

## 0.5A and 1.5A Low Dropout Positive Adjustable Regulators

### DESCRIPTION

The RH1086M positive adjustable regulator is designed to provide 0.5A for the H package and 1.5A for the K package with higher efficiency than currently available devices. All internal circuitry is designed to operate down to 1V input-to-output differential and the dropout voltage is fully specified as a function of load current. Dropout is guaranteed at a maximum of 1.5V at maximum output current, decreasing at lower load currents. On-chip trimming adjusts the output voltage to 1%. Current limit is also trimmed, minimizing the stress on both the regulator and power source circuitry under overload conditions.

The RH1086M is pin compatible with older 3-terminal regulators. A 10 $\mu$ F output capacitor is required on this new device. However, this is usually included in most regulator designs.

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

### ABSOLUTE MAXIMUM RATINGS

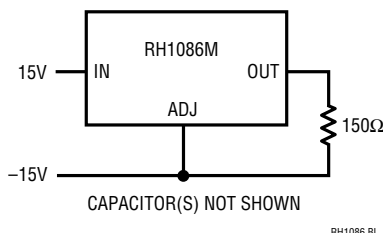
|                                            |                    |
|--------------------------------------------|--------------------|
| Power Dissipation .....                    | Internally Limited |
| Input-to-Output Voltage Differential ..... | 25V                |
| Operating Junction Temperature Range       |                    |
| Control Section .....                      | -55°C to 150°C     |
| Power Transistor .....                     | -55°C to 200°C     |
| Storage Temperature Range .....            | -65°C to 150°C     |
| Lead Temperature (Soldering, 10 sec) ..... | 300°C              |

### PRECONDITIONING

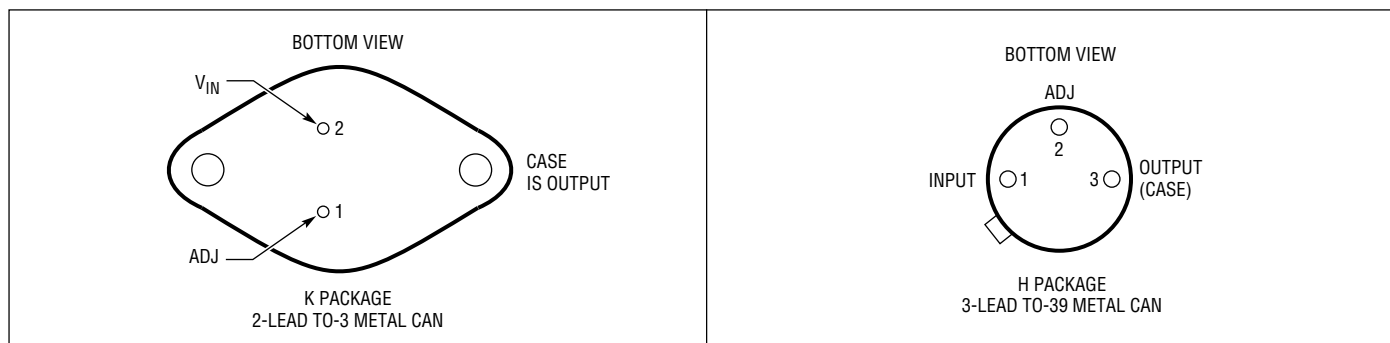
100% Thermal Limit Burn-In

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### BURN-IN CIRCUIT



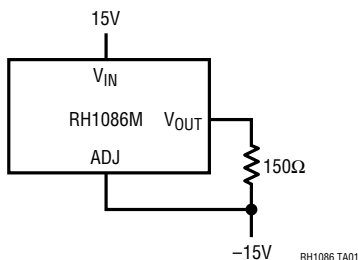
### PACKAGE INFORMATION



**Note: For ordering information contact LTC.**

**TABLE 1: ELECTRICAL CHARACTERISTICS** (Preirradiation)

| 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   |           |                      |
| Reference Voltage                      | $I_{OUT} = 10\text{mA}$ , $(V_{IN} - V_{OUT}) = 3\text{V}$ (K)                                                                                                |       | 1.238                      |       | 1.262 | 1         |                                                         |     |       |           | V                    |
|                                        | $10\text{mA} \leq I_{OUT} \leq I_{FULL\text{ LOAD}}$ ,<br>$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 15\text{V}$                                               | 5     | 1.225                      |       | 1.270 |           | 1.225                                                   |     | 1.270 | 2,3       | V                    |
| Line Regulation                        | $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 15\text{V}$                                                                               | 1,2   |                            |       | 0.2   | 1         |                                                         |     | 0.2   | 2,3       | %                    |
| Load Regulation                        | $(V_{IN} - V_{OUT}) = 3\text{V}$ ,<br>$10\text{mA} \leq I_{OUT} \leq I_{FULL\text{ LOAD}}$                                                                    | 1,2,5 |                            |       | 0.3   | 1         |                                                         |     | 0.4   | 2,3       | %                    |
| Dropout Voltage                        | $\Delta V_{REF} = 1\%$ , $I_{OUT} = 1.5\text{A}$ (K)<br>$\Delta V_{REF} = 1\%$ , $I_{OUT} = 0.5\text{A}$ (H)                                                  | 3     |                            |       | 1.5   | 1         |                                                         |     | 1.5   | 2,3       | V                    |
| Current Limit                          | $(V_{IN} - V_{OUT}) = 5\text{V}$ (K)                                                                                                                          |       | 1.5                        |       |       | 1         | 1.5                                                     |     |       | 2,3       | A                    |
|                                        | $(V_{IN} - V_{OUT}) = 5\text{V}$ (H)                                                                                                                          |       | 0.5                        |       |       | 1         | 0.5                                                     |     |       | 2,3       | A                    |
|                                        | $(V_{IN} - V_{OUT}) = 25\text{V}$ (K)                                                                                                                         |       | 0.05                       |       |       | 1         | 0.05                                                    |     |       | 2,3       | A                    |
|                                        | $(V_{IN} - V_{OUT}) = 25\text{V}$ (H)                                                                                                                         |       | 0.020                      |       |       | 1         | 0.020                                                   |     |       | 2,3       | A                    |
| Minimum Load Current                   | $(V_{IN} - V_{OUT}) = 25\text{V}$                                                                                                                             |       |                            |       | 10    | 1         |                                                         |     | 10    | 2,3       | mA                   |
| Thermal Regulation                     | 30ms Pulse                                                                                                                                                    |       |                            |       | 0.04  | 4         |                                                         |     |       |           | %/W                  |
| Ripple Rejection                       | $f = 120\text{Hz}$ , $C_{ADJ} = 25\mu\text{F}$ ,<br>$C_{OUT} = 25\mu\text{F}$ Tantalum,<br>$I_{OUT} = I_{FULL\text{ LOAD}}$ ( $V_{IN} - V_{OUT}) = 3\text{V}$ | 5     | 60                         |       |       | 4         | 60                                                      |     |       | 5,6       | dB                   |
| Adjust Pin Current                     |                                                                                                                                                               |       |                            | 55    | 120   |           |                                                         |     | 120   | 2,3       | $\mu\text{A}$        |
| Adjust Pin Current Change              | $10\text{mA} \leq I_{OUT} \leq I_{FULL\text{ LOAD}}$ ,<br>$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 15\text{V}$                                               | 5     |                            |       | 5     | 1         |                                                         |     | 5     | 2,3       | $\mu\text{A}$        |
| Temperature Stability                  |                                                                                                                                                               |       |                            | 0.5   |       |           |                                                         | 0.5 |       |           | %                    |
| Long Term Stability                    | $T_A = 125^{\circ}\text{C}$ , 1000 Hours                                                                                                                      | 4     |                            | 0.3   |       |           |                                                         |     |       |           | %                    |
| RMS Output Noise<br>(% of $V_{OUT}$ )  | $10\text{Hz} \leq f \leq 10\text{kHz}$                                                                                                                        |       |                            | 0.003 |       |           |                                                         |     |       |           | %                    |
| Thermal Resistance<br>Junction-to-Case | Control Circuitry (K)                                                                                                                                         | 4     |                            | 1.7   |       |           |                                                         |     |       |           | $^{\circ}\text{C/W}$ |
|                                        | Control Circuitry (H)                                                                                                                                         | 4     |                            | 15.0  |       |           |                                                         |     |       |           | $^{\circ}\text{C/W}$ |
|                                        | Power Transistor (K)                                                                                                                                          | 4     |                            | 4.0   |       |           |                                                         |     |       |           | $^{\circ}\text{C/W}$ |
|                                        | Power Transistor (H)                                                                                                                                          | 4     |                            | 20.0  |       |           |                                                         |     |       |           | $^{\circ}\text{C/W}$ |

**Total Dose Bias Circuit**

**TABLE 1A: ELECTRICAL CHARACTERISTICS** (Postirradiation)  $T_A = 25^\circ\text{C}$  unless otherwise noted.

| PARAMETER                          | CONDITIONS                                                                                                    | 10KRAD(Si) |       | 20KRAD(Si) |       | 50KRAD(Si) |       | 100KRAD(Si) |       | 200KRAD(Si) |       | UNITS         |
|------------------------------------|---------------------------------------------------------------------------------------------------------------|------------|-------|------------|-------|------------|-------|-------------|-------|-------------|-------|---------------|
|                                    |                                                                                                               | MIN        | MAX   | MIN        | MAX   | MIN        | MAX   | MIN         | MAX   | MIN         | MAX   |               |
| Reference Voltage (Note 5)         | $I_{OUT} = 10\text{mA}$ ( $V_{IN} - V_{OUT} = 3\text{V}$ (K))                                                 | 1.234      | 1.258 | 1.230      | 1.257 | 1.225      | 1.253 | 1.220       | 1.247 | 1.205       | 1.241 | V             |
|                                    | $10\text{mA} \leq I_{OUT} \leq I_{FULL\text{ LOAD}}$<br>$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 15\text{V}$ | 1.220      | 1.275 | 1.219      | 1.275 | 1.215      | 1.275 | 1.210       | 1.275 | 1.20        | 1.275 | V             |
| Line Regulation (Notes 1, 2)       | $I_{OUT} = 10\text{mA}$<br>$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 15\text{V}$                              |            | 0.2   |            | 0.21  |            | 0.23  |             | 0.25  |             | 0.3   | %             |
| Load Regulation (Notes 1, 2, 5)    | $(V_{IN} - V_{OUT}) = 3\text{V}$<br>$10\text{mA} \leq I_{OUT} \leq I_{FULL\text{ LOAD}}$                      |            | 0.3   |            | 0.3   |            | 0.3   |             | 0.3   |             | 0.3   | %             |
| Dropout Voltage (Note 3)           | $\Delta V_{REF} = 1\%$ , $I_{OUT} = 1.5\text{A}$ (K)<br>$\Delta V_{REF} = 1\%$ , $I_{OUT} = 0.5\text{A}$ (H)  |            | 1.5   |            | 1.51  |            | 1.52  |             | 1.55  |             | 1.575 | V             |
| Current Limit                      | $(V_{IN} - V_{OUT}) = 5\text{V}$ (K)                                                                          | 1.5        |       | 1.5        |       | 1.5        |       | 1.5         |       | 1.5         |       | A             |
|                                    | $(V_{IN} - V_{OUT}) = 25\text{V}$ (K)                                                                         | 0.05       |       | 0.049      |       | 0.048      |       | 0.047       |       | 0.045       |       | A             |
|                                    | $(V_{IN} - V_{OUT}) = 5\text{V}$ (H)                                                                          | 0.5        |       | 0.5        |       | 0.5        |       | 0.5         |       | 0.5         |       | A             |
|                                    | $(V_{IN} - V_{OUT}) = 25\text{V}$ (H)                                                                         | 0.020      |       | 0.019      |       | 0.019      |       | 0.018       |       | 0.017       |       | A             |
| Minimum Load Current               | $(V_{IN} - V_{OUT}) = 25\text{V}$                                                                             |            | 10    |            | 10    |            | 10    |             | 10    |             | 10    | mA            |
| Adjust Pin Current                 |                                                                                                               |            | 120   |            | 120   |            | 120   |             | 120   |             | 120   | $\mu\text{A}$ |
| Adjust Pin Current Change (Note 5) | $10\text{mA} \leq I_{OUT} \leq I_{FULL\text{ LOAD}}$<br>$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 15\text{V}$ |            | 5     |            | 5     |            | 5     |             | 5     |             | 5     | $\mu\text{A}$ |

**Note 1:** See thermal regulation specifications for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing.

**Note 2:** Line and load regulation are guaranteed up to the maximum power dissipation of 15W for RH1086MK and 3W for the RH1086MH. Power dissipation is determined by the input/output differential voltage and the output current. Guaranteed maximum power dissipation will not be available over the full input/output voltage range.

**Note 3:** Dropout voltage is specified over the full output current range of the device. Test points and limits are shown on the Dropout Voltage curve in the LT<sup>®</sup>1086 data sheet.

**Note 4:** Guaranteed by design, characterization, or correlation to other tested parameters.

**Note 5:**  $I_{FULL\text{ LOAD}}$  is defined in the Current Limit curves in the standard data sheet. For compliance with 883 revision C current density specifications, the RH1086MK is derated to 1A.

**TABLE 2: ELECTRICAL TEST REQUIREMENTS**

| MIL-STD-883 TEST REQUIREMENTS                               | SUBGROUP     |
|-------------------------------------------------------------|--------------|
| Final Electrical Test Requirements (Method 5004)            | 1*,2,3,4,5,6 |
| Group A Test Requirements (Method 5005)                     | 1,2,3,4,5,6  |
| Group C and D End Point Electrical Parameters (Method 5005) | 1            |

\* PDA Applies to subgroup 1. See PDA Test Notes.

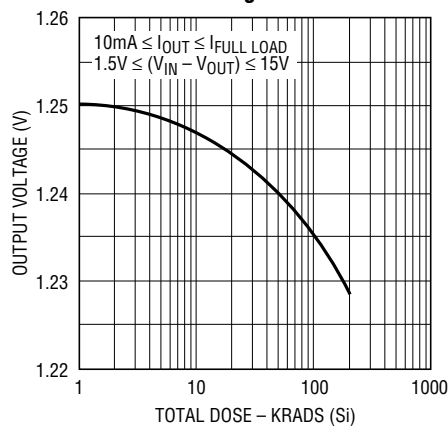
#### PDA Test Notes

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 Class B. 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.

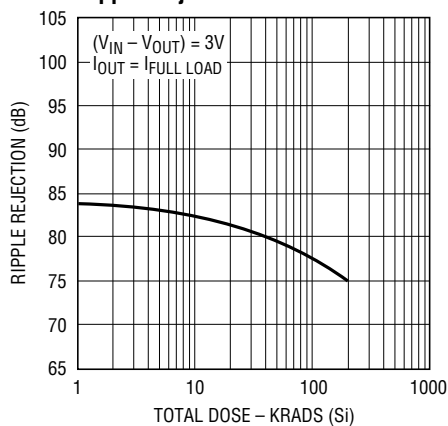
Linear Technology Corporation reserves the right to test to tighter limits than those given.

# TYPICAL PERFORMANCE CHARACTERISTICS

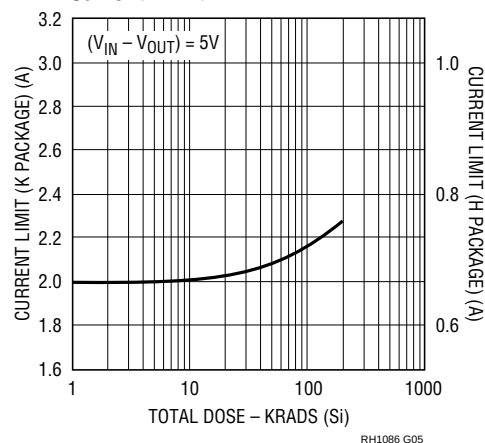
Reference Voltage



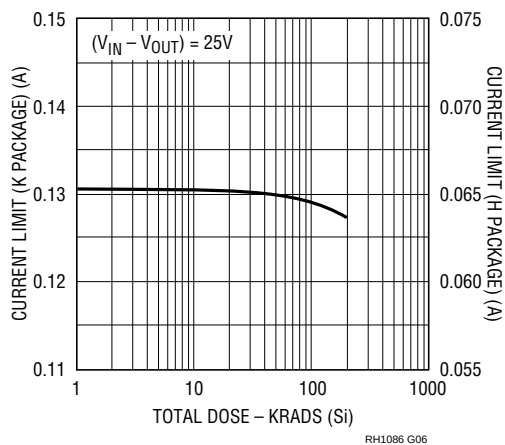
Ripple Rejection



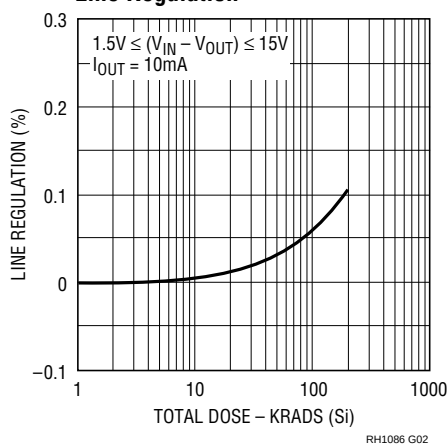
Current Limit



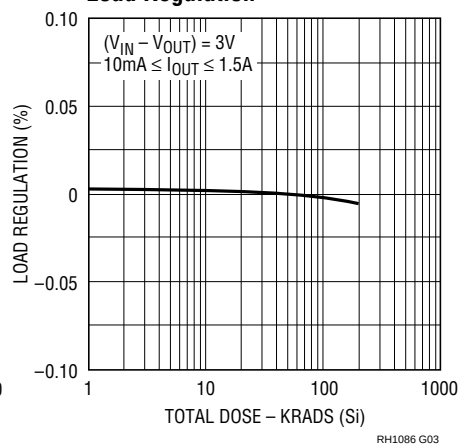
Current Limit



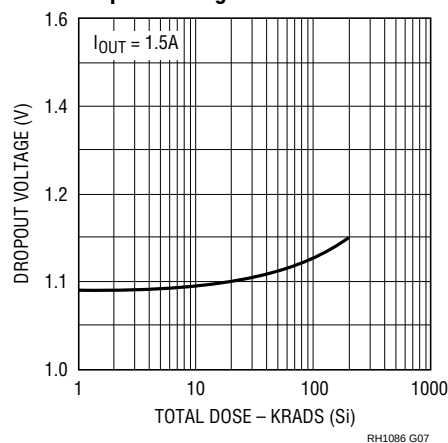
Line Regulation



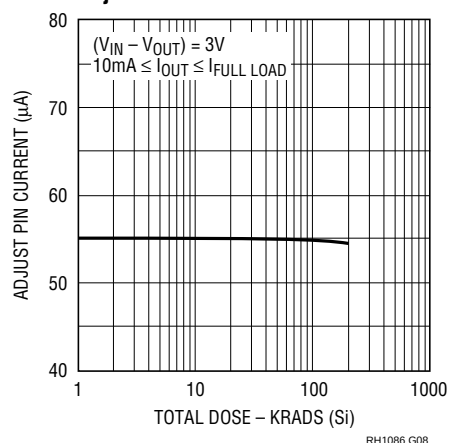
Load Regulation



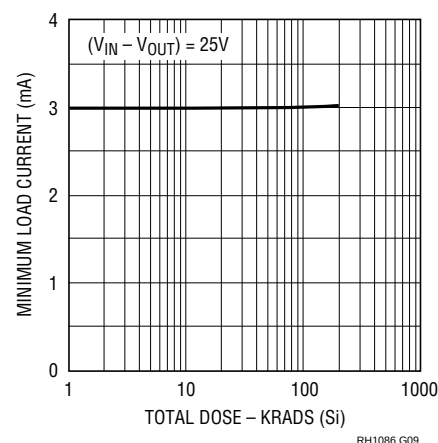
Dropout Voltage



Adjust Pin Current



Minimum Load Current



I.D. No. 66-11-1086