Unisys

DATE: April 21, 1999 PPM-99-021
TO: T. O'Connor/Ball Aerospace
FROM: K. Sahu/S. Kniffin/300.1
SUBJECT: Radiation Report on **QT22AC10M (Q-Tech) (LDC 9842)**
PROJECT: Ball Aerospace (GOES)

cc: M. D'Ordine/Ball Aerospace, R. Reed/562, A. Sharma/562, OFA Library/300.1

A radiation evaluation was performed on **QT22AC10M 36MHz Crystal Oscillator (Q-Tech)** to determine the total dose tolerance of these parts. The total dose testing was performed using a Co^{60} gamma ray source. During the radiation testing, ten 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 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 40.0, 50.0, and 100.0kRads.[1] The dose rate was 0.030 kRads/hour (0.08 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 100.0kRad irradiation, the parts were annealed under bias at 25°C for 48, 96 and 168 hours and at 100°C for 48, 96, and 168 hours.[2] After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits[3] listed in Table III. An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step.

All parts passed all tests up to 100kRads. No significant changed was noted in any parameter after any annealing step. No rebound effects were noted.

Initial electrical measurements were made on 11 samples. Six samples (SN's 7103, 7103, 7105, 7106, 7107, 7109, 7115, 7116, 7117, and 7118) were used as radiation samples while SN 3853 was used as a control sample. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 100.0kRads.

After annealing the parts for 96 and 168 hours at 25°C, all parts showed no significant change in any parameter.

After annealing the parts for 96 and 168 hours at 100°C, all parts showed no rebound effects.

Table IV provides a summary of the test results with the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

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

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[1] The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.
[2] The temperature 25°C as used in this document implies room temperature.
[3] These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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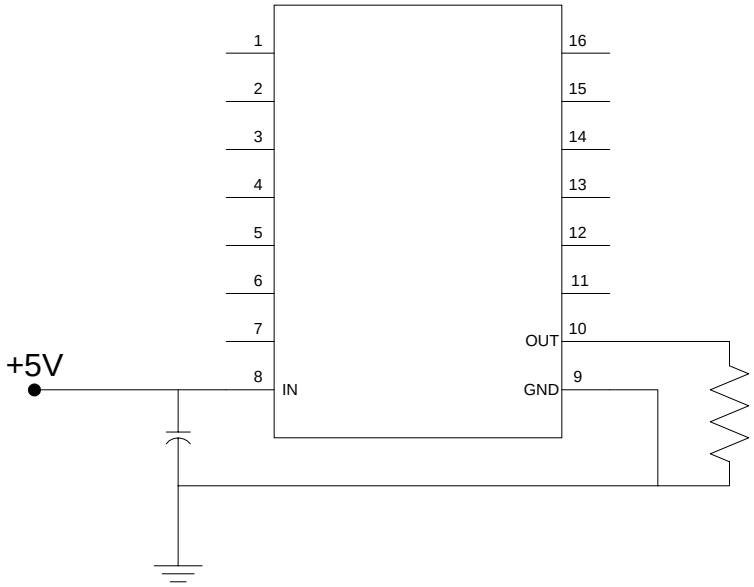
Figure 1. Radiation Bias Circuit for QT22AC10M



Notes:
1. R = 10kΩ ±5%, ¼W.
2. C = 0.1µF, 10%, 50V.

TABLE I. Part Information

Generic Part Number:	QT22AC10M
GOES Part Number	QT22AC10M
Charge Number:	D-0326-0013-0000-002-0
Manufacturer:	Q-Tech
Lot Date Code (LDC):	9842
Quantity Tested:	11
Serial Number of Control Samples:	3853
Serial Numbers of Radiation Samples:	7102, 7103, 7105, 7106, 7107, 7109, 7115, 7116, 7117, 7118
Part Function:	36MHz Crystal Oscillator
Part Technology:	Hybrid
Package Style:	16-Pin Metal Flatpack
Test Equipment:	A540
Test Engineer:	S. Archer-Davies

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for QT22AC10M

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	02/16/98
2) 5.0 KRAD IRRADIATION (0.294 KRADS/HOUR)	03/23/98
POST-5.0 KRAD ELECTRICAL MEASUREMENT	03/24/99
3) 10.0 KRAD IRRADIATION (0.294 KRADS/HOUR)	03/24/98
POST-10.0 KRAD ELECTRICAL MEASUREMENT	03/25/99
4) 15.0 KRAD IRRADIATION (0.294 KRADS/HOUR)	03/25/98
POST-15.0 KRAD ELECTRICAL MEASUREMENT	03/26/99
5) 20.0 KRAD IRRADIATION (0.121 KRADS/HOUR)	03/26/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT	03/29/99
6) 25.0 KRAD IRRADIATION (0.294 KRADS/HOUR)	03/29/98
POST-25.0 KRAD ELECTRICAL MEASUREMENT	03/30/99
7) 30.0 KRAD IRRADIATION (0.294 KRADS/HOUR)	03/30/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/31/99
8) 40.0 KRAD IRRADIATION (0.588 KRADS/HOUR)	03/31/98
POST-40.0 KRAD ELECTRICAL MEASUREMENT	04/01/99
9) 50.0 KRAD IRRADIATION (0.588 KRADS/HOUR)	04/01/98
POST-50.0 KRAD ELECTRICAL MEASUREMENT	04/02/99
10) 100.0 KRAD IRRADIATION (0.562 KRADS/HOUR)	04/02/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	04/06/99
11) 96 HOUR ANNEALING @25°C	04/06/99
POST-96 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/09/99
12) 168 HOUR ANNEALING @25°C	04/06/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/13/99
13) 96 HOUR ANNEALING @100°C	04/13/99
POST-96 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/16/99
14) 168 HOUR ANNEALING @100°C	04/13/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/20/99

Effective Dose Rate = 100,000 RADS/14 DAYS=297.6 RADS/HOUR=0.083 RADS/SEC

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

Table III. Electrical Characteristics of QT22AC10M /1

Test #	Parameter	Units	Spec. min	Lim. max	Test Conditions
1	Icc	mA		50	No Load, +5V DC
2	Frequency	MHz	35.964001	36.035999	+5V DC
3	Freq. Dev.	ppm		1000	
4	Duty_Cyc_%	%	40	60	+5V DC
5	Rise_time	ns		10	From 0.1Vcc to 0.9Vcc with a 15pF load.
6	Fall_time	ns		10	From 0.9Vcc to 0.1Vcc with a 15pF load.

Notes:

1/ These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for QT22AC10M /1

					Total Dose Exposure (kRads Si)																				Annealing				Annealing			
					Initial		5.0		10.0		15.0		20.0		25.0		30.0		40.0		50.0		100		96 hours @25°C		168 hours @25°C		96 hours @100°C		168 hours @100°C	
Test #	Parameters	Units	Spec. Lim. /2 min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Icc	mA		50	29	0.3	29	0.3	29	0.3	30	0.5	30	0.3	30	0.3	30	0.3	30	0.3	30	0.4	30	0.4	29	0.3	29	0.3	29	0.3	29	0.3
2	Frequency	MHz	5.96400	6.03599	6.0003	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0001	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002	6.0002	0.0002
3	Freq. Dev.	ppm		1000	7	4	6	4	7	4	7	4	5	3	7	5	7	5	5	5	4	4	6	3	7	5	7	5	6	4	7	4
4	Duty_Cyc_%	%	40	60	56	1	56	1	57	1	57	1	57	1	57	1	57	1	57	1	58	1	58	1	58	1	58	1	55	1	55	1
5	Rise_time	ns		10	2.5	0.1	2.8	0.9	3.3	1.2	3.7	1.3	2.5	0.2	2.6	0.4	2.8	0.8	2.8	0.9	2.5	0.1	2.9	0.9	2.5	0.1	2.5	0.1	2.5	0.1	2.5	0.1
6	Fall_time	ns		10	3.9	0.1	3.8	0.2	3.9	0.1	3.9	0.4	3.9	0.4	3.9	0.4	3.9	0.4	3.9	0.4	3.9	0.4	3.9	0.4	3.9	0.4	3.9	0.4	3.8	0.3	3.9	0.1

Notes:

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

2/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Radiation sensitive parameters: None.