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2 % negative voltage regulators

Features

- Output current to 1.5 A
- Output voltages of -5; -8; -12; -15; -24 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection

Description

The L79xxAC series of three-terminal negative regulators is available in TO-220 and D²PAK packages and several fixed output voltages. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation; furthermore, having the same voltage option as the L78xxA positive standard series, they are particularly suited for split power supplies. If adequate heat sinking is provided, they can deliver over 1.5 A output current.

Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

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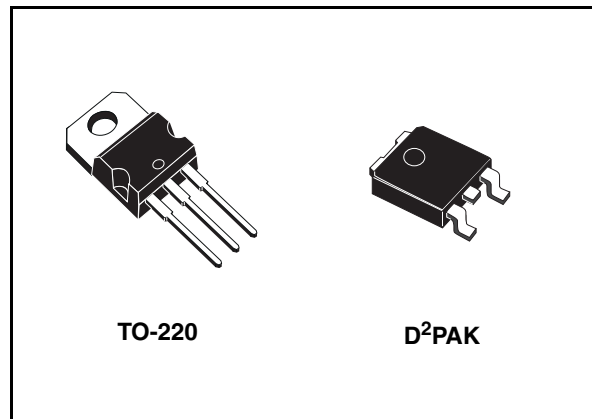


Table 1. Device summary

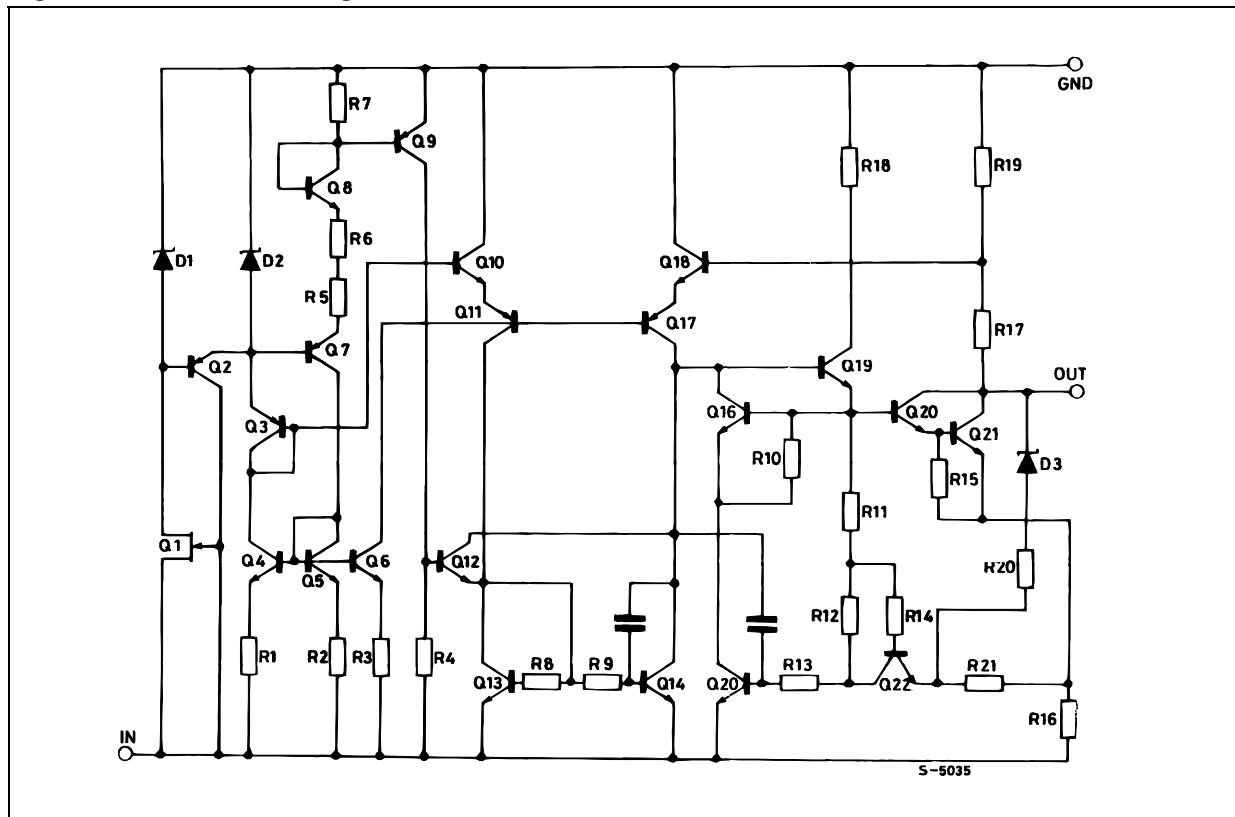
Part number	Order codes		
	TO-220	D ² PAK	Out. Volt.
L7905AC	L7905ACV	L7905ACD2T-TR	-5 V
L7908AC	L7908ACV	L7908ACD2T-TR	-8 V
L7912AC	L7912ACV	L7912ACD2T-TR	-12 V
L7915AC	L7915ACV		-15 V
L7924AC	L7924ACV		-24 V

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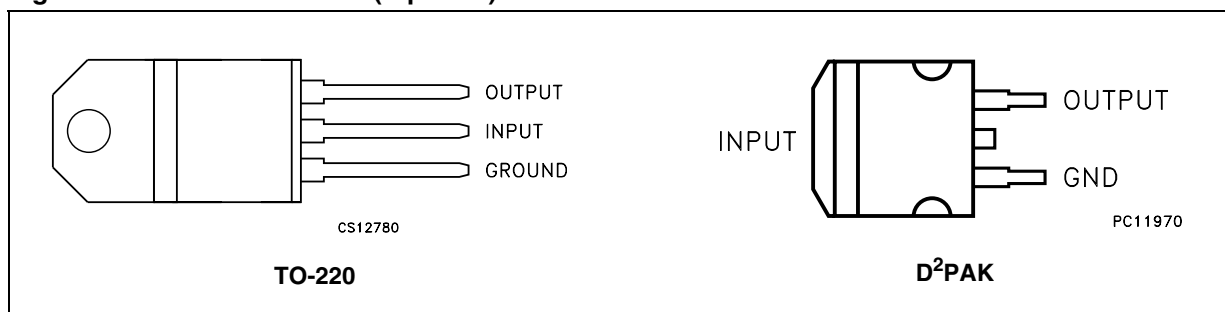
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_I	DC input voltage	for $V_O = -5$ to $-18V$	-35	V
		for $V_O = -20, -24V$	-40	
I_O	Output current		Internally Limited	
P_D	Power dissipation		Internally Limited	
T_{STG}	Storage temperature range		-65 to 150	°C
T_{OP}	Operating junction temperature range		0 to 125	°C

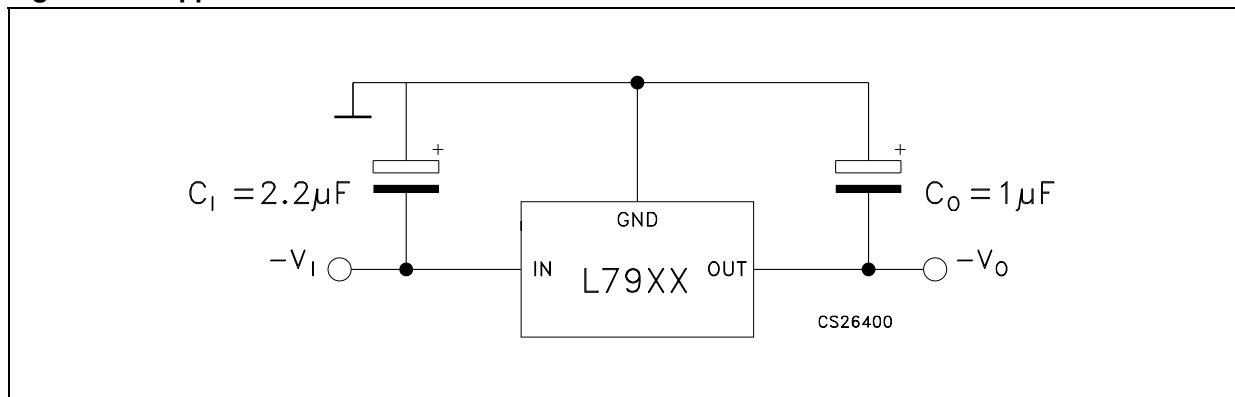
Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

Table 3. Thermal data

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

4 Application

Figure 3. Application circuit



5 Electrical characteristics

Table 4. Electrical characteristics of L7905AC (refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -10$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	-4.9	-5	-5.1	V
V_O	Output voltage	$I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -8$ to -20 V	-4.8	-5	-5.2	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -7$ to -25 V, $T_J = 25^\circ\text{C}$			100	mV
		$V_I = -8$ to -12 V, $T_J = 25^\circ\text{C}$			50	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$			100	mV
		$I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$			50	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
ΔI_d	Quiescent current change	$I_O = 5$ mA to 1 A			0.5	mA
		$V_I = -8$ to -25 V			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5$ mA		-0.4		mV/°C
eN	Output noise voltage	$B = 10$ Hz to 100 kHz, $T_J = 25^\circ\text{C}$		100		μ V
SVR	Supply voltage rejection	$\Delta V_I = 10$ V, $f = 120$ Hz	54	60		dB
V_d	Dropout voltage	$I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV		1.4		V
I_{sc}	Short circuit current			2.1		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.5		A

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Table 5. Electrical characteristics of L7908AC (refer to the test circuits, $T_J = 0$ to $125\text{ }^\circ\text{C}$, $V_I = -14\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 2.2\text{ }\mu\text{F}$, $C_O = 1\text{ }\mu\text{F}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	-7.84	-8	-8.16	V
V_O	Output voltage	$I_O = -5\text{ mA to } -1\text{ A}$, $P_O \leq 15\text{ W}$ $V_I = -11.5\text{ to } -23\text{ V}$	-7.68	-8	-8.32	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -10.5\text{ to } -25\text{ V}$, $T_J = 25^\circ\text{C}$			160	mV
		$V_I = -11\text{ to } -17\text{ V}$, $T_J = 25^\circ\text{C}$			80	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to } 1.5\text{ A}$, $T_J = 25^\circ\text{C}$			160	mV
		$I_O = 250\text{ to } 750\text{ mA}$, $T_J = 25^\circ\text{C}$			80	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA to } 1\text{ A}$			0.5	mA
		$V_I = -11.5\text{ to } -25\text{ V}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-0.6		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz to } 100\text{ kHz}$, $T_J = 25^\circ\text{C}$		175		μV
SVR	Supply voltage rejection	$\Delta V_I = 10\text{ V}$, $f = 120\text{ Hz}$	54	60		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100\text{ mV}$		1.1		V
I_{sc}	Short circuit current			1.5		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.5		A

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Table 6. Electrical characteristics of L7912AC (refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -19$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	-11.75	-12	-12.25	V
V_O	Output voltage	$I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -15.5$ to -27 V	-11.5	-12	-12.5	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -14.5$ to -30 V, $T_J = 25^\circ\text{C}$			240	mV
		$V_I = -16$ to -22 V, $T_J = 25^\circ\text{C}$			120	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$			240	mV
		$I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$			120	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
ΔI_d	Quiescent current change	$I_O = 5$ mA to 1 A			0.5	mA
		$V_I = -15$ to -30 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5$ mA		-0.8		mV/°C
eN	Output noise voltage	$B = 10\text{Hz}$ to 100kHz , $T_J = 25^\circ\text{C}$		200		μ V
SVR	Supply voltage rejection	$\Delta V_I = 10$ V, $f = 120\text{Hz}$	54	60		dB
V_d	Dropout voltage	$I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV		1.1		V
I_{sc}	Short circuit current			1.5		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.5		A

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Table 7. Electrical characteristics of L7915AC (refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -23$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	-14.7	-15	-15.3	V
V_O	Output voltage	$I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -18.5$ to -30 V	-14.4	-15	-15.6	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -17.5$ to -30 V, $T_J = 25^\circ\text{C}$			300	mV
		$V_I = -20$ to -26 V, $T_J = 25^\circ\text{C}$			150	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$			300	mV
		$I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$			150	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
ΔI_d	Quiescent current change	$I_O = 5$ mA to 1 A			0.5	mA
		$V_I = -18.5$ to -30 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5$ mA		-0.9		mV/°C
eN	Output noise voltage	$B = 10\text{Hz}$ to 100kHz , $T_J = 25^\circ\text{C}$		250		μ V
SVR	Supply voltage rejection	$\Delta V_I = 10$ V, $f = 120\text{Hz}$	54	60		dB
V_d	Dropout voltage	$I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV		1.1		V
I_{sc}	Short circuit current			1.3		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.5		A

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

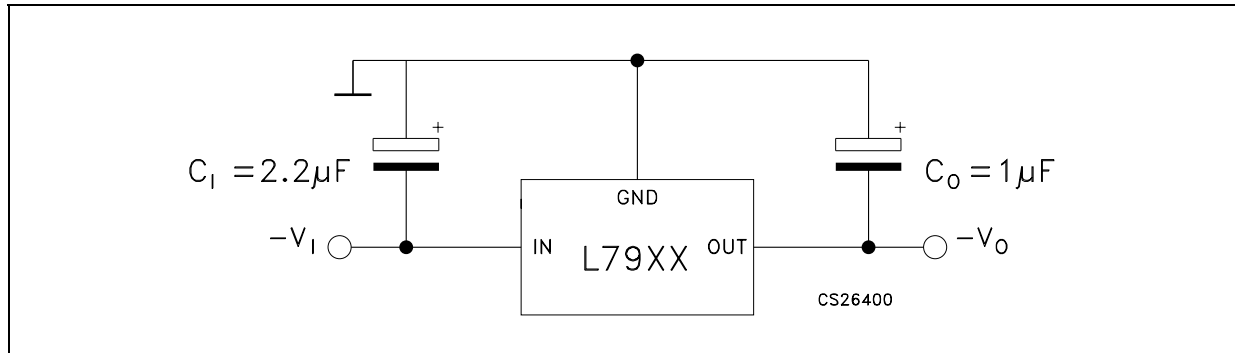
Table 8. Electrical characteristics of L7924AC (refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -33$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	-23.5	-24	-24.5	V
V_O	Output voltage	$I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -27$ to -38 V	-23	-24	-25	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -27$ to -38 V, $T_J = 25^\circ\text{C}$			480	mV
		$V_I = -30$ to -36 V, $T_J = 25^\circ\text{C}$			240	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$			480	mV
		$I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$			240	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
ΔI_d	Quiescent current change	$I_O = 5$ mA to 1 A			0.5	mA
		$V_I = -27$ to -38 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5$ mA		-1		mV/°C
eN	Output noise voltage	$B = 10\text{Hz}$ to 100kHz , $T_J = 25^\circ\text{C}$		400		μ V
SVR	Supply voltage rejection	$\Delta V_I = 10$ V, $f = 120\text{Hz}$	54	60		dB
V_d	Dropout voltage	$I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV		1.1		V
I_{sc}	Short circuit current			1.1		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.2		A

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

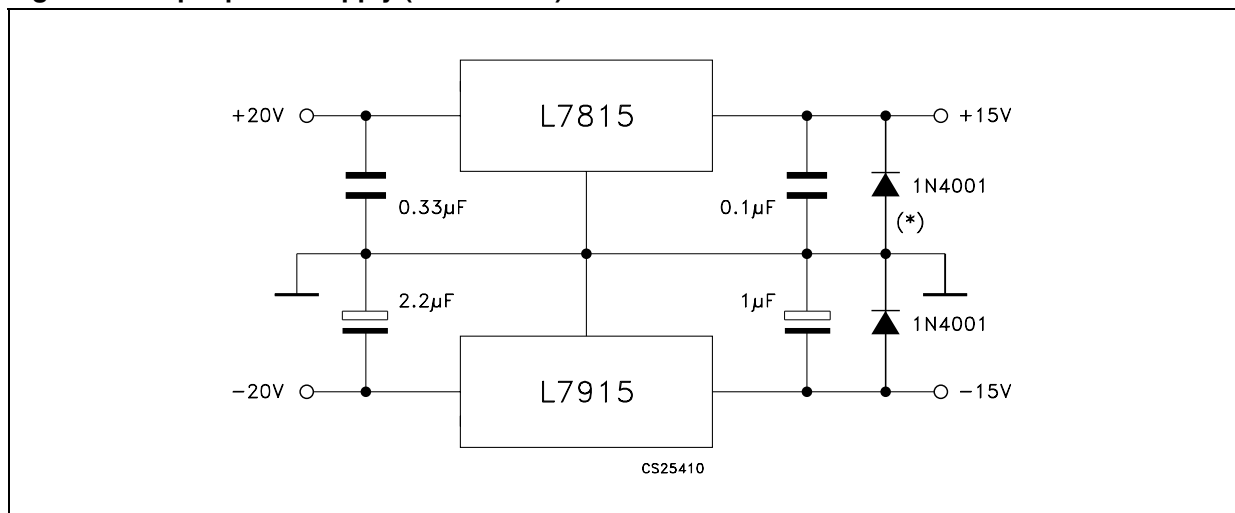
6 Application information

Figure 4. Fixed output regulator



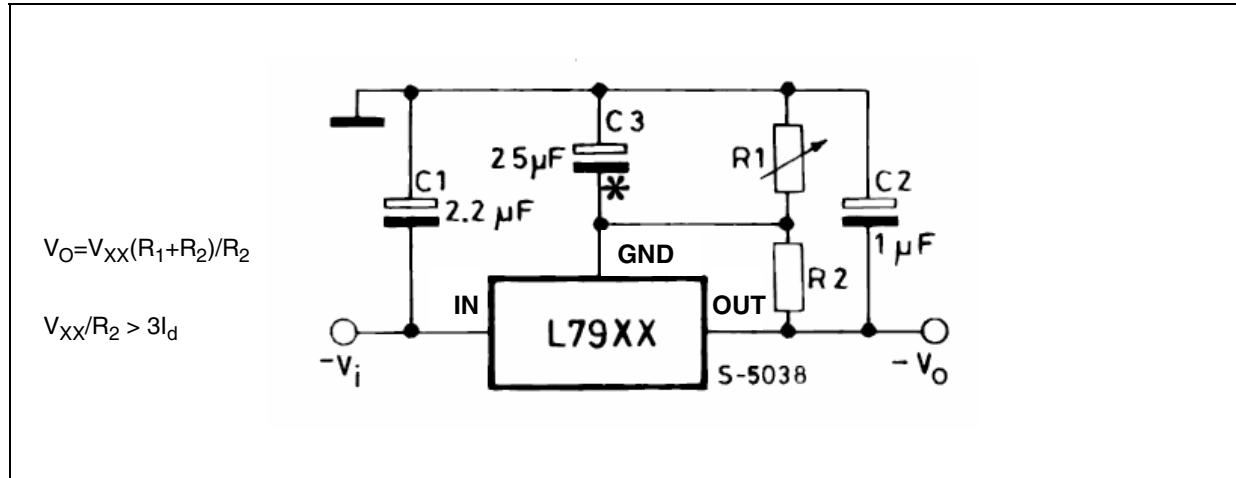
1. To specify an output voltage, substitute voltage value for "XX".
2. Required for stability. For value given, capacitor must be solid tantalum. If aluminium electrolytic are used, at least ten times value should be selected. C1 is required if regulator is located an appreciable distance from power supply filter.
3. To improve transient response. If large capacitors are used, a high current diode from input to output (1N4001 or similar) should be introduced to protect the device from momentary input short circuit.

Figure 5. Split power supply ($\pm 15\text{ V} - 1\text{ A}$)



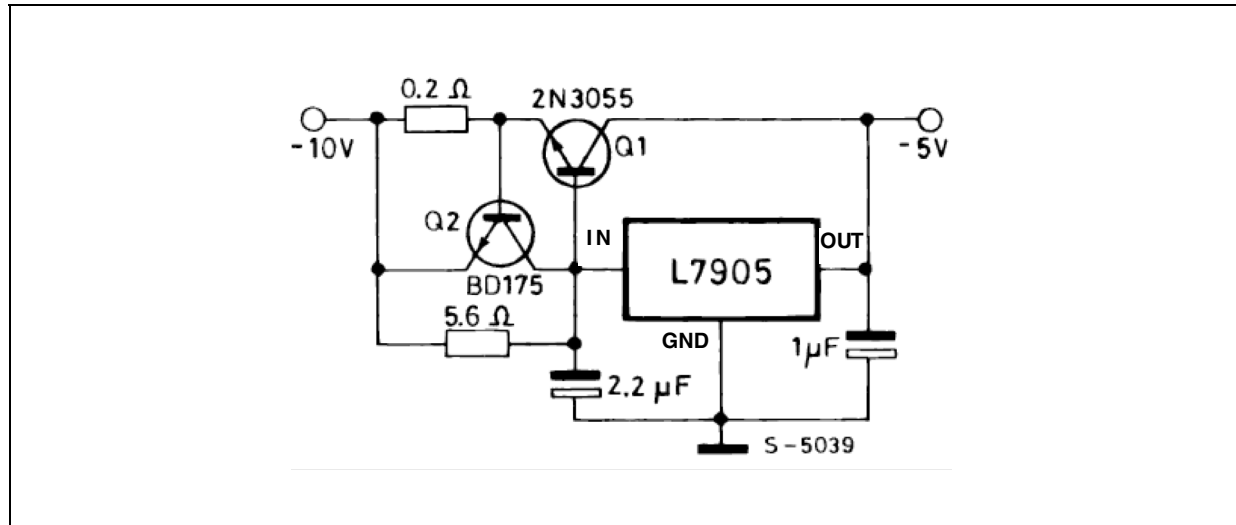
(*) Against potential latch-up problems.

Figure 6. Circuit for increasing output voltage



C3 Optional for improved transient response and ripple rejection.

Figure 7. High current negative regulator (-5 V / 4 A with 5 A current limiting)

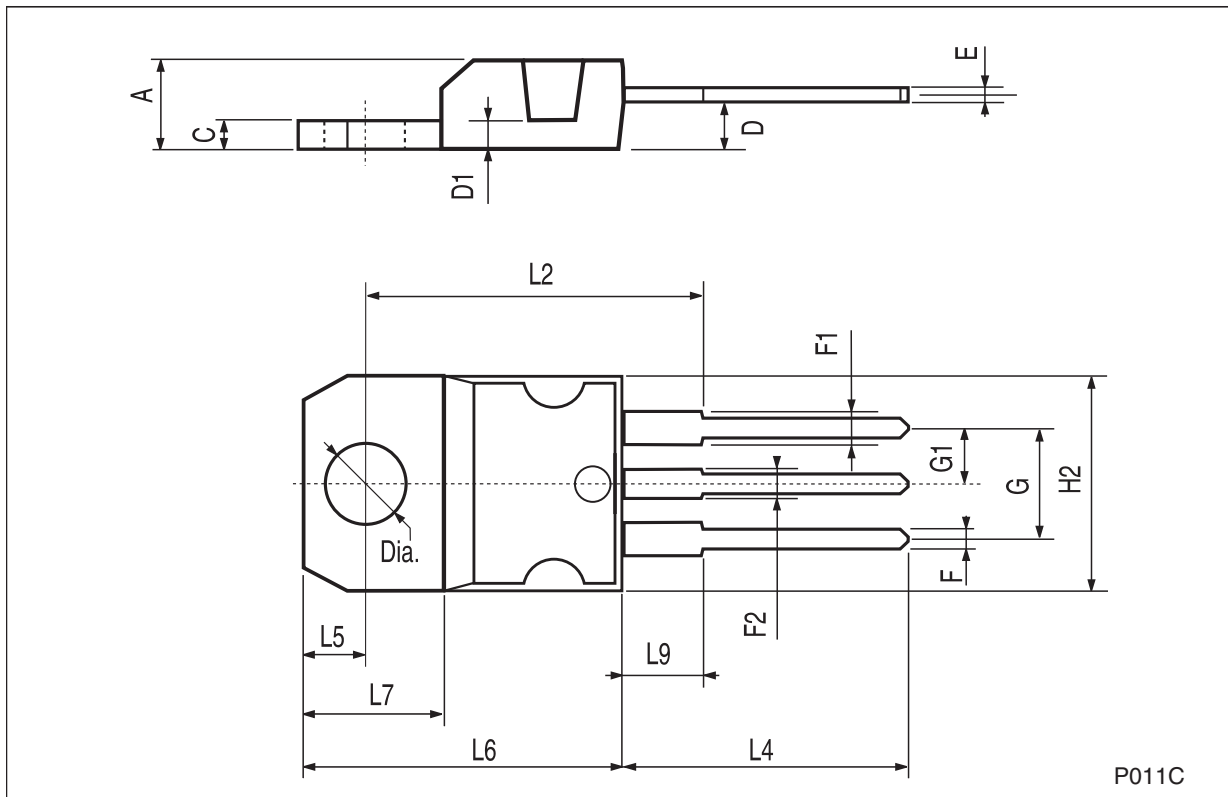


7 Package mechanical data

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



P011C

Figure 8. Drawing dimension D²PAK (type STD-ST)

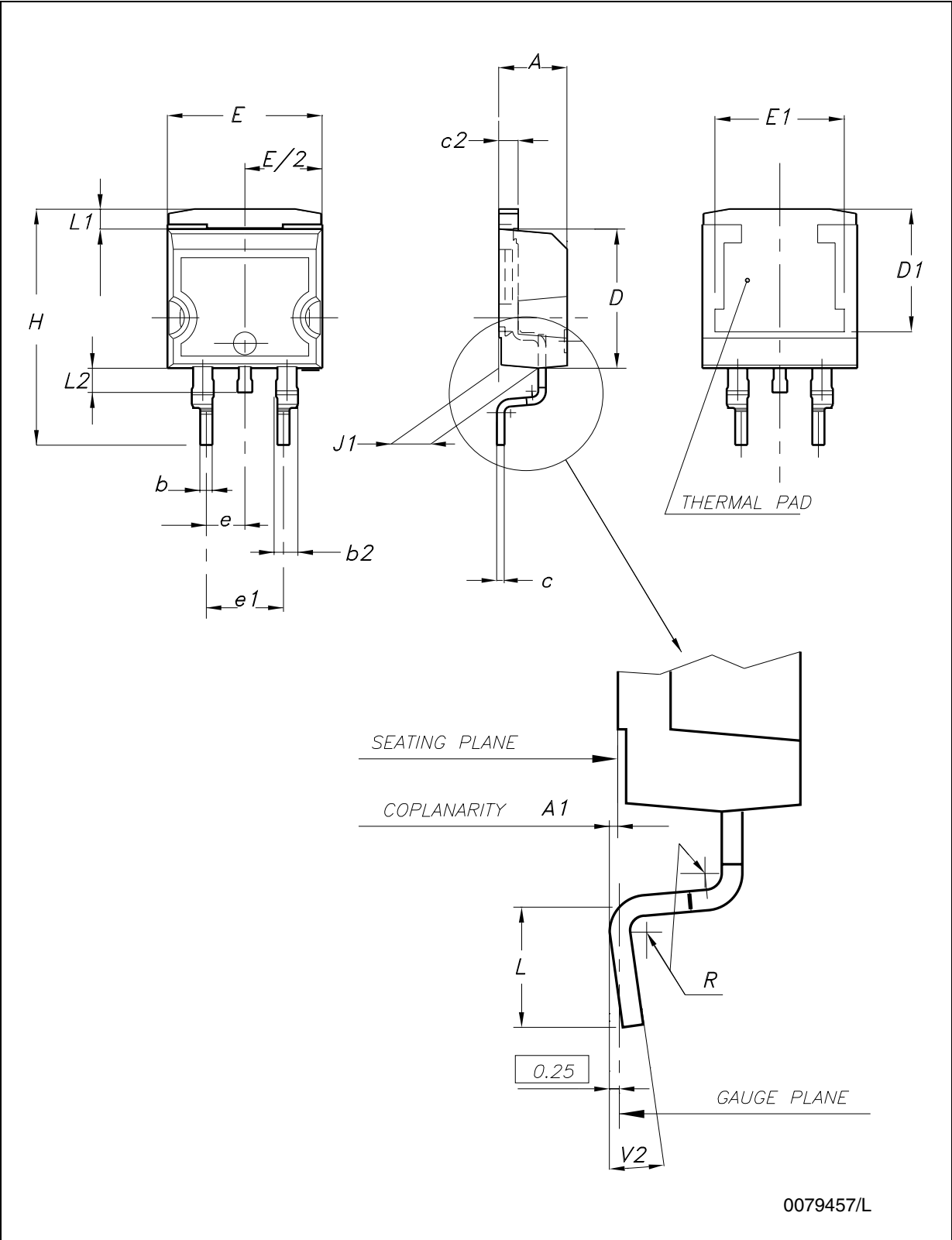


Figure 9. Drawing dimension D²PAK (type WOOSEOK-subcon.)

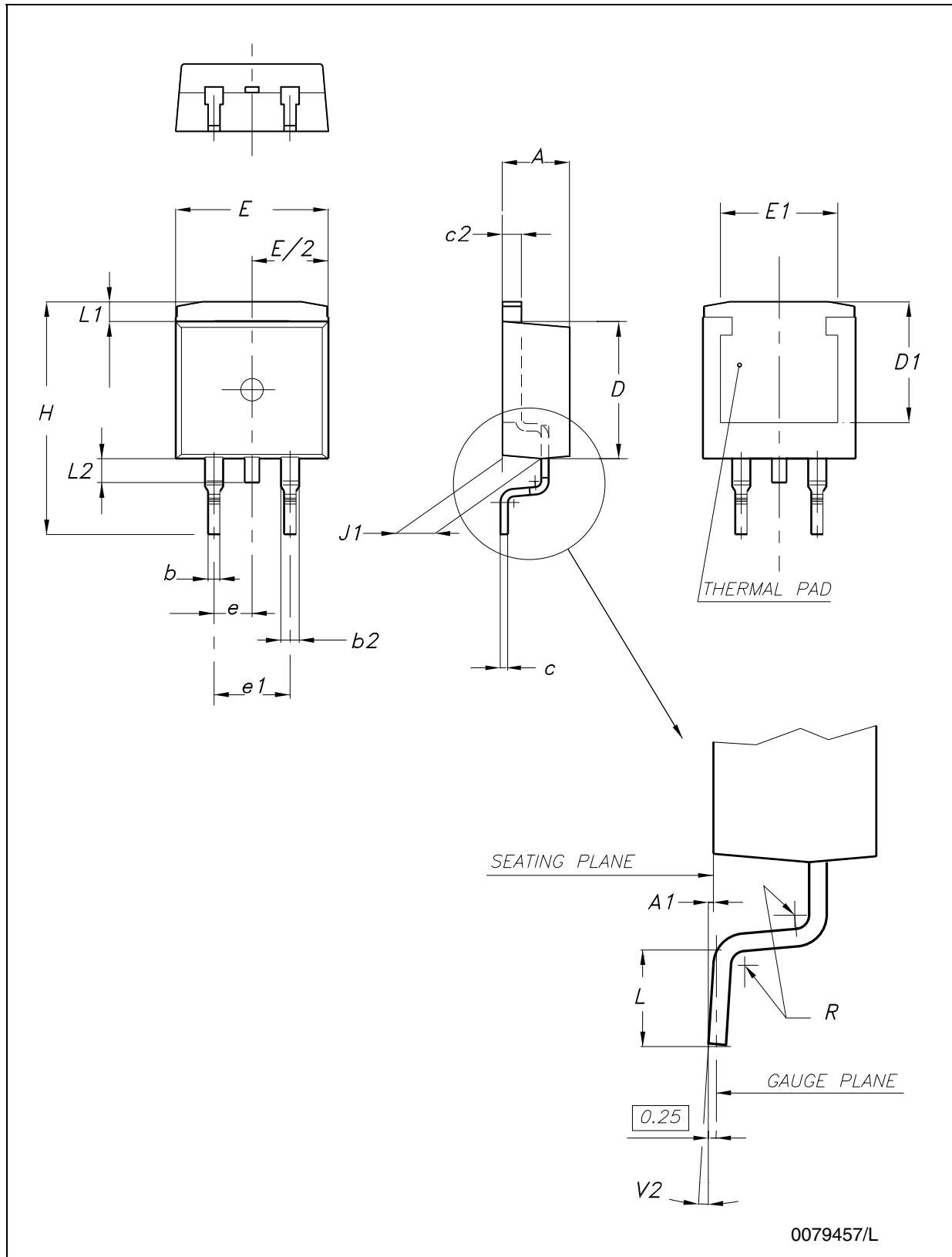


Table 9. D²PAK mechanical data

Dim.	Type STD-ST			Type WOOSEOK-subcon.		
	mm.			mm.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	4.30		4.70
A1	0.03		0.23	0		0.20
b	0.70		0.93	0.70		0.90
b2	1.14		1.70	1.17		1.37
c	0.45		0.60	0.45	0.50	0.60
c2	1.23		1.36	1.25	1.30	1.40
D	8.95		9.35	9	9.20	9.40
D1	7.50			7.50		
E	10		10.40	9.80		10.20
E1	8.50			7.50		
e		2.54			2.54	
e1	4.88		5.28		5.08	
H	15		15.85	15	15.30	15.60
J1	2.49		2.69	2.20		2.60
L	2.29		2.79	1.79		2.79
L1	1.27		1.40	1		1.40
L2	1.30		1.75	1.20		1.60
R		0.4			0.30	
V2	0°		8°	0°		3°

Note: The D²PAK package coming from the subcontractor WOOSEOK is fully compatible with the ST's package suggested footprint.

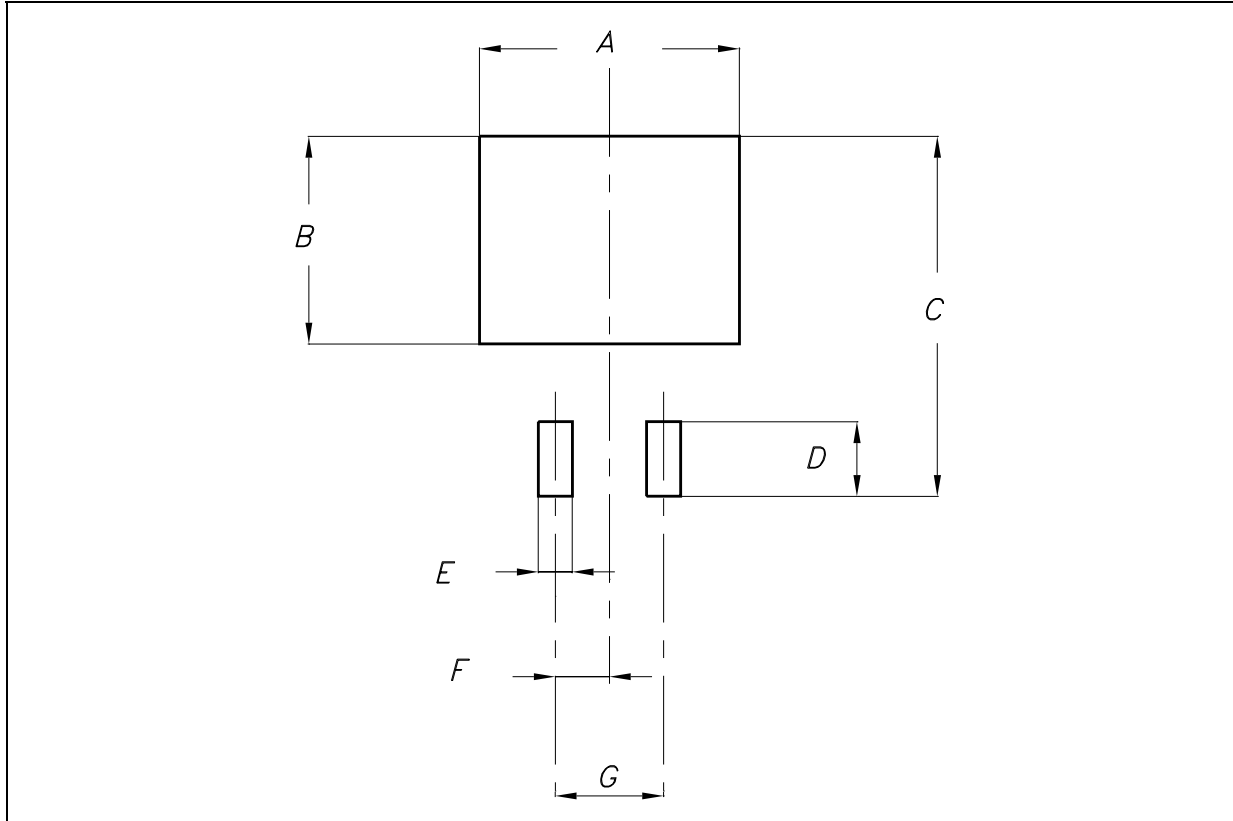
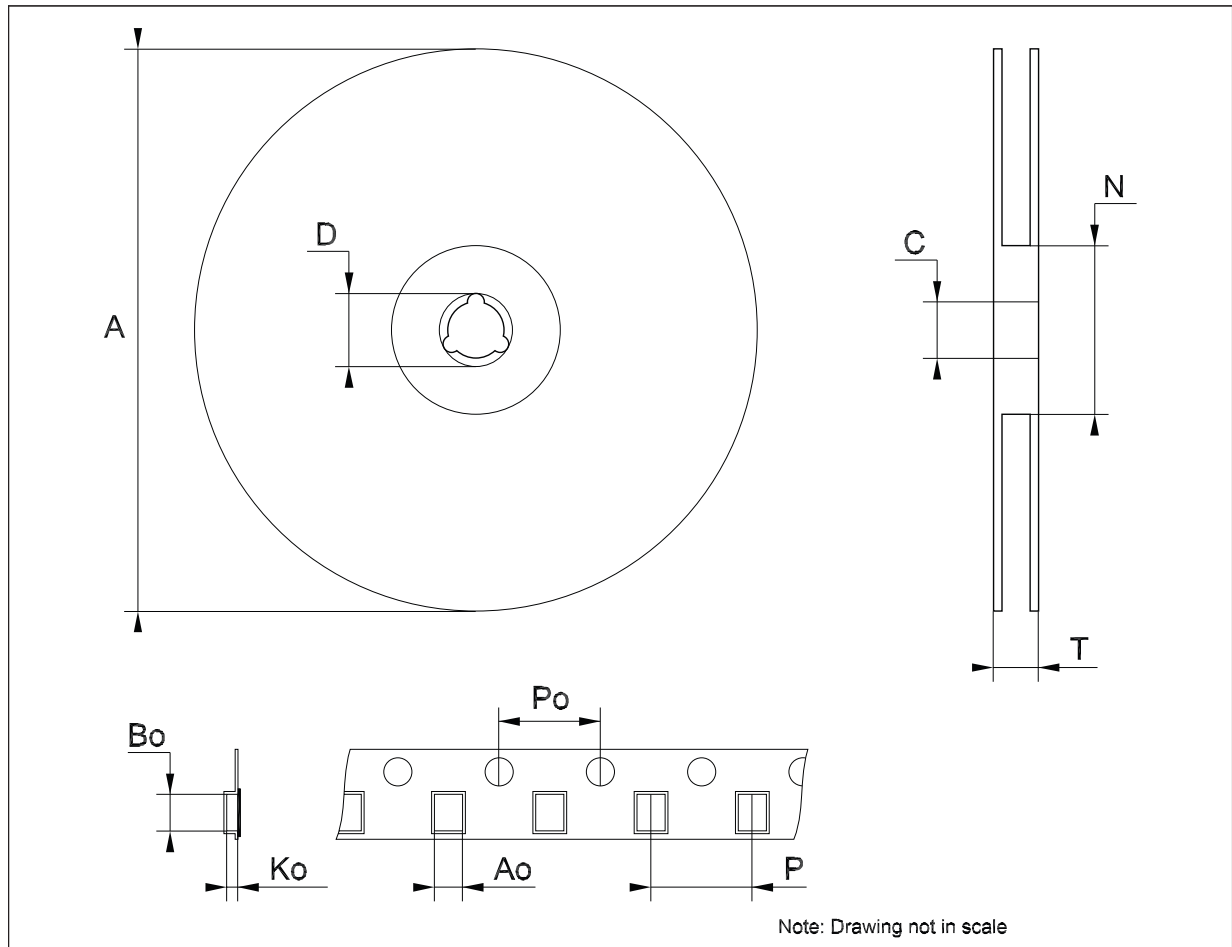
Figure 10. D²PAK footprint recommended data

Table 10. Footprint data

	Values	
	mm.	inch.
A	12.20	0.480
B	9.75	0.384
C	16.90	0.665
D	3.50	0.138
E	1.60	0.063
F	2.54	0.100
G	5.08	0.200

Tape & reel D²PAK-P²PAK-D²PAK/A-P²PAK/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



8 Revision history

Table 11. Document revision history

Date	Revision	Changes
22-Jun-2004	7	Order codes updated.
12-Dec-2007	8	Added Table 1 .

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