

REVISION RECORD		
REV	DESCRIPTION	DATE
0	INITIAL RELEASE	06/10/98
A	ADDED PARAGRAPH 3.3, SPECIAL HANDLING OF DICE, TO PAGE 2. THE PARAGRAPHS WERE RENUMBERED AND PARAGRAPHS THAT FOLLOWED WERE RELOCATED TO PAGES 3 THROUGH 5. DELETED PARAGRAPH 3.6, ESD CLASS. ADDED $\theta_{ja}$ AND $\theta_{jc}$ TO THE TO5. CASE OUTLINE, PAGE 9	07/07/99
B	PAGE 3, PARAGRAPH 3.8 CHANGED VERBIAGE ADDED "HEREIN" AFTER TABLE 1. PAGE 4, PARAGRAPH 5.0 CHANGED VERBIAGE ADDED "HEREIN" AFTER TABLE 3. PARAGRAPH 5.2 ADDED "HEREIN" AFTER TABLE 2. PAGE 5, PARAGRAPH 6.2, 6.3 CHANGED VERBIAGE ADDED "HEREIN" AFTER TABLE 3.	01/04/00
C	<ul style="list-style-type: none"> <li>PAGE 3, PARAGRAPH 3.7.1, CHANGED THE DOSAGE RATE FROM "APPROXIMATELY 20 RADS PER SECOND" TO "LESS THAN OR EQUAL TO 10 RADS PER SECOND".</li> <li>PAGE 4, PARAGRAPH 6.1 CHANGED QUALITY ASSURANCE PROVISIONS TO STATE THAT LTC IS QML CERTIFIED AND THAT RAD HARD CANDIDATES ARE ASSEMBLED ON QUALIFIED CLASS S MANUFACTURING LINES.</li> <li>PAGES 6 THROUGH 9, ALL FIGURE TITLES CHANGED TO HAVE DEVICE OPTIONS AND PACKAGE TYPES AT TOP OF PAGE, AND HAVE ALL FIGURES AT BOTTOM OF PAGE.</li> <li>PAGE 6, FIGURES 1 AND 2 NOW ON THE SAME PAGE.</li> <li>PAGE 10, TABLES I AND II NOW ON THE SAME PAGE.</li> <li>SPEC NOW ONLY 11 PAGES LONG. CONVERSION OF SPECIFICATION FROM WORD PERFECT TO MICROSOFT WORD.</li> </ul>	01/08/03
D	<ul style="list-style-type: none"> <li>PAGE 3, CHANGED INITIAL RATE OF RADS TO 240 RADS/SEC.</li> </ul>	03/21/05
E	<ul style="list-style-type: none"> <li>PAGE 3, PARAGRAPH 3.7.1 CHANGED VERBIAGE.</li> </ul>	05/06/08
F	<ul style="list-style-type: none"> <li>PAGE 11, CHANGED RH CANNED SAMPLE TABLE III FOR QUALIFYING DICE SALES ADDED TEMPERATURE CYCLE, CONSTANT ACCELERATION &amp; REMOVED PIND TEST.</li> </ul>	02/10/09
G	<ul style="list-style-type: none"> <li>PAGE 10, TABLE II: NOTE 4 REVISED AND ADDED TO POWER SUPPLY REJECTION RATIO INPOST-IRRADIATION.</li> </ul>	01/31/11

**CAUTION: ELECTROSTATIC DISCHARGE SENSITIVE PART**

REVISION	PAGE NO.	1	2	3	4	5	6	7	8	9	10	11	12				
INDEX	REVISION	I	I	I	I	I	I	I	I	I	I	I	I				
REVISION	PAGE NO.																
INDEX	REVISION																
		ORIG								<b>LINEAR TECHNOLOGY CORPORATION</b> <b>MILPITAS, CALIFORNIA</b> TITLE: <b>MICROCIRCUIT, LINEAR, RH108A</b> <b>OPERATIONAL AMPLIFIER DICE</b>							
		DSGN															
		ENGR															
		MFG															
		CM															
		QA															
		PROG								SIZE	CAGE CODE	DRAWING NUMBER	REV				
											<b>64155</b>	<b>05-08-5111</b>	<b>I</b>				
APPLICATION	FUNCT	SIGNOFFS		DATE		CONTRACT:											

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REVISION RECORD		
REV	DESCRIPTION	DATE
H	Page 3, amended section 3.3 <u>Special Handling of Dice</u> to more accurately describe our current procedures and requirements.	04/05/12
I	<b>Page 12, 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%".</b>	7/2/13

## 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 RH108A Operational Amplifier Dice and Element Evaluation Test Samples, processed to space level manufacturing flow as specified herein.

- 3.2 Part Number: **RH108A 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 with 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:

Supply Voltage . . . . .	$\pm 20\text{V}$
Differential Input Voltage (Note 1) . . . . .	$\pm 10\text{mV}$
Input Voltage (Note 2) . . . . .	$\pm 15\text{V}$
Output Short Circuit Duration . . . . .	Indefinite
Operating Temperature Range . . . . .	$-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$
Storage Temperature Range . . . . .	$-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$
Lead Temperature (Soldering, 10 sec.) . . . . .	$300^{\circ}\text{C}$

**NOTE 1/** Differential input voltages greater than 1V will cause excessive current to flow through the input diodes unless limiting resistance is used.

**NOTE 2/** For supply voltages less than  $\pm 15\text{V}$ , the maximum input voltage is equal to the supply voltage.

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  $T_a = +25^{\circ}\text{C}$  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  $4\text{K}\text{\AA}$ .

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 and Table II 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 TO5 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 Kovar 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 III herein.
- 6.3 Screening: Screening requirements shall be in accordance with Table III 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)

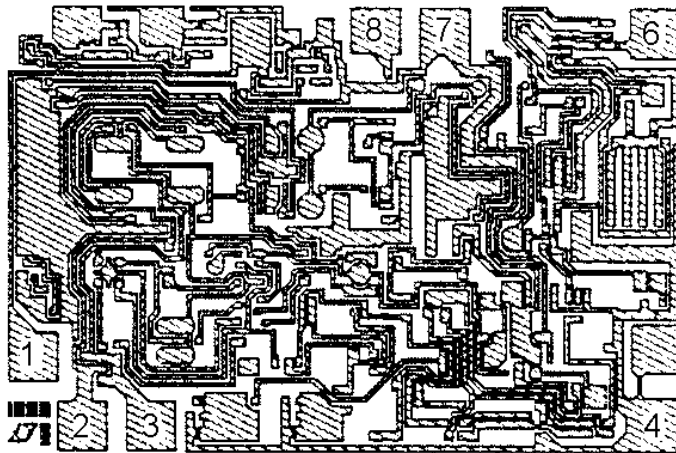
6.5.6 A copy of outside test laboratory radiation report if ordered

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. This is noted on the Purchase Order Review Form as "No Charge Data".**

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**



74 × 51 mils

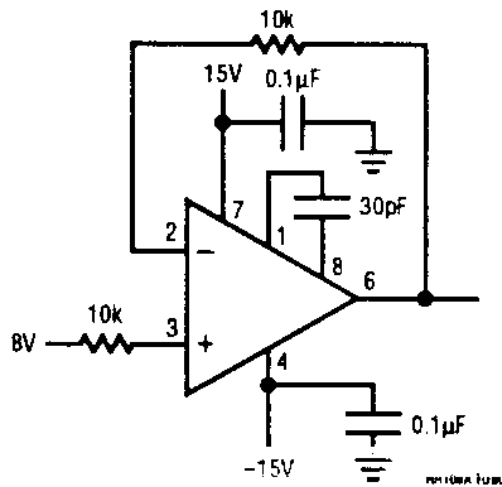
**PAD FUNCTION**

- 1. COMP 1
- 2. -IN
- 3. +IN
- 4. V<sup>-</sup> (substrate)
- 5. NC
- 6. OUT
- 7. V<sup>+</sup>
- 8. COMP 2

Backside (substrate) is an alloyed gold layer. Connect to V<sup>-</sup>.

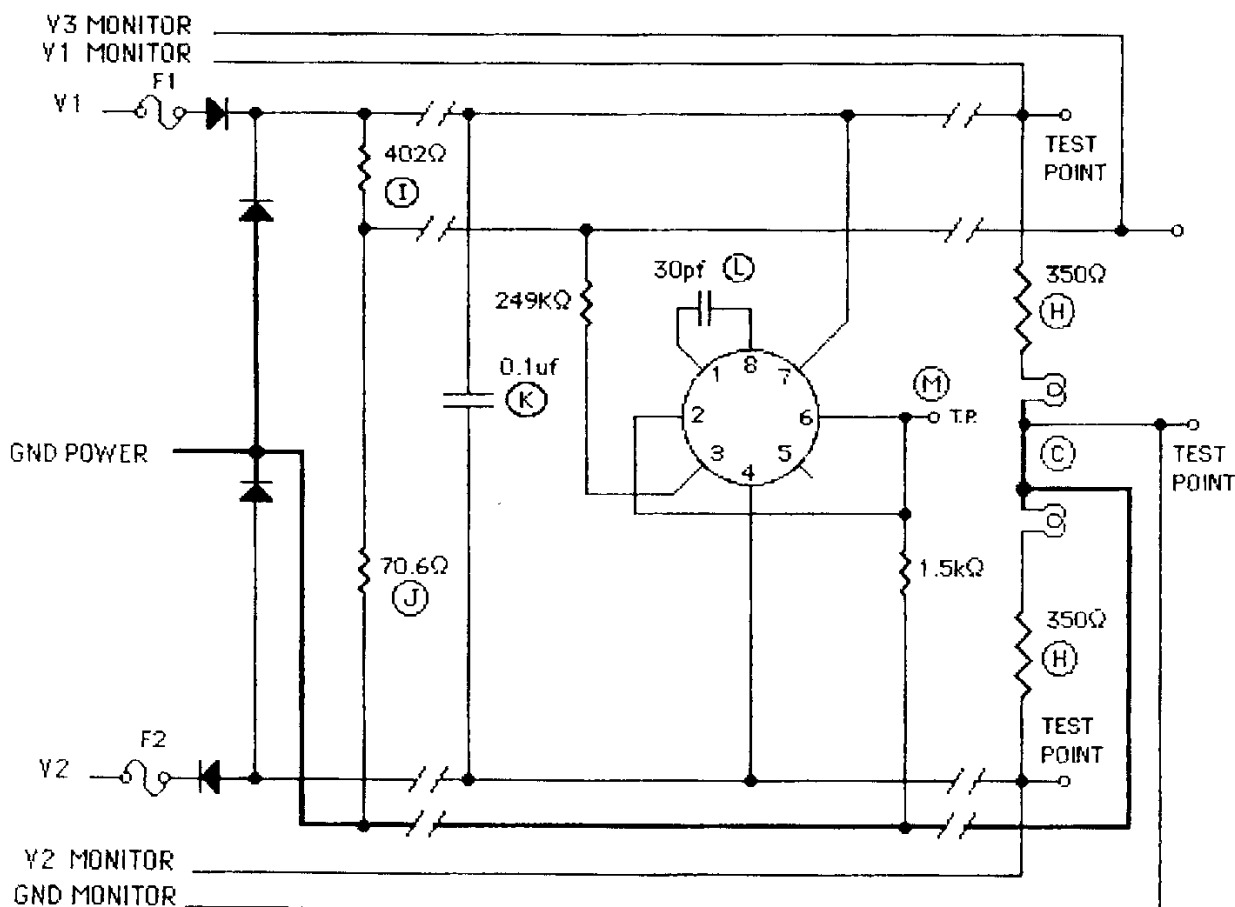
**FIGURE 1**

**TOTAL DOSE BIAS CIRCUIT**



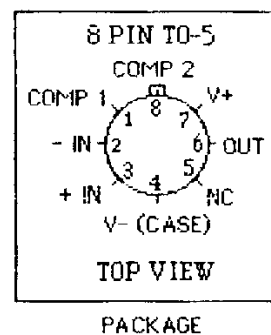
**FIGURE 2**

**BURN-IN CIRCUIT TO5, METAL CAN 8 LEAD**



**NOTES:**

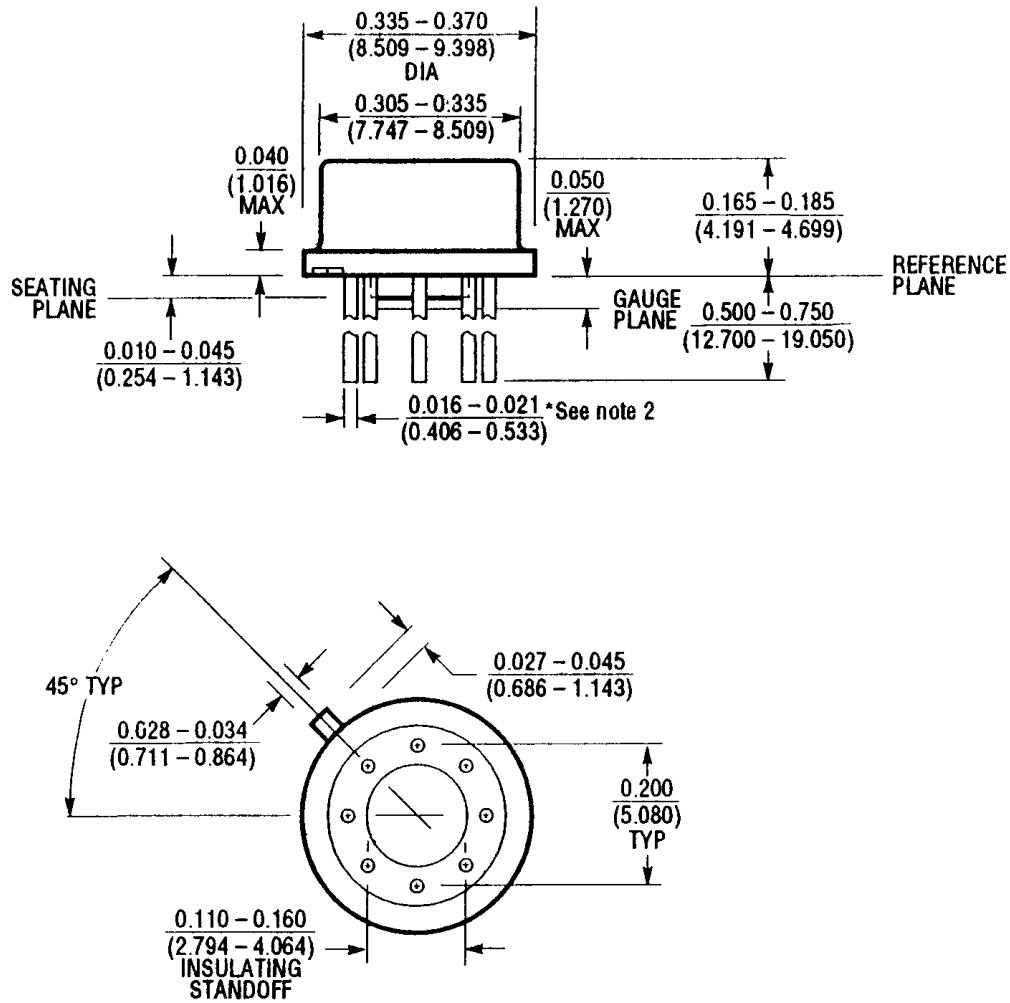
1. Unless otherwise specified, component tolerances shall be per military specification.
2.  $T_j = 166^\circ\text{C}$  maximum at  $150^\circ\text{C}$  ambient.
3. Burn-in Voltages:  $V_1 = +20\text{V}$  to  $+22\text{V}$   
 $V_2 = -20\text{V}$  to  $-22\text{V}$   
 $V_3 = +3.0\text{V}$  to  $+3.3\text{V}$  MONITOR ONLY



**FIGURE 3**



**TO5, 8 LEADS, CASE OUTLINE**

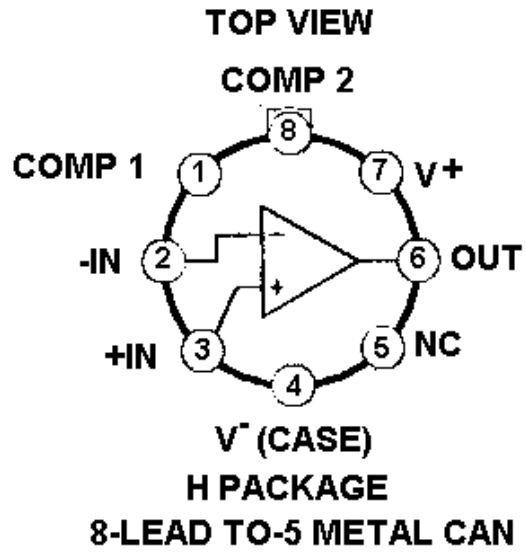


- NOTE: 1. LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND SEATING PLANE.  
 2. FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS 0.016 - 0.024 (0.406 - 0.610)

**FIGURE 4**

$\theta_{ja} = +150^{\circ}\text{C/W}$

$\theta_{jc} = +40^{\circ}\text{C/W}$

**TERMINAL CONNECTIONS****FIGURE 5**

**TABLE I DICE ELECTRICAL CHARACTERISTICS – Element Evaluation (Notes 4, 5, 7)**

SYMBOL	PARAMETER	CONDITIONS	NOTES	$T_A = 25^\circ\text{C}$		SUB-GROUP	$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$		SUB-GROUP	UNITS
				MIN	MAX		MIN	MAX		
$V_{OS}$	Input Offset Voltage				0.5	1		1.0	2,3	mV
$I_{OS}$	Input Offset Current				0.2	1		0.4	2,3	nA
$I_B$	Input Bias Current				2.0	1		3.0	2,3	nA
$A_{VOL}$	Large-Signal Voltage Gain	$V_S = \pm 15\text{V}$ , $V_{OUT} = \pm 10\text{V}$ $R_L \geq 10\text{k}$		80		4	40		5,6	V/mV
CMRR	Common Mode Rejection Ratio			96		1	96		2,3	dB
PSRR	Power Supply Rejection Ratio			96		1	96		2,3	dB
	Input Voltage Range	$V_S = \pm 15\text{V}$	3	$\pm 13.5$			$\pm 13.5$			V
$V_{OUT}$	Output Voltage Swing	$V_S = \pm 15\text{V}$ , $R_L = 10\text{k}$		$\pm 13$		4	$\pm 13$		5,6	V
$I_S$	Supply Current	(Note 6)			0.6	1		0.4 0.6	2 3	mA mA

**Note 1:** Differential input voltages greater than 1V will cause excessive current to flow through the input diodes unless limiting resistance is used.

**Note 2:** For supply voltages less than  $\pm 15\text{V}$ , the maximum input voltage is equal to the supply voltage.

**Note 3:** Guaranteed by design, characterization or correlation to other tested parameters.

**Note 4:**  $\pm 5\text{V} \leq V_S \leq \pm 20\text{V}$  unless otherwise noted.

**Note 5:**  $V_S = \pm 15\text{V}$ ,  $V_{CM} = 0\text{V}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise noted.

**Note 6:**  $25^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ .

**Note 7:** Dice are probe tested at  $25^\circ\text{C}$  to the limits shown. Final specs after assembly are sample tested during the elemental evaluation. Please refer to RH108AH data sheet. For absolute maximum ratings, typical specifications, performance curves and finished product specifications, please refer to the standard RH data sheets.

**TABLE II ELECTRICAL CHARACTERISTICS – Post-Irradiation (Note 5)**

SYMBOL	PARAMETER	CONDITIONS	NOTES	10KRAD (Si)		20KRAD (Si)		50KRAD (Si)		80KRAD (Si)		UNITS
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$V_{OS}$	Input Offset Voltage				0.5		0.5		0.5		1.0	mV
$I_{OS}$	Input Offset Current				0.3		0.3		0.3		0.3	nA
$I_B$	Input Bias Current				$\pm 2.0$		$\pm 2.0$		$\pm 2.0$		$\pm 4.0$	nA
$A_{VOL}$	Large-Signal Voltage Gain	$V_S = \pm 15\text{V}$ , $V_{OUT} = \pm 10\text{V}$ $R_L \geq 10\text{k}$		98		98		90		86		dB
CMRR	Common Mode Rejection Ratio			96		96		84		70		dB
PSRR	Power Supply Rejection Ratio		4	96		96		84		70		dB
	Input Voltage Range		3	$\pm 13.5$		$\pm 13.5$		$\pm 13.5$		$\pm 13.5$		V
$V_{OUT}$	Output Voltage Swing			$\pm 13$		$\pm 13$		$\pm 13$		$\pm 13$		V
$R_{IN}$	Input Resistance		3	30		30		30		30		M $\Omega$
$I_S$	Supply Current				0.6		0.6		0.6		0.6	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:** For supply voltages less than  $\pm 15\text{V}$ , the maximum input voltage is equal to the supply voltage.

**Note 3:** Guaranteed by design, characterization or correlation to other tested parameters.

**Note 4:**  $\pm 5\text{V} \leq V_S \leq \pm 20\text{V}$  preirradiation,  $\pm 5\text{V} \leq V_S \leq \pm 15\text{V}$  postirradiation, unless otherwise noted.

**Note 5:**  $V_S = \pm 15\text{V}$ ,  $V_{CM} = 0\text{V}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise noted.

**Note 6:**  $25^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ .

**TABLE III RH ELEMENT EVALUATION TABLE QUALIFICATION OF DICE SALES**



RH CANNED SAMPLE TABLE FOR QUALIFYING DICE SALES

SUBGROUP	CLASS K/S I/H/B	OPERATION	MIL-STD-883		QUANTITY (ACCEPT NUMBER) REF. METHOD 2018 FOR S/S
			METHOD	CONDITION	
1	X	SEM	2018	N/A	100%
2	X	ELEMENT ELECTRICAL (WAFER SORT @ 25°C)			100%
3	X	ELEMENT VISUAL (2nd OP)	2010	A	100%
4	X	INTERNAL VISUAL (3rd OP)	2010	A	ASSEMBLED PARTS ONLY
	X	DIE SHEAR MONITOR	2019		
	X	BOND PULL MONITOR	2011		
5	X	STABILIZATION BAKE	1008	C	ASSEMBLED PARTS ONLY
	X	TEMPERATURE CYCLE	1010	C	
	X	CONSTANT ACCELERATION	2001	E	
	X	FINE LEAK	1014	A	
	X	GROSS LEAK	1014	C	
6	X	FIRST ROOM ELECTRICAL - READ & RECORD (REPLACE ANY ASSEMBLY-RELATED REJECTS)			65 (3)
	X	ELECT. READ & RECORD @ +125°C or +150°C, -55°C			
	X	BURN-IN: +125°C/240 hrs. or +150°C/120 hrs.	1015	+125°C MINIMUM 240 HOURS	
	X	POST BURN-IN ELECTRICAL @ 25°C READ & RECORD			
	X	PRE OP-LIFE ELECTRICAL @ 25°C READ & RECORD			
	X	OPERATING LIFE: +125°C/1000 hrs. or +150°C/500 hrs.	1005	+125°C MINIMUM 1000 HOURS	
	X	POST OP-LIFE ELECT. (R&R 25°C, +125°C or +150°C, -55°C)			
7	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 a Sample Size Series of 10%, accept on 3, and note that the actual sample and accept number does not begin until Subgroup 6.

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

NOTE: LTC's radiation tolerant (RH) die has a topside glassivation thickness of 4KÅ 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, Subgroup 7. The larger sample size is at all times kept segregated and, if used for qualification, has all the required processing imposed.

05/22/13