

## Positive-Voltage Regulator

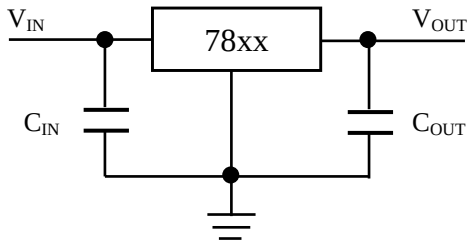
### ◆ Description

The 78xx series are fixed-voltage monolithic integrated circuit voltage regulators designed for wide range of applications. Each of these regulators can deliver up to 1.5A of output current. The internal limiting and thermal shutdown features of these regulators make them essentially immune to overload.

### ◆ Features

- Three Terminal Regulators.
- Output Current up to:1.5A.
- No External Components.
- Internal Thermal Overload Protection.
- Internal Short-Circuit Limiting.
- Output Voltage Offered in 4% Tolerance.

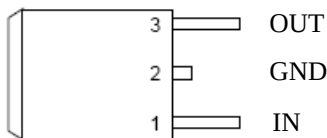
### ◆ Typical Application



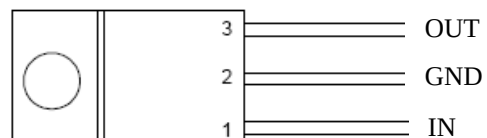
### ◆ Applications

- Linear Regulator
- Microprocessor Power Supply
- Graphic Card
- Mother Board
- Security Product

### ◆ Pin Description



**TO-263 (Top View)**



**TO-220 (Top View)**

# ◆ Ordering Information

| Part Number | Temperature Range | Package | Pin Assignment |     |        | Packing     |
|-------------|-------------------|---------|----------------|-----|--------|-------------|
|             |                   |         | Input          | GND | Output |             |
| 7805GI      | -40 °C ~ +125 °C  | TO-263  | 1              | 2   | 3      | Tape & Reel |
| 7806GI      |                   |         |                |     |        |             |
| 7808GI      |                   |         |                |     |        |             |
| 7809GI      |                   |         |                |     |        |             |
| 7810GI      |                   |         |                |     |        |             |
| 7812GI      |                   |         |                |     |        |             |
| 7815GI      |                   |         |                |     |        |             |
| 7818GI      |                   |         |                |     |        |             |
| 7820GI      |                   |         |                |     |        |             |
| 7824GI      |                   |         |                |     |        |             |
| 7805FI      | -40 °C ~ +125 °C  | TO-220  | 1              | 2   | 3      | Tube        |
| 7806FI      |                   |         |                |     |        |             |
| 7808FI      |                   |         |                |     |        |             |
| 7809FI      |                   |         |                |     |        |             |
| 7810FI      |                   |         |                |     |        |             |
| 7812FI      |                   |         |                |     |        |             |
| 7815FI      |                   |         |                |     |        |             |
| 7818FI      |                   |         |                |     |        |             |
| 7820FI      |                   |         |                |     |        |             |
| 7824FI      |                   |         |                |     |        |             |

# ◆ Absolute Maximum Ratings

| Symbol            | Parameter                                       | Value      |           | Unit |
|-------------------|-------------------------------------------------|------------|-----------|------|
|                   |                                                 | 7805~7818  | 7820~7824 |      |
| V <sub>IN</sub>   | Input voltage                                   | 35         | 40        | V    |
| I <sub>OUT</sub>  | Output current                                  | 1.5        |           | A    |
| T <sub>A</sub>    | Operating ambient temperature                   | -40 ~ +125 |           | °C   |
| T <sub>J</sub>    | Operating junction temperature                  | 150        |           | °C   |
| T <sub>STG</sub>  | Storage temperature                             | -65 ~ +150 |           | °C   |
| T <sub>LEAD</sub> | Lead temperature 1.6mm from case for 10 seconds | 260        |           | °C   |

### ◆ Thermal Characteristics

| Symbol        | Parameter                                                                                                                                                          | Package | Typical Value | Unit                 |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------------|----------------------|
| $\theta_{JA}$ | Thermal Resistance From Junction to Ambient in Free Air.<br>(Measured with the component mounted on a high effective thermal conductivity test board in free air.) | TO-263  | 55            | $^{\circ}\text{C/W}$ |
|               |                                                                                                                                                                    | TO-220  | 65            |                      |

### ◆ 7805 Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ , $V_{IN}=10\text{V}$ , $I_{OUT}=500\text{mA}$ , unless otherwise noted.)

| Symbol              | Parameter            | Test Conditions*                                                    |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|---------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                     |                            | 4.8  | 5.0  | 5.2  | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=7\text{V to }20\text{V}$ | 0 to $125^{\circ}\text{C}$ | 4.75 | 5.00 | 5.25 |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=7\text{V to }25\text{V}$                                    |                            | -    | -    | 100  | mV            |
|                     |                      | $V_{IN}=8\text{V to }12\text{V}$                                    |                            | -    | -    | 50   |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                  |                            | -    | -    | 50   | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                     |                            | -    | -    | 100  |               |
| PSRR                | Ripple rejection     | $V_{IN}=8\text{V to }18\text{V}$ , $f=120\text{Hz}$                 |                            | 62   | 80   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                    |                            | -    | 40   | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                     |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                     |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=7\text{V to }25\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.3  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                     |                            | -    | -    | 0.5  |               |

### ◆ 7806 Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ , $V_{IN}=11\text{V}$ , $I_{OUT}=500\text{mA}$ , unless otherwise noted.)

| Symbol              | Parameter            | Test Conditions*                                                    |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|---------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                     |                            | 5.75 | 6.00 | 6.25 | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=8\text{V to }21\text{V}$ | 0 to $125^{\circ}\text{C}$ | 5.7  | 6.0  | 6.3  |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=8\text{V to }25\text{V}$                                    |                            | -    | -    | 120  | mV            |
|                     |                      | $V_{IN}=9\text{V to }13\text{V}$                                    |                            | -    | -    | 60   |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                  |                            | -    | -    | 60   | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                     |                            | -    | -    | 120  |               |
| PSRR                | Ripple rejection     | $V_{IN}=9\text{V to }19\text{V}$ , $f=120\text{Hz}$                 |                            | 62   | 80   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                    |                            | -    | 45   | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                     |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                     |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=8\text{V to }25\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.0  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                     |                            | -    | -    | 0.5  |               |

**◆ 7808 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=14\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

| Symbol              | Parameter            | Test Conditions*                                                       |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|------------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                        |                            | 7.7  | 8.0  | 8.3  | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=10.5\text{V to }23\text{V}$ | 0 to $125^{\circ}\text{C}$ | 7.6  | 8.0  | 8.4  |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=10.5\text{V to }25\text{V}$                                    |                            | -    | -    | 160  | mV            |
|                     |                      | $V_{IN}=11\text{V to }17\text{V}$                                      |                            | -    | -    | 80   |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                     |                            | -    | -    | 80   | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                        |                            | -    | -    | 160  |               |
| PSRR                | Ripple rejection     | $V_{IN}=11.5\text{V to }21.5\text{V}$ , $f=120\text{Hz}$               |                            | 62   | 80   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                       |                            | -    | 52   | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                        |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                        |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=10.5\text{V to }25\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.0  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                        |                            | -    | -    | 0.5  |               |

**◆ 7809 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=15\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

| Symbol              | Parameter            | Test Conditions*                                                       |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|------------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                        |                            | 8.65 | 9.00 | 9.35 | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=11.5\text{V to }24\text{V}$ | 0 to $125^{\circ}\text{C}$ | 8.55 | 9.00 | 9.45 |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=11\text{V to }26\text{V}$                                      |                            | -    | -    | 180  | mV            |
|                     |                      | $V_{IN}=11.5\text{V to }17\text{V}$                                    |                            | -    | -    | 90   |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                     |                            | -    | -    | 90   | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                        |                            | -    | -    | 180  |               |
| PSRR                | Ripple rejection     | $V_{IN}=12\text{V to }23.5\text{V}$ , $f=120\text{Hz}$                 |                            | 62   | 80   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                       |                            | -    | 58   | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                        |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                        |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=11.5\text{V to }26\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.0  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                        |                            | -    | -    | 0.5  |               |

**◆ 7812 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=19\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

| Symbol               | Parameter            | Test Conditions*                                             |            | Min. | Typ. | Max. | Unit |
|----------------------|----------------------|--------------------------------------------------------------|------------|------|------|------|------|
| V <sub>OUT</sub> **  | Output voltage       |                                                              |            | 11.5 | 12.0 | 12.5 | V    |
|                      |                      | I <sub>O</sub> =5mA to 1.0A<br>V <sub>IN</sub> =14.5V to 27V | 0 to 125°C | 11.4 | 12.0 | 12.6 |      |
| Reg <sub>line</sub>  | Line regulation      | V <sub>IN</sub> =14.5V to 30V                                |            | -    | -    | 240  | mV   |
|                      |                      | V <sub>IN</sub> =16V to 23V                                  |            | -    | -    | 120  |      |
| Reg <sub>load</sub>  | Load regulation      | I <sub>O</sub> =250mA to 750mA                               |            | -    | -    | 120  | mV   |
|                      |                      | I <sub>O</sub> =5mA to 1.0A                                  |            | -    | -    | 240  |      |
| PSRR                 | Ripple rejection     | V <sub>IN</sub> =15V to 25V, f=120Hz                         |            | 62   | 80   | -    | dB   |
| V <sub>n</sub>       | Output noise voltage | F=10Hz~100Hz                                                 |            | -    | 75   | -    | uV   |
| V <sub>DROPOUT</sub> | Dropout voltage      |                                                              |            | -    | 2.0  | -    | V    |
| I <sub>Q</sub>       | Bias current         |                                                              |            | -    | -    | 8.0  | mA   |
| ΔI <sub>Q</sub>      | Bias current change  | V <sub>IN</sub> =14.5V to 30V                                | 0 to 125°C | -    | -    | 1.0  | mA   |
|                      |                      | I <sub>O</sub> =5mA to 1.0A                                  |            | -    | -    | 0.5  |      |

**◆ 7815 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=23\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

| Symbol               | Parameter            | Test Conditions*                                             |            | Min.  | Typ. | Max.  | Unit |
|----------------------|----------------------|--------------------------------------------------------------|------------|-------|------|-------|------|
| V <sub>OUT</sub> **  | Output voltage       |                                                              |            | 14.4  | 15.0 | 15.6  | V    |
|                      |                      | I <sub>O</sub> =5mA to 1.0A<br>V <sub>IN</sub> =17.5V to 30V | 0 to 125°C | 14.25 | 15.0 | 15.75 |      |
| Reg <sub>line</sub>  | Line regulation      | V <sub>IN</sub> =17.5V to 30V                                |            | -     | -    | 300   | mV   |
|                      |                      | V <sub>IN</sub> =20V to 26V                                  |            | -     | -    | 150   |      |
| Reg <sub>load</sub>  | Load regulation      | I <sub>O</sub> =250mA to 750mA                               |            | -     | -    | 150   | mV   |
|                      |                      | I <sub>O</sub> =5mA to 1.0A                                  |            | -     | -    | 300   |      |
| PSRR                 | Ripple rejection     | V <sub>IN</sub> =18.5V to 28.5V, f=120Hz                     |            | 60    | 70   | -     | dB   |
| V <sub>n</sub>       | Output noise voltage | F=10Hz~100Hz                                                 |            | -     | 100  | -     | uV   |
| V <sub>DROPOUT</sub> | Dropout voltage      |                                                              |            | -     | 2.0  | -     | V    |
| I <sub>Q</sub>       | Bias current         |                                                              |            | -     | -    | 8.0   | mA   |
| ΔI <sub>Q</sub>      | Bias current change  | V <sub>IN</sub> =17.5V to 30V                                | 0 to 125°C | -     | -    | 1.0   | mA   |
|                      |                      | I <sub>O</sub> =5mA to 1.0A                                  |            | -     | -    | 0.5   |      |

**◆ 7818 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=27\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

| Symbol              | Parameter            | Test Conditions*                                                     |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|----------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                      |                            | 17.3 | 18.0 | 18.7 | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=21\text{V to }33\text{V}$ | 0 to $125^{\circ}\text{C}$ | 17.1 | 18.0 | 18.9 |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=21.5\text{V to }33\text{V}$                                  |                            | -    | -    | 360  | mV            |
|                     |                      | $V_{IN}=24\text{V to }30\text{V}$                                    |                            | -    | -    | 180  |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                   |                            | -    | -    | 180  | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                      |                            | -    | -    | 360  |               |
| PSRR                | Ripple rejection     | $V_{IN}=22.5\text{V to }32\text{V}$ , $f=120\text{Hz}$               |                            | 60   | 70   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                     |                            | -    | 100  | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                      |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                      |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=21\text{V to }33\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.0  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                      |                            | -    | -    | 0.5  |               |

**◆ 7820 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=29\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

| Symbol              | Parameter            | Test Conditions*                                                     |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|----------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                      |                            | 19.2 | 20.0 | 20.8 | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=23\text{V to }35\text{V}$ | 0 to $125^{\circ}\text{C}$ | 19.0 | 20.0 | 21.0 |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=23\text{V to }35\text{V}$                                    |                            | -    | -    | 400  | mV            |
|                     |                      | $V_{IN}=26\text{V to }32\text{V}$                                    |                            | -    | -    | 200  |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                   |                            | -    | -    | 200  | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                      |                            | -    | -    | 400  |               |
| PSRR                | Ripple rejection     | $V_{IN}=24.5\text{V to }35\text{V}$ , $f=120\text{Hz}$               |                            | 55   | 65   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                     |                            | -    | 120  | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                      |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                      |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=23\text{V to }35\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.0  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                      |                            | -    | -    | 0.5  |               |

**◆ 7824 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=31\text{V}$ ,  $I_{OUT}=500\text{mA}$ , unless otherwise noted .)

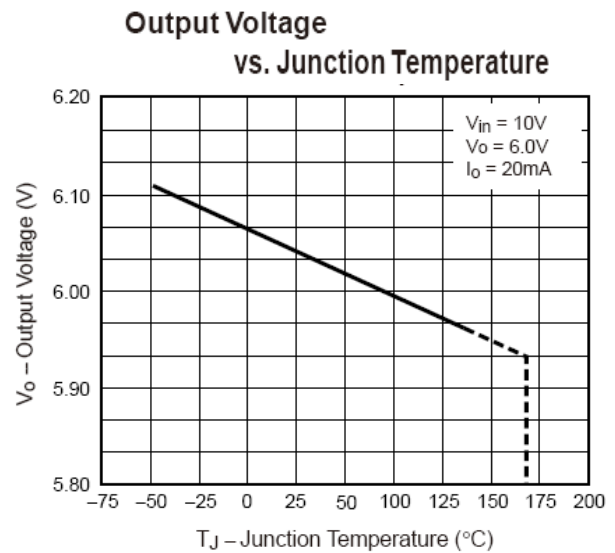
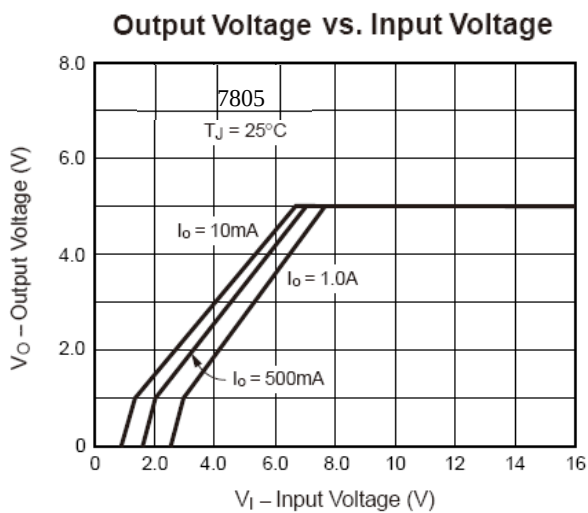
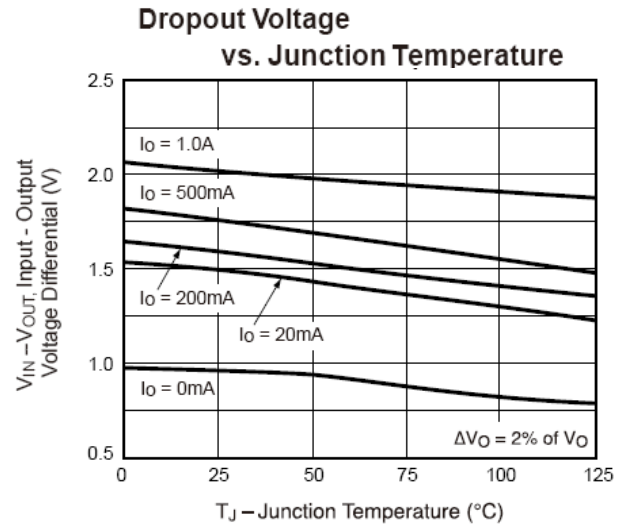
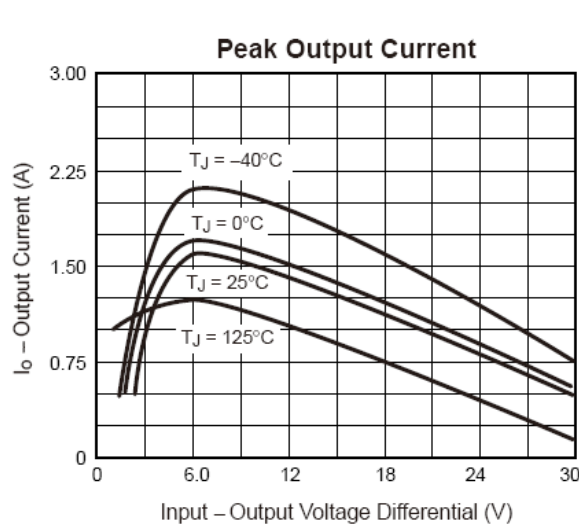
| Symbol              | Parameter            | Test Conditions*                                                     |                            | Min. | Typ. | Max. | Unit          |
|---------------------|----------------------|----------------------------------------------------------------------|----------------------------|------|------|------|---------------|
| $V_{OUT}^{**}$      | Output voltage       |                                                                      |                            | 23.0 | 24.0 | 25.0 | V             |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$<br>$V_{IN}=27\text{V to }38\text{V}$ | 0 to $125^{\circ}\text{C}$ | 22.8 | 24.0 | 25.2 |               |
| $\text{Reg}_{line}$ | Line regulation      | $V_{IN}=27\text{V to }38\text{V}$                                    |                            | -    | -    | 480  | mV            |
|                     |                      | $V_{IN}=30\text{V to }36\text{V}$                                    |                            | -    | -    | 240  |               |
| $\text{Reg}_{load}$ | Load regulation      | $I_O=250\text{mA to }750\text{mA}$                                   |                            | -    | -    | 240  | mV            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                      |                            | -    | -    | 480  |               |
| PSRR                | Ripple rejection     | $V_{IN}=28.5\text{V to }37\text{V}$ , $f=120\text{Hz}$               |                            | 55   | 65   | -    | dB            |
| $V_n$               | Output noise voltage | $F=10\text{Hz}\sim 100\text{Hz}$                                     |                            | -    | 140  | -    | $\mu\text{V}$ |
| $V_{DROPOUT}$       | Dropout voltage      |                                                                      |                            | -    | 2.0  | -    | V             |
| $I_Q$               | Bias current         |                                                                      |                            | -    | -    | 8.0  | mA            |
| $\Delta I_Q$        | Bias current change  | $V_{IN}=27\text{V to }38\text{V}$                                    | 0 to $125^{\circ}\text{C}$ | -    | -    | 1.0  | mA            |
|                     |                      | $I_O=5\text{mA to }1.0\text{A}$                                      |                            | -    | -    | 0.5  |               |

Note:

\* 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. All characteristics are measured with a  $0.33\mu\text{F}$  capacitor across the input and a  $0.1\mu\text{F}$  capacitor across the output.

\*\* The specification applies only for DC power dissipation permitted by absolute maximum rating.

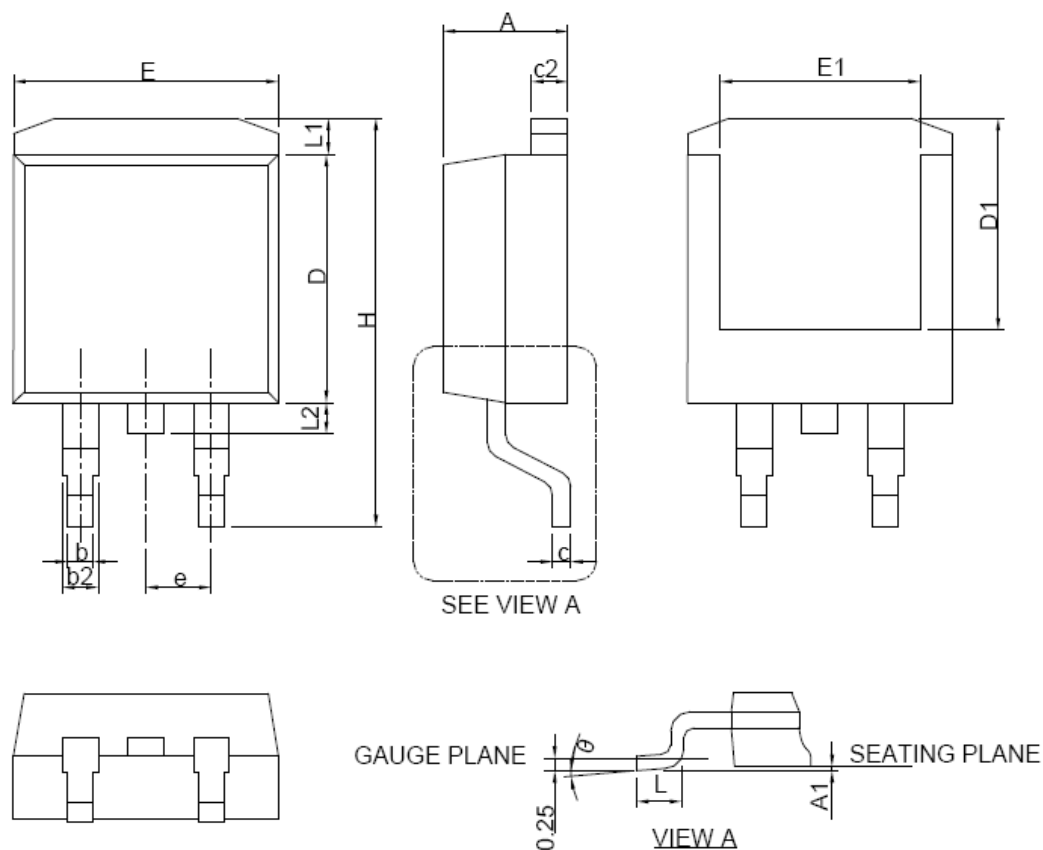
## ◆ Typical Characteristics





# ◆ Package Information

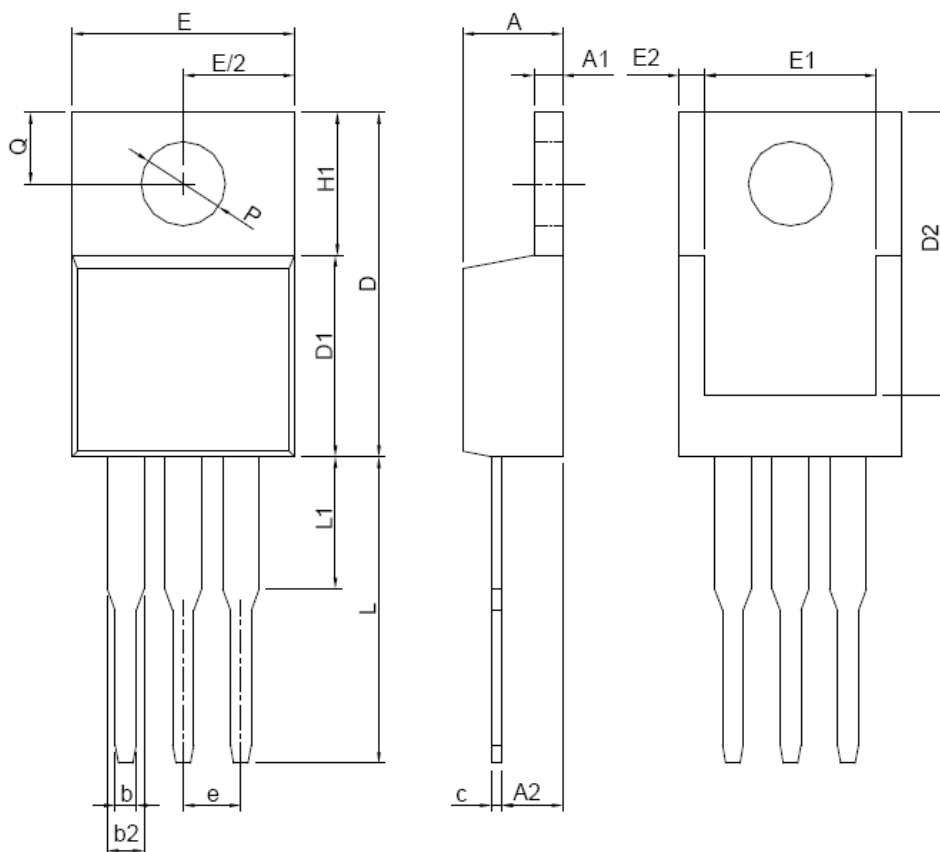
TO-263



| SYMBOL | TO-263      |       |           |       |
|--------|-------------|-------|-----------|-------|
|        | MILLIMETERS |       | INCHES    |       |
|        | MIN.        | MAX.  | MIN.      | MAX.  |
| A      | 4.06        | 4.83  | 0.160     | 0.190 |
| A1     | 0.00        | 0.25  | 0.000     | 0.010 |
| b      | 0.51        | 0.99  | 0.020     | 0.039 |
| b2     | 1.14        | 1.78  | 0.045     | 0.070 |
| c      | 0.38        | 0.74  | 0.015     | 0.029 |
| c2     | 1.14        | 1.65  | 0.045     | 0.065 |
| D      | 8.38        | 9.65  | 0.330     | 0.380 |
| D1     | 6.00        | 9.00  | 0.236     | 0.354 |
| E      | 9.65        | 11.43 | 0.380     | 0.450 |
| E1     | 6.22        | 9.00  | 0.245     | 0.354 |
| e      | 2.54 BSC    |       | 0.100 BSC |       |
| H      | 14.61       | 15.88 | 0.575     | 0.625 |
| L      | 1.78        | 2.79  | 0.070     | 0.110 |
| L1     |             | 1.68  |           | 0.066 |
| L2     |             | 1.78  |           | 0.070 |
| θ      | 0°          | 8°    | 0°        | 8°    |

# ◆ Package Information

TO-220



| Symbol | TO-220      |       |           |       |
|--------|-------------|-------|-----------|-------|
|        | MILLIMETERS |       | INCHES    |       |
|        | MIN.        | MAX.  | MIN.      | MAX.  |
| A      | 3.56        | 4.83  | 0.140     | 0.190 |
| A1     | 0.51        | 1.40  | 0.020     | 0.055 |
| A2     | 2.03        | 2.92  | 0.080     | 0.115 |
| b      | 0.38        | 1.02  | 0.015     | 0.040 |
| b2     | 1.14        | 1.78  | 0.045     | 0.070 |
| c      | 0.36        | 0.61  | 0.014     | 0.024 |
| D      | 14.22       | 16.51 | 0.560     | 0.650 |
| D1     | 8.38        | 9.02  | 0.330     | 0.355 |
| D2     | 12.19       | 12.88 | 0.480     | 0.507 |
| E      | 9.65        | 10.67 | 0.380     | 0.420 |
| E1     | 6.86        | 8.89  | 0.270     | 0.350 |
| E2     |             | 0.76  |           | 0.030 |
| e      | 2.54 BSC    |       | 0.100 BSC |       |
| H1     | 5.84        | 6.86  | 0.230     | 0.270 |
| L      | 12.70       | 14.73 | 0.500     | 0.580 |
| L1     |             | 6.35  |           | 0.250 |
| P      | 3.53        | 4.09  | 0.139     | 0.161 |
| Q      | 2.54        | 3.43  | 0.100     | 0.135 |