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Digital Development Memo #196

To: Eldon Hall
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Subj: Block II AGC/LGC Characteristics. General
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The following is a general outline of the logical and structural differences between Block II and Block I computers. The Block II design is predicated on the dual computer system to the extent that a certain amount of space has been allotted for logic and for memory.

Memory

Erasable memory is doubled to 2048 words, at the urging of the SGA group. Additional addressing is done by a bank register system like the one for fixed memory. See Digital Development Memo #194.

Fixed memory remains at 24,000 words. The present Block II packaging concept does not allow for more. However, logical provision will be made so as to be able to address up to 64,000 words of fixed memory.

Instructions

The set of Block I instructions is preserved. Eight additional instructions are provided which allow increased efficiency of double word operations. The net additional cost of the Block II sequence generator (over Block I) is about 120 gates. See Digital Development Memo #193.

Counters

The Block II counters which control commands to the various appliances have been increased and rearranged so as to provide a

substantial increase in input-output capability, by allowing for simultaneous control of all CDU's. Counter logic has also been changed so as to simplify programming and avoid certain hazards inherent in the Block I system. See Digital Development Memo #192. The net cost of these changes is an increase of about 50 gates over the corresponding Block I number.

Links

One of the additional output counters included above (OUTLINK) is designed to generate a serial message in a format compatible with the UPLINK format. Such an output counter is useful for secondary AGC updating and for AGC-LGC communications, including possibly remote communications. See Digital Development Memo #186. The cost involved is primarily that of interface circuitry.

Accelerometer Inputs

Accelerometer moding is such that a precounting circuit is necessary before entering the pulses into the PIPA counters of the AGC. In Block I that circuit is located in the PSA. Because such a circuit can be synthesized readily with AGC logic it was decided that in Block II it should be incorporated into the AGC. The cost of that circuit is estimated at 100 gates (about one Block I logic stick).

Power Supplies and Alarm Circuits

Block II power supplies must allow for switching of the +13V supply to the output circuits, for standby power switching and possibly for low-power gates. Various miscellaneous analog alarm circuits will also be changed.

The bulk of the Block II logical alarms remain the same as in Block I. The alarm signals would be combined differently, however, and give more compact indication of malfunction.

Interrupts

The number of interrupt options is expected to remain within one of the number in Block I, with approximately the same utilization. Each Block II Keyboard will have its own interrupt, and there may be an interrupt associated with gyro torquing.

Display and Keyboard (DSKY)

There are three separate DSKY's in Block II: C/M Nav Panel, C/M Main Panel and LEM Main Panel. These have different shapes, but it is intended that they be logically and electrically as alike as possible. There is an unresolved problem in the LEM which involves a possible splitting of the DSKY into a display section and a keyboard section. A further question, related to the ultimate location of the numeric displays, is whether an additional pair of digits is required near the ruled LEM window.

The numeric displays will remain as in Block I, excepting possibly for the addition of another digit to the major program lights and of decimal points between second and third and third and fourth digits. The number of discrete lights, however, has been increased to 24 (in all three DSKY's). If possible all G/N status and alarm lights that are controlled by the DSKY will be located on the DSKY, thus saving considerably in cabling, shielding and interface documentation. The ground rule is to have DSKY's connect only to AGC (or LGC).

Block II DSKY's will be made with half-size crystal can relays, if these pass qualification tests. A design based on NOR gates and

SCR's proved to be only slightly lighter (1 or 2 pounds), and to require tenfold the power of the Relay DSKY if implemented with Block I NOR gates.

Additional logical changes would make the DSKY's truly independent and thus avoid the Block I hazard of having certain failures in one DSKY disable the other one.

General Input-Output

Present lists of LEM interfaces indicate that the LGC, and consequently Block II AGC, will have many more interfaces than Block I AGC. Rough estimates indicate that Block II will have about half again as much interface circuitry as Block I. Direct control of the CM SCS jets will add even more, if adopted.