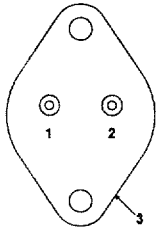
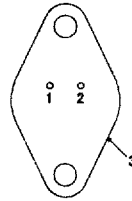


1.5 AMP NEGATIVE VOLTAGE REGULATOR



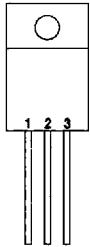
Pin 1 – Ground
 Pin 2 – V_{OUT}
 Case – V_{IN}

K Package – TO-3



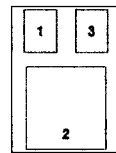
Pin 1 – Ground
 Pin 2 – V_{OUT}
 Case – V_{IN}

R Package – TO-66



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

G Package – TO-257



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

**SG Package – TO-220
CERAMIC SURFACE
MOUNT**

FEATURES

- **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 OPTION (-A VERSIONS)**

DESCRIPTION

The IP120A / LM120 / IP7900A / IP7900 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 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.

Order Information

| Part Number | K-Pack (TO-3) | R-Pack (TO-66) | G-Pack (TO-257) | SG-Pack TO220-SM | Temp. Range | Note: To order, add the package identifier to the part number. eg. IP7900AK IP120SG |
|-------------|---------------|----------------|-----------------|------------------|---------------|---|
| IP7900A | ✓ | ✓ | ✓ | ✓ | -55 to +150°C | |
| IP7900 | ✓ | ✓ | ✓ | ✓ | " | |
| IP120A | ✓ | ✓ | ✓ | ✓ | " | |
| IP120 | ✓ | ✓ | ✓ | ✓ | " | |
| LM120 | ✓ | ✓ | ✓ | ✓ | " | |

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

| Parameter | Test Conditions | IP7905A IP120A-05 | | | IP7905, IP120-05 LM120-05 | | | Units | |
|---|--|--|------|-------|------------------------------|------|-------|----------------------------|---------------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | | |
| V_O Output Voltage | $I_O = 500\text{mA}$ $V_{IN} = -10\text{V}$ | -4.95 | -5 | -5.05 | -4.9 | -5 | -5.1 | V | |
| | $I_O = 5\text{mA to } I_{MAX}$ $V_{IN} = -7.5\text{V to } -20\text{V}$ $P_D \leq P_{MAX}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | | | -5.15 | -4.8 | | -5.2 | | |
| V_O Low Supply | $I_O = 5\text{mA to } I_{MAX}$ $P_D \leq P_{MAX}$ $V_{IN} = -7\text{V to } -20\text{V}$ | -4.75 | | -5.15 | -4.75 | | -5.25 | V | |
| ΔV_O Line Regulation | $I_O = 0.5 I_{MAX}$ | $V_{IN} = -7\text{V to } -25\text{V}$ | | 3 | 10 | | 3 | 25 | mV |
| | | $V_{IN} = -7.5\text{V to } -20\text{V}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | | 3 | 10 | | 3 | 50 | |
| | $V_{IN} = -8\text{V to } -12\text{V}$ $I_O \leq I_{MAX}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | | 1 | 4 | | 1 | 25 | | |
| ΔV_O Load Regulation | $V_{IN} = -10\text{V}$ | $I_O = 5\text{mA to } 1.5\text{A}$ | | 10 | 25 | | 10 | 75 | mV |
| | | $I_O = 250\text{mA to } 750\text{mA}$ | | 4 | 15 | | 4 | 25 | |
| I_Q Quiescent Current | $I_O \leq 0.5 I_{MAX}$ $V_{IN} = -10\text{V}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | | | 1 | 1.9 | | 1 | 1.9 | mA |
| | | | | 1 | 2 | | 1 | 2 | |
| ΔI_Q Quiescent Current Change | $I_O = 5\text{mA to } I_{MAX}$ $V_{IN} = -10\text{V}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | | | 0.2 | 0.4 | | 0.2 | 0.4 | mA |
| | | | | 0.2 | 0.5 | | 0.2 | 0.5 | |
| | $I_O \leq 0.5 I_{MAX}$ | $V_{IN} = -7\text{V to } -25\text{V}$ | | 0.1 | 0.4 | | 0.1 | 0.4 | |
| V_N Output Noise Voltage | $f = 10\text{Hz to } 100\text{kHz}$ $V_{IN} = -10\text{V}$ | | | 40 | 400 | | 40 | 400 | μV |
| | | | | | | | | | |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ Ripple Rejection | $f = 120\text{Hz}$ $V_{IN} = -8\text{V to } -18\text{V}$ | $I_O \leq I_{MAX}$ | | 66 | 80 | | 54 | 80 | dB |
| | | $I_O \leq 0.5 I_{MAX}$ $T_J = -55 \text{ to } 150^\circ\text{C}$ | | 66 | 80 | | 54 | 80 | |
| Dropout Voltage | $I_O = I_{MAX}$ | | 1.1 | 2.3 | | 1.1 | 2.3 | V | |
| R_O Output Resistance | $f = 1 \text{ kHz}$ | | 5 | | | 5 | | $\text{m}\Omega$ | |
| I_{sc} Short Circuit Current | $V_{IN} = -35\text{V}$ | | 0.6 | 1.2 | | 0.6 | 1.2 | A | |
| I_{pk} Peak Output Current | $V_{IN} = -10\text{V}$ | | 2.4 | 3.3 | | 2.4 | 3.3 | | |
| Average Temperature Coefficient of V_O | $I_O = 5\text{mA}$ | | 0.2 | 2 | | 0.2 | 2 | $\text{mV}/^\circ\text{C}$ | |
| Input Voltage required to maintain line regulation | $I_O \leq I_{MAX}$ | -7.3 | | | -7.3 | | | V | |

- 1) All characteristics are measured with a capacitor across the input of $0.22\mu\text{F}$ and a capacitor across the output of $0.1\mu\text{F}$.
 All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_p \leq 10\text{ms}$, $\delta \leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.
- 2) Test Conditions unless otherwise stated: $P_{MAX} = 10\text{W}$ for TO-220SM, $P_{MAX} = 20\text{W}$ for all other package styles
 $I_{MAX} = 1.0\text{A}$, $T_J = 25^\circ\text{C}$

| Parameter | Test Conditions | IP7912A IP120A-12 | | | IP7912, IP120-12 LM120-12 | | | Units |
|---|--|----------------------|------|--------|------------------------------|------|--------|---------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| V _O Output Voltage | I _O = 500mA V _{IN} = -19V | -11.88 | -12 | -12.12 | -11.76 | -12 | -12.24 | V |
| | V _{IN} = -14.8V to -27V P _D ≤ P _{MAX} I _O = 5mA to I _{MAX} T _J = -55 to 150°C | | | -12.36 | -11.52 | | -12.48 | |
| V _O Low Supply | I _O = 5mA to I _{MAX} P _D ≤ P _{MAX} V _{IN} = -14.5V to -27V | -11.40 | | -12.36 | -11.40 | | -12.60 | V |
| ΔV _O Line Regulation | I _O = 0.5 I _{MAX} V _{IN} = -14.5V to -30V V _{IN} = -14.8V to -27V T _J = -55 to 150°C | | 4 | 18 | | 4 | 120 | mV |
| | | | 4 | 18 | | 4 | 200 | |
| | I _O ≤ I _{MAX} V _{IN} = -16V to -22V T _J = -55 to 150°C | | 1 | 4 | | 1 | 25 | |
| ΔV _O Load Regulation | V _{IN} = -19V I _O = 5mA to 1.5A I _O = 250mA to 750mA | | 12 | 32 | | 12 | 80 | mV |
| | | | 4 | 19 | | 4 | 60 | |
| | V _{IN} = -19V I _O = 5mA to I _{MAX} T _J = -55 to 150°C | | 8 | 60 | | 8 | 120 | |
| I _Q Quiescent Current | I _O ≤ 0.5 I _{MAX} V _{IN} = -19V T _J = -55 to 150°C | | 0.2 | 0.4 | | 0.2 | 0.4 | mA |
| | | | 1 | 2 | | 1 | 2 | |
| ΔI _Q Quiescent Current Change | I _O = 5mA to I _{MAX} V _{IN} = -19V T _J = -55 to 150°C | | 0.2 | 0.4 | | 0.2 | 0.4 | mA |
| | | | 0.2 | 0.5 | | 0.2 | 0.5 | |
| | I _O ≤ 0.5 I _{MAX} V _{IN} = -14.5V to -30V V _{IN} = -15V to -30V T _J = -55 to 150°C | | 0.1 | 0.4 | | 0.1 | 0.4 | |
| | | | 0.1 | 0.5 | | 0.1 | 1.0 | |
| V _N Output Noise Voltage | f = 10Hz to 100kHz V _{IN} = -19V | | 75 | 960 | | 75 | 960 | μV |
| ΔV _{IN} / ΔV _O Ripple Rejection | f = 120Hz I _O ≤ I _{MAX} | 58 | 72 | | 56 | 72 | | dB |
| | V _{IN} = -15V to -25V I _O ≤ 0.5 I _{MAX} T _J = -55 to 150°C | 58 | 72 | | 56 | 72 | | |
| Dropout Voltage | I _O = I _{MAX} | | 1.1 | 2.3 | | 1.1 | 2.3 | 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 | | 0.5 | 4.8 | mV / °C |
| Input Voltage required to maintain line regulation | I _O ≤ I _{MAX} | -14.5 | | | -14.5 | | | 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 ≤ 10ms, δ ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

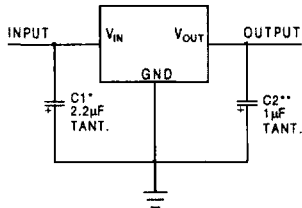
2) Test Conditions unless otherwise stated: P_{MAX} = 10W for TO-220SM, P_{MAX} = 20W for all other package styles

I_{MAX} = 1.0A, T_J = 25°C

| Parameter | Test Conditions | IP7915A IP120A-15 | | | IP7915, IP120-15 LM120-15 | | | Units |
|---|--|----------------------|------|--------|------------------------------|------|--------|-------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| V _O Output Voltage | I _O = 500mA V _{IN} = -23V | -14.85 | -15 | -15.15 | -14.7 | -15 | -15.3 | V |
| | V _{IN} = -17.9V to -30V P _D ≤ P _{MAX} I _O = 5mA to I _{MAX} T _J = -55 to 150°C | -14.55 | | -15.45 | -14.4 | | -15.6 | |
| V _O Low Supply | I _O = 5mA to I _{MAX} P _D ≤ P _{MAX} V _{IN} = -17.5V to -30V | -14.25 | | -15.45 | -14.25 | | -15.75 | V |
| ΔV _O Line Regulation | I _O = 0.5 I _{MAX} V _{IN} = -17.5V to -30V V _{IN} = -17.9V to -30V T _J = -55 to 150°C | 4 | | 22 | 4 | | 150 | mV |
| | | 4 | | 22 | 4 | | 250 | |
| | I _O ≤ I _{MAX} V _{IN} = -20V to -26V T _J = -55 to 150°C | 2 | | 10 | 2 | | 75 | |
| ΔV _O Load Regulation | V _{IN} = -23V I _O = 5mA to 1.5A I _O = 250mA to 750mA | 12 | | 35 | 12 | | 80 | mV |
| | | 4 | | 21 | 4 | | 75 | |
| | V _{IN} = -23V I _O = 5mA to I _{MAX} T _J = -55 to 150°C | 9 | | 75 | 9 | | 150 | |
| I _Q Quiescent Current | I _O ≤ 0.5 I _{MAX} V _{IN} = -23V T _J = -55 to 150°C | 1 | | 1.9 | 1 | | 1.9 | mA |
| | | 1 | | 2 | 1 | | 2 | |
| ΔI _Q Quiescent Current Change | I _O = 5mA to I _{MAX} V _{IN} = -23V T _J = -55 to 150°C | 0.2 | | 0.4 | 0.2 | | 0.4 | mA |
| | | 0.2 | | 0.5 | 0.2 | | 0.5 | |
| | I _O ≤ 0.5 I _{MAX} V _{IN} = -17.5V to -30V V _{IN} = -18.5V to -30V T _J = -55 to 150°C | 0.1 | | 0.4 | 0.1 | | 0.4 | |
| | | 0.1 | | 0.5 | 0.1 | | 1.0 | |
| V _N Output Noise Voltage | f = 10Hz to 100kHz V _{IN} = -23V | 90 | | 1200 | 90 | | 1200 | μV |
| ΔV _{IN} / ΔV _O Ripple Rejection | f = 120Hz V _{IN} = -18.5V to -28.5V I _O ≤ I _{MAX} | 56 | | 70 | 54 | | 70 | dB |
| | I _O ≤ 0.5 I _{MAX} T _J = -55 to 150°C | 56 | | 70 | 54 | | 70 | |
| Dropout Voltage | I _O = I _{MAX} | 1.1 | | 2.3 | 1.1 | | 2.3 | 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 | 0.6 | | 6 | mV/°C |
| Input Voltage required to maintain line regulation | I _O ≤ I _{MAX} | -17.5 | | | -17.5 | | | V |

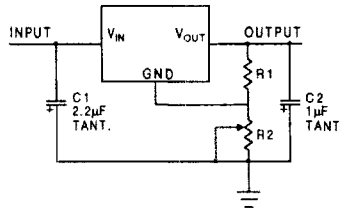
- 1) All characteristics are measured with a capacitor across the input of 0.22μF and a capacitor across the output of 0.1μF.
 All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (t_p ≤ 10ms, δ ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.
- 2) Test Conditions unless otherwise stated: P_{MAX} = 10W for TO-220SM, P_{MAX} = 20W for all other package styles
 I_{MAX} = 1.0A, T_J = 25°C

APPLICATIONS INFORMATION



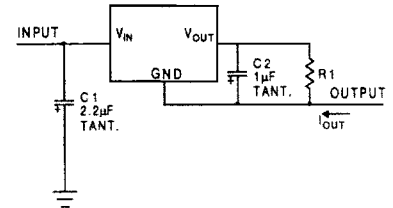
Fixed Output Regulator

- * Required if the regulator is located far from the power supply.
- ** Required for stability. 25µF electrolytic may be substituted.



Adjustable Output Regulator

$$V_{OUT} \approx V_{REG} \frac{(R1+R2)}{R1}$$



Current Regulator

$$I_{OUT} = \frac{V_{REG}}{R1} + I_Q$$