

REVISION RECORD		
REV	DESCRIPTION	DATE
0	INITIAL RELEASE	06/12/96
A	<ul style="list-style-type: none"> PAGE 2, ADDED PARAGRAPHS 3.2.1, 3.2.2, 3.2.3. PARAGRAPH 3.3.B, ADDED “(SEE PARAGRAPH 3.2)”. PAGE 3, PARAGRAPH 3.12, WAFER LOT ACCEPTANCE, REDEFINED. PAGE 4, PARAGRAPH 4.4.2, GROUP B INSPECTION, REDEFINED. PARAGRAPH 4.4.3, GROUP D INSPECTION, REDEFINED. PARAGRAPH 4.5, SOURCE INSPECTION, REDEFINED. PAGE 6, FIGURE 1, TO46 CASE OUTLINE, ADDED θ_{ja} AND θ_{jc}. 	11/25/97
B	<ul style="list-style-type: none"> PAGE 4, AMENDED PARAGRAPHS 4.1 AND 4.1.1 TAKING EXCEPTION TO ANALYSIS OF CATASTROPHIC FAILURES. 	02/23/98
C	<ul style="list-style-type: none"> PAGE 6, FIGURE 1, CHANGED θ_{ja} AND θ_{jc}. 	09/29/99
D	<ul style="list-style-type: none"> PAGE 2, PARAGRAPHS 3.2.1, 3.2.2, 3.2.3 HAD FIGURES 1, 2, AND 3 REMOVED. PAGE 3, PARAGRAPH 3.7, CHANGED VERBIAGE FROM “SPECIFIED IN TABLE III” TO “ AND AS SPECIFIED IN TABLE III HEREIN”, LINE 2. PARAGRAPH 3.9 ADDED “HEREIN” AFTER “TABLE II” LINE 2. PARAGRAPH 3.9, ADDED “HEREIN” AFTER “TABLE II”, LINE 2. PAGE 4, PARAGRAPH 4.3, ADDED “HEREIN” AFTER “TABLE III”, LINE 2. PARAGRAPH 4.4.1, ADDED “HEREIN” AFTER “TABLE III”, LINE 2. PARAGRAPH 4.4.2.2, CHANGED VERBIAGE IN LINE 1 FROM “ALL FOOTNOTES OF TABLE IIA OF MIL-STD-883” TO “ALL FOOTNOTES PERTAINING TO TABLE IIA IN MIL-STD-883”. PARAGRAPH 4.4.3.2, CHANGED VERBIAGE IN LINE 1 FROM “ALL FOOTNOTES OF TABLE IV OF MIL-STD-883” TO “ALL FOOTNOTES PERTAINING TO TABLE IV IN MIL-STD-883”. 	04/05/01
E	<ul style="list-style-type: none"> PAGE 3: PARAGRAPH 3.6, TABLE IA CHANGED TO TABLE II. PARAGRAPH 3.7, TABLE III CHANGED TO TABLE IV. PARAGRAPH 3.9, TABLE II CHANGED TO TABLE III. PARAGRAPH 3.11.1 WAS CHANGED FROM “...dosage rate of approximately 20 Rads per second” TO “...dosage rate of less than or equal to 10 Rads per second”. PAGE 4: PARAGRAPHS 4.1 THROUGH 4.4.2.1 CHANGES WERE DONE TO CLARIFY GROUP SAMPLING. PARAGRAPH 4.4.3 CHANGE WAS DONE TO CLARIFY GROUP SAMPLING. PAGE 5: PARAGRAPHS 4.6.2 THROUGH 4.6.4 WERE RE-WRITTEN. THESE DATA PROVIDED, AND DATA AVAILABLE. PARAGRAPH 4.6.10 NOTE, ADDED FURTHER EXPLANATION OF MINIMUM DELIVERED DATA. PAGES 6 THROUGH 9, ALL FIGURE TITLES CHANGED TO HAVE DEVICE AND PACKAGE TYPES AT TOP OF PAGE, AND HAVE ALL FIGURES AT BOTTOM OF PAGE. PAGE 8, NOW HAS TOTAL DOSE CIRCUIT, FIGURE 3. PAGE 9, WRONG BURN-IN CIRCUIT REPLACED BY CORRECT BURN-IN CIRCUIT FOR DEVICE. NOW HAS STATIC BURN-IN CIRCUIT AS FIGURE 4 INSTEAD OF FIGURE 3. PAGE 10, TABLE I AND TABLE II PUT ON ONE PAGE. PAGE 11, TABLE II BECAME TABLE III, TABLE III BECAME TABLE IV. 	03/14/03

REVISION RECORD AND DESCRIPTION CONTINUED ON NEXT PAGE.

CAUTION: ELECTROSTATIC DISCHARGE SENSITIVE PART

REVISION	PAGE NO.	1	2	3	4	5	6	7	8	9	10	11	12					
INDEX	REVISION	H	H	H	H	H	H	H	H	H	H	H	H					
	ORIG																	
	DSGN																	
	ENGR																	
	MFG																	
	CM																	
	QA																	
	PROG																	
APPLICATION	FUNCT																	

LINEAR TECHNOLOGY CORPORATION
MILPITAS, CALIFORNIA
 TITLE:
MICROCIRCUIT, LINEAR,
6.9V, RH129, PRECISION REFERENCE

SIZE CAGE CODE DRAWING NUMBER REV
 64155 05-08-5027 H

CONTRACT:

FOR OFFICIAL USE ONLY

REVISION RECORD		
REV	DESCRIPTION	DATE
F	PAGE 4, CHANGED INITIAL RATE OF RADS TO 240 RADS/SEC.	03/15/05
G	PAGE 5, 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	01/07/08
H	PAGE 4, PARAGRAPH 3.11.1 CHANGED VERBIAGE.	05/05/08

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 RH129, Precision Reference, processed to space level manufacturing flow.

3.2 Part Number:

- 3.2.1 Device 01 – RH129AH (TO46 METAL CAN, 2 LEAD)
- 3.2.1 Device 02 – RH129BH (TO46 METAL CAN, 2 LEAD)
- 3.2.1 Device 03 – RH129CH (TO46 METAL CAN, 2 LEAD)

3.3 Part Marking Includes:

- a. LTC Logo
- b. LTC Part Number (See Paragraph 3.2)
- c. Date Code
- d. Serial Number
- e. ESD Identifier per MIL-PRF-38535, Appendix A

3.4 The Absolute Maximum Ratings:

Reverse Breakdown Current	. . . . .	30mA
Forward Current	. . . . .	2mA
Operating Temperature Range	. . . . .	-55°C to +125°C
Storage Temperature Range	. . . . .	-65°C to +150°C
Lead Temperature (Soldering, 10 sec)	. . . . .	+300°C

3.5 Electrostatic discharge sensitivity, ESDS, shall be Class 3.

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

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 IV** herein.

3.8 Burn-In Requirement: Burn-in circuit is specified in Figure 4.

3.9 Delta Limit Requirement: Delta limit parameters are specified in **Table III** 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.

3.10.2 Terminal Connections: The terminal connections shall be as specified in Figure 2.

3.10.3 Lead Material and Finish: The lead material and finish for Device shall be gold plated Kovar and may 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 3.

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 IV** 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 IV** 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% |
| | Group B, Subgroup 3 = 10% | (*per wafer or inspection lot |
| | | whichever is the larger quantity) |
| | 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:

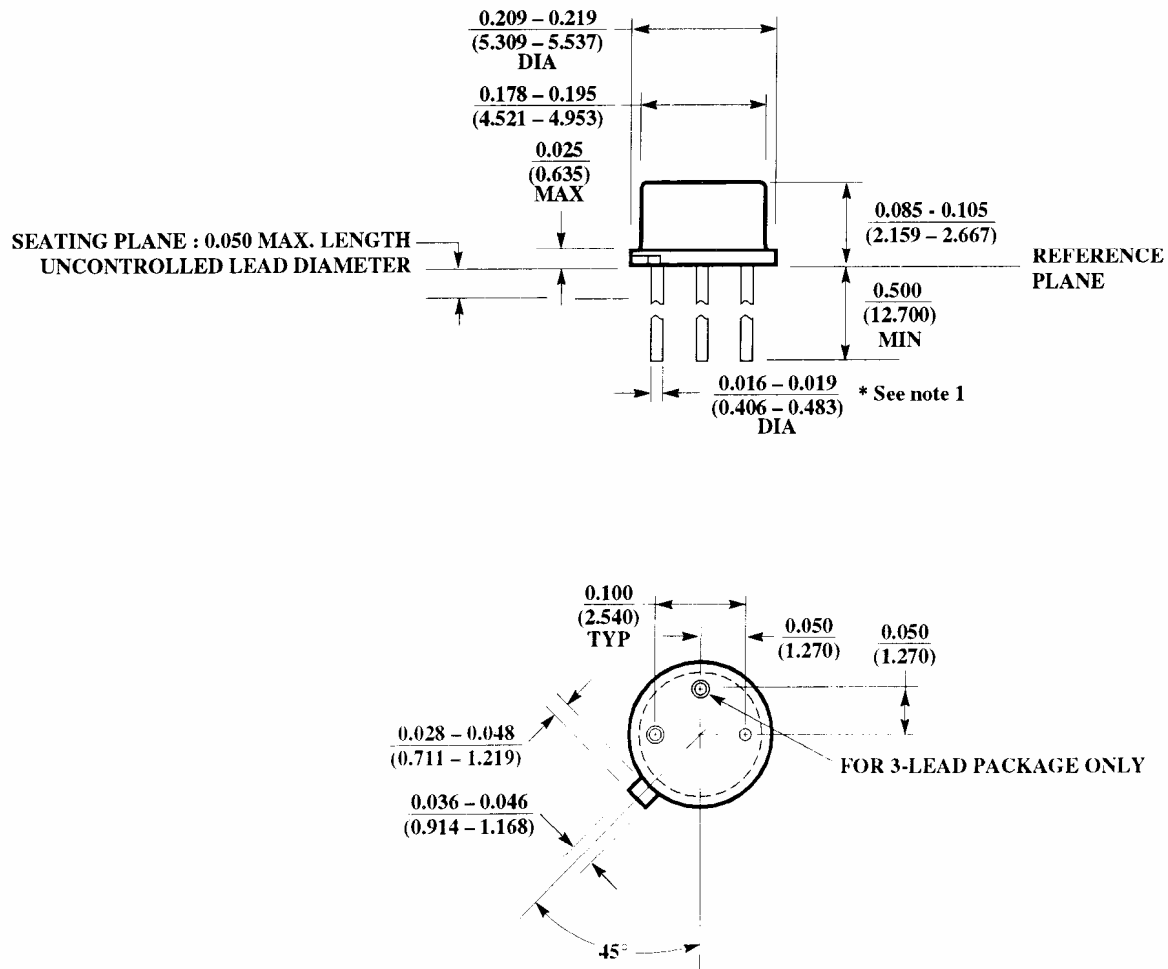
- 4.5.1 The manufacturer will coordinate Source Inspection at wafer lot acceptance and pre-seal internal visual.
- 4.5.2 The procuring activity has the right to perform source inspection at the supplier's facility prior to shipment for each lot of deliverables when specified as a customer purchase order 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.

(H) TO46 / 2 LEADS CASE OUTLINE

NOTE: 1. FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS $\frac{0.016 - 0.024}{(0.406 - 0.610)}$

$$\theta_{ja} = +440^{\circ}\text{C/W}$$

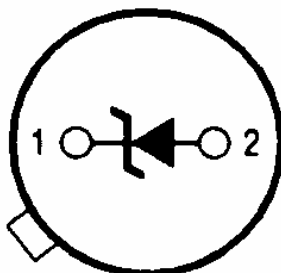
$$\theta_{jc} = +80^{\circ}\text{C/W}$$

NOTE: THIS CASE OUTLINE IS FOR BOTH 2 AND 3 LEAD TO46 PACKAGES.

FIGURE 1

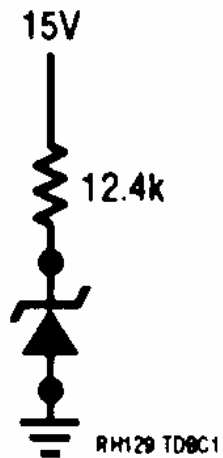
TERMINAL CONNECTIONS

BOTTOM VIEW

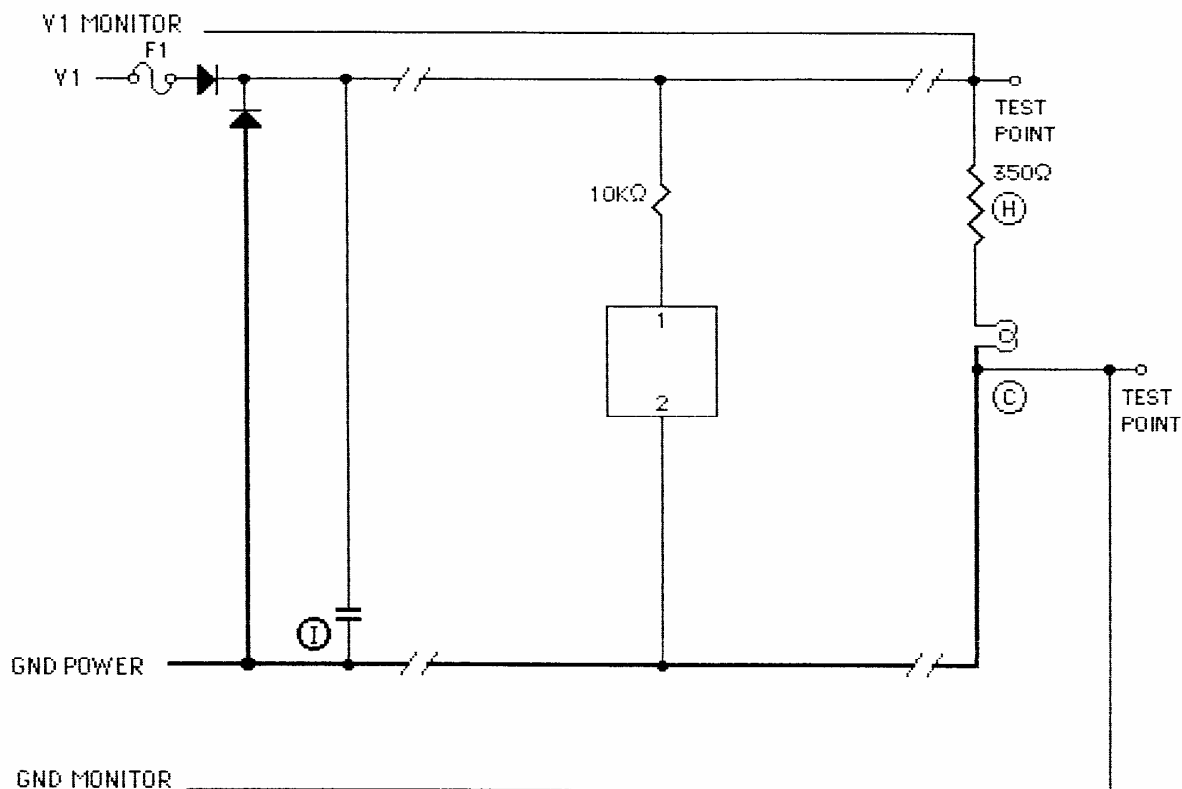


H PACKAGE
2-LEAD TO-46 METAL CAN

FIGURE 2

TOTAL DOSE BIAS CIRCUIT**FIGURE 3**

**STATIC BURN-IN CIRCUIT
TO46 METAL CAN / 2 LEADS**



NOTES:

1. Unless otherwise specified, component tolerances shall be per military specification.
2. $T_j = 159^\circ\text{C}$ maximum.
3. $T_a = 150^\circ\text{C}$.
4. Burn-in Voltages: $V_1 = +20\text{V}$ to $+22\text{V}$

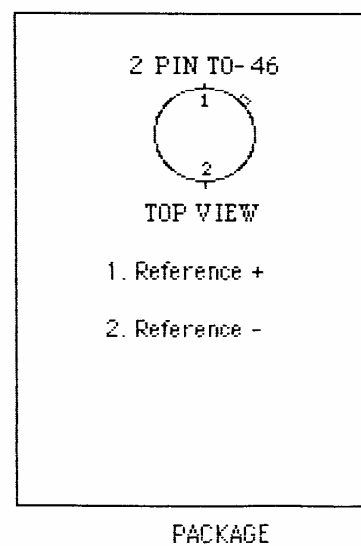


FIGURE 4

TABLE I: ELECTRICAL CHARACTERISTICS (PRE-IRRADIATION)

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	TYP	MAX		MIN	TYP	MAX		
V_Z	Reverse Breakdown Voltage	$0.6\text{mA} \leq I_R \leq 15\text{mA}$		6.7		7.2	1					V
$\frac{\Delta V_Z}{\Delta I_R}$	Reverse Breakdown Voltage Change with Current	$0.6\text{mA} \leq I_R \leq 15\text{mA}$ $1\text{mA} \leq I_R \leq 15\text{mA}$				14			12			mV mV
$\frac{\Delta V_Z}{\Delta \text{Temp}}$	Temperature Coefficient	$I_R = 1\text{mA}$, RH129A RH129B RH129C							10 20 50		2, 3 2, 3 2, 3	ppm/ $^\circ\text{C}$ ppm/ $^\circ\text{C}$ ppm/ $^\circ\text{C}$
	Change in TC	$1\text{mA} \leq I_R \leq 15\text{mA}$							1			ppm/ $^\circ\text{C}$
r_Z	Dynamic Impedance	$I_R = 1\text{mA}$ $1\text{mA} \leq I_R \leq 15\text{mA}$	1			2			0.8			Ω Ω
en	RMS Noise	$10\text{Hz} \leq f \leq 10\text{kHz}$	2			20	1					μV
$\frac{\Delta V_Z}{\Delta \text{Time}}$	Long Term Stability	$T_A = 25^\circ\text{C} \pm 0.1^\circ\text{C}$, $I_R = 1\text{mA} \pm 0.3\%$				20						ppm/kHr

TABLE II: ELECTRICAL CHARACTERISTICS (POST-IRRADIATION) NOTE 3

SYMBOL	PARAMETER	CONDITIONS	NOTES	10KRAD(Si)		20KRAD(Si)		50KRAD(Si)		100KRAD(Si)		200KRAD(Si)		UNITS
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
V_Z	Reverse Breakdown Voltage	$0.6\text{mA} \leq I_R \leq 15\text{mA}$		6.7	7.2	6.7	7.2	6.7	7.2	6.7	7.2	6.7	7.2	V
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse Breakdown Voltage Change with Current	$0.6\text{mA} \leq I_R \leq 15\text{mA}$			14		14		20		30		50	mV
$\frac{\Delta V_Z}{\Delta \text{Temp}}$	Temperature Coefficient	$I_R = 1\text{mA}$, RH129A			10		10		10		15		20	ppm/ $^\circ\text{C}$
	$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$	RH129B			20		20		20		25		30	ppm/ $^\circ\text{C}$
		RH129C			50		50		50		55		60	ppm/ $^\circ\text{C}$

Note 1: Guaranteed by design, characterization or correlation to other tested parameters.

Note 2: Guaranteed by correlation testing including enhancements for popcorn noise detection.

Note 3: $T_A = 25^\circ\text{C}$ unless otherwise noted.

TABLE III: POST BURN-IN ENDPOINTS AND DELTA LIMIT REQUIREMENTS $T_A = 25^{\circ}\text{C}$

PARAMETER	ENDPOINT LIMIT		DELTA		UNITS
	MIN	MAX	MIN	MAX	
V_Z	6.7	7.2	-0.03	0.03	V

TABLE IV: ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUP
FINAL ELECTRICAL TEST REQUIREMENTS (METHOD 5004)	1*, 2, 3
GROUP A TEST REQUIREMENTS (METHOD 5005)	1, 2, 3
GROUP B AND D FOR CLASS S ENDPOINT ELECTRICAL PARAMETERS (METHOD 5005)	1, 2, 3

*PDA APPLIES TO SUBGROUP 1.

PDA TEST NOTE: 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 and delta rejects 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.


DESCRIPTION

The RH129 precision reference features excellent stability over a wide range of voltage, temperature and operating current conditions. The device achieves low dynamic impedance by incorporating a high gain shunt regulator around the Zener. The excellent noise performance of the device is achieved by using a buried Zener design which eliminates surface noise usually associated with ordinary Zeners.

The wafer lots are processed to LTC's in-house Class S flow to yield circuits usable in stringent military applications.

ABSOLUTE MAXIMUM RATINGS

Reverse Breakdown Current	30mA
Forward Current	2mA
Operating Temperature Range	-55°C to 125°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

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BURN-IN CIRCUIT TOTAL DOSE BIAS CIRCUIT PACKAGE INFORMATION

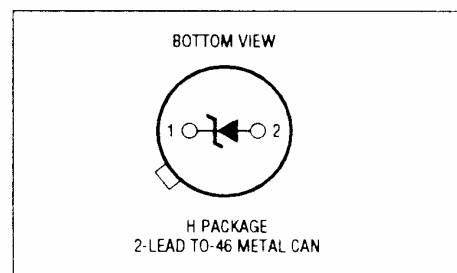
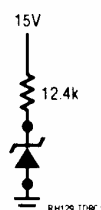
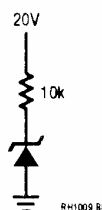


TABLE 1: ELECTRICAL CHARACTERISTICS (Preirradiation)

SYMBOL	PARAMETER	CONDITIONS	NOTES	T _A = 25°C			SUB-GROUP	-55°C ≤ T _A ≤ 125°C			SUB-GROUP	UNITS
				MIN	TYP	MAX		MIN	TYP	MAX		
V _Z	Reverse Breakdown Voltage	0.6mA ≤ I _R ≤ 15mA		6.7	7.2		1					V
ΔV _Z /ΔI _R	Reverse Breakdown Voltage Change with Current	0.6mA ≤ I _R ≤ 15mA 1mA ≤ I _R ≤ 15mA			14				12			mV mV
ΔV _Z /ΔTemp	Temperature Coefficient	I _R = 1mA, RH129A RH129B RH129C							10 20 50		2, 3 2, 3 2, 3	ppm/°C ppm/°C ppm/°C
	Change in TC	1mA ≤ I _R ≤ 15mA							1			ppm/°C
r _Z	Dynamic Impedance	I _R = 1mA 1mA ≤ I _R ≤ 15mA	1		2				0.8			Ω Ω
e _n	RMS Noise	10Hz ≤ f ≤ 10kHz	2		20		1					μV
ΔV _Z /ΔTime	Long Term Stability	T _A = 25°C ± 0.1°C, I _R = 1mA ± 0.3%			20							ppm/kHr

TABLE 1A: ELECTRICAL CHARACTERISTICS (Postirradiation) (Note 3)

SYMBOL	PARAMETER	CONDITIONS	NOTES	10KRAD(Si)		20KRAD(Si)		50KRAD(Si)		100KRAD(Si)		200KRAD(Si)		UNITS
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
V_Z	Reverse Breakdown Voltage	$0.6\text{mV} \leq I_R \leq 15\text{mA}$		6.7	7.2	6.7	7.2	6.7	7.2	6.7	7.2	6.7	7.2	V
$\frac{\Delta V_Z}{\Delta I_Z}$	Reverse Breakdown Voltage Change with Current	$0.6\text{mV} \leq I_R \leq 15\text{mA}$			14		14		20		30		50	mV
$\frac{\Delta V_Z}{\Delta T_{\text{Temp}}}$	Temperature Coefficient	$I_R = 1\text{mA}$, RH129A			10		10		10		15		20	ppm/°C
		$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$, RH129B			20		20		20		25		30	ppm/°C
		RH129C			50		50		50		55		60	ppm/°C

Note 1: Guaranteed by design, characterization or correlation to other tested parameters.

Note 2: Guaranteed by correlation testing including enhancements for popcorn noise detection.

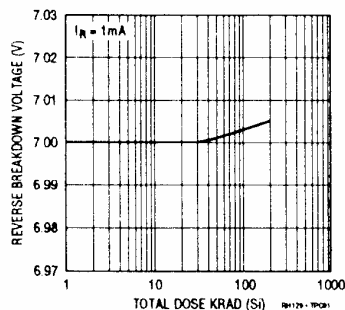
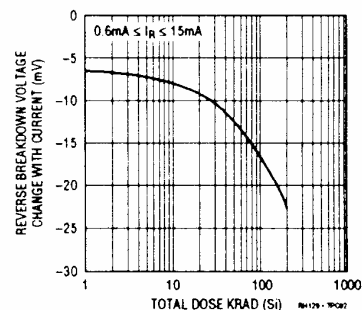
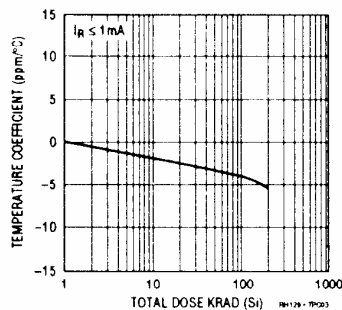
Note 3: $T_A = 25^\circ\text{C}$ unless otherwise noted.

TABLE 2: ELECTRICAL TEST REQUIREMENTS

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

* 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.

TYPICAL PERFORMANCE CHARACTERISTICS**Reverse Breakdown Voltage****Reverse Breakdown Voltage Change with Current****Temperature Coefficient****Reverse Dynamic Impedance**