

## LM137QML 3 端子可调节负稳压器

### 1 特性

- SMD 5962-99517
- 支持高达 30krad(Si) 的 TID
- 可调节输出电压范围为  $-37V$  至  $-1.2V$
- 1.5A 额定输出电流,  $-55^{\circ}C$  至  $+150^{\circ}C$
- 线路调节 0.01%/V (典型值)
- 负载调节 0.3% (典型值)
- 出色的热调节: 0.002%/W
- 77dB 纹波抑制
- 出色的热瞬态抑制
- 50ppm/ $^{\circ}C$  温度系数
- 电流限制不受温度影响
- 内部热过载保护
- 标准 3 引线晶体管封装
- 输出受到短路保护

### 2 应用

- 通用电源
- 卡上电压调节
- 可编程电压电源
- 高精度电流电源
- 苛刻的环境

### 3 说明

LM137 是一种可调节 3 端子负电压稳压器, 能够在  $-37V$  至  $-1.2V$  的输出电压范围内提供超过 1.5A 的电流。这类稳压器仅需要使用 2 个外部电阻器来设置输出电压, 使用 1 个输出电容器来进行频率补偿, 因此使用非常简单。电路设计已经过优化, 可实现出色的稳压和低热瞬态。此外, LM137 系列还具有内部电流限制、热关断和安全区域补偿功能, 使其几乎能够在过载时防止烧毁。

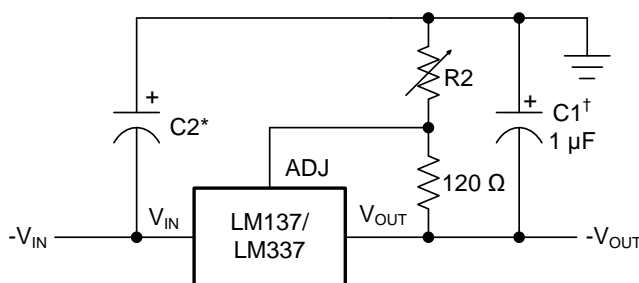
LM137 适用于各种应用, 包括局部卡上调节、可编程输出电压调节或高精度电流调节。LM137 是对 LM117 可调节正稳压器的理想补充。

器件信息<sup>(1)</sup>

| 器件型号         | SMD 数据                    | 封装          |
|--------------|---------------------------|-------------|
| LM137K/883   |                           | TO-3 (K)    |
| LM137H/883   |                           | TO-39 (NDT) |
| LM137H1PQMLV | 5962P9951708VXA<br>30krad | TO-39 (NDT) |
| LM137H-MD8   |                           | 裸片          |
| LM137KG-MD8  |                           | 裸片          |
| LM137KG-MW8  |                           | 晶圆          |

(1) 如需了解所有可用封装, 请参阅数据表末尾的可订购产品附录。

简化原理图



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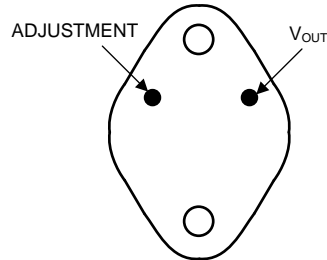
4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

|  |             |
|--|-------------|
| <b>Changes from Revision E (December 2016) to Revision F</b>   | <b>Page</b> |
| • Changed the T0-39 Metal Can Package From: Top View To: Bottom View .....   | 3           |
| <b>Changes from Revision D (February 2015) to Revision E</b>   | <b>Page</b> |
| • 更新了可订购封装附录 .....   | 1           |
| <b>Changes from Revision C (April 2013) to Revision D</b>  | <b>Page</b> |
| • 添加、更新或重命名以下部分：“器件信息”表、规格、特性说明、布局、应用和实施、电源相关建议、器件和文档支持以及机械、封装和可订购信息 .....   | 1           |
| • Changed Vout Recovery condition from -4.25 V to -40 V .....  | 9           |
| <b>Changes from Revision B (March 2013) to Revision C</b>  | <b>Page</b> |
| • 将美国国家半导体数据表的版面布局更改为 TI 格式。 .....   | 1           |
| <b>Changes from Revision A (December 2010) to Revision B</b>   | <b>Page</b> |
| • 在订购信息中添加了新的 LM137H1PQMLV .....   | 1           |
| • Added to the HEADER of DC Parameters — Post Radiation Limits 5962P9951701VXA. Added the HEADER and TABLE of DC Parameters — Post Radiation Limits 5962P9951708VXA for <i>Electrical Characteristics</i> tables ..... | 6           |

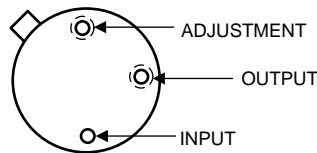
## 5 Pin Configuration and Functions

**TO-3 Metal Can Package  
Package K  
(Bottom View)**



NOTE: Case is Input

**T0-39 Metal Can Package  
Package NDT  
(Bottom View)**



NOTE: Case Is Input

### Pin Functions

| NAME                     | PIN    |        | I/O | DESCRIPTION |
|--------------------------|--------|--------|-----|-------------|
|                          | NUMBER |        |     |             |
|                          | K      | NDT    |     |             |
| ADJUSTMENT               | 1      | 1      | O   | Adjustment  |
| INPUT                    | Case   | 3/Case | I   | Input       |
| OUTPUT /V <sub>OUT</sub> | 2      | 2      | O   | Output      |

## 6 Specifications

### 6.1 Absolute Maximum Ratings<sup>(1)</sup>

|                                       |                 |                          | UNIT |
|---------------------------------------|-----------------|--------------------------|------|
| Power Dissipation <sup>(2)</sup>      |                 | Internally Limited       |      |
| Input-Output Voltage Differential     |                 | 40                       | V    |
| Operating Ambient Temperature         |                 | $-55 \leq T_A \leq +125$ | °C   |
| Operating Junction Temperature        |                 | $-55 \leq T_J \leq +150$ | °C   |
| Storage Temperature                   |                 | $-65 \leq T_A \leq +150$ | °C   |
| Maximum Junction Temperature          |                 | 150                      | °C   |
| Lead Temperature (Soldering, 10 sec.) |                 | 300                      | °C   |
| Maximum Power Dissipation (@25°C)     | T0–3            | 28                       | W    |
|                                       | T0–39           | 2.5                      | W    |
| Package Weight (typical)              | T0–3            | 12,750                   | mg   |
|                                       | T0–39 Metal Can | 955                      | mg   |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) The maximum power dissipation must be derated at elevated temperatures and is dictated by  $T_{Jmax}$  (maximum junction temperature),  $R_{\theta JA}$  (package junction to ambient thermal resistance), and  $T_A$  (ambient temperature). The maximum allowable power dissipation at any temperature is  $P_{Dmax} = (T_{Jmax} - T_A)/R_{\theta JA}$  or the number given in the Absolute Maximum Ratings, whichever is lower.

### 6.2 ESD Ratings

|             |                         | VALUE   | UNIT       |
|-------------|-------------------------|---|------------|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup> | ±4000<br>V |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible with the necessary precautions. Pins listed as ±4000 V may actually have higher performance. Human body model, 100 pF discharged through 1.5 KΩ.

### 6.3 Recommended Operating Conditions

|               | MIN    | MAX                      | UNIT |
|---------------|--------|--------------------------|------|
| $T_A$         |        | $-55 \leq T_A \leq +125$ | °C   |
| Input Voltage | -41.25 | -4.25                    | V    |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup>                          | TO-3 METAL CAN                 | TO-39 METAL CAN                               | UNIT |
|--|--------------------------------|---|------|
|  | 2 PINS                         | 3 PINS  |      |
| $R_{\theta JA}$ Junction-to-ambient thermal resistance | 40 (Still Air)<br>14 (500 LFM) | 174 (Still Air @ 0.5W)<br>64 (500 LFM @ 0.5W) | °C/W |
| $R_{\theta JC}$ Junction-to-case thermal resistance    | 4                              | 15 (@ 1.0W)                                   |      |

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

## 6.5 Quality Conformance Inspection

**Table 1. Mil-Std-883, Method 5005 — Group A<sup>(1)</sup>**

| SUBGROUP | DESCRIPTION         | TEMP (°C) |
|----------|---------------------|-----------|
| 1        | Static tests at     | +25       |
| 2        | Static tests at     | +125      |
| 3        | Static tests at     | -55       |
| 4        | Dynamic tests at    | +25       |
| 5        | Dynamic tests at    | +125      |
| 6        | Dynamic tests at    | -55       |
| 7        | Functional tests at | +25       |
| 8A       | Functional tests at | +125      |
| 8B       | Functional tests at | -55       |
| 9        | Switching tests at  | +25       |
| 10       | Switching tests at  | +125      |
| 11       | Switching tests at  | -55       |

(1) Group "A" sample only, test at all temps.

## 6.6 LM137H 883 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.  $V_{IN} = -4.25V$ ,  $I_L = 8mA$ ,  $V_{OUT} = V_{Ref}^{(1)(2)}$

| PARAMETER                   | TEST CONDITIONS                            | SUB-GROUPS  | MIN     | MAX    | UNIT   |         |
|-----------------------------|--|---|---------|--------|--------|---------|
| $V_{Ref}$                   | Reference Voltage                          | 1   | -1.275  | -1.225 | V      |         |
|                             |  | 2, 3  | -1.3    | -1.2   | V      |         |
|                             |  | $V_{IN} = -42 V$                                  | 1       | -1.275 | -1.225 | V       |
|                             |  | $V_{IN} = -41.3 V$                                | 2, 3    | -1.3   | -1.2   | V       |
| $I_Q$                       | Minimum Load Current                       | $V_{OUT} = -1.7 V$                                | 1, 2, 3 |        | 3.0    | mA      |
|                             |  | $V_{OUT} = -1.7 V$ , $V_{IN} = -11.75 V$          | 1, 2, 3 |        | 3.0    | mA      |
|                             |  | $V_{OUT} = -1.7 V$ , $V_{IN} = -42 V$             | 1       |        | 5.0    | mA      |
|                             |  | $V_{OUT} = -1.7 V$ , $V_{IN} = -41.3 V$           | 2, 3    |        | 5.0    | mA      |
| $R_{Line}$                  | Line Regulation                            | $-42 V \leq V_{IN} \leq -4.25 V$                  | 1       | -9.0   | 9.0    | mV      |
|                             |  | $-41.3 V \leq V_{IN} \leq -4.25 V$                | 2, 3    | -23    | 23     | mV      |
| $R_{Load}$                  | Load Regulation                            | $5 mA \leq I_L \leq 500 mA$ , $V_{IN} = -6.25 V$  | 1, 2, 3 | -25    | 25     | mV      |
|                             |  | $5mA \leq I_L \leq 500 mA$ , $V_{IN} = -14.5 V$   | 1       | -25    | 25     | mV      |
|                             |  | $5mA \leq I_L \leq 150 mA$ , $V_{IN} = -40 V$     | 1, 2, 3 | -25    | 25     | mV      |
| $I_{Adj}$                   | Adjustment Pin Current                     | $I_L = 5 mA$                                      | 1, 2, 3 |        | 100    | $\mu A$ |
|                             |  | $V_{IN} = -42 V$                                  | 1       |        | 100    | $\mu A$ |
|                             |  | $V_{IN} = -41.3 V$                                | 2, 3    |        | 100    | $\mu A$ |
| $\Delta I_{Adj} / V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | $-42 V \leq V_{IN} \leq -4.25 V$ , $I_L = 5 mA$   | 1       | -5.0   | 5.0    | $\mu A$ |
|                             |  | $-41.3 V \leq V_{IN} \leq -4.25 V$ , $I_L = 5 mA$ | 2, 3    | -5.0   | 5.0    | $\mu A$ |
| $\Delta I_{Adj} / I_{Load}$ | Adjust Pin Current Change vs. Load Current | $5 mA \leq I_L \leq 500 mA$ , $V_{IN} = -6.5 V$   | 1, 2, 3 | -5.0   | 5.0    | $\mu A$ |
| $V_{Rth}$                   | Thermal Regulation                         | $V_{IN} = -14.5 V$ , $I_L = 500 mA$ , $t = 10 mS$ | 1       | -5.0   | 5.0    | mV      |
|                             |  | $V_{IN} = -14.5 V$ , $I_L = 5 mA$ , $t = 10 mS$   | 1       | -5.0   | 5.0    | mV      |
| $I_{CL}$                    | Current Limit                              | $V_{IN} = -5 V$                                   | 1, 2, 3 | -1.8   | -0.5   | A       |
|                             |  | $V_{IN} = -40 V$                                  | 1, 2, 3 | -0.65  | -0.15  | A       |
| $V_O$                       | Output Voltage                             | 1   | -1.28   | -1.22  | V      |         |
|                             |  | 2, 3  | -1.3    | -1.2   | V      |         |

(1)  $V_{IN} = -41.3V$  at  $+125^\circ C$  and  $-55^\circ C$

(2)  $-41.3V \leq V_{IN} \leq -4.25V$  at  $+125^\circ C$  and  $-55^\circ C$

## 6.7 LM137H 883 Electrical Characteristics AC Parameters

| PARAMETER | TEST CONDITIONS               | SUB-GROUPS   | MIN   | MAX | UNIT |
|-----------|-------------------------------|--|-------|-----|------|
| $R_R$     | Ripple Rejection Ratio<br>(1) | $V_{IN} = -6.25 V$ , $V_{OUT} = V_{Ref}$ ,<br>$I_L = 125 mA$ , $e_i = 1V_{RMS}$ , $F = 120 Hz$ | 4,5,6 | 66  | dB   |

(1) Test at  $+25^\circ C$ , ensured but not tested at  $+125^\circ C$  and  $-55^\circ C$

## 6.8 LM137K 883 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.  $V_{IN} = -4.25V$ ,  $I_L = 8mA$ ,  $V_{OUT} = V_{Ref}^{(1)(2)}$

| PARAMETER                   | TEST CONDITIONS                            | SUB-GROUPS                                     | MIN     | MAX    | UNIT   |         |
|-----------------------------|--|--|---------|--------|--------|---------|
| $V_{Ref}$                   | Reference Voltage                          | 1  | -1.275  | -1.225 | V      |         |
|                             |  | 2, 3   | -1.3    | -1.2   | V      |         |
|                             |  | $V_{IN} = -42V$                                | 1       | -1.275 | -1.225 | V       |
|                             |  | $V_{IN} = -41.3V$                              | 2, 3    | -1.3   | -1.2   | V       |
| $I_Q$                       | Minimum Load Current                       | $V_{OUT} = -1.7V$                              | 1, 2, 3 |        | 3.0    | mA      |
|                             |  | $V_{OUT} = -1.7V$ , $V_{IN} = -11.75V$         | 1, 2, 3 |        | 3.0    | mA      |
|                             |  | $V_{OUT} = -1.7V$ , $V_{IN} = -42V$            | 1       |        | 5.0    | mA      |
|                             |  | $V_{OUT} = -1.7V$ , $V_{IN} = -41.3V$          | 2, 3    |        | 5.0    | mA      |
| $R_{Line}$                  | Line Regulation                            | $-42V \leq V_{IN} \leq -4.25V$                 | 1       | -9.0   | 9.0    | mV      |
|                             |  | $-41.3V \leq V_{IN} \leq -4.25V$               | 2, 3    | -23    | 23     | mV      |
| $R_{Load}$                  | Load Regulation                            | $V_{IN} = -6.25V$ , $8mA \leq I_L \leq 1.5A$   | 1, 2, 3 | -25    | 25     | mV      |
|                             |  | $V_{IN} = -14.5V$ , $8mA \leq I_L \leq 1.5A$   | 1       | -25    | 25     | mV      |
|                             |  | $V_{IN} = -40V$ , $8mA \leq I_L \leq 300mA$    | 1       | -25    | 25     | mV      |
|                             |  | $V_{IN} = -40V$ , $8mA \leq I_L \leq 250mA$    | 2, 3    | -25    | 25     | mV      |
| $I_{Adj}$                   | Adjustment Pin Current                     |  | 1, 2, 3 |        | 100    | $\mu A$ |
|                             |  | $V_{IN} = -42V$                                | 1       |        | 100    | $\mu A$ |
|                             |  | $V_{IN} = -41.3V$                              | 2, 3    |        | 100    | $\mu A$ |
| $\Delta I_{Adj} / V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | $-42V \leq V_{IN} \leq -4.25V$                 | 1       | -5.0   | 5.0    | $\mu A$ |
|                             |  | $-41.3V \leq V_{IN} \leq -4.25V$               | 2, 3    | -5.0   | 5.0    | $\mu A$ |
| $\Delta I_{Adj} / I_{Load}$ | Adjust Pin Current Change vs. Load Current | $8mA \leq I_L \leq 1.5A$ , $V_{IN} = -6.25V$   | 1, 2, 3 | -5.0   | 5.0    | $\mu A$ |
| $V_{Rth}$                   | Thermal Regulation                         | $V_{IN} = -14.5V$ , $I_L = 1.5mA$ , $t = 10mS$ | 1       | -5.0   | 5.0    | mV      |
|                             |  | $V_{IN} = -14.5V$ , $I_L = 8mA$ , $t = 10mS$   | 1       | -5.0   | 5.0    | mV      |
| $I_{CL}$                    | Current Limit                              | $V_{IN} = -5V$                                 | 1, 2, 3 | -3.5   | -1.5   | A       |
|                             |  | $V_{IN} = -40V$                                | 1, 2, 3 | -1.2   | -0.24  | A       |

(1)  $V_{IN} = -41.3V$  at  $+125^\circ C$  and  $-55^\circ C$

(2)  $-41.3V \leq V_{IN} \leq -4.25V$  at  $+125^\circ C$  and  $-55^\circ C$

## 6.9 LM137K 883 Electrical Characteristics AC Parameters

| PARAMETER | TEST CONDITIONS               | SUB-GROUPS  | MIN   | MAX | UNIT |
|-----------|-------------------------------|---|-------|-----|------|
| $R_R$     | Ripple Rejection Ratio<br>(1) | $V_{IN} = -6.25V$ , $V_{OUT} = V_{Ref}$ ,<br>$f = 120Hz$ , $I_L = 0.5A$ ,<br>$e_i = 1V_{RMS}$ | 4,5,6 | 66  | dB   |

(1) Test at  $+25^\circ C$ , ensured but not tested at  $+125^\circ C$  and  $-55^\circ C$

## 6.10 LM137H RH Electrical Characteristics DC Parameters 5962P9951708VXA

The following conditions apply, unless otherwise specified. <sup>(1)</sup>

| PARAMETER                   | TEST CONDITIONS  | SUB-GROUPS   | MIN     | MAX    | UNIT   |               |
|-----------------------------|--|--|---------|--------|--------|---------------|
| $V_{OUT}$                   | Output Voltage   | $V_{IN} = -4.25\text{ V}, I_L = 5\text{ mA}$                     | 1       | -1.275 | -1.225 | V             |
|                             |  |  | 2, 3    | -1.3   | -1.2   | V             |
|                             |  | $V_{IN} = -4.25\text{ V}, I_L = 500\text{ mA}$                   | 1       | -1.275 | -1.225 | V             |
|                             |  |  | 2, 3    | -1.3   | -1.2   | V             |
|                             |  | $V_{IN} = -41.25\text{ V}, I_L = 5\text{ mA}$                    | 1       | -1.275 | -1.225 | V             |
|                             |  |  | 2, 3    | -1.3   | -1.2   | V             |
| $V_{R\text{ Line}}$         | Line Regulation  | $V_{IN} = -41.25\text{ V to } -4.25\text{ V}, I_L = 5\text{ mA}$ | 1       | -9.0   | 9.0    | mV            |
|                             |  |  | 2, 3    | -23    | 23     | mV            |
| $V_{R\text{ Load}}$         | Load Regulation  | $V_{IN} = -6.25\text{ V}, I_L = 5\text{ mA to } 500\text{ mA}$   | 1       | -12    | 12     | mV            |
|                             |  |  | 2, 3    | -24    | 24     | mV            |
|                             |  | $V_{IN} = -41.25\text{ V}, I_L = 5\text{ mA to } 50\text{ mA}$   | 1       | -6.0   | 6.0    | mV            |
|                             |  |  | 2, 3    | -12    | 12     | mV            |
|                             |  | $V_{IN} = -6.25\text{ V}, I_L = 5\text{ mA to } 200\text{ mA}$   | 1       | -6.0   | 6.0    | mV            |
|                             |  |  | 2, 3    | -12    | 12     | mV            |
| $V_{Rth}$                   | Thermal Regulation   | $V_{IN} = -14.6\text{ V}, I_L = 500\text{ mA}$                   | 1       | -5.0   | 5.0    | mV            |
| $I_{Adj}$                   | Adjust Pin Current   | $V_{IN} = -4.25\text{ V}, I_L = 5\text{ mA}$                     | 1, 2, 3 | 25     | 100    | $\mu\text{A}$ |
|                             |  | $V_{IN} = -41.25\text{ V}, I_L = 5\text{ mA}$                    | 1, 2, 3 | 25     | 100    | $\mu\text{A}$ |
| $\Delta I_{Adj} / V_{Line}$ | Adjust Pin Current Change vs. Line Voltage                 | $V_{IN} = -41.25\text{ V to } -4.25\text{ V}, I_L = 5\text{ mA}$ | 1, 2, 3 | -5.0   | 5.0    | $\mu\text{A}$ |
| $\Delta I_{Adj} / I_{Load}$ | Adjust Pin Current Change vs. Load Current                 | $V_{IN} = -6.25\text{ V}, I_L = 5\text{ mA to } 500\text{ mA}$   | 1, 2, 3 | -5.0   | 5.0    | $\mu\text{A}$ |
| $I_{OS}$                    | Output Short Circuit Current                               | $V_{IN} = -4.25\text{ V}$  | 1, 2, 3 | 0.5    | 1.8    | A             |
|                             |  | $V_{IN} = -40\text{ V}$  | 1, 2, 3 | 0.05   | 0.5    | A             |
| $V_{OUT\text{ Recovery}}$   | Output Voltage Recovery After Output Short Circuit Current | $V_{IN} = -4.25\text{ V}$  | 1       | -1.275 | -1.225 | V             |
|                             |  |  | 2, 3    | -1.3   | -1.2   | V             |
|                             |  | $V_{IN} = -40\text{ V}$  | 1       | -1.275 | -1.225 | V             |
|                             |  |  | 2, 3    | -1.3   | -1.2   | V             |
| $I_Q$                       | Minimum Load Current                                       | $V_{IN} = -4.25\text{ V}$  | 1, 2, 3 | 0.2    | 3.0    | mA            |
|                             |  | $V_{IN} = -14.25\text{ V}$                                       | 1, 2, 3 | 0.2    | 3.0    | mA            |
|                             |  | $V_{IN} = -41.25\text{ V}$                                       | 1, 2, 3 | 1.0    | 5.0    | mA            |
| $V_{Start}$                 | Voltage Start-up   | $V_{IN} = -4.25\text{ V}, I_L = 500\text{ mA}$                   | 1       | -1.275 | -1.225 | V             |
|                             |  |  | 2, 3    | -1.3   | -1.2   | V             |
| $V_{OUT}$                   | Output Voltage <sup>(2)</sup>                              | $V_{IN} = -6.25\text{ V}, I_L = 5\text{ mA}$                     | 2       | -1.3   | -1.2   | V             |

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

(2) Tested at +125°C; correlated to +150°C



## 6.11 LM137H RH Electrical Characteristics AC Parameters 5962P9951708VXA

The following conditions apply, unless otherwise specified.<sup>(1)</sup>

| PARAMETER                        |  | TEST CONDITIONS  | SUB-GROUPS | MIN | MAX | UNIT          |
|----------------------------------|--|--|------------|-----|-----|---------------|
| $\Delta V_{IN} / \Delta V_{OUT}$ | Ripple Rejection                       | $V_{IN} = -6.25\text{ V}$ , $I_L = 125\text{ mA}$ ,<br>$e_i = 1V_{RMS}$ at 2400 Hz | 9          | 48  |     | dB            |
| $V_{NO}$                         | Output Noise Voltage                   | $V_{IN} = -6.25\text{ V}$ , $I_L = 50\text{ mA}$                                   | 9          |     | 120 | $\mu V_{RMS}$ |
| $\Delta V_{OUT} / \Delta V_{IN}$ | Line Transient Response                | $V_{IN} = -6.25\text{ V}$ , $V_{Pulse} = -1\text{ V}$ , $I_L = 50\text{ mA}$       | 9          |     | 80  | mV/V          |
| $\Delta V_O / \Delta I_L$        | Load Transient Response <sup>(2)</sup> | $V_{IN} = -6.25\text{ V}$ , $I_L = 50\text{ mA}$ , $\Delta I_L = 200\text{ mA}$    | 9          |     | 60  | mV            |

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

(2) Limit of 0.3mV/mA is equivalent to 60mV

## 6.12 LM137H RH Electrical Characteristics DC Parameters Drift Values 5962P9951708VXA

The following conditions apply, unless otherwise specified.<sup>(1)</sup>

Delta calculations performed on QMLV devices at group B, subgroup 5 only.

| PARAMETER     |                    | TEST CONDITIONS  | SUB-GROUPS | MIN   | MAX  | UNIT    |
|---------------|--------------------|--|------------|-------|------|---------|
| $V_{OUT}$     | Output Voltage     | $V_{IN} = -4.25\text{ V}$ , $I_L = 5\text{ mA}$                      | 1          | -0.01 | 0.01 | V       |
|               |                    | $V_{IN} = -4.25\text{ V}$ , $I_L = 500\text{ mA}$                    | 1          | -0.01 | 0.01 | V       |
|               |                    | $V_{IN} = -41.25\text{ V}$ , $I_L = 5\text{ mA}$                     | 1          | -0.01 | 0.01 | V       |
|               |                    | $V_{IN} = -41.25\text{ V}$ , $I_L = 50\text{ mA}$                    | 1          | -0.01 | 0.01 | V       |
| $V_{R\ Line}$ | Line Regulation    | $V_{IN} = -41.25\text{ V}$ to $-4.25\text{ V}$ , $I_L = 5\text{ mA}$ | 1          | -4.0  | 4.0  | mV      |
| $I_{Adj}$     | Adjust Pin Current | $V_{IN} = -4.25\text{ V}$ , $I_L = 5\text{ mA}$                      | 1          | -10   | 10   | $\mu A$ |
|               |                    | $V_{IN} = -41.25\text{ V}$ , $I_L = 5\text{ mA}$                     | 1          | -10   | 10   | $\mu A$ |

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

## 6.13 LM137H RH Electrical Characteristics DC Parameters Post Radiation Limits +25°C 5962P9951708VXA

The following conditions apply, unless otherwise specified.<sup>(1)</sup>

| PARAMETER                   |  | TEST CONDITIONS  | SUB-GROUPS | MIN   | MAX    | UNIT    |
|-----------------------------|--|--|------------|-------|--------|---------|
| $V_{OUT}$                   | Output Voltage   | $V_{IN} = -41.25\text{ V}$ , $I_L = 5\text{ mA}$                     | 1          | -1.30 | -1.225 | V       |
|                             |  | $V_{IN} = -41.25\text{ V}$ , $I_L = 50\text{ mA}$                    | 1          | -1.30 | -1.225 | V       |
| $V_{R\ Line}$               | Line Regulation  | $V_{IN} = -41.25\text{ V}$ to $-4.25\text{ V}$ , $I_L = 5\text{ mA}$ | 1          | -9.0  | +50    | mV      |
| $I_{Adj}$                   | Adjust Pin Current   | $V_{IN} = -41.25\text{ V}$ , $I_L = 5\text{ mA}$                     | 1          | 25    | 140    | $\mu A$ |
| $\Delta I_{Adj} / V_{Line}$ | Adjust Pin Current Change vs. Line Voltage                 | $V_{IN} = -41.25\text{ V}$ to $-4.25\text{ V}$ , $I_L = 5\text{ mA}$ | 1          | -70   | +20    | $\mu A$ |
| $V_{OUT\ Recovery}$         | Output Voltage Recovery After Output Short Circuit Current | $V_{IN} = -40\text{ V}$  | 1          | -1.30 | -1.225 | V       |

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

### 6.14 Typical Performance Characteristics

(NDT & K Packages)

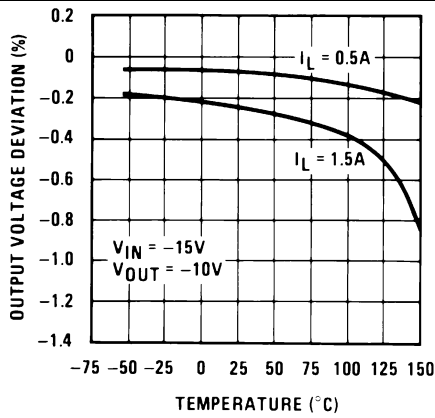


Figure 1. Load Regulation

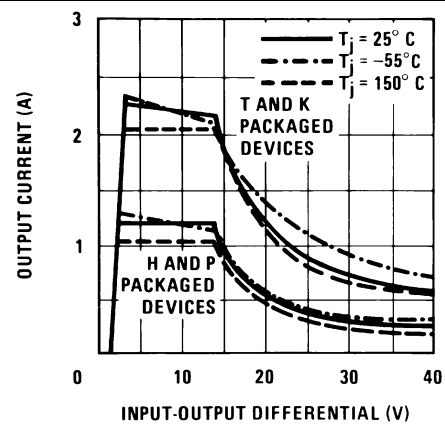


Figure 2. Current Limit

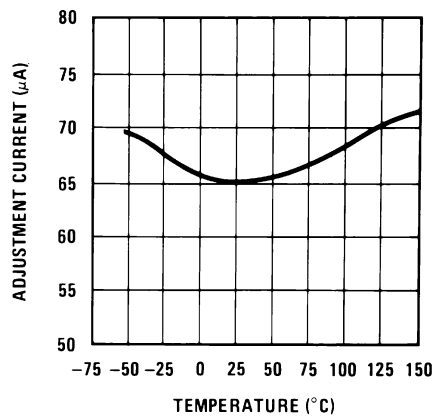


Figure 3. Adjustment Current

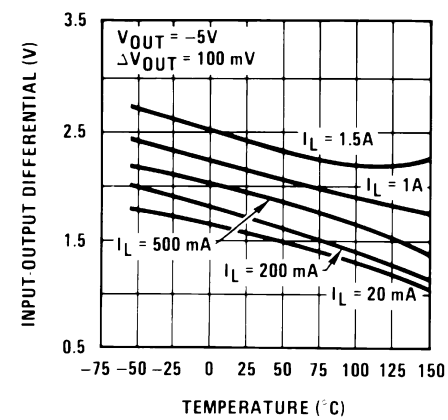


Figure 4. Dropout Voltage

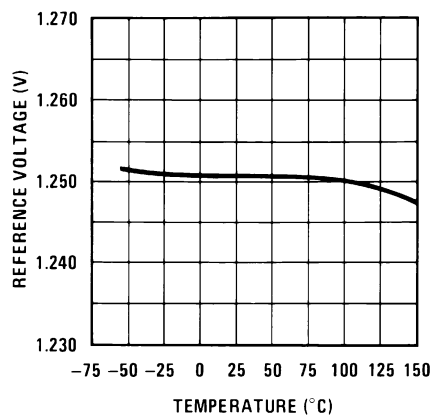


Figure 5. Temperature Stability

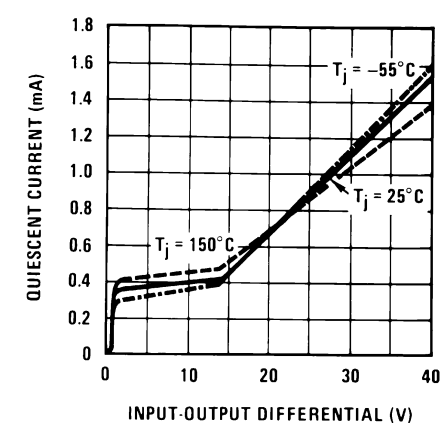


Figure 6. Minimum Operating Current

Typical Performance Characteristics (continued)

(NDT & K Packages)

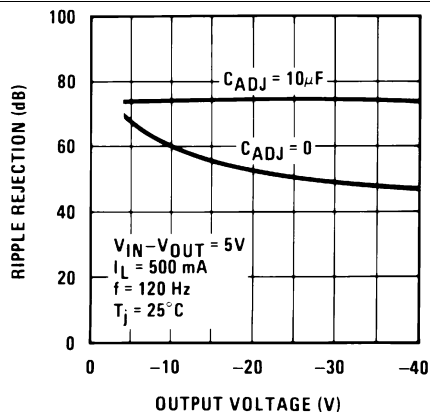


Figure 7. Ripple Rejection

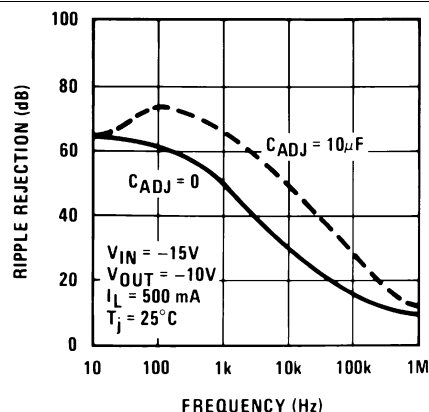


Figure 8. Ripple Rejection

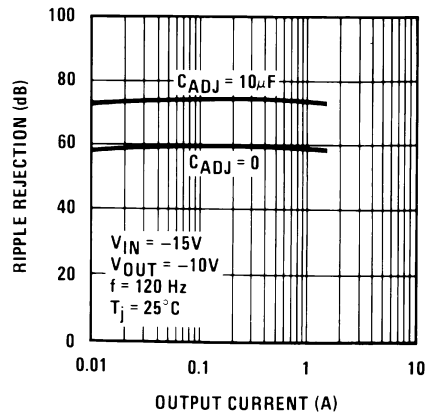


Figure 9. Ripple Rejection

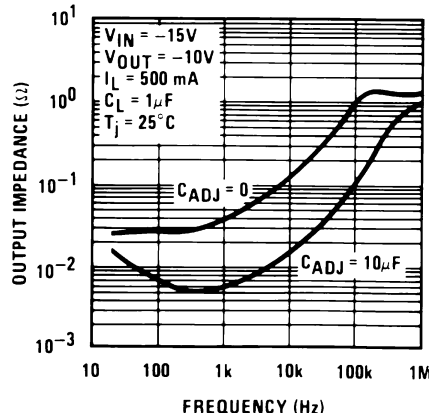


Figure 10. Output Impedance

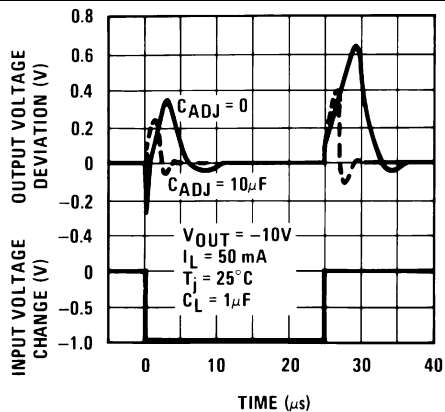


Figure 11. Line Transient Response

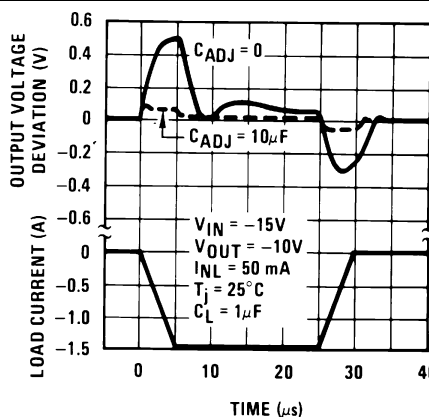
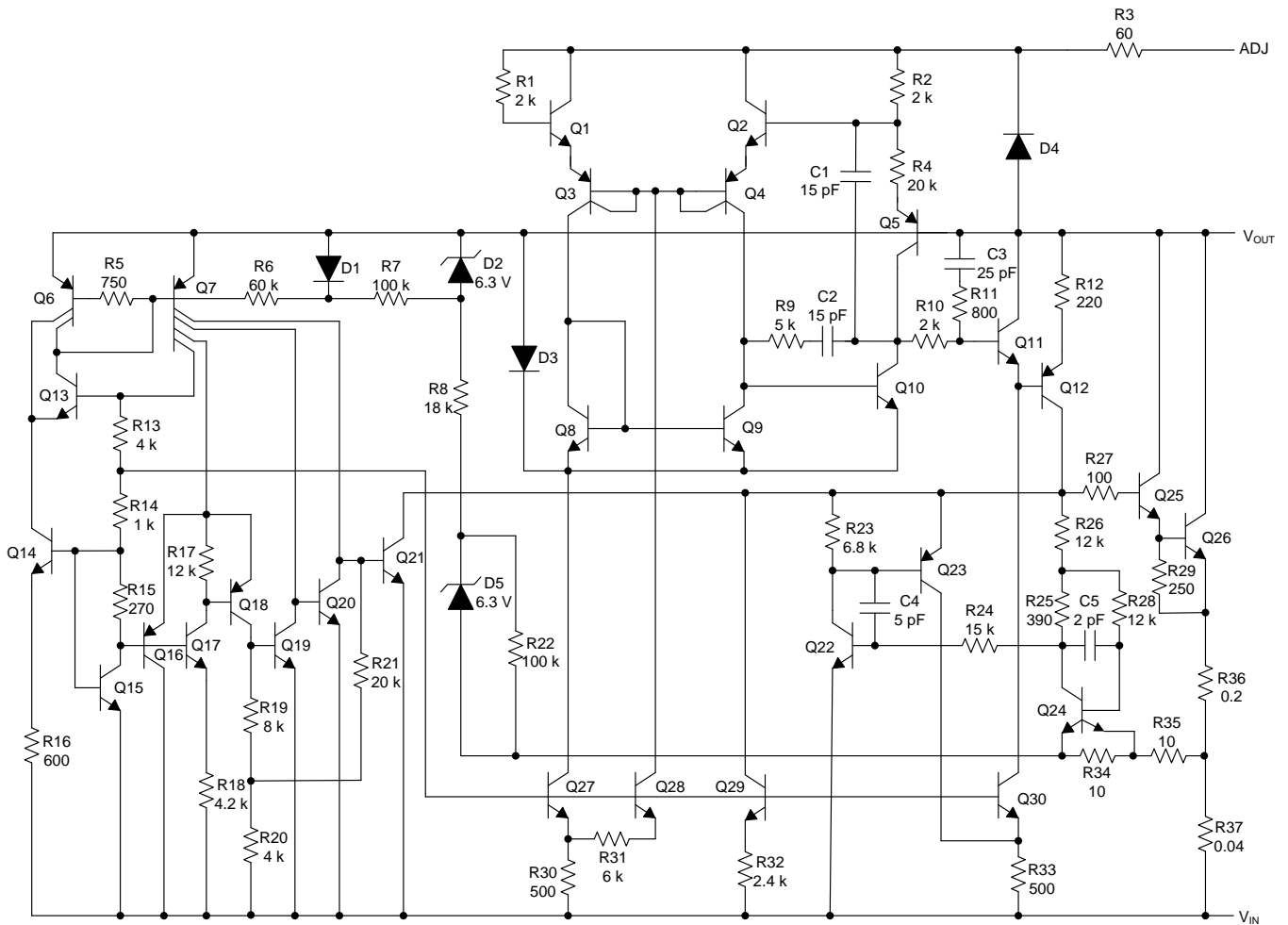


Figure 12. Load Transient Response

## 7 Detailed Description

### 7.1 Functional Block Diagram



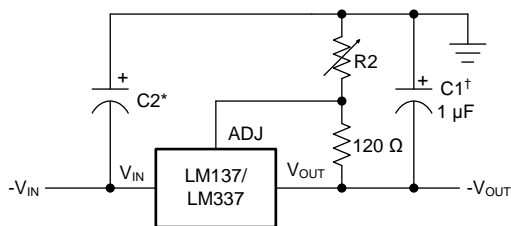
**Figure 13. Schematic Diagram**

## 8 Application and Implementation

### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 8.1 Application Information and Schematic Diagram



Full output current not available at high input-output voltages

$$-V_{OUT} = 1.25 \left( V_1 + \frac{R_2}{120} \right) + (-I_{ADJ} \times R_2)$$

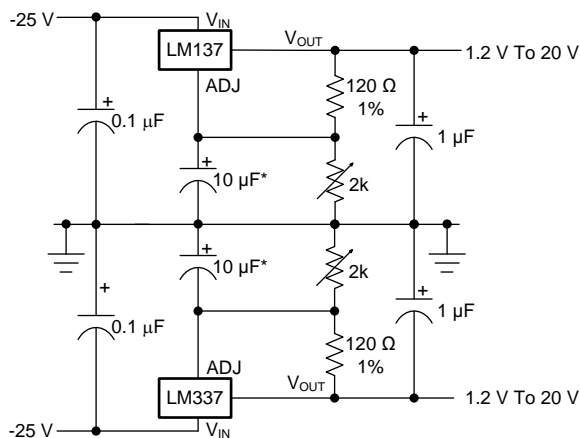
†C1 = 1 μF solid tantalum or 10 μF aluminum electrolytic required for stability

\*C2 = 1 μF solid tantalum is required only if regulator is more than 4" from power-supply filter capacitor

Output capacitors in the range of 1 μF to 1000 μF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients

Figure 14. Adjustable Negative Voltage Regulator

### 8.2 Typical Applications



Full output current not available at high input-output voltages

\*The 10 μF capacitors are optional to improve ripple rejection

Figure 15. Adjustable Lab Voltage Regulator

Typical Applications (continued)

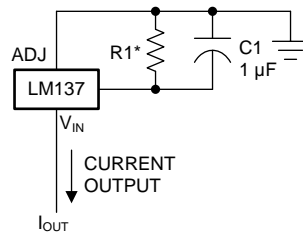
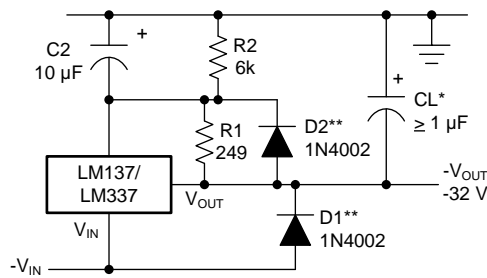


Figure 16. Current Regulator

$$I_{OUT} = \frac{1.250 \text{ V}}{R1}$$

$$*0.8 \Omega \leq R1 \leq 120 \Omega$$

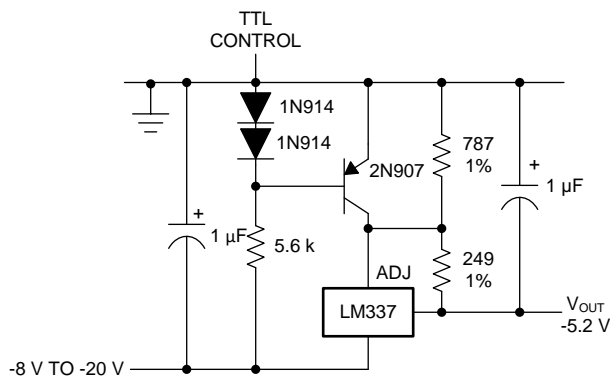
(1)



\*When  $C_L$  is larger than  $20 \mu\text{F}$ , D1 protects the LM137 in case the input supply is shorted

\*\*When  $C_L$  is larger than  $10 \mu\text{F}$  and  $-V_{OUT}$  is larger than  $-25\text{V}$ , D2 protects the LM137 in case the output is shorted

Figure 17. Negative Regulator with Protection Diodes



\*Minimum output  $\approx -1.3\text{V}$  when control input is low

Figure 18. -5.2V Regulator with Electronic Shutdown\*

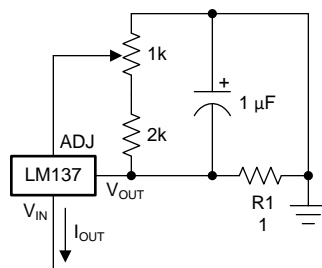


Figure 19. Adjustable Current Regulator

Typical Applications (continued)

$$I_{OUT} = \left( \frac{1.5 \text{ V}}{R1} \right) \pm 15\% \text{ adjustable}$$

(2)

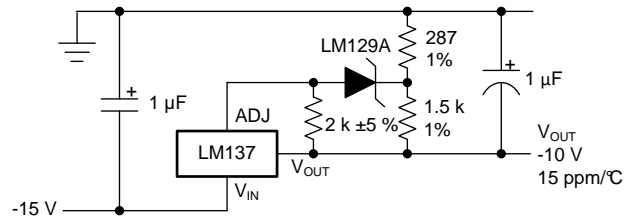
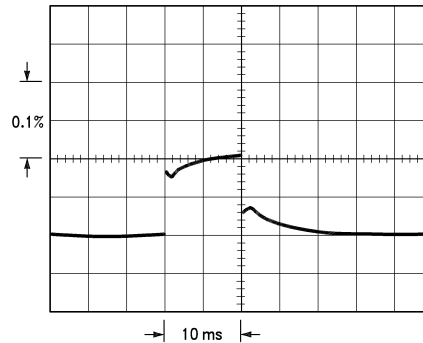


Figure 20. High Stability -10V Regulator

## 9 Power Supply Recommendations

### 9.1 Thermal Regulation

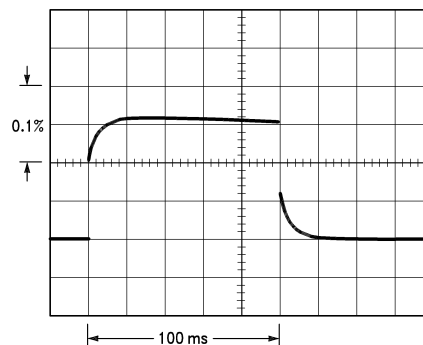
When power is dissipated in an IC, a temperature gradient occurs across the IC chip affecting the individual IC circuit components. With an IC regulator, this gradient can be especially severe since power dissipation is large. Thermal regulation is the effect of these temperature gradients on output voltage (in percentage output change) per Watt of power change in a specified time. Thermal regulation error is independent of electrical regulation or temperature coefficient, and occurs within 5 ms to 50 ms after a change in power dissipation. Thermal regulation depends on IC layout as well as electrical design. The thermal regulation of a voltage regulator is defined as the percentage change of  $V_{OUT}$ , per Watt, within the first 10 ms after a step of power is applied. The LM137's specification is 0.02%/W, max.



LM137,  $V_{OUT} = -10V$   $V_{IN} - V_{OUT} = -40V$   
 Horizontal sensitivity, 5 ms/div  $I_L = 0A \rightarrow 0.25A \rightarrow 0A$

**Figure 21.**

In [Figure 21](#), a typical LM137's output drifts only 3 mV (or 0.03% of  $V_{OUT} = -10V$ ) when a 10W pulse is applied for 10 ms. This performance is thus well inside the specification limit of  $0.02\%/W \times 10W = 0.2\%$  max. When the 10W pulse is ended, the thermal regulation again shows a 3 mV step as the LM137 chip cools off. Note that the load regulation error of about 8 mV (0.08%) is additional to the thermal regulation error. In [Figure 22](#), when the 10W pulse is applied for 100 ms, the output drifts only slightly beyond the drift in the first 10 ms, and the thermal error stays well within 0.1% (10 mV).



LM137,  $V_{OUT} = -10V$   $V_{IN} - V_{OUT} = -40V$   
 Horizontal sensitivity, 20 ms/div  $I_L = 0A \rightarrow 0.25A \rightarrow 0A$

**Figure 22.**



## 10 器件和文档支持

### 10.1 接收文档更新通知

要接收文档更新通知，请导航至 [TI.com.cn](http://TI.com.cn) 上的器件产品文件夹。单击右上角的 [通知我](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 10.2 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [《使用条款》](#)。

**TI E2E™ 在线社区** [TI 的工程师对工程师 \(E2E\) 社区](#)。此社区的创建目的在于促进工程师之间的协作。在 [e2e.ti.com](http://e2e.ti.com) 中，您可以咨询问题、分享知识、拓展思路并与同行工程师一道帮助解决问题。

**设计支持** [TI 参考设计支持](#) 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

### 10.3 商标

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 10.4 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

### 10.5 术语表

[SLYZ022](#) — *TI 术语表*。

这份术语表列出并解释术语、缩写和定义。

## 11 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此数据表的浏览器版本，请查阅左侧的导航栏。

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)      | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)   | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|----------------------|--------------------------------------|----------------------|--------------|---|-------------------------|
| 5962P9951708VXA  | ACTIVE        | TO           | NDT             | 3    | 20          | Non-RoHS & Non-Green | Call TI                              | Call TI              | -55 to 125   | LM137H1PQMLV<br>5962P9951708VXA Q<br>ACO<br>5962P9951708VXA Q<br>>T | <a href="#">Samples</a> |
| LM137H MD8       | ACTIVE        | DIESALE      | Y               | 0    | 120         | RoHS & Green         | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   |   | <a href="#">Samples</a> |
| LM137H/883       | ACTIVE        | TO           | NDT             | 3    | 20          | Non-RoHS & Green     | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | LM137H/883 Q ACO<br>LM137H/883 Q >T                                 | <a href="#">Samples</a> |
| LM137H1PQMLV     | ACTIVE        | TO           | NDT             | 3    | 20          | Non-RoHS & Green     | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | LM137H1PQMLV<br>5962P9951708VXA Q<br>ACO<br>5962P9951708VXA Q<br>>T | <a href="#">Samples</a> |
| LM137K/883       | ACTIVE        | TO           | K               | 2    | 50          | RoHS & Green         | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | (LM120H-15P+, LM13<br>7K)<br>/883 Q ACO<br>/883 Q >T                | <a href="#">Samples</a> |
| LM137KG MD8      | ACTIVE        | DIESALE      | Y               | 0    | 120         | RoHS & Green         | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   |   | <a href="#">Samples</a> |
| LM137KG-MW8      | ACTIVE        | WAFERSALE    | YS              | 0    | 1           | RoHS & Green         | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   |   | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

- (3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

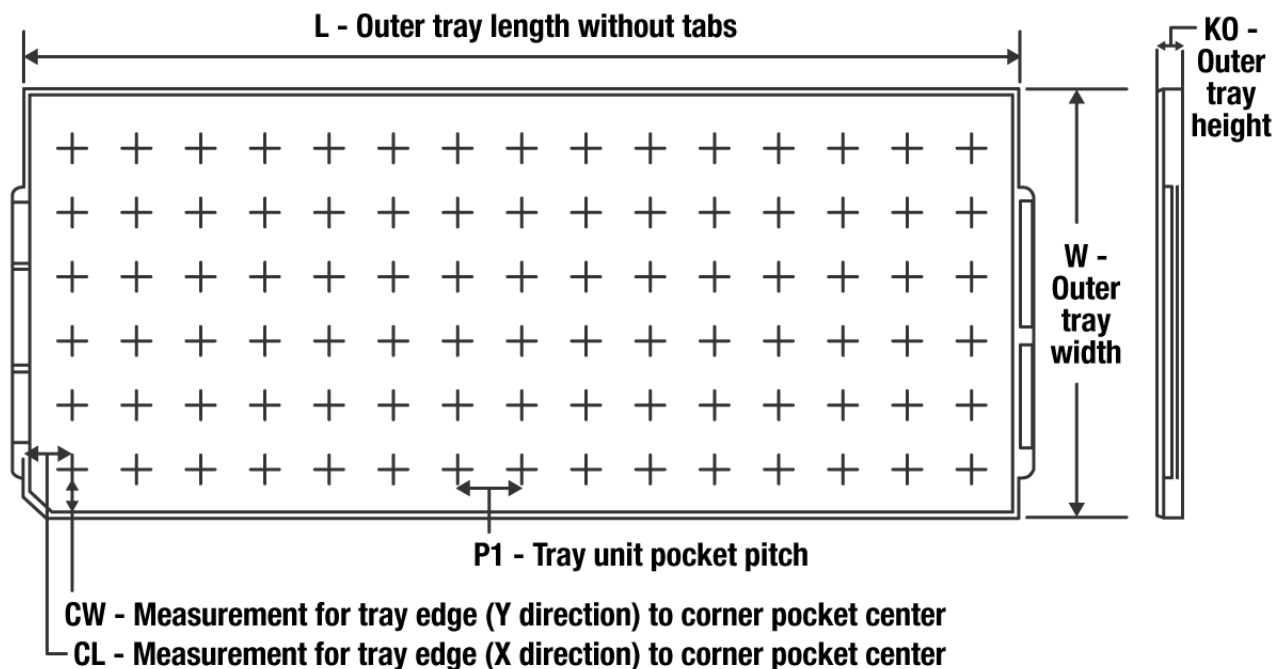
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF LM137QML, LM137QML-SP :**

- Military : [LM137QML](#)
- Space : [LM137QML-SP](#)

NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

**TRAY**


Chamfer on Tray corner indicates Pin 1 orientation of packed units.

\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | Unit array matrix | Max temperature (°C) | L (mm) | W (mm) | K0 (µm) | P1 (mm) | CL (mm) | CW (mm) |
|-----------------|--------------|--------------|------|-----|-------------------|----------------------|--------|--------|---------|---------|---------|---------|
| 5962P9951708VXA | NDT          | TO-CAN       | 3    | 20  | 2 X 10            | 150                  | 126.49 | 61.98  | 8890    | 11.18   | 12.95   | 18.54   |
| LM137H/883      | NDT          | TO-CAN       | 3    | 20  | 2 X 10            | 150                  | 126.49 | 61.98  | 8890    | 11.18   | 12.95   | 18.54   |
| LM137H1PQMLV    | NDT          | TO-CAN       | 3    | 20  | 2 X 10            | 150                  | 126.49 | 61.98  | 8890    | 11.18   | 12.95   | 18.54   |
| LM137K/883      | K            | TO-CAN       | 2    | 50  | 9 X 6             | NA                   | 292.1  | 215.9  | 25654   | 3.87    | 22.3    | 25.4    |

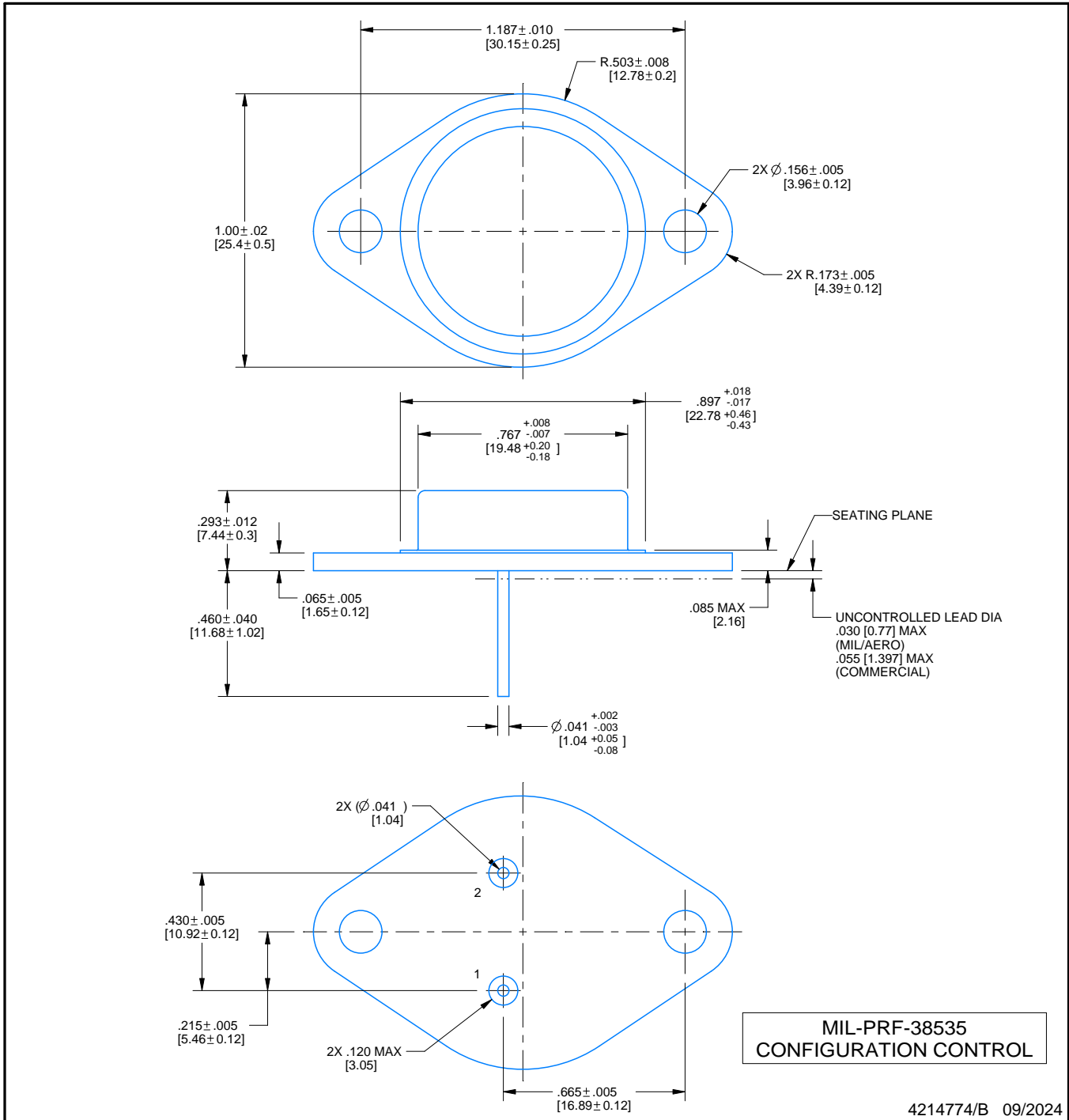
K0002A



# PACKAGE OUTLINE

## TO-CAN - 7.747 mm max height

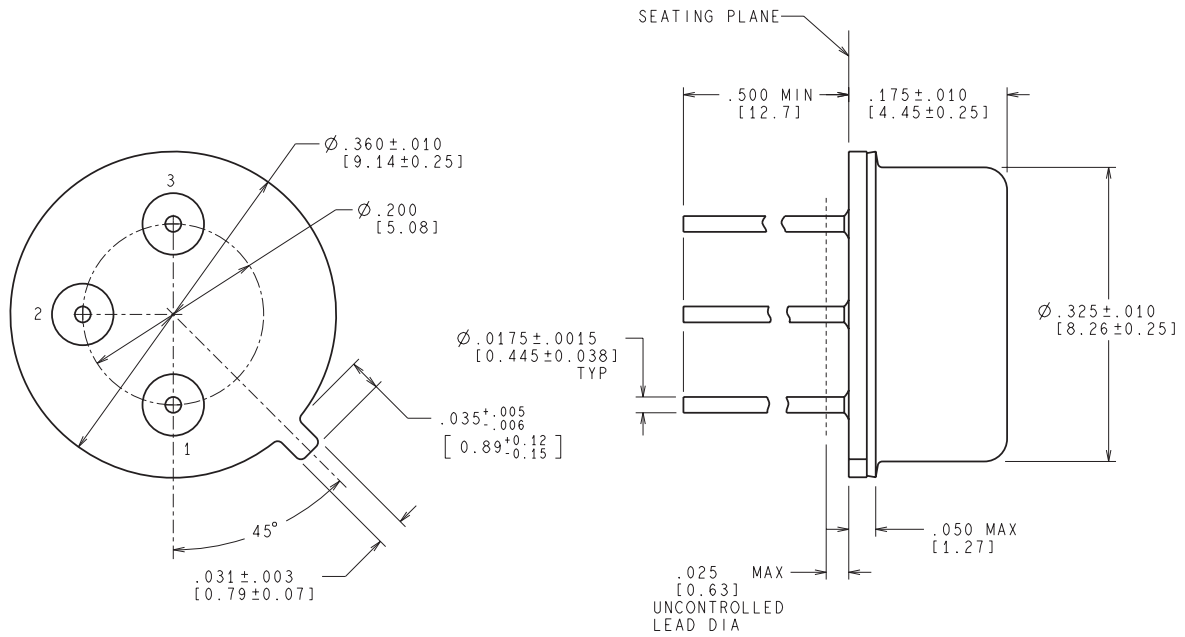
TRANSISTOR OUTLINE



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Leads not to be bent greater than 15°.

NDT0003A



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535  
CONFIGURATION CONTROL

H03A (Rev D)

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