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## Interoffice Memorandum

To  
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Department  
Code 311  
From  
K. Sahu KS  
Department  
7809  
Subject  
Radiation Report on TSC426MJA  
Project: MODIS-1

PEM-91-509  
Date  
August 12, 1991  
Location  
GSFC  
Telephone  
731-8954  
Location  
Lanham  
cc  
J. Buckner/303  
S. Esmacher  
P. Thornton

A radiation evaluation was performed on TSC426 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 I.

The total dose testing was performed using a cobalt-60 gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation steps were 5, 10, 15, 20, 30, 40, and 50 krads. After 50 krads, parts were annealed at 25°C for 24 and 168 hours. The dose rate was between 0.3 - 0.5 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III. These tests included two functional tests at 1MHz with  $V_S = 4.5V$  and  $V_S = 18V$ .

All (8) parts passed all AC, DC and functional tests to 15 krads. After 20 krads irradiation, three parts (SNs 24, 28 and 29) marginally exceeded the maximum specification limit of 0.4mA for ICC0 (readings were .47mA, .49mA and .54mA, respectively). Some continued ICC0 degradation was observed in these three parts after cumulative exposures of 30 and 40 krads, while all other parts passed all tests. After 50 krads, four parts (SNs 24, 26, 27 and 29) marginally exceeded the maximum specification limit of 40ns for TD1 (failed readings ranged from 40.4ns to 41.3ns).

Upon annealing the parts for 24 hours, all parts, except SN 28, marginally exceeded the maximum specification limit for TD1, and SNs 24, 28 and 29 continued to exceed the specification limit for ICC0. Also, two parts, SNs 28 and 29, showed an increased sensitivity to VIH in the functional tests, and in VOL2 and ROUT0 (see note 3 in Table IV). Upon annealing the parts for 168 hours, the same post 24 hour annealing failures were observed, in addition to further degradation in SN 28 and 29's sensitivity to VIH.

Table IV provides the mean and standard deviation values for each parameter after each radiation/annealing step. Table V provides the same information on tests performed at high and low temperatures for initial and final electrical measurements.

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

TABLE I. Part Information

Generic Part Number:	TSC426
Manufacturer:	Teledyne
Lot Date Code:	9026
Quantity Tested:	10
Serial Numbers of Radiation Samples:	22, 23, 24, 25, 26, 27, 28, 29
Serial Numbers of Control Samples:	20, 21
Part Function:	MOSFET Driver
Part Technology:	CMOS
Package Style:	8-Pin DIP
Test Engineer:	T. Mondy

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	06/28/91
2) 5 krad irradiation @ 250 rads/hr Post 5 krad Electrical Measurements	07/10/91 07/11/91
3) 10 krad irradiation @ 250 rads/hr Post 10 krad Electrical Measurements	07/11/91 07/12/91
4) 15 krad irradiation @ 250 rads/hr Post 15 krad Electrical Measurements	07/12/91 07/15/91
5) 20 krad irradiation @ 250 rads/hr Post 20 krad Electrical Measurements	07/15/91 07/16/91
6) 30 krad irradiation @ 500 rads/hr Post 30 krad Electrical Measurements	07/16/91 07/17/91
7) 40 krad irradiation @ 500 rads/hr Post 40 krad Electrical Measurements	07/17/91 07/18/91
8) 50 krad irradiation @ 500 rads/hr Post 50 krad Electrical Measurements	07/18/91 07/19/91
9) 24 hrs annealing Post 24 hr Electrical Measurements	07/19/91 07/20/91
10) 168 hrs annealing Post 168 hr Electrical Measurements	07/19/91 07/26/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- Annealing was performed at 25°C under bias.

Table III. Electrical Characteristics of TSC426

1/, 2/

TEST NAME	TEST CONDITIONS	-55°C		+25°C		+125°C		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	
IINH1	VIN=0, 4.5 VDC VS=4.5 VDC	-10	10	-1	1	-10	10	uA
IINH2	VIN=0, 18 VDC VS=18 VDC	-10	10	-1	1	-10	10	uA
IINL1	VIN=0, 4.5 VDC VS=4.5 VDC	-10	10	-1	1	-10	10	uA
IINL2	VIN=0, 18 VDC VS=18 VDC	-10	10	-1	1	-10	10	uA
VOH1	VIN=0.8 VDC VS=4.5 VDC	4.475	-	4.475	-	4.475	-	VDC
VOH2	VIN=0.8 VDC VS=18 VDC	17.975	-	17.975	-	17.975	-	VDC
VOL1	VIN=2.4 VDC VS=4.5 VDC	-	25	-	25	-	25	mVDC
VOL2	VIN=2.4 VDC VS=18 VDC	-	25	-	25	-	25	mVDC
ROUT1	VIN=0.8 VDC IO=-10 mA VS=18 VDC	0	20	0	15	0	20	OHMS
ROUT0	VIN=2.4 VDC IO=10 mA VS=18 VDC	0	15	0	10	0	15	OHMS
ICC0	VIN=0 VDC VS=4.5, 18 VDC	0	0.6	0	0.4	0	0.6	mA
ICC1	VIN=3.0 VDC VS=4.5, 18 VDC	0	12	0	8	0	12	mA
VIL 1/	VS=4.5, 18 VDC	0	0.8	0	0.8	0	0.8	VDC
VIH 1/	VS=4.5, 18 VDC	2.4	-	2.4	-	2.4	-	VDC
TD1	VIN=0.4, 5.0 VDC VS=18 VDC CL=1000 pF	0	60	0	40	0	60	ns
TD2	VIN=0.4, 5.0 VDC VS=18 VDC CL=1000 pF	0	120	0	75	0	120	ns

1/ VIL and VIH are tested during functional testing at 1 MHz with VS = 4.5 and 18 VDC. A 10kOhm load is placed on the outputs during functional testing.

2/ The initial and final electricals were performed at -55, 25 and 125°C. At all other radiation and annealing steps, parts were measured at 25°C only.

TABLE IV: Summary of Elect. Measurements after  
Total Dose Exposures and Annealing for TSC426MJA

1/, 2/

Parameters	Spec. Limits min max	Initials mean sd		Total Dose Exposure (krads)																Annealing			
				5		10		15		20		30		40		50		24 hrs 4/		168 hrs 4/			
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
Func1		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func2	3/	Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VIH1	uA	-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIH2	uA	-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL1	V	4.48		4.5	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5	0
VOL2	V	17.98		18	0	18	0	18	0	18	0	18	0	18	0	18	0	18	0	18	0	18	0
ROUT1	Ohm	0	15	10.0	0.1	10.0	0.3	9.9	0.3	10.0	0.3	10.0	0.3	10.1	0.3	10.1	0.3	10.1	0.6	10.1	.3	10.1	.3
ROUT0	Ohm	0	10	5.5	0.1	5.4	.05	5.4	.05	5.5	.06	5.5	.08	5.6	.06	5.6	.07	5.6	0.3	5.6	.04	5.6	.03
ICC0	mA	0	0.4	.22	.08	.20	.05	.20	.06	.20	.10	.29	.14	.34	.19	.35	.23	.40	.27	.39	.25	.37	.24
ICC1	mA	0	8	5.1	0.6	4.7	1.1	4.7	1.1	4.8	1.1	4.7	1.1	4.7	1.1	4.6	1.2	4.6	1.2	4.7	1.2	4.8	1.2
TD1	ns	0	40	35.8	0.7	35.9	0.9	36.2	0.8	36.6	0.8	37.2	1.4	37.7	1.4	37.3	1.0	38.5	1.8	38.6	2.3	39.6	1.4
TD2	ns	0	75	65	2	65	2	64	2	64	2	63	2	63	2	55	8	63	3	62	2	63	2.2

Notes:

- 1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.
- 2/ The values in Table IV reflect only those measurements made at 25°C and a VIH testing level of 2.4V.
- 3/ After annealing the parts for 24 hours, a significant increase in VOL2 and ROUT0 on one of the testing pins and 18V readings for VOL2 were recorded for these parts due to a degraded VIH sensitivity. Upon increasing VIH to 3.0V, SN 28, the one part which had failed functional test #2, passed functional test #2, and SNs 28 and 29 passed VOL2 and ROUT0. After annealing the parts for 168 hours, the same post 24 hour anneal failures were observed and SNs 28 and 29 did not pass VOL2 and ROUT0 until VIH was increased to 4.0V. However, the remaining six parts did not show this degradation in VIH sensitivity at 25°C.
- 4/ The data for VOL2 and ROUT0 in Table IV for Post 24 and 168 hour annealing measurements does not include the test data from SNs 28 and 29.

Table V. Summary of Initial and Final Electrical Measurements  
at Low and High Temperatures for TSC426 1/, 2/

Parameters	Spec. Limits min max	-55°C				125°C			
		Initials		50 krad		Initials		50 krad	
		mean	sd	mean	sd	mean	sd	mean	sd
Func1		Pass		Pass		Pass		5P/3F	
Func2		Pass		Fail		Pass		Pass	
IINH1	uA -10 10	0	0	0	0	0	0	.01	0
IINL1	uA -10 10	0	0	0	0	0	0	-.01	0
VOH1	V 4.48 -	4.5	0	4.5	0	4.5	0	3.7	1.8
VOE2	V 17.98 -	18	0	18	0	18	0	18	0
VOL1	mV - 25	1.8	0.1	1.8	0.2	1.7	0.1	1.2	.08
VOL2 3/	mV - 25	2.1	0.1	15E3	7E3	2.0	0.1	1.4	.08
ROUT1	Ohm 0 20	7.0	0.1	7.2	0.3	14.3	0.4	14.6	0.5
ROUT0 3/	Ohm 0 15	3.7	0.1	1E3	906	8.3	0.1	8.6	0.1
ICCC	mA 0 0.6	.31	.03	.53	.33	.10	.03	.16	.17
ICCL	mA 0 12	7.1	1.0	7.0	1.8	2.5	0.2	.97	.45
TD1	ns - 60	29.7	0.8	32.9	1.7	45.8	1.0	48.2	2.7
TD2	ns - 120	52.0	2.0	49.8	1.5	92	4	>102	-

Notes:

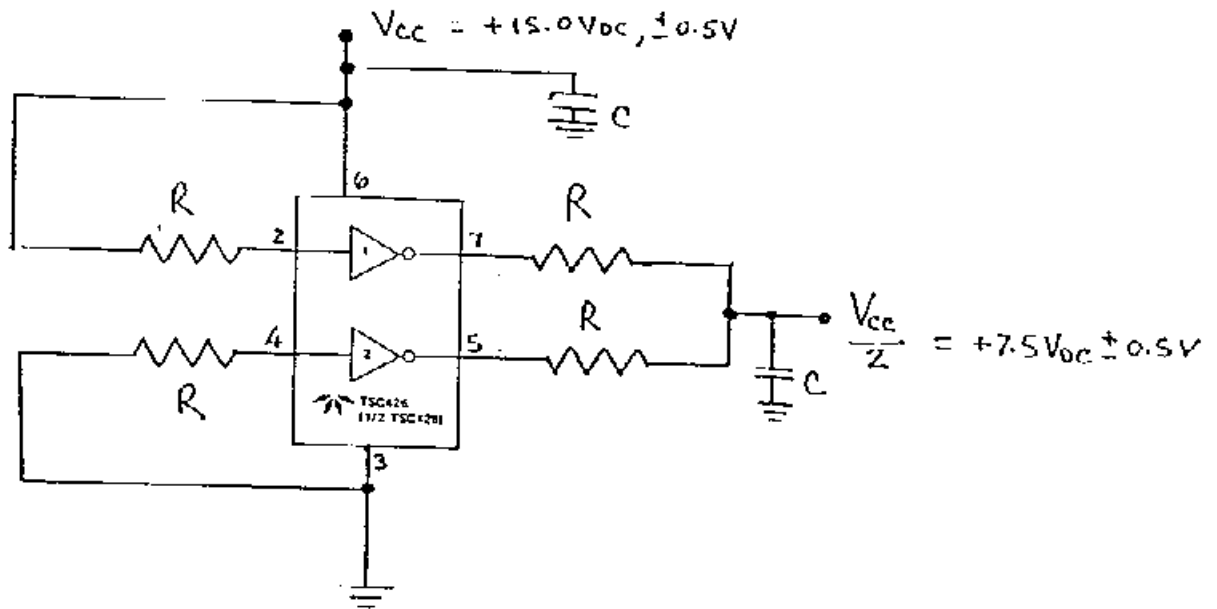
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ Parts exceeded the testing range limit of 102 ns for TD2 during high temperature, post 50 krad electrical measurements.

3/ All parts failed VOL2 and ROUTC during -55°C, post 50 krad electrical measurements, due to the problem discussed in note 3 of Table IV. However, when VIH was increased to 3.0V, all parts passed these parametric tests. All values in Table V reflect measurements made with VIH = 2.4V.



Figure 1. Radiation Bias Circuit for TSC426



TEST CONDITIONS:

$$V_{cc} = +15V \pm 0.5V_{DC}$$

$$\frac{V_{cc}}{2} = +7.5V \pm 0.5V_{DC}$$

$$R = 10k\Omega, \frac{1}{4}W @ 10\%$$

$$C = 0.1\mu f @ 50V$$