

Memorandum



DATE: November 24, 1993
TO: B. Fafaul/311
FROM: K. Sahu/300.1 *KS*
SUBJECT: Radiation Report on FAST/MUE
Part No. G311P759-4M194304 (S311-P-759)
Control No. 6013

PPM-93-101

cc: R. Kolecki/740.4
T. Miccolis/300.1
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Library/300.1
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SMEX, PPM File

A radiation evaluation was performed on G311P759 (Oscillator) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through IV and Figure 1.

The total dose testing was performed using a cobalt-60 gamma ray source. During the radiation testing, four parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation levels were 5, 10, 15, 25 and 75 krads. The dose rate was between .025 and 0.36 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 75 krad irradiation, parts were annealed at 25°C for 168 hours, after which the parts were annealed at 100°C for 168 hours. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III.

All parts passed initial electrical measurements. All four irradiated parts passed all electrical tests throughout all irradiation and annealing steps. No significant sensitivity to radiation was observed in any test parameters. After the 100°C annealing step, S/N 27, 28 and 32 exhibited slight shifts in the output frequency. This shift may be due to thermal aging rather than the effects of the radiation.

Table V provides a summary of the functional test results, as well as the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

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

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

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TABLE I. Part Information

Generic Part Number:	S511-P-759
Part Number:	G311P759-4M194304*
FAST/MUE Control Number:	6013
Charge Number:	C33703
Manufacturer:	Monitor Products Co., Inc.
Lot Date Code:	9315
Quantity Tested:	5
Serial Numbers of Radiation Samples:	26, 27, 28, 32
Serial Number of Control Sample:	24
Part Function:	Oscillator
Part Technology:	HCMOS
Package Style:	4-pin metal
Test Equipment:	bench test
Test Engineer:	T. Mondy

*These are radiation-hardened parts, guaranteed to 60 krads.

TABLE II. Radiation Schedule for C311P759-4M194304

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/21/93
2) 5 KRAD IRRADIATION (0.28 KRADS/HOUR)	09/22/93
POST-5 KRAD ELECTRICAL MEASUREMENT	09/23/93
3) 10 KRAD IRRADIATION (0.03 KRADS/HOUR)	09/23/93
POST-10 KRAD ELECTRICAL MEASUREMENT	09/24/93
4) 15 KRAD IRRADIATION (0.07 KRADS/HOUR)	09/24/93
POST-15 KRAD ELECTRICAL MEASUREMENT	09/27/93
5) 25 KRAD IRRADIATION (0.50 KRADS/HOUR)*	09/27/93
POST-25 KRAD ELECTRICAL MEASUREMENT	10/15/93
6) 75 KRAD IRRADIATION (0.37 KRADS/HOUR)	10/15/93
POST-75 KRAD ELECTRICAL MEASUREMENT	10/18/93
7) 168 HOUR ANNEALING @25°C	10/18/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/25/93
8) 168 HOUR ANNEALING @100°C**	10/26/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/02/93

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

*The Co-60 irradiator was down for 18 days during this irradiation. Parts were kept under bias at 25°C during this period.

**High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of G311P759-4M194304

Test Parameter	Specification Limit		Test Conditions
	Lower	Upper	
Icc	-	50MA	Vdd = 5.0 V ± 10%
tr	-	10 ns	
tf	-	10 ns	
VoH	4.5V	5.0V	
VoL	0V	0.5V	
Freq. Shift*	-1PPM	+1PPM	0°C - 40°C
Dcyc	45%	55%	

*Initial values of frequency for the four radiation samples and control sample were:

S/N 24: 4.194302 MHz (control sample)
 26: 4.194303 MHz
 27: 4.194293 MHz
 28: 4.194298 MHz
 32: 4.194300 MHz

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for G311P759-4M194304 /1

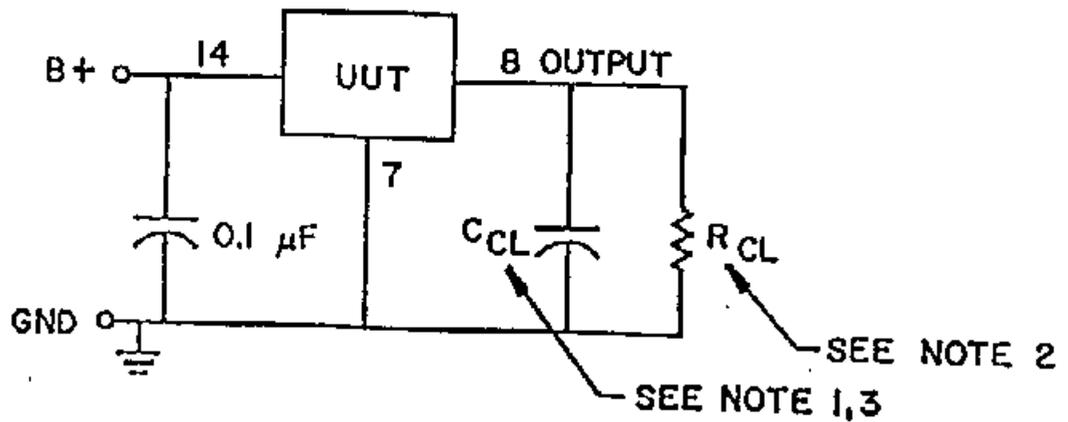
Parameters	min	max	Total Dose Exposure (krads)										Annealing						
			Initials		5		10		15		25		75		168 hrs @25°C		168 hrs @100°C		
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
Icc	mA	-	50	19.5	0.1	19.5	.12	19.4	0.1	19.1	.15	19.4	.14	19.2	.71	19.2	.52	18.8	.15
tr	ns	-	10	2.3	.09	2.5	.06	2.9	.06	2.8	0.1	2.8	.08	2.9	.13	2.9	.13	2.8	0.1
t _f	ns	-	10	2.1	.13	2.1	0.1	2.0	.05	2.0	.08	2.0	.05	2.1	.08	2.1	0	2.1	.06
VcH	V		5.0	4.8	.01	4.8	0	4.8	0	4.8	0	4.8	0	4.8	.05	4.8	.05	4.8	0
VcL	V		0.5	0.2	.01	0.2	0	0.2	0	0.2	0	0.2	0	0.2	.05	0.2	.05	0.2	0
Freq. shift	PPM/2	-1	+1	0	0	0	0	.18	.12	0	0	.12	.14	.12	.14	.12	.14	1.5	2.0
Dcyc	%	45%	55%	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0

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

2/ The values of frequency for the four irradiated parts and control sample before irradiation, after 75 krads and after 168 hours at 100°C were as follows:

S/N	Frequency (MHz)		
	Initial	75 krads Irrad.	100 hrs. Anneal
24	4.194302	4.194302	4.194301
26	4.194303	4.194303	4.194304
27	4.194293	4.194293	4.194312
28	4.194298	4.194299	4.194295
32	4.194300	4.194301	4.194298

Figure 1. Radiation Bias Circuit for G311P759-4M194304



- 1) For HCMOS: $C_{CL} = 30 \text{ pF} \pm 5 \%$.
- 2) For HCMOS: $R_{CL} = 100 \text{ k}\Omega \pm 5 \%$.
- 3) C_{CL} includes scope capacitance.