REVISION RECORD

REV	DESCRIPTION	DATE
0	INITIAL RELEASE	10/05/10

CAUTION: ELECTROSTATIC DISCHARGE SENSITIVE PART

REVISION	PAGE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
INDEX	REVISION	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
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	ORIG		
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APPLICATION	FUNCT	SIGNOFFS	DATE

LINEAR TECHNOLOGY CORPORATION
MILPITAS, CALIFORNIA

TITLE:
MICROCIRCUIT, LINEAR, RH 1965MK
0.9A LOW NOISE
LOW DROPOUT REGULATOR DICE

SIZE	CAGE CODE	DRAWING NUMBER	REV
	64155	**05-08-5273**	**0**

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 RH1965 LOW DROPOUT REGULATOR DICE and Element Evaluation Test Samples, processed to space level manufacturing flow as specified herein.

3.2 Part Number: **RH1965MK 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 edges 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 ABSOLUTE MAXIMUM RATINGS
(Note 1)
IN Pin Voltage..±22V
OUT Pin Voltage..±22V
Input to Output Differential Voltage (Note 2).........±22V
ADJ Pin Voltage...±9V
SHDN Pin Voltage..±22V
Output Short-Circuit Duration..........................Indefinite
Operating Junction Temperature
Range (Notes 3, 5, 13).............................–55°C to 125°C
Storage Temperature Range....................–65°C to 150°C

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°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 VI** 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, Table III, Table IV and Table V** 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 **TO-3** 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 Die Bonding Pad Locations and Electrical Functions: Die layout (X-Y Coordinates) is specified in Table A

5.8.1 Die physical dimensions:

5.8.1.1 Die size: 71 mils x 66 mils

5.8.1.2 Scribe width: 3 mils

5.8.1.3 Die thickness: 12 mils

5.8.2 Interface materials:

5.8.2.1 Top metallization: AlSi1%Cu0.5%

5.8.2.2 Backside metallization: (Substrate) Alloyed gold layer

5.8.3 Glassivation:

5.8.3.1 Type: SiO_2

5.8.3.2 Thickness: Minimum of 4 kÅ

5.8.4 Substrate: Single crystal silicon

5.8.5 Assembly related information:

5.8.5.1 Substrate potential: GROUND

5.8.5.4 Die Attach: AuSi 30 x 30 x 2 mils

5.8.5.5 Bond wire: 1.75 mil AlSi

5.9 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 VI** herein.

6.3 Screening: Screening requirements shall be in accordance with **Table VI** 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)

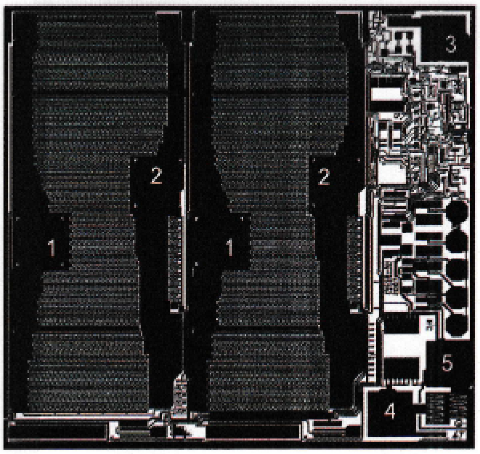
6.5.6 A copy of outside test laboratory radiation report if ordered

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



71mils × 66mils,
Backside metal: Alloyed gold (K) layer
Backside potential: GND

PAD FUNCTION

1. OUT
2. IN
3. SHDN
4. ADJ
5. GND

DIE CROSS REFERENCE

LTC® Finished Part Number	Order Part Number
RH1965MK	RH1965MK DICE
RH1965MK	RH1965MK DWF*

Please refer to LTC standard product data sheet for other applicable product information.
* DWF = DICE in wafer form.

FIGURE 1

TABLE A: DIE LAYOUT – X-Y COORDINATES

Pad Name	X (µm)	Y (µm)	W (µm)	H (µm)
OUT1	-718.00	-48.50	150.00	150.00
OUT2	-71.00	-48.50	150.00	150.00
IN1	-293.50	159.50	150.00	150.00
SHDN	735.00	671.50	150.00	150.00
IN2	349.00	159.50	150.00	150.00
TP_5_	786.00	-54.50	67.00	67.00
TP_4_	785.00	-52.50	67.00	67.00
TP_3_	785.50	-151.50	67.00	67.00
TP_2_	785.00	-250.50	67.00	67.00
TP_1_	785.00	-347.50	67.00	67.00
AGND	755.00	-486.00	150.00	150.00
ADJ	543.50	-663.00	150.00	150.00

Notes:

1. Origin of coordinates is the centroid of the dice.

TOTAL DOSE BIAS CIRCUIT

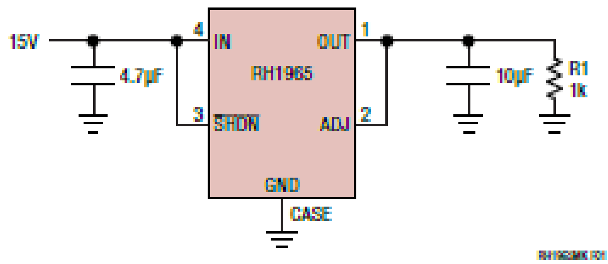
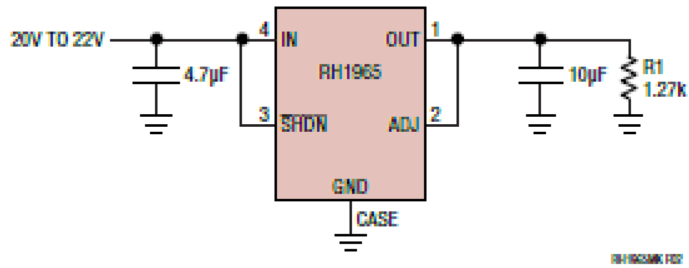


FIGURE 2

BURN-IN CIRCUIT



V_A = V1 = 20V TO 22V
V_C = GROUND
T_A = 125˚C
T_{JMAX} = 134 ˚C
THERMAL SHUTDOWN = 165±10˚C
DUT CURRENT = 1.65mA

1. OUT
2. ADJ
3. SHDN
4. IN
5. GROUND

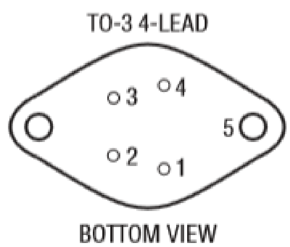
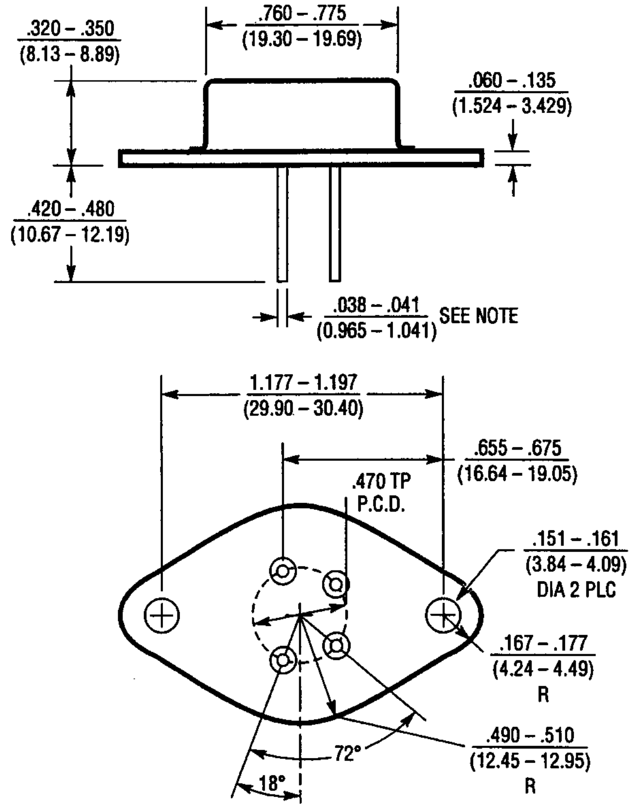


FIGURE 3

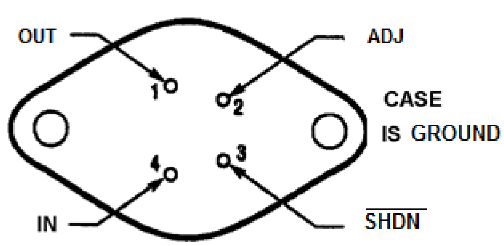
TO3, 4 LEADS, CASE OUTLINE



NOTE: FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .038 – .044 (0.965 – 1.118)

FIGURE 4

TERMINAL CONNECTIONS



K PACKAGE
4-LEAD TO-3 METAL CAN

TABLE I. DICE /DWF ELECTRICAL TEST LIMITS
T_A = 25°C (Note 3, 14, 15, 16)

PARAMETER	CONDITIONS	MIN	MAX	UNITS
ADJ Pin Voltage (Notes 4, 5)	V_{IN} = 2.1V, I_{LOAD} = 1mA	1.182	1.218	V
Line Regulation	ΔV_{IN} = 2.1V to 20V, I_{LOAD} = 1mA (Note 4)		5	mV
Load Regulation	V_{IN} = 2.3V, ΔI_{LOAD} = 1mA to 50mA (Note 4)		7	mV
Dropout Voltage $V_{IN} = V_{OUT(NOMINAL)}$ (Notes 6, 7, 12)	I_{LOAD} = 1mA I_{LOAD} = 50mA		0.08 0.16	V V
GND Pin Current $V_{IN} = V_{OUT(NOMINAL)}$ + 1V (Notes 6, 8)	I_{LOAD} = 0mA I_{LOAD} = 1mA I_{LOAD} = 100mA		0.7 1 4.5	mA mA mA
ADJ Pin Bias Current (Notes 4, 9)			4.5	µA
Shutdown Threshold	V_{OUT} = Off to On V_{OUT} = On to Off	 0.43	1.2 	V V
$\overline{SHDN}$ Pin Current (Note 10)	$V_{\overline{SHDN}}$ = 0V $V_{\overline{SHDN}}$ = 20V		1 10	µA µA
Quiescent Current in Shutdown	V_{IN} = 6V, $V_{\overline{SHDN}}$ = 0V		1	µA
Input Reverse-Leakage Current	V_{IN} = −20V, V_{OUT} = 0V		1	mA
Reverse-Output Current (Note 11)	V_{OUT} = 1.2V, V_{IN} = 0V (Note 4)		400	µA

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: Absolute maximum input to output differential voltage is not achievable with all combinations of rated IN pin and OUT pin voltages. With the IN pin at 22V, the OUT pin may not be pulled below 0V. The total measured voltage from IN to OUT must not exceed ±22V.

Note 3: The RH1965MK DICE is tested and specified under pulse load conditions such that $T_J \cong T_A$.

Note 4: The RH1965MK DICE is tested and specified for these conditions with the ADJ pin connected to the output.

Note 5: Maximum junction temperature limits operating conditions. The regulated output voltage specification does not apply for all possible combinations of input voltage and output current. Limit the output current range if operating at the maximum input voltage. Limit the input-to-output voltage differential if operating at the maximum output current.

Note 6: To satisfy minimum input voltage requirements, the RH1965MK DICE is tested and specified for these conditions with an external resistor divider (bottom 4.02k, top 4.32k) for an output voltage of 2.5V. The external resistor divider adds 300µA of output DC load current. This external current is not factored into GND pin current.

Note 7: Dropout voltage is the minimum input-to-output voltage differential needed to maintain regulation at a specified output current. In dropout, the output voltage equals: ($V_{IN} - V_{DROPOUT}$).

Note 8: GND pin current is tested with $V_{IN} = V_{OUT(NOMINAL)}$ + 1V and a current source load. GND pin current increases slightly in dropout.

Note 9: ADJ pin bias current flows into the ADJ pin.

Note 10: $\overline{SHDN}$ pin current flows into the $\overline{SHDN}$ pin.

Note 11: Reverse-output current is tested with the IN pin grounded and the OUT pin forced to 1.2V. This current flows into the OUT pin and out of the GND pin.

Note 12: The minimum input voltage specification limits the dropout voltage under some output voltage/load conditions

Note 13: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature exceeds the maximum junction temperature when overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

Note 14: Dice are probe tested at 25°C to the limits shown in Table 1. Except for high current tests, dice are tested under low current conditions which assure full load current specifications when assembled.

Note 15: Dice that are not qualified by Linear Technology with a can sample are guaranteed to meet specifications of Table 1 only. Dice qualified by Linear Technology with a can sample meet specifications in all tables.

Note 16: Please refer to the LT1965 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information, and Typical Applications.

TABLE II. ELECTRICAL CHARACTERISTICS (Preirradiation) (Notes 3, 15, 16)

PARAMETER	CONDITIONS	$T_A = 25°C$ MIN	MAX	SUB-GROUP	$-55°C < T_A < 125°C$ MIN	MAX	SUB-GROUP	UNITS
Minimum Input Voltage (Notes 4, 12)	$I_{LOAD} = 0.9A$		2.3	1		2.3	2, 3	V
ADJ Pin Voltage (Notes 4, 5)	$V_{IN} = 2.1V$, $I_{LOAD} = 1mA$	1.182	1.218	1	1.164	1.236	2, 3	V
Line Regulation	$\Delta V_{IN} = 2.1V$ to 20V, $I_{LOAD} = 1mA$ (Note 4)		6	1		8	2, 3	mV
Load Regulation	$V_{IN} = 2.3V$, $\Delta I_{LOAD} = 1mA$ to 0.9A (Note 4)		8	1		16	2, 3	mV
Dropout Voltage $V_{IN} = V_{OUT(NOMINAL)}$ (Notes 6, 7, 12)	$I_{LOAD} = 1mA$ $I_{LOAD} = 100mA$ $I_{LOAD} = 500mA$ $I_{LOAD} = 0.9A$		80 185 300 435	1 1 1 1		140 295 430 600	2, 3 2, 3 2, 3 2, 3	mV mV mV mV
GND Pin Current $V_{IN} = V_{OUT(NOMINAL)} + 1V$ (Notes 6, 8)	$I_{LOAD} = 0mA$ $I_{LOAD} = 1mA$ $I_{LOAD} = 100mA$ $I_{LOAD} = 500mA$ $I_{LOAD} = 0.9A$		0.85 1.1 4.6 16.5 30	1 1 1 1 1		1.1 1.5 5.5 20 38	2, 3 2, 3 2, 3 2, 3 2, 3	mA mA mA mA mA
Output Voltage Noise	$V_{OUT} = 2.5V$, $C_{OUT} = 10\mu F$, $I_{LOAD} = 0.9A$, BW = 10Hz to 100kHz	TYP = 40		1				μV_{RMS}
ADJ Pin Bias Current (Notes 4, 9)			4.5	1		4.5		μA
Shutdown Threshold	V_{OUT} = Off to On V_{OUT} = On to Off	 0.37	1.5	1	 0.2	2	2, 3	V V
$\overline{SHDN}$ Pin Current (Note 10)	$V_{\overline{SHDN}} = 0V$ $V_{\overline{SHDN}} = 20V$		1 10	1				μA μA
Quiescent Current in Shutdown	$V_{IN} = 6V$, $V_{\overline{SHDN}} = 0V$		1	1				μA
Ripple Rejection	$V_{IN} - V_{OUT} = 1.5V$ (AVG), $V_{RIPPLE} = 0.5V_{P-P}$, $f_{RIPPLE} = 120Hz$, $I_{LOAD} = 0.75A$	57		1				dB
Current Limit (Note 6)	$V_{IN} = V_{OUT(NOMINAL)} + 1V$, $\Delta V_{OUT} = -0.1V$	1.0		1	1.0		2, 3	A
Input Reverse-Leakage Current	$V_{IN} = -20V$, $V_{OUT} = 0V$		1	1				mA
Reverse-Output Current (Note 11)	$V_{OUT} = 1.2V$, $V_{IN} = 0V$ (Note 4)		400	1				μA

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: Absolute maximum input to output differential voltage is not achievable with all combinations of rated IN pin and OUT pin voltages. With the IN pin at 22V, the OUT pin may not be pulled below 0V. The total measured voltage from IN to OUT must not exceed ±22V.

Note 3: The RH1965MK DICE is tested and specified under pulse load conditions such that $T_J \cong T_A$.

Note 4: The RH1965MK DICE is tested and specified for these conditions with the ADJ pin connected to the output.

Note 8: GND pin current is tested with $V_{IN} = V_{OUT(NOMINAL)} + 1V$ and a current source load. GND pin current increases slightly in dropout.

Note 9: ADJ pin bias current flows into the ADJ pin.

Note 10: $\overline{SHDN}$ pin current flows into the $\overline{SHDN}$ pin.

Note 11: Reverse-output current is tested with the IN pin grounded and the OUT pin forced to 1.2V. This current flows into the OUT pin and out of the GND pin.

Note 12: The minimum input voltage specification limits the dropout voltage under some output voltage/load conditions

Note 13: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature exceeds the maximum junction temperature when

Note 5: Maximum junction temperature limits operating conditions. The regulated output voltage specification does not apply for all possible combinations of input voltage and output current. Limit the output current range if operating at the maximum input voltage. Limit the input-to-output voltage differential if operating at the maximum output current.

Note 6: To satisfy minimum input voltage requirements, the RH1965MK DICE is tested and specified for these conditions with an external resistor divider (bottom 4.02k, top 4.32k) for an output voltage of 2.5V. The external resistor divider adds 300μA of output DC load current. This external current is not factored into GND pin current.

Note 7: Dropout voltage is the minimum input-to-output voltage differential needed to maintain regulation at a specified output current. In dropout, the output voltage equals: $(V_{IN} - V_{DROPOUT})$.

overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

Note 14: Dice are probe tested at 25°C to the limits shown in Table 1. Except for high current tests, dice are tested under low current conditions which assure full load current specifications when assembled.

Note 15: Dice that are not qualified by Linear Technology with a can sample are guaranteed to meet specifications of Table 1 only. Dice qualified by Linear Technology with a can sample meet specifications in all tables.

Note 16: Please refer to the LT1965 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information, and Typical Applications.

TABLE III. ELECTRICAL CHARACTERISTICS (Postirradiation) $T_A = 25^{\circ}C$ (Notes 3, 15, 16)

PARAMETER	CONDITIONS	10kRads (Si)		20kRads (Si)		50kRads (Si)		100kRads (Si)		200kRads (Si)		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Minimum Input Voltage (Notes 4, 12)	$I_{LOAD} = 0.9A$		2.3		2.3		2.3		2.3		2.3	V
ADJ Pin Voltage (Notes 4, 5)	$V_{IN} = 2.1V$, $I_{LOAD} = 1mA$	1.176	1.224	1.176	1.224	1.176	1.224	1.176	1.224	1.176	1.224	V
Line Regulation (Note 4)	$\Delta V_{IN} = 2.1V$ to 20V, $I_{LOAD} = 1mA$		6		6		6		6		6	mV
Load Regulation	$V_{IN} = 2.3V$, $\Delta I_{LOAD} = 1mA$ to 0.9A (Note 4)		8		8		9		10		12	mV
Dropout Voltage (Notes 6, 7, 12)	$I_{LOAD} = 1mA$ $I_{LOAD} = 100mA$ $I_{LOAD} = 500mA$ $I_{LOAD} = 0.9A$		80 185 300 435		80 185 300 440		80 186 305 450		80 188 310 455		80 190 320 465	mV mV mV mV
GND Pin Current $V_{IN} = V_{OUT(NOMINAL)} + 1V$ (Notes 6, 8)	$I_{LOAD} = 0mA$ $I_{LOAD} = 1mA$ $I_{LOAD} = 100mA$ $I_{LOAD} = 500mA$ $I_{LOAD} = 0.9A$		0.85 1.1 4.8 17 31		0.85 1.1 4.9 18 32		0.85 1.1 5.2 19 34		0.85 1.1 6 21 38		0.85 1.1 7 25 45	mA mA mA mA mA
Output Voltage Noise	$V_{OUT} = 2.5V$, $C_{OUT} = 10\mu F$, $I_{LOAD} = 0.9A$, BW = 10Hz to 100kHz	TYP = 40		TYP = 40		TYP = 40		TYP = 40		TYP = 40		μV_{RMS}
ADJ Pin Bias Current (Notes 4, 9)			4.5		4.5		4.5		4.5		4.5	µA
Shutdown Threshold	V_{OUT} = Off to On V_{OUT} = On to Off	 0.37	1.5 	 0.37	1.5 	 0.37	1.5 	 0.37	1.5 	 0.37	1.5 	V V
$\overline{SHDN}$ Pin Current (Note 10)	$V_{\overline{SHDN}} = 0V$ $V_{\overline{SHDN}} = 20V$		1 10		1 10		1 10		1 10		1 10	µA µA
Quiescent Current in Shutdown	$V_{IN} = 6V$, $V_{\overline{SHDN}} = 0V$		1		1		1		1		1	µA
Ripple Rejection	$V_{IN} = 2.7V + 0.5V_{P-P}$, $V_{OUT} = 1.2V$ $f_{RIPPLE} = 120Hz$, $I_{LOAD} = 0.75A$	56		55		54		52		50		dB
Current Limit	$V_{IN} = V_{OUT(NOMINAL)} + 1V$, $\Delta V_{OUT} = -0.1V$	1.0		1.0		1.0		1.0		1.0		A
Input Reverse-Leakage Current	$V_{IN} = -20V$, $V_{OUT} = 0V$		1		1		1		1		1	mA
Reverse-Output Current (Note 11)	$V_{OUT} = 1.2V$, $V_{IN} = 0V$ (Note 4)		400		400		400		400		400	µA

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: Absolute maximum input to output differential voltage is not achievable with all combinations of rated IN pin and OUT pin voltages. With the IN pin at 22V, the OUT pin may not be pulled below 0V. The total measured voltage from IN to OUT must not exceed ±22V.

Note 3: The RH1965MK DICE is tested and specified under pulse load conditions such that $T_J \cong T_A$.

Note 4: The RH1965MK DICE is tested and specified for these conditions with the ADJ pin connected to the output.

Note 5: Maximum junction temperature limits operating conditions. The regulated output voltage specification does not apply for all possible combinations of input voltage and output current. Limit the output current range if operating at the maximum input voltage. Limit the input-to-output voltage differential if operating at the maximum output current.

Note 6: To satisfy minimum input voltage requirements, the RH1965MK DICE is tested and specified for these conditions with an external resistor divider (bottom 4.02k, top 4.32k) for an output voltage of 2.5V. The external resistor divider adds 300µA of output DC load current. This external current is not factored into GND pin current.

Note 7: Dropout voltage is the minimum input-to-output voltage differential needed to maintain regulation at a specified output current. In dropout, the output voltage equals: $(V_{IN} - V_{DROPOUT})$.

Note 8: GND pin current is tested with $V_{IN} = V_{OUT(NOMINAL)} + 1V$ and a current source load. GND pin current increases slightly in dropout.

Note 9: ADJ pin bias current flows into the ADJ pin.

Note 10: $\overline{SHDN}$ pin current flows into the $\overline{SHDN}$ pin.

Note 11: Reverse-output current is tested with the IN pin grounded and the OUT pin forced to 1.2V. This current flows into the OUT pin and out of the GND pin.

Note 12: The minimum input voltage specification limits the dropout voltage under some output voltage/load conditions

Note 13: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature exceeds the maximum junction temperature when overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

Note 14: Dice are probe tested at 25°C to the limits shown in Table 1. Except for high current tests, dice are tested under low current conditions which assure full load current specifications when assembled.

Note 15: Dice that are not qualified by Linear Technology with a can sample are guaranteed to meet specifications of Table 1 only. Dice qualified by Linear Technology with a can sample meet specifications in all tables.

Note 16: Please refer to the LT1965 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information, and Typical Applications.

TABLE IV. POST BURN-IN ENDPOINTS AND DELTA LIMIT REQUIREMENTS

T_A = 25°C

PARAMETER	CONDITIONS	ENDPOINT LIMITS MIN	ENDPOINT LIMITS MAX	DELTA LIMITS MIN	DELTA LIMITS MAX	UNITS
ADJ Pin Voltage (Notes 4, 5)	V_{IN} = 2.1V, I_{LOAD} = 1mA	1.182	1.218	–0.010	0.010	V
ADJ Pin Bias Current (Notes 4, 9)			4.5	–0.4	0.4	µA

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: Absolute maximum input to output differential voltage is not achievable with all combinations of rated IN pin and OUT pin voltages. With the IN pin at 22V, the OUT pin may not be pulled below 0V. The total measured voltage from IN to OUT must not exceed ±22V.

Note 3: The RH1965MK DICE is tested and specified under pulse load conditions such that $T_J \cong T_A$.

Note 4: The RH1965MK DICE is tested and specified for these conditions with the ADJ pin connected to the output.

Note 8: GND pin current is tested with $V_{IN} = V_{OUT(NOMINAL)}$ + 1V and a current source load. GND pin current increases slightly in dropout.

Note 9: ADJ pin bias current flows into the ADJ pin.

Note 10: $\overline{SHDN}$ pin current flows into the $\overline{SHDN}$ pin.

Note 11: Reverse-output current is tested with the IN pin grounded and the OUT pin forced to 1.2V. This current flows into the OUT pin and out of the GND pin.

Note 12: The minimum input voltage specification limits the dropout voltage under some output voltage/load conditions

Note 13: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature exceeds the maximum junction temperature when

Note 5: Maximum junction temperature limits operating conditions. The regulated output voltage specification does not apply for all possible combinations of input voltage and output current. Limit the output current range if operating at the maximum input voltage. Limit the input-to-output voltage differential if operating at the maximum output current.

Note 6: To satisfy minimum input voltage requirements, the RH1965MK DICE is tested and specified for these conditions with an external resistor divider (bottom 4.02k, top 4.32k) for an output voltage of 2.5V. The external resistor divider adds 300µA of output DC load current. This external current is not factored into GND pin current.

Note 7: Dropout voltage is the minimum input-to-output voltage differential needed to maintain regulation at a specified output current. In dropout, the output voltage equals: $(V_{IN} - V_{DROPOUT})$.

overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

Note 14: Dice are probe tested at 25°C to the limits shown in Table 1. Except for high current tests, dice are tested under low current conditions which assure full load current specifications when assembled.

Note 15: Dice that are not qualified by Linear Technology with a can sample are guaranteed to meet specifications of Table 1 only. Dice qualified by Linear Technology with a can sample meet specifications in all tables.

Note 16: Please refer to the LT1965 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information, and Typical Applications.

TABLE V. 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, 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.

TABLE VI. RH CANNED SAMPLE TABLE FOR 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 @ 25°C)			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: +125°C/240 hrs. or +150°C/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 @ 25°C READ & RECORD			
	X	X		OPERATING LIFE: +125°C/1000 hrs. or +150°C/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.