LM137, LM337-N 3-Terminal Adjustable Negative Regulators

1 Features
- 1.5-A Output Current
- Line Regulation 0.01%/V (Typical)
- Load Regulation 0.3% (Typical)
- 77-dB Ripple Rejection
- 50 ppm/°C Temperature Coefficient
- Thermal Overload Protection
- Internal Short-Circuit Current Limiting Protections

2 Applications
- Industrial Power Supplies
- Factory Automation Systems
- Building Automation Systems
- PLC Systems
- Instrumentation
- IGBT Drive Negative Gate Supplies
- Networking
- Set-Top Boxes

3 Description
The LM137 and LM337-N are adjustable 3-terminal negative voltage regulators capable of supplying −1.5 A or more currents over an output voltage range of −1.25 V to −37 V. It requires only two external resistors to set the output voltage and one output capacitor for frequency compensation. The circuit design has been optimized for excellent regulation and low thermal transients. Further, the LM137 and LM337-N feature internal current limiting, thermal shutdown and safe-area compensation, making it virtually blowout-proof against overloads.

The LM137 and LM337-N are ideal complements to the LM117 and LM317 adjustable positive regulators. The LM137 has a wider operating temperature range than the LM337-N and is also offered in military and space qualified versions.

Device Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BODY SIZE (NOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM137</td>
<td>TO (3)</td>
<td>8.255 mm × 8.255 mm</td>
</tr>
<tr>
<td>LM337-N</td>
<td>TO (3)</td>
<td>8.255 mm × 8.255 mm</td>
</tr>
<tr>
<td></td>
<td>SOT-223 (4)</td>
<td>3.50 mm × 6.50 mm</td>
</tr>
<tr>
<td></td>
<td>TO-220 (3)</td>
<td>10.16 mm × 14.986 mm</td>
</tr>
</tbody>
</table>

(1) For all available packages, see the orderable addendum at the end of the data sheet. The LF01 is a lead formed (bent) version of the TO-220 package.

Adjustable Negative Voltage Regulator

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

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.
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4 Revision History

Changes from Revision D (April 2013) to Revision E Page

- Added ESD Ratings table, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section. ........................................... 1
- Deleted soldering information from Absolute Maximum Ratings ................................................................. 4

Changes from Revision C (April 2013) to Revision D Page

- Changed layout of National Data Sheet to TI format ............................................................. 7

Submit Documentation Feedback

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Product Folder Links: LM137 LM337-N
5 Pin Configuration and Functions

### Pin Functions

<table>
<thead>
<tr>
<th>NAME</th>
<th>TO-220</th>
<th>TO</th>
<th>SOT-223</th>
<th>I/O</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>Adjust pin</td>
</tr>
<tr>
<td>Vᵢn</td>
<td>2, TAB</td>
<td>3, CASE</td>
<td>2, 4</td>
<td>I</td>
<td>Input voltage pin for the regulator</td>
</tr>
<tr>
<td>Vₒuₜ</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>O</td>
<td>Output voltage pin for the regulator</td>
</tr>
</tbody>
</table>
6 Specifications

6.1 Absolute Maximum Ratings

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power dissipation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internally Limited</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input-output voltage differential</td>
<td>–0.3</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>LM137</td>
<td>–55</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>LM337-N</td>
<td>0</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>LM337I</td>
<td>–40</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature, T_{stg}</td>
<td>–65</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

6.2 ESD Ratings

<table>
<thead>
<tr>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{(ESD)}</td>
<td>Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001</td>
</tr>
</tbody>
</table>

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±2000 V may actually have higher performance.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating junction temperature</td>
<td>LM137</td>
<td>–55</td>
<td>150</td>
</tr>
<tr>
<td>LM337-N</td>
<td>0</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>LM337I</td>
<td>–40</td>
<td>125</td>
<td>°C</td>
</tr>
</tbody>
</table>

6.4 Thermal Information

<table>
<thead>
<tr>
<th>THERMAL METRIC(1)</th>
<th>LM137</th>
<th>LM337-N</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NDT (TO)</td>
<td>NDT (TO)</td>
<td>DCY (SOT-223)</td>
</tr>
<tr>
<td></td>
<td>3 PINS</td>
<td>3 PINS</td>
<td>3 PINS</td>
</tr>
<tr>
<td>R_{JA} Junction-to-ambient thermal resistance</td>
<td>140(2)</td>
<td>140(2)</td>
<td>58.3</td>
</tr>
<tr>
<td>R_{JC(top)} Junction-to-case (top) thermal resistance</td>
<td>12</td>
<td>12</td>
<td>36.6</td>
</tr>
<tr>
<td>R_{JB} Junction-to-board thermal resistance</td>
<td>—</td>
<td>—</td>
<td>7.2</td>
</tr>
<tr>
<td>Ψ_{JT} Junction-to-top characterization parameter</td>
<td>—</td>
<td>—</td>
<td>1.3</td>
</tr>
<tr>
<td>Ψ_{JB} Junction-to-board characterization parameter</td>
<td>—</td>
<td>—</td>
<td>7</td>
</tr>
<tr>
<td>R_{JC(bot)} Junction-to-case (bottom) thermal resistance</td>
<td>—</td>
<td>—</td>
<td>1</td>
</tr>
</tbody>
</table>

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report, SPRA953.
(2) No heat sink.
6.5 Electrical Characteristics

Unless otherwise specified, these specifications apply −55°C ≤ Tj ≤ 150°C for the LM137, 0°C ≤ Tj ≤ 125°C for the LM337-N; VIN − VOUT = 5 V; and IOUT = 0.1 A for the TO package and IOUT = 0.5 A for the SOT-223 and TO-220 packages. Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2 W for the TO and SOT-223, and 20 W for the TO-220. IMAX is 1.5 A for the SOT-223 and TO-220 packages, and 0.2 A for the TO package.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>LM137</th>
<th>LM337-N</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line regulation</td>
<td>Tj = 25°C, 3 V ≤</td>
<td>VIN − VOUT</td>
<td>≤ 40 V(1)</td>
<td>0.01 0.02</td>
</tr>
<tr>
<td></td>
<td>I = 10 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load regulation</td>
<td>Tj = 25°C, 10 mA ≤</td>
<td>IOUT</td>
<td>≤ IMAX</td>
<td>0.3% 0.5%</td>
</tr>
<tr>
<td>Thermal regulation</td>
<td>Tj = 25°C, 10-ms Pulse</td>
<td>0.002 0.02</td>
<td>0.003 0.04</td>
<td></td>
</tr>
<tr>
<td>Adjustment pin current</td>
<td></td>
<td>65 100</td>
<td>65 100</td>
<td>µA</td>
</tr>
<tr>
<td>Adjustment pin current charge</td>
<td>10 mA ≤ l ≤ IMAX</td>
<td>2 5</td>
<td>2 5</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td>3 V ≤</td>
<td>VIN − VOUT</td>
<td>≤ 40 V, Tj = 25°C</td>
<td></td>
</tr>
<tr>
<td>Reference voltage</td>
<td>3 V ≤</td>
<td>VIN − VOUT</td>
<td>≤ 40 V, P ≤ PMAX</td>
<td>Tj = 25°C (2)</td>
</tr>
<tr>
<td></td>
<td>10 mA ≤</td>
<td>IOUT</td>
<td>≤ IMAX, P ≤ PMAX</td>
<td>−55°C ≤ Tj ≤ 150°C</td>
</tr>
<tr>
<td>Line regulation</td>
<td>3 V ≤</td>
<td>VIN − VOUT</td>
<td>≤ 40 V, (1)</td>
<td>0.02 0.05</td>
</tr>
<tr>
<td>Load regulation</td>
<td>10 mA ≤</td>
<td>IOUT</td>
<td>≤ IMAX, (1)</td>
<td>0.3% 1%</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>Tmin ≤ Tj ≤ Tmax</td>
<td>0.6%</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td>Minimum load current</td>
<td></td>
<td>VIN − VOUT</td>
<td>≤ 40 V</td>
<td>2.5 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VIN − VOUT</td>
<td>≤ 10 V</td>
<td>1.2 3</td>
</tr>
<tr>
<td>Current limit</td>
<td></td>
<td>VIN − VOUT</td>
<td>≤ 15 V</td>
<td>K, DCY and NDE package</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VIN − VOUT</td>
<td>≤ 10 V</td>
<td>K, DCY and NDE package</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VIN − VOUT</td>
<td>= 40 V, Tj = 25°C</td>
<td>K, DCY and NDE package</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VIN − VOUT</td>
<td>= 40 V, Tj = 25°C</td>
<td>NDT package</td>
</tr>
<tr>
<td>RMS output noise, % of VOUT</td>
<td>Tj = 25°C, 10 Hz ≤ f ≤ 10 kHz</td>
<td>0.003%</td>
<td>0.003%</td>
<td></td>
</tr>
<tr>
<td>Ripple rejection ratio</td>
<td>VOUT = −10 V, f = 120 Hz</td>
<td>60</td>
<td>60</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>CADJ = 10 µF</td>
<td>66 77</td>
<td>66 77</td>
<td>dB</td>
</tr>
<tr>
<td>Long-term stability</td>
<td>Tj = 125°C, 1000 Hours</td>
<td>0.3% 1%</td>
<td>0.3% 1%</td>
<td></td>
</tr>
</tbody>
</table>

(1) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation. Load regulation is measured on the output pin at a point ¼ in. below the base of the TO packages.

(2) Selected devices with tightened tolerance reference voltage available.
6.6 Typical Characteristics
(NDE Package)

**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 Characteristics (continued)

(NDE Package)

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 Overview
In operation, the LM137 and LM337-N develops a nominal $-1.25$-$V$ reference voltage between the output and adjustment terminal. The reference voltage is impressed across program resistor $R_1$ ($120 \, \Omega$ for example) and, because the voltage is constant, a constant current then flows through the output set resistor $R_2$, giving an output voltage calculated by Equation 1.

$$V_{\text{OUT}} = -1.25V \left( 1 + \frac{R_2}{120} \right) + (-I_{\text{ADJ}} \times R_2)$$  \hspace{1cm} (1)

7.2 Functional Block Diagram

7.3 Feature Description

7.3.1 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 because 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 $V_{\text{OUT}}$, per Watt, within the first 10 ms after a step of power is applied. The LM137 device’s specification is $0.02\%$/W, maximum.
Feature Description (continued)

In Figure 13, a typical LM137 device’s output drifts only 3 mV (or 0.03% of $V_{OUT} = -10$ V) when a 10-W pulse is applied for 10 ms. This performance is thus well inside the specification limit of $0.02\%/W \times 10 \text{ W} = 0.2\%$ maximum. When the 10-W pulse is ended, the thermal regulation again shows a 3-mV step at the LM137 chip cools off.

**NOTE**

The load regulation error of about 8 mV (0.08%) is additional to the thermal regulation error.

In Figure 14, when the 10-W 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).
Feature Description (continued)

![Graph](image)

LM137

\[ V_{\text{OUT}} = -10 \text{ V} \]

\[ V_{\text{IN}} - V_{\text{OUT}} = -40 \text{ V} \]

\[ I_L = 0 \text{ A} \rightarrow 0.25 \text{ A} \rightarrow 0 \text{ A} \]

Horizontal sensitivity, 20 ms/div

Figure 14. Output Drift (10-W Pulse for 100 ms)

7.4 Device Functional Modes

7.4.1 Protection Diodes

When external capacitors are used with any IC regulator, it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator. Most 10-μF capacitors have low enough internal series resistance to deliver 20-A spikes when shorted. Although the surge is short, there is enough energy to damage parts of the IC.

When an output capacitor is connected to a negative output regulator and the input is shorted, the output capacitor pulls current out of the output of the regulator. The current depends on the value of the capacitor, the output voltage of the regulator, and the rate at which \( V_{\text{IN}} \) is shorted to ground.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when either the input, or the output, is shorted. Figure 15 shows the placement of the protection diodes.
Device Functional Modes (continued)

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

**When $C_2$ is larger than 10 $\mu$F and $-V_{OUT}$ is larger than $-25$V, D2 protects the LM137 in case the output is shorted

Figure 15. Regulator With Protection Diodes
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
The LM137 and LM337-N are versatile, high performance, negative output linear regulators with high accuracy and a wide temperature range. An output capacitor can be added to further improve transient response, and the ADJ pin can be bypassed to achieve very high ripple-rejection ratios. The device's functionality can be utilized in many different applications that require negative voltage supplies, such as bipolar amplifiers, operational amplifiers, and constant current regulators.

8.2 Typical Applications

8.2.1 Adjustable Negative Voltage Regulator
The LM137 and LM337-N can be used as a simple, negative output regulator to enable a variety of output voltages needed for demanding applications. By using an adjustable R2 resistor, a variety of negative output voltages can be made possible as shown in Figure 16.

8.2.1.1 Design Requirements
The device component count is very minimal, employing two resistors as part of a voltage divider circuit and an output capacitor for load regulation. An input capacitor is needed if the device is more than 4 inches from the filter capacitors.

8.2.1.2 Detailed Design Procedure
The output voltage is set based on the selection of the two resistors, R1 and R2, as shown in Figure 16.

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

(2)

8.2.1.1 Design Requirements
The device component count is very minimal, employing two resistors as part of a voltage divider circuit and an output capacitor for load regulation. An input capacitor is needed if the device is more than 4 inches from the filter capacitors.

8.2.1.2 Detailed Design Procedure
The output voltage is set based on the selection of the two resistors, R1 and R2, as shown in Figure 16.
Typical Applications (continued)

8.2.1.3 Application Curve

As shown in Figure 17, the maximum output current capability is limited by the input-output voltage differential, package type, and junction temperature.

![Figure 17. Current Limit](image)

8.2.2 Adjustable Lab Voltage Regulator

The LM337-N can be combined with a positive regulator such as the LM317-N to provide both a positive and negative voltage rail. This can be useful in applications that use bi-directional amplifiers and dual-supply operational amplifiers.

![Circuit Diagram](image)

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

A simple, fixed current regulator can be made by placing a resistor between the $V_{OUT}$ and ADJ pins of the LM137. By regulating a constant 1.25 V between these two terminals, a constant current can be delivered.

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

*0.8 Ω ≤ R1 ≤ 120 Ω

8.2.4 −5.2-V Regulator with Electronic Shutdown

The LM337-N can be used with a PNP transistor to provide shutdown control from a TTL control signal. The PNP can short or open the ADJ pin to GND. When ADJ is shorted to GND by the PNP, the output is −1.3V. When ADJ is disconnected from GND by the PNP, then the LM337-N outputs the programmed output of −5.2 V.
Typical Applications (continued)

8.2.5 High Stability -10-V Regulator

Using a high stability shunt voltage reference in the feedback path, such as the LM329, provides damping necessary for a stable, low noise output.
9 Power Supply Recommendations

The input supply to the LM137 and LM337-N must be kept at a voltage level such that its maximum input to output differential voltage rating is not exceeded. The minimum dropout voltage must also be met with extra headroom when possible to keep the LM137 and LM337-N in regulation. TI recommends an input capacitor, especially when the input pin is placed more than 4 inches away from the power-supply filter capacitor.

10 Layout

10.1 Layout Guidelines

Some layout guidelines must be followed to ensure proper regulation of the output voltage with minimum noise. Traces carrying the load current must be wide to reduce the amount of parasitic trace inductance and the feedback loop from \( V_{\text{OUT}} \) to \( \text{ADJ} \) must be kept as short as possible. To improve PSRR, a bypass capacitor can be placed at the \( \text{ADJ} \) pin and must be placed as close as possible to the IC. In cases when \( V_{\text{IN}} \) shorts to ground, an external diode must be placed from \( V_{\text{IN}} \) to \( V_{\text{OUT}} \) to divert the surge current into the output capacitor and protect the IC. Similarly, in cases when a large bypass capacitor is placed at the \( \text{ADJ} \) pin and \( V_{\text{OUT}} \) shorts to ground, an external diode must be placed from \( V_{\text{OUT}} \) to \( \text{ADJ} \) to provide a path for the bypass capacitor to discharge. These diodes must be placed close to the corresponding IC pins to increase their effectiveness.

10.2 Layout Example

![Figure 18. Layout Example (SOT-223)](image-url)
10.3 Thermal Considerations

10.3.1 Heatsinking SOT-223 Package Parts

The SOT-223 DCY packages use a copper plane on the PCB and the PCB itself as a heatsink. To optimize the heat sinking ability of the plane and PCB, solder the tab of the package to the plane.

Figure 19 and Figure 20 show the information for the SOT-223 package. Figure 20 assumes a $\theta_{(J-A)}$ of 75°C/W for 1 ounce copper and 51°C/W for 2 ounce copper and a maximum junction temperature of 125°C.

![Figure 19. $\theta_{(J-A)}$ vs Copper (2 ounce) Area for the SOT-223 Package](image)

![Figure 20. Maximum Power Dissipation vs $T_{AMB}$ for the SOT-223 Package](image)

See AN-1028, SNVA036, for power enhancement techniques to be used with the SOT-223 package.
11 Device and Documentation Support

11.1 Documentation Support

11.1.1 Related Documentation
For related documentation see the following:
   AN-1028, SNVA036

11.2 Related Links
The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

<table>
<thead>
<tr>
<th>PARTS</th>
<th>PRODUCT FOLDER</th>
<th>SAMPLE &amp; BUY</th>
<th>TECHNICAL DOCUMENTS</th>
<th>TOOLS &amp; SOFTWARE</th>
<th>SUPPORT &amp; COMMUNITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM137</td>
<td>Click here</td>
<td>Click here</td>
<td>Click here</td>
<td>Click here</td>
<td>Click here</td>
</tr>
<tr>
<td>LM337-N</td>
<td>Click here</td>
<td>Click here</td>
<td>Click here</td>
<td>Click here</td>
<td>Click here</td>
</tr>
</tbody>
</table>

11.3 Community Resources
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11.4 Trademarks
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11.5 Electrostatic Discharge Caution

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.

11.6 Glossary

**SLYZ022 — TI Glossary.**
This glossary lists and explains terms, acronyms, and definitions.

12 Mechanical, Packaging, and Orderable Information
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.
## PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status (1)</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan (2)</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp (3)</th>
<th>Op Temp (°C)</th>
<th>Device Marking (4/5)</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM137H</td>
<td>ACTIVE</td>
<td>TO</td>
<td>NDT</td>
<td>3</td>
<td>500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>AU</td>
<td>Call TI</td>
<td>Level-1-NA-UNLIM</td>
<td>-55 to 150</td>
<td>(LM137HP+, LM137H P+)</td>
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<tr>
<td>LM137H/NOPB</td>
<td>ACTIVE</td>
<td>TO</td>
<td>NDT</td>
<td>3</td>
<td>500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>AU</td>
<td>Call TI</td>
<td>Level-1-NA-UNLIM</td>
<td>-55 to 150</td>
<td>(LM137HP+, LM137H P+)</td>
</tr>
<tr>
<td>LM337IMP</td>
<td>NRND</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>1000</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-40 to 125</td>
<td>N02A</td>
<td>Samples</td>
</tr>
<tr>
<td>LM337IMP/NOPB</td>
<td>ACTIVE</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>1000</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-1-260C-UNLIM</td>
<td>-40 to 125</td>
<td>N02A</td>
<td>Samples</td>
</tr>
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<td>NRND</td>
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<td>DCY</td>
<td>4</td>
<td>2000</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-40 to 125</td>
<td>N02A</td>
<td>Samples</td>
</tr>
<tr>
<td>LM337T</td>
<td>NRND</td>
<td>TO-220</td>
<td>NDE</td>
<td>3</td>
<td>45</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 125</td>
<td>LM337T P+</td>
<td>Samples</td>
</tr>
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<td>LM337T/LF01</td>
<td>ACTIVE</td>
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<td>NDG</td>
<td>3</td>
<td>45</td>
<td>Pb-Free (RoHS Exempt)</td>
<td>CU SN</td>
<td>Level-3-245C-168 HR</td>
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<td>LM337T P+</td>
<td>Samples</td>
</tr>
<tr>
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<td>TO-220</td>
<td>NDE</td>
<td>3</td>
<td>45</td>
<td>Pb-Free (RoHS Exempt)</td>
<td>CU SN</td>
<td>Level-1-NA-UNLIM</td>
<td>0 to 125</td>
<td>LM337T P+</td>
<td>Samples</td>
</tr>
</tbody>
</table>

(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.
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.

Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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### TAPE AND REEL INFORMATION

#### REEL DIMENSIONS

- **Reel Diameter**

#### TAPE DIMENSIONS

- **A0**: Dimension designed to accommodate the component width
- **B0**: Dimension designed to accommodate the component length
- **K0**: Dimension designed to accommodate the component thickness
- **W**: Overall width of the carrier tape
- **P1**: Pitch between successive cavity centers

#### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

- **Sprocket Holes**
- **User Direction of Feed**
- **Pocket Quadrants**

*All dimensions are nominal*

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0  (mm)</th>
<th>B0  (mm)</th>
<th>K0  (mm)</th>
<th>P1  (mm)</th>
<th>W  (mm)</th>
<th>Pin1 Quadrant</th>
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<tr>
<td>LM337IMP</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>1000</td>
<td>330.0</td>
<td>16.4</td>
<td>7.0</td>
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<td>2.2</td>
<td>12.0</td>
<td>16.0</td>
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<tr>
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<td>DCY</td>
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<td>7.0</td>
<td>7.5</td>
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<td>12.0</td>
<td>16.0</td>
<td>Q3</td>
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## TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>367.0</td>
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<td>35.0</td>
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<td>LM337IMP/NOPB</td>
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<td>367.0</td>
<td>35.0</td>
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<tr>
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<td>35.0</td>
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<td>2000</td>
<td>367.0</td>
<td>367.0</td>
<td>35.0</td>
</tr>
</tbody>
</table>
MECHANICAL DATA

DCY (R-PDSO-G4)

PLASTIC SMALL-OUTLINE

NOTES:
A. All linear dimensions are in millimeters (inches).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC TO-261 Variation AA.

MECHANICAL DATA
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC-7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil recommendations. Refer to IPC 7525 for stencil design considerations.
MECHANICAL DATA

NDG0003F

www.ti.com

T03F (Rev B)

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