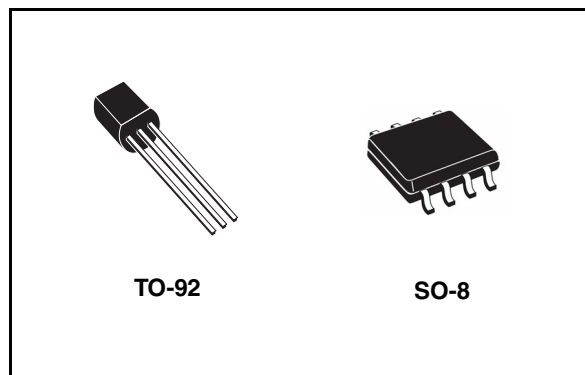


## Low current 1.2 to 37V adjustable voltage regulator

### 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) <sup>(1)</sup> |
| LM217L       | LM217LD13TR        | LM217LZ                    |
| LM317L       | LM317LD13TR        | LM317LZ                    |

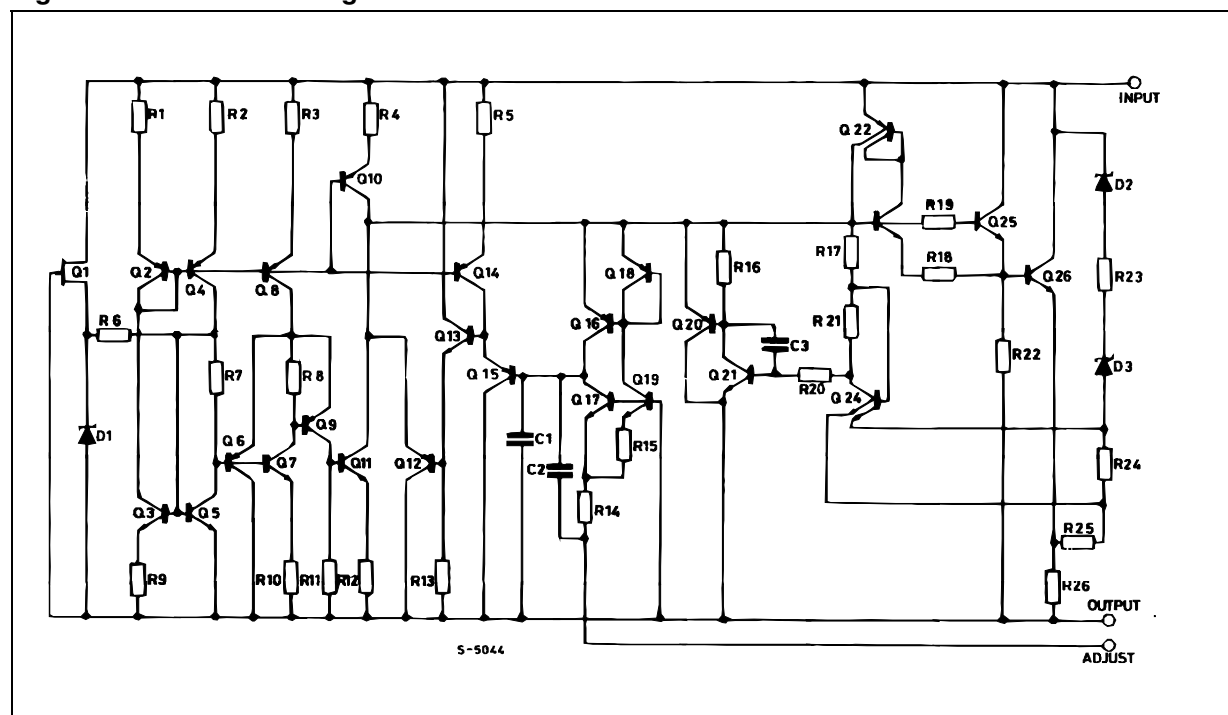
1. Available in tape & reel with the suffix "-TR" and in Ammopak with the suffix "-AP". Please note that in these cases pins are shaped according to tape & reel specifications

## Contents

|          |                                         |           |
|----------|-----------------------------------------|-----------|
| <b>1</b> | <b>Diagram .....</b>                    | <b>3</b>  |
| <b>2</b> | <b>Pin configuration .....</b>          | <b>4</b>  |
| <b>3</b> | <b>Maximum ratings .....</b>            | <b>5</b>  |
| <b>4</b> | <b>Electrical characteristics .....</b> | <b>6</b>  |
| <b>5</b> | <b>Typical performance .....</b>        | <b>8</b>  |
| <b>6</b> | <b>Application information .....</b>    | <b>9</b>  |
| <b>7</b> | <b>Application circuits .....</b>       | <b>10</b> |
| <b>8</b> | <b>Package mechanical data .....</b>    | <b>12</b> |
| <b>9</b> | <b>Revision history .....</b>           | <b>17</b> |

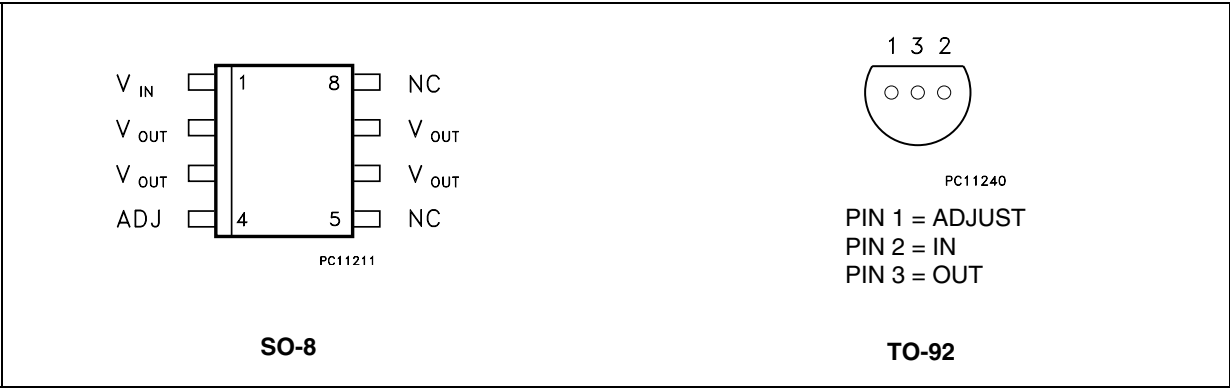
# 1 Diagram

Figure 1. Schematic diagram



## 2 Pin configuration

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

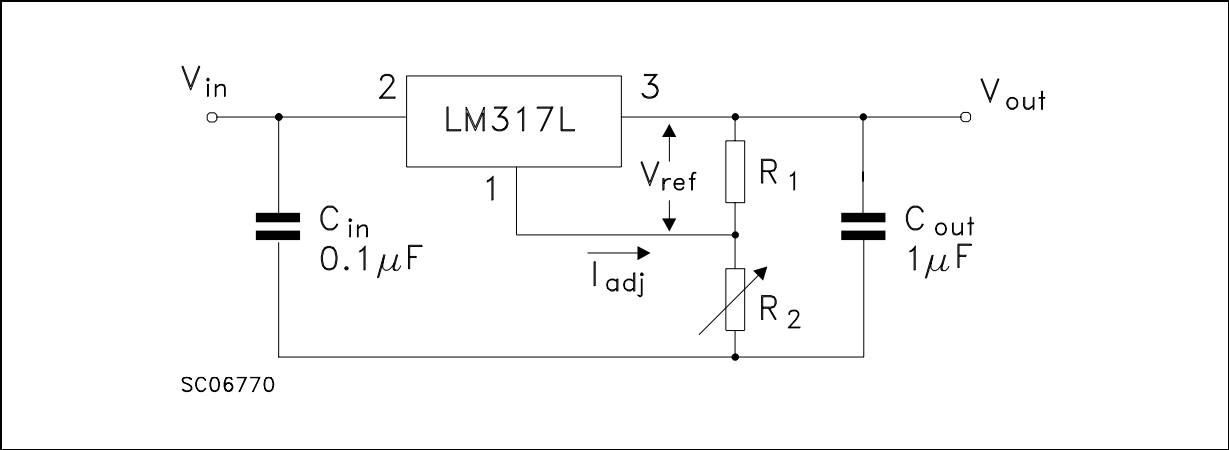


### 3 Maximum ratings

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         | °C   |
|           |                                      | 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  $125^\circ\text{C}$ ,  $V_I - V_O = 5\text{ V}$ ,  $I_O = 40\text{ mA}$ , unless otherwise specified)

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

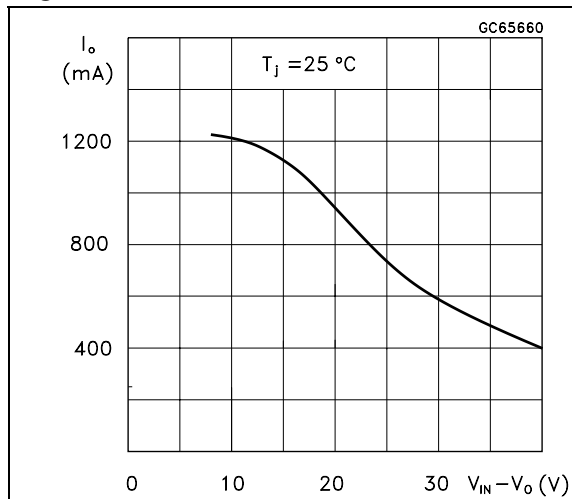
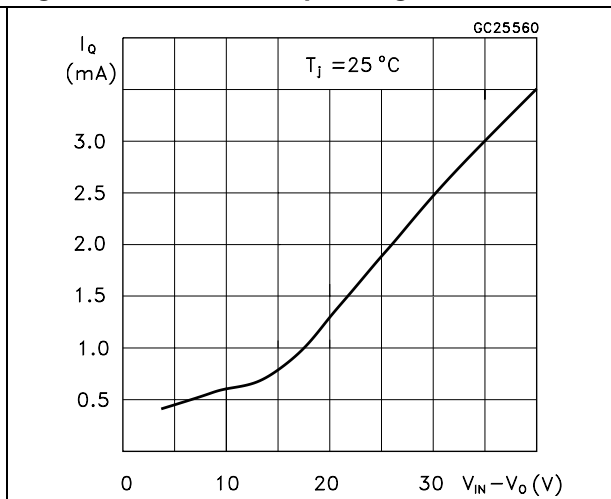
1.  $C_{ADJ}$  is connected between adjust pin and ground.

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

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

1.  $C_{\text{ADJ}}$  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  $I_{ADJ}$  (100μA 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

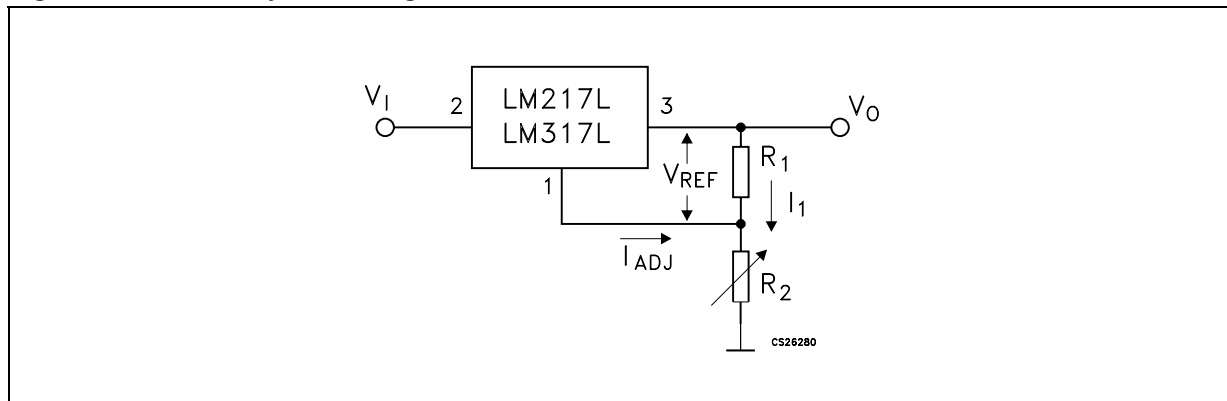


Figure 7. Voltage regulator with protection diodes

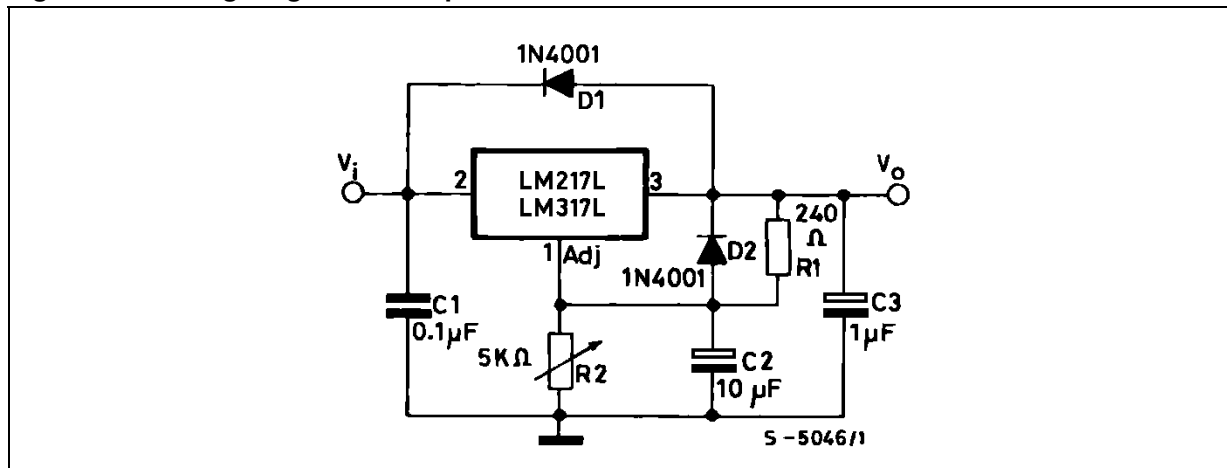


Figure 8. Slow Turn-on 15V Regulator

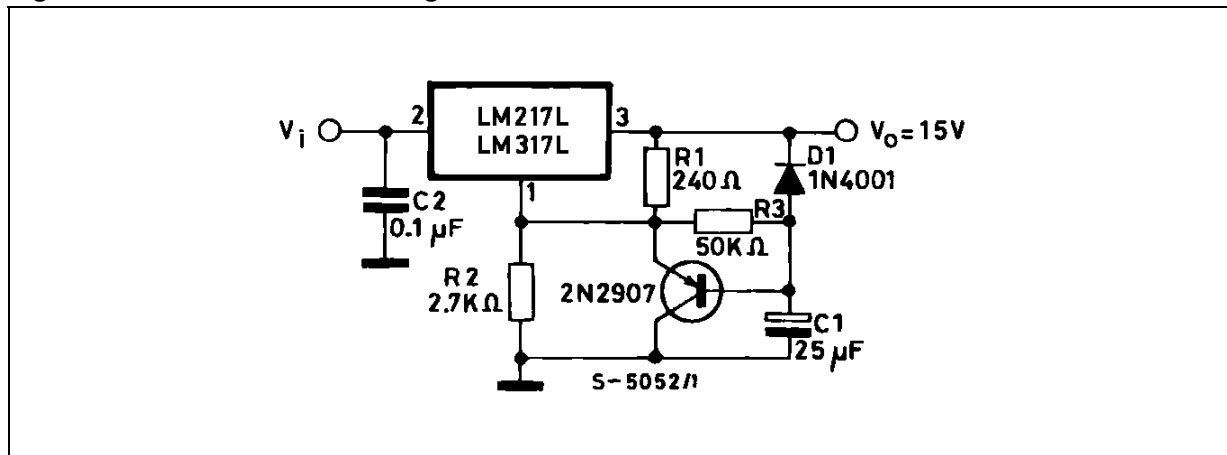


Figure 9. Current regulator

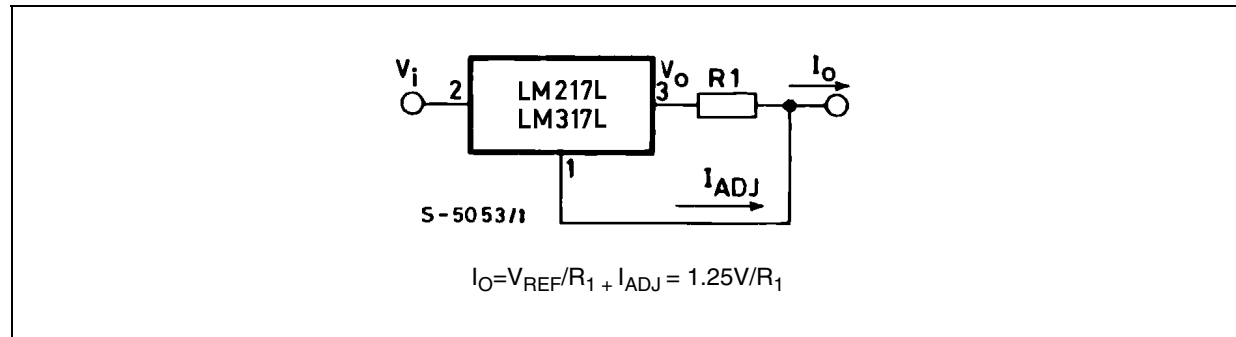


Figure 10. 5V Electronic shut-down regulator

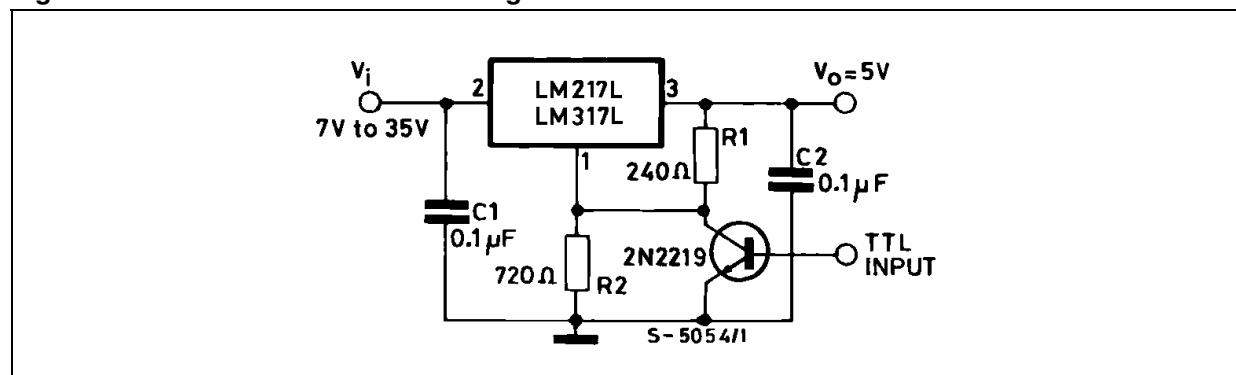
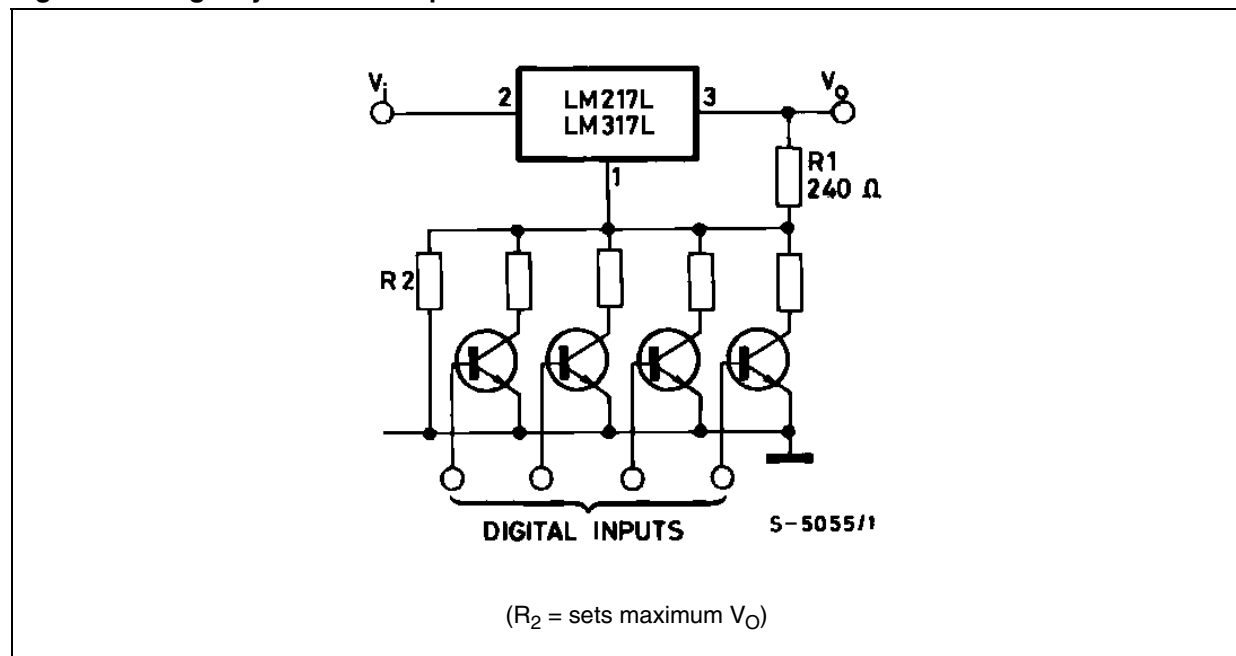


Figure 11. Digitally selected outputs

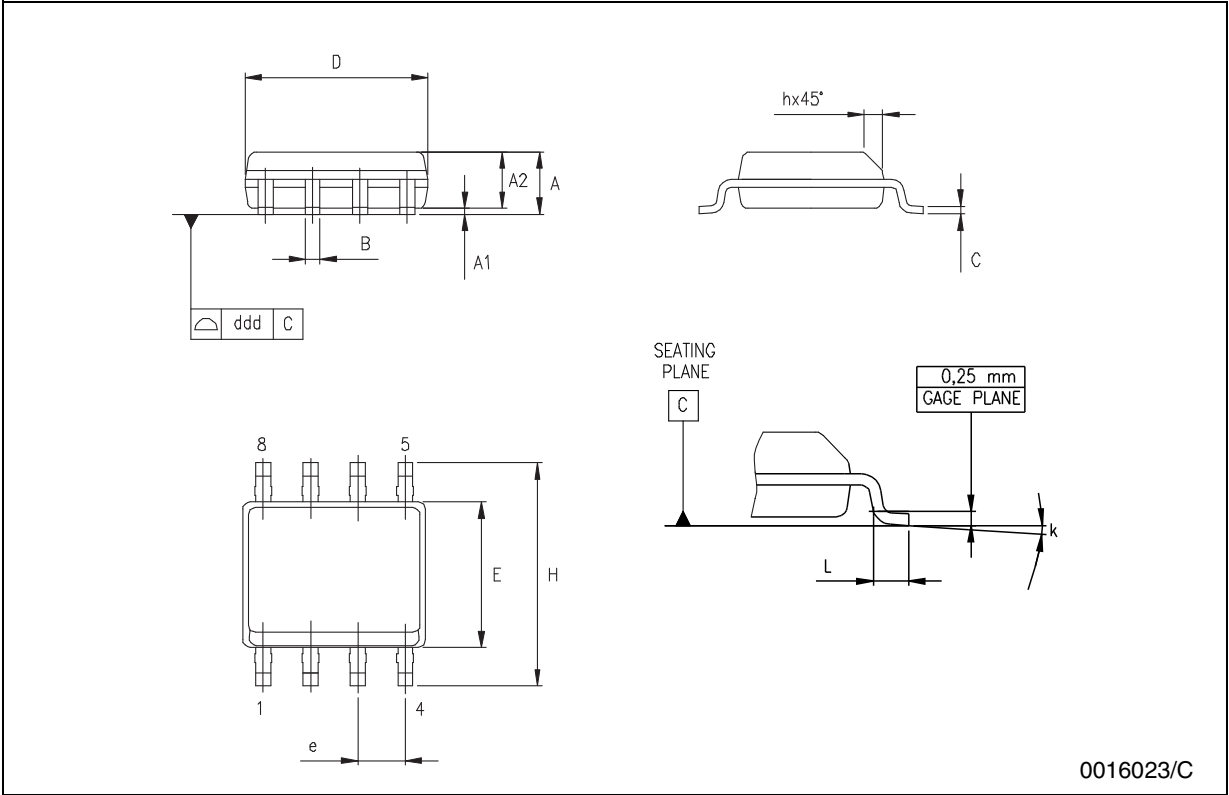


## 8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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](http://www.st.com).

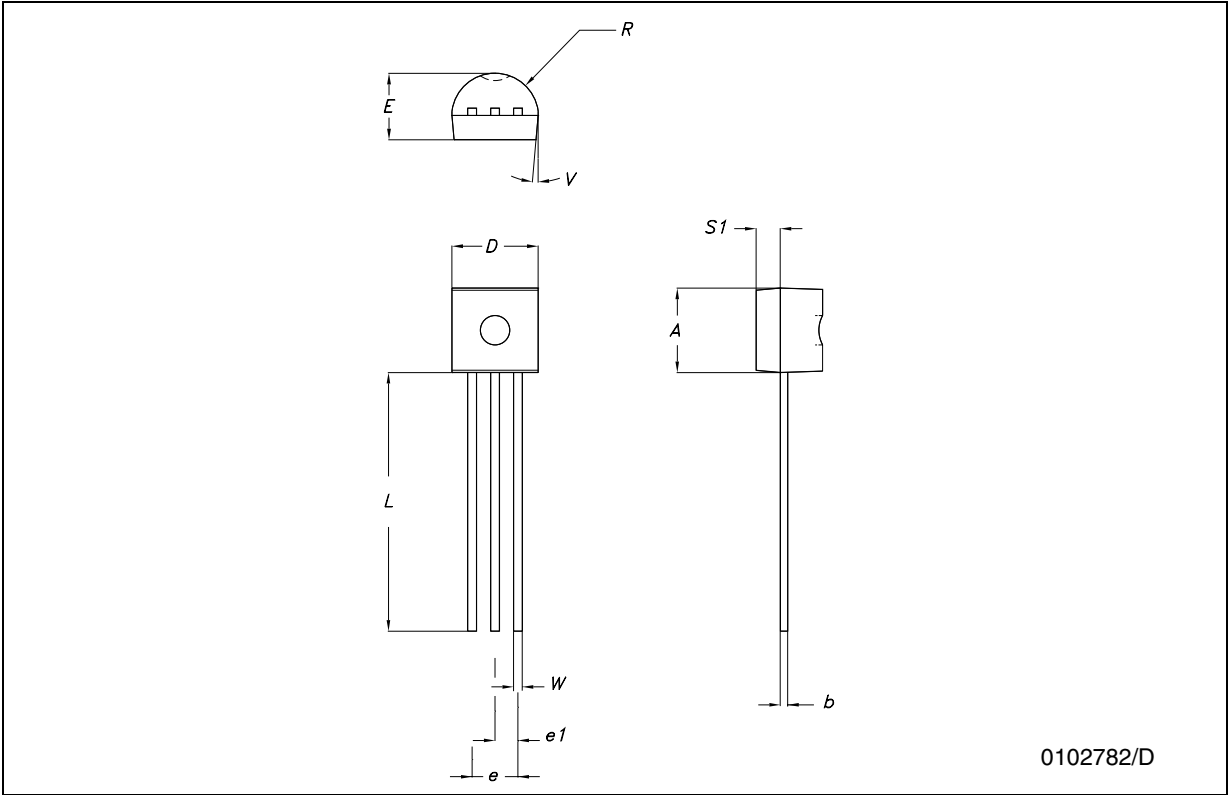
SO-8 MECHANICAL DATA

| 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  |



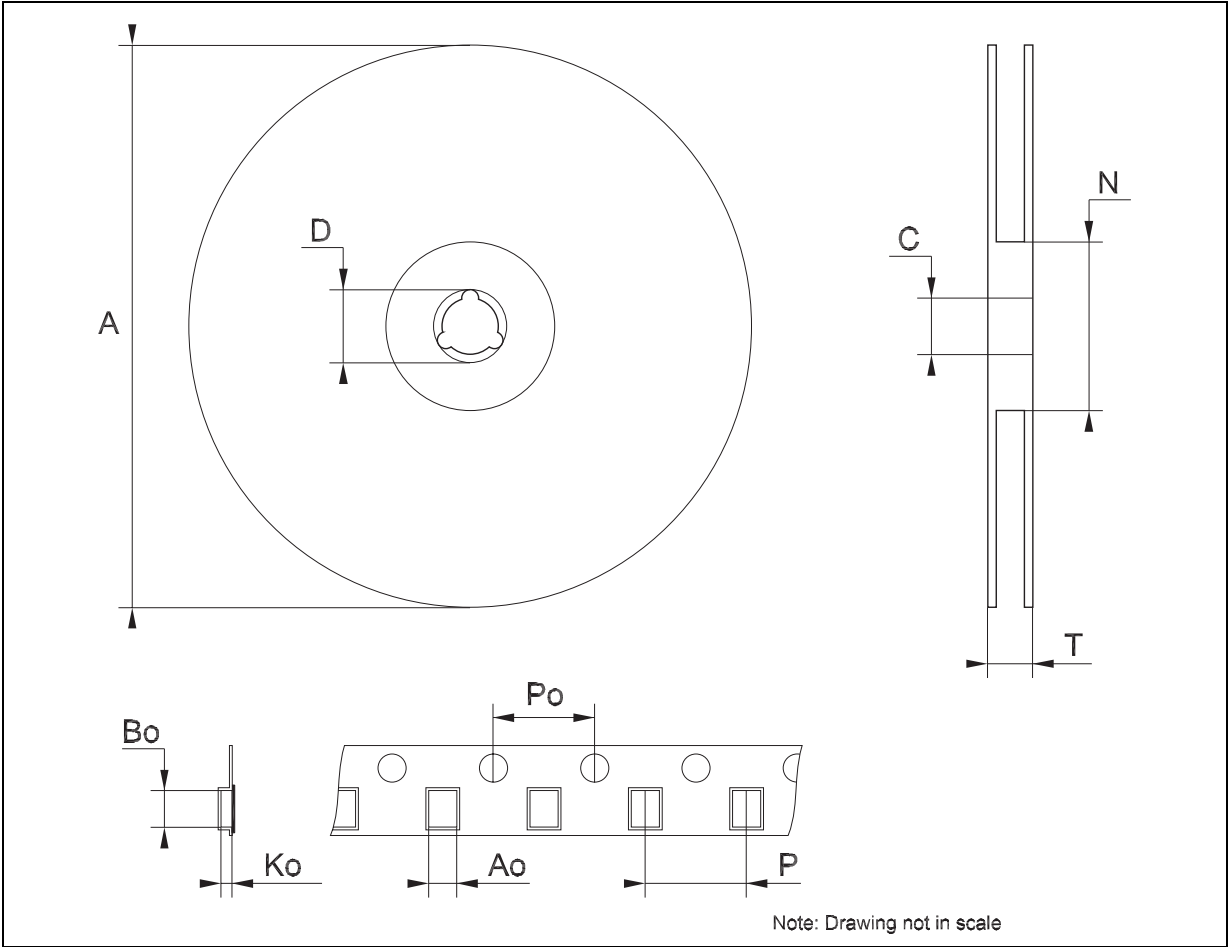
TO-92 MECHANICAL DATA

| 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  |
| $\alpha$ |      | 5°  |       |       | 5°   |       |



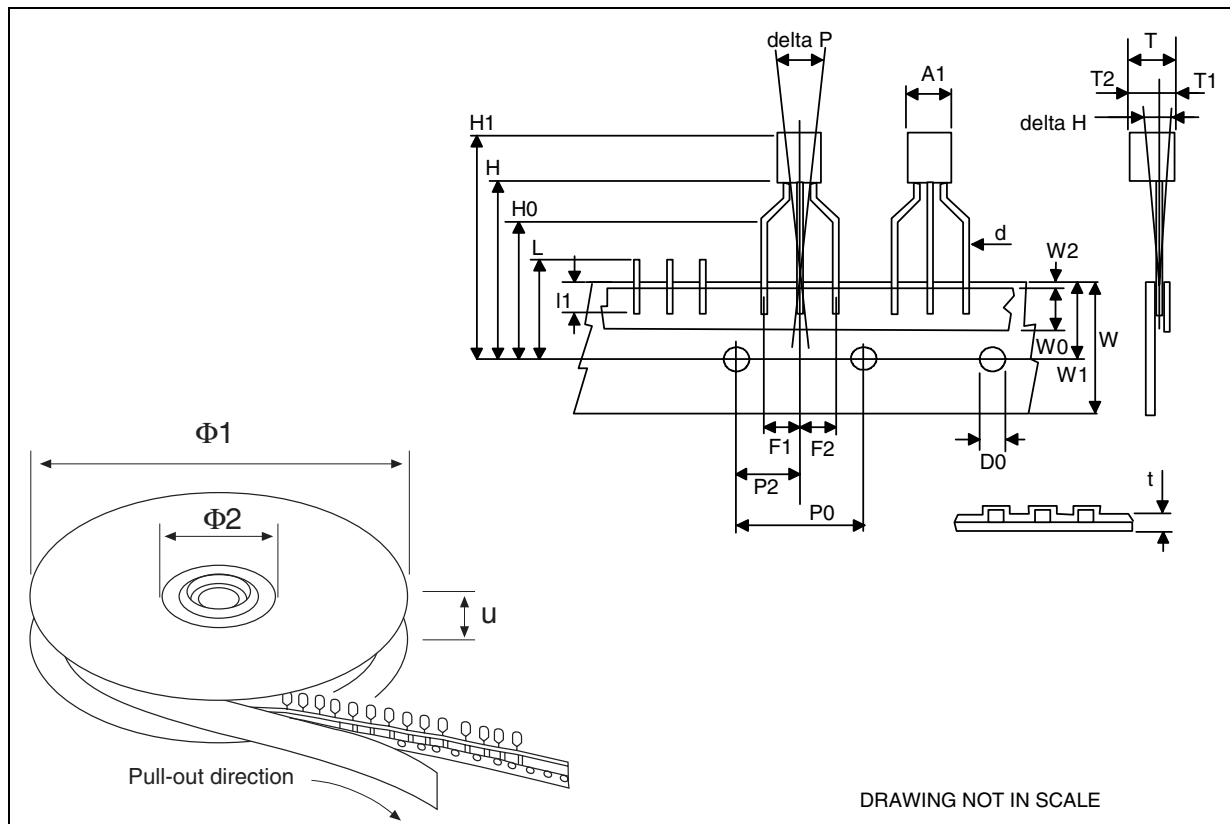
Tape & Reel SO-8 MECHANICAL DATA

| 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 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. |

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2007 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)