



L78L00 SERIES

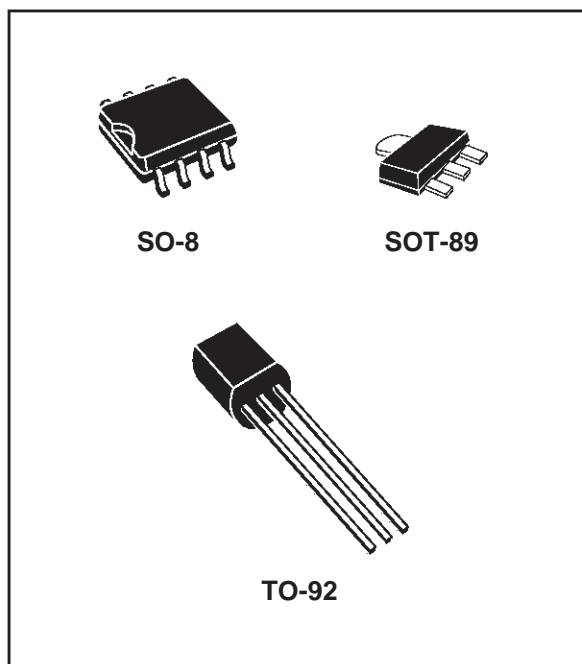
POSITIVE VOLTAGE REGULATORS

- OUTPUT CURRENT UP TO 100 mA
- OUTPUT VOLTAGES OF 3.3; 5; 6; 8; 9; 12; 15; 18; 24V
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- NO EXTERNAL COMPONENTS ARE REQUIRED
- AVAILABLE IN EITHER $\pm 5\%$ (AC) OR $\pm 10\%$ (C) SELECTION

DESCRIPTION

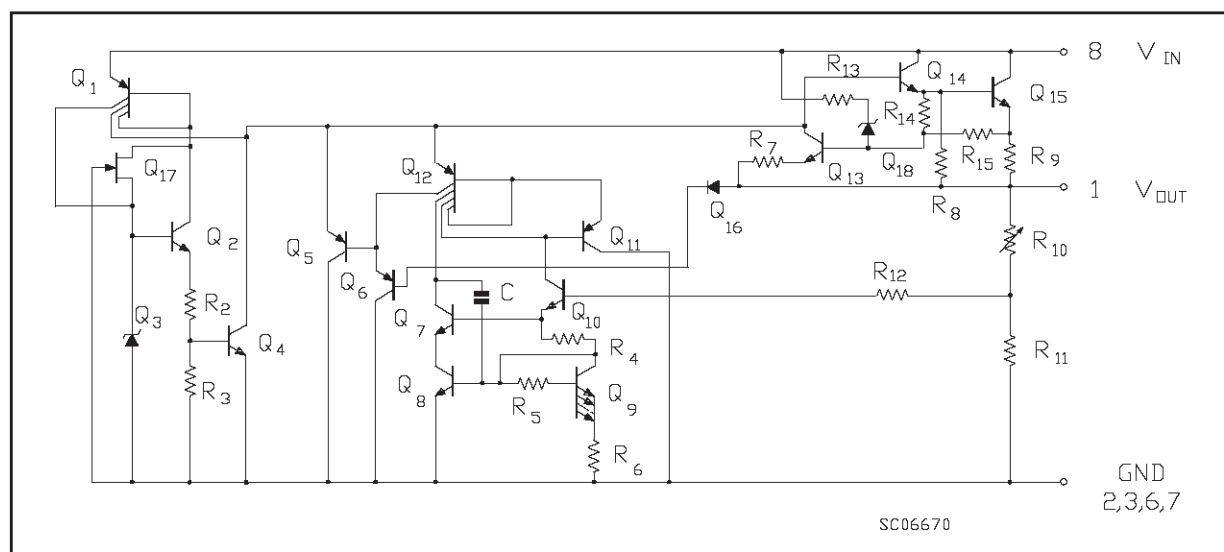
The L78L00 series of three-terminal positive regulators employ internal current limiting and thermal shutdown, making them essentially indestructible. If adequate heatsink is provided, they can deliver up to 100 mA output current. They are intended as fixed voltage regulators in a wide range of applications including local or on-card regulation for elimination of noise and distribution problems associated with single-point regulation. In addition, they can be used with power pass elements to make high-current voltage regulators.

The L78L00 series used as Zener diode/resistor combination replacement, offers an effective



output impedance improvement of typically two orders of magnitude, along with lower quiescent current and lower noise.

BLOCK DIAGRAM



L78L00

ABSOLUTE MAXIMUM RATING

| Symbol | Parameter | Value | Unit | |
|-----------|---|------------------------------------|------|---|
| V_i | DC Input Voltage | $V_o = 3.3\text{ V to }9\text{ V}$ | 30 | V |
| | | $V_o = 12\text{ V to }15\text{ V}$ | 35 | V |
| | | $V_o = 18\text{ V to }24\text{ V}$ | 40 | V |
| I_o | Output Current | 100 | mA | |
| P_{tot} | Power Dissipation | Internally limited (*) | | |
| T_{stg} | Storage Temperature Range | - 40 to 150 | °C | |
| T_{op} | Operating Junction Temperature Range For L78L00C, L78L00AC For L78L00AB | 0 to 125 | °C | |
| | | - 40 to 125 | °C | |

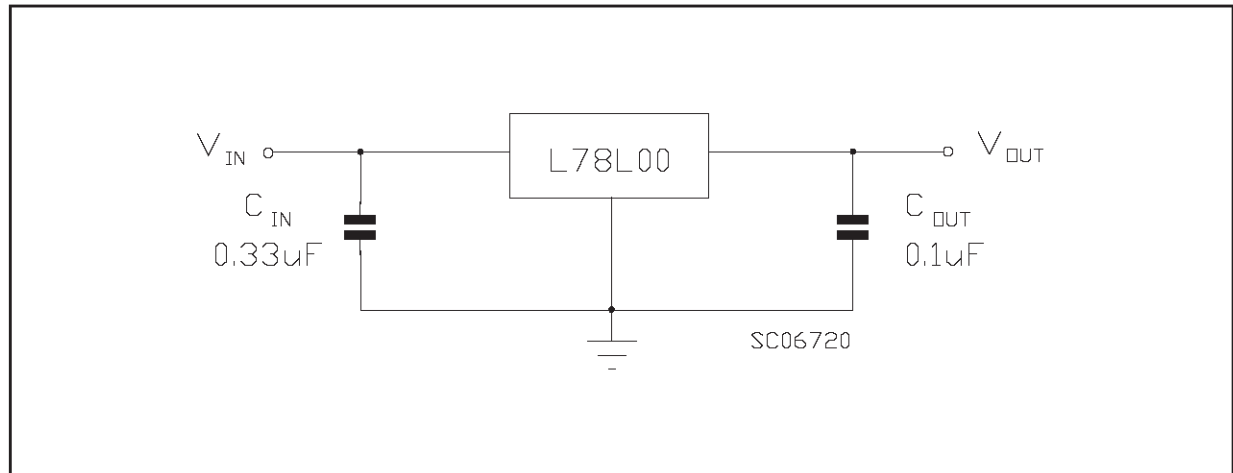
(*) Our SO-8 package used for Voltage Regulators is modified internally to have pins 2, 3, 6 and 7 electrically commoned to the die attach flag. This particular frame decreases the total thermal resistance of the package and increases its ability to dissipate power when an appropriate area of copper on the printed circuit board is available for heatsinking. The external dimensions are the same as for the standard SO-8

THERMAL DATA

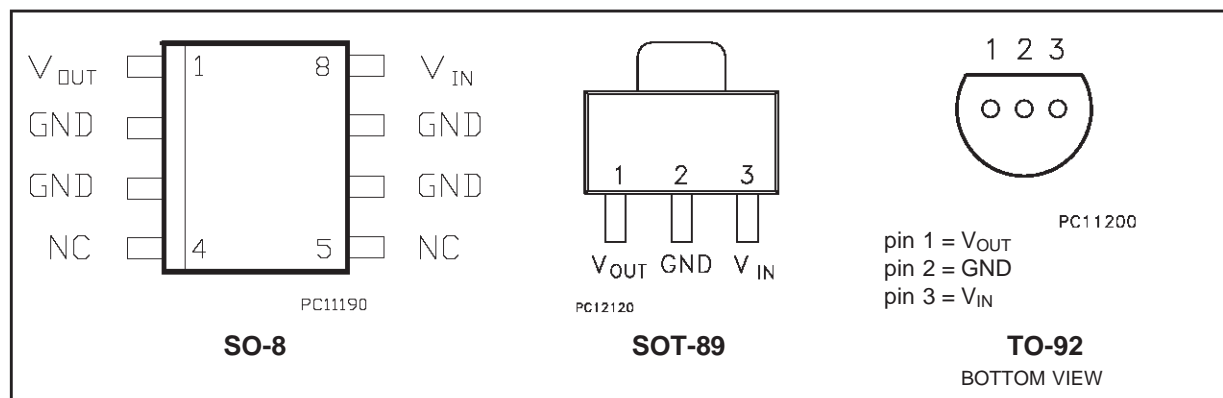
| Symbol | Parameter | | SO-8 | TO-92 | SOT-89 | Unit |
|----------------|-------------------------------------|-----|--------|-------|--------|------|
| $R_{thj-case}$ | Thermal Resistance Junction-case | Max | 20 | | 15 | °C/W |
| $R_{thj-amb}$ | Thermal Resistance Junction-ambient | Max | 55 (*) | 200 | | °C/W |

(*) Considering 6cm² of copper Board heat-sink

TEST CIRCUITS



CONNECTION DIAGRAM AND ORDERING NUMBERS (top view)



ORDERING NUMBERS

| Type | SO-8 | TO-92 | SOT-89 | Output Voltage |
|----------|-----------|-----------|-----------|----------------|
| L78L33AC | L78L33ACD | L78L33ACZ | L78L33ACU | 3.3 V |
| L78L33AB | L78L33ABD | L78L33ABZ | L78L33ABU | 3.3 V |
| L78L05C | L78L05CD | L78L05CZ | | 5 V |
| L78L05AC | L78L05ACD | L78L05ACZ | L78L05ACU | 5 V |
| L78L05AB | L78L05ABD | L78L05ABZ | L78L05ABU | 5 V |
| L78L06C | L78L06CD | L78L06CZ | | 6 V |
| L78L06AC | L78L06ACD | L78L06ACZ | L78L06ACU | 6 V |
| L78L06AB | L78L06ABD | L78L06ABZ | L78L06ABU | 6 V |
| L78L08C | L78L08CD | L78L08CZ | | 8 V |
| L78L08AC | L78L08ACD | L78L08ACZ | L78L08ACU | 8 V |
| L78L08AB | L78L08ABD | L78L08ABZ | L78L08ABU | 8 V |
| L78L09C | L78L09CD | L78L09CZ | | 9 V |
| L78L09AC | L78L09ACD | L78L09ACZ | L78L09ACU | 9 V |
| L78L09AB | L78L09ABD | L78L09ABZ | L78L09ABU | 9 V |
| L78L12C | L78L12CD | L78L12CZ | | 12 V |
| L78L12AC | L78L12ACD | L78L12ACZ | L78L12ACU | 12 V |
| L78L12AB | L78L12ABD | L78L12ABZ | L78L12ABU | 12 V |
| L78L15C | L78L15CD | L78L15CZ | | 15 V |
| L78L15AC | L78L15ACD | L78L15ACZ | L78L15ACU | 15 V |
| L78L15AB | L78L15ABD | L78L15ABZ | L78L15ABU | 15 V |
| L78L18C | L78L18CD | L78L18CZ | | 18 V |
| L78L18AC | L78L18ACD | L78L18ACZ | L78L18ACU | 18 V |
| L78L18AB | L78L18ABD | L78L18ABZ | L78L18ABU | 18 V |
| L78L24C | L78L24CD | L78L24CZ | | 24 V |
| L78L24AC | L78L24ACD | L78L24ACZ | L78L24ACU | 24 V |
| L78L24AB | L78L24ABD | L78L24ABZ | L78L24ABU | 24 V |

L78L00

ELECTRICAL CHARACTERISTICS FOR L78L05 (refer to the test circuits, $T_j = 0$ to 125 °C, $V_i = 10$ V, $I_o = 40$ mA, $C_i = 0.33$ μ F, $C_o = 0.1$ μ F unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|------------|------|------------|----------|
| V_o | Output Voltage | $T_j = 25$ °C | 4.6 | 5 | 5.4 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 7$ to 20 V $I_o = 1$ to 70 mA $V_i = 10$ V | 4.5 4.5 | | 5.5 5.5 | V V |
| ΔV_o | Line Regulation | $V_i = 7$ to 20 V $T_j = 25$ °C $V_i = 8$ to 20 V $T_j = 25$ °C | | | 200 150 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25$ °C $I_o = 1$ to 40 mA $T_j = 25$ °C | | | 60 30 | mV mV |
| I_d | Quiescent Current | $T_j = 25$ °C $T_j = 125$ °C | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 8$ to 20 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10$ Hz to 100 KHz $T_j = 25$ °C | | 40 | | μ V |
| SVR | Supply Voltage Rejection | $I_o = 40$ mA $f = 120$ Hz $T_j = 25$ °C $V_i = 8$ to 18 V | 40 | 49 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L06 (refer to the test circuits, $T_j = 0$ to 125 °C, $V_i = 12$ V, $I_o = 40$ mA, $C_i = 0.33$ μ F, $C_o = 0.1$ μ F unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|------------|------|------------|----------|
| V_o | Output Voltage | $T_j = 25$ °C | 5.52 | 6 | 6.48 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 8.5$ to 20 V $I_o = 1$ to 70 mA $V_i = 12$ V | 5.4 5.4 | | 6.6 6.6 | V V |
| ΔV_o | Line Regulation | $V_i = 8.5$ to 20 V $T_j = 25$ °C $V_i = 9$ to 20 V $T_j = 25$ °C | | | 200 150 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25$ °C $I_o = 1$ to 40 mA $T_j = 25$ °C | | | 60 30 | mV mV |
| I_d | Quiescent Current | $T_j = 25$ °C $T_j = 125$ °C | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 8$ to 20 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10$ Hz to 100 KHz $T_j = 25$ °C | | 50 | | μ V |
| SVR | Supply Voltage Rejection | $I_o = 40$ mA $f = 120$ Hz $T_j = 25$ °C $V_i = 9$ to 20 V | 38 | 46 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L08 (refer to the test circuits, $T_j = 0$ to 125 °C, $V_i = 14$ V, $I_o = 40$ mA, $C_i = 0.33$ μ F, $C_o = 0.1$ μ F unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|------------|------|------------|----------|
| V_o | Output Voltage | $T_j = 25$ °C | 7.36 | 8 | 8.64 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 10.5$ to 23 V $I_o = 1$ to 70 mA $V_i = 14$ V | 7.2 7.2 | | 8.8 8.8 | V V |
| ΔV_o | Line Regulation | $V_i = 10.5$ to 23 V $T_j = 25$ °C $V_i = 11$ to 23 V $T_j = 25$ °C | | | 200 150 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25$ °C $I_o = 1$ to 40 mA $T_j = 25$ °C | | | 80 40 | mV mV |
| I_d | Quiescent Current | $T_j = 25$ °C $T_j = 125$ °C | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 11$ to 23 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10$ Hz to 100 KHz $T_j = 25$ °C | | 60 | | μ V |
| SVR | Supply Voltage Rejection | $I_o = 40$ mA $f = 120$ Hz $T_j = 25$ °C $V_i = 12$ to 23 V | 36 | 45 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L09 (refer to the test circuits, $T_j = 0$ to 125 °C, $V_i = 15$ V, $I_o = 40$ mA, $C_i = 0.33$ μ F, $C_o = 0.1$ μ F unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|------------|------|------------|----------|
| V_o | Output Voltage | $T_j = 25$ °C | 8.28 | 9 | 9.72 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 11.5$ to 23 V $I_o = 1$ to 70 mA $V_i = 15$ V | 8.1 8.1 | | 9.9 9.9 | V V |
| ΔV_o | Line Regulation | $V_i = 11.5$ to 23 V $T_j = 25$ °C $V_i = 12$ to 23 V $T_j = 25$ °C | | | 250 200 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25$ °C $I_o = 1$ to 40 mA $T_j = 25$ °C | | | 80 40 | mV mV |
| I_d | Quiescent Current | $T_j = 25$ °C $T_j = 125$ °C | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 12$ to 23 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10$ Hz to 100 KHz $T_j = 25$ °C | | 70 | | μ V |
| SVR | Supply Voltage Rejection | $I_o = 40$ mA $f = 120$ Hz $T_j = 25$ °C $V_i = 12$ to 23 V | 36 | 44 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L12 (refer to the test circuits, $T_j = 0$ to $125\text{ }^\circ\text{C}$, $V_i = 19\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$ unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 11.1 | 12 | 12.9 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 14.5$ to 27 V $I_o = 1$ to 70 mA $V_i = 19\text{ V}$ | 10.8 10.8 | | 13.2 13.2 | V V |
| ΔV_o | Line Regulation | $V_i = 14.5$ to 27 V $T_j = 25\text{ }^\circ\text{C}$ $V_i = 16$ to 27 V $T_j = 25\text{ }^\circ\text{C}$ | | | 250 200 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1$ to 40 mA $T_j = 25\text{ }^\circ\text{C}$ | | | 100 50 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 16$ to 27 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz}$ to 100kHz $T_j = 25\text{ }^\circ\text{C}$ | | 80 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 15$ to 25 V | 36 | 42 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L15 (refer to the test circuits, $T_j = 0$ to $125\text{ }^\circ\text{C}$, $V_i = 23\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$ unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 13.8 | 15 | 16.2 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 17.5$ to 30 V $I_o = 1$ to 70 mA $V_i = 23\text{ V}$ | 13.5 13.5 | | 16.5 16.5 | V V |
| ΔV_o | Line Regulation | $V_i = 17.5$ to 30 V $T_j = 25\text{ }^\circ\text{C}$ $V_i = 20$ to 30 V $T_j = 25\text{ }^\circ\text{C}$ | | | 300 250 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1$ to 40 mA $T_j = 25\text{ }^\circ\text{C}$ | | | 150 75 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 20$ to 30 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz}$ to 100kHz $T_j = 25\text{ }^\circ\text{C}$ | | 90 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 18.5$ to 28.5 V | 33 | 39 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L18 (refer to the test circuits, $T_j = 0$ to $125\text{ }^\circ\text{C}$,
 $V_i = 27\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$ unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 16.6 | 18 | 19.4 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 22$ to 33 V $I_o = 1$ to 70 mA $V_i = 27\text{ V}$ | 16.2 16.2 | | 19.8 19.8 | V V |
| ΔV_o | Line Regulation | $V_i = 22$ to 33 V $T_j = 25\text{ }^\circ\text{C}$ $V_i = 22$ to 33 V $T_j = 25\text{ }^\circ\text{C}$ | | | 320 270 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1$ to 40 mA $T_j = 25\text{ }^\circ\text{C}$ | | | 170 85 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 23$ to 33 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz}$ to 100kHz $T_j = 25\text{ }^\circ\text{C}$ | | 120 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 23$ to 33 V | 32 | 38 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L24 (refer to the test circuits, $T_j = 0$ to $125\text{ }^\circ\text{C}$,
 $V_i = 33\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$ unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 22.1 | 24 | 25.9 | V |
| V_o | Output Voltage | $I_o = 1$ to 40 mA $V_i = 27$ to 38 V $I_o = 1$ to 70 mA $V_i = 33\text{ V}$ | 21.6 21.6 | | 26.4 26.4 | V V |
| ΔV_o | Line Regulation | $V_i = 27$ to 38 V $T_j = 25\text{ }^\circ\text{C}$ $V_i = 28$ to 38 V $T_j = 25\text{ }^\circ\text{C}$ | | | 350 300 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1$ to 100 mA $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1$ to 40 mA $T_j = 25\text{ }^\circ\text{C}$ | | | 200 100 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1$ to 40 mA | | | 0.2 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 28$ to 38 V | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz}$ to 100kHz $T_j = 25\text{ }^\circ\text{C}$ | | 200 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 29$ to 35 V | 30 | 37 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L33AB AND L78L33AC(refer to the test circuits, $V_i = 8.3V$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L33AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L33AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|----------------|------|----------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 3.168 | 3.3 | 3.432 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 5.3\text{ to }20\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 8.3\text{ V}$ | 3.135 3.135 | | 3.465 3.465 | V V |
| ΔV_o | Line Regulation | $V_i = 5.3\text{ to }20\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 6.3\text{ to }20\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 150 100 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 60 30 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 6.3\text{ to }20\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 40 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 6.3\text{ to }16.3\text{ V}$ | 41 | 49 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L05AB AND L78L05AC(refer to the test circuits, $V_i = 10V$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L05AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L05AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 4.8 | 5 | 5.2 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 7\text{ to }20\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 10\text{ V}$ | 4.75 4.75 | | 5.25 5.25 | V V |
| ΔV_o | Line Regulation | $V_i = 7\text{ to }20\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 8\text{ to }20\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 150 100 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 60 30 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 8\text{ to }20\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 40 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 8\text{ to }18\text{ V}$ | 41 | 49 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L06AB AND L78L06AC(refer to the test circuits, $V_i = 12\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L06AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L06AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|------------|------|------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 5.76 | 6 | 6.24 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 8.5\text{ to }20\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 12\text{ V}$ | 5.7 5.7 | | 6.3 6.3 | V V |
| ΔV_o | Line Regulation | $V_i = 8.5\text{ to }20\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 9\text{ to }20\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 150 100 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 60 30 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 9\text{ to }20\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 50 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 9\text{ to }20\text{ V}$ | 39 | 46 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L08AB AND L78L08AC(refer to the test circuits, $V_i = 14\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L08AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L08AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|------------|------|------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 7.68 | 8 | 8.32 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 10.5\text{ to }23\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 14\text{ V}$ | 7.6 7.6 | | 8.4 8.4 | V V |
| ΔV_o | Line Regulation | $V_i = 10.5\text{ to }23\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 11\text{ to }23\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 175 125 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 80 40 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 11\text{ to }23\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 60 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 12\text{ to }23\text{ V}$ | 37 | 45 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L09AB AND L78L09AC(refer to the test circuits, $V_i = 15V$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L09AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L09AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 8.64 | 9 | 9.36 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 11.5\text{ to }23\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 15\text{ V}$ | 8.55 8.55 | | 9.45 9.45 | V V |
| ΔV_o | Line Regulation | $V_i = 11.5\text{ to }23\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 12\text{ to }23\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 225 150 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 80 40 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6 5.5 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 12\text{ to }23\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 70 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 12\text{ to }23\text{ V}$ | 37 | 44 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L12AB AND L78L12AC(refer to the test circuits, $V_i = 19V$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L12AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L12AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 11.5 | 12 | 12.5 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 14.5\text{ to }27\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 19\text{ V}$ | 11.4 11.4 | | 12.6 12.6 | V V |
| ΔV_o | Line Regulation | $V_i = 14.5\text{ to }27\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 16\text{ to }27\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 250 200 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 100 50 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 16\text{ to }27\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 80 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 15\text{ to }25\text{ V}$ | 37 | 42 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L15AB AND L78L15AC(refer to the test circuits, $V_i = 23\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L15AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L15AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|----------------|------|----------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 14.4 | 15 | 15.6 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 17.5\text{ to }30\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 23\text{ V}$ | 14.25 14.25 | | 15.75 15.75 | V V |
| ΔV_o | Line Regulation | $V_i = 17.5\text{ to }30\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 20\text{ to }30\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 300 250 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 150 75 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 20\text{ to }30\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 90 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 18.5\text{ to }28.5\text{ V}$ | 34 | 39 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L18AB AND L78L18AC(refer to the test circuits, $V_i = 27\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L18AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L18AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 17.3 | 18 | 18.7 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 22\text{ to }33\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 27\text{ V}$ | 17.1 17.1 | | 18.9 18.9 | V V |
| ΔV_o | Line Regulation | $V_i = 22\text{ to }33\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 22\text{ to }33\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 320 270 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 170 85 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 23\text{ to }33\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 120 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 23\text{ to }33\text{ V}$ | 33 | 38 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

ELECTRICAL CHARACTERISTICS FOR L78L24AB AND L78L24AC(refer to the test circuits, $V_i = 33\text{V}$, $I_o = 40\text{ mA}$, $C_i = 0.33\text{ }\mu\text{F}$, $C_o = 0.1\text{ }\mu\text{F}$, $T_j = 0\text{ to }125\text{ }^\circ\text{C}$ for L78L24AC, $T_j = -40\text{ to }125\text{ }^\circ\text{C}$ for L78L24AB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|---|--------------|------|--------------|---------------|
| V_o | Output Voltage | $T_j = 25\text{ }^\circ\text{C}$ | 23 | 24 | 25 | V |
| V_o | Output Voltage | $I_o = 1\text{ to }40\text{ mA}$ $V_i = 27\text{ to }38\text{ V}$ $I_o = 1\text{ to }70\text{ mA}$ $V_i = 33\text{ V}$ | 22.8 22.8 | | 25.2 25.2 | V V |
| ΔV_o | Line Regulation | $V_i = 27\text{ to }38\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 28\text{ to }38\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 350 300 | mV mV |
| ΔV_o | Load Regulation | $I_o = 1\text{ to }100\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ $I_o = 1\text{ to }40\text{ mA}$ $T_j = 25\text{ }^\circ\text{C}$ | | | 200 100 | mV mV |
| I_d | Quiescent Current | $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$ | | | 6.5 6 | mA mA |
| ΔI_d | Quiescent Current Change | $I_o = 1\text{ to }40\text{ mA}$ | | | 0.1 | mA |
| ΔI_d | Quiescent Current Change | $V_i = 28\text{ to }38\text{ V}$ | | | 1.5 | mA |
| eN | Output Noise Voltage | $B = 10\text{Hz to }100\text{kHz}$ $T_j = 25\text{ }^\circ\text{C}$ | | 200 | | μV |
| SVR | Supply Voltage Rejection | $I_o = 40\text{ mA}$ $f = 120\text{ Hz}$ $T_j = 25\text{ }^\circ\text{C}$ $V_i = 29\text{ to }35\text{ V}$ | 31 | 37 | | dB |
| V_d | Dropout Voltage | | | 1.7 | | V |

Figure 1 : L78L05/12 Output Voltage vs Ambient Temperature

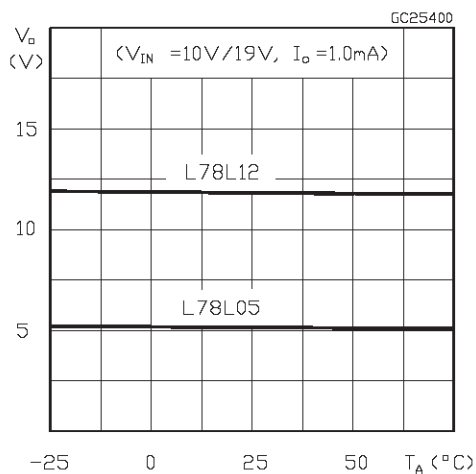


Figure 2 : L78L05/12/24 Load Characteristics.

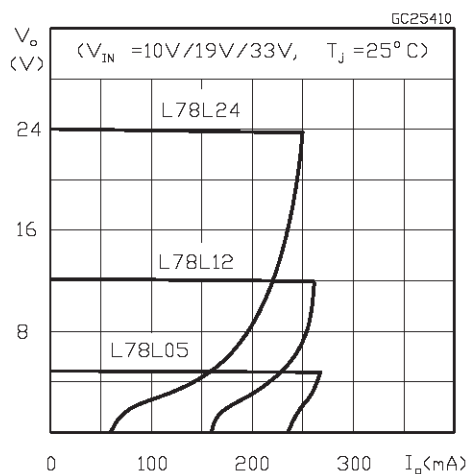


Figure 3 : L78L05/12/24 Thermal Shutdown.

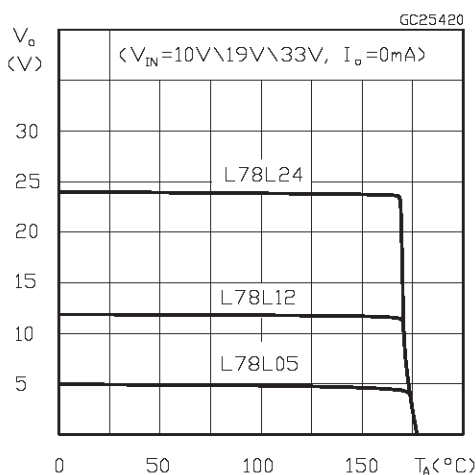


Figure 4 : L78L05/12 Quiescent Current vs Output Current

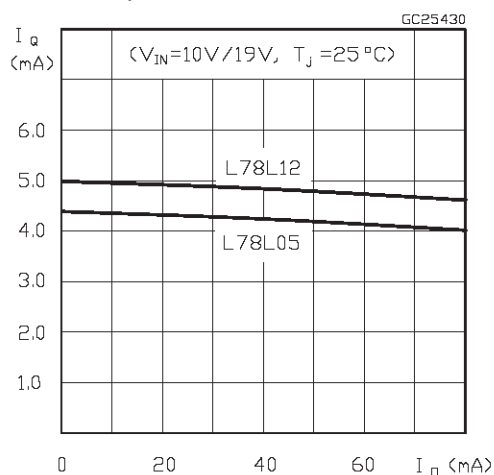


Figure 5 : L78L05 Quiescent Current vs Input Voltage

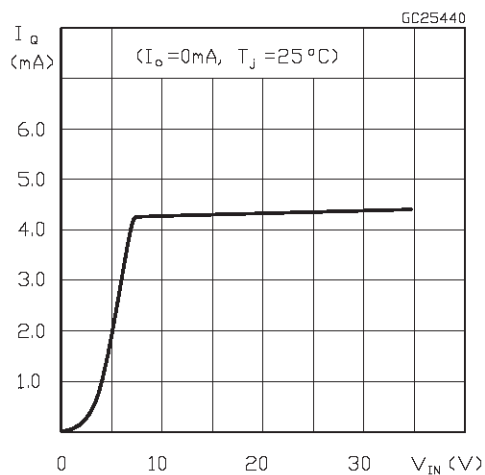


Figure 6 : L78L05/12/24 Output Characteristics.

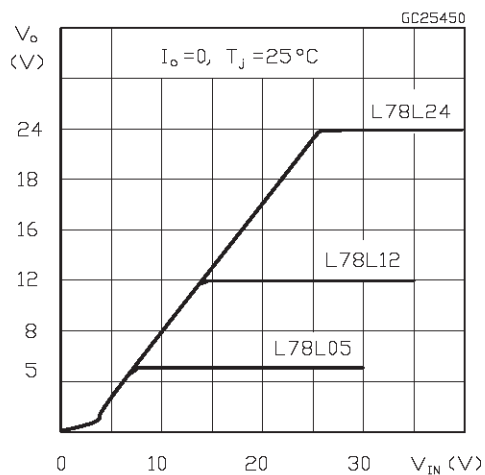


Figure 7 : L78L05/12/24Ripple Rejection.

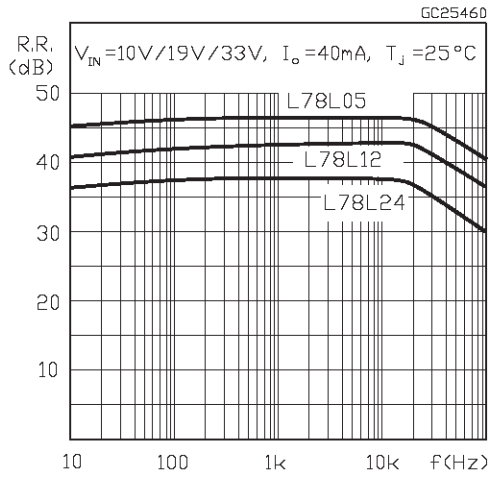


Figure 8 : L78L05 Dropout Characteristics.

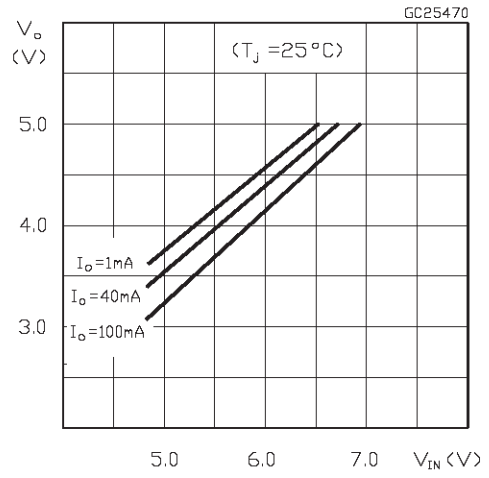
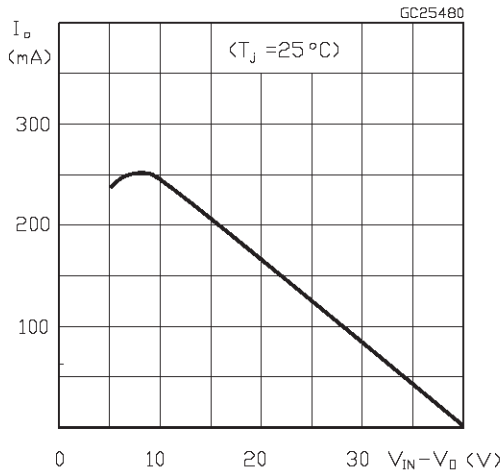


Figure 9 : L78L00 Series Short Circuit Output Current.



TYPICAL APPLICATIONS:

Figure 10: High Output Current Short Circuit Protected

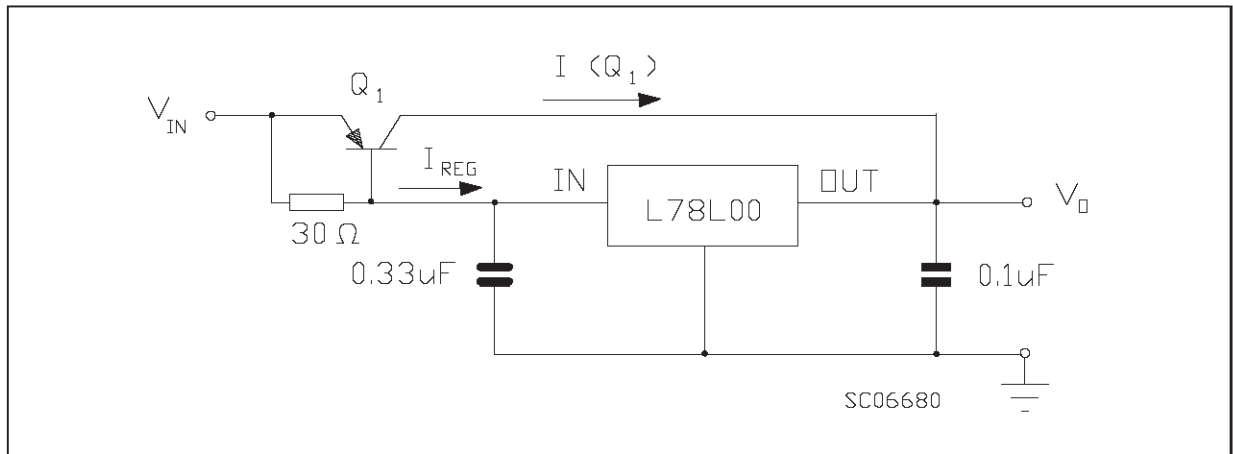


Figure 11 : Output Boost Circuit.

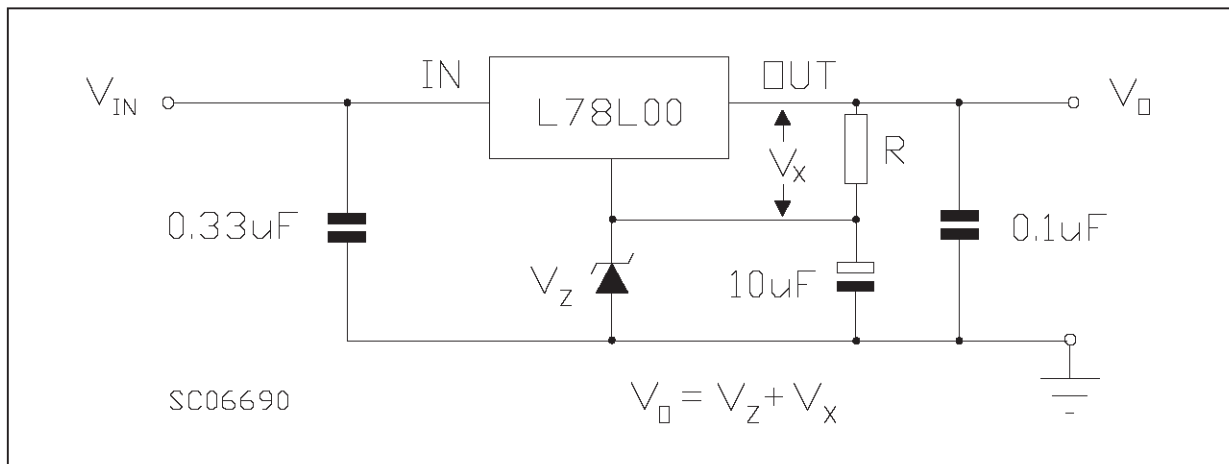


Figure 12 : Current Regulator.

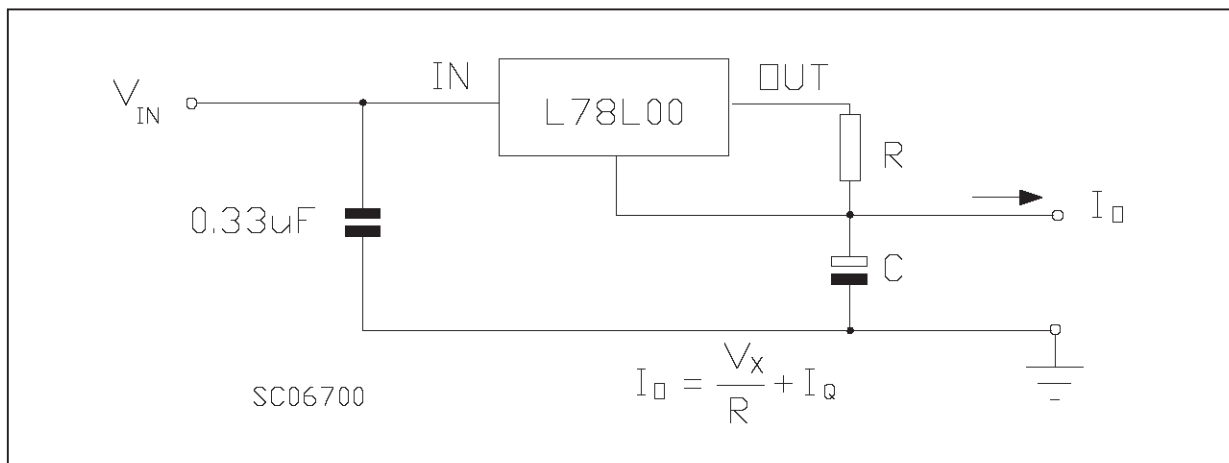
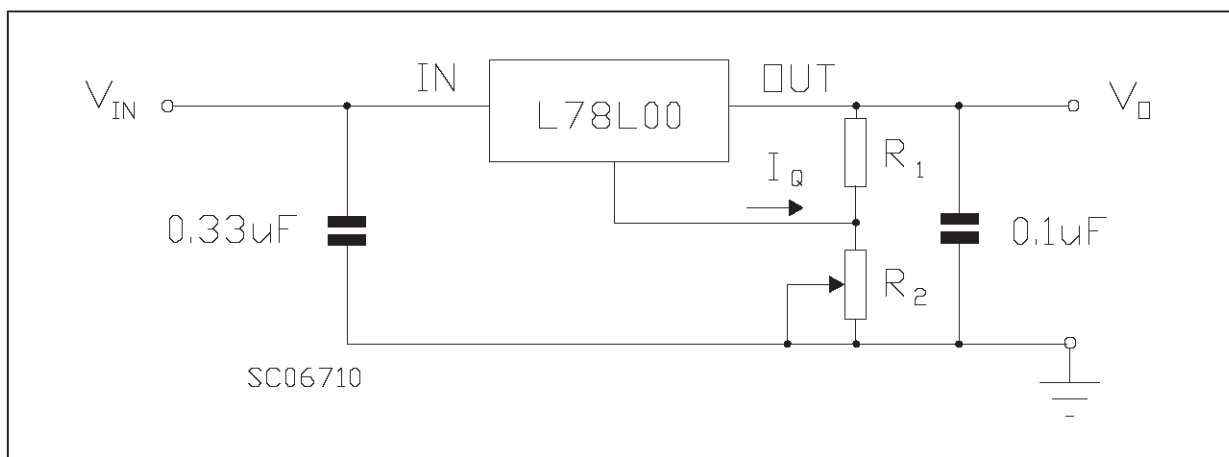
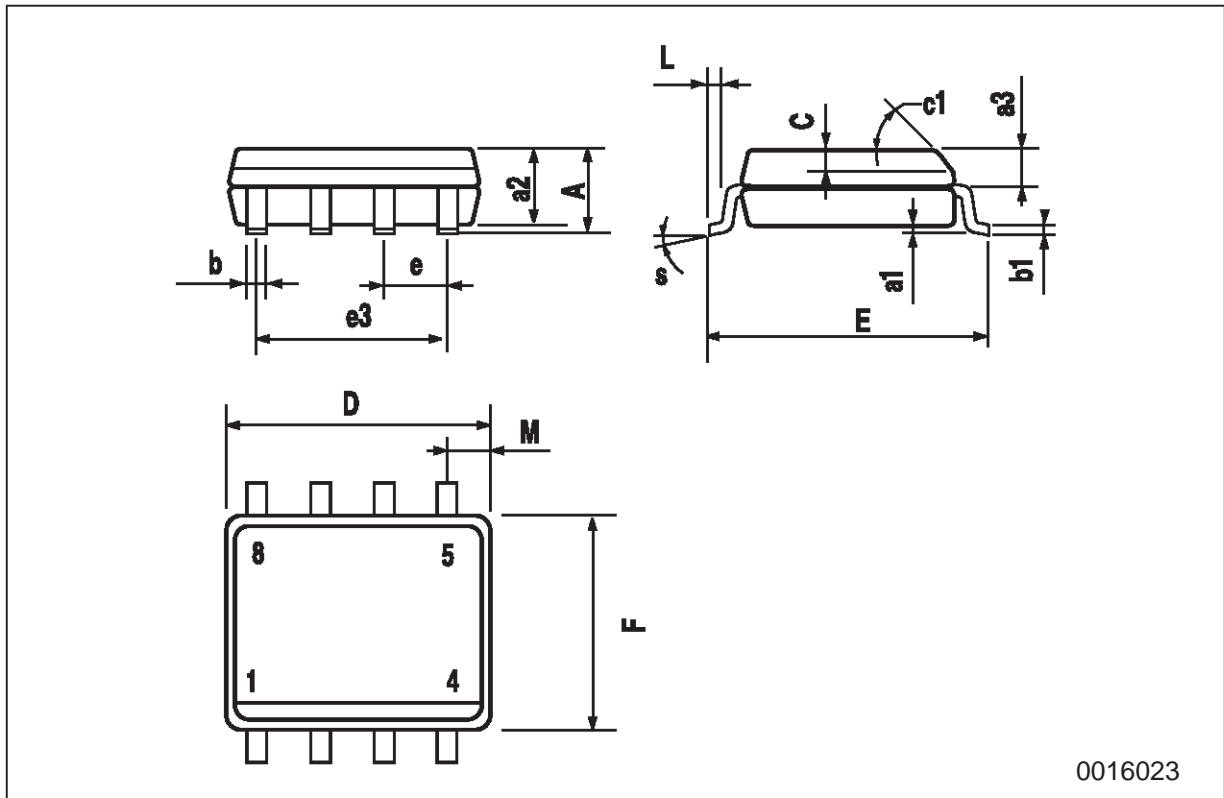


Figure 13: Adjustable Output Regulator



SO-8 MECHANICAL DATA

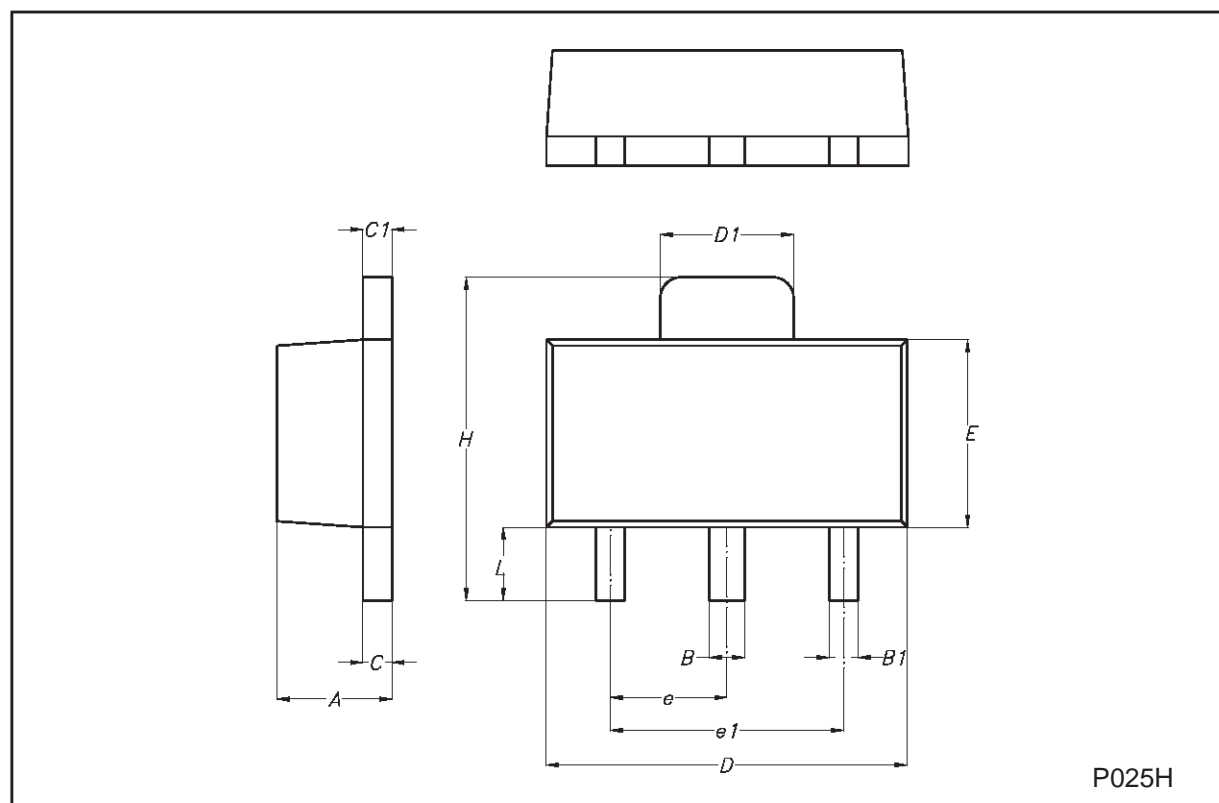
| DIM. | mm | | | inch | | |
|------|-----------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.25 | 0.003 | | 0.009 |
| a2 | | | 1.65 | | | 0.064 |
| a3 | 0.65 | | 0.85 | 0.025 | | 0.033 |
| b | 0.35 | | 0.48 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | 0.25 | | 0.5 | 0.010 | | 0.019 |
| c1 | 45 (typ.) | | | | | |
| D | 4.8 | | 5.0 | 0.188 | | 0.196 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 3.81 | | | 0.150 | |
| F | 3.8 | | 4.0 | 0.14 | | 0.157 |
| L | 0.4 | | 1.27 | 0.015 | | 0.050 |
| M | | | 0.6 | | | 0.023 |
| S | 8 (max.) | | | | | |



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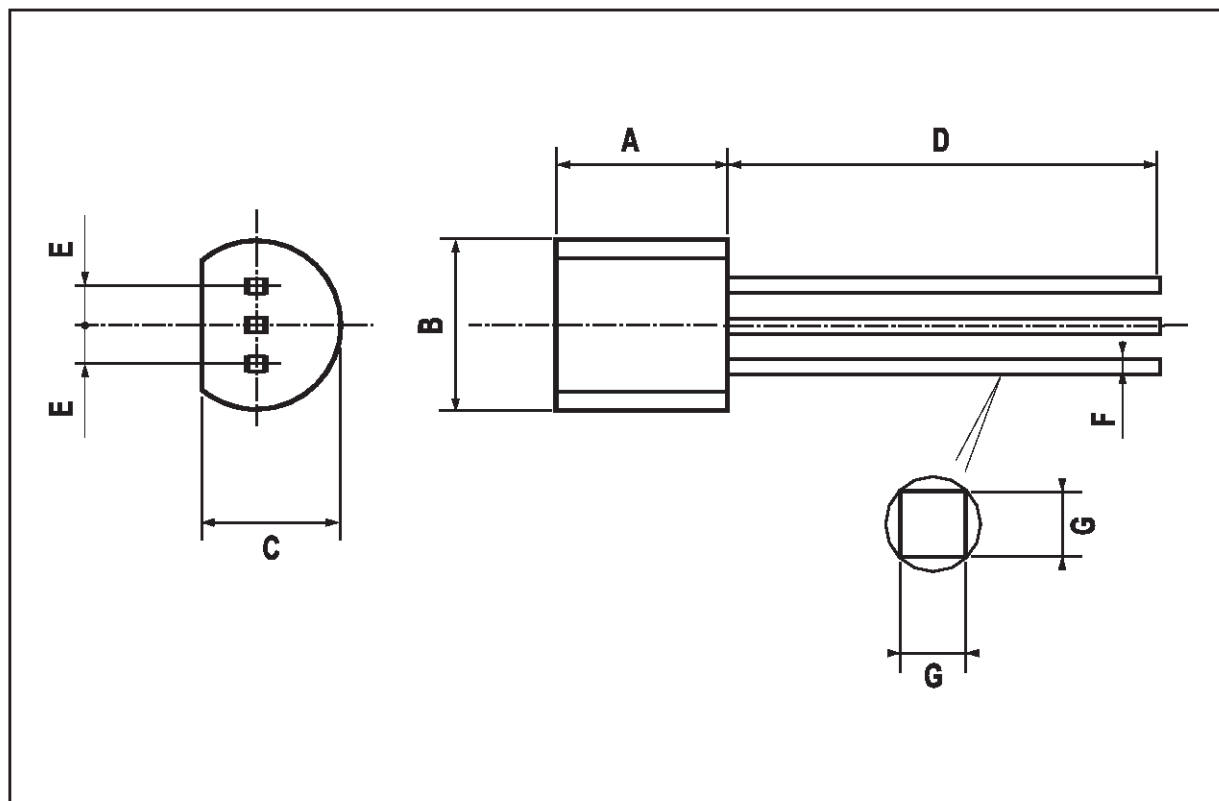
SOT-89 MECHANICAL DATA

| DIM. | mm | | | mils | | |
|------|------|------|------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 1.4 | | 1.6 | 55.1 | | 63.0 |
| B | 0.44 | | 0.56 | 17.3 | | 22.0 |
| B1 | 0.36 | | 0.48 | 14.2 | | 18.9 |
| C | 0.35 | | 0.44 | 13.8 | | 17.3 |
| C1 | 0.35 | | 0.44 | 13.8 | | 17.3 |
| D | 4.4 | | 4.6 | 173.2 | | 181.1 |
| D1 | 1.62 | | 1.83 | 63.8 | | 72.0 |
| E | 2.29 | | 2.6 | 90.2 | | 102.4 |
| e | 1.42 | | 1.57 | 55.9 | | 61.8 |
| e1 | 2.92 | | 3.07 | 115.0 | | 120.9 |
| H | 3.94 | | 4.25 | 155.1 | | 167.3 |
| L | 0.89 | | 1.2 | 35.0 | | 47.2 |



TO-92 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.58 | | 5.33 | 0.180 | | 0.210 |
| B | 4.45 | | 5.2 | 0.175 | | 0.204 |
| C | 3.2 | | 4.2 | 0.126 | | 0.165 |
| D | 12.7 | | | 0.500 | | |
| E | | 1.27 | | | 0.050 | |
| F | 0.4 | | 0.51 | 0.016 | | 0.020 |
| G | 0.35 | | | 0.14 | | |



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