ANALOG DEVICES | ADI Power by Linear™

RH3080MK DICE

Adjustable 0.9A Single Resistor Low Dropout Regulator

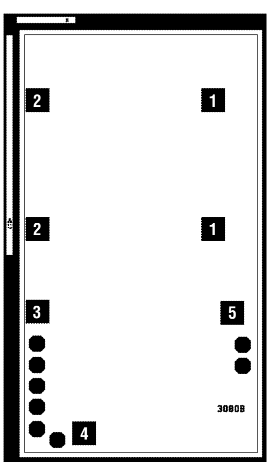
FEATURES

- **Outputs May Be Paralleled for Higher Current and Heat Spreading**
- **Single Resistor Sets Output Voltage**
- **Output Adjustable to 0V**
- **10µA SET Pin Current: 2% 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)
- Displacement Damage Defects (DDD) Up to 1E12 Neutrons/cm^2
- 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 RH3080 is a 0.9A 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 36V. 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 2.2µF 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 RH3080-based part is fixed by internal wire length/resistance. Linear Technology dice element evaluations are based on parts rated for 0.9A output current.

DICE PINOUT



44mils x 75mils
Backside metal: Alloyed gold 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
RH3080MK	**RH3080MK DICE**

Please refer to LT®3080 standard product data sheet for other applicable product information.

ABSOLUTE MAXIMUM RATINGS

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

$V_{CONTROL}$ Pin Voltage .... 40V, –0.3V
IN Pin Voltage (Note 11)................................ 40V, –0.3V
SET Pin Current (Note 6) .... ±10mA
SET Pin Voltage (Relative to OUT, Note 6) .... ±0.3V
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

Rev. D

TABLE 1. DICE ELECTRICAL TEST LIMITS

T_A = 25°C (Notes 2, 5, 8, 9, 12)

PARAMETER	CONDITIONS	MIN	MAX	UNITS
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	9.9	10.1	µA
Output Offset Voltage (V_{OUT} – V_{SET})	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	–5	5	mV
Load Regulation, I_{SET}	I_{LOAD} = 1mA to 100mA	–15	15	nA
Load Regulation, V_{OS}	I_{LOAD} = 1mA to 100mA	–1.0	1.0	mV
Line Regulation, I_{SET}	V_{IN} = 1V to 26V, $V_{CONTROL}$ = 2V to 26V, I_{LOAD} = 1mA	–0.45	0.45	nA/V
Line Regulation, V_{OS}	V_{IN} = 1V to 26V, $V_{CONTROL}$ = 2V to 26V, I_{LOAD} = 1mA	–0.05	0.05	mV/V
Minimum Load Current (Note 3)	V_{IN} = 10V, $V_{CONTROL}$ = 10V V_{IN} = 26V, $V_{CONTROL}$ = 26V		0.4 0.9	mA mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	V_{IN} = 1V, I_{LOAD} = 0.1A		1.4	V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A		0.17	V
$V_{CONTROL}$ Pin Current (Note 5)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A		5.3	mA

TABLE 2. ELECTRICAL CHARACTERISTICS

(Preirradiation) (Notes 2, 9, 12)

PARAMETER	CONDITIONS	T_A = 25°C MIN	T_A = 25°C MAX	SUB-GROUP	–55°C < T_A < 125°C MIN	–55°C < T_A < 125°C MAX	SUB-GROUP	UNITS
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	9.8	10.2	1	9.8	10.4	2, 3	µA
Output Offset Voltage (V_{OUT} – V_{SET})	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	–5	5	1	–6	6	2, 3	mV
Load Regulation, I_{SET}	I_{LOAD} = 1mA to 0.9A	–15	15	1	–30	30	2, 3	nA
Load Regulation, V_{OS}	I_{LOAD} = 1mA to 0.9A	–1.0	1.0	1	–1.5	1.5	2, 3	mV
Line Regulation, I_{SET} (Note 11)	V_{IN} = 1V to 26V, $V_{CONTROL}$ = 2V to 26V, I_{LOAD} = 1mA	–0.45	0.45	1	–0.6	0.6	2, 3	nA/V
Line Regulation, V_{OS} (Note 11)	V_{IN} = 1V to 26V, $V_{CONTROL}$ = 2V to 26V, I_{LOAD} = 1mA	–0.05	0.05	1	–0.06	0.06	2, 3	mV/V
Minimum Load Current (Notes 3, 11)	V_{IN} = 10V, $V_{CONTROL}$ = 10V V_{IN} = 26V, $V_{CONTROL}$ = 26V		0.4 0.9	1 1		0.6 1	2, 3 2, 3	mA mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	V_{IN} = 1V, I_{LOAD} = 0.1A V_{IN} = 1V, I_{LOAD} = 0.5A V_{IN} = 1V, I_{LOAD} = 0.9A		1.4 1.5 1.5	1 1 1		1.5 1.7	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} = 0.5A $V_{CONTROL}$ = 2V, I_{LOAD} = 0.8A		0.17 0.27 0.45	1 1 1		0.2 0.6	2, 3 2, 3 2, 3	V V V
$V_{CONTROL}$ Pin Current (Note 5)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.9A		5.3 22	1 1		6.3 30	2, 3 2, 3	mA mA
Current Limit	V_{IN} = 5V, $V_{CONTROL}$ = 5V, V_{SET} = 0V, V_{OUT} = –0.1V	0.9		1	0.9		2, 3	A
Error Amplifier RMS Output Noise (Note 7)	I_{LOAD} = 0.9A, 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, 12)

PARAMETER	CONDITIONS	10KRads(Si) MIN	10KRads(Si) MAX	20KRads(Si) MIN	20KRads(Si) MAX	50KRads(Si) MIN	50KRads(Si) MAX	100KRads(Si) MIN	100KRads(Si) MAX	200KRads(Si) MIN	200KRads(Si) MAX	UNITS
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	9.8	10.4	9.8	10.4	9.8	10.5	9.8	10.6	9.8	10.7	μA
Output Offset Voltage (V_{OUT} – V_{SET})	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	–8	8	–8	8	–8	8	–9	9	–10	10	mV
Load Regulation, I_{SET}	I_{LOAD} = 1mA to 0.9A	–15	15	–15	15	–25	25	–25	25	–25	25	nA
Load Regulation, V_{OS}	I_{LOAD} = 1mA to 0.9A	–1.25	1.25	–1.3	1.3	–1.35	1.35	–1.4	1.4	–1.5	1.5	mV
Line Regulation, I_{SET}	V_{IN} = 1V to 26V, $V_{CONTROL}$ = 2V to 26V, I_{LOAD} = 1mA	–0.8	0.8	–0.8	0.8	–0.9	0.9	–0.9	0.9	–1	1	nA/V
Line Regulation, V_{OS}	V_{IN} = 1V to 26V, $V_{CONTROL}$ = 2V to 26V, I_{LOAD} = 1mA	–0.06	0.06	–0.08	0.08	–0.1	0.1	–0.15	0.15	–0.2	0.2	mV/V
Minimum Load Current (Note 3)	V_{IN} = 10V, $V_{CONTROL}$ = 10V V_{IN} = 26V, $V_{CONTROL}$ = 26V		0.4 0.9		0.4 0.9		0.4 0.9		0.4 0.9		0.4 0.9	mA mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	V_{IN} = 1V, I_{LOAD} = 0.1A V_{IN} = 1V, I_{LOAD} = 0.9A		1.5 1.5		1.5 1.5		1.55 1.55		1.6 1.6		1.65 1.65	V V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A $V_{CONTROL}$ = 2V, I_{LOAD} = 0.8A		0.2 0.5		0.21 0.51		0.23 0.53		0.25 0.55		0.3 0.6	V V
CONTROL Pin Current (Note 5)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.1A V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 0.9A		5.3 22		5.3 22		5.3 22		5.3 22		5.3 22	mA mA
Current Limit	V_{IN} = 5V, $V_{CONTROL}$ = 5V, V_{SET} = 0V, V_{OUT} = –0.1V	0.9		0.9		0.9		0.9		0.9		A
Error Amplifier RMS Output Noise (Note 7)	I_{LOAD} = 0.9A, 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 RH3080MK DICE is tested and specified under pulse load conditions such that $T_J \approx T_A$.

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: SET pin is clamped to the output with diodes. These devices 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 LT3080 data sheet and Application Note AN83).

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: Current limit may decrease to zero at input-to-output differential voltages (V_{IN} – V_{OUT}) greater than 26V. Operation at voltages for both IN and $V_{CONTROL}$ is allowed up to a maximum of 36V as long as the difference between input and output voltage is below the specified differential (V_{IN} – V_{OUT}) voltage. Line and load regulation specifications are not applicable when the device is in current limit.

Note 12: Please refer to LT3080 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information and Typical Applications.

TABLE 4. 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
SET Pin Current (Note 6)	V_{IN} = 1V, $V_{CONTROL}$ = 2V, I_{LOAD} = 1mA	9.8	10.2	–0.2	0.2	µA

TABLE 5. 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

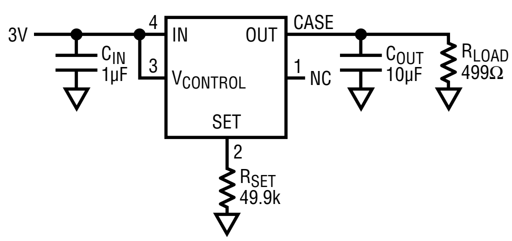
*PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

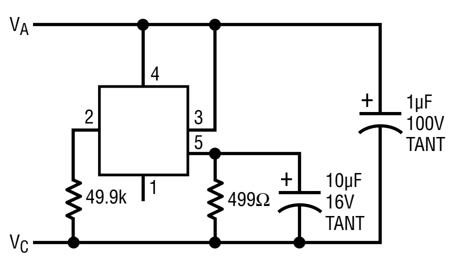
The PDA is specified as 5% based on failures from Group A, Subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of Group A, Subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot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

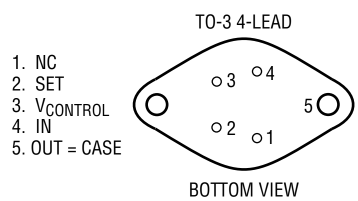
Linear Technology Corporation reserves the right to test to tighter limits than those given.

TOTAL DOSE BIAS CIRCUIT



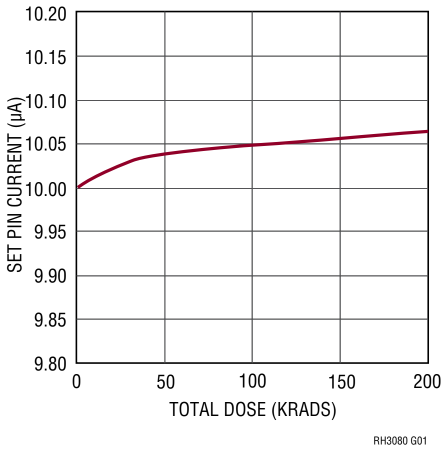
BURN-IN CIRCUIT



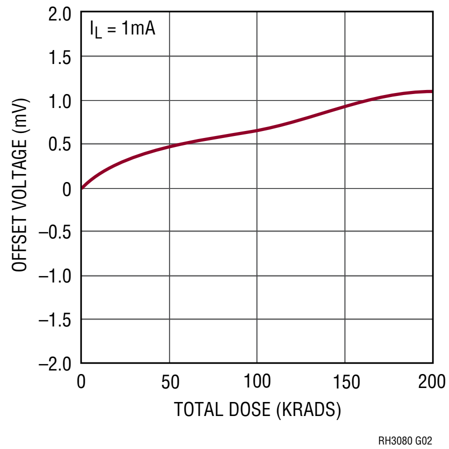


TYPICAL PERFORMANCE CHARACTERISTICS

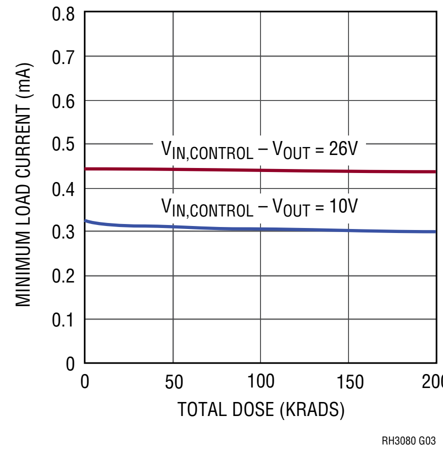
SET Pin Current



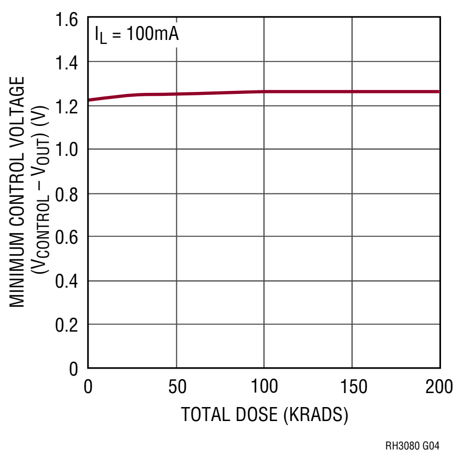
Offset Voltage (V_{OUT}-V_{SET})



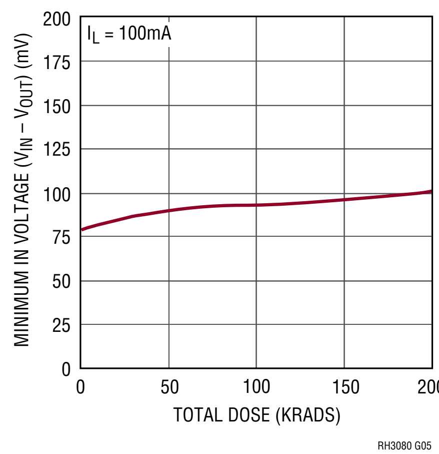
Minimum Load Current



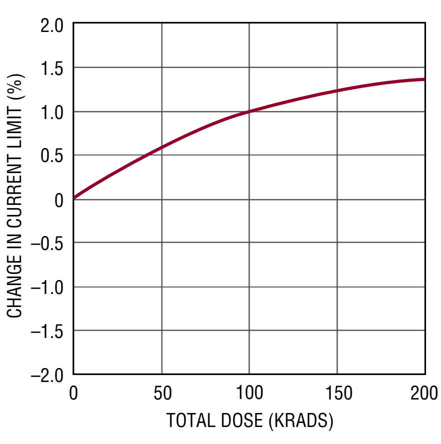
Dropout Voltage (Minimum $V_{CONTROL}$ Pin Voltage)



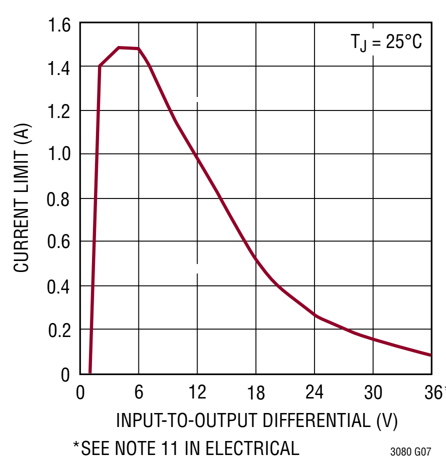
Dropout Voltage (Minimum IN Voltage)



Current Limit



Current Limit



*SEE NOTE 11 IN ELECTRICAL CHARACTERISTICS TABLE

REVISION HISTORY (Revision history begins at Rev B)

REV	DATE	DESCRIPTION	PAGE NUMBER
B	10/14	$V_{CONTROL}$ Pin Current, I_{LOAD} = 0.9A; Line Reg I_{SET}/V_{OS} $V_{CONTROL}$ = 2V to 26V, added Notes 11, 12.	1, 2, 3
C	05/15	V_A = V5 = 24.5V to 26.5V.	4
D	03/21	Changes made to Min, Max, Over-temp Max, post-radiation, and delta specification limits for SET Pin Current. Removed all DWF references from document.	1-5

Wafer level testing is performed per the indicated specifications for dice. Considerable differences in performance can often be observed for dice versus packaged units due to the influences of packaging and assembly on certain devices and/or parameters. Please consult factory for more information on dice performance and lot qualifications via lot sampling test procedures.

Dice data sheet subject to change. Please consult factory for current revision in production.