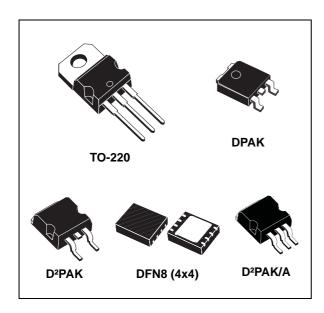


#### 1.5 A adjustable and fixed low drop positive voltage regulator

Datasheet - production data



#### **Features**

- Typical dropout: 1.3 V at 1.5 A
- Three-terminal adjustable or fixed output voltage: 1.8 V, 2.5 V, 3.3 V, 5 V, 12 V
- Automotive grade (adjustable V<sub>OUT</sub> in TO-220 and DPAK packages only)
- Output current guaranteed up to 1.5 A
- Output tolerance: ± 1 % at 25 °C and ± 2 % in full temperature range
- Internal power and thermal limit
- Wide operating temperature range 40 °C to 125 °C
- Package available: TO-220, D<sup>2</sup>PAK, D<sup>2</sup>PAK/A, DPAK and DFN8 (4 x 4 mm)
- Pinout compatibility with standard adjustable voltage regulators

#### **Description**

The LD1086 is a low drop voltage regulator capable of providing up to 1.5 A of output current. Dropout is guaranteed at a maximum of 1.2 V at the maximum output current, decreasing at lower loads. The LD1086 is pin-to-pin compatible with older 3-terminal adjustable regulators, but has better performance in terms of drop and output tolerance. Unlike PNP regulators, where a part of the output current is wasted as quiescent current, the LD1086 quiescent current flows into the load, increasing efficiency. Only a 10 µF (minimum) capacitor is needed for stability. The device is available in a TO-220, D2PAK, D2PAK/A, DPAK or DFN8 (4x4 mm) package. On-chip trimming allows the regulator to reach a very tight output voltage tolerance; within ± 1% at 25 °C. The LD1086 is available as automotive grade for adjustable output voltages in the TO-220 and DPAK packages. The PAT, SYL, SBL statistical tests have been performed, and the devices are qualified according to the AEC-Q100 specification for the automotive market in the temperature range of - 40 °C to 125 °C.

Contents LD1086

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LD1086 Diagram

#### Diagram 1

THERMAL PROTECTION VOUT SC14280

Figure 1. Schematic diagram

Pin configuration LD1086

## 2 Pin configuration

INPUT INPUT OUTPUT OUTPUT OUTPUT ADJ/GND ADJ/GND TO-220 D<sup>2</sup>PAK INPUT ⊐ INPUT OUTPUT OUTPUT ADJ/GND ADJ/GND CS00890 **DPAK** D<sup>2</sup>PAK/A 0 1 NC 8 IN IN NC 2 7 OUTPUT 3 6 NC ADJ/GND 5 NC NC 4 **DFN8 (4x4)** 

Figure 2. Pin connections (top view)

Note: The TAB is physically connected to the output (this is valid for the TO-220 package too).

LD1086 Maximum ratings

## 3 Maximum ratings

Table 1. Absolute maximum ratings

| Symbol           | Parameter                            | Value              | Unit |
|------------------|--------------------------------------|--------------------|------|
| VI               | DC input voltage                     | 30                 | V    |
| I <sub>O</sub>   | Output current                       | Internally Limited | mA   |
| P <sub>D</sub>   | Power dissipation                    | Internally Limited | mW   |
| T <sub>STG</sub> | Storage temperature range            | -55 to +150        | °C   |
| T <sub>OP</sub>  | Operating junction temperature range | -40 to +125        | °C   |

Note:

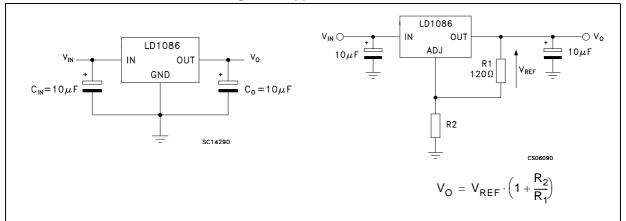
Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

Table 2. Thermal data

| Symbol            | Parameter                           | TO-220 | D²PAK<br>D²PAK/A | DPAK | DFN8 | Unit |
|-------------------|-------------------------------------|--------|------------------|------|------|------|
| R <sub>thJC</sub> | Thermal resistance junction-case    | 5      | 3                | 8    | 1.5  | °C/W |
| R <sub>thJA</sub> | Thermal resistance junction-ambient | 50     | 62.5             | 100  | 33   | °C/W |

## 4 Schematic application

Figure 3. Application circuit



### 5 Electrical characteristics

 $V_I$  = 4.8 V,  $C_I$  =  $C_O$  =10  $\mu F,\, T_A$  = -40 to 125 °C, unless otherwise specified.

Table 3. Electrical characteristics of LD1086#18

| Symbol  | Parameter                                       | Test condition  | Min.  | Тур.  | Max.  | Unit |
|---|---|---|-------|-------|-------|------|
| V   | Output voltage (1)                              | $I_O = 0$ mA, $T_J = 25$ °C   | 1.782 | 1.8   | 1.818 | V    |
| $V_{O}$ $\Delta V_{O}$ $V_{d}$  | Output voltage V                                | $I_O = 0$ to 1.5 A, $V_I = 3.4$ to 30 V   | 1.764 | 1.8   | 1.836 | V    |
| V <sub>O</sub> ΔV <sub>O</sub>  | Line regulation                                 | $I_O = 0$ mA, $V_I = 3.4$ to 18 V, $T_J = 25$ °C  |       | 0.2   | 4     | mV   |
|   |   | $I_{O} = 0 \text{ mA}, V_{I} = 3.4 \text{ to } 15 \text{ V}$                                |       | 0.4   | 4     | mV   |
| V <sub>O</sub> O ΔV <sub>O</sub> Li ΔV <sub>O</sub> Li V <sub>d</sub> D I <sub>q</sub> Q I <sub>sc</sub> S TI SVR S eN (9) S Te | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A, T <sub>J</sub> = 25 °C   |       | 0.5   | 8     | mV   |
|   | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A   |       | 1     | 16    | mV   |
| V <sub>d</sub>  | Dropout voltage                                 | I <sub>O</sub> = 1.5 A  |       | 1.3   | 1.5   | V    |
| Iq  | Quiescent current                               | V <sub>I</sub> ≤ 30 V   |       | 5     | 10    | mA   |
| V <sub>d</sub>  | Ob and aims if a summer                         | $V_I - V_O = 5 V$   | 1.5   | 2     |       | Α    |
| 'sc   | Short circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V  | 0.05  | 0.02  |       | Α    |
|   | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse   |       | 0.01  | 0.04  | %/W  |
| SVR   | Supply voltage rejection                        | $f = 120 \text{ Hz}, C_O = 25 \mu\text{F}, I_O = 1.5 \text{ A}$ $V_I = 6.8 \pm 3 \text{ V}$ | 60    | 82    |       | dB   |
| eN  | RMS output noise voltage (% of V <sub>O</sub> ) | $T_A = 25 ^{\circ}\text{C}$ , f =10 Hz to 10 kHz  |       | 0.003 |       | %    |
| S   | Temperature stability                           |   |       | 0.5   |       | %    |
| S   | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs   |       | 0.5   |       | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

Electrical characteristics LD1086

 $V_{I}$  = 5.5 V,  $C_{I}$  =  $C_{O}$  =10  $\mu F,\, T_{A}$  = -40 to 125 °C, unless otherwise specified.

Table 4. Electrical characteristics of LD1086#25

| Symbol  | Parameter                                       | Test condition  | Min.  | Тур.  | Max.  | Unit |
|---|---|---|-------|-------|-------|------|
| V   | Output voltage <sup>(1)</sup>                   | $I_O = 0$ mA, $T_J = 25$ °C   | 2.475 | 2.5   | 2.525 | V    |
| $\begin{tabular}{ c c c c c } \hline Symbol & & & \\ & V_O & & \\ & \Delta V_O & & \\ & V_d & & \\ & I_q & & \\ & I_{sc} & & \\ \hline & SVR & & \\ & eN & & \\ \hline \end{tabular}$ | Output voltage ( )                              | I <sub>O</sub> = 0 to 1.5 A, V <sub>I</sub> = 4.1 to 30 V                                   | 2.45  | 2.5   | 2.55  | V    |
| ΔV <sub>O</sub>   | Line regulation                                 | $I_O = 0$ mA, $V_I = 4.1$ to 18 V,<br>$T_J = 25$ °C   |       | 0.2   | 4     | mV   |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR  |   | $I_O = 0 \text{ mA}, V_I = 4.1 \text{ to } 18 \text{ V}$                                    |       | 0.4   | 4     | mV   |
| $V_{O}$ $C$ $\Delta V_{O}$ $C$ $\Delta V_{O}$ $C$ $\Delta V_{O}$ $C$  | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A, T <sub>J</sub> = 25 °C   |       | 0.5   | 8     | mV   |
|   | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A   |       | 1     | 16    | mV   |
| V <sub>d</sub>  | Dropout voltage                                 | I <sub>O</sub> = 1.5 A  |       | 1.3   | 1.5   | V    |
| Iq  | Quiescent current                               | V <sub>I</sub> ≤ 30 V   |       | 5     | 10    | mA   |
| V <sub>O</sub>  | 0   | $V_I - V_O = 5 V$   | 1.5   | 2     |       | Α    |
|   | Short circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V  | 0.05  | 0.2   |       | Α    |
|   | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse   |       | 0.008 | 0.04  | %/W  |
| SVR   | Supply voltage rejection                        | $f = 120 \text{ Hz}, C_O = 25 \mu\text{F}, I_O = 1.5 \text{ A}$ $V_I = 7.5 \pm 3 \text{ V}$ | 60    | 81    |       | dB   |
| eN  | RMS output noise voltage (% of V <sub>O</sub> ) | T <sub>A</sub> = 25 °C, f =10 Hz to 10 kHz  |       | 0.003 |       | %    |
| S   | Temperature stability                           |   |       | 0.5   |       | %    |
| S   | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs   |       | 0.5   |       | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

 $V_I$  = 6.3 V,  $C_I$  =  $C_O$  =10  $\mu F,\, T_A$  = -40 to 125 °C, unless otherwise specified.

Table 5. Electrical characteristics of LD1086#33

| Symbol   | Parameter                                       | Test condition   | Min.  | Тур.  | Max.  | Unit |
|--|---|--|-------|-------|-------|------|
| W  | Output voltage (1)                              | I <sub>O</sub> = 0 mA, T <sub>J</sub> = 25 °C                        | 3.267 | 3.3   | 3.333 | V    |
| $\begin{tabular}{c} Symbol \\ V_O \\ $\Delta V_O$ \\ $V_d$ \\ $I_q$ \\ $I_{sc}$ \\ $SVR$ \\ \end{tabular}$ | Output voltage (**)                             | $I_O = 0$ to 1.5 A, $V_I = 4.9$ to 30 V                              | 3.234 | 3.3   | 3.366 | V    |
| $\Delta V_{\mathbf{O}}$  | Line regulation                                 | $I_O = 0$ mA, $V_I = 4.9$ to 18 V, $T_J = 25$ °C                     |       | 0.5   | 6     | mV   |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR eN S                      |   | $I_O = 0$ mA, $V_I = 4.9$ to 18 V                                    |       | 1     | 6     | mV   |
| V <sub>O</sub>   | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A, T <sub>J</sub> = 25 °C                  |       | 1     | 10    | mV   |
|  | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A  |       | 7     | 25    | mV   |
| V <sub>d</sub>   | Dropout voltage                                 | I <sub>O</sub> = 1.5 A   |       | 1.3   | 1.5   | V    |
| Iq   | Quiescent current                               | V <sub>I</sub> ≤ 30 V  |       | 5     | 10    | mA   |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR eN S                      | Short-circuit current                           | $V_I - V_O = 5 V$  | 1.5   | 2     |       | Α    |
|  | Short-circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V                               | 0.05  | 0.2   |       | Α    |
|  | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse                                  |       | 0.008 | 0.04  | %/W  |
| SVR  | Supply voltage rejection                        | $f$ = 120 Hz, $C_O$ = 25 $\mu F,  I_O$ = 1.5 A $V_I$ = 8.3 $\pm$ 3 V | 60    | 79    |       | dB   |
| eN   | RMS output noise voltage (% of V <sub>O</sub> ) | $T_A = 25 ^{\circ}\text{C}$ , f =10 Hz to 10 kHz                     |       | 0.003 |       | %    |
| S  | Temperature stability                           |  |       | 0.5   |       | %    |
| S  | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs                                    |       | 0.5   |       | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

Electrical characteristics LD1086

 $V_{I}$  = 8 V,  $C_{I}$  =  $C_{O}$  =10  $\mu F,\, T_{A}$  = -40 to 125 °C, unless otherwise specified.

Table 6. Electrical characteristics of LD1086#50

| Symbol  | Parameter                                       | Test condition  | Min. | Тур.  | Max. | Unit |
|---|---|---|------|-------|------|------|
| W   | Output voltage <sup>(1)</sup>                   | $I_O = 0$ mA, $T_J = 25$ °C   | 4.95 | 5     | 5.05 | V    |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR eN   | Output voltage (*)                              | I <sub>O</sub> = 0 to 1.5 A, V <sub>I</sub> = 6.6 to 30 V                                   | 4.9  | 5     | 5.1  | V    |
| $\Delta V_{O}$  | Line regulation                                 | $I_O = 0$ mA, $V_I = 6.6$ to 20V,<br>$T_J = 25$ °C  |      | 0.5   | 10   | mV   |
| $V_{O}$ $\Delta V_{O}$ $V_{d}$ $I_{q}$ $I_{sc}$ SVR                                   |   | I <sub>O</sub> = 0 mA, V <sub>I</sub> = 6.6 to 20 V   |      | 1     | 10   | mV   |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR eN   | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A, T <sub>J</sub> = 25 °C   |      | 5     | 20   | mV   |
|   | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A   |      | 10    | 35   | mV   |
| V <sub>d</sub>  | Dropout voltage                                 | I <sub>O</sub> = 1.5 A  |      | 1.3   | 1.5  | V    |
| Iq  | Quiescent current                               | V <sub>I</sub> ≤ 30 V   |      | 5     | 10   | mA   |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR eN S | Ob and aims it assessed                         | V <sub>I</sub> - V <sub>O</sub> = 5 V   | 1.5  | 2     |      | Α    |
|   | Short circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V  | 0.05 | 0.2   |      | Α    |
|   | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse   |      | 0.01  | 0.04 | %/W  |
| SVR   | Supply voltage rejection                        | $f = 120 \text{ Hz}, C_O = 25 \mu\text{F}, I_O = 1.5 \text{ A} $ $V_I = 10 \pm 3 \text{ V}$ | 60   | 75    |      | dB   |
| eN  | RMS output noise voltage (% of V <sub>O</sub> ) | T <sub>A</sub> = 25 °C, f =10 Hz to 10 kHz  |      | 0.003 |      | %    |
| S   | Temperature stability                           |   |      | 0.5   |      | %    |
| S   | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs   |      | 0.5   |      | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

 $V_I$  = 15 V,  $C_I$  =  $C_O$  =10  $\mu F,\, T_A$  = -40 to 125 °C, unless otherwise specified.

Table 7. Electrical characteristics of LD1086#12

| Symbol  | Parameter                                       | Test condition   | Min.  | Тур.  | Max.  | Unit |
|---|---|--|-------|-------|-------|------|
| \/  | Output voltage <sup>(1)</sup>                   | I <sub>O</sub> = 0 mA, T <sub>J</sub> = 25 °C                      | 11.88 | 12    | 12.12 | V    |
| ۷O  | Output voltage V                                | I <sub>O</sub> = 0 to 1.5 A, V <sub>I</sub> = 13.8 to 30 V         | 11.76 | 12    | 12.24 | V    |
| $\Delta V_{O}$  | Line regulation                                 | $I_O = 0$ mA, $V_I = 13.8$ to 25 V,<br>$T_J = 25$ °C               |       | 1     | 25    | mV   |
| $\Delta V_{O}$ $V_{d}$ $I_{q}$  |   | $I_O = 0 \text{ mA}, V_I = 13.8 \text{ to } 25 \text{ V}$          |       | 2     | 25    | mV   |
| V <sub>O</sub>  | Load regulation                                 | $I_{O} = 0$ to 1.5 A, $T_{J} = 25$ °C                              |       | 12    | 36    | mV   |
|   |   | I <sub>O</sub> = 0 to 1.5 A  |       | 24    | 72    | mV   |
| V <sub>d</sub>  | Dropout voltage                                 | I <sub>O</sub> = 1.5 A   |       | 1.3   | 1.5   | V    |
| Iq  | Quiescent current                               | V <sub>I</sub> ≤ 30 V  |       | 5     | 10    | mA   |
| ı   | Short circuit current                           | $V_I - V_O = 5 V$  | 1.5   | 2     |       | Α    |
| V <sub>O</sub> ΔV <sub>O</sub> V <sub>d</sub> I <sub>q</sub> I <sub>sc</sub> SVR eN S | Short circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V                             | 0.05  | 0.2   |       | Α    |
|   | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse                                |       | 0.01  | 0.04  | %/W  |
| SVR   | Supply voltage rejection                        | f = 120 Hz, $C_O$ = 25 $\mu$ F, $I_O$ = 1.5 A $V_I$ = 17 $\pm$ 3 V | 54    | 66    |       | dB   |
| eN  | RMS output noise voltage (% of V <sub>O</sub> ) | T <sub>A</sub> = 25 °C, f =10 Hz to 10 kHz                         |       | 0.003 |       | %    |
| S   | Temperature stability                           |  |       | 0.5   |       | %    |
| S   | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs                                  |       | 0.5   |       | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

Electrical characteristics LD1086

 $V_I$  = 4.25 V,  $C_I$  =  $C_O$  =10  $\mu F,\, T_A$  = -40 to 125 °C, unless otherwise specified.

Table 8. Electrical characteristics of LD1086B#

| Symbol   | Parameter                                       | Test condition   | Min.  | Тур.  | Max.  | Unit |
|--|---|--|-------|-------|-------|------|
|  |   | $I_O = 10 \text{ mA T}_J = 25 \text{ °C}$  | 1.231 | 1.25  | 1.269 | V    |
| V <sub>ref</sub>   | Reference voltage (1)                           | $I_O$ = 10 mA to 1.5 A, $V_I$ = 2.85 to 30 V   | 1.219 | 1.25  | 1.281 | V    |
| ΔVO  | Line regulation                                 | $I_O = 10 \text{ mA}, V_I = 2.8 \text{ to } 16.5 \text{ V},$<br>$T_J = 25 \text{ °C}$  |       | 0.015 | 0.2   | %    |
| $\begin{array}{c} V_{ref} \\ \\ \Delta V_{O} \\ \\ V_{d} \\ \\ I_{O(min)} \\ \\ I_{sc} \\ \\ \\ SVR \\ \\ I_{ADJ} \\ \\ \Delta I_{ADJ} \\ \\ eN \\ \\ S \\ \end{array}$  | -   | $I_O = 10 \text{ mA}, V_I = 2.8 \text{ to } 16.5 \text{ V}$  |       | 0.035 | 0.2   | %    |
| V <sub>ref</sub> F  ΔV <sub>O</sub> L  ΔV <sub>O</sub> L  V <sub>d</sub> [  I <sub>O(min)</sub> N  I <sub>sc</sub> S  SVR S  I <sub>ADJ</sub> A  AI <sub>ADJ</sub> A  eN f   | Load regulation                                 | $I_{O}$ = 10 mA to 1.5 A, $T_{J}$ = 25 °C  |       | 0.1   | 0.3   | %    |
|  | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A  |       | 0.2   | 0.4   | %    |
| V <sub>d</sub>   | Dropout voltage                                 | I <sub>O</sub> = 1.5 A   |       | 1.3   | 1.5   | V    |
| I <sub>O(min)</sub>  | Minimum load current                            | V <sub>I</sub> = 30 V  |       | 3     | 10    | mA   |
| $\begin{array}{c c} V_{ref} \\ \hline \\ \Delta V_{O} \\ \hline \\ \Delta V_{O} \\ \hline \\ V_{d} \\ \hline \\ I_{O(min)} \\ \hline \\ I_{SC} \\ \hline \\ SVR \\ \hline \\ I_{ADJ} \\ \Delta I_{ADJ} \\ \\ eN \\ \hline \\ S \\ \end{array}$ | Short circuit current                           | $V_I - V_O = 5 V$  | 1.5   | 2.3   |       | Α    |
|  | Short circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V   | 0.05  | 0.2   |       | Α    |
|  | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse  |       | 0.01  | 0.04  | %/W  |
| SVR  | Supply voltage rejection                        | $ f = 120 \text{ Hz}, C_O = 25  \mu\text{F}, C_{ADJ} = 25  \mu\text{F}, \\ I_O = 1.5 \text{ A}, \ V_I = 6.25 \pm 3 \text{ V} $ | 60    | 88    |       | dB   |
| I <sub>ADJ</sub>   | Adjust pin current                              | V <sub>I</sub> = 4.25 V, I <sub>O</sub> = 10 mA  |       | 40    | 120   | μA   |
| Δl <sub>ADJ</sub>  | Adjust pin current change (1)                   | $I_O$ = 10 mA to 1.5 A, $V_I$ = 2.8 to 16.5 V  |       | 0.2   | 5     | μA   |
| eN   | RMS output noise voltage (% of V <sub>O</sub> ) | T <sub>A</sub> = 25 °C, f =10 Hz to 10 kHz   |       | 0.003 |       | %    |
| S  | Temperature stability                           |  |       | 0.5   |       | %    |
| S  | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs  |       | 0.5   |       | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

 $V_I$  = 4.25 V,  $C_I$  =  $C_O$  =10  $\mu F,\, T_A$  = -40 to 125 °C, unless otherwise specified.

Table 9. Electrical characteristics of LD1086#

| Symbol  | Parameter                                       | Test condition  | Min.  | Тур.  | Max.  | Unit |
|---|---|---|-------|-------|-------|------|
|   |   | $I_O = 10 \text{ mA T}_J = 25 \text{ °C}$   | 1.237 | 1.25  | 1.263 | V    |
| V <sub>ref</sub>  | Reference voltage (1)                           | $I_O = 10$ mA to 1.5 A, $V_I = 2.85$ to 30 V  | 1.225 | 1.25  | 1.275 | V    |
| ΔVO   | Line regulation                                 | $I_O = 10 \text{ mA}, V_I = 2.8 \text{ to } 16.5 \text{ V},$<br>$T_J = 25 ^{\circ}\text{C}$ |       | 0.015 | 0.2   | %    |
| $V_{ref}$ $\Delta V_{O}$ $\Delta V_{O}$ $V_{d}$ $I_{O(min)}$ $I_{sc}$ SVR $I_{ADJ}$   |   | I <sub>O</sub> = 10 mA, V <sub>I</sub> = 2.8 to 16.5 V                                      |       | 0.035 | 0.2   | %    |
| V <sub>ref</sub> F ΔV <sub>O</sub> L ΔV <sub>O</sub> L V <sub>d</sub> [I I <sub>O(min)</sub> f SVR S I <sub>ADJ</sub> f AI <sub>ADJ</sub> f S S - | Load regulation                                 | $I_O$ = 10 mA to 1.5 A, $T_J$ = 25 °C   |       | 0.1   | 0.3   | %    |
| Δνο   | Load regulation                                 | I <sub>O</sub> = 0 to 1.5 A   |       | 0.2   | 0.4   | %    |
| V <sub>d</sub>  | Dropout voltage                                 | I <sub>O</sub> = 1.5 A  |       | 1.3   | 1.5   | V    |
| I <sub>O(min)</sub>   | Minimum load current                            | V <sub>I</sub> = 30 V   |       | 3     | 10    | mA   |
|   | Short circuit current                           | $V_I - V_O = 5 V$   | 1.5   | 2.3   |       | Α    |
| Isc   | Short circuit current                           | V <sub>I</sub> - V <sub>O</sub> = 25 V  | 0.05  | 0.2   |       | Α    |
|   | Thermal regulation                              | T <sub>A</sub> = 25 °C, 30 ms pulse   |       | 0.01  | 0.04  | %/W  |
| SVR   | Supply voltage rejection                        |   | 60    | 88    |       | dB   |
| I <sub>ADJ</sub>  | Adjust pin current                              | V <sub>I</sub> = 4.25 V, I <sub>O</sub> = 10 mA   |       | 40    | 120   | μA   |
| Δl <sub>ADJ</sub>   | Adjust pin current change (1)                   | $I_O$ = 10 mA to 1.5 A, $V_I$ = 2.8 to 16.5 V   |       | 0.2   | 5     | μΑ   |
| eN  | RMS output noise voltage (% of V <sub>O</sub> ) | T <sub>A</sub> = 25 °C, f =10 Hz to 10 kHz  |       | 0.003 |       | %    |
| S   | Temperature stability                           |   |       | 0.5   |       | %    |
| S   | Long term stability                             | T <sub>A</sub> = 125 °C, 1000 Hrs   |       | 0.5   |       | %    |

<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.



Electrical characteristics LD1086

 $V_I$  = 4.25 V,  $C_I$  =  $C_O$  =10  $\mu F,\, T_A$  = -40 to 125 °C, unless otherwise specified.

Table 10. Electrical characteristics of LD1086DTTRY and LD1086VY (Automotive grade)

| Symbol              | Parameter   | Test condition  | Min.  | Тур.  | Max.  | Unit |
|---------------------|---|---|-------|-------|-------|------|
| \/                  | / <sub>ref</sub> Reference voltage <sup>(1)</sup> | $I_O = 10 \text{ mA T}_A = 25 \text{ °C}$   |       | 1.25  | 1.263 | V    |
| V <sub>ref</sub>    | Reference voltage V                               | $I_{O}$ = 10 mA to 1.5 A, $V_{I}$ = 2.85 to 30 V  | 1.225 | 1.25  | 1.275 | V    |
| $\Delta V_{O}$      | Line regulation                                   | $I_O = 10 \text{ mA}, V_I = 2.8 \text{ to } 16.5 \text{ V}$   |       | 0.035 | 0.2   | %    |
| ΔV <sub>O</sub>     | Load regulation                                   | I <sub>O</sub> = 0 to 1.5 A   |       | 0.2   | 0.4   | %    |
| V <sub>d</sub>      | Dropout voltage                                   | I <sub>O</sub> = 1.5 A  |       | 1.3   | 1.5   | V    |
| I <sub>O(min)</sub> | Minimum load current                              | V <sub>I</sub> = 30 V   |       | 3     | 10    | mA   |
|                     | l Object singuity comment                         | V <sub>I</sub> - V <sub>O</sub> = 5 V, T <sub>A</sub> = 25 °C   | 1.5   | 2.3   |       | Α    |
| I <sub>sc</sub> S   | Short circuit current                             | V <sub>I</sub> - V <sub>O</sub> = 25 V, T <sub>A</sub> = 25 °C  | 0.05  | 0.2   |       | Α    |
|                     | Thermal regulation                                | T <sub>A</sub> = 25 °C, 30 ms pulse   |       | 0.01  | 0.04  | %/W  |
| SVR                 | Supply voltage rejection                          | $ \begin{array}{l} f = 120 \; Hz, \; C_O = 25 \; \mu F, C_{ADJ} = 25 \; \mu F, \\ I_O = 1.5 \; A, \; V_I = 6.25 \pm 3 \; V, \; T_A = 25 \; ^{\circ}C \\ \end{array} $ | 60    | 88    |       | dB   |
| I <sub>ADJ</sub>    | Adjust pin current                                | V <sub>I</sub> = 4.25 V, I <sub>O</sub> = 10 mA   |       | 40    | 120   | μΑ   |
| $\Delta I_{ADJ}$    | Adjust pin current change (1)                     | $I_O = 10 \text{ mA to } 1.5 \text{ A}, V_I = 2.8 \text{ to } 16.5 \text{ V}$   |       | 0.2   | 5     | μΑ   |
| eN                  | RMS output noise voltage (% of V <sub>O</sub> )   | T <sub>A</sub> = 25 °C, f =10 Hz to 10 kHz  |       | 0.003 |       | %    |
| S                   | Temperature stability                             |   |       | 0.5   |       | %    |
| S                   | Long term stability                               | T <sub>A</sub> = 125 °C, 1000 Hrs   |       | 0.5   |       | %    |

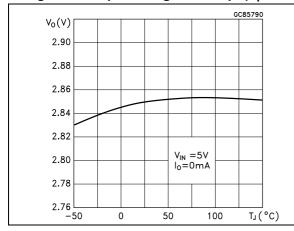
<sup>1.</sup> See short-circuit current curve for available output current at fixed dropout.

LD1086 Typical application

### 6 Typical application

Unless otherwise specified  $T_J = 25$  °C,  $C_I = C_O = 10 \mu F$ .

Figure 4. Output voltage vs. temp.  $(V_1 = 5 \text{ V})$  Figure 5. Output voltage vs. temp.  $(V_1 = 15 \text{ V})$ 



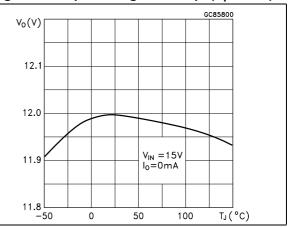
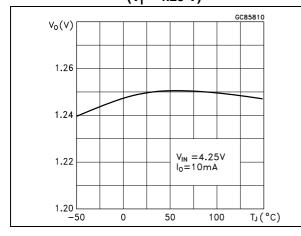
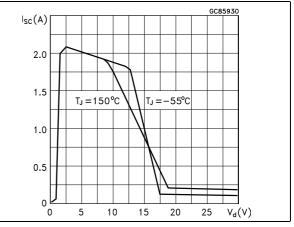


Figure 6. Output voltage vs. temperature  $(V_I = 4.25 \text{ V})$ 

Figure 7. Short circuit current vs. dropout voltage

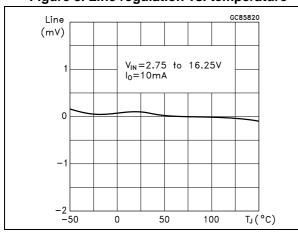




Typical application LD1086

Figure 8. Line regulation vs. temperature

Figure 9. Load regulation vs. temperature



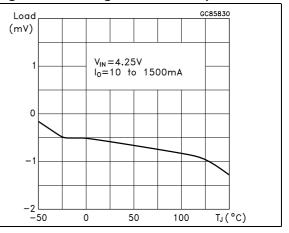
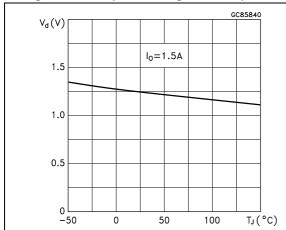


Figure 10. Dropout voltage vs. temperature

Figure 11. Dropout voltage vs. output current



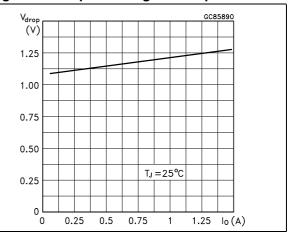
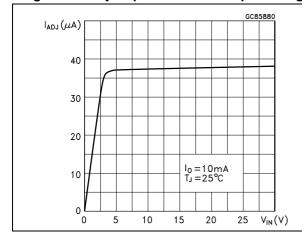
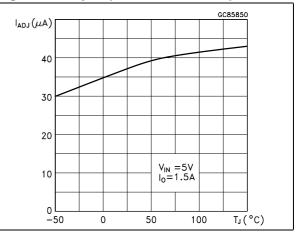


Figure 12. Adjust pin current vs. input voltage

Figure 13. Adjust pin current vs. temperature



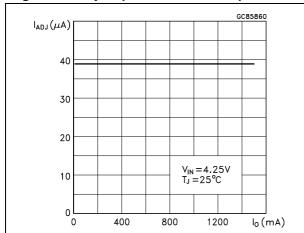


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Figure 14. Adjust pin current vs. output current Figure 15. Quiescent current vs. output current



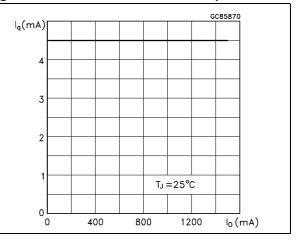
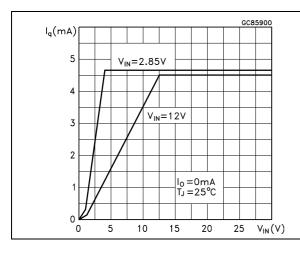


Figure 16. Quiescent current vs. input voltage

Figure 17. Supply voltage rejection vs. output current



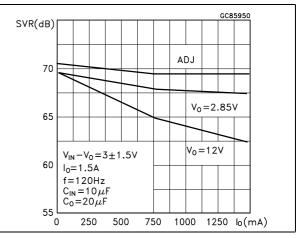
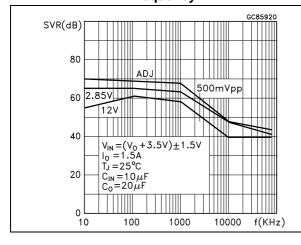
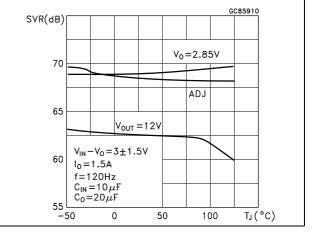


Figure 18. Supply voltage rejection vs. frequency

Figure 19. Supply voltage rejection vs. temperature

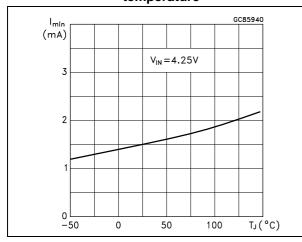




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Figure 20. Minimum load current vs. temperature

Figure 21. Stability for adjustable



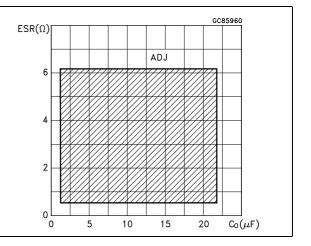
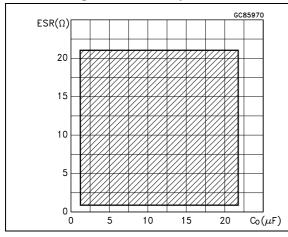


Figure 22. Stability for 2.85 V

Figure 23. Stability for 12 V



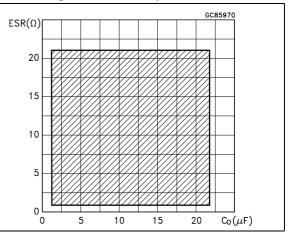
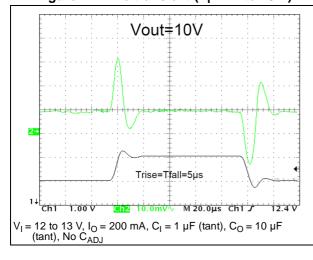
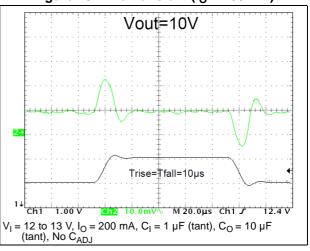


Figure 24. Line transient  $(V_I = 12 \text{ to } 13 \text{ V})$ 

Figure 25. Line transient (I<sub>O</sub> = 200 mA)



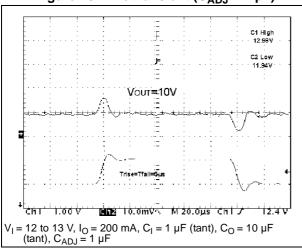


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Figure 26. Line transient ( $C_{ADJ} = 1 \mu F$ )

Figure 27. Load transient



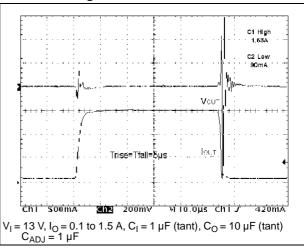
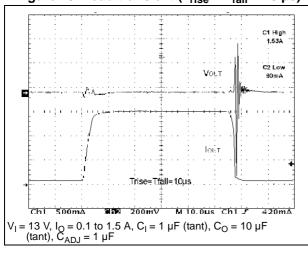
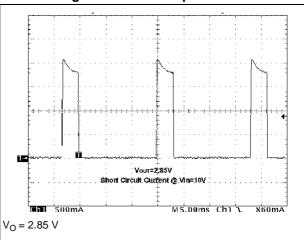


Figure 28. Load transient ( $T_{rise} = T_{fall} = 10 \mu s$ )

Figure 29. Thermal protection



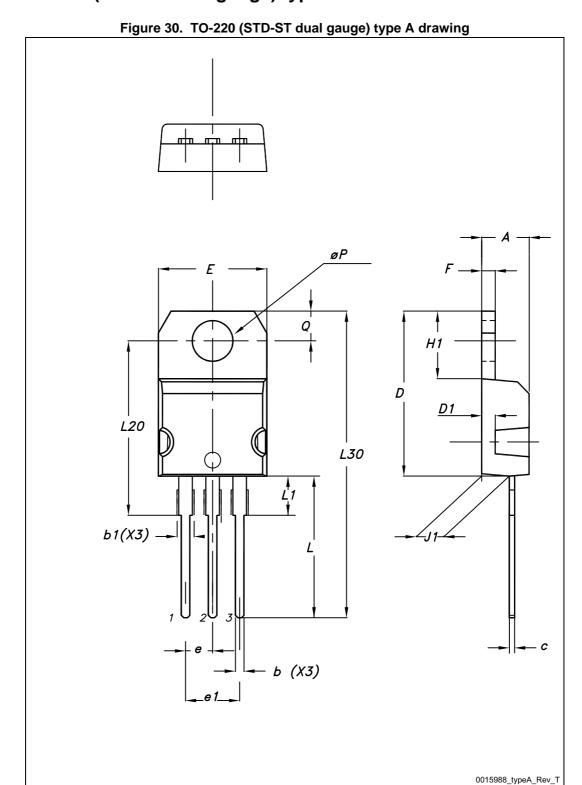


# 7 Package mechanical data

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: <a href="https://www.st.com">www.st.com</a>. ECOPACK<sup>®</sup> is an ST trademark.

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### 7.1 TO-220 (STD-ST dual gauge) type A



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Table 11. TO-220 (STD-ST dual gauge) type A mechanical data

| Di     |       | mm    |       |
|--------|-------|-------|-------|
| Dim. — | Min.  | Тур.  | Max.  |
| А      | 4.40  |       | 4.60  |
| b      | 0.61  |       | 0.88  |
| b1     | 1.14  |       | 1.70  |
| С      | 0.48  |       | 0.70  |
| D      | 15.25 |       | 15.75 |
| D1     |       | 1.27  |       |
| E      | 10    |       | 10.40 |
| е      | 2.40  |       | 2.70  |
| e1     | 4.95  |       | 5.15  |
| F      | 1.23  |       | 1.32  |
| H1     | 6.20  |       | 6.60  |
| J1     | 2.40  |       | 2.72  |
| L      | 13    |       | 14    |
| L1     | 3.50  |       | 3.93  |
| L20    |       | 16.40 |       |
| L30    |       | 28.90 |       |
| ØP     | 3.75  |       | 3.85  |
| Q      | 2.65  |       | 2.95  |

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## 7.2 TO-220 (STD-ST single gauge)

F  $\Xi$  $\Gamma$ J1 Gate Note 9-10 С b (x3) e1 8174627\_revD

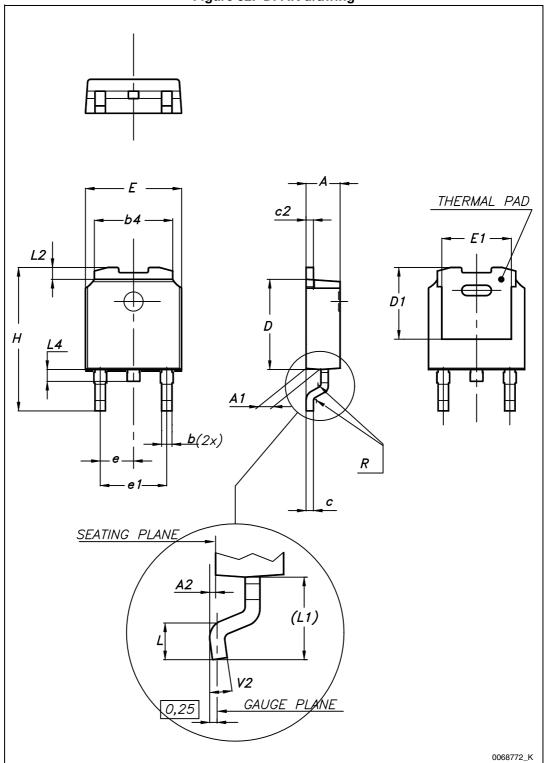
Figure 31. TO-220 (STD-ST single gauge) drawing

Table 12. TO-220 (STD-ST single gauge) mechanical data

| Dim  |       | mm    |       |
|------|-------|-------|-------|
| Dim. | Min.  | Тур.  | Max.  |
| А    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| С    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| E    | 10    |       | 10.40 |
| е    | 2.40  |       | 2.70  |
| e1   | 4.95  |       | 5.15  |
| F    | 0.51  |       | 0.60  |
| H1   | 6.20  |       | 6.60  |
| J1   | 2.40  |       | 2.72  |
| L    | 13    |       | 14    |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| ØP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

#### 7.3 DPAK

Figure 32. DPAK drawing



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Table 13. DPAK mechanical data

|      | 100.0 10.2 | mm   |       |
|------|------------|------|-------|
| Dim. | Min.       | Тур. | Max.  |
| А    | 2.20       |      | 2.40  |
| A1   | 0.90       |      | 1.10  |
| A2   | 0.03       |      | 0.23  |
| b    | 0.64       |      | 0.90  |
| b4   | 5.20       |      | 5.40  |
| С    | 0.45       |      | 0.60  |
| c2   | 0.48       |      | 0.60  |
| D    | 6.00       |      | 6.20  |
| D1   |            | 5.10 |       |
| Е    | 6.40       |      | 6.60  |
| E1   |            | 4.70 |       |
| е    |            | 2.28 |       |
| e1   | 4.40       |      | 4.60  |
| Н    | 9.35       |      | 10.10 |
| L    | 1.00       |      | 1.50  |
| (L1) |            | 2.80 |       |
| L2   |            | 0.80 |       |
| L4   | 0.60       |      | 1.00  |
| R    |            | 0.20 |       |
| V2   | 0°         |      | 8°    |

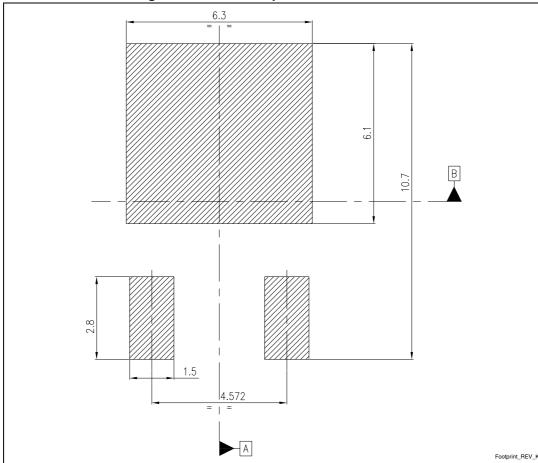


Figure 33. DPAK footprint recommended<sup>(a)</sup>

a. All dimensions are in millimeters



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## 7.4 D<sup>2</sup>PAK (SMD 2L STD-ST) type A

SEATING PLANE
COPLANARITY A1

R

CAUGE PLANE
V2

0079457. T

Figure 34. D<sup>2</sup>PAK (SMD 2L STD-ST) type A drawing

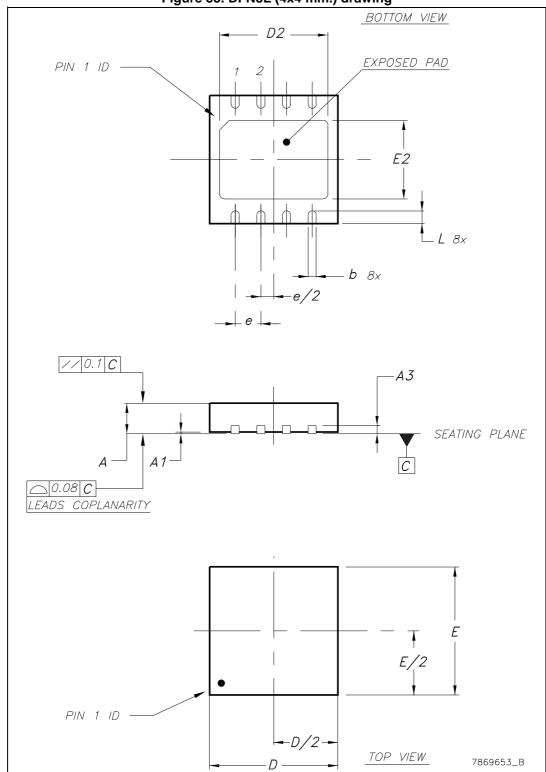
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Table 14. D<sup>2</sup>PAK (SMD 2L STD-ST) type A mechanical data

| Dim  |      | mm   |       |
|------|------|------|-------|
| Dim. | Min. | Тур. | Max.  |
| А    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| С    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| е    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| Н    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| L2   | 1.30 |      | 1.75  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

#### 7.5 DFN8L (4x4 mm.)

Figure 35. DFN8L (4x4 mm.) drawing

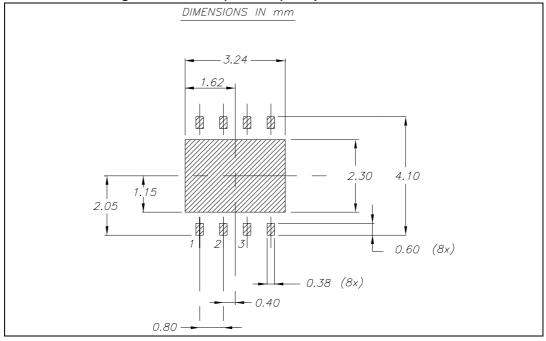


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Table 15. DFN8L (4x4 mm.) mechanical data

| Dim.   |      | mm.  |      |
|--------|------|------|------|
| Dilli. | Min. | Тур. | Max. |
| А      | 0.80 | 0.90 | 1    |
| A1     | 0    | 0.02 | 0.05 |
| A3     |      | 0,20 |      |
| b      | 0.23 | 0.30 | 0.38 |
| D      | 3.90 | 4    | 4.10 |
| D2     | 2.82 | 3    | 3.23 |
| E      | 3.90 | 4    | 4.10 |
| E2     | 2.05 | 2.20 | 2.30 |
| е      |      | 0.80 |      |
| L      | 0.40 | 0.50 | 0.60 |

Figure 36. DFN8L (4x4 mm.) footprint recommended





## 7.6 D<sup>2</sup>PAK (SMD 3L STD-ST) type A

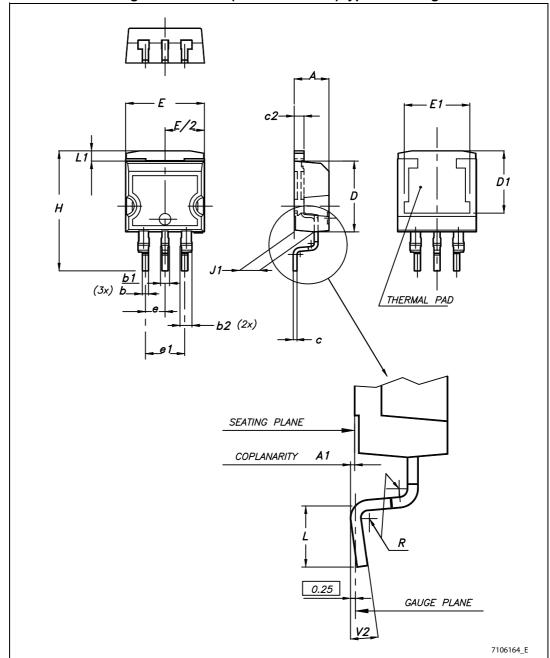


Figure 37. D<sup>2</sup>PAK (SMD 3L STD-ST) type A drawing

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Table 16. D<sup>2</sup>PAK (SMD 3L STD-ST) type A mechanical data

| Dim  |      | mm   |       |
|------|------|------|-------|
| Dim. | Min. | Тур. | Max.  |
| А    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b1   | 0.80 |      | 1.30  |
| b2   | 1.14 |      | 1.70  |
| С    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| е    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| Н    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

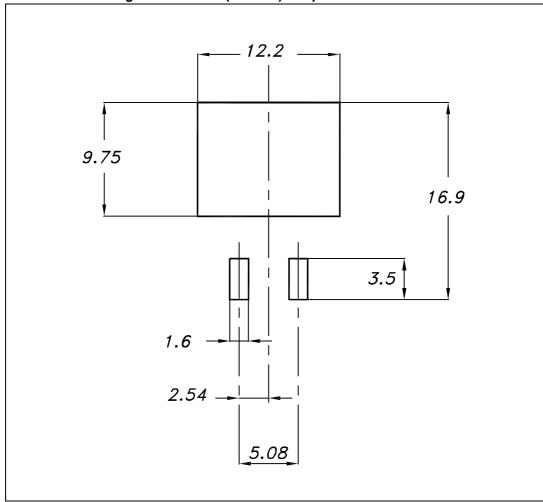


Figure 38. D<sup>2</sup>PAK (SMD 3L) footprint recommended

## 8 Packaging mechanical data

Figure 39. Tape for DPAK and D<sup>2</sup>PAK

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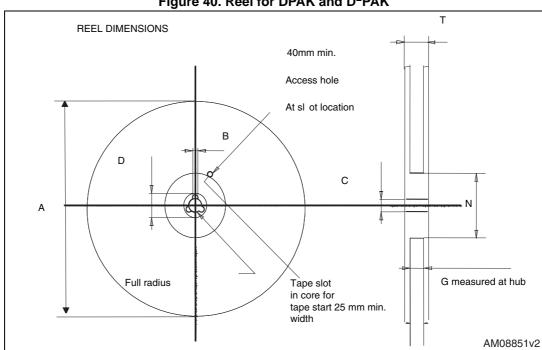


Figure 40. Reel for DPAK and D<sup>2</sup>PAK

Table 17. DPAK and D2PAK tape and reel mechanical data

| Таре   |      |      |      | Reel      |      |
|--------|------|------|------|-----------|------|
| Dim.   | n    | nm   | Dim. | n         | nm   |
| Dilli. | Min. | Max. |      | Min.      | Max. |
| A0     | 6.8  | 7    | А    |           | 330  |
| В0     | 10.4 | 10.6 | В    | 1.5       |      |
| B1     |      | 12.1 | С    | 12.8      | 13.2 |
| D      | 1.5  | 1.6  | D    | 20.2      |      |
| D1     | 1.5  |      | G    | 16.4      | 18.4 |
| Е      | 1.65 | 1.85 | N    | 50        |      |
| F      | 7.4  | 7.6  | Т    |           | 22.4 |
| K0     | 2.55 | 2.75 |      |           |      |
| P0     | 3.9  | 4.1  |      | Base qty. | 2500 |
| P1     | 7.9  | 8.1  |      | Bulk qty. | 2500 |
| P2     | 1.9  | 2.1  |      |           |      |
| R      | 40   |      |      |           |      |
| Т      | 0.25 | 0.35 |      |           |      |
| W      | 15.7 | 16.3 |      |           |      |

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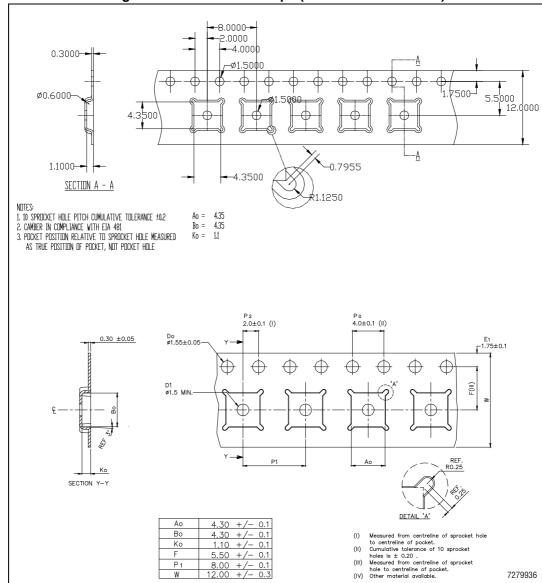


Figure 41. DFN8L carrier tape (dimension are in mm.)

Table 18. Reel DFN8L dimensions

| Dim. |      | mm.  |      |       | inch. |        |
|------|------|------|------|-------|-------|--------|
|      | Min. | Тур. | Max. | Min.  | Тур.  | Max.   |
| А    |      |      | 330  |       |       | 12.992 |
| С    | 12.8 | 13.0 | 13.2 | 0.504 | 0.512 | 0.519  |
| D    | 20.2 |      |      | 0.795 |       |        |
| N    | 60   |      |      | 2.362 |       |        |
| Т    |      |      | 22.4 |       |       | 0.882  |

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A D C Note: Drawing not in scale

Figure 42. Reel DFN8L drawing

LD1086 Order codes

#### 9 Order codes

Table 19. Order codes

| Packages                   |               |               |                 |           |                    |  |
|----------------------------|---------------|---------------|-----------------|-----------|--------------------|--|
| TO-220                     | D²PAK         | D²PAK/A       | DPAK            | DFN8      | Output<br>voltages |  |
| LD1086V18                  | LD1086D2T18TR |               | LD1086DT18TR    |           | 1.8 V              |  |
|                            |               |               | LD1086DT25TR    |           | 2.5 V              |  |
| LD1086V33                  | LD1086D2T33TR | LD1086D2M33TR | LD1086DT33TR    |           | 3.3 V              |  |
|                            | LD1086D2T50TR |               | LD1086DT50TR    |           | 5.0 V              |  |
|                            | LD1086D2T12TR |               |                 |           | 12.0 V             |  |
| LD1086V                    | LD1086D2TTR   | LD1086D2MTR   | LD1086DTTR      | LD1086PUR | ADJ                |  |
| LD1086V-DG <sup>(1)</sup>  |               |               |                 |           | ADJ                |  |
| LD1086VY <sup>(2)</sup>    |               |               | LD1086DTTRY (2) |           | ADJ                |  |
| LD1086BV                   | LD1086BD2TTR  | LD1086BD2MTR  | LD1086BDTTR     |           | ADJ                |  |
| LD1086BV-DG <sup>(1)</sup> |               |               |                 |           | ADJ                |  |

<sup>1.</sup> TO-220 Dual Gauge frame.

<sup>2.</sup> Automotive grade products.

Revision history LD1086

## 10 Revision history

Table 20. Document revision history

| Date        | Revision | Changes  |  |
|-------------|----------|--|--|
| 16-May-2006 | 14       | Order codes updated and new template.  |  |
| 19-Jan-2007 | 15       | D²PAK mechanical data updated and add footprint data.  |  |
| 05-Apr-2007 | 16       | Order codes updated.   |  |
| 07-Jun-2007 | 17       | Order codes updated.   |  |
| 19-Jul-2007 | 18       | Add note on Figure 2.  |  |
| 03-Dec-2007 | 19       | Modified: Table 19.  |  |
| 31-Jan-2008 | 20       | Added new order codes for Automotive grade products.   |  |
| 18-Feb-2008 | 21       | Modified: Table 19 on page 41.   |  |
| 14-Jul-2008 | 22       | Modified: Table 1 on page 7 and Table 19 on page 41.   |  |
| 10-Mar-2010 | 23       | Added: Table 12 on page 26, Figure 30 on page 23, Figure 31 on page 25, Figure 32 and Figure 33 on page 29.  |  |
| 15-Nov-2010 | 24       | Modified: R <sub>thJC</sub> value for TO-220 <i>Table 2 on page 7</i> .  |  |
| 11-Jul-2011 | 25       | Modified: Figure 24, Figure 25 on page 20 and Table 19 on page 41.   |  |
| 10-Feb-2012 | 26       | Added: order code LD1086V-DG Table 19 on page 41.  |  |
| 15-Mar-2012 | 27       | Added: new order code LD1086PUR <i>Table 19 on page 41</i> and new package mechanical data DFN8 (4x4 mm) <i>Table 15 on page 33, Figure 35 on page 32, Figure 36 on page 33, Figure 41 on page 39</i> and <i>Figure 42 on page 40</i> .  |  |
| 19-Oct-2012 | 28       | Added: R <sub>thJA</sub> value for DPAK <i>Table 2 on page 7</i> .   |  |
| 13-Feb-2013 | 29       | Modified: Output voltage in Voltage reference parameter <i>Table 8 on page 14</i> and <i>Table 10 on page 16</i> .   |  |
| 01-Mar-2013 | 30       | Modified: DFN8 (4 x 4) pin configuration Figure 2 on page 6.   |  |
| 17-Jun-2013 | 31       | Added Table 8: Electrical characteristics of LD1086B# and Section 8: Packaging mechanical data.  Updated Section 7: Package mechanical data and Table 19: Order codes.  Minor text changes.  |  |
| 22-Oct-2013 | 32       | RPN LD1086xx changed to LD1086. Updated the Description in cover page. Cancelled Table 1: Device summary. Updated Figure 2: Pin connections (top view), Section 5: Electrical characteristics, Section 7: Package mechanical data and Table 19: Order codes. Minor text changes. |  |
| 18-Dec-2014 | 33       | Updated Table 6.: Electrical characteristics of LD1086#50, Section 7: Package mechanical data and Section 8: Packaging mechanical data.  Minor text changes.   |  |

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