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Code 311
From
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Subject
Radiation Report on
ISTP Common Buy Part No. HCS4538KMSR

PPM-91-004
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January 3, 1991
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A radiation evaluation was performed on HCS4538KMSR 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 doses 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 50 and 100 krads. After 100 krads, parts were annealed at 25°C for 96 and 168 hours, and then the irradiation was continued up to 200 and 300 krads (cumulative). The dose rate was between 1.4-5.0 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, electrical testing was performed as described below.

i) A functional test was performed immediately after irradiation, while the devices were still in the radiation bias fixture. This test was performed using a bench set-up at the radiation facility (see Figure 1 for more details).

ii) An off-site electrical test (DC parameters and functional) was performed as per Table III, using Sentry S-50 automatic test equipment.

Initial measurements (before irradiation) showed all parts passing the functional testing as per i) and ii) above and the parts were well within the specification limits for all DC parameters. However, after the first exposure to 50 krads, all parts failed the on-site functional test which was performed within 2-3 minutes after removing the parts from the radiation chamber. However, on performing this test after 5-10 minutes, all parts passed this test. The parts were then tested off-site as per Table III and all parts passed functional as well as parametric tests. The parts were then exposed to 100 krads (cumulative) and the same test results (as above for 50 krads)

were observed. The parts were then allowed to anneal for 96 and 168 hours at 25°C, and were tested as per Table III. All parts passed the functional and the DC parametric tests after annealing.

On continued irradiation to 200 and 300 krads, parts continued to fail on-site functional testing immediately after the exposure, but passed the same test within the next 15-20 minutes. It was noted that as the radiation exposure was increased from 50 to 300 krads, the time taken by the parts to pass on-site functional testing increased from approximately 5 minutes to 15 minutes. However, at all radiation exposures, parts passed all tests, as per Table III, performed at the off-site facility using an automatic (S-50) tester.

Table IV provides the mean and standard deviation values for each parameter after different exposures and annealing treatments. As Table IV shows, except for the on-site functional testing, all parts passed all tests and stayed well within the specification limits during this testing.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at 731-8661.

TABLE I. Part Information

Generic Part Number:	HCS4538KMSR
ISTP Common Buy Part Number:	HCS4538KMSR
ISTP Common Buy Control Number:	374, 374A
Manufacturer:	Harris Corp
Quantity Procured:	87
Lot Date Code:	9025
Quantity Tested:	10
Serial Numbers of Radiation Samples:	3762,3772,3788,3797, 3505,3812,3819,3834
Serial Numbers of Control Samples:	3748,3755
Part Function:	Multivibrator
Part Technology:	CMOS/SOS - Radiation Hardened
Package Style:	16 Pin Flat Pack

TABLE II. Radiation Schedule

EVENTS	DOSE RATE	DATE
1) Initial Electrical Measurements		10/10/90
2) 50 krad irradiation @ 2.5 krad/hr		10/16/90
Post 50krads Functional Check (on-site)		10/17/90
Post 50krads Electrical Measurements (off-site)		10/17/90
3) 100 krad irradiation @ 2.5 krad/hr		10/17/90
Post 100krads Functional Check (on-site)		10/18/90
Post 100krads Electrical Measurements (off-site)		10/18/90
* 4) 96 hrs annealing		
Post 24 hr Electrical Measurements		10/22/90
5) 168 hrs annealing		
Post 168 hr Electrical Measurements		10/25/90
6) 200 krad irradiation @ 5 krad/hr		10/25/90
Post 200krads Functional Check (on-site)		10/26/90
Post 200krads Electrical Measurements (off-site)		10/26/90
7) 300 krad irradiation @ 1.4 krad/hr		10/26/90
Post 300krads Functional Check (on-site)		11/01/90
Post 300krads Electrical Measurements (off-site)		11/01/90

1) All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.

2) All electrical measurements were performed at 25°C.

3) Annealing performed at 25°C under bias.

* Anomalous Event

The initial 24 hour annealing was extended to 96 hours due to the time needed to repair the auxiliary S-50 Load Board adapter. These parts cannot be electrically tested without the auxiliary adapter.

TABLE III. Electrical Characteristics of HCS4538KMSR

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 25 DEG.C
DEVICE:	PART NO: HCS4538DMSR		PART TYPE: DUAL MONOSTABLE MULTIVIBRATOR			
DISK LABEL: LIB 8		LOCATION:		TEST SPECIFICATIONS		
DIRECTORY: [PROGRAMS.191]		ISTP_PVT_002				
TESTS PERFORMED						
FUNC 1	5.0V	1.50V	3.50V	FREQ = 2 MHZ	ALL I/O	VOH > 4.4V, VOL < 0.1V
FUNC 2	5.0V	1.50V	3.50V	FREQ = 2 MHZ	ALL I/O	VOH > 4.1V, VOL < 0.4V
IOL1Q	4.5V	INPUTS AT 1.50V AND 3.50V		VOH = 0.4V		4.8MA TO 25MA
IOL2Q	4.5V	INPUTS AT 1.50V AND 3.50V		VOH = 0.4V		4.8MA TO 25MA
IOH1Q	4.5V	INPUTS AT 1.50V AND 3.50V		VOH = 4.1V		-25MA TO -4.8MA
IOH2Q	4.5V	INPUTS AT 1.50V AND 3.50V		VOH = 4.1V		-25MA TO -4.8MA
VOH1Q	4.5V	INPUTS AT 1.50V AND 3.50V		EACH OUTPUT AT		-50UA 4.4V MIN
VOH2Q	4.5V	INPUTS AT 1.50V AND 3.50V		EACH OUTPUT AT		-50UA 4.4V MIN
VOL1Q	4.5V	INPUTS AT 1.50V AND 3.50V		EACH OUTPUT AT		50UA 0.1V MIN
VOL2Q	4.5V	INPUTS AT 1.50V AND 3.50V		EACH OUTPUT AT		50UA 0.1V MIN
IIH	5.5V	EACH INPUT TESTED AT VIN = 5.5V				0UA TO 50UA
IIL	5.5V	EACH INPUT TESTED AT VIN = 0.0V				-5UA TO 0UA
CC	5.5V	INPUTS (1R, 2R, 1A, 2A, 1B, 2B) AT 0.0V				40.0UA MAX
COMMENTS/EXCEPTIONS						
VIH AND VIL WERE CHECKED WITHIN THE FUNCTIONAL, VOH AND VOL TESTS.						
NO AC PARAMETERS WERE TESTED.						
FUNCTIONAL TEST #1 WAS PERFORMED AT IOH = -50.0UA AND IOL = 50.0UA.						
FUNCTIONAL TEST #2 WAS PERFORMED AT IOH = -4.8MA AND IOL = 4.8MA.						
* IOL, IOH, VOL, VOH FOR THE COMPLEMENTARY OUTPUT WERE TESTED DURING THE FUNCTIONAL TESTS.						
DUT PIN NUMBERS (1, 2, 14, 15) WERE NOT TESTED FOR IIL AND IIH.						
EXTERNAL COMPONENTS: RX = 10 KOHMS / CX = 0.1 UF (SOCKET ADAPTER "MV_1").						

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for HCS4538. Tests 1/, 2/, 3/.

Parameters	Spec. Limits min max	Initials mean sd		Total Dose Exposure (krads)				Annealing at 25°C				Total Dose Exposure (krads)					
				50		100		96 hrs.		168 hrs.		200		300			
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
Func1	.25kHz			8P		8P		8P					8P		8P		
Func2	2MHz			8P		8P		8P		8P		8P		8P		8P	
Func3	2MHz			8P		8P		8P		8P		8P		8P		8P	
IOL1Q	mA	4.8	25	10.4	0.1	10.6	0.1	10.7	0.1	10.7	0.1	10.7	0.1	10.9	0.1	10.9	0.1
IOL2Q	mA	4.8	25	10.4	0.1	10.6	0.1	10.8	0.1	10.8	0.1	10.7	0.1	11.0	0.1	11.0	0.1
IOH1Q	mA	-25	-4.8	-9.2	0.1	-9.0	0.1	-8.7	0.6	-8.9	0.1	-8.9	0.1	-8.8	0.1	-8.7	0.1
IOH2Q	mA	-25	-4.8	-9.1	0.1	-8.9	0.1	-8.6	0.5	-8.9	0.1	-8.9	0.1	-8.7	0.1	-8.6	1.0
VOH1Q	V	4.4	4.55	4.5		4.5		4.5		4.5		4.5		4.5		4.5	
VOH2Q	V	4.4	4.55	4.5		4.5		4.5		4.5		4.5		4.5		4.5	
VOL1Q	mV	0	100	0		0		0		0		0		0		0	
VOL2Q	mV	0	100	0		0		0		0		0		0		0	
IIN	nA	0	500	0		2.6	3.4	4.4	3.5	1.8	3.0	1.8	3.0	4.8	3.2	5.1	3.2
IIL	nA	-500	0	0		-5	7	-6	8	-5	6	-4.5	6.4	-5.3	7.4	-5.3	7.4
ICC	uA	0	40	0		16	7	25	11	16	7	6.0	7.7	21.9	10.4	21.4	12.1

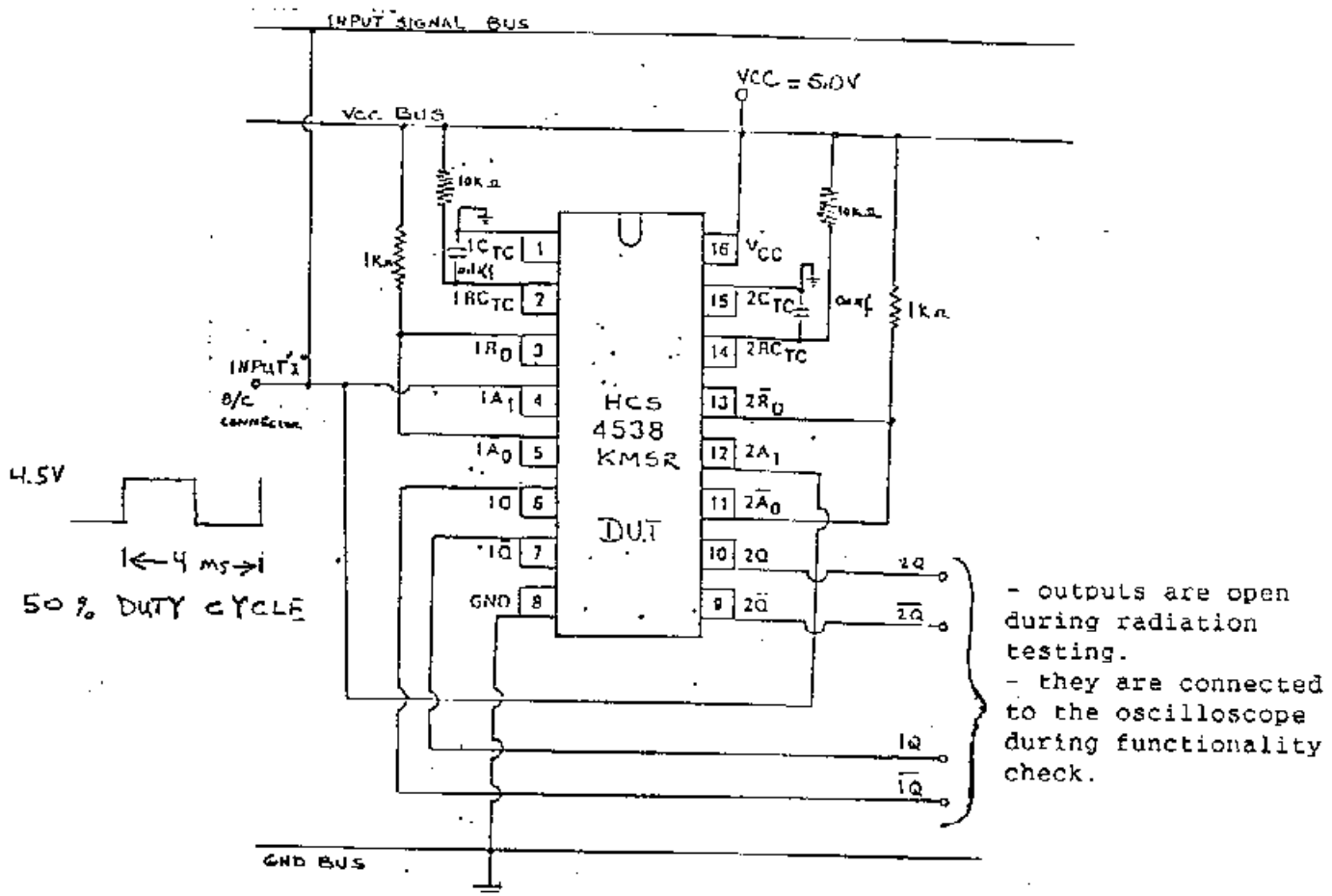
Notes:

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/ Functional 1 was performed at the radiation facility within 5 minutes of each total dose exposure, without removing the parts from the radiation bias circuit board. A bench setup was used to perform this test (see Figure 1 for more details on this setup). Immediately after the exposure, all parts failed this test; however, on retesting after 5-15 minutes, all parts passed this test on exposures up to 200 krads. After 300 krads, one part took about 1 hour before it passed the functional 1 test. However, the remaining 7 parts passed this test within 15 minutes of the 300 krads exposure.

3/ Functional Tests 2 and 3 were performed using the Automatic tester (S-50) within one hour of the total dose exposure. All parts passed these tests, on exposures up to 300 krads.

Figure 1. Radiation Bias Circuit and Bench Set-up for On-site Functional Testing of HCS4538KMSR.



Notes:

1. Use only ceramic capacitors in this set-up. All capacitors and resistors should be 1/4 W, ±10%.
2. During radiation exposures, connect Input "X" to GND. During on-site functional check at the radiation facility, disconnect Input "X" from GND and apply a square wave input (250 kHz @ 4.5V ±0.2V, 50% duty cycle). Monitor outputs with oscilloscope. Record failures.
3. This test must be performed immediately after radiation exposure - and without removal of DC bias.