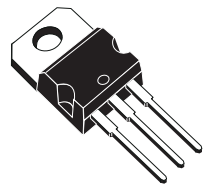
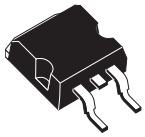
L4940

1.5 A very low drop voltage regulator IC

Datasheet - production data



TO-220



D²PAK

Table 1. Device summary

Order code		Output voltages
TO-220	D²PAK	
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

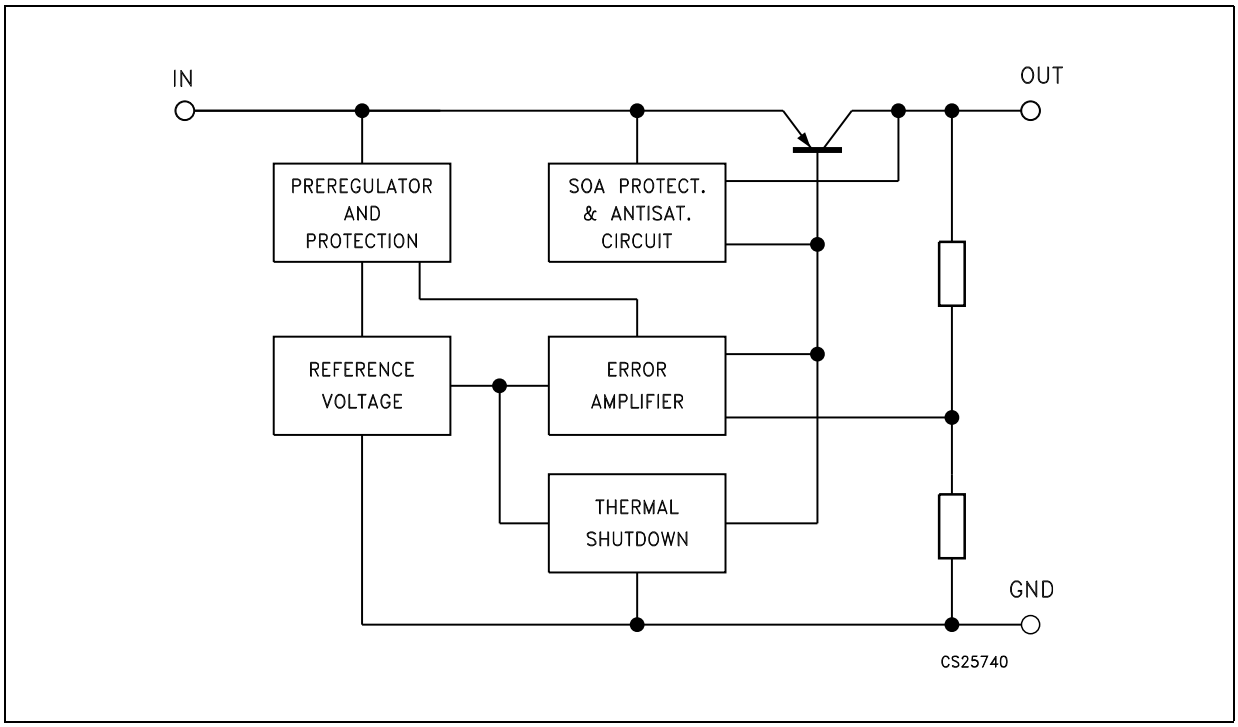
Description

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

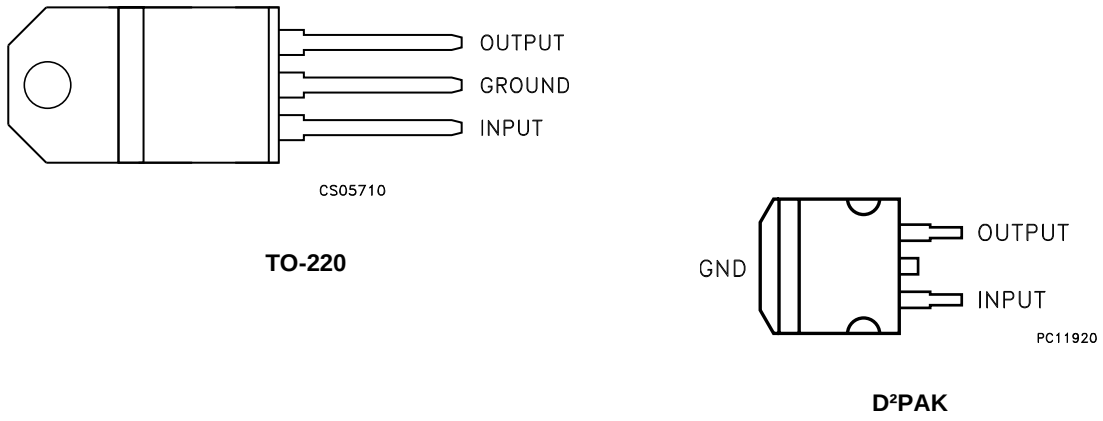
1 Block diagram

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 V, R_O = 100 Ω	-15	V
		V_O = 8.5 V, R_O = 180 Ω	-15	V
		V_O = 12 V, R_O = 240 Ω	-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	D²PAK	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

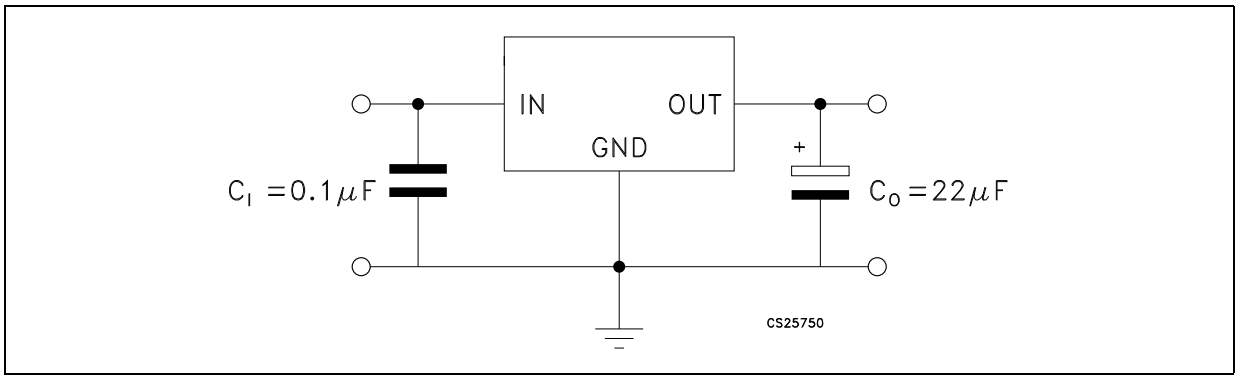


Figure 4. Load regulation

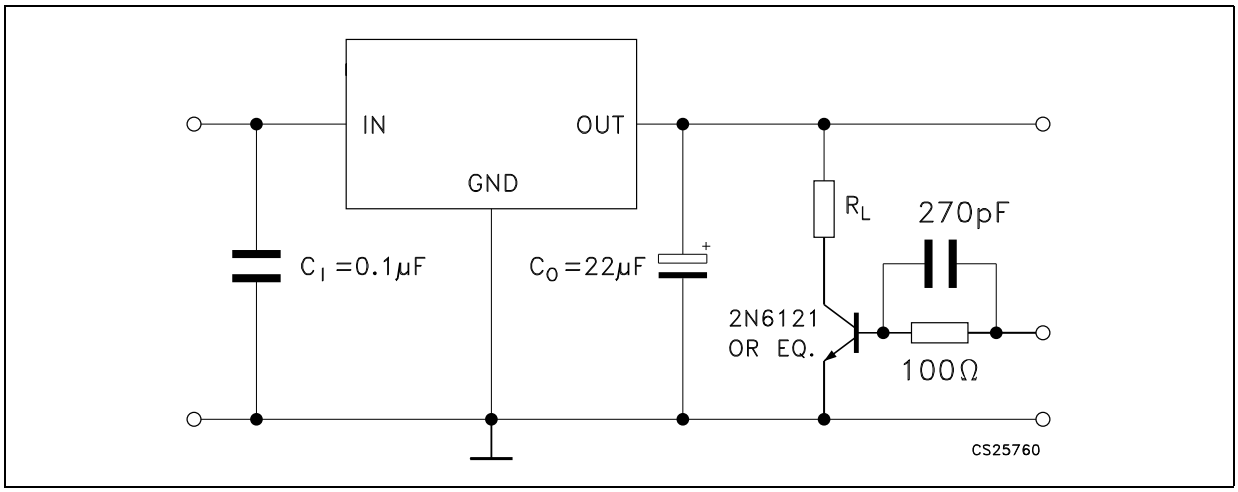
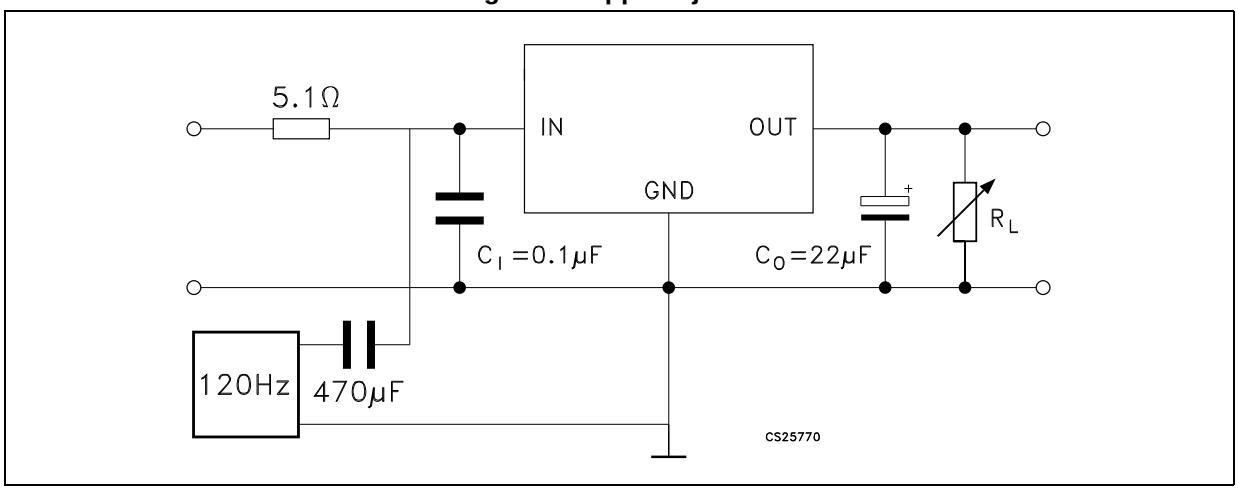


Figure 5. Ripple rejection



5 Electrical characteristics

Refer to test circuit, V_I = 7 V, C_I = 0.1 µF, C_O = 22 µF, T_J = 25 °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 mA	4.9	5	5.1	V
V_O	Output voltage	I_O = 5 mA to 1.5 A, V_I = 6.5 to 15 V	4.8	5	5.2	V
V_I	Maximum input voltage	I_O = 5 mA			17	V
ΔV_O	Line regulation	V_I = 6 to 17 V, I_O = 5 mA		4	10	mV
ΔV_O	Load regulation	I_O = 5 mA to 1.5 A		8	25	mV
		I_O = 0.5 A to 1 A		5	15	mV
I_q	Quiescent current	I_O = 5 mA		5	8	mA
		I_O = 1.5 A, V_I = 6.5 V		30	50	mA
ΔI_q	Quiescent current change	I_O = 5 mA			3	mA
		I_O = 1.5 A, V_I = 6.5 to 16 V			15	mA
ΔV_O / ΔT	Output voltage drift			0.5		mV/°C
SVR	Supply voltage rejection	f = 120 Hz, I_O = 1 A	58	68		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 = 6.5 V		2.2	2.9	

Refer to test circuit, V_I = 10.5 V, C_I = 0.1 µF, C_O = 22 µF, T_J = 25 °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 mA	8.3	8.5	8.7	V
V_O	Output voltage	I_O = 5 mA to 1.5 A, V_I = 10.2 to 15 V	8.15	8.5	8.85	V
V_I	Maximum input voltage	I_O = 5 mA			17	V
ΔV_O	Line regulation	V_I = 9.5 to 17 V, I_O = 5 mA		4	9	mV
ΔV_O	Load regulation	I_O = 5 mA to 1.5 A		12	30	mV
		I_O = 0.5 A to 1 A		8	16	mV
I_q	Quiescent current	I_O = 5 mA		4	8	mA
		I_O = 1.5 A, V_I = 10.2 V		30	50	mA
ΔI_q	Quiescent current change	I_O = 5 mA			2.5	mA
		I_O = 1.5 A, V_I = 10.2 to 16 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

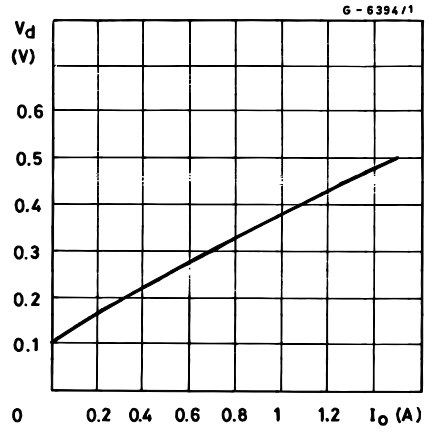


Figure 7. Dropout voltage vs. temperature

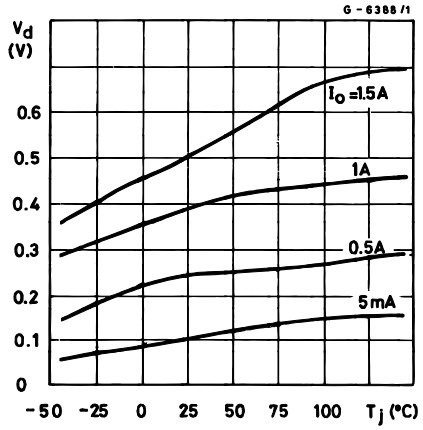


Figure 8. Output voltage vs. temperature (L4940V5)

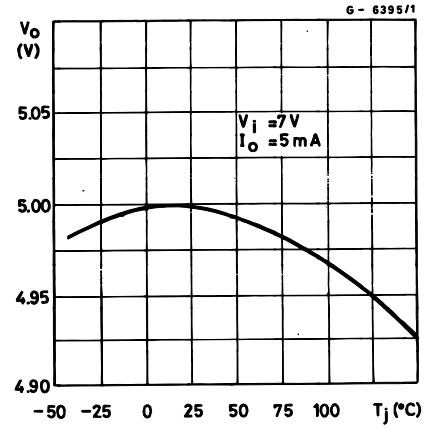


Figure 9. Output voltage vs. temperature (L4940V85)

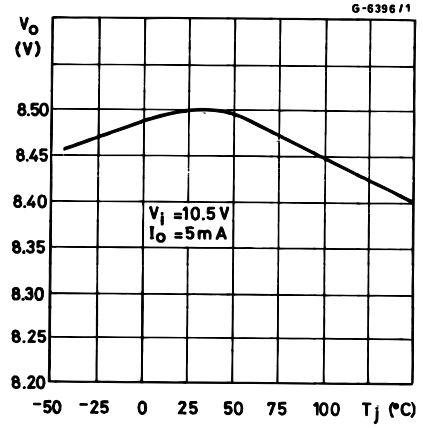


Figure 10. Output voltage vs. temperature (L4940V12)

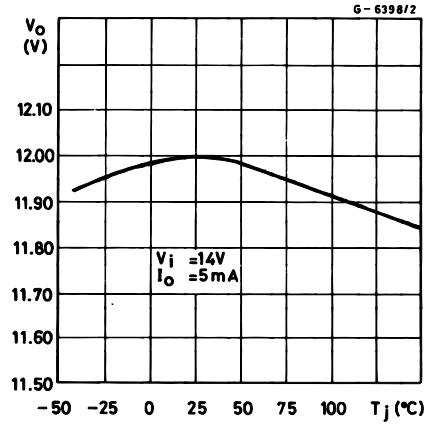


Figure 11. Quiescent current vs. temperature (L4940V5)

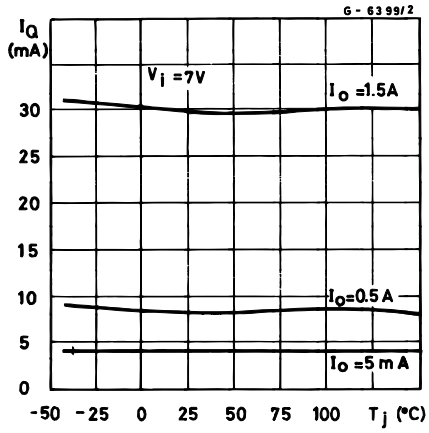


Figure 12. Quiescent current vs. input voltage (L4940V5)

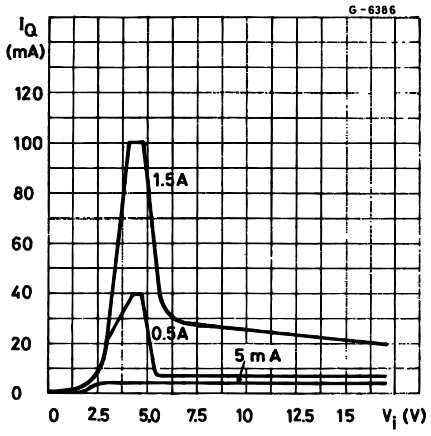


Figure 13. Quiescent current vs. output current (L4940V5)

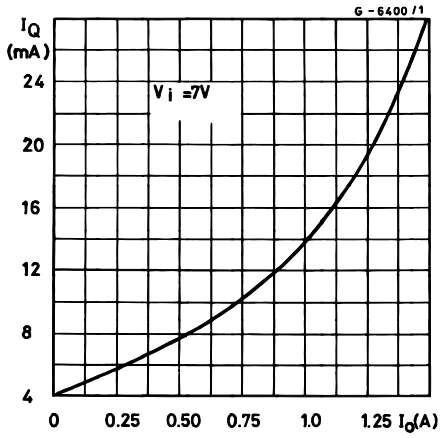


Figure 14. Short-circuit current vs. temperature (L4940V5)

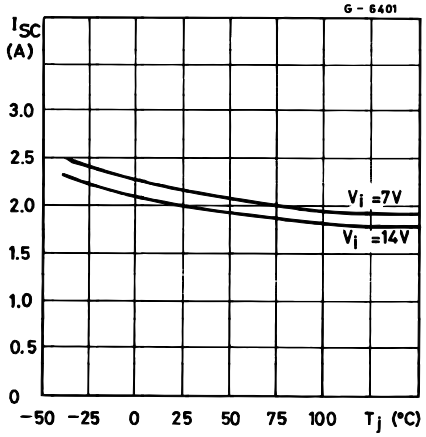


Figure 15. Peak output current vs. input/output differential voltage (L4940V5)

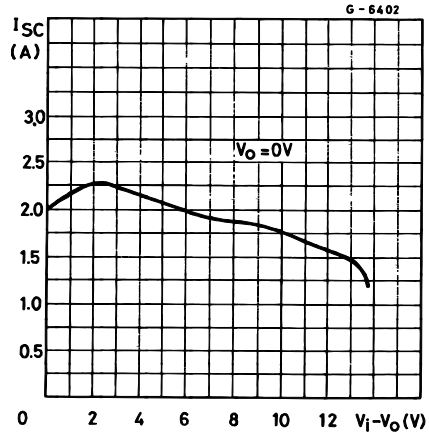


Figure 16. Low voltage behavior (L4940V5)

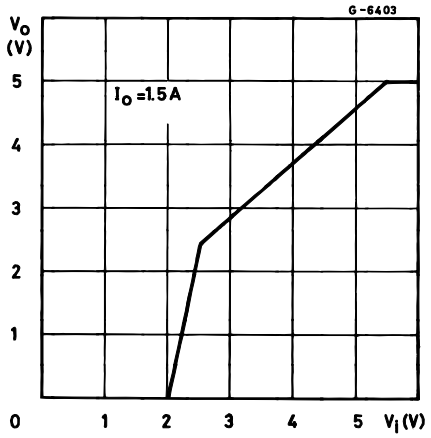


Figure 17. Low voltage behavior (L4940V85)

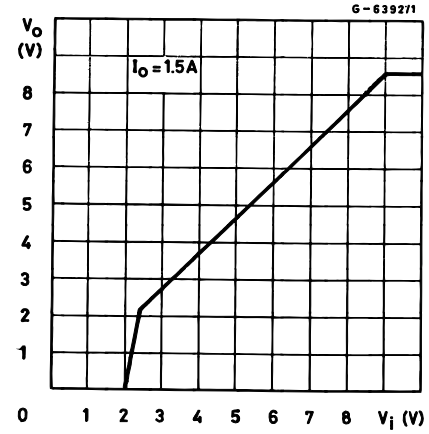


Figure 18. Low voltage behavior (L4940V12)

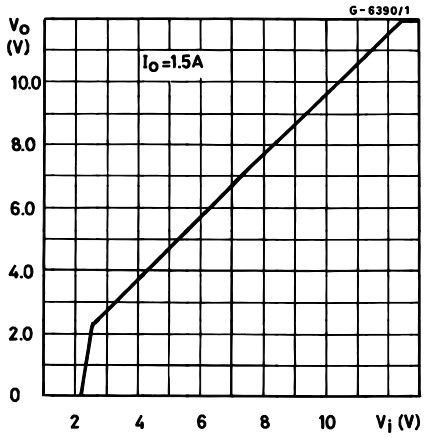


Figure 19. Supply voltage rejection vs. frequency (L4940V5)

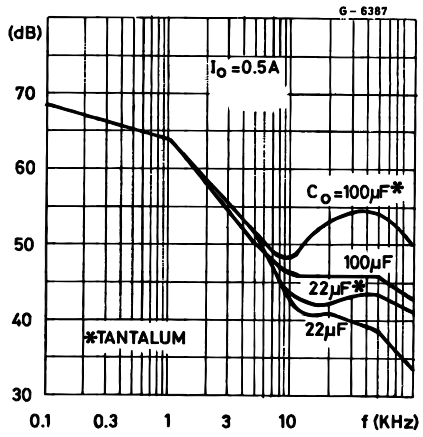


Figure 20. Supply voltage rejection vs. output current (L4940V5)

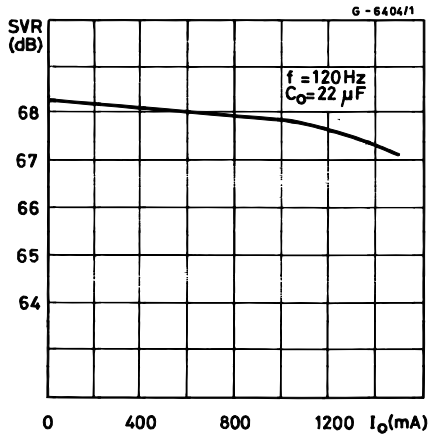


Figure 21. Load dump characteristics (L4940V5)

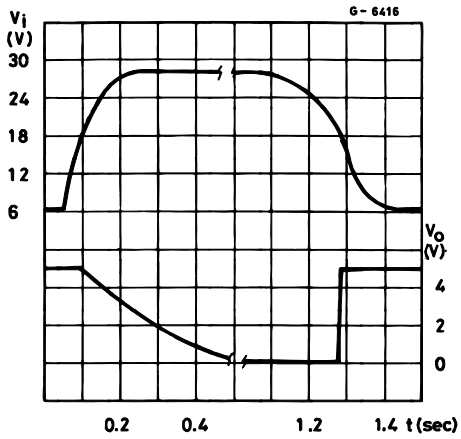


Figure 22. Line transient response (L4940V5)

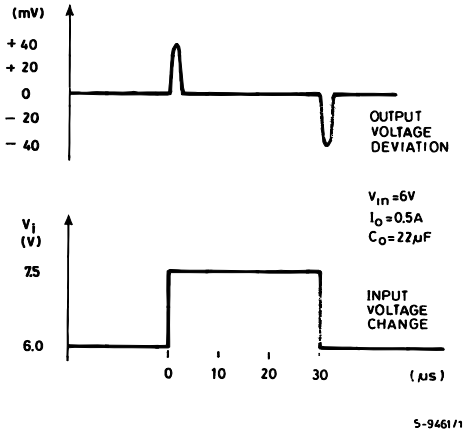


Figure 23. Total power dissipation

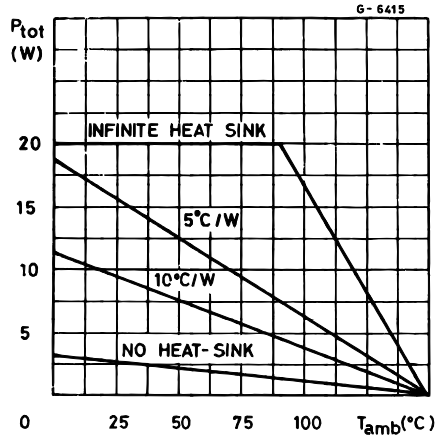
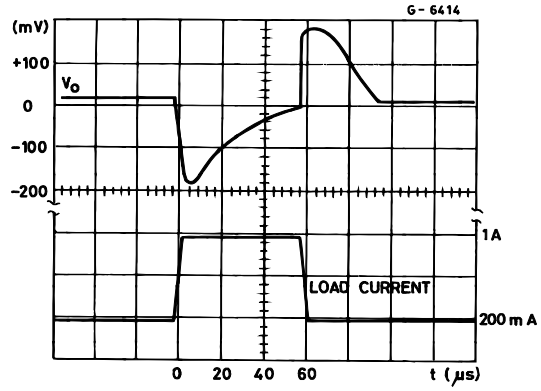


Figure 24. Load transient response



7 Application circuits

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

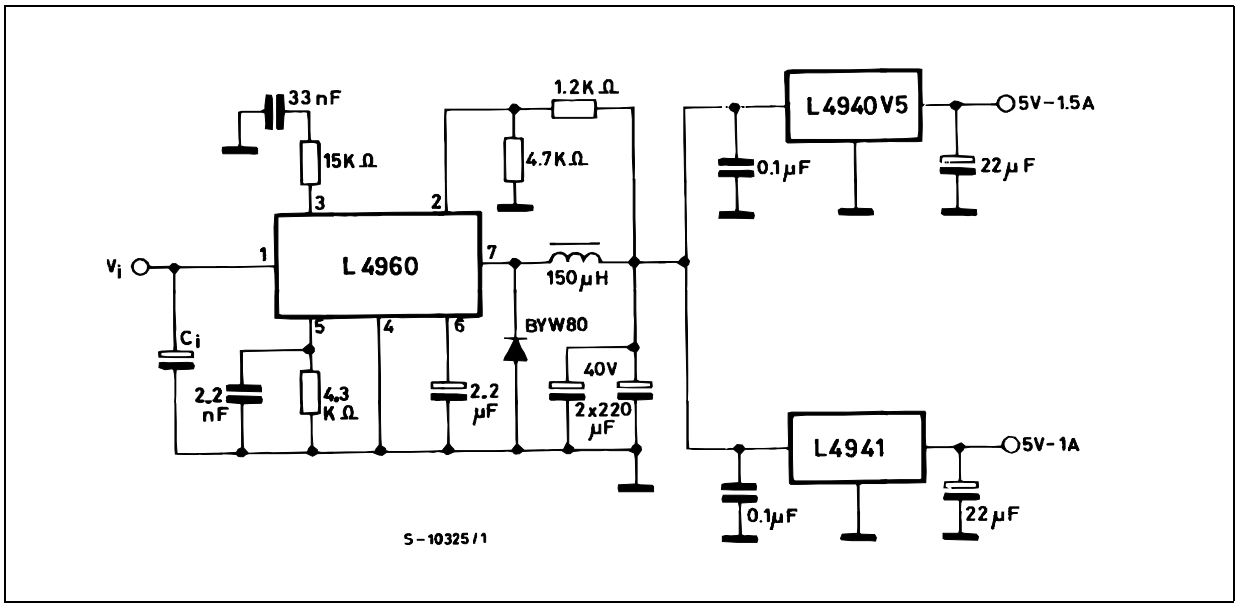
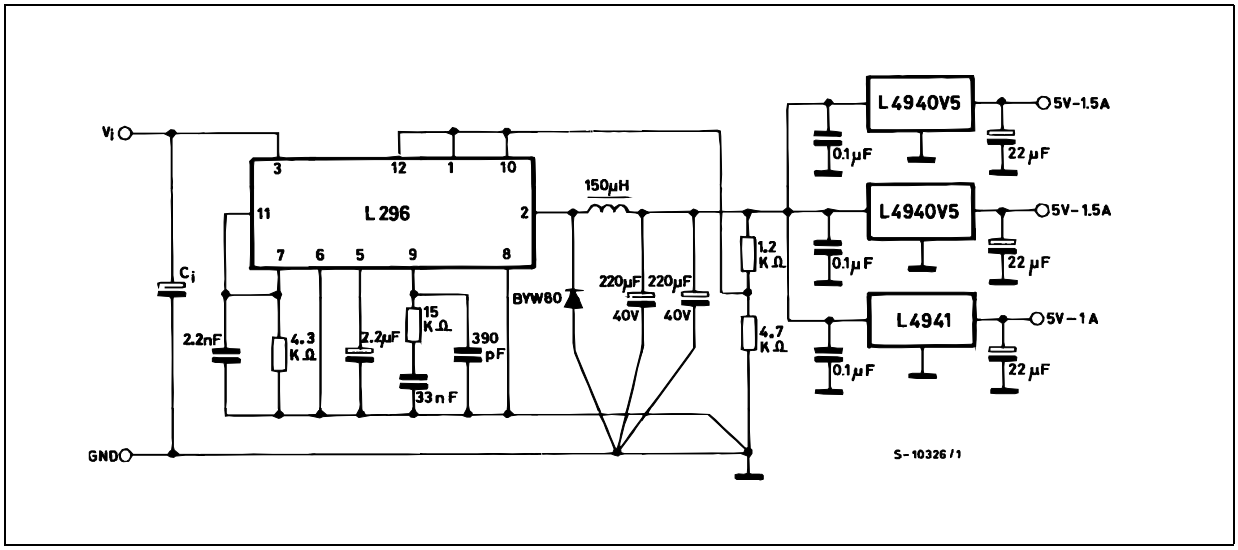


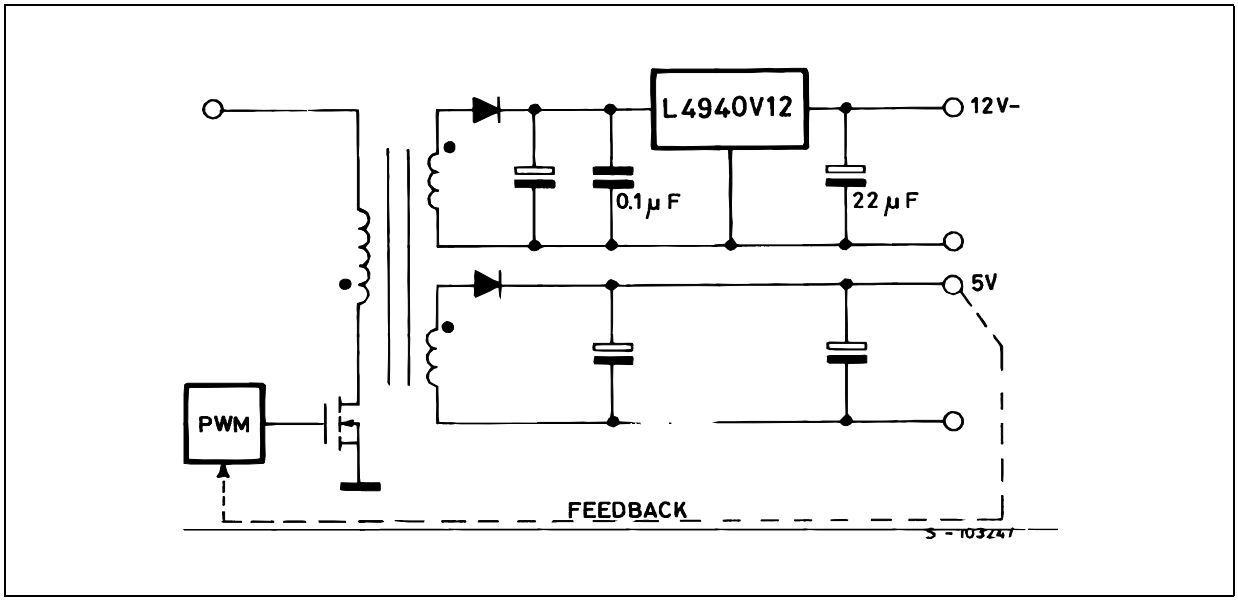
Figure 26. Distributed power supply with the L296, L4940, and the L4941



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 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

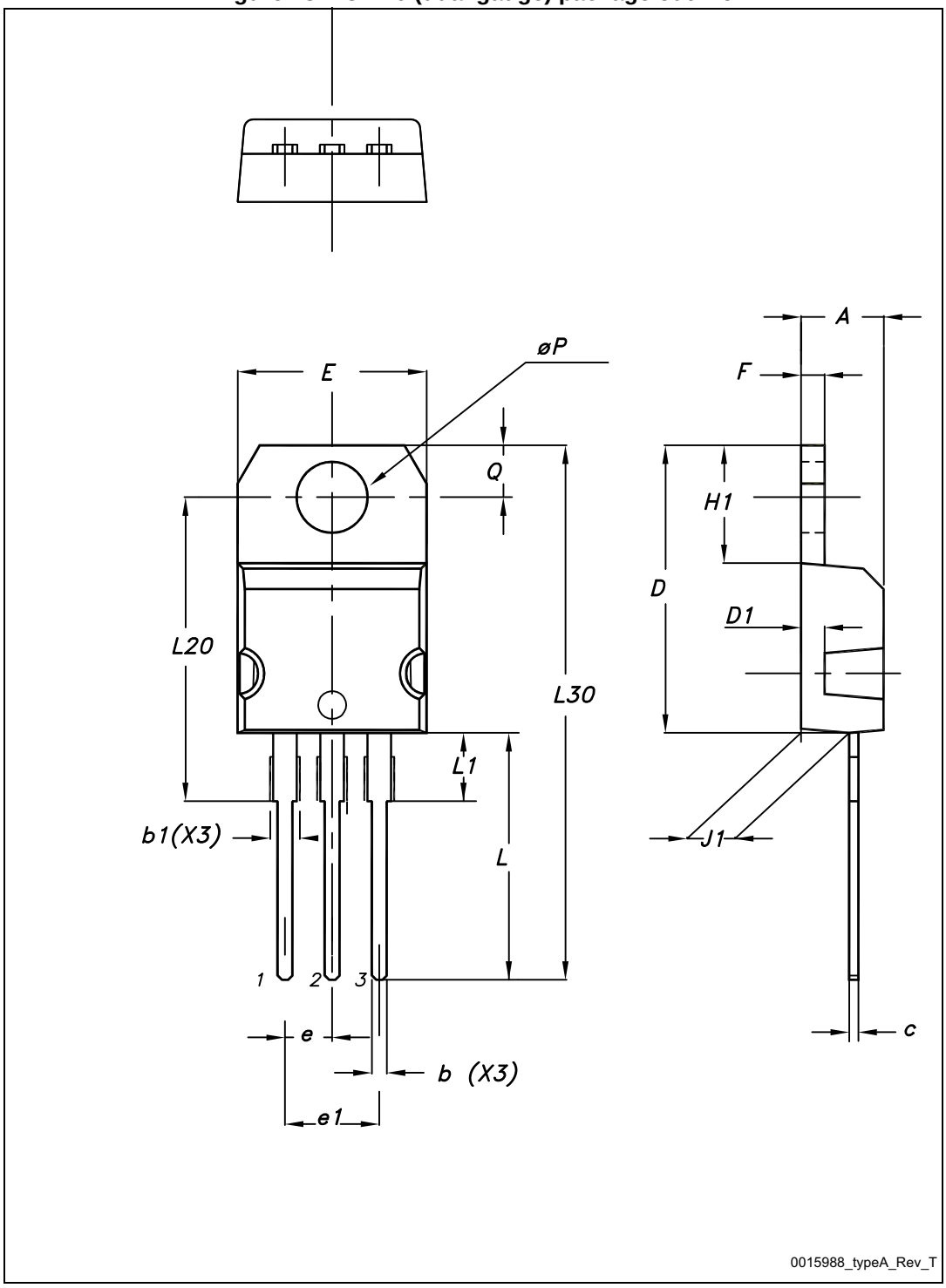
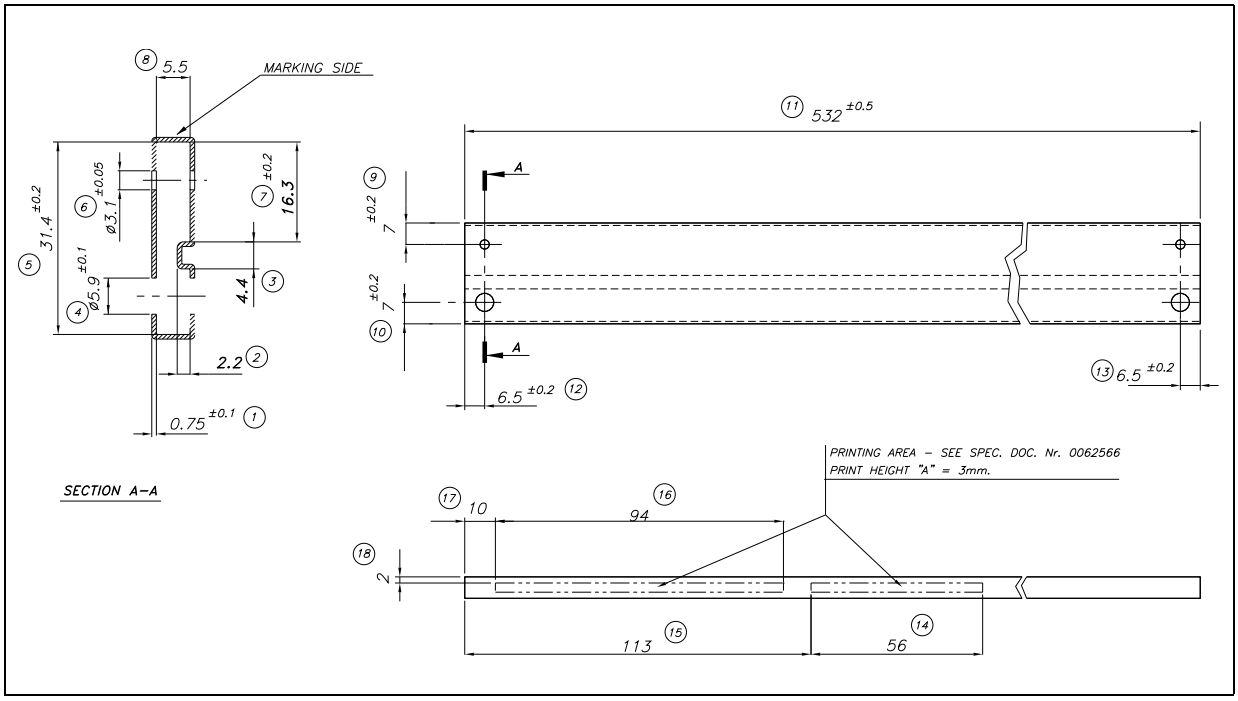


Table 7. TO-220 (dual gauge) mechanical data

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	
∅P	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

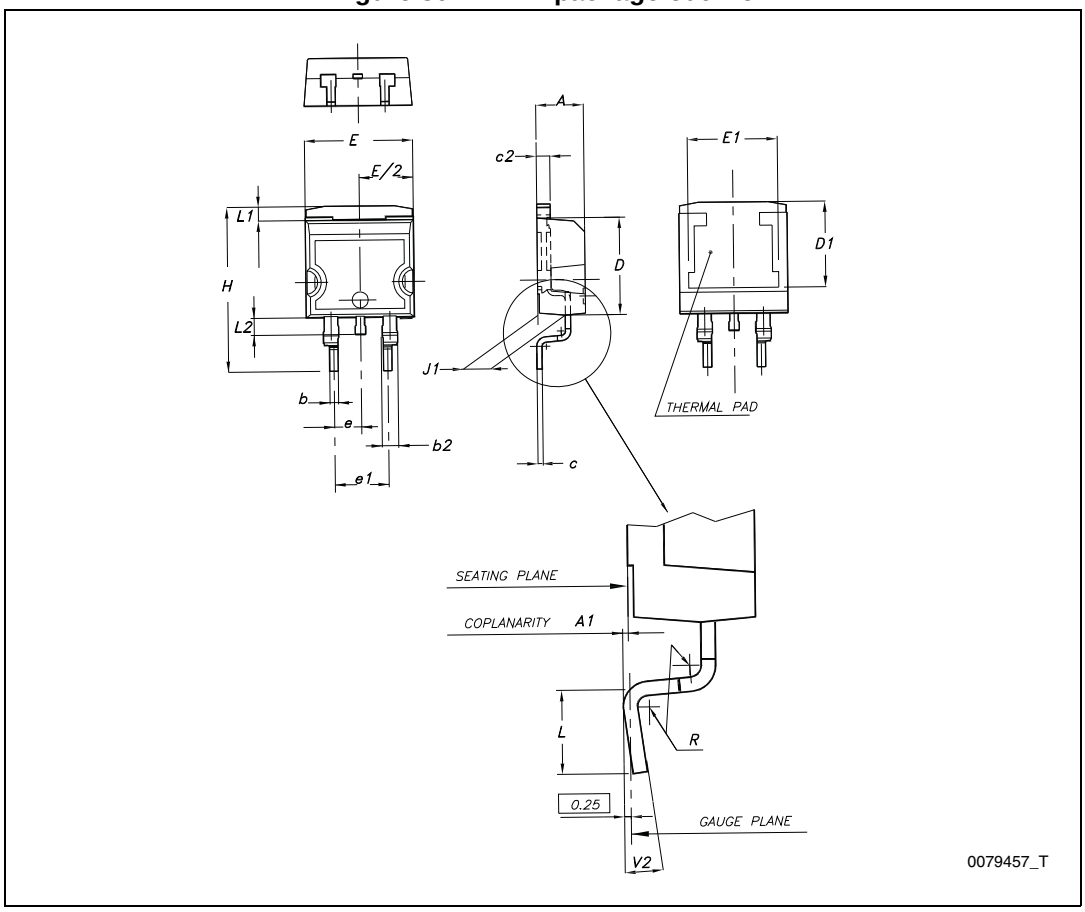
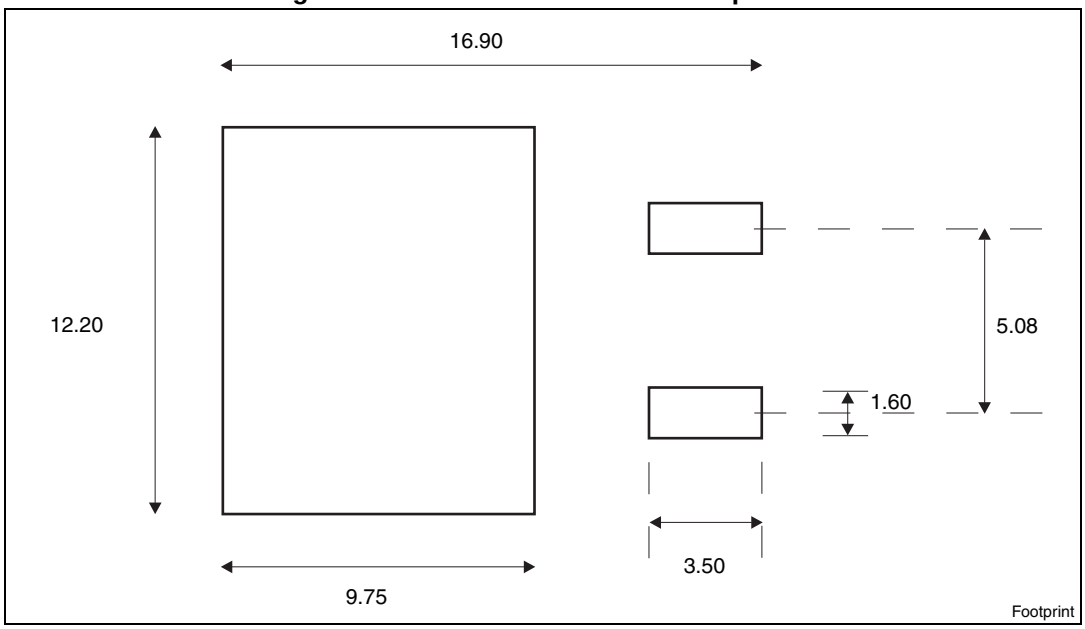


Table 8. D²PAK mechanical data

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

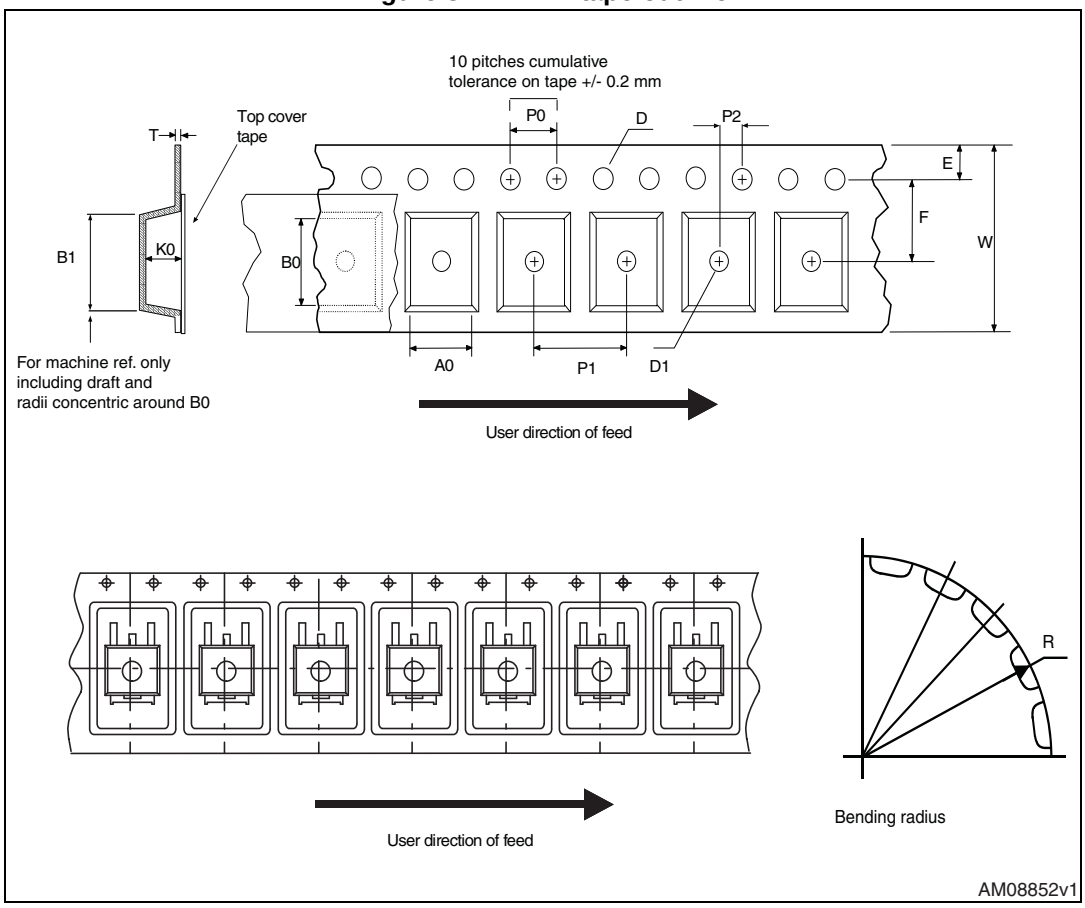


Figure 33. D²PAK reel outline

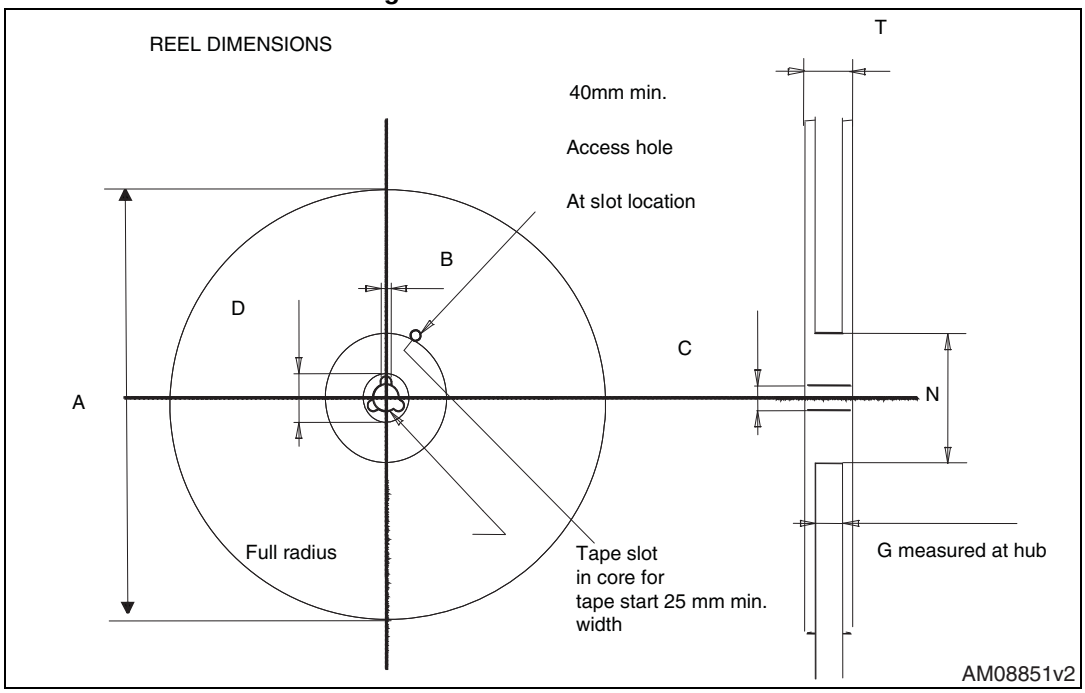


Table 9. D²PAK tape and reel mechanical data

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 D²PAK/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	The L4940XX5, L4940XX85, L4940XX10, L4940XX12 have been changed into the L4940. Updated: the title and the description in cover page. Updated *Section 4: Test circuits*, *Section 5: Electrical characteristics*, *Section 6: Performance characteristics* and *Section 8: Package information*. Added *Section 8.4: D²PAK packing information*. Minor text changes.
08-Apr-2015	14	Updated title in *Table 1: Device summary*. Updated *Section 8: Package information*. Minor text changes.