REVISION RECORD

REV	DESCRIPTION	DATE
0	INITIAL RELEASE	12/11/07
A	• PAGE 3, PARAGRAPH 3.7.1 CHANGED VERBIAGE. CHANGED TITLE FROM QUAD TO DUAL.	05/09/08
B	• PAGE 13, CHANGED RH CANNED SAMPLE TABLE V FOR QUALIFYING DICE SALES ADDED TEMPERATURE CYCLE, CONSTANT ACCELERATION & REMOVED PIND TEST.	02/17/09
C	• PAGE 12, 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;	05/21/10
D	Page 2, amended section 3.3 Special Handling of Dice to more accurately describe our current procedures and requirements.	04/05/12
E	Page 13, Changed RH Canned Sample Table for Qualifying Dice Sales: Subgroup 6 Sample Size Series changed from 45 (3) to 65 (3). First note had the Sample Size Series from "15%" to "10%".	07/02/13
F	Updated Die Sales table on pg 13.	03/27/15
G	**Removed & replace figure 4 package drawing on pg 9**	**12/13/16**

CAUTION: ELECTROSTATIC DISCHARGE SENSITIVE PART

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				LINEAR TECHNOLOGY CORPORATION MILPITAS, CALIFORNIA			
	ORIG			TITLE:			
	DSGN			**Microcircuit, Linear, RH1814M,**			
	ENGR			**DUAL OPERATIONAL AMPLIFIER DICE**			
	MFG						
	CM						
	QA			SIZE	CAGE CODE	DRAWING NUMBER	REV
	PROG				**64155**	**05-08-5220**	**G**
APPLICATION	FUNCT	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 RH1814M, Operational Amplifier Dice, and Element Evaluation Test Samples, processed to space level manufacturing flow as specified herein.

3.2 Part Number: **RH1814M Dice**

3.3 **Special Handling of Dice:** Rad Hard dice require special handling as compared to standard IC dice. Rad Hard dice are susceptible to surface damage due to the absence of silicon nitride passivation that is present on most standard dice. Silicon nitride protects the dice surface from scratches by its hard and dense properties. The passivation on Linear Technology's Rad Hard dice is silicon dioxide which is much "softer" than silicon nitride. During the visual and preparation for shipment, ESD safe Tweezers are used and only the edge of the die are touched.

LTC recommends that dice handling be performed with extreme care so as to protect the die surface from scratches. If the need arises to move the die in or out of the chip shipment tray (waffle pack), use an ESD-Safe-Plastic-tipped Bent Metal Vacuum Probe, preferably .020" OD x .010" ID (for use with tiny parts). The wand should be compatible with continuous air vacuums. The tip material should be static dissipative Delrin (or equivalent) plastic.

During die attach, care must be exercised to ensure no tweezers, or other equipment, touch the top of the dice.

3.4 The Absolute Maximum Ratings:
(Note 1)

Supply Voltage	12.6V
Differential Input Voltage **(Note 2)**	$\pm$6V
Input Voltage	$\pm$Vs
Output Short Circuit Duration	Indefinite

Junction Temperature . . . . . 150°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 Design, Construction, and Physical Dimensions: Detail design, construction, physical dimensions, and electrical requirements shall be specified herein.

3.6 Outline Dimensions and Pad Functions: Dice outline dimensions, pad functions, and locations shall be specified in **Figure 1**.

3.7 Radiation Hardness Assurance (RHA):

3.7.1 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.

3.7.2 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.

3.7.3 Total dose bias circuit is specified in **Figure 2**.

3.8 Wafer (or Dice) Probe: Dice shall be 100% probed at Ta = +25°C to the limits shown in **Table I** herein. All reject dice shall be removed from the lot. This testing is normally performed prior to dicing the wafer into chips. Final specifications after assembly are sample tested during the element evaluation.

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

3.10 Wafer Lot Acceptance Report: SEM is performed per MIL-STD-883, Method 2018. 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.

3.11 Traceability: Wafer Diffusion Lot and Wafer traceability shall be maintained through Quality Conformance Inspection.

4.0 QUALITY CONFORMANCE INSPECTION: Quality Conformance Inspection shall consist of the tests and inspections specified herein.

5.0 SAMPLE ELEMENT EVALUATION: A sample from each wafer supplying dice shall be assembled and subjected to element evaluation per **Table III** herein.

5.1 100 Percent Visual Inspection: All dice supplied to this specification shall be inspected in accordance with MIL-STD-883, Method 2010, Condition A. All reject dice shall be removed from the lot.

5.2 Electrical Performance Characteristics for Element Evaluation: The electrical performance characteristics shall be as specified in **Table I**, **Table II, and Table III** herein.

5.3 Sample Testing: Each wafer supplying dice for delivery to this specification shall be subjected to element evaluation sample testing. No dice shall be delivered until all the lot sample testing has been performed and the results found to be acceptable unless the customer supplies a written approval for shipment prior to completion of wafer qualification as specified in this specification.

5.4 Part Marking of Element Evaluation Sample Includes**:**

5.4.1 LTC Logo

5.4.2 LTC Part Number

5.4.3 Date Code

5.4.4 Serial Number

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

5.4.6 Diffusion Lot Number

5.4.7 Wafer Number

5.5 Burn-In Requirement: Burn-In circuit for Flatpak, 14 lead package is specified in **Figure 3**.

5.6 Mechanical/Packaging Requirements: Case Outline and Dimensions are in accordance with **Figure 4.**

5.7 Terminal Connections: The terminal connections shall be as specified in **Figure 5.**

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

6.0 VERIFICATION (QUALITY ASSURANCE PROVISIONS)

6.1 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.

6.2 Sampling and Inspection: Sampling and Inspection shall be in accordance with **Table IV** herein.

6.3 Screening: Screening requirements shall be in accordance with **Table IV** herein.

6.4 Source Inspection:

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

6.4.2 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, die visual, and final data review.

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

6.5.1 Lot Serial Number Sheets identifying all Canned Sample devices accepted through final inspection by serial number.

6.5.2 100% attributes (completed element evaluation traveler).

6.5.3 Element Evaluation variables data, including Burn-In and Op Life

6.5.4 SEM photographs (3.10 herein)

6.5.5 Wafer Lot Acceptance Report (3.9 herein)

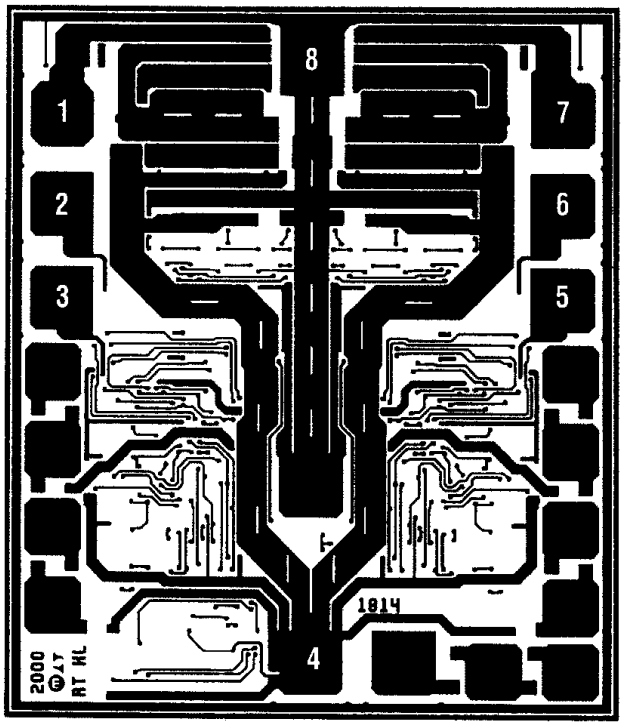
6.5.6 A copy of outside test laboratory radiation report if ordered

6.5.7 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 6.5.1 and 6.5.7 will be delivered as a minimum, with each shipment.

7.0 Packaging Requirements: Packaging shall be in accordance with Appendix A of MIL-PRF-38535. All dice shall be packaged in multicavity containers composed of conductive, anti-static, or static dissipative material with an external conductive field shielding barrier.

DICE OUTLINE DIMENSIONS AND PAD FUNCTIONS



PAD FUNCTION

1. OUTPUT A
2. –INA
3. +INA
4. V^-
5. +INB
6. –INB
7. OUTPUT B
8. V^+

40mils × 45mils,
Thickness: 12mils.
Backside metal: Gold.

FIGURE 1

TOTAL DOSE BIAS CIRCUIT

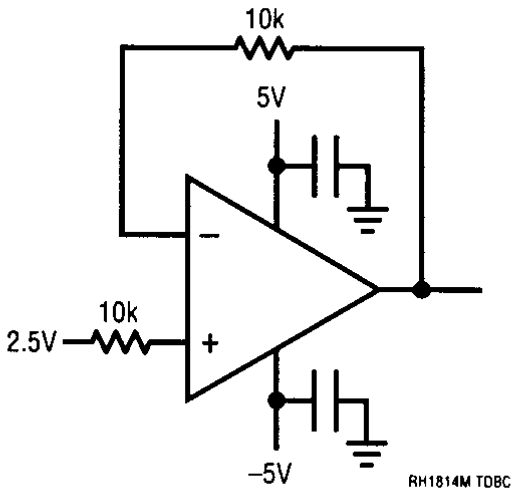
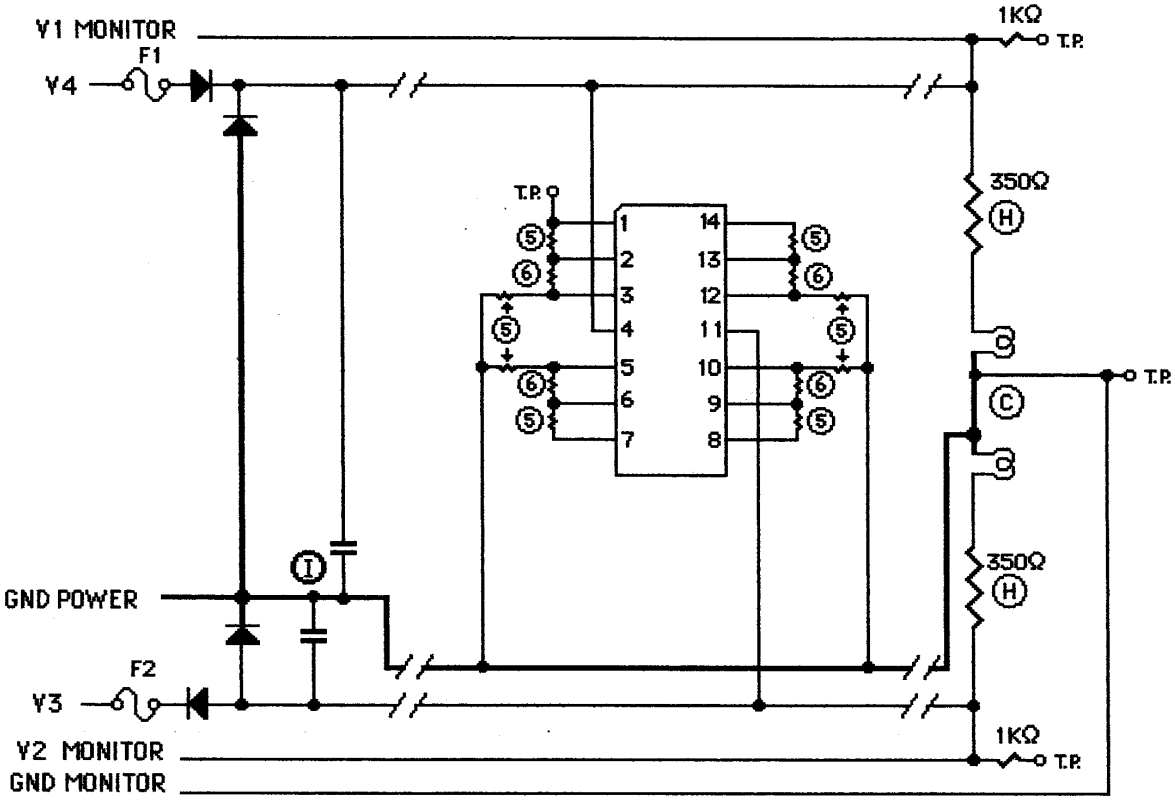


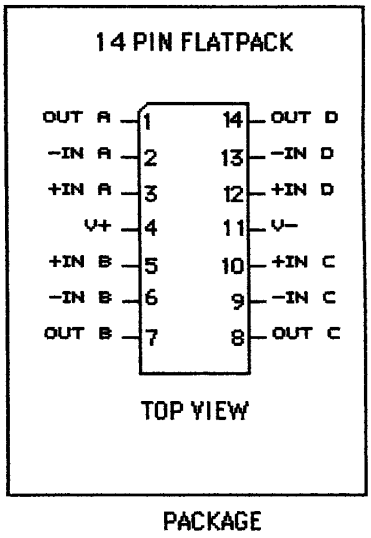
FIGURE 2

STATIC BURN-IN CIRCUIT



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

FLATPAK, 14 LEADS, CASE OUTLINE

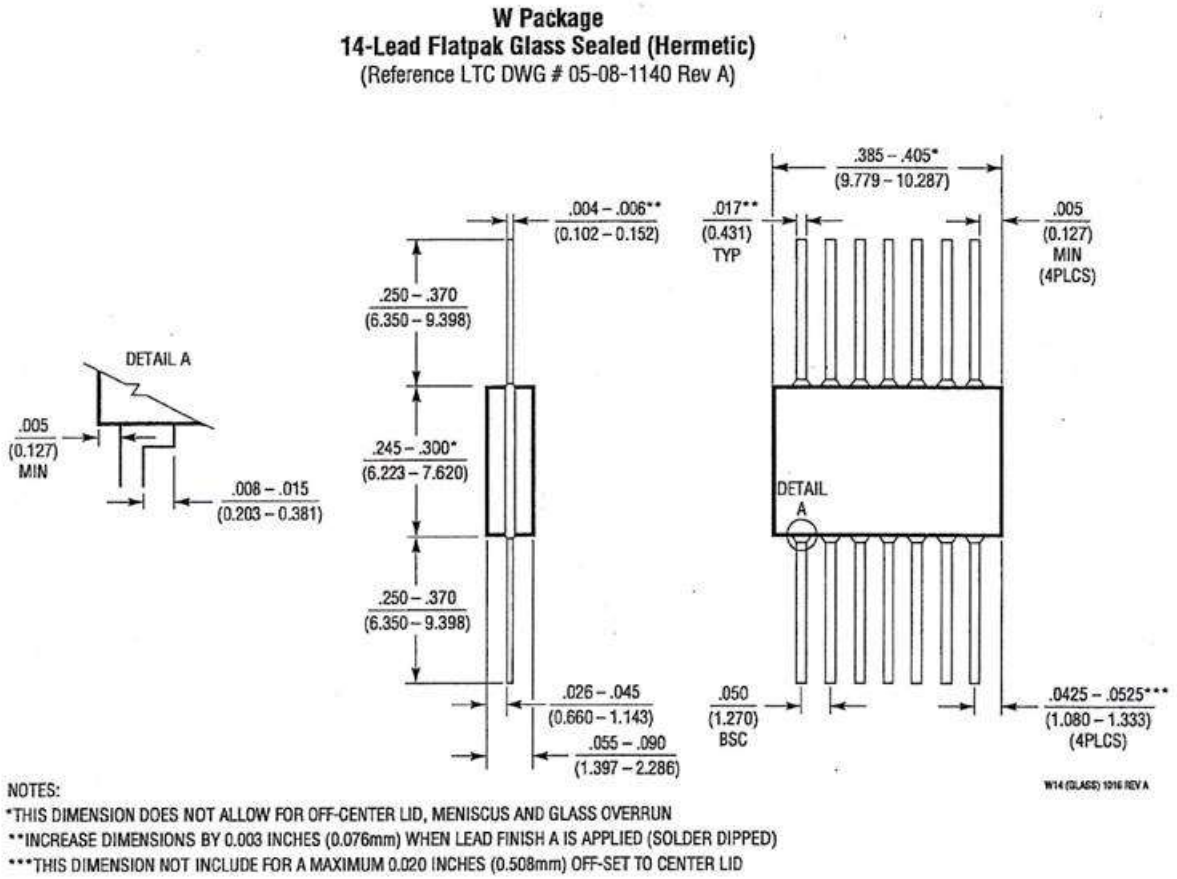


FIGURE 4

TERMINAL CONNECTIONS

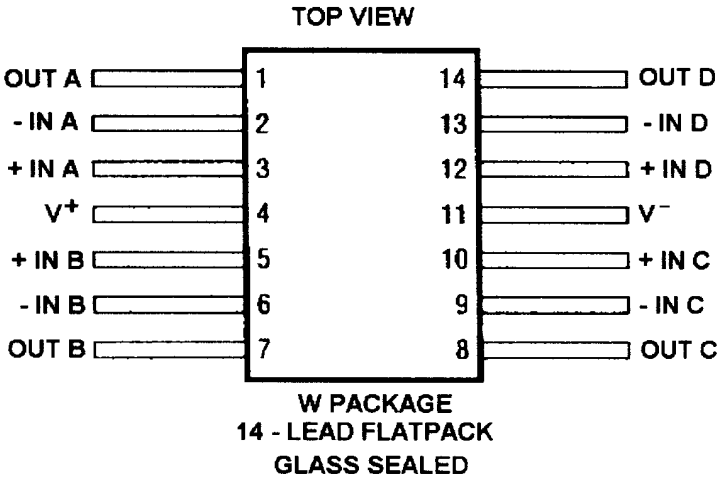


FIGURE 5

TABLE I DICE ELECTRICAL CHARACTERISTICS - Pre-Irradiation

$V_S = \pm 5V$

DICE ELECTRICAL TEST LIMITS $V_S = \pm 5V$, $V_{CM} = 0V$, $T_A = 25°C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNITS
V_{OS}	Input Offset Voltage	(Note 3)		1.5	mV
I_{OS}	Input Offset Current			400	nA
I_B	Input Bias Current			±4	µA
R_{IN}	Input Resistance	$V_{CM} = \pm 3.5V$	3		MΩ
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 3V$, $R_L \geq 500\Omega$	1.5		V/mV
		$V_O = \pm 3V$, $R_L \geq 100\Omega$	1		V/mV
	Input Voltage Range	Guaranteed by CMRR	±3.5		V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = \pm 3.5V$	75		dB
SYMBOL	**PARAMETER**	**CONDITIONS**	**MIN**	**MAX**	**UNITS**
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 5.5V$	78		dB
	Channel Separation	$V_O = \pm 3V$, $R_L = 100\Omega$	82		dB
V_{OUT}	Output Voltage Swing	$R_L = 500\Omega$, 30mV Overdrive	±3.8		V
		$R_L = 100\Omega$, 30mV Overdrive	±3.35		V
I_{OUT}	Maximum Output Current	$V_{OUT} = \pm 3V$, 30mV Overdrive	±40		mA
I_{SC}	Output Short-Circuit Current	$V_{OUT} = 0V$, 1V Overdrive	±75		mA
I_S	Supply Current	Per Amplifier		3.6	mA

TABLE II DICE ELECTRICAL CHARACTERISTICS – Pre-Irradiation

$V_S = 5V$

DICE ELECTRICAL TEST LIMITS (Pre-Irradiation)

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

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNITS
V_{OS}	Input Offset Voltage	(Note 3)		2	mV
I_{OS}	Input Offset Current			400	nA
I_B	Input Bias Current			±4	µA
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, $R_L \geq 500\Omega$	1		V/mV
		V_O = 1.5V to 3.5V, $R_L \geq 100\Omega$	0.7		V/mV
	Input Voltage Range (Positive)	Guaranteed by CMRR	3.5		V
	Input Voltage Range (Negative)	Guaranteed by CMRR		1.5	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 1.5V to 3.5V	73		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 5.5V$	78		dB
	Channel Separation	V_{OUT} = 1.5V to 3.5V, $R_L = 100\Omega$	81		mA
V_{OUT}	Output Voltage Swing (Positive)	$R_L = 500\Omega$, 30mV Overdrive	3.9		V
		$R_L = 100\Omega$, 30mV Overdrive	3.7		V
V_{OUT}	Output Voltage Swing (Negative)	$R_L = 500\Omega$, 30mV Overdrive		1.1	V
		$R_L = 100\Omega$, 30mV Overdrive		1.3	V
I_{OUT}	Maximum Output Current	V_{OUT} = 1.5V to 3.5V, 30mV Overdrive	±25		mA
I_{SC}	Output Short-Circuit Current	V_{OUT} = 2.5V, 1V Overdrive	±55		mA
I_S	Supply Current	Per Amplifier		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: Input offset voltage is pulse tested and is exclusive of warm-up drift.

TABLE III ELECTRICAL CHARACTERISTICS – Post-Irradiation

$V_S = \pm 5V$

$V_S = \pm 5V$, $V_{CM} = 0V$, $T_A = 25°C$, 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		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	$V_{CM} = \pm 3.5V$	73		73		62		62		62		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 5.5V$	77		75		65		65		65		dB
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 3V$, $R_L = 500\Omega$ $V_O = \pm 3V$, $R_L = 100\Omega$	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	$R_L = 500\Omega$, 30mV Overdrive $R_L = 100\Omega$, 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

TABLE IV ELECTRICAL CHARACTERISTICS – Post-Irradiation

$V_S = 5V$

$V_S = 5V$, $V_{CM} = 0V$, $T_A = 25°C$, 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	$V_S = \pm 2V$ to $\pm 5.5V$	77		75		65		65		65		dB
A_{VOL}	Large-Signal Voltage Gain	$V_O = 1.5V$ to $3.5V$, $R_L = 500\Omega$ $V_O = 1.5V$ to $3.5V$, $R_L = 100\Omega$	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)	$R_L = 500\Omega$, 30mV Overdrive $R_L = 100\Omega$, 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)	$R_L = 500\Omega$, 30mV Overdrive $R_L = 100\Omega$, 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 RH ELEMENT EVALUATION TABLE QUALIFICATION OF DICE SALES

RH CANNED SAMPLE TABLE FOR QUALIFYING DICE SALES

SUBGROUP	CLASS K/S	CLASS V	CLASS H/B	OPERATION	MIL-STD-883 METHOD	MIL-STD-883 CONDITION	QUANTITY (ACCEPT NUMBER)
1	X	X		SEM	2018	N/A	REF. METHOD 2018 FOR S/S
2	X	X	X	ELEMENT ELECTRICAL (WAFER SORT @ 25ºC)			100%
3	X	X	X	ELEMENT VISUAL (2nd OP)	2010	A	100%
4	X	X	X	INTERNAL VISUAL (3rd OP)	2010	A	ASSEMBLED PARTS ONLY
	X	X		DIE SHEAR MONITOR	2019		
	X	X		BOND PULL MONITOR	2011		
5	X	X		STABILIZATION BAKE	1008	C	ASSEMBLED PARTS ONLY
	X	X		TEMPERATURE CYCLE	1010	C	
	X	X		CONSTANT ACCELERATION	2001	E	
	X	X		FINE LEAK	1014	A	
	X	X		GROSS LEAK	1014	C	
6	X	X		FIRST ROOM ELECTRICAL - READ & RECORD (REPLACE ANY ASSEMBLY-RELATED REJECTS)			45(0)
	X	X		PRE BURN-IN ELECT. READ & RECORD @ +125ºC or +150ºC, -55ºC			
	X	X		BURN-IN: +125ºC/240 hrs. or +150ºC/120 hrs.	1015	+ 125ºc MINIMUM 240 HOURS	
	X	X		POST BURN-IN ELECT. READ & RECORD @ 25ºC			
	X	X		POST BURN-IN ELECT. READ & RECORD @ +125ºC or +150ºC, -55ºC			
		X		TOTAL IRRADIATION DOSE	1019	A	
	X	X		PRE OP-LIFE ELECTRICAL @ 25ºC READ & RECORD			
	X	X		OPERATING LIFE: +125ºC/1000 hrs. or +150ºC/500 hrs.	1005	+ 125ºc MINIMUM 1000 HOURS	
	X	X		POST OP-LIFE ELECT. (R & R @ 25ºC, +125ºC OR +150ºC, -55ºC			
7	X	X	X	WIRE BOND EVALUATION	2011		15(0) OR 25(1) - # of wires

NOTE: LTC is not qualified to process to MIL-PRF-38534. This is an LTC imposed element evaluation that follows MIL-STD-883 test methods and conditions. Please note the quantity and accept number from Sample Size Series of 5%, accept on 0, and note that the actual sample and accept number does not begin until Subgroup 6 OP-LIFE.

NOTE: Tests within Subgroup 5 may be performed in any sequence.

NOTE: LTC's radiation tolerance (RH) die has a topside glassivation thickness of 4KA minimum.

NOTE: Sample sizes on the travelers may be larger than that indicated in the above table; however, the larger sample size is to accommodate extra units for replacement devices in the event of equipment or operator error and for assembly related rejects in Subgroup 6, and for Wire Bond Evaluation, Surgroup 7. The larger sample size is at all times kept segregated and, if used for qualification, has all the required processing imposed.