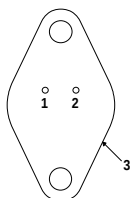


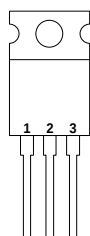
Pin 1 – ADJ.  
 Pin 2 –  $V_{OUT}$   
 Case –  $V_{IN}$

**K Package – TO-3**



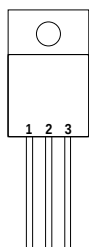
Pin 1 – ADJ.  
 Pin 2 –  $V_{OUT}$   
 Case –  $V_{IN}$

**R Package – TO-66**



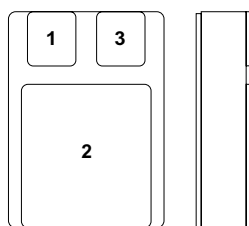
Pin 1 – ADJ.  
 Pin 2 –  $V_{IN}$   
 Pin 3 –  $V_{OUT}$   
 Case –  $V_{IN}$

**T Package – TO-220**



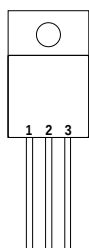
Pin 1 – ADJ.  
 Pin 2 –  $V_{IN}$   
 Pin 3 –  $V_{OUT}$   
 Case –  $V_{IN}$

**G Package – TO-257**



Pin 1 – ADJ.  
 Pin 2 –  $V_{IN}$   
 Pin 3 –  $V_{OUT}$

**SG Package – SMD1**  
**CERAMIC SURFACE**  
**MOUNT**



Pin 1 – ADJ.  
 Pin 2 –  $V_{IN}$   
 Pin 3 –  $V_{OUT}$

**IG Package – TO-257**  
**(Isolated)**

## **1.5 AMP** **NEGATIVE ADJUSTABLE** **VOLTAGE REGULATOR**

### FEATURES

- **OUTPUT VOLTAGE RANGE OF:**  
1.25 TO 40V FOR STANDARD VERSION  
1.25 TO 50V FOR –HV VERSION
- **1% OUTPUT VOLTAGE TOLERANCE**
- **0.3% LOAD REGULATION**
- **0.01% / V LINE REGULATION**
- **COMPLETE SERIES OF PROTECTIONS:**
  - **CURRENT LIMITING**
  - **THERMAL SHUTDOWN**
  - **SOA CONTROL**

### ABSOLUTE MAXIMUM RATINGS ( $T_{case} = 25^{\circ}C$ unless otherwise stated)

|           |                                      |             |                             |
|-----------|--------------------------------------|-------------|-----------------------------|
| $V_{I-O}$ | Input - Output Differential Voltage  | – Standard  | 40V                         |
|           |                                      | – HV Series | 50V                         |
| $I_O$     | Output Current                       |             | Internally limited          |
| $P_D$     | Power Dissipation                    |             | Internally limited          |
| $T_j$     | Operating Junction Temperature Range |             | See Order Information Table |
| $T_{stg}$ | Storage Temperature                  |             | -65 to 150°C                |

| Parameter                                                      | Test Conditions                                                                                                                                 | IP137A , IP137AHV<br>LM137A , LM137AHV                                 |       |        | IP137 , IP137HV<br>LM137 , LM137HV |        |        | Units              |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|-------|--------|------------------------------------|--------|--------|--------------------|
|                                                                |                                                                                                                                                 | Min.                                                                   | Typ.  | Max.   | Min.                               | Typ.   | Max.   |                    |
| $V_{REF}$ Reference Voltage                                    | $I_{OUT} = 10\text{mA}$                                                                                                                         | -1.238                                                                 | -1.25 | -1.262 | -1.225                             | -1.25  | -1.275 | V                  |
|                                                                | $I_{OUT} = 10\text{mA to } I_{MAX}$<br>$V_{IN} - V_{OUT} = 3\text{V to } V_{MAX}$<br>$P \leq P_{MAX}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | -1.220                                                                 | -1.25 | -1.280 | -1.200                             | -1.250 | -1.300 | V                  |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ Line Regulation 1      | $V_{IN} - V_{OUT} = 3\text{V to } V_{MAX}$<br>$T_J = -55 \text{ to } 150^\circ\text{C}$                                                         |                                                                        | 0.005 | 0.010  |                                    | 0.010  | 0.020  | %V                 |
|                                                                |                                                                                                                                                 |                                                                        | 0.010 | 0.030  |                                    | 0.020  | 0.050  |                    |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ Load Regulation 1      | $I_{OUT} = 10\text{mA to } I_{MAX}$                                                                                                             | $V_{OUT} \leq 5\text{V}$                                               |       | 5      | 25                                 | 15     | 25     | mV                 |
|                                                                |                                                                                                                                                 | $V_{OUT} \geq 5\text{V}$                                               |       | 0.1    | 0.5                                | 0.3    | 0.5    | %                  |
|                                                                | $I_{OUT} = 10\text{mA to } I_{MAX}$<br>$T_J = -55 \text{ to } 150^\circ\text{C}$                                                                | $V_{OUT} \leq 5\text{V}$                                               |       | 10     | 50                                 | 20     | 50     | mV                 |
|                                                                |                                                                                                                                                 | $V_{OUT} \geq 5\text{V}$                                               |       | 0.2    | 1                                  | 0.3    | 1      | %                  |
| Thermal Regulation                                             | $t_p = 10\text{ms}$ $T_A = 25^\circ\text{C}$                                                                                                    |                                                                        | 0.002 | 0.020  |                                    | 0.002  | 0.02   | %/W                |
| Ripple Rejection                                               | $V_{OUT} = -10\text{V}$<br>$f = 120\text{Hz}$                                                                                                   | $C_{ADJ} = 0$                                                          |       | 60     | 66                                 | 60     |        | dB                 |
|                                                                |                                                                                                                                                 | $C_{ADJ} = 10\mu\text{F}$<br>$T_J = -55 \text{ to } 150^\circ\text{C}$ |       | 70     | 80                                 | 66     | 77     | dB                 |
| $I_{ADJ}$ Adjust Pin Current                                   | $T_J = -55 \text{ to } 150^\circ\text{C}$                                                                                                       |                                                                        | 65    | 100    |                                    | 65     | 100    | $\mu\text{A}$      |
| $\Delta I_{ADJ}$ Adjust Pin Current Change                     | $T_J = -55 \text{ to } 150^\circ\text{C}$                                                                                                       | $I_{OUT} = 10\text{mA to } I_{MAX}$                                    |       | 0.2    | 2                                  | 0.5    | 5      | $\mu\text{A}$      |
|                                                                |                                                                                                                                                 | $V_{IN} - V_{OUT} = 3\text{V to } 40\text{V}$                          |       | 1.0    | 5                                  | 2      | 5      |                    |
|                                                                |                                                                                                                                                 | $V_{IN} - V_{OUT} = 3\text{V to } 50\text{V}$<br><b>(HV SERIES)</b>    |       | 2.0    | 6                                  | 3      | 6      |                    |
| $I_{MIN}$ Minimum Load Current                                 | $T_J = -55 \text{ to } 150^\circ\text{C}$                                                                                                       | $V_{IN} - V_{OUT} \leq 40\text{V}$                                     |       | 2.5    | 5                                  | 2.5    | 5      | mA                 |
|                                                                |                                                                                                                                                 | $V_{IN} - V_{OUT} \leq 10\text{V}$                                     |       | 1.2    | 3                                  | 1.2    | 3      |                    |
| $I_{CL}$ Current Limit                                         | $T_J = -55 \text{ to } 150^\circ\text{C}$                                                                                                       | $V_{IN} - V_{OUT} \leq 15\text{V}$                                     |       | 1.5    | 2.2                                | 3.2    | 3.2    | A                  |
|                                                                |                                                                                                                                                 | $V_{IN} - V_{OUT} = 40\text{V}$                                        |       | 0.24   | 0.4                                | 1      | 0.24   |                    |
|                                                                |                                                                                                                                                 | $V_{IN} - V_{OUT} = 50\text{V}$<br><b>(HV SERIES)</b>                  |       | 0.2    | 0.4                                | 0.8    | 0.2    |                    |
| $\frac{\Delta V_{OUT}}{\Delta T_{TEMP}}$ Temperature Stability | $T_J = -55 \text{ to } 150^\circ\text{C}$                                                                                                       |                                                                        | 0.6   | 1.5    |                                    | 0.6    |        | %                  |
| $\frac{\Delta V_{OUT}}{\Delta T_{TIME}}$ Long Term Stability   | $T_A = +125^\circ\text{C}$<br>$t = 1000 \text{ Hrs}$                                                                                            |                                                                        | 0.3   | 1      |                                    | 0.3    | 1      | %                  |
| $e_n$ RMS Output Noise<br>(% of $V_{OUT}$ )                    | $f = 10 \text{ Hz to } 10 \text{ kHz}$<br>$T_A = 25^\circ\text{C}$                                                                              |                                                                        | 0.003 |        |                                    | 0.003  |        | %                  |
| $R_{\theta JC}$ Thermal Resistance<br>Junction to Case         | K Package                                                                                                                                       |                                                                        | 2.3   | 3      |                                    | 2.3    | 3      | $^\circ\text{C/W}$ |
|                                                                | R Package                                                                                                                                       |                                                                        | 5     | 7      |                                    | 5      | 7      |                    |
|                                                                | G Package                                                                                                                                       |                                                                        | 3     | 5      |                                    | 3      | 5      |                    |

1) Regulation is measured at constant junction temperature, using pulse testing at a low duty cycle. Changes in output voltage due to heating effects are covered under thermal regulation specifications. Load regulation is measured at a point  $\frac{1}{8}$ " from the bottom of the package for the TO-3 and TO-66 packages, at the junction of the wide and narrow portion of the output lead for the SMD1 package, and  $\frac{1}{8}$ " below the base of the package on the output pin of the TO-257 package.

2) Test Conditions unless otherwise stated:  $V_{IN} - V_{OUT} = 5\text{V}$  ,  $I_{OUT} = 0.5\text{A}$  ,  $P_{MAX} = 20\text{W}$  ,  $I_{MAX} = 1.5\text{A}$   
 $V_{MAX} = 40\text{V}$  for standard series ,  $50\text{V}$  for HV series.

| Parameter                                                         | Test Conditions                                                                                                                                  | IP337AHV                                                             |       |        | IP337HV<br>LM337HV |        |        | Units              |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------|--------|--------------------|--------|--------|--------------------|
|                                                                   |                                                                                                                                                  | Min.                                                                 | Typ.  | Max.   | Min.               | Typ.   | Max.   |                    |
| $V_{REF}$ Reference Voltage                                       | $I_{OUT} = 10\text{mA}$                                                                                                                          | -1.238                                                               | -1.25 | -1.262 | -1.213             | -1.25  | -1.287 | V                  |
|                                                                   | $I_{OUT} = 10\text{mA to } I_{MAX}$<br>$V_{IN} - V_{OUT} = 3\text{V to } V_{MAX}$<br>$P \leq P_{MAX}$<br>$T_J = 0 \text{ to } 125^\circ\text{C}$ | -1.220                                                               | -1.25 | -1.280 | -1.200             | -1.250 | -1.300 | V                  |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ Line Regulation 1         | $V_{IN} - V_{OUT} = 3\text{V to } V_{MAX}$<br>$T_J = 0 \text{ to } 125^\circ\text{C}$                                                            | 0.005                                                                | 0.010 |        | 0.010              | 0.040  |        | %V                 |
|                                                                   |                                                                                                                                                  | 0.010                                                                | 0.030 |        | 0.020              | 0.070  |        |                    |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ Load Regulation 1         | $I_{OUT} = 10\text{mA to } I_{MAX}$<br>$T_J = 0 \text{ to } 125^\circ\text{C}$                                                                   | $V_{OUT} \leq 5\text{V}$                                             |       | 5      | 25                 | 15     | 50     | mV                 |
|                                                                   |                                                                                                                                                  | $V_{OUT} \geq 5\text{V}$                                             |       | 0.1    | 0.5                | 0.3    | 1      | %                  |
|                                                                   | $I_{OUT} = 10\text{mA to } I_{MAX}$<br>$T_J = 0 \text{ to } 125^\circ\text{C}$                                                                   | $V_{OUT} \leq 5\text{V}$                                             |       | 10     | 50                 | 20     | 70     | mV                 |
|                                                                   |                                                                                                                                                  | $V_{OUT} \geq 5\text{V}$                                             |       | 0.2    | 1                  | 0.3    | 1.5    | %                  |
| Thermal Regulation                                                | $t_p = 10\text{ms}$<br>$T_A = 25^\circ\text{C}$                                                                                                  | 0.002                                                                | 0.020 |        | 0.003              | 0.04   |        | %/W                |
| Ripple Rejection                                                  | $V_{OUT} = 10\text{V}$<br>$f = 120\text{Hz}$                                                                                                     | $C_{ADJ} = 0$                                                        |       | 60     | 66                 | 60     |        | dB                 |
|                                                                   |                                                                                                                                                  | $C_{ADJ} = 10\mu\text{F}$<br>$T_J = 0 \text{ to } 125^\circ\text{C}$ |       | 70     | 80                 | 66     | 77     | dB                 |
| $I_{ADJ}$ Adjust Pin Current                                      | $T_J = 0 \text{ to } 125^\circ\text{C}$                                                                                                          | 65                                                                   | 100   |        | 65                 | 100    |        | $\mu\text{A}$      |
| $\Delta I_{ADJ}$ Adjust Pin Current Change                        | $T_J = 0 \text{ to } 125^\circ\text{C}$                                                                                                          | $I_{OUT} = 10\text{mA to } I_{MAX}$                                  |       | 0.2    | 2                  | 0.5    | 5      | $\mu\text{A}$      |
|                                                                   |                                                                                                                                                  | $V_{IN} - V_{OUT} = 3\text{V to } 40\text{V}$                        |       | 1.0    | 5                  | 2      | 5      |                    |
|                                                                   |                                                                                                                                                  | $V_{IN} - V_{OUT} = 3\text{V to } 50\text{V}$<br>(HV SERIES)         |       | 2.0    | 6                  | 3      | 6      |                    |
| $I_{MIN}$ Minimum Load Current                                    | $T_J = 0 \text{ to } 125^\circ\text{C}$                                                                                                          | $V_{IN} - V_{OUT} \leq 40\text{V}$                                   |       | 2.5    | 5                  | 2.5    | 10     | mA                 |
|                                                                   |                                                                                                                                                  | $V_{IN} - V_{OUT} \leq 10\text{V}$                                   |       | 1.2    | 3                  | 1      | 6      |                    |
| $I_{CL}$ Current Limit                                            | $T_J = 0 \text{ to } 125^\circ\text{C}$                                                                                                          | $V_{IN} - V_{OUT} \leq 15\text{V}$                                   |       | 1.5    | 2.2                | 3.5    |        | A                  |
|                                                                   |                                                                                                                                                  | $V_{IN} - V_{OUT} = 40\text{V}$                                      |       | 0.24   | 0.4                | 1      | 0.15   |                    |
|                                                                   |                                                                                                                                                  | $V_{IN} - V_{OUT} = 50\text{V}$<br>(HV SERIES)                       |       | 0.2    | 0.4                | 0.8    | 0.1    |                    |
| $\frac{\Delta V_{OUT}}{\Delta \text{TEMP}}$ Temperature Stability | $T_J = 0 \text{ to } 125^\circ\text{C}$                                                                                                          | 0.6                                                                  | 1.5   |        | 0.6                |        |        | %                  |
| $\frac{\Delta V_{OUT}}{\Delta \text{TIME}}$ Long Term Stability   | $t = 1000 \text{ Hrs}$                                                                                                                           | 0.3                                                                  | 1     |        | 0.3                | 1      |        | %                  |
| $e_n$ RMS Output Noise<br>(% of $V_{OUT}$ )                       | $f = 10 \text{ Hz to } 10 \text{ kHz}$<br>$T_A = 25^\circ\text{C}$                                                                               | 0.003                                                                |       |        | 0.003              |        |        | %                  |
| $R_{\theta JC}$ Thermal Resistance<br>Junction to Case            | K Package                                                                                                                                        | 2.3                                                                  | 3     |        | 2.3                | 3      |        | $^\circ\text{C/W}$ |
|                                                                   | T Package                                                                                                                                        | 4                                                                    | 5     |        | 4                  |        |        |                    |

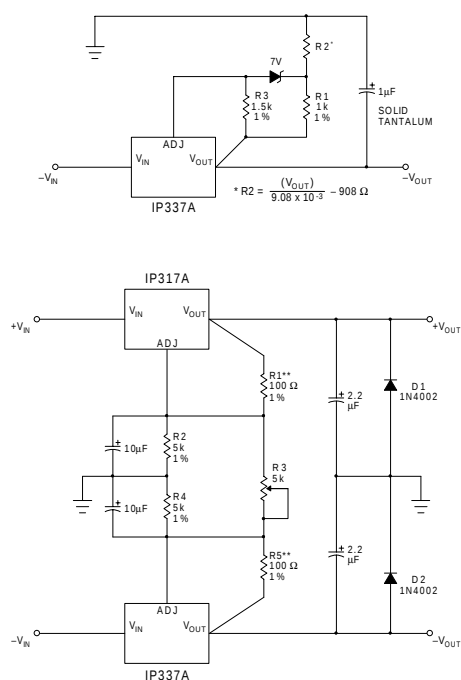
1) Regulation is measured at constant junction temperature, using pulse testing at a low duty cycle. Changes in output voltage due to heating effects are covered under thermal regulation specifications. Load regulation is measured at a point  $\frac{1}{8}$ " from the bottom of the package for the TO-3 and TO-66 packages, at the junction of the wide and narrow portion of the output lead for the SMD1 package, and  $\frac{1}{8}$ " below the base of the package on the output pin of the TO-257 package.

2) Test Conditions unless otherwise stated:  $V_{IN} - V_{OUT} = 5\text{V}$ ,  $I_{OUT} = 0.5\text{A}$ ,  $P_{MAX} = 20\text{W}$ ,  $I_{MAX} = 1.5\text{A}$   
 $V_{MAX} = 40\text{V}$  for standard series,  $50\text{V}$  for HV series.

## APPLICATIONS INFORMATION

### High Stability Regulator

The output stability, load regulation, line regulation, thermal regulation, temperature drift, long term drift, and noise, can be improved by a factor of 6.6 over the standard regulator configuration. This assumes a zener has 20PPM/°C maximum drift and about 10 times lower noise than the regulator.



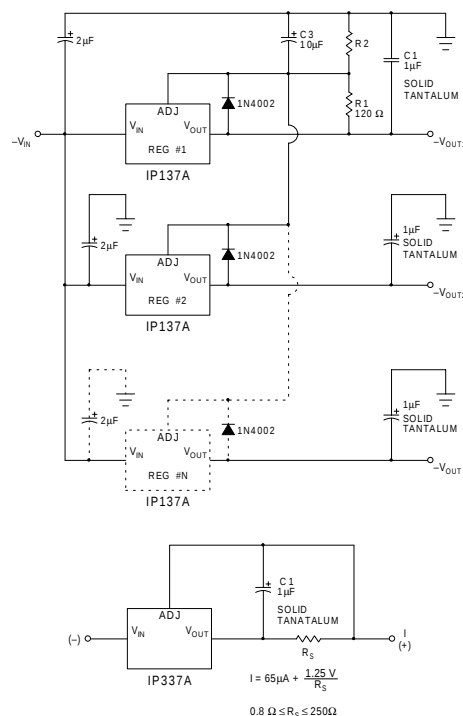
\* Solid Tantalum  
\*\* R1 or R5 may be trimmed slightly to improve tracking.

### Dual Tracking Supply

### Multiple Tracking Regulators

In the application shown below, regulator #2 to "N" will track regulator #1 to within  $\pm 24\text{mV}$  initially, and to  $\pm 60\text{mV}$  over all load, line, and temperature conditions.

If any regulator output is shorted to ground, all other outputs will drop to -2V. Load regulation of regulators 2 to "N" will be improved by  $V_{\text{OUT}} / 1.25\text{V}$  compared to a standard regulator, so regulator #1 should be the one which has the lowest load current.



### Current Regulator

## Order Information

| Part Number | K-Pack (TO-3) | R-Pack (TO-66) | IG-Pack G-Pack (TO-257) | T-Pack (TO-220) | SG-Pack SMD1 | Temp. Range   |
|-------------|---------------|----------------|-------------------------|-----------------|--------------|---------------|
| LM137       | ✓             | ✓              | ✓                       |                 | ✓            | -55 to +150°C |
| LM137HV     | ✓             | ✓              | ✓                       |                 | ✓            | "             |
| LM137A      | ✓             | ✓              | ✓                       |                 | ✓            | "             |
| LM137AHV    | ✓             | ✓              | ✓                       |                 | ✓            | "             |
| IP137       | ✓             | ✓              | ✓                       |                 | ✓            | -55 to +150°C |
| IP137HV     | ✓             | ✓              | ✓                       |                 | ✓            | "             |
| IP137A      | ✓             | ✓              | ✓                       |                 | ✓            | "             |
| IP137AHV    | ✓             | ✓              | ✓                       |                 | ✓            | "             |
| LM337       | ✓             |                |                         | ✓               |              | 0 to 125°C    |
| LM337HV     | ✓             |                |                         | ✓               |              | 0 to 125°C    |
| IP337       | ✓             |                |                         | ✓               |              | 0 to 125°C    |
| IP337HV     | ✓             |                |                         | ✓               |              | "             |
| IP337A      | ✓             |                |                         | ✓               |              | 0 to 125°C    |
| IP337AHV    | ✓             |                |                         | ✓               |              | "             |