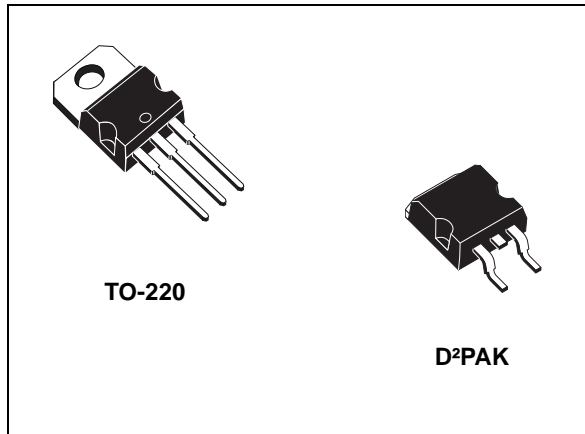


1.5 A very low drop voltage regulator IC

Datasheet - production data


Table 1. Ordering table

| Order codes | | 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

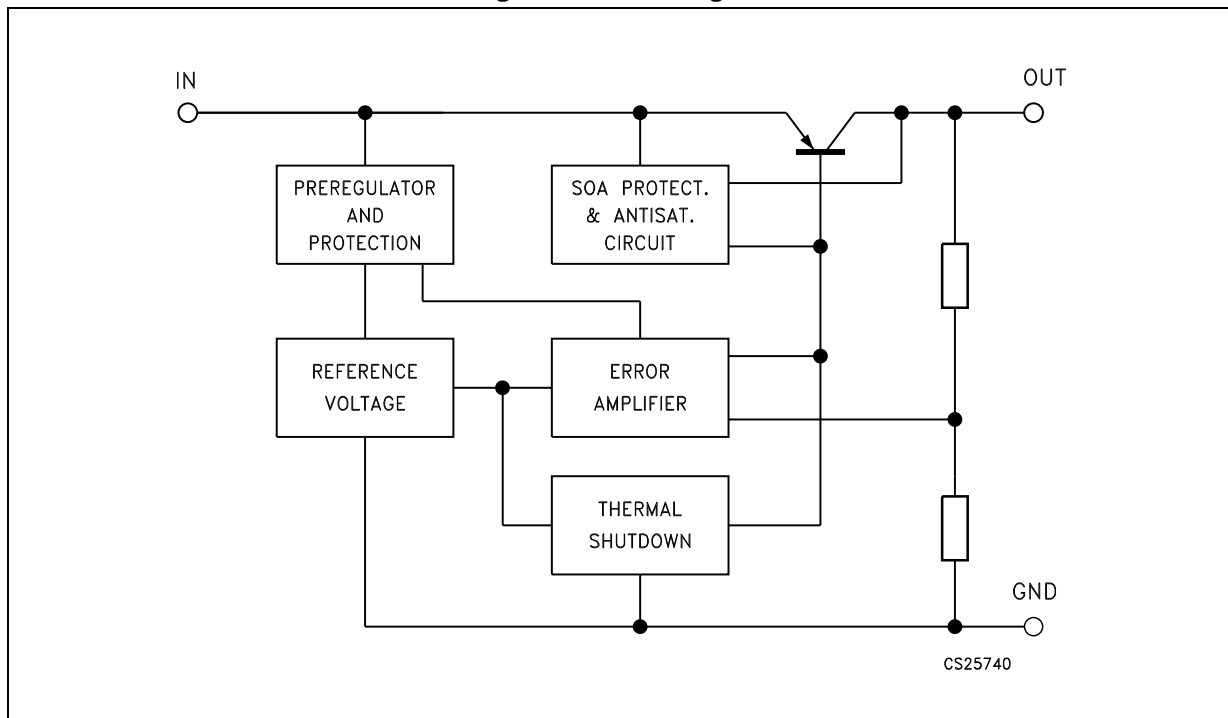
The L4940 series of three-terminal positive regulators is available in TO-220 and D²PAK packages and with several fixed output voltages, making it useful in a wide range of industrial and consumer applications. Thanks to their very low input/output voltage drop, these devices are particularly suitable 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

| | | |
|----|-----------------------------------|----|
| 1 | Block diagram | 3 |
| 2 | Pin configuration | 4 |
| 3 | Maximum ratings | 5 |
| 4 | Test circuits | 6 |
| 5 | Electrical characteristics | 7 |
| 6 | Performance characteristics | 9 |
| 7 | Application circuits | 13 |
| 8 | Package mechanical data | 15 |
| 9 | Packaging mechanical data | 19 |
| 10 | Revision history | 21 |

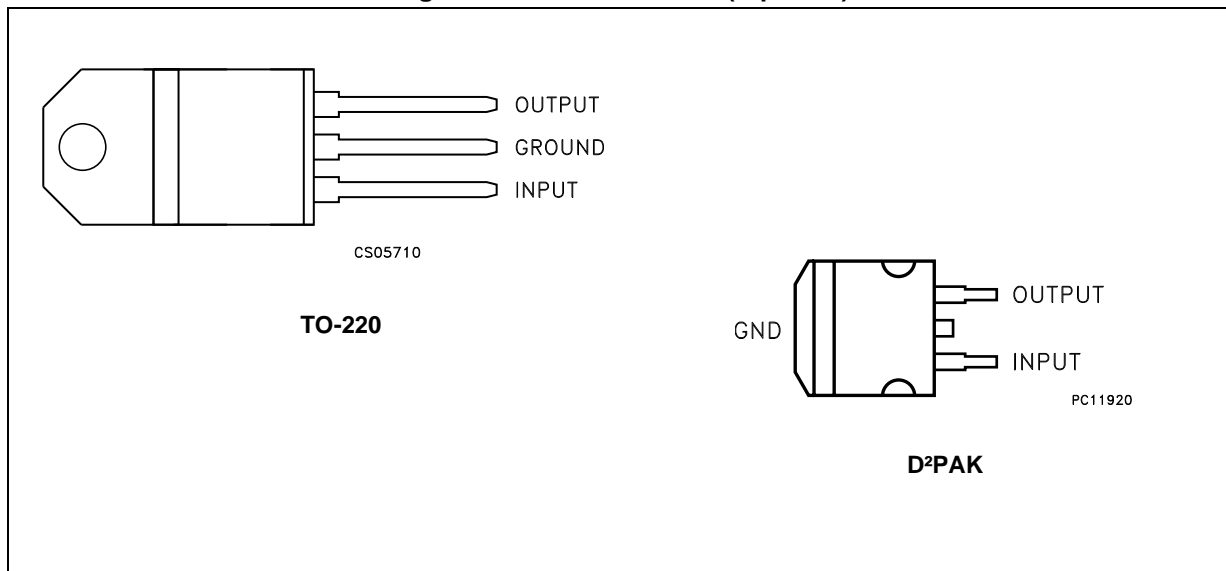
1 Block diagram

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

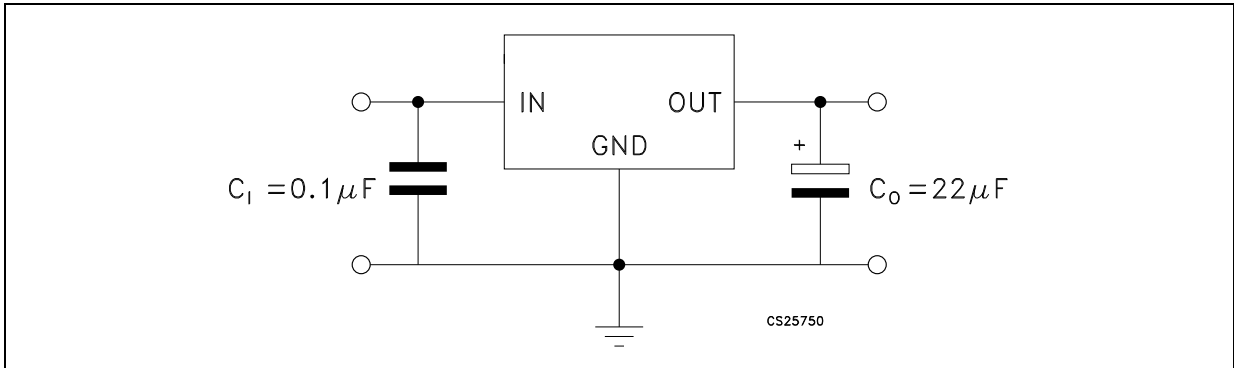


Figure 4. Load regulation

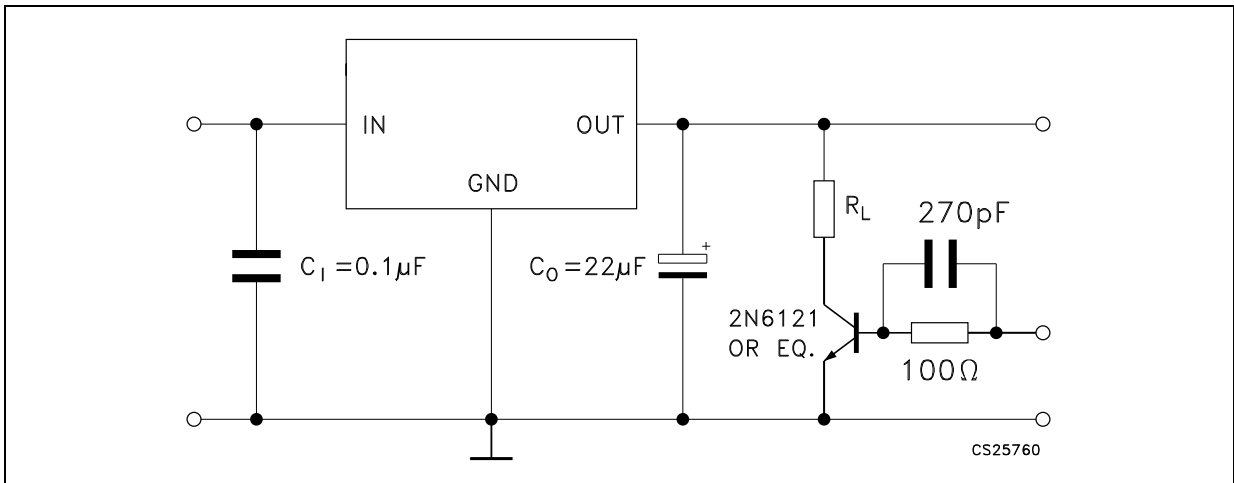
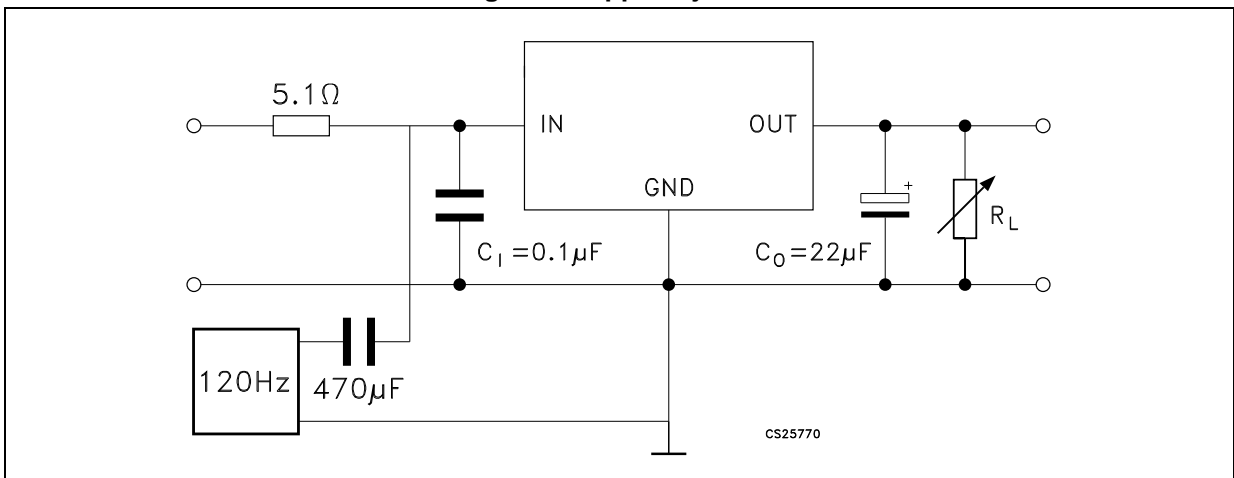


Figure 5. Ripple rejection



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

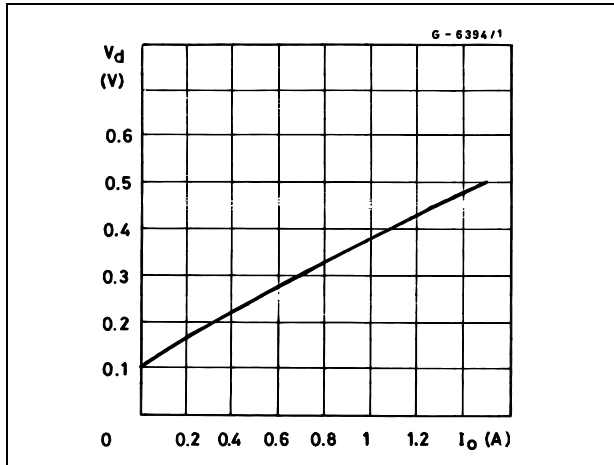


Figure 7. Dropout voltage vs. temperature

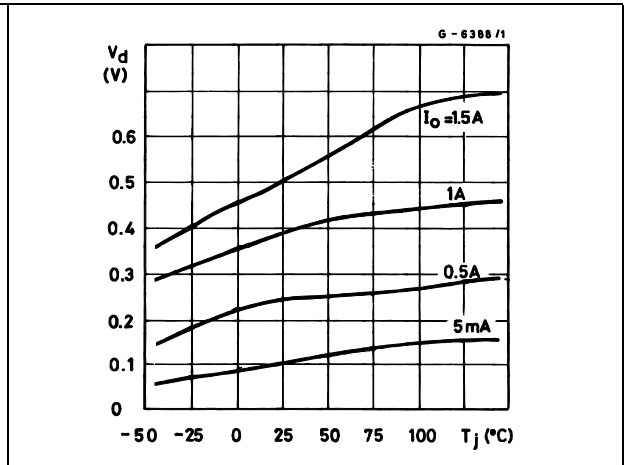


Figure 8. Output voltage vs. temperature (L4940V5)

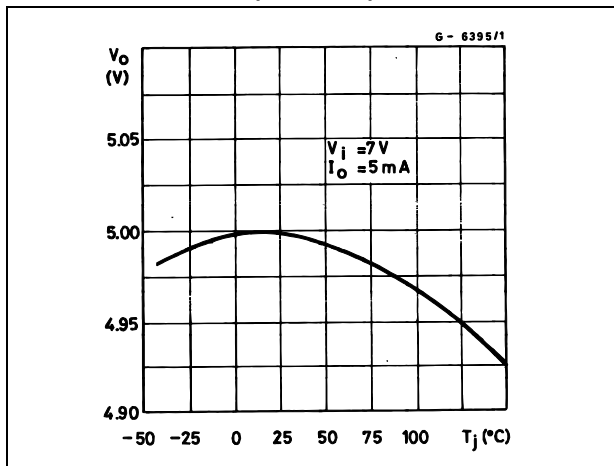


Figure 9. Output voltage vs. temperature (L4940V85)

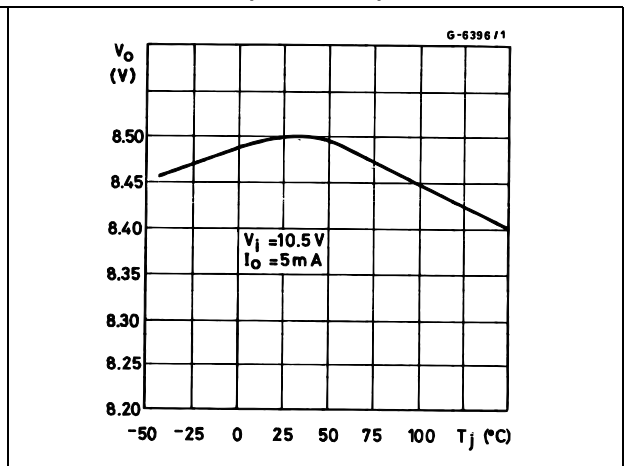


Figure 10. Output voltage vs. temperature (L4940V12)

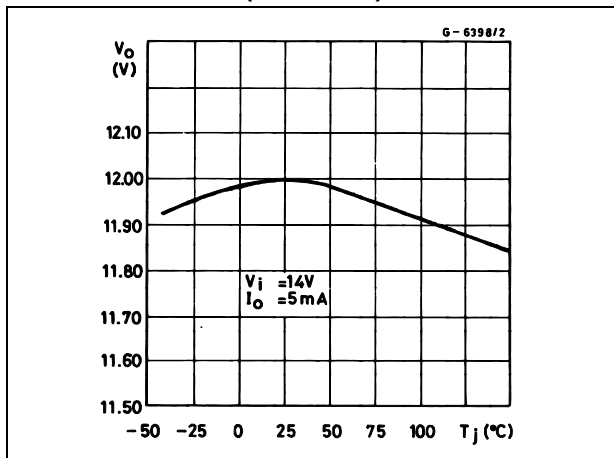


Figure 11. Quiescent current vs. temperature (L4940V5)

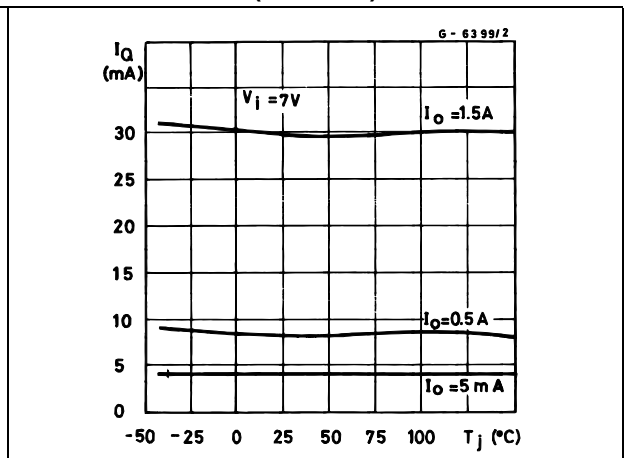


Figure 12. Quiescent current vs. input voltage (L4940V5)

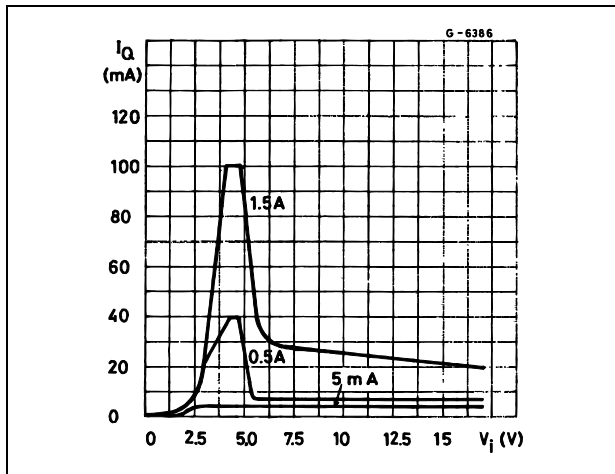


Figure 13. Quiescent current vs. output current (L4940V5)

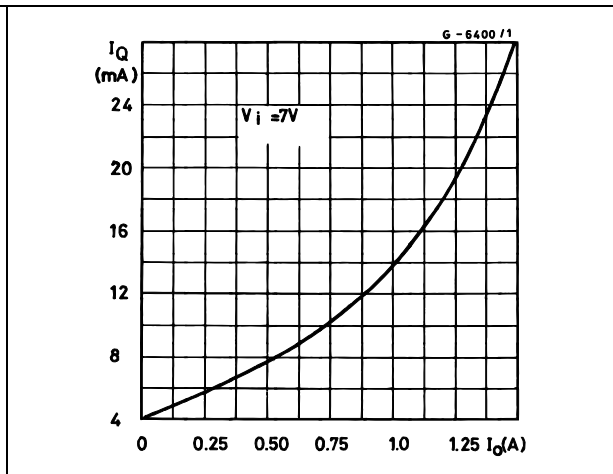


Figure 14. Short-circuit current vs. temperature (L4940V5)

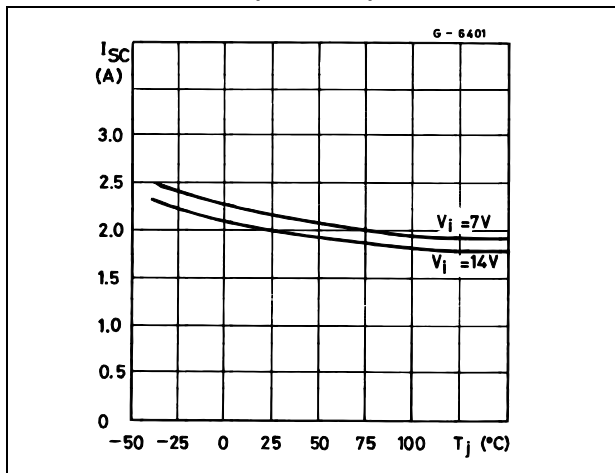


Figure 15. Peak output current vs. input/output differential voltage (L4940V5)

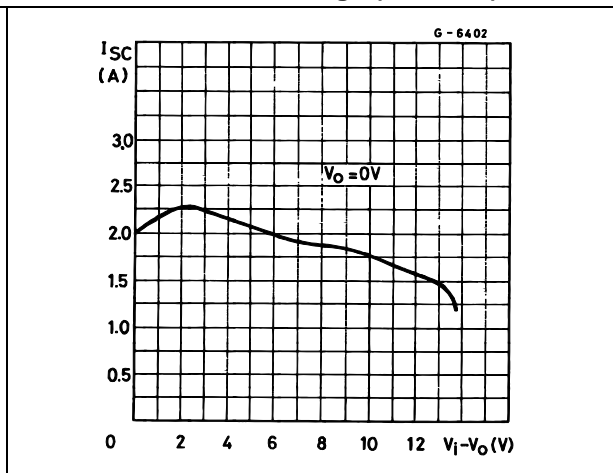


Figure 16. Low voltage behavior (L4940V5)

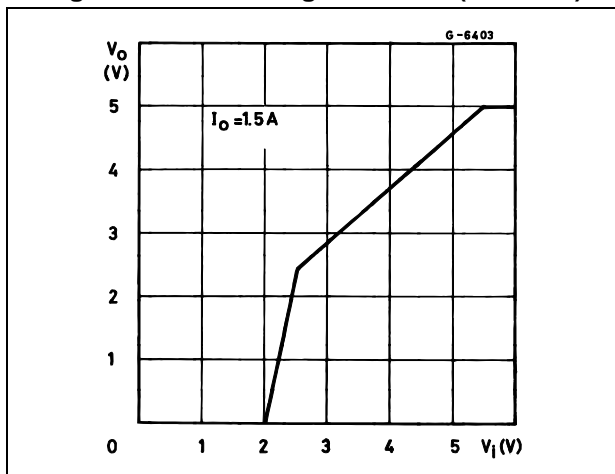


Figure 17. Low voltage behavior (L4940V85)

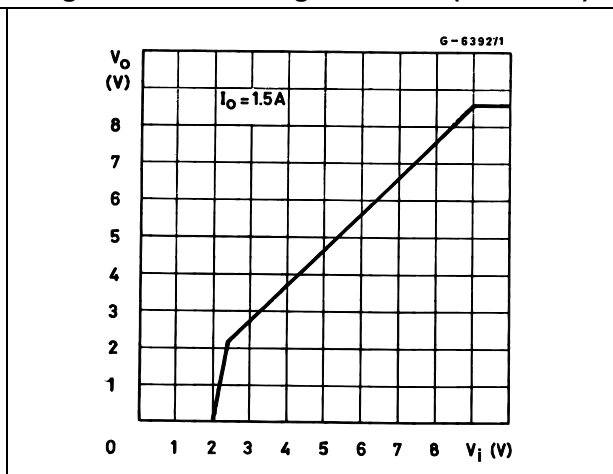


Figure 18. Low voltage behavior (L4940V12)

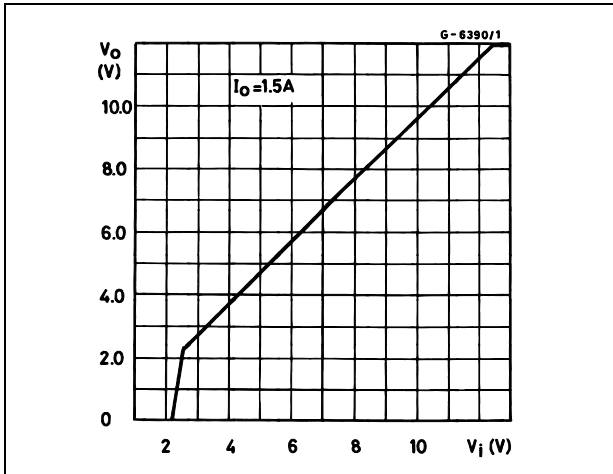


Figure 19. Supply voltage rejection vs. frequency (L4940V5)

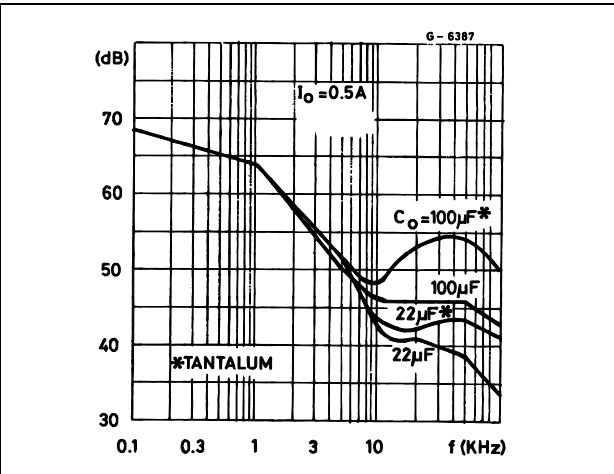


Figure 20. Supply voltage rejection vs. output current (L4940V5)

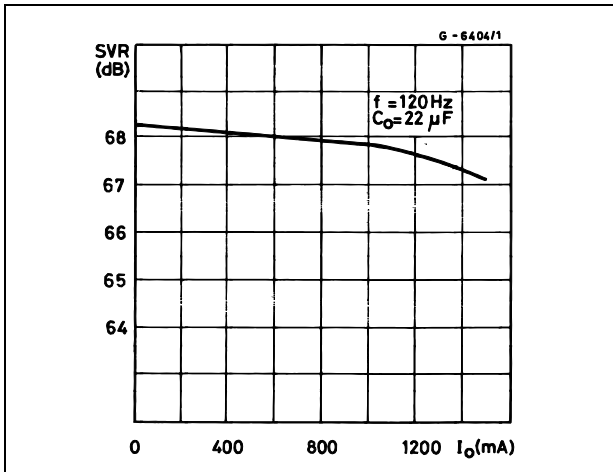


Figure 21. Load dump characteristics (L4940V5)

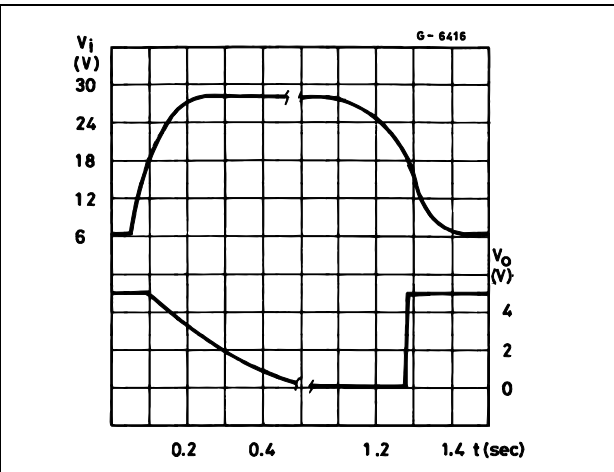


Figure 22. Line transient response (L4940V5)

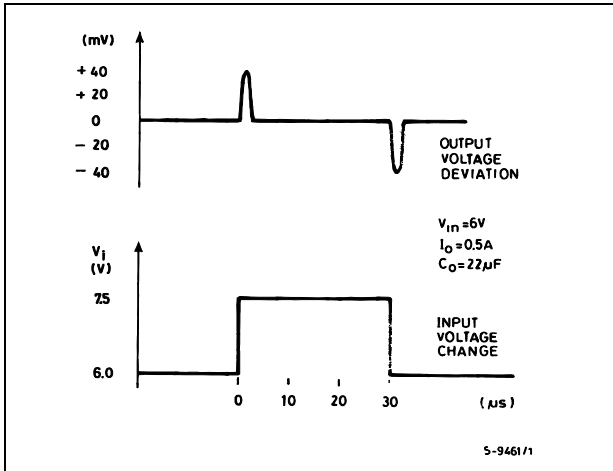


Figure 23. Total power dissipation

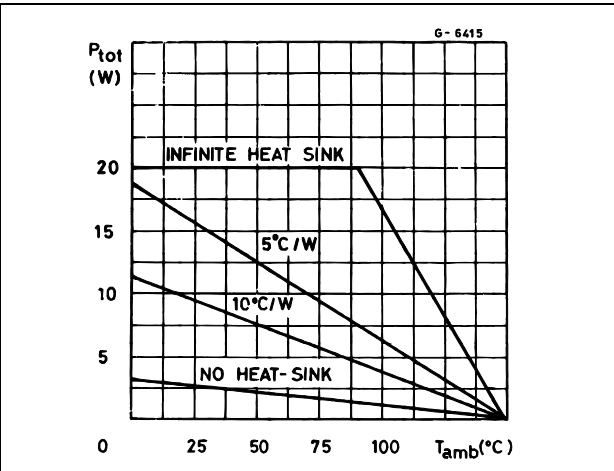
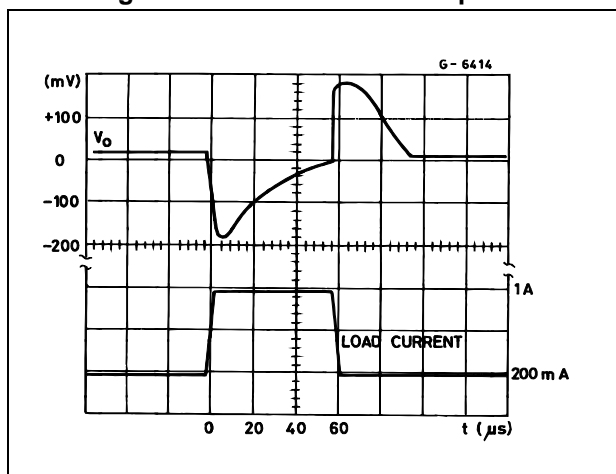


Figure 24. Load transient response



7 Application circuits

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

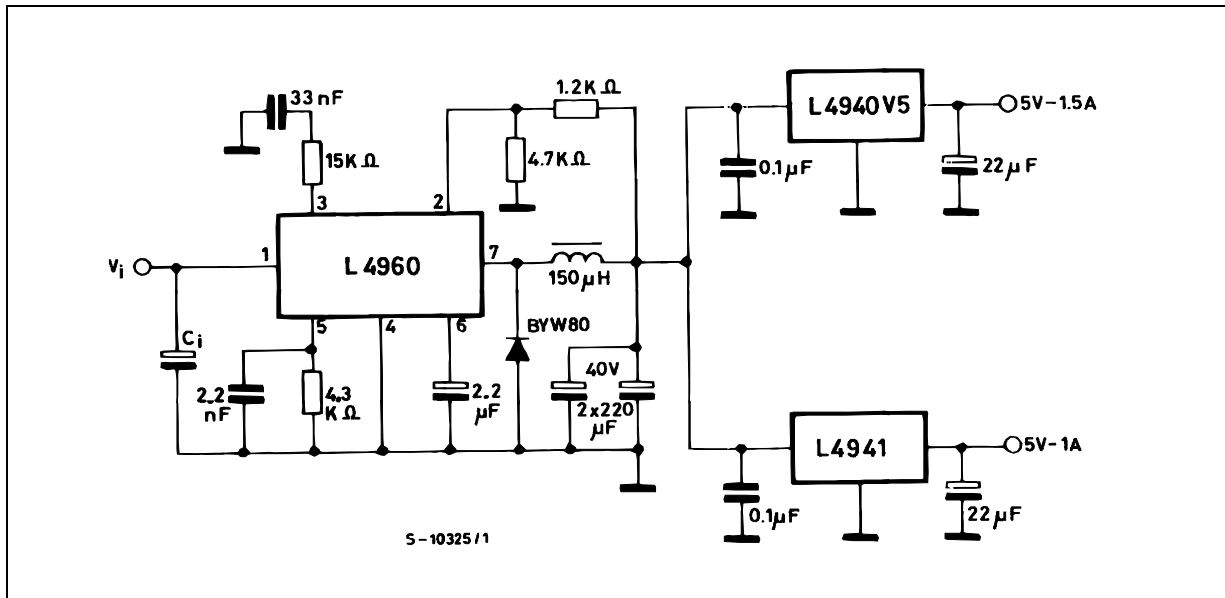
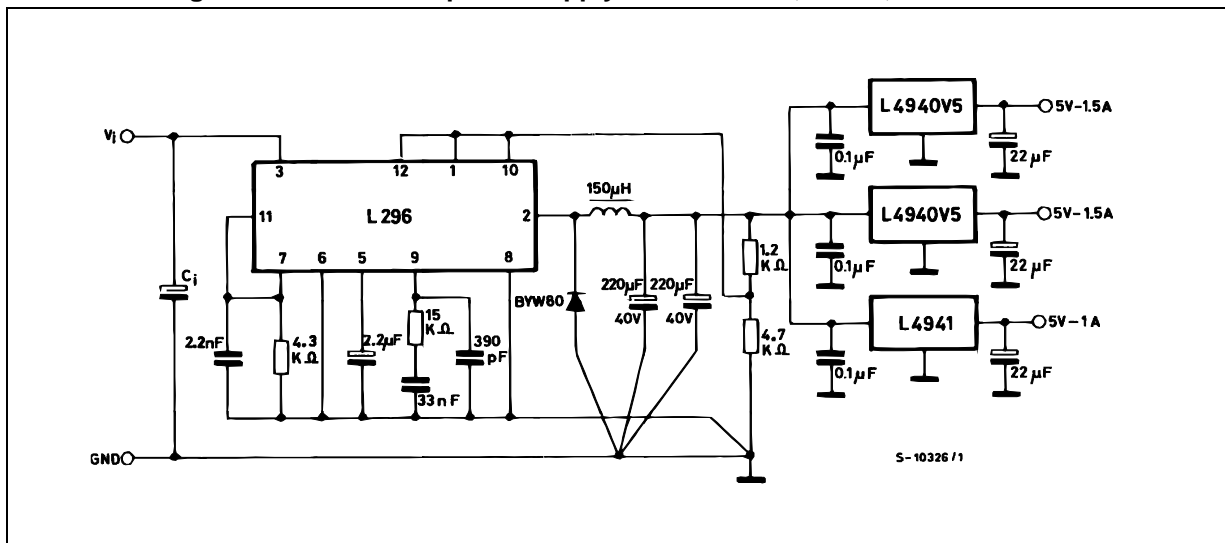
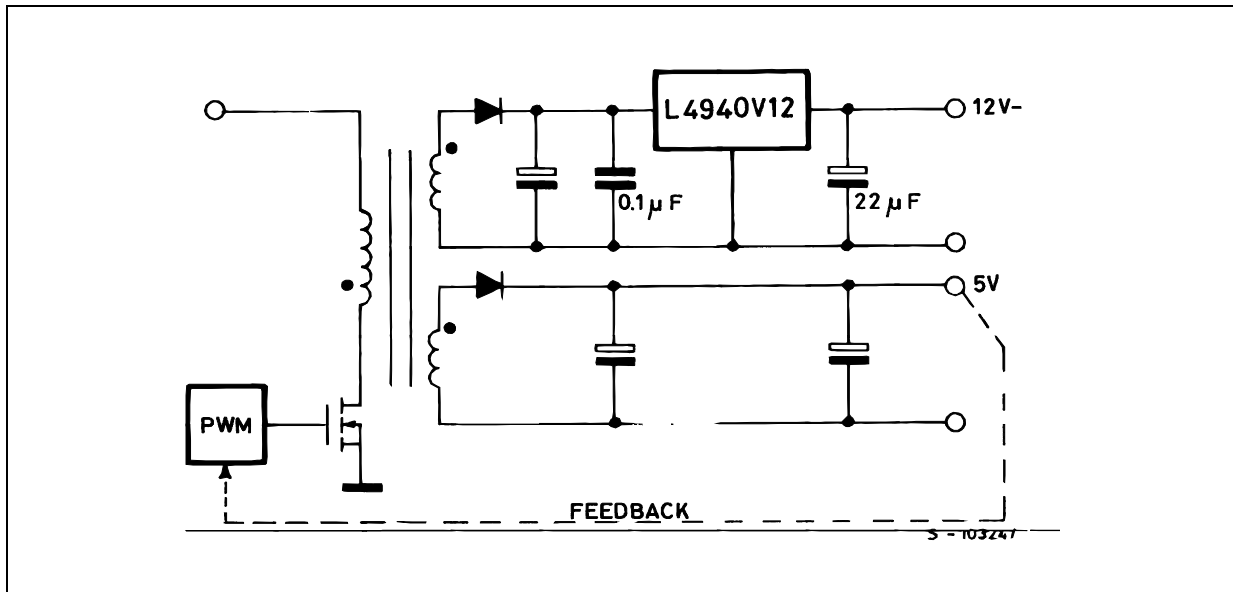


Figure 26. Distributed power supply with the L296, L4940, and the L4941



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.

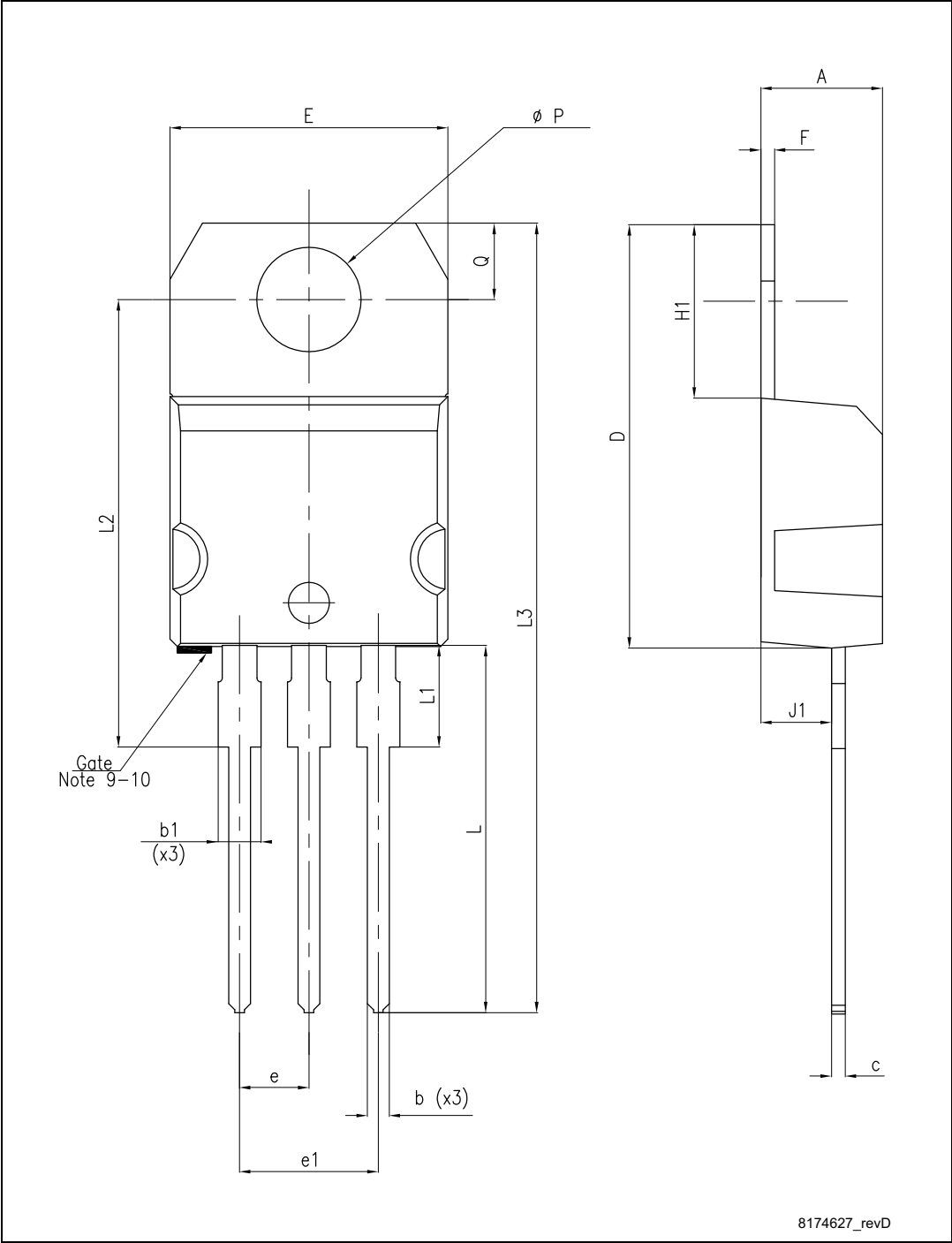
8 Package mechanical data

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.

Table 7. TO-220 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 |

Figure 28. TO-220 drawings



8174627_revD

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 29. D²PAK drawings

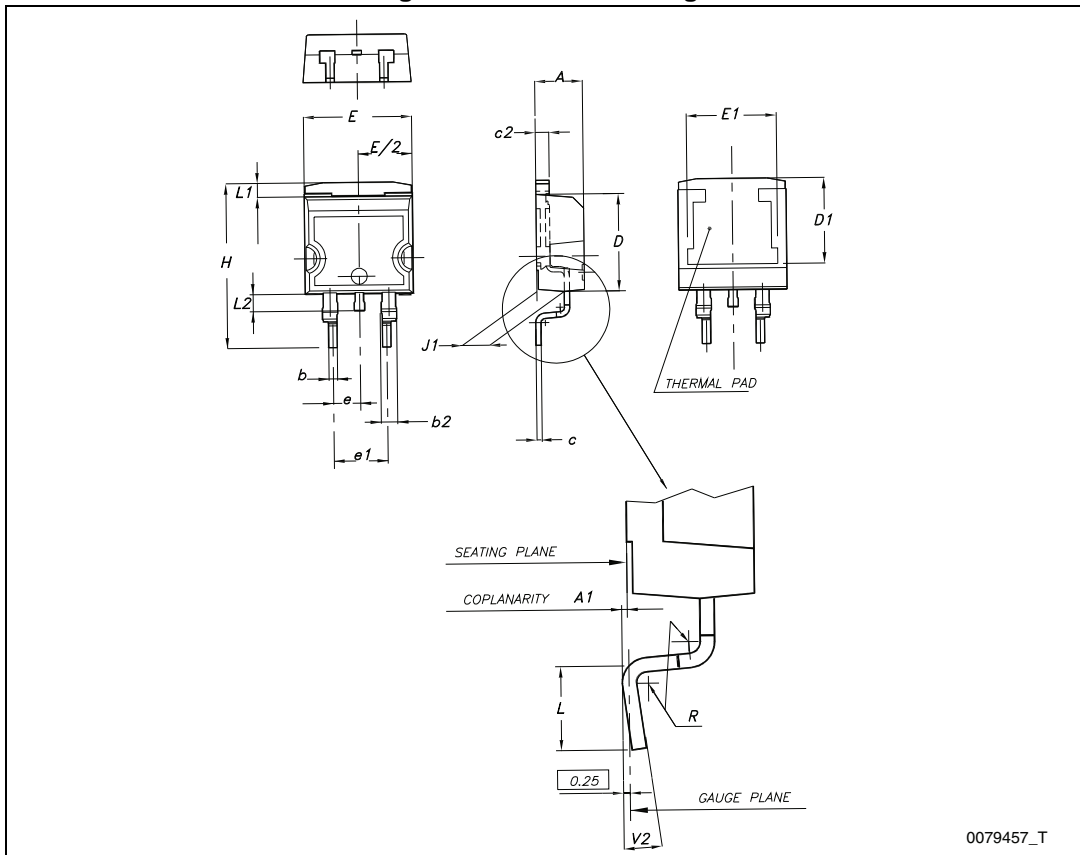
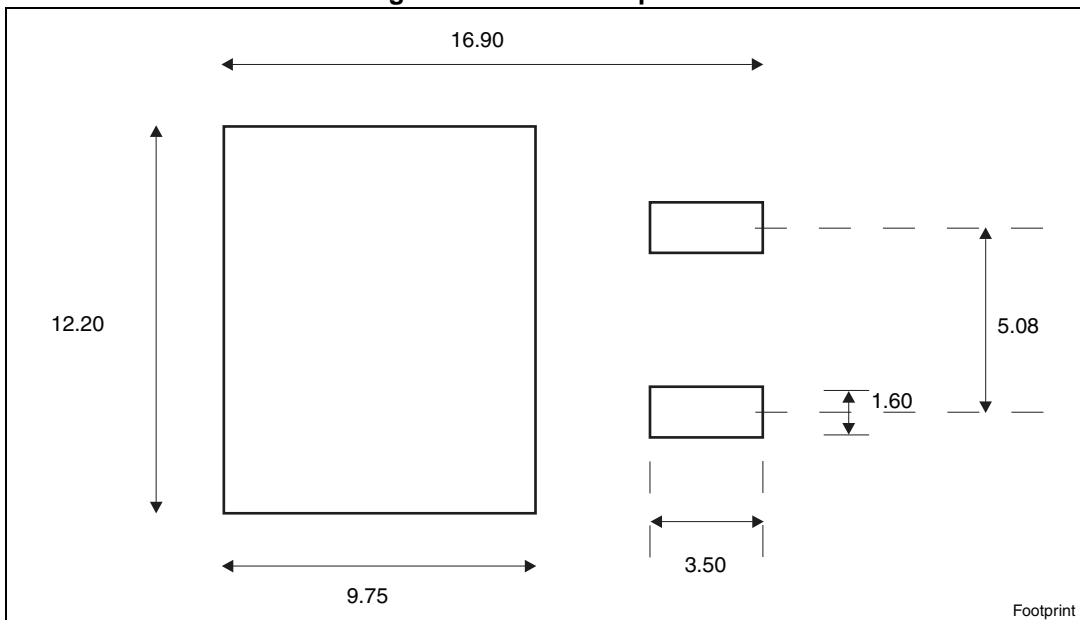


Figure 30. D²PAK footprint^(a)



a. All dimensions are in millimeters.

9 Packaging mechanical data

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 | | | |

Figure 31. Tape

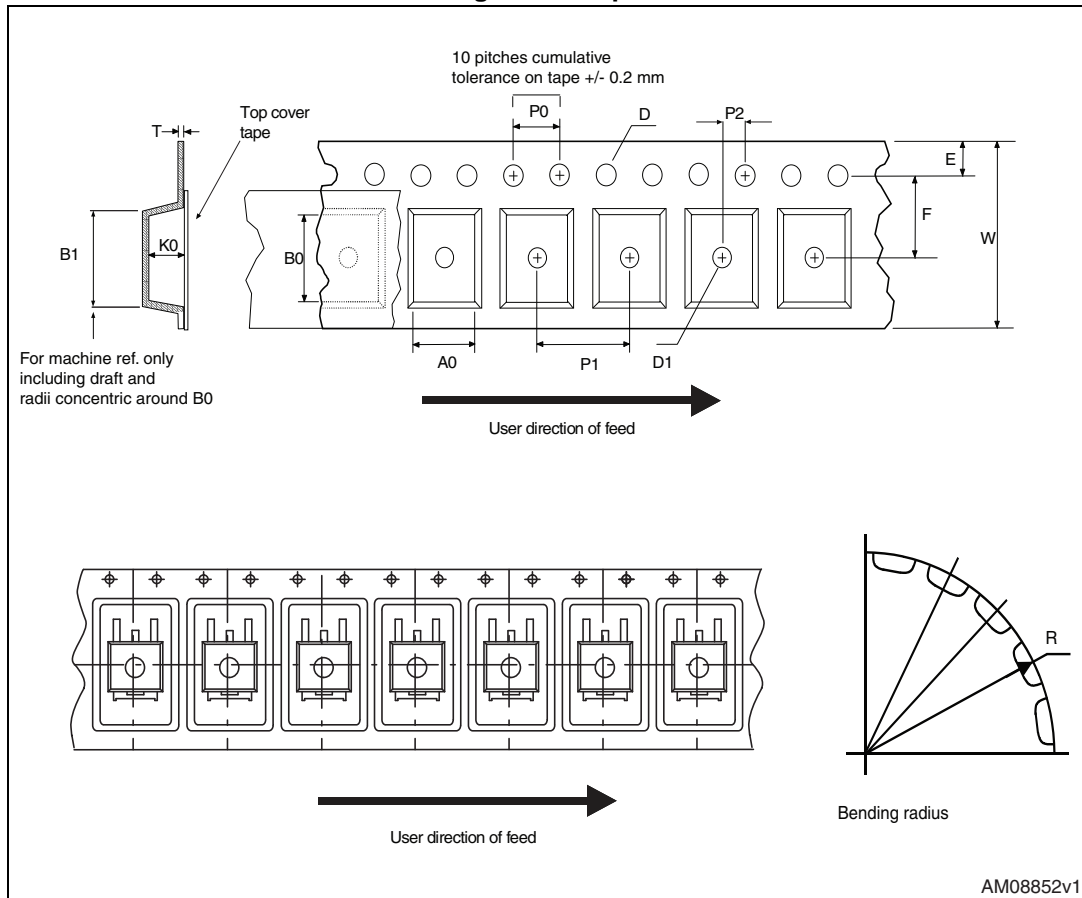
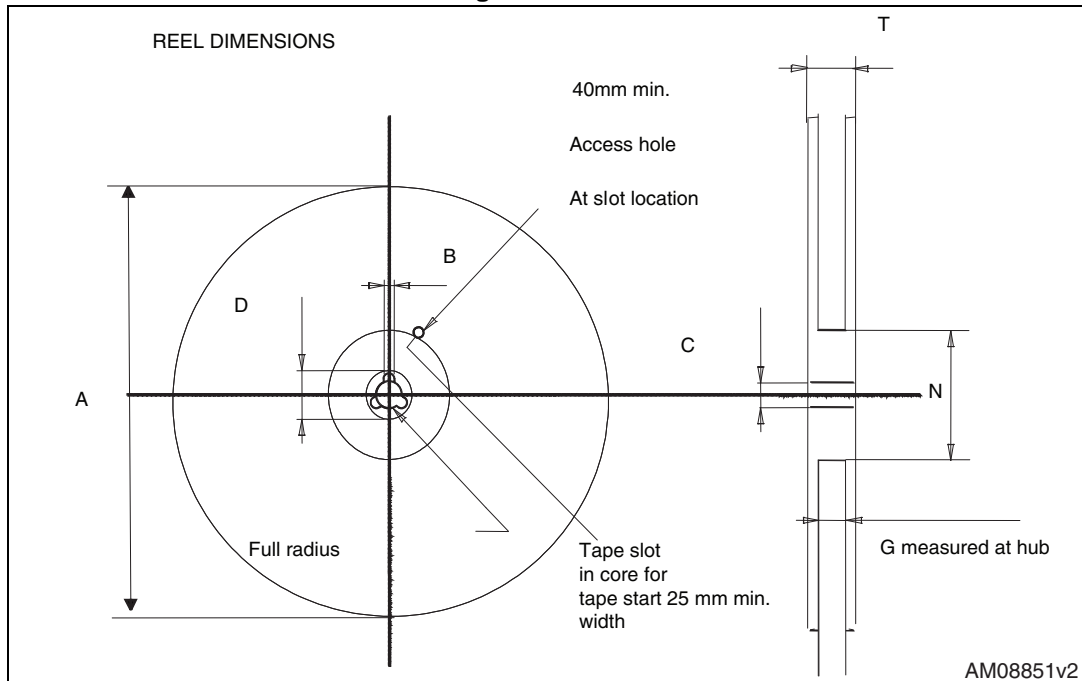


Figure 32. Reel



10 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 mechanical data.</p> <p>Added Section 9: Packaging mechanical data.</p> <p>Minor text changes.</p> |

Please Read Carefully:

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

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

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

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

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

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

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

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

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

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

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

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

www.st.com

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

STMicroelectronics:

[L4940V12](#) [L4940D2T10](#) [L4940D2T85](#) [L4940D2T10-TR](#) [L4940D2T85-TR](#) [L4940P85](#) [L4940V10](#) [L4940D2T5](#)
[L4940D2M5-TR](#)