Adjustable 2.8A Single Resistor Low Dropout Regulator

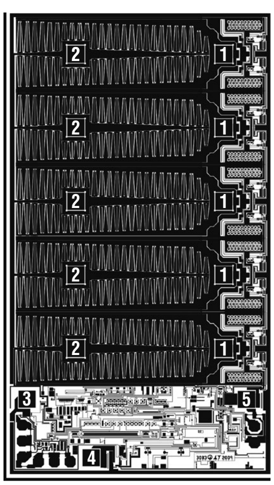
FEATURES

- **Outputs May Be Paralleled for Higher Current and Heat Spreading**
- **Single Resistor Sets Output Voltage**
- **Output Adjustable to 0V**
- **50μA SET Pin Current: 1% Initial Accuracy**
- Total Ionizing Dose (TID) Tolerance, per TM1019.8, MIL-STD-883 up to:
  - 200kRad (Si), per Condition A, at 50Rads(Si)/sec
  - 100kRad (Si), per Condition D, at 10mRads(Si)/sec
  - ELDRS Pass 100kRad(Si)
- Single Event Latchup (SEL) Threshold Linear Energy Transfer (LET) ≥ 110MeV • cm^2/mg at T_{CASE} = 100°C
- MIL-PRF-38535 Class V Compliant

DESCRIPTION

The RH3083 is a 2.8A low dropout linear regulator with a unique architecture featuring a precision current source and voltage follower which allows the output to be programmed to any voltage between zero and 18V. Multiple regulators can be paralleled to increase total output current and spread heat over a system PC board with no need for heat sinking. The pass transistor collector can be brought out independently of the circuit supply voltage to allow dropout voltage to approach the saturation limit of the pass transistor. A small 10μF capacitor on the output with an ESR of less than 0.5Ω is adequate to ensure stability. Applications with large output load transients require a larger output capacitor value to minimize output voltage change. Input circuitry ensures output safe operating area current limiting and thermal shutdown protection. The rated output current of an RH3083-based part is fixed by internal wire length/resistance. Linear Technology dice element evaluations are based on parts rated for 2.8A output current.

DICE PINOUT



66mils x 113mils
Backside metal: Alloyed gold (K) layer
Backside potential: OUT
Tie SENSE to OUT

PAD FUNCTION

1. IN
2. OUT
3. SENSE
4. SET
5. $V_{CONTROL}$

DIE CROSS REFERENCE

LTC® Finished Part Number	Order Part Number
RH3083MK	**RH3083MK DICE**
RH3083MK	**RH3083MK DWF***

Please refer to LT®3083 standard product data sheet for other applicable product information.

***DWF = DICE in wafer form.**

ABSOLUTE MAXIMUM RATINGS

(Note 1) (All voltages relative to V_{OUT})

$V_{CONTROL}$ Pin Voltage ....±28V
IN Pin Voltage ....18V, –0.3V
  No Overload or Short-Circuit ....23V, –0.3V
SET Pin Current (Note 6) ....±25mA
SET Pin Voltage (Relative to OUT, Note 6) .... ±10V
Output Short-Circuit Duration .... Indefinite
Operating Junction Temperature
Range (Notes 2, 10) .... –55°C to 125°C
Storage Temperature Range .... –65°C to 150°C

TABLE 1. DICE/DWF ELECTRICAL TEST LIMITS T_A = 25°C (Notes 2, 5, 8, 9, 11)

PARAMETER	CONDITIONS	MIN	MAX	UNITS
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	49.5	50.5	µA
Output Offset Voltage (V_{OUT} – V_{SET})	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	–2	2	mV
Load Regulation, I_{SET}	I_{LOAD} = 1mA to 50mA	–30	30	nA
Load Regulation, V_{OS}	I_{LOAD} = 1mA to 50mA	–0.5	0.5	mV
Line Regulation, I_{SET}	V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 1mA	–5	5	nA/V
Line Regulation, V_{OS}	V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 1mA	–0.008	0.008	mV/V
Minimum Load Current (Note 3)	V_{IN} = 1V, $V_{CONTROL}$ = 2V V_{IN} = 23V, $V_{CONTROL}$ = 25V		0.5 1	mA mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	V_{IN} = 1V, I_{LOAD} = 50mA		1.4	V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL}$ = 2V, I_{LOAD} = 50mA		25	mV
$V_{CONTROL}$ Pin Current (Note 5)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 50mA		6.5	mA

TABLE 2. ELECTRICAL CHARACTERISTICS (Preirradiation) (Notes 2, 9, 11)

PARAMETER	CONDITIONS	T_A = 25°C MIN	MAX	SUB-GROUP	–55°C < T_A < 125°C MIN	MAX	SUB-GROUP	UNITS
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	49.5	50.5	1	49	51.5	2, 3	µA
Output Offset Voltage (V_{OUT} – V_{SET})	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	–4	4	1	–6	6	2, 3	mV
Load Regulation, I_{SET}	I_{LOAD} = 1mA to 2.8A	–200	200	1	–300	300	2, 3	nA
Load Regulation, V_{OS}	I_{LOAD} = 5mA to 2.8A	–3	3	1	–4	4	2, 3	mV
Line Regulation, I_{SET}	V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 1mA V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 5mA	–8	8	1	 –10	 10	 2, 3	nA/V nA/V
Line Regulation, V_{OS}	V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 1mA V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 5mA	–0.02	0.02	1	 –0.05	 0.05	 2, 3	mV/V mV/V
Minimum Load Current (Note 3)	V_{IN} = 1V, $V_{CONTROL}$ = 2V V_{IN} = 23V, $V_{CONTROL}$ = 25V		0.5 1	1 1		5 5	2, 3 2, 3	mA mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	V_{IN} = 1V, I_{LOAD} = 0.1A V_{IN} = 1V, I_{LOAD} = 1A V_{IN} = 1V, I_{LOAD} = 2.8A		1.4 1.45 1.5	1 1 1		1.55 1.6 1.65	2, 3 2, 3 2, 3	V V V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A $V_{CONTROL}$ = 2V, I_{LOAD} = 1A $V_{CONTROL}$ = 2V, I_{LOAD} = 2.8A		35 220 650	1 1 1		35 280 750	2, 3 2, 3 2, 3	mV mV mV
$V_{CONTROL}$ Pin Current (Note 5)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1A V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 2.8A		10 35 80	1 1 1		10 40 90	2, 3 2, 3 2, 3	mA mA mA
Current Limit	V_{IN} = 5V, $V_{CONTROL}$ = 5V, V_{SET} = 0V, V_{OUT} = –0.1V	2.8		1	2.8		2, 3	A
Error Amplifier RMS Output Noise (Note 7)	I_{LOAD} = 500mA, 10Hz ≤ f ≤100kHz, C_{OUT} = 10µF, C_{SET} = 0.1µF	TYP = 40		1				$µV_{RMS}$
Reference Current RMS Output Noise (Note 7)	10Hz ≤ f ≤100kHz	TYP = 1		1				nA_{RMS}

TABLE 3. ELECTRICAL CHARACTERISTICS (Postirradiation) (Notes 2, 9, 11)

PARAMETER	CONDITIONS	10KRads(Si)		20KRads(Si)		50KRads(Si)		100KRads(Si)		200KRads(Si)		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	49	51	49	51	49	51	49	51	49	51	µA
Output Offset Voltage (V_{OUT} – V_{SET})	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	–4.5	4.5	–4.5	4.5	–4.5	4.5	–4.5	4.5	–4.5	4.5	mV
Load Regulation, I_{SET}	I_{LOAD} = 1mA to 2.8A	–300	300	–300	300	–300	300	–300	300	–300	300	nA
Load Regulation, V_{OS}	I_{LOAD} = 5mA to 2.8A	–3.5	3.5	–3.5	3.5	–3.5	3.5	–3.5	3.5	–3.5	3.5	mV
Line Regulation, I_{SET}	V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 1mA	–10	10	–10	10	–10	10	–10	10	–10	10	nA/V
Line Regulation, V_{OS}	V_{IN} = 1V to 23V, $V_{CONTROL}$ = 2V to 25V, I_{LOAD} = 1mA	–0.025	0.025	–0.025	0.025	–0.025	0.025	–0.03	0.03	–0.04	0.04	mV/V
Minimum Load Current (Note 3)	V_{IN} = 1V, $V_{CONTROL}$ = 2V V_{IN} = 23V, $V_{CONTROL}$ = 25V		0.5 1		0.5 1		0.5 1		0.5 1		0.5 1	mA mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	V_{IN} = 1V, I_{LOAD} = 0.1A V_{IN} = 1V, I_{LOAD} = 1A V_{IN} = 1V, I_{LOAD} = 2.8V		1.41 1.46 1.51		1.41 1.46 1.51		1.42 1.47 1.52		1.43 1.48 1.53		1.45 1.5 1.55	V V V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A $V_{CONTROL}$ = 2V, I_{LOAD} = 1A $V_{CONTROL}$ = 2V, I_{LOAD} = 2.8A		35 225 655		40 225 655		40 225 655		45 225 660		45 230 670	mV mV mV
$V_{CONTROL}$ Pin Current (Note 5)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1A V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 2.8A		10.1 36 82		10.1 37 83		10.2 38 85		10.5 40 90		11 45 100	mA mA mA
Current Limit	V_{IN} = 5V, $V_{CONTROL}$ = 5V, V_{SET} = 0V, V_{OUT} = –0.1V	2.8		2.8		2.8		2.8		2.8		A
Error Amplifier RMS Output Noise (Note 7)	I_{LOAD} = 500mA, 10Hz ≤ f ≤100kHz, C_{OUT} = 10µF, C_{SET} = 0.1µF	TYP = 40		TYP = 40		TYP = 40		TYP = 40		TYP = 40		$µV_{RMS}$
Reference Current RMS Output Noise (Note 7)	10Hz ≤ f ≤100kHz	TYP = 1		TYP = 1		TYP = 1		TYP = 1		TYP = 1		nA_{RMS}

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: Unless otherwise specified, all voltages are with respect to V_{OUT}. The RH3083MK DICE is tested and specified under pulse load conditions such that $T_J \cong T_A$.

Note 3: Minimum load current is equivalent to the quiescent current of the part. Since all quiescent and drive current is delivered to the output of the part, the minimum load current is the minimum current required to maintain regulation.

Note 4: Dropout results from either of minimum control voltage, $V_{CONTROL}$, or minimum input voltage, V_{IN}, both specified with respect to V_{OUT}. These specifications represent the minimum input-to-output differential voltage required to maintain regulation.

Note 5: The $V_{CONTROL}$ pin current is the drive current required for the output transistor. This current tracks output current with roughly a 1:60 ratio. The minimum value is equal to the quiescent current of the device.

Note 6: The SET pin is clamped to the output with diodes through 1k resistors. These resistors and diodes only carry current under transient overloads.

Note 7: Adding a small capacitor across the reference current resistor lowers output noise. Adding this capacitor bypasses the resistor shot noise and reference current noise; output noise is then equal to error amplifier noise (see LT®3083 Data Sheet and Application Note 83).

Note 8: 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 9: 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 10: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature exceeds the maximum operating junction temperature when overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

Note 11: Please refer to LT3083 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information, and Typical Applications.

TABLE 4. 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

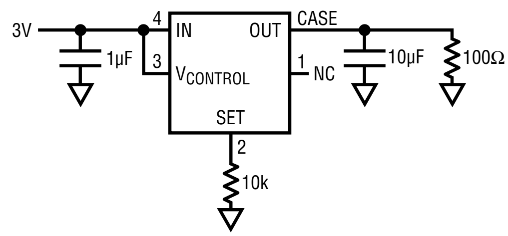
*PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

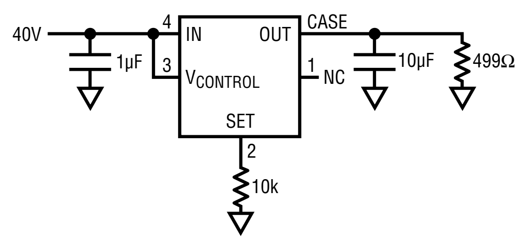
The PDA is specified as 5% based on failures from Group A, Subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of Group A, Subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot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

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

TOTAL DOSE BIAS CIRCUIT

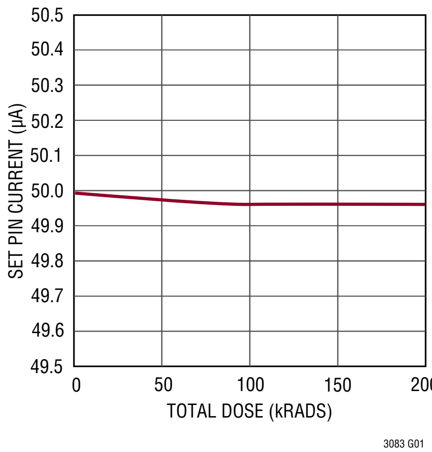


BURN-IN CIRCUIT

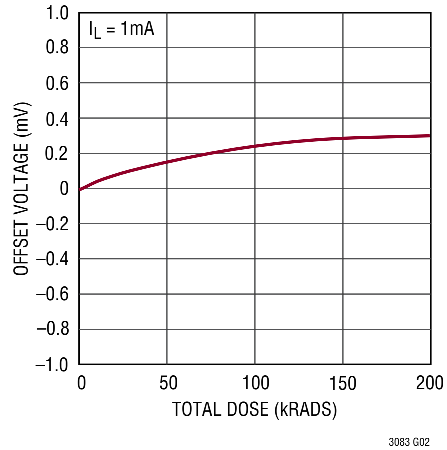


TYPICAL PERFORMANCE CHARACTERISTICS

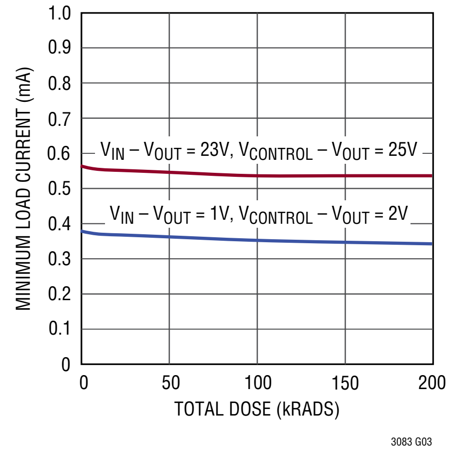
SET Pin Current



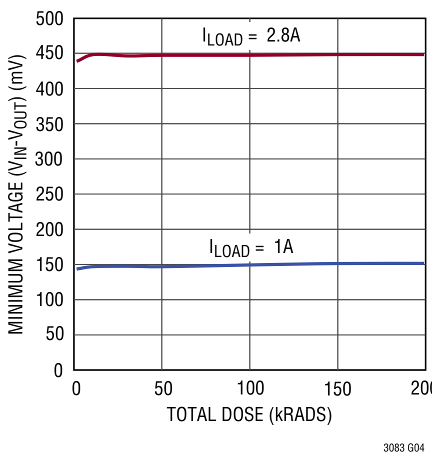
Offset Voltage



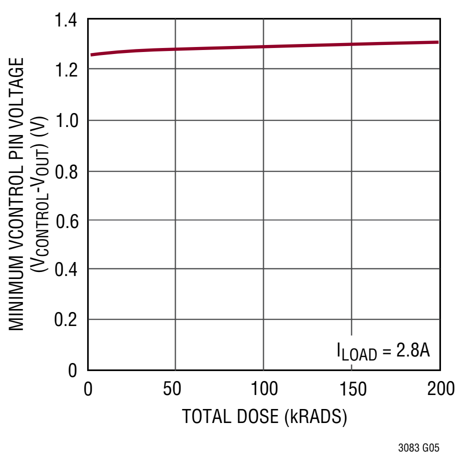
Minimum Load Current



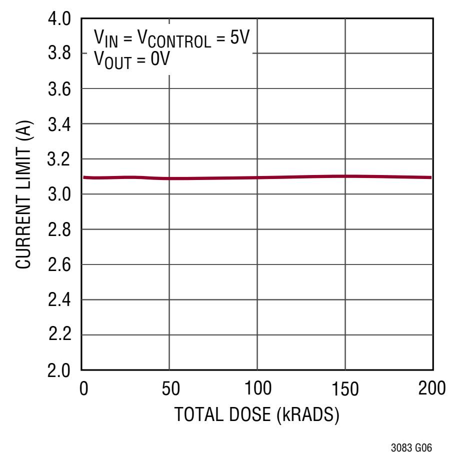
Dropout Voltage (Minimum IN Voltage)



Dropout Voltage (Minimum $V_{CONTROL}$ Pin Voltage)



Current Limit



REVISION HISTORY

REV	DATE	DESCRIPTION	PAGE NUMBER
A	10/14	I_L Min = 5mA; $V_{CONTROL}$ = 2V to 25V; Line Reg I_{SET} and Line Reg, V_{OS} update, added Note 11	2, 3, 4

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