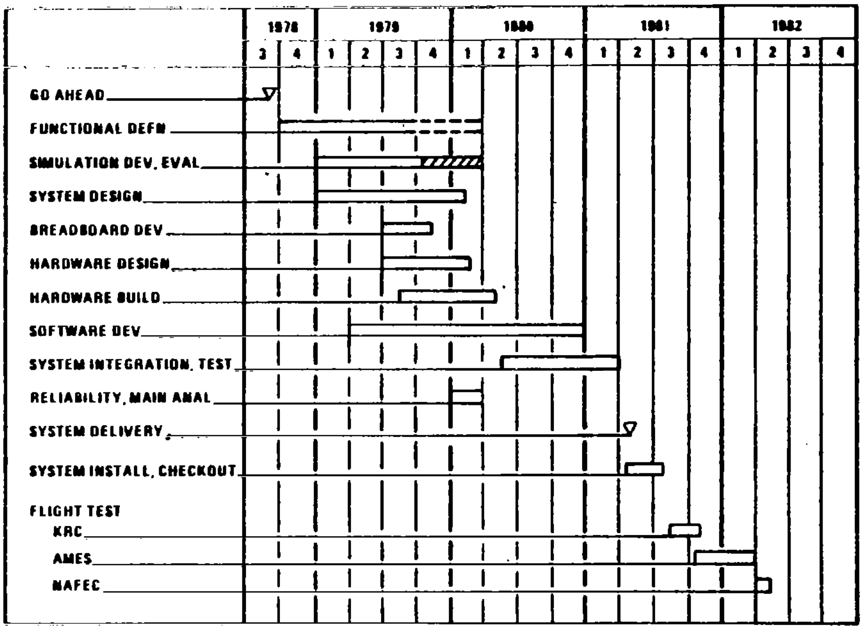
## DAAS PROGRAM SCHEDULE



The DAAS is an integrated system. It performs a broad range of general aviation avionics functions using one computer system and shared controls and displays.

The DAAS system also has the capability of simulating navigation and aircraft sensor signals on the ground. This provides the pilot with the ability to demonstrate, test or train using the navigation and flight control features of the system without flying the aircraft.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

### DAAS FUNCTIONS

- AUTOPILOT/FLIGHT DIRECTOR
- NAVIGATION/FLIGHT PLANNING
- FLIGHT WARNING SYSTEM
- GMT CLOCK
- FUEL TOTALIZER
- WEIGHT AND BALANCE
- PERFORMANCE COMPUTATIONS
- DISCRETE ADDRESS BEACON SYSTEM
- BUILT-IN TEST
- NORMAL, EMERGENCY CHECKLISTS

INTEGRATED --COMMON COMPUTER SYSTEM, SHARED CONTROLS AND DISPLAYS

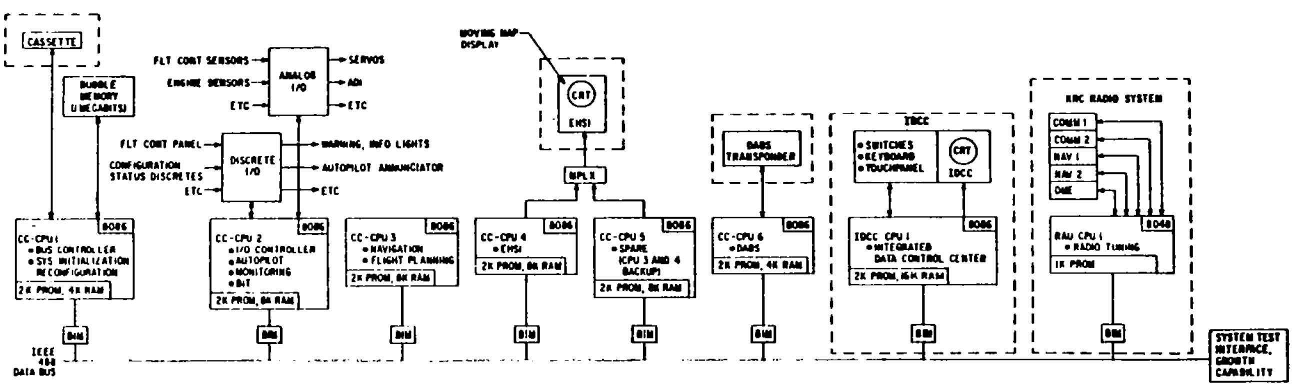
The DAAS architecture is characterized by a modular computer system structure; ie., multimicroprocessor interconnected by an IEEE 488 data bus. Each processor, except for the radio system, represents an Intel 8086 16-bit microprocessor, 2Kx16 PROM memory and 4Kx16 to 16Kx16 RAM memory. The radio system uses the Intel 8048 8-bit microprocessor.

Each processor performs a function and interfaces directly with the subsystems associated with that function. At power on, the bus controller central computer (CC) CPU-1 takes functional programs from the non-volatile EEPROM memory, and subsequently loads each processor. CC-CPU-5 is a spare processor used to demonstrate reconfiguration capability. If processor CC-CPU-3 or CC-CPU-4 fail, the bus controller will load the appropriate software into the spare which will then take over the function of the failed processor.

Six processors are contained in the DAAS central computer unit. One processor is contained in the IDCC, and one processor is contained in the Radio Adaptor Unit.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

## DAAS ARCHITECTURE



The DAAS system employs multifunction controls and displays including an Integrated Data Control Center (IDCC) and Electronic Horizontal Situation Indicator (EHSI).

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

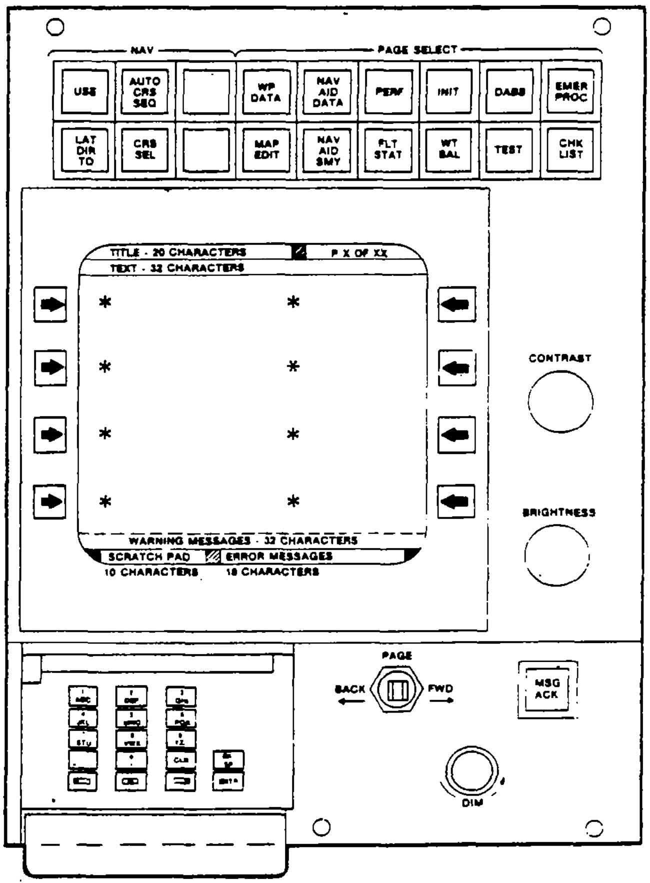
**MULTIFUNCTION DISPLAYS AND CONTROLS**

- **INTEGRATED DATA CONTROL CENTER (IDCC)**
- **ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)**

The IDCC is the pilot's primary means of interacting with the DAAS. Included are a keyboard at the bottom of the unit and a set of function buttons to control navigation and page selection along the top. The IDCC is implemented with menu select buttons (touchpoints) along each side of the CRT.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

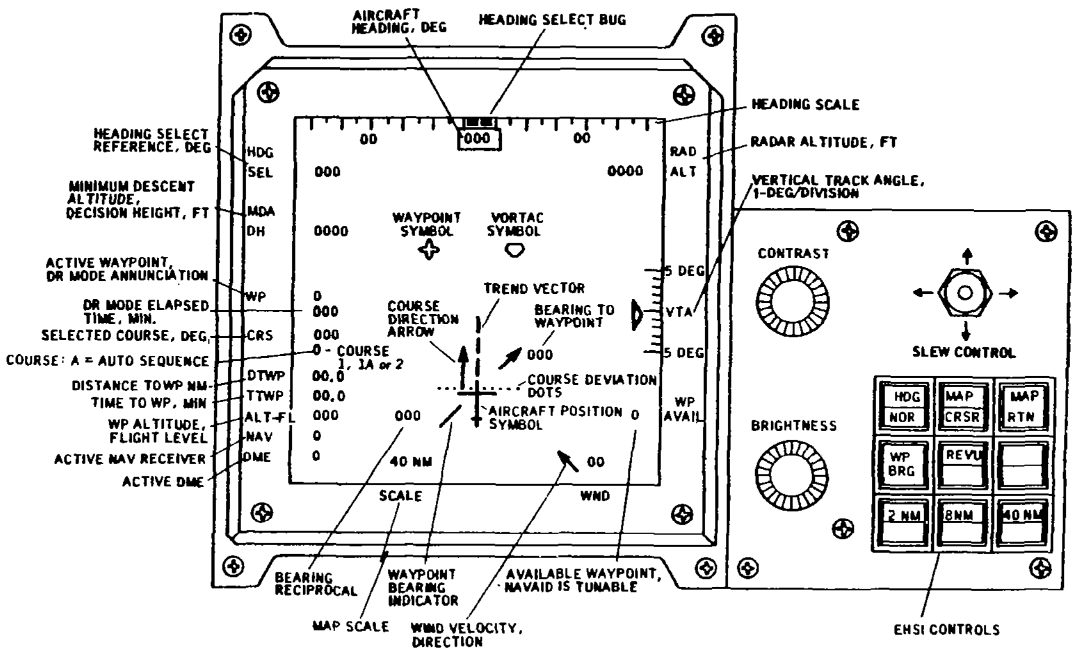
### MULTIFUNCTION DISPLAY – INTEGRATED DATA CONTROL CENTER



The EHSI is the primary output of DAAS system information. It presents a moving map display showing aircraft position with respect to course, along with other flight status information. The EHSI is controlled by functional control buttons and a map slew controller.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

### MULTIFUNCTION DISPLAY – ELECTRONIC HORIZONTAL SITUATION DISPLAY



The DAAS autopilot is a digital version of the King Radio KFC 200 modified for compatibility with DAAS.

**DEMONSTRATION ADVANCED AVIONICS SYSTEM**

**AUTOPILOT/FLIGHT DIRECTOR FUNCTIONS**

- PITCH ATTITUDE HOLD
- GO-AROUND
- CONTROL WHEEL STEERING (CWS)
- ALTITUDE
  - ALTITUDE HOLD
  - ALTITUDE SELECT
- VERTICAL NAVIGATION (VNAV)
- WINGS LEVEL
- HEADING HOLD
- HEADING SELECT
- NAVIGATION (NAV)
- APPROACH
  - GLIDESLOPE
  - LATERAL BEAM FOLLOWING

The navigation/flight planning function computes aircraft position with respect to an entered flight plan and data from the automatically tuned VOR/DME radio receivers. In the event of radio failure, dead-reckoning position (as determined from airspeed and heading) is estimated with respect to the entered flight plan.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

### NAVIGATION/FLIGHT PLANNING

- VOR/DME
- 10 WAYPOINT, 10 NAVAID STORAGE
- MOVING MAP DISPLAY
- PRESENT POSITION DIRECT TO DESTINATION CAPABILITY

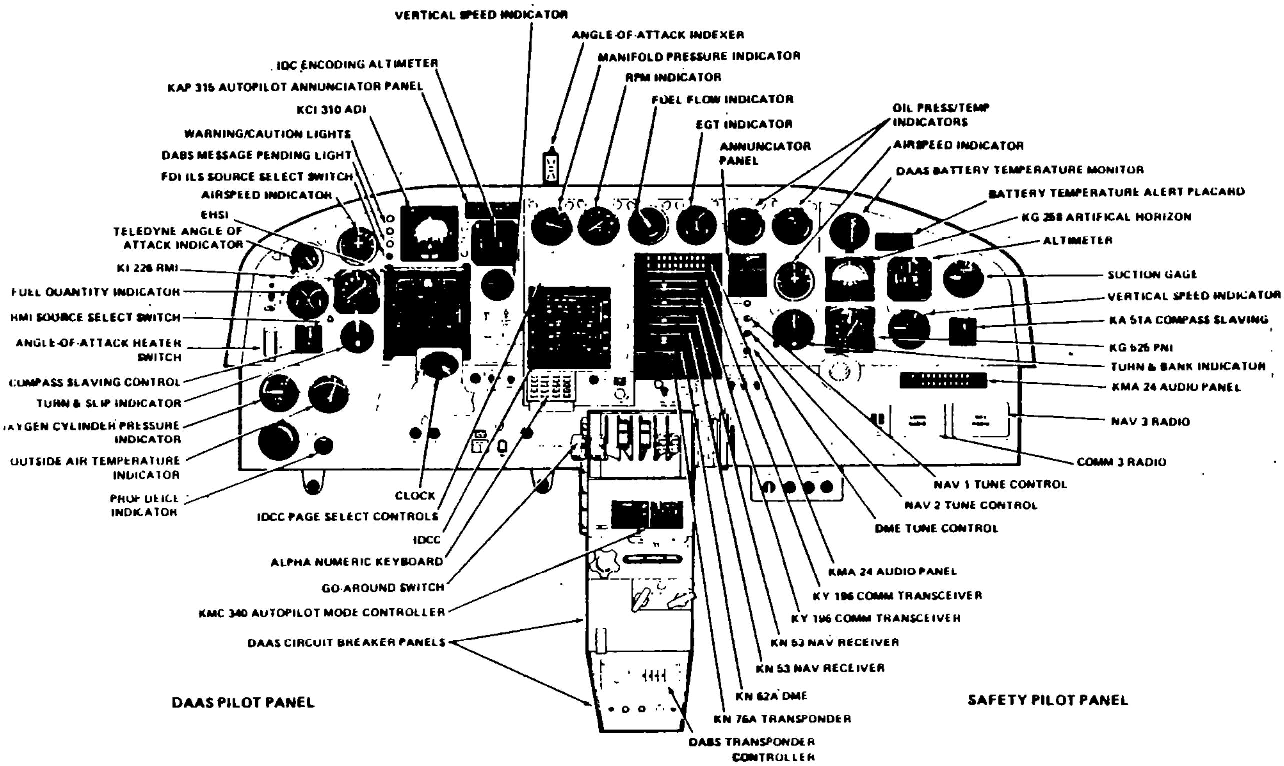
DAAS includes extensive monitoring, with warning capability. For example, the DAAS system monitors engine parameters (MAP, RPM), aircraft configuration (door open, gear retracted) with respect to flight condition and ground proximity and informs the pilot of undesirable situations.

## DEMONSTRATION ADVANCED AVIONICS SYSTEM

**ELEMENTS FLIGHT WARNING/ADVISORY FUNCTION**

- ENGINE PARAMETER MONITORING, WARNING
- AIRCRAFT CONFIGURATION MONITORING, WARNING
- GROUND PROXIMITY MONITORING, WARNING
- AIRSPEED AND STALL MONITORING, WARNING
- ALTITUDE ADVISORY FUNCTION
- NAVAID IDENTIFICATION MONITORING, WARNING
- BUILT IN TEST, BIT
- AUTOPILOT/FLIGHT DIRECTOR MONITORING, WARNING
- OTHER

Shown below is the DAAS EHSI and IDCC, as well as other system components, as they appear in the Cessna 402 cockpit. The safety pilot instrument set is independent of the DAAS instruments and is adequate for safe flight with DAAS inoperative.




BIBLIOGRAPHY


Demonstration Advanced Avionics System (DAAS) Functional Description. NASA CR-166282, January 1982.

Demonstration Advanced Avionics System (DAAS) Final Report. NASA CR-166281, January 1982.