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# L78LxxAB, L78LxxAC, L78LxxC

## Positive voltage regulators

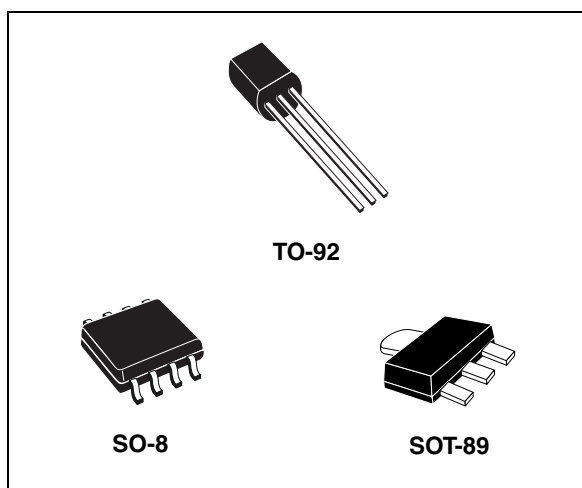
Datasheet — production data

### Features

- Output current up to 100 mA
- Output voltages of 3.3; 5; 6; 8; 9; 10; 12; 15; 18; 24 V
- Thermal overload protection
- Short-circuit protection
- No external components are required
- Available in either  $\pm 4\%$  (AC) or  $\pm 8\%$  (C) selection

### Description

The L78Lxx series of three-terminal positive regulators employ internal current limiting and thermal shutdown, making them essentially indestructible. If adequate heat-sink 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 L78Lxx 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.

Table 1. Device summary

| Part numbers |          |          |
|--------------|----------|----------|
| L78L33C      | L78L08AC | L78L15C  |
| L78L33AC     | L78L08AB | L78L15AC |
| L78L33AB     | L78L09C  | L78L15AB |
| L78L05C      | L78L09AC | L78L18C  |
| L78L05AC     | L78L09AB | L78L18AC |
| L78L05AB     | L78L10AC | L78L24C  |
| L78L06AC     | L78L12C  | L78L24AC |
| L78L06AB     | L78L12AC | L78L24AB |
| L78L08C      | L78L12AB |          |

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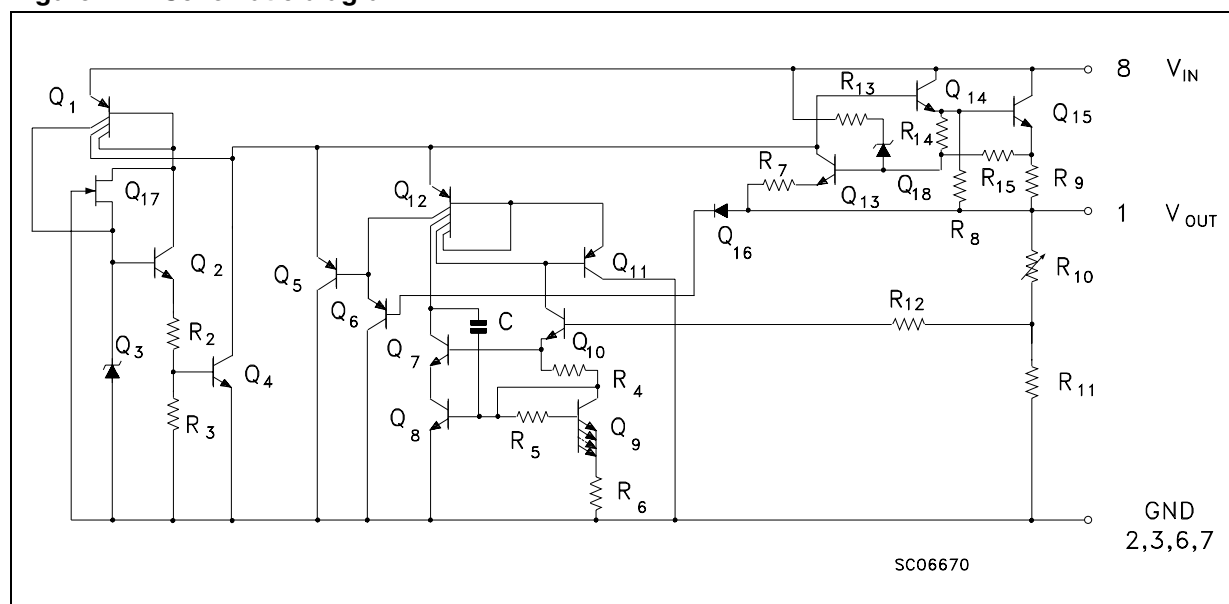
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# 1 Diagram

**Figure 1. Schematic diagram**

## 2 Pin configuration

Figure 2. Pin connection (top view, bottom view for TO-92)

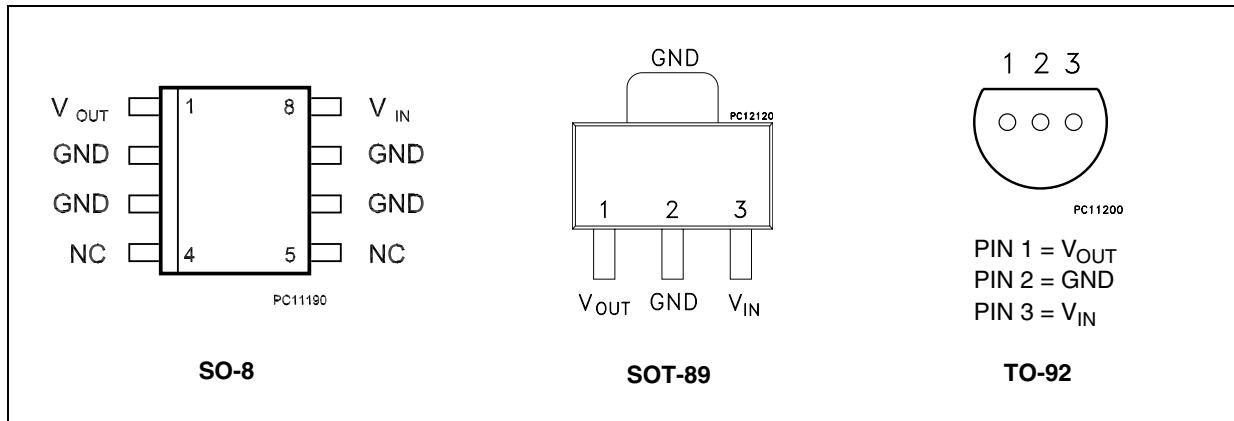
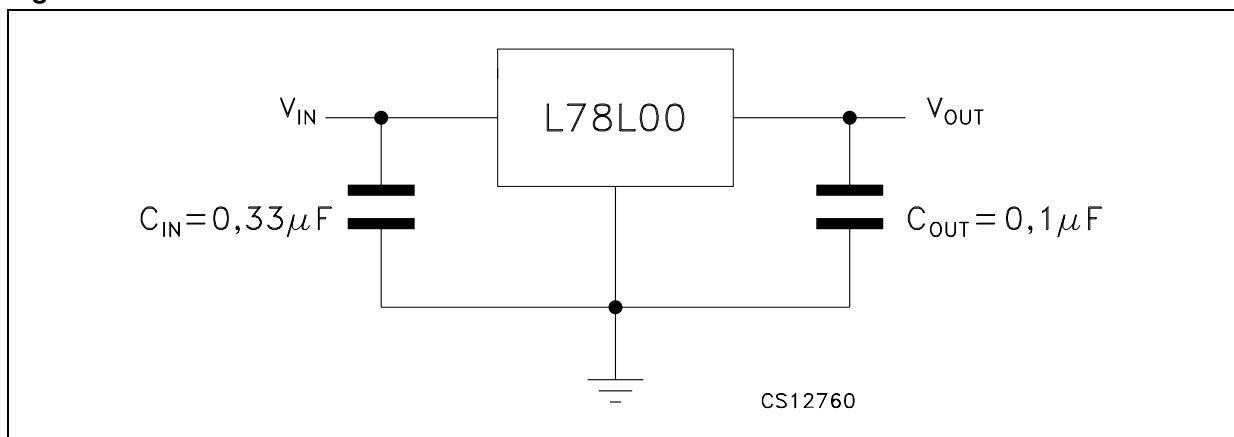


Figure 3. Test circuits



### 3 Maximum ratings

**Table 2. Absolute maximum ratings**

| Symbol    | Parameter                            |                    | Value                             | Unit |
|-----------|--------------------------------------|--------------------|-----------------------------------|------|
| $V_I$     | DC Input voltage                     | $V_O = 3.3$ to 9 V | 30                                | V    |
|           |                                      | $V_O = 12$ to 15 V | 35                                |      |
|           |                                      | $V_O = 18$ to 24 V | 40                                |      |
| $I_O$     | Output current                       |                    | 100                               | mA   |
| $P_D$     | Power dissipation                    |                    | Internally limited <sup>(1)</sup> | mW   |
| $T_{STG}$ | Storage temperature range            |                    | -65 to 150                        | °C   |
| $T_{OP}$  | Operating junction temperature range | for L78L00AC       | 0 to 125                          | °C   |
|           |                                      | for L78L00AB       | -40 to 125                        |      |

1. Our SO-8 package used for voltage regulators is modified internally to have pins 2, 3, 6 and 7 electrically communed 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 heat-sinking. The external dimensions are the same as for the standard SO-8.

**Table 3. Thermal data**

| Symbol     | Parameter                                  | SO-8              | TO-92 | SOT-89            | Unit |
|------------|--------------------------------------------|-------------------|-------|-------------------|------|
| $R_{thJC}$ | Thermal resistance junction-case. (max)    | 20                |       | 15                | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient. (max) | 55 <sup>(1)</sup> | 200   | 55 <sup>(1)</sup> | °C/W |

1. Considering 6 cm<sup>2</sup> of copper Board heat-sink.

## 4 Electrical characteristics

Refer to the test circuits,  $T_J = 0$  to  $125\text{ }^{\circ}\text{C}$ ,  $I_O = 40\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 4. Electrical characteristics of L78L33C ( $V_I = 8.3\text{ V}$ )**

| Symbol       | Parameter                | Test conditions                                                                                                   | Min.  | Typ. | Max.  | Unit          |
|--------------|--------------------------|-------------------------------------------------------------------------------------------------------------------|-------|------|-------|---------------|
| $V_O$        | Output voltage           | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                | 3.036 | 3.3  | 3.564 | V             |
| $V_O$        | Output voltage           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 5.3$ to $20\text{ V}$                                                        | 2.97  |      | 3.63  | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 8.3\text{ V}$                                                                | 2.97  |      | 3.63  |               |
| $\Delta V_O$ | Line regulation          | $V_I = 5.3$ to $20\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                 |       |      | 150   | mV            |
|              |                          | $V_I = 6.3$ to $20\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                 |       |      | 100   |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                 |       |      | 60    | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                  |       |      | 30    |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                |       |      | 6     | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                               |       |      | 5.5   | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                       |       |      | 0.2   | mA            |
|              |                          | $V_I = 6.3$ to $20\text{ V}$                                                                                      |       |      | 1.5   |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                       |       | 40   |       | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 6.3$ to $16.3\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 41    | 49   |       | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                   |       | 1.7  |       | V             |

**Table 5. Electrical characteristics of L78L05C ( $V_I = 10\text{ V}$ )**

| Symbol       | Parameter                | Test conditions                                                             | Min. | Typ. | Max. | Unit          |
|--------------|--------------------------|-----------------------------------------------------------------------------|------|------|------|---------------|
| $V_O$        | Output voltage           | $T_J = 25\text{ }^{\circ}\text{C}$                                          | 4.6  | 5    | 5.4  | V             |
| $V_O$        | Output voltage           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 7$ to $20\text{ V}$                    | 4.5  |      | 5.5  | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 10\text{ V}$                           | 4.5  |      | 5.5  |               |
| $\Delta V_O$ | Line regulation          | $V_I = 8.5$ to $20\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$           |      |      | 200  | mV            |
|              |                          | $V_I = 9$ to $20\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$             |      |      | 150  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$           |      |      | 60   | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$            |      |      | 30   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                          |      |      | 6    | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                         |      |      | 5.5  | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                 |      |      | 0.2  | mA            |
|              |                          | $V_I = 8$ to $20\text{ V}$                                                  |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$ |      | 40   |      | $\mu\text{V}$ |

**Table 5. Electrical characteristics of L78L05C ( $V_I = 10$  V) (continued)**

| Symbol | Parameter                | Test conditions                                                   | Min. | Typ. | Max. | Unit |
|--------|--------------------------|-------------------------------------------------------------------|------|------|------|------|
| SVR    | Supply voltage rejection | $V_I = 9$ to $20$ V, $f = 120$ Hz<br>$I_O = 40$ mA, $T_J = 25$ °C | 40   | 49   |      | dB   |
| $V_d$  | Dropout voltage          |                                                                   |      | 1.7  |      | V    |

**Table 6. Electrical characteristics of L78L08C ( $V_I = 14$  V)**

| 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, $V_I = 8.5$ to $20$ V                       | 7.2  |      | 8.8  | V       |
|              |                          | $I_O = 1$ to $70$ mA, $V_I = 12$ V                                | 7.2  |      | 8.8  |         |
| $\Delta V_O$ | Line regulation          | $V_I = 8.5$ to $20$ V, $T_J = 25$ °C                              |      |      | 200  | mV      |
|              |                          | $V_I = 9$ to $20$ V, $T_J = 25$ °C                                |      |      | 150  |         |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100$ mA, $T_J = 25$ °C                              |      |      | 80   | mV      |
|              |                          | $I_O = 1$ to $40$ mA, $T_J = 25$ °C                               |      |      | 40   |         |
| $I_d$        | Quiescent current        | $T_J = 25$ °C                                                     |      |      | 6    | mA      |
|              |                          | $T_J = 125$ °C                                                    |      |      | 5.5  | mA      |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40$ mA                                              |      |      | 0.2  | mA      |
|              |                          | $V_I = 8$ to $20$ V                                               |      |      | 1.5  |         |
| eN           | Output noise voltage     | $B = 10$ Hz to $100$ kHz, $T_J = 25$ °C                           |      | 60   |      | $\mu$ V |
| SVR          | Supply voltage rejection | $V_I = 9$ to $20$ V, $f = 120$ Hz<br>$I_O = 40$ mA, $T_J = 25$ °C | 36   | 45   |      | dB      |
| $V_d$        | Dropout voltage          |                                                                   |      | 1.7  |      | V       |

**Table 7. Electrical characteristics of L78L09C ( $V_I = 15$  V)**

| 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 | 8.1  |      | 9.9  | V    |
|              |                          | $I_O = 1$ to $70$ mA, $V_I = 15$ V           | 8.1  |      | 9.9  |      |
| $\Delta V_O$ | Line regulation          | $V_I = 11.5$ to $23$ V, $T_J = 25$ °C        |      |      | 250  | mV   |
|              |                          | $V_I = 12$ to $23$ V, $T_J = 25$ °C          |      |      | 200  |      |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100$ mA, $T_J = 25$ °C         |      |      | 80   | mV   |
|              |                          | $I_O = 1$ to $40$ mA, $T_J = 25$ °C          |      |      | 40   |      |
| $I_d$        | Quiescent current        | $T_J = 25$ °C                                |      |      | 6    | mA   |
|              |                          | $T_J = 125$ °C                               |      |      | 5.5  | mA   |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40$ mA                         |      |      | 0.2  | mA   |
|              |                          | $V_I = 12$ to $23$ V                         |      |      | 1.5  |      |

**Table 7. Electrical characteristics of L78L09C ( $V_I = 15\text{ V}$ ) (continued)**

| Symbol | Parameter                | Test conditions                                                                                                   | Min. | Typ. | Max. | Unit          |
|--------|--------------------------|-------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| eN     | Output noise voltage     | B = 10 Hz to 100 kHz, $T_J = 25\text{ }^\circ\text{C}$                                                            |      | 70   |      | $\mu\text{V}$ |
| SVR    | Supply voltage rejection | $V_I = 12\text{ to }23\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$ | 36   | 44   |      | dB            |
| $V_d$  | Dropout voltage          |                                                                                                                   |      | 1.7  |      | V             |

**Table 8. Electrical characteristics of L78L10C ( $V_I = 16\text{ V}$ )**

| Symbol       | Parameter                | Test conditions                                                                                                   | Min. | Typ. | Max. | Unit          |
|--------------|--------------------------|-------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_O$        | Output voltage           | $T_J = 25\text{ }^\circ\text{C}$                                                                                  | 9.2  | 10   | 10.8 | V             |
| $V_O$        | Output voltage           | $I_O = 1\text{ to }40\text{ mA}$ , $V_I = 12.5\text{ to }23\text{ V}$                                             | 9    |      | 11   | V             |
|              |                          | $I_O = 1\text{ to }70\text{ mA}$ , $V_I = 16\text{ V}$                                                            | 9    |      | 11   |               |
| $\Delta V_O$ | Line regulation          | $V_I = 12.5\text{ to }23\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$                                             |      |      | 230  | mV            |
|              |                          | $V_I = 13\text{ to }23\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$                                               |      |      | 170  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1\text{ to }100\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$                                              |      |      | 80   | mV            |
|              |                          | $I_O = 1\text{ to }40\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$                                               |      |      | 40   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^\circ\text{C}$                                                                                  |      |      | 6    | mA            |
|              |                          | $T_J = 125\text{ }^\circ\text{C}$                                                                                 |      |      | 5.5  | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                                  |      |      | 0.1  | mA            |
|              |                          | $V_I = 13\text{ to }23\text{ V}$                                                                                  |      |      | 1.5  |               |
| eN           | Output noise voltage     | B = 10Hz to 100kHz, $T_J = 25\text{ }^\circ\text{C}$                                                              |      | 60   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 14\text{ to }23\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$ | 37   | 45   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                   |      | 1.7  |      | V             |

**Table 9. Electrical characteristics of L78L12C ( $V_I = 19\text{ V}$ )**

| 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    | $I_O = 1\text{ to }40\text{ mA}$ , $V_I = 14.5\text{ to }27\text{ V}$ | 10.8 |      | 13.2 | V    |
|              |                   | $I_O = 1\text{ to }70\text{ mA}$ , $V_I = 19\text{ V}$                | 10.8 |      | 13.2 |      |
| $\Delta V_O$ | Line regulation   | $V_I = 14.5\text{ to }27\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$ |      |      | 250  | mV   |
|              |                   | $V_I = 16\text{ to }27\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$   |      |      | 200  |      |
| $\Delta V_O$ | Load regulation   | $I_O = 1\text{ to }100\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$  |      |      | 100  | mV   |
|              |                   | $I_O = 1\text{ to }40\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$   |      |      | 50   |      |
| $I_d$        | Quiescent current | $T_J = 25\text{ }^\circ\text{C}$                                      |      |      | 6.5  | mA   |
|              |                   | $T_J = 125\text{ }^\circ\text{C}$                                     |      |      | 6    | mA   |

**Table 9. Electrical characteristics of L78L12C ( $V_I = 19\text{ V}$ ) (continued)**

| Symbol       | Parameter                | Test conditions                                                                                       | Min. | Typ. | Max. | Unit          |
|--------------|--------------------------|-------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                      |      |      | 0.2  | mA            |
|              |                          | $V_I = 16\text{ to }27\text{ V}$                                                                      |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$ , $T_J = 25\text{ °C}$                                           |      | 80   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 15\text{ to }25\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ °C}$ | 36   | 42   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                       |      | 1.7  |      | V             |

**Table 10. Electrical characteristics of L78L15C ( $V_I = 23\text{ V}$ )**

| Symbol       | Parameter                | Test conditions                                                                                           | Min. | Typ. | Max. | Unit          |
|--------------|--------------------------|-----------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_O$        | Output voltage           | $T_J = 25\text{ °C}$                                                                                      | 13.8 | 15   | 16.2 | V             |
| $V_O$        | Output voltage           | $I_O = 1\text{ to }40\text{ mA}$ , $V_I = 17.5\text{ to }30\text{ V}$                                     | 13.5 |      | 16.5 | V             |
|              |                          | $I_O = 1\text{ to }70\text{ mA}$ , $V_I = 23\text{ V}$                                                    | 13.5 |      | 16.5 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 17.5\text{ to }30\text{ V}$ , $T_J = 25\text{ °C}$                                                 |      |      | 300  | mV            |
|              |                          | $V_I = 20\text{ to }30\text{ V}$ , $T_J = 25\text{ °C}$                                                   |      |      | 250  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1\text{ to }100\text{ mA}$ , $T_J = 25\text{ °C}$                                                  |      |      | 150  | mV            |
|              |                          | $I_O = 1\text{ to }40\text{ mA}$ , $T_J = 25\text{ °C}$                                                   |      |      | 75   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ °C}$                                                                                      |      |      | 6.5  | mA            |
|              |                          | $T_J = 125\text{ °C}$                                                                                     |      |      | 6    | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                          |      |      | 0.2  | mA            |
|              |                          | $V_I = 20\text{ to }30\text{ V}$                                                                          |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$ , $T_J = 25\text{ °C}$                                               |      | 90   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 18.5\text{ to }28.5\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ °C}$ | 33   | 39   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                           |      | 1.7  |      | V             |

**Table 11. Electrical characteristics of L78L18C ( $V_I = 27\text{ V}$ )**

| Symbol       | Parameter       | Test conditions                                                     | Min. | Typ. | Max. | Unit |
|--------------|-----------------|---------------------------------------------------------------------|------|------|------|------|
| $V_O$        | Output voltage  | $T_J = 25\text{ °C}$                                                | 16.6 | 18   | 19.4 | V    |
| $V_O$        | Output voltage  | $I_O = 1\text{ to }40\text{ mA}$ , $V_I = 22\text{ to }33\text{ V}$ | 16.2 |      | 19.8 | V    |
|              |                 | $I_O = 1\text{ to }70\text{ mA}$ , $V_I = 27\text{ V}$              | 16.2 |      | 19.8 |      |
| $\Delta V_O$ | Line regulation | $V_I = 22\text{ to }33\text{ V}$ , $T_J = 25\text{ °C}$             |      |      | 320  | mV   |
|              |                 | $V_I = 22\text{ to }33\text{ V}$ , $T_J = 25\text{ °C}$             |      |      | 270  |      |
| $\Delta V_O$ | Load regulation | $I_O = 1\text{ to }100\text{ mA}$ , $T_J = 25\text{ °C}$            |      |      | 170  | mV   |
|              |                 | $I_O = 1\text{ to }40\text{ mA}$ , $T_J = 25\text{ °C}$             |      |      | 85   |      |

**Table 11. Electrical characteristics of L78L18C ( $V_I = 27\text{ V}$ ) (continued)**

| Symbol       | Parameter                | Test conditions                                                                                             | Min. | Typ. | Max. | Unit          |
|--------------|--------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^\circ\text{C}$                                                                            |      |      | 6.5  | mA            |
|              |                          | $T_J = 125\text{ }^\circ\text{C}$                                                                           |      |      | 6    | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                            |      |      | 0.2  | mA            |
|              |                          | $V_I = 23\text{ to }33\text{ V}$                                                                            |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}, T_J = 25\text{ }^\circ\text{C}$                                        |      | 120  |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 23\text{ to }33\text{ V}, f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$ | 32   | 38   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                             |      | 1.7  |      | V             |

**Table 12. Electrical characteristics of L78L24C ( $V_I = 33\text{ V}$ )**

| 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           | $I_O = 1\text{ to }40\text{ mA}, V_I = 27\text{ to }38\text{ V}$                                            | 21.6 |      | 26.4 | V             |
|              |                          | $I_O = 1\text{ to }70\text{ mA}, V_I = 33\text{ V}$                                                         | 21.6 |      | 26.4 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 27\text{ to }38\text{ V}, T_J = 25\text{ }^\circ\text{C}$                                            |      |      | 350  | mV            |
|              |                          | $V_I = 28\text{ to }38\text{ V}, T_J = 25\text{ }^\circ\text{C}$                                            |      |      | 300  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1\text{ to }100\text{ mA}, T_J = 25\text{ }^\circ\text{C}$                                           |      |      | 200  | mV            |
|              |                          | $I_O = 1\text{ to }40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$                                            |      |      | 100  |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^\circ\text{C}$                                                                            |      |      | 6.5  | mA            |
|              |                          | $T_J = 125\text{ }^\circ\text{C}$                                                                           |      |      | 6    | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                            |      |      | 0.2  | mA            |
|              |                          | $V_I = 28\text{ to }38\text{ V}$                                                                            |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}, T_J = 25\text{ }^\circ\text{C}$                                        |      | 200  |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 29\text{ to }35\text{ V}, f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$ | 30   | 37   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                             |      | 1.7  |      | V             |

$T_J = 0\text{ to }125\text{ }^\circ\text{C}$  for L78L33AC,  $T_J = -40\text{ to }125\text{ }^\circ\text{C}$  for L78L33AB.

**Table 13. Electrical characteristics of L78L33AB and L78L33AC ( $V_I = 8.3\text{ V}$ )**

| 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  | $I_O = 1\text{ to }40\text{ mA}, V_I = 5.3\text{ to }20\text{ V}$ | 3.135 |      | 3.465 | V    |
|              |                 | $I_O = 1\text{ to }70\text{ mA}, V_I = 8.3\text{ V}$              | 3.135 |      | 3.465 |      |
| $\Delta V_O$ | Line regulation | $V_I = 5.3\text{ to }20\text{ V}, T_J = 25\text{ }^\circ\text{C}$ |       |      | 150   | mV   |
|              |                 | $V_I = 6.3\text{ to }20\text{ V}, T_J = 25\text{ }^\circ\text{C}$ |       |      | 100   |      |

**Table 13. Electrical characteristics of L78L33AB and L78L33AC ( $V_I = 8.3$  V) (continued)**

| Symbol       | Parameter                | Test conditions                                                     | Min. | Typ. | Max. | Unit    |
|--------------|--------------------------|---------------------------------------------------------------------|------|------|------|---------|
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to 100 mA, $T_J = 25$ °C                                  |      |      | 60   | mV      |
|              |                          | $I_O = 1$ to 40 mA, $T_J = 25$ °C                                   |      |      | 30   |         |
| $I_d$        | Quiescent current        | $T_J = 25$ °C                                                       |      |      | 6    | mA      |
|              |                          | $T_J = 125$ °C                                                      |      |      | 5.5  | mA      |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to 40 mA                                                  |      |      | 0.1  | mA      |
|              |                          | $V_I = 6.3$ to 20 V                                                 |      |      | 1.5  |         |
| eN           | Output noise voltage     | B = 10 Hz to 100 kHz, $T_J = 25$ °C                                 |      | 40   |      | $\mu$ V |
| SVR          | Supply voltage rejection | $V_I = 6.3$ to 16.3 V, $f = 120$ Hz<br>$I_O = 40$ mA, $T_J = 25$ °C | 41   | 49   |      | dB      |
| $V_d$        | Dropout voltage          |                                                                     |      | 1.7  |      | V       |

$T_J = 0$  to 125 °C for L78L05AC,  $T_J = -40$  to 125 °C for L78L05AB.

**Table 14. Electrical characteristics of L78L05AB and L78L05AC ( $V_I = 10$  V)**

| Symbol       | Parameter                | Test conditions                                                 | Min. | Typ. | Max. | Unit    |
|--------------|--------------------------|-----------------------------------------------------------------|------|------|------|---------|
| $V_O$        | Output voltage           | $T_J = 25$ °C                                                   | 4.8  | 5    | 5.2  | V       |
| $V_O$        | Output voltage           | $I_O = 1$ to 40 mA, $V_I = 7$ to 20 V                           | 4.75 |      | 5.25 | V       |
|              |                          | $I_O = 1$ to 70 mA, $V_I = 10$ V                                | 4.75 |      | 5.25 |         |
| $\Delta V_O$ | Line regulation          | $V_I = 7$ to 20 V, $T_J = 25$ °C                                |      |      | 150  | mV      |
|              |                          | $V_I = 8$ to 20 V, $T_J = 25$ °C                                |      |      | 100  |         |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to 100 mA, $T_J = 25$ °C                              |      |      | 60   | mV      |
|              |                          | $I_O = 1$ to 40 mA, $T_J = 25$ °C                               |      |      | 30   |         |
| $I_d$        | Quiescent current        | $T_J = 25$ °C                                                   |      |      | 6    | mA      |
|              |                          | $T_J = 125$ °C                                                  |      |      | 5.5  | mA      |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to 40 mA                                              |      |      | 0.1  | mA      |
|              |                          | $V_I = 8$ to 20 V                                               |      |      | 1.5  |         |
| eN           | Output noise voltage     | B = 10 Hz to 100 kHz, $T_J = 25$ °C                             |      | 40   |      | $\mu$ V |
| SVR          | Supply voltage rejection | $V_I = 8$ to 18 V, $f = 120$ Hz<br>$I_O = 40$ mA, $T_J = 25$ °C | 41   | 49   |      | dB      |
| $V_d$        | Dropout voltage          |                                                                 |      | 1.7  |      | V       |

$T_J = 0$  to 125 °C for L78L06AC,  $T_J = -40$  to 125 °C for L78L06AB.

**Table 15. Electrical characteristics of L78L06AB and L78L06AC ( $V_I = 12\text{ V}$ )**

| 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           | $I_O = 1\text{ to }40\text{ mA}, V_I = 8.5\text{ to }20\text{ V}$                                          | 5.7  |      | 6.3  | V             |
|              |                          | $I_O = 1\text{ to }70\text{ mA}, V_I = 12\text{ V}$                                                        | 5.7  |      | 6.3  |               |
| $\Delta V_O$ | Line regulation          | $V_I = 8.5\text{ to }20\text{ V}, T_J = 25\text{ }^\circ\text{C}$                                          |      |      | 150  | mV            |
|              |                          | $V_I = 9\text{ to }20\text{ V}, T_J = 25\text{ }^\circ\text{C}$                                            |      |      | 100  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1\text{ to }100\text{ mA}, T_J = 25\text{ }^\circ\text{C}$                                          |      |      | 60   | mV            |
|              |                          | $I_O = 1\text{ to }40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$                                           |      |      | 30   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^\circ\text{C}$                                                                           |      |      | 6    | mA            |
|              |                          | $T_J = 125\text{ }^\circ\text{C}$                                                                          |      |      | 5.5  | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                           |      |      | 0.1  | mA            |
|              |                          | $V_I = 9\text{ to }20\text{ V}$                                                                            |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}, T_J = 25\text{ }^\circ\text{C}$                                       |      | 50   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 9\text{ to }20\text{ V}, f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$ | 39   | 46   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                            |      | 1.7  |      | V             |

$T_J = 0\text{ to }125\text{ }^\circ\text{C}$  for L78L08AC,  $T_J = -40\text{ to }125\text{ }^\circ\text{C}$  for L78L08AB.

**Table 16. Electrical characteristics of L78L08AB and L78L08AC ( $V_I = 14\text{ V}$ )**

| 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           | $I_O = 1\text{ to }40\text{ mA}, V_I = 10.5\text{ to }23\text{ V}$                                          | 7.6  |      | 8.4  | V             |
|              |                          | $I_O = 1\text{ to }70\text{ mA}, V_I = 14\text{ V}$                                                         | 7.6  |      | 8.4  |               |
| $\Delta V_O$ | Line regulation          | $V_I = 10.5\text{ to }23\text{ V}, T_J = 25\text{ }^\circ\text{C}$                                          |      |      | 175  | mV            |
|              |                          | $V_I = 11\text{ to }23\text{ V}, T_J = 25\text{ }^\circ\text{C}$                                            |      |      | 125  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1\text{ to }100\text{ mA}, T_J = 25\text{ }^\circ\text{C}$                                           |      |      | 80   | mV            |
|              |                          | $I_O = 1\text{ to }40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$                                            |      |      | 40   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^\circ\text{C}$                                                                            |      |      | 6    | mA            |
|              |                          | $T_J = 125\text{ }^\circ\text{C}$                                                                           |      |      | 5.5  | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1\text{ to }40\text{ mA}$                                                                            |      |      | 0.1  | mA            |
|              |                          | $V_I = 11\text{ to }23\text{ V}$                                                                            |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}, T_J = 25\text{ }^\circ\text{C}$                                        |      | 60   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 12\text{ to }23\text{ V}, f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}, T_J = 25\text{ }^\circ\text{C}$ | 37   | 45   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                             |      | 1.7  |      | V             |

$T_J = 0$  to  $125\text{ }^{\circ}\text{C}$  for L78L09AC,  $T_J = -40$  to  $125\text{ }^{\circ}\text{C}$  for L78L09AB.

**Table 17. Electrical characteristics of L78L09AB and L78L09AC ( $V_I = 15\text{ V}$ )**

| 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           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 11.5$ to $23\text{ V}$                                                    | 8.55 |      | 9.45 | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 15\text{ V}$                                                              | 8.55 |      | 9.45 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 11.5$ to $23\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                             |      |      | 225  | mV            |
|              |                          | $V_I = 12$ to $23\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 150  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                              |      |      | 80   | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 40   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                             |      |      | 6    | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                            |      |      | 5.5  | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                    |      |      | 0.1  | mA            |
|              |                          | $V_I = 12$ to $23\text{ V}$                                                                                    |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                    |      | 70   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 12$ to $23\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 37   | 44   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                |      | 1.7  |      | V             |

$T_J = 0$  to  $125\text{ }^{\circ}\text{C}$  for L78L10AC,  $T_J = -40$  to  $125\text{ }^{\circ}\text{C}$  for L78L10AB.

**Table 18. Electrical characteristics of L78L10AC ( $V_I = 16\text{ V}$ )**

| Symbol       | Parameter                | Test conditions                                                                                                | Min. | Typ. | Max. | Unit          |
|--------------|--------------------------|----------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_O$        | Output voltage           | $T_J = 25\text{ }^{\circ}\text{C}$                                                                             | 9.6  | 10   | 10.4 | V             |
| $V_O$        | Output voltage           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 12.5$ to $23\text{ V}$                                                    | 9.5  |      | 10.5 | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 16\text{ V}$                                                              | 9.5  |      | 10.5 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 12.5$ to $23\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                             |      |      | 230  | mV            |
|              |                          | $V_I = 13$ to $23\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 170  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                              |      |      | 80   | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 40   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                             |      |      | 6    | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                            |      |      | 5.5  | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                    |      |      | 0.1  | mA            |
|              |                          | $V_I = 13$ to $23\text{ V}$                                                                                    |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                    |      | 60   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 14$ to $23\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 37   | 45   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                |      | 1.7  |      | V             |

$T_J = 0$  to  $125\text{ }^{\circ}\text{C}$  for L78L12AC,  $T_J = -40$  to  $125\text{ }^{\circ}\text{C}$  for L78L12AB.

**Table 19. Electrical characteristics of L78L12AB and L78L12AC ( $V_I = 19\text{ V}$ )**

| 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           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 14.5$ to $27\text{ V}$                                                    | 11.4 |      | 12.6 | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 19\text{ V}$                                                              | 11.4 |      | 12.6 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 14.5$ to $27\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                             |      |      | 250  | mV            |
|              |                          | $V_I = 16$ to $27\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 200  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                              |      |      | 100  | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 50   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                             |      |      | 6.5  | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                            |      |      | 6    | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                    |      |      | 0.1  | mA            |
|              |                          | $V_I = 16$ to $27\text{ V}$                                                                                    |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                    |      | 80   |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 15$ to $25\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 37   | 42   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                |      | 1.7  |      | V             |

$T_J = 0$  to  $125\text{ }^{\circ}\text{C}$  for L78L15AC,  $T_J = -40$  to  $125\text{ }^{\circ}\text{C}$  for L78L15AB.

**Table 20. Electrical characteristics of L78L15AB and L78L15AC ( $V_I = 23\text{ V}$ )**

| 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           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 17.5$ to $30\text{ V}$                                                        | 14.25 |      | 15.75 | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 23\text{ V}$                                                                  | 14.25 |      | 15.75 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 17.5$ to $30\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                 |       |      | 300   | mV            |
|              |                          | $V_I = 20$ to $30\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                   |       |      | 250   |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                  |       |      | 150   | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                                   |       |      | 75    |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                                 |       |      | 6.5   | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                                |       |      | 6     | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                        |       |      | 0.1   | mA            |
|              |                          | $V_I = 20$ to $30\text{ V}$                                                                                        |       |      | 1.5   |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                        |       | 90   |       | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 18.5$ to $28.5\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 34    | 39   |       | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                    |       | 1.7  |       | V             |

$T_J = 0$  to  $125\text{ }^{\circ}\text{C}$  for L78L18AC,  $T_J = -40$  to  $125\text{ }^{\circ}\text{C}$  for L78L18AB.

**Table 21. Electrical characteristics of L78L18AC ( $V_I = 27\text{ V}$ )**

| 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           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 22$ to $33\text{ V}$                                                      | 17.1 |      | 18.9 | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 27\text{ V}$                                                              | 17.1 |      | 18.9 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 22$ to $33\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 320  | mV            |
|              |                          | $V_I = 22$ to $33\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 270  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                              |      |      | 170  | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 85   |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                             |      |      | 6.5  | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                            |      |      | 6    | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                    |      |      | 0.1  | mA            |
|              |                          | $V_I = 23$ to $33\text{ V}$                                                                                    |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                    |      | 120  |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 23$ to $33\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 33   | 38   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                |      | 1.7  |      | V             |

$T_J = 0$  to  $125\text{ }^{\circ}\text{C}$  for L78L24AC,  $T_J = -40$  to  $125\text{ }^{\circ}\text{C}$  for L78L24AB.

**Table 22. Electrical characteristics of L78L24AB and L78L24AC ( $V_I = 33\text{ V}$ )**

| 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           | $I_O = 1$ to $40\text{ mA}$ , $V_I = 27$ to $38\text{ V}$                                                      | 22.8 |      | 25.2 | V             |
|              |                          | $I_O = 1$ to $70\text{ mA}$ , $V_I = 33\text{ V}$                                                              | 22.8 |      | 25.2 |               |
| $\Delta V_O$ | Line regulation          | $V_I = 27$ to $38\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 350  | mV            |
|              |                          | $V_I = 28$ to $38\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 300  |               |
| $\Delta V_O$ | Load regulation          | $I_O = 1$ to $100\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                              |      |      | 200  | mV            |
|              |                          | $I_O = 1$ to $40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                               |      |      | 100  |               |
| $I_d$        | Quiescent current        | $T_J = 25\text{ }^{\circ}\text{C}$                                                                             |      |      | 6.5  | mA            |
|              |                          | $T_J = 125\text{ }^{\circ}\text{C}$                                                                            |      |      | 6    | mA            |
| $\Delta I_d$ | Quiescent current change | $I_O = 1$ to $40\text{ mA}$                                                                                    |      |      | 0.1  | mA            |
|              |                          | $V_I = 28$ to $38\text{ V}$                                                                                    |      |      | 1.5  |               |
| eN           | Output noise voltage     | $B = 10\text{ Hz}$ to $100\text{ kHz}$ , $T_J = 25\text{ }^{\circ}\text{C}$                                    |      | 200  |      | $\mu\text{V}$ |
| SVR          | Supply voltage rejection | $V_I = 29$ to $33\text{ V}$ , $f = 120\text{ Hz}$<br>$I_O = 40\text{ mA}$ , $T_J = 25\text{ }^{\circ}\text{C}$ | 31   | 37   |      | dB            |
| $V_d$        | Dropout voltage          |                                                                                                                |      | 1.7  |      | V             |

# 5 Typical performance

Figure 4. L78L05/12 output voltage vs. ambient temperature

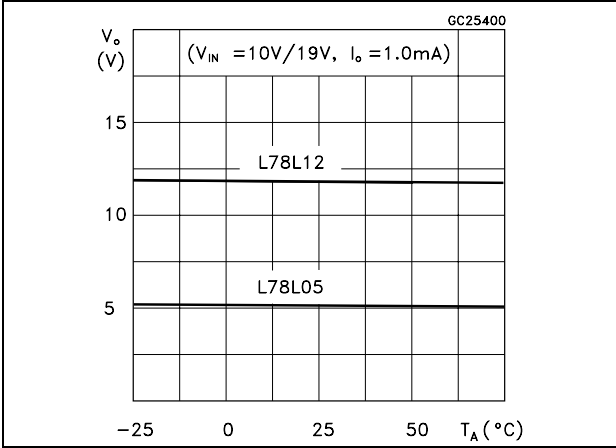


Figure 5. L78L05/12/24 load characteristics

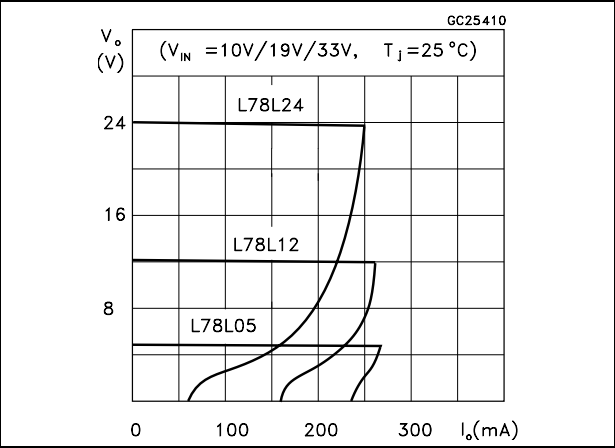


Figure 6. L78L05/12/24 thermal shutdown

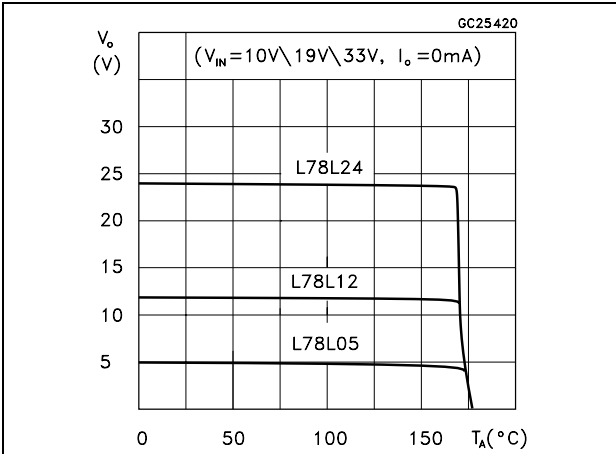


Figure 7. L78L05/12 quiescent current vs. output current

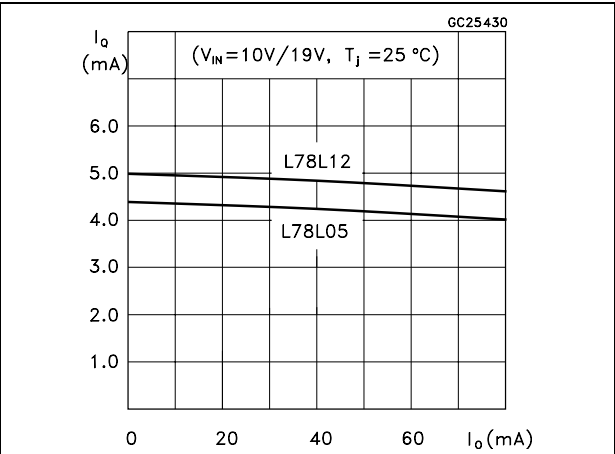


Figure 8. L78L05 quiescent current vs. input voltage

Figure 9. L78L05/12/24 output characteristics

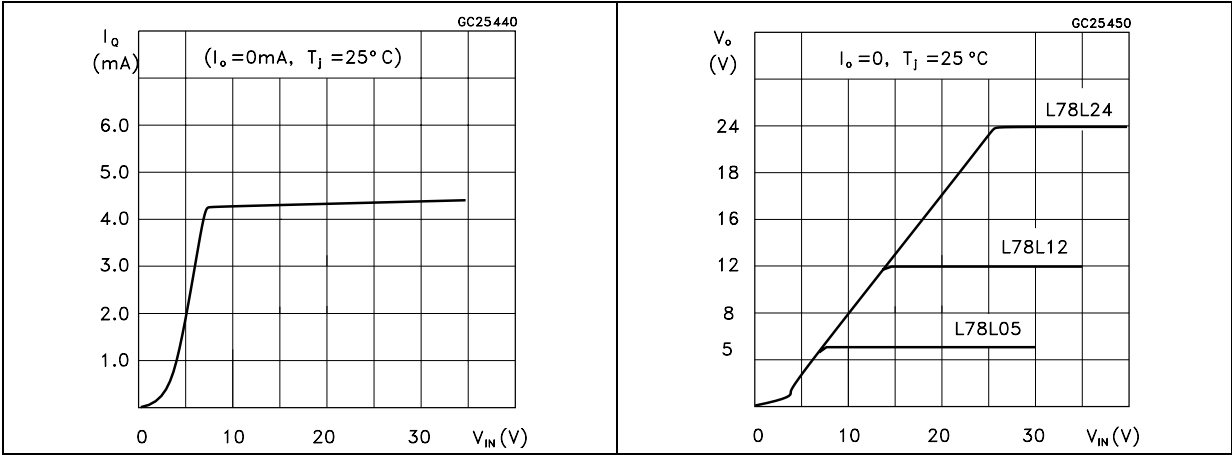


Figure 10. L78L05/12/24 ripple rejection

Figure 11. L78L05 dropout characteristics

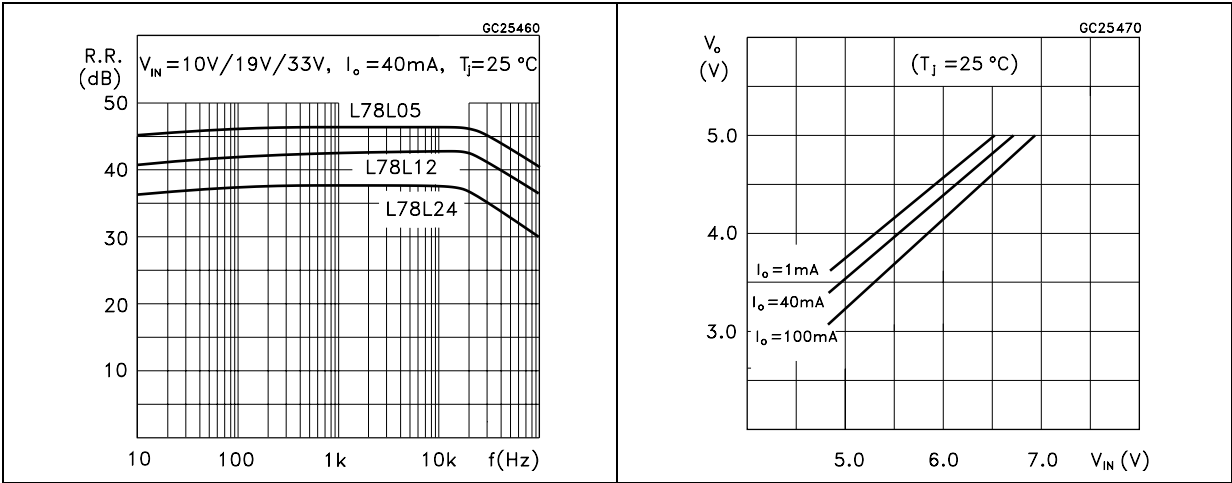
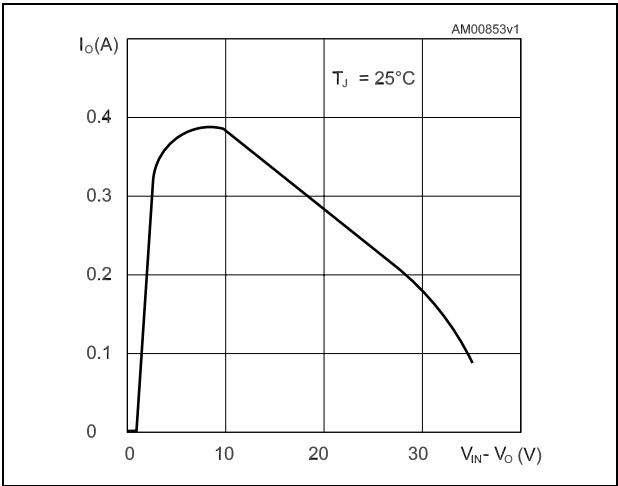


Figure 12. L78Lxx short-circuit output current



## 6 Typical application

Figure 13. High output current short-circuit protected

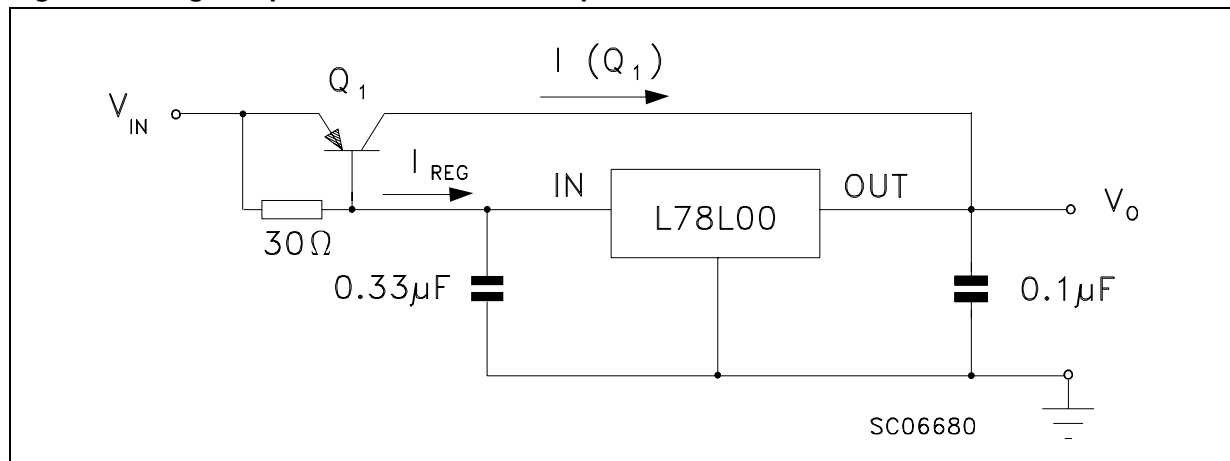


Figure 14. Edit boost circuit

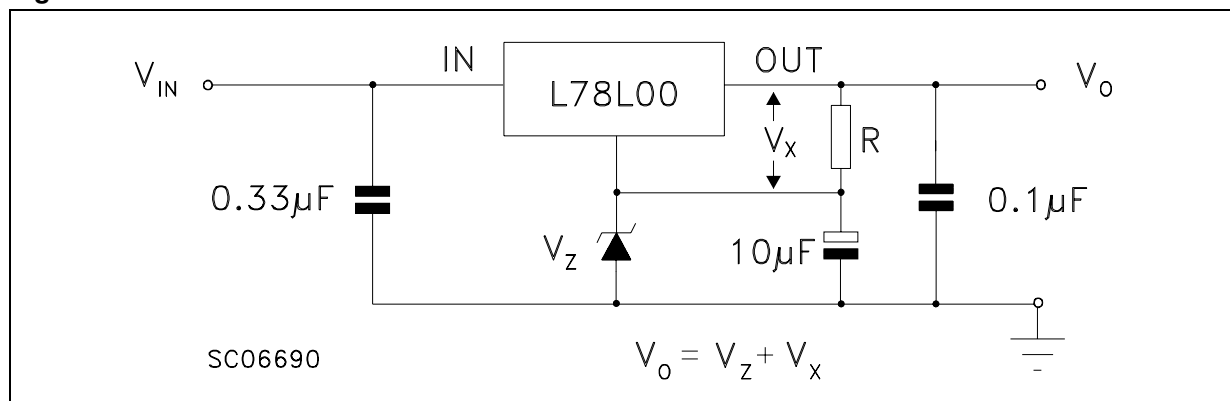


Figure 15. Current regulator

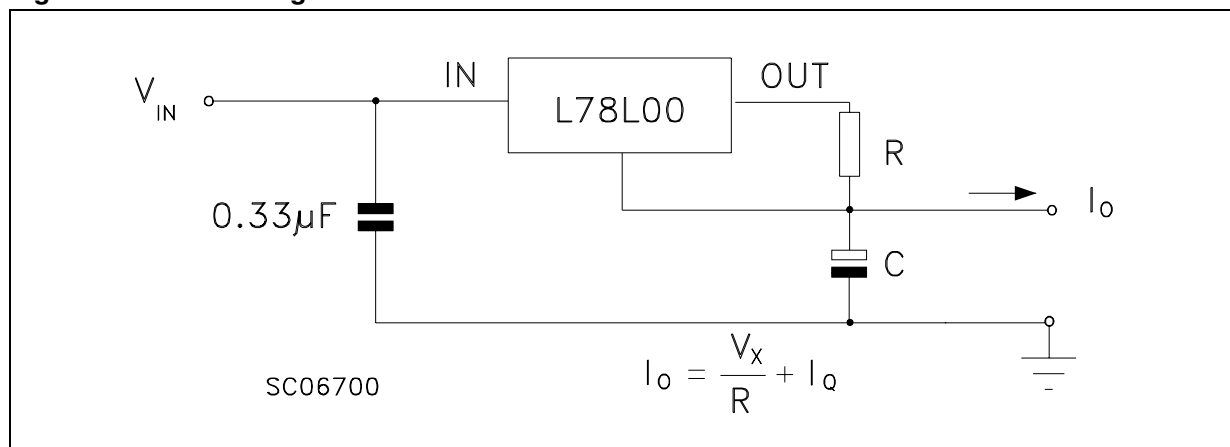
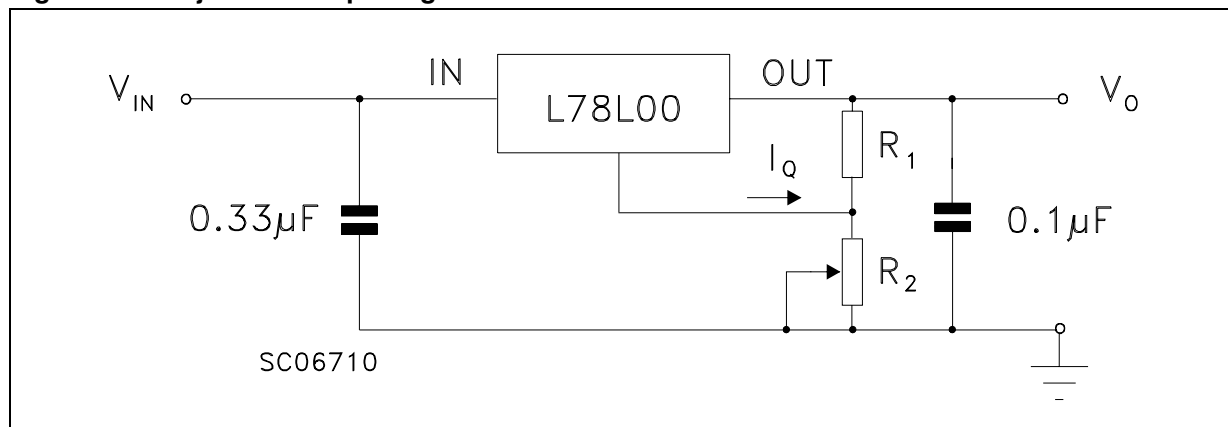


Figure 16. Adjustable output regulator

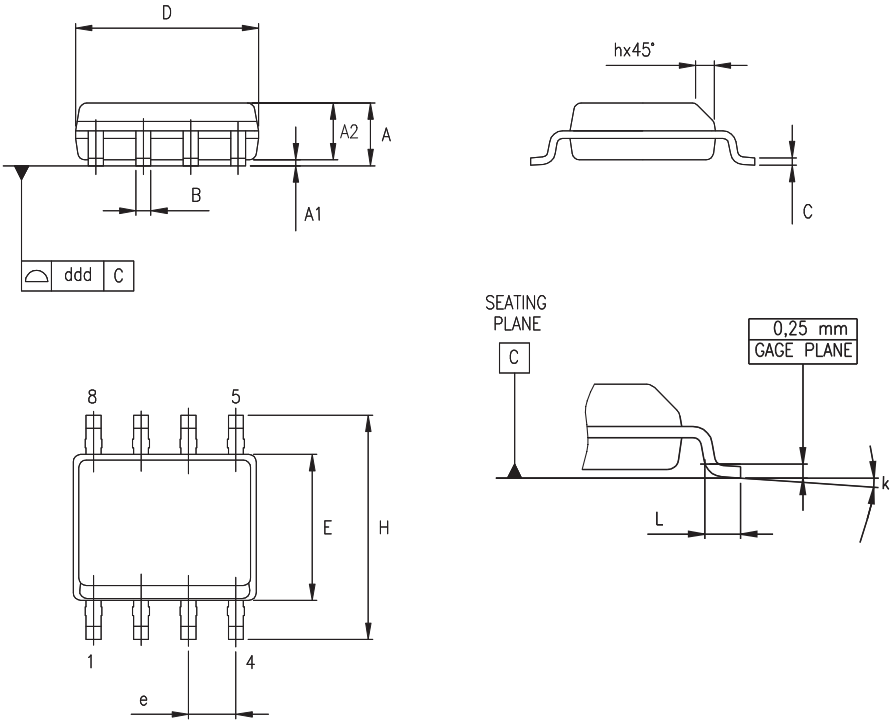


## 7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

SO-8 mechanical data

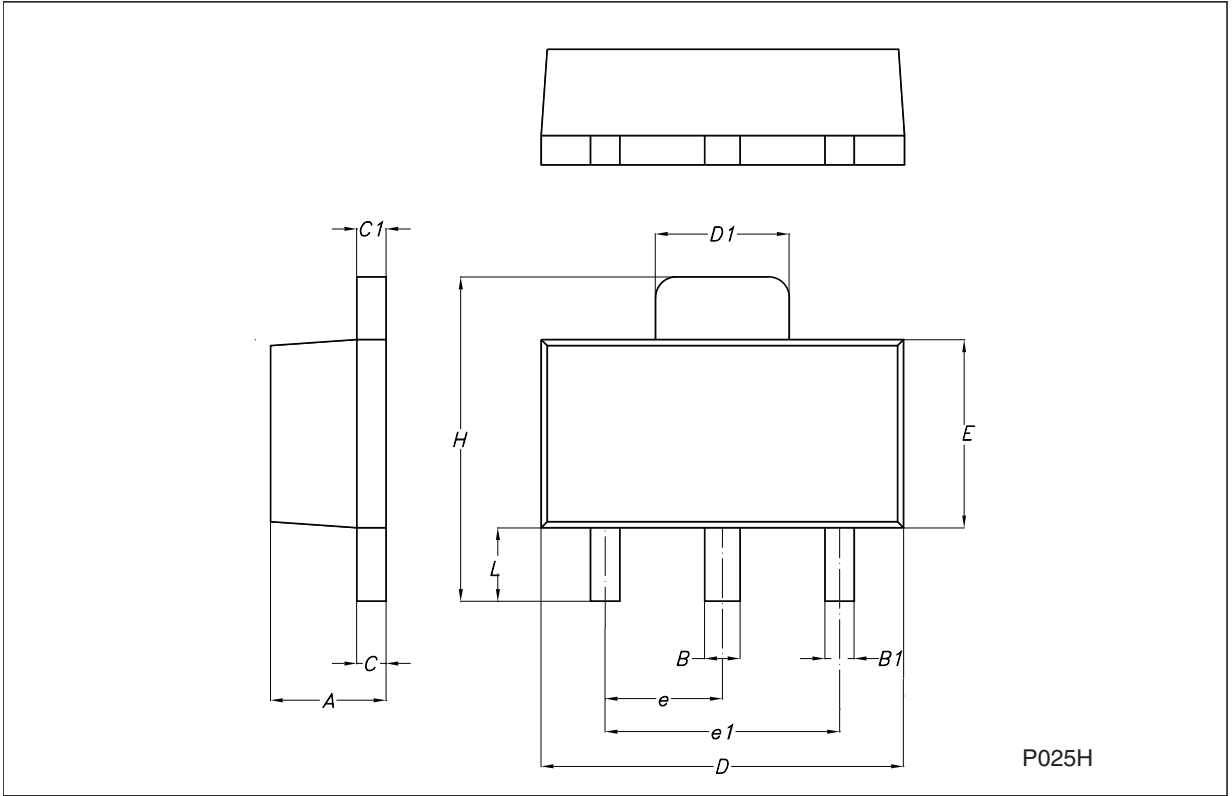
| Dim. | mm.       |      |      | inch. |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | Min.      | Typ. | Max. | Min.  | Typ.  | Max.  |
| A    | 1.35      |      | 1.75 | 0.053 |       | 0.069 |
| A1   | 0.10      |      | 0.25 | 0.04  |       | 0.010 |
| A2   | 1.10      |      | 1.65 | 0.043 |       | 0.065 |
| B    | 0.33      |      | 0.51 | 0.013 |       | 0.020 |
| C    | 0.19      |      | 0.25 | 0.007 |       | 0.010 |
| D    | 4.80      |      | 5.00 | 0.189 |       | 0.197 |
| E    | 3.80      |      | 4.00 | 0.150 |       | 0.157 |
| e    |           | 1.27 |      |       | 0.050 |       |
| H    | 5.80      |      | 6.20 | 0.228 |       | 0.244 |
| h    | 0.25      |      | 0.50 | 0.010 |       | 0.020 |
| L    | 0.40      |      | 1.27 | 0.016 |       | 0.050 |
| k    | 8° (max.) |      |      |       |       |       |
| ddd  |           |      | 0.1  |       |       | 0.04  |



0016023/C

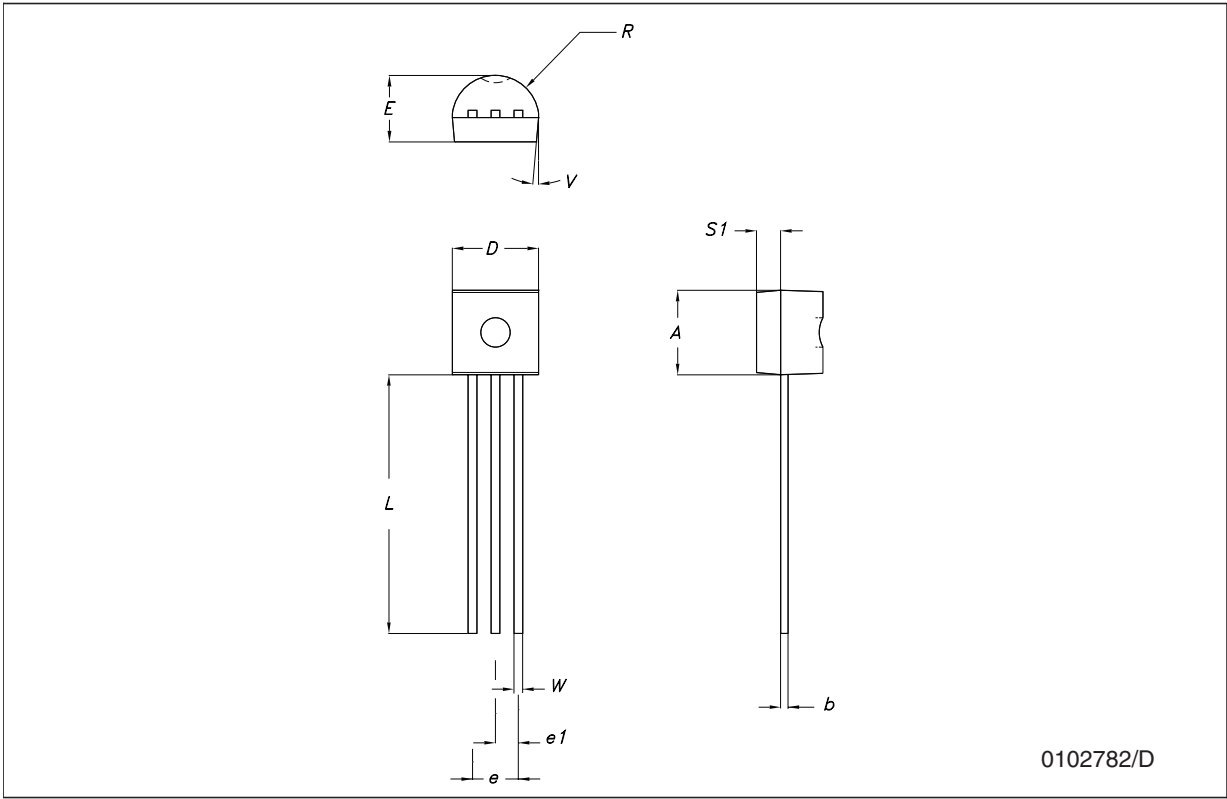
SOT-89 mechanical data

| 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  |



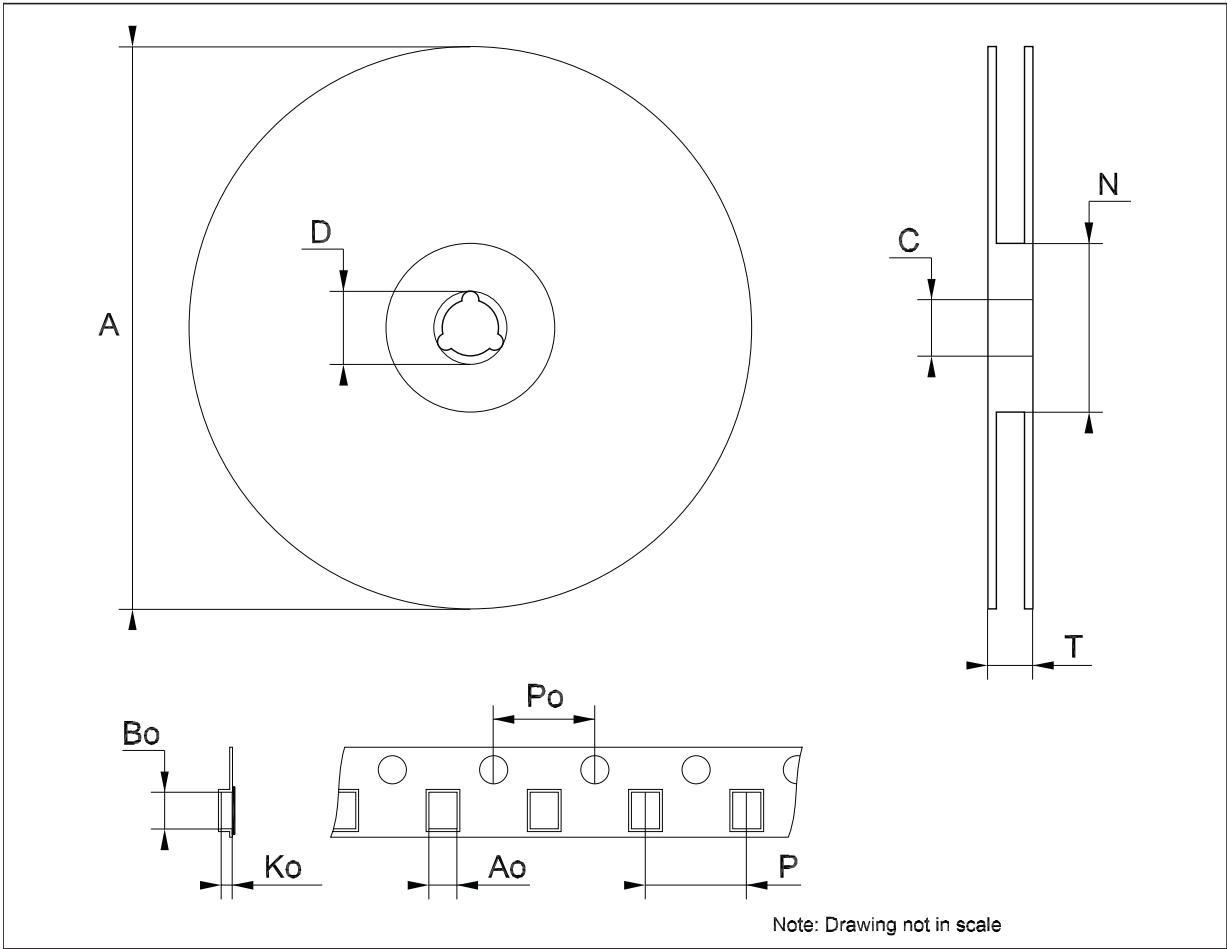
TO-92 mechanical data

| Dim.     | mm.  |      |       | mils. |      |       |
|----------|------|------|-------|-------|------|-------|
|          | Min. | Typ. | Max.  | Min.  | Typ. | Max.  |
| A        | 4.32 |      | 4.95  | 170.1 |      | 194.9 |
| b        | 0.36 |      | 0.51  | 14.2  |      | 20.1  |
| D        | 4.45 |      | 4.95  | 175.2 |      | 194.9 |
| E        | 3.30 |      | 3.94  | 129.9 |      | 155.1 |
| e        | 2.41 |      | 2.67  | 94.9  |      | 105.1 |
| e1       | 1.14 |      | 1.40  | 44.9  |      | 55.1  |
| L        | 12.7 |      | 15.49 | 500.0 |      | 609.8 |
| R        | 2.16 |      | 2.41  | 85.0  |      | 94.9  |
| S1       | 0.92 |      | 1.52  | 36.2  |      | 59.8  |
| W        | 0.41 |      | 0.56  | 16.1  |      | 22.0  |
| $\alpha$ |      | 5°   |       |       | 5°   |       |



Tape & reel SO-8 mechanical data

| Dim. | mm.  |      |      | inch. |      |        |
|------|------|------|------|-------|------|--------|
|      | Min. | Typ. | Max. | Min.  | Typ. | Max.   |
| A    |      |      | 330  |       |      | 12.992 |
| C    | 12.8 |      | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |      |      | 0.795 |      |        |
| N    | 60   |      |      | 2.362 |      |        |
| T    |      |      | 22.4 |       |      | 0.882  |
| Ao   | 8.1  |      | 8.5  | 0.319 |      | 0.335  |
| Bo   | 5.5  |      | 5.9  | 0.216 |      | 0.232  |
| Ko   | 2.1  |      | 2.3  | 0.082 |      | 0.090  |
| Po   | 3.9  |      | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |      | 8.1  | 0.311 |      | 0.319  |



Tape & reel SOT-89 mechanical data

| Dim. | mm.  |      |      | inch. |       |       |
|------|------|------|------|-------|-------|-------|
|      | Min. | Typ. | Max. | Min.  | Typ.  | Max.  |
| A    |      |      | 180  |       |       | 7.086 |
| C    | 12.8 | 13.0 | 13.2 | 0.504 | 0.512 | 0.519 |
| D    | 20.2 |      |      | 0.795 |       |       |
| N    | 60   |      |      | 2.362 |       |       |
| T    |      |      | 14.4 |       |       | 0.567 |
| Ao   | 4.70 | 4.80 | 4.90 | 0.185 | 0.189 | 0.193 |
| Bo   | 4.30 | 4.40 | 4.50 | 0.169 | 0.173 | 0.177 |
| Ko   | 1.70 | 1.80 | 1.90 | 0.067 | 0.071 | 0.075 |
| Po   | 3.9  | 4.0  | 4.1  | 0.153 | 0.157 | 0.161 |
| P    | 7.9  | 8.0  | 8.1  | 0.311 | 0.315 | 0.319 |

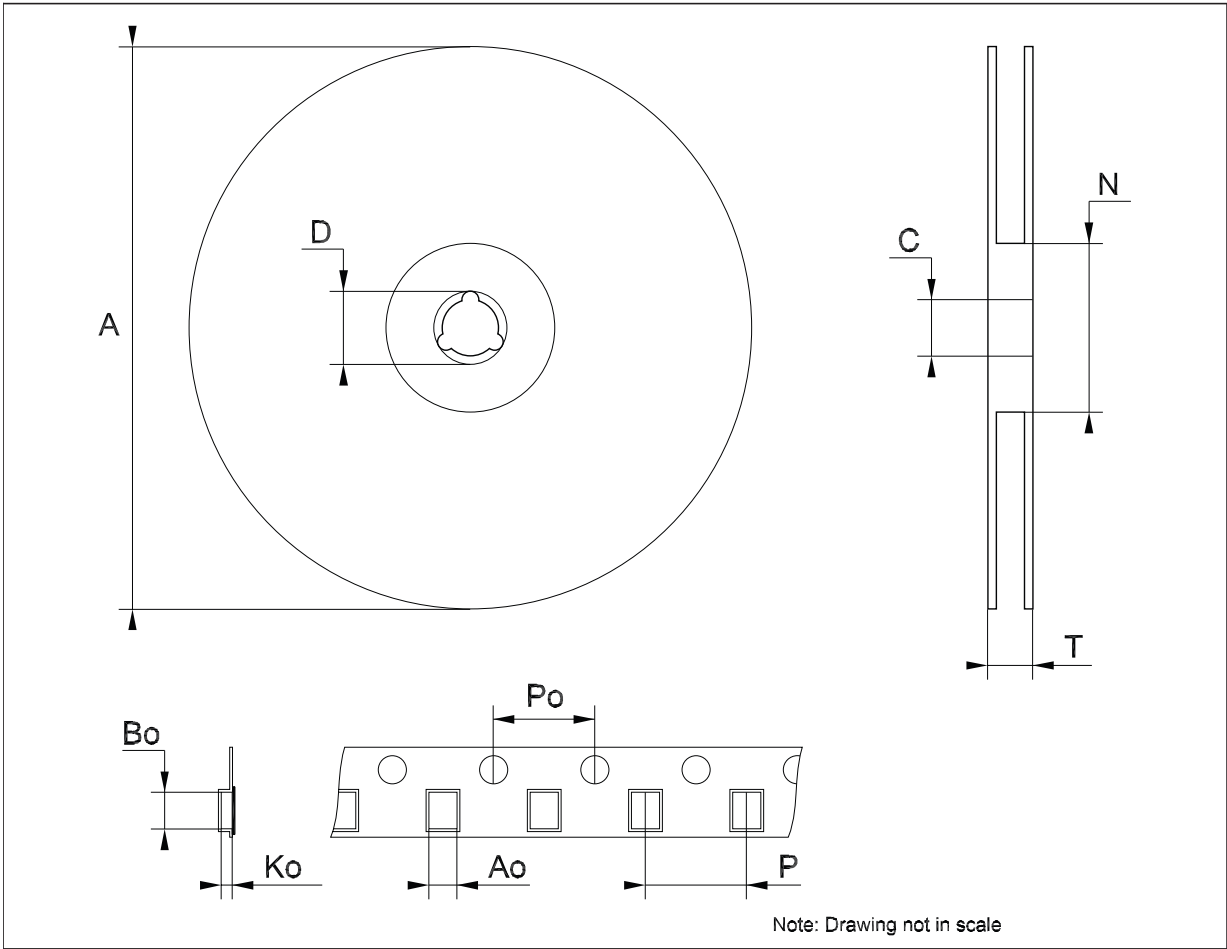
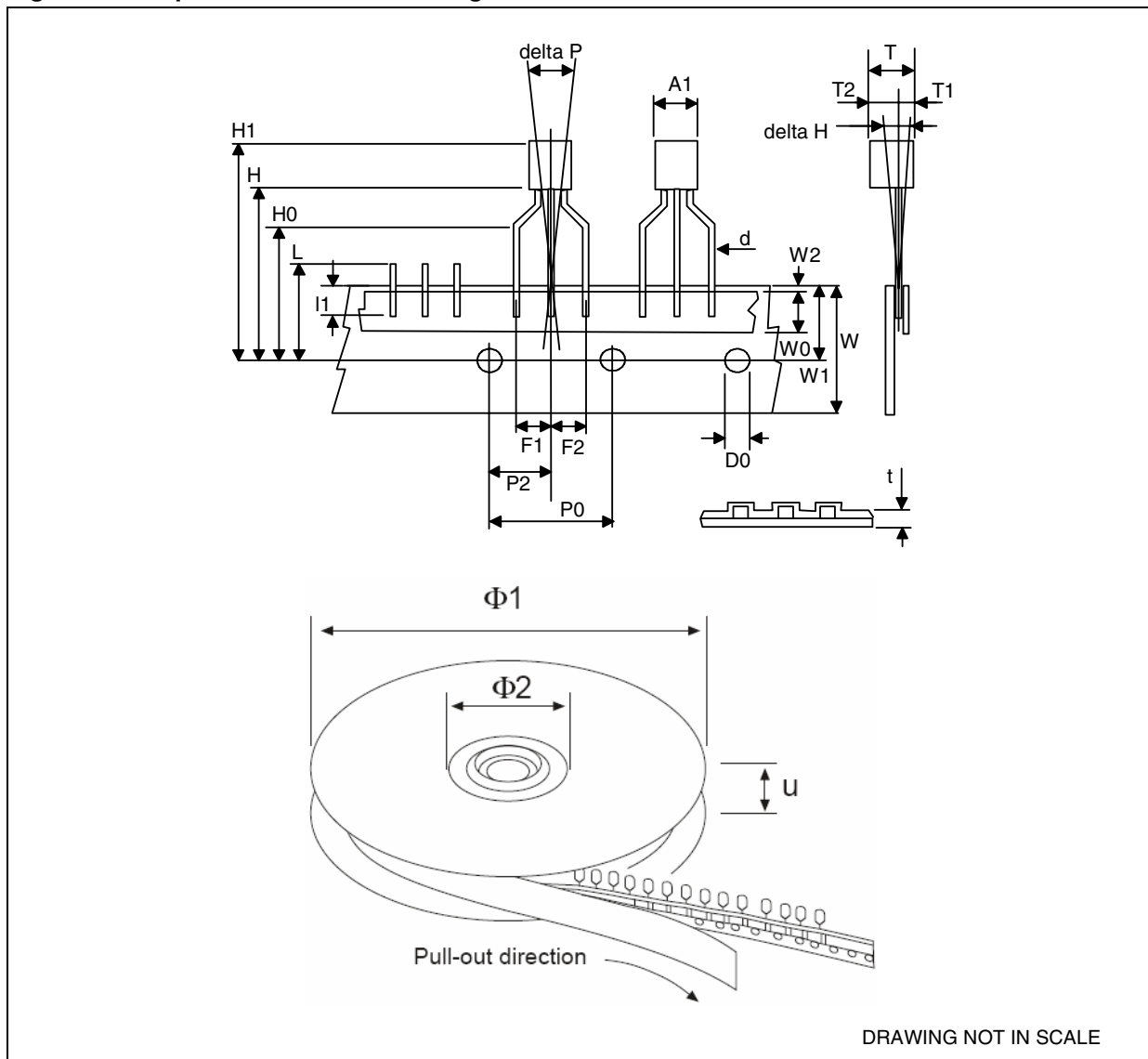


Table 23. Tape and reel TO-92 mechanical data

| Dim.              | mm.   |       |       | inch. |        |       |
|-------------------|-------|-------|-------|-------|--------|-------|
|                   | Min.  | Typ.  | Max.  | Min.  | Typ.   | Max.  |
| A1 <sup>(1)</sup> |       | 4.80  |       |       | 0.189  |       |
| T <sup>(1)</sup>  |       | 3.80  |       |       | 0.150  |       |
| T1                |       | 1.60  |       |       | 0.063  |       |
| T2                |       | 2.30  |       |       | 0.091  |       |
| d                 |       | 0.48  |       |       | 0.019  |       |
| P0                | 12.5  |       | 12.9  | 0.492 |        | 0.508 |
| P2                | 5.65  |       | 7.05  | 0.222 |        | 0.278 |
| F1, F2            | 2.44  | 2.54  | 2.94  | 0.096 | 0.100  | 0.116 |
| delta H           |       | ±2    |       |       | 0.079  |       |
| W                 | 17.5  | 18.00 | 19.0  | 0.689 | 0.709  | 0.748 |
| W0                | 5.7   |       | 6.3   | 0.224 |        | 0.248 |
| W1                | 8.5   |       | 9.25  | 0.335 |        | 0.364 |
| W2                |       | 0.50  |       |       | 0.20   |       |
| H                 |       | 18.50 | 18.70 |       | 0.728  | 0.726 |
| H0                | 15.50 |       | 16.50 | 0.610 |        | 0.650 |
| H1                |       | 25.00 |       |       | 0.984  |       |
| D0                | 3.8   |       | 4.2   | 0.150 |        | 0.165 |
| t                 |       | 0.90  |       |       | 0.035  |       |
| L1                |       | 3     |       |       | 0.118  |       |
| delta P           |       | ±1    |       |       | 0.039  |       |
| u                 |       | 50    |       |       | 1.968  |       |
| Φ1                |       | 360   |       |       | 14.173 |       |
| Φ2                |       | 30    |       |       | 1.181  |       |

1. For the MAX and MIN values refer to the TO-92 mechanical data [on page 23](#).

Figure 17. Tape and reel TO-92 drawing dimension



## 8 Order codes

Table 24. Order codes

| Part numbers | Packages      |                           |             | Output voltages |
|--------------|---------------|---------------------------|-------------|-----------------|
|              | SO-8          | TO92 (BAG) <sup>(1)</sup> | SOT-89      |                 |
| L78L33C      | L78L33CD-TR   |                           |             | 3.3 V           |
| L78L33AC     | L78L33ACD13TR | L78L33ACZ                 | L78L33ACUTR | 3.3 V           |
| L78L33AB     | L78L33ABD-TR  | L78L33ABZ                 | L78L33ABUTR | 3.3 V           |
| L78L05C      | L78L05CD13TR  | L78L05CZ                  |             | 5 V             |
| L78L05AC     | L78L05ACD13TR | L78L05ACZ                 | L78L05ACUTR | 5 V             |
| L78L05AB     | L78L05ABD13TR | L78L05ABZ                 | L78L05ABUTR | 5 V             |
| L78L06AC     | L78L06ACD13TR | L78L06ACZ                 | L78L06ACUTR | 6 V             |
| L78L06AB     | L78L06ABD13TR | L78L06ABZ                 | L78L06ABUTR | 6 V             |
| L78L08C      | L78L08CD13TR  |                           |             | 8 V             |
| L78L08AC     | L78L08ACD13TR | L78L08ACZ                 | L78L08ACUTR | 8 V             |
| L78L08AB     | L78L08ABD13TR | L78L08ABZ                 | L78L08ABUTR | 8 V             |
| L78L09C      | L78L09CD13TR  |                           |             | 9 V             |
| L78L09AC     | L78L09ACD13TR | L78L09ACZ                 | L78L09ACUTR | 9 V             |
| L78L09AB     | L78L09ABD13TR | L78L09ABZ                 | L78L09ABUTR | 9 V             |
| L78L10AC     |               |                           | L78L10ACUTR | 10 V            |
| L78L12C      | L78L12CD13TR  |                           |             | 12 V            |
| L78L12AC     | L78L12ACD13TR | L78L12ACZ                 | L78L12ACUTR | 12 V            |
| L78L12AB     | L78L12ABD-TR  | L78L12ABZ                 | L78L12ABUTR | 12 V            |
| L78L15C      | L78L15CD-TR   |                           |             | 15 V            |
| L78L15AC     | L78L15ACD13TR | L78L15ACZ                 | L78L15ACUTR | 15 V            |
| L78L15AB     |               | L78L15ABZ                 | L78L15ABUTR | 15 V            |
| L78L18C      | L78L18CD13TR  |                           |             | 18 V            |
| L78L18AC     |               |                           | L78L18ACUTR | 18 V            |
| L78L24C      | L78L24CD-TR   |                           |             | 24 V            |
| L78L24AC     |               | L78L24ACZ                 | L78L24ACUTR | 24 V            |
| L78L24AB     |               | L78L24ABZ                 |             | 24 V            |

1. Available in Ammopak with the suffix "-AP" or in tape and reel with the suffix "TR". Please note that in these cases pins are shaped according to tape and reel specifications.

Table 25. Marking information

| Part numbers | Marking | Packages | Output voltages |
|--------------|---------|----------|-----------------|
| L78L05ABD    | 78L05B  | SO8      | 5 V             |
| L78L05ABUTR  | 8C      | SOT 89   | 5 V             |
| L78L05ABZ    | L78L05  | TO 92    | 5 V             |
| L78L05ABZ-AP | L78L05  | TO 92    | 5 V             |
| L78L05ABZ-TR | L78L05  | TO 92    | 5 V             |
| L78L05ACD    | 78L05A  | SO8      | 5 V             |
| L78L05ACUTR  | 8C      | SOT 89   | 5 V             |
| L78L05ACZ    | L78L05  | TO 92    | 5 V             |
| L78L05ACZ-AP | L78L05  | TO 92    | 5 V             |
| L78L05ACZTR  | L78L05  | TO 92    | 5 V             |
| L78L05CD     | 78L05   | SO8      | 5 V             |
| L78L05CZ     | L78L05  | TO 92    | 5 V             |
| L78L06ABD    | 78L06B  | SO8      | 6 V             |
| L78L06ABUTR  | 8E      | SOT 89   | 6 V             |
| L78L06ABZ    | L78L06  | TO 92    | 6 V             |
| L78L06ACD    | 78L06A  | SO8      | 6 V             |
| L78L06ACUTR  | 8E      | SOT 89   | 6 V             |
| L78L06ACZ    | L78L06  | TO 92    | 6 V             |
| L78L06ACZ-AP | L78L06  | TO 92    | 6 V             |
| L78L06ACZ-TR | L78L06  | TO 92    | 6 V             |
| L78L06CD     | 78L06   | SO8      | 6 V             |
| L78L08ABD    | 78L08B  | SO8      | 8 V             |
| L78L08ABUTR  | 8G      | SOT 89   | 8 V             |
| L78L08ABZ    | L78L08  | TO 92    | 8 V             |
| L78L08ABZ-AP | L78L08  | TO 92    | 8 V             |
| L78L08ABZTR  | L78L08  | TO 92    | 8 V             |
| L78L08ACD    | 78L08A  | SO8      | 8 V             |
| L78L08ACUTR  | 8G      | SOT 89   | 8 V             |
| L78L08ACZ    | L78L08  | TO 92    | 8 V             |
| L78L08ACZ-AP | L78L08  | TO 92    | 8 V             |
| L78L08ACZTR  | L78L08  | TO 92    | 8 V             |
| L78L08CD     | 78L08   | SO8      | 8 V             |
| L78L09ABD    | 78L09B  | SO8      | 9 V             |
| L78L09ABUTR  | 8H      | SOT 89   | 9 V             |
| L78L09ABZ    | L78L09  | TO 92    | 9 V             |

Table 25. Marking information (continued)

| Part numbers | Marking | Packages | Output voltages |
|--------------|---------|----------|-----------------|
| L78L09ACD    | 78L09A  | SO8      | 9 V             |
| L78L09ACUTR  | 8H      | SOT 89   | 9 V             |
| L78L09ACZ    | L78L09  | TO 92    | 9 V             |
| L78L09ACZ-AP | L78L09  | TO 92    | 9 V             |
| L78L09ACZ-TR | L78L09  | TO 92    | 9 V             |
| L78L09CD     | 78L09   | SO8      | 9 V             |
| L78L10ACUTR  | 8I      | SOT 89   | 10 V            |
| L78L12ABD    | 78L12B  | SO8      | 12 V            |
| L78L12ABUTR  | 8K      | SOT 89   | 12 V            |
| L78L12ABZ    | L78L12  | TO 92    | 12 V            |
| L78L12ABZ-AP | L78L12  | TO 92    | 12 V            |
| L78L12ACD    | 78L12A  | SO8      | 12 V            |
| L78L12ACUTR  | 8K      | SOT 89   | 12 V            |
| L78L12ACZ    | L78L12  | TO 92    | 12 V            |
| L78L12ACZ-AP | L78L12  | TO 92    | 12 V            |
| L78L12ACZ-TR | L78L12  | TO 92    | 12 V            |
| L78L12CD     | 78L12   | SO8      | 12 V            |
| L78L15ABD    | 78L15B  | SO8      | 15 V            |
| L78L15ABUTR  | 8L      | SOT 89   | 15 V            |
| L78L15ABZ    | L78L15  | TO 92    | 15 V            |
| L78L15ABZ-AP | L78L15  | TO 92    | 15 V            |
| L78L15ACD    | 78L15A  | SO8      | 15 V            |
| L78L15ACUTR  | 8L      | SOT 89   | 15 V            |
| L78L15ACZ    | L78L15  | TO 92    | 15 V            |
| L78L15ACZ-AP | L78L15  | TO 92    | 15 V            |
| L78L15ACZ-TR | L78L15  | TO 92    | 15 V            |
| L78L15CD     | 78L15   | SO8      | 15 V            |
| L78L15CD-TR  | 78L15A  | SO8      | 15 V            |
| L78L18ACUTR  | 8B      | SOT 89   | 18 V            |
| L78L24ABD    | 78L24B  | SO8      | 24 V            |
| L78L24ABUTR  | 8P      | SOT 89   | 24 V            |
| L78L24ABZ-TR | L78L24  | TO 92    | 24 V            |
| L78L24ACD    | 78L24A  | SO8      | 24 V            |
| L78L24ACUTR  | 8P      | SOT 89   | 24 V            |
| L78L24ACZ    | L78L24  | TO 92    | 24 V            |
| L78L24ACZ-AP | L78L24  | TO 92    | 24 V            |

**Table 25. Marking information (continued)**

| Part numbers  | Marking | Packages | Output voltages |
|---------------|---------|----------|-----------------|
| L78L24CD      | 78L24   | SO8      | 24 V            |
| L78L33ABD     | 78L33B  | SO8      | 3.3 V           |
| L78L33ABUTR   | 8A      | SOT 89   | 3.3 V           |
| L78L33ABZ-AP  | L78L33  | TO 92    | 3.3 V           |
| L78L33ACD     | 78L33A  | SO8      | 3.3 V           |
| L78L33ACD13TR | 78L33A  | SO8      | 3.3 V           |
| L78L33ACUTR   | 8A      | SOT 89   | 3.3 V           |
| L78L33ACZ     | L78L33  | TO 92    | 3.3 V           |
| L78L33ACZ-AP  | L78L33  | TO 92    | 3.3 V           |
| L78L33ACZTR   | L78L33  | TO 92    | 3.3 V           |
| L78L33CD      | 78L33   | SO8      | 3.3 V           |
| L78L33CD-TR   | 78L33   | SO8      | 3.3 V           |

## 9 Revision history

**Table 26. Document revision history**

| Date        | Revision | Changes                                                                                           |
|-------------|----------|---------------------------------------------------------------------------------------------------|
| 14-Mar-2005 | 9        | Add tape and reel for TO-92.                                                                      |
| 15-Mar-2005 | 10       | Add note on Table 3.                                                                              |
| 23-Dec-2005 | 11       | Mistake on ordering Table in header.                                                              |
| 12-Sep-2006 | 12       | Order codes updated.                                                                              |
| 07-Jun-2007 | 13       | Order codes updated.                                                                              |
| 18-Sep-2007 | 14       | Added <a href="#">Table 1</a> in cover page.                                                      |
| 15-Jul-2008 | 15       | Modified: <a href="#">Table 1 on page 1</a> and <a href="#">Table 24 on page 28</a> .             |
| 18-Aug-2008 | 16       | Modified <a href="#">Figure 12 on page 17</a> .                                                   |
| 03-Apr-2009 | 17       | Added: $R_{thJA}$ value for SOT-89 <a href="#">Table 3 on page 5</a> .                            |
| 08-Feb-2011 | 18       | Added note <a href="#">Table 23 on page 26</a>                                                    |
| 21-Feb-2012 | 19       | Modified: SOT-89 <a href="#">Figure 2 on page 4</a> .                                             |
| 14-Aug-2012 | 20       | Updated $T_{OP}$ value for L78L00AC in <a href="#">Table 2 on page 5</a> .<br>Minor text changes. |
| 07-Sep-2012 | 21       | Added: <a href="#">Table 25 on page 29</a> .                                                      |

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