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PAYLOAD 176

New Code 5170 Design Areas

Electronics Packaging

A problem that exists in any program where a large number of spacecraft must be built in a relatively short period of time, is in the packaging techniques used within the spacecraft. In order to reduce engineering redesign and construction time, the packaging techniques must be somewhat modular. The 7107 launch requirements will place a strain on the basic satellite structure being used in terms of the increase in hardware to be flown.

In order to get a headstart on the problem, a unique modular packaging technique was introduced in Payload 176 as a prototype for the 7107 launch. A family of modular packages was developed using standard and rails and varying length top and sides. The engineering design is non recurring and the packages can be utilized for practically any NRL satellite electronics requirement. The design will mean a considerable savings in both size of subsystems and in the time required to complete the system since the package design is complete and the parts can be fabricated in advance.

In addition to the mechanical package, the system used a modular construction technique consisting of thick film hybrid, integrated and discrete component (1.2" x .6") modules interconnected on a two sided printed circuit motherboard. All module lead terminations are interconnected through the use of bifurcated terminals. The terminals are swaged and soldered into plated thru holes in the motherboard, and spaced 0.10 inch

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on centers. The module leads are inserted through 0.025 inch clearance holes, bent at the prescribed radius and soldered to the terminals on the opposite side of the board. The interconnections are accessible and provide the key to module serviceability. The proper use of the miniature terminals effectively gives a third level of interconnect to a two side board. The technique provides an excellent compromise between size and serviceability.

The packaging technique was used exclusively in FL176. As PL 176 was a small Aft-Rack payload, the modular high density packaging was a necessity. The technique successfully passed all qualification tests with no modifications necessary. The design resulted in a 4 to 1 reduction in the size of command, control, telemetry and video processing equipment ρ_{L} (dign) in 176 and will be flown on 7107 spacecraft.

Data Link Modulator Design

An area in past payloads where considerable time has been spent has been in the flight qualifying of threshold detectors and down link transponder timing circuitry. Requirements of wide temperature and voltage variations had to be met.

A new D.L. modulator - threshold detector circuit was designed and developed for P/L 176. The design performance variation is no greater than 0.5% over a temperature range of 100° C and 30% variation in supply voltage. The design does not use voltage regulators or temperature compensation. The size is small and the stand-by power is low. The circuit offers

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considerably improved performance over its predecessors. This particular circuitry is a crucial link in the Elint data chain of all NEL spacecraft. Because of the nature of the circuit, it can be used redundantly in a failsafe modulator for all Elint transmitters. Although NEL has never experienced a flight failure in its modulators, this circuitry should decrease the likely-hood of a catastrophic failure in this system.

The system met all design goals. The system has operated properly in P.L 176 with no degradation in performance. The system offers such a considerable advantage over previous designs in terms of redundancy case of flight qualitying and size reduction, the circuitry will be used in the 7107 spacecraft.

Command System

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The planned experiments for the 7107 payloads created a need for more capacity from the existing command system. Payload 176 provided an opportunity to develop and fly a prototype system that will be used in flight systems in the 7107 payloads. As the system was being redesigned and redpackaged using techniques previously discussed, the entire system was looked at from the standpoint of designing it such that a single point failure can be tolerated without a major loss of capability. Certain critical circuits were redesigned using quad redundant techniques. Relays that had been used in previous systems were replaced with redundant solid state circuitry. A novel printed circuit layout technique was used that

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allowed for total redundancy in all module interconnect. The system was then packaged using techniques that will be used in 7107 payloads.

The system was given complete environmental vibration, and other flight qualification tests to ensure that all design goals had been met.

PAM TM

The spacecraft in the 7107 launch will use a large number of PAM multiplexers in their telemetry systems. In order to help meet schedules for the 7107 launch, it was desirable to redesign and repackage these multiplexers to meet the requirements of the 7107llaunch. The systems flown in P/L 176 were flight prototypes of units to be flown in 7107.

The units were packaged in the form factor chosen for 7107. The units were redesigned using low power F.E.T. circuitry consistent with NRL $f_{\rm plicy}$ of designing telemetry and control circuitry to be as low power as practical in order to conserve available spacecraft power for Elint experiments.

Flight performance showed no flaws in the system design and all design goals were met. The units will be flown on future NRL spacecraft.

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1. Stal Drager

A $\omega \neq p \le r$, when pulse encoder was developed for use with the experi $u \in 1$ N . 1 (frequency distribution). The unit was used in a comparison for the with modulation versus pulse code modulation on the down link u = 0 modulation. The unit used thick film low power hybrid directory and was packaged using the design for 7107. Because of the modularity of the system design, it can be used again in future systems. The experiment provided a means for measuring data quality through the satire data u = 0 modulation.

The system performed flawlessly through all environmental tests and $p \in v$ flight tests.

The experiment results are discussed in the section on the frequency discrimination.

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9 January 1970.

given by H.O. Lorenzen & Mayo

1. ORGANIZATION ddescription of:

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Administrative Brief

A		NRL	Loren	zen/Mayo	in EW	with	Wilhelm	under	Applic	ations	Research
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Doheny, POPPY under Chas Cram, Abplanalp, Gallagher. D. NSG G-50=

54= Olson/McGraw/Morgan/Lentz & 2 Chėefs.

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Note some of the historic organization participants were given.

2. First POPPY/briefing for ADM MOORER described in detail with the mandate to demonstrate the capability for Ship locations ...resulted in NSG getting interested in this program for the first time. Lt POTTS progress in this direction outlined (PRF fingerprinting of ships described

3. ADM MOORER's visit to NRL described (April 69), with the obvious power struggle now evident between 94, 76 and 92. EX-TIG mentioned but not in detail.

4. DR. SORREL'S treacherous visit to described with the pitch that the questions raised during this visit should have been sent back so that NRL could have presented the SAME party line as

5. Dr. COOK & ______ and the disclosure that SORS had a charter to evaluate how the community carried out their USIB orders and that he, DR COOK, would be starting such an evaluation. NRL feels strongly that if such a study group is formed we want to at least listen, if not be the spokesman for POPPY.

6. described and how NSG chose to very mildly indicate that NRL <u>might</u> send a representative to participate in this briefing, but in spite of this weak mandate the briefing was made and from this the total POPPY image for report was obtained.

7. ADM LENARD's study of the Navy in Space was mentioned in explanation of ADM Moran's presence and stance...he was selected as the Navy Space CZAR, by ADM MOORER. His history in the areas of NAVY R & D under given to show his background. Also in SOC) spent a week with ADM MORAN to give his insight as to what is wrong with the Navy Space program POPPY...this influence brought Adm Moran into frequence hange with NRL but each series of YEMANAISWERS just CONTROL SYSTEM ONLY C05025499

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resulted in another set of the ons until the questions seem to have run out...until 13 January 1970 when he visits NRL field station at

8. Mrl Lorenzen attempted to explain how our participation with 6th Fleet and _______office in London have directly brought POPPY intoxxx consideration as a Tactical system which can supply some timely information to this part of the Fleet.

- 9. Priority Problem Areas given as Definition of 7107 Concept
 - (2) definition of personnel resources in the Program including overseas. A- Identify the training needed and the tenure at sites.
 - (3) establish SORS working relationship
 - (4) Need for Navy-Only working meetings at frequent intervals to prepart the work load for TOG and Program Review Meetings.



HANDLE VIA Byeman Control System Only C05025499 Approved for Release: 2024/06/11 C05025499 N information relative to POPPY: 1. = Director 1000 2 Director of Research (head civilian) 4000 Dir Support Services 2 Capt ROSS 3 (acting)5000 4 Associate Dir for Electronics = 5. 11 11 Materials = ** 6. 7. Supt Electronic Warfare Div = H.O. Lorenzen 5600 Applications Research Div.= 8. 5100 11 9. Branch Head of Satellite Techniques = Pete Wilhelm 5170 " of Space Systems Branch = R.D. Mayo 5660 10. " 1 -3 Shops, PW, etc. 6 MIN 11111 **(**10 Mayo withelm Flite Hardware except ELINT for Bird 4 ELINT . Laumeh Ops Gud Stations routine in Alite evaluation 90 MARYERS 47: Million /year @ NRL.





Briefing Team = Mayo, Wilhelm, Hammarstrom, J Martin, D Wales.

I: Review of History, How Program works and how spacecraft are designed tested and deployed were given by Many and Wilhelm. Historic (1967) data reduction review showing some of the computer aided manual anaylsis tools which are available at the sites, by Martin and Hammarstrom.

Lunch followed by a second session dealing with specific signals seen in our data which have from our standpoint not been adequately exploited. Among the examples offered is the Oct 68 msg from

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