

Memorandum

PARAMAX
A Unisys Company

DATE: November 24, 1993
TO: B. Pafaul/311
FROM: K. Sahu/300.1 /KS
SUBJECT: Radiation Report on FAST/MUE
Part No. G311P759/01-18M (S311-P-759)
Control No. 6014

PPM-93-102

cc: R. Kolecki/740.4
T. Miccolis/300.1
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Library/300.1
L. Cusick/740.4
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 krad. The dose rate was between .025 and 0.50 krad/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. After the 5 krad irradiation, one part (S/N 40) marginally exceeded the specification limit of 1 PPM for frequency shift, and continued to marginally exceed the specification limit for this parameter at every irradiation and annealing step except for the 10 krad level. All four irradiated parts passed all other electrical tests throughout all irradiation and annealing steps.

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 me 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:	G311P759/01-18M*
FAST/MUE Control Number:	6014
Charge Number:	C33704
Manufacturer:	Monitor Products Co., Inc.
Lot Date Code:	unknown
Quantity Tested:	5
Serial Numbers of Radiation Samples:	7, 17, 35, 40
Serial Number of Control Sample:	6
Part Function:	Oscillator
Part Technology:	HCMOS
Package Style:	8-pin metal
Test Equipment:	bench test
Test Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for G311P759/01-18M

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/16/93
2) 5 KRAD IRRADIATION (0.28 KRADS/HOUR) POST-5 KRAD ELECTRICAL MEASUREMENT	09/22/93 09/23/93
3) 10 KRAD IRRADIATION (0.03 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	09/23/93 09/24/93
4) 15 KRAD IRRADIATION (0.07 KRADS/HOUR) POST-15 KRAD ELECTRICAL MEASUREMENT	09/24/93 09/27/93
5) 25 KRAD IRRADIATION (0.50 KRADS/HOUR)* POST-25 KRAD ELECTRICAL MEASUREMENT	09/27/93 10/15/93
6) 75 KRAD IRRADIATION (0.37 KRADS/HOUR) POST-75 KRAD ELECTRICAL MEASUREMENT	10/15/93 10/18/93
7) 168 HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/18/93 10/25/93
8) 168 HOUR ANNEALING @100°C** POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/26/93 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 G311P759/01-18M

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 6: 17.999911 MHz (control sample)
 7: 17.999897 MHz
 17: 18.000018 MHz
 35: 17.999898 MHz
 40: 17.999747 MHz

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for G311P759/01-18M /1

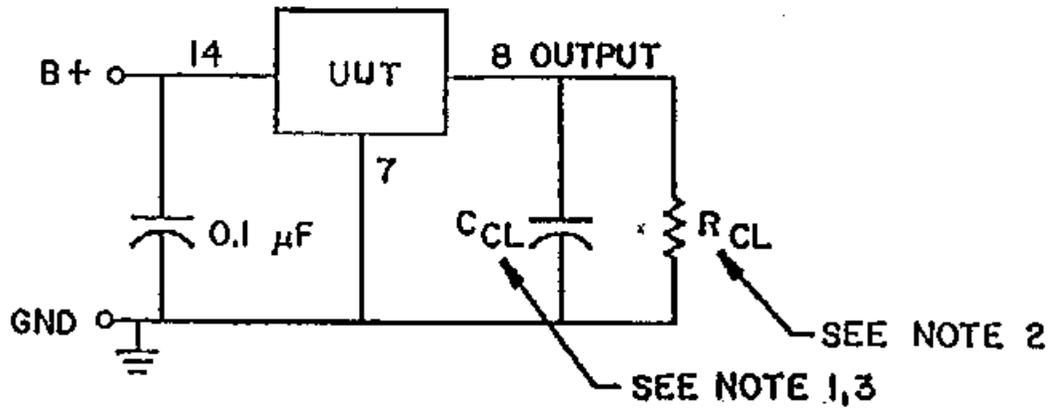
Parameters		min	max	Total Dose Exposure (krads)										Annealing					
				Initials		5		10		15		25		75		168 hrs @25°C		168 hrs @100°C	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Icc	mA	-	50	39.3	.10	40.4	.76	39.8	.34	39.9	.36	40.3	.31	39.3	.25	39.1	.24	38.5	.38
tr	ns	-	10	2.4	.15	2.1	.21	3.0	0	3.0	.13	3.0	0	3.0	.05	2.8	.08	3.0	.10
tf	ns	-	10	1.6	.08	1.3	.14	2.1	.10	2.6	.05	2.1	.06	2.0	.05	1.9	.08	2.0	.06
VcH	V		5.0	4.6	.02	4.8	.03	4.8	.06	4.8	.05	4.8	0	4.8	0	4.8	0	4.8	.03
VcL	V		0.5	0.4	.01	0.2	.03	0.3	.06	0.2	.05	0.2	0	0.2	0	0.2	0	0.2	.03
Freq. shift	PPM/2	-1	-1	0	0	.75	.34	.68	.29	.90	.42	1.1	.71	.45	.49	.45	.35	.97	.63
Dcyc	%	45%	55%	49%	0	50%	.58	50%	.58	50%	.58	49%	.50	49%	.82	45%	0	50%	.58

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
6	17.999911	17.999898	17.999886
7	17.999897	17.999896	17.999867
17	18.000018	18.000015	18.000021
35	17.999898	17.999890	17.999882
40	17.999747	17.999726	17.999728

Figure 1. Radiation Bias Circuit for G311P759/01-18M



- 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.