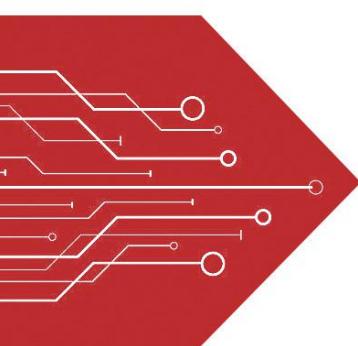


MSKSEMI

SEMICONDUCTOR



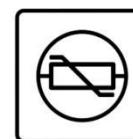
ESD



TVS



TSS



MOV

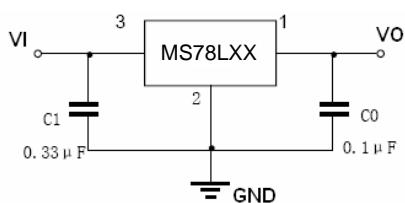


GDT



PLED

Product data sheet


SOT-89


FEATURES

- Wide range of available, fixed output voltage.
- Low cost.
- Internal short-circuit current limiting.
- Internal thermal overload protection.
- No external components required.
- Complementary negative regulators offered (79LXX series).

APPLICATIONS

- Three-terminal positive voltage regulator.

MAXIMUM RATING operating temperature range applies unless otherwise specified

| Symbol | Parameter | Value | Units |
|----------------|--|----------------|-------|
| V_I | Input voltage(3.3V-9V) (10V-15V) (18V-24V) | 30 35 40 | V |
| I_{CM} | Maximum output current | 100 | mA |
| P_D | Power dissipation | 500 | mW |
| T_{OPR} | Operating junction temperature | -40 to +125 | °C |
| T_j, T_{stg} | Storage temperature range | -40 to +150 | °C |

ELECTRICAL CHARACTERISTICS

● MS78L33
 $(V_{IN}=10V, I_O=40mA, 0^\circ C < T_j < 125^\circ C, C_I=0.33\mu F, C_O=0.1\mu F, \text{unless otherwise specified})$

| Parameter | Symbol | Test conditions | MS78L33 | | | UNIT |
|---------------------------|-----------------|--|-------------------------|------------|-------------------------|-------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_O | $T_j=25^\circ C$ $5.3V \leq V_i \leq 20V, I_O=1mA-40mA$ $V_1=8.3V, I_O=1mA-70mA$ | 3.168 3.135 3.135 | 3.3 | 3.432 3.465 3.465 | V |
| Load regulation | Reg_{load} | $T_j=25^\circ C, I_O=1mA-100mA$ $T_j=25^\circ C, I_O=1mA-40mA$ | | | 60 30 | mV |
| Line regulation | Reg_{line} | $5.3V \leq V_i \leq 20V, T_j=25^\circ C$ $6.3V \leq V_i \leq 20V, T_j=25^\circ C$ | | | 150 100 | mV |
| Input Bias Current | I_{IB} | $T_j=25^\circ C$ $T_j=125^\circ C$ | | | 6.0 5.5 | mA |
| Input Bias Current Change | ΔI_{IB} | $6.3V \leq V_i \leq 20V$ $1mA \leq I_O \leq 40mA$ | | | 1.5 0.1 | mA |
| Output noise voltage | V_N | $10Hz \leq f \leq 100KHz$ | | 40 | | μV |
| Ripple rejection | RR | $I_O=40mA, 6.3V \leq V_i \leq 16.3V$ $f=120Hz, T_j=25^\circ C$ | 41 | 49 | | dB |
| Dropout voltage | V_I-V_O | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

● MS78L05
 $(V_{IN}=10V, I_O=40mA, 0^\circ C < T_j < 125^\circ C, C_I=0.33\mu F, C_O=0.1\mu F, \text{unless otherwise specified})$

| Parameter | Symbol | Test conditions | 78L05 | | | UNIT |
|---------------------------|-----------------|---|---------------------|------------|---------------------|-------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_O | $T_j=25^\circ C$ $7V \leq V_i \leq 20V, I_O=1mA-40mA$ $V_1=10V, I_O=1mA-70mA$ | 4.8 4.75 4.75 | 5.0 | 5.2 5.25 5.25 | V |
| Load regulation | Reg_{load} | $T_j=25^\circ C, I_O=1mA-100mA$ $T_j=25^\circ C, I_O=1mA-40mA$ | | 11 5 | 60 30 | mV |
| Line regulation | Reg_{line} | $7V \leq V_i \leq 20V, T_j=25^\circ C$ $8V \leq V_i \leq 20V, T_j=25^\circ C$ | | 55 45 | 150 100 | mV |
| Input Bias Current | I_{IB} | $T_j=25^\circ C$ $T_j=125^\circ C$ | | 3.8 | 6.0 5.5 | mA |
| Input Bias Current Change | ΔI_{IB} | $8V \leq V_i \leq 20V$ $1mA \leq I_O \leq 40mA$ | | | 1.5 0.1 | mA |
| Output noise voltage | V_N | $10Hz \leq f \leq 100KHz$ | | 40 | | μV |
| Ripple rejection | RR | $I_O=40mA, 8V \leq V_i \leq 18V, f=120Hz$ $, T_j=25^\circ C$ | 41 | 49 | | dB |
| Dropout voltage | V_I-V_O | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

- **MS78L06** ($V_{IN}=12V, I_O=40mA, 0^\circ C < T_j < 125^\circ C, C_i=0.33\mu F, C_o=0.1\mu F$, unless otherwise specified)

| Parameter | Symbol | Test conditions | MS78L06 | | | UNIT |
|---------------------------|-----------------|--|--------------------|-------------|--------------------|-------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_O | $T_j=25^\circ C$ $V_1=8.5V-20V, I_O=1mA-40mA$ $V_1=8.5V, I_O=1mA-70mA$ | 5.75 5.7 5.7 | 6.0 | 6.25 6.3 6.3 | V |
| Load regulation | Reg_{load} | $T_j=25^\circ C, I_O=1mA-100mA$ $T_j=25^\circ C, I_O=1mA-70mA$ | | 12.8 5.8 | 80 40 | mV |
| Line regulation | Reg_{line} | $8.5V \leq V_i \leq 20V, T_j=25^\circ C$ $9V \leq V_i \leq 20V, T_j=25^\circ C$ | | 64 54 | 175 125 | mV |
| Input Bias Current | I_{IB} | $T_j=25^\circ C, V_{IN}=12V, I_O=40mA$ $T_j=125^\circ C, V_{IN}=12V, I_O=40mA$ | | 3.9 | 5.5 6.0 | mA |
| Input Bias Current Change | ΔI_{IB} | $9V \leq V_i \leq 20V$ $1mA \leq I_O \leq 40mA$ | | | 1.5 0.1 | mA |
| Output noise voltage | V_N | $10Hz \leq f \leq 100KHz$ | | 40 | | $\mu V/V_O$ |
| Ripple rejection | RR | $I_O=40mA, 10V \leq V_i \leq 20V, f=120Hz, T_j=25^\circ C$ | 40 | 46 | | dB |
| Dropout voltage | V_D | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

- **MS78L08** ($V_i=14V, I_O=40mA, 0^\circ C < T_j < 125^\circ C, C_i=0.33\mu F, C_o=0.1Mf$, unless otherwise specified)

| Parameter | Symbol | Test conditions | MS78L08 | | | UNIT |
|---------------------------|-----------------|--|-------------------|-----------|-------------------|---------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_O | $T_j=25^\circ C$ $10.5V \leq V_i \leq 23V, I_O=1mA-40mA$ $V_i=14V, I_O=1mA-70mA$ | 7.7 7.6 7.6 | 8.0 | 8.3 8.4 8.4 | V |
| Load regulation | Reg_{load} | $T_j=25^\circ C, I_O=1mA-100mA$ $T_j=25^\circ C, I_O=1mA-40mA$ | | 15 8.0 | 80 40 | mV |
| Line regulation | Reg_{line} | $10.5V \leq V_i \leq 23V, T_j=25^\circ C$ $11V \leq V_i \leq 23V, T_j=25^\circ C$ | | 20 12 | 175 125 | mV |
| Input Bias Current | I_{IB} | $T_j=25^\circ C$ $T_j=125^\circ C$ | | 3 | 6.0 5.5 | mA |
| Input Bias Current Change | ΔI_{IB} | $11V \leq V_i \leq 23V$ $1mA \leq I_O \leq 40mA$ | | | 1.5 0.1 | mA |
| Output noise voltage | V_N | $T_A=25^\circ C, 10Hz \leq f \leq 100KHz$ | | 60 | | μV |
| Ripple rejection | RR | $I_O=40mA, 12V \leq V_i \leq 23V, f=120Hz, T_j=25^\circ C$ | 37 | 57 | | dB |
| Dropout voltage | V_i-V_O | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

- **MS78L09** ($V_i=15V, I_o=40mA, 0^\circ C < T_j < 125^\circ C, C_l=0.33\mu F, C_o=0.1\mu F$, unless otherwise specified)

| Parameter | Symbol | Test conditions | MS78L09 | | | UNIT |
|---------------------------|-----------------|--|-------------------|------------|-------------------|-------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_o | $T_j=25^\circ C$ $V_i=11.5V-24V, I_o=1mA-40mA$ $V_i=15V, I_o=1mA-70mA$ | 8.6 8.5 8.5 | 9.0 | 9.4 9.5 9.5 | V |
| Load regulation | Reg_{load} | $T_j=25^\circ C, I_o=1mA-100mA$ $T_j=25^\circ C, I_o=1mA-40mA$ | | 15 8.0 | 90 40 | mV |
| Line regulation | Reg_{line} | $11.5V \leq V_i \leq 24V, T_j=25^\circ C$ $12V \leq V_i \leq 24V, T_j=25^\circ C$ | | 20 12 | 175 125 | mV |
| Input Bias Current | I_{IB} | $T_j=25^\circ C$ $T_j=125^\circ C$ | | 3.0 | 6.0 5.5 | mA |
| Input Bias Current Change | ΔI_{IB} | $11V \leq V_i \leq 23V$ $1mA \leq I_o \leq 40mA$ | | | 1.5 0.1 | mA |
| Output noise voltage | V_N | $T_A=25^\circ C, 10Hz \leq f \leq 100KHz$ | | 60 | | μV |
| Ripple rejection | RR | $I_o=40mA, 13V \leq V_i \leq 24V, f=120Hz$ $T_j=25^\circ C$ | 37 | 57 | | dB |
| Dropout voltage | V_i-V_o | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

- **MS78L10** ($V_{IN}=16V, I_o=40mA, C_{IN}=0.33\mu F, C_o=0.1\mu F$, $T_j = 0$ to $125^\circ C$, unless otherwise specified)

| Parameter | Symbol | Test conditions | MS78L10 | | | UNIT |
|---------------------------|---------------------|--|----------------|------------|------------|---------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_o | $T_j=25^\circ C$ | 9.6 | 10 | 10.4 | V |
| Load regulation(Note1) | ΔReg_{load} | $I_o = 1$ to $100mA, T_j = 25^\circ C$ | - | 17 | 90 | mV |
| | | $I_o = 1$ to $40mA, T_j = 25^\circ C$ | - | 9 | 45 | mV |
| Line regulation(Note1) | ΔReg_{line} | $V_i = 12.5$ to $25V, T_j = 25^\circ C$ | - | 100 | 210 | mV |
| | | $V_i = 13$ to $25V, T_j = 25^\circ C$ | - | 90 | 160 | mV |
| Input Bias Current | I_{IB} | $T_j = 25^\circ C$ | - | 2.0 | 3.0 | mA |
| Input Bias Current Change | ΔI_{IB} | $V_i = 13$ to $25V, T_j = 25^\circ C$ | - | - | 1.0 | mA |
| Output Noise Voltage | V_N | $10Hz \leq f \leq 100KHz$ | - | 70 | - | μV |
| Ripple Rejection | RR | $V_i = 13$ to $23V, I_o = 40mA, f = 120Hz$ | 42 | 52 | - | dB |
| Dropout Voltage | V_D | $T_j=25^\circ C$ | - | 1.7 | - | V |
| Dropout voltage | V_i-V_o | $I_o = 5mA, T_j = 0$ to $125^\circ C$ | - | 0.9 | - | $mV/^\circ C$ |

ELECTRICAL CHARACTERISTICS

● MS78L12
 $(V_i=19V, I_o=40mA, 0^\circ C < T_j < 125^\circ C, C_l=0.33\mu F, C_o=0.1\mu F, \text{unless otherwise specified})$

| Parameter | Symbol | Test conditions | MS78L12 | | | UNIT |
|---------------------------|----------------------------|--|---------|-----|------|---------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_o | $T_j=25^\circ C$ | 11.5 | 12 | 12.5 | V |
| | | $V_i=14.5V-27V, I_o=1mA-40mA$ | 11.4 | | 12.6 | |
| | | $V_i=19V, I_o=1mA-70mA$ | 11.4 | | 12.6 | |
| Load regulation | Reg_{load} | $T_j=25^\circ C, I_o=1mA-100mA$ | | 20 | 100 | mV |
| | | $T_j=25^\circ C, I_o=1mA-40mA$ | | 10 | 50 | |
| Line regulation | Reg_{line} | $14.5V \leq V_i \leq 27V, T_j=25^\circ C$ | | 120 | 250 | mV |
| | | $16V \leq V_i \leq 27V, T_j=25^\circ C$ | | 100 | 200 | |
| Input Bias Current | I_{IB} | $T_j=25^\circ C$ | | 4.2 | 6.5 | mA |
| | | $T_j=125^\circ C$ | | | 6.0 | |
| Input Bias Current Change | ΔI_{IB} | $16V \leq V_i \leq 27V$ | | | 1.5 | mA |
| | | $1mA \leq I_o \leq 40mA$ | | | 0.1 | |
| Output Noise Voltage | V_N | $10Hz \leq f \leq 100KHz, T_A=25^\circ C$ | | 80 | | μV |
| Ripple rejection | RR | $I_o=40mA, 15V \leq V_i \leq 25V, f=120Hz, T_j=25^\circ C$ | 37 | 42 | | dB |
| Dropout voltage | V_i-V_o | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

● MS78L15
 $(V_{IS}=23V, I_o=40mA, 0^\circ C < T_j < 125^\circ C, C_l=0.33\mu F, C_o=0.1\mu F, \text{unless otherwise specified})$

| Parameter | Symbol | Test conditions | MS78L15 | | | UNIT |
|---------------------------|-----------------------------------|--|---------|-----|-------|---------|
| | | | MIN | TYP | MAX | |
| Output voltage | V_o | $T_j=25^\circ C$ | 14.4 | 15 | 15.6 | V |
| | | $V_i=17.5V-30V, I_o=1mA-40mA$ | 14.25 | | 15.75 | |
| | | $V_i=23V, I_o=1mA-70mA$ | 14.25 | | 15.75 | |
| Load regulation | $\Delta \text{Reg}_{\text{load}}$ | $T_j=25^\circ C, I_o=1mA-100mA$ | | 25 | 150 | mV |
| | | $T_j=25^\circ C, I_o=1mA-40mA$ | | 12 | 75 | |
| Line regulation | $\Delta \text{Reg}_{\text{line}}$ | $17.5V \leq V_i \leq 30V, T_j=25^\circ C$ | | 130 | 300 | mV |
| | | $20V \leq V_i \leq 30V, T_j=25^\circ C$ | | 110 | 250 | |
| Input Bias Current | I_{IB} | $T_j=25^\circ C$ | | 4.4 | 6.5 | mA |
| | | $T_j=125^\circ C$ | | | 6.0 | |
| Input Bias Current Change | ΔI_{IB} | $20V \leq V_i \leq 30V$ | | | 1.5 | mA |
| | | $1mA \leq I_o \leq 40mA$ | | | 0.1 | |
| Output noise voltage | V_N | $10Hz \leq f \leq 100KHz, T_A=25^\circ C$ | | 90 | | μV |
| Ripple rejection | RR | $I_o=40mA, 18.5V \leq V_i \leq 28.5V, f=120Hz, T_j=25^\circ C$ | 34 | 39 | | dB |
| Dropout voltage | V_i-V_o | $T_j=25^\circ C$ | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS

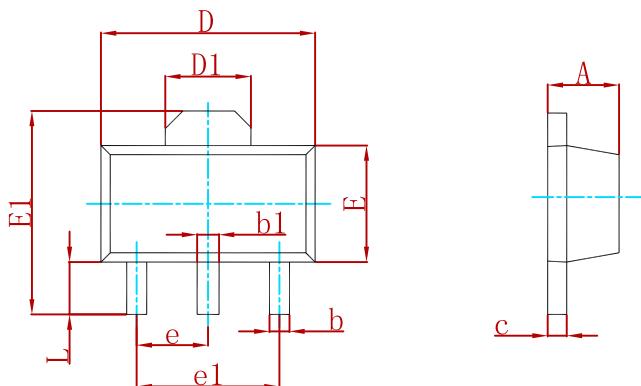
● **MS78L18**
(V_i=27V,I_O=40mA,0°C<T_j<125°C,C_I=0.33μF,C_O=0.1μf,unless otherwise specified)

| Parameter | Symbol | Test conditions | MS78L18 | | | UNIT |
|---------------------------|--------------------------------|--|----------------------|------------|----------------------|-------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V _O | T _j =25°C V _i =20.7V-33V, I _O =1mA-40mA V _i =27V, I _O =1mA-70mA | 17.3 17.1 17.1 | 18 | 18.7 18.9 18.9 | V |
| Load regulation | Reg _{load} | T _j =25°C, I _O =1mA-100mA T _j =25°C, I _O =1mA-40mA | | 30 15 | 170 85 | mV |
| Line regulation | Reg _{line} | 20.7V≤V _i ≤33V, T _j =25°C 21V≤V _i ≤33V, T _j =25°C | | 45 35 | 325 275 | mV |
| Input Bias Current | I _{IB} | T _j =25°C T _j =125°C | | 3.1 | 6.5 6.0 | mA |
| Input Bias Current Change | △I _{IB} | 21V≤V _i ≤33V 1mA≤I _O ≤40mA | | | 1.5 0.1 | mA |
| Output Noise Voltage | V _N | 10Hz≤f≤100KHz, T _A =25°C | | 150 | | μV |
| Ripple rejection | RR | I _O =40mA, 23V≤V _i ≤33V, f=120Hz, T _j =25°C | 33 | 48 | | dB |
| Dropout voltage | V _i -V _O | T _j =25°C | | 1.7 | | V |

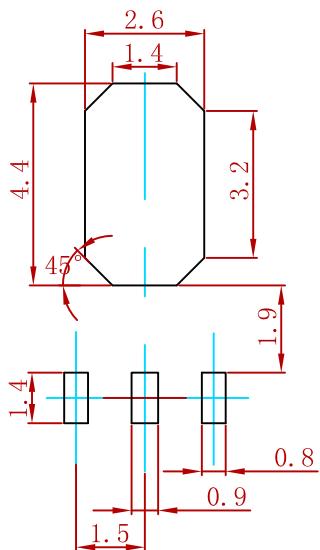
ELECTRICAL CHARACTERISTICS

● **MS78L24**
(V_{IS}=33V,I_O=40mA,0°C<T_j<125°C,C_I=0.33μF,C_O=0.1μf,unless otherwise specified)

| Parameter | Symbol | Test conditions | 78L24 | | | UNIT |
|---------------------------|--------------------------------|--|--------------------|------------|--------------------|-------------|
| | | | MIN | TYP | MAX | |
| Output voltage | V _O | T _j =25°C V _i =27V-38V, I _O =1mA-40mA V _i =27V-33V, I _O =1mA-70mA | 23 22.8 22.8 | 24 | 25 25.2 25.2 | V |
| Load regulation | △Reg _{load} | T _j =25°C, I _O =1mA-100mA T _j =25°C, I _O =1mA-40mA | | 40 20 | 200 100 | mV |
| Line regulation | △Reg _{line} | 28V≤V _i ≤80V, T _j =25°C 27V≤V _i ≤38V, T _j =25°C | | 50 60 | 300 350 | mV |
| Input Bias Current | I _{IB} | T _j =25°C T _j =125°C | | 3.1 | 6.5 6.0 | mA |
| Input Bias Current Change | △I _{IB} | 28V≤V _i ≤38V 1mA≤I _O ≤40mA | | | 1.5 0.1 | mA |
| Output noise voltage | V _N | 10Hz≤f≤100KHz, T _A =25°C | | 200 | | μV |
| Ripple rejection | RR | I _O =40mA, 29V≤V _i ≤35V, f=120Hz, T _j =25°C | 31 | 45 | | dB |
| Dropout voltage | V _i -V _O | T _j =25°C | | 1.7 | | V |

PACKAGE MECHANICAL DATA


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 1.400 | 1.600 | 0.055 | 0.063 |
| b | 0.320 | 0.520 | 0.013 | 0.020 |
| b1 | 0.400 | 0.580 | 0.016 | 0.023 |
| c | 0.350 | 0.440 | 0.014 | 0.017 |
| D | 4.400 | 4.600 | 0.173 | 0.181 |
| D1 | 1.550 | REF. | 0.061 | REF. |
| E | 2.300 | 2.600 | 0.091 | 0.102 |
| E1 | 3.940 | 4.250 | 0.155 | 0.167 |
| e | 1.500 | TYP. | 0.060 | TYP. |
| e1 | 3.000 | TYP. | 0.118 | TYP. |
| L | 0.900 | 1.200 | 0.035 | 0.047 |

Suggested Pad Layout

Note:

1. Controlling dimension: in millimeters.
2. General tolerance: ± 0.05 mm.
3. The pad layout is for reference purposes only.

REEL SPECIFICATION

| P/N | PKG | QTY |
|--------|--------|------|
| MS78XX | SOT-89 | 1000 |

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