RTDAP:REAL-TIME DATA ACQUISITION, PROCESSING AND DISPLAY SYSTEM

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ABSTRACT

This paper describes a data acquisition, processing and display system which is suitable for various telemetry applications.

The system can be connected either to a PCM encoder or to a telemetry decommutator through a built-in interface and can directly address any channel from the PCM stream for processing. Its compact size and simplicity allow it to be used in the flight line as a test console, in mobile stations as the main data processing system, or on-board test civil aircrafts for in-flight monitoring and data processing.

INTRODUCTION

In Aircraft and Vehicle Testing, real-time data reduction has become a major need in all situations where test safety and program expedition are important.

In many applications, there is a requirement for the telemetry computer to provide, in the field, means for efficient test management, as well as data monitoring.

The RTDAP, which was defined by a team of Flight Test engineers, has been designed with these goals in mind. It is a compact system which provides the test engineers with the tools necessary to prepare and conduct the tests, have real-time results and output data on plots for analysis.

APPLICATIONS

The RTDAP can be used in the following configurations as summarized in fig. 1:

- In Preflight Consoles

In this configuration, the RTDAP is connected directly to the test instrumentation PCM system, using a cable of up to 50 ft. It can then work in two modes:

- In the Setup mode, it processes all setup data to binary files and downloads these files to the PCM system for defining the PCM stream format.

- In the preflight monitor mode, the RTDAP acquires, in real-time, PCM frames, converts binary values to engineering units and presents results on a CRT display. It can also check parameter results and either print all of them, or those outside selectable limits.

- In mobile Telemetry Ground Stations:

In this configuration, the RTDAP is connected to the Telemetry PCM front-end system and can carry out simultanously and in real-time, the following tasks:

- Data acquisition on disk
- Data conversion to Engineering Units
- Derived parameters computations
- Alarm monitoring
- Alphanumeric and graphics display
- Test management
- Signal Processing

The graphics refresh rate is between four and ten points per second, depending upon the number of displayed parameters and the graphics complexity.

Also, in real-time, or between manoeuvers, an additional package provides plots of selected parameters versus time or cross plots.

- On-board Flight testing of civil aircrafts

In this configuration, the system is connected on-board as per the Preflight Console described above, but actually performs all the tasks mentioned for the Mobile Telemetry application.

A version of this system was used on-board an ASTRA aircraft for data acquisition and analysis of icing and

external noise tests. Data could therefore be expedited and analyzed and as a result, the flight test program was shortened significantly.

SYSTEM HARDWARE DESCRIPTION

The RTDAP is based on the DEC (DIGITAL EQUIPMENT CORPORATION) MICRO-PDP series of Microcomputers (23+ up to 83). A typical system includes the following:

- A MICRO-PDP 11/73
- 1 MB memory
- 30 MB Winchester disk
- 0.8 MB dual diskette drives
- A 500x500 pixel resolution graphic display
- A lazer plotter (QMS KISS+ series)
- A 300 cps printer

The RTDAP computer, which can be rack mounted, is only 5" high and includes a plug-in telemetry interface.

This interface. which has up to 16K dual-ported memory, is packaged in a Q-BUS compatible card. It can be connected either to the serial output of a PCM encoder, or to the parallel output of a PCM decommutator. One port receives PCM data and the other allows the microcomputer to directly address any PCM channel within the interface’s buffer memory.

SYSTEM SOFTWARE

The software operating system is TSX-Plus from S&H Computer Systems, which is a real-time, multitasking, multiuser superset of Digital Equipment Corporation’s RT11.

In the Preflight configuration the system software consists of the following main packages.

- System Database
- Display Setup
- Real-time Monitoring
- Print out of results

The System database contains all the parameter definitions, calibrations and limits. It can be created or changed either locally, through the console keyboard, or remotely, using a host Computer.

The Display setup allows the selection of parameters for the real-time monitoring and for the results printout.

The Real-Time monitor displays selected parameter results, in engineering units and can, at any time, print the current values.

The printout can include a set of selected parameters or all the parameters and results, or just those whose results are outside the limits specified in the database. Three possible sets of results are available: the ambient, the Rcal and Zcal calibration points or any combination of these three.

In the mobile station, the system software consists of the following packages:

- System Database
- Display Setup
- Plotter Setup
- Real-time Data Acquisition and Display
- Plot
- Print
- Signal Processing

The System Database is the same as that used in the preflight configuration but is created to include derived parameters.

The Display Setup defines groups of selected parameters for the real-time data acquisition and display package. Each group, or test, can consist of up to one hundred parameters and can be easily and quickly altered.

The Plotter Setup allows each display test to be sub-divided into plotter tests. Up to three plotter tests are possible for each main test, with each plotter test consisting of up to fifteen plotter pages, including up to eight parameters per page.

Both the Setup and Data Processing software packages have been designed with human engineering criterion in mind, in order to allow the system to be operated without needing any special technical skills.

The Real-time Data Acquisition and Display package allows the results of selected parameters to be stored on

disk and/or displayed in real-time and in engineering units. Parameters can be displayed either in a graphics and/or in an alphanumeric form and can include alarm warnings. A typical display is depicted in fig.2.

The Plotter package allows either real-time or off-line plotting of parameters, On each page, up to eight selectable parameters can be plotted versus time or any other parameter. The parameters can be plotted using either automatic scaling or selected limits. A typical plot is depicted in fig.3.

When plotting against time, the system allows zooming through the selection of start and stop times.

Using the Print package, the data from a stored test can be printed. The printout can be selected to include either all or stepped parameter data, or the average values, or all the data within a selected time span.

The Signal Processing software package is an integrated module which can load raw data files from disk and creates parameter vectorial buffers of constant length (512, 1024....). It computes Fourier Transforms and Power Spectrum Density and outputs results in graphic form on the screen or on the plotter. The scaling of the results, can be selected to be either in a linear or logarithmic form.

CONCLUSION

For small to medium telemetry data processing needs, the RTDAP System has proved, in the field, to be as powerful and flexible as expected, in all the applications described above. The on-board versions were particularly successful as they allowed the flight test program expedition to be carried out at a minimal cost.

With the constant improvement in the microcomputer technology, together with the significant decrease in equipment size and price, powerful data reduction systems can now be assembled in relatively small ruggedized packages. This will open new horizons in the telemetry data processing field, especially for mobile and on-board applications.

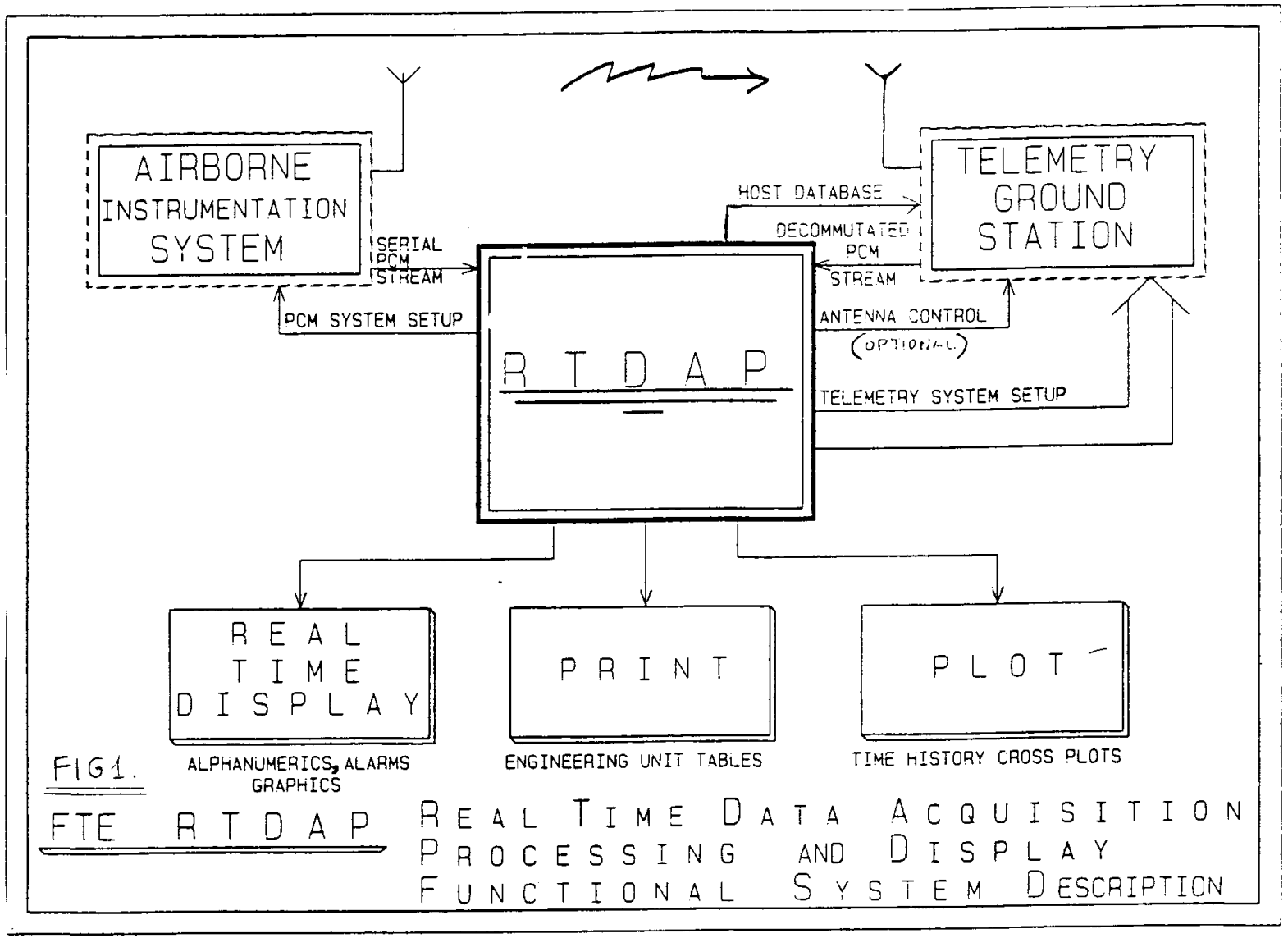

FIG 1.

FTE RTDAP REAL TIME DATA ACQUISITION PROCESSING AND DISPLAY FUNCTIONAL SYSTEM DESCRIPTION

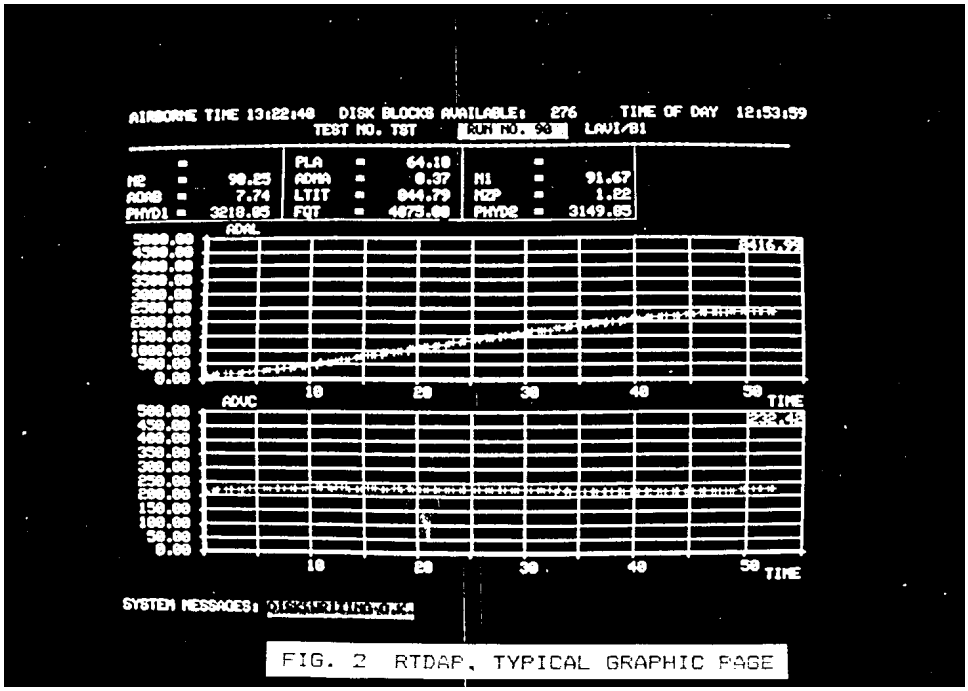

FIG. 2 RTDAP, TYPICAL GRAPHIC PAGE

HEADING	TEST DESCRIPTION	DEPARTMENT
FLIGHT DATE	FLIGHT NO:	FILE NAME
FLIGHT TIME	TEST NUMBER:	RUN START TIME
TEST DESCRIPTION		

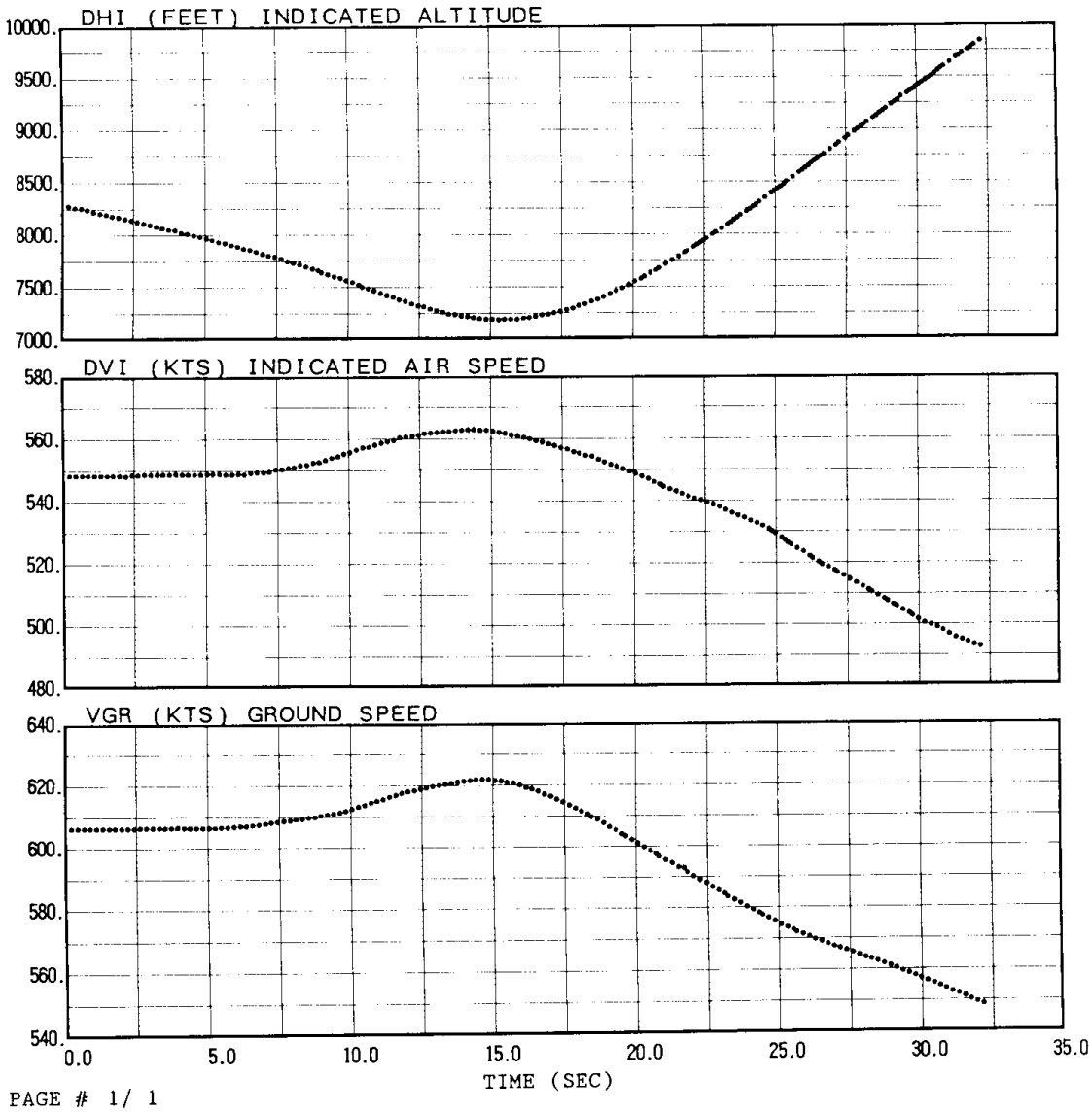

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FIG 3. PLOT OF PARAMETER RESULTS