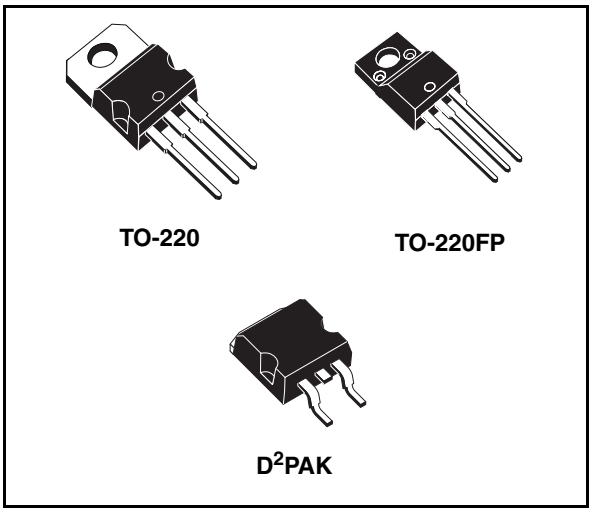
L4940xx

Very low drop 1.5 A regulator

Features

- Precise 5, 8.5, 10, 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, TO-220FP and D^2PAK packages and with several fixed output voltages, making it useful in a wide range of industrial and consumer applications. Thanks to its very low input/output voltage drop, these devices are particularly suitable for batteries powered equipment, reducing consumption and prolonging battery life. Each type employs internal current limiting, antisaturation circuit, thermal shut-down and safe area protection.

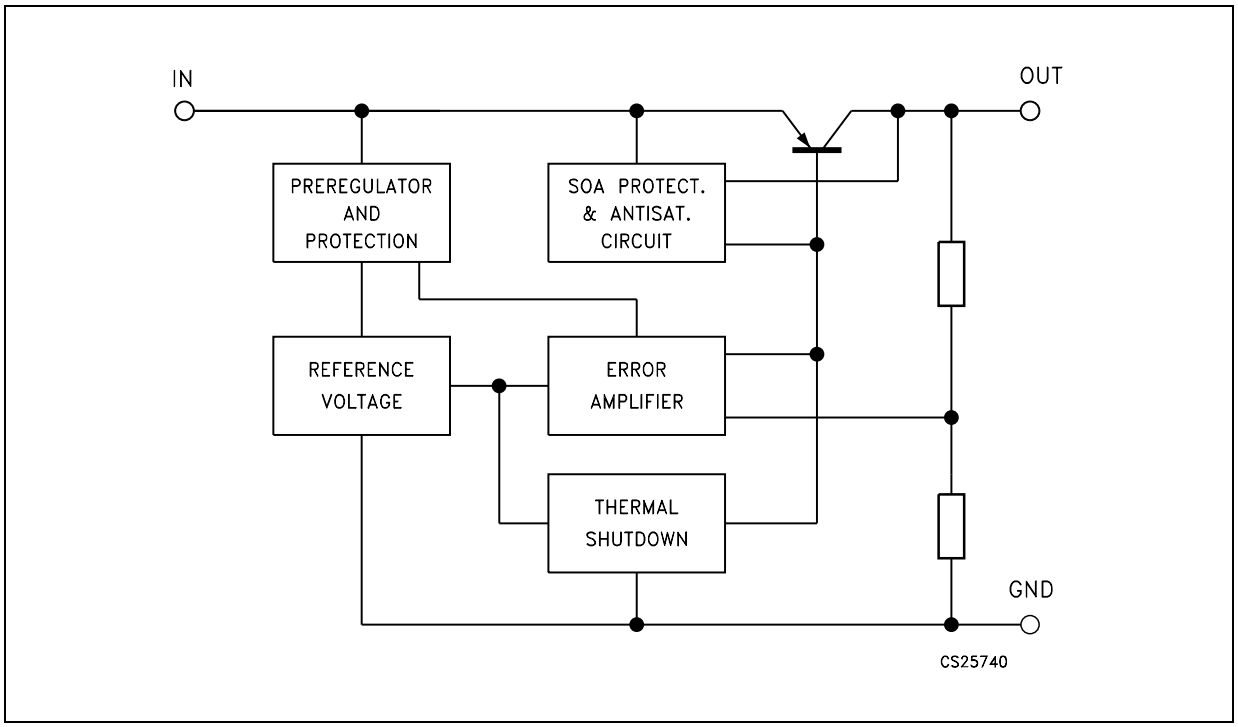
Table 1. Device summary

Part number	Order code			Output voltage
	TO-220	TO-220FP	D^2PAK	
L4940xx5	L4940V5		L4940D2T5-TR	5 V
L4940xx85	L4940V85	L4940P85	L4940D2T85-TR	8.5 V
L4940xx10			L4940D2T10-TR	10 V
L4940xx12			L4940D2T12-TR	12 V

Contents

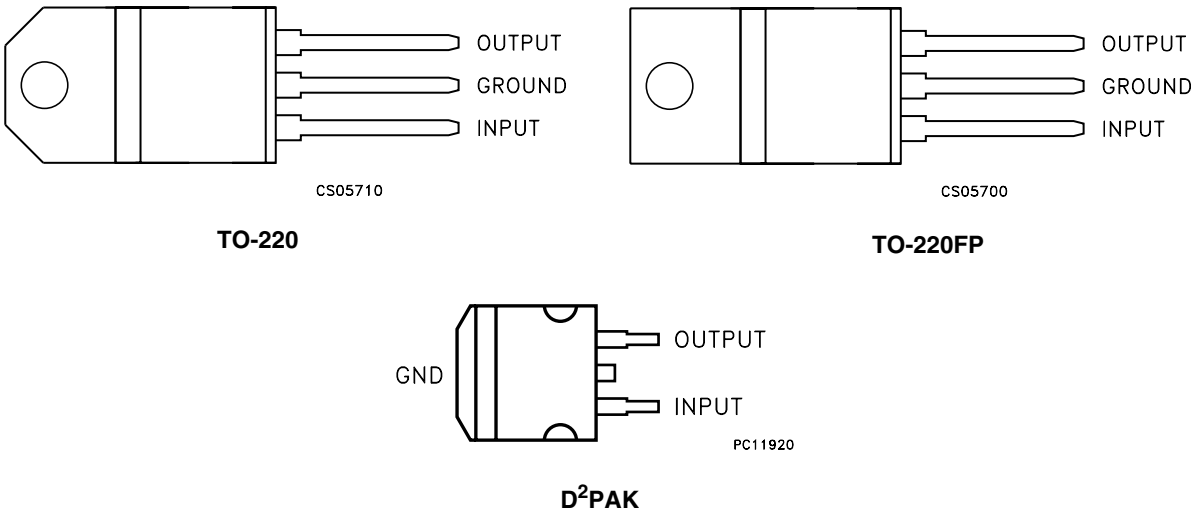
1 Block diagram

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 = 5V, R_O = 100Ω	-15	V
		V_O = 8.5V, R_O = 180Ω	-15	V
		V_O = 10V, R_O = 200Ω	-15	V
		V_O = 12V, R_O = 240Ω	-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 condition is not implied.

Table 3. Thermal data

Symbol	Parameter	TO-220	TO-220FP	D^2PAK	Unit
R_{thJC}	Thermal resistance junction-case	3	5	3	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	60	62.5	°C/W

4 Test circuits

Figure 3. DC parameters

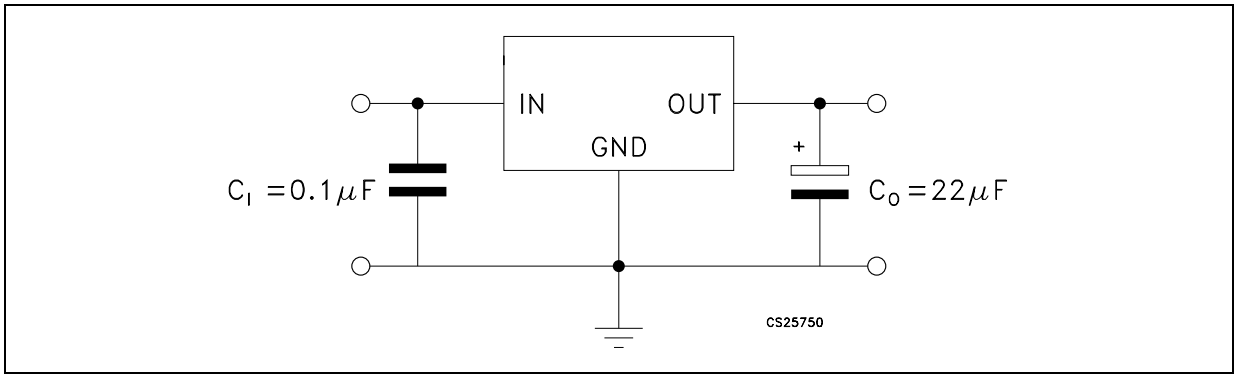


Figure 4. Load rejection

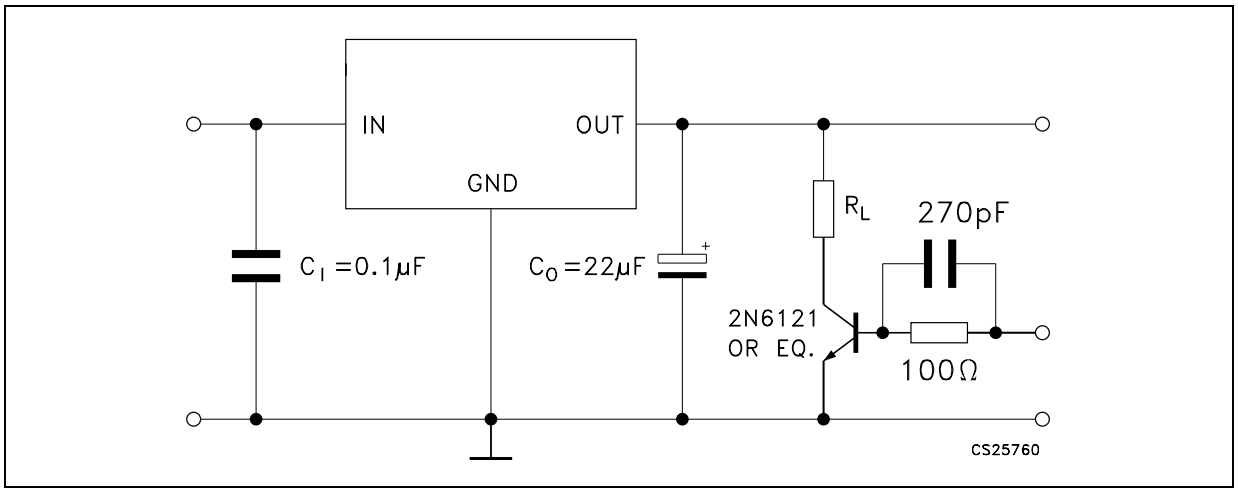
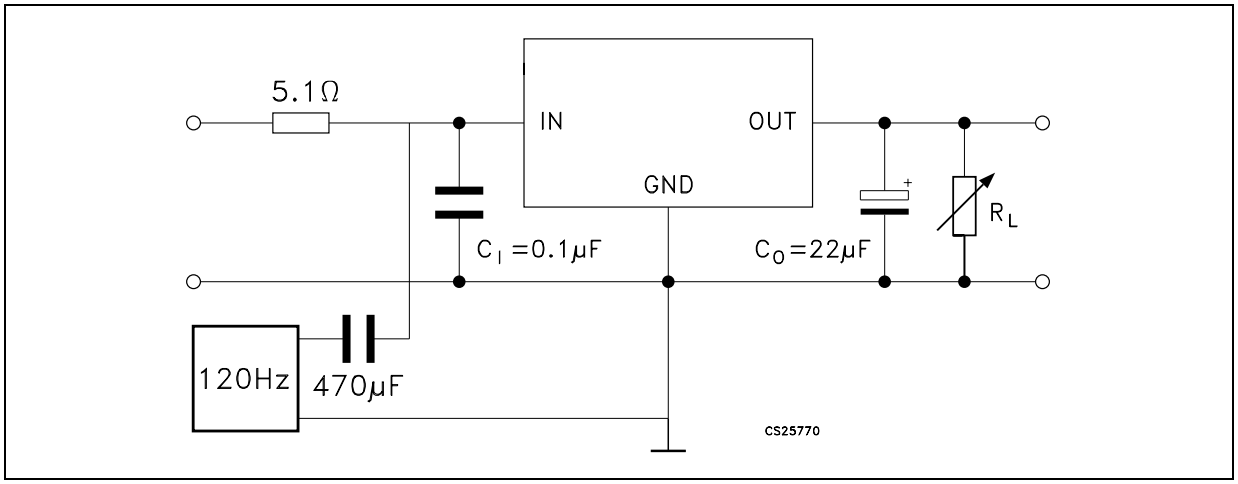


Figure 5. Ripple rejection



5 Electrical characteristics

Table 4. Electrical characteristics of L4940xx5 (Refer to test circuit, V_I = 7 V, C_I = 0.1 µF, C_O = 22 µF, T_J = 25°C, unless otherwise specified.)

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 = 5mA to 1.5A, V_I = 6.5 to 15 V	4.8	5	5.2	V
V_I	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
$\Delta V_O/\Delta T$	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	

Table 5. Electrical characteristics of L4940xx85 (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.)

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 = 5mA to 1.5A, V_I = 10.2 to 15V	8.15	8.5	8.85	V
V_I	Input voltage	I_O = 5 mA			17	V
ΔV_O	Line regulation	V_I = 9.5 to 17V, I_O = 5 mA		4	9	mV
ΔV_O	Load regulation	I_O = 5mA to 1.5A		12	30	mV
		I_O = 0.5A to 1A		8	16	mV
I_q	Quiescent current	I_O = 5 mA		4	8	mA
		I_O = 1.5A, V_I = 10.2V		30	50	mA
ΔI_q	Quiescent current change	I_O = 5 mA			2.5	mA
		I_O = 1.5A, V_I = 10.2 to 16V			15	mA
$\Delta V_O/\Delta T$	Output voltage drift			0.8		mV/°C
SVR	Supply voltage rejection	f = 120Hz, I_O = 1A	58	66		dB
V_d	Dropout voltage	I_O = 0.5A		200	400	mV
		I_O = 1.5A		500	900	mV
I_{sc}	Short circuit current	V_I = 14V		2	2.7	A
		V_I = 10.2V		2.2	2.9	

Table 6. Electrical characteristics of L4940xx10 (Refer to test circuit, V_I = 12V, C_I = 0.1 µF, C_O = 22 µF, T_J = 25°C, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	I_O = 500 mA	9.8	10	10.2	V
V_O	Output voltage	I_O = 5 mA to 1.5 A, V_I = 11.7 to 15 V	9.6	10	10.4	V
V_I	Input voltage	I_O = 5 mA			17	V
ΔV_O	Line regulation	V_I = 11 to 17 V, I_O = 5 mA		3	8	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	20	mV
I_q	Quiescent current	I_O = 5 mA		5	8	mA
		I_O = 1.5 A, V_I = 11.7 V		30	50	mA
ΔI_q	Quiescent current change	I_O = 5 mA			2	mA
		I_O = 1.5 A, V_I = 11.7 to 16 V			13	mA
$\Delta V_O/\Delta T$	Output voltage drift			1		mV/°C
SVR	Supply voltage rejection	f = 120 Hz, I_O = 1 A	56	62		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 = 11.7 V		2.2	2.9	

Table 7. Electrical characteristics of L4940xx12 (Refer to test circuit, V_I = 14 V, C_I = 0.1 µF, C_O = 22 µF, T_J = 25°C, unless otherwise specified.)

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 = 11.7 to 15 V	11.5	12	12.5	V
V_I	Input voltage	I_O = 5 mA			17	V
ΔV_O	Line regulation	V_I = 11 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 = 11.7 V		30	50	mA
ΔI_q	Quiescent current change	I_O = 5 mA			1.5	mA
		I_O = 1.5 A, V_I = 11.7 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 Typical application

Figure 6. Dropout voltage vs output current

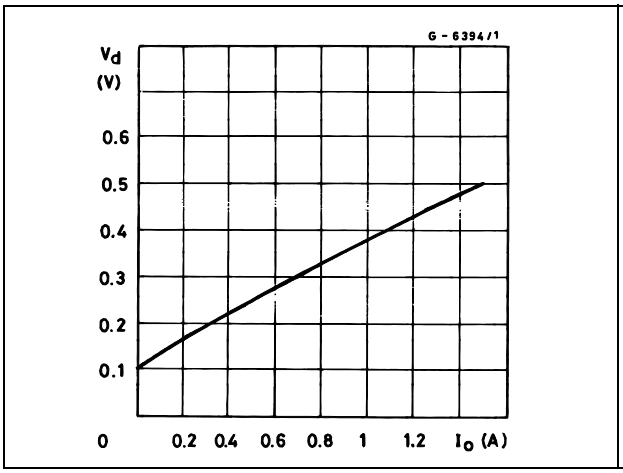


Figure 7. Dropout voltage vs temperature

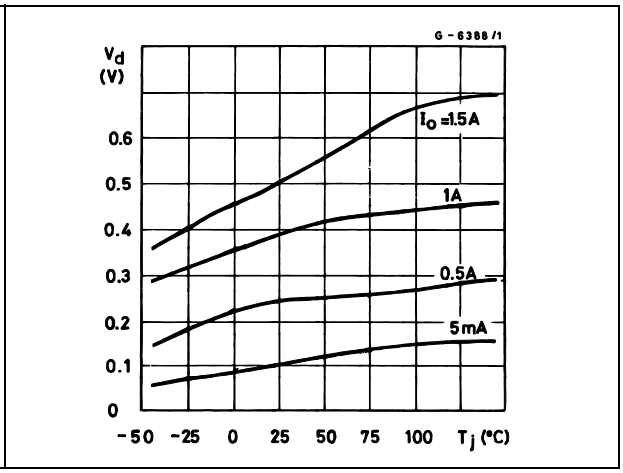


Figure 8. Output voltage vs temperature (L4940V5)

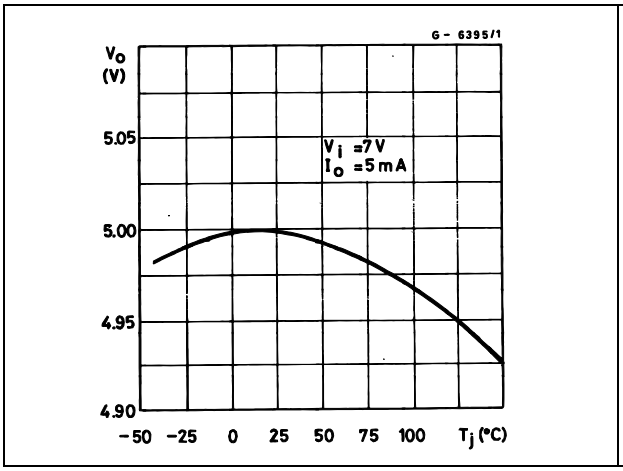


Figure 9. Output voltage vs temperature (L4940V85)

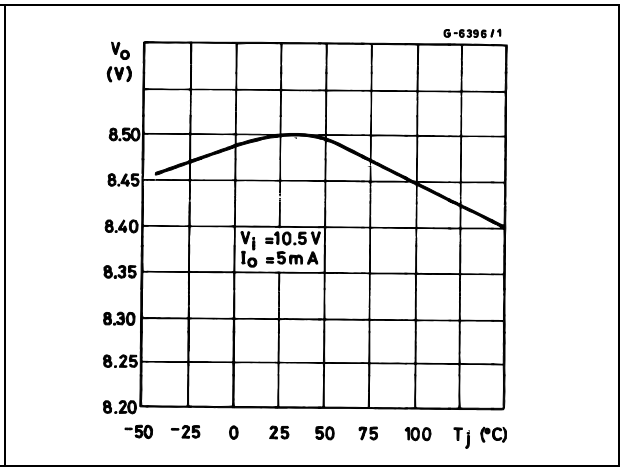


Figure 10. Output voltage vs temperature (L4940V10)

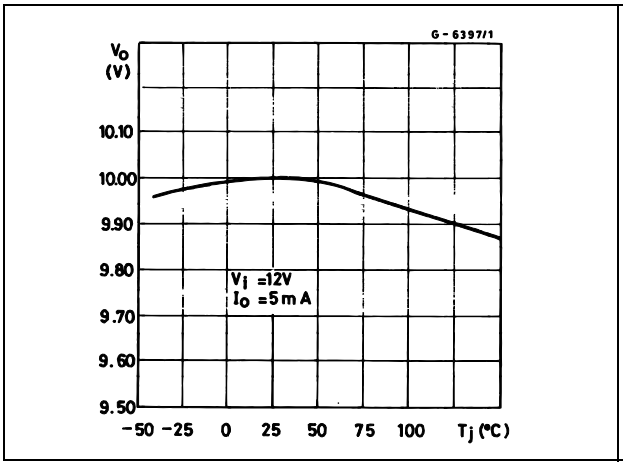


Figure 11. Output voltage vs temperature (L4940V12)

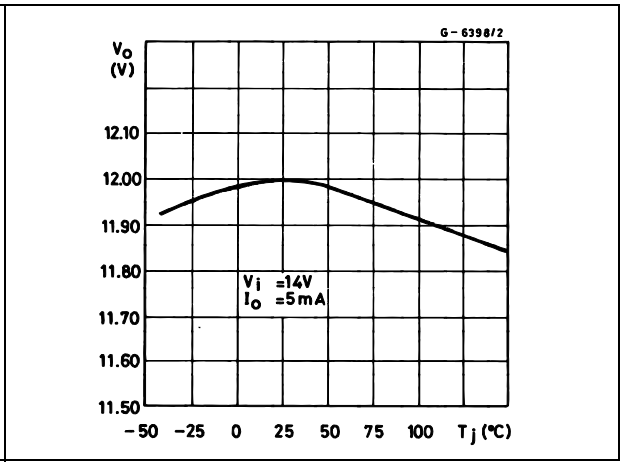


Figure 12. Quiescent current vs temperature (L4940V5)

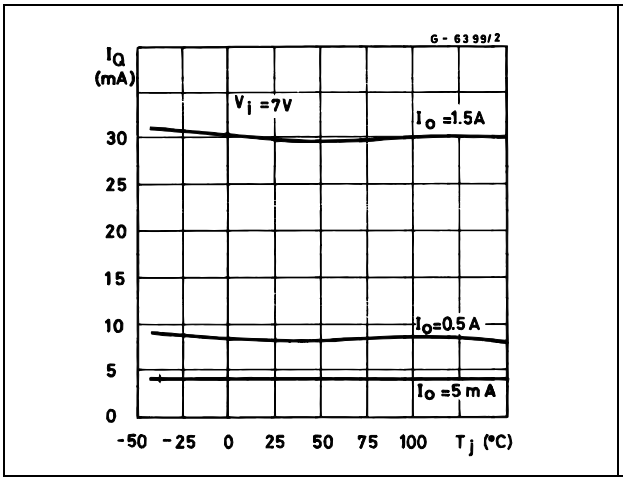


Figure 13. Quiescent current vs input voltage (L4940V5)

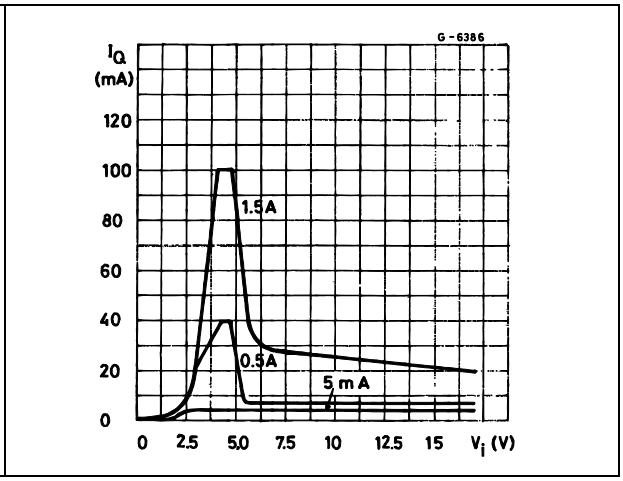


Figure 14. Quiescent current vs output current (L4940V5)

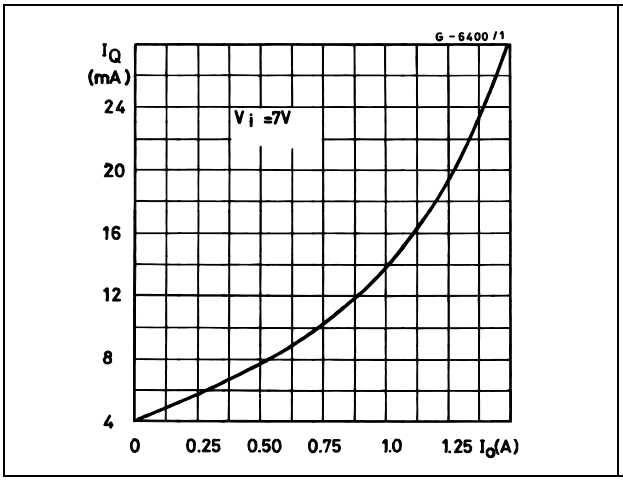


Figure 15. Short circuit current vs temperature (L4940V5)

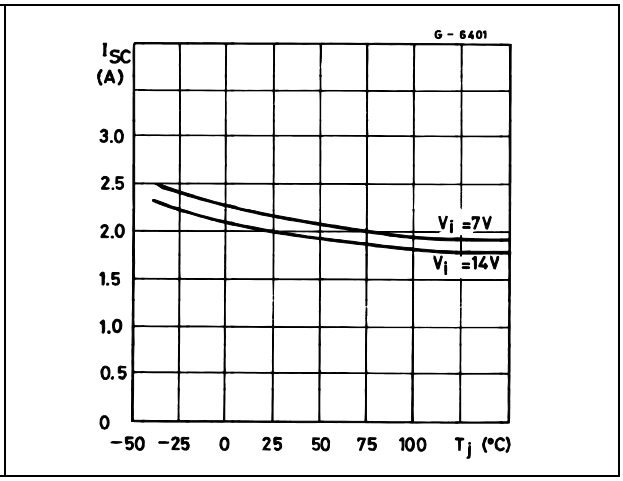


Figure 16. Peak output current vs input/output differential voltage (L4940V5)

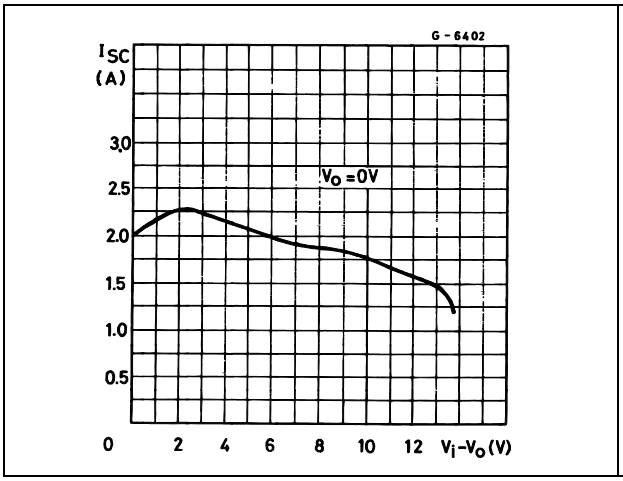


Figure 17. Low voltage behavior (L4940V5)

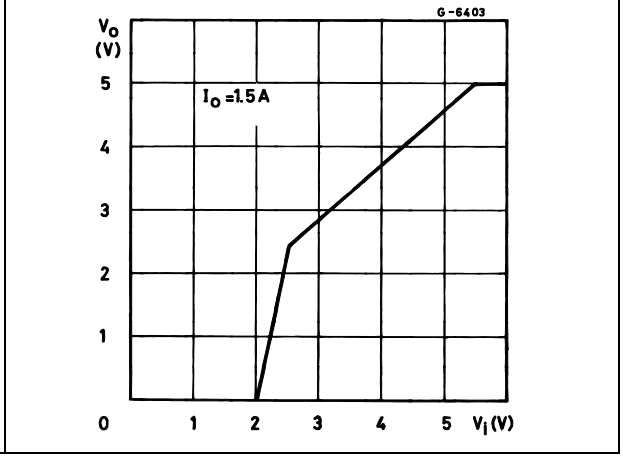


Figure 18. Low voltage behavior (L4940V85)

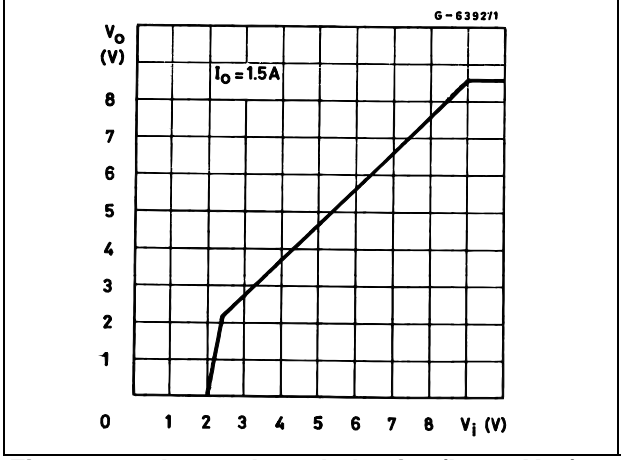


Figure 19. Low voltage behavior (L4940V10)

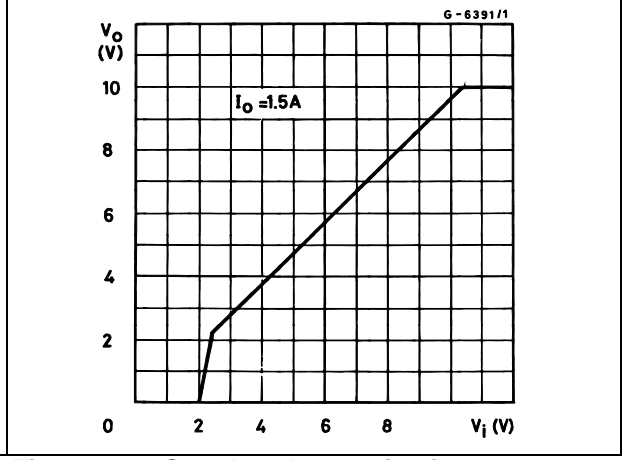


Figure 20. Low voltage behavior (L4940V12)

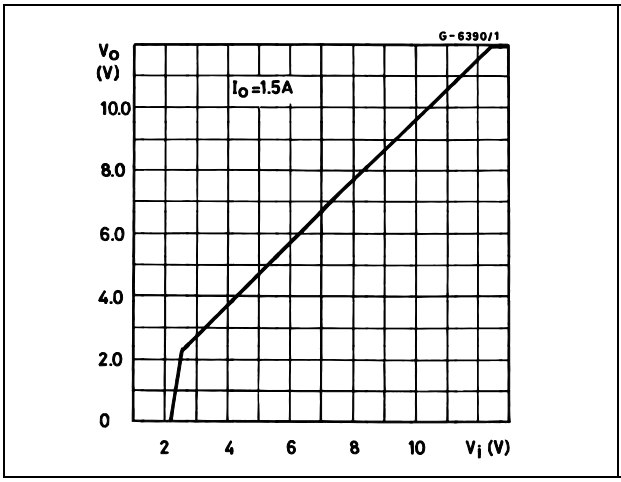


Figure 21. Supply voltage rejection vs frequency (L4940V5)

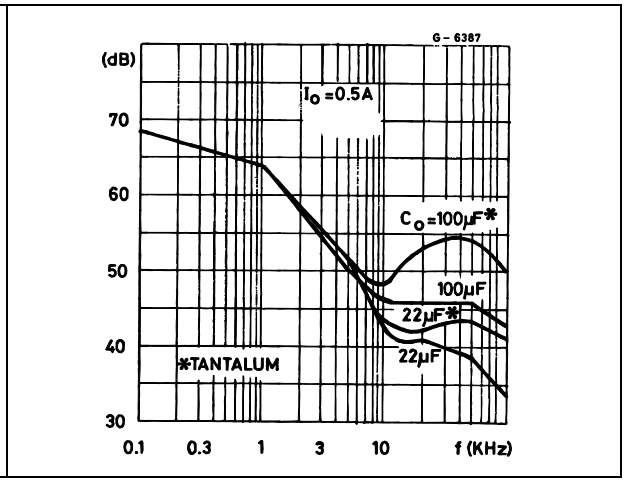


Figure 22. Supply voltage rejection vs output current (L4940V5)

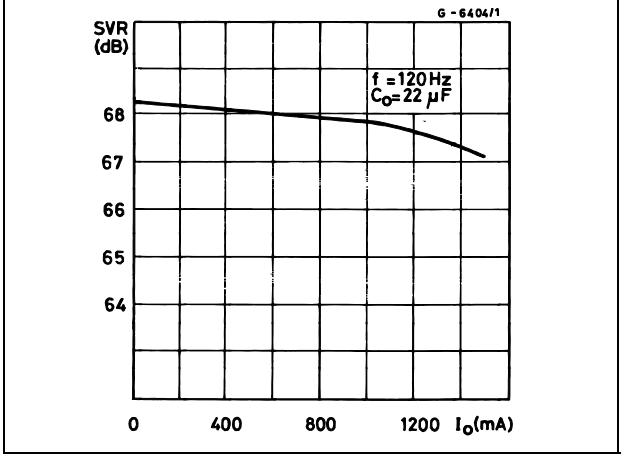


Figure 23. Lad dump characteristics (L4940V5)

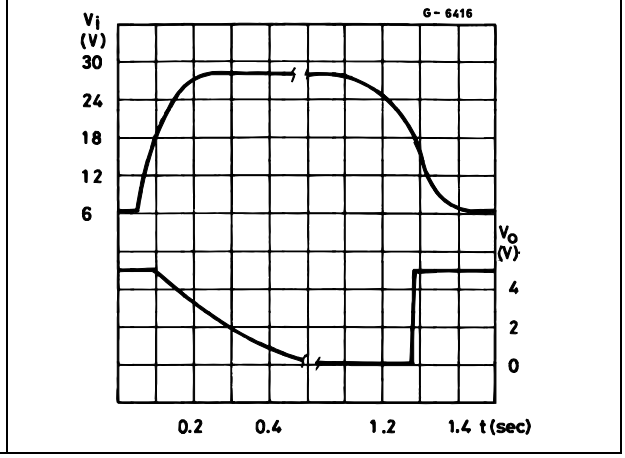


Figure 24. Line transient response (L4940V5)

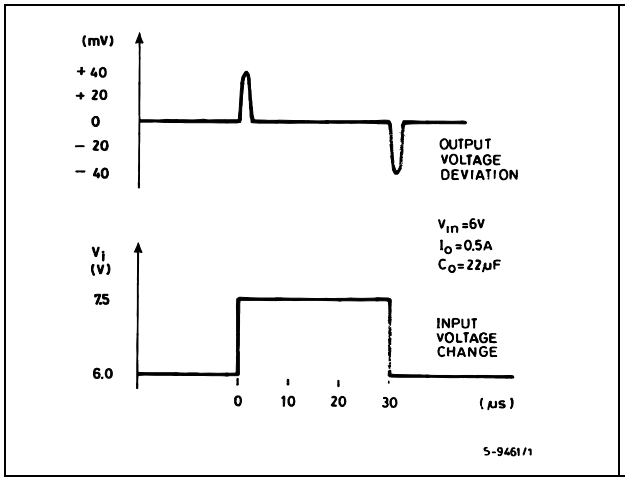


Figure 25. Total power dissipation

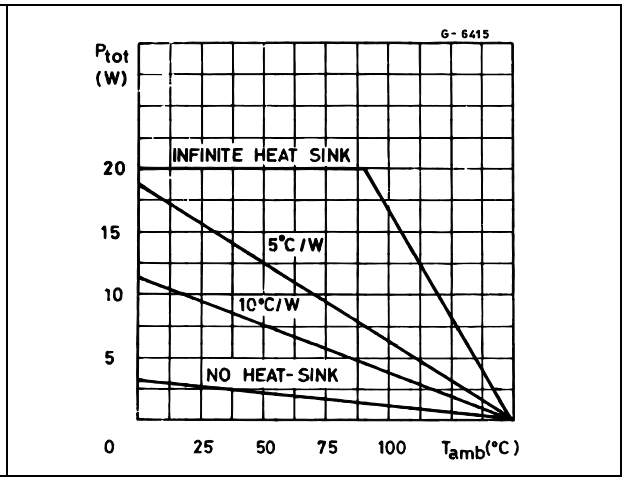
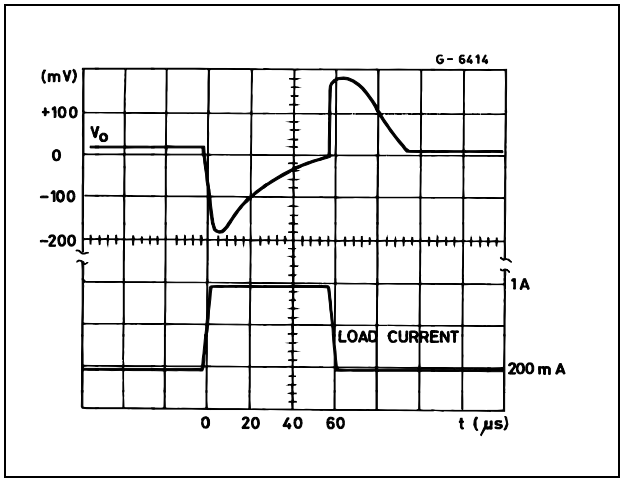


Figure 26. Load transient response



7 Schematic application

Figure 27. Distributed supply with On-card L4940 and L4941 low drop regulator

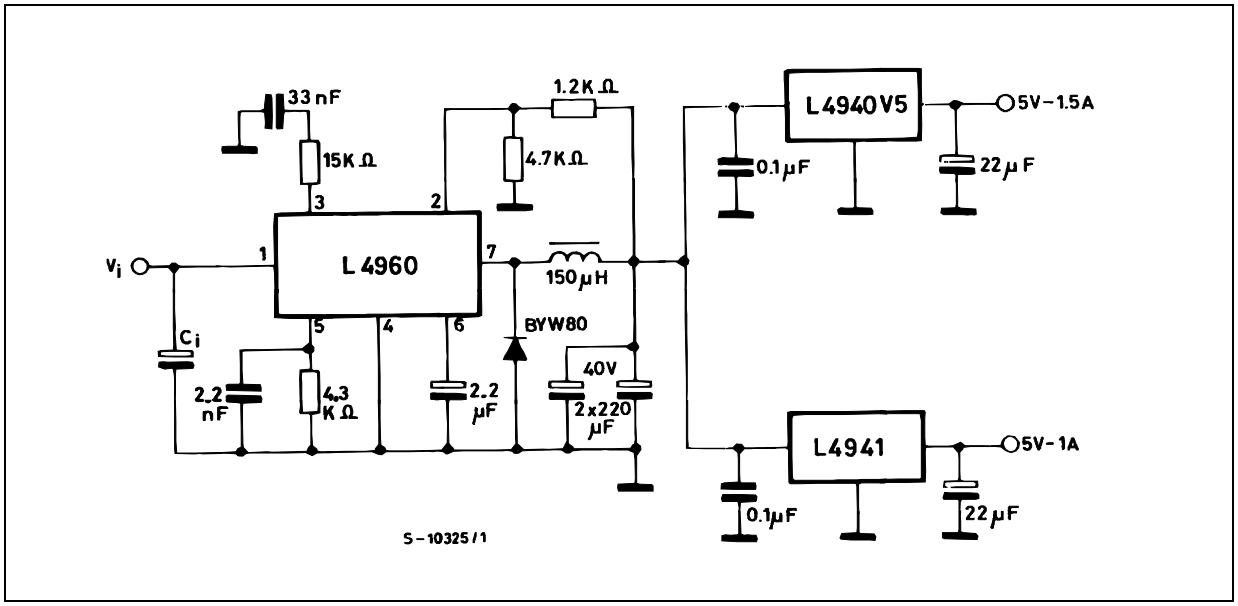
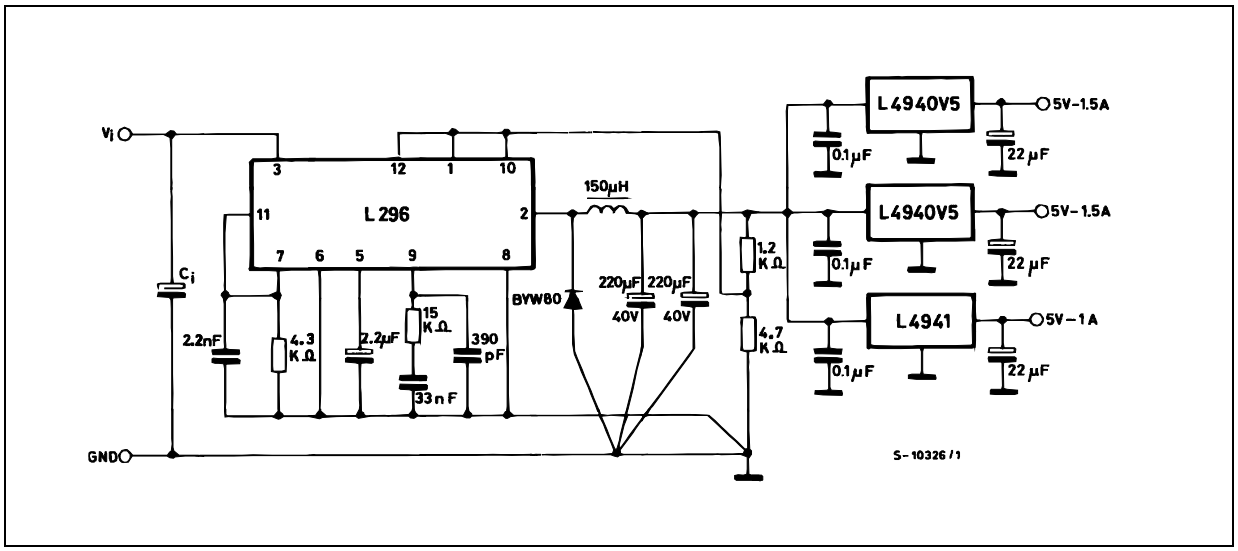


Figure 28. Distributed supply with On-card L4940 and L4941 low drop regulator

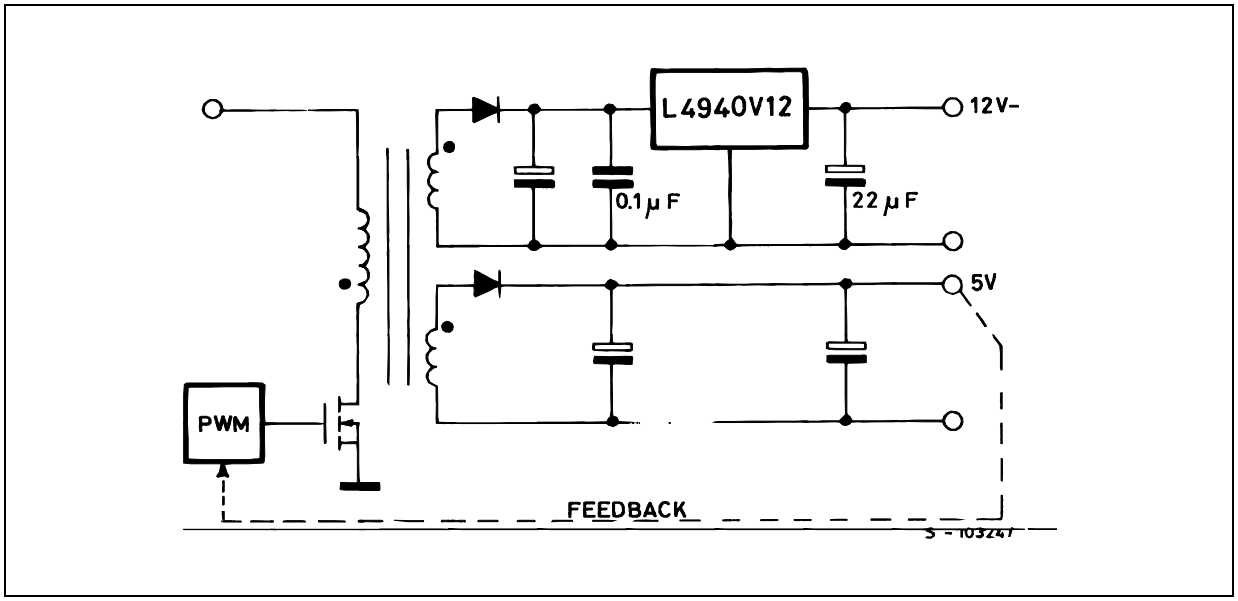


ADVANTAGES OF THESE APPLICATION ARE:

On card regulation with short-circuit and thermal protection on each output.

Vary high total system efficiency due to the switching pre-regulation and very low-drop post-regulation.

Figure 29. Distributed supply with On-card L4940 and L4941 low drop regulator



ADVANTAGES OF THIS CONFIGURATION ARE:

Very high regulation (line and load on both the output voltage

12V output short circuit and thermally protected

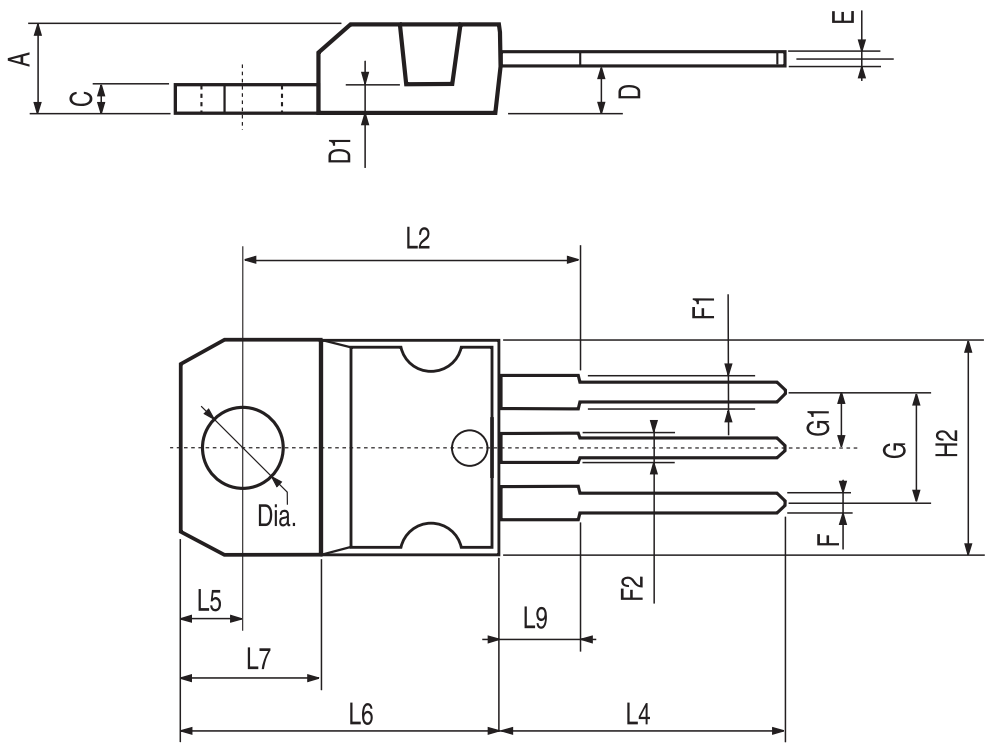
Very high efficiency on the 12 V output due to the low drop regulator

8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

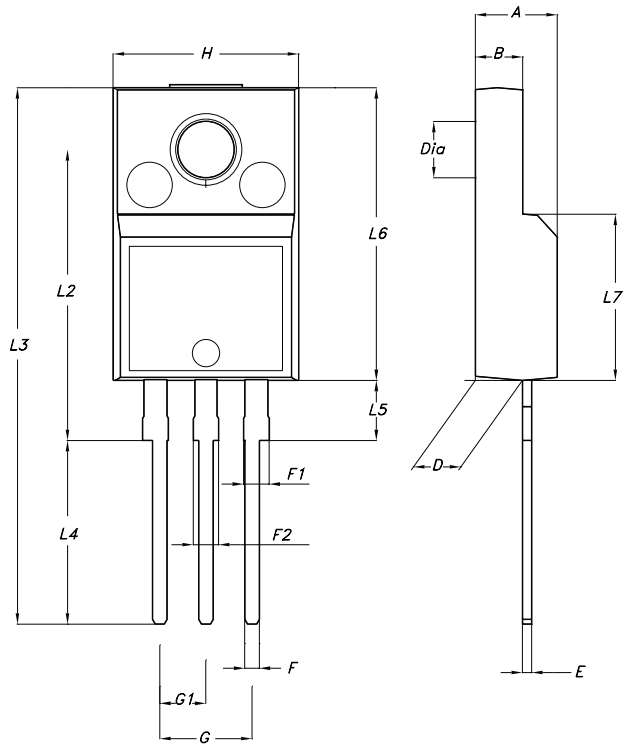
TO-220 mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



TO-220FP mechanical data

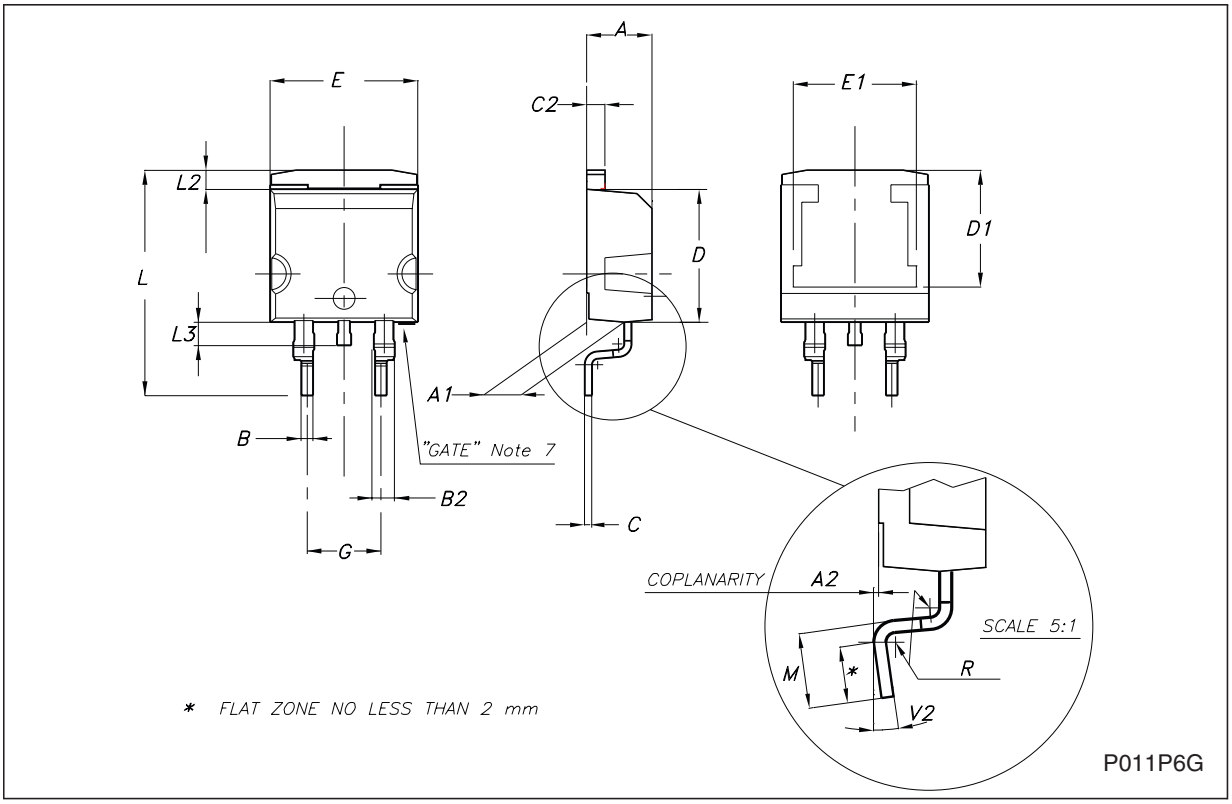
Dim.	mm.			inch.		
	Min.	Typ	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.70	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.50	0.045		0.059
F2	1.15		1.50	0.045		0.059
G	4.95		5.2	0.194		0.204
G1	2.4		2.7	0.094		0.106
H	10.0		10.40	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
L5	2.9		3.6	0.114		0.142
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
DIA.	3		3.2	0.118		0.126



7012510A-H

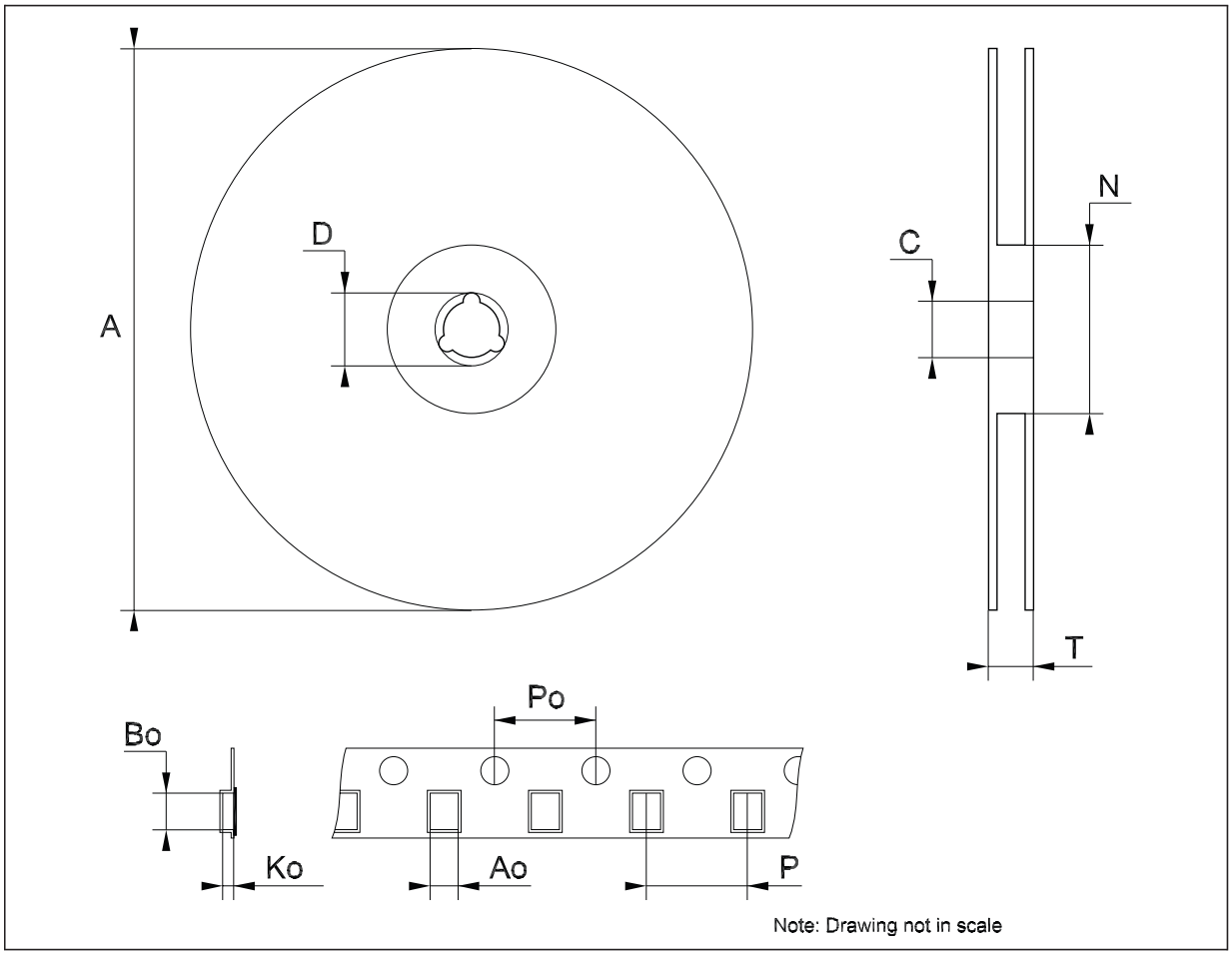
D^2PAK mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		0.409
E1		8.5			0.335	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.624
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.016	
V2	0°		8°	0°		8°



Tape & reel D^2PAK-P^2PAK-D^2PAK/A-P^2PAK/A mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			180			7.086
C	12.8	13.0	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	60			2.362		
T			14.4			0.567
Ao	10.50	10.6	10.70	0.413	0.417	0.421
Bo	15.70	15.80	15.90	0.618	0.622	0.626
Ko	4.80	4.90	5.00	0.189	0.193	0.197
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	11.9	12.0	12.1	0.468	0.472	0.476



9 Revision history

Table 8. Document revision history

Date	Revision	Changes
04-Feb-2005	6	Add new package D^2PAK/A.
18-Sep-2006	7	Order codes has been updated and new template.
31-May-2007	8	Order codes has been updated.
19-Sep-2007	9	Add *Table 1* in cover page.
20-Feb-2008	10	Modified: *Table 1 on page 1*.

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