# LM237, LM337
# 3-TERMINAL ADJUSTABLE REGULATORS

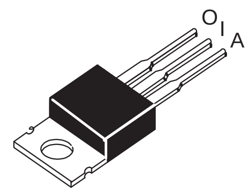
SLVS047C – NOVEMBER 1981 – REVISED JULY 1999

- **Output Voltage Range Adjustable From –1.2 V to –37 V**
- **Output Current Capability of 1.5 A Max**
- **Input Regulation Typically 0.01% Per Input-Voltage Change**
- **Output Regulation Typically 0.3%**
- **Peak Output Current Constant Over Temperature Range of Regulator**
- **Ripple Rejection Typically 77 dB**
- **Direct Replacement for National Semiconductor LM237 and LM337**

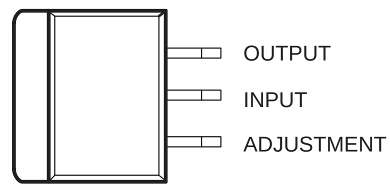
**KC PACKAGE**
**(TOP VIEW)**


The INPUT terminal is in electrical contact with the mounting base.

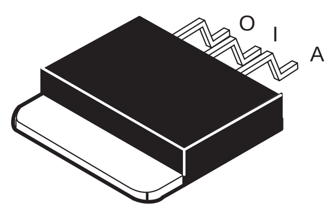
**TO-220AB**




**KTE PACKAGE**
**(TOP VIEW)**




The INPUT terminal is in electrical contact with the mounting base.




## description

The LM237 and LM337 are adjustable 3-terminal negative-voltage regulators capable of supplying in excess of –1.5 A over an output voltage range of –1.2 V to –37 V. They are exceptionally easy to use, requiring only two external resistors to set the output voltage and one output capacitor for frequency compensation. The current design has been optimized for excellent regulation and low thermal transients. In addition, the LM237 and LM337 feature internal current limiting, thermal shutdown, and safe-area compensation, making them virtually immune to failure by overloads.

The LM237 and LM337 serve a wide variety of applications, including local on-card regulation, programmable output-voltage regulation, and precision current regulation.

The LM237 is characterized for operation over the virtual junction temperature range of –25°C to 150°C. The LM337 is characterized for operation over the virtual junction temperature range of 0°C to 125°C.

**AVAILABLE OPTIONS**

| $T_J$ | PACKAGED DEVICES | | CHIP FORM (Y) |
|---|---|---|---|
| | HEAT-SINK MOUNTED (KC) | PLASTIC FLANGE MOUNTED (KTE) | |
| –25°C to 150°C | LM237KC | LM237KTE | — |
| 0°C to 125°C | LM337KC | LM337KTE | LM337Y |

The KTE package is only available taped and reeled. Add the R suffix to the device type (e.g., LM237KTER). Chip forms are tested at 25°C.



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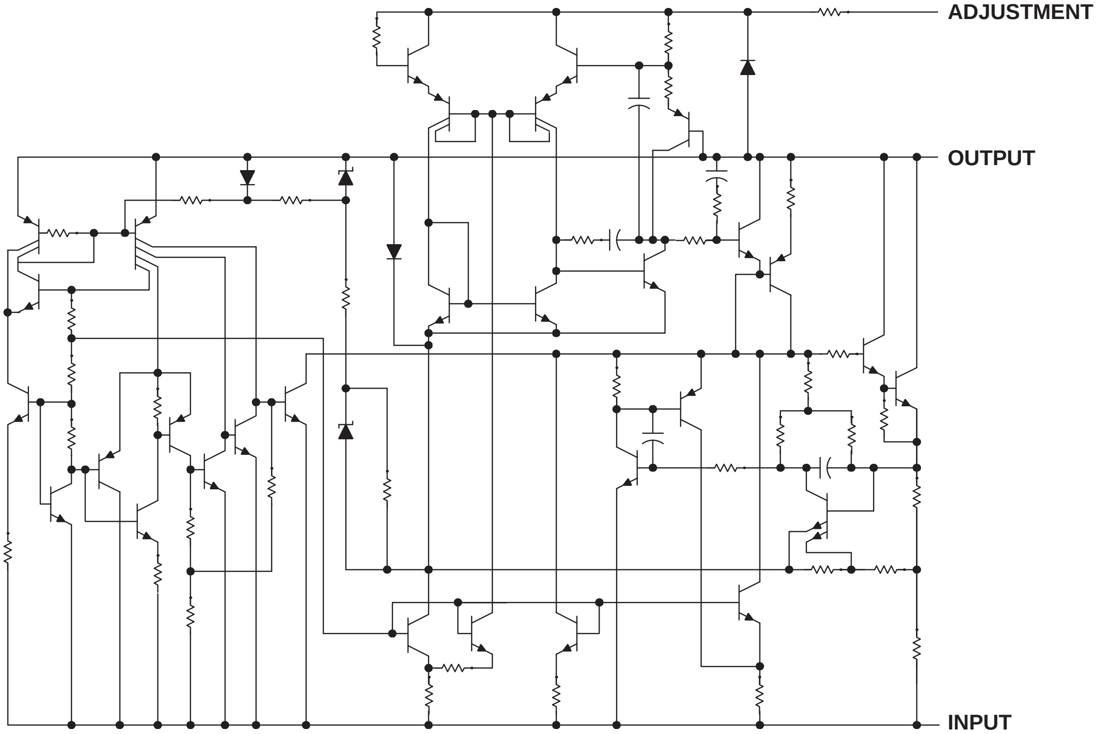
## schematic diagram




## absolute maximum ratings over operating temperature ranges (unless otherwise noted)†

Input-to-output differential voltage, $V_I - V_O$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –40 V
Package thermal impedance, $\theta_{JA}$ (see Notes 1 and 2): KC package . . . . . . . . . . . . . . . . . . . . . . . . . . 22°C/W
KTE package . . . . . . . . . . . . . . . . . . . . . . . . . 23°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 260°C
Storage temperature range, $T_{stg}$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. Maximum power dissipation is a function of $T_J$(max), $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can impact reliability. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.
2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

## recommended operating conditions

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| Output current, $I_O$ | $\lvert V_I - V_O \rvert \le 40$ V, P ≤ 15 W | | 10 | 1500 | mA |
| | $\lvert V_I - V_O \rvert \le 10$ V, P ≤ 15 W | | 6 | 1500 | |
| Operating virtual junction temperature, $T_J$ | | LM237 | –25 | 150 | °C |
| | | LM337 | 0 | 125 | |

## electrical characteristics over recommended ranges of operating virtual junction temperature (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | | LM237 MIN | LM237 TYP | LM237 MAX | LM337 MIN | LM337 TYP | LM337 MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Input regulation‡ | $V_I - V_O = -3$ V to $-40$ V | $T_J = 25°C$ | | 0.01 | 0.02 | | 0.01 | 0.04 | %/V |
| | | $T_J$ = MIN to MAX | | 0.02 | 0.05 | | 0.02 | 0.07 | |
| Ripple rejection | $V_O = -10$ V, | f = 120 Hz | | 60 | | | 60 | | dB |
| | $V_O = -10$ V, f = 120 Hz, | $C_{ADJ} = 10\ \mu F$ | 66 | 77 | | 66 | 77 | | |
| Output regulation | $I_O$ = 10 mA to 1.5 A, $T_J = 25°C$ | $\lvert V_O \rvert \le 5$ V | | | 25 | | | 50 | mV |
| | | $\lvert V_O \rvert \ge 5$ V | | 0.3% | 0.5% | | 0.3% | 1% | |
| | $I_O$ = 10 mA to 1.5 A | $\lvert V_O \rvert \le 5$ V | | | 50 | | | 70 | mV |
| | | $\lvert V_O \rvert \ge 5$ V | | | 1% | | | 1.5% | |
| Output-voltage change with temperature | $T_J$ = MIN to MAX | | | 0.6% | | | 0.6% | | |
| Output-voltage long-term drift | After 1000 h at $T_J$ = MAX and $V_I - V_O = -40$ V | | | 0.3% | 1% | | 0.3% | 1% | |
| Output noise voltage | f = 10 Hz to 10 kHz, | $T_J = 25°C$ | | 0.003% | | | 0.003% | | |
| Minimum output current to maintain regulation | $\lvert V_I - V_O \rvert \le 40$ V | | | 2.5 | 5 | | 2.5 | 10 | mA |
| | $\lvert V_I - V_O \rvert \le 10$ V | | | 1.2 | 3 | | 1.5 | 6 | |
| Peak output current | $\lvert V_I - V_O \rvert \le 15$ V | | 1.5 | 2.2 | | 1.5 | 2.2 | | A |
| | $\lvert V_I - V_O \rvert \le 40$ V, | $T_J = 25°C$ | 0.24 | 0.4 | | 0.15 | 0.4 | | |
| Adjustment-terminal current | | | | 65 | 100 | | 65 | 100 | μA |
| Change in adjustment-terminal current | $V_I - V_O = -2.5$ V to $-40$ V, $I_O$ = 10 mA to MAX | $T_J = 25°C$, | | 2 | 5 | | 2 | 5 | μA |
| Reference voltage (output to ADJ) | $V_I - V_O = -3$ V to $-40$ V, $I_O$ = 10 mA to 1.5 A, P ≤ rated dissipation | $T_J = 25°C$ | –1.225 | –1.25 | –1.275 | –1.213 | –1.25 | –1.287 | V |
| | | $T_J$ = MIN to MAX | –1.2 | –1.25 | –1.3 | –1.2 | –1.25 | –1.3 | |
| Thermal regulation | Initial $T_J = 25°C$, | 10-ms pulse | | 0.002 | 0.02 | | 0.003 | 0.04 | %/W |

† Unless otherwise noted, these specifications apply for the following test conditions $\lvert V_I - V_O \rvert = 5$ V and $I_O = 0.5$ A. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions. All characteristics are measured with a 0.1-μF capacitor across the input and a 1-μF capacitor across the output. Pulse-testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

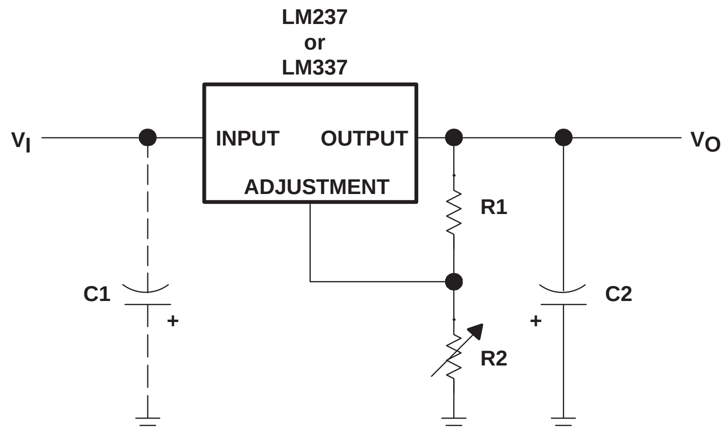
‡ Input regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

## electrical characteristics, $T_J$ = 25°C

| PARAMETER | TEST CONDITIONS† | | LM237, LM337 MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input regulation‡ | $V_I - V_O$ = –3 V to –40 V | | | 0.01 | 0.04 | %/V |
| Ripple rejection | $V_O$ = –10 V, f = 120 Hz | | | 60 | | dB |
| | $V_O$ = –10 V, $C_{ADJ}$ = 10 µF, f = 120 Hz | | 66 | 77 | | |
| Output regulation | $I_O$ = 10 mA to 1.5 A | $\lvert V_O \rvert \le$ 5 V | | | 50 | mV |
| | | $\lvert V_O \rvert \ge$ 5 V | | 0.3% | 1% | |
| Output noise voltage | f = 10 Hz to 10 kHz | | | 0.003% | | |
| Minimum output current to maintain regulation | $\lvert V_I - V_O \rvert \le$ 40 V | | | 2.5 | 10 | mA |
| | $\lvert V_I - V_O \rvert \le$ 10 V | | | 1.5 | 6 | |
| Peak output current | $\lvert V_I - V_O \rvert \le$ 15 V | | 1.5 | 2.2 | | A |
| | $\lvert V_I - V_O \rvert \le$ 40 V | | 0.15 | 0.4 | | |
| Adjustment-terminal current | | | | 65 | 100 | µA |
| Change in adjustment-terminal current | $V_I - V_O$ = – 2.5 V to –40 V, $I_O$ = 10 mA to MAX | | | 2 | 5 | µA |
| Reference voltage (output to ADJ) | $V_I - V_O$ = – 3 V to –40 V, $I_O$ = 10 mA to 1.5 A, P ≤ rated dissipation | | –1.213 | –1.25 | –1.287 | V |

† Unless otherwise noted, these specifications apply for the following test conditions $\lvert V_I - V_O \rvert$ = 5 V and $I_O$ = 0.5 A. All characteristics are measured with a 0.1-µF capacitor across the input and a 1-µF capacitor across the output. Pulse-testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.
‡ Input regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

## APPLICATION INFORMATION

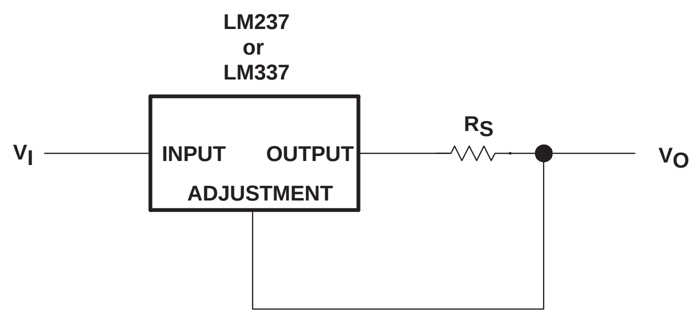



R1 is typically 120 Ω.

$$R2 = R1\left(\frac{-V_O}{-1.25} - 1\right)$$ where $V_O$ is the output in volts.

C1 is a 1-µF solid tantalum capacitor required only if the regulator is more than 10 cm (4 in) from the power-supply filter capacitor.
C2 is a 1-µF solid tantalum or 10-µF aluminum electrolytic capacitor required for stability.

**Figure 1. Adjustable Negative-Voltage Regulator**




$$R_S = \frac{1.25\ V}{I_{LIMIT}}$$

**Figure 2. Current-Limiting Circuit**

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