BIF-107-50082-68
Page 1
Total Pages: 5
Copy 1 of 3

To: G. D. McGhee cc: E. Jacobs Date: 1 August 1968

Subject: Soft Switching In the PSS From: D. R. Howard

On 25 July 1968, Dr. E. Jacobs of the Systems Integration Office, with Mr. R. S. Robins of the Systems Engineering Office visited the EK facility for a fact finding on the soft switching parameters of those switches that have bypass circuits. The enclosed attachment contains a detailed discussion of our fact finding.

It is the opinion of the Systems Integration Office that the bus enabling switch design is satsifactory and that from the present data, no design changes are necessary. However, there is an administrative problem, in that the deviation granted to EK is very excessive considering what the design reflects. It is recommended that the deviation be changed to include only the bus enabling switches and that the ramp and bypass step be restricted to $\geq 30,000$A/sec and ≥ 0.3 A, respectively. If the deviation is not so restricted, it is possible for EK to make design changes that could adversely affect the total system EMC. The SO would not be aware of this situation since EK would be within their contractual requirements. It is pointed out that it is probable that in the development of his system segment, EK will find it necessary to modify the switching. However, there would be sufficient latitude in the recommended deviation change to accommodate switching modifications, but not jeopardizing system EMC.

It has been the experience of this office that interface agreements will not be agreed upon to any limits other than the contractual requirements regardless of the real world design. Also, whenever a EMC deviation affecting the interface is granted one contractor, the other segment contractors are successful in obtaining the same deviation. It is the policy of this office to recommend granting uniform deviations affecting interfaces to assure system compatibility. It is felt that the deviation granted EK, i.e., 1.75 volts at 1.75 amps, does not represent the design, jeopardizes system EMC and is not in the best interest of the MOL.

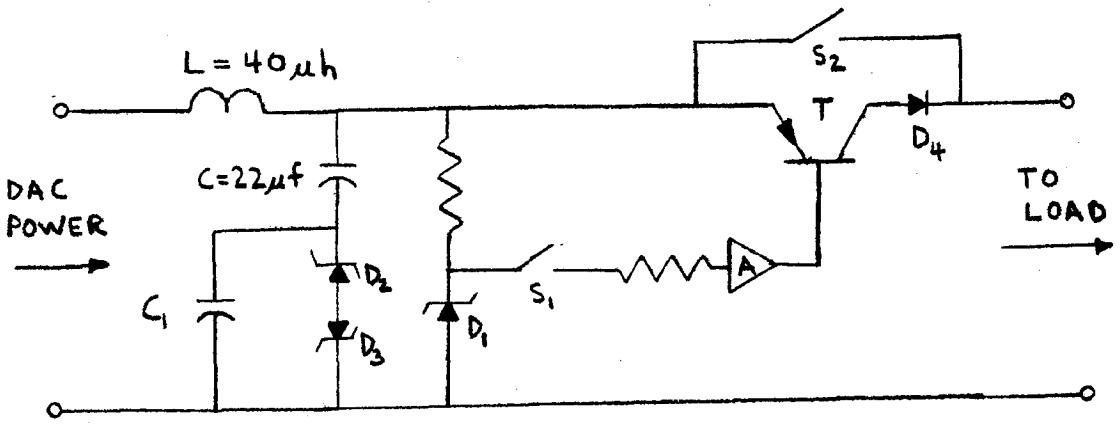
DRH/da

D R Howard
D. R. HOWARD

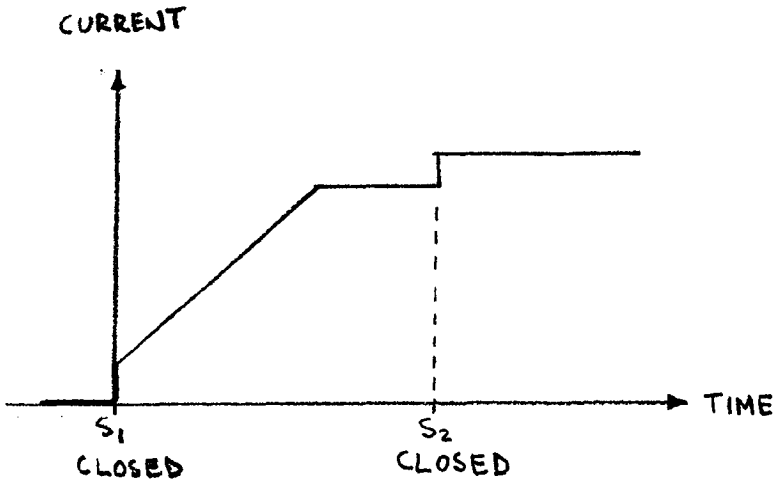
29 JULY 1968 SOFT SWITCH FACT FINDING

TECHNICAL DISCUSSION

The following is a simplified schematic of the soft switch circuit that is being incorporated in the equipments with the resulting current trace.



(a) SOFT SWITCH



(b) CURRENT FUNCTION

The switching action is initiated by closing switch S_1. The zener diode D_1 limits the initial step to 5 volts (and 5 ma.). The amplifier, A, - transistor, T, combination causes the current to ramp after the initial 5 ma step. The LC combination acts as a filter to prevent transients from damaging the transistor and to generally reduce CW ripple. The zener diodes D_2 and D_3 are used to counteract the effective ripple amplification that will take place around the filter resonance. These diodes are set to breakdown at 5 volts so that the protection is for ripple of approximately 3.5 volts RMS (resonance is at approximately 5.35 kHz). The addition of these diodes removes C from RF ground which has the tendency to cause the switch transistor T to oscillate. This necessitates the addition of C_1 to bring C back down to zero RF potential.

The diode D_4 is inserted for all circuits that require redundancy to provide isolation in the case of a fault. After the current has built up to its steady state value the bypass switch S_2 is closed to eliminate the power loss in the transistor (and Diode D_4 for redundant circuits) during the non-switching operation. The voltage drops across the transistor and diode are approximately 0.5 to 1. volt, respectively.

The following table lists the switching parameters for all systems that incorporate a bypass switch in the soft switch circuit.

POWER SYSTEM A

Function	Switching Parameters			Maximum Load (A)	Frequency
	Load (A)	Ramp (A/Sec)	By-Pass Step (A)		
Recorder Bus	2 to 3	60.	0.15	30.	Twice each orbit
*Record Handling Bus	3.	60.	0.15	10.	Twice each orbit
Gain Control Bus	5.	100.	0.25	6.	2 to 3 times each day
*DCU Bus	6.	100.	0.3	6.5	Twice each orbit
Sight Ass'y Bus	>0.4	8.	0.02	12.	2 to 3 times each day
POWER SYSTEM B					
Heaters	26.7	600.	0.4	26.7	Before launch & in the power saving mode.
Lock Set "Prime"	0.28	5.	.014	3.	Once early orbit
Lock Set "B/U"	.14	2.5	.007	3	Once early orbit
Leveler Bus	4.	80	0.2	20.	Once early orbit & once or twice each day.

*Operated simultaneously.

CONCLUSIONS AND RECOMMENDATIONS:

This data has been reviewed for EMC and it is the opinion of the System Integration Office that the contractor has designed his circuits to keep the EMI to the minimum and that these switching levels and frequencies should not cause any system EMI problems. It is therefore felt that if no changes are made to these values, the segment does not have an EMI problem due to switching. It is recommended that no changes be made to the present design. However, it is pointed out that the deviation granted to the contractor allows switching levels which are approximately three orders of magnitude greater than presently exist. It is recommended that the deviation be changed to more closely describe the present design.