National Semiconductor

Voltage Regulators

# LM145/LM345 Negative Three Amp Regulator

## General Description

The LM145 is a three-terminal negative regulator with a fixed output voltage of −5V or −5.2V, and up to 3A load current capability. This device needs only one external component—a compensation capacitor at the output, making it easy to apply. Worst case guarantees on output voltage deviation due to any combination of line, load or temperature variation assure satisfactory system operation.

Exceptional effort has been made to make the LM145 immune to overload conditions. The regulator has current limiting which is independent of temperature, combined with thermal overload protection. Internal current limiting protects against momentary faults while thermal shutdown prevents junction temperatures from exceeding safe limits during prolonged overloads.

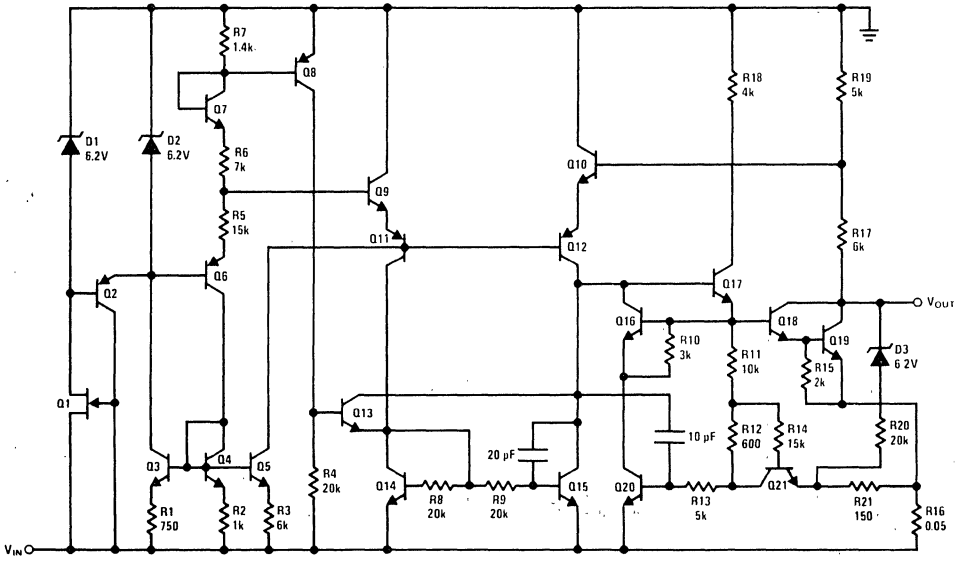
Although primarily intended for fixed output voltage applications, the LM145 may be programmed for higher output voltages with a simple resistive divider. The low quiescent drain current of the device allows this technique to be used with good regulation.

The LM145 comes in a hermetic TO-3 package rated at 25W. A reduced temperature range part LM345 is also available.

## Features

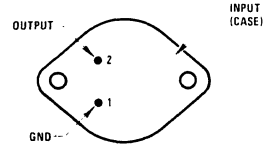
- Output voltage accurate to better than ±2%
- Current limit constant with temperature
- Internal thermal shutdown protection
- Operates with input-output voltage differential of 2.8V at full rated load over full temperature range
- Regulation guaranteed with 25W power dissipation
- 3A output current guaranteed
- Only one external component needed
- 100% electrical burn-in

## Schematic Diagram




## Connection Diagram

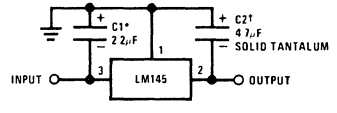
**Metal Can Package**




BOTTOM VIEW

**Order Number LM145K-5.0, LM345K-5.0, LM145K-5.2, or LM345K-5.2**
**See NS Package K02A**

## Typical Applications




†Required for stability. For value given, capacitor must be solid tantalum. 50µF aluminum electrolytic may be substituted. Values given may be increased with out limit.

*Required if regulator is separated from filter capacitor. For value given, capacitor must be solid tantalum. 50µF aluminum electrolytic may be substituted

**Fixed Regulator**

## Absolute Maximum Ratings

| | |
|---|---|
| Input Voltage | 20V |
| Input-Output Differential | 20V |
| Power Dissipation | Internally Limited |
| Operating Junction Temperature Range | |
| LM145 | −55°C to +150°C |
| LM345 | 0°C to +125°C |
| Storage Temperature Range | −65°C to +150°C |
| Lead Temperature (Soldering, 10 seconds) | 300°C |

## Electrical Characteristics (−5V & −5.2V) (Note 1)

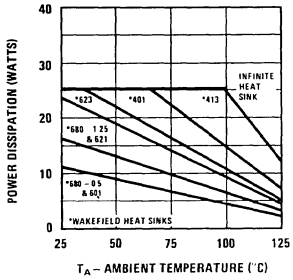
| PARAMETER | CONDITIONS | LIMITS | | | | | | UNITS |
|---|---|---|---|---|---|---|---|---|
| | | LM145 | | | LM345 | | | |
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Output Voltage | $T_j = 25°C$, $I_{OUT} = 5$ mA, | | | | | | | |
| 5.0V | $V_{IN} = -7.5$ | −5.1 | −5.0 | −4.9 | −5.2 | −5.0 | −4.8 | V |
| 5.2V | | −5.3 | −5.2 | −5.1 | −5.4 | −5.2 | −5.0 | V |
| Line Regulation (Note 2) | $T_j = 25°C$<br>$-20V \leq V_{IN} \leq -7.5V$ | | 5 | 15 | | 5 | 25 | mV |
| Load Regulation (Note 2) | $T_j = 25°C$, $V_{IN} = -7.5V$<br>$5\text{ mA} \leq I_{OUT} \leq 3A$ | | 30 | 75 | | 30 | 100 | mV |
| Output Voltage | $-20V \leq V_{IN} \leq -7.8V$ | | | | | | | |
| 5.0V | $5\text{ mA} \leq I_{OUT} \leq 3A$ | −5.20 | | −4.80 | −5.25 | | −4.75 | V |
| 5.2V | $P \leq 25W$<br>$T_{MIN} \leq T_j \leq T_{MAX}$ | −5.40 | | −5.00 | −5.45 | | −4.95 | V |
| Quiescent Current | $-20V \leq V_{IN} \leq -7.5V$<br>$5\text{ mA} \leq I_{OUT} \leq 3A$ | | 1.0 | 3.0 | | 1.0 | 3.0 | mA |
| Short Circuit Current | $V_{IN} = -7.5V$, $T_j = +25°C$ | | 4 | 5.5 | | 4 | 5.5 | A |
| | $V_{IN} = -20V$, $T_j = +25°C$ | | 2 | 3.5 | | 2 | 3.5 | A |
| Output Noise Voltage | $T_A = 25°C$, $C_L = 4.7\mu F$<br>$10\text{ Hz} \leq f \leq 100\text{ kHz}$ | | 150 | | | 150 | | $\mu V$ |
| Long Term Stability | | | 5 | 50 | | 5 | 50 | mV |
| Thermal Resistance Junction to Case | | | 2 | | | 2 | | °C/W |

**Note 1:** Unless otherwise specified, these specifications apply: $-55°C \leq T_j \leq +150°C$ for the LM145 and $0°C \leq T_j \leq +125°C$ for the LM345. $V_{IN} = 7.5V$ and $I_{OUT} = 5mA$. Although power dissipation is internally limited, electrical specifications apply only for power levels up to 25W. For calculations of junction temperature rise due to power dissipation, use a thermal resistance of 35°C/W for the TO-3 with no heat sink. With a heat sink, use 2°C/W for junction to case thermal resistance.

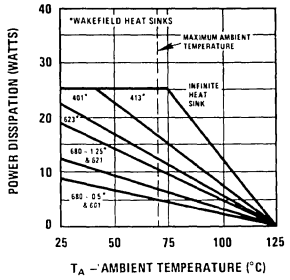
**Note 2:** Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. To ensure constant junction temperature, pulse testing with a low duty cycle is used.

# Typical Performance Characteristics

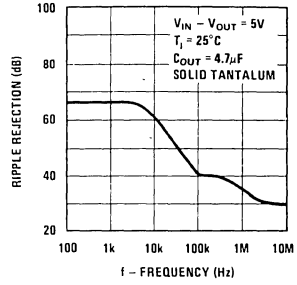
**Maximum Average Power Dissipation for LM145,**



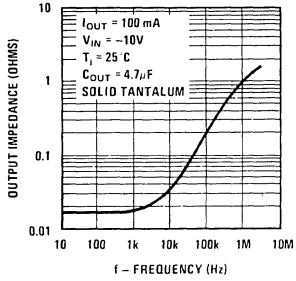

**Maximum Average Power Dissipation for LM345**



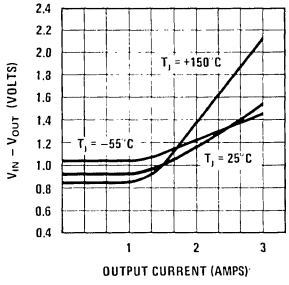

**Ripple Rejection**



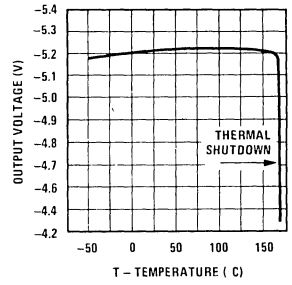

**Output Impedance**



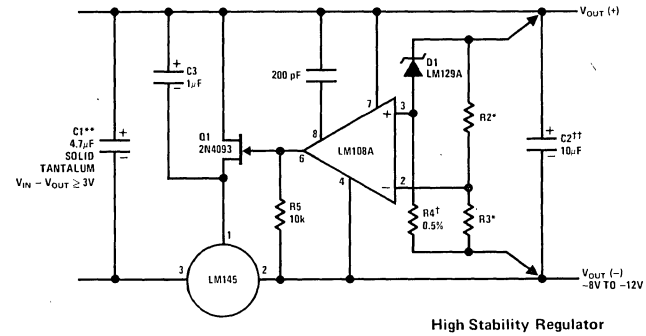

**Minimum Input-Output Voltage Differential**




**Output Voltage vs Temperature**




# Typical Applications (Continued)




*Select resistors to set output voltage. 1 ppm/°C tracking suggested

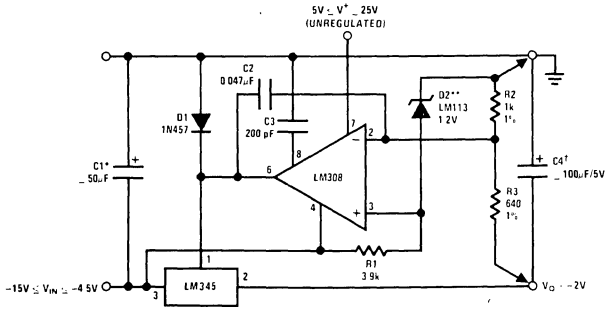
**C1 is not needed if power supply filter capacitor is within 3" of regulator.

†Determines zener current. May be adjusted to minimize temperature drift.

††Solid tantalum

Load and line regulation < 0.01%
Temperature drift < 0.001%/°C

**High Stability Regulator**



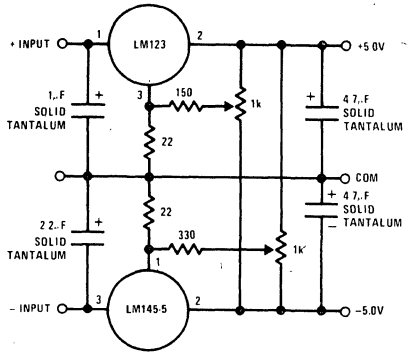

**C1 is not needed if power supply filter capacitor is within 3" of regulator.

†Keep C4 within 2" of LM345.

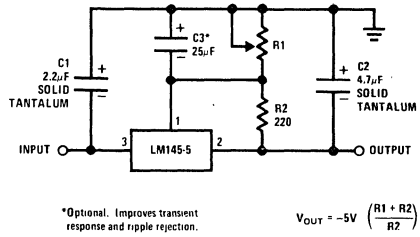
**D2 sets initial output voltage accuracy. The LM113 is available in 0.5, 0.2, and 1% tolerance

**–2V ECL Termination Regulator**

## Typical Applications (Continued)




Dual 3 Amp Trimmed Supply




Variable Output (-5.0V to -15V)