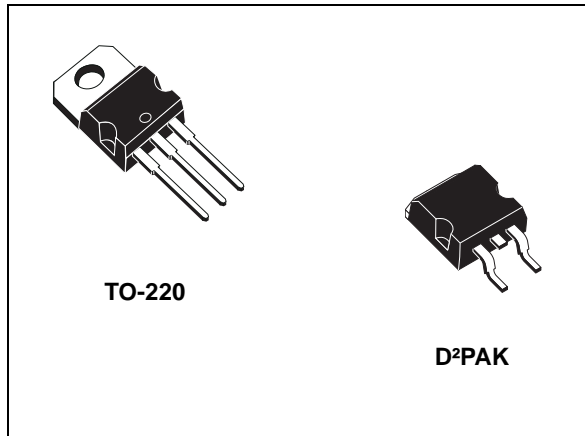


1.5 A very low drop voltage regulator IC

Datasheet - production data


Table 1. Device summary

| Order code | | Output voltages |
|------------|--------------------|-----------------|
| TO-220 | D ² PAK | |
| L4940V5 | L4940D2T5-TR | 5 V |
| L4940V85 | | 8.5 V |
| | L4940D2T12-TR | 12 V |

Features

- Precise 5, 8.5, 12 V outputs
- Low dropout voltage (450 mV typ. at 1 A)
- Very low quiescent current
- Thermal shutdown
- Short-circuit protection
- Reverse polarity protection

Description

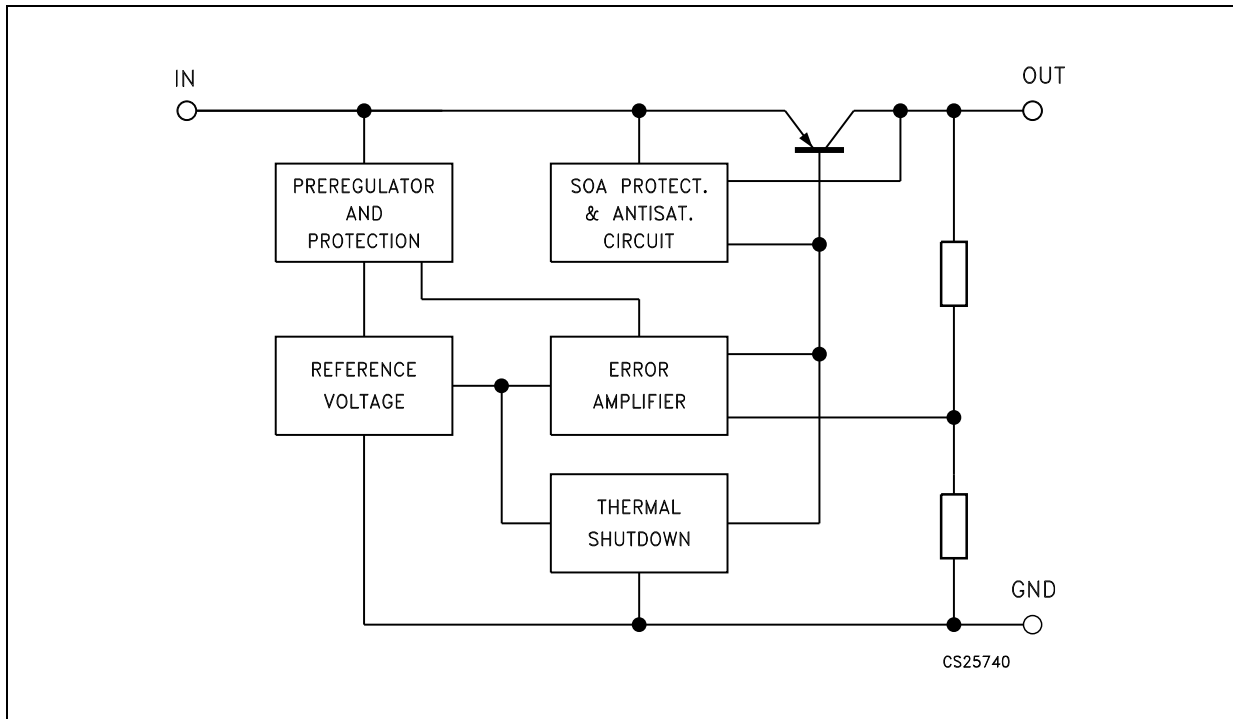
The L4940 series of three-terminal positive regulators is available in TO-220 and D²PAK packages and with several fixed output voltages, making it useful in a wide range of industrial and consumer applications. Thanks to their very low input/output voltage drop, these devices are particularly suitable for battery-powered equipment, reducing consumption and prolonging battery-life. Each type employs internal current limiting, anti-saturation circuit, thermal shutdown and safe area protection.

Contents

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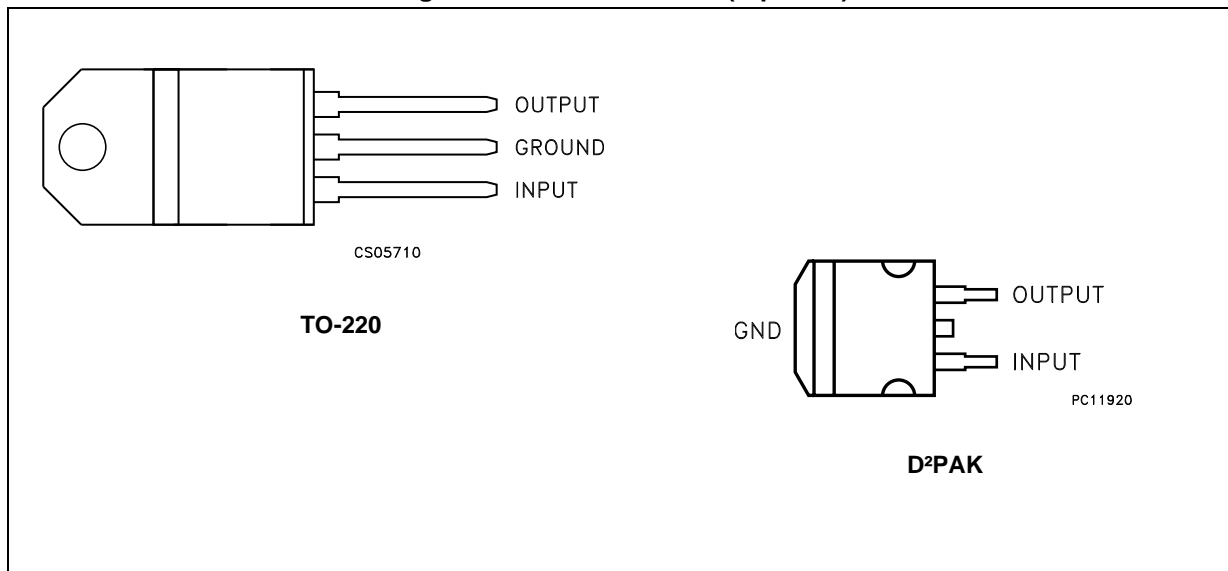
1 Block diagram

Figure 1. Block diagram



2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit | |
|-----------|--------------------------------------|---|------|---|
| V_I | Forward input voltage | 30 | V | |
| V_{IR} | Reverse input voltage | $V_O = 5\text{ V}, R_O = 100\ \Omega$ | -15 | V |
| | | $V_O = 8.5\text{ V}, R_O = 180\ \Omega$ | -15 | V |
| | | $V_O = 12\text{ V}, R_O = 240\ \Omega$ | -15 | V |
| I_O | Output current | Internally limited | mA | |
| P_D | Power dissipation | Internally limited | mW | |
| T_{stg} | Storage temperature range | -40 to +150 | °C | |
| T_{op} | Operating junction temperature range | -40 to +150 | °C | |

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

Table 3. Thermal data

| Symbol | Parameter | TO-220 | D ² PAK | Unit |
|------------|-------------------------------------|--------|--------------------|------|
| R_{thJC} | Thermal resistance junction-case | 3 | 3 | °C/W |
| R_{thJA} | Thermal resistance junction-ambient | 50 | 62.5 | °C/W |

4 Test circuits

Figure 3. DC parameters

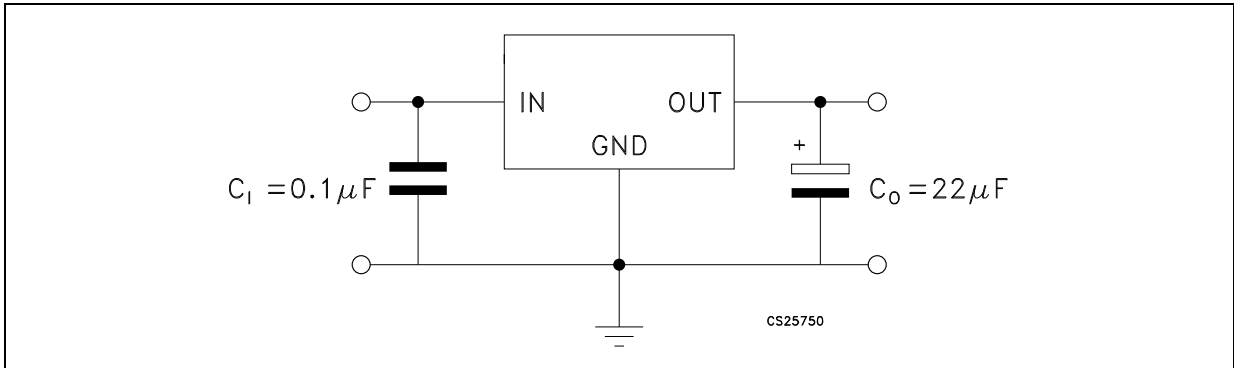


Figure 4. Load regulation

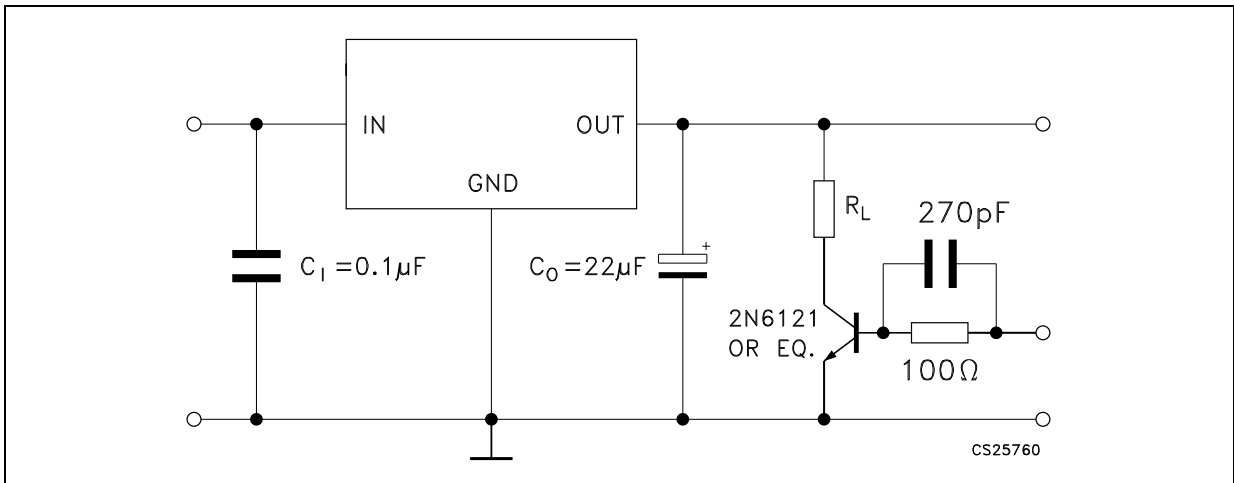
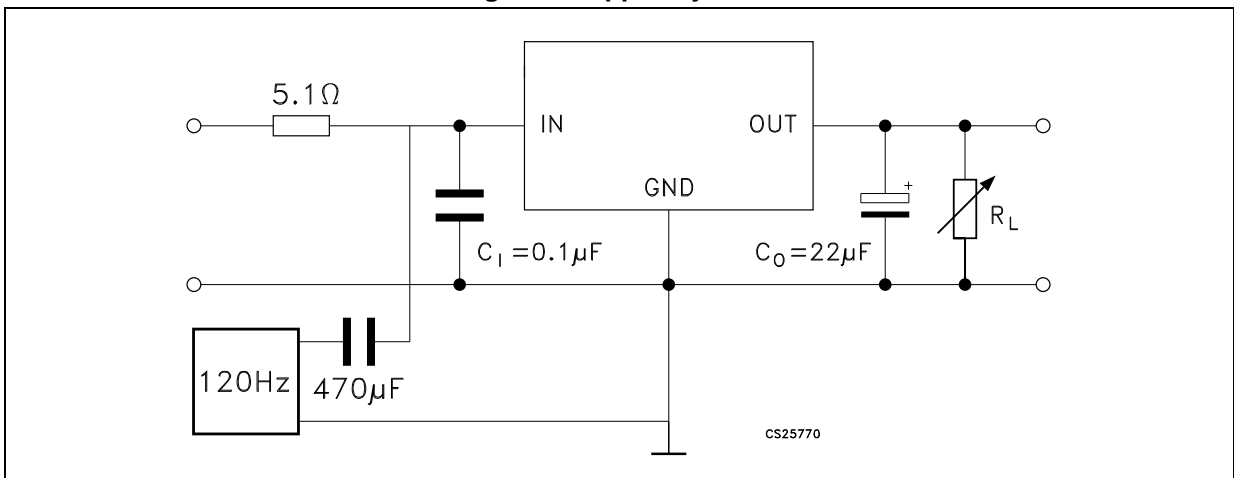


Figure 5. Ripple rejection



5 Electrical characteristics

Refer to test circuit, $V_I = 7\text{ V}$, $C_I = 0.1\ \mu\text{F}$, $C_O = 22\ \mu\text{F}$, $T_J = 25\ ^\circ\text{C}$, unless otherwise specified.

Table 4. L4940#5 electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------|--------------------------|---|------|------|------|----------------------|
| V_O | Output voltage | $I_O = 500\text{ mA}$ | 4.9 | 5 | 5.1 | V |
| V_O | Output voltage | $I_O = 5\text{ mA to }1.5\text{ A}$, $V_I = 6.5\text{ to }15\text{ V}$ | 4.8 | 5 | 5.2 | V |
| V_I | Maximum input voltage | $I_O = 5\text{ mA}$ | | | 17 | V |
| ΔV_O | Line regulation | $V_I = 6\text{ to }17\text{ V}$, $I_O = 5\text{ mA}$ | | 4 | 10 | mV |
| ΔV_O | Load regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | | 8 | 25 | mV |
| | | $I_O = 0.5\text{ A to }1\text{ A}$ | | 5 | 15 | mV |
| I_q | Quiescent current | $I_O = 5\text{ mA}$ | | 5 | 8 | mA |
| | | $I_O = 1.5\text{ A}$, $V_I = 6.5\text{ V}$ | | 30 | 50 | mA |
| ΔI_q | Quiescent current change | $I_O = 5\text{ mA}$ | | | 3 | mA |
| | | $I_O = 1.5\text{ A}$, $V_I = 6.5\text{ to }16\text{ V}$ | | | 15 | mA |
| $\Delta V_O / \Delta T$ | Output voltage drift | | | 0.5 | | mV/ $^\circ\text{C}$ |
| SVR | Supply voltage rejection | $f = 120\text{ Hz}$, $I_O = 1\text{ A}$ | 58 | 68 | | dB |
| V_d | Dropout voltage | $I_O = 0.5\text{ A}$ | | 200 | 400 | mV |
| | | $I_O = 1.5\text{ A}$ | | 500 | 900 | mV |
| I_{sc} | Short-circuit current | $V_I = 14\text{ V}$ | | 2 | 2.7 | A |
| | | $V_I = 6.5\text{ V}$ | | 2.2 | 2.9 | |

Refer to test circuit, $V_I = 10.5\text{ V}$, $C_I = 0.1\ \mu\text{F}$, $C_O = 22\ \mu\text{F}$, $T_J = 25\ ^\circ\text{C}$, unless otherwise specified.

Table 5. L4940#85 electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------------|--|------|------|------|------|
| V_O | Output voltage | $I_O = 500\text{ mA}$ | 8.3 | 8.5 | 8.7 | V |
| V_O | Output voltage | $I_O = 5\text{ mA to }1.5\text{ A}$, $V_I = 10.2\text{ to }15\text{ V}$ | 8.15 | 8.5 | 8.85 | V |
| V_I | Maximum input voltage | $I_O = 5\text{ mA}$ | | | 17 | V |
| ΔV_O | Line regulation | $V_I = 9.5\text{ to }17\text{ V}$, $I_O = 5\text{ mA}$ | | 4 | 9 | mV |
| ΔV_O | Load regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | | 12 | 30 | mV |
| | | $I_O = 0.5\text{ A to }1\text{ A}$ | | 8 | 16 | mV |
| I_q | Quiescent current | $I_O = 5\text{ mA}$ | | 4 | 8 | mA |
| | | $I_O = 1.5\text{ A}$, $V_I = 10.2\text{ V}$ | | 30 | 50 | mA |
| ΔI_q | Quiescent current change | $I_O = 5\text{ mA}$ | | | 2.5 | mA |
| | | $I_O = 1.5\text{ A}$, $V_I = 10.2\text{ to }16\text{ V}$ | | | 15 | mA |

Table 5. L4940#85 electrical characteristics (continued)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------|--------------------------|----------------------------------|------|------|------|-------|
| $\Delta V_O / \Delta T$ | Output voltage drift | | | 0.8 | | mV/°C |
| SVR | Supply voltage rejection | f = 120 Hz, I _O = 1 A | 58 | 66 | | dB |
| V _d | Dropout voltage | I _O = 0.5 A | | 200 | 400 | mV |
| | | I _O = 1.5 A | | 500 | 900 | mV |
| I _{sc} | Short-circuit current | V _I = 14 V | | 2 | 2.7 | A |
| | | V _I = 10.2 V | | 2.2 | 2.9 | |

Refer to test circuit, V_I = 14 V, C_I = 0.1 μF, C_O = 22 μF, T_J = 25 °C, unless otherwise specified.

Table 6. L4940#12 electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------|--------------------------|---|-------|------|-------|-------|
| V _O | Output voltage | I _O = 500 mA | 11.75 | 12 | 12.25 | V |
| V _O | Output voltage | I _O = 5 mA to 1.5 A, V _I = 13.8 to 15 V | 11.5 | 12 | 12.5 | V |
| V _I | Maximum input voltage | I _O = 5 mA | | | 17 | V |
| ΔV_O | Line regulation | V _I = 13 to 17 V, I _O = 5 mA | | 3 | 7 | mV |
| ΔV_O | Load regulation | I _O = 5 mA to 1.5 A | | 15 | 35 | mV |
| | | I _O = 0.5 A to 1 A | | 10 | 25 | mV |
| I _q | Quiescent current | I _O = 5 mA | | 4 | 8 | mA |
| | | I _O = 1.5 A, V _I = 13.8 V | | 30 | 50 | mA |
| ΔI_q | Quiescent current change | I _O = 5 mA | | | 1.5 | mA |
| | | I _O = 1.5 A, V _I = 13.8 to 16 V | | | 10 | mA |
| $\Delta V_O / \Delta T$ | Output voltage drift | | | 1.2 | | mV/°C |
| SVR | Supply voltage rejection | f = 120 Hz, I _O = 1 A | 55 | 61 | | dB |
| V _d | Dropout voltage | I _O = 0.5 A | | 200 | 400 | mV |
| | | I _O = 1.5 A | | 500 | 900 | mV |
| I _{sc} | Short-circuit current | V _I = 14 V | | 2 | 2.7 | A |
| Z _O | Output impedance | f = 120 Hz, I _O = 0.5 A | | 40 | | mΩ |

6 Performance characteristics

Figure 6. Dropout voltage vs. output current

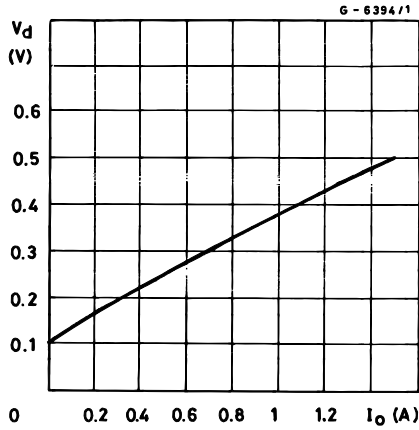


Figure 7. Dropout voltage vs. temperature

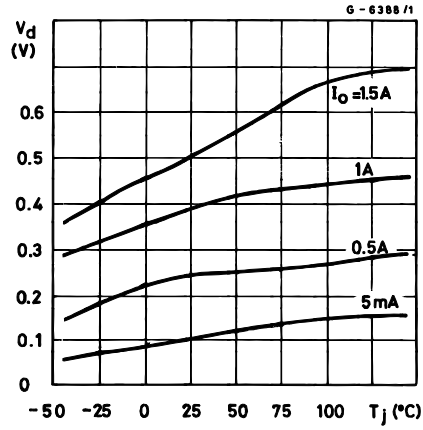


Figure 8. Output voltage vs. temperature (L4940V5)

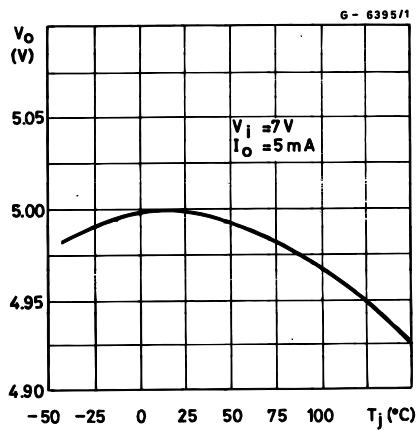


Figure 9. Output voltage vs. temperature (L4940V85)

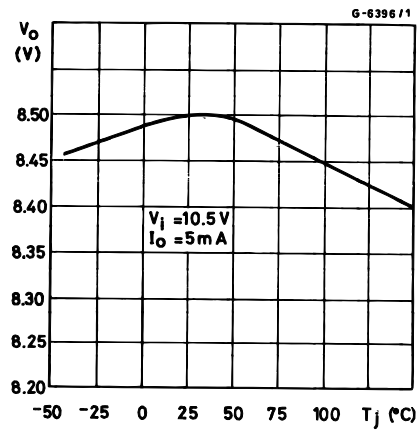


Figure 10. Output voltage vs. temperature (L4940V12)

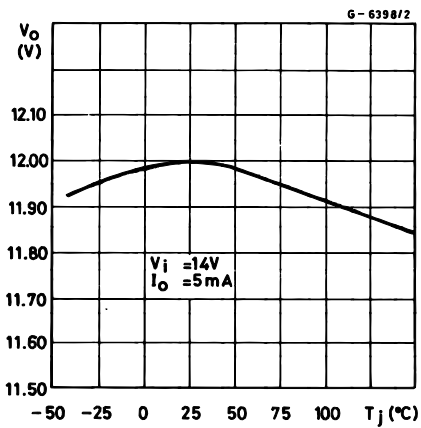


Figure 11. Quiescent current vs. temperature (L4940V5)

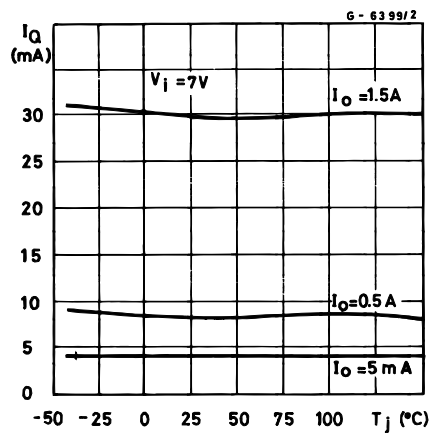


Figure 12. Quiescent current vs. input voltage (L4940V5)

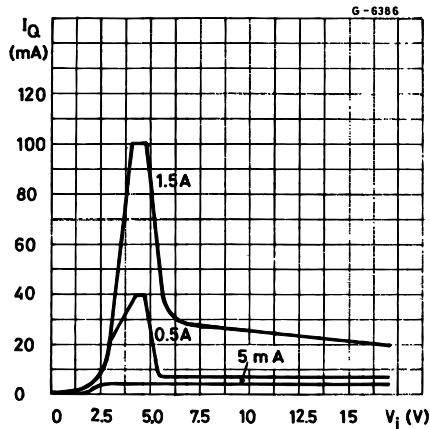


Figure 13. Quiescent current vs. output current (L4940V5)

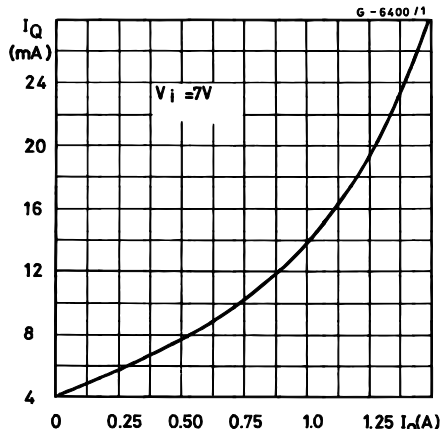


Figure 14. Short-circuit current vs. temperature (L4940V5)

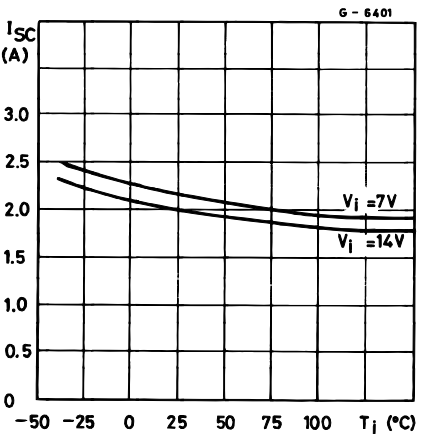


Figure 15. Peak output current vs. input/output differential voltage (L4940V5)

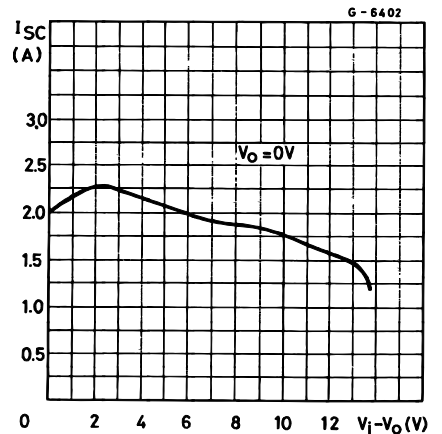


Figure 16. Low voltage behavior (L4940V5)

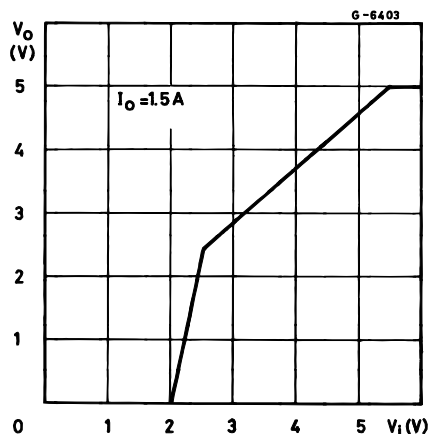


Figure 17. Low voltage behavior (L4940V85)

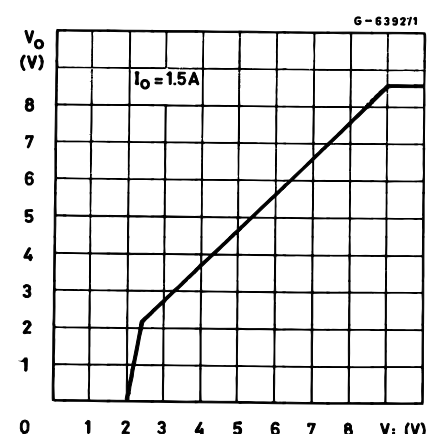


Figure 18. Low voltage behavior (L4940V12)

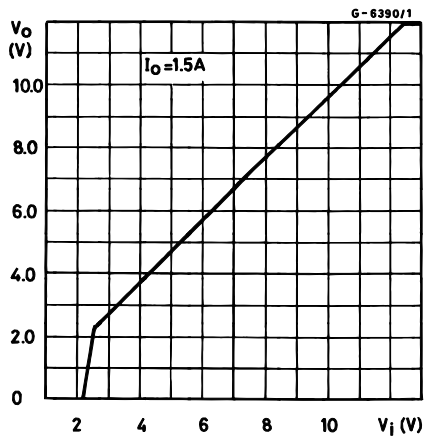


Figure 19. Supply voltage rejection vs. frequency (L4940V5)

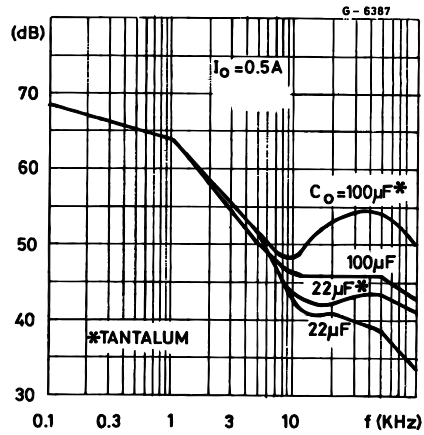


Figure 20. Supply voltage rejection vs. output current (L4940V5)

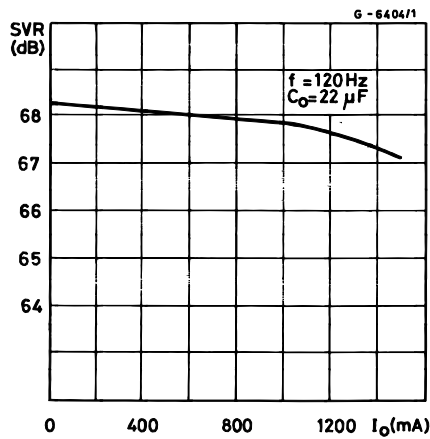


Figure 21. Load dump characteristics (L4940V5)

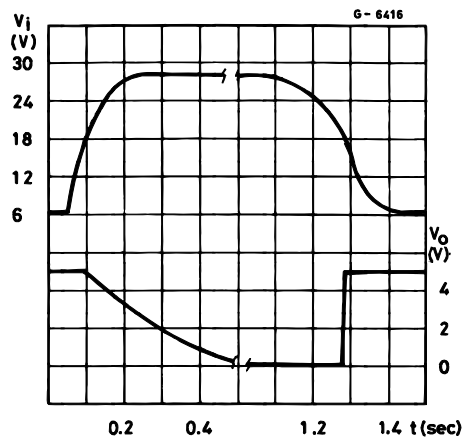


Figure 22. Line transient response (L4940V5)

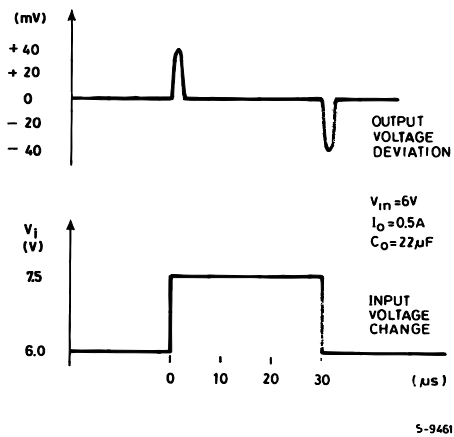
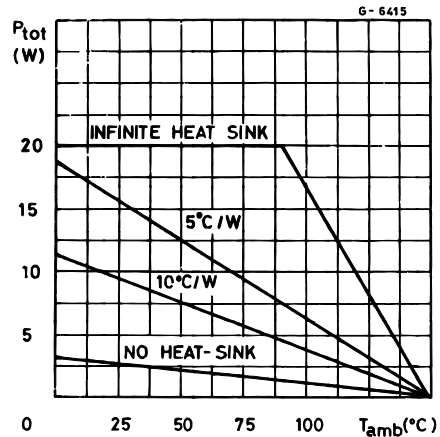
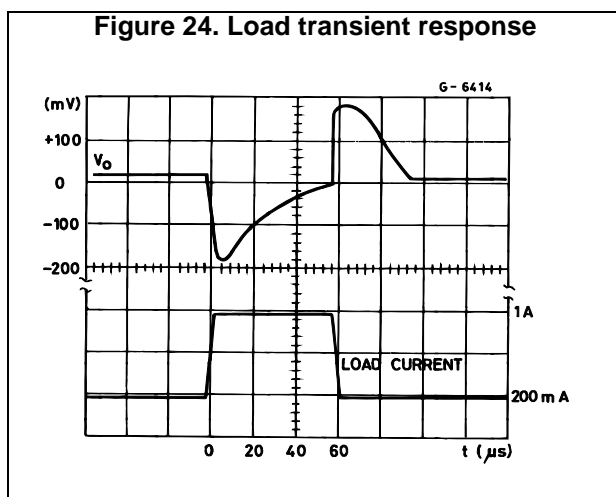


Figure 23. Total power dissipation





7 Application circuits

Figure 25. Distributed power supply with the L4960, L4940 and the L4941

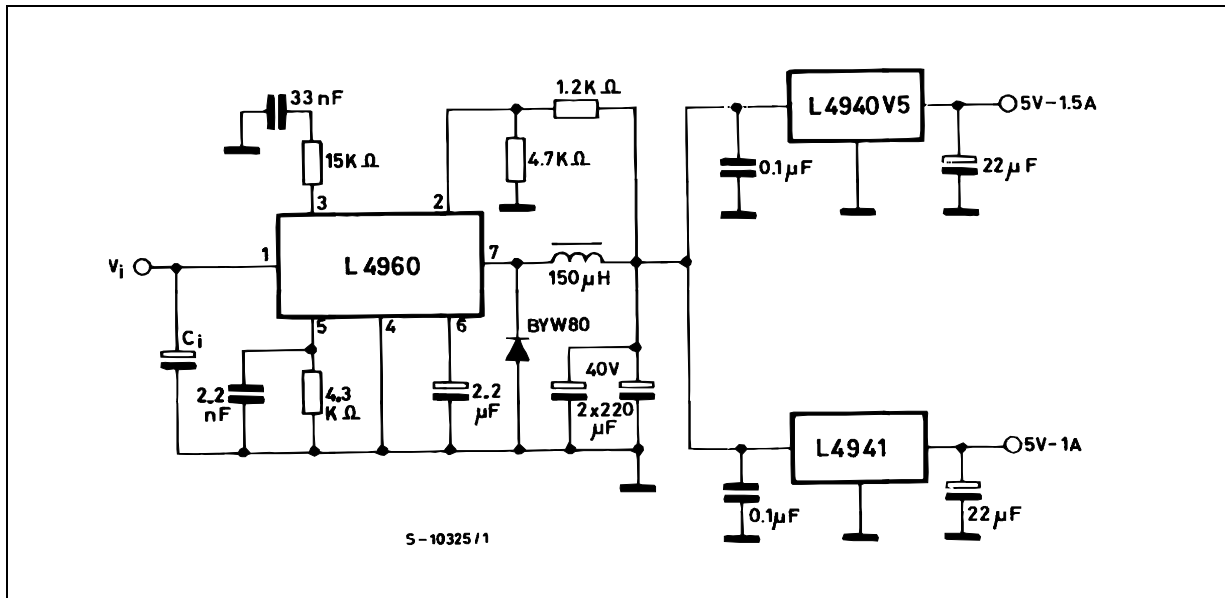
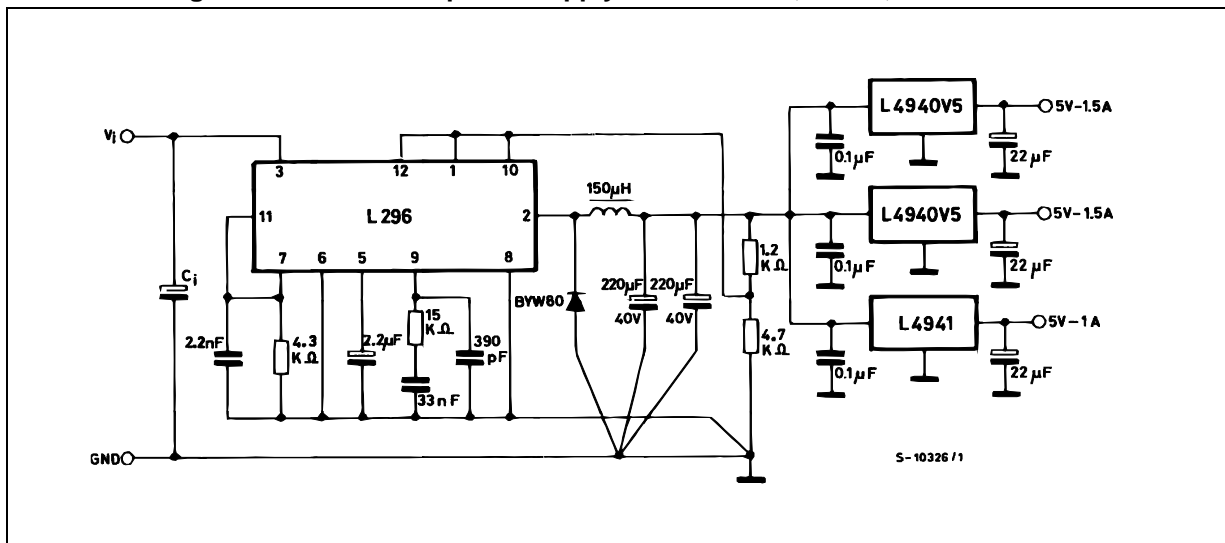
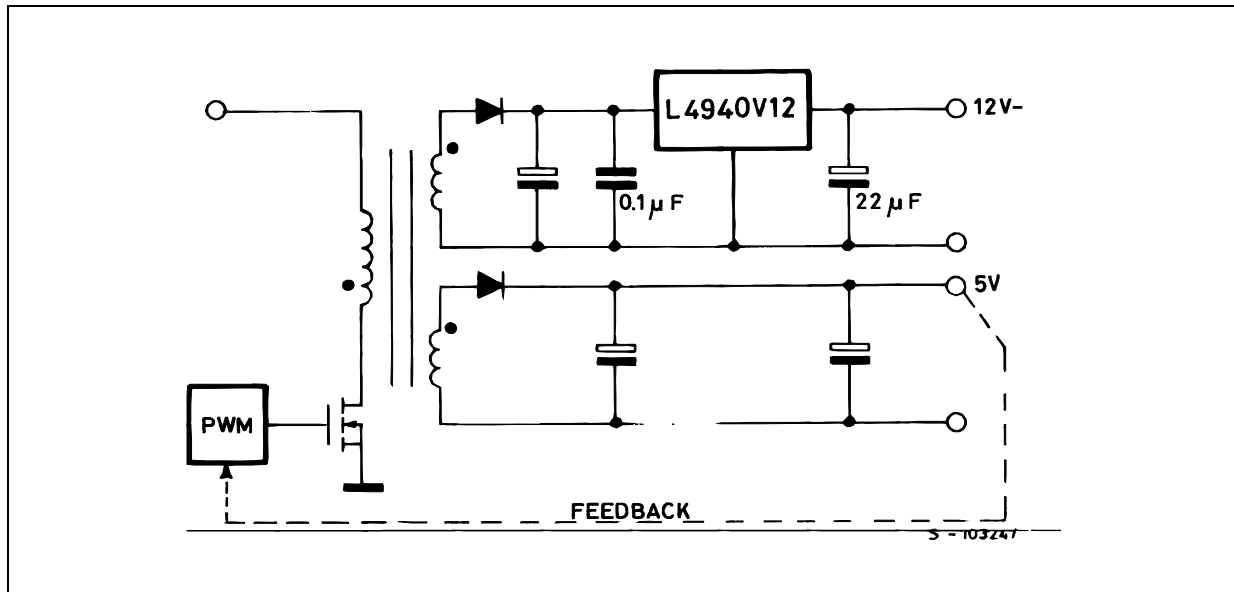


Figure 26. Distributed power supply with the L296, L4940, and the L4941



Note: Advantages of these applications are:
 On-card regulation with short-circuit and thermal protection on each output. Very high total system efficiency due to the switching pre-regulation and very low drop post-regulation.

Figure 27. Secondary regulation for switch mode power supply with the L4940



Note: Advantages of this configuration are:
Very high regulation (line and load on both the output voltage. 12 V output short-circuit and thermal protection. Very high efficiency on the 12 V output due to the low drop regulator.

8 Package information

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

8.1 TO-220 (dual gauge) package information

Figure 28. TO-220 (dual gauge) package outline

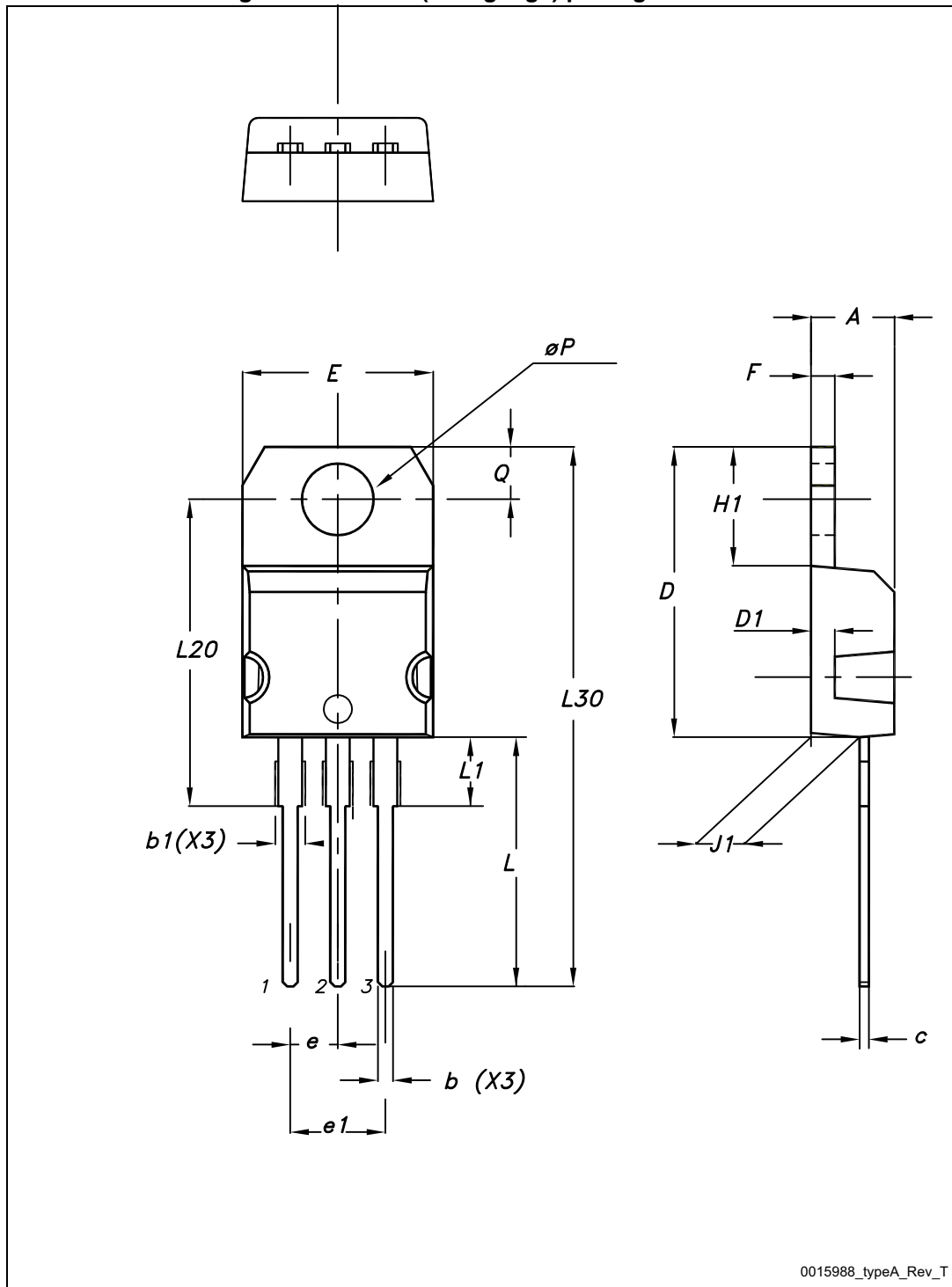
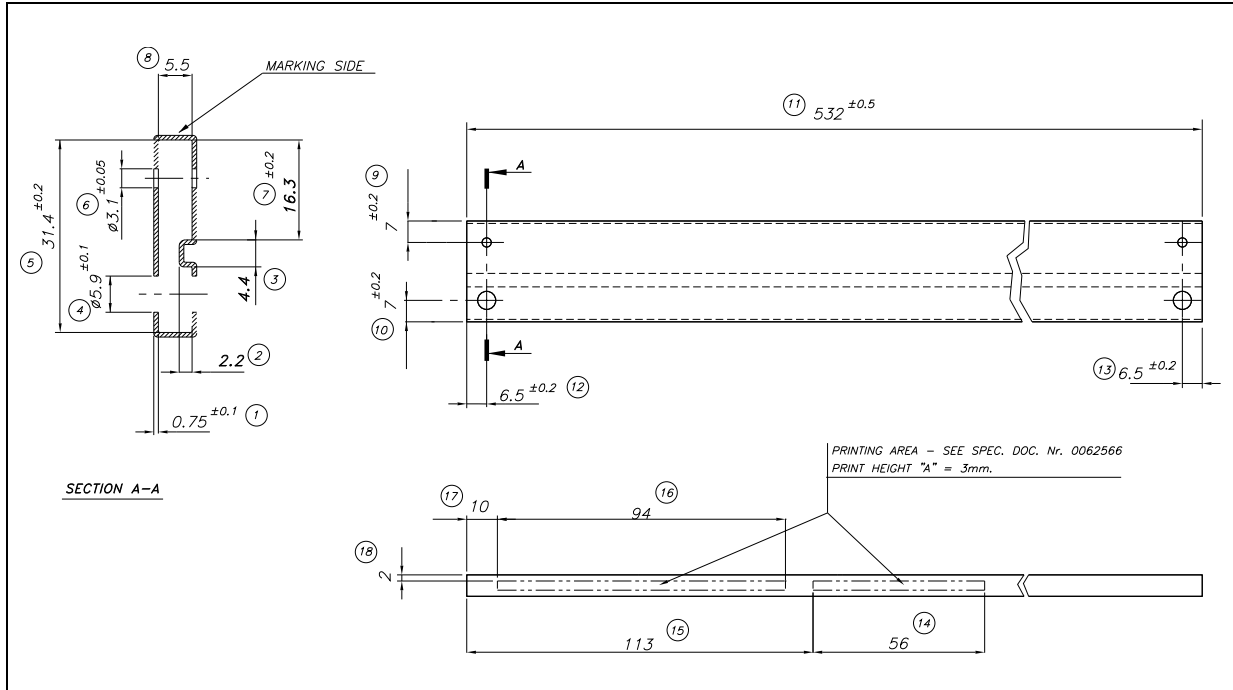


Table 7. TO-220 (dual gauge) mechanical data

| 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 |
| 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 |

8.2 TO-220 (dual gauge) packing information

Figure 29. Tube for TO-220 (dual gauge) outline (mm.)



8.3 D²PAK package information

Figure 30. D²PAK package outline

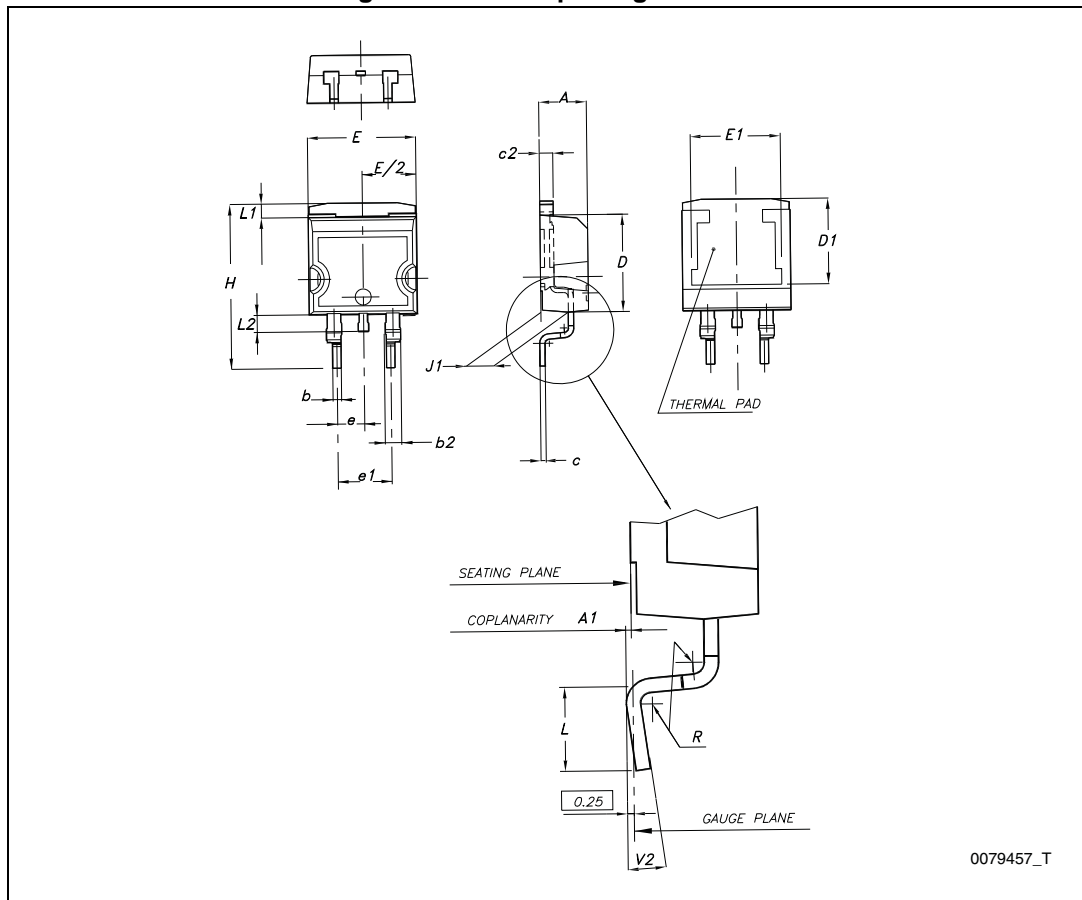
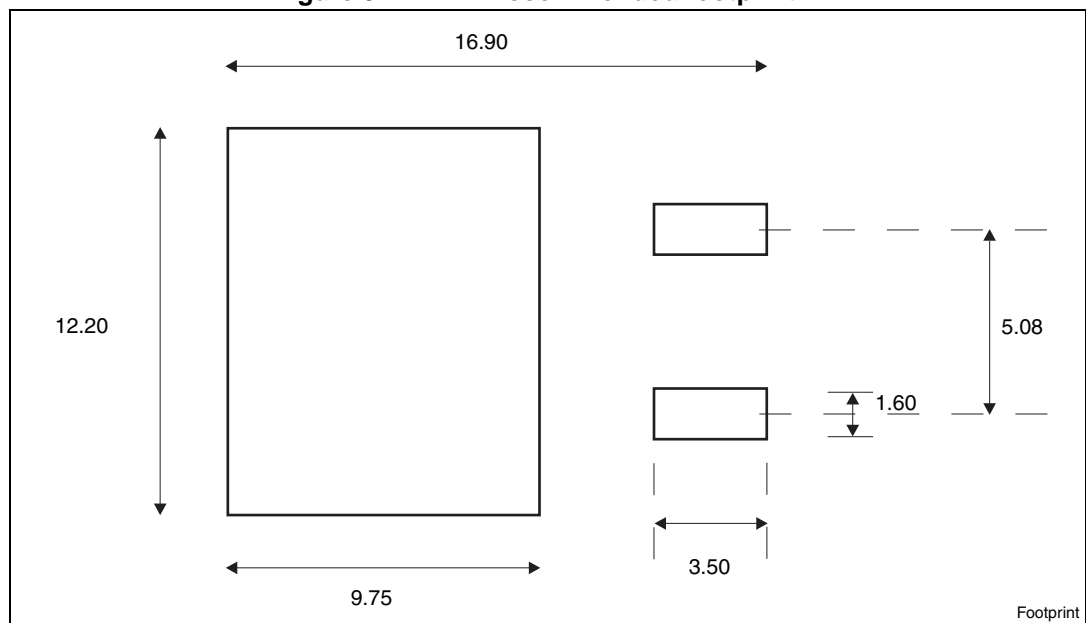


Table 8. D²PAK mechanical data

| 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° |

Figure 31. D²PAK recommended footprint^(a)

a. All dimensions are in millimeters.

8.4 D²PAK packing information

Figure 32. D²PAK tape outline

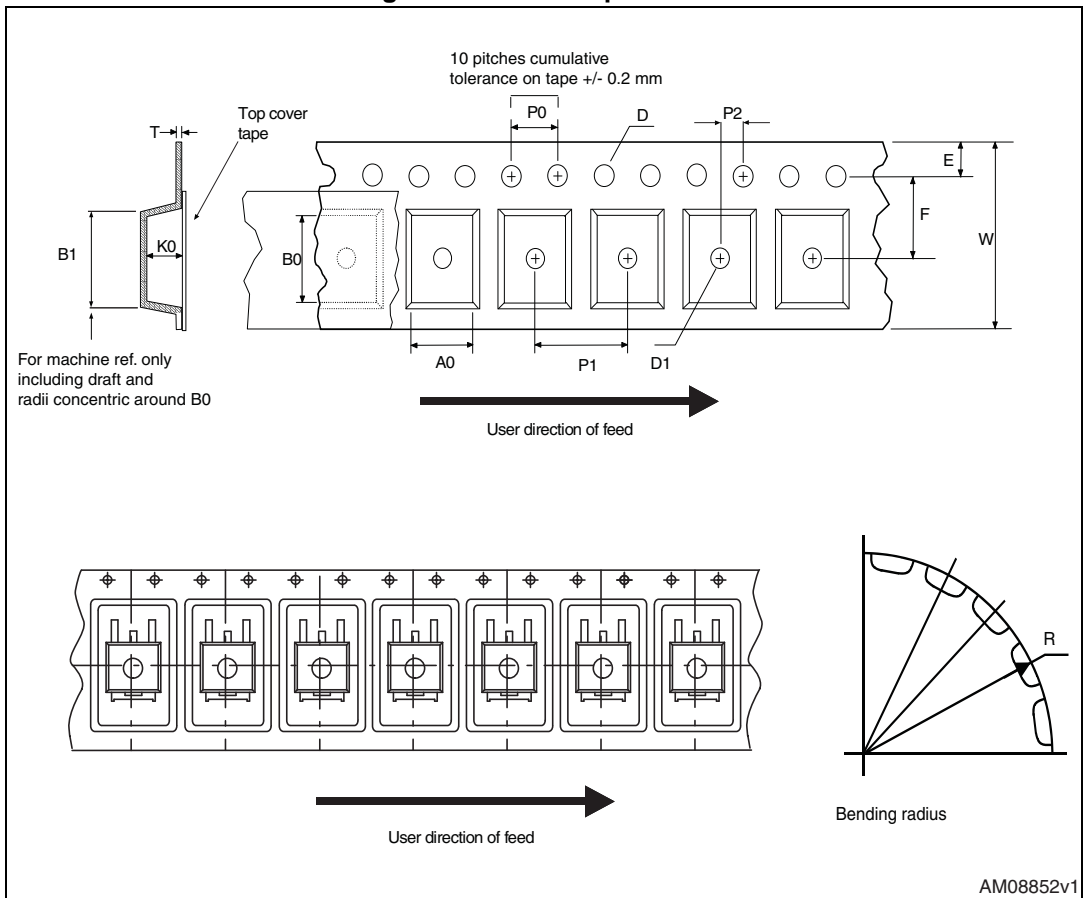


Figure 33. D²PAK reel outline

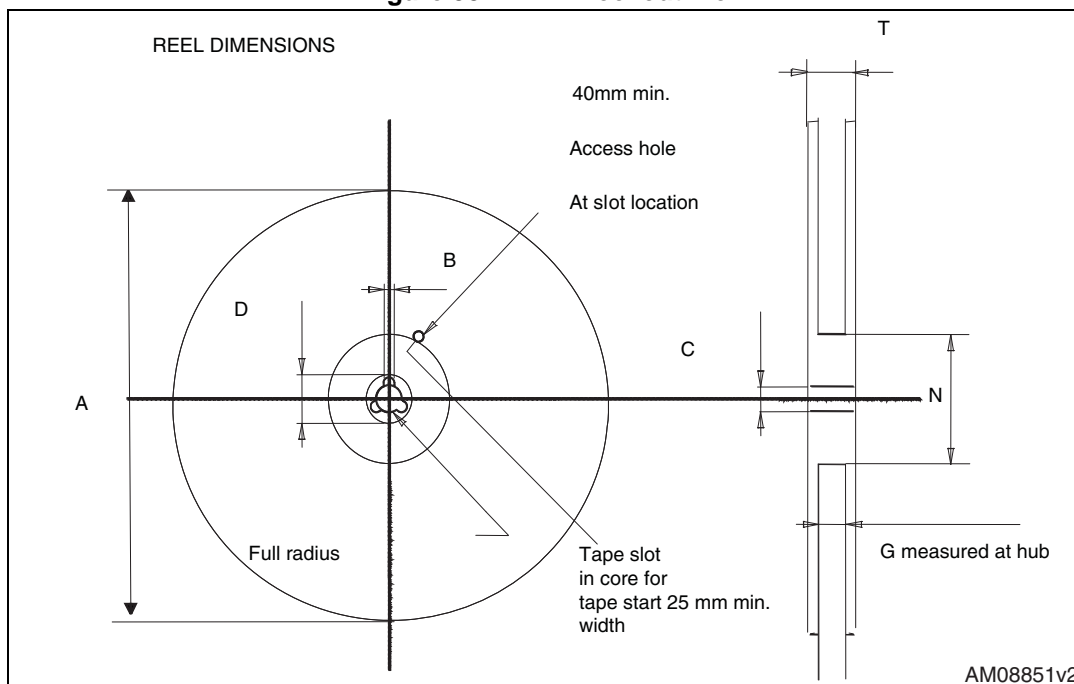


Table 9. D²PAK tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|------|----------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 10.5 | 10.7 | A | | 330 |
| B0 | 15.7 | 15.9 | B | 1.5 | |
| D | 1.5 | 1.6 | C | 12.8 | 13.2 |
| D1 | 1.59 | 1.61 | D | 20.2 | |
| E | 1.65 | 1.85 | G | 24.4 | 26.4 |
| F | 11.4 | 11.6 | N | 100 | |
| K0 | 4.8 | 5.0 | T | | 30.4 |
| P0 | 3.9 | 4.1 | | | |
| P1 | 11.9 | 12.1 | | Base qty | 1000 |
| P2 | 1.9 | 2.1 | | Bulk qty | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

9 Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 04-Feb-2005 | 6 | Added new package D ² PAK/A. |
| 18-Sep-2006 | 7 | Order codes and new template have been updated. |
| 31-May-2007 | 8 | Order codes have been updated. |
| 19-Sep-2007 | 9 | Added Table 1 to cover page. |
| 20-Feb-2008 | 10 | Modified: Table 1 on page 1 . |
| 29-Jul-2009 | 11 | Modified: Table 1 on page 1 . |
| 16-Dec-2009 | 12 | Modified: Table 6 on page 8 . |
| 04-Nov-2013 | 13 | <p>The L4940XX5, L4940XX85, L4940XX10, L4940XX12 have been changed into the L4940.</p> <p>Updated: the title and the description in cover page.</p> <p>Updated Section 4: Test circuits, Section 5: Electrical characteristics, Section 6: Performance characteristics and Section 8: Package information.</p> <p>Added Section 8.4: D²PAK packing information.</p> <p>Minor text changes.</p> |
| 08-Apr-2015 | 14 | <p>Updated title in Table 1: Device summary.</p> <p>Updated Section 8: Package information.</p> <p>Minor text changes.</p> |

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QQ 800077892

Skype [ameyasales1](#) [ameyasales2](#)

➤ Customer Service :

Email service@ameya360.com

➤ Partnership :

Tel +86 (21) 64016692-8333

Email mkt@ameya360.com