

## Negative voltage regulators

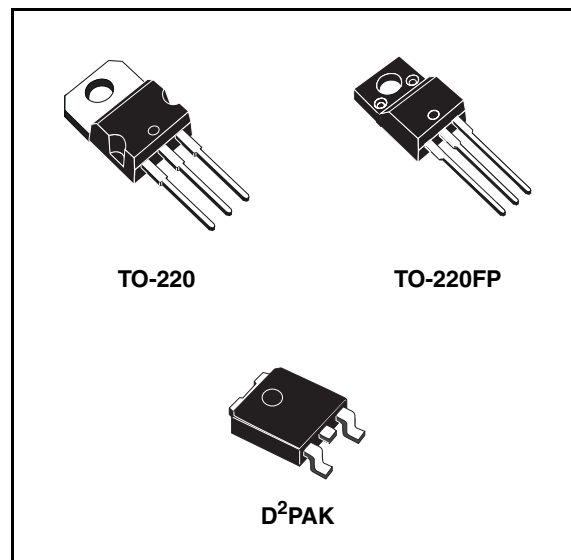
### Features

- Output current up to 1.5 A
- Output voltages of -5; -8; -12; -15; -20 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection

### Description

The L79XXC series of three-terminal negative regulators is available in TO-220, TO-220FP and D<sup>2</sup>PAK packages and several fixed output voltages, making it useful in a wide range of applications. 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 L78XX 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.



**Table 1. Device summary**

Part numbers	Order codes			Output voltages
	TO-220 (A type)	D <sup>2</sup> PAK	TO-220FP	
L7905C	L7905CV	L7905CD2T-TR	L7905CP	-5 V
L7908C	L7908CV			-8 V
L7912C	L7912CV	L7912CD2T-TR	L7912CP	-12 V
L7915C	L7915CV	L7915CD2T-TR	L7915CP	-15 V
L7920C	L7920CV	L7920CD2T-TR <sup>(1)</sup>		-20 V

1. Available on request.

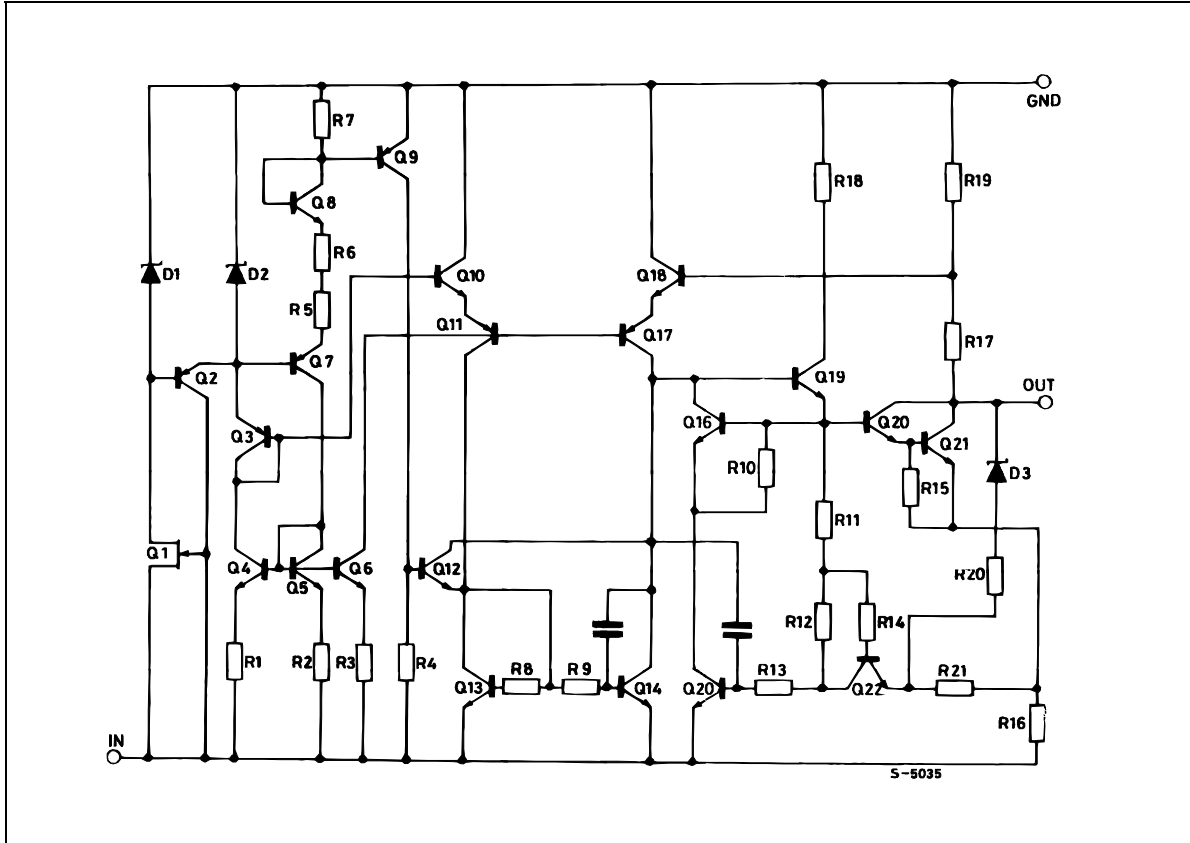
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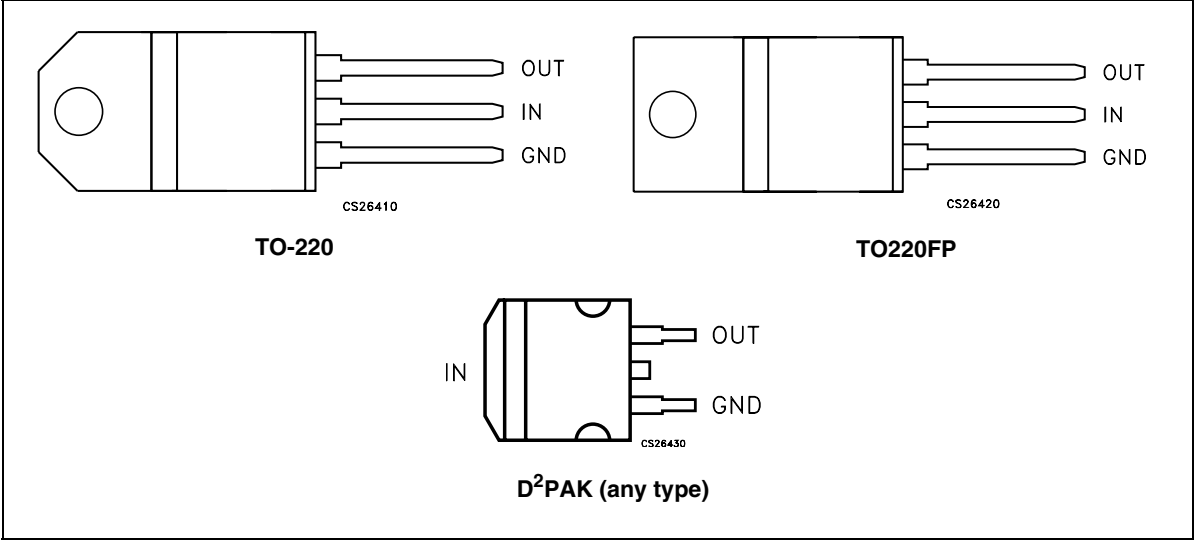
# 1 Diagram

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
		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 150	°C

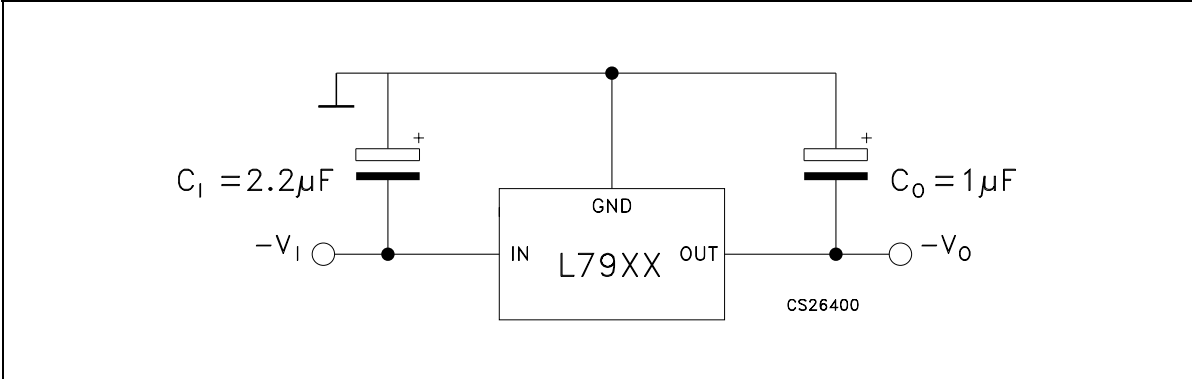
*Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied*

**Table 3. Thermal data**

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

# 4 Test circuit

Figure 3. Test circuit



## 5 Electrical characteristics

**Table 4. Electrical characteristics of L7905C** (refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $V_I = -10$  V,  $I_O = 500$  mA,  $C_I = 2.2$   $\mu$ F,  $C_O = 1$   $\mu$ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$T_J = 25^\circ\text{C}$	-4.8	-5	-5.2	V
$V_O$	Output voltage	$I_O = -5$ mA to $-1$ A, $P_O \leq 15$ W $V_I = -8$ to $-20$ V	-4.75	-5	-5.25	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
$\Delta I_d$	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	$B = 10\text{Hz}$ to $100\text{kHz}$ , $T_J = 25^\circ\text{C}$		100		$\mu$ 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		1.4		V
$I_{sc}$	Short circuit current			2.1		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 L7908C** (refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $V_I = -14$  V,  $I_O = 500$  mA,  $C_I = 2.2$   $\mu$ F,  $C_O = 1$   $\mu$ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$T_J = 25^\circ\text{C}$	-7.7	-8	-8.3	V
$V_O$	Output voltage	$I_O = -5$ mA to $-1$ A, $P_O \leq 15$ W $V_I = -11.5$ to $-23$ V	-7.6	-8	-8.4	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -10.5$ to $-25$ V, $T_J = 25^\circ\text{C}$			160	mV
		$V_I = -11$ to $-17$ V, $T_J = 25^\circ\text{C}$			80	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5$ mA to $1.5$ A, $T_J = 25^\circ\text{C}$			160	mV
		$I_O = 250$ to $750$ mA, $T_J = 25^\circ\text{C}$			80	
$I_d$	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
$\Delta I_d$	Quiescent current change	$I_O = 5$ mA to $1$ A			0.5	mA
		$V_I = -11.5$ to $-25$ V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5$ mA		-0.6		mV/°C
eN	Output noise voltage	$B = 10\text{Hz}$ to $100\text{kHz}$ , $T_J = 25^\circ\text{C}$		175		$\mu$ 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

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 L7912C** (refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $V_I = -19$  V,  $I_O = 500$  mA,  $C_I = 2.2$   $\mu$ F,  $C_O = 1$   $\mu$ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$T_J = 25^\circ\text{C}$	-11.5	-12	-12.5	V
$V_O$	Output voltage	$I_O = -5$ mA to $-1$ A, $P_O \leq 15$ W $V_I = -15.5$ to $-27$ V	-11.4	-12	-12.6	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
$\Delta I_d$	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 $100\text{kHz}$ , $T_J = 25^\circ\text{C}$		200		$\mu$ 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

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 L7915C** (refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $V_I = -23$  V,  $I_O = 500$  mA,  $C_I = 2.2$   $\mu$ F,  $C_O = 1$   $\mu$ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$T_J = 25^\circ\text{C}$	-14.4	-15	-15.6	V
$V_O$	Output voltage	$I_O = -5$ mA to $-1$ A, $P_O \leq 15$ W $V_I = -18.5$ to $-30$ V	-14.3	-15	-15.7	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
$\Delta I_d$	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 $100\text{kHz}$ , $T_J = 25^\circ\text{C}$		250		$\mu$ 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

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.

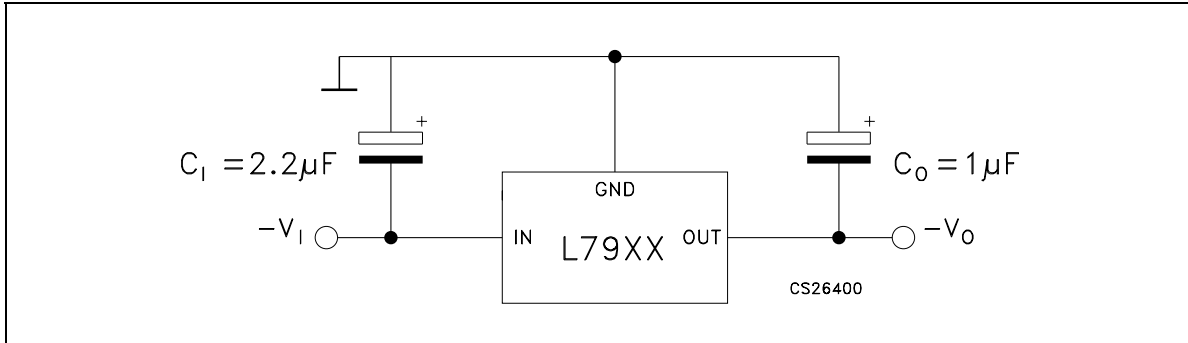
**Table 8. Electrical characteristics of L7920C** (refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $V_I = -29$  V,  $I_O = 500$  mA,  $C_I = 2.2$   $\mu$ F,  $C_O = 1$   $\mu$ F unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$T_J = 25^\circ\text{C}$	-19.2	-20	-20.8	V
$V_O$	Output voltage	$I_O = -5$ mA to $-1$ A, $P_O \leq 15$ W $V_I = -24$ to $-35$ V	-19	-20	-21	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = -23$ to $-35$ V, $T_J = 25^\circ\text{C}$			400	mV
		$V_I = -26$ to $-32$ V, $T_J = 25^\circ\text{C}$			200	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5$ mA to $1.5$ A, $T_J = 25^\circ\text{C}$			400	mV
		$I_O = 250$ to $750$ mA, $T_J = 25^\circ\text{C}$			200	
$I_d$	Quiescent current	$T_J = 25^\circ\text{C}$			3	mA
$\Delta I_d$	Quiescent current change	$I_O = 5$ mA to $1$ A			0.5	mA
		$V_I = -24$ to $-35$ V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5$ mA		-1.1		mV/°C
eN	Output noise voltage	$B = 10\text{Hz}$ to $100\text{kHz}$ , $T_J = 25^\circ\text{C}$		350		$\mu$ 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			0.9		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.

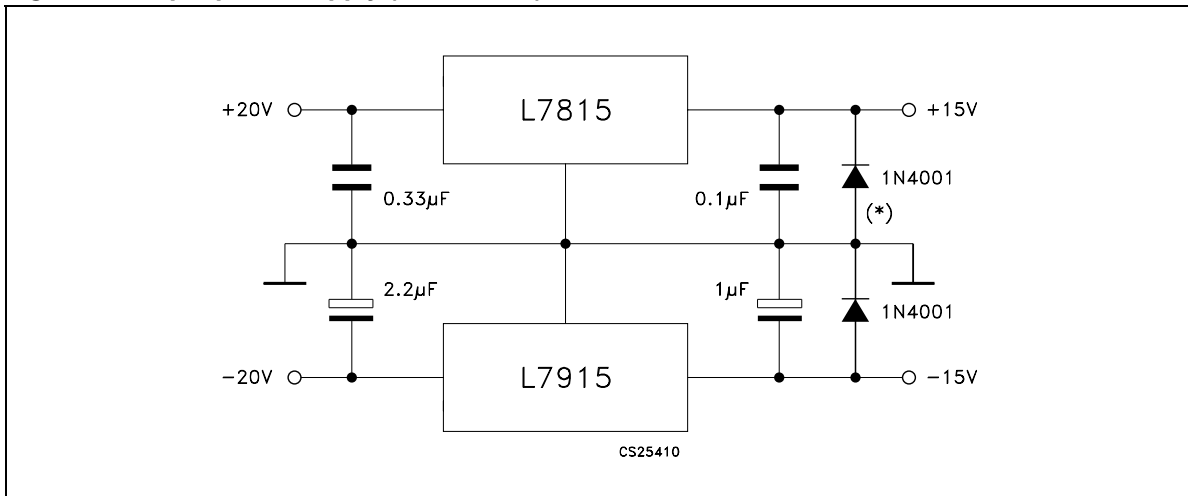
## 6 Application information

Figure 4. Fixed output regulator



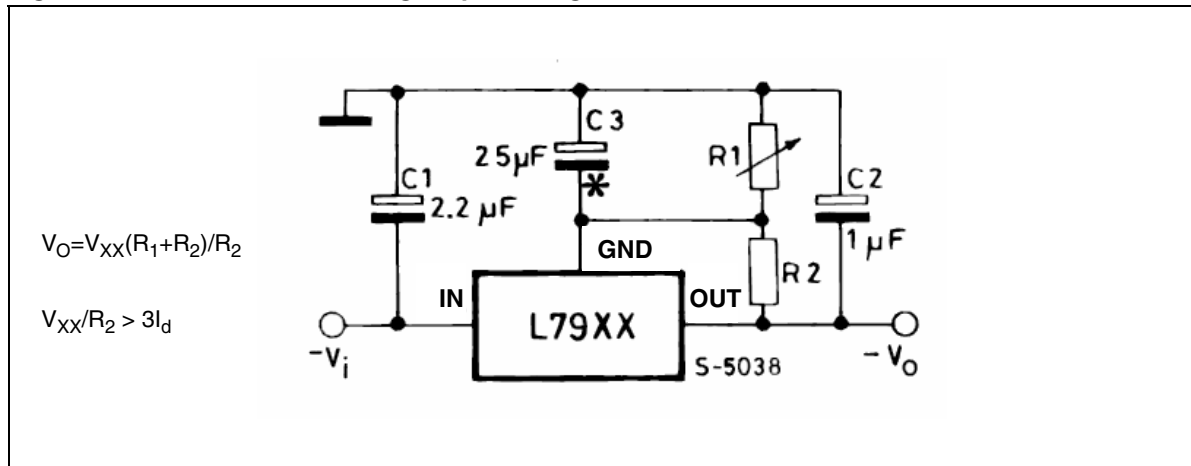
1. To specify an output voltage, substitute voltage value for "XX".
2. Required for stability. For value given, capacitor must be solid tantalum. If aluminium electrolytic are used, at least ten times value should be selected. C1 is required if regulator is located an appreciable distance from power 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 ( $\pm 15\text{ V} - 1\text{ A}$ )



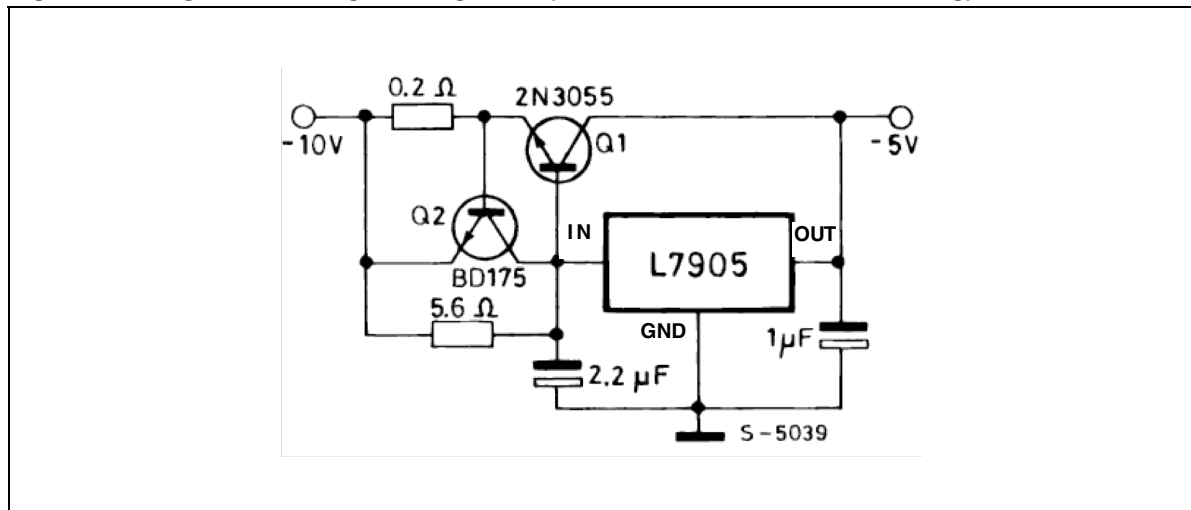
(\*) Against potential latch-up problems.

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)

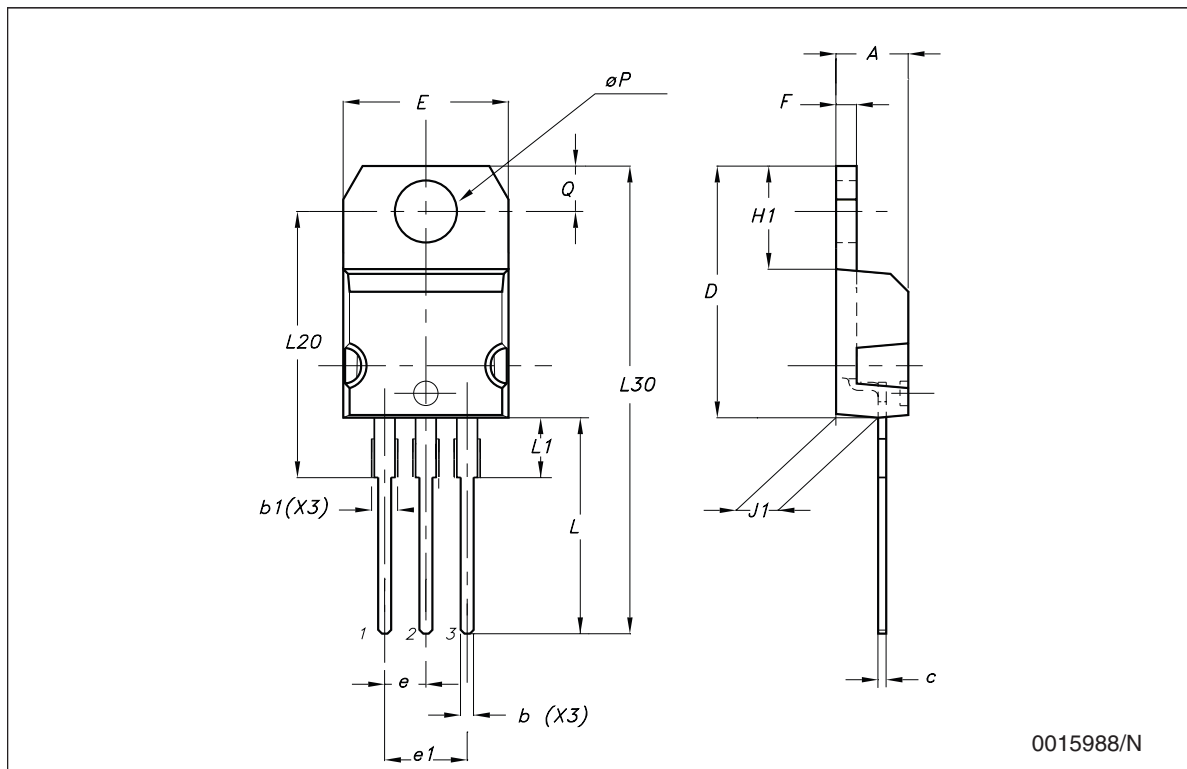


## 7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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](http://www.st.com).

## TO-220 (A type) mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.035
b1	1.15		1.70	0.045		0.067
c	0.49		0.70	0.019		0.028
D	15.25		15.75	0.600		0.620
E	10.0		10.40	0.394		0.409
e	2.4		2.7	0.094		0.106
e1	4.95		5.15	0.195		0.203
F	1.23		1.32	0.048		0.052
H1	6.2		6.6	0.244		0.260
J1	2.40		2.72	0.094		0.107
L	13.0		14.0	0.512		0.551
L1	3.5		3.93	0.138		0.155
L20		16.4			0.646	
L30		28.9			1.138	
$\phi P$	3.75		3.85	0.148		0.152
Q	2.65		2.95	0.104		0.116



**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

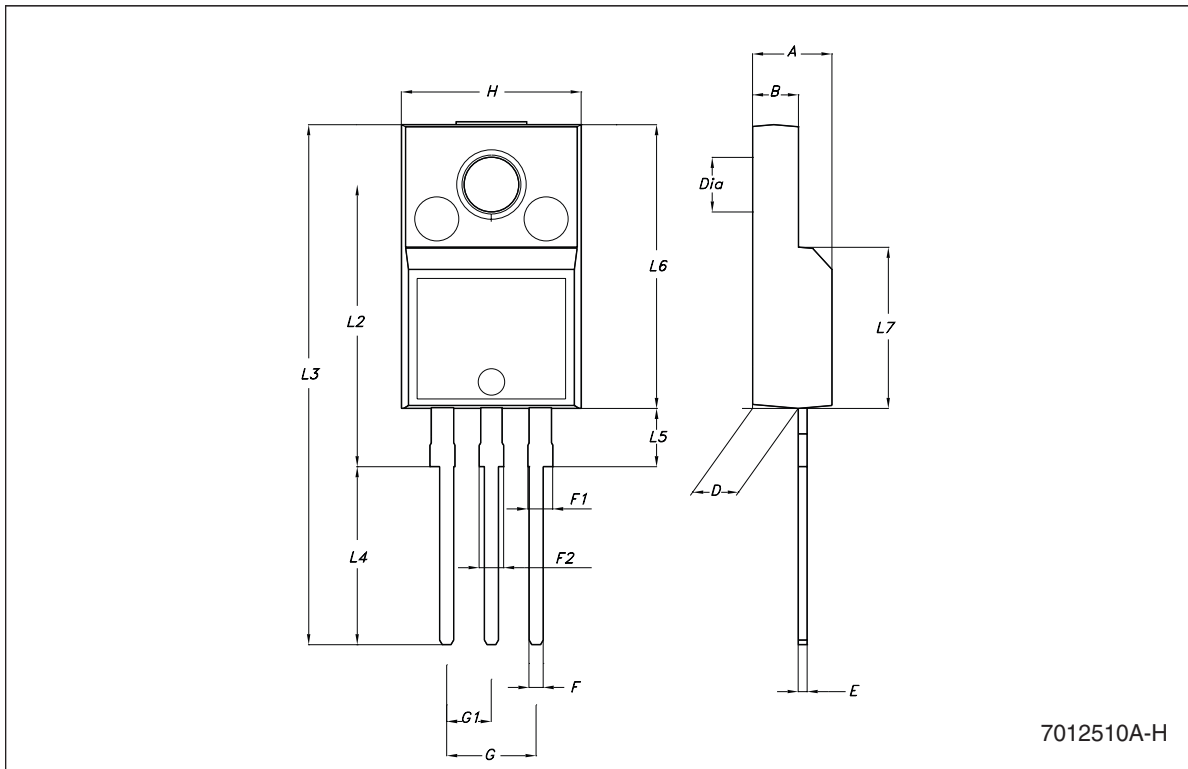


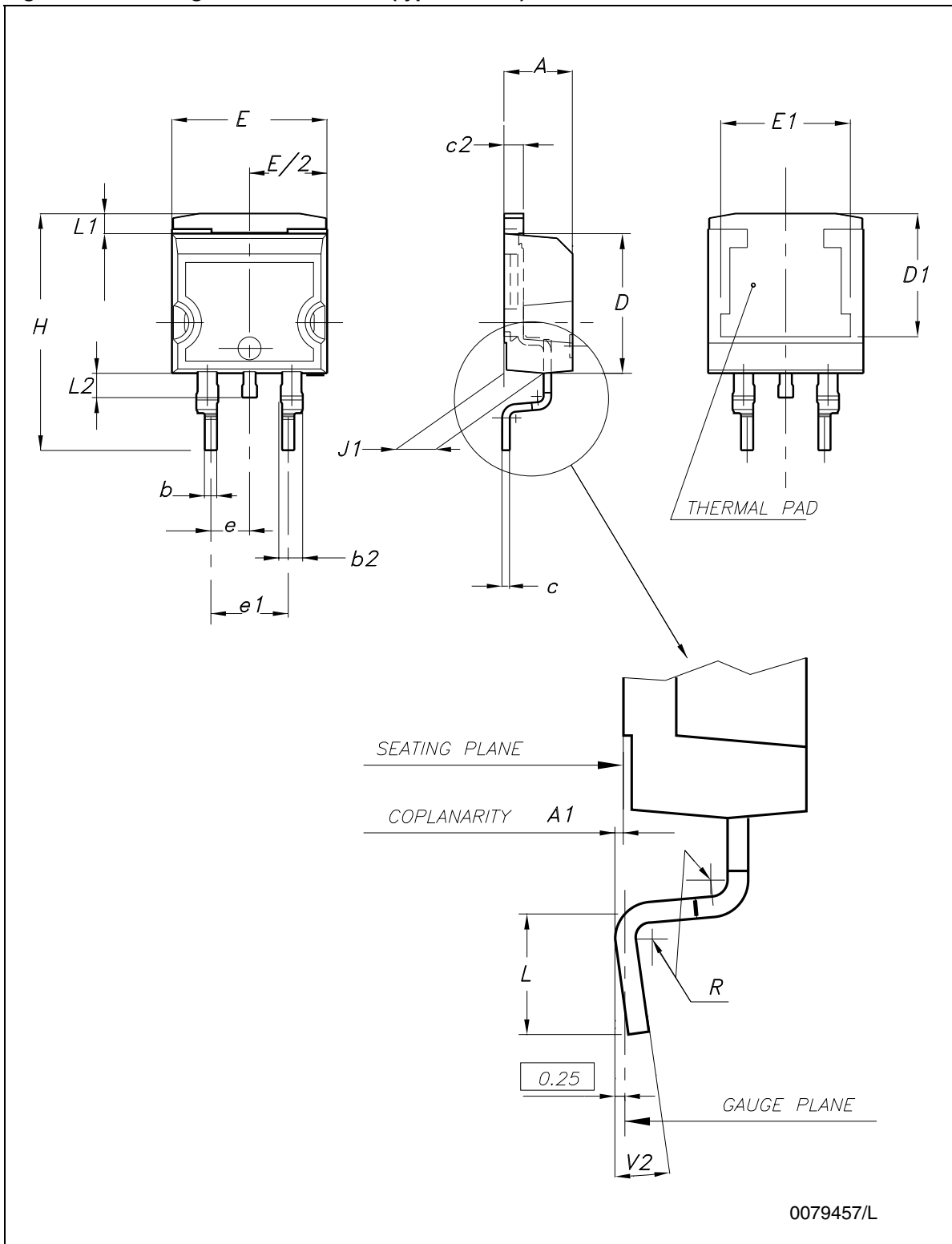
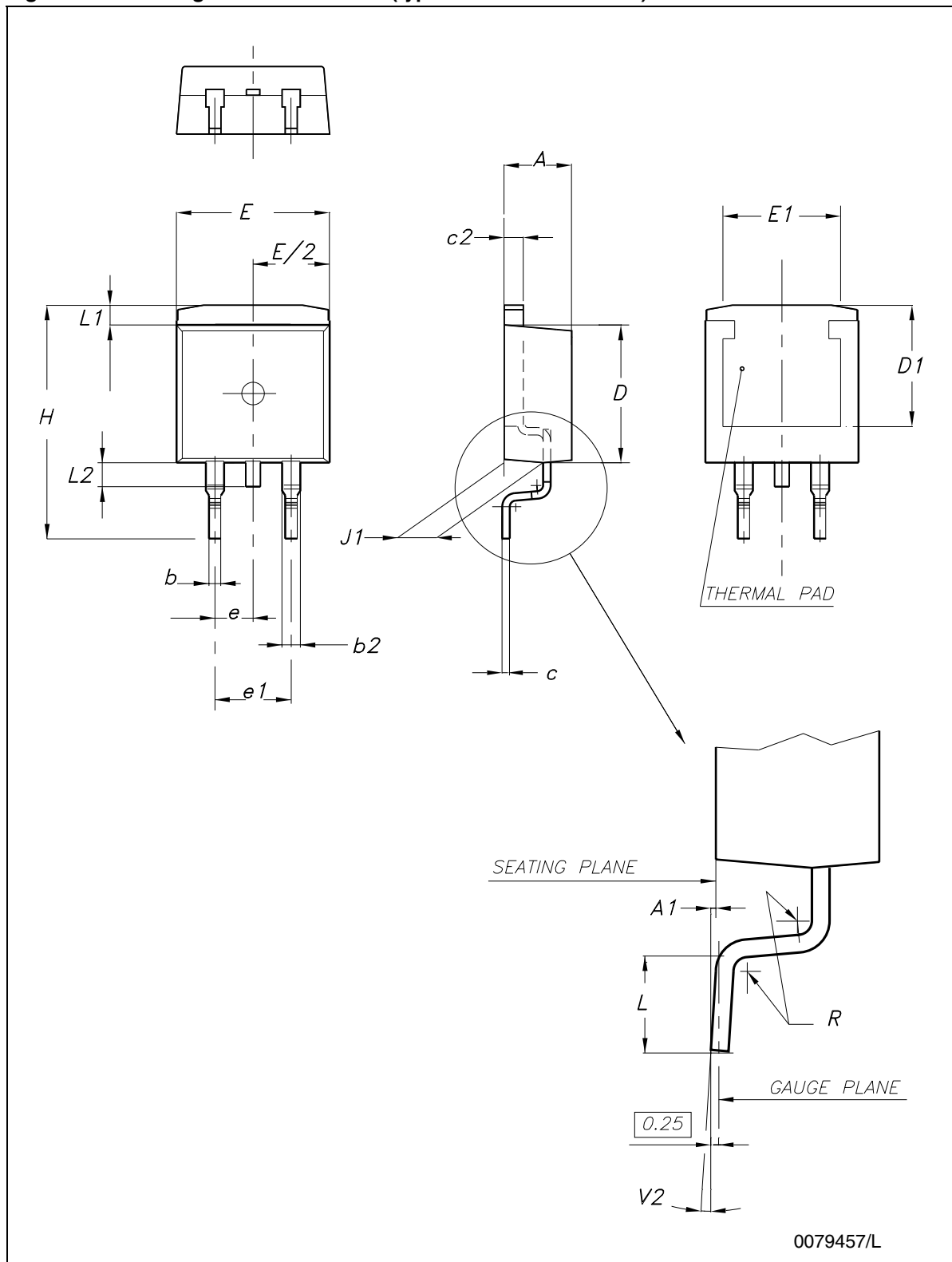
Figure 8. Drawing dimension D<sup>2</sup>PAK (type STD-ST)

Figure 9. Drawing dimension D<sup>2</sup>PAK (type WOOSEOK-subcon.)



0079457/L



Table 9. D<sup>2</sup>PAK 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 D<sup>2</sup>PAK package coming from the subcontractor WOOSEOK is fully compatible with the ST's package suggested footprint.

Figure 10. D<sup>2</sup>PAK footprint recommended data

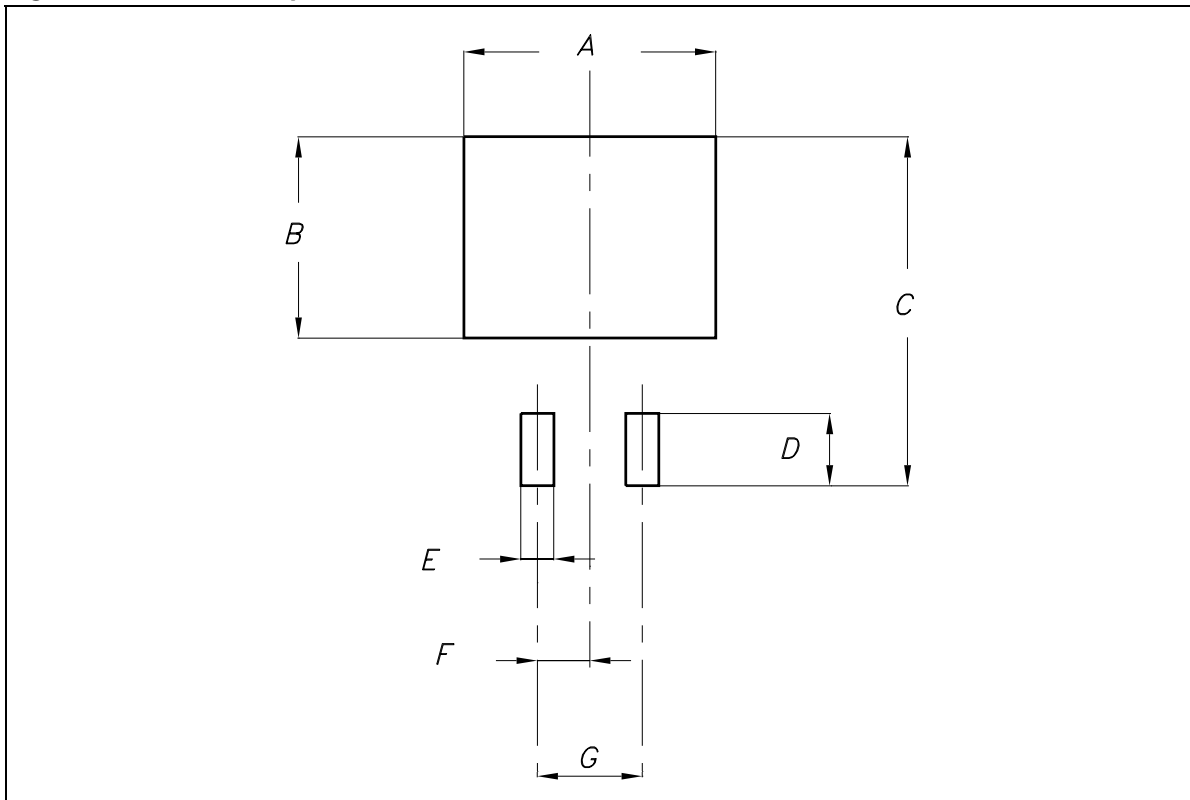
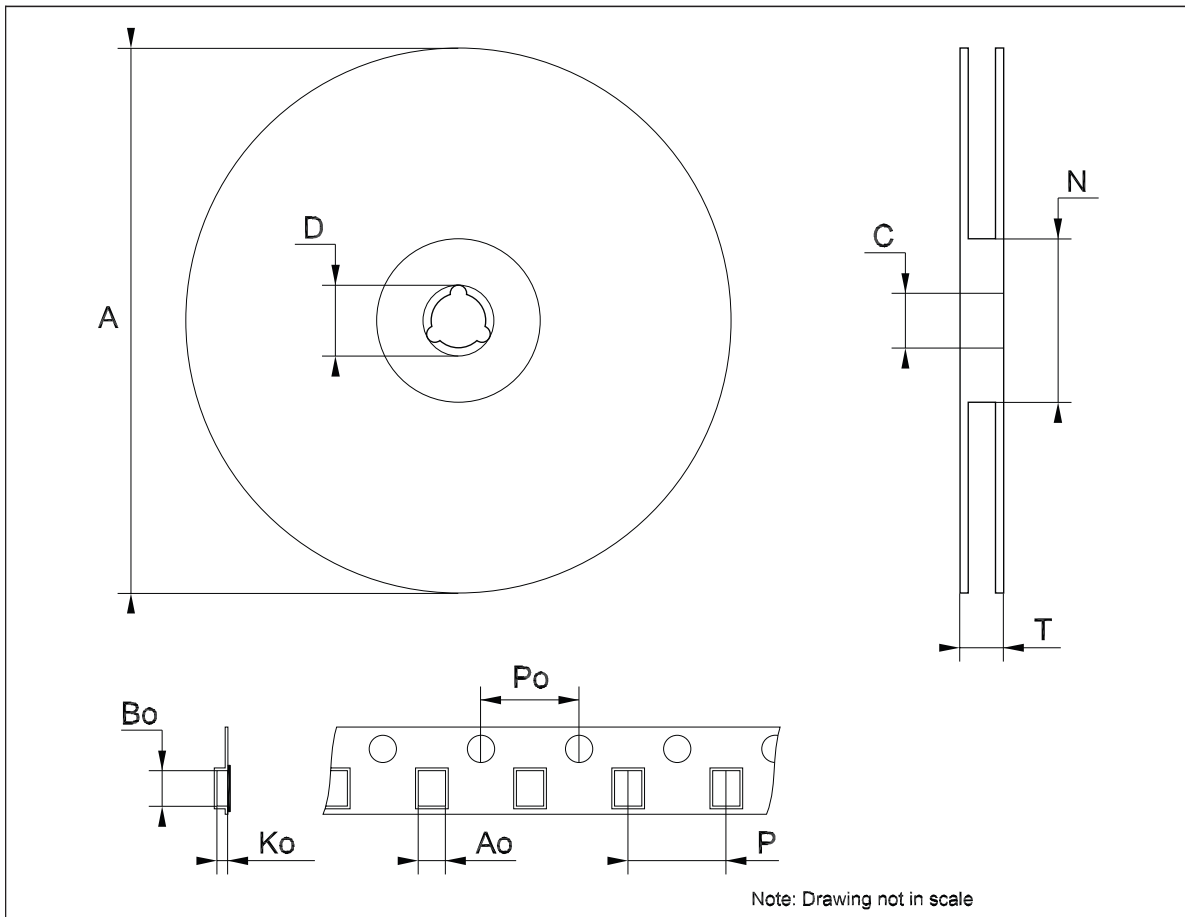


Table 10. Footprint data

Dim.	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 D<sup>2</sup>PAK-P<sup>2</sup>PAK-D<sup>2</sup>PAK/A-P<sup>2</sup>PAK/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	9	Order Codes updated Table 3, pag. 3.
31-Aug-2005	10	Add new order codes (TO-220 E Type) on Table 3, pag. 3.
19-Jan-2007	11	D <sup>2</sup> PAK mechanical data has been updated, add footprint data and the document reformatted.
06-Jun-2007	12	Order codes updated.
25-Oct-2007	13	Modified: <a href="#">Figure 3</a> , <a href="#">Figure 4</a> , <a href="#">Figure 6</a> and <a href="#">Figure 7</a> .
05-Dec-2007	14	Modified: <a href="#">Table 1</a> .
18-Feb-2008	15	Modified: <a href="#">Table 1 on page 1</a> .

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