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DATE: August 27, 1997 PPM-97-037
TO: J. Lohr/311
FROM: K. Sahu / 300.1
SUBJECT: Radiation Report on: MHV2803R3
Project: SMEX
Job #: C61243/C78111
Project part #: MHV2803R3

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A radiation evaluation was performed on MHV2803R3 (DC/DC Converter) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Figure 1, and Tables I through IV.

The total dose testing was performed using a Co^{60} gamma ray source. During the radiation testing, three parts (SN's 16, 20, and 24) were irradiated under bias (see Figure 1 for bias configuration) and one part (SN 28) was used as a control sample. The total dose radiation levels were 5.0, 10.0, 15.0, 20.0, 30.0, and 50 kRads*. The dose rate was between 0.06 and 1.250 kRads/hour (0.018 to 0.35 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 10.0 kRad irradiation, the parts were annealed under bias for 360 hours at 25°C. Also, following the 50.0 kRad irradiation the parts were given a final annealing for 168 hours at 25°C. After each radiation exposure and the annealing step, the parts were electrically tested according to the test conditions and the specification limits listed in Table III. **

After the 5.0 kRad irradiation, all parts showed significant degradation in Load Regulation (Reg). SN's 16 and 20 exceeded the specification limit of 50mV for Load Reg with readings of 142 and 58.7 mV. All parts passed all other tests.

After the 10.0 kRad irradiation, all three parts exceeded the specification limit for Load Reg with readings of 553, 519 and 222 mV. All parts passed all other tests.

The parts were annealed at 25°C for 360 hours and showed some recovery in Load Reg with readings of 365, 313 and 97 mV. All parts passed all other tests.

After the 15.0 kRad irradiation, all three parts continued to exceed the specification limit for Load Reg with readings of 755, 702 and 410 mV. SN's 16 and 20 exceeded the specification limit of 20 mV for Line Reg with readings of 214 and 198 mV. All parts passed all other tests.

After the 20.0 kRad irradiation, SN's 16 and 20 exceeded the specification limit of 3.35V for Vout with readings of 3.55 and 3.58 V. All parts failed and continued to degrade in Load Reg with readings of 847, 790 and 639 mV and Line Reg with readings of 287, 290 and 108 mV. All parts passed all other tests.

After the 30.0 kRad irradiation, all parts failed Vout with readings of 3.98, 4.02 and 3.64 V; Load Reg with readings of 1028, 960 and 771 mV; and Line Reg with readings of 426, 438 and 296 mV. All parts passed all other tests.

* The term Rads, as used in this document, means Rads (SiO_2). All radiation levels cited are cumulative.

** These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

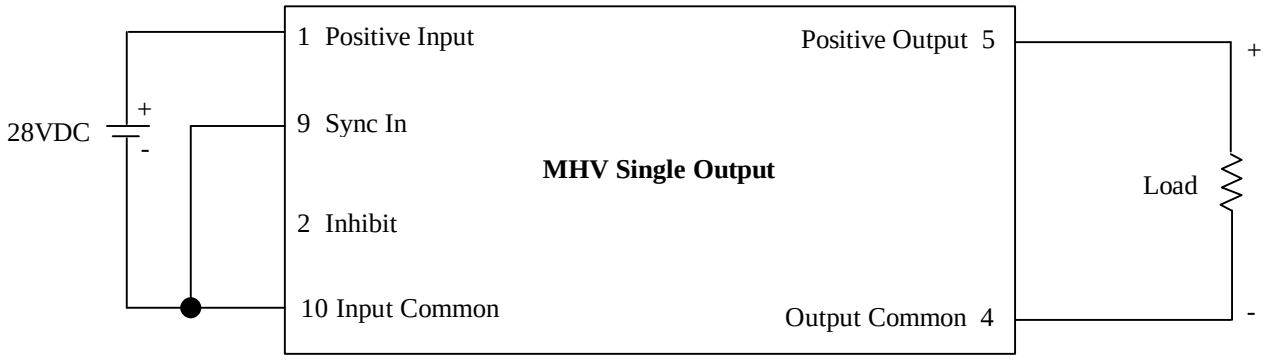
After the 50.0 kRad irradiation, all parts continued to degrade with Vout readings of 4.56, 4.59 and 4.13 V; Load Reg with readings of 1171, 1094 and 912 mV; and Line Reg with readings of 719, 604 and 400 mV. SN 16 marginally exceeded the specification limit of 30 mA for Iin No Load with a reading of 30.2 mA. All parts passed all other tests.

The parts were annealed at 25°C for 168 hours and showed little to no recovery, all parts continued to fail Vout, Load Reg and Line Reg.

Table IV provides a summary of the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

Figure 1. Radiation Bias Circuit for MHV2803R3 (DC/DC Converter)



Note:
Resistor is 10Ω ±5%, 2.0 W min.

TABLE I. Part Information

Generic Part Numbers:	MHV2803R3
SMEX Part Numbers	MHV2803R3
Charge Number:	C61243/C78111
Manufacturer:	Interpoint Corp.
Lot Date Code (LDC):	9712
Quantities Tested:	4
Serial Numbers of Control Sample:	28
Serial Numbers of Radiation Samples:	16, 20, 24
Part Function:	DC/DC Converter
Part Technology:	Hybrid
Package Style:	10 Pin Metal Hermetic
Test Equipment:	Bench Test
Engineer:	S. Norris

* The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for MHV2803R3

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	07/15/97
2) 5.0 KRAD IRRADIATION (0.06 KRADS/HOUR)	07/21/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	07/23/97
3) 10.0 KRAD IRRADIATION (0.06 KRADS/HOUR)	07/23/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	07/25/97
4) 360-HOUR ANNEALING @25°C	07/25/97
POST-360 HOUR ANNEAL ELECTRICAL MEASUREMENT	08/08/97
5) 15.0 KRAD IRRADIATION (0.06 KRADS/HOUR)	08/08/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	08/11/97
6) 20.0 KRAD IRRADIATION (0.12 KRADS/HOUR)	08/11/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	08/13/97
7) 30.0 KRAD IRRADIATION (0.12 KRADS/HOUR)	08/13/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	08/15/97
8) 50.0 KRAD IRRADIATION (0.12 KRADS/HOUR)	08/15/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	08/18/97
9) 168-HOUR ANNEALING @25°C	08/18/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	08/25/97

Effective dose rate = 50,000 RADS/29 DAYS = 71.8 RADS/HOUR = 0.020 RADS/SEC.
The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

The interim annealing following the 10.0 kRad step was added due to significant degradation in the parts. The addition of an interim annealing step better simulates the space environment's lower dose rate for very sensitive devices. This may allow the parts to show satisfactory performance at higher doses or indicate that the part can not be used beyond the previous dose level.

All parts were irradiated and annealed under bias. See Figure 1

Table III: Electrical Characteristics of MHV2803R3

Test #	Parameter	Units	Test Conditions /1 /2	Spec. min	Lim. max
1	**V_{OUT} Full Load**	**V**		**3.25**	**3.35**
2	**Efficiency**	**%**		**66.0**	
3	**I_{IN} No Load**	**mA**	**No Load**		**30**
4	**Load Reg**	**mV**	**No Load to Full Load**		**50**
5	**Line Reg**	**mV**	**V_{IN} = 16 to 50VDC**		**20**
6	**Output Ripple**	**mV p-p**	**10 kHz to 20 MHz**		**70**

Note:

1/ These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

2/ Full Load and V_{IN} = 28VDC unless otherwise specified.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for MHV2803R3 /1

			Spec. Lim. /2				Total Dose Exposure (kRads)				Annealing /3		Total Dose Exposure (kRads)								Annealing	
#	Parameters	Units	min	max	Initial		5.0		10		360hrs @25°C		15		20		30		50		168hrs @25°C	
1	Vout	V	3.25	3.35	3.29	0	3.29	0	3.29	0.01	3.29	0.01	3.33	0.03	3.47	0.13	3.88	0.17	4.43	0.21	3.96	0.16
2	Efficiency	%	66		68	0	68	0	68	0	68	0	68	0	69	0.5	70	0	72	0.5	70	0
3	Iin	mA		30	21	0	21	0	21	0.5	21	0.5	23	0.8	24	0.9	27	1.2	29	1.2	25	1.2
4	Load Reg	mV		50	15	0.2	72	52	432	149	136	159	622	152	759	88	920	109	1059	109	875	94
5	Line Reg	mV		20	0.1	0.05	0.1	0.05	3.2	3.9	0.4	0.4	137	97	228	85	387	64	574	132	667	208
6	Output Ripple	mV p-p		70	1.3	0.5	1.1	0.4	0.9	0.2	1.0	0.3	1.1	0.4	1.4	0.2	1.3	0.2	1.2	0.2	1.1	0.1

Notes:

1/ The mean and standard deviation values were calculated over the three parts irradiated in this testing. The control sample remained constant throughout the testing and is not included in this table.

2/ These are the manufacturer's pre-irradiation data sheet specification limits. No post irradiation limits were provided by the manufacturer at the time these tests were performed.

3/ The interim annealing step was added due to significant degradation in the parts at this level. The addition of this interim annealing step better simulates the space environment's lower dose rate for very sensitive devices. This may allow parts to show satisfactory performance at higher doses or indicate that the part can not be used beyond the previous dose level.

Radiation Sensitive Parameters: Vout, Iin, Load Reg, Line Reg.