Total Ionizing Dose (TID) Radiation Testing of the Microsemi LX7730 Telemetry Controller (100krad(Si) exposure)

Test information

Location: Defense Microelectronics Activity (DMEA) Science and Engineering Gamma Irradiation Test Facility in McClellan, California
Radiation Source: Co-60
Date: 11th August 2016
Lot #: Die1: T71899 - Die2: E27915
Date Code: 1612
Quantity tested: 4; Serial Numbers: 021, 070, 149, 276
Test Method: MIL-STD-883J, Test Method 1019.9, Condition A (Dose rate 50rad(Si)/s)
Irradiation Temperature: Room
Irradiation Bias (VCC/VDD): Static at 3.3 V/15 V
Annealing: Room temperature for 168 hours
Pre and Post Test facility: Microsemi AMS - San Jose

Summary

The LX7730 performance after 100krad(Si) exposure is overall very stable and comparable to pre-radiation.
A few shifts that could push some parameters outside the pre-radiation specification were observed:

- ADC_IN input
  - ADC_IN leakage increased by up to 150nA
- Programmable current source
  - Full scale decreases by about 5%
- Instrumentation amplifier
  - At nominal VCC, offset variation of up to 7mV at gain=0.4 and 3mV at gain=2 and 10 were observed
  - At max VCC, offset variation of up to 14mV at gain=0.4 and 3mV at gain=2 and 10 were observed
  - At min VCC, offset variation of up to 7mV at gain=0.4 and 9mV at gain=2 and 10 were observed
- Adjustable threshold Bi-level MUX and DAC
  - The threshold might shift by up to 50mV and the hysteresis is halved when the comparator input is biased between 0 and 5V
  - The threshold might shift by up to 10% and the hysteresis is halved when the comparator input is biased at a negative voltage
- Fixed Threshold Bi-Level Inputs
  - The threshold might shift by up to 50mV and the hysteresis is reduced by 20%
  - The propagation delays increase by up to 80%

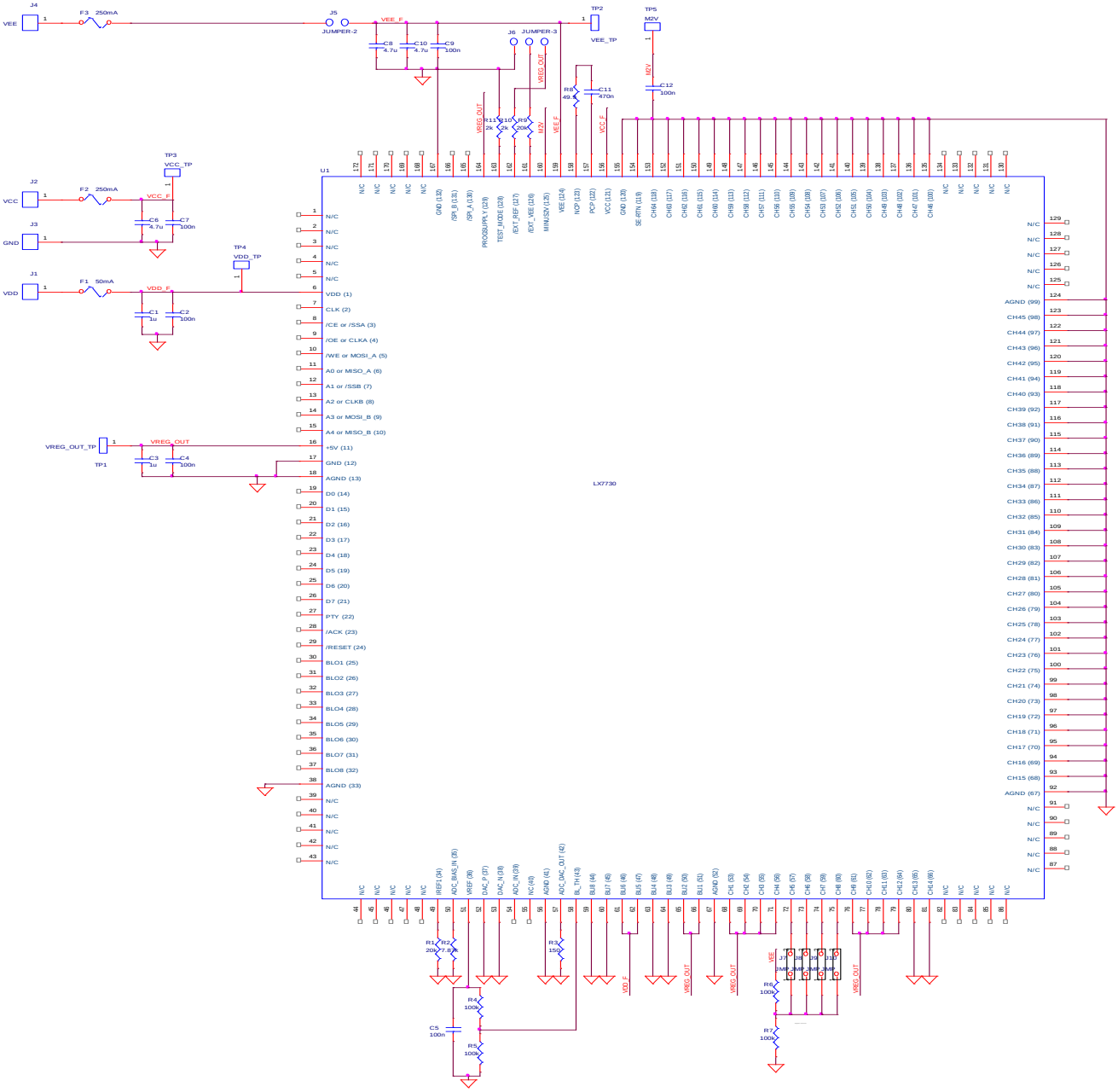
Conclusions

The test results indicate that after 100kRad exposure, the performance of the LX7730 is consistent with the pre-radiation results.

The few observed performance degradations can be mitigated at the system level as follows:

- Programmable current source full scale shift
  - Providing a method to calibrate the variation in programmable current using a precision current sense resistor on a dedicated calibration channel
- Instrumentation amplifier offset shift
  - The offset voltage can be assessed using a 100mV reference from a VREF voltage divider on a dedicated channel.
- Adjustable threshold Bi-level MUX and DAC shift
  - The threshold shift can be minimized by ensuring the comparator input is not biased with a negative voltage.

Bias circuit



Detailed Data

The pre-radiation specifications apply over the operating ambient temperature of -55C ≤ T_A ≤ 125C except where otherwise noted with the following test conditions: VCC = 15V, VDD = 3.3V; R_{IREF} = 20kΩ; $R_{ADC\_BIAS\_IN}$ = 7.87kΩ; $R_{ADC\_DAC\_OUT}$ = 158Ω; / EXT_VEE open, /EXT_REF open. CH1 and CH2 selected and CH2 grounded. CLK = 500kHz. Reg 7 =001010xx. Typical parameter refers to T_J = 25°C. Positive currents flow into the pin.

Pre and Post Irradiation measurements taken at 25C.

	Pre Radiation Specification				SN 021		SN 070		SN 149		SN276		
Parameters	**Min**	**Typ**	**Max**	**Units**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Comment**
Operating Current													
VCC Normal Current	38	73	84	mA	66.189	63.97	65.226	62.082	64.537	62.63	65.83	62.658	Slight decrease
VCC Standby Current	2.0	4.0	7.0	mA	4.229	4.097	3.956	3.814	4.069	3.984	4.041	4.248	Slight decrease
VEE Current	-6.0	-5.0	-2.5	mA	-5.107	-4.343	-4.843	-4.012	-4.692	-3.927	-4.938	-4.031	Slight decrease
Under Voltage Detection													
VCC UVLO	9.5	10	10.5	V	9.965	9.975	9.975	9.98	9.955	9.965	9.965	9.975	Very stable
VCC UVLO Hyst	150	200	400	mV	0.205	0.200	0.195	0.195	0.185	0.190	0.205	0.200	Very stable
VEE UVLO	-7.5	-8.00	-8.20	V	-8	-8.045	-8.005	-8.04	-8.01	-8.055	-8	-8.045	Very stable
VEE UVLO Hyst	150	200	400	mV	0.200	0.195	0.205	0.200	0.190	0.190	0.200	0.195	Very stable
+5V UVLO	3.9	4.15	4.40	V	4.15	4.155	4.16	4.165	4.125	4.13	4.15	4.155	Very stable
+5V UVLO Hyst	0	200	400	mV	0.195	0.200	0.195	0.200	0.195	0.195	0.195	0.200	Very stable
Internally Regulated Voltages and Currents													
VCC to VEE voltage drop	1.5	2.5	3.0	V	2.683	2.434	2.623	2.384	2.597	2.369	2.683	2.434	Slight decrease
+5V voltage	4.75	5.00	5.25	V	5.053	5.055	5.052	5.046	4.992	4.994	5.053	5.055	Very stable
VREF voltage	4.95	5.00	5.05	V	5.003	5.009	5.000	4.998	5.003	5.004	5.003	5.009	Very stable
IREF pin voltage	1.568	1.60	1.632	V	1.608	1.609	1.599	1.599	1.591	1.591	1.608	1.609	Very stable
Analog MUX													
Differential Range	0		5	V	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	
Common Mode Range	-5		5	V	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	
Voltage Clamp power applied	15	16	17	V	15.993	16.006	15.987	16.002	15.998	16.023	15.991	15.996	Very stable
	-23	-17	-15	V	-20.585	-20.694	-20.78	-20.925	-20.594	-20.647	-20.605	-20.739	Very stable
Voltage Clamp (VCC=VEE=0)	15	20	23	V	20.47	20.579	20.679	20.809	20.474	20.592	20.438	20.556	Very stable
	-23	-20	-15	V	-20.547	-20.666	-20.459	-20.624	-20.571	-20.688	-20.639	-20.782	Very stable
Settling Time			10	us	2.42	3.69	2.11	3.59	2.25	3.58	2.49	4.17	50% increase
Bias Current	-200	0	200	nA	-1.74	-1.62	-1.86	-0.96	-1.87	-2.02	-1.72	-0.66	Very stable
Leakage Current	-200	0	200	nA	-0.01	1.10	0.43	0.07	-0.12	1.02	0.23	0.16	Very stable
Programmable Current Source													
Full scale current	1.880	1.940	2.000	mA	1.927	1.833	1.932	1.839	1.904	1.816	1.929	1.848	~4-5% Decrease
Integral nonlinearity	-7.5	0	7.5	µA	2.93	2.04	2.24	0.70	3.56	2.29	2.63	2.04	Stable
Differential nonlinearity	-5.0	0	5.0	µA	3.07	1.17	2.60	0.78	3.12	1.43	3.02	1.60	Stable
Full scale current	3710	3840	3950	µA	3.797	3.638	3.807	3.646	3.748	3.599	3.802	3.660	~4-5% Decrease
Integral nonlinearity	-15		15	µA	8.09	3.78	7.55	4.86	9.98	10.79	7.82	6.61	Stable
Differential nonlinearity	-15		15	µA	8.65	4.48	8.65	6.70	10.15	9.07	9.21	7.16	Stable
At DAC=31	290	300	310	uA	296.5	276.3	298.8	279.6	299.8	280.3	297.1	281.1	~5-6% Decrease

	Pre Radiation Specification				SN 021		SN 070		SN 149		SN276		
Parameters	**Min**	**Typ**	**Max**	**Units**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Comment**
Integral nonlinearity	-2.0		2.0	uA	0.219	0.606	0.746	0.713	0.241	0.545	0.329	0.475	Stable
Differential nonlinearity	-2.0		2.0	uA	0.498	1.297	0.473	1.088	0.676	1.194	0.721	0.572	Stable
Instrumentation Amplifier													
Offset Voltage, Gain = 0.4	-2		25	mV	1.784	5.367	14.487	21.078	13.873	16.331	12.260	19.593	Up to 7mV increase
Offset Voltage, Gain = 2	-3		3	mV	-0.454	0.092	0.107	0.934	0.281	-2.022	-0.438	2.676	Up to 3mV change
Offset Voltage, Gain = 10	-3		3	mV	0.439	1.158	-2.162	-2.040	-1.047	-3.536	-1.122	1.367	Up to 3mV change
Gain Accuracy, Gain = 0.4	0.398	0.400	0.402	-	0.4005	0.4003	0.4004	0.4001	0.4000	0.3998	0.4002	0.3999	Very stable
Gain Accuracy, Gain = 2	1.992	2.000	2.004	-	1.998	1.998	1.998	1.997	1.998	1.997	1.998	1.997	Very stable
Gain Accuracy, Gain = 10	9.965	9.995	10.025	-	9.996	9.993	9.998	9.989	9.996	9.997	9.998	9.998	Very stable
400Hz 1st Pole Frequency	360	600	1000	Hz	586.089	582.183	566.558	563.281	594.531	590.625	586.089	582.183	Very stable
2kHz 1st Pole Frequency	1.4	2.8	3.8	kHz	2.164	2.180	2.102	2.109	2.195	2.211	2.164	2.180	Very stable
10kHz 1st Pole Frequency	8.8	13.5	18.2	kHz	10.500	10.617	10.461	10.539	10.539	10.656	10.539	10.656	Very stable
400Hz 2nd Pole Frequency	360	600	1000	Hz	590.625	586.089	570.464	566.558	597.808	597.808	590.625	586.089	Very stable
2kHz 2^{nd} Pole Frequency	1.4	2.8	3.8	kHz	2.227	2.242	2.156	2.172	2.250	2.266	2.234	2.250	Very stable
10kHz 2^{nd} Pole Frequency	8.8	13.5	18.2	kHz	10.812	10.891	10.695	10.773	10.773	10.891	10.773	10.891	Very stable
Output Step Rise Time, G=0.4	120	210	333	us	215.02	250.00	201.65	233.67	217.86	249.05	210.64	245.45	~15-17% Increase
Output Step Rise Time, G=2	31	52	87	us	52.63	57.50	52.42	56.60	52.91	57.07	52.39	56.59	~8-10% Increase
Output Step Rise Time, G=10	31	52	87	us	53.42	58.35	53.25	58.01	54.44	58.86	52.78	57.02	~8-10% Increase
Analog-to-Digital Converter (input at ADC_IN)													
Linear Range	0		2.0	V	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	
Full scale error	-2.5	0	2.5	%	-0.06	-0.07	-0.17	-0.15	-0.04	-0.01	-0.12	-0.06	Very stable
Offset Error	-10		10	mV	1.82	0.94	-0.23	-0.32	1.36	1.48	0.52	1.32	Very stable
Integral nonlinearity	-6		6	LSB	3.027	2.685	3.348	3.094	2.808	2.719	4.107	4.425	Very stable
Differential nonlinearity	-1		3	LSB	1.833	1.469	1.609	1.634	2.277	2.171	1.719	1.687	Very stable
Leakage current	-0.2	0	0.2	uA	0.113	0.047	0.057	0.198	0.047	0.160	0.066	0.057	Up to 150nA increase
Adjustable threshold Bi-level MUX and DAC													
Threshold DAC Max Output (If input is >=0V during TID)	4.95	5	5.05	V	4.988	5.03	4.999	5.048	4.985	5.02	4.967	5.002	Up to 50mV increase
Hysteresis DAC Max Output (If input is >=0V during TID)	**0.075**	**0.112**	**0.150**	V	0.102	0.065	0.095	0.044	0.098	0.062	0.109	0.048	~50% decrease
Threshold DAC Max Output (If input is VEE/2 during TID)	4.95	5	5.05	V	4.985	4.468	4.981	4.499	4.988	4.464	4.971	4.51	~10% decrease
Hysteresis DAC Max Output (If input is VEE/2 during TID)	**0.075**	**0.112**	**0.150**	V	0.102	0.062	0.091	0.044	0.098	0.065	0.113	0.044	~50% decrease
10 Bit Current DAC													
Full Scale	-2.06	-2.00	-1.94	mA	-1.986	-1.984	-2.000	-2.000	-1.996	-2.000	-2.004	-2.003	Very stable
Integral nonlinearity	-5		5	LSB	-1.94	-2.49	-0.75	-1.34	-2.47	-2.98	-0.53	-0.47	Very stable
					1.16	1.23	0.41	0.61	1.15	1.31	0.85	0.65	Very stable
Differential nonlinearity	-0.5		0.5	LSB	-0.31	-0.33	-0.33	-0.34	-0.32	-0.33	-0.33	-0.33	Very stable
					0.08	0.06	0.08	0.07	0.08	0.07	0.08	0.08	Very stable
DAC Settling Time			1	us	0.615	0.615	0.601	0.612	0.607	0.604	0.602	0.612	Very stable
Fixed Threshold Bi-Level Inputs													

	Pre Radiation Specification				SN 021		SN 070		SN 149		SN276		
Parameters	**Min**	**Typ**	**Max**	**Units**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Comment**
Threshold – Internal ref (Rising Voltage)	2.45	2.50	2.55	V	2.504	2.538	2.526	2.554	2.509	2.542	2.496	2.52	Slight increase
Threshold Hysteresis – Internal reference	60	120	180	mV	110	92	115	101	110	96	122	100	~20% decrease
Threshold – External 2.5V (Rising Voltage)	2.45	2.50	2.55	V	2.51	2.54	2.53	2.555	2.515	2.55	2.505	2.525	Slight increase
Threshold Hysteresis – External 2.5V	60	120	180	mV	115	95	120	100	110	100	125	100	~20% decrease
Voltage Clamp (power applied) – 1mA into the pin	15	20	23	V	20.438	20.545	20.434	20.605	20.387	20.44	20.46	20.575	Very stable
Voltage Clamp (power applied) – 1mA out of the pin	-23	-20	-15	V	-20.545	-20.639	-20.438	-20.528	-20.404	-20.449	-20.545	-20.647	Very stable
Voltage Clamp (power remove) – 1mA into the pin	15	20	23	V	20.364	20.453	20.321	20.494	20.287	20.398	20.363	20.524	Very stable
Voltage Clamp (power removed) – 1mA out of the pin	-23	-20	-15	V	-20.447	-20.545	-20.336	-20.451	-20.306	-20.423	-20.442	-20.564	Very stable
Bias Current at 5V	-0.2	0	1.5	uA	0.133	0.148	0.16	0.159	0.215	0.234	0.105	0.103	Very stable
Bias Current at 0V	-0.2	0	1.5	uA	0	0	0	0	0	0	0	0	Very stable
Leakage Current at 5V (power off)	-0.2	0	1.5	uA	0.187	0.194	0.241	0.255	0.123	0.126	0.169	0.171	Very stable
Leakage Current at 0V (power off)	-0.2	0	1.5	uA	0	0	0	0	0	0	0	0	Very stable
Propagation Delay - High to Low transition	0.3	0.8	1.3	us	0.817	1.330	0.726	1.300	0.805	1.350	0.853	1.550	~60-80% increase
Propagation Delay - Low to High transition	0.8	2.1	3.4	us	2.40	3.19	2.68	3.90	2.41	3.21	2.32	3.36	~30-50% increase
Threshold Pin Leakage at 5V	-0.2	0	2.0	uA	0.449	0.424	0.351	0.336	0.343	0.327	0.390	0.380	Very stable
Threshold Pin Leakage at 0V	-0.2	0	2.0	uA	0.02	-0.01	0.01	-0.01	0.01	-0.01	0.02	0.00	Very stable
Logic Levels for FPGA Interface I/Os													
Input Logic Threshold at 3.3V	1.155	1.65	2.145	V	1.7	1.66	1.7	1.67	1.72	1.67	1.7	1.68	Very stable
Program pins Threshold	2.0	2.5	3.0	V	2.55	2.51	2.56	2.54	2.55	2.51	2.56	2.53	Very stable
Logic Output VOH at 100uA at 3.3V	3.0		3.3	V	3.171	3.172	3.171	3.173	3.172	3.174	3.17	3.172	Very stable
Logic Output VOL at 100uA at 3.3V	0		0.3	V	0.105	0.105	0.105	0.107	0.103	0.105	0.105	0.107	Very stable
IIH SPI_A, SPI_B (3.3V)	-2	0	2	uA	0.02	0.03	0.00	0.01	0.01	0.01	0.02	0.02	Very stable
IIL SPI_A, SPI_B (0V)	-10	-4	-1.5	uA	-4.32	-4.05	-4.04	-3.81	-4.22	-3.91	-4.29	-4.03	Stable
IIH Pins 2,6,8-10,14-21, 22: I/O as input (3.3V)	1.5	4	10	uA	4.40	4.33	4.16	4.05	4.28	4.13	4.38	4.29	Very stable
IIL Pins 2,6,8-10,14-21, 22: I/O as input (0V)	-2	0	2	uA	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	Very stable
IIH Pins 3-5, 7 I/O as input (3.3V)	-2	0	2	uA	0.03	-0.01	0.03	-0.01	0.03	-0.01	0.03	-0.01	Very stable
IIL Pins 3-5, 7: I/O as input (0V)	-10	-4	-1.5	uA	-4.28	-4.28	-4.01	-3.99	-4.16	-4.09	-4.23	-4.25	Very stable
IIH /EXT_VREF or /EXT_VEE = 5V	-2	0	2	uA	-0.01	0.02	0.03	0.05	0.06	0.06	0.02	0.03	Very stable

	Pre Radiation Specification				SN 021		SN 070		SN 149		SN276		
Parameters	**Min**	**Typ**	**Max**	**Units**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Pre**	**Post 100k**	**Comment**
IIL /EXT_VREF or /EXT_VEE = 0V	-12	-6	-1.5	uA	-6.60	-6.52	-6.23	-6.19	-6.35	-6.24	-6.54	-6.49	Very stable
IIH /RESET (5V)	-1.5	4	10	uA	4.73	4.24	4.49	3.99	4.67	4.08	4.74	4.24	Very stable
IIL /RESET (0V)	-150	-66	-33	uA	-81.3	-80.9	-77.5	-78.1	-77.6	-76.5	-80.0	-80.0	Very stable

Parameters tested but not specified

	Pre Radiation Test Limits				SN 021		SN 070		SN 149		SN276		
Parameters	**Min**	**Typ**	**Max**	**Units**	**Pre**	**100kR Post**	**Pre**	**100kR Post**	**Pre**	**100kR Post**	**Pre**	**100kR Post**	**Comment**
Instrumentation Amplifier													
Offset Voltage, Gain = 0.4 16V/3.3V	-2		32	mV	1.609	11.515	14.641	26.774	14.085	17.323	12.953	26.614	Up to 14mV increase
Offset Voltage, Gain = 0.4 12V/3.3V	-2		32	mV	1.453	4.243	14.221	19.439	13.492	15.450	11.867	18.488	Up to 7mV increase
Offset Voltage, Gain = 2 16V/3.3V	-3		4.5	mV	-0.558	-1.038	-0.207	-0.758	0.177	-3.154	-0.830	1.333	Up to 3mV change
Offset Voltage, Gain = 2 12V/3.3V	-3		4.5	mV	-0.014	6.240	0.170	6.291	0.735	-1.630	0.651	9.740	Up to 9mV change
Offset Voltage, Gain = 10 16V/3.3V	-3		3	mV	0.363	0.596	-2.176	-2.953	-1.107	-4.024	-1.292	0.674	Up to 3mV change
Offset Voltage, Gain = 10 12V/3.3V	-3		3	mV	0.368	4.957	-2.199	1.095	-1.063	-3.563	-0.635	6.613	Up to 7mV change
Gain Accuracy, Gain = 0.4 15V/3.3V at CM=5V	0.398		0.402	-	0.3999	0.3995	0.3997	0.3993	0.3994	0.3990	0.3995	0.3990	Very stable
Gain Accuracy, Gain = 0.4 15V/3.3V at CM=-5V	0.398		0.402	-	0.3997	0.3992	0.3996	0.3991	0.3992	0.3987	0.3993	0.3988	Very stable
Gain Accuracy, Gain = 0.4 12V/3.3V at CM=0V	0.398		0.402	-	0.4011	0.4010	0.4010	0.4008	0.4006	0.4004	0.4006	0.4005	Very stable
Gain Accuracy, Gain = 0.4 16V/3.3V at CM=5V	0.398		0.402	-	0.3998	0.3994	0.3997	0.3992	0.3993	0.3989	0.3994	0.3990	Very stable
Gain Accuracy, Gain = 0.4 16V/3.3V at CM=0V	0.398		0.402	-	0.4005	0.4002	0.4003	0.4001	0.4000	0.3997	0.4001	0.3998	Very stable
Gain Accuracy, Gain = 0.4 16V/3.3V at CM=-5V	0.398		0.402	-	0.3996	0.3992	0.3995	0.3990	0.3992	0.3987	0.3993	0.3987	Very stable
Gain Accuracy, Gain = 2 15V/3.3V at CM=5V	1.992		2.004	-	1.997	1.996	1.997	1.996	1.997	1.996	1.997	1.995	Very stable
Gain Accuracy, Gain = 2 15V/3.3V at CM=-5V	1.992		2.004	-	1.997	1.996	1.997	1.995	1.997	1.996	1.997	1.995	Very stable
Gain Accuracy, Gain = 2 12V/3.3V at CM=-5V	1.992		2.004	-	1.997	1.996	1.997	1.996	1.997	1.996	1.997	1.995	Very stable
Gain Accuracy, Gain = 2 12V/3.3V at CM=0V	1.992		2.004	-	1.999	1.998	1.998	1.997	1.998	1.997	1.998	1.997	Very stable
Gain Accuracy, Gain = 2 12V/3.3V at CM=5V	1.992		2.004	-	1.997	1.996	1.997	1.996	1.997	1.996	1.997	1.995	Very stable
Gain Accuracy, Gain = 2 16V/3.3V at CM=5V	1.992		2.004	-	1.997	1.996	1.997	1.996	1.997	1.996	1.997	1.996	Very stable
Gain Accuracy, Gain = 2 16V/3.3V at CM=0V	1.992		2.004	-	1.998	1.997	1.998	1.997	1.998	1.997	1.998	1.997	Very stable

	Pre Radiation Test Limits				SN 021		SN 070		SN 149		SN276		
Parameters	**Min**	**Typ**	**Max**	**Units**	**Pre**	**100kR Post**	**Pre**	**100kR Post**	**Pre**	**100kR Post**	**Pre**	**100kR Post**	**Comment**
Gain Accuracy, Gain = 2 16V/3.3V at CM=-5V	1.992		2.004	-	1.997	1.996	1.997	1.995	1.997	1.995	1.997	1.995	Very stable
Gain Accuracy, Gain = 10 15V/3.3V at CM=5V	9.965		10.025	-	9.989	9.984	9.989	9.984	9.989	9.993	9.991	9.993	Very stable
Gain Accuracy, Gain = 10 15V/3.3V at CM=-5V	9.965		10.025	-	9.991	9.986	9.991	9.985	9.990	9.987	9.992	9.990	Very stable
Gain Accuracy, Gain = 10 12V/3.3V at CM=-5V	9.965		10.025	-	9.988	9.982	9.990	9.985	9.988	10.002	9.990	9.989	Very stable
Gain Accuracy, Gain = 10 12V/3.3V at CM=0V	9.965		10.025	-	9.995	9.996	9.999	9.997	9.997	10.003	9.999	10.002	Very stable
Gain Accuracy, Gain = 10 12V/3.3V at CM=5V	9.965		10.025	-	9.990	9.985	9.993	9.985	9.989	9.992	9.993	9.992	Very stable
Gain Accuracy, Gain = 10 16V/3.3V at CM=5V	9.965		10.025	-	9.987	9.985	9.991	9.983	9.990	9.990	9.992	9.991	Very stable
Gain Accuracy, Gain = 10 16V/3.3V at CM=0V	9.965		10.025	-	9.997	9.992	9.996	9.994	9.997	9.996	9.998	9.998	Very stable
Gain Accuracy, Gain = 10 16V/3.3V at CM=-5V	9.965		10.025	-	9.991	9.983	9.992	9.985	9.990	9.986	9.992	9.991	Very stable