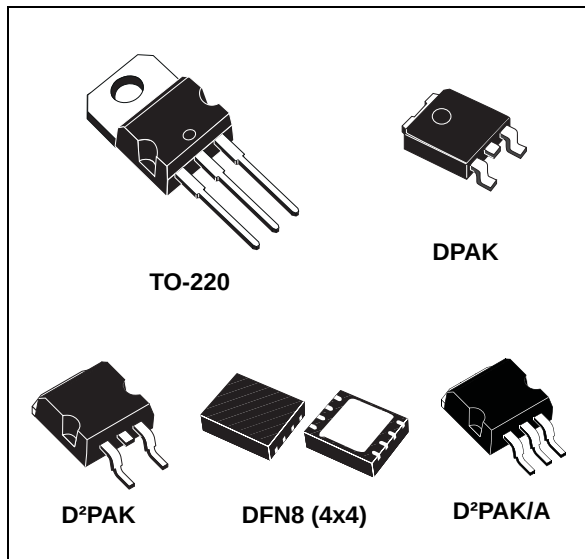


## 1.5 A adjustable and fixed low drop positive voltage regulator

Datasheet - production data



### 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  $\mu$ F (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  $\pm 1\%$  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.

### 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  $V_{OUT}$  in TO-220 and DPAK packages only)
- Output current guaranteed up to 1.5 A
- Output tolerance:  $\pm 1\%$  at 25 °C and  $\pm 2\%$  in full temperature range
- Internal power and thermal limit
- Wide operating temperature range - 40 °C to 125 °C
- Package available: TO-220, D²PAK, D²PAK/A, DPAK and DFN8 (4 x 4 mm)
- Pinout compatibility with standard adjustable voltage regulators

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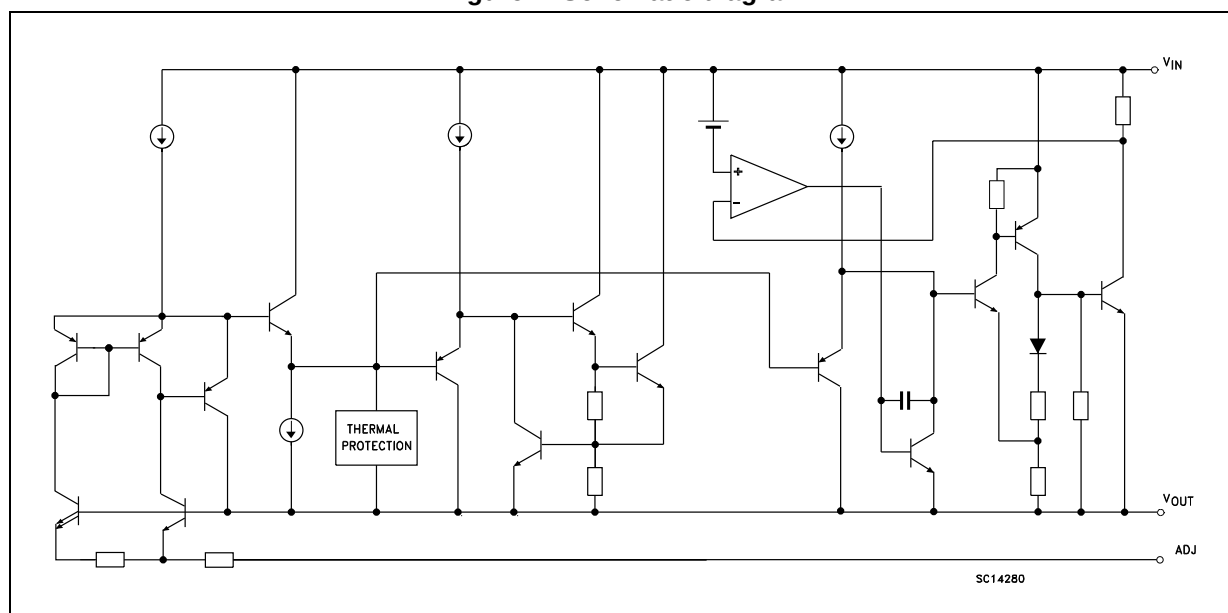
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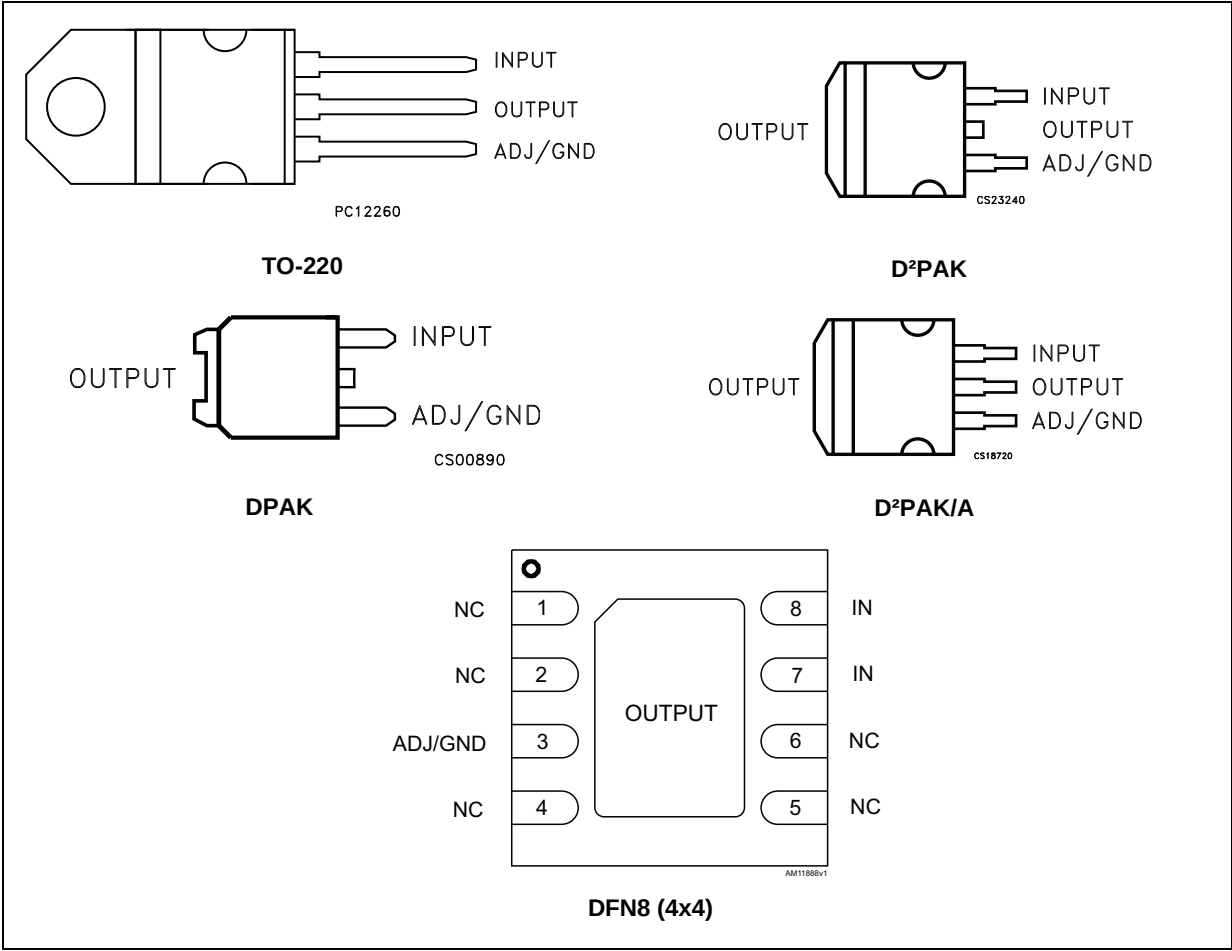
# 1 Diagram

Figure 1. Schematic diagram



## 2 Pin configuration

Figure 2. Pin connections (top view)



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

### 3 Maximum ratings

**Table 1. Absolute maximum ratings**

| Symbol    | Parameter                            | Value              | Unit |
|-----------|--------------------------------------|--------------------|------|
| $V_I$     | DC input voltage                     | 30                 | V    |
| $I_O$     | Output current                       | Internally Limited | mA   |
| $P_D$     | Power dissipation                    | Internally Limited | mW   |
| $T_{STG}$ | Storage temperature range            | -55 to +150        | °C   |
| $T_{OP}$  | Operating junction temperature range | -40 to +125        | °C   |

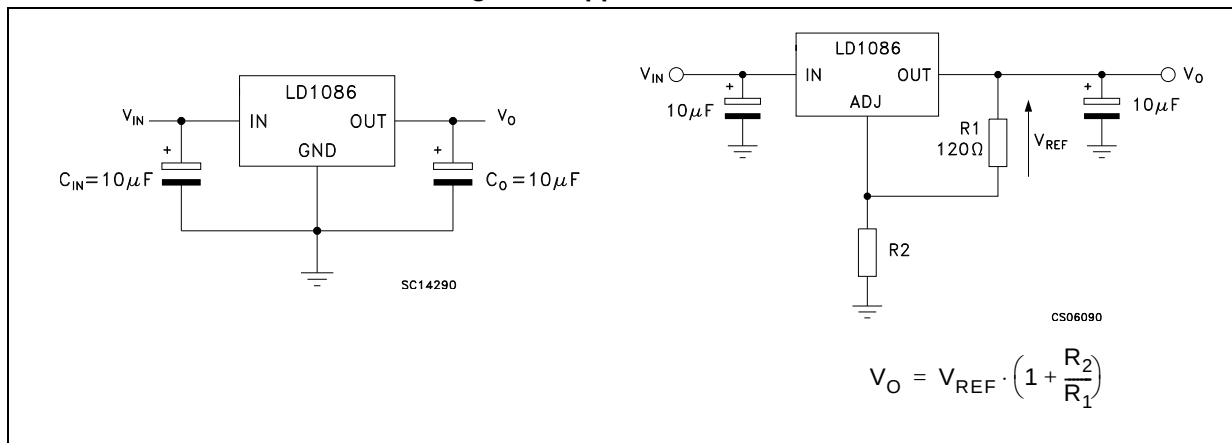
*Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.*

**Table 2. Thermal data**

| Symbol     | Parameter                           | TO-220 | D <sup>2</sup> PAK<br>D <sup>2</sup> PAK/A | DPAK | DFN8 | Unit |
|------------|-------------------------------------|--------|--------------------------------------------|------|------|------|
| $R_{thJC}$ | Thermal resistance junction-case    | 5      | 3                                          | 8    | 1.5  | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50     | 62.5                                       | 100  | 33   | °C/W |

## 4 Schematic application

Figure 3. Application circuit



## 5 Electrical characteristics

$V_I = 4.8\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 3. Electrical characteristics of LD1086#18**

| Symbol       | Parameter                                 | Test condition                                                                                           | Min.  | Typ.  | Max.  | Unit |
|--------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------|-------|-------|-------|------|
| $V_O$        | Output voltage <sup>(1)</sup>             | $I_O = 0\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$                                                   | 1.782 | 1.8   | 1.818 | V    |
|              |                                           | $I_O = 0\text{ to }1.5\text{ A}$ , $V_I = 3.4\text{ to }30\text{ V}$                                     | 1.764 | 1.8   | 1.836 | V    |
| $\Delta V_O$ | Line regulation                           | $I_O = 0\text{ mA}$ , $V_I = 3.4\text{ to }18\text{ V}$ ,<br>$T_J = 25\text{ }^\circ\text{C}$            |       | 0.2   | 4     | mV   |
|              |                                           | $I_O = 0\text{ mA}$ , $V_I = 3.4\text{ to }15\text{ V}$                                                  |       | 0.4   | 4     | mV   |
| $\Delta V_O$ | Load regulation                           | $I_O = 0\text{ to }1.5\text{ A}$ , $T_J = 25\text{ }^\circ\text{C}$                                      |       | 0.5   | 8     | mV   |
|              |                                           | $I_O = 0\text{ to }1.5\text{ A}$                                                                         |       | 1     | 16    | mV   |
| $V_d$        | Dropout voltage                           | $I_O = 1.5\text{ A}$                                                                                     |       | 1.3   | 1.5   | V    |
| $I_q$        | Quiescent current                         | $V_I \leq 30\text{ V}$                                                                                   |       | 5     | 10    | mA   |
| $I_{sc}$     | Short circuit current                     | $V_I - V_O = 5\text{ V}$                                                                                 | 1.5   | 2     |       | A    |
|              |                                           | $V_I - V_O = 25\text{ V}$                                                                                | 0.05  | 0.02  |       | A    |
|              | Thermal regulation                        | $T_A = 25\text{ }^\circ\text{C}$ , 30 ms pulse                                                           |       | 0.01  | 0.04  | %/W  |
| SVR          | Supply voltage rejection                  | $f = 120\text{ Hz}$ , $C_O = 25\text{ }\mu\text{F}$ , $I_O = 1.5\text{ A}$<br>$V_I = 6.8 \pm 3\text{ V}$ | 60    | 82    |       | dB   |
| eN           | RMS output noise voltage<br>(% of $V_O$ ) | $T_A = 25\text{ }^\circ\text{C}$ , $f = 10\text{ Hz to }10\text{ kHz}$                                   |       | 0.003 |       | %    |
| S            | Temperature stability                     |                                                                                                          |       | 0.5   |       | %    |
| S            | Long term stability                       | $T_A = 125\text{ }^\circ\text{C}$ , 1000 Hrs                                                             |       | 0.5   |       | %    |

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 5.5\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 4. Electrical characteristics of LD1086#25**

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

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 6.3 \text{ V}$ ,  $C_I = C_O = 10 \mu\text{F}$ ,  $T_A = -40 \text{ to } 125 \text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 5. Electrical characteristics of LD1086#33**

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

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 8\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 6. Electrical characteristics of LD1086#50**

| Symbol       | Parameter                                 | Test condition                                                                                          | Min. | Typ.  | Max. | Unit |
|--------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------|------|-------|------|------|
| $V_O$        | Output voltage <sup>(1)</sup>             | $I_O = 0\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$                                                  | 4.95 | 5     | 5.05 | V    |
|              |                                           | $I_O = 0\text{ to }1.5\text{ A}$ , $V_I = 6.6\text{ to }30\text{ V}$                                    | 4.9  | 5     | 5.1  | V    |
| $\Delta V_O$ | Line regulation                           | $I_O = 0\text{ mA}$ , $V_I = 6.6\text{ to }20\text{ V}$ ,<br>$T_J = 25\text{ }^\circ\text{C}$           |      | 0.5   | 10   | mV   |
|              |                                           | $I_O = 0\text{ mA}$ , $V_I = 6.6\text{ to }20\text{ V}$                                                 |      | 1     | 10   | mV   |
| $\Delta V_O$ | Load regulation                           | $I_O = 0\text{ to }1.5\text{ A}$ , $T_J = 25\text{ }^\circ\text{C}$                                     |      | 5     | 20   | mV   |
|              |                                           | $I_O = 0\text{ to }1.5\text{ A}$                                                                        |      | 10    | 35   | mV   |
| $V_d$        | Dropout voltage                           | $I_O = 1.5\text{ A}$                                                                                    |      | 1.3   | 1.5  | V    |
| $I_q$        | Quiescent current                         | $V_I \leq 30\text{ V}$                                                                                  |      | 5     | 10   | mA   |
| $I_{sc}$     | Short circuit current                     | $V_I - V_O = 5\text{ V}$                                                                                | 1.5  | 2     |      | A    |
|              |                                           | $V_I - V_O = 25\text{ V}$                                                                               | 0.05 | 0.2   |      | A    |
|              | Thermal regulation                        | $T_A = 25\text{ }^\circ\text{C}$ , 30 ms pulse                                                          |      | 0.01  | 0.04 | %/W  |
| SVR          | Supply voltage rejection                  | $f = 120\text{ Hz}$ , $C_O = 25\text{ }\mu\text{F}$ , $I_O = 1.5\text{ A}$<br>$V_I = 10 \pm 3\text{ V}$ | 60   | 75    |      | dB   |
| eN           | RMS output noise voltage<br>(% of $V_O$ ) | $T_A = 25\text{ }^\circ\text{C}$ , $f = 10\text{ Hz to }10\text{ kHz}$                                  |      | 0.003 |      | %    |
| S            | Temperature stability                     |                                                                                                         |      | 0.5   |      | %    |
| S            | Long term stability                       | $T_A = 125\text{ }^\circ\text{C}$ , 1000 Hrs                                                            |      | 0.5   |      | %    |

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 15\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 7. Electrical characteristics of LD1086#12**

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

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 4.25\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 8. Electrical characteristics of LD1086B#**

| Symbol                  | Parameter                                 | Test condition                                                                                                                                      | Min.  | Typ.  | Max.  | Unit          |
|-------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|---------------|
| $V_{\text{ref}}$        | Reference voltage <sup>(1)</sup>          | $I_O = 10\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$                                                                                             | 1.231 | 1.25  | 1.269 | V             |
|                         |                                           | $I_O = 10\text{ mA}$ to $1.5\text{ A}$ , $V_I = 2.85\text{ to }30\text{ V}$                                                                         | 1.219 | 1.25  | 1.281 | V             |
| $\Delta V_O$            | Line regulation                           | $I_O = 10\text{ mA}$ , $V_I = 2.8\text{ to }16.5\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$                                                       |       | 0.015 | 0.2   | %             |
|                         |                                           | $I_O = 10\text{ mA}$ , $V_I = 2.8\text{ to }16.5\text{ V}$                                                                                          |       | 0.035 | 0.2   | %             |
| $\Delta V_O$            | Load regulation                           | $I_O = 10\text{ mA}$ to $1.5\text{ A}$ , $T_J = 25\text{ }^\circ\text{C}$                                                                           |       | 0.1   | 0.3   | %             |
|                         |                                           | $I_O = 0\text{ to }1.5\text{ A}$                                                                                                                    |       | 0.2   | 0.4   | %             |
| $V_d$                   | Dropout voltage                           | $I_O = 1.5\text{ A}$                                                                                                                                |       | 1.3   | 1.5   | V             |
| $I_{O(\text{min})}$     | Minimum load current                      | $V_I = 30\text{ V}$                                                                                                                                 |       | 3     | 10    | mA            |
| $I_{\text{sc}}$         | Short circuit current                     | $V_I - V_O = 5\text{ V}$                                                                                                                            | 1.5   | 2.3   |       | A             |
|                         |                                           | $V_I - V_O = 25\text{ V}$                                                                                                                           | 0.05  | 0.2   |       | A             |
|                         | Thermal regulation                        | $T_A = 25\text{ }^\circ\text{C}$ , 30 ms pulse                                                                                                      |       | 0.01  | 0.04  | %/W           |
| SVR                     | Supply voltage rejection                  | $f = 120\text{ Hz}$ , $C_O = 25\text{ }\mu\text{F}$ , $C_{\text{ADJ}} = 25\text{ }\mu\text{F}$ , $I_O = 1.5\text{ A}$ , $V_I = 6.25 \pm 3\text{ V}$ | 60    | 88    |       | dB            |
| $I_{\text{ADJ}}$        | Adjust pin current                        | $V_I = 4.25\text{ V}$ , $I_O = 10\text{ mA}$                                                                                                        |       | 40    | 120   | $\mu\text{A}$ |
| $\Delta I_{\text{ADJ}}$ | Adjust pin current change <sup>(1)</sup>  | $I_O = 10\text{ mA}$ to $1.5\text{ A}$ , $V_I = 2.8\text{ to }16.5\text{ V}$                                                                        |       | 0.2   | 5     | $\mu\text{A}$ |
| eN                      | RMS output noise voltage<br>(% of $V_O$ ) | $T_A = 25\text{ }^\circ\text{C}$ , $f = 10\text{ Hz to }10\text{ kHz}$                                                                              |       | 0.003 |       | %             |
| S                       | Temperature stability                     |                                                                                                                                                     |       | 0.5   |       | %             |
| S                       | Long term stability                       | $T_A = 125\text{ }^\circ\text{C}$ , 1000 Hrs                                                                                                        |       | 0.5   |       | %             |

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 4.25\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 9. Electrical characteristics of LD1086#**

| Symbol                  | Parameter                                 | Test condition                                                                                                                                      | Min.  | Typ.  | Max.  | Unit          |
|-------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|---------------|
| $V_{\text{ref}}$        | Reference voltage <sup>(1)</sup>          | $I_O = 10\text{ mA}$ , $T_J = 25\text{ }^\circ\text{C}$                                                                                             | 1.237 | 1.25  | 1.263 | V             |
|                         |                                           | $I_O = 10\text{ mA}$ to $1.5\text{ A}$ , $V_I = 2.85\text{ to }30\text{ V}$                                                                         | 1.225 | 1.25  | 1.275 | V             |
| $\Delta V_O$            | Line regulation                           | $I_O = 10\text{ mA}$ , $V_I = 2.8\text{ to }16.5\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$                                                       |       | 0.015 | 0.2   | %             |
|                         |                                           | $I_O = 10\text{ mA}$ , $V_I = 2.8\text{ to }16.5\text{ V}$                                                                                          |       | 0.035 | 0.2   | %             |
| $\Delta V_O$            | Load regulation                           | $I_O = 10\text{ mA}$ to $1.5\text{ A}$ , $T_J = 25\text{ }^\circ\text{C}$                                                                           |       | 0.1   | 0.3   | %             |
|                         |                                           | $I_O = 0\text{ to }1.5\text{ A}$                                                                                                                    |       | 0.2   | 0.4   | %             |
| $V_d$                   | Dropout voltage                           | $I_O = 1.5\text{ A}$                                                                                                                                |       | 1.3   | 1.5   | V             |
| $I_{O(\text{min})}$     | Minimum load current                      | $V_I = 30\text{ V}$                                                                                                                                 |       | 3     | 10    | mA            |
| $I_{\text{sc}}$         | Short circuit current                     | $V_I - V_O = 5\text{ V}$                                                                                                                            | 1.5   | 2.3   |       | A             |
|                         |                                           | $V_I - V_O = 25\text{ V}$                                                                                                                           | 0.05  | 0.2   |       | A             |
|                         | Thermal regulation                        | $T_A = 25\text{ }^\circ\text{C}$ , 30 ms pulse                                                                                                      |       | 0.01  | 0.04  | %/W           |
| SVR                     | Supply voltage rejection                  | $f = 120\text{ Hz}$ , $C_O = 25\text{ }\mu\text{F}$ , $C_{\text{ADJ}} = 25\text{ }\mu\text{F}$ , $I_O = 1.5\text{ A}$ , $V_I = 6.25 \pm 3\text{ V}$ | 60    | 88    |       | dB            |
| $I_{\text{ADJ}}$        | Adjust pin current                        | $V_I = 4.25\text{ V}$ , $I_O = 10\text{ mA}$                                                                                                        |       | 40    | 120   | $\mu\text{A}$ |
| $\Delta I_{\text{ADJ}}$ | Adjust pin current change <sup>(1)</sup>  | $I_O = 10\text{ mA}$ to $1.5\text{ A}$ , $V_I = 2.8\text{ to }16.5\text{ V}$                                                                        |       | 0.2   | 5     | $\mu\text{A}$ |
| eN                      | RMS output noise voltage<br>(% of $V_O$ ) | $T_A = 25\text{ }^\circ\text{C}$ , $f = 10\text{ Hz to }10\text{ kHz}$                                                                              |       | 0.003 |       | %             |
| S                       | Temperature stability                     |                                                                                                                                                     |       | 0.5   |       | %             |
| S                       | Long term stability                       | $T_A = 125\text{ }^\circ\text{C}$ , 1000 Hrs                                                                                                        |       | 0.5   |       | %             |

1. See short-circuit current curve for available output current at fixed dropout.

$V_I = 4.25\text{ V}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ ,  $T_A = -40\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified.

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

| Symbol                  | Parameter                                 | Test condition                                                                                                                                                                            | Min.  | Typ.  | Max.  | Unit          |
|-------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|---------------|
| $V_{\text{ref}}$        | Reference voltage <sup>(1)</sup>          | $I_O = 10\text{ mA}$ , $T_A = 25\text{ }^\circ\text{C}$                                                                                                                                   | 1.237 | 1.25  | 1.263 | V             |
|                         |                                           | $I_O = 10\text{ mA to }1.5\text{ A}$ , $V_I = 2.85\text{ to }30\text{ V}$                                                                                                                 | 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   | %             |
| $\Delta V_O$            | Load regulation                           | $I_O = 0\text{ to }1.5\text{ A}$                                                                                                                                                          |       | 0.2   | 0.4   | %             |
| $V_d$                   | Dropout voltage                           | $I_O = 1.5\text{ A}$                                                                                                                                                                      |       | 1.3   | 1.5   | V             |
| $I_{O(\text{min})}$     | Minimum load current                      | $V_I = 30\text{ V}$                                                                                                                                                                       |       | 3     | 10    | mA            |
| $I_{\text{sc}}$         | Short circuit current                     | $V_I - V_O = 5\text{ V}$ , $T_A = 25\text{ }^\circ\text{C}$                                                                                                                               | 1.5   | 2.3   |       | A             |
|                         |                                           | $V_I - V_O = 25\text{ V}$ , $T_A = 25\text{ }^\circ\text{C}$                                                                                                                              | 0.05  | 0.2   |       | A             |
|                         | Thermal regulation                        | $T_A = 25\text{ }^\circ\text{C}$ , 30 ms pulse                                                                                                                                            |       | 0.01  | 0.04  | %/W           |
| SVR                     | Supply voltage rejection                  | $f = 120\text{ Hz}$ , $C_O = 25\text{ }\mu\text{F}$ , $C_{\text{ADJ}} = 25\text{ }\mu\text{F}$ ,<br>$I_O = 1.5\text{ A}$ , $V_I = 6.25 \pm 3\text{ V}$ , $T_A = 25\text{ }^\circ\text{C}$ | 60    | 88    |       | dB            |
| $I_{\text{ADJ}}$        | Adjust pin current                        | $V_I = 4.25\text{ V}$ , $I_O = 10\text{ mA}$                                                                                                                                              |       | 40    | 120   | $\mu\text{A}$ |
| $\Delta I_{\text{ADJ}}$ | Adjust pin current change <sup>(1)</sup>  | $I_O = 10\text{ mA to }1.5\text{ A}$ , $V_I = 2.8\text{ to }16.5\text{ V}$                                                                                                                |       | 0.2   | 5     | $\mu\text{A}$ |
| eN                      | RMS output noise voltage<br>(% of $V_O$ ) | $T_A = 25\text{ }^\circ\text{C}$ , $f = 10\text{ Hz to }10\text{ kHz}$                                                                                                                    |       | 0.003 |       | %             |
| S                       | Temperature stability                     |                                                                                                                                                                                           |       | 0.5   |       | %             |
| S                       | Long term stability                       | $T_A = 125\text{ }^\circ\text{C}$ , 1000 Hrs                                                                                                                                              |       | 0.5   |       | %             |

1. See short-circuit current curve for available output current at fixed dropout.

# 6 Typical application

Unless otherwise specified  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $C_I = C_O = 10\text{ }\mu\text{F}$ .

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

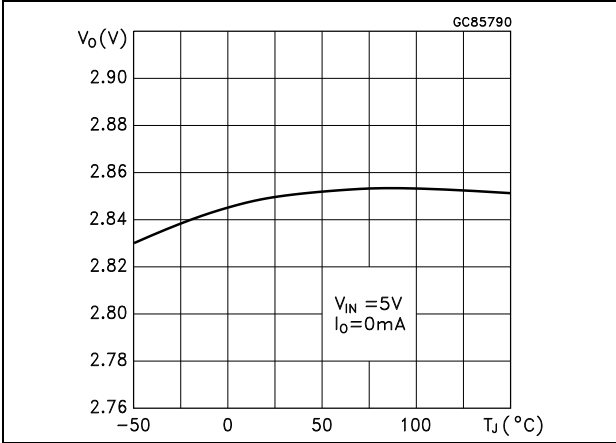


Figure 5. Output voltage vs. temp. ( $V_I = 15\text{ V}$ )

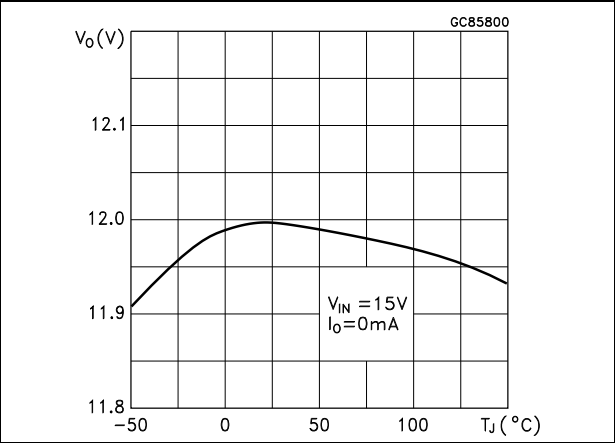


Figure 6. Output voltage vs. temperature ( $V_I = 4.25\text{ V}$ )

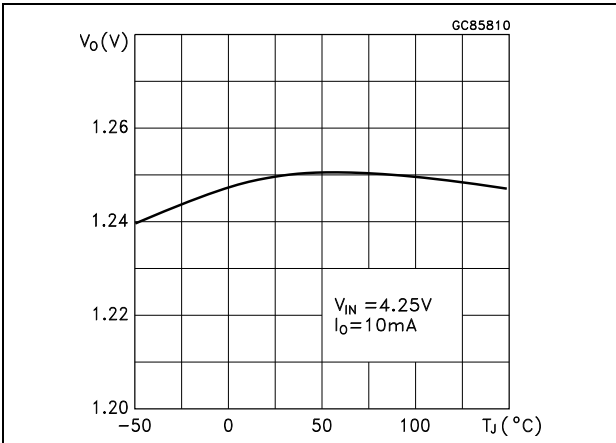


Figure 7. Short circuit current vs. dropout voltage

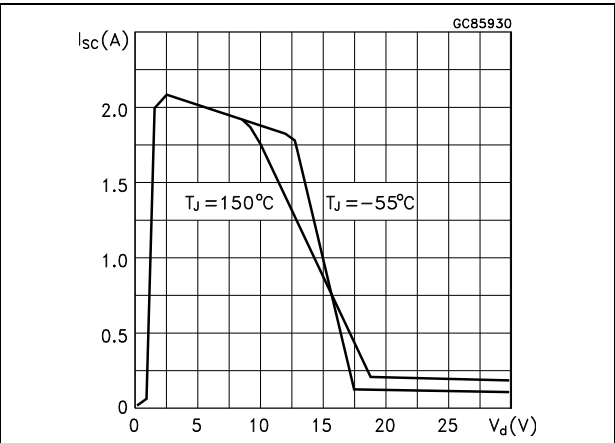


Figure 8. Line regulation vs. temperature

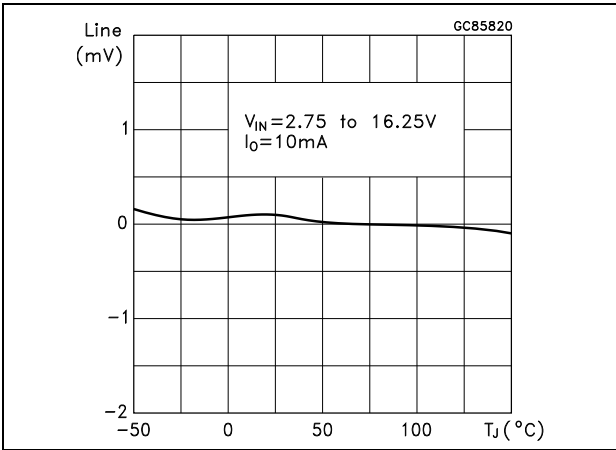


Figure 9. Load regulation vs. temperature

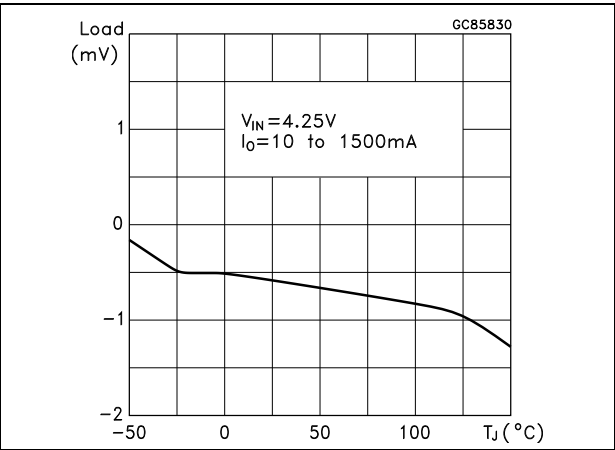


Figure 10. Dropout voltage vs. temperature

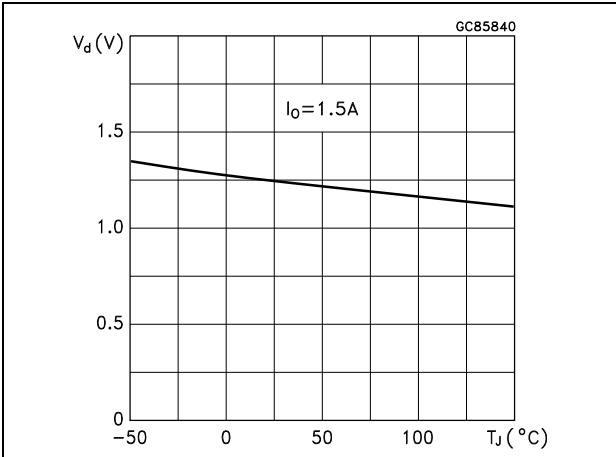


Figure 11. Dropout voltage vs. output current

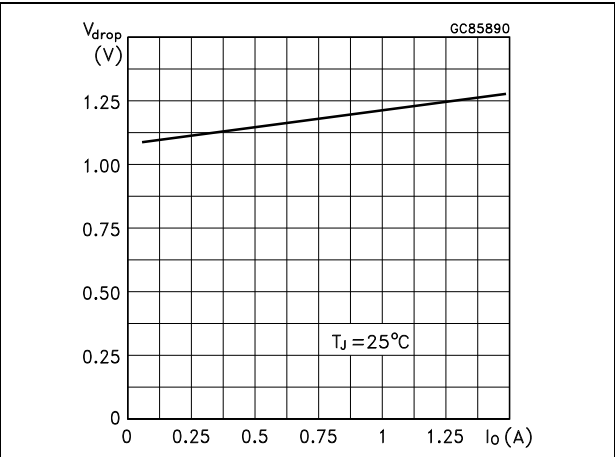


Figure 12. Adjust pin current vs. input voltage

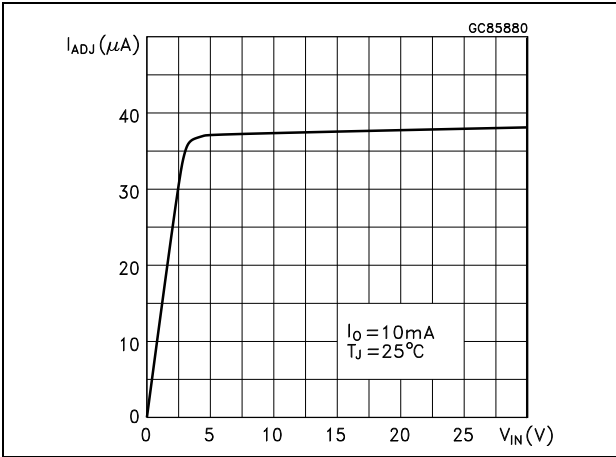


Figure 13. Adjust pin current vs. temperature

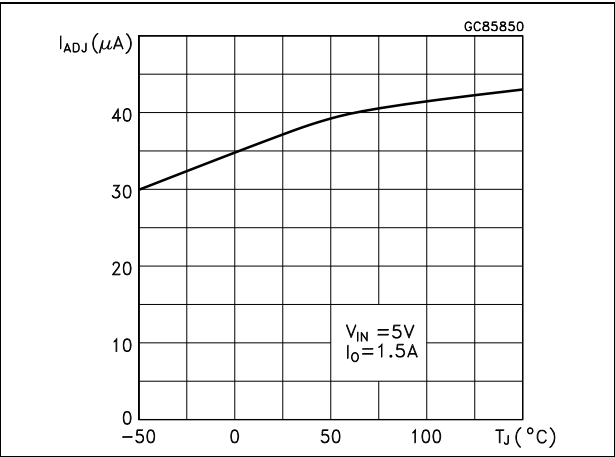


Figure 14. Adjust pin current vs. output current      Figure 15. Quiescent current vs. output current

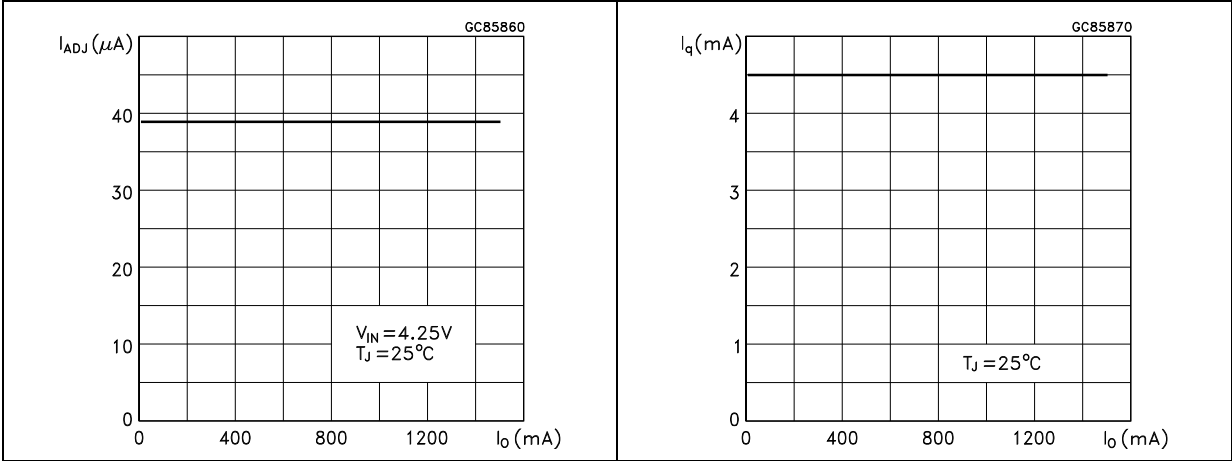


Figure 16. Quiescent current vs. input voltage      Figure 17. Supply voltage rejection vs. output current

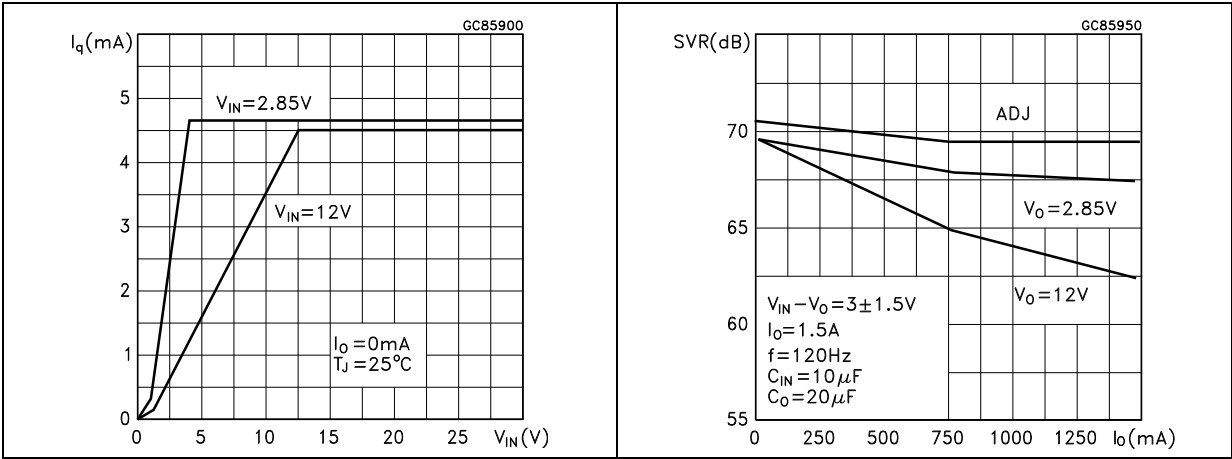


Figure 18. Supply voltage rejection vs. frequency      Figure 19. Supply voltage rejection vs. temperature

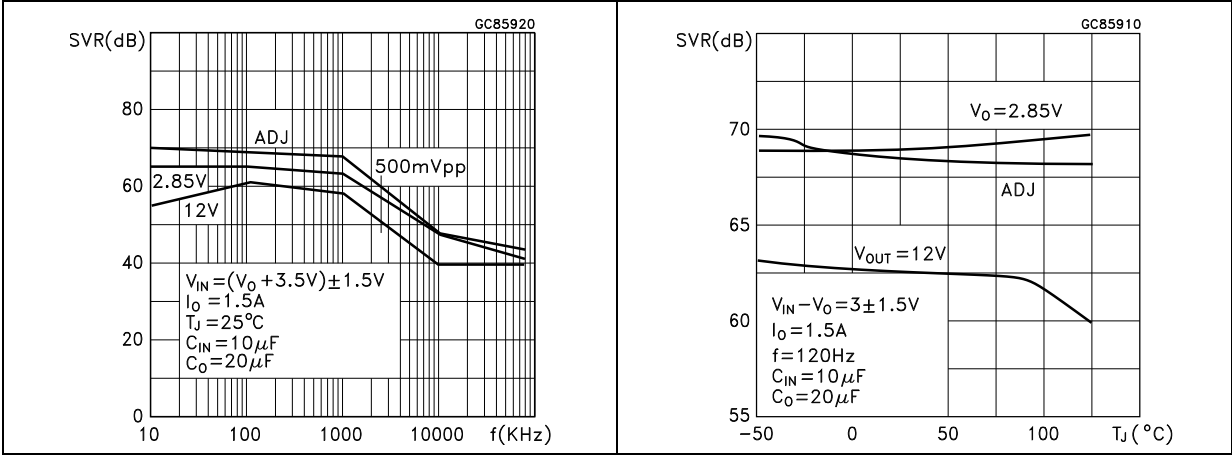


Figure 20. Minimum load current vs. temperature

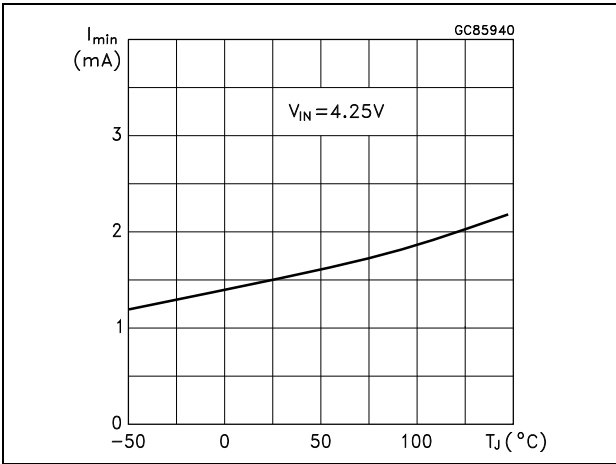


Figure 21. Stability for adjustable

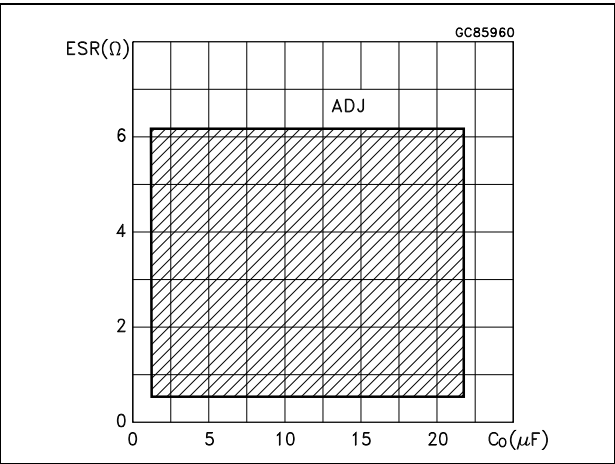


Figure 22. Stability for 2.85 V

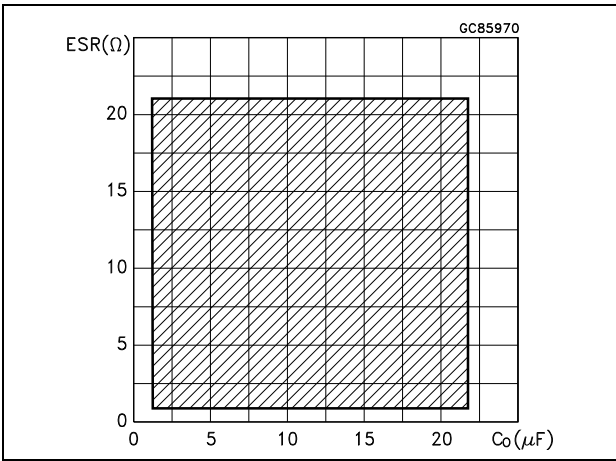


Figure 23. Stability for 12 V

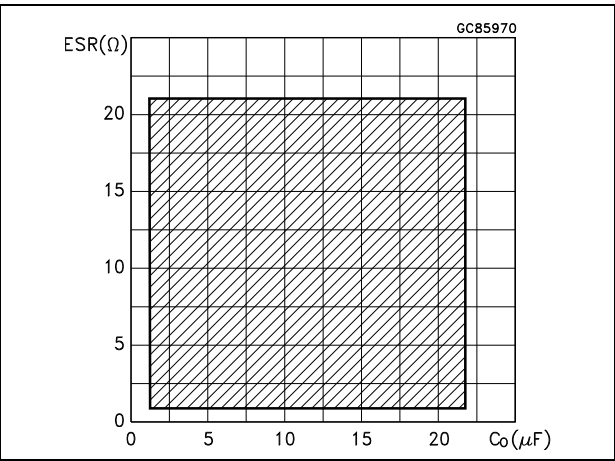


Figure 24. Line transient ( $V_I = 12$  to 13 V)

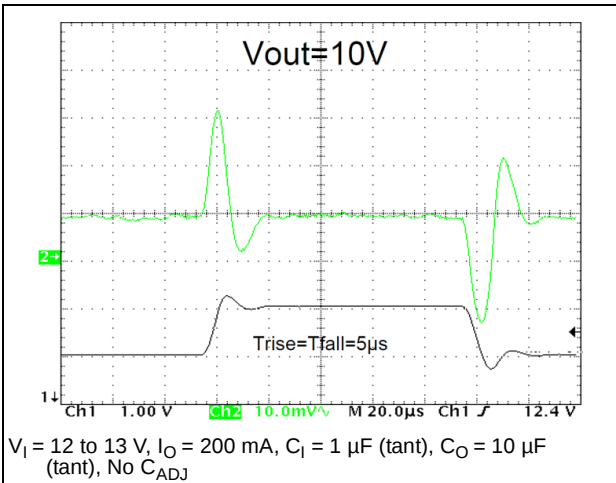


Figure 25. Line transient ( $I_O = 200$  mA)

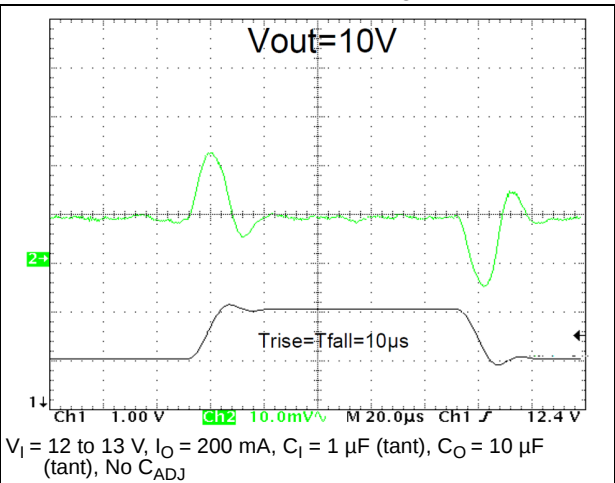


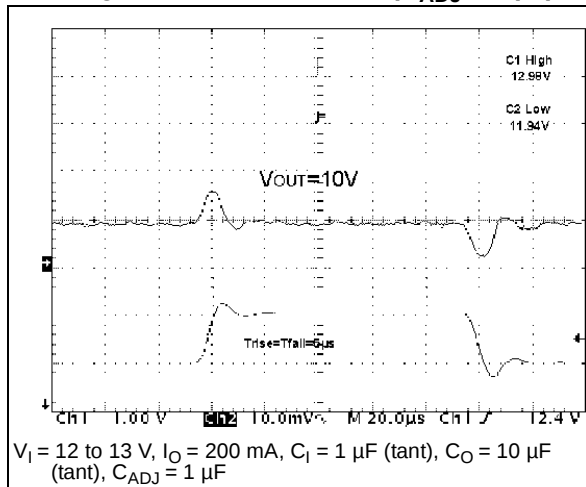
Figure 26. Line transient ( $C_{ADJ} = 1 \mu F$ )

Figure 27. Load transient

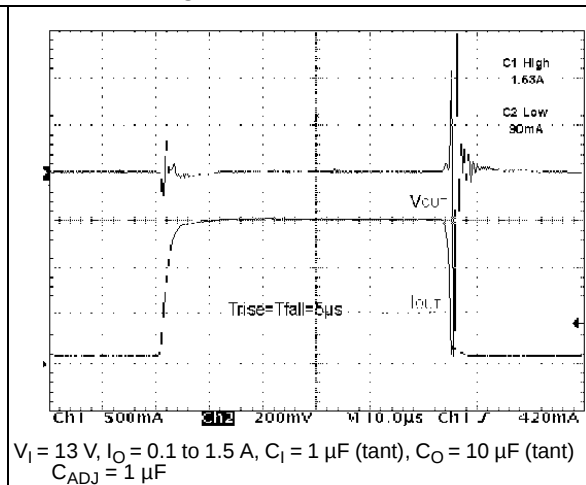
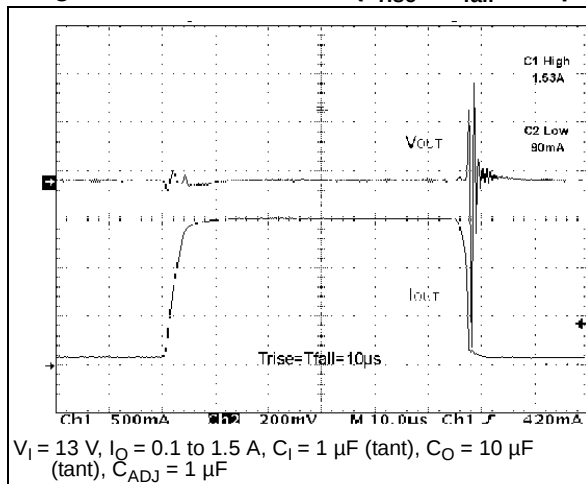
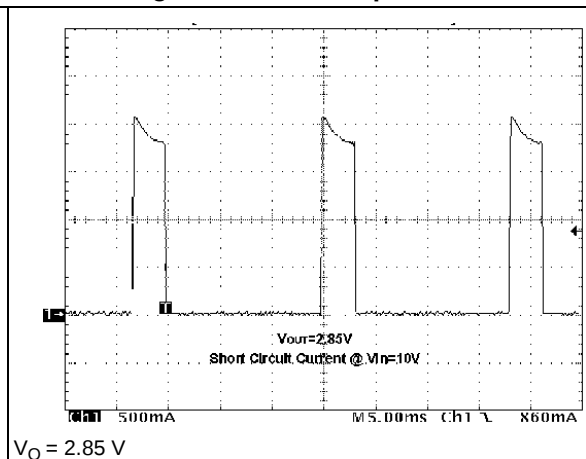
Figure 28. Load transient ( $T_{rise} = T_{fall} = 10 \mu s$ )

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: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

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

Figure 30. TO-220 (STD-ST dual gauge) type A drawing

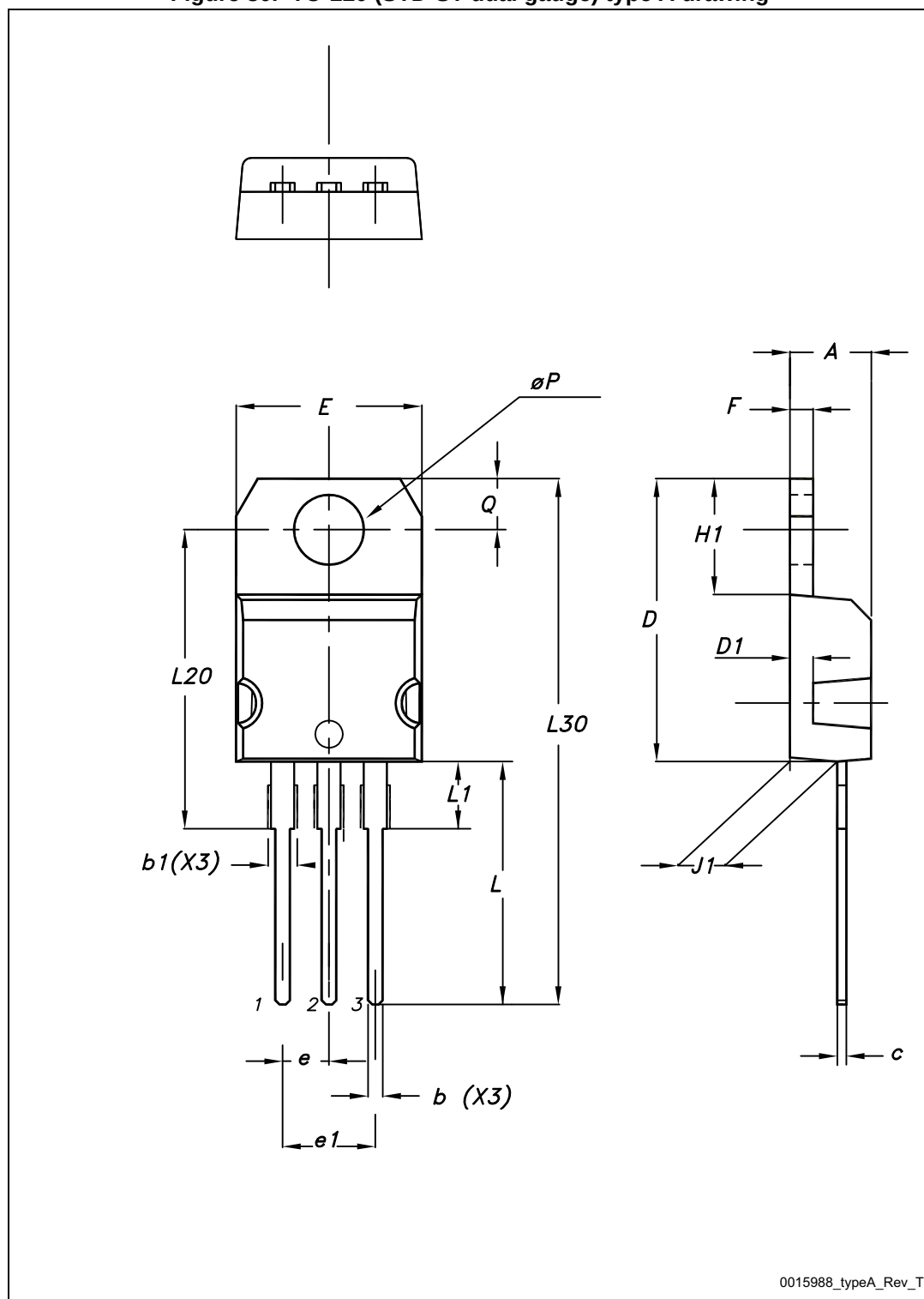


Table 11. TO-220 (STD-ST dual gauge) type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10    |       | 10.40 |
| e    | 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  |

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

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

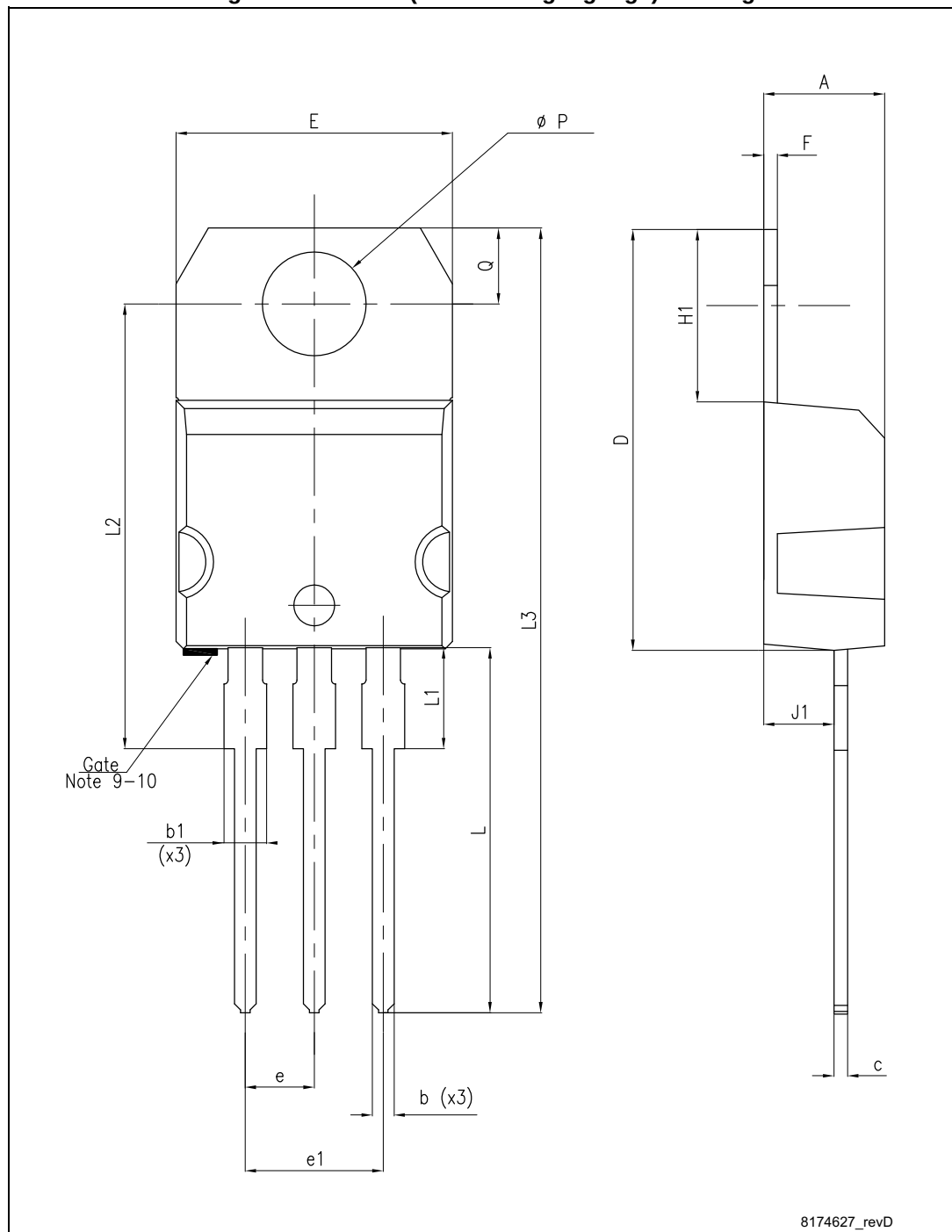


Table 12. TO-220 (STD-ST single gauge) mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| E    | 10    |       | 10.40 |
| e    | 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

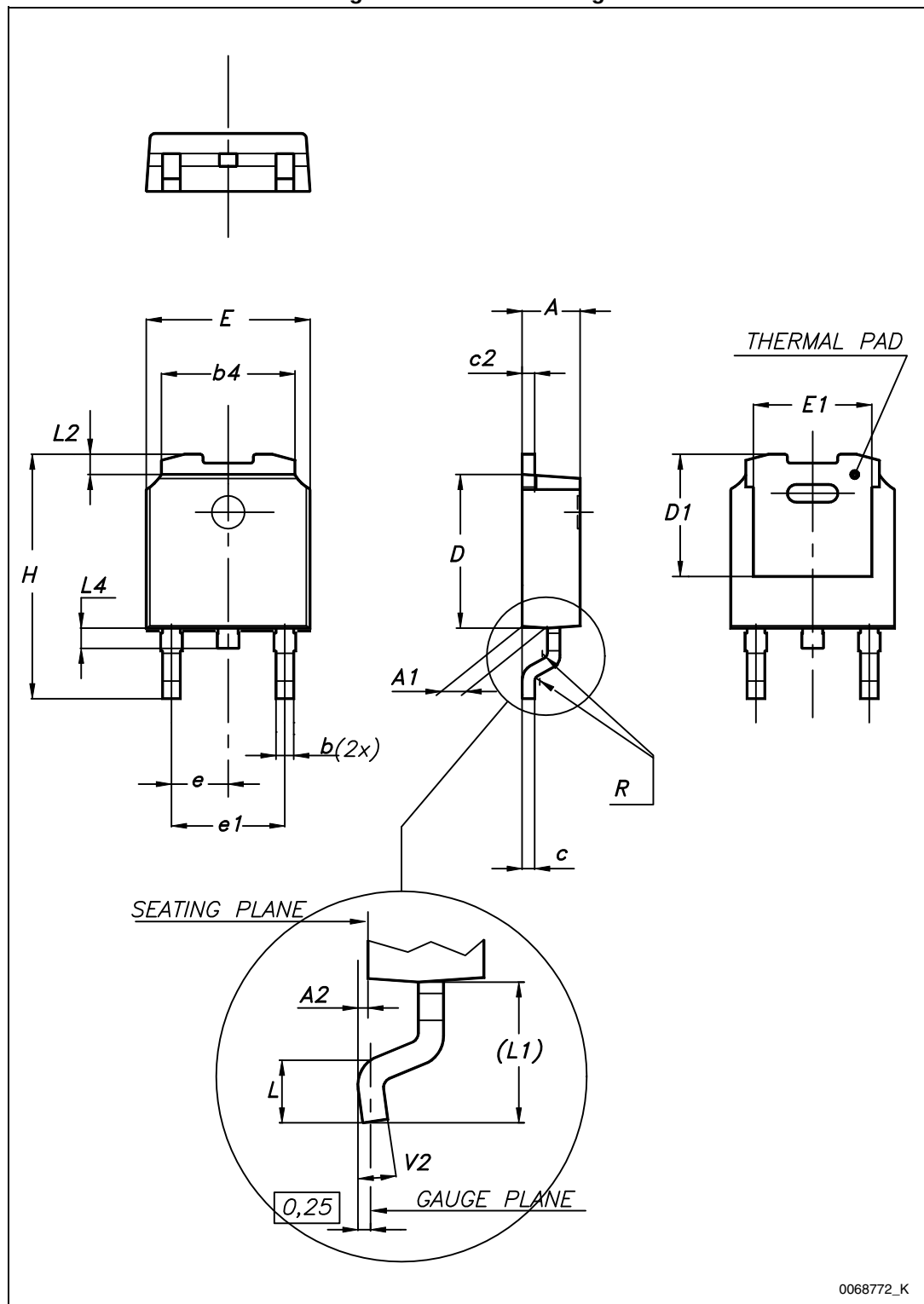
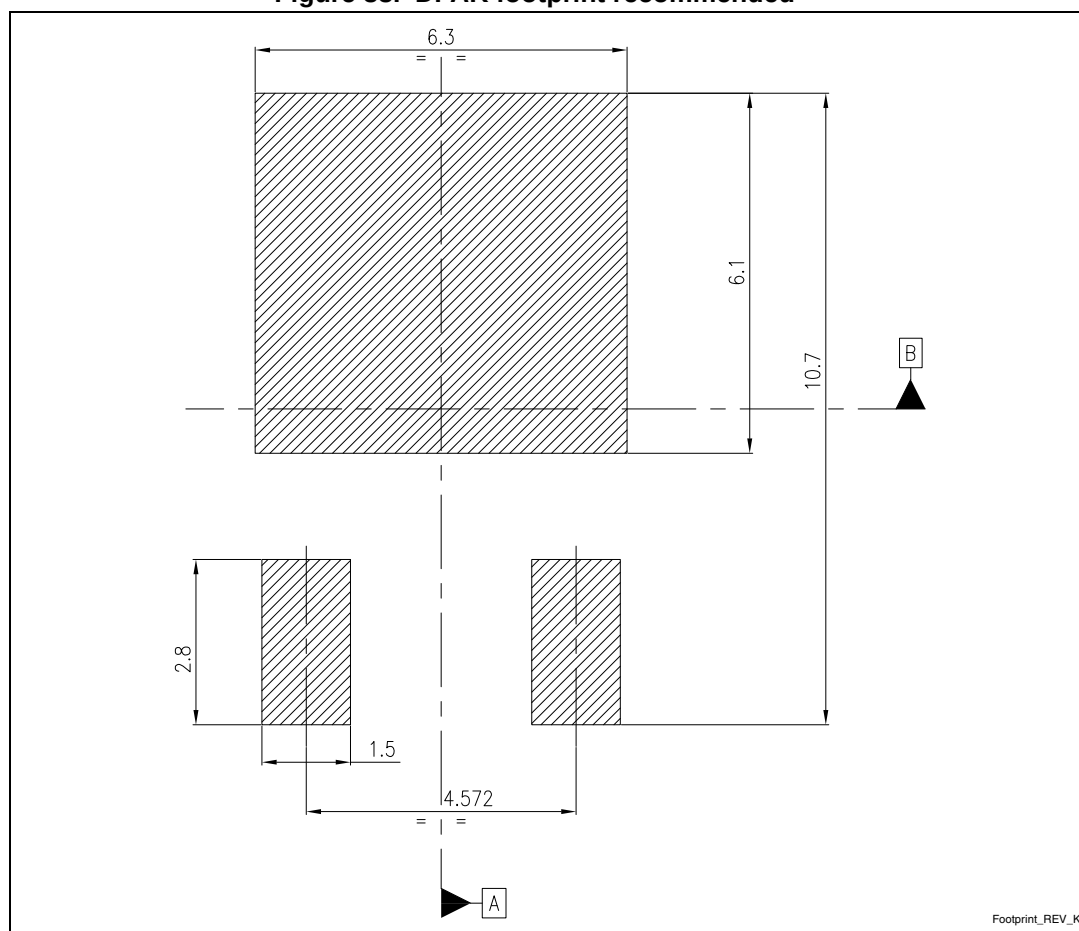


Table 13. DPAK mechanical data

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| D1   |      | 5.10 |       |
| E    | 6.40 |      | 6.60  |
| E1   |      | 4.70 |       |
| e    |      | 2.28 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 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

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

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

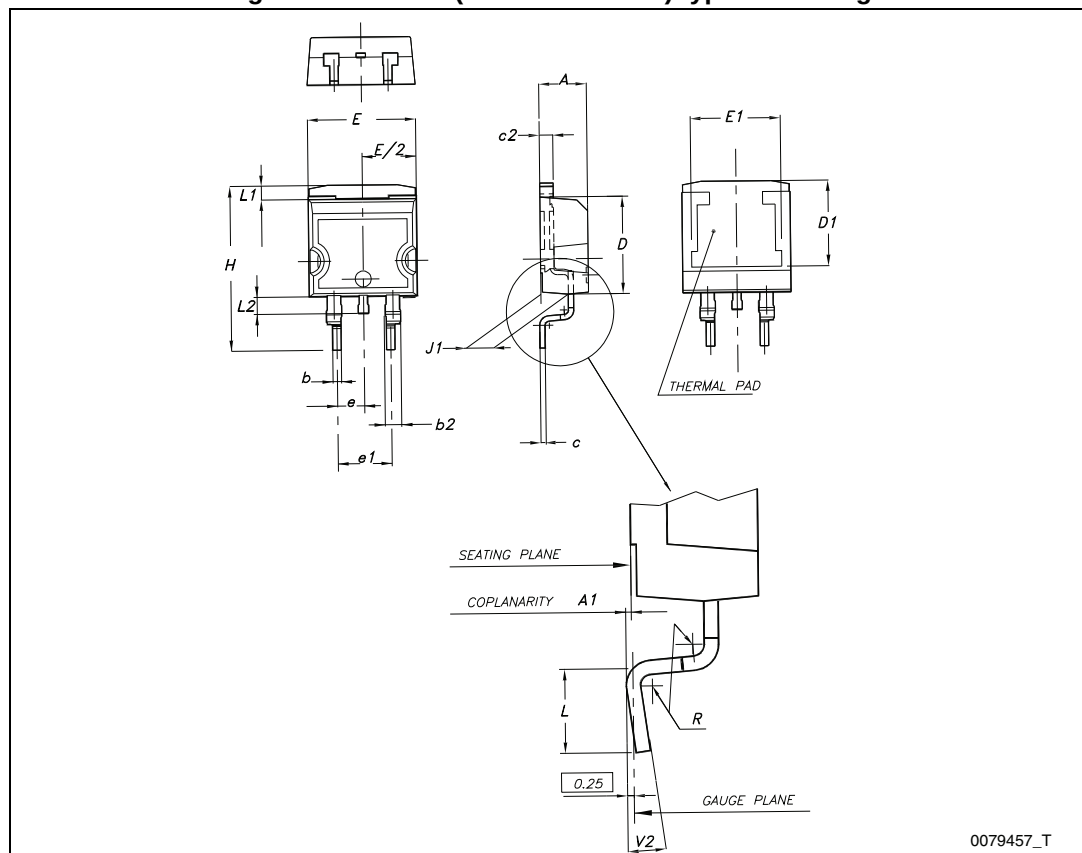


Table 14. D<sup>2</sup>PAK (SMD 2L STD-ST) type A mechanical data

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 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

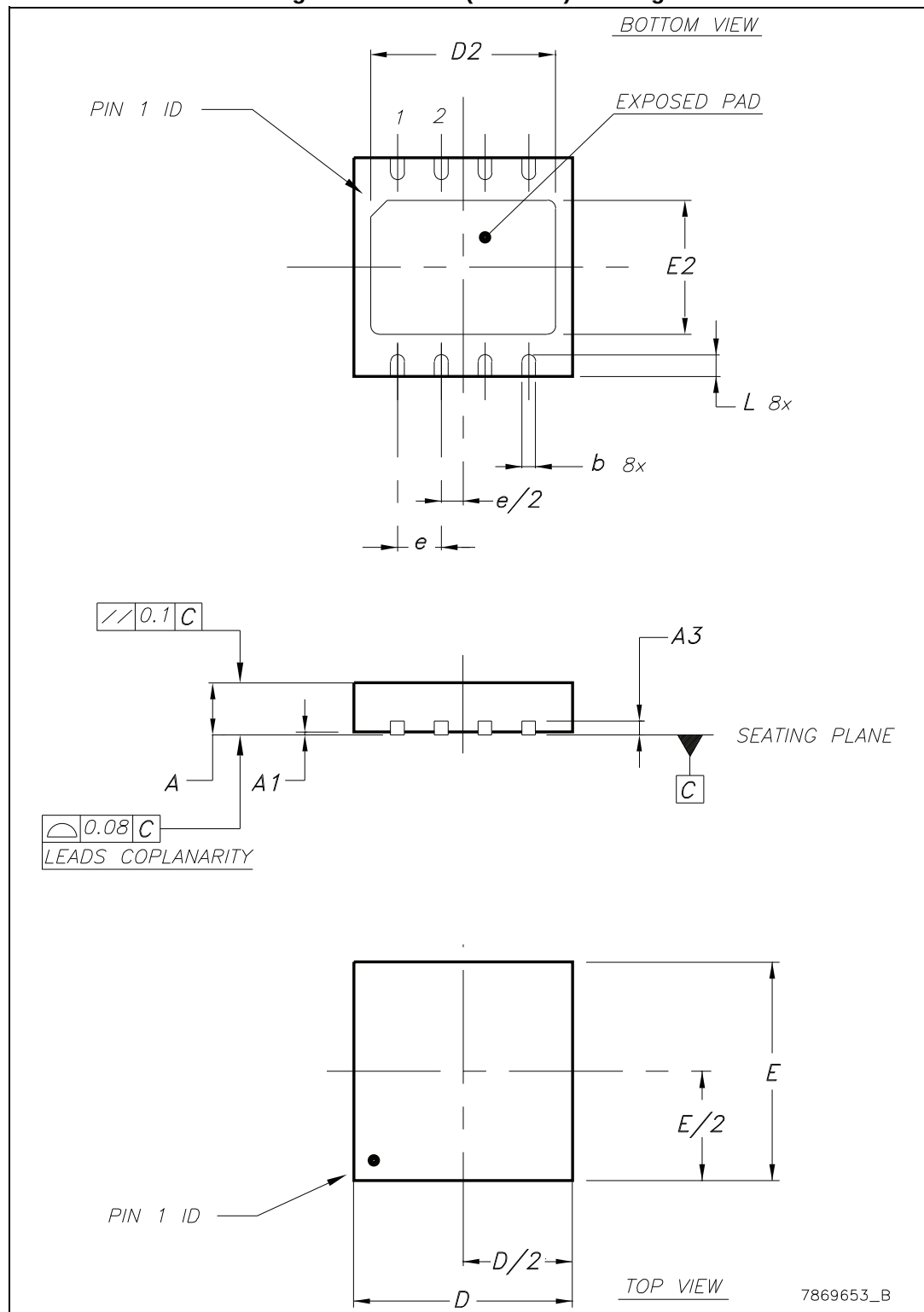
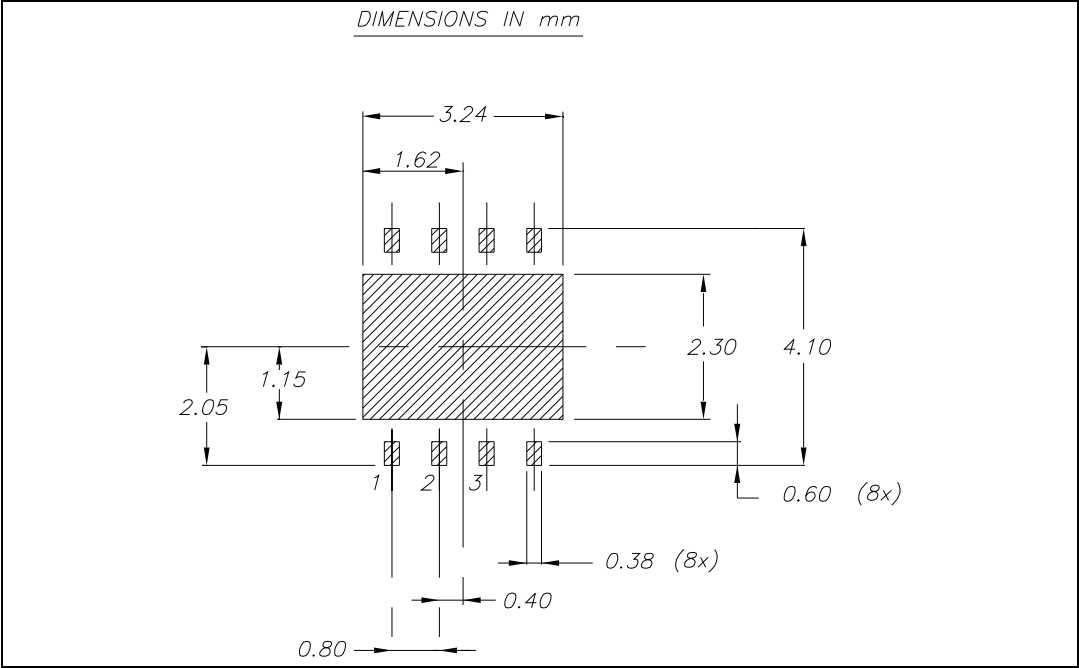


Table 15. DFN8L (4x4 mm.) mechanical data

| Dim. | mm.  |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 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 |
| e    |      | 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

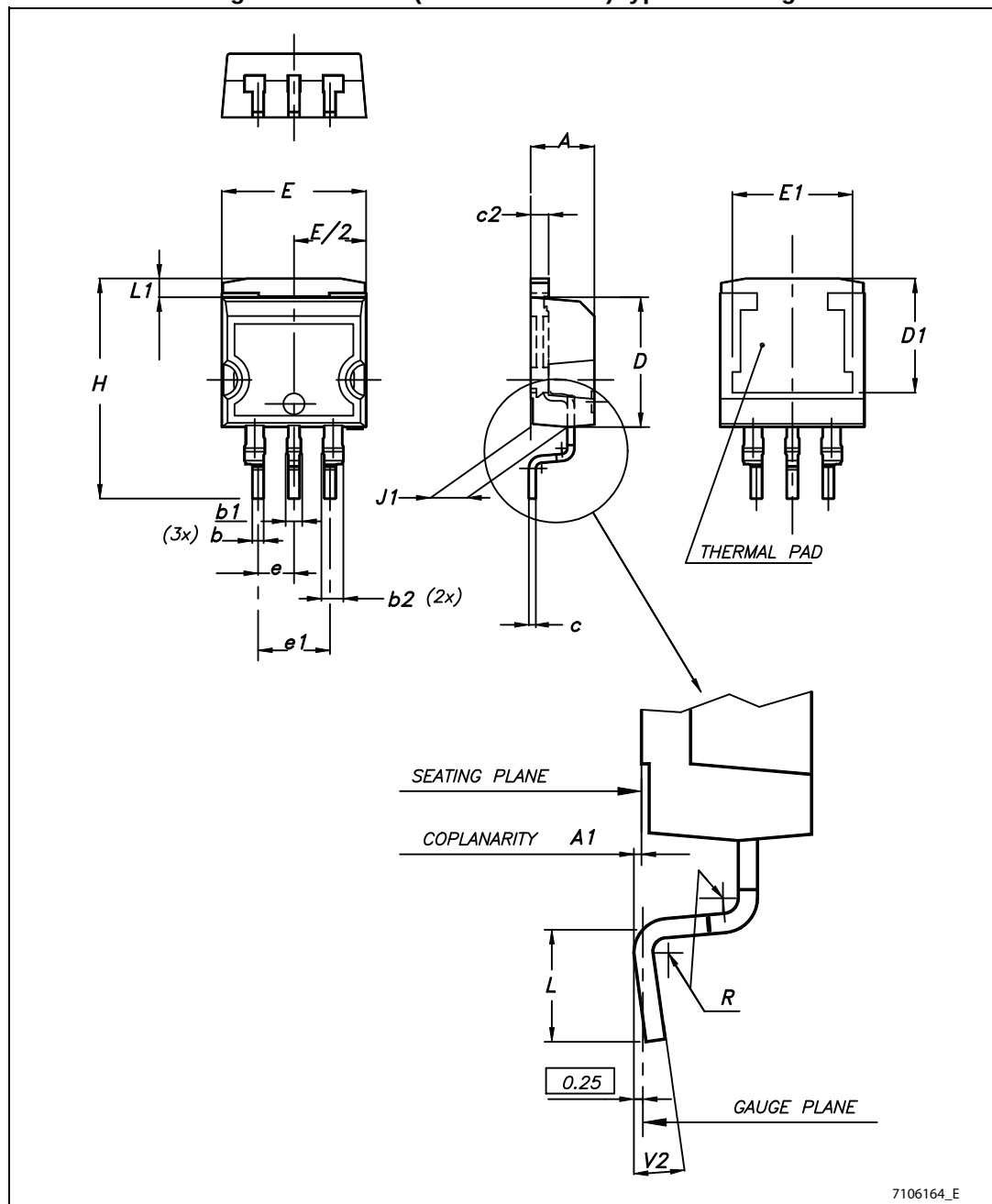
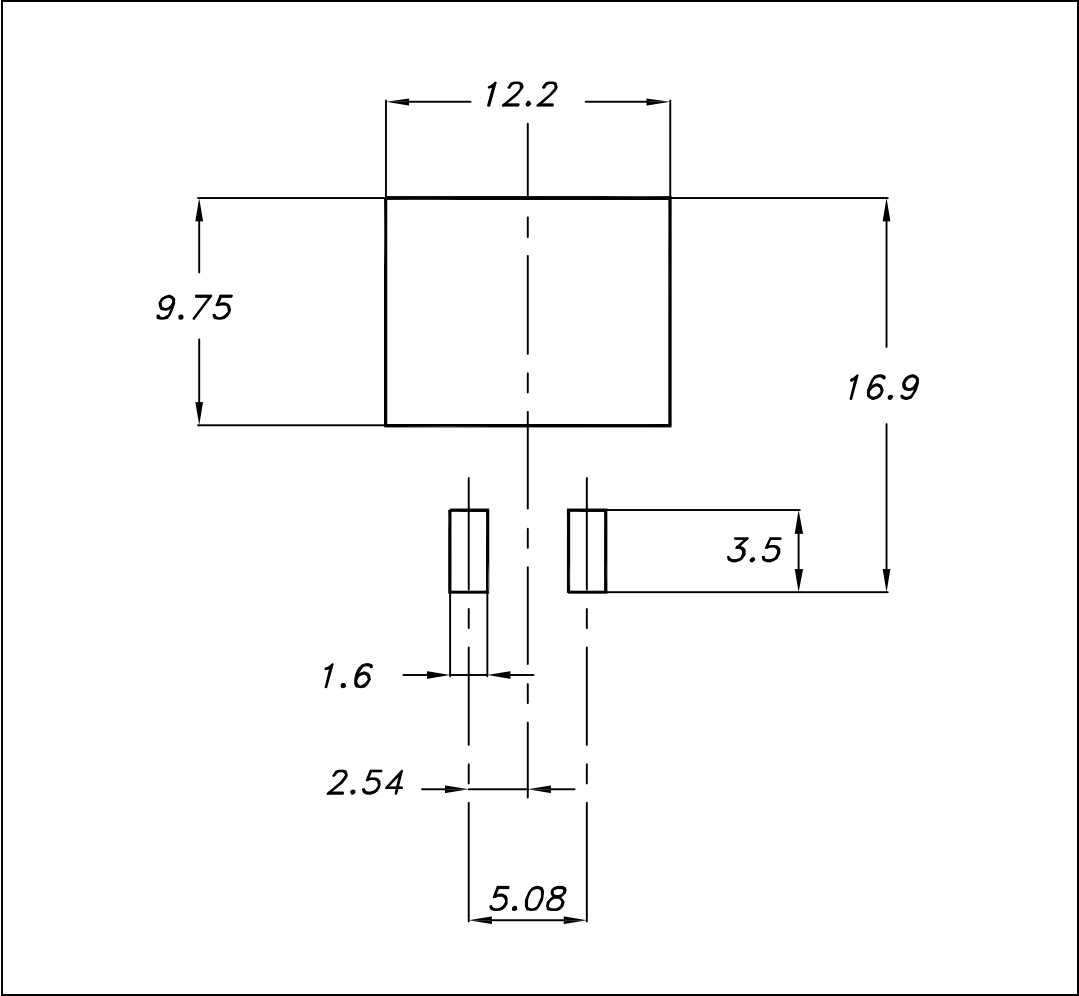
Figure 37. D<sup>2</sup>PAK (SMD 3L STD-ST) type A drawing

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

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b1   | 0.80 |      | 1.30  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 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

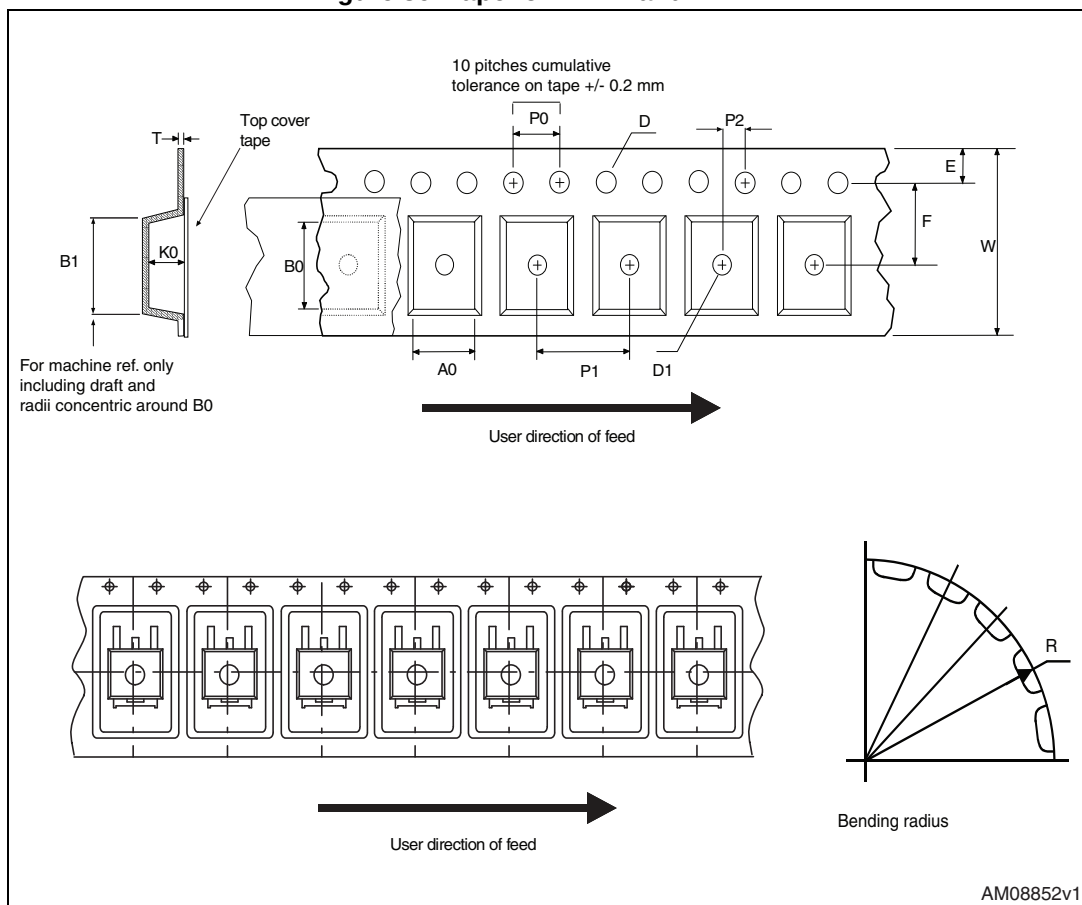
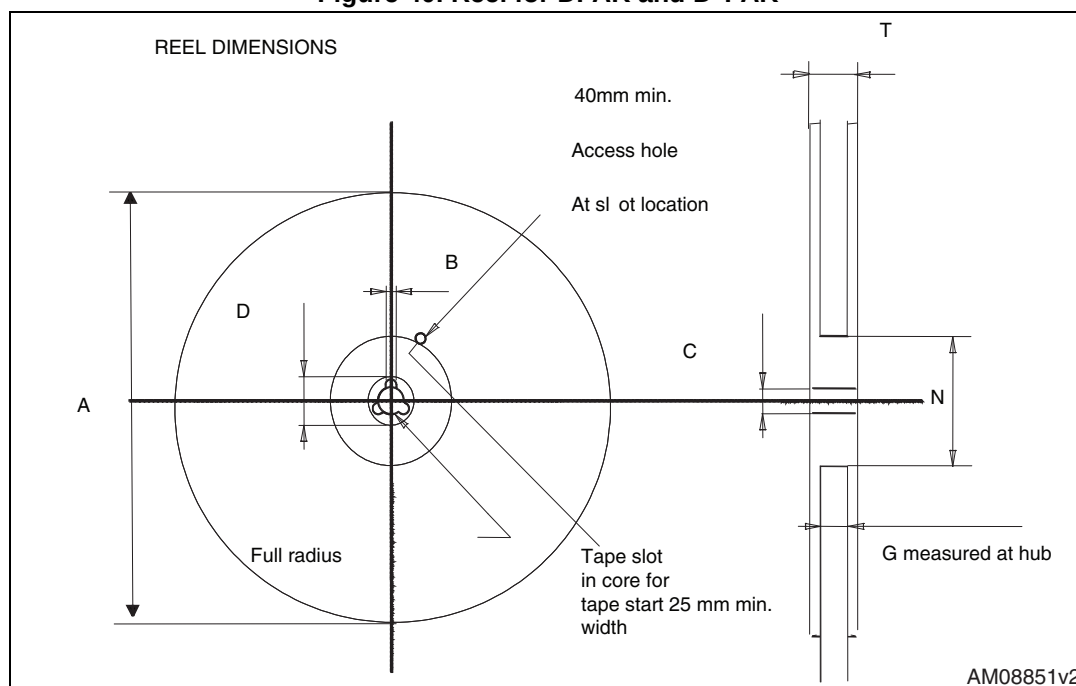


Figure 40. Reel for DPAK and D<sup>2</sup>PAKTable 17. DPAK and D<sup>2</sup>PAK tape and reel mechanical data

| Tape |      |      | Reel      |      |      |
|------|------|------|-----------|------|------|
| Dim. | mm   |      | Dim.      | mm   |      |
|      | Min. | Max. |           | Min. | Max. |
| A0   | 6.8  | 7    | A         |      | 330  |
| B0   | 10.4 | 10.6 | B         | 1.5  |      |
| B1   |      | 12.1 | C         | 12.8 | 13.2 |
| D    | 1.5  | 1.6  | D         | 20.2 |      |
| D1   | 1.5  |      | G         | 16.4 | 18.4 |
| E    | 1.65 | 1.85 | N         | 50   |      |
| F    | 7.4  | 7.6  | T         |      | 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   |      |           |      |      |
| T    | 0.25 | 0.35 |           |      |      |
| W    | 15.7 | 16.3 |           |      |      |

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

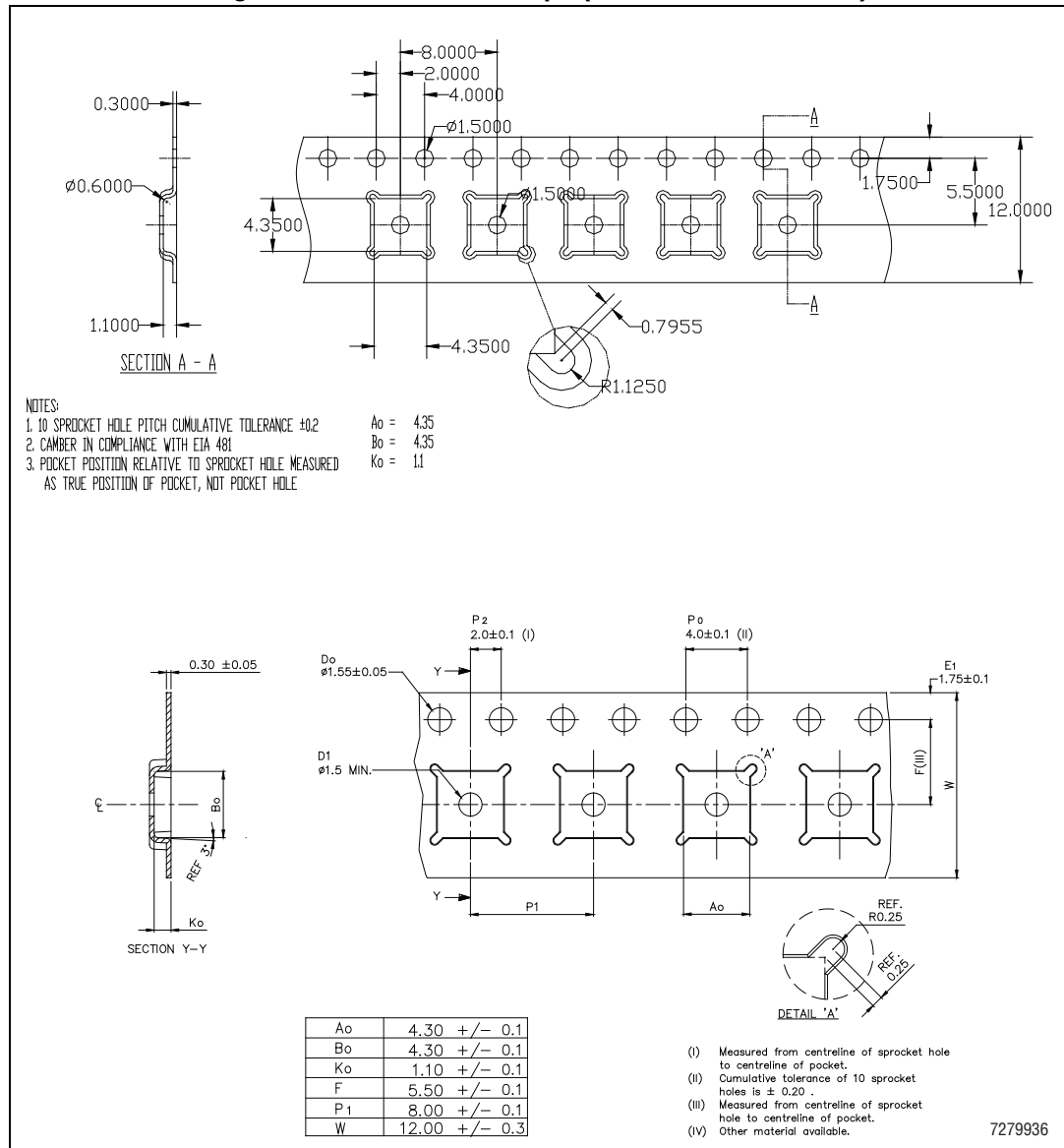
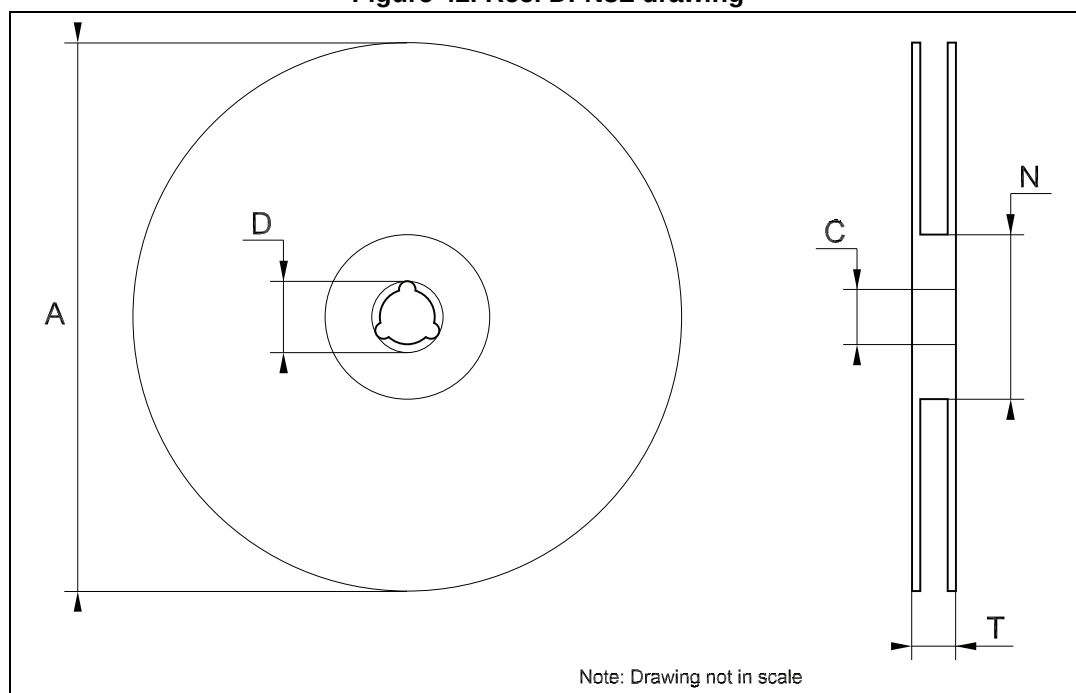


Table 18. Reel DFN8L dimensions

| Dim. | mm.  |      |      | inch. |       |        |
|------|------|------|------|-------|-------|--------|
|      | Min. | Typ. | Max. | Min.  | Typ.  | Max.   |
| A    |      |      | 330  |       |       | 12.992 |
| C    | 12.8 | 13.0 | 13.2 | 0.504 | 0.512 | 0.519  |
| D    | 20.2 |      |      | 0.795 |       |        |
| N    | 60   |      |      | 2.362 |       |        |
| T    |      |      | 22.4 |       |       | 0.882  |

Figure 42. Reel DFN8L drawing



## 9 Order codes

Table 19. Order codes

| Packages                   |                    |                      |                            |           |                 |
|----------------------------|--------------------|----------------------|----------------------------|-----------|-----------------|
| TO-220                     | D <sup>2</sup> PAK | D <sup>2</sup> PAK/A | DPAK                       | DFN8      | Output 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 <sup>(2)</sup> |           | ADJ             |
| LD1086BV                   | LD1086BD2TTR       | LD1086BD2MTR         | LD1086BDTTR                |           | ADJ             |
| LD1086BV-DG <sup>(1)</sup> |                    |                      |                            |           | ADJ             |

1. TO-220 Dual Gauge frame.

2. Automotive grade products.

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

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