

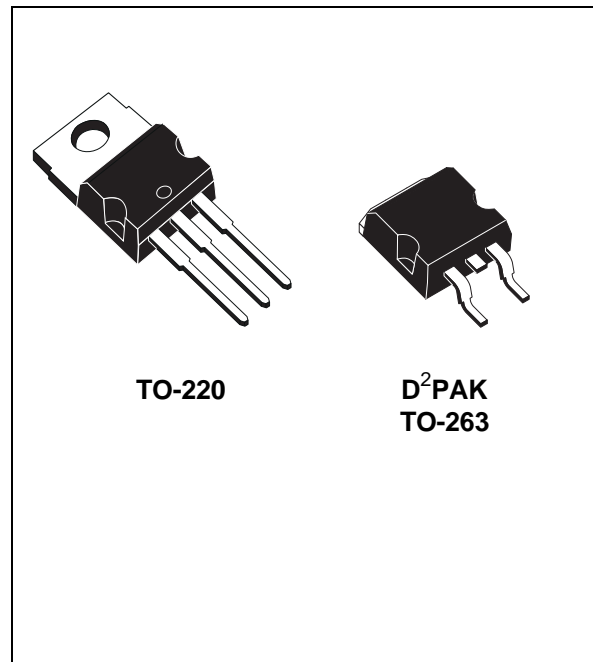


## VERY LOW DROP 1.5 A REGULATORS

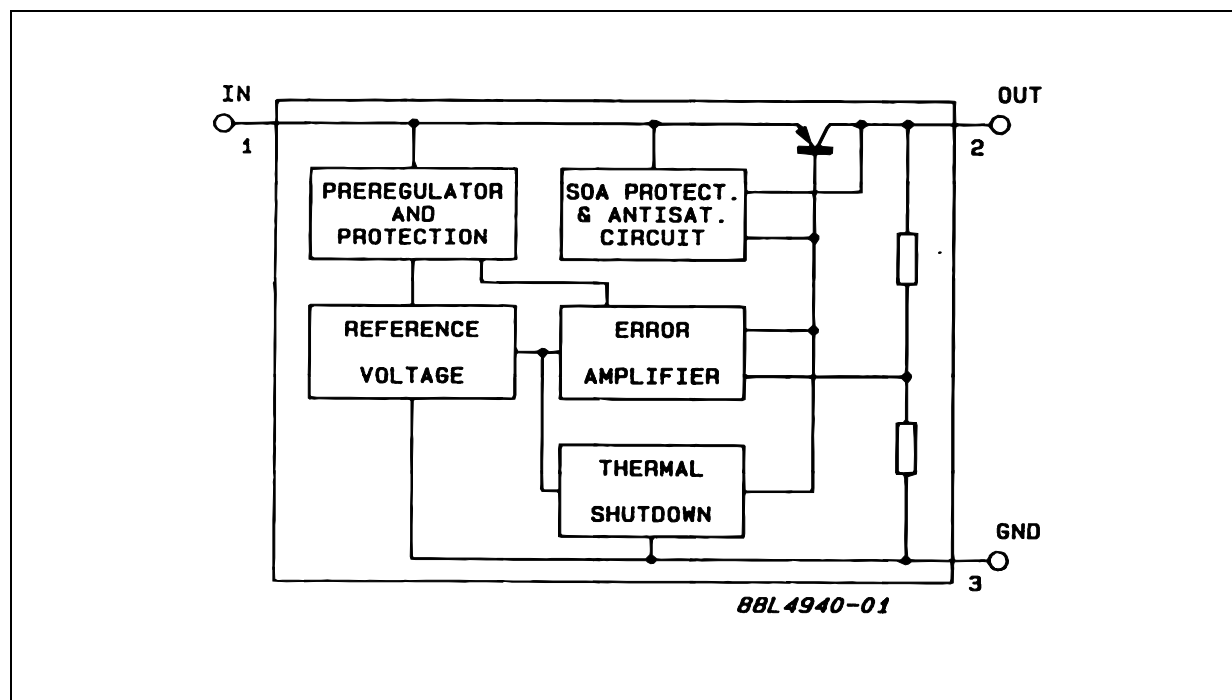
- PRECISE 5 V, 8.5 V, 10 V, 12 V OUTPUTS
- LOW DROPOUT VOLTAGE (500 mV typ at 1.5A)
- VERY LOW QUIESCENT CURRENT
- THERMAL SHUTDOWN
- SHORT CIRCUIT PROTECTION
- REVERSE POLARITY PROTECTION

### DESCRIPTION

The L4940 series of three terminal positive regulators is available in TO-220 and D<sup>2</sup>PAK package 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 battery powered equipments, reducing consumption and prolonging battery life. Each type employs internal current limiting, antisaturation circuit, thermal shut-down and safe area protection.

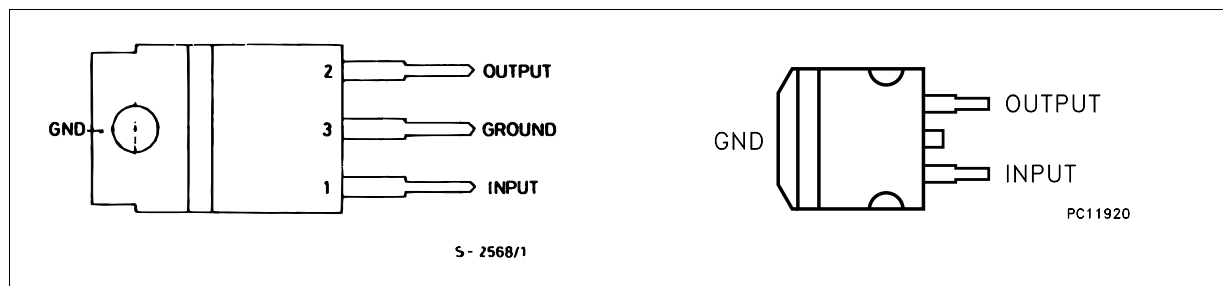


### BLOCK DIAGRAM



## L4940 series

### PIN CONNECTION AND ORDER CODES



ORDERING NUMBERS		OUTPUT VOLTAGE
TO-220	D <sup>2</sup> PAK	
L4940V5	L4940D2T5	5V
L4940V85	L4940D2T85	8.5V
L4940V10	L4940D2T10	10V
L4940V12	L4940D2T12	12V

### ABSOLUTE MAXIMUM RATING

Symbol	Description	Values	Unit	
$V_I$	Forward Input Voltage	30	V	
$V_{IR}$	Reverse Input Voltage	$V_O = 5\text{ V}$ $R_O = 100\ \Omega$	-15	V
		$V_O = 8.5\text{ V}$ $R_O = 180\ \Omega$		
		$V_O = 10\text{ V}$ $R_O = 200\ \Omega$		
		$V_O = 12\text{ V}$ $R_O = 240\ \Omega$		
$I_O$	Output Current	Internally Limited		
$P_{tot}$	Power Dissipation	Internally Limited		
$T_j, T_{stg}$	Junction and Storage Temperature	-40 to 150	°C	

### THERMAL DATA

Symbol	Description	Value		Unit
		TO-220	D <sup>2</sup> PAK	
$R_{thj-case}$	Thermal Resistance Junction-case Max	3	3	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient Max	50	62.5	°C/W

## TEST CIRCUITS

Figure 1 : DC Parameter.

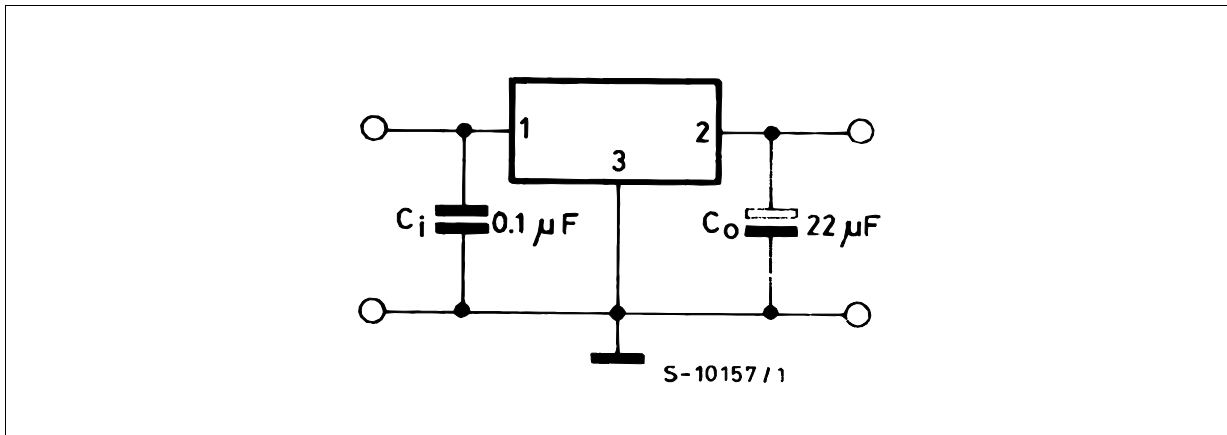


Figure 2 : Load Rejection.

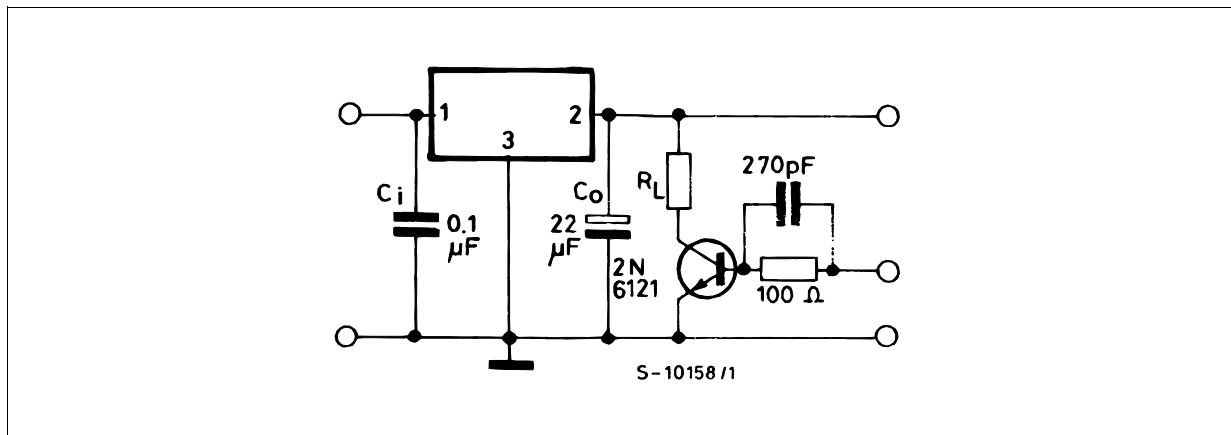
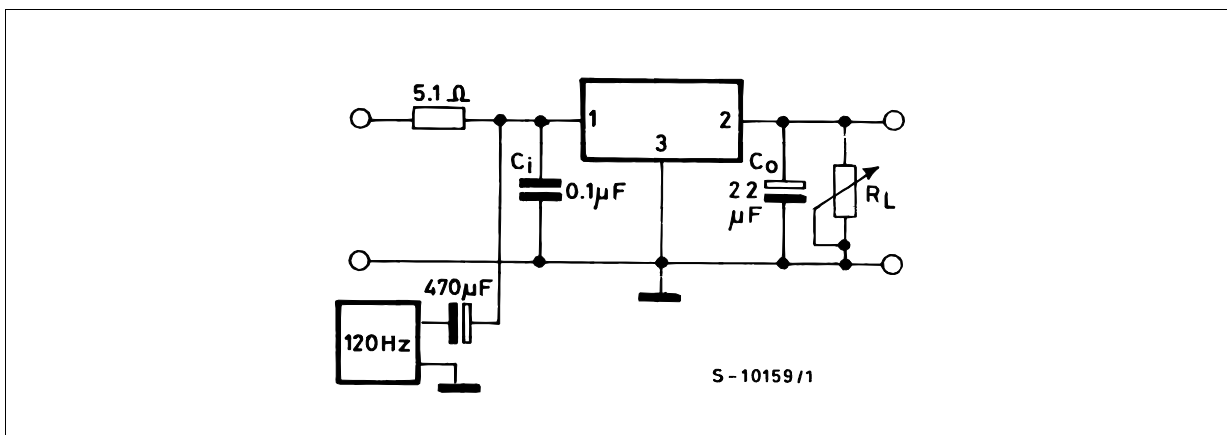


Figure 3 : Ripple Rejection.



## L4940 series

**ELECTRICAL CHARACTERISTICS FOR L4940V5** (refer to the test circuits,  $T_j = 25\text{ }^\circ\text{C}$ ,  
 $V_i = 7\text{V}$ ,  $C_i = 0.1\text{ }\mu\text{F}$ ,  $C_o = 22\text{ }\mu\text{F}$  unless otherwise specified)

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	$I_o = 5\text{ mA to }1500\text{ mA}$ $V_i = 6.5\text{ to }16\text{ V}$	4.8	5	5.2	V
$V_i$	Operating Input Voltage	$I_o = 5\text{ mA}$			17	V
$\Delta V_o$	Line Regulation	$I_o = 5\text{ mA}$ $V_i = 6\text{ to }17\text{ V}$		4	10	mV
$\Delta V_o$	Load Regulation	$I_o = 5\text{ to }1500\text{ mA}$ $I_o = 500\text{ to }1000\text{ mA}$		8 5	25 15	mV
$I_Q$	Quiescent Current	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 6.5\text{ V}$		5 30	8 50	mA
$\Delta I_Q$	Quiescent Current Change	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 6.5\text{ to }16\text{ V}$			3 15	mA
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			0.5		mV/ $^\circ\text{C}$
SVR	Supply Voltage Rejection	$I_o = 1\text{ A}$ $f = 120\text{ Hz}$	58	68		dB
$V_d$	Dropout Voltage	$I_o = 0.5\text{ A}$ $I_o = 1.5\text{ A}$		200 500	400 900	mV
$I_{sc}$	Short Circuit Current	$V_i = 14\text{ V}$ $V_i = 6.5\text{ V}$		2 2.2	2.7 2.9	A

**ELECTRICAL CHARACTERISTICS FOR L4940V85** (refer to the test circuits,  $T_j = 25\text{ }^\circ\text{C}$ ,  
 $V_i = 10.5\text{V}$ ,  $C_i = 0.1\text{ }\mu\text{F}$ ,  $C_o = 22\text{ }\mu\text{F}$  unless otherwise specified)

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	$I_o = 5\text{ mA to }1500\text{ mA}$ $V_i = 10.2\text{ to }16\text{ V}$	8.15	8.5	8.85	V
$V_i$	Operating Input Voltage	$I_o = 5\text{ mA}$			17	V
$\Delta V_o$	Line Regulation	$I_o = 5\text{ mA}$ $V_i = 9.5\text{ to }17\text{ V}$		4	9	mV
$\Delta V_o$	Load Regulation	$I_o = 5\text{ to }1500\text{ mA}$ $I_o = 500\text{ to }1000\text{ mA}$		12 8	30 16	mV
$I_Q$	Quiescent Current	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 10.2\text{ V}$		4 30	8 50	mA
$\Delta I_Q$	Quiescent Current Change	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 10.2\text{ to }16\text{ V}$			2.5 15	mA
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			0.8		mV/ $^\circ\text{C}$
SVR	Supply Voltage Rejection	$I_o = 1\text{ A}$ $f = 120\text{ Hz}$	58	66		dB
$V_d$	Dropout Voltage	$I_o = 0.5\text{ A}$ $I_o = 1.5\text{ A}$		200 500	400 900	mV
$I_{sc}$	Short Circuit Current	$V_i = 14\text{ V}$ $V_i = 10.2\text{ V}$		2 2.2	2.7 2.9	A

**ELECTRICAL CHARACTERISTICS FOR L4940V10** (refer to the test circuits,  $T_j = 25\text{ }^\circ\text{C}$ ,  
 $V_i = 12\text{V}$ ,  $C_i = 0.1\text{ }\mu\text{F}$ ,  $C_o = 22\text{ }\mu\text{F}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_o$	Output Voltage	$I_o = 500\text{ mA}$	9.8	10	10.2	V
$V_o$	Output Voltage	$I_o = 5\text{ mA to }1500\text{ mA}$ $V_i = 11.7\text{ to }16\text{ V}$	9.6	10	10.4	V
$V_i$	Operating Input Voltage	$I_o = 5\text{ mA}$			17	V
$\Delta V_o$	Line Regulation	$I_o = 5\text{ mA}$ $V_i = 11\text{ to }17\text{ V}$		3	8	mV
$\Delta V_o$	Load Regulation	$I_o = 5\text{ to }1500\text{ mA}$ $I_o = 500\text{ to }1000\text{ mA}$		15 10	35 20	mV
$I_Q$	Quiescent Current	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 11.7\text{ V}$		4 30	8 50	mA
$\Delta I_Q$	Quiescent Current Change	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 11.7\text{ to }16\text{ V}$			2 13	mA
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			1		mV/ $^\circ\text{C}$
SVR	Supply Voltage Rejection	$I_o = 1\text{ A}$ $f = 120\text{ Hz}$	56	62		dB
$V_d$	Dropout Voltage	$I_o = 0.5\text{ A}$ $I_o = 1.5\text{ A}$		200 500	400 900	mV
$I_{sc}$	Short Circuit Current	$V_i = 14\text{ V}$ $V_i = 11.7\text{ V}$		2 2.2	2.7 2.9	A

**ELECTRICAL CHARACTERISTICS FOR L4940V12** (refer to the test circuits,  $T_j = 25\text{ }^\circ\text{C}$ ,  
 $V_i = 14\text{V}$ ,  $C_i = 0.1\text{ }\mu\text{F}$ ,  $C_o = 22\text{ }\mu\text{F}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_o$	Output Voltage	$I_o = 500\text{ mA}$	11.75	12	12.25	V
$V_o$	Output Voltage	$I_o = 5\text{ mA to }1500\text{ mA}$ $V_i = 13.8\text{ to }17\text{ V}$	11.5	12	12.5	V
$V_i$	Operating Input Voltage	$I_o = 5\text{ mA}$			17	V
$\Delta V_o$	Line Regulation	$I_o = 5\text{ mA}$ $V_i = 13\text{ to }17\text{ V}$		3	7	mV
$\Delta V_o$	Load Regulation	$I_o = 5\text{ to }1500\text{ mA}$ $I_o = 500\text{ to }1000\text{ mA}$		15 10	35 25	mV
$I_Q$	Quiescent Current	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 13.8\text{ V}$		4 30	8 50	mA
$\Delta I_Q$	Quiescent Current Change	$I_o = 5\text{ mA}$ $I_o = 1.5\text{ A}$ $V_i = 13.8\text{ to }16\text{ V}$			1.5 10	mA
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			1.2		mV/ $^\circ\text{C}$
SVR	Supply Voltage Rejection	$I_o = 1\text{ A}$ $f = 120\text{ Hz}$	55	61		dB
$V_d$	Dropout Voltage	$I_o = 0.5\text{ A}$ $I_o = 1.5\text{ A}$		200 500	400 900	mV
$I_{sc}$	Short Circuit Current	$V_i = 14\text{ V}$		2	2.7	A
$Z_o$	Output Impedance	$f = 1\text{ KHz}$ $I_o = 0.5\text{ A}$		40		m $\Omega$

Figure 4 : Dropout voltage vs. Output Current.

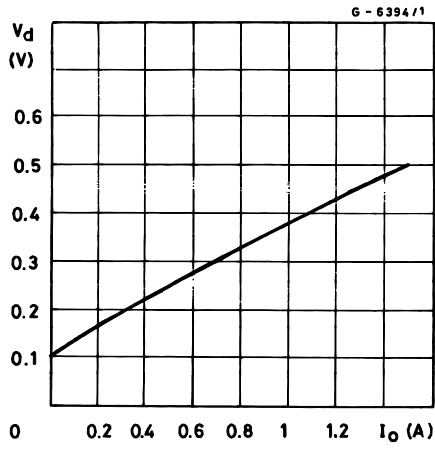


Figure 5 : Dropout Voltage vs. Temperature.

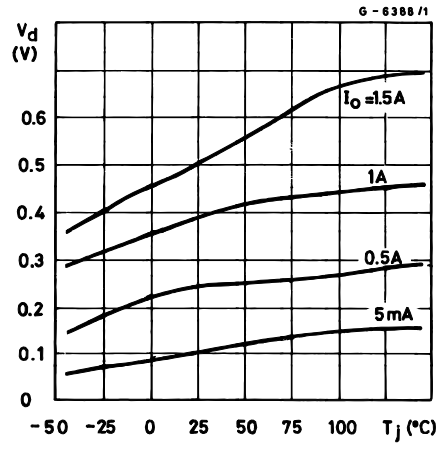


Figure 6 : Output voltage vs. Temperature (L4940V5).

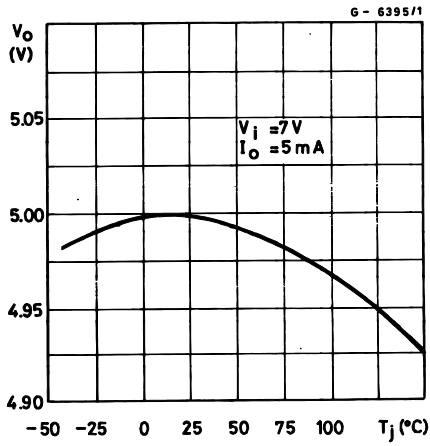


Figure 7 : Output Voltage vs. Temperature (L4940V85).

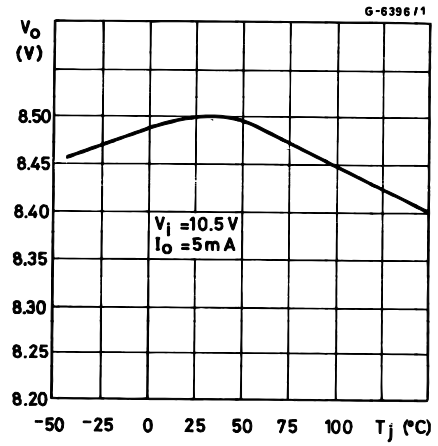


Figure 8 : Output voltage vs. Temperature (L4940V10).

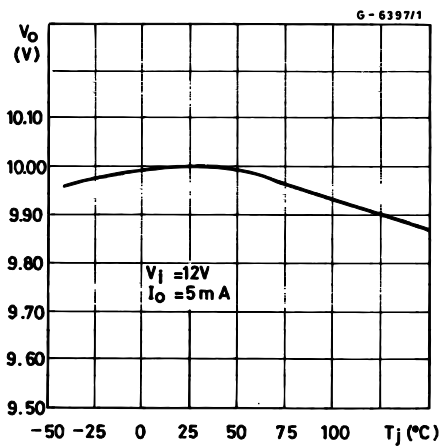
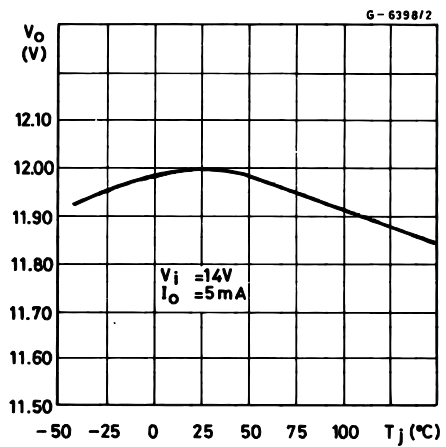
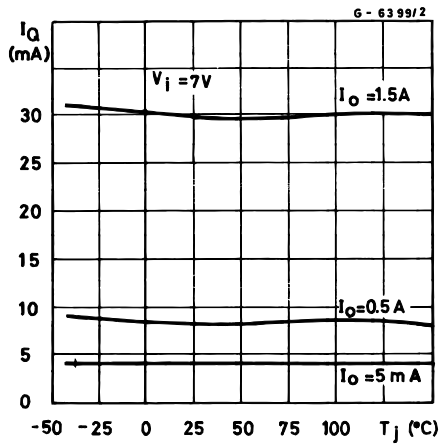


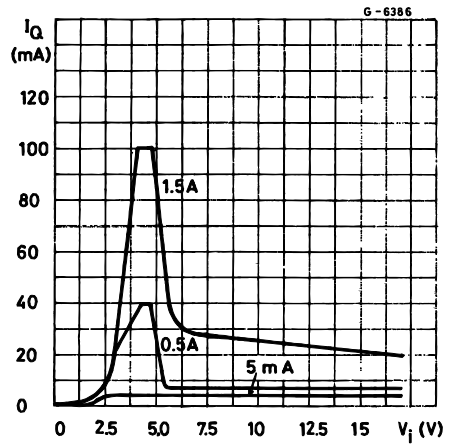
Figure 9 : Output Voltage vs. Temperature (L4940V12).



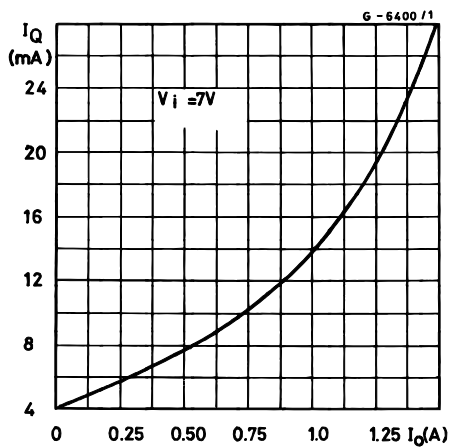
**Figure 10 :** Quiescent Current vs. Temperature (L4940V5).



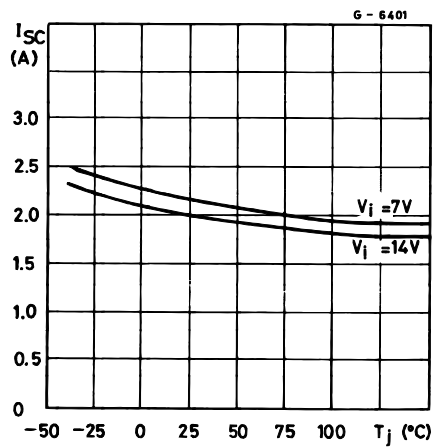
**Figure 11 :** Quiescent Current vs. Input Voltage (L4940V5).



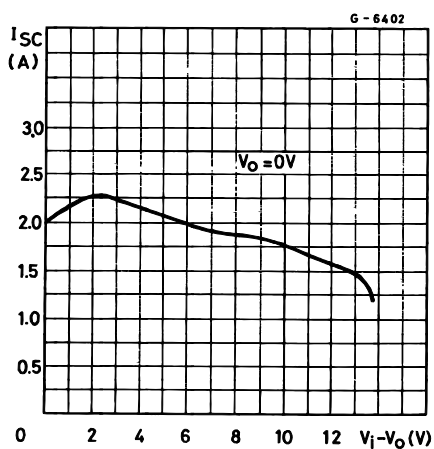
**Figure 12 :** Quiescent Current vs. Output Current (L4940V5).



**Figure 13 :** Short-circuit Current vs. Temperature (L4940V5).



**Figure 14 :** Peak Output Current vs. Input/Output Differential Voltage (L4940V5).



**Figure 15 :** Low Voltage Behavior (L4940V5).

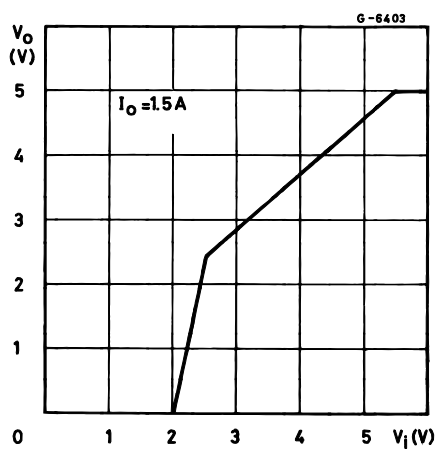


Figure 16 : Low Voltage Behavior (L4940V85).

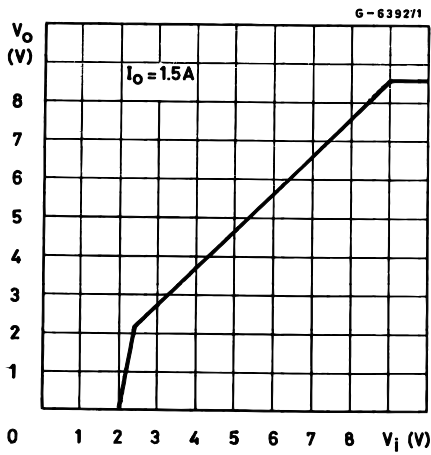


Figure 17 : Low Voltage Behavior (L4940V10).

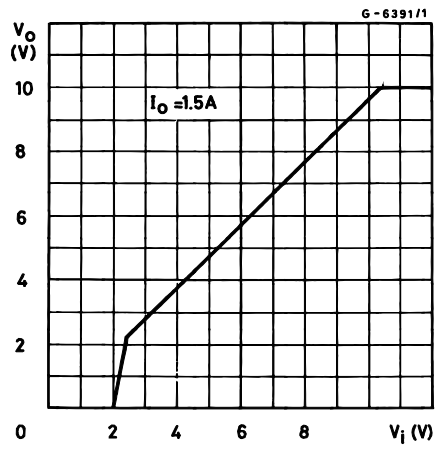


Figure 18 : Low Voltage Behavior (L4940V12).

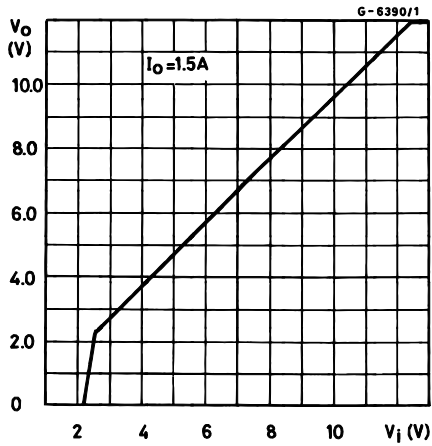


Figure 19 : Supply Voltage Rejection vs. Frequency (L4940V5).

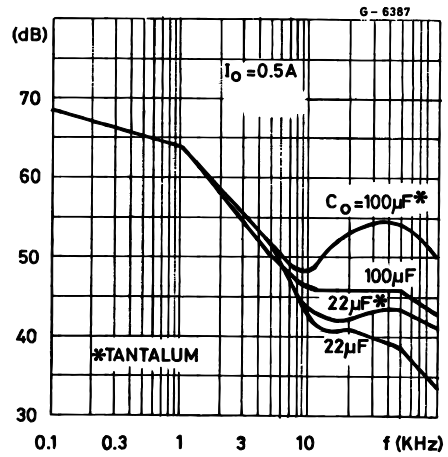


Figure 20 : Supply Voltage Rejection vs. output Current.

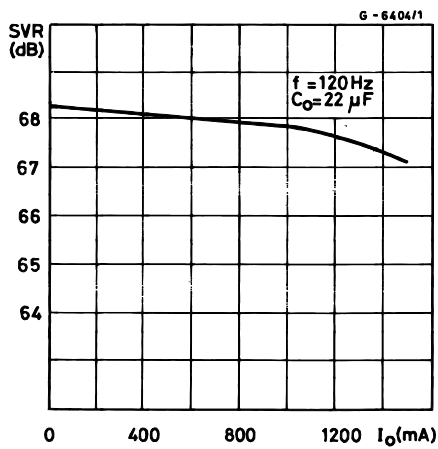


Figure 21 : Load Dump Characteristics (L4940V5 ).

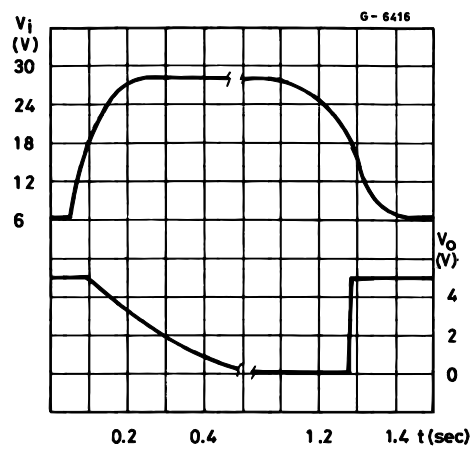
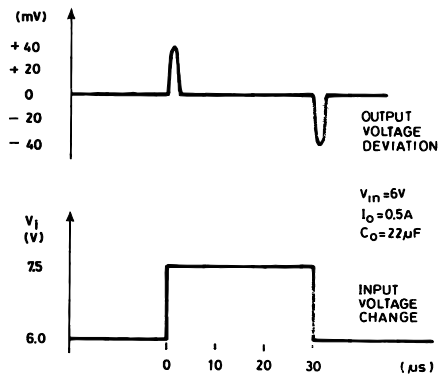




Figure 22 : Line Transient Response (L4940V5).



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Figure 23 : Load Transient Response.

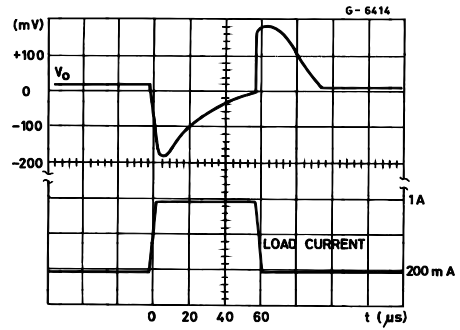


Figure 24 : Total Power Dissipation.

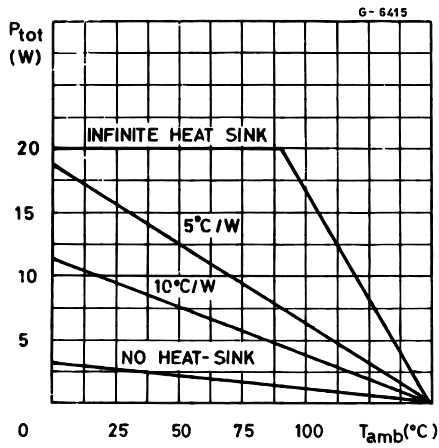
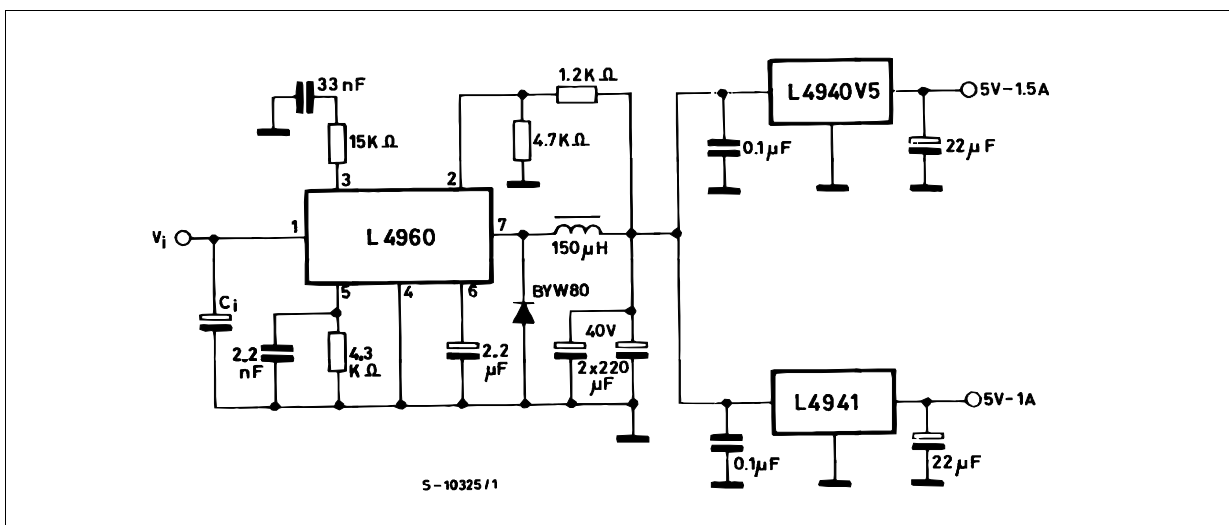


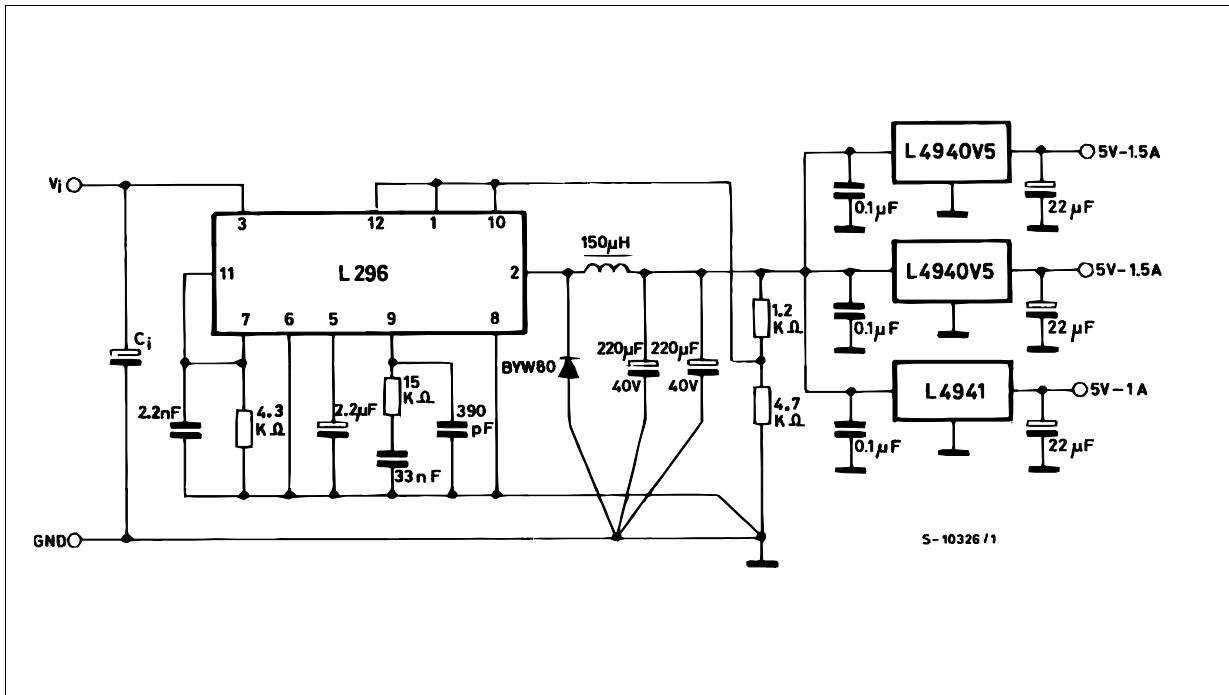
Figure 25 : Distributed Supply with On-card L4940 and L4941 Low-drop Regulators.



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## L4940 series

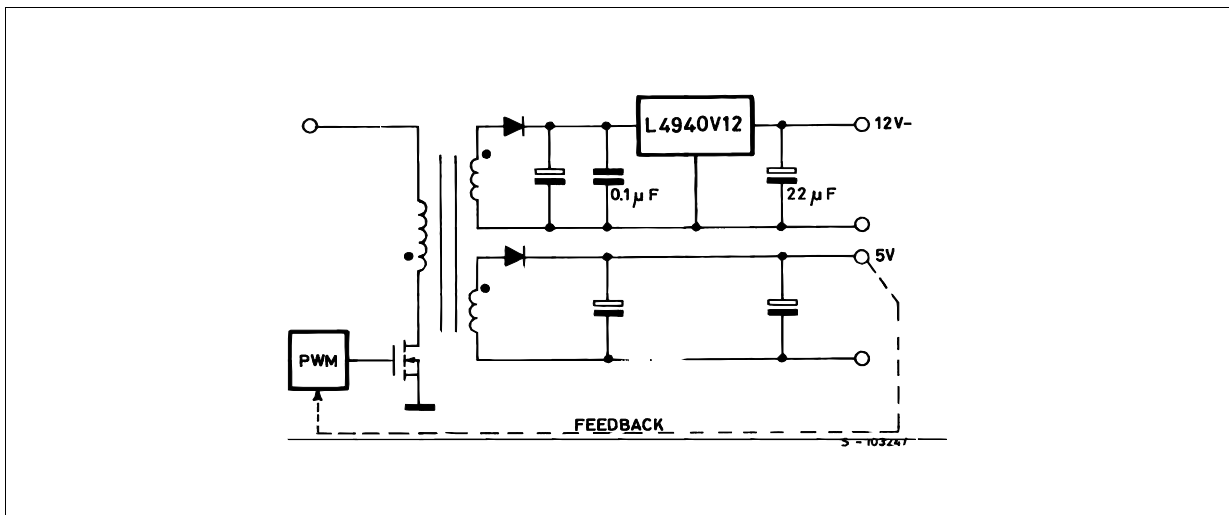
**Figure 26 :** Distributed Supply with On-card L4940 and L4941 Low-drop Regulators.



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 preregulation and very low-drop postregulations.

**Figure 27.**

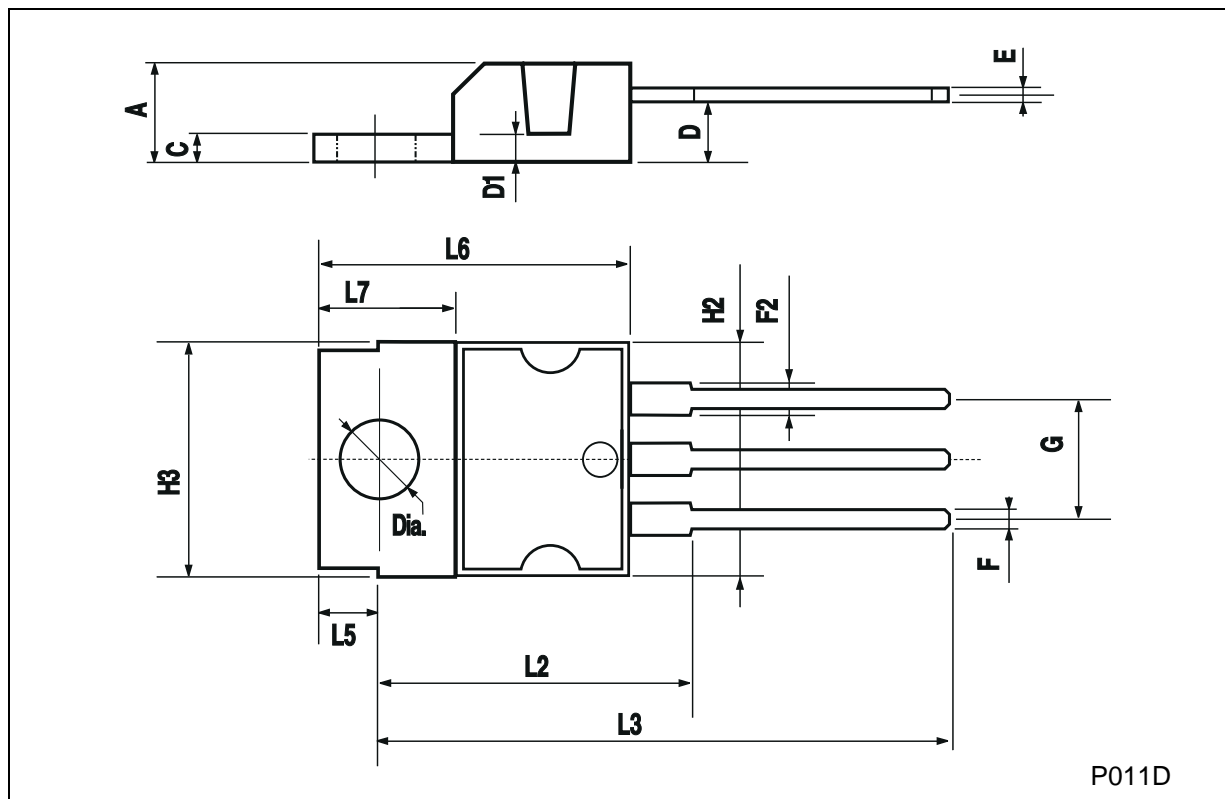


ADVANTAGES OF THIS CONFIGURATION ARE :

Very high regulation (line and load) on both the output voltages.  
 12 V output short-circuit and thermally protected.  
 Very high efficiency on the 12 V output due to the very low drop regulator.

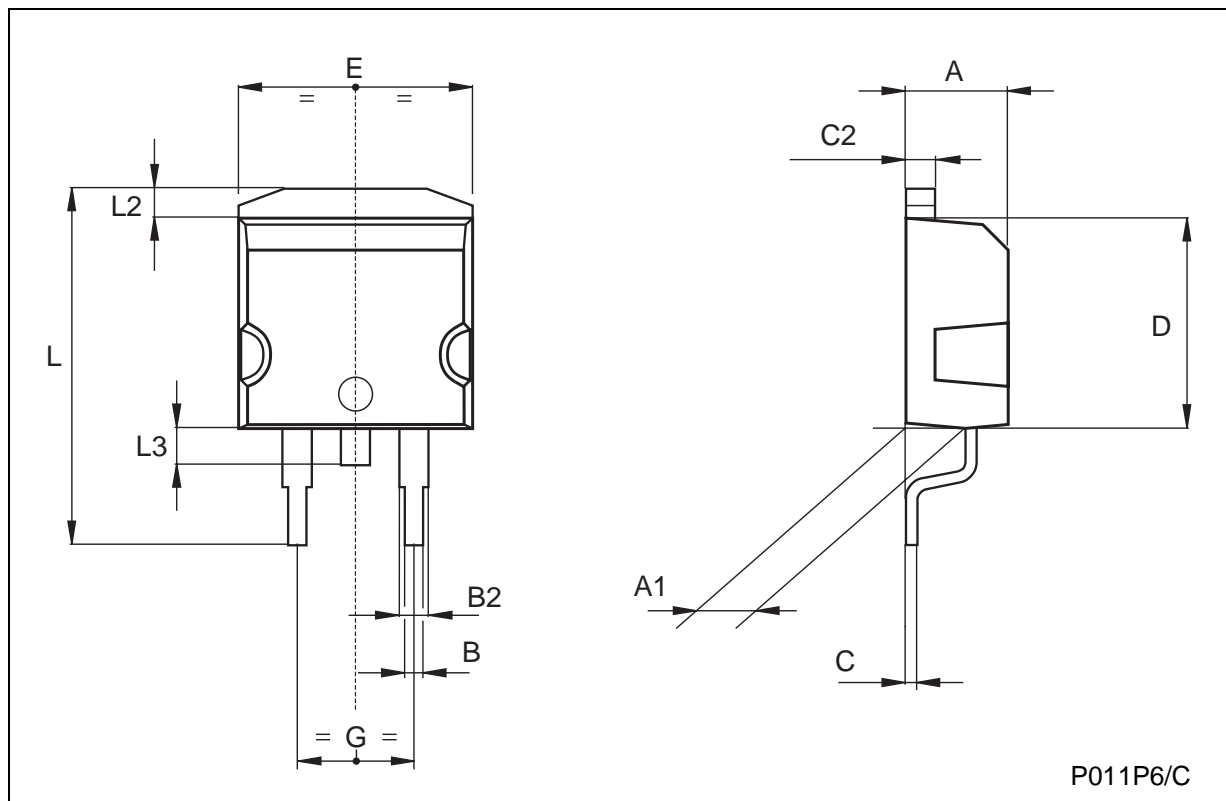
## TO-220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.61		0.94	0.024		0.037
F2	1.15		1.4	0.045		0.055
G	4.95	5.08	5.21	0.195	0.200	0.205
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L2		16.2			0.638	
L3	26.3	26.7	27.1	1.035	1.051	1.067
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
Dia.	3.65		3.85	0.144		0.152



**TO-263 (D<sup>2</sup>PAK) MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.3		4.6	0.169		0.181
A1	2.49		2.69	0.098		0.106
B	0.7		0.93	0.027		0.036
B2	1.25		1.4	0.049		0.055
C	0.45		0.6	0.017		0.023
C2	1.21		1.36	0.047		0.053
D	8.95		9.35	0.352		0.368
E	10		10.28	0.393		0.404
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



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