

Memorandum

**PARAMAX**  
A Unisys Company

DATE: May 26, 1993  
TO: B. Fafaul/311  
FROM: K. Sahu/300.1 *KS*  
SUBJECT: Radiation Report on FAST/MU3  
Part No. 5962-8670404PA ((UC1845J/883)  
Control No. 7342

PPM-93-059

cc: R. Kolecki/740.4  
T. Miccolis/300.1  
A. Sharma/311  
Library/300.1  
E. Bentley/740.4  
SMEX, PPM File

A radiation evaluation was performed on UC1845J/883 (Pulse Width Modulator) 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 two parts were used as control samples. The total dose radiation levels were 5, 10, 20, 40 and 60 krads\*. After 60 krads, parts were annealed at 25°C for 168 hours. The irradiation was then continued to 100 krads (cumulative). The dose rate was between 0.24 and 1.82 krads/hour, depending on the total dose level (see Table II for radiation schedule). Finally the parts were annealed for 168 hours at 100°C. 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 ten parts passed initial (pre-rad) electrical tests. All eight irradiated parts passed all electrical tests at each irradiation and annealing level up to and including the 40-krad irradiation. After the 60-krad irradiation, one part (S/N 78) read marginally below the minimum specification limit of 4.95 V for  $V_{ref}$ , with a reading of 4.947 V. All other irradiated parts passed all tests at this radiation level.

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\*The term rads, as used in this document, means rads(silicon).  
All radiation levels cited are cumulative.

\*\*These are manufacturers' non-irradiated data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

After annealing for 168 hours at 25°C, all irradiated parts recovered to within specification limits. Upon continued irradiation to 100 krad (cumulative), four parts (S/N 72, 73, 78 and 79) marginally fell below the minimum specification limit of 4.95 V for  $V_{ref}$  with readings ranging from 4.938 to 4.948 V. In addition, one part (S/N 71 marginally read below the minimum specification limit of 7.80 V for  $V_{START}$ , with a reading of 7.77 V. All other irradiated parts passed all tests at this radiation level.

After a final annealing at 100°C, no rebound effects were observed. All irradiated parts passed all other functional and electrical tests throughout all irradiation and annealing steps. No significant sensitivity to radiation was observed in any other test parameter.

Table IV 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.

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TABLE I. Part Information

Generic Part Number:	UC1845J/883
Part Number:	5962-8670404PA*
FAST/MU3 Control Number:	7342
Charge Number:	C33178
Manufacturer:	Unitrode
Lot Date Code:	9252
Quantity Tested:	10
Serial Numbers of Radiation Samples:	71, 72, 73, 74, 75, 77, 78, 79
Serial Numbers of Control Samples:	70, 76
Part Function:	Current Mode Pulse Width Modulator
Part Technology:	CMOS
Package Style:	8-pin DIP
Test Equipment:	MARS_T
Test Engineer:	T. Scharer

\* No radiation tolerance/hardness was guaranteed by the manufacturer for this part.

TABLE II. Radiation Schedule for UC1845

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	04/26/93
2) 5 KRAD IRRADIATION (0.25 KRADS/HOUR) POST-5 KRAD ELECTRICAL MEASUREMENT	04/26/93 04/27/93
3) 10 KRAD IRRADIATION (0.24 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	04/27/93 04/27/93
4) 20 KRAD IRRADIATION (0.48 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT	04/28/93 04/29/93
5) 40 KRAD IRRADIATION (0.90 KRADS/HOUR) POST-40 KRAD ELECTRICAL MEASUREMENT	04/29/93 04/30/93
6) 60 KRAD IRRADIATION (0.30 KRADS/HOUR) POST-60 KRAD ELECTRICAL MEASUREMENT	04/30/93 05/03/93
7) 168 HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	05/03/93 05/10/93
8) 100 KRAD IRRADIATION (1.82 KRADS/HOUR) POST-100 KRAD ELECTRICAL MEASUREMENT	05/10/93 05/11/93
9) 168 HOUR ANNEALING @100°C* POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	05/12/93 05/19/93

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT 25°C.

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

\*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 UC1845

TEST	CONDITIONS	LIMIT		UNITS
		Min	Max	
$I_{START}$	$V_{CC}=7.8V$		1	mA
$I_{CC}$	$V_{CC}=15.0V$		17	mA
	REFERENCE SECTION:			
$V_{REF}$	$I_{OUT} = 1.0mA$	4.95	5.05	V
$V_{LINE}$	$12V < V_{CC} < 25V$		20	mV
$V_{LOAD}$	$1mA < I_{OUT} < 20mA$		25	mV
	ERROR AMP SECTION:			
$V_{IN}$	$V_{COMP} = 2.5V$	2.45	2.55	V
$A_{VOL}$	$2.0V < V_{COMP} < 4.0V$	65		dB
$PSRR$	$12V < V_{CC} < 25V, V_{COMP} = 2.5V$	60		dB
$I_{FB}$	$V_{COMP} = 2.5V, R_S = 100K OHM$	-1		uA
$I_{SINK}$	$V_{FB} = 2.7V, V_{COMP} = 1.1V$	2.0		mA
$I_{SOURCE}$	$V_{FB} = 2.3V, V_{COMP} = 5.0V$		-0.5	mA
$V_{OH}$	$I_{OUT} = -333.3uA$	5.0		V
$V_{OL}$	$I_{OUT} = 260uA$		1.1	V
	SENSE AMP SECTION:			
$GAIN$	$0.0V < V_{ISENSE} < 0.8V$ Note:1	2.85	3.15	V/V
$V_{SENSE}$	$V_{COMP} = 5.0V$ Note:2	0.9	1.1	V
$I_{SENSE}$	$V_{ISENSE} = 0.0V, R_S = 100K OHM$	-10		uA

Table III. Electrical Characteristics of UC1845 (cont.)

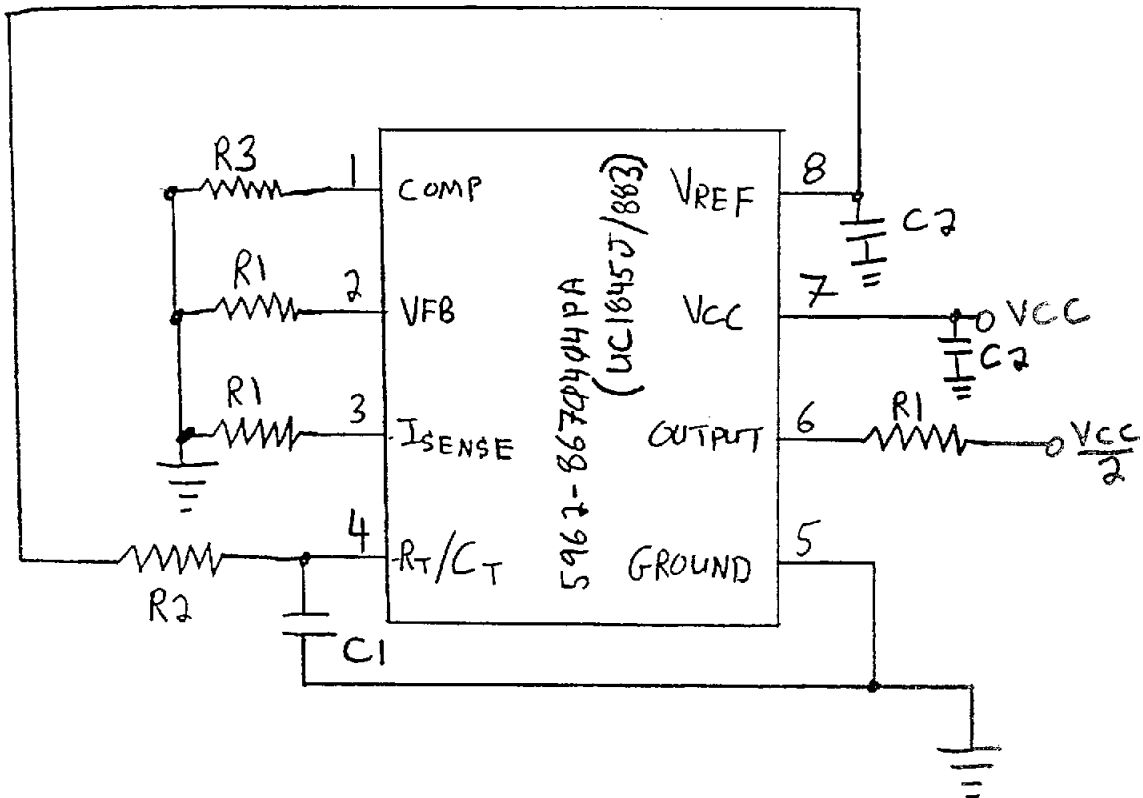
TEST	CONDITIONS	LIMIT		UNITS
		Min	Max	
	OUTPUT SECTION:			
V <sub>OL</sub>	I <sub>OUT</sub> = 20mA		0.4	V
V <sub>OL</sub>	I <sub>OUT</sub> = 200mA		2.2	V
V <sub>OH</sub>	I <sub>OUT</sub> = -20mA	13		V
V <sub>OH</sub>	I <sub>OUT</sub> = -200mA	12		V
	UNDER VOLTAGE LOCKOUT SECTION			
V <sub>TH</sub>		7.8	9.0	V
V <sub>MIN</sub>	AFTER TURN-ON	7.0	8.2	V
AC Electrical Characteristics				
	OUTPUT SECTION:			
DELAY <sub>td</sub>	VFB 0V, V <sub>ISENSE</sub> = 2V STEP		300	nS
T <sub>rise</sub>			150	nS
T <sub>fall</sub>			150	nS
	PWM SECTION:			
Freq	Oscillator Accuracy	47	57	KHz
DutyCyc	Maximum Duty Cycle	46	50	%
DutyCyc	Minimum Duty Cycle		0	%

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for UC1845 1/

Parameters	Spec. Lim./2	min	max	Total Dose Exposure (TDE) (krads)												TDE		Anneal			
				Initial		5		10		20		40		60		100		168 hrs @25°C		168 hrs @100°C	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
I_START	mA	-	1	9.47	0	0.46	0	0.47	0	0.46	0	0.45	0.01	0.44	0.01	0.44	0.01	0.44	0.01	0.44	0.01
ICC	mA	-	17	13.4	1.8	13.2	2.0	13.2	1.9	13.1	2.0	13.0	2.0	12.8	2.1	12.9	2.1	12.7	2.2	12.9	2.0
V_REF	V	4.95	5.05	5.01	0.02	5.00	0.02	5.00	0.02	4.98	0.01	4.98	0.01	4.96	0.01	4.97	0.01	4.95	0.01	4.97	0.02
V_LINE	mV	0	20	1.27	0.01	1.27	0.03	1.25	0.01	1.29	0.04	1.27	0.02	1.25	0.01	1.25	0.01	1.28	0.03	1.27	0.04
V_LOAD	mV	0	25	0.09	0.04	0.04	0.03	0.07	0.05	0.07	0.03	0.06	0.04	0.06	0.02	0.06	0.04	0.07	0.03	0.06	0.03
V_IN	V	2.45	2.55	2.52	0.01	2.51	0.01	2.51	0.01	2.51	0.01	2.50	0.01	2.49	0.01	2.50	0.01	2.49	0.01	2.50	0.01
A_VOL	dB	55	-	90.1	3.4	91.8	7.2	89.2	6.7	92.3	6.7	90.2	3.4	93.4	7.9	92.2	3.9	97.8	7.7	86.2	4.3
FRR	dB	60	-	90.0	0.78	90.5	1.1	90.4	0.91	90.3	0.72	90.4	0.92	90.7	0.79	90.8	1.0	90.6	0.68	89.8	0.59
I_FB	uA	-1	-	-0.2	0.02	-0.2	0.02	-0.2	0.02	-0.2	0.02	-0.2	0.02	-0.2	0.02	-0.2	0.02	-0.3	0.02	-0.2	0.02
I_SINK	mA	2.0	-	7.11	0	7.17	0.21	7.03	0.19	7.05	0.19	6.95	0.20	6.96	0.20	6.94	0.20	6.88	0.19	6.93	0.20
I_SOURCE	mA	-	-0.5	-0.9	0.03	-0.9	0.03	-0.9	0.03	-0.9	0.03	-0.9	0.04	-0.9	0.04	-0.9	0.03	-0.9	0.04	-0.9	0.03
V_OH	V	5.0	-	5.69	0.02	5.68	0.02	5.68	0.02	5.67	0.01	5.66	0.01	5.65	0.01	5.65	0.01	5.64	0.01	5.66	0.02
V_OL	V	-	1.1	0.84	0	0.83	0	0.84	0	0.84	0	0.84	0	0.84	0	0.84	0	0.84	0	0.84	0
SENSE_GAIN	V/V	2.95	3.15	3.03	0	3.02	0.01	3.02	0.01	3.02	0.01	3.02	0.01	3.02	0.01	3.03	0.01	3.02	0.02	3.02	0.01
V_SENSE	V	0.9	1.1	0.99	0	0.99	0.01	0.99	0.01	0.99	0.01	0.99	0.01	0.99	0.01	0.99	0.01	0.98	0.01	0.99	0.01
I_SENSE	uA	-10	-	-10	0.09	-10	0.09	-10	0.08	-10	0.10	-10	0.10	-10	0.07	-10	0.09	-10	0.07	-10	0.01
VOL_20mA	V	-	0.4	0.09	0	0.09	0	0.09	0	0.10	0	0.10	0	0.10	0	0.10	0	0.10	0	0.10	0
VOL_200mA	V	-	2.2	1.77	0.01	1.77	0.02	1.79	0.01	1.79	0.03	1.79	0.02	1.80	0.02	1.82	0.03	1.80	0.01	1.81	0.08
VOH_20mA	V	13	-	13.5	0	13.5	0	13.5	0.01	13.5	0.03	13.5	0	13.5	0.01	13.5	0.01	13.5	0.01	13.5	0.01
VOH_200mA	V	12	-	13.0	0.01	13.1	0.02	13.0	0.02	13.1	0.17	13.1	0.03	13.1	0.08	12.9	0.14	13.0	0.05	12.9	0.09
V_TH	V	7.5	9.0	8.43	0.08	8.37	0.11	8.33	0.10	8.28	0.10	8.19	0.10	8.06	0.11	8.07	0.11	7.93	0.11	8.08	0.1
V_MIN	V	7.0	8.2	7.68	0.07	7.64	0.09	7.61	0.09	7.58	0.09	7.53	0.09	7.45	0.09	7.46	0.09	7.37	0.09	7.47	0.09
Delay_td	nS	-	300	222	64	214	57	209	53	202	53	187	51	175	53	180	54	164	54	188	51
RISE_TIME	nS	-	150	33.3	2.1	33.4	1.7	33.8	1.8	35.0	2.5	34.7	2.1	35.1	1.7	35.5	2.3	35.7	2.2	35.7	2.3
FALL_TIME	nS	-	150	32.7	1.1	32.7	0.9	33.0	0.95	33.6	0.97	34.2	1.0	34.4	1.0	34.4	1.1	35.0	1.1	33.7	1.2
OSC_FREQ	KHZ	47	57	54.6	0.54	54.5	0.48	54.7	0.48	54.9	0.48	55.2	0.47	55.4	0.47	55.4	0.46	55.8	0.46	55.2	0.49
MAX-DUTY	%	45	50	48	0.08	48	0.09	48	0.08	48	0.09	48	0.08	48	0.1	48	0.1	48	0.1	48	0.09
MIN-DUTY	%	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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/ These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.  
**Radiation-sensitive parameters were V\_REF and V\_START.**

Figure 1. Radiation Bias Circuit for UC1845



- 1)  $V_{CC} = +15.0 \text{ VDC} \pm 5\%$
- 2)  $R_1 = 1\text{K Ohms} \pm 10\%$ , 1/2 W minimum  
 $R_2 = 10\text{K Ohms} \pm 10\%$ , 1/2 W minimum  
 $R_3 = 100\text{K Ohms} \pm 10\%$ , 1/2 W minimum  
 $C_1 = 0.022 \text{ uF} \pm 10\%$ , 50V minimum