BC II + flatpacks

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EG-64-79

TO : NASA Headquarters
Attention: Maj. Gen. Samuel C. Phillips, MA

FROM : Muenger, Apollo Spacecraft Program Office

SUBJECT: Integrated Circuit Packages for the Block II Apollo Guidance Computer (AGC)

As you know, a program definition phase for the Block II guidance and control system was performed during the period June 9 to August 18, 1964, by MSC/NAA/MIT. During this period, we reviewed all technical aspects of the CSM and SCS systems including the packaging techniques to be employed in the Apollo Guidance Computer (AGC). As one result of this comprehensive review, we have made the decision to employ "flat packs" in the Block II AGC. This is the packaging technique used in the Wing VI Minuteman computer (Autonetics), MARIM computer (Univac), Navy AGM-48 aircraft navigation system (Litton), and in many other aircraft, missile, and space systems. This packaging scheme has become an accepted military standard package.

Flat packs were initially chosen for the Block II computer to allow a reduction in guidance system weight, volume, and internal connections while eliminating the problems associated with low-level, single source production of the six-leaded Apollo TO-47 container. At the time, the weight and volume reductions associated with the redundant computer configuration were estimated to be significant. The weight saving alone was estimated to be over 35 lb. The use of flat packs was first authorized on December 30, 1963, when MIT/IL was directed to proceed with a Block II AGC by MSC TWX SG-12-430. This TWX authorized the use of dual block I micrologic elements encapsulated in a flat package. Since that time, flat packages containing dual NOR gates have been obtained from Fairchild, Raytheon, Texas Instruments, and General Microelectronics.

dual computer eliminated

As a result of Bellcomm reliability studies, we subsequently decided to use only one AGC in the CSM instead of dual computers. This decision was based on Bellcomm's conclusion that redundant guidance computers could not be justified without additional system redundancy which does not exist. This reduced the weight and volume motivations for the use of flat packs. Due to this decision, in May 1964 Bellcomm suggested that a change back to the TO-47 container or a change to a TO-5 container

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would result in a higher confidence in the Block II guidance system without significant weight penalties. This recommendation led us to reexamine the packaging question during the program definition phase cited previously. During the course of this study, we have been working closely with Bellcomm in order to take advantage of their semiconductor experience. The Bellcomm work has been very helpful and has improved our knowledge and appreciation of potential problem areas in the various types of packaging.

As Bellcomm has pointed out, the six-leaded TO-47 package used in the Block I AGC is rapidly becoming obsolete. As a result we were faced with the following three alternatives:

a. Change the Block II design back to the TO-47 and take positive steps to insure a continuing supply of packages.

b. Change from the current flat pack design to one based on the TO-5 container.

c. Continue the Block II design with flat packs.

Since the same micrologic elements will be used in any type of encapsulation, the primary area of concern is the package and its ability to be sealed satisfactorily without increasing the failure rates of the chip or the internal connections. Based on discussions with F. D'Altroy and S. Peck of MIT, as well as Bellcomm, Autonetics, and Texas Instruments personnel, we believe that the Texas Instruments flat package being used on the Minuteman program has no inherent weaknesses when compared to TO-5 or TO-47 cans. All three packages use the same materials and the glass seal lengths are identical for this flat pack and the present TO-47 can. The current MIL/H-bank test program on TI packages has substantiated the opinion of F. D'Altroy and S. Peck that the stitch weld used to close the TI package would cause no leakage problems. In the event the lead seals cause difficulty, the leaky seals can, as pointed out by Bellcomm, be screened out of the product by good quality control. We do not anticipate significantly more difficulty with the flat pack lead seal than with the TO-47.

Original Signed By
EMORY W. HARRIS

The sealing and contamination problems associated with other flat packages, in addition to the TI units, are discussed in detail in the enclosed internal MSC memorandum.

The flat package will soon be an accepted military standard package and is rapidly becoming the industry standard as evidenced by its use in:

a. Advanced Minuteman electronics

b. Univac [illegible] computer

c. Litton ASN/64

d. GGC

e. EGC

f. POGO

g. TIROS

h. OAGO

i. DAP

j. Mariner C

k. TVX

l. Sergeant

m. LORAN C

n. ASW/21

o. AN/ASW27

In addition to the Block II guidance system, the Apollo program uses flat packs in the Command Module central timer. Flat packs have also been recommended by STL for use in the LEM short guidance system.

Based on our understanding of the status of the packaging techniques and general industry development emphasis, we cannot justify continuing six-leaded TO-47 production at a rate necessary to approach flat pack reliability confidence levels during the projected four years of AGC production. Therefore, we will use flat packs in the guidance computer for both the CSM and LEM.

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Joseph F. Shea

Enclosure

cc:
NASA Hqs, G. E. Mueller, MA
Bellcomm, Inc., J. A. Hornbeck

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