Paper 15

A PRODUCTION PERIPHERAL VISION DISPLAY SYSTEM

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Abstract - A small number of Peripheral Vision Display Systems in three significantly different configurations have been evaluated in various aircraft and simulator situations. The use of these development systems has enabled the gathering of much subjective and quantitative data regarding this concept of flight deck instrumentation. However, much has also been learned about the limitations of this equipment which need to be addressed prior to wide-spread use. This paper briefly discusses a program at Garrett Manufacturing Limited in which the Peripheral Vision Display System is being redesigned and transformed into a viable production avionics system.

Introduction -

In preparing the development system for the various evaluation applications, and in assessing the feedback resulting from their use and their servicing, it became obvious very quickly that none of the three evaluation system configurations was suited from hardware and software standpoints to introduction and use in the field in large numbers. Further, it was felt that the required system and hardware characteristics could not be achieved satisfactorily by further development of any of the development configurations. Also, it was realized that the first applications of production systems will be by way of retrofit to existing aircraft making a 12 to 18-month design and development cycle unacceptable.

Consequently in June 1982, Garrett Manufacturing Limited (GML) embarked on a program to design a new PVD system, incorporating some significant new design features and drawing heavily on GML's experience as a supplier of quality avionic equipment. It was decided that to achieve a satisfactory result in the shortest time the new design would use technology which was then currently available at GML from the previous PVD equipment or from other sources. The design would be modular in concept which would permit maximum upward compatibility with advanced new systems which will incorporate the technology expected to emerge from the various concurrent and ongoing R&D programs. Some of the salient features of the new design are discussed below:

The Production PVD System -

(a) Modular Implementation

The production design is being implemented in a modular arrangement which will minimize the impact and lead-time for later incorporation of added functions or features which may be unique to particular applications.

The electronic circuitry in the Processor is functionally grouped into plug-in modules and the detachable power supply can be produced in versions which utilize 115V 400 Hz, 28VDC or 270VDC aircraft power sources.

The microcomputer program is also organized in approximately 50 software modules permitting easier documentation and configuration management and also facilitating the preparation of unique-application programs or features with a minimum of software redesign.

(b) Interchangeable, Line Replaceable Units

Unlike the existing evaluation PVD systems, the production system comprises units which are individually interchangeable and line-replaceable. Large unit-to-unit performance characteristic variations in the laser beam scanning devices require five calibration adjustments for each scanner in the drive and feedback electronics. Utilizing multilayer thick-film hybrid microcircuits, the scanner drive and feedback electronics and the calibration adjustments have been located with the scanners in the projector head enabling precise and constant interface definition between the Processor and Projector.

(c) Extended Dimming Range

The production system incorporates a new electronically-controlled optical attenuator in series with the light beam which provides selectable attenuation of the solid line from 0 to 30 db without interfering with the line scan. This means that a sky pointer or any other symbology on the line is simultaneously attenuated, but otherwise unaltered. Also, a mask in the projector is now unnecessary which means a longer display line can be projected. Existing evaluation systems provide only about 10 db dimming of the solid line by means of an altered scanning rate and periodic "parking" of the beam in the projector mask.

(d) Fail Safety and Built-In-Test-Equipment

Because of the compelling influence of the PVD display on the pilot, it is imperative that the PVD be prevented from displaying erroneous attitude information. The production system has a comprehensive monitoring and fault detection scheme to ensure that the laser light source is turned off if any system malfunction occurs. As a design objective, the display of erroneous attitude information can be caused only by two or more simultaneous unrelated failures with a mean time between occurrences of at least 10^9 operating hours.

The monitoring scheme continuously checks the onboard microcomputer, internal power supplies, analog to digital and digital to analog conversion circuits, optical scanner operation and the laser with its power supply and dimming system.

Having incorporated the capability of fault monitoring and detection for fail safety, a very small further increase in complexity provides fault isolation to the discrepant line replaceable unit, greatly simplifying the first line maintenance of the system.

(e) Improved Reliability

The present evaluation systems being essentially hand-built prototypes have not exhibited the reliability necessary for day-to-day in-service use. Reliability on the production system will be achieved by stringent electronic parts selection and derating criteria and an end-unit burn-in. The design will be supported by a thorough Failure Modes and Effects Analysis and Reliability Analysis per MIL-HDBK-217. A preliminary parts-count reliability analysis indicates that a system Mean Time Between Failures exceeding 2000 operating hours should be achievable.

(f) Environmental Integrity

The production PVD system is designed to meet the requirements of MIL-E-5400 Class 2 (-54°C to 71°C and altitudes to 70,000 feet). It is felt that these and other environmental parameters defined for the new system will accommodate the known potential applications for the PVD system.