PPM-91-637

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(82)

UNISYS

Interoffice Memorandum

PPM-91-637

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Subject
Radiation Report on TSC430MJA
(MODIS-T Project)

A radiation evaluation was performed on TSC430MJA 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, eight parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 2.5, 5, 10, 20, 40 and 50 krads*. After 50 krads, parts were annealed at +25°C for 72 and 312 hours. The dose rate was between 0.1 and 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 @ +25°C according to the test conditions and the specification limits listed in Table III. Also, parts were tested initially, and after the 50 krads irradiation step at -55°C and +125°C.

Parts passed all tests and stayed within the specified limits up to 2.5 krads of irradiation. Parts began to display degradation in ICC0 at 5 krads, where S/N 19 exceeded the specification limit of 300 uA. After 10 krads of irradiation, all irradiated parts exceeded the limit for ICC0. After 20 krads of irradiation, the output resistance also displayed sensitivity to the radiation. ICC0 exceeded 10 mA for all parts, and S/N 1, 14 and 17 also exceeded the specification limit for the ROUT test.

After 40 krads exposure, all parts showed continued degradation in ICC0 and ROUT. Also, all parts failed to function under static DC conditions as evident by the VOH and VOL failures. However, these parts did pass the 1 MHz functional tests. After investigating the VOH and VOL failures, it was determined that when the part was conditioned for a logic one (1) output, the output would only remain in this state momentarily. Therefore, a 100 kHz functional test was added, which revealed that the part output could sustain a high (1) level for a time interval of 500 ns < TVOH < 5 us, independent of the state of the input. Thus, the exposed parts failed the 100 kHz functional test and the static VOH and VOL tests.

After 50 krads of irradiation, there was not much change from the post 40 krads results. On annealing for 72 and 312 hours, the parts showed no significant recovery.

Tables IVa and IVb provide a summary of the 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.

*In this report, the term rads is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	TSC430
MODIS-T Part Number:	TSC430MJA/883
MODIS-T Control Number:	4042
Charge Number:	C14041
Manufacturer:	Teledyne
Lot Date Code:	9001
Quantity Tested:	9
Serial Numbers of Radiation Samples:	1, 2, 13, 14, 15, 16, 17, 19
Serial Number of Control Sample:	18
Part Function:	MOSFET DRIVER
Part Technology:	CMOS
Package Style:	8-pin DIP
Test Engineer:	T. Mondy

TABLE II. Radiation Schedule for TSC430

EVENTS	DATE
1) Initial Electrical Measurements	07/18/91
2) 2.5 KRAD IRRADIATION (0.125 krads/hour)	08/05/91
POST-2.5 KRAD ELECTRICAL MEASUREMENT	08/06/91
3) 5 KRAD IRRADIATION (0.125 krads/hour)	08/06/91
POST-5 KRAD ELECTRICAL MEASUREMENT	08/07/91
4) 10 KRAD IRRADIATION (0.25 krads/hour)	08/07/91
POST-10 KRAD ELECTRICAL MEASUREMENT	08/08/91
5) 20 KRAD IRRADIATION (0.5 KRADS/HOUR)	08/08/91
POST-20 KRAD ELECTRICAL MEASUREMENT	08/09/91
6) 40 KRAD IRRADIATION (0.295 krads/hour)	08/09/91
POST-40 KRAD ELECTRICAL MEASUREMENT*	08/15/91
7) 50 KRAD IRRADIATION (0.5 krads/hour)	08/15/91
POST-50 KRAD ELECTRICAL MEASUREMENT	08/16/91
8) POST 72 HOUR ANNEAL ELECTRICAL MEASUREMENTS	08/19/91
9) POST 312 HOUR ANNEAL ELECTRICAL MEASUREMENTS	08/29/91

All electrical measurements performed at +25°C.

Initial and post 50 krad electrical measurements also performed at -55°C and +125°C.

The post 40 krad and post 312 hour annealing steps also included a 100 kHz functional test.

*Anomalous event - The electrical measurements after 40 krads exposure were delayed by 72 hours. The parts were kept under bias from 8/12 to 8/15.

Table III. Electrical Characteristics of TSC430

T_A=-55, 125°C

TEST	CONDITIONS	LIMIT		UNITS
		Min	Max	
I_{INH1}	V_{CC}=4.5V, V_{IN}=V_{CC}	-10	10	uA
I_{INH2}	V_{CC}=12V, V_{IN}=V_{CC}	-10	10	uA
I_{INL1}	V_{CC}=4.5V, V_{IN}=0.0V	-10	10	uA
I_{INL2}	V_{CC}=12V, V_{IN}=0.0V	-10	10	uA
V_{OH1}	V_{CC}=4.5V, V_{IN}=0.8V,2.4V	4.425		V
V_{OH2}	V_{CC}=12V, V_{IN}=0.8V,2.4V	11.975		V
V_{OL1}	V_{CC}=4.5V, V_{IN}=0.8V,2.4V		.025	V
V_{OL2}	V_{CC}=12V, V_{IN}=0.8V,2.4V		.025	V
R_{OUT1}	VCC=12V, V_{IN}=3V, I_{OUT}=10mA		7	OHM
R_{OUT0}	VCC=12V, V_{IN}=0V, I_{OUT}=10mA		7	OHM
I_{CC0}	VCC=12V, V_{IN}=0V	0	500	uA
$I_{CC\phi}$	VCC=12V, V_{IN}=3V	0	8	mA
T_{D1}[1]	VCC=12V, V_{IN}=0,5V	1	35	nS
T_{D2}[1]	VCC=12V, V_{IN}=0,5V	1	35	nS

Exceptions:

The following tests were not performed due to equipment limitations:

TEST:	Explanation:
I_{PK}	ATE does not have AC-current capability
T_R	Requires special fixturing
T_F	Requires special fixturing
T_{SKEW}	Requires special fixturing
T_{D1}, T_{D2}	Test Performed with C_L = 35 pF. (OPEN – LOAD)

Notes:

1. V_{IL} and V_{IH} tests are performed G/NGo at 1MHz in the functional test.

TABLE IVa: Summary of Electrical Measurements after Total Dose Exposures and Annealing for TSC430MJA 1/ 2/

				Initials 25°C		Total Dose Exposure (krads)												Annealing					
		Spec. Limits				2.5		5		10		20		40		50		72 hrs		312 hrs 1 mhZ		312 hrs 100 KhZ	
Parameters		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
IINH1	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IINL1	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOH1	V	4.425	-	4.5	0	4.5	0	4.5	0	4.5	0	4.5	.02	4.5	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
VOH2	V	11.97	-	12	0	12	0	12	0	12	0	12	.01	6	6.2	6	6.2	6	6.2	6	6.2	6	6.2
VOL1	mV	0	25	1.3	.05	1.1	.07	1.1	.08	1.1	.01	1.5	0.5	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
VOL2	mV	0	25	1.4	0.1	1.1	0.1	1.2	.09	1.2	0.1	1.7	0.6	6	6.2	6	6.2	6	6.2	6	6.2	6	6.2
ROUT1	ohms	5	-	3.2	0.4	3.2	0.4	3.2	0.3	3.3	0.3	3.7	0.8	192	443	603	609	603	609	602	608	602	608
ICCO	uA	0	300	147.6	23.8	150	24.9	230	62.7	2950	01.	14E3	2096	16E3	18E3	7461	3722	6488	3897	7410	3789	7410	3789
ICC1	mA	0	5	2.2	0.6	2.2	0.7	2.2	0.6	2.3	0.6	2.4	0.6	2.9	0.8	7.6	3.6	6.6	3.8	7.5	3.6	7.5	3.7
TD1	ns	1	25	20.7	3.5	21.1	3.5	21	3.5	20.9	3.5	20.8	3.6	19.4	3.5	20.9	0.6	21.4	0.6	21.9	0.3	21.8	0.3
TD2	ns	1	25	21	0.5	20.9	0.8	21	0.8	21.1	0.7	21.5	0.8	21.6	0.8	20.5	0.4	21	0.5	21.5	0.5	21.5	0.5

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

2/ The notation nE3 implies n x 1000.

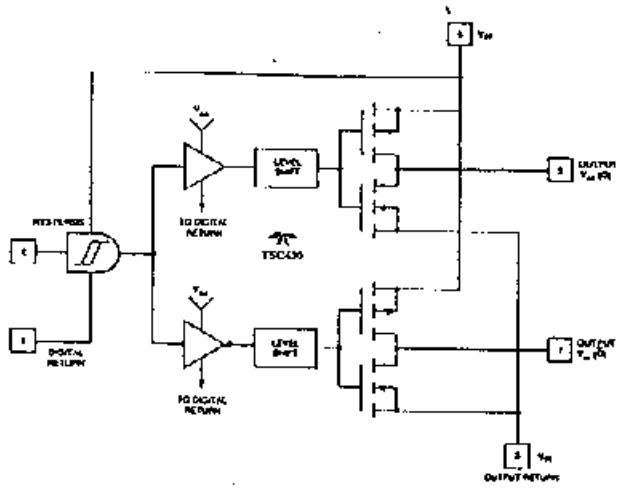
TABLE IVb: Summary of Electrical Measurements
@ -55°C and +125°C After Total Dose Exposures
for TSC430MJ 1/ 2/

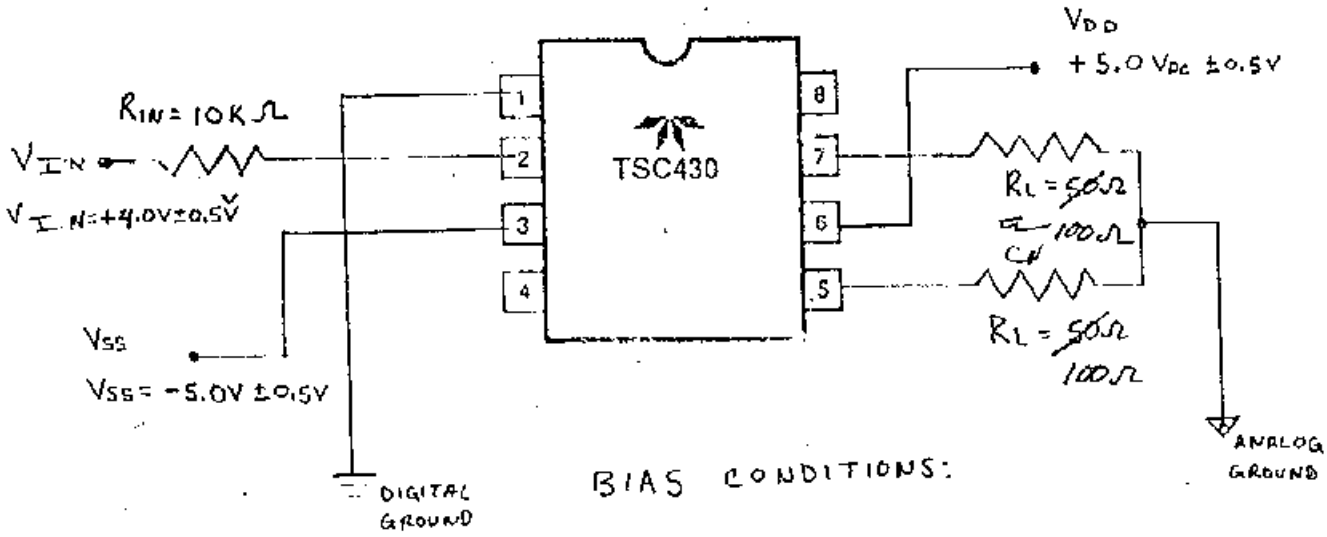
				Initials				50 Krads			
				-55°C		+125°C		-55°C		+125°C	
	Spec. Limits										
Parameters	min	max	mean	sd	mean	sd	mean	sd	mean	sd
IINH1 uA	-10	10	0	0	0	0	0	0	0	0
IINL1 uA	-10	10	0	0	-.04	0	0	0	-.02	0
VOH1 V	4.425	-	4.5	0	4.5	0	2.3	2.3	2.3	2.3
VOH2 V	11.97	-	12	0	12	0	6	6.2	6	6.2
VOL1 mV	0	25	1.3	0.1	1.5	0.1	2.3	2.3	2.3	2.3
VOL2 mV	0	25	1.3	0.1	1.5	0.1	6.0	6.2	6.0	6.2
RCUT1 ohms	5	-	2.5	0.5	4.5	0.4	603	610	454	588
ICCO uA	0	300	186	30.9	103	23.1	10E3	5E3	16E3	22E3
ICC1 mA	0	5	2.7	0.8	1.5	0.5	10.2	0	3.69	2.7
TD1 ns	1	25	17.2	3.1	26.8	4.2	21.8	4.2	26.2	2.1
TD2 ns	1	25	16.8	0.7	29	0.5	15.6	0.6	28.1	0.6

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

2/ The notation nE3 implies n x 1000.

Figure 1. Radiation Bias Circuit for TSC430





BIAS CONDITIONS:

V_{DD} = +5.0 V_{DC} ± 0.5V

V_{SS} = −5.0 V_{DC} ± 0.5V

V_{IN} = +4.0V ± 0.5V

R_{IN} = 10KΩ ± 10%, 1/4 WATT

R_L = ~~50~~ 100Ω ± 10%, 1/2 WATT

▽ Note: The analog ground must be a separate return wire. DO NOT CONNECT TO DIGITAL GROUND.

Prepared By: Timothy Mondy 2/26/91

Reviewed By