

## 100 mA POSITIVE VOLTAGE REGULATORS

- Wide range of Fixed Output Voltages
- Output Current up to 100 mA
- No External Components Required
- Internal Thermal Overload Protection
- Internal Short Circuit Current-Limiting
- Available in TO-92, SOT-89 and SOP-8 packages

The GM78L00 series of positive voltage regulators are low-cost devices providing a simple solution for a wide variety of applications requiring a regulated supply of up to 100mA.

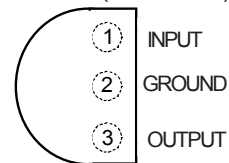
These virtually indestructible positive voltage regulators are protected by thermal shutdown and internal current-limiting. Most applications require no external components.

The GM78L00's are very versatile. Use them as fixed voltage regulators in a wide range of applications, including local on-card regulation for elimination of noise and distribution problems associated with single-point regulation. They can also be used with power pass elements to make high current voltage regulators.

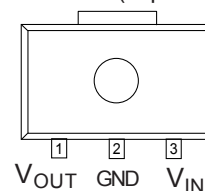
The GM78L00's offer impressive performance advantages over old-fashioned zener diode-resistor combinations, providing lower output impedance and reduced quiescent current, along with lower noise.

### PIN CONFIGURATIONS

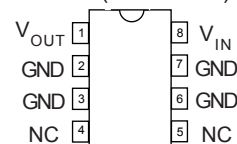
TO-92 (TOP VIEW)



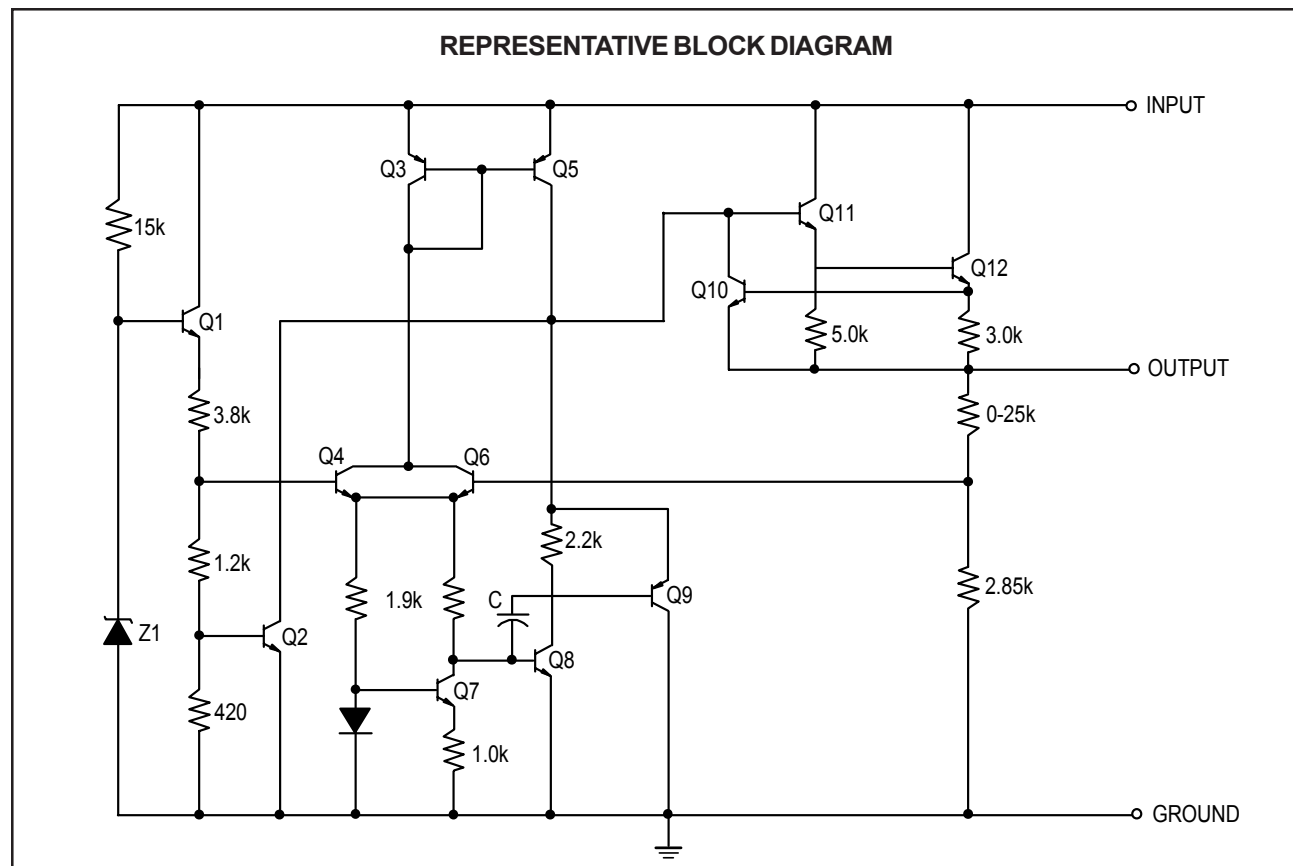
SOT-89 (Top View)



SOP-8 (TOP VIEW)



### REPRESENTATIVE BLOCK DIAGRAM



# 100 mA POSITIVE VOLTAGE REGULATORS

## ■ ELECTRICAL CHARACTERISTICS GM78L05

$T_A = 0^\circ\text{C}$  to  $125^\circ\text{C}$ ,  $V_I=10\text{V}$ ,  $I_O=40\text{mA}$ ,  $C_I=0.33\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS         | SYMBOL                    | TEST CONDITIONS                                                                   | MIN  | TYP | MAX  | UNIT          |
|-------------------------|---------------------------|-----------------------------------------------------------------------------------|------|-----|------|---------------|
| Output Voltage          | $V_O$                     | $T_J=25^\circ\text{C}$                                                            | 4.8  | 5.0 | 5.2  | V             |
| Line Regulation         | $V_{R\text{ LINE}}$       | $T_J=25^\circ\text{C}$ , $7\text{V} \leq V_I \leq 20\text{V}$                     |      | 32  | 150  | mV            |
|                         |                           | $T_J=25^\circ\text{C}$ , $8\text{V} \leq V_I \leq 20\text{V}$                     |      | 26  | 100  |               |
| Load Regulation         | $V_{R\text{ LOAD}}$       | $T_J=25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                  |      | 11  | 60   | mV            |
|                         |                           | $T_J=25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                   |      | 5   | 30   |               |
| Output Voltage (Note 2) | $V_O$                     | $7\text{V} \leq V_I \leq 20\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$     | 4.75 | 5   | 5.25 | V             |
|                         |                           | $7\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$ | 4.75 | 5   | 5.25 |               |
| Quiscent Current        | $I_Q$                     | $T_J=25^\circ\text{C}$                                                            |      | 3.8 | 6.0  | mA            |
| Quiscent Current Change | $\Delta I_Q$              | (with Line) $8\text{V} \leq V_I \leq 20\text{V}$                                  |      |     | 1.5  | mA            |
|                         |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                |      |     | 0.1  |               |
| Noise                   | $N_O$                     | $T_A=25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                  |      | 42  |      | $\mu\text{V}$ |
| Ripple Rejection        | $\Delta V_I / \Delta V_O$ | $T_J=25^\circ\text{C}$ , $f=120\text{kHz}$ , $8\text{V} \leq V_I \leq 18\text{V}$ | 41   | 49  |      | dB            |
| Dropout Voltage         | $V_{DO}$                  | $T_J=25^\circ\text{C}$                                                            |      | 1.7 |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

## ■ ELECTRICAL CHARACTERISTICS GM78L06

$T_A = 0^\circ\text{C}$  to  $125^\circ\text{C}$ ,  $V_I=11\text{V}$ ,  $I_O=40\text{mA}$ ,  $C_I=0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS         | SYMBOL                    | TEST CONDITIONS                                                                   | MIN  | TYP | MAX  | UNIT          |
|-------------------------|---------------------------|-----------------------------------------------------------------------------------|------|-----|------|---------------|
| Output Voltage          | $V_O$                     | $T_J=25^\circ\text{C}$                                                            | 5.75 | 6.0 | 6.25 | V             |
| Line Regulation         | $V_{R\text{ LINE}}$       | $T_J=25^\circ\text{C}$ , $8.0\text{V} \leq V_I \leq 20\text{V}$                   |      | 35  | 175  | mV            |
|                         |                           | $T_J=25^\circ\text{C}$ , $9.0\text{V} \leq V_I \leq 20\text{V}$                   |      | 29  | 125  |               |
| Load Regulation         | $V_{R\text{ LOAD}}$       | $T_J=25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                  |      | 16  | 80   | mV            |
|                         |                           | $T_J=25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                   |      | 9   | 40   |               |
| Output Voltage (Note 2) | $V_O$                     | $8\text{V} \leq V_I \leq 20\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$     | 5.7  | 6   | 6.3  | V             |
|                         |                           | $8\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$ | 5.7  | 6   | 6.3  |               |
| Quiscent Current        | $I_Q$                     | $T_J=25^\circ\text{C}$                                                            |      | 3.9 | 6.0  | mA            |
| Quiscent Current Change | $\Delta I_Q$              | (with Line) $9\text{V} \leq V_I \leq 20\text{V}$                                  |      |     | 1.5  | mA            |
|                         |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                |      |     | 0.1  |               |
| Noise                   | $N_O$                     | $T_A=25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                  |      | 46  |      | $\mu\text{V}$ |
| Ripple Rejection        | $\Delta V_I / \Delta V_O$ | $T_J=25^\circ\text{C}$ , $f=120\text{kHz}$ , $9\text{V} \leq V_I \leq 19\text{V}$ | 40   | 48  |      | dB            |
| Dropout Voltage         | $V_{DO}$                  | $T_J=25^\circ\text{C}$                                                            |      | 1.7 |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**100 mA POSITIVE VOLTAGE REGULATORS**
**■ ELECTRICAL CHARACTERISTICS GM78L08**
 $T_A = 0^\circ\text{C to } 125^\circ\text{C}$ ,  $V_I = 14\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS         | SYMBOL                    | TEST CONDITIONS                                                                        | MIN | TYP | MAX | UNIT          |
|-------------------------|---------------------------|----------------------------------------------------------------------------------------|-----|-----|-----|---------------|
| Output Voltage          | $V_O$                     | $T_J = 25^\circ\text{C}$                                                               | 7.7 | 8.0 | 8.3 | V             |
| Line Regulation         | $V_{R\text{ LINE}}$       | $T_J = 25^\circ\text{C}$ , $11\text{V} \leq V_I \leq 23\text{V}$                       |     | 42  | 175 | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $12\text{V} \leq V_I \leq 23\text{V}$                       |     | 36  | 125 |               |
| Load Regulation         | $V_{R\text{ LOAD}}$       | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                     |     | 18  | 80  | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                      |     | 10  | 40  |               |
| Output Voltage (Note 2) | $V_O$                     | $11\text{V} \leq V_I \leq 23\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$         | 7.6 | 8   | 8.4 | V             |
|                         |                           | $11\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$     | 7.6 | 8   | 8.4 |               |
| Quiscent Current        | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                               |     | 4   | 6   | mA            |
| Quiscent Current Change | $\Delta I_Q$              | (with Line) $12\text{V} \leq V_I \leq 23\text{V}$                                      |     |     | 1.5 | mA            |
|                         |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                     |     |     | 0.1 |               |
| Noise                   | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                     |     | 54  |     | $\mu\text{V}$ |
| Ripple Rejection        | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $12\text{V} \leq V_I \leq 22\text{V}$ | 37  | 46  |     | dB            |
| Dropout Voltage         | $V_{DO}$                  | $T_J = 25^\circ\text{C}$                                                               |     | 1.7 |     | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**■ ELECTRICAL CHARACTERISTICS GM78L09**
 $T_A = 0^\circ\text{C to } 125^\circ\text{C}$ ,  $V_I = 16\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS         | SYMBOL                    | TEST CONDITIONS                                                                        | MIN  | TYP | MAX  | UNIT          |
|-------------------------|---------------------------|----------------------------------------------------------------------------------------|------|-----|------|---------------|
| Output Voltage          | $V_O$                     | $T_J = 25^\circ\text{C}$                                                               | 8.6  | 9.0 | 9.4  | V             |
| Line Regulation         | $V_{R\text{ LINE}}$       | $T_J = 25^\circ\text{C}$ , $12\text{V} \leq V_I \leq 24\text{V}$                       |      | 45  | 175  | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $13\text{V} \leq V_I \leq 24\text{V}$                       |      | 40  | 125  |               |
| Load Regulation         | $V_{R\text{ LOAD}}$       | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                     |      | 19  | 90   | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                      |      | 11  | 40   |               |
| Output Voltage (Note 2) | $V_O$                     | $12\text{V} \leq V_I \leq 24\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$         | 8.55 | 9.0 | 9.45 | V             |
|                         |                           | $12\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$     | 8.55 | 9.0 | 9.45 |               |
| Quiscent Current        | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                               |      | 4.1 | 6.0  | mA            |
| Quiscent Current Change | $\Delta I_Q$              | (with Line) $13\text{V} \leq V_I \leq 24\text{V}$                                      |      |     | 1.5  | mA            |
|                         |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                     |      |     | 0.1  |               |
| Noise                   | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                     |      | 58  |      | $\mu\text{V}$ |
| Ripple Rejection        | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $15\text{V} \leq V_I \leq 25\text{V}$ | 38   | 45  |      | dB            |
| Dropout Voltage         | $V_{DO}$                  | $T_J = 25^\circ\text{C}$                                                               |      | 1.7 |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**100 mA POSITIVE VOLTAGE REGULATORS**
**■ ELECTRICAL CHARACTERISTICS GM78L10**
 $T_A = 0^\circ\text{C to } 125^\circ\text{C}$ ,  $V_I = 17\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS         | SYMBOL                    | TEST CONDITIONS                                                                        | MIN | TYP | MAX  | UNIT          |
|-------------------------|---------------------------|----------------------------------------------------------------------------------------|-----|-----|------|---------------|
| Output Voltage          | $V_O$                     | $T_J = 25^\circ\text{C}$                                                               | 9.6 | 10  | 10.4 | V             |
| Line Regulation         | $V_{R\text{ LINE}}$       | $T_J = 25^\circ\text{C}$ , $13\text{V} \leq V_I \leq 24\text{V}$                       |     | 51  | 175  | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $14\text{V} \leq V_I \leq 24\text{V}$                       |     | 42  | 125  |               |
| Load Regulation         | $V_{R\text{ LOAD}}$       | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                     |     | 22  | 100  | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                      |     | 13  | 50   |               |
| Output Voltage (Note 2) | $V_O$                     | $13\text{V} \leq V_I \leq 24\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$         | 9.5 | 10  | 10.5 | V             |
|                         |                           | $13\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$     | 9.5 | 10  | 10.5 |               |
| Quiscent Current        | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                               |     | 4.3 | 6.5  | mA            |
| Quiscent Current Change | $\Delta I_Q$              | (with Line) $14\text{V} \leq V_I \leq 24\text{V}$                                      |     |     | 1.5  | mA            |
|                         |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                     |     |     | 0.1  |               |
| Noise                   | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                     |     | 62  |      | $\mu\text{V}$ |
| Ripple Rejection        | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $16\text{V} \leq V_I \leq 27\text{V}$ | 37  | 44  |      | dB            |
| Dropout Voltage         | $V_{DO}$                  | $T_J = 25^\circ\text{C}$                                                               |     | 1.7 |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**■ ELECTRICAL CHARACTERISTICS GM78L12**
 $T_A = 0^\circ\text{C to } 125^\circ\text{C}$ ,  $V_I = 19\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS         | SYMBOL                    | TEST CONDITIONS                                                                        | MIN  | TYP  | MAX  | UNIT          |
|-------------------------|---------------------------|----------------------------------------------------------------------------------------|------|------|------|---------------|
| Output Voltage          | $V_O$                     | $T_J = 25^\circ\text{C}$                                                               | 11.5 | 12.0 | 12.5 | V             |
| Line Regulation         | $V_{R\text{ LINE}}$       | $T_J = 25^\circ\text{C}$ , $14.5\text{V} \leq V_I \leq 27\text{V}$                     |      | 55   | 250  | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $16\text{V} \leq V_I \leq 27\text{V}$                       |      | 49   | 200  |               |
| Load Regulation         | $V_{R\text{ LOAD}}$       | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                     |      | 22   | 100  | mV            |
|                         |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                      |      | 13   | 50   |               |
| Output Voltage (Note 2) | $V_O$                     | $14.5\text{V} \leq V_I \leq 27\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$       | 11.4 | 12   | 12.6 | V             |
|                         |                           | $14.5\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$   | 11.4 | 12   | 12.6 |               |
| Quiscent Current        | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                               |      | 4.3  | 6.5  | mA            |
| Quiscent Current Change | $\Delta I_Q$              | (with Line) $16\text{V} \leq V_I \leq 27\text{V}$                                      |      |      | 1.5  | mA            |
|                         |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                     |      |      | 0.1  |               |
| Noise                   | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                     |      | 70   |      | $\mu\text{V}$ |
| Ripple Rejection        | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $15\text{V} \leq V_I \leq 25\text{V}$ | 37   | 42   |      | dB            |
| Dropout Voltage         | $V_{DO}$                  | $T_J = 25^\circ\text{C}$                                                               |      | 1.7  |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**100 mA POSITIVE VOLTAGE REGULATORS**
**■ ELECTRICAL CHARACTERISTICS GM78L15**

$T_A = 0^\circ\text{C}$  to  $125^\circ\text{C}$ ,  $V_I = 23\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS            | SYMBOL                    | TEST CONDITIONS                                                                            | MIN   | TYP  | MAX   | UNIT          |
|----------------------------|---------------------------|--------------------------------------------------------------------------------------------|-------|------|-------|---------------|
| Output Voltage             | $V_O$                     | $T_J = 25^\circ\text{C}$                                                                   | 14.4  | 15.0 | 15.6  | V             |
| Line Regulation            | $V_{R\text{LINE}}$        | $T_J = 25^\circ\text{C}$ , $17.5\text{V} \leq V_I \leq 30\text{V}$                         |       | 65   | 300   | mV            |
|                            |                           | $T_J = 25^\circ\text{C}$ , $20\text{V} \leq V_I \leq 30\text{V}$                           |       | 58   | 250   |               |
| Load Regulation            | $V_{R\text{LOAD}}$        | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                         |       | 25   | 150   | mV            |
|                            |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                          |       | 15   | 75    |               |
| Output Voltage<br>(Note 2) | $V_O$                     | $17.5\text{V} \leq V_I \leq 30\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$           | 14.25 | 15   | 15.75 | V             |
|                            |                           | $17.5\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$       | 14.25 | 15   | 15.75 |               |
| Quiscent Current           | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                                   |       | 4.7  | 6.5   | mA            |
| Quiscent Current Change    | $\Delta I_Q$              | (with Line) $20\text{V} \leq V_I \leq 30\text{V}$                                          |       |      | 1.5   | mA            |
|                            |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                         |       |      | 0.1   |               |
| Noise                      | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                         |       | 82   |       | $\mu\text{V}$ |
| Ripple Rejection           | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $18.5\text{V} \leq V_I \leq 28.5\text{V}$ | 34    | 39   |       | dB            |
| Dropout Voltage            | $V_{\text{DO}}$           | $T_J = 25^\circ\text{C}$                                                                   |       | 1.7  |       | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**■ ELECTRICAL CHARACTERISTICS GM78L18**

$T_A = 0^\circ\text{C}$  to  $125^\circ\text{C}$ ,  $V_I = 26\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS            | SYMBOL                    | TEST CONDITIONS                                                                            | MIN  | TYP  | MAX  | UNIT          |
|----------------------------|---------------------------|--------------------------------------------------------------------------------------------|------|------|------|---------------|
| Output Voltage             | $V_O$                     | $T_J = 25^\circ\text{C}$                                                                   | 17.3 | 18.0 | 18.7 | V             |
| Line Regulation            | $V_{R\text{LINE}}$        | $T_J = 25^\circ\text{C}$ , $20.5\text{V} \leq V_I \leq 33\text{V}$                         |      | 70   | 360  | mV            |
|                            |                           | $T_J = 25^\circ\text{C}$ , $22\text{V} \leq V_I \leq 33\text{V}$                           |      | 64   | 300  |               |
| Load Regulation            | $V_{R\text{LOAD}}$        | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                         |      | 27   | 180  | mV            |
|                            |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                          |      | 19   | 90   |               |
| Output Voltage<br>(Note 2) | $V_O$                     | $20.5\text{V} \leq V_I \leq 30\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$           | 17.1 | 18   | 18.9 | V             |
|                            |                           | $20.5\text{V} \leq V_I \leq V_{\text{MAX}}$ , $1\text{mA} \leq I_O \leq 70\text{mA}$       | 17.1 | 18   | 18.9 |               |
| Quiscent Current           | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                                   |      | 4.7  | 6.5  | mA            |
| Quiscent Current Change    | $\Delta I_Q$              | (with Line) $22\text{V} \leq V_I \leq 33\text{V}$                                          |      |      | 1.5  | mA            |
|                            |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                         |      |      | 0.1  |               |
| Noise                      | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                         |      | 89   |      | $\mu\text{V}$ |
| Ripple Rejection           | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $21.5\text{V} \leq V_I \leq 31.5\text{V}$ | 32   | 36   |      | dB            |
| Dropout Voltage            | $V_{\text{DO}}$           | $T_J = 25^\circ\text{C}$                                                                   |      | 1.7  |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**100 mA POSITIVE VOLTAGE REGULATORS**
**■ ELECTRICAL CHARACTERISTICS GM78L24**

$T_A = 0^\circ\text{C}$  to  $125^\circ\text{C}$ ,  $V_I = 32\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified (Note 1)

| CHARACTERISTICS            | SYMBOL                    | TEST CONDITIONS                                                                            | MIN  | TYP | MAX  | UNIT          |
|----------------------------|---------------------------|--------------------------------------------------------------------------------------------|------|-----|------|---------------|
| Output Voltage             | $V_O$                     | $T_J = 25^\circ\text{C}$                                                                   | 23   | 24  | 25   | V             |
| Line Regulation            | $V_{R\text{ LINE}}$       | $T_J = 25^\circ\text{C}$ , $26.5\text{V} \leq V_I \leq 39\text{V}$                         |      | 95  | 480  | mV            |
|                            |                           | $T_J = 25^\circ\text{C}$ , $29\text{V} \leq V_I \leq 39\text{V}$                           |      | 78  | 400  |               |
| Load Regulation            | $V_{R\text{ LOAD}}$       | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 100\text{mA}$                         |      | 41  | 240  | mV            |
|                            |                           | $T_J = 25^\circ\text{C}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$                          |      | 28  | 120  |               |
| Output Voltage<br>(Note 2) | $V_O$                     | $26.5\text{V} \leq V_I \leq 39\text{V}$ , $1\text{mA} \leq I_O \leq 40\text{mA}$           | 22.8 | 24  | 25.2 | V             |
|                            |                           | $26.5\text{V} \leq V_I \leq V_{\text{MAX}}^*$ , $1\text{mA} \leq I_O \leq 70\text{mA}$     | 22.8 | 24  | 25.2 |               |
| Quiscent Current           | $I_Q$                     | $T_J = 25^\circ\text{C}$                                                                   |      | 4.8 | 6.5  | mA            |
| Quiscent Current Change    | $\Delta I_Q$              | (with Line) $22\text{V} \leq V_I \leq 33\text{V}$                                          |      |     | 1.5  | mA            |
|                            |                           | (with Load) $1\text{mA} \leq I_O \leq 40\text{mA}$                                         |      |     | 0.1  |               |
| Noise                      | $N_O$                     | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 100\text{kHz}$                         |      | 97  |      | $\mu\text{V}$ |
| Ripple Rejection           | $\Delta V_I / \Delta V_O$ | $T_J = 25^\circ\text{C}$ , $f = 120\text{kHz}$ , $27.5\text{V} \leq V_I \leq 37.5\text{V}$ | 30   | 33  |      | dB            |
| Dropout Voltage            | $V_{\text{DO}}$           | $T_J = 25^\circ\text{C}$                                                                   |      | 1.7 |      | V             |

**Note 1:** The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.

**Note 2:** Power Dissipation  $\leq 0.75\text{W}$ .

**■ ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                            | SYMBOL           | VALUE              | UNITS            |
|--------------------------------------|------------------|--------------------|------------------|
| Input Voltage (5.0 to 15V)           | $V_I$            | 35                 | V                |
| Power Dissipation                    | $P_D$            | internally limited | W                |
| Operating Junction Temperature Range | $T_J$            | 0 to +125          | $^\circ\text{C}$ |
| Storage Temperature Range            | $T_{\text{stg}}$ | -65 to +150        | $^\circ\text{C}$ |
| Lead Temperature (soldering 10sec.)  | $T_L$            | 265                | $^\circ\text{C}$ |

## 100 mA POSITIVE VOLTAGE REGULATORS

### ■ APPLICATION INFORMATION

#### Design Considerations

The GM78L series regulators have thermal overload protection from excessive power, internal short-circuit protection which limits each circuit's maximum current, and output transistor safe-area protection for reducing the output current as the voltage across each pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature (125°C) in order to meet data sheet specifications.

#### Thermal Considerations

The TO-92 molded package is capable of unusually high power dissipation due to the lead frame design. However, its thermal capabilities are generally overlooked because of a lack of understanding of the thermal paths from the semiconductor junction to ambient temperature.

While thermal resistance is normally specified for the device mounted 1 cm above an infinite heat sink, very little has been mentioned of the options available to improve on the conservatively rated thermal capability. An explanation of the thermal paths of the TO-92 will allow the designer to determine the thermal stress he is applying in any given application.

#### The TO-92 Package

The TO-92 package thermal paths are complex. In addition to the path through the molding compound to ambient temperature, there is another path through the leads, in parallel with the case path, to ambient temperature, as shown in Figure 1.

The total thermal resistance in this model is then:

$$\theta_{JA} = \frac{(\theta_{JC} + \theta_{CA})(\theta_{JL} + \theta_{LA})}{\theta_{JC} + \theta_{CA} + \theta_{JL} + \theta_{LA}}$$

Where:

$\theta_{JC}$  = thermal resistance of the case between the regulator die and a point on the case directly above the die location.

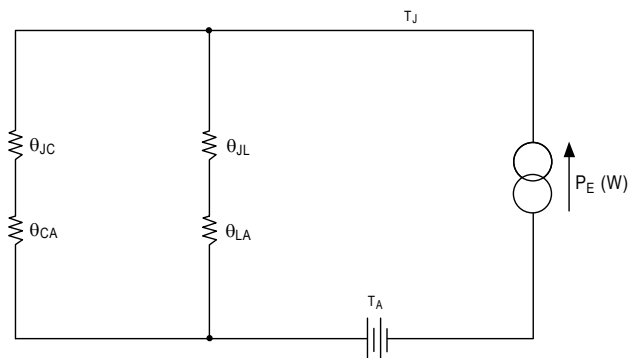
$\theta_{CA}$  = thermal resistance between the case and air at ambient temperature.

$\theta_{JL}$  = thermal resistance from regulator die through the input lead to a point  $1/16$  inch below the regulator case.

$\theta_{LA}$  = total thermal resistance of the input/output ground leads to ambient temperature.

$\theta_{JA}$  = junction to ambient thermal resistance.

**FIGURE 1. TO-92 Thermal Equivalent Circuit**



### ■ ORDERING INFORMATION

|                | OUTPUT VOLTAGE | PACKAGE     |              |            |
|----------------|----------------|-------------|--------------|------------|
|                |                | TO-92       | SOT-89       | SOP 8      |
| <b>GM78L00</b> | 5V             | GM78L05-T92 | GM78L05-ST89 | GM78L05-S8 |
|                | 6V             | GM78L06-T92 | GM78L06-ST89 | GM78L06-S8 |
|                | 8V             | GM78L08-T92 | GM78L08-ST89 | GM78L08-S8 |
|                | 9V             | GM78L09-T92 | GM78L09-ST89 | GM78L09-S8 |
|                | 10V            | GM78L10-T92 | GM78L10-ST89 | GM78L10-S8 |
|                | 12V            | GM78L12-T92 | GM78L12-ST89 | GM78L12-S8 |
|                | 15V            | GM78L15-T92 | GM78L15-ST89 | GM78L15-S8 |
|                | 18V            | GM78L18-T92 | GM78L18-ST89 | GM78L18-S8 |
|                | 24V            | GM78L24-T92 | GM78L24-ST89 | GM78L24-S8 |

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