REVISION RECORD

REV	DESCRIPTION	DATE
0	INITIAL RELEASE	01/05/05
A	• PAGE 3, CHANGED INITIAL RATE OF RADS TO 240 RADS/SEC	03/15/05
B	• PAGE 4, CHANGED IN BOTH PARAGRAPHS 4.2, 4.3 IN CONJUNCTION TO 3.3 CHANGED TO 3.4 AND PARAGRAPH 4.3 CHANGED 3.1.1 TO 3.1 AND 3.2.1 TO 3.1.1	01/09/08
C	• PAGE 3, PARAGRAPH 3.11.1 CHANGED VERBIAGE.	05/05/08
D	• PAGE 10, TABLE II: CHANGED VOS 50K RAD(Si), MAX FROM 2.5 mV TO 4 mV; CHANGED VOS 100K RAD (Si), MAX FROM 3 mV TO 4 mV. • PAGE 12, TABLE IV: CHANGED VOS 50K RAD (Si), MAX FROM 3nA TO 4.5 nA; CHANGED VOS 100K RAD (Si), CHANGED MAX FROM 3.5 nA TO 4.5 nA; CHANGED CMRR 50K RAD (Si) MIN FROM 69dB TO 60 dB; CHANGED CMRR 100K RAD (Si) MIN FROM 66 dB TO 60 dB; CHANGED CMRR 200K RAD (Si) MIN FROM 63 dB TO 60 dB; CHANGED PSRR 50K RAD (Si) MIN FROM 72dB TO 65 dB; CHANGED PSRR 100K RAD (Si) MIN FROM 70 dB TO 65 dB; CHANGED PSRR 200K RAD (Si) MIN FROM 68 dB TO 65 dB;	05/03/10
E	• PAGE 10, TABLE II: DELETED "NOTE 7" FROM HEADER. PAGE 11, TABLE III AND 12, TABLE IV HAD CORRECTION TO V_{CM} FROM 0V TO 2.5V.	06/13/11
F	**Removed & replace figure 1 package drawing on pg 6**	**12/13/16**

CAUTION: ELECTROSTATIC DISCHARGE SENSITIVE PART

REVISION	PAGE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13				
INDEX	REVISION	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**				
REVISION	PAGE NO.																	
INDEX	REVISION																	

	ORIG			**LINEAR TECHNOLOGY CORPORATION MILPITAS, CALIFORNIA**	
	DSGN				
	ENGR			TITLE:	
	MFG			**MICROCIRCUIT, LINEAR, RH1814M, QUAD OPERATIONAL AMPLIFIER**	
	CM				
	QA				
	PROG			SIZE:	CAGE CODE: **64155** / DRAWING NUMBER: **05-08-5204** / REV: **F**
	FUNCT				
APPLICATION		SIGNOFFS	DATE	CONTRACT:	

FOR OFFICIAL USE ONLY

1.0 SCOPE:

1.1 This specification defines the performance and test requirements for a microcircuit processed to a space level manufacturing flow.

2.0 APPLICABLE DOCUMENTS:

2.1 Government Specifications and Standards: the following documents listed in the Department of Defense Index of Specifications and Standards, of the issue in effect on the date of solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS:

MIL-PRF-38535 Integrated Circuits (Microcircuits) Manufacturing, General Specification for

MIL-STD-883 Test Method and Procedures for Microcircuits

MIL-STD-1835 Microcircuits Case Outlines

2.2 Order of Precedence: In the event of a conflict between the documents referenced herein and the contents of this specification, the order of precedence shall be this specification, MIL-PRF-38535 and other referenced specifications.

3.0 REQUIREMENTS:

3.1 General Description: This specification details the requirements for the RH1814, Operational Amplifier, processed to space level manufacturing flow.

3.2 Part Number:

3.2.1 RH1814MW (FLATPACK, GLASS SEAL, 14 LEAD)

3.3 Part Marking Includes:

3.3.1 LTC Logo

3.3.2 LTC Part Number (See Paragraph 3.2)

3.3.3 Date Code

3.3.4 Serial Number

3.3.5 ESD Identifier per MIL-PRF-38535, Appendix A

3.4 The Absolute Maximum Ratings:
(NOTE 1)

Supply Voltage	12.6V
Differential Input Voltage **(Note 2)**	±6V
Input Voltage	±Vs
Output Short Circuit Duration **(Note 3)**	Indefinite
Operating Temperature Range	-55°C to 125°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

Note 2: Differential inputs of ±6V are appropriate for transient operation only. such as during slewing. Large sustained differential inputs can cause excessive power dissipation and may damage the part.

Note 3: A heat sink may be required to keep the junction temperature below absolute maximum when the output is shorted indefinitely.

3.5 Electrostatic discharge sensitivity, ESDS, shall be Class 2.

3.6 Electrical Performance Characteristics: The electrical performance characteristics shall be as specified in Table I, Table II, Table III, and Table IV.

3.7 Electrical Test Requirements: Screening requirements shall be in accordance with 4.1 herein, MIL-STD-883, Method 5004, and as specified in Table V herein.

3.8 Burn-In Requirement:

3.8.1 (Glass Sealed Flatpack) : Static Burn-In, Figure 3.

3.9 Delta Limit Requirement: Delta limit parameters are specified in Table V herein, are calculated after each burn-in, and the delta rejects are included in the PDA calculation.

3.10 Design, Construction, and Physical Dimensions: Detail design, construction, physical dimensions, and electrical requirements shall be specified herein.

3.10.1 Mechanical / Packaging Requirements: Case outlines and dimensions are in accordance with Figure 1(Glass Sealed Flatpack/14 Leads).

3.10.2 Terminal Connections: The terminal connections shall be as specified in Figure 2 **(**Glass Sealed Flatpack/14 Leads).

3.10.3 Lead Material and Finish: The lead material shall be Alloy 42 for Flatpack. The lead finish shall be hot solder dip (Finish letter A) in accordance with MIL-PRF-38535.

3.11 Radiation Hardness Assurance (RHA):

3.11.1 The manufacturer shall perform a lot sample test as an internal process monitor for total dose radiation tolerance. The sample test is performed with MIL-STD-883 TM1019 Condition A as a guideline.

3.11.2 For guaranteed radiation performance to MIL-STD-883, Method 1019, total dose irradiation, the manufacturer will provide certified RAD testing and report through an independent test laboratory when required as a customer purchase order line item.

3.11.3 Total dose bias circuit is specified in Figure 4.

3.12 Wafer Lot Acceptance: Wafer lot acceptance shall be in accordance with MIL-PRF-38535, Appendix A, except for the following: Topside glassivation thickness shall be a minimum of 4KÅ.

3.13 Wafer Lot Acceptance Report: SEM is performed per MIL-STD-883, Method 2018 and copies of SEM photographs shall be supplied with the Wafer Lot Acceptance Report as part of a Space Data Pack when specified as a customer purchase order line item.

4.0 VERIFICATION (QUALITY ASSURANCE PROVISIONS)

4.1 Quality Assurance Provisions: Quality Assurance provisions shall be in accordance with MIL-PRF-38535. Linear Technology is a QML certified company and all Rad Hard candidates are assembled on qualified Class S manufacturing lines.

4.2 Sampling and Inspection: Sampling and Inspection shall be in accordance with MIL-STD-883, Method 5005 with QML allowed and TRB approved deviations in conjunction with paragraphs 3.1.1, 3.2.1, and 3.4 of the test method.

4.3 Screening: Screening requirements shall be in accordance with MIL-STD-883, Method 5004 with QML allowed and TRB approved deviations in conjunction with paragraphs 3.1, 3.1.1, and 3.4 of the test method. Electrical testing shall be as specified in Table VI herein.

4.3.1 Analysis of catastrophic (open/short) failures from burn-in will be conducted only when a lot fails the burn-in or re-burn-in PDA requirements.

4.4 Quality Conformance Inspection: Quality conformance inspection shall be in accordance with 4.2 and 4.3 herein and as follows:

4.4.1 Group A Inspection: Group A inspection shall be performed in accordance with 4.1 herein, per MIL-STD-883, Method 5005, and specified in Table VI herein.

4.4.2 Group B Inspection: When purchased, a full Group B is performed on an inspection lot. As a minimum, Subgroup B2 (Resistance to Solvents / Mark Permanency) and Subgroup B3 (Solderability) are performed prior to the first shipment from any inspection lot and Attributes provided when a Full Space Data Pack is ordered. Subgroup B5 (Operating Life) is performed on each wafer lot. This subgroup may or may not be from devices built in the same package style as the current inspection lot. Attributes and variables data for this subgroup will be provided upon request at no charge.

4.4.2.1

Group B, Subgroup 2c = 10%	Group B, Subgroup 5 = *5% (*per wafer or inspection lot whichever is the larger quantity)
Group B, Subgroup 3 = 10%	
Group B, Subgroup 4 = 5%	Group B, Subgroup 6 = 15%

4.4.2.2 All footnotes pertaining to Table IIa in MIL-STD-883, Method 5005 apply. The quantity (accept number) of all other subgroups are per MIL-STD-883, Method 5005, Table IIa.

4.4.3 Group D Inspection: When purchased, a full Group D is performed on an inspection lot. As a minimum, periodic full Group D sampling is performed on each package family for each assembly location every 26 weeks. A generic Group D Summary is provided when a full Space Data Pack is ordered.

4.4.3.1 Group D, Subgroups 3, 4 and 5 = 15% each (Sample Size Series).

4.4.3.2 All footnotes pertaining to Table IV in MIL-STD-883, Method 5005 apply. The quantity (accept number) or sample number and accept number of all other subgroups are per MIL-STD-883, Method 5005, Table IV.

4.5 Source Inspection:

4.5.1 The manufacturer will coordinate Source Inspection at wafer lot acceptance and pre-seal internal visual.

4.5.2 The procuring activity has the right to perform source inspection at the supplier's facility prior to shipment for each lot of deliverables when specified as a customer purchase order line item. This may include wafer lot acceptance and final data review.

4.6 Deliverable Data: Deliverable data that will ship with devices when a Space Data Pack is ordered:

4.6.1 Lot Serial Number Sheets identifying all devices accepted through final inspection by serial number.

4.6.2 100% attributes (completed lot specific traveler; includes Group A Summary)

4.6.3 Burn-In Variables Data and Deltas (if applicable)

4.6.4 Group B2, B3, and B5 Attributes (Variables data, if performed on lot shipping)

4.6.5 Generic Group D data (4.4.3 herein)

4.6.6 SEM photographs (3.13 herein)

4.6.7 Wafer Lot Acceptance Report (3.13 herein)

4.6.8 X-Ray Negatives and Radiographic Report

4.6.9 A copy of outside test laboratory radiation report if ordered

4.6.10 Certificate of Conformance certifying that the devices meet all the requirements of this specification and have successfully completed the mandatory tests and inspections herein.

Note: Items 4.6.1 and 4.6.10 will be delivered as a minimum, with each shipment. This is noted on the Purchase Order Review Form as "No Charge Data".

5.0 Packaging Requirements: Packaging shall be in accordance with Appendix A of MIL-PRF-38535. All devices shall be packaged in conductive material or packaged in anti-static material with an external conductive field shielding barrier.

W PACKAGE
14-LEAD FLATPAK GLASS SEALED (HERMETIC)
(REFERENCE LTC DWG # 05-08-1140)

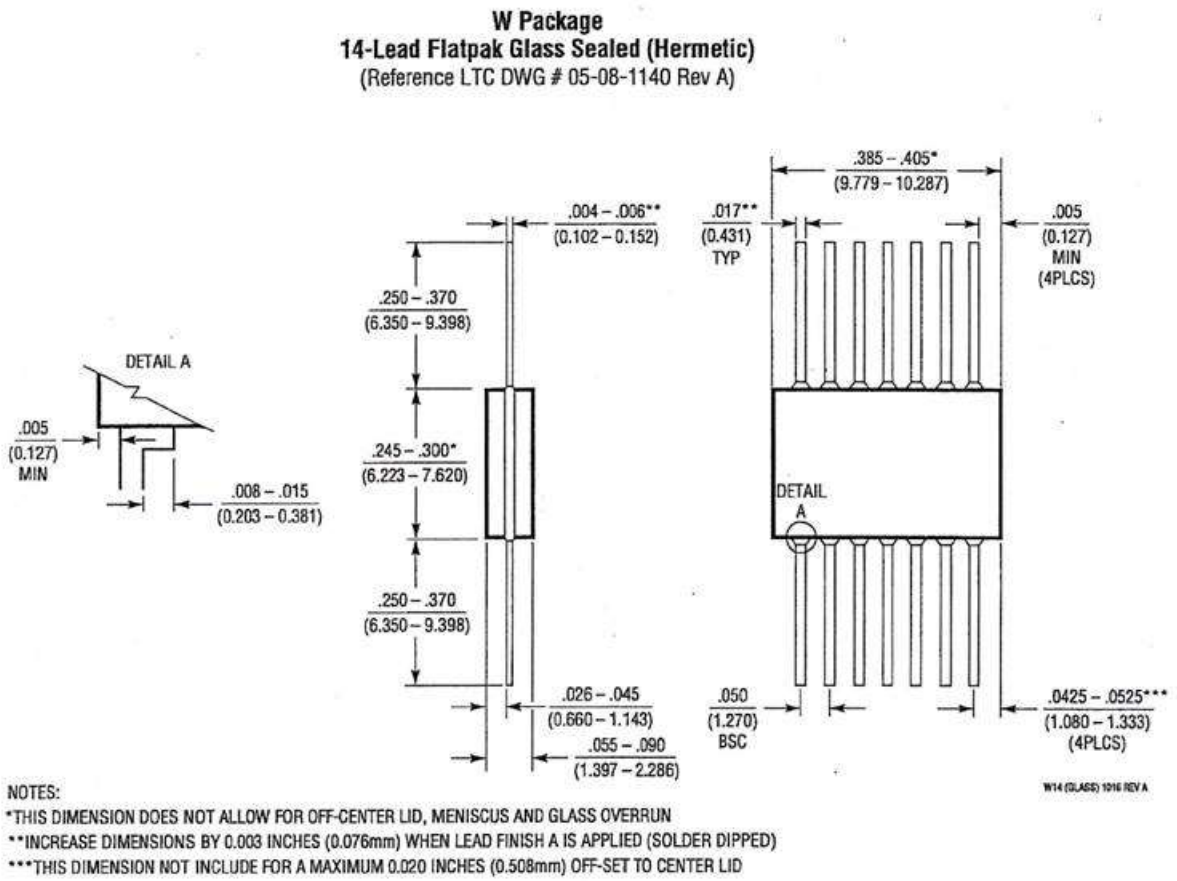


FIGURE 1

GLASS SEALED FLATPACK / 14 LEADS

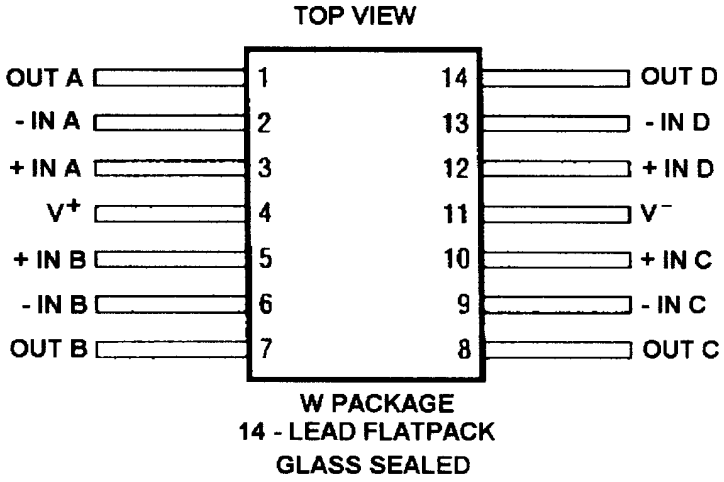
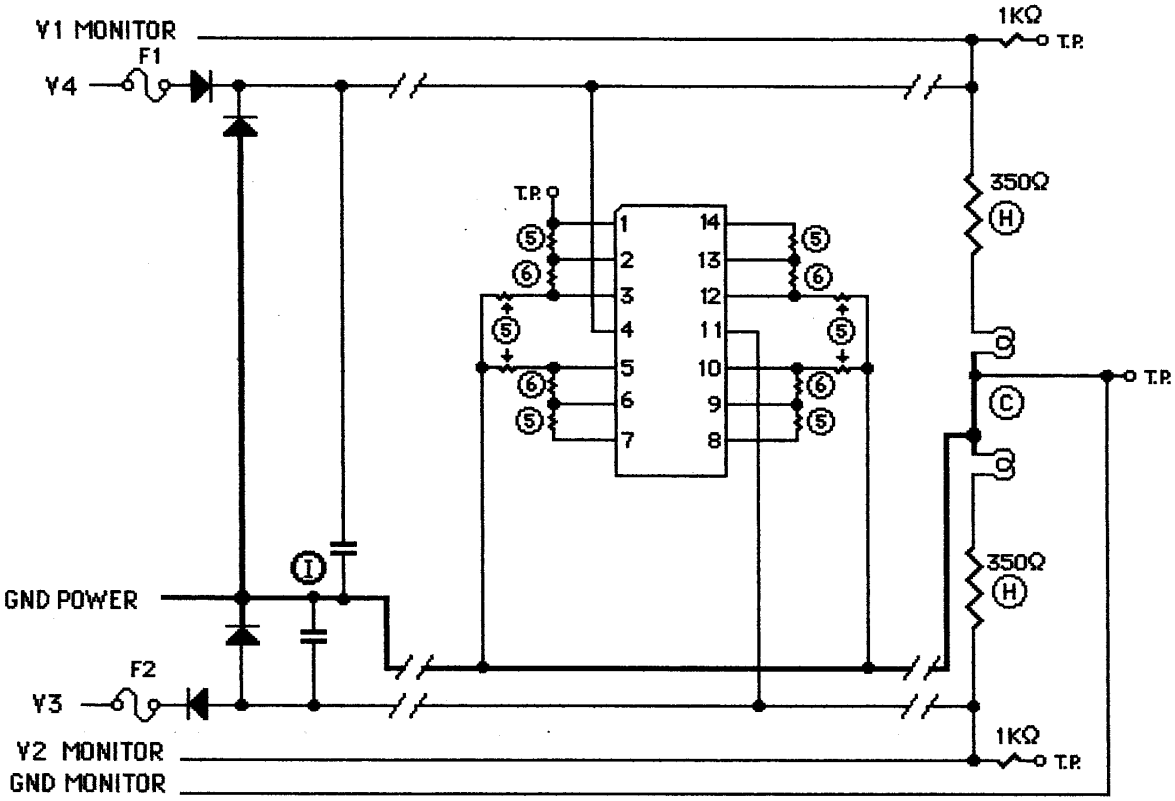


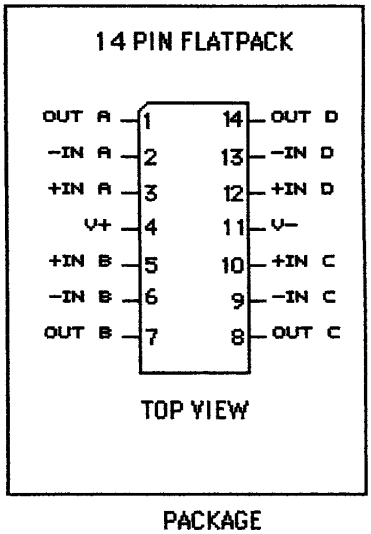
FIGURE 2

STATIC BURN-IN CIRCUIT
FLATPACK, GLASS SEAL / 14 LEADS



NOTES:

1. Unless otherwise specified, component tolerances shall be per military specification.
2. Tj = +200 °C maximum, at ambient of 150 °C.
3. Tj = +175 °C maximum, at ambient of 125 °C.
4. Burn-in Voltages: V4 = +5.5V to +6.0V
   V3 = -5.5V to -6.0V
5. Resistors to be 1/2 watt, 49.9KΩ per specification.
6. Resistors to be 1/2 watt, 100Ω per specification.



PACKAGE

FIGURE 3

TOTAL DOSE BIAS CIRCUIT

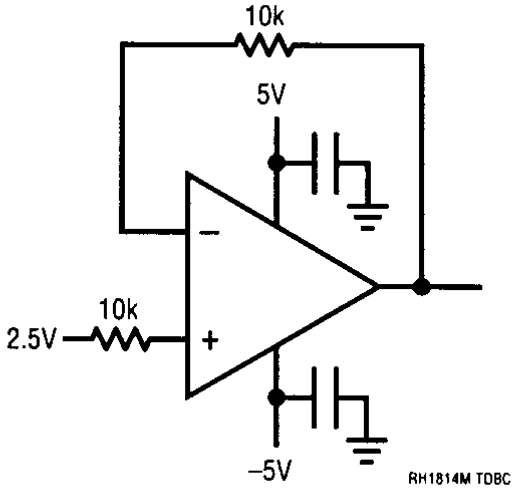


FIGURE 4

TABLE I: ELECTRICAL CHARACTERISTICS (PRE-IRRADIATION)

V_S = ±5V, V_{CM} = 0V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	T_A = 25°C MIN	TYP	MAX	SUB-GROUP	−55°C ≤ T_A ≤ 125°C MIN	TYP	MAX	SUB-GROUP	UNITS
V_{OS}	Input Offset Voltage	(Note 4)			1.5	1			4	2, 3	mV
$\frac{\Delta V_{OS}}{\Delta Temp}$	Average Tempco of Offset Voltage	(Note 5)							30		µV/°C
I_{OS}	Input Offset Current				400	1			1000	2, 3	nA
I_B	Input Bias Current				±4	1			±10	2, 3	µA
e_n	Input Noise Voltage Density	f_O = 10kHz		8							nV/√Hz
i_n	Input Noise Current Density	f_O = 10kHz		1							pA/√Hz
R_{IN}	Input Resistance	V_{CM} = ±3.5V	3								MΩ
A_{VOL}	Large-Signal Voltage Gain	V_O = ±3V, R_L ≥ 500Ω V_O = ±3V, R_L ≥ 100Ω	1.5 1			4 4	0.7 0.5			5, 6	V/mV V/mV
	Input Voltage Range	Guaranteed by CMRR	±3.5				±3.5				V
CMRR	Common Mode Rejection Ratio	V_{CM} = ±3.5V	75			1	70				dB
PSRR	Power Supply Rejection Ratio	V_S = ±2V to ±5.5V	78			1	72			2, 3	dB
	Channel Separation	V_O = ±3V, R_L = 100Ω	82			1	78				dB
V_{OUT}	Output Voltage Swing	R_L = 500Ω, 30mV Overdrive R_L = 100Ω, 30mV Overdrive	±3.8 ±3.35			4 4	±3.4 ±3			5, 6 5, 6	V V
I_{OUT}	Maximum Output Current	V_{OUT} = ±3V, 30mV Overdrive	±40				±20				mA
I_{SC}	Output Short-Circuit Current	V_{OUT} = 0V, 1V Overdrive (Note 3)	±75				±40				mA
I_S	Supply Current	per Amplifier			3.6	1			6.5	2, 3	mA

TABLE II: ELECTRICAL CHARACTERISTICS (POST-IRRADIATION)

V_S = ±5V, V_{CM} = 0V, T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	10KRAD(Si) MIN	MAX	20KRAD(Si) MIN	MAX	50KRAD(Si) MIN	MAX	100KRAD(Si) MIN	MAX	200KRAD(Si) MIN	MAX	UNITS
V_{OS}	Input Offset Voltage	(Note 4)		2		2		4		4		4	mV
I_{OS}	Input Offset Current			500		500		750		1000		1500	nA
I_B	Input Bias Current			±5		±5		±7.5		±10		±15	µA
	Input Voltage Range	Guaranteed by CMRR	±3.5		±3.5		±3.5		±3.5		±3.5		V
CMRR	Common Mode Rejection Ratio	V_{CM} = ±3.5V	73		73		62		62		62		dB
PSRR	Power Supply Rejection Ratio	V_S = ±2V to ±5.5V	77		75		65		65		65		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = ±3V, R_L = 500Ω V_O = ±3V, R_L = 100Ω	1.4 0.9		1.3 0.8		1.0 0.6		0.8 0.5		0.6 0.4		V/mV V/mV
V_{OUT}	Maximum Output Voltage Swing	R_L = 500Ω, 30mV Overdrive R_L = 100Ω, 30mV Overdrive	±3.8 ±3.35		±3.8 ±3.30		±3.7 ±3.25		±3.6 ±3.15		±3.5 ±3.05		V V
I_S	Supply Current	per Amplifier		3.6		3.6		3.6		3.6		3.6	mA

Notes are on page 12 following the post irradiation table IV

TABLE III: ELECTRICAL CHARACTERISTICS (PRE-IRRADIATION)

V_S = 5V, 0V, V_{CM} = 2.5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	T_A = 25°C MIN	TYP	MAX	SUB-GROUP	−55°C ≤ T_A ≤ 125°C MIN	TYP	MAX	SUB-GROUP	UNITS
V_{OS}	Input Offset Voltage	(Note 4)			2	1			5	2, 3	mV
$\frac{\Delta V_{OS}}{\Delta Temp}$	Average Tempco of Offset Voltage	(Note 5)							30		µV/°C
I_{OS}	Input Offset Current				400	1			1000	2, 3	nA
I_B	Input Bias Current				±4	1			±10	2, 3	µA
e_n	Input Noise Voltage Density	f_O = 10kHz		8							nV/√Hz
i_n	Input Noise Current Density	f_O = 10kHz		1							pA/√Hz
R_{IN}	Input Resistance	V_{CM} = 1.5V to 3.5V	3								MΩ
A_{VOL}	Large-Signal Voltage Gain	V_O = 1.5V to 3.5V, R_L ≥ 500Ω V_O = 1.5V to 3.5V, R_L ≥ 100Ω	1 0.7			4 4	0.5 0.3			5, 6	V/mV V/mV
	Input Voltage Range (Positive)	Guaranteed by CMRR	3.5				3.5				V
	Input Voltage Range (Negative)	Guaranteed by CMRR			1.5				1.5		V
CMRR	Common Mode Rejection Ratio	V_{CM} = 1.5V to 3.5V	73			1	68				dB
PSRR	Power Supply Rejection Ratio	V_S = ±2V to ±5.5V	78			1	72			2, 3	dB
	Channel Separation	V_{OUT} = 1.5V to 3.5V, R_L = 100Ω	81			1	77				dB
V_{OUT}	Output Voltage Swing (Positive)	R_L = 500Ω, 30mV Overdrive R_L = 100Ω, 30mV Overdrive	3.9 3.7			4 4	3.5 3.3			5, 6 5, 6	V V
	Output Voltage Swing (Negative)	R_L = 500Ω, 30mV Overdrive R_L = 100Ω, 30mV Overdrive			1.1 1.3				1.3 1.5	 5, 6	V V
I_{OUT}	Maximum Output Current	V_{OUT} = 1.5V to 3.5V, 30mV Overdrive	±25				±15				mA
I_{SC}	Output Short-Circuit Current	V_{OUT} = 2.5V, 1V Overdrive (Note 3)	±55				±30				mA
I_S	Supply Current	per Amplifier			4	1			7.5	2, 3	mA

Notes are on page 12 following the post irradiation table IV

TABLE IV: ELECTRICAL CHARACTERISTICS (POST-IRRADIATION)

V_S = 5V, 0V, V_{CM} = 2.5V, T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	10KRAD(Si) MIN	10KRAD(Si) MAX	20KRAD(Si) MIN	20KRAD(Si) MAX	50KRAD(Si) MIN	50KRAD(Si) MAX	100KRAD(Si) MIN	100KRAD(Si) MAX	200KRAD(Si) MIN	200KRAD(Si) MAX	UNITS
V_{OS}	Input Offset Voltage	(Note 4)		2.5		2.5		4.5		4.5		4.5	mV
I_{OS}	Input Offset Current			500		500		750		1000		1500	nA
I_B	Input Bias Current			±5		±5		±7.5		±10		±15	µA
	Input Voltage Range Negative Positive	Guaranteed by CMRR	 3.5	 1.5	 3.5	 1.5	 3.5	 1.5	 3.5	 1.5	 3.5	 1.5	 V V
CMRR	Common Mode Rejection Ratio	V_{CM} = 1.5V to 3.5V	71		71		60		60		60		dB
PSRR	Power Supply Rejection Ratio	V_S = ±2V to ±5.5V	77		75		65		65		65		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = 1.5V to 3.5V, R_L = 500Ω V_O = 1.5V to 3.5V, R_L = 100Ω	0.9 0.6		0.8 0.55		0.6 0.45		0.5 0.40		0.4 0.35		V/mV V/mV
V_{OUT}	Maximum Output Voltage Swing (Positive)	R_L = 500Ω, 30mV Overdrive R_L = 100Ω, 30mV Overdrive	3.9 3.7		3.9 3.65		3.8 3.55		3.7 3.45		3.6 3.40		V V
	Maximum Output Voltage Swing (Negative)	R_L = 500Ω, 30mV Overdrive R_L = 100Ω, 30mV Overdrive		1.1 1.3		1.1 1.35		1.15 1.4		1.2 1.45		1.3 1.5	V V
I_S	Supply Current	per Amplifier		4		4		4		4		4	mA

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: Differential inputs of ±6V are appropriate for transient operation only, such as during slewing. Large sustained differential inputs can cause excessive power dissipation and may damage the part.

Note 3: A heat sink may be required to keep the junction temperature below absolute maximum when the output is shorted indefinitely.

Note 4: Input offset voltage is pulse tested and is exclusive of warm-up drift.

Note 5: This parameter is not 100% tested.

TABLE V: POST BURN-IN ENDPOINTS AND DELTA LIMIT REQUIREMENTS

T_A = 25°C, V_S = ±5V, V_{CM} = 0V unless otherwise noted

	ENDPOINT LIMIT		DELTA		
PARAMETER	MIN	MAX	MIN	MAX	UNITS
V_{OS}	-1.5	+1.5	-0.5	+0.5	mV
$+I_B$	-4	+4	-1.5	+1.5	µA
$-I_B$	-4	+4	-1.5	+1.5	µA

TABLE VI: ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUP
Final Electrical Test Requirements (Method 5004)	1*,2,3,4,5,6
Group A Test Requirements (Method 5005)	1,2,3,4,5,6
Group B and D for Class S End Point Electrical Parameters (Method 5005)	1,2,3

* PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

The PDA is specified as 5% based on failures from group A, subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent for the lot.

Linear Technology Corporation reserves the right to test to tighter limits than those given.