



100 mA Negative Voltage Regulators

The MC79L00, A Series negative voltage regulators are inexpensive, easy-to-use devices suitable for numerous applications requiring up to 100 mA. Like the higher powered MC7900 Series negative regulators, this series features thermal shutdown and current limiting, making them remarkably rugged. In most applications, no external components are required for operation.

The MC79L00 devices are useful for on-card regulation or any other application where a regulated negative voltage at a modest current level is needed. These regulators offer substantial advantage over the common resistor/zener diode approach.

- No External Components Required
- Internal Short Circuit Current Limiting
- Internal Thermal Overload Protection
- Low Cost
- Complementary Positive Regulators Offered (MC78L00 Series)
- Available in Either $\pm 5\%$ (AC) or $\pm 10\%$ (C) Selections

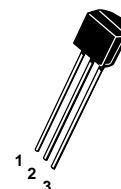
MC79L00, MC79L00A Series

THREE-TERMINAL LOW CURRENT NEGATIVE FIXED VOLTAGE REGULATORS

SEMICONDUCTOR TECHNICAL DATA

P SUFFIX
PLASTIC PACKAGE
CASE 29

- Pin 1. Ground
2. Input
3. Output

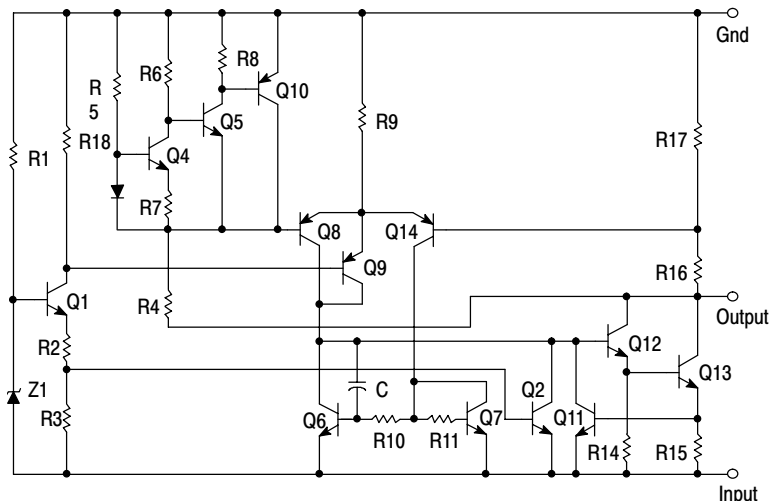


D SUFFIX
PLASTIC PACKAGE
CASE 751
(SOP-8)*

- Pin 1. V_{out} 5. GND
2. V_{in} 6. V_{in}
3. V_{in} 7. V_{in}
4. NC 8. NC

*SOP-8 is an internally modified SO-8 package. Pins 2, 3, 6, and 7 are electrically common to the die attach flag. This internal lead frame modification decreases package thermal resistance and increases power dissipation capability when appropriately mounted on a printed circuit board. SOP-8 conforms to all external dimensions of the standard SO-8 package.

Representative Schematic Diagram



* Automotive temperature range selections are available with special test conditions and additional tests in 5, 12 and 15 V devices. Contact your local ON Semiconductor sales office for information.

| Device No. $\pm 10\%$ | Device No. 5% | Nominal Voltage |
|--------------------------|------------------|--------------------|
| MC79L05C | MC79L05AC | -5.0 |
| MC79L12C | MC79L12AC | -12 |
| MC79L15C | MC79L15AC | -15 |
| MC79L18C | MC79L18AC | -18 |
| MC79L24C | MC79L24AC | -24 |

ORDERING INFORMATION

| Device | Operating Temperature Range | Package |
|-------------|---|---------------|
| MC79LXXACD* | $T_J = 0^\circ \text{ to } +125^\circ \text{C}$ | SOP-8 |
| MC79LXXACP | | Plastic Power |
| MC79LXXCP | | Plastic Power |
| MC79LXXABD* | $T_J = -40^\circ \text{ to } +125^\circ \text{C}$ | SOP-8 |
| MC79LXXABP* | | Plastic Power |

XX indicates nominal voltage

MC79L00, MC79L00A Series

MAXIMUM RATINGS (T_A = +25°C, unless otherwise noted.)

| Rating | Symbol | Value | Unit |
|--|------------------|-------------------|------|
| Input Voltage (-5 V) (-12, -15, -18 V) (-24 V) | V _I | -30 -35 -40 | Vdc |
| Storage Temperature Range | T _{stg} | -65 to +150 | °C |
| Junction Temperature | T _J | +150 | °C |

ELECTRICAL CHARACTERISTICS (V_I = -10 V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF, -40°C < T_J +125°C (for MC79LXXAB), 0°C < T_J < +125°C (for MC79LXXAC)).

| Characteristics | Symbol | MC79L05C, AB | | | MC79L05AC, AB | | | Unit |
|---|--------------------------------|--------------|------|--------------|----------------|------|----------------|------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Output Voltage (T _J = +25°C) | V _O | -4.6 | -5.0 | -5.4 | -4.8 | -5.0 | -5.2 | Vdc |
| Input Regulation (T _J = +25°C) -7.0 Vdc ≥ V _I ≥ -20 Vdc -8.0 Vdc ≥ V _I ≥ -20 Vdc | Reg _{line} | - | - | 200 150 | - | - | 150 100 | mV |
| Load Regulation T _J = +25°C, 1.0 mA ≤ I _O ≤ 100 mA 1.0 mA ≤ I _O ≤ 40 mA | Reg _{load} | - | - | 60 30 | - | - | 60 30 | mV |
| Output Voltage -7.0 Vdc ≥ V _I ≥ -20 Vdc, 1.0 mA ≤ I _O ≤ 40 mA V _I = -10 Vdc, 1.0 mA ≤ I _O ≤ 70 mA | V _O | -4.5 -4.5 | - | -5.5 -5.5 | -4.75 -4.75 | - | -5.25 -5.25 | Vdc |
| Input Bias Current (T _J = +25°C) (T _J = +125°C) | I _{IB} | - | - | 6.0 5.5 | - | - | 6.0 5.5 | mA |
| Input Bias Current Change -8.0 Vdc ≥ V _I ≥ -20 Vdc 1.0 mA ≤ I _O ≤ 40 mA | I _{IB} | - | - | 1.5 0.2 | - | - | 1.5 0.1 | mA |
| Output Noise Voltage (T _A = +25°C, 10 Hz ≤ f ≤ 100 kHz) | V _n | - | 40 | - | - | 40 | - | μV |
| Ripple Rejection (-8.0 ≥ V _I ≥ -18 Vdc, f = 120 Hz, T _J = +25°C) | RR | 40 | 49 | - | 41 | 49 | - | dB |
| Dropout Voltage (I _O = 40 mA, T _J = +25°C) | V _I -V _O | - | 1.7 | - | - | 1.7 | - | Vdc |

ELECTRICAL CHARACTERISTICS (V_I = -19 V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF, -40°C < T_J +125°C (for MC79LXXAC), 0°C < T_J < +125°C (for MC79LXXAB)).

| Characteristics | Symbol | MC79L12C, AB | | | MC79L12AC, AB | | | Unit |
|--|--------------------------------|----------------|-----|----------------|----------------|-----|----------------|------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Output Voltage (T _J = +25°C) | V _O | -11.1 | -12 | -12.9 | -11.5 | -12 | -12.5 | Vdc |
| Input Regulation (T _J = +25°C) -14.5 Vdc ≥ V _I ≥ -27 Vdc -16 Vdc ≥ V _I ≥ -27 Vdc | Reg _{line} | - | - | 250 200 | - | - | 250 200 | mV |
| Load Regulation T _J = +25°C, 1.0 mA ≤ I _O ≤ 100 mA 1.0 mA ≤ I _O ≤ 40 mA | Reg _{load} | - | - | 100 50 | - | - | 100 50 | mV |
| Output Voltage -14.5 Vdc ≥ V _I ≥ -27 Vdc, 1.0 mA ≤ I _O ≤ 40 mA V _I = -19 Vdc, 1.0 mA ≤ I _O ≤ 70 mA | V _O | -10.8 -10.8 | - | -13.2 -13.2 | -11.4 -11.4 | - | -12.6 -12.6 | Vdc |
| Input Bias Current (T _J = +25°C) (T _J = +125°C) | I _{IB} | - | - | 6.5 6.0 | - | - | 6.5 6.0 | mA |
| Input Bias Current Change -16 Vdc ≥ V _I ≥ -27 Vdc 1.0 mA ≤ I _O ≤ 40 mA | I _{IB} | - | - | 1.5 0.2 | - | - | 1.5 0.2 | mA |
| Output Noise Voltage (T _A = +25°C, 10 Hz ≤ f ≤ 100 kHz) | V _n | - | 80 | - | - | 80 | - | μV |
| Ripple Rejection (-15 ≤ V _I ≤ -25 Vdc, f = 120 Hz, T _J = +25°C) | RR | 36 | 42 | - | 37 | 42 | - | dB |
| Dropout Voltage (I _O = 40 mA, T _J = +25°C) | V _I -V _O | - | 1.7 | - | - | 1.7 | - | Vdc |

MC79L00, MC79L00A Series

ELECTRICAL CHARACTERISTICS ($V_I = -23\text{ V}$, $I_O = 40\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, $-40^\circ\text{C} < T_J < +125^\circ\text{C}$ (for MC79LXXAB), $0^\circ\text{C} < T_J < +125^\circ\text{C}$ (for MC79LXXAC)).

| Characteristics | Symbol | MC79L15C | | | MC79L15AC, AB | | | Unit |
|--|----------------------------|----------------|-----|----------------|------------------|-----|------------------|---------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Output Voltage ($T_J = +25^\circ\text{C}$) | V_O | -13.8 | -15 | -16.2 | -14.4 | -15 | -15.6 | Vdc |
| Input Regulation ($T_J = +25^\circ\text{C}$) $-17.5\text{ Vdc} \geq V_I \geq -30\text{ Vdc}$ $-20\text{ Vdc} \geq V_I \geq -30\text{ Vdc}$ | Reg_{line} | - | - | 300 250 | - | - | 300 250 | mV |
| Load Regulation $T_J = +25^\circ\text{C}$, $1.0\text{ mA} \leq I_O \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ | Reg_{load} | - | - | 150 75 | - | - | 150 75 | mV |
| Output Voltage $-17.5\text{ Vdc} \geq V_I \geq -\text{Vdc}$, $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ $V_I = -23\text{ Vdc}$, $1.0\text{ mA} \leq I_O \leq 70\text{ mA}$ | V_O | -13.5 -13.5 | - | -16.5 -16.5 | -14.25 -14.25 | - | -15.75 -15.75 | Vdc |
| Input Bias Current ($T_J = +25^\circ\text{C}$) ($T_J = +125^\circ\text{C}$) | I_{IB} | - | - | 6.5 6.0 | - | - | 6.5 6.0 | mA |
| Input Bias Current Change $-20\text{ Vdc} \geq V_I \geq -30\text{ Vdc}$ $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ | ΔI_{IB} | - | - | 1.5 0.2 | - | - | 1.5 0.1 | mA |
| Output Noise Voltage ($T_A = +25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$) | V_N | - | 90 | - | - | 90 | - | μV |
| Ripple Rejection ($-18.5 \leq V_I \leq -28.5\text{ Vdc}$, $f = 120\text{ Hz}$) | RR | 33 | 39 | - | 34 | 39 | - | dB |
| Dropout Voltage $I_O = 40\text{ mA}$, $T_J = +25^\circ\text{C}$ | $ V_I - V_O $ | - | 1.7 | - | - | 1.7 | - | Vdc |

ELECTRICAL CHARACTERISTICS ($V_I = -27\text{ V}$, $I_O = 40\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} < T_J < +125^\circ\text{C}$, unless otherwise noted).

| Characteristics | Symbol | MC79L18C | | | MC79L18AC | | | Unit |
|---|----------------------------|---------------------|-----|------------|------------|-----|----------------------|---------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Output Voltage ($T_J = +25^\circ\text{C}$) | V_O | -16.6 | -18 | -19.4 | -17.3 | -18 | -18.7 | Vdc |
| Input Regulation ($T_J = +25^\circ\text{C}$) $-20.7\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$ $-21.4\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$ $-22\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$ $-21\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$ | Reg_{line} | - | - | - | - | - | 325 - - 275 | mV |
| Load Regulation $T_J = +25^\circ\text{C}$, $1.0\text{ mA} \leq I_O \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ | Reg_{load} | - | - | 170 85 | - | - | 170 85 | mV |
| Output Voltage $-20.7\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$, $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ $-21.4\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$, $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ $V_I = -27\text{ Vdc}$, $1.0\text{ mA} \leq I_O \leq 70\text{ mA}$ | V_O | - -16.2 -16.2 | - | - | -17.1 - | - | -18.9 - -18.9 | Vdc |
| Input Bias Current ($T_J = +25^\circ\text{C}$) ($T_J = +125^\circ\text{C}$) | I_{IB} | - | - | 6.5 6.0 | - | - | 6.5 6.0 | mA |
| Input Bias Current Change $-21\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$ $-27\text{ Vdc} \geq V_I \geq -33\text{ Vdc}$ $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ | I_{IB} | - | - | - | - | - | 1.5 - 0.1 | mA |
| Output Noise Voltage ($T_A = +25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$) | V_n | - | 150 | - | - | 150 | - | μV |
| Ripple Rejection ($-23 \leq V_I \leq -33\text{ Vdc}$, $f = 120\text{ Hz}$, $T_J = +25^\circ\text{C}$) | RR | 32 | 46 | - | 33 | 48 | - | dB |
| Dropout Voltage $I_O = 40\text{ mA}$, $T_J = +25^\circ\text{C}$ | $ V_I - V_O $ | - | 1.7 | - | - | 1.7 | - | Vdc |

MC79L00, MC79L00A Series

ELECTRICAL CHARACTERISTICS ($V_I = -33\text{ V}$, $I_O = 40\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} < T_J < +125^\circ\text{C}$, unless otherwise noted).

| Characteristics | Symbol | MC79L24C | | | MC79L24AC | | | Unit |
|---|----------------------------|----------|-----|-------|-----------|-----|-------|---------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Output Voltage ($T_J = +25^\circ\text{C}$) | V_O | -22.1 | -24 | -25.9 | -23 | -24 | -25 | Vdc |
| Input Regulation ($T_J = +25^\circ\text{C}$) $-27\text{ Vdc} \geq V_I \geq -38\text{ Vdc}$ $-27.5\text{ Vdc} \geq V_I \geq -38\text{ Vdc}$ $-28\text{ Vdc} \geq V_I \geq -38\text{ Vdc}$ | Reg_{line} | - | - | - | - | - | 350 | mV |
| Load Regulation $T_J = +25^\circ\text{C}$, $1.0\text{ mA} \leq I_O \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ | Reg_{load} | - | - | 200 | - | - | 200 | mV |
| Output Voltage $-27\text{ Vdc} \geq V_I \geq -38\text{ V}$, $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ $-28\text{ Vdc} \geq V_I \geq -38\text{ Vdc}$, $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ $V_I = -33\text{ Vdc}$, $1.0\text{ mA} \leq I_O \leq 70\text{ mA}$ | V_O | - | - | - | -22.8 | - | -25.2 | Vdc |
| Input Bias Current ($T_J = +25^\circ\text{C}$) ($T_J = +125^\circ\text{C}$) | I_{IB} | - | - | 6.5 | - | - | 6.5 | mA |
| Input Bias Current Change $-28\text{ Vdc} \geq V_I \geq -38\text{ Vdc}$ $1.0\text{ mA} \leq I_O \leq 40\text{ mA}$ | ΔI_{IB} | - | - | 1.5 | - | - | 1.5 | mA |
| Output Noise Voltage ($T_A = +25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$) | V_n | - | 200 | - | - | 200 | - | μV |
| Ripple Rejection ($-29 \leq V_I \leq -35\text{ Vdc}$, $f = 120\text{ Hz}$, $T_J = +25^\circ\text{C}$) | RR | 30 | 43 | - | 31 | 47 | - | dB |
| Dropout Voltage $I_O = 40\text{ mA}$, $T_J = +25^\circ\text{C}$ | $ V_I - V_O $ | - | 1.7 | - | - | 1.7 | - | Vdc |

APPLICATIONS INFORMATION

Design Considerations

The MC79L00, A Series of fixed voltage regulators are designed with Thermal Overload Protections that shuts down the circuit when subjected to an excessive power overload condition, Internal Short Circuit Protection that limits the maximum current the circuit will pass.

In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire length, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good

high-frequency characteristics to insure stable operation under all load conditions. A $0.33\text{ }\mu\text{F}$ or larger tantalum, mylar, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulator's input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead. Bypassing the output is also recommended.

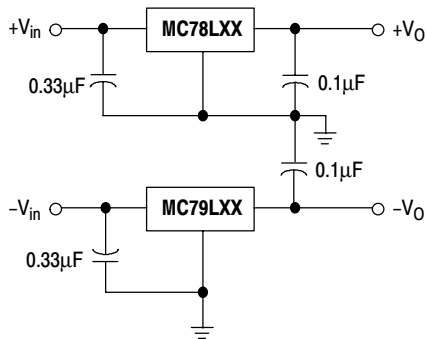
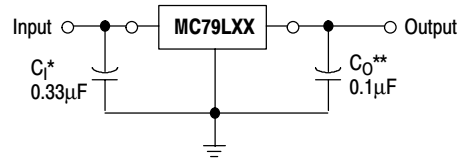


Figure 1. Positive and Negative Regulator



A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0 V above the output voltage even during the low point on the ripple voltage.

* C_I is required if regulator is located an appreciable distance from the power supply filter

** C_O improves stability and transient response.

Figure 2. Standard Application

MC79L00, MC79L00A Series

TYPICAL CHARACTERISTICS

($T_A = +25^\circ\text{C}$, unless otherwise noted.)

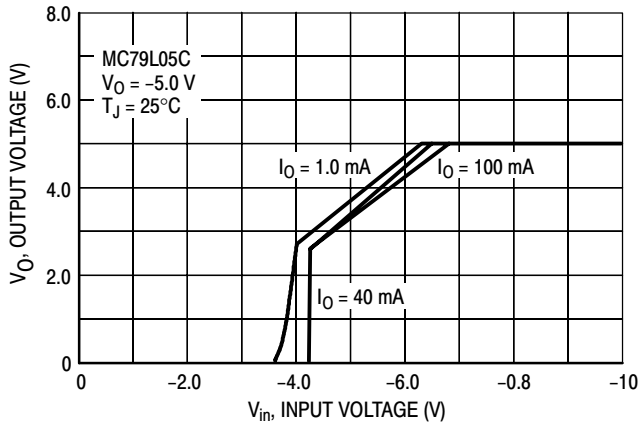


Figure 3. Dropout Characteristics

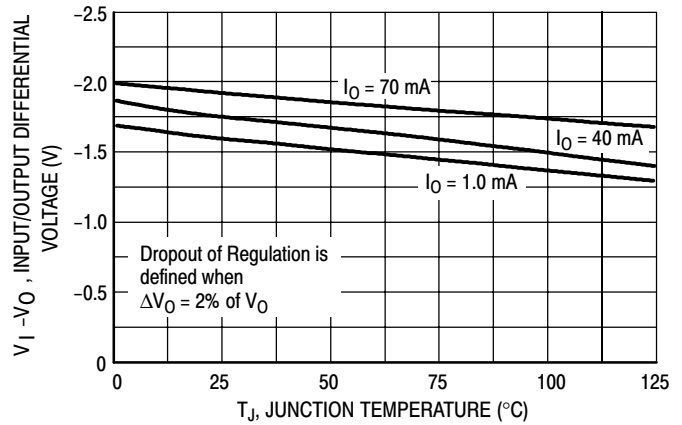


Figure 4. Dropout Voltage versus Junction Temperature

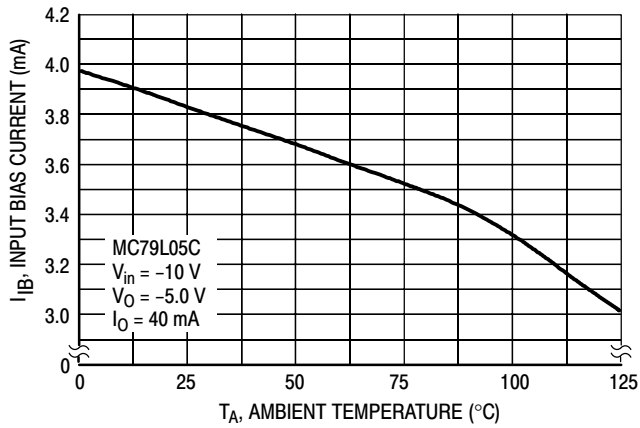


Figure 5. Input Bias Current versus Ambient Temperature

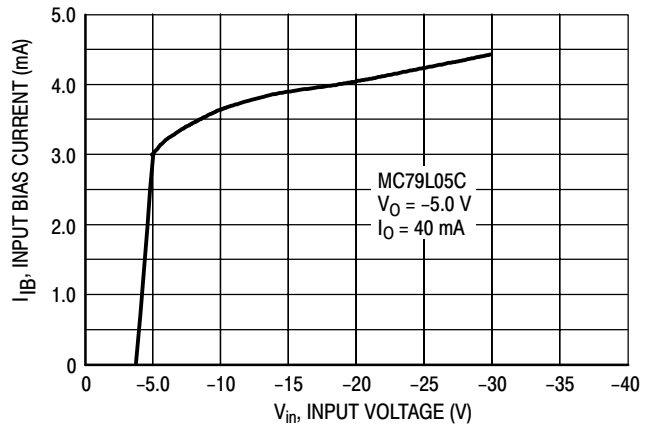


Figure 6. Input Bias Current versus Input Voltage

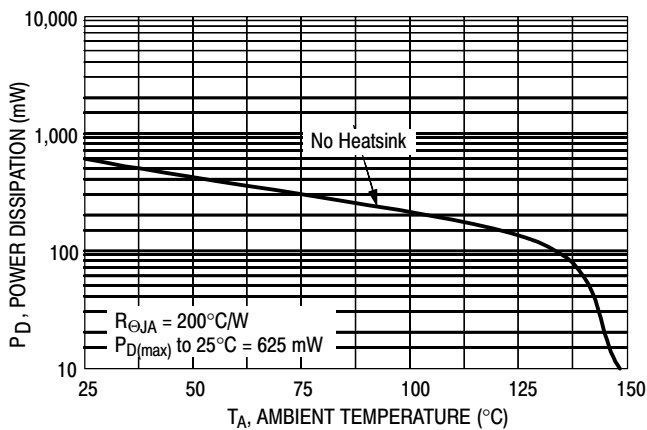


Figure 7. Maximum Average Power Dissipation versus Ambient Temperature (TO-92)

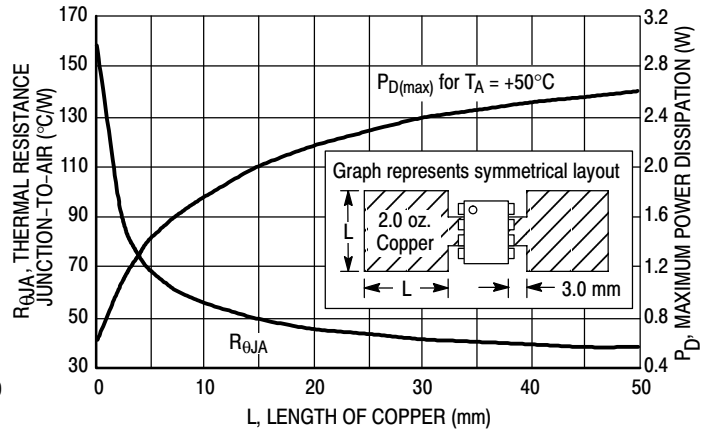
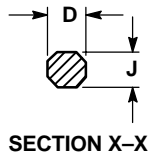
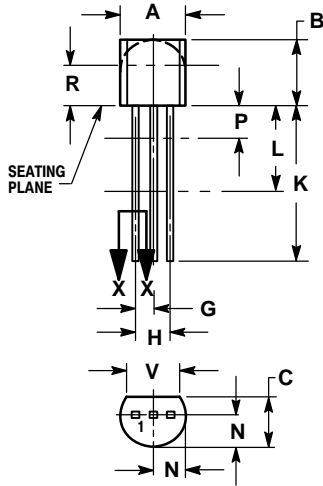


Figure 8. SOP-8 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

MC79L00, MC79L00A Series

PACKAGE DIMENSIONS

P SUFFIX
 PLASTIC PACKAGE
 CASE 29-11
 ISSUE AL



NOTES:

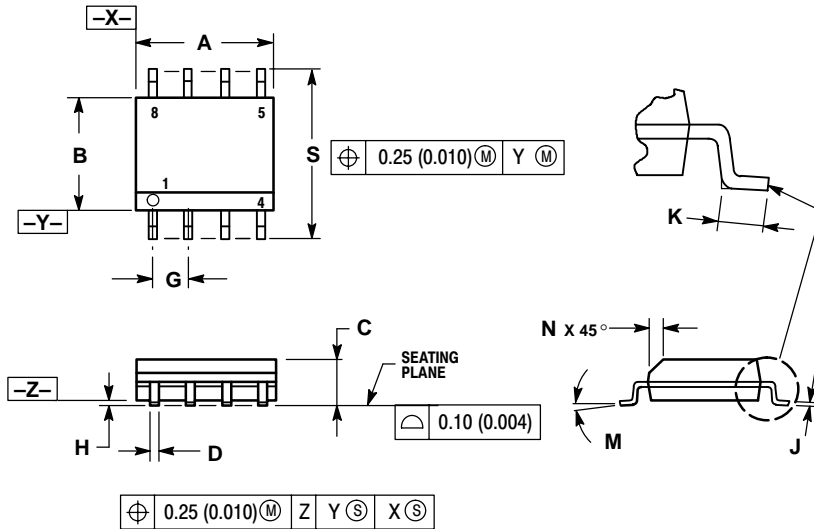
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.45 | 5.20 |
| B | 0.170 | 0.210 | 4.32 | 5.33 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.016 | 0.021 | 0.407 | 0.533 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.015 | 0.020 | 0.39 | 0.50 |
| K | 0.500 | ---- | 12.70 | ---- |
| L | 0.250 | ---- | 6.35 | ---- |
| N | 0.080 | 0.105 | 2.04 | 2.66 |
| P | ---- | 0.100 | ---- | 2.54 |
| R | 0.115 | ---- | 2.93 | ---- |
| V | 0.135 | ---- | 3.43 | ---- |

MC79L00, MC79L00A Series

PACKAGE DIMENSIONS

D SUFFIX
 PLASTIC PACKAGE
 CASE 751-07
 ISSUE W




NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0° | 8° | 0° | 8° |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

MC79L00, MC79L00A Series

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

PUBLICATION ORDERING INFORMATION

Literature Fulfillment:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

JAPAN: ON Semiconductor, Japan Customer Focus Center
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031
Phone: 81-3-5740-2700
Email: r14525@onsemi.com

ON Semiconductor Website: <http://onsemi.com>

For additional information, please contact your local Sales Representative.