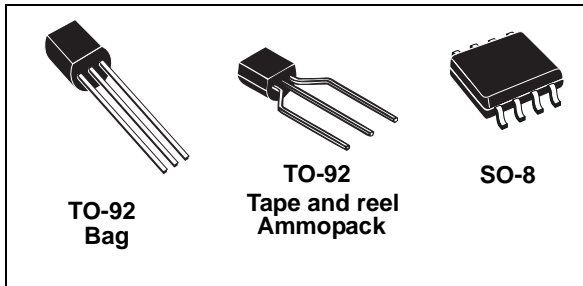


Low current 1.2 to 37 V adjustable voltage regulators

Datasheet - production data



Description

The LM217L/LM317L are monolithic integrated circuits in SO-8 and TO-92 packages intended for use as positive adjustable voltage regulators. They are designed to supply up to 100 mA of load current with an output voltage adjustable over a 1.2 to 37 V 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.

Features

- Output voltage range: 1.2 to 37 V
- Output current up to 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

Table 1. Device summary

| Order codes | | | |
|----------------------|-------------|------------------|-----------------------|
| SO-8 (tape and reel) | TO-92 (Bag) | TO-92 (Ammopack) | TO-92 (tape and reel) |
| LM217LD13TR | | | LM217LZ-TR |
| LM317LD13TR | LM317LZ | LM317LZ-AP | LM317LZ-TR |

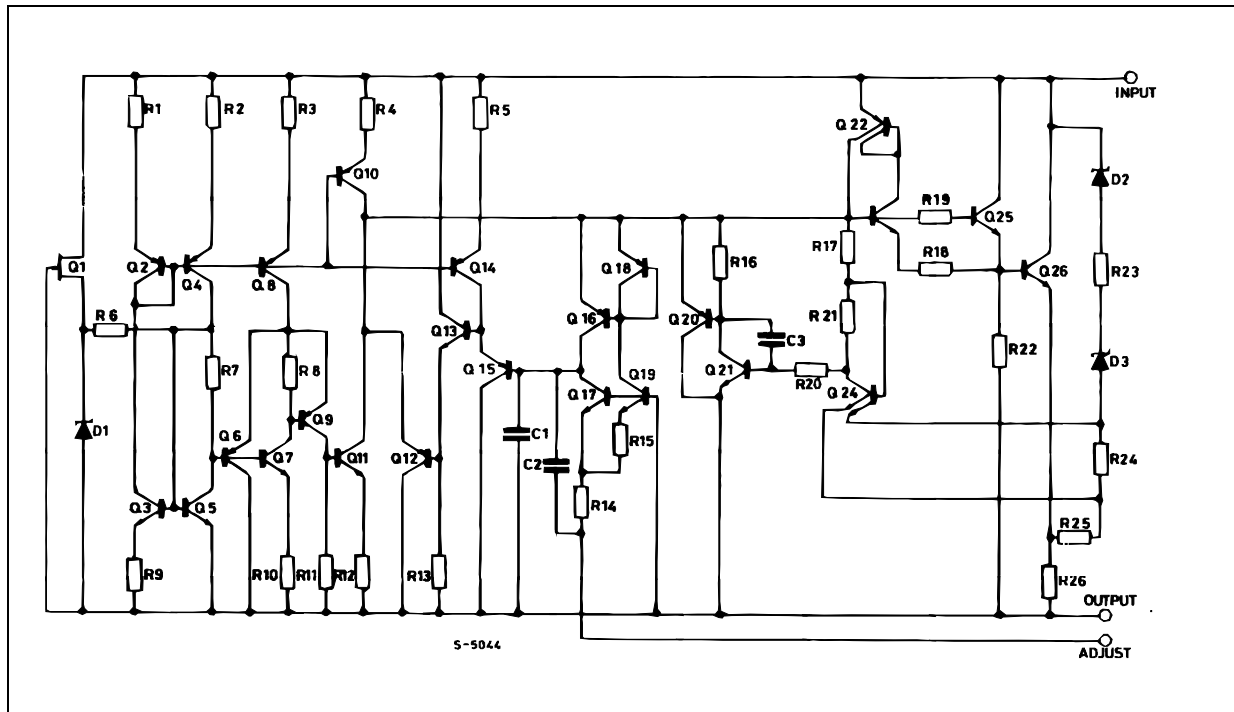
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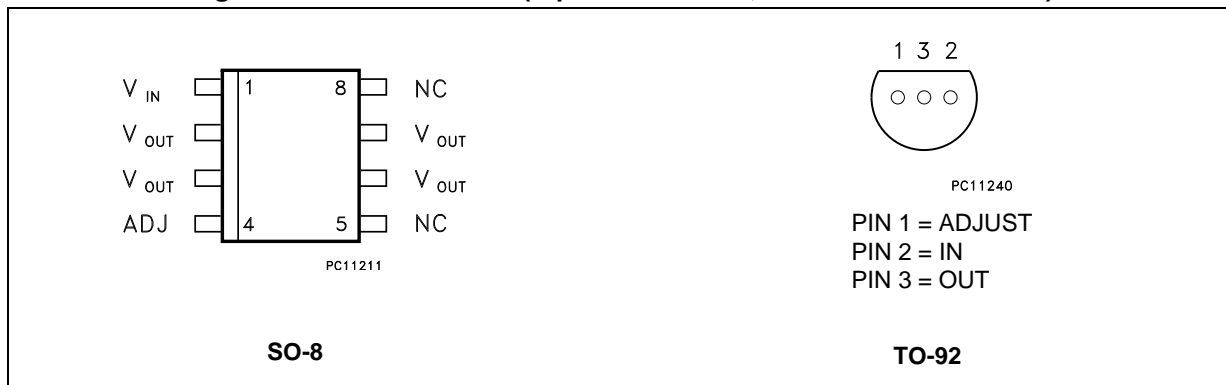
1 Diagram

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 2. Absolute maximum ratings

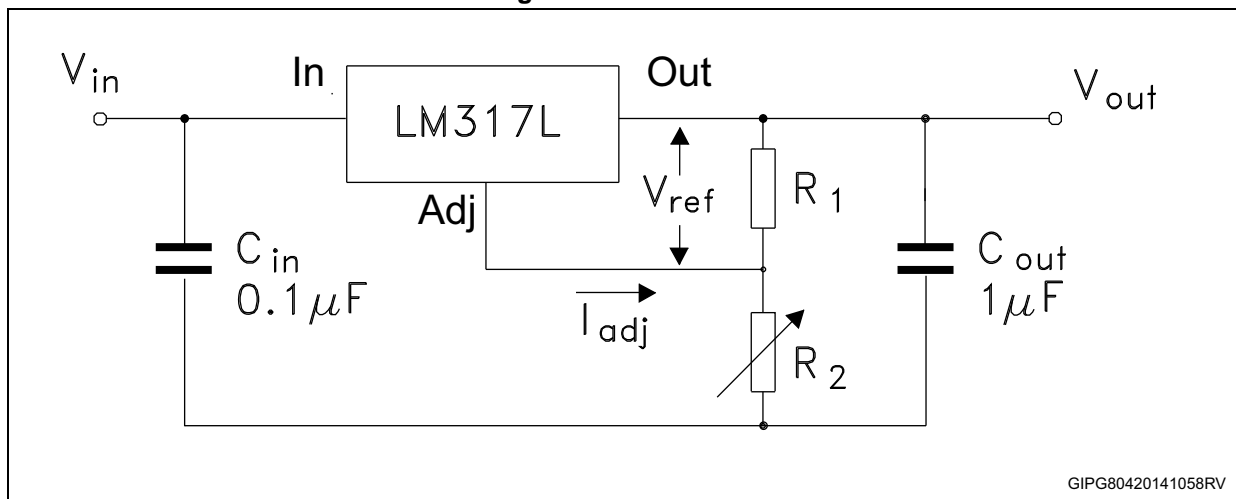
| Symbol | Parameter | Value | Unit |
|-----------|--------------------------------------|--------------------|------------|
| V_I-V_O | Input-output differential voltage | 40 | V |
| P_D | Power dissipation | Internally limited | mW |
| T_{OP} | Operating junction temperature range | for LM217L | -40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

Table 3. Thermal data

| Symbol | Parameter | SO-8 | TO-92 | Unit |
|------------|-------------------------------------------|----------------------|-------|------|
| R_{thJC} | Thermal resistance junction-case (max) | 20 | | °C/W |
| R_{thJA} | Thermal resistance junction-ambient (max) | 55 ⁽¹⁾⁽²⁾ | 200 | |

1. Considering 6 cm² of copper Board heat-sink.
2. 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.

Figure 3. Test circuit



4 Electrical characteristics

(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)

Table 4. Electrical characteristics of LM217L

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit | |
|------------------|-----------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------|-------|------|---------------|--------|
| ΔV_O | Line regulation | $V_I - V_O = 3$ to 40 V , $I_O = 20\text{ mA}$ | $T_J = 25^\circ\text{C}$ | | 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 100 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 | $B = 10\text{ Hz}$ 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.

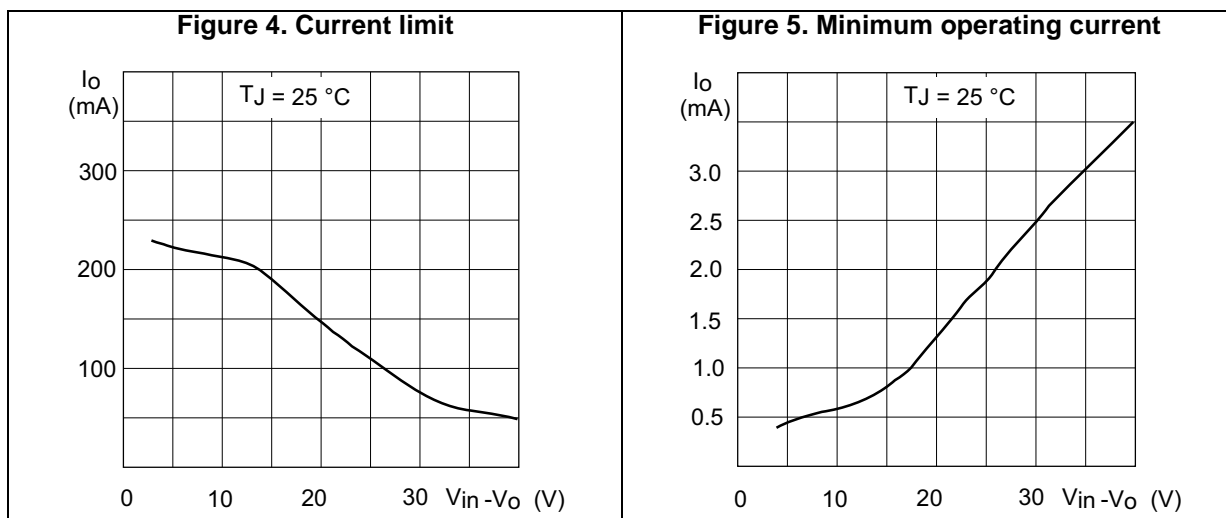
(Refer to the test circuits, $T_J = 0$ to 125°C , $V_I - V_O = 5$ V, $I_O = 40$ mA, unless otherwise specified)

Table 5. Electrical characteristics of LM317L

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit | |
|------------------|-----------------------------------------|--------------------------------------------------------------------|------------------------------|-------|------|---------------|----|
| ΔV_O | Line regulation | $V_I - V_O = 3$ to 40 V, $I_O = 20$ 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



6 Application information

The LM317L provides an internal reference voltage of 1.25 V between the output and adjustments terminals. This is used to set a constant current flow across an external resistor divider (see [Figure 6.](#)), 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 regulator as the maximum input-to-output differential is not exceeded. Furthermore, programmable regulators 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 6.](#)) 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

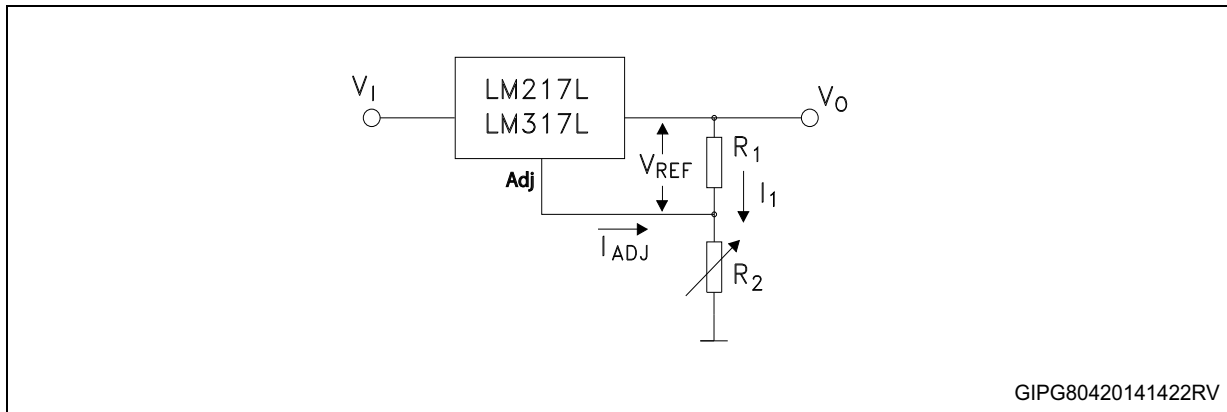


Figure 7. Voltage regulator with protection diodes

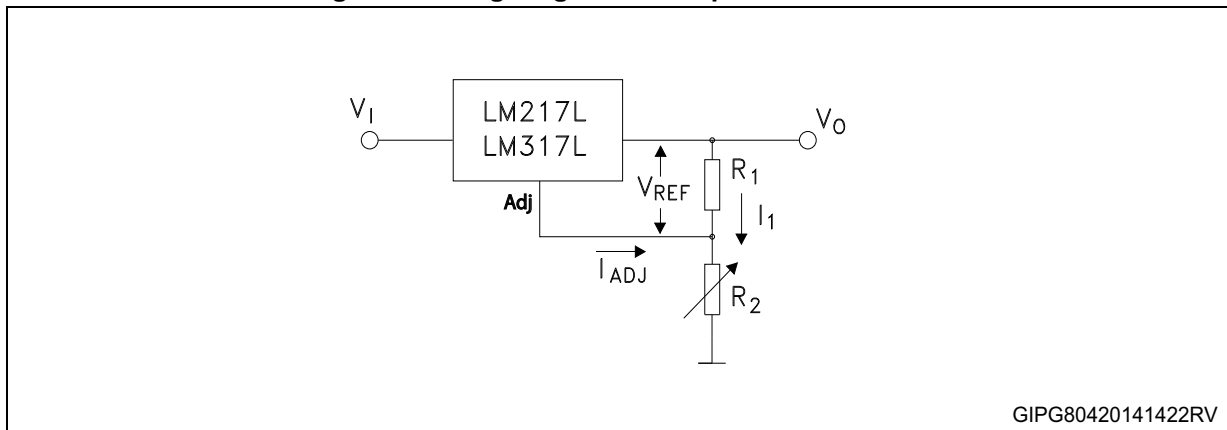


Figure 8. Slow turn-on 15 V regulator

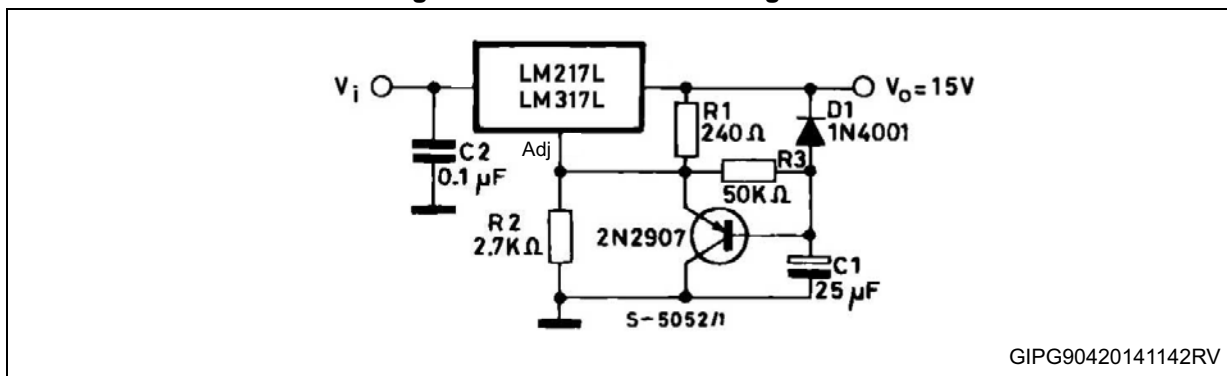


Figure 9. Current regulator

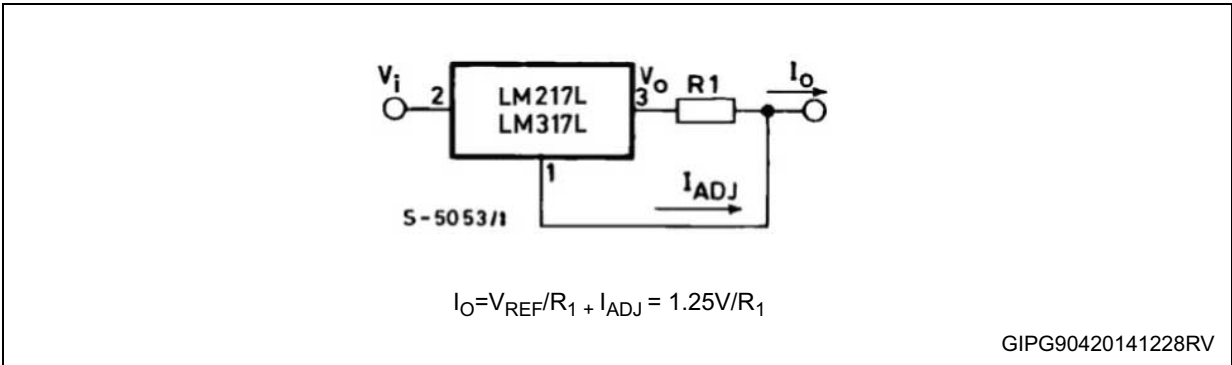


Figure 10. 5 V Electronic shut-down regulator

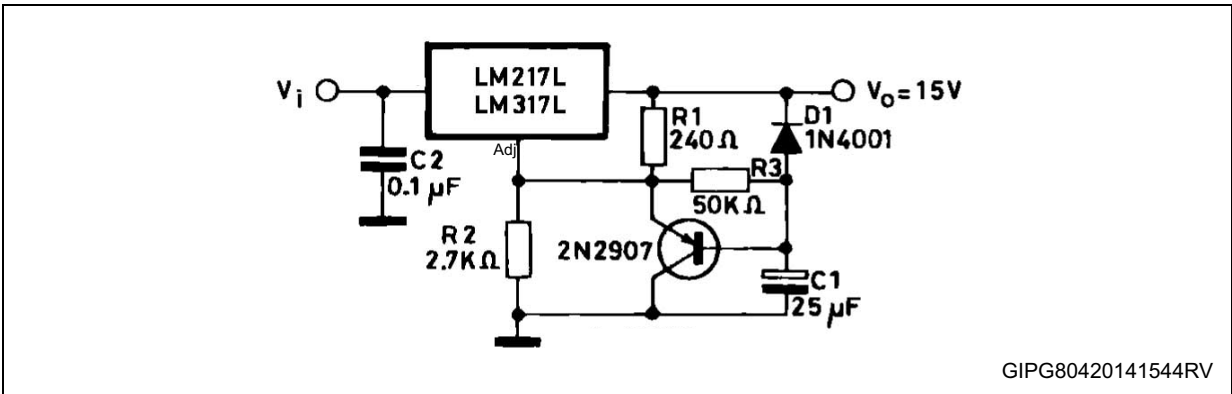
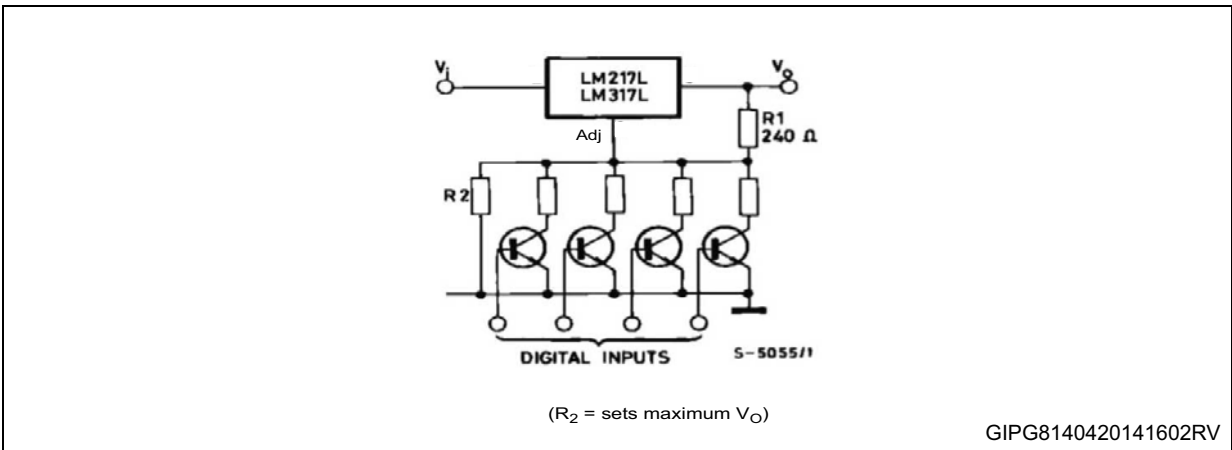


Figure 11. Digitally selected outputs



8 Package information

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

8.1 TO-92 Bag package information

Figure 12. TO-92 Bag package outline

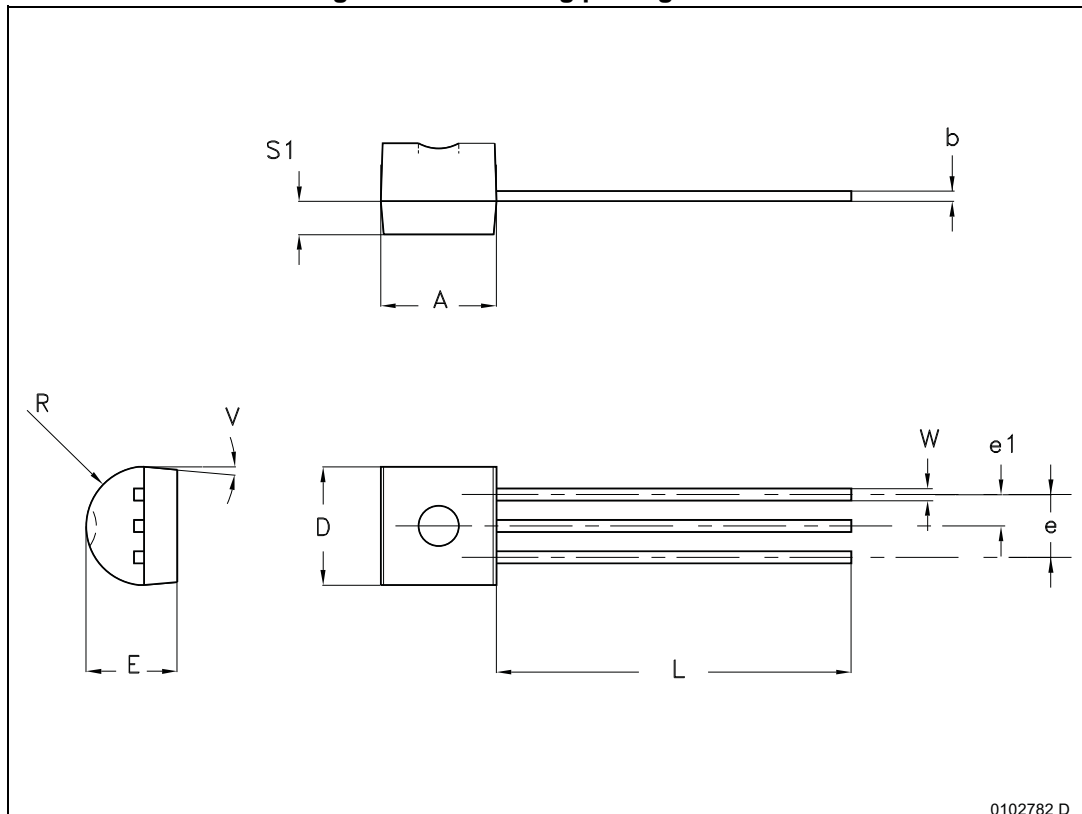


Table 6. TO-92 Bag mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.32 | | 4.95 |
| b | 0.36 | | 0.51 |
| D | 4.45 | | 4.95 |
| E | 3.30 | | 3.94 |
| e | 2.41 | | 2.67 |
| e1 | 1.14 | | 1.40 |
| L | 12.70 | | 15.49 |
| R | 2.16 | | 2.41 |
| S1 | 0.92 | | 1.52 |
| W | 0.41 | | 0.56 |
| V | | 5° | |

8.2 TO-92 Ammopack package information

Figure 13. TO-92 Ammopack package outline

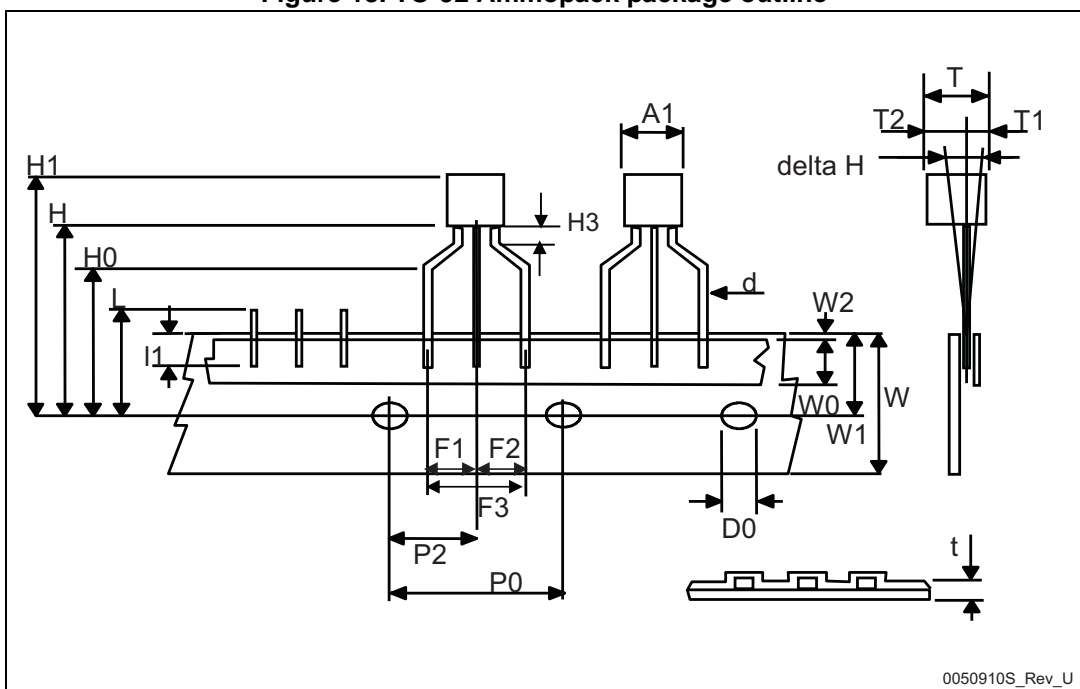


Table 7. TO-92 Ammopack mechanical data

| Dim. | mm | | |
|---------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A1 | | | 4.80 |
| T | | | 3.80 |
| T1 | | | 1.60 |
| T2 | | | 2.30 |
| d | 0.45 | 0.47 | 0.48 |
| P0 | 12.50 | 12.70 | 12.90 |
| P2 | 5.65 | 6.35 | 7.05 |
| F1, F2 | 2.40 | 2.50 | 2.94 |
| F3 | 4.98 | 5.08 | 5.48 |
| delta H | -2.00 | | 2.00 |
| W | 17.50 | 18.00 | 19.00 |
| W0 | 5.5 | 6.00 | 6.5 |
| W1 | 8.50 | 9.00 | 9.25 |
| W2 | | | 0.50 |
| H | | 18.50 | 21 |
| H3 | 0.5 | 1 | 2 |
| H0 | 15.50 | 16.00 | 18.8 |
| H1 | | 25.0 | 27.0 |
| D0 | 3.80 | 4.00 | 4.20 |
| t | | | 0.90 |
| L | | | 11.00 |
| l1 | 3.00 | | |
| delta P | -1.00 | | 1.00 |

8.3 TO-92 packing information

Figure 14. TO-92 tape and reel outline

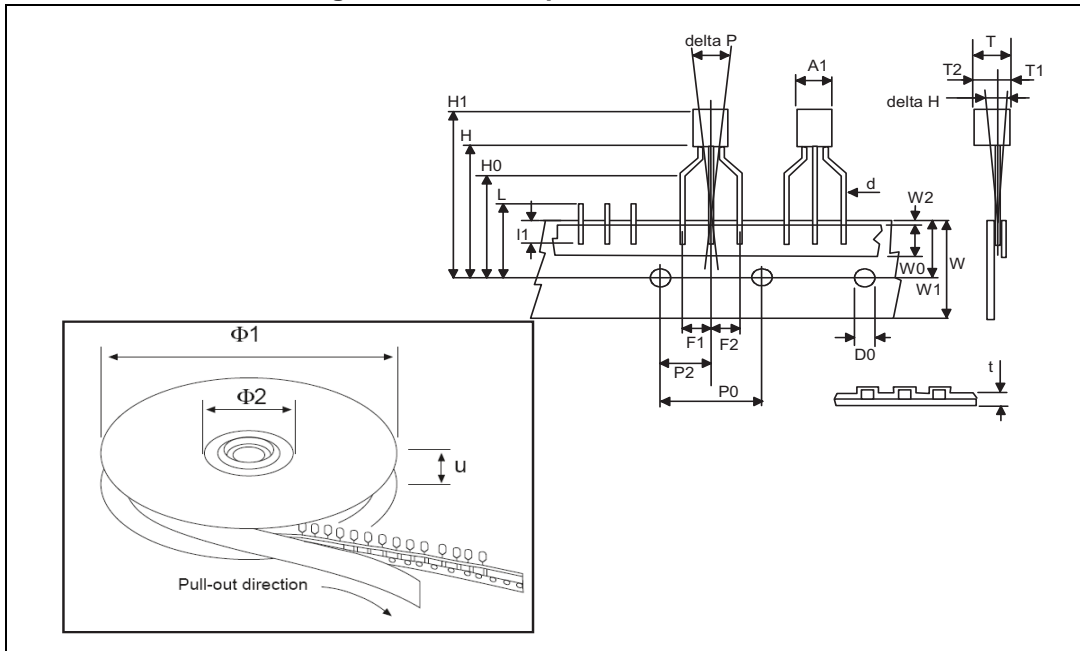


Table 8. TO-92 tape and reel mechanical data

| Dim. | mm | | |
|---------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A1 | | | 4.80 |
| T | | | 3.80 |
| T1 | | | 1.60 |
| T2 | | | 2.30 |
| d | 0.45 | 0.47 | 0.48 |
| P0 | 12.50 | 12.70 | 12.90 |
| P2 | 5.65 | 6.35 | 7.05 |
| F1, F2 | 2.40 | 2.50 | 2.94 |
| F3 | 4.98 | 5.08 | 5.48 |
| delta H | -2.00 | | 2.00 |
| W | 17.50 | 18.00 | 19.00 |
| W0 | 5.5 | 6.00 | 6.5 |
| W1 | 8.50 | 9.00 | 9.25 |
| W2 | | | 0.50 |
| H | | 18.50 | 21 |
| H3 | 0.5 | 1 | 2 |
| H0 | 15.50 | 16.00 | 18.8 |
| H1 | | 25.0 | 27.0 |
| D0 | 3.80 | 4.00 | 4.20 |
| t | | | 0.90 |
| L | | | 11.00 |
| l1 | 3.00 | | |
| delta P | -1.00 | | 1.00 |
| Ø1 | 352 | 355 | 358 |
| Ø2 | 28 | 30 | 32 |
| u | 44 | 47 | 50 |

8.4 SO-8 package information

Figure 15. SO-8 package outline

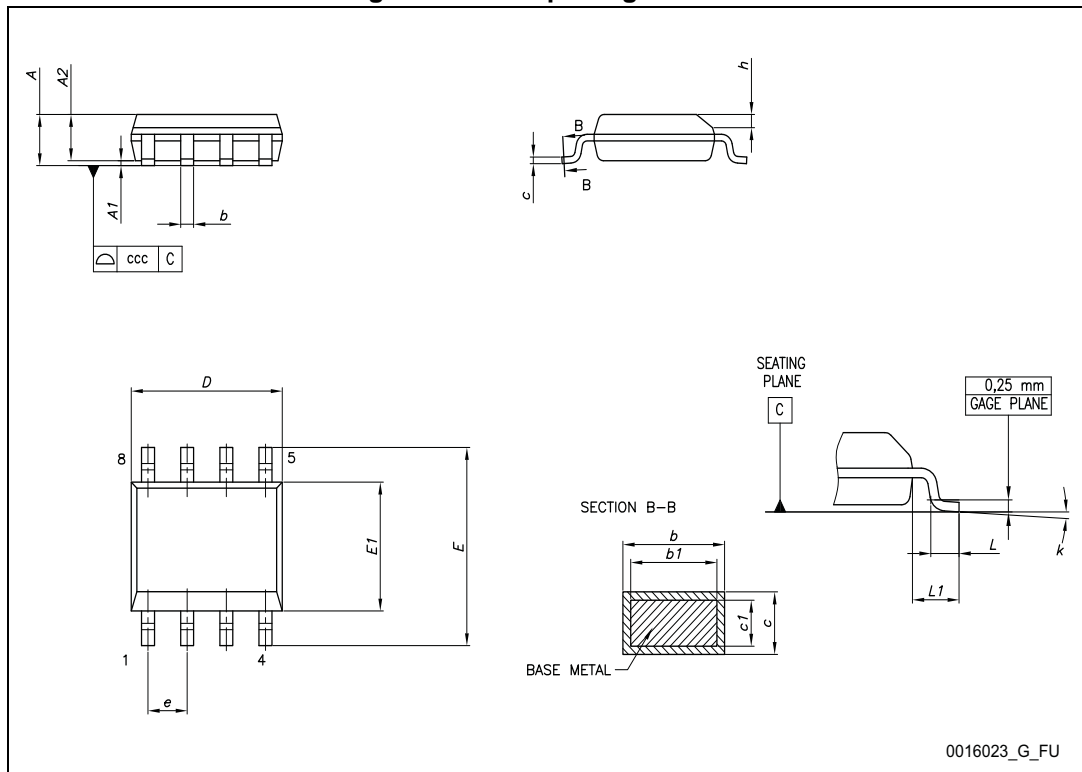
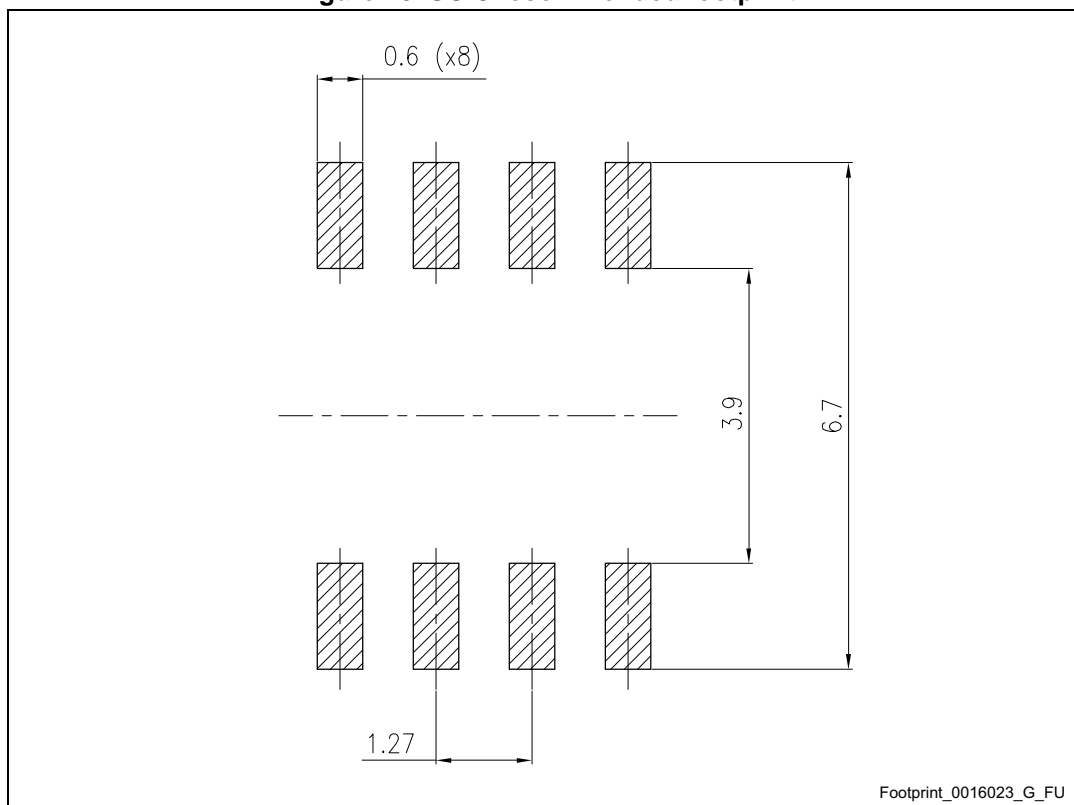


Table 9. SO-8 mechanical data

| Dim. | mm | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | | | 1.75 |
| A1 | 0.10 | | 0.25 |
| A2 | 1.25 | | |
| b | 0.31 | | 0.51 |
| b1 | 0.28 | | 0.48 |
| c | 0.10 | | 0.25 |
| c1 | 0.10 | | 0.23 |
| D | 4.80 | 4.90 | 5.00 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.80 | 3.90 | 4.00 |
| e | | 1.27 | |
| h | 0.25 | | 0.50 |
| L | 0.40 | | 1.27 |
| L1 | | 1.04 | |
| L2 | | 0.25 | |
| k | 0° | | 8° |
| ccc | | | 0.10 |

Figure 16. SO-8 recommended footprint



8.5 SO-8 packing information

Figure 17. SO-8 tape and reel outline

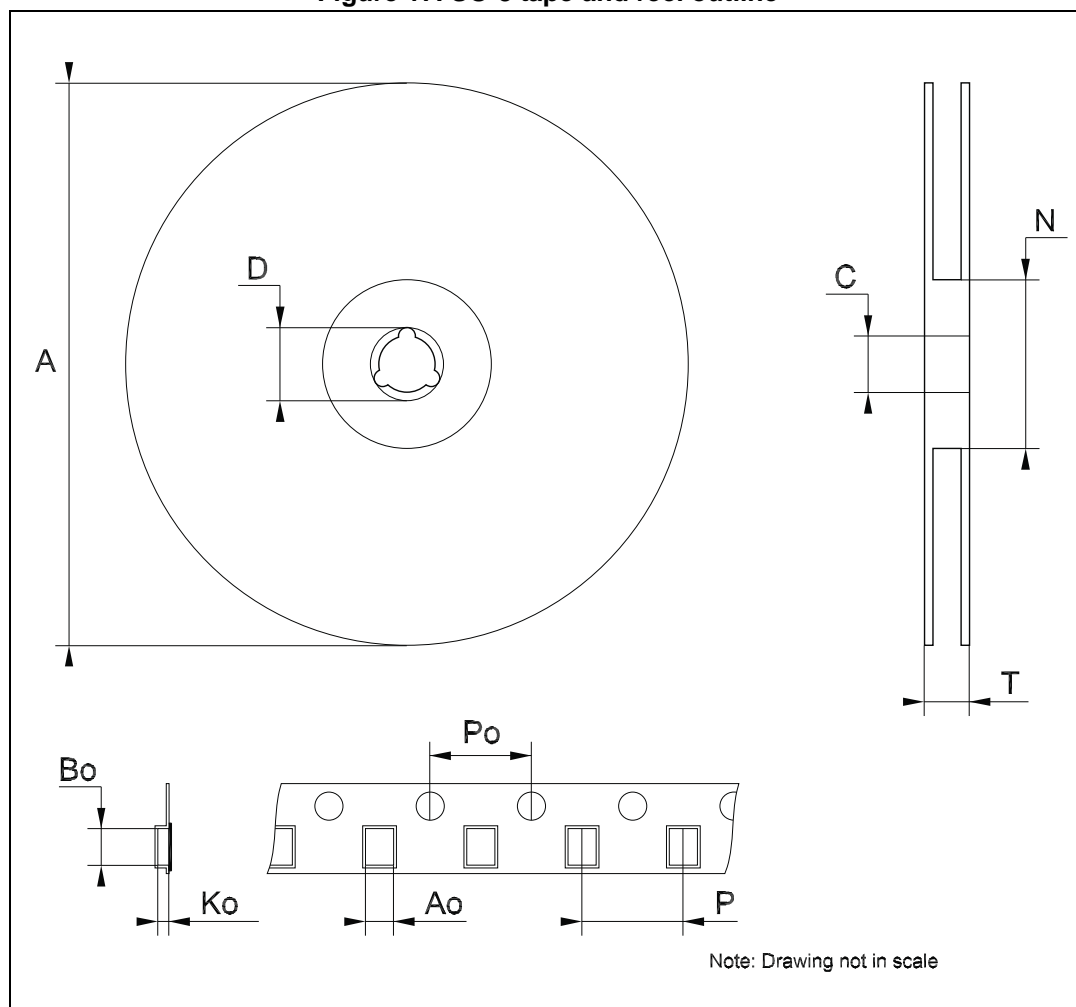


Table 10. SO-8 tape and reel mechanical data

| Dim. | mm | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | | | 330 |
| C | 12.8 | | 13.2 |
| D | 20.2 | | |
| N | 60 | | |
| T | | | 22.4 |
| Ao | 8.1 | | 8.5 |
| Bo | 5.5 | | 5.9 |
| Ko | 2.1 | | 2.3 |
| Po | 3.9 | | 4.1 |
| P | 7.9 | | 8.1 |

9 Revision history

Table 11. 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. |
| 20-May-2014 | 5 | Added TO-92 Ammopack package. Updated Section 6: Application information and Section 8: Package information . Added Section 8.5: SO-8 packing information . Minor text changes. |
| 19-May-2015 | 6 | Updated the features in cover page, Table 4: Electrical characteristics of LM217L , Table 5: Electrical characteristics of LM317L and Figure 4: Current limit . Added Table 3: Thermal data . Minor text changes. |
| 17-Sep-2015 | 7 | Updated Table 1: Device summary . Minor text changes. |

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