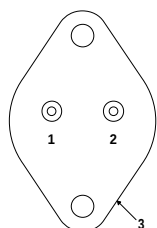
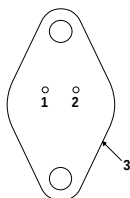


## 1 AMP POSITIVE VOLTAGE REGULATOR



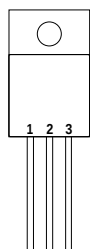
Pin 1 –  $V_{IN}$   
Pin 2 –  $V_{OUT}$   
Case – Ground

**K Package – TO-3**



Pin 1 –  $V_{IN}$   
Pin 2 –  $V_{OUT}$   
Case – Ground

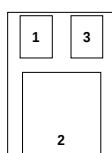
**R Package – TO-66**



Pin 1 –  $V_{IN}$   
Pin 2 – Ground  
Pin 3 –  $V_{OUT}$   
Case – Ground\*

**G Package – TO-257**  
**IG Package– TO-257\***

\* isolated Case on IG package



Pin 1 –  $V_{IN}$   
Pin 2 – Ground  
Pin 3 –  $V_{OUT}$

**SG Package – TO-220**  
Ceramic Surface Mount

### FEATURES

- OUTPUT CURRENT UP TO 1.0A
- OUTPUT VOLTAGES OF 5, 12, 15V
- 0.01% / V LINE REGULATION
- 0.3% / A LOAD REGULATION
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- OUTPUT TRANSISTOR SOA PROTECTION
- 1% VOLTAGE TOLERANCE (–A VERSIONS)

### DESCRIPTION

The IP140A / LM140 / IP7800A / IP7800 series of 3 terminal regulators is available with several fixed output voltage making them useful in a wide range of applications.

The A suffix devices are fully specified at 1A, provide 0.01% / V line regulation, 0.3% / A load regulation and  $\pm 1\%$  output voltage tolerance at room temperature.

Protection features include Safe Operating Area current limiting and thermal shutdown.

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

|           |                                            |                                 |
|-----------|--------------------------------------------|---------------------------------|
| $V_I$     | DC Input Voltage (for $V_O = 5, 12, 15V$ ) | 35V                             |
| $P_D$     | Power Dissipation                          | Internally limited <sup>1</sup> |
| $T_j$     | Operating Junction Temperature Range       | –55 to 150°C                    |
| $T_{stg}$ | Storage Temperature                        | –65 to 150°C                    |

Note 1. Although power dissipation is internally limited, these specifications are applicable for maximum power dissipation  $P_{MAX}$  of 20W.  $I_{MAX} = 1.0A$ .

| Parameter                                             |                             | Test Conditions                                                                                                                              |                                                                        | IP7805A<br>IP140A-05 |      |      | IP7805<br>IP140A-05 |                |      | Units |
|-------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------|------|------|---------------------|----------------|------|-------|
|                                                       |                             |                                                                                                                                              |                                                                        | Min.                 | Typ. | Max. | Min.                | Typ.           | Max. |       |
| V <sub>O</sub>                                        | Output Voltage              | I <sub>O</sub> = 1A      V <sub>IN</sub> = 10V                                                                                               |                                                                        | 4.95                 | 5    | 5.05 | 4.8                 | 5              | 5.2  | V     |
|                                                       |                             | I <sub>O</sub> = 5mA to I <sub>MAX</sub> P <sub>D</sub> ≤ P <sub>MAX</sub><br>V <sub>IN</sub> = 7.5V to 20V    T <sub>J</sub> = -55 to 150°C |                                                                        | 4.85                 |      | 5.15 |                     | 4.75      5.25 |      |       |
| V <sub>O</sub>                                        | Low Supply                  | I <sub>O</sub> = 5mA to I <sub>MAX</sub> P <sub>D</sub> ≤ P <sub>MAX</sub><br>V <sub>IN</sub> = 7V to 20V                                    |                                                                        | 4.75                 |      | 5.15 |                     | 4.75      5.25 |      | V     |
| ΔV <sub>O</sub>                                       | Line Regulation             | I <sub>O</sub> = 0.5 I <sub>MAX</sub>                                                                                                        | V <sub>IN</sub> = 7V to 25V                                            | 3                    |      | 10   |                     | 50             |      | mV    |
|                                                       |                             |                                                                                                                                              | V <sub>IN</sub> = 7.5V to 25V<br>T <sub>J</sub> = -55 to 150°C         | 3                    |      | 10   |                     | 50             |      |       |
|                                                       |                             | I <sub>O</sub> ≤ I <sub>MAX</sub> V <sub>IN</sub> = 7.3V to 20V                                                                              |                                                                        | 3                    |      | 10   |                     | 50             |      |       |
|                                                       |                             | V <sub>IN</sub> = 8V to 12V                                                                                                                  |                                                                        | 1                    |      | 4    |                     | 20             |      |       |
|                                                       |                             | T <sub>J</sub> = -55 to 150°C                                                                                                                |                                                                        | 2                    |      | 12   |                     | 25             |      |       |
| ΔV <sub>O</sub>                                       | Load Regulation             | V <sub>IN</sub> = 10V                                                                                                                        | I <sub>O</sub> = 5mA to 1.5A                                           | 10                   |      | 25   |                     | 50             |      | mV    |
|                                                       |                             |                                                                                                                                              | I <sub>O</sub> = 250mA to 750mA                                        | 4                    |      | 15   |                     | 25             |      |       |
|                                                       |                             | V <sub>IN</sub> = 10V      I <sub>O</sub> = 5mA to I <sub>MAX</sub><br>T <sub>J</sub> = -55 to 150°C                                         |                                                                        | 7                    |      | 25   |                     | 50             |      |       |
| I <sub>Q</sub>                                        | Quiescent Current           | I <sub>O</sub> ≤ I <sub>MAX</sub>                                                                                                            |                                                                        | 4                    |      | 6    |                     | 6              |      | mA    |
|                                                       |                             | V <sub>IN</sub> = 10V      T <sub>J</sub> = -55 to 150°C                                                                                     | 4                                                                      |                      | 6.5  |      | 7                   |                |      |       |
| ΔI <sub>Q</sub>                                       | Quiescent Current<br>Change | I <sub>O</sub> = 5mA to I <sub>MAX</sub> V <sub>IN</sub> = 10V                                                                               |                                                                        | 0.2                  |      | 0.5  |                     | 0.5            |      | mA    |
|                                                       |                             | I <sub>O</sub> ≤ I <sub>MAX</sub> V <sub>IN</sub> = 7.5V to 20V<br>T <sub>J</sub> = -55 to 150°C                                             |                                                                        | 0.1                  |      | 0.8  |                     | 0.8            |      |       |
|                                                       |                             | I <sub>O</sub> ≤ 0.5 I <sub>MAX</sub> V <sub>IN</sub> = 8V to 25V                                                                            |                                                                        | 0.1                  |      | 0.8  |                     | 0.8            |      |       |
|                                                       |                             | I <sub>O</sub> ≤ 0.5 I <sub>MAX</sub> V <sub>IN</sub> = 7V to 25V<br>T <sub>J</sub> = -55 to 150°C                                           |                                                                        | 0.2                  |      | 1    |                     | 1.0            |      |       |
| V <sub>N</sub>                                        | Output Noise<br>Voltage     | f = 10Hz to 100kHz<br>V <sub>IN</sub> = 10V                                                                                                  |                                                                        | 40                   |      | 200  |                     | 40             |      | μV    |
| $\frac{\Delta V_{IN}}{\Delta V_O}$                    | Ripple Rejection            | f = 120Hz<br>V <sub>IN</sub> = 8V to 18V                                                                                                     | I <sub>O</sub> ≤ I <sub>MAX</sub>                                      | 68                   | 80   | 68   |                     |                | dB   |       |
|                                                       |                             |                                                                                                                                              | I <sub>O</sub> ≤ 0.5 I <sub>MAX</sub><br>T <sub>J</sub> = -55 to 150°C | 68                   | 80   | 68   |                     |                |      |       |
| Dropout Voltage                                       |                             | I <sub>O</sub> = I <sub>MAX</sub>                                                                                                            |                                                                        | 2                    |      | 2.5  |                     | 2              |      | V     |
| R <sub>O</sub>                                        | Output Resistance           | f = 1 kHz                                                                                                                                    |                                                                        | 5                    |      | 5    |                     | 5              |      | mΩ    |
| I <sub>sc</sub>                                       | Short Circuit Current       | V <sub>IN</sub> = 35V                                                                                                                        |                                                                        | 0.6                  |      | 1.2  |                     | 0.6      1.2   |      | A     |
| I <sub>pk</sub>                                       | Peak Output Current         | V <sub>IN</sub> = 10V                                                                                                                        |                                                                        | 2.4                  |      | 3.3  |                     | 2.4      3.3   |      |       |
| Average Temperature<br>Coefficient of V <sub>O</sub>  |                             | I <sub>O</sub> = 5mA                                                                                                                         |                                                                        | 0.2                  |      | 2    |                     | 0.6            |      | mV/°C |
| Input Voltage required to<br>maintain line regulation |                             | I <sub>O</sub> ≤ I <sub>MAX</sub>                                                                                                            |                                                                        | 7.3                  |      | 7.3  |                     | 7.3            |      | V     |

- All characteristics are measured with a capacitor across the input of  $0.22\mu F$  and a capacitor across the output of  $0.1\mu F$ . All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ( $t_p \leq 10ms$ ,  $\delta \leq 5\%$ ). Output voltage changes due to changes in internal temperature must be taken into account separately.
- Although power dissipation is internally limited, these specifications are applicable for maximum power dissipation  $P_{MAX}$  of  $20W$ ,  $I_{MAX} = 1.0A$ .
- $T_J = 25^\circ C$  unless otherwise stated.

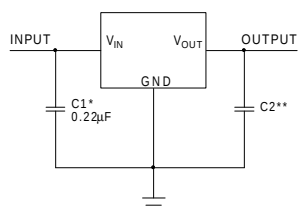
| Parameter                                           | Test Conditions                                                                                       | IP7812A<br>IP140A-12                                      |      |       | IP7812<br>IP140A-12 |      |      | Units                 |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|------|-------|---------------------|------|------|-----------------------|
|                                                     |                                                                                                       | Min.                                                      | Typ. | Max.  | Min.                | Typ. | Max. |                       |
| $V_O$ Output Voltage                                | $I_O = 1A$ $V_{IN} = 19V$                                                                             | 11.88                                                     | 12   | 12.12 | 11.5                | 12   | 12.5 | V                     |
|                                                     | $I_O = 5mA$ to $I_{MAX}$ $P_D \leq P_{MAX}$<br>$V_{IN} = 14.8V$ to $27V$ $T_J = -55$ to $150^\circ C$ | 11.64                                                     |      | 12.36 | 11.4                |      | 12.6 |                       |
| $V_O$ Low Supply                                    | $I_O = 5mA$ to $I_{MAX}$ $P_D \leq P_{MAX}$<br>$V_{IN} = 14.5V$ to $27V$                              | 11.40                                                     |      | 12.36 | 11.4                |      | 12.6 | V                     |
| $\Delta V_O$ Line Regulation                        | $I_O = 0.5 I_{MAX}$                                                                                   | $V_{IN} = 14.5V$ to $30V$                                 |      | 4     | 18                  |      | 120  | mV                    |
|                                                     |                                                                                                       | $V_{IN} = 14.8V$ to $30V$<br>$T_J = -55$ to $150^\circ C$ |      | 4     | 18                  |      | 120  |                       |
|                                                     | $I_O \leq I_{MAX}$                                                                                    | $V_{IN} = 14.5V$ to $27V$                                 |      | 4     | 18                  |      | 120  |                       |
|                                                     | $V_{IN} = 16V$ to $22V$                                                                               |                                                           |      | 2     | 9                   |      | 50   |                       |
|                                                     | $T_J = -55$ to $150^\circ C$                                                                          |                                                           |      | 4     | 30                  |      | 60   |                       |
| $\Delta V_O$ Load Regulation                        | $V_{IN} = 19V$                                                                                        | $I_O = 5mA$ to $1.5A$                                     |      | 12    | 32                  |      | 120  | mV                    |
|                                                     |                                                                                                       | $I_O = 250mA$ to $750mA$                                  |      | 4     | 19                  |      | 60   |                       |
|                                                     | $V_{IN} = 19V$                                                                                        | $I_O = 5mA$ to $I_{MAX}$<br>$T_J = -55$ to $150^\circ C$  |      | 8     | 60                  |      | 120  |                       |
| $I_Q$ Quiescent Current                             | $I_O \leq I_{MAX}$                                                                                    |                                                           |      | 4     | 6                   |      | 6    | mA                    |
|                                                     | $V_{IN} = 19V$                                                                                        | $T_J = -55$ to $150^\circ C$                              |      | 4     | 6.5                 |      | 7    |                       |
| $\Delta I_Q$ Quiescent Current Change               | $I_O = 5mA$ to $I_{MAX}$                                                                              | $V_{IN} = 19V$                                            |      | 0.2   | 0.5                 |      | 0.5  | mA                    |
|                                                     | $I_O \leq I_{MAX}$                                                                                    | $V_{IN} = 14.8V$ to $27V$<br>$T_J = -55$ to $150^\circ C$ |      | 0.1   | 0.8                 |      | 0.8  |                       |
|                                                     | $I_O \leq 0.5 I_{MAX}$                                                                                | $V_{IN} = 15V$ to $30V$                                   |      | 0.1   | 0.8                 |      | 0.8  |                       |
|                                                     | $I_O \leq 0.5 I_{MAX}$                                                                                | $V_{IN} = 14.5V$ to $30V$<br>$T_J = -55$ to $150^\circ C$ |      | 0.2   | 1                   |      | 1    |                       |
| $V_N$ Output Noise Voltage                          | $f = 10Hz$ to $100kHz$<br>$V_{IN} = 19V$                                                              |                                                           | 75   | 480   |                     | 75   |      | $\mu V$               |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ Ripple Rejection | $f = 120Hz$<br>$V_{IN} = 15V$ to $25V$                                                                | $I_O \leq I_{MAX}$                                        |      | 61    | 72                  |      | 61   | dB                    |
|                                                     |                                                                                                       | $I_O \leq 0.5 I_{MAX}$<br>$T_J = -55$ to $150^\circ C$    |      | 61    | 72                  |      | 61   |                       |
| Dropout Voltage                                     | $I_O = I_{MAX}$                                                                                       |                                                           | 2    | 2.5   |                     | 2    |      | V                     |
| $R_O$ Output Resistance                             | $f = 1 kHz$                                                                                           |                                                           | 8    |       |                     | 8    |      | $m\Omega$             |
| $I_{sc}$ Short Circuit Current                      | $V_{IN} = 35V$                                                                                        |                                                           | 0.6  | 1.2   |                     | 0.6  | 1.2  | A                     |
| $I_{pk}$ Peak Output Current                        | $V_{IN} = 19V$                                                                                        |                                                           | 2.4  | 3.3   |                     | 2.4  | 3.3  |                       |
| Average Temperature Coefficient of $V_O$            | $I_O = 5mA$                                                                                           |                                                           | 0.5  | 4.8   |                     | 1.5  |      | $\frac{mV}{^\circ C}$ |
| Input Voltage required to maintain line regulation  | $I_O \leq I_{MAX}$                                                                                    |                                                           | 14.5 |       |                     | 14.6 |      | V                     |

- 1) All characteristics are measured with a capacitor across the input of  $0.22\mu F$  and a capacitor across the output of  $0.1\mu F$ . All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ( $t_p \leq 10ms$ ,  $\delta \leq 5\%$ ). Output voltage changes due to changes in internal temperature must be taken into account separately.
- 2) Although power dissipation is internally limited, these specifications are applicable for maximum power dissipation  $P_{MAX}$  of  $20W$ ,  $I_{MAX} = 1.0A$ .
- 3)  $T_J = 25^\circ C$  unless otherwise stated.

| Parameter                                           | Test Conditions                                                                                       | IP7815A<br>IP140A-15                                      |      |       | IP7815<br>IP140A-15 |      |       | Units         |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|------|-------|---------------------|------|-------|---------------|
|                                                     |                                                                                                       | Min.                                                      | Typ. | Max.  | Min.                | Typ. | Max.  |               |
| $V_O$ Output Voltage                                | $I_O = 1A$ $V_{IN} = 23V$                                                                             | 14.85                                                     | 15   | 15.15 | 14.4                | 15   | 15.60 | V             |
|                                                     | $I_O = 5mA$ to $I_{MAX}$ $P_D \leq P_{MAX}$<br>$V_{IN} = 17.9V$ to $30V$ $T_J = -55$ to $150^\circ C$ | 14.55                                                     |      | 15.45 | 14.25               |      | 15.75 |               |
| $V_O$ Low Supply                                    | $I_O = 5mA$ to $I_{MAX}$ $P_D \leq P_{MAX}$<br>$V_{IN} = 17.5V$ to $30V$                              | 14.25                                                     |      | 15.45 | 14.25               |      | 15.75 | V             |
| $\Delta V_O$ Line Regulation                        | $I_O = 0.5 I_{MAX}$                                                                                   | $V_{IN} = 17.5V$ to $30V$                                 |      | 4     | 22                  |      | 150   | mV            |
|                                                     |                                                                                                       | $V_{IN} = 17.9V$ to $30V$<br>$T_J = -55$ to $150^\circ C$ |      | 4     | 22                  |      | 150   |               |
|                                                     | $I_O \leq I_{MAX}$                                                                                    | $V_{IN} = 17.5V$ to $30V$                                 |      | 4     | 22                  |      | 150   |               |
|                                                     | $V_{IN} = 20V$ to $26V$                                                                               |                                                           |      | 2     | 10                  |      | 60    |               |
|                                                     |                                                                                                       | $T_J = -55$ to $150^\circ C$                              |      | 5     | 30                  |      | 75    |               |
| $\Delta V_O$ Load Regulation                        | $V_{IN} = 23V$                                                                                        | $I_O = 5mA$ to $1.5A$                                     |      | 12    | 35                  |      | 150   | mV            |
|                                                     |                                                                                                       | $I_O = 250mA$ to $750mA$                                  |      | 4     | 21                  |      | 75    |               |
|                                                     | $V_{IN} = 23V$                                                                                        | $I_O = 5mA$ to $I_{MAX}$<br>$T_J = -55$ to $150^\circ C$  |      | 9     | 75                  |      | 150   |               |
| $I_Q$ Quiescent Current                             | $I_O \leq I_{MAX}$                                                                                    |                                                           |      | 4     | 6                   |      | 6     | mA            |
|                                                     | $V_{IN} = 23V$                                                                                        | $T_J = -55$ to $150^\circ C$                              |      | 4     | 6.5                 |      | 7     |               |
| $\Delta I_Q$ Quiescent Current Change               | $I_O = 5mA$ to $I_{MAX}$                                                                              | $V_{IN} = 23V$                                            |      | 0.2   | 0.5                 |      | 0.5   | mA            |
|                                                     | $I_O \leq I_{MAX}$                                                                                    | $V_{IN} = 17.9V$ to $30V$<br>$T_J = -55$ to $150^\circ C$ |      | 0.1   | 0.8                 |      | 0.8   |               |
|                                                     | $I_O \leq 0.5 I_{MAX}$                                                                                | $V_{IN} = 18.5V$ to $30V$                                 |      | 0.1   | 0.8                 |      | 0.8   |               |
|                                                     | $I_O \leq 0.5 I_{MAX}$                                                                                | $V_{IN} = 17.5V$ to $30V$<br>$T_J = -55$ to $150^\circ C$ |      | 0.2   | 1                   |      | 1     |               |
| $V_N$ Output Noise Voltage                          | $f = 10Hz$ to $100kHz$<br>$V_{IN} = 23V$                                                              |                                                           | 90   | 600   |                     | 90   |       | $\mu V$       |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ Ripple Rejection | $f = 120Hz$                                                                                           | $I_O \leq I_{MAX}$                                        |      | 60    | 70                  |      | 60    | dB            |
|                                                     | $V_{IN} = 18.5V$ to $28.5V$                                                                           | $I_O \leq 0.5 I_{MAX}$<br>$T_J = -55$ to $150^\circ C$    |      | 60    | 70                  |      | 60    |               |
| Dropout Voltage                                     | $I_O = I_{MAX}$                                                                                       |                                                           | 2    | 2.5   |                     | 2    |       | V             |
| $R_O$ Output Resistance                             | $f = 1 kHz$                                                                                           |                                                           | 9    |       |                     | 9    |       | $m\Omega$     |
| $I_{sc}$ Short Circuit Current                      | $V_{IN} = 35V$                                                                                        |                                                           | 0.6  | 1.2   |                     | 0.6  | 1.2   | A             |
| $I_{pk}$ Peak Output Current                        | $V_{IN} = 23V$                                                                                        |                                                           | 2.4  | 3.3   |                     | 2.4  | 3.3   |               |
| Average Temperature Coefficient of $V_O$            | $I_O = 5mA$                                                                                           |                                                           | 0.6  | 6     |                     | 1.8  |       | $mV/^\circ C$ |
| Input Voltage required to maintain line regulation  | $I_O \leq I_{MAX}$                                                                                    |                                                           | 17.5 |       |                     | 17.7 |       | V             |

- 1) All characteristics are measured with a capacitor across the input of  $0.22\mu F$  and a capacitor across the output of  $0.1\mu F$ . All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ( $t_p \leq 10ms$ ,  $\delta \leq 5\%$ ). Output voltage changes due to changes in internal temperature must be taken into account separately.
- 2) Although power dissipation is internally limited, these specifications are applicable for maximum power dissipation  $P_{MAX}$  of  $20W$ ,  $I_{MAX} = 1.0A$ .
- 3)  $T_J = 25^\circ C$  unless otherwise stated.

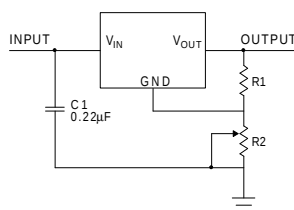
## APPLICATIONS INFORMATION



**Fixed Output Regulator**

\* Required if the regulator is located far from the power supply.

\*\* Although no output capacitor is needed for stability, it does help transient response. (If needed, use 0.1µF ceramic disc)

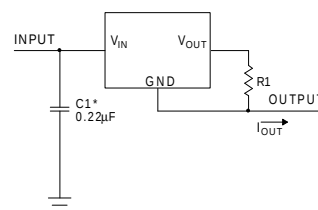


**Adjustable Output Regulator**

$$V_{OUT} = 5V + \left( \frac{5V}{R1 + V} \right) R2$$

$$\left( \frac{5V}{R1} \right) > 3I_Q, \text{ Load Regulation } \approx$$

$$\left[ \frac{R1+R2}{R1} \right] (L_R \text{ of Regulator})$$



**Current Regulator**

$$I_{OUT} = \left( \frac{V2 - V3}{R1} \right) + I_Q$$

$$\Delta I_Q = 1.3mA \text{ over line and load changes}$$

## Order Information

| Part Number | K-Pack (TO-3) | R-Pack (TO-66) | G/IG-Pack (TO-257) | SG-Pack TO220-SM | Temp. Range   | <b>Note:</b><br><br>To order, add the package identifier to the part number.<br>eg. IP7805AK<br>IP140SG-12 |
|-------------|---------------|----------------|--------------------|------------------|---------------|------------------------------------------------------------------------------------------------------------|
| IP7800A     | ✓             | ✓              | ✓                  | ✓                | -55 to +150°C |                                                                                                            |
| IP7800      | ✓             | ✓              | ✓                  | ✓                | "             |                                                                                                            |
| IP140A      | ✓             | ✓              | ✓                  | ✓                | "             |                                                                                                            |
| IP140       | ✓             | ✓              | ✓                  | ✓                | "             |                                                                                                            |
| LM140       | ✓             | ✓              | ✓                  | ✓                | "             |                                                                                                            |