# LM137QML 3-Terminal Adjustable Negative Regulators

**Check for Samples: LM137QML**

## FEATURES

- **Output Voltage Adjustable from −37V to −1.2V**
- **1.5A Output Current Guaranteed, −55°C to +150°C**
- **Line Regulation Typically 0.01%/V**
- **Load Regulation Typically 0.3%**
- **Excellent Thermal Regulation, 0.002%/W**
- **77 dB Ripple Rejection**
- **Excellent Rejection of Thermal Transients**
- **50 ppm/°C Temperature Coefficient**
- **Temperature-independent Current Limit**
- **Internal Thermal Overload Protection**
- **Standard 3-lead Transistor Package**
- **Output is Short Circuit Protected**

## DESCRIPTION

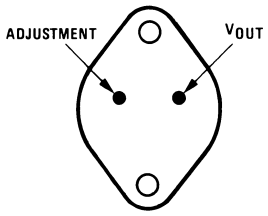
The LM137 are adjustable 3-terminal negative voltage regulators capable of supplying in excess of −1.5A over an output voltage range of −37V to −1.2V. These regulators are exceptionally easy to apply, requiring only 2 external resistors to set the output voltage and 1 output capacitor for frequency compensation. The circuit design has been optimized for excellent regulation and low thermal transients. Further, the LM137 series features internal current limiting, thermal shutdown and safe-area compensation, making them virtually blowout-proof against overloads.

The LM137 serve a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM137 are ideal complements to the LM117 adjustable positive regulators.

**Table 1. LM137 Series Packages and Power Capability**

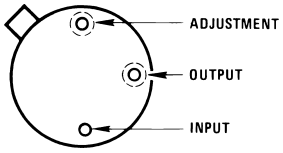
| Device | Package | Rated Power Dissipation | Design Load Current |
|---|---|---|---|
| LM137 | TO-3 (K) | 20W | 1.5A |
| | TO-39 (NDT) | 2W | 0.5A |

## Connection Diagram




NOTE: Case is Input

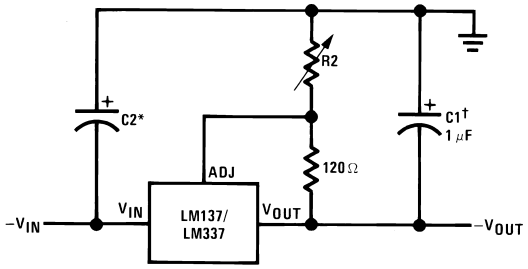
**Figure 1. TO-3, Bottom View**
**Metal Can Package**




NOTE: Case Is Input

**Figure 2. TO-39, Bottom View
Metal Can Package**

## Typical Applications




Full output current not available at high input-output voltages

$$-V_{OUT} = -1.25V\left(1 + \frac{R2}{120}\right) + \left(-I_{ADJ} \times R2\right)$$

†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 1µF to 1000 µF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients

**Figure 3. Adjustable Negative Voltage Regulator**

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings[1]

| | | | |
|---|---|---|---|
| Power Dissipation[2] | | | Internally Limited |
| Input-Output Voltage Differential | | | 40V |
| Operating Ambient Temperature Range | | | $-55°C \le T_A \le +125°C$ |
| Operating Junction Temperature Range | | | $-55°C \le T_J \le +150°C$ |
| Storage Temperature | | | $-65°C \le T_A \le +150°C$ |
| Maximum Junction Temperature | | | 150°C |
| Lead Temperature (Soldering, 10 sec.) | | | 300°C |
| Minimum Input Voltage | | | −41.25V |
| Maximum Power Dissipation (@25°C) | T0–3 | | 28 Watts |
| | T0–39 | | 2.5 Watts |
| Thermal Resistance | $\theta_{JA}$ | T0–3 Metal Can (Still Air) | 40°C/W |
| | | T0–3 Metal Can (500LF/Min Air Flow) | 14°C/W |
| | | T0–39 Metal Can (Still Air @ 0.5W) | 174°C/W |
| | | T0–39 Metal Can (500LF/Min Air Flow @ 0.5W) | 64°C/W |
| | $\theta_{JC}$ | T0–3 | 4°C/W |
| | | T0–39 Metal Can (@ 1.0W) | 15°C/W |
| Package Weight (typical) | T0–3 | | 12,750mg |
| | T0–39 Metal Can | | 955mg |
| ESD Rating [3] | | | 4000V |

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. 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), $\theta_{JA}$ (package junction to ambient thermal resistance), and $T_A$ (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.
(3) Human body model, 100pF discharged through 1.5KΩ

## Recommended Operating Conditions

| | |
|---|---|
| $T_A$ | $-55°C \le T_A \le +125°C$ |
| Input Voltage Range | −41.25V to −4.25V |

## Quality Conformance Inspection

**Table 2. Mil-Std-883, Method 5005 — Group A[1]**

| 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.

## 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)

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $V_{Ref}$ | Reference Voltage | | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| | | $V_{IN}$ = -42V | | -1.275 | -1.225 | V | 1 |
| | | $V_{IN}$ = -41.3V | | -1.3 | -1.2 | V | 2, 3 |
| $I_Q$ | Minimum Load Current | $V_{OUT}$ = -1.7V | | | 3.0 | mA | 1, 2, 3 |
| | | $V_{OUT}$ = -1.7V, $V_{IN}$ = -11.75V | | | 3.0 | mA | 1, 2, 3 |
| | | $V_{OUT}$ = -1.7V, $V_{IN}$ = -42V | | | 5.0 | mA | 1 |
| | | $V_{OUT}$ = -1.7V, $V_{IN}$ = -41.3V | | | 5.0 | mA | 2, 3 |
| $R_{Line}$ | Line Regulation | -42V ≤ $V_{IN}$ ≤ -4.25V | | -9.0 | 9.0 | mV | 1 |
| | | -41.3V ≤ $V_{IN}$ ≤ -4.25V | | -23 | 23 | mV | 2, 3 |
| $R_{Load}$ | Load Regulation | 5mA ≤ $I_L$ ≤ 500mA, $V_{IN}$ = -6.25V | | -25 | 25 | mV | 1, 2, 3 |
| | | 5mA ≤ $I_L$ ≤ 500mA, $V_{IN}$ = -14.5V | | -25 | 25 | mV | 1 |
| | | 5mA ≤ $I_L$ ≤ 150mA, $V_{IN}$ = -40V | | -25 | 25 | mV | 1, 2, 3 |
| $I_{Adj}$ | Adjustment Pin Current | $I_L$ = 5 mA | | | 100 | µA | 1, 2, 3 |
| | | $V_{IN}$ = -42V | | | 100 | µA | 1 |
| | | $V_{IN}$ = -41.3V | | | 100 | µA | 2, 3 |
| Δ $I_{Adj}$ / $V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | -42V ≤ $V_{IN}$ ≤ -4.25V, $I_L$ = 5 mA | | -5.0 | 5.0 | µA | 1 |
| | | -41.3V ≤ $V_{IN}$ ≤ -4.25V, $I_L$ = 5 mA | | -5.0 | 5.0 | µA | 2, 3 |
| Δ $I_{Adj}$ / $I_{Load}$ | Adjust Pin Current Change vs. Load Current | 5 mA ≤ $I_L$ ≤ 500 mA, $V_{IN}$ = -6.5V | | -5.0 | 5.0 | µA | 1, 2, 3 |
| $\theta_R$ | Thermal Regulation | $V_{IN}$ = -14.5V, $I_L$ = 500mA, t = 10mS | | -5.0 | 5.0 | mV | 1 |
| | | $V_{IN}$ = -14.5V, $I_L$ = 5mA, t = 10mS | | -5.0 | 5.0 | mV | 1 |
| $\theta_{JC}$ | Thermal Resistance | | (3) | | 15 | °C/W | 1 |
| $I_{CL}$ | Current Limit | $V_{IN}$ = -5V | | -1.8 | -0.5 | A | 1, 2, 3 |
| | | $V_{IN}$ = -40V | | -0.65 | -0.15 | A | 1, 2, 3 |
| $V_O$ | Output Voltage | | | -1.28 | -1.22 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |

(1) $V_{IN}$ = −41.3V at +125°C and −55°C
(2) −41.3V ≤ $V_{IN}$ ≤ −4.25V at +125°C and −55°C
(3) Ensured parameter, not tested.

## LM137H 883 Electrical Characteristics AC Parameters

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $R_R$ | Ripple Rejection Ratio | $V_{IN}$ = -6.25V, $V_{OUT}$ = $V_{Ref}$, $I_L$ = 125mA, $e_I$ = 1$V_{RMS}$, F = 120Hz | (1)(2) (1) | 66 | | dB | 4, 5, 6 |

(1) Bench test, refer to (SG)RPI-3-362.
(2) Test at +25°C, ensured but not tested at +125°C and −55°C

## 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)

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $V_{Ref}$ | Reference Voltage | | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| | | $V_{IN}$ = -42V | | -1.275 | -1.225 | V | 1 |
| | | $V_{IN}$ = -41.3V | | -1.3 | -1.2 | V | 2, 3 |
| $I_Q$ | Minimum Load Current | $V_{OUT}$ = -1.7V | | | 3.0 | mA | 1, 2, 3 |
| | | $V_{OUT}$ = -1.7V, $V_{IN}$ = -11.75V | | | 3.0 | mA | 1, 2, 3 |
| | | $V_{OUT}$ = -1.7V, $V_{IN}$ = -42V | | | 5.0 | mA | 1 |
| | | $V_{OUT}$ = -1.7V, $V_{IN}$ = -41.3V | | | 5.0 | mA | 2, 3 |
| $R_{Line}$ | Line Regulation | -42V ≤ $V_{IN}$ ≤ -4.25V | | -9.0 | 9.0 | mV | 1 |
| | | -41.3V ≤ $V_{IN}$ ≤ -4.25V | | -23 | 23 | mV | 2, 3 |
| $R_{Load}$ | Load Regulation | $V_{IN}$ = -6.25V, 8mA ≤ $I_L$ ≤ 1.5A | | -25 | 25 | mV | 1, 2, 3 |
| | | $V_{IN}$ = -14.5V, 8mA ≤ $I_L$ ≤ 1.5A | | -25 | 25 | mV | 1 |
| | | $V_{IN}$ = -40V, 8mA ≤ $I_L$ ≤ 300 mA | | -25 | 25 | mV | 1 |
| | | $V_{IN}$ = -40V, 8mA ≤ $I_L$ ≤ 250 mA | | -25 | 25 | mV | 2, 3 |
| $I_{Adj}$ | Adjustment Pin Current | | | | 100 | µA | 1, 2, 3 |
| | | $V_{IN}$ = -42V | | | 100 | µA | 1 |
| | | $V_{IN}$ = -41.3V | | | 100 | µA | 2, 3 |
| Δ $I_{Adj}$ / $V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | -42V ≤ $V_{IN}$ ≤ -4.25V | | -5.0 | 5.0 | µA | 1 |
| | | -41.3V ≤ $V_{IN}$ ≤ -4.25V | | -5.0 | 5.0 | µA | 2, 3 |
| Δ $I_{Adj}$ / $I_{Load}$ | Adjust Pin Current Change vs. Load Current | 8 mA ≤ $I_L$ ≤ 1.5A, $V_{IN}$ = -6.25V | | -5.0 | 5.0 | µA | 1, 2, 3 |
| $V_{Rth}$ | Thermal Regulation | $V_{IN}$ = -14.5V, $I_L$ = 1.5mA, t = 10mS | | -5.0 | 5.0 | mV | 1 |
| | | $V_{IN}$ = -14.5V, $I_L$ = 8mA, t = 10mS | | -5.0 | 5.0 | mV | 1 |
| $\theta_{JC}$ | Thermal Resistance | | (3) | | 4.0 | °C/W | 1 |
| $I_{CL}$ | Current Limit | $V_{IN}$ = -5V | | -3.5 | -1.5 | A | 1, 2, 3 |
| | | $V_{IN}$ = -40V | | -1.2 | -0.24 | A | 1, 2, 3 |

(1) $V_{IN}$ = −41.3V at +125°C and −55°C
(2) −41.3V ≤ $V_{IN}$ ≤ −4.25V at +125°C and −55°C
(3) Ensured parameter, not tested.

## LM137K 883 Electrical Characteristics AC Parameters

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $R_R$ | Ripple Rejection Ratio | $V_{IN}$ = -6.25V, $V_{OUT}$ = $V_{Ref}$, f = 120Hz, $I_L$ = 0.5A, $e_I$ = 1$V_{RMS}$ | (1)(2) (1) | 66 | | dB | 4, 5, 6 |

(1) Bench test, refer to (SG)RPI-3-362.
(2) Test at +25°C, ensured but not tested at +125°C and −55°C

## LM137H RH Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified. (1)

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$ = -4.25V, $I_L$ = 5mA | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| | | $V_{IN}$ = -4.25V, $I_L$ = 500mA | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 5mA | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 50mA | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| $V_{R\ Line}$ | Line Regulation | $V_{IN}$ = -41.25V to -4.25V, $I_L$ = 5mA | | -9.0 | 9.0 | mV | 1 |
| | | | | -23 | 23 | mV | 2, 3 |
| $V_{R\ Load}$ | Load Regulation | $V_{IN}$ = -6.25V, $I_L$ = 5mA to 500mA | | -12 | 12 | mV | 1 |
| | | | | -24 | 24 | mV | 2, 3 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 5mA to 50mA | | -6.0 | 6.0 | mV | 1 |
| | | | | -12 | 12 | mV | 2, 3 |
| | | $V_{IN}$ = -6.25V, $I_L$ = 5mA to 200mA | | -6.0 | 6.0 | mV | 1 |
| | | | | -12 | 12 | mV | 2, 3 |
| $V_{Rth}$ | Thermal Regulation | $V_{IN}$ = -14.6V, $I_L$ = 500mA | | -5.0 | 5.0 | mV | 1 |
| $I_{Adj}$ | Adjust Pin Current | $V_{IN}$ = -4.25V, $I_L$ = 5mA | | 25 | 100 | µA | 1, 2, 3 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 5mA | | 25 | 100 | µA | 1, 2, 3 |
| $\Delta I_{Adj} / V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | $V_{IN}$ = -41.25V to -4.25V, $I_L$ = 5mA | | -5.0 | 5.0 | µA | 1, 2, 3 |
| $\Delta I_{Adj} / I_{Load}$ | Adjust Pin Current Change vs. Load Current | $V_{IN}$ = -6.25V, $I_L$ = 5mA to 500mA | | -5.0 | 5.0 | µA | 1, 2, 3 |
| $I_{OS}$ | Output Short Circuit Current | $V_{IN}$ = -4.25V | | 0.5 | 1.8 | A | 1, 2, 3 |
| | | $V_{IN}$ = -40V | | 0.05 | 0.5 | A | 1, 2, 3 |
| $V_{OUT}$ Recovery | Output Voltage Recovery After Output Short Circuit Current | $V_{IN}$ = -4.25V | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| | | $V_{IN}$ = -40V | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| $I_Q$ | Minimum Load Current | $V_{IN}$ = -4.25V | | 0.2 | 3.0 | mA | 1, 2, 3 |
| | | $V_{IN}$ = -14.25V | | 0.2 | 3.0 | mA | 1, 2, 3 |
| | | $V_{IN}$ = -41.25V | | 1.0 | 5.0 | mA | 1, 2, 3 |
| $V_{Start}$ | Voltage Start-up | $V_{IN}$ = -4.25V, $I_L$ = 500mA | | -1.275 | -1.225 | V | 1 |
| | | | | -1.3 | -1.2 | V | 2, 3 |
| $V_{OUT}$ | Output Voltage | $V_{IN}$ = -6.25V, $I_L$ = 5mA | (2) | -1.3 | -1.2 | V | 2 |

(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

## LM137H RH Electrical Characteristics AC Parameters

The following conditions apply, unless otherwise specified.
(1)

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $\Delta V_{IN}$ / $\Delta V_{OUT}$ | Ripple Rejection | $V_{IN}$ = -6.25V, $I_L$ = 125mA, $e_I$ = $1V_{RMS}$ at 2400Hz | | 48 | | dB | 9 |
| $V_{NO}$ | Output Noise Voltage | $V_{IN}$ = -6.25V, $I_L$ = 50mA | | | 120 | $\mu V_{RMS}$ | 9 |
| $\Delta V_{OUT}$ / $\Delta V_{IN}$ | Line Transient Response | $V_{IN}$ = -6.25V, $V_{Pulse}$ = -1V, $I_L$ = 50mA | | | 80 | mV/V | 9 |
| $\Delta V_O$ / $\Delta I_L$ | Load Transient Response | $V_{IN}$ = -6.25V, $I_L$ = 50mA, $\Delta I_L$ = 200mA | (2) | | 60 | mV | 9 |

(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

## LM137H RH Electrical Characteristics DC Parameters Drift Values

The following conditions apply, unless otherwise specified.
(1)

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

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$ = -4.25V, $I_L$ = 5mA | | -0.01 | 0.01 | V | 1 |
| | | $V_{IN}$ = -4.25V, $I_L$ = 500mA | | -0.01 | 0.01 | V | 1 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 5mA | | -0.01 | 0.01 | V | 1 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 50mA | | -0.01 | 0.01 | V | 1 |
| $V_{R\ Line}$ | Line Regulation | $V_{IN}$ = -41.25V to -4.25V, $I_L$ = 5mA | | -4.0 | 4.0 | mV | 1 |
| $I_{Adj}$ | Adjust Pin Current | $V_{IN}$ = -4.25V, $I_L$ = 5mA | | -10 | 10 | µA | 1 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 5mA | | -10 | 10 | µA | 1 |

(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.

## LM137H RH Electrical Characteristics DC Parameters Post Radiation Limits +25°C 5962P9951701VXA(1)

The following conditions apply, unless otherwise specified.
(2)

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $\Delta I_{Adj}$ / $V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | $V_{IN}$ = -41.25V to -4.25V, $I_L$ = 5mA | | -20 | 20 | µA | 1 |

(1) Pre Burn-In stress test per RPI-5-025.
(2) 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.

## LM137H RH Electrical Characteristics DC Parameters Post Radiation Limits +25°C 5962P9951708VXA(1)

The following conditions apply, unless otherwise specified.
(2)

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$ = -41.25V, $I_L$ = 5mA | | -1.30 | -1.225 | V | 1 |
| | | $V_{IN}$ = -41.25V, $I_L$ = 50mA | | -1.30 | -1.225 | V | 1 |
| $V_{R\ Line}$ | Line Regulation | $V_{IN}$ = -41.25V to -4.25V, $I_L$ = 5mA | | -9.0 | +50 | mV | 1 |
| $I_{Adj}$ | Adjust Pin Current | $V_{IN}$ = -41.25V, $I_L$ = 5mA | | 25 | 140 | µA | 1 |
| $\Delta I_{Adj}$ / $V_{Line}$ | Adjust Pin Current Change vs. Line Voltage | $V_{IN}$ = -41.25V to -4.25V, $I_L$ = 5mA | | -70 | +20 | µA | 1 |
| $V_{OUT}$ Recovery | Output Voltage Recovery After Output Short Circuit Current | $V_{IN}$ = -4.25V | | -1.30 | -1.225 | V | 1 |

(1) Pre Burn-In stress test per RPI-5-025.
(2) 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.

## APPLICATION INFORMATION

### Schematic Diagram

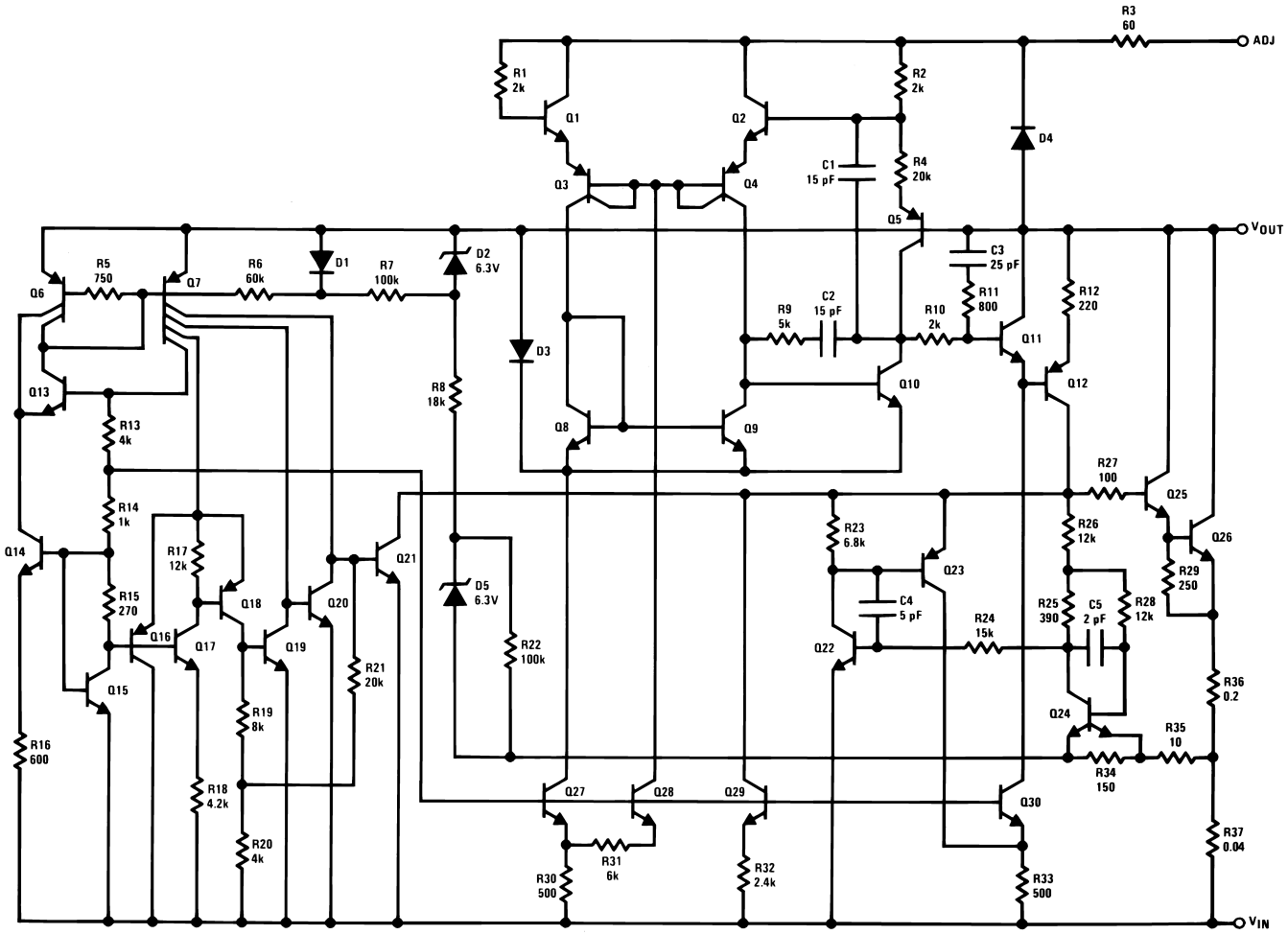
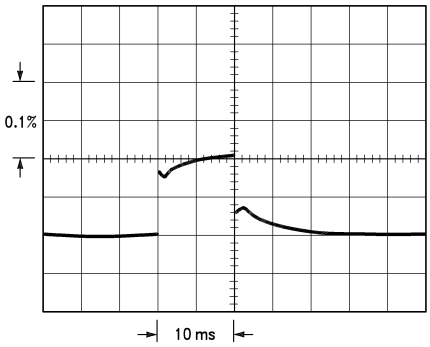



**Figure 4. Schematic Diagram**

### Thermal Regulation

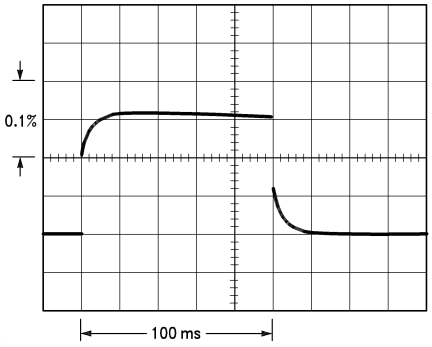
When power is dissipated in an IC, a temperature gradient occurs across the IC chip affecting the individual IC circuit components. With an IC regulator, this gradient can be especially severe since power dissipation is large. Thermal regulation is the effect of these temperature gradients on output 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
$I_{IL}$ = 0A → 0.25A → 0A
Vertical sensitivity, 5 mV/div

**Figure 5.**

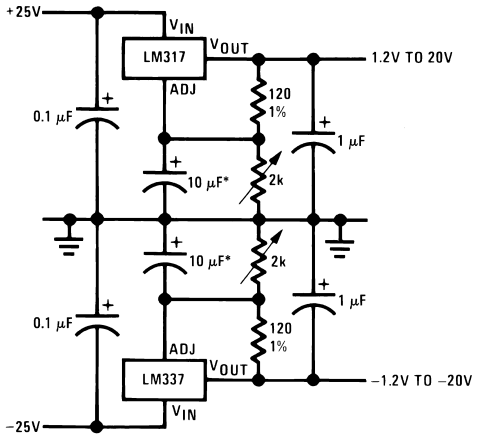
In Figure 5, a typical LM137's output drifts only 3 mV (or 0.03% of $V_{OUT}$ = −10V) when a 10W pulse is applied for 10 ms. This performance is thus well inside the specification limit of 0.02%/W × 10W = 0.2% max. When the 10W pulse is ended, the thermal regulation again shows a 3 mV step as the LM137 chip cools off. Note that the load regulation error of about 8 mV (0.08%) is additional to the thermal regulation error. In Figure 6, 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
$I_L$ = 0A → 0.25A → 0A
Horizontal sensitivity, 20 ms/div

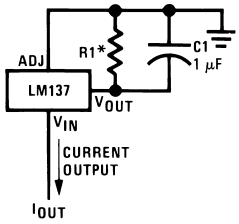
**Figure 6.**

## Typical Applications



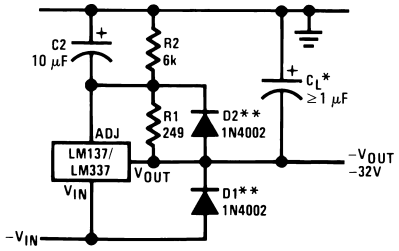

Full output current not available
at high input-output voltages
*The 10 µF capacitors are optional to improve ripple rejection

**Figure 7. Adjustable Lab Voltage Regulator**



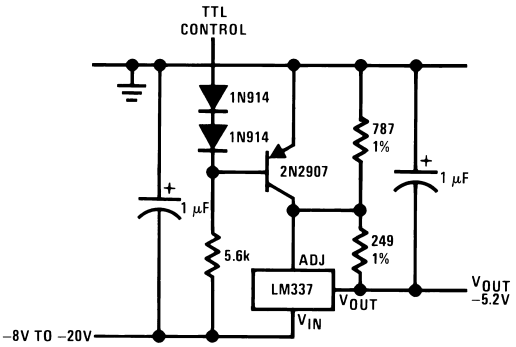

$I_{OUT} = \frac{1.250V}{R1}$
*0.8Ω ≤ R1 ≤ 120Ω

**Figure 8. Current Regulator**



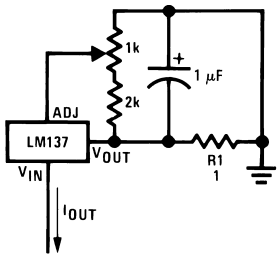

*When $C_L$ is larger than 20 µF, D1 protects the LM137 in case the input supply is shorted
**When C2 is larger than 10 µF and $-V_{OUT}$ is larger than −25V, D2 protects the LM137 in case the output is shorted

**Figure 9. Negative Regulator with Protection Diodes**




*Minimum output ≈ −1.3V when control input is low

**Figure 10. −5.2V Regulator with Electronic Shutdown***




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

**Figure 11. Adjustable Current Regulator**

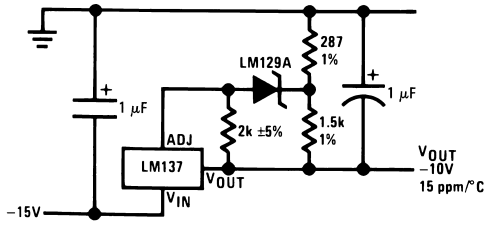



**Figure 12. High Stability −10V Regulator**

## Typical Performance Characteristics

(NDT & K Packages)

**Load Regulation**

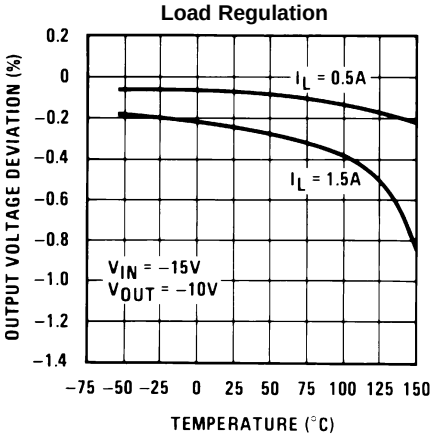



**Figure 13.**

**Current Limit**

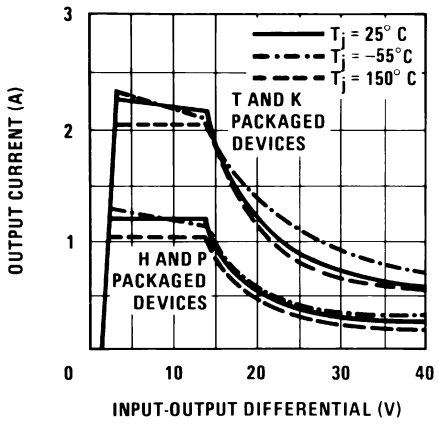



**Figure 14.**

**Adjustment Current**

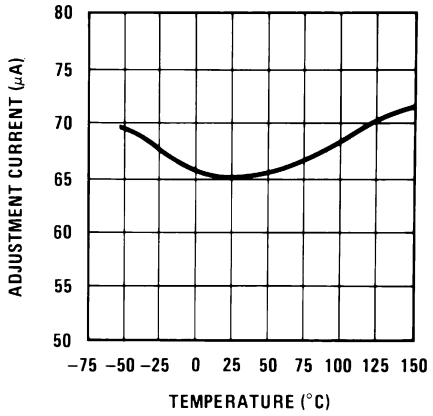



**Figure 15.**

**Dropout Voltage**

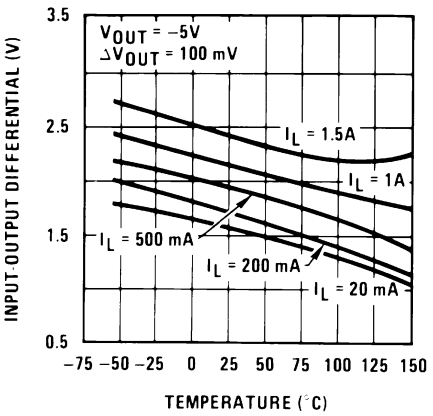



**Figure 16.**

**Temperature Stability**

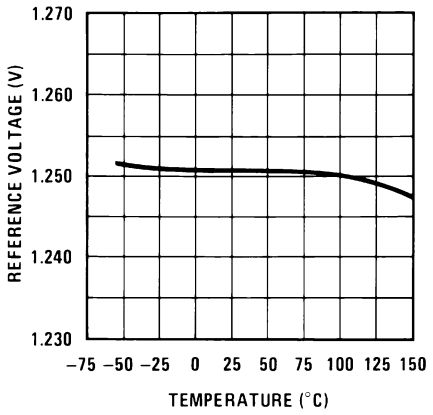



**Figure 17.**

**Minimum Operating Current**

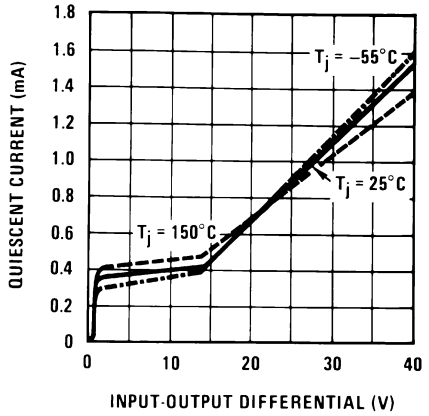



**Figure 18.**

## Typical Performance Characteristics (continued)

(NDT & K Packages)

**Ripple Rejection**

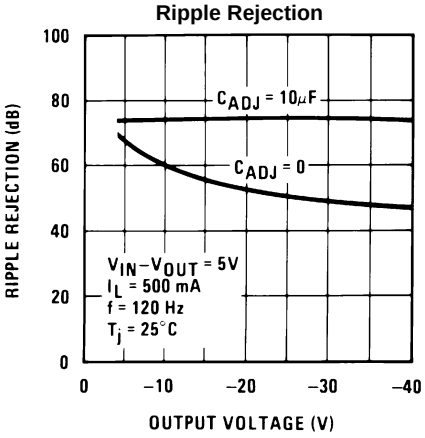



Figure 19.

**Ripple Rejection**

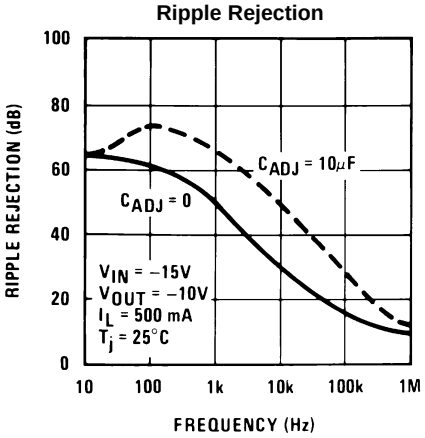



Figure 20.

**Ripple Rejection**

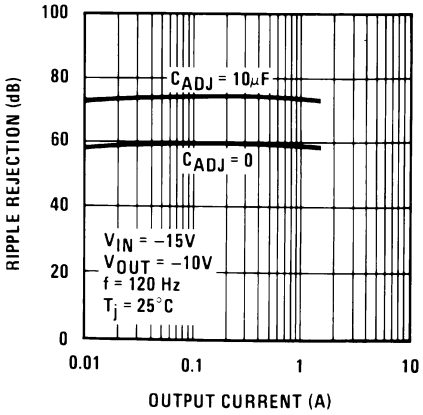



Figure 21.

**Output Impedance**

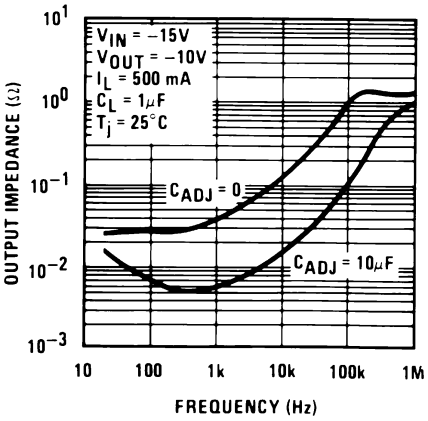



Figure 22.

**Line Transient Response**

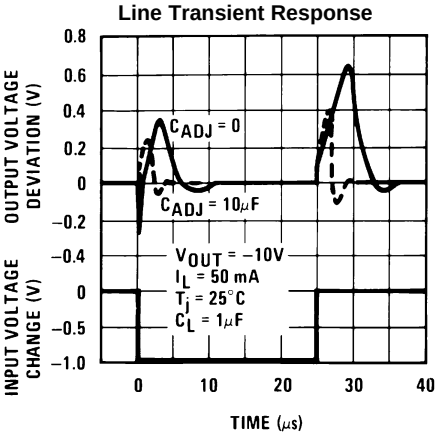



Figure 23.

**Load Transient Response**

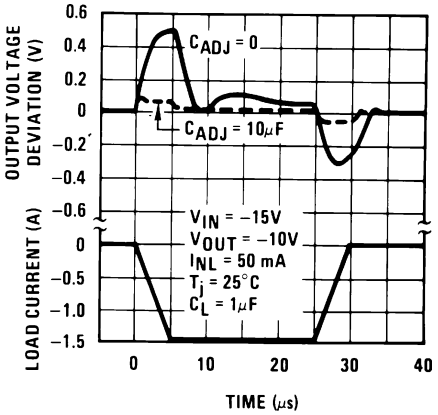



Figure 24.

## REVISION HISTORY

| Date Released | Revision | Section | Changes |
|---|---|---|---|
| 12/08/2010 | A | New Release, Corporate format | 3 MDS data sheets converted into one Corp. data sheet format. MNLM137-X, Rev. 0B1, MNLM137-K Rev. 0A0, and MRLM137–X-RH Rev. 2A0. MDS data sheets will be archived. |
| 03/16/2012 | B | Ordering Information, LM137K 883 Electrical Characteristics DC Parameters., LM137H RH Electrical Characteristics DC Parameters., DC Parameters Post Radiation Limits +25 Deg. C for 701VXA., DC Parameters Post Radiation Limits +25 Deg. C for 708VXA | Ordering Info — Added new LM137H1PQMLV., For the DC Parameters of LM137K 883 and LM137 RH, widened columns to accommodate correct limits. Added to the HEADER of DC Parameters — Post Radiation Limits 5962P9951701VXA. Added the HEADER and TABLE of DC Parameters — Post Radiation Limits 5962P9951708VXA. Rev A will be archived. |
| 04/17/2013 | C | | Changed layout of National Data Sheet to TI format. |

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM137H/883 | ACTIVE | TO | NDT | 3 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM137H/883 Q ACO<br>LM137H/883 Q >T | Samples |
| LM137K/883 | ACTIVE | TO | K | 2 | 50 | TBD | Call TI | Call TI | -55 to 125 | LM137K<br>/883 Q ACO<br>/883 Q >T | Samples |

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.



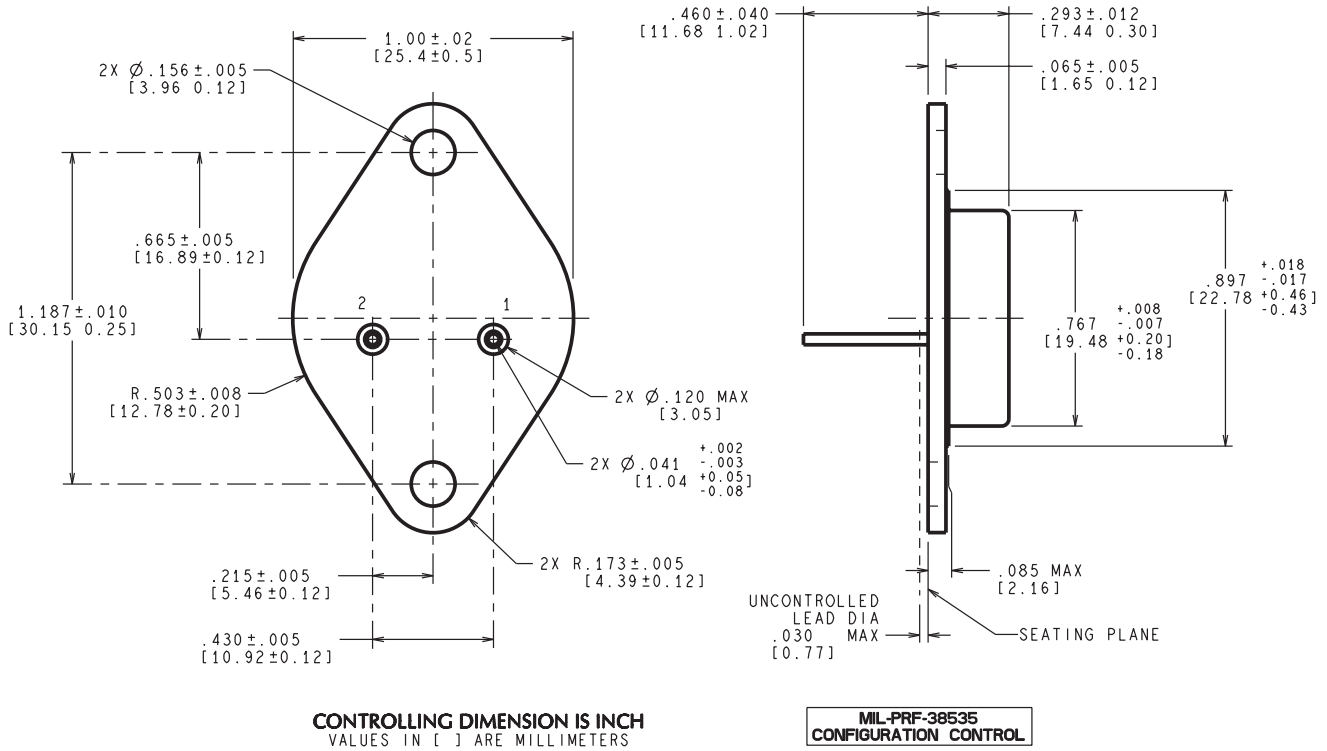
**OTHER QUALIFIED VERSIONS OF LM137QML, LM137QML-SP :**

- 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

# K0002C



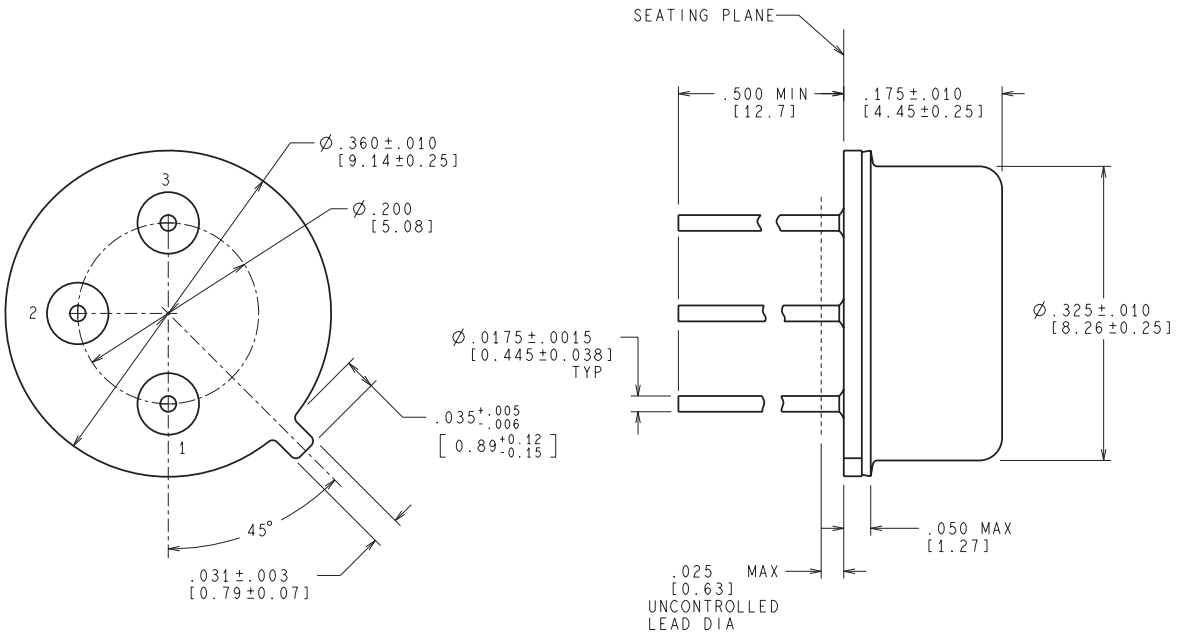

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

2. This drawing is subject to change without notice.

3. Leads not to be bent greater than 15º

# NDT0003A

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