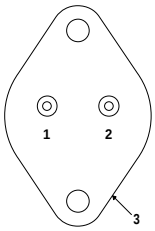
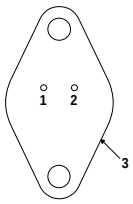
# IP140A SERIES
# IP140 SERIES
# IP7800A SERIES
# IP7800 SERIES
# LM140 SERIES

# 1 AMP POSITIVE VOLTAGE REGULATOR



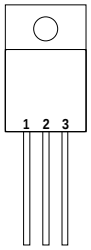

Pin 1 – $V_{IN}$
Pin 2 – $V_{OUT}$
Case – Ground

**K Package – TO–3**



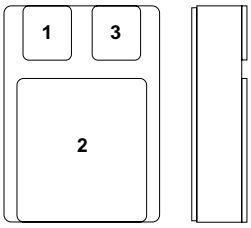

Pin 1 – $V_{IN}$
Pin 2 – $V_{OUT}$
Case – Ground

**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 – $V_{OUT}$

**SMD 1 PACKAGE**
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 ±1% output voltage tolerance at room temperature.

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

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

| | | | |
|---|---|---|---|
| $V_I$ | DC Input Voltage | (for $V_O$ = 5, 12, 15V) | 35V |
| $P_D$ | Power Dissipation | | Internally limited [1] |
| $T_j$ | 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.

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# IP140A SERIES
# IP140 SERIES
# IP7800A SERIES
# IP7800 SERIES
# LM140 SERIES

| Parameter | | Test Conditions | | IP7805A LM,IP140–05 Min. | IP7805A LM,IP140–05 Typ. | IP7805A LM,IP140–05 Max. | IP7805 LM,IP140–05 Min. | IP7805 LM,IP140–05 Typ. | IP7805 LM,IP140–05 Max. | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| $V_O$ | Output Voltage | $I_O$ = 1A | $V_{IN}$ = 10V | 4.95 | 5 | 5.05 | 4.8 | 5 | 5.2 | V |
| | | $I_O$ = 5mA to $I_{MAX}$<br>$V_{IN}$ = 7.5V to 20V | $P_D \le P_{MAX}$<br>$T_J$ = -55 to 150°C | 4.85 | | 5.15 | 4.75 | | 5.25 | |
| $V_O$ | Low Supply | $I_O$ = 5mA to $I_{MAX}$<br>$V_{IN}$ = 7V to 20V | $P_D \le P_{MAX}$ | 4.75 | | 5.15 | 4.75 | | 5.25 | V |
| $\Delta V_O$ | Line Regulation | $I_O$ = 0.5 $I_{MAX}$ | $V_{IN}$ = 7V to 25V | | 3 | 10 | | | 50 | mV |
| | | | $V_{IN}$ = 7.5V to 25V<br>$T_J$ = -55 to 150°C | | 3 | 10 | | | 50 | |
| | | $I_O \le I_{MAX}$ | $V_{IN}$ = 7.3V to 20V | | 3 | 10 | | | 50 | |
| | | $V_{IN}$ = 8V to 12V | | | 1 | 4 | | | 20 | |
| | | | $T_J$ = -55 to 150°C | | 2 | 12 | | | 25 | |
| $\Delta V_O$ | Load Regulation | $V_{IN}$ = 10V | $I_O$ = 5mA to 1.5A | | 10 | 25 | | | 50 | mV |
| | | | $I_O$ = 250mA to 750mA | | 4 | 15 | | | 25 | |
| | | $V_{IN}$ = 10V | $I_O$ = 5mA to $I_{MAX}$<br>$T_J$ = -55 to 150°C | | 7 | 25 | | | 50 | |
| $I_Q$ | Quiescent Current | $I_O \le I_{MAX}$ | | | 4 | 6 | | | 6 | mA |
| | | $V_{IN}$ = 10V | $T_J$ = -55 to 150°C | | 4 | 6.5 | | | 7 | |
| $\Delta I_Q$ | Quiescent Current Change | $I_O$ = 5mA to $I_{MAX}$ | $V_{IN}$ = 10V | | 0.2 | 0.5 | | | 0.5 | mA |
| | | $I_O \le I_{MAX}$ | $V_{IN}$ = 7.5V to 20V<br>$T_J$ = -55 to 150°C | | 0.1 | 0.8 | | | 0.8 | |
| | | $I_O \le 0.5\ I_{MAX}$ | $V_{IN}$ = 8V to 25V | | 0.1 | 0.8 | | | 0.8 | |
| | | $I_O \le 0.5\ I_{MAX}$ | $V_{IN}$ = 7V to 25V<br>$T_J$ = -55 to 150°C | | 0.2 | 1 | | | 1.0 | |
| $V_N$ | Output Noise Voltage | f = 10Hz to 100kHz<br>$V_{IN}$ = 10V | | | 40 | 200 | | 40 | | µV |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ | Ripple Rejection | f = 120Hz<br>$V_{IN}$ = 8V to 18V | $I_O \le I_{MAX}$ | 68 | 80 | | 68 | | | dB |
| | | | $I_O \le 0.5\ I_{MAX}$<br>$T_J$ = -55 to 150°C | 68 | 80 | | 68 | | | |
| | Dropout Voltage | $I_O = I_{MAX}$ | | | 2 | 2.5 | | 2 | | V |
| $R_O$ | Output Resistance | f = 1 kHz | | | 5 | | | 5 | | mΩ |
| $I_{sc}$ | Short Circuit Current | $V_{IN}$ = 35V | | | 0.6 | 1.2 | | 0.6 | 1.2 | A |
| $I_{pk}$ | Peak Output Current | $V_{IN}$ = 10V | | | 2.4 | 3.3 | | 2.4 | 3.3 | |
| Average Temperature Coefficient of $V_O$ | | $I_O$ = 5mA | | | 0.2 | 2 | | 0.6 | | mV/°C |
| Input Voltage required to maintain line regulation | | $I_O \le I_{MAX}$ | | 7.3 | | | 7.3 | | | V |

1) All characteristics are measured with a capacitor across the input of 0.22µF and a capacitor across the output of 0.1µF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_p \le 10$ms, $\delta \le 5\%$). 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°C unless otherwise stated.

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| Parameter | | Test Conditions | | IP7812A LM,IP140–12 Min. | Typ. | Max. | IP7812 LM,IP140–12 Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| $V_O$ | Output Voltage | $I_O$ = 1A | $V_{IN}$ = 19V | 11.88 | 12 | 12.12 | 11.5 | 12 | 12.5 | V |
| | | $I_O$ = 5mA to $I_{MAX}$<br>$V_{IN}$ = 14.8V to 27V | $P_D \le P_{MAX}$<br>$T_J$ = -55 to 150°C | 11.64 | | 12.36 | 11.4 | | 12.6 | |
| $V_O$ | Low Supply | $I_O$ = 5mA to $I_{MAX}$<br>$V_{IN}$ = 14.5V to 27V | $P_D \le P_{MAX}$ | 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°C | | 4 | 18 | | | 120 | |
| | | $I_O \le I_{MAX}$ | $V_{IN}$ = 14.5V to 27V | | 4 | 18 | | | 120 | |
| | | $V_{IN}$ = 16V to 22V | | | 2 | 9 | | | 50 | |
| | | | $T_J$ = -55 to 150°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°C | | 8 | 60 | | | 120 | |
| $I_Q$ | Quiescent Current | $I_O \le I_{MAX}$ | | | 4 | 6 | | | 6 | mA |
| | | $V_{IN}$ = 19V | $T_J$ = -55 to 150°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 |
| | | $I_O \le I_{MAX}$ | $V_{IN}$ = 14.8V to 27V<br>$T_J$ = -55 to 150°C | | 0.1 | 0.8 | | | 0.8 | |
| | | $I_O \le 0.5\ I_{MAX}$ | $V_{IN}$ = 15V to 30V | | 0.1 | 0.8 | | | 0.8 | |
| | | $I_O \le 0.5\ I_{MAX}$ | $V_{IN}$ = 14.5V to 30V<br>$T_J$ = -55 to 150°C | | 0.2 | 1 | | | 1 | |
| $V_N$ | Output Noise Voltage | f = 10Hz to 100kHz<br>$V_{IN}$ = 19V | | | 75 | 480 | | 75 | | µV |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ | Ripple Rejection | f = 120Hz<br>$V_{IN}$ = 15V to 25V | $I_O \le I_{MAX}$ | 61 | 72 | | 61 | | | dB |
| | | | $I_O \le 0.5\ I_{MAX}$<br>$T_J$ = -55 to 150°C | 61 | 72 | | 61 | | | |
| | Dropout Voltage | $I_O$ = $I_{MAX}$ | | | 2 | 2.5 | | 2 | | V |
| $R_O$ | Output Resistance | f = 1 kHz | | | 8 | | | 8 | | mΩ |
| $I_{sc}$ | 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 | | mV/°C |
| Input Voltage required to maintain line regulation | | $I_O \le I_{MAX}$ | | 14.5 | | | 14.6 | | | V |

1) All characteristics are measured with a capacitor across the input of 0.22µF and a capacitor across the output of 0.1µF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_p \le$ 10ms, $\delta \le$ 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°C unless otherwise stated.

# IP140A SERIES
# IP140 SERIES
# IP7800A SERIES
# IP7800 SERIES
# LM140 SERIES

| Parameter | | Test Conditions | | IP7815A LM,IP140A–15 Min. | Typ. | Max. | IP7815 LM,IP140–15 Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| $V_O$ | Output Voltage | $I_O$ = 1A | $V_{IN}$ = 23V | 14.85 | 15 | 15.15 | 14.4 | 15 | 15.60 | V |
| | | $I_O$ = 5mA to $I_{MAX}$ $V_{IN}$ = 17.9V to 30V | $P_D \le P_{MAX}$ $T_J$ = -55 to 150°C | 14.55 | | 15.45 | 14.25 | | 15.75 | |
| $V_O$ | Low Supply | $I_O$ = 5mA to $I_{MAX}$ $V_{IN}$ = 17.5V to 30V | $P_D \le P_{MAX}$ | 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 $T_J$ = -55 to 150°C | | 4 | 22 | | | 150 | |
| | | $I_O \le I_{MAX}$ | $V_{IN}$ = 17.5V to 30V | | 4 | 22 | | | 150 | |
| | | $V_{IN}$ = 20V to 26V | | | 2 | 10 | | | 60 | |
| | | | $T_J$ = -55 to 150°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 $I_{MAX}$ $T_J$ = -55 to 150°C | | 9 | 75 | | | 150 | |
| $I_Q$ | Quiescent Current | $I_O \le I_{MAX}$ | | | 4 | 6 | | | 6 | mA |
| | | $V_{IN}$ = 23V | $T_J$ = -55 to 150°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 |
| | | $I_O \le I_{MAX}$ | $V_{IN}$ = 17.9V to 30V $T_J$ = -55 to 150°C | | 0.1 | 0.8 | | | 0.8 | |
| | | $I_O \le 0.5\ I_{MAX}$ | $V_{IN}$ = 18.5V to 30V | | 0.1 | 0.8 | | | 0.8 | |
| | | $I_O \le 0.5\ I_{MAX}$ | $V_{IN}$ = 17.5V to 30V $T_J$ = -55 to 150°C | | 0.2 | 1 | | | 1 | |
| $V_N$ | Output Noise Voltage | f = 10Hz to 100kHz $V_{IN}$ = 23V | | | 90 | 600 | | 90 | | µV |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ | Ripple Rejection | f = 120Hz | $I_O \le I_{MAX}$ | 60 | 70 | | 60 | | | dB |
| | | $V_{IN}$ = 18.5V to 28.5V | $I_O \le 0.5\ I_{MAX}$ $T_J$ = -55 to 150°C | 60 | 70 | | 60 | | | |
| | Dropout Voltage | $I_O = I_{MAX}$ | | | 2 | 2.5 | | 2 | | V |
| $R_O$ | Output Resistance | f = 1 kHz | | | 9 | | | 9 | | mΩ |
| $I_{sc}$ | 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/°C |
| Input Voltage required to maintain line regulation | | $I_O \le I_{MAX}$ | | 17.5 | | | 17.7 | | | V |

1) All characteristics are measured with a capacitor across the input of 0.22µF and a capacitor across the output of 0.1µF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_p \le 10$ms, $\delta \le 5\%$). 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°C unless otherwise stated.

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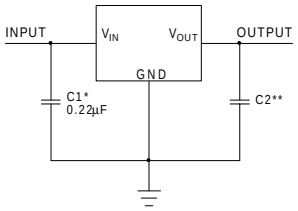
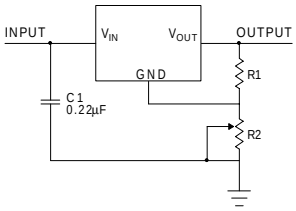
## APPLICATIONS INFORMATION




**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)

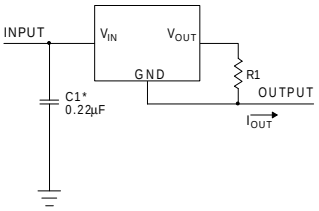



**Adjustable Output Regulator**

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

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

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




**Current Regulator**

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

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

## Order Information

| Part Number | K–Pack (TO–3) | R–Pack (TO–66) | G/IG–Pack (TO–257) | SMD 1 | Temp. Range |
|---|---|---|---|---|---|
| IP7800A | ✔ | ✔ | ✔ | ✔ | -55 to +150°C |
| IP7800 | ✔ | ✔ | ✔ | ✔ | ” |
| IP140A | ✔ | ✔ | ✔ | ✔ | ” |
| IP140 | ✔ | ✔ | ✔ | ✔ | ” |
| LM140 | ✔ | ✔ | ✔ | ✔ | ” |

**Note:**

To order, add the package identifier to the part number.
eg. IP7805AK
IP140SMD-12