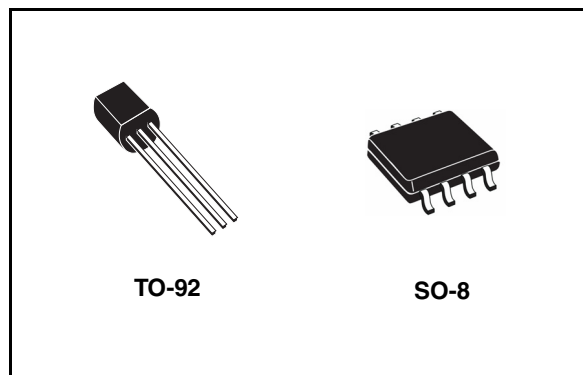


Low current 1.2 to 37V adjustable voltage regulator

Features

- Output voltage range: 1.2 to 37V
- Output current in excess of 100 mA
- Line regulation typ. 0.01%
- Load regulation typ. 0.1%
- Thermal overload protection
- Short circuit protection
- Output transition safe area compensation
- Floating operation for high voltage applications



Description

The LM217L/LM317L are monolithic integrated circuit in SO-8 and TO-92 packages intended for use as positive adjustable voltage regulators.

They are designed to supply until 100 mA of load current with an output voltage adjustable over a 1.2 to 37V range.

The nominal output voltage is selected by means of only a resistive divider, making the device exceptionally easy to use and eliminating the stocking of many fixed regulators.

Order codes

| Part numbers | Packages | |
|--------------|--------------------|----------------------------|
| | SO-8 (Tape & reel) | TO-92 (BAG) ⁽¹⁾ |
| LM217L | LM217LD13TR | LM217LZ |
| LM317L | LM317LD13TR | LM317LZ |

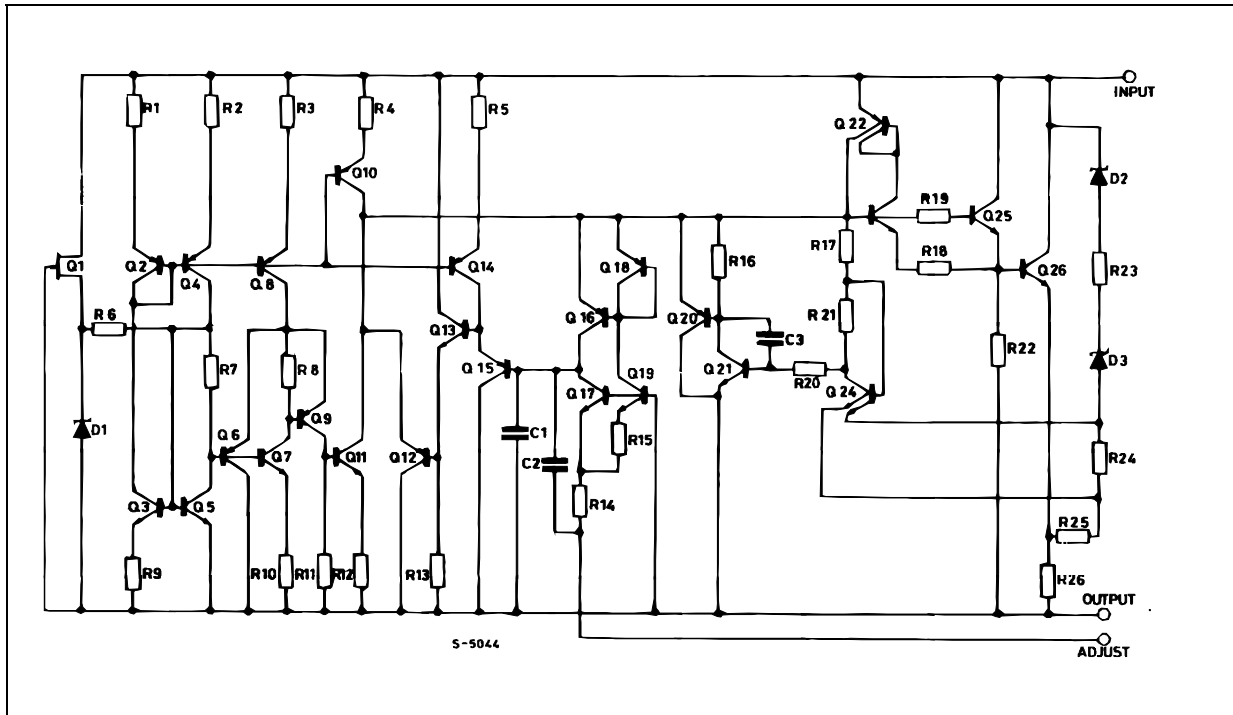
1. Available in tape & reel with the suffix "-TR" and in Ammopak with the suffix "-AP". Please note that in these cases pins are shaped according to tape & reel specifications

Contents

| | | |
|---|----------------------------------|----|
| 1 | Diagram | 3 |
| 2 | Pin configuration | 4 |
| 3 | Maximum ratings | 5 |
| 4 | Electrical characteristics | 6 |
| 5 | Typical performance | 8 |
| 6 | Application information | 9 |
| 7 | Application circuits | 10 |
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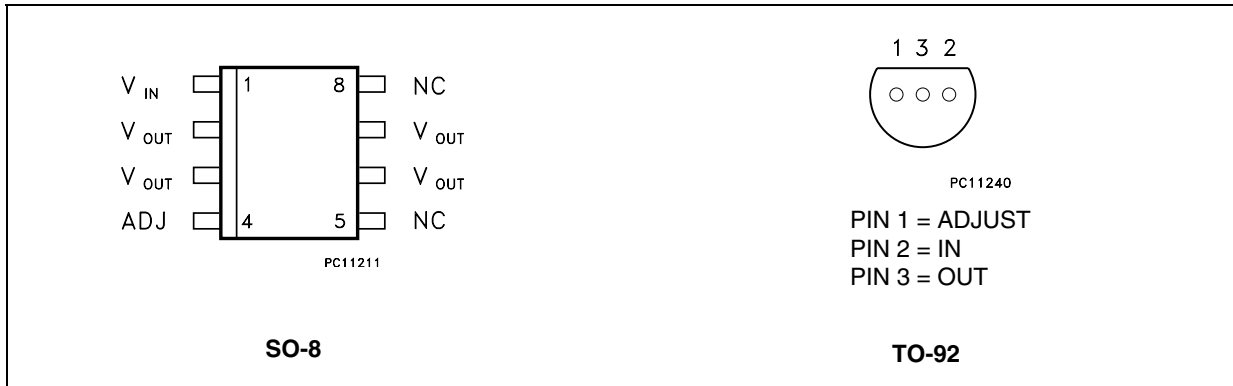
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view for SO-8, bottom view for TO-92)

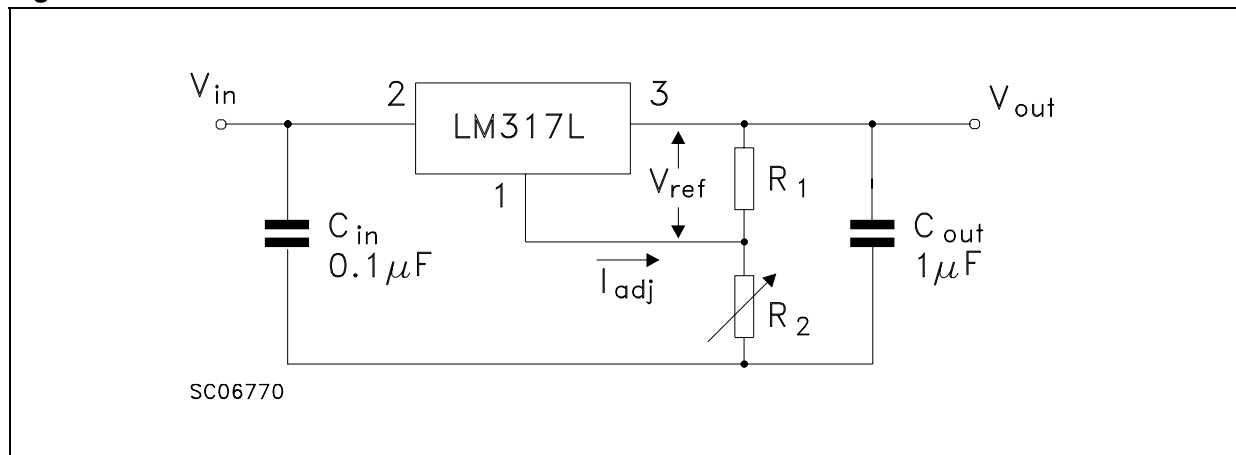


3 Maximum ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|-------------|--------------------------------------|--------------------|------------|
| V_{I-V_O} | Input-output differential voltage | 40 | V |
| P_D | Power dissipation | Internally Limited | mW |
| T_{OP} | Operating junction temperature range | for LM217L | -40 to 125 |
| | | for LM317L | 0 to 125 |
| T_{STG} | Storage temperature range | -55 to 150 | °C |

Figure 3. Test circuit



4 Electrical characteristics

Table 2. Electrical characteristics of LM217L (refer to the test circuits, $T_J = -40$ to 125°C , $V_I - V_O = 5\text{ V}$, $I_O = 40\text{ mA}$, unless otherwise specified)

| Symbol | Parameter | Test conditions | | Min. | Typ. | Max. | Unit |
|------------------|---|---|-----------------------------|------|-------|---------------|---------------|
| ΔV_O | Line regulation | $V_I - V_O = 3$ to 40 V $I_L < 20\text{ mA}$ | $T_J = 25^\circ\text{C}$ | | 0.01 | 0.02 | %V |
| | | | | | 0.02 | 0.05 | |
| ΔV_O | Load regulation | $V_O \leq 5\text{ V}$ $I_O = 5$ to 100 mA | $T_J = 25^\circ\text{C}$ | | 5 | 15 | mV |
| | | | | | 20 | 50 | |
| | | $V_O \geq 5\text{ V}$ $I_O = 5$ to 100 mA | $T_J = 25^\circ\text{C}$ | | 0.1 | 0.3 | % |
| | | | | | 0.3 | 1 | |
| I_{ADJ} | Adjustment pin current | | | 50 | 100 | μA | |
| ΔI_{ADJ} | Adjustment pin current | $V_I - V_O = 3$ to 40 V , $I_O = 5$ to 100 mA $P_d < 625\text{ mW}$ | | | 0.2 | 5 | μA |
| V_{REF} | Reference voltage | $V_I - V_O = 3$ to 40 V , $I_O = 10$ to 500 mA $P_d < 625\text{ mW}$ | | 1.2 | 1.25 | 1.3 | V |
| $\Delta V_O/V_O$ | Output voltage temperature stability | | | | 0.7 | | % |
| $I_{O(\min)}$ | Minimum load current | $V_I - V_O = 40\text{ V}$ | | | 3.5 | 5 | mA |
| $I_{O(\max)}$ | Maximum output current | $V_I - V_O = 3$ to 13 V | | 100 | 200 | | mA |
| | | $V_I - V_O = 40\text{ V}$ | | | 50 | | |
| eN | Output noise voltage | B = 10 Hz to 10 KHz, $T_J = 25^\circ\text{C}$ | | | 0.003 | | % |
| SVR | Supply voltage rejection ⁽¹⁾ | $T_J = 25^\circ\text{C}$ $f = 120\text{ Hz}$ | $C_{ADJ} = 0$ | | 65 | | dB |
| | | | $C_{ADJ} = 10\ \mu\text{F}$ | 66 | 80 | | |

1. C_{ADJ} is connected between adjust pin and ground.

Table 3. Electrical characteristics of LM317L (refer to the test circuits, $T_J = 0$ to 125°C , $V_I - V_O = 5$ V, $I_O = 40$ mA, unless otherwise specified)

| Symbol | Parameter | Test conditions | | Min. | Typ. | Max. | Unit |
|------------------|---|--|------------------------------|------|-------|---------------|------|
| ΔV_O | Line regulation | $V_I - V_O = 3$ to 40 V $I_L < 20$ mA | $T_J = 25^\circ\text{C}$ | | 0.01 | 0.04 | %V |
| | | | | | 0.02 | 0.07 | |
| ΔV_O | Load regulation | $V_O \leq 5$ V $I_O = 5$ to 100 mA | $T_J = 25^\circ\text{C}$ | | 5 | 25 | mV |
| | | | | | 20 | 70 | |
| | | $V_O \geq 5$ V $I_O = 5$ to 100 mA | $T_J = 25^\circ\text{C}$ | | 0.1 | 0.5 | % |
| | | | | | 0.3 | 1.5 | |
| I_{ADJ} | Adjustment pin current | | | 50 | 100 | μA | |
| ΔI_{ADJ} | Adjustment pin current | $V_I - V_O = 3$ to 40 V, $I_O = 5$ to 100 mA $P_d < 625$ mW | | 0.2 | 5 | μA | |
| V_{REF} | Reference voltage | $V_I - V_O = 3$ to 40 V, $I_O = 5$ to 100 mA $P_d < 625$ mW | | 1.2 | 1.25 | 1.3 | V |
| $\Delta V_O/V_O$ | Output voltage temperature stability | | | | 0.7 | | % |
| $I_{O(\min)}$ | Minimum load current | $V_I - V_O = 40$ V | | | 3.5 | 5 | mA |
| $I_{O(\max)}$ | Maximum output current | $V_I - V_O = 3$ to 13 V | | 100 | 200 | | mA |
| | | $V_I - V_O = 40$ V | | | 50 | | |
| eN | Output noise voltage | $B = 10$ Hz to 10 KHz, $T_J = 25^\circ\text{C}$ | | | 0.003 | | % |
| SVR | Supply voltage rejection ⁽¹⁾ | $T_J = 25^\circ\text{C}$ $f = 120$ Hz | $C_{ADJ} = 0$ | | 65 | | dB |
| | | | $C_{ADJ} = 10$ μF | 66 | 80 | | |

1. C_{ADJ} is connected between adjust pin and ground.

5 Typical performance

Figure 4. Current limit

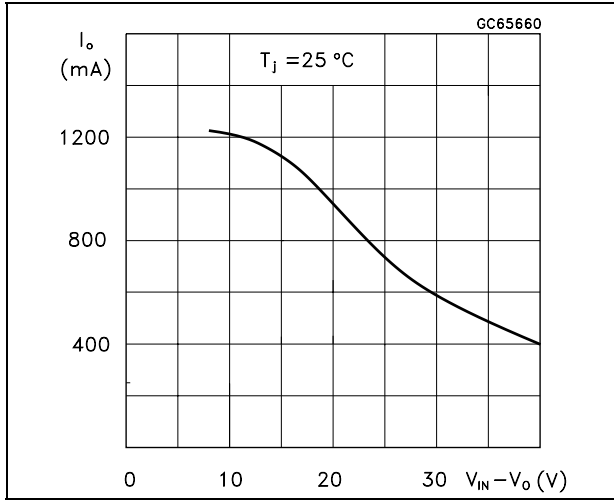
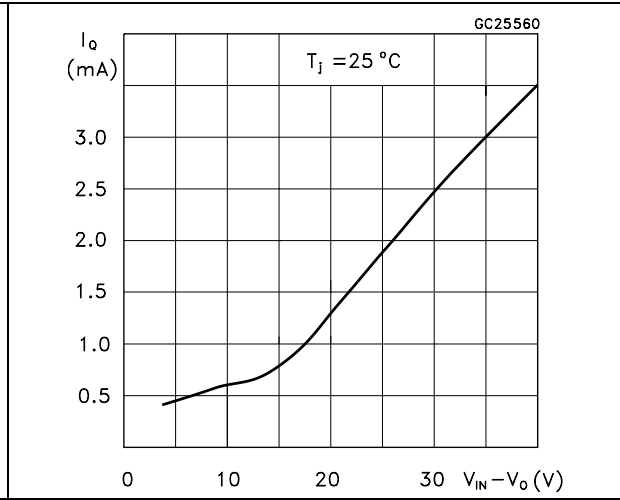


Figure 5. Minimum operating current



6 Application information

The LM317L provides an internal reference voltage of 1.25V between the output and adjustments terminals. This is used to set a constant current flow across an external resistor divider (see [Figure 4.](#)), giving an output voltage V_O of:

$$V_O = V_{REF} (1 + R_2/R_1) + I_{ADJ} R_2$$

The device was designed to minimize the term I_{ADJ} (100 μ A max) and to maintain it very constant with line and load changes. Usually, the error term $I_{ADJ} \times R_2$ can be neglected. To obtain the previous requirement, all the regulator quiescent current is returned to the output terminal, imposing a minimum load current condition. If the load is insufficient, the output voltage will rise.

Since the LM317L is a floating regulator and "sees" only the input-to-output differential voltage, supplies of very high voltage with respect to ground can be regulated as long as the maximum input-to-output differential is not exceeded. Furthermore, programmable regulator are easily obtainable and, by connecting a fixed resistor between the adjustment and output, the device can be used as a precision current regulator. In order to optimize the load regulation, the current set resistor R_1 (see [Figure 4.](#)) should be tied as close as possible to the regulator, while the ground terminal of R_2 should be near the ground of the load to provide remote ground sensing.

7 Application circuits

Figure 6. Basic adjustable regulator

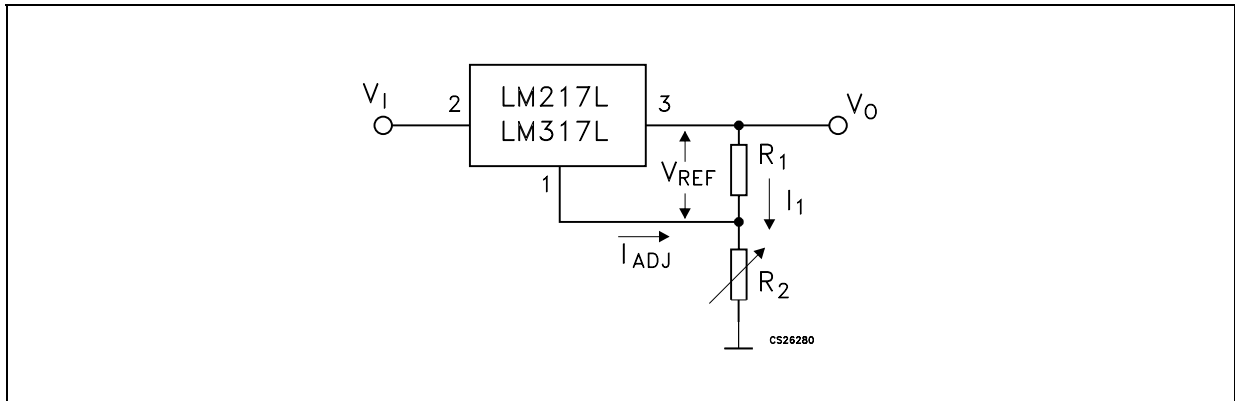


Figure 7. Voltage regulator with protection diodes

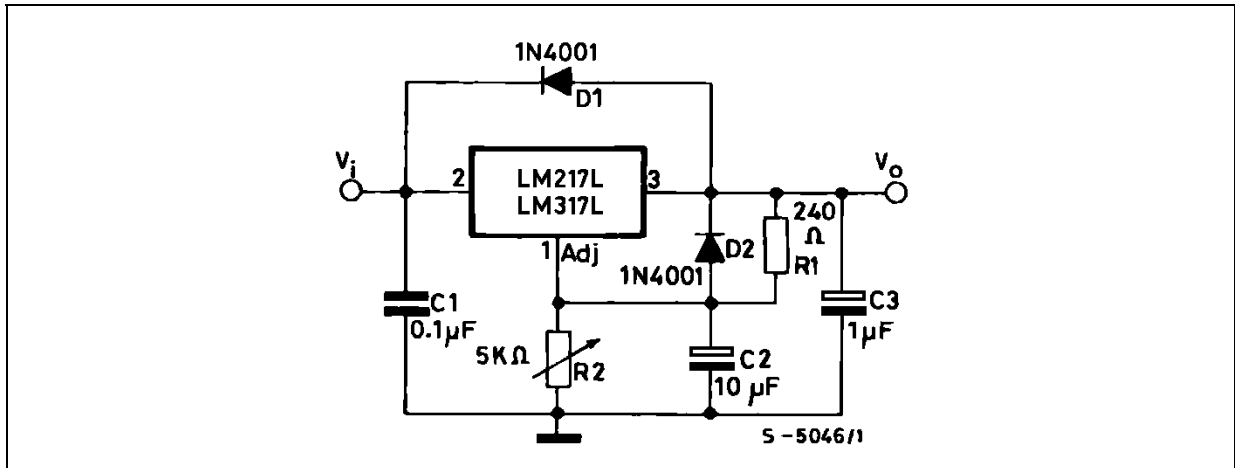


Figure 8. Slow Turn-on 15V Regulator

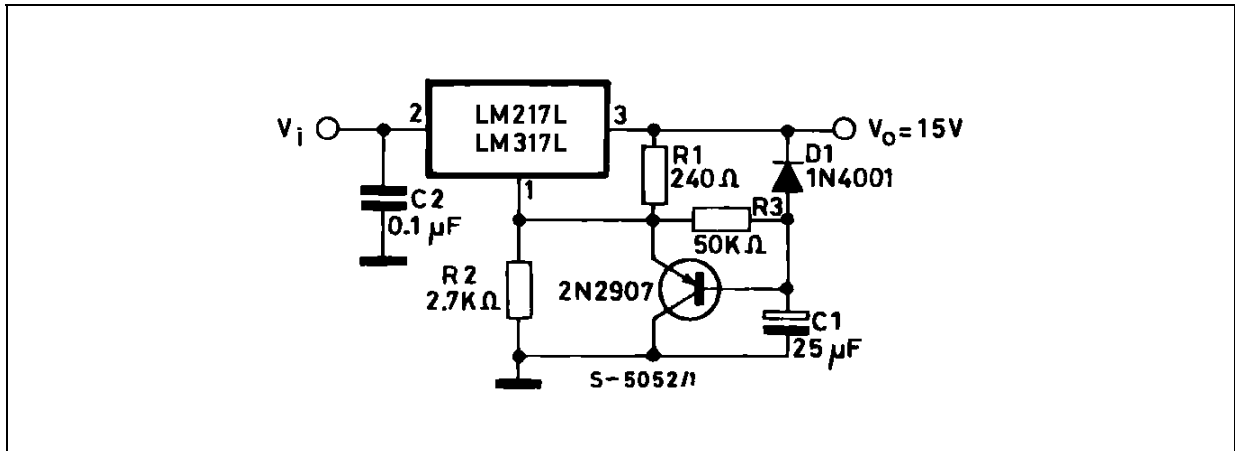


Figure 9. Current regulator

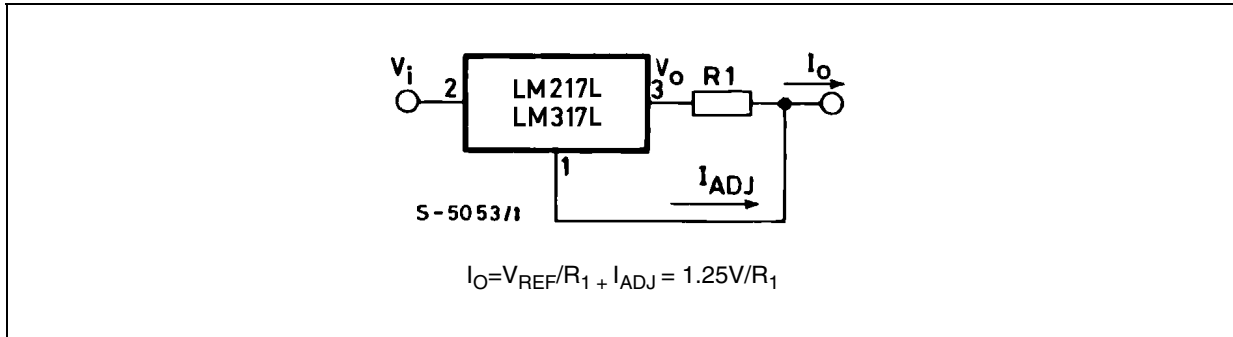


Figure 10. 5V Electronic shut-down regulator

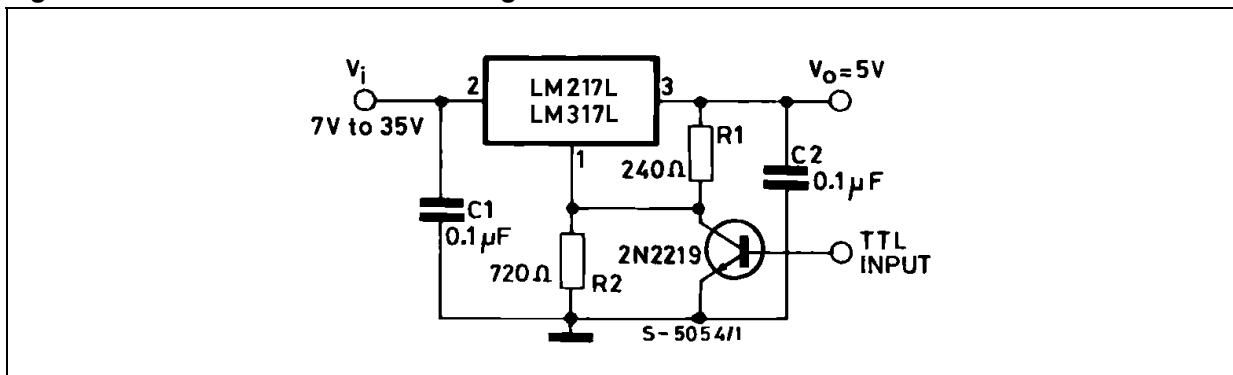
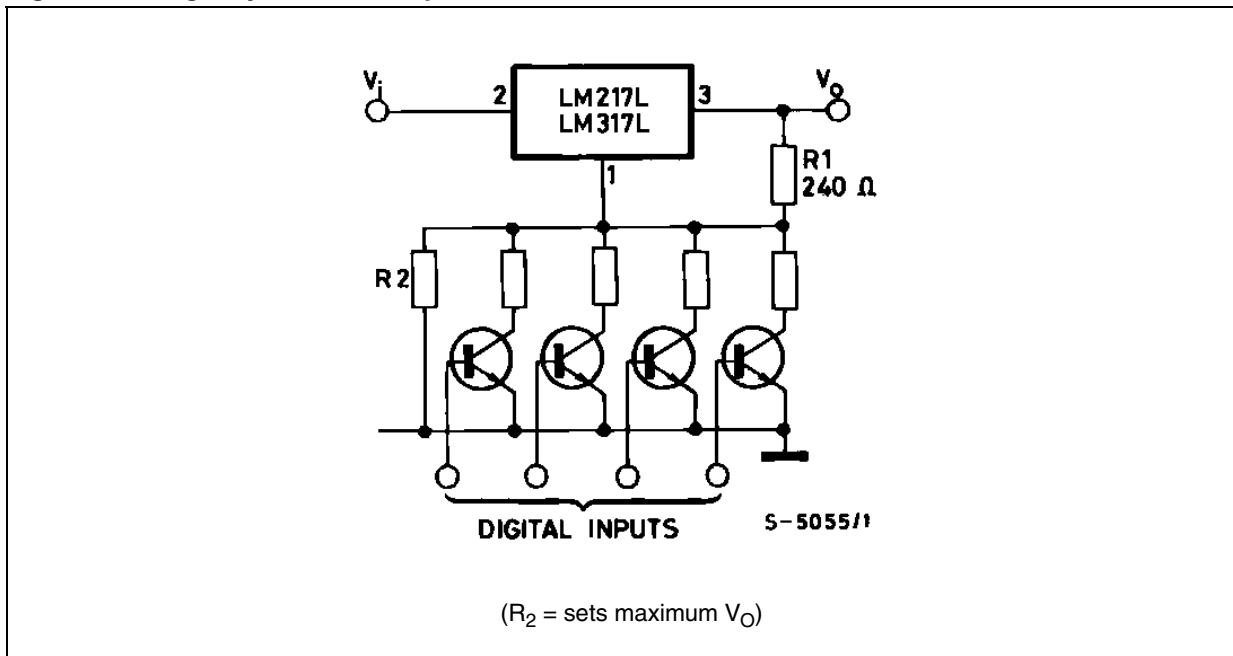


Figure 11. Digitally selected outputs

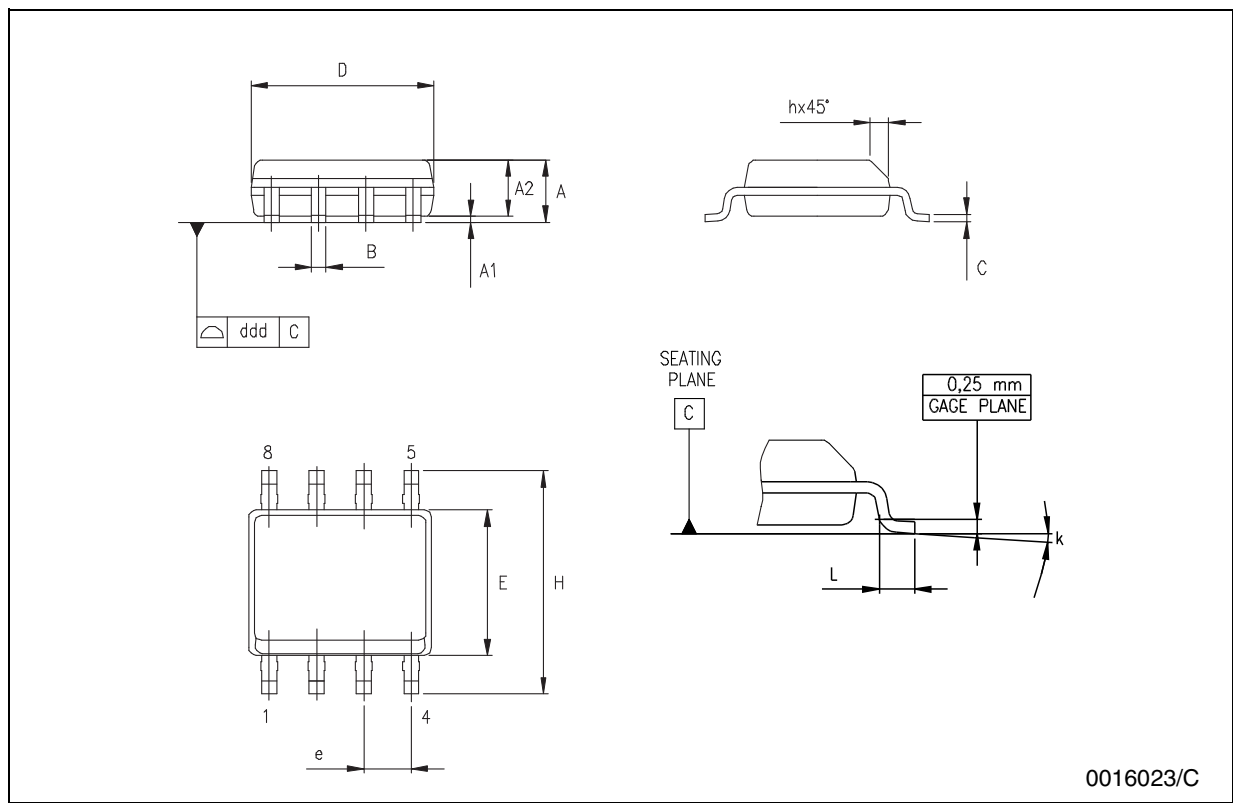


8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK[®] packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

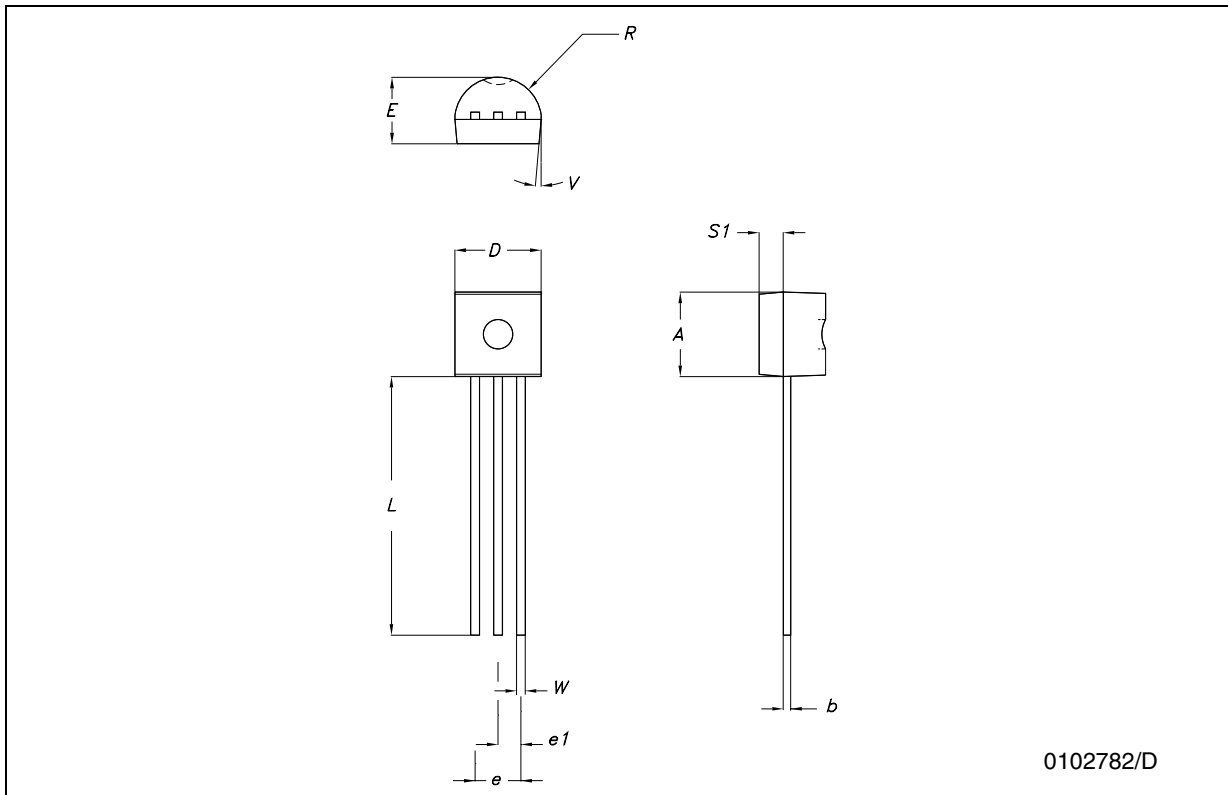
SO-8 MECHANICAL DATA

| 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 |



TO-92 MECHANICAL DATA

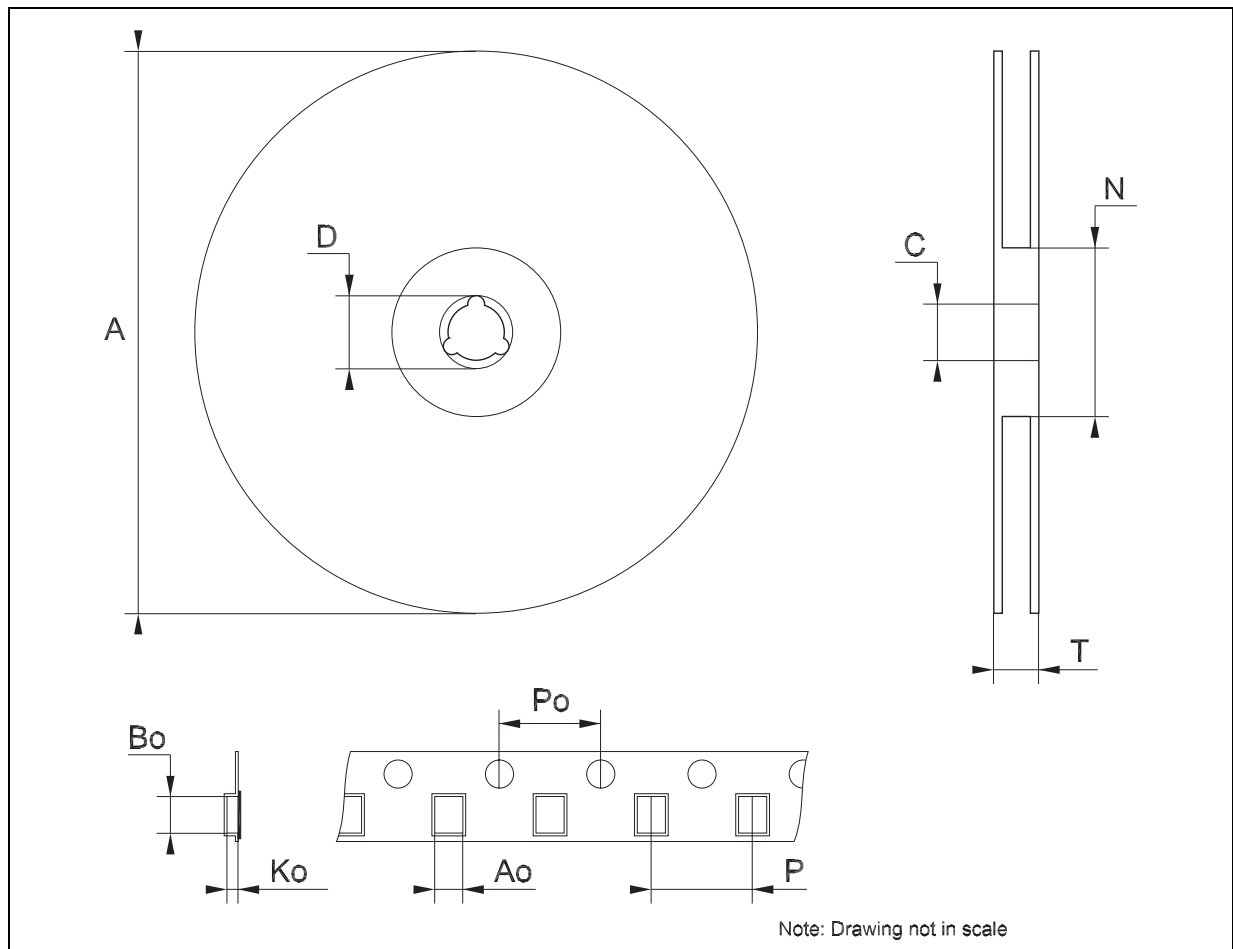
| DIM. | mm. | | | mils | | |
|----------|------|-----|-------|-------|------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.32 | | 4.95 | 170.1 | | 194.9 |
| b | 0.36 | | 0.51 | 14.2 | | 20.1 |
| D | 4.45 | | 4.95 | 175.2 | | 194.9 |
| E | 3.30 | | 3.94 | 129.9 | | 155.1 |
| e | 2.41 | | 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 |
| α | | 5° | | | 5° | |



0102782/D

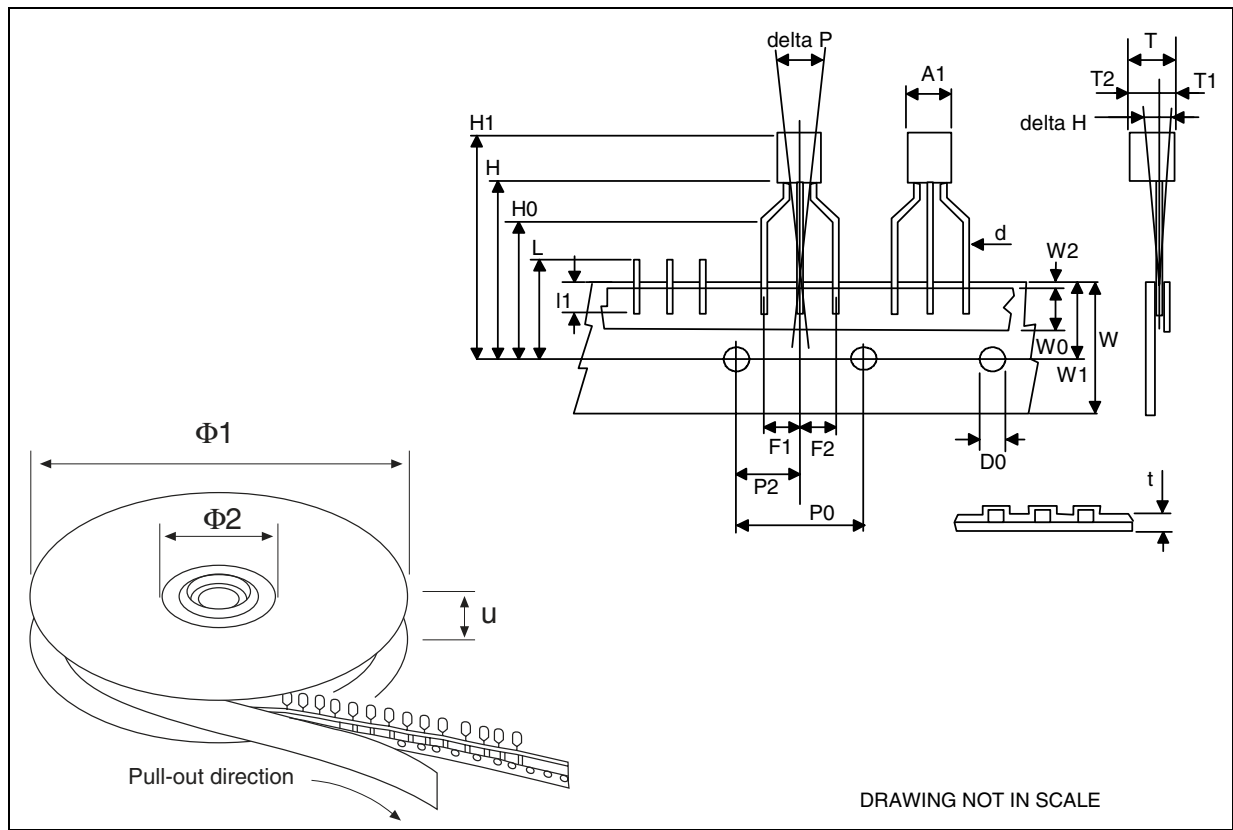
Tape & Reel SO-8 MECHANICAL DATA

| 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 for TO-92 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|---------|-------|-------|-------|-------|--------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A1 | | 4.80 | | | 0.189 | |
| T | | 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 | |



9 Revision history

Table 4. Revision history

| Date | Revision | Changes |
|-------------|-----------------|---|
| 16-Mar-2005 | 2 | Add Tape & reel for TO-92. |
| 23-Dec-2005 | 3 | Mistake on ordering table in header. |
| 18-May-2007 | 4 | Order codes has been updated and the document has been reformatted. |

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