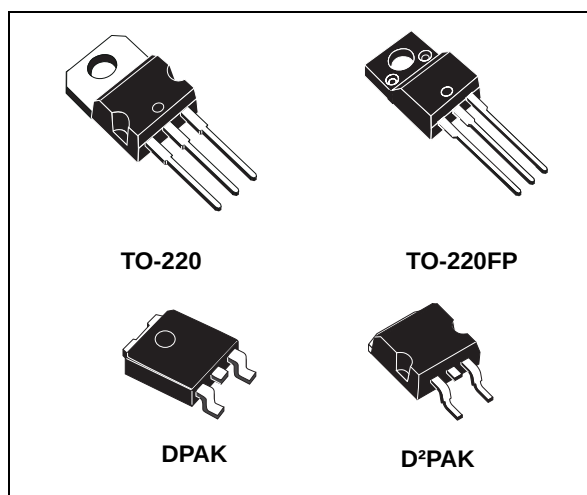


Positive voltage regulator ICs

Datasheet - production data



Description

The L78 series of three-terminal positive regulators is available in TO-220, TO-220FP, D²PAK and DPAK 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. Each type embeds internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

Features

- Output current up to 1.5 A
- Output voltages of 5; 6; 8; 8.5; 9; 12; 15; 18; 24 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection
- 2 % output voltage tolerance (A version)
- Guaranteed in extended temperature range (A version)

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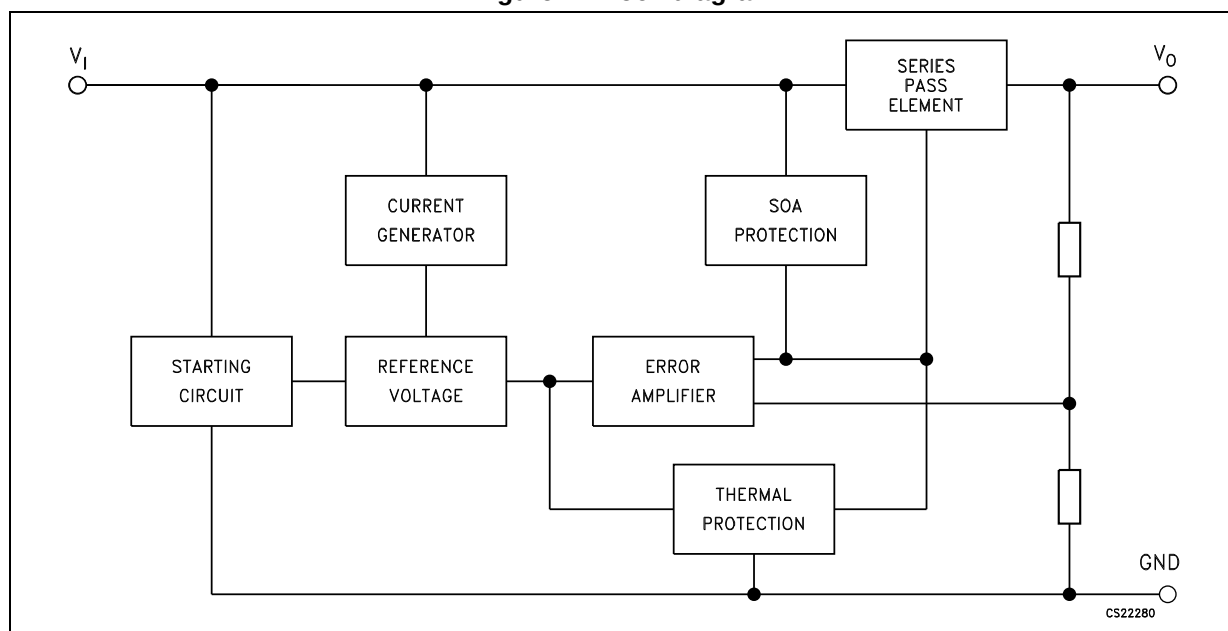
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1 Diagram

Figure 1. Block diagram



2 Pin configuration

Figure 2. Pin connections (top view)

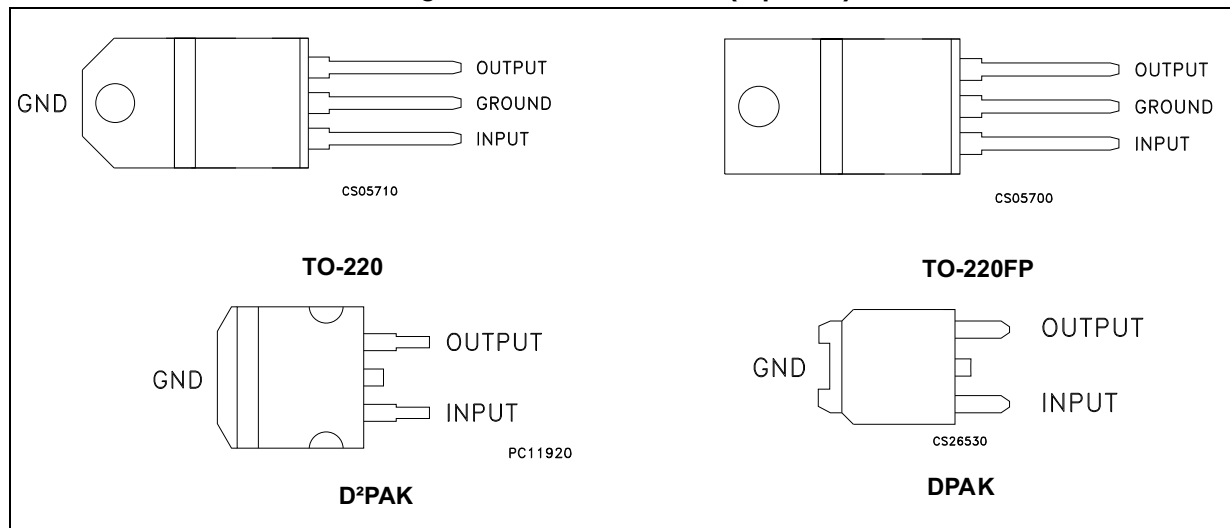
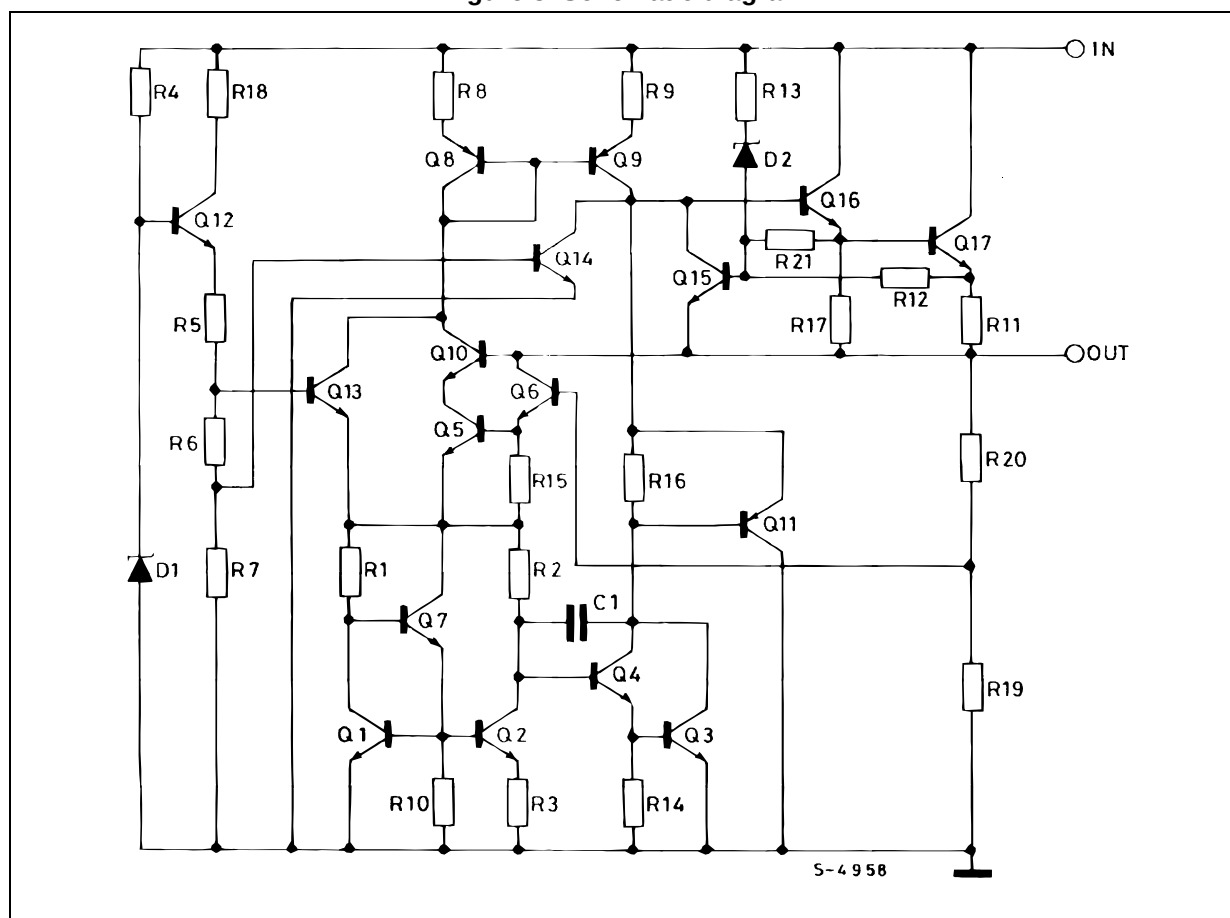


Figure 3. Schematic diagram



3 Maximum ratings

Table 1. Absolute maximum ratings

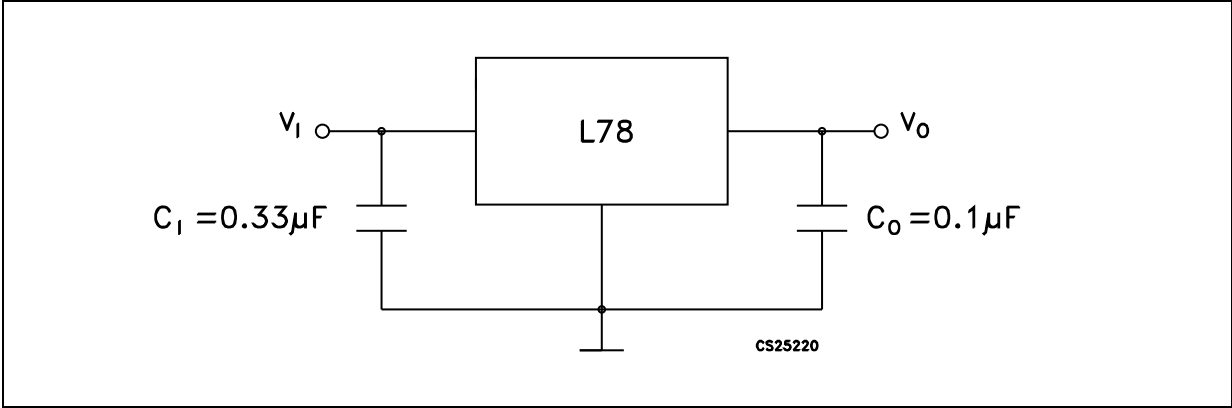
Symbol	Parameter		Value	Unit
V _I	DC input voltage	for V _O = 5 to 18 V	35	V
		for V _O = 20, 24 V	40	
I _O	Output current		Internally limited	
P _D	Power dissipation		Internally limited	
T _{STG}	Storage temperature range		-65 to 150	°C
T _{OP}	Operating junction temperature range	for L78xxC, L78xxAC	0 to 125	°C
		for L78xxAB	-40 to 125	

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

Table 2. Thermal data

Symbol	Parameter	D ² PAK	DPAK	TO-220	TO-220FP	Unit
R _{thJC}	Thermal resistance junction-case	3	8	5	5	°C/W
R _{thJA}	Thermal resistance junction-ambient	62.5	100	50	60	°C/W

Figure 4. Application circuits



4 Test circuits

Figure 5. DC parameter

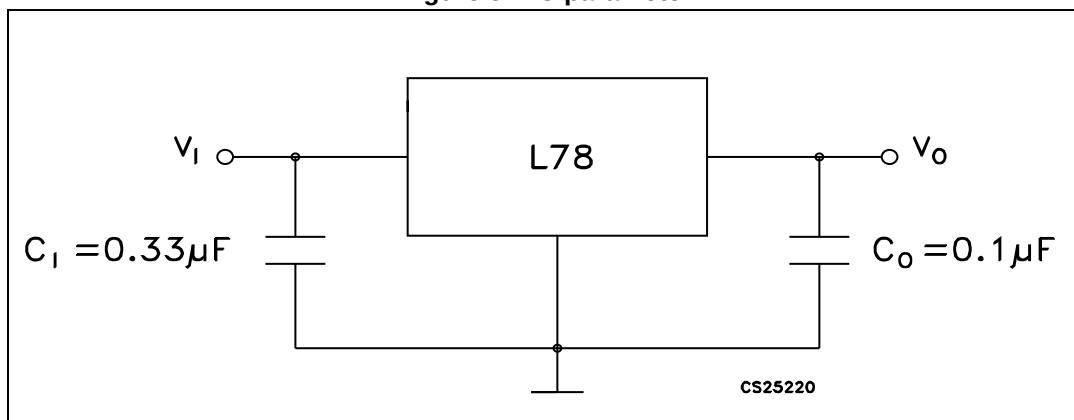


Figure 6. Load regulation

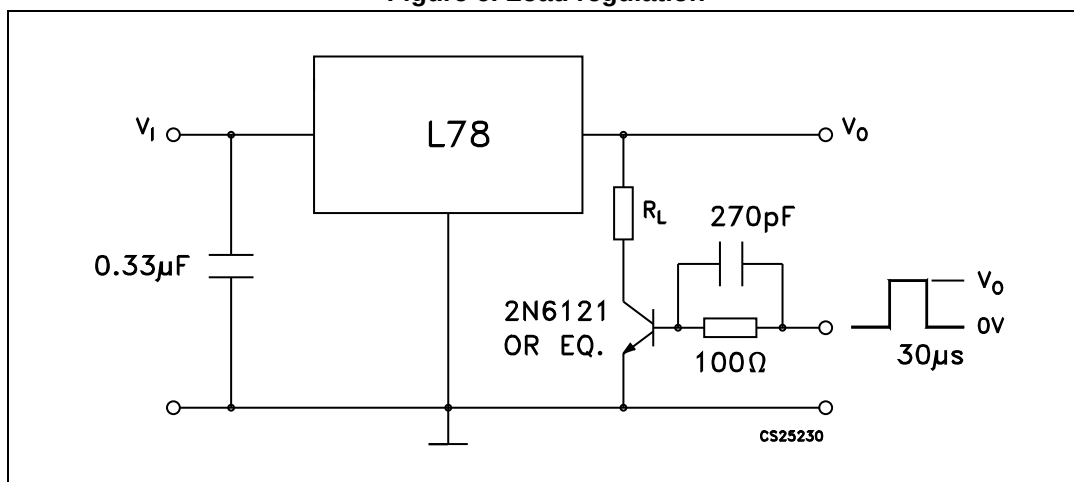
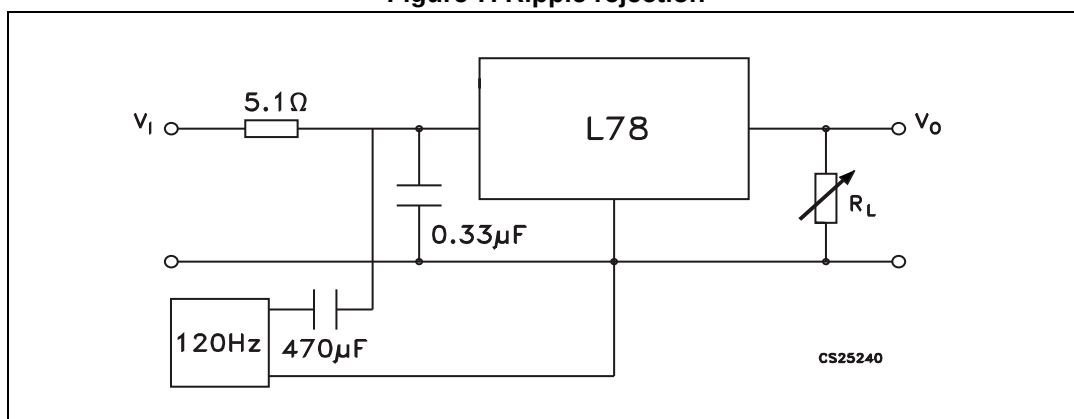


Figure 7. Ripple rejection



5 Electrical characteristics

$V_I = 10\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ °C}$ (L7805AC), $T_J = -40\text{ to }125\text{ °C}$ (L7805AB), unless otherwise specified^(a).

Table 3. Electrical characteristics of L7805A

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25\text{ °C}$	4.9	5	5.1	V
V_O	Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 7.5\text{ to }18\text{ V}$	4.8	5	5.2	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 18\text{ to }20\text{ V}$, $T_J = 25\text{ °C}$	4.8	5	5.2	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 7.5\text{ to }25\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25\text{ °C}$		7	50	mV
		$V_I = 8\text{ to }12\text{ V}$		10	50	mV
		$V_I = 8\text{ to }12\text{ V}$, $T_J = 25\text{ °C}$		2	25	mV
		$V_I = 7.3\text{ to }20\text{ V}$, $T_J = 25\text{ °C}$		7	50	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25\text{ °C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		8	50	
I_q	Quiescent current	$T_J = 25\text{ °C}$		4.3	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 8\text{ to }23\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 7.5\text{ to }20\text{ V}$, $T_J = 25\text{ °C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 8\text{ to }18\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		68		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25\text{ °C}$		2		V
eN	Output noise voltage	$T_A = 25\text{ °C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		17		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25\text{ °C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25\text{ °C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-1.1		$\text{mV}/\text{°C}$

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.

a. Minimum load current for regulation is 5 mA.

$V_I = 11\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ °C}$ (L7806AC), $T_J = -40\text{ to }125\text{ °C}$ (L7806AB), unless otherwise specified^(b).

Table 4. Electrical characteristics of L7806A

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25\text{ °C}$	5.88	6	6.12	V
V_O	Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 8.6\text{ to }19\text{ V}$	5.76	6	6.24	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 19\text{ to }21\text{ V}$, $T_J = 25\text{ °C}$	5.76	6	6.24	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 8.6\text{ to }25\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25\text{ °C}$		9	60	mV
		$V_I = 9\text{ to }13\text{ V}$		11	60	mV
		$V_I = 9\text{ to }13\text{ V}$, $T_J = 25\text{ °C}$		3	30	mV
		$V_I = 8.3\text{ to }21\text{ V}$, $T_J = 25\text{ °C}$		9	60	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25\text{ °C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		10	50	
I_q	Quiescent current	$T_J = 25\text{ °C}$		4.3	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 9\text{ to }24\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 8.6\text{ to }21\text{ V}$, $T_J = 25\text{ °C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 9\text{ to }19\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		65		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25\text{ °C}$		2		V
eN	Output noise voltage	$T_A = 25\text{ °C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		17		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25\text{ °C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25\text{ °C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-0.8		$\text{mV}/\text{°C}$

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.

b. Minimum load current for regulation is 5 mA.

$V_I = 14\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ }^\circ\text{C}$ (L7808AC), $T_J = -40\text{ to }125\text{ }^\circ\text{C}$ (L7808AB), unless otherwise specified^(c).

Table 5. Electrical characteristics of L7808A

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	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 10.6\text{ to }21\text{ V}$	7.7	8	8.3	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 21\text{ to }23\text{ V}$, $T_J = 25^\circ\text{C}$	7.7	8	8.3	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 10.6\text{ to }25\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25^\circ\text{C}$		12	80	mV
		$V_I = 11\text{ to }17\text{ V}$		15	80	mV
		$V_I = 11\text{ to }17\text{ V}$, $T_J = 25^\circ\text{C}$		5	40	mV
		$V_I = 10.4\text{ to }23\text{ V}$, $T_J = 25^\circ\text{C}$		12	80	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25^\circ\text{C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		10	50	
I_q	Quiescent current	$T_J = 25^\circ\text{C}$		4.3	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 11\text{ to }23\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 10.6\text{ to }23\text{ V}$, $T_J = 25^\circ\text{C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 11.5\text{ to }21.5\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		62		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
eN	Output noise voltage	$T_A = 25^\circ\text{C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		18		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25^\circ\text{C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-0.8		$\text{mV}/^\circ\text{C}$

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.

c. Minimum load current for regulation is 5 mA.

$V_I = 15\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ }^\circ\text{C}$ (L7809AC), $T_J = -40\text{ to }125\text{ }^\circ\text{C}$ (L7809AB), unless otherwise specified^(d).

Table 6. Electrical characteristics of L7809A

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	8.82	9	9.18	V
V_O	Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 10.6\text{ to }22\text{ V}$	8.65	9	9.35	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 22\text{ to }24\text{ V}$, $T_J = 25^\circ\text{C}$	8.65	9	9.35	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 10.6\text{ to }25\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25^\circ\text{C}$		12	90	mV
		$V_I = 11\text{ to }17\text{ V}$		15	90	mV
		$V_I = 11\text{ to }17\text{ V}$, $T_J = 25^\circ\text{C}$		5	45	mV
		$V_I = 11.4\text{ to }23\text{ V}$, $T_J = 25^\circ\text{C}$		12	90	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25^\circ\text{C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		10	50	
I_q	Quiescent current	$T_J = 25^\circ\text{C}$		4.3	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 11\text{ to }25\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 10.6\text{ to }23\text{ V}$, $T_J = 25^\circ\text{C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 11.5\text{ to }21.5\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		61		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
eN	Output noise voltage	$T_A = 25^\circ\text{C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		18		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25^\circ\text{C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-0.8		$\text{mV}/^\circ\text{C}$

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.

d. Minimum load current for regulation is 5 mA.

$V_I = 19\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ }^\circ\text{C}$ (L7812AC), $T_J = -40\text{ to }125\text{ }^\circ\text{C}$ (L7812AB), unless otherwise specified^(e).

Table 7. Electrical characteristics of L7812A

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	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 14.8\text{ to }25\text{ V}$	11.5	12	12.5	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 25\text{ to }27\text{ V}$, $T_J = 25^\circ\text{C}$	11.5	12	12.5	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 14.8\text{ to }30\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25^\circ\text{C}$		13	120	mV
		$V_I = 16\text{ to }12\text{ V}$		16	120	mV
		$V_I = 16\text{ to }12\text{ V}$, $T_J = 25^\circ\text{C}$		6	60	mV
		$V_I = 14.5\text{ to }27\text{ V}$, $T_J = 25^\circ\text{C}$		13	120	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25^\circ\text{C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		10	50	
I_q	Quiescent current	$T_J = 25^\circ\text{C}$		4.4	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 15\text{ to }30\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 14.8\text{ to }27\text{ V}$, $T_J = 25^\circ\text{C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 15\text{ to }25\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		60		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
eN	Output noise voltage	$T_A = 25^\circ\text{C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		18		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25^\circ\text{C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-1		$\text{mV}/^\circ\text{C}$

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.

e. Minimum load current for regulation is 5 mA.

$V_I = 23\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ }^\circ\text{C}$ (L7815AC), $T_J = -40\text{ to }125\text{ }^\circ\text{C}$ (L7815AB), unless otherwise specified^(f).

Table 8. Electrical characteristics of L7815A

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	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 17.9\text{ to }28\text{ V}$	14.4	15	15.6	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 28\text{ to }30\text{ V}$, $T_J = 25^\circ\text{C}$	14.4	15	15.6	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 17.9\text{ to }30\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25^\circ\text{C}$		13	150	mV
		$V_I = 20\text{ to }26\text{ V}$		16	150	mV
		$V_I = 20\text{ to }26\text{ V}$, $T_J = 25^\circ\text{C}$		6	75	mV
		$V_I = 17.5\text{ to }30\text{ V}$, $T_J = 25^\circ\text{C}$		13	150	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25^\circ\text{C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		10	50	
I_q	Quiescent current	$T_J = 25^\circ\text{C}$		4.4	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 17.5\text{ to }30\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 17.5\text{ to }30\text{ V}$, $T_J = 25^\circ\text{C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 18.5\text{ to }28.5\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		58		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
eN	Output noise voltage	$T_A = 25^\circ\text{C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		19		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25^\circ\text{C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-1		$\text{mV}/^\circ\text{C}$

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.

f. Minimum load current for regulation is 5 mA.

$V_I = 33\text{ V}$, $I_O = 1\text{ A}$, $T_J = 0\text{ to }125\text{ °C}$ (L7824AC), $T_J = -40\text{ to }125\text{ °C}$ (L7824AB), unless otherwise specified^(g).

Table 9. Electrical characteristics of L7824A

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25\text{ °C}$	23.5	24	24.5	V
V_O	Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 27.3\text{ to }37\text{ V}$	23	24	25	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 37\text{ to }38\text{ V}$, $T_J = 25\text{ °C}$	23	24	25	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 27\text{ to }38\text{ V}$, $I_O = 500\text{ mA}$, $T_J = 25\text{ °C}$		31	240	mV
		$V_I = 30\text{ to }36\text{ V}$		35	200	mV
		$V_I = 30\text{ to }36\text{ V}$, $T_J = 25\text{ °C}$		14	120	mV
		$V_I = 26.7\text{ to }38\text{ V}$, $T_J = 25\text{ °C}$		31	240	mV
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1\text{ A}$		25	100	mV
		$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25\text{ °C}$		30	100	
		$I_O = 250\text{ to }750\text{ mA}$		10	50	
I_q	Quiescent current	$T_J = 25\text{ °C}$		4.6	6	mA
					6	mA
ΔI_q	Quiescent current change	$V_I = 27.3\text{ to }38\text{ V}$, $I_O = 500\text{ mA}$			0.8	mA
		$V_I = 27.3\text{ to }38\text{ V}$, $T_J = 25\text{ °C}$			0.8	mA
		$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
SVR	Supply voltage rejection	$V_I = 28\text{ to }38\text{ V}$, $f = 120\text{ Hz}$, $I_O = 500\text{ mA}$		54		dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25\text{ °C}$		2		V
eN	Output noise voltage	$T_A = 25\text{ °C}$, $B = 10\text{ Hz to }100\text{ kHz}$		10		$\mu\text{V}/V_O$
R_O	Output resistance	$f = 1\text{ kHz}$		20		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_A = 25\text{ °C}$		0.2		A
I_{scp}	Short circuit peak current	$T_J = 25\text{ °C}$		2.2		A
$\Delta V_O/\Delta T$	Output voltage drift			-1.5		$\text{mV}/\text{°C}$

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.

g. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 10\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified^(h).

Table 10. Electrical characteristics of L7805C

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	$I_O = 5\text{ mA}$ to 1 A , $V_I = 7$ to 18 V	4.75	5	5.25	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 18$ to 20 V , $T_J = 25^\circ\text{C}$	4.75	5	5.25	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 7$ to 25 V , $T_J = 25^\circ\text{C}$		3	100	mV
		$V_I = 8$ to 12 V , $T_J = 25^\circ\text{C}$		1	50	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA}$ 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	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 7$ to 23 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-1.1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		40		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 8$ to 18 V , $f = 120\text{ Hz}$	62			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		17		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.75		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.

h. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 11\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified⁽¹⁾.

Table 11. Electrical characteristics of L7806C

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	5.75	6	6.25	V
V_O	Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $V_I = 8\text{ to }19\text{ V}$	5.7	6	6.3	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 19\text{ to }21\text{ V}$, $T_J = 25^\circ\text{C}$	5.7	6	6.3	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 8\text{ to }25\text{ V}$, $T_J = 25^\circ\text{C}$			120	mV
		$V_I = 9\text{ to }13\text{ V}$, $T_J = 25^\circ\text{C}$			60	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA to }1.5\text{ A}$, $T_J = 25^\circ\text{C}$			120	mV
		$I_O = 250\text{ to }750\text{ mA}$, $T_J = 25^\circ\text{C}$			60	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 8\text{ to }24\text{ V}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-0.8		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$, $T_J = 25^\circ\text{C}$		45		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 9\text{ to }19\text{ V}$, $f = 120\text{ Hz}$	59			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		19		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.55		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.

i. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 14\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified⁽¹⁾.

Table 12. Electrical characteristics of L7808C

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	$I_O = 5\text{ mA}$ to 1 A , $V_I = 10.5$ to 21 V	7.6	8	8.4	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 21$ to 25 V , $T_J = 25^\circ\text{C}$	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	$I_O = 5\text{ mA}$ 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	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 10.5$ to 25 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-0.8		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		52		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 11.5$ to 21.5 V , $f = 120\text{ Hz}$	56			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		16		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.45		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.

j. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 14.5\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified^(k).

Table 13. Electrical characteristics of L7885C

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	8.2	8.5	8.8	V
V_O	Output voltage	$I_O = 5\text{ mA}$ to 1 A , $V_I = 11$ to 21.5 V	8.1	8.5	8.9	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 21.5$ to 26 V , $T_J = 25^\circ\text{C}$	8.1	8.5	8.9	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 11$ to 27 V , $T_J = 25^\circ\text{C}$			160	mV
		$V_I = 11.5$ to 17.5 V , $T_J = 25^\circ\text{C}$			80	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA}$ 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	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 11$ to 26 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-0.8		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		55		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 12$ to 22 V , $f = 120\text{ Hz}$	56			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		16		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.45		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.

k. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 15\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified⁽¹⁾.

Table 14. Electrical characteristics of L7809C

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	8.64	9	9.36	V
V_O	Output voltage	$I_O = 5\text{ mA}$ to 1 A , $V_I = 11.5$ to 22 V	8.55	9	9.45	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 22$ to 26 V , $T_J = 25^\circ\text{C}$	8.55	9	9.45	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 11.5$ to 26 V , $T_J = 25^\circ\text{C}$			180	mV
		$V_I = 12$ to 18 V , $T_J = 25^\circ\text{C}$			90	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA}$ to 1.5 A , $T_J = 25^\circ\text{C}$			180	mV
		$I_O = 250$ to 750 mA , $T_J = 25^\circ\text{C}$			90	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 11.5$ to 26 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		70		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 12$ to 23 V , $f = 120\text{ Hz}$	55			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		17		$\text{m}\Omega$
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.40		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.

I. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 19\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified^(m).

Table 15. Electrical characteristics of L7812C

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	$I_O = 5\text{ mA}$ to 1 A , $V_I = 14.5$ to 25 V	11.4	12	12.6	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 25$ to 27 V , $T_J = 25^\circ\text{C}$	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	$I_O = 5\text{ mA}$ 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	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 14.5$ to 30 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		75		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 15$ to 25 V , $f = 120\text{ Hz}$	55			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		18		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.35		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.

m. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 23\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified⁽ⁿ⁾.

Table 16. Electrical characteristics of L7815C

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	$I_O = 5\text{ mA}$ to 1 A , $V_I = 17.5$ to 28 V	14.25	15	15.75	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 28$ to 30 V , $T_J = 25^\circ\text{C}$	14.25	15	15.75	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	$I_O = 5\text{ mA}$ 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	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 17.5$ to 30 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		90		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 18.5$ to 28.5 V , $f = 120\text{ Hz}$	54			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		19		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.23		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.

n. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 26\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified^(o).

Table 17. Electrical characteristics of L7818C

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	17.3	18	18.7	V
V_O	Output voltage	$I_O = 5\text{ mA}$ to 1 A , $V_I = 21$ to 31 V	17.1	18	18.9	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 31$ to 33 V , $T_J = 25^\circ\text{C}$	17.1	18	18.9	V
$\Delta V_O^{(1)}$	Line regulation	$V_I = 21$ to 33 V , $T_J = 25^\circ\text{C}$			360	mV
		$V_I = 24$ to 30 V , $T_J = 25^\circ\text{C}$			180	
$\Delta V_O^{(1)}$	Load regulation	$I_O = 5\text{ mA}$ to 1.5 A , $T_J = 25^\circ\text{C}$			360	mV
		$I_O = 250$ to 750 mA , $T_J = 25^\circ\text{C}$			180	
I_d	Quiescent current	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 21$ to 33 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		110		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 22$ to 32 V , $f = 120\text{ Hz}$	53			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		22		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.20		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		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.

o. Minimum load current for regulation is 5 mA.

Refer to the test circuits, $T_J = 0$ to 125°C , $V_I = 33\text{ V}$, $I_O = 500\text{ mA}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$ unless otherwise specified^(p).

Table 18. Electrical characteristics of L7824C

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$T_J = 25^\circ\text{C}$	23	24	25	V
V_O	Output voltage	$I_O = 5\text{ mA}$ to 1 A , $V_I = 27$ to 37 V	22.8	24	25.2	V
V_O	Output voltage	$I_O = 1\text{ A}$, $V_I = 37$ to 38 V , $T_J = 25^\circ\text{C}$	22.8	24	25.2	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	$I_O = 5\text{ mA}$ 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	$T_J = 25^\circ\text{C}$			8	mA
ΔI_d	Quiescent current change	$I_O = 5\text{ mA}$ to 1 A			0.5	mA
		$V_I = 27$ to 38 V			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$		-1.5		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25^\circ\text{C}$		170		$\mu\text{V}/V_O$
SVR	Supply voltage rejection	$V_I = 28$ to 38 V , $f = 120\text{ Hz}$	50			dB
V_d	Dropout voltage	$I_O = 1\text{ A}$, $T_J = 25^\circ\text{C}$		2		V
R_O	Output resistance	$f = 1\text{ kHz}$		28		m Ω
I_{sc}	Short circuit current	$V_I = 35\text{ V}$, $T_J = 25^\circ\text{C}$		0.15		A
I_{scp}	Short circuit peak current	$T_J = 25^\circ\text{C}$		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.

p. Minimum load current for regulation is 5 mA.

6 Application information

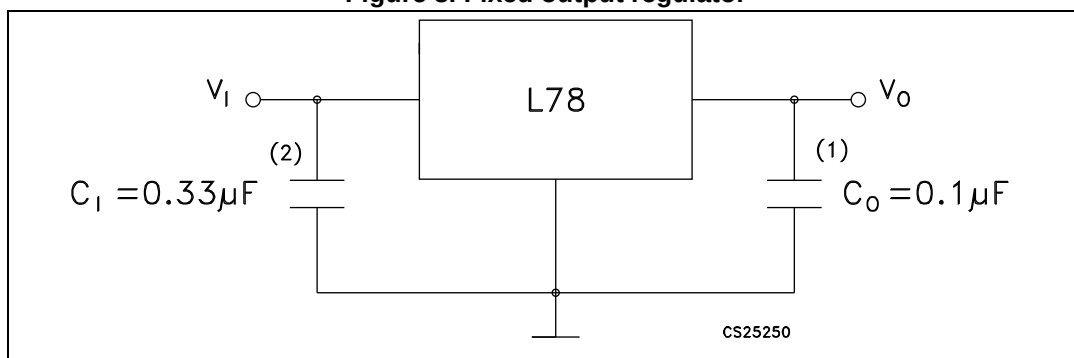
6.1 Design consideration

The L78 Series of fixed voltage regulators are designed with thermal overload protection that shuts down the circuit when subjected to an excessive power overload condition, internal short-circuit protection that limits the maximum current the circuit will pass, and output transistor safe-area compensation that reduces the output short-circuit current as the voltage across the pass transistor is increased. In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with capacitor if the regulator is connected to the power supply filter with long lengths, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good high frequency characteristics to insure stable operation under all load conditions. A $0.33\ \mu\text{F}$ or larger tantalum, mylar or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulators input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead.

The addition of an operational amplifier allows adjustment to higher or intermediate values while retaining regulation characteristics. The minimum voltage obtained with the arrangement is 2 V greater than the regulator voltage.

The circuit of [Figure 13](#) can be modified to provide supply protection against short circuit by adding a short circuit sense resistor, RSC, and an additional PNP transistor. The current sensing PNP must be able to handle the short circuit current of the three terminal regulator. Therefore a four ampere plastic power transistor is specified.

Figure 8. Fixed output regulator



1. Although no output capacitor is need for stability, it does improve transient response.
2. Required if regulator is located an appreciable distance from power supply filter.

Figure 9. Current regulator

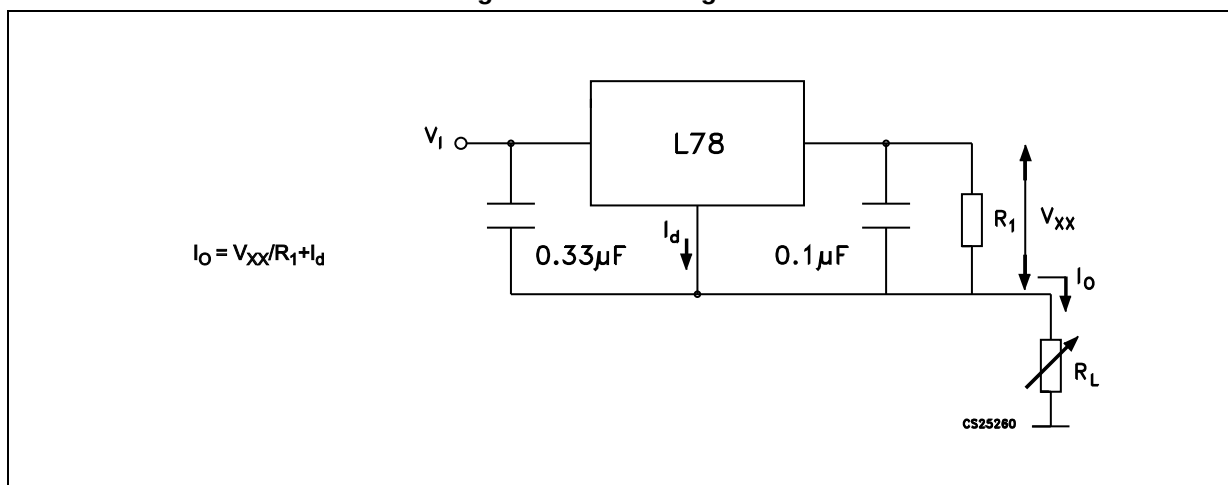


Figure 10. Circuit for increasing output voltage

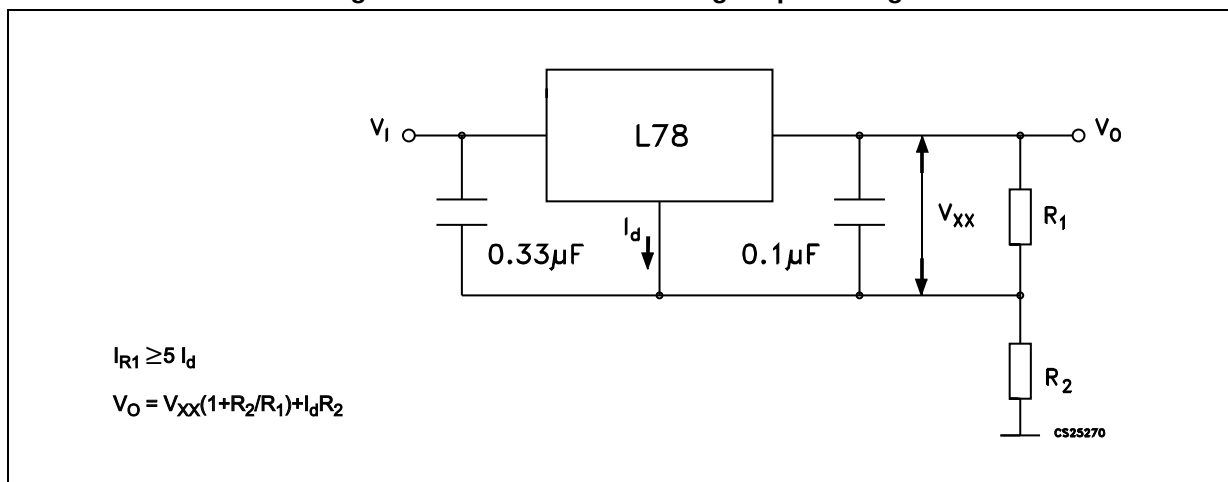


Figure 11. Adjustable output regulator (7 to 30 V)

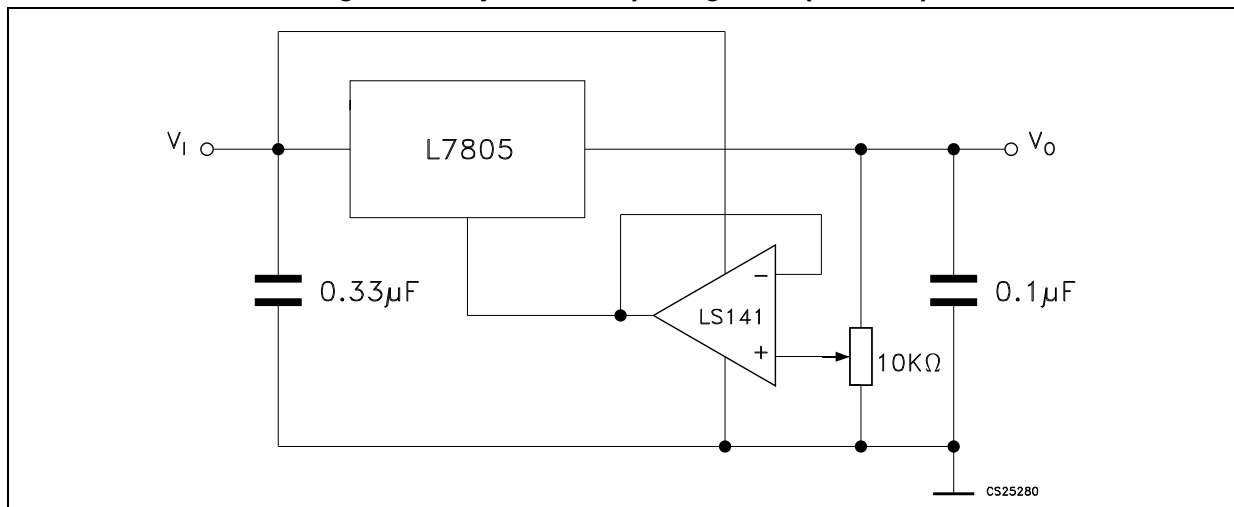


Figure 12. 0.5 to 10 V regulator

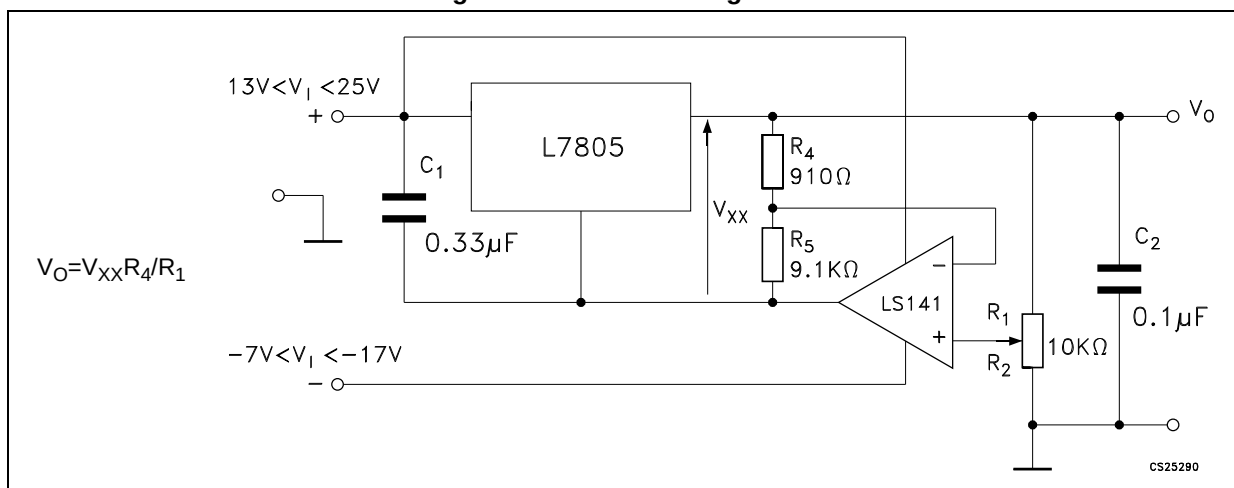


Figure 13. High current voltage regulator

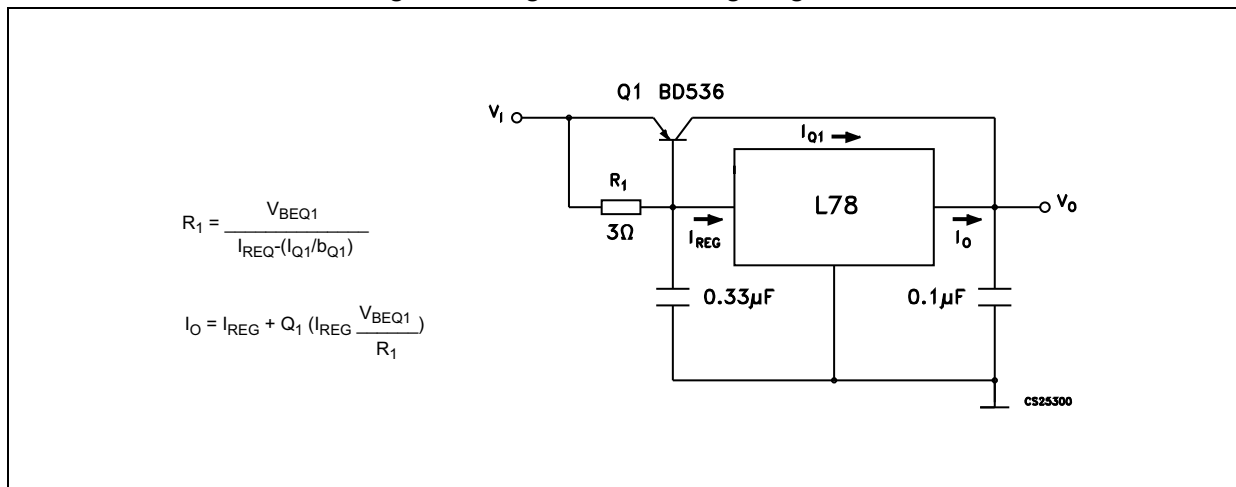


Figure 14. High output current with short circuit protection

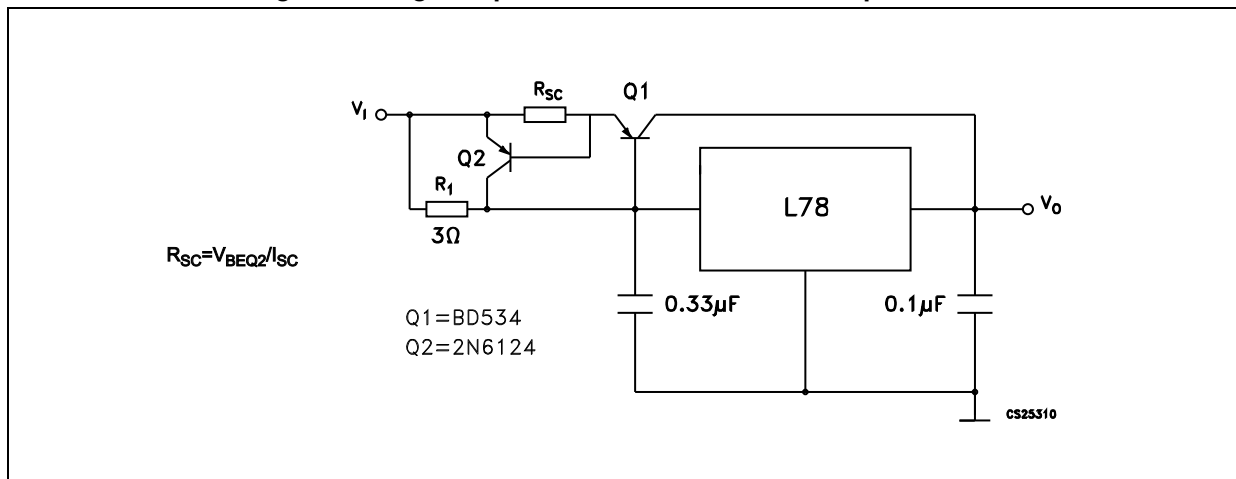


Figure 15. Tracking voltage regulator

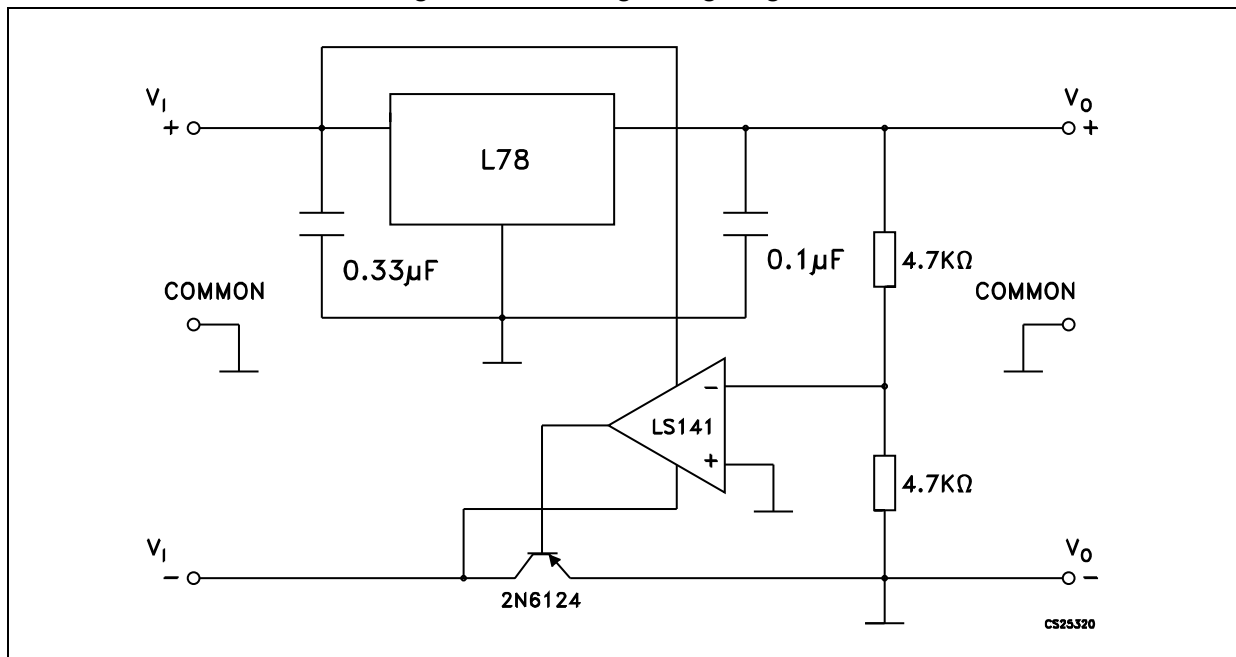
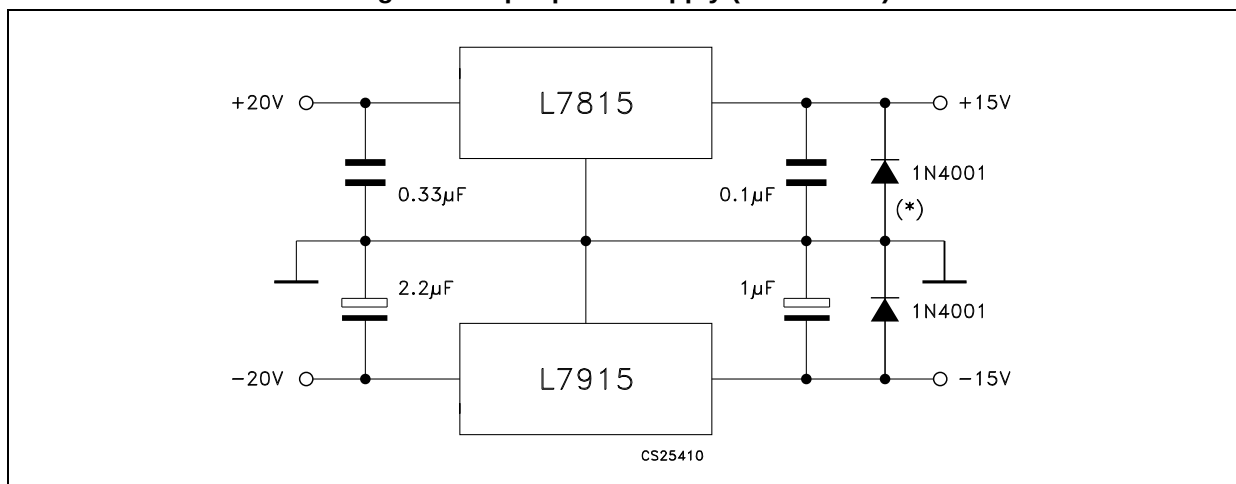


Figure 16. Split power supply ($\pm 15\text{ V} - 1\text{ A}$)



* Against potential latch-up problems.

Figure 17. Negative output voltage circuit

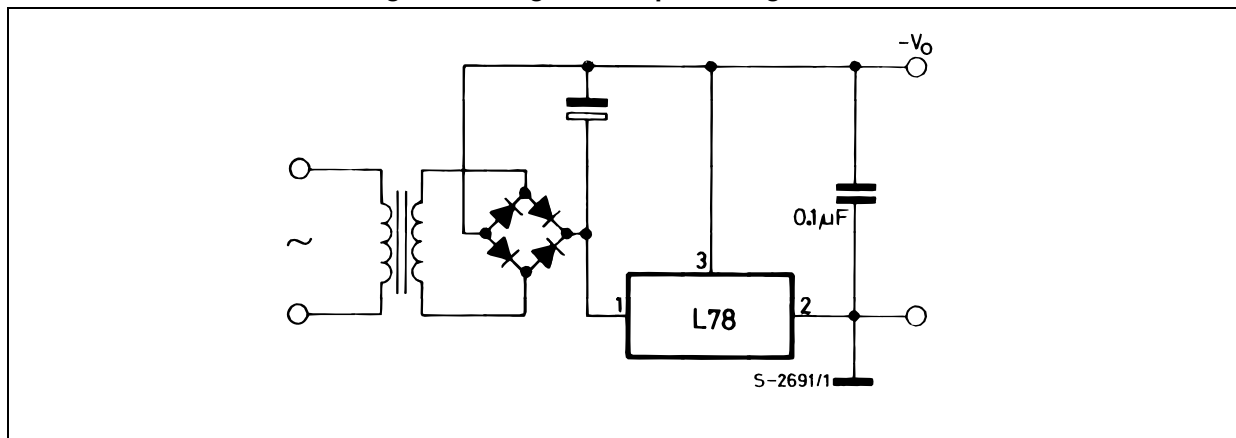


Figure 18. Switching regulator

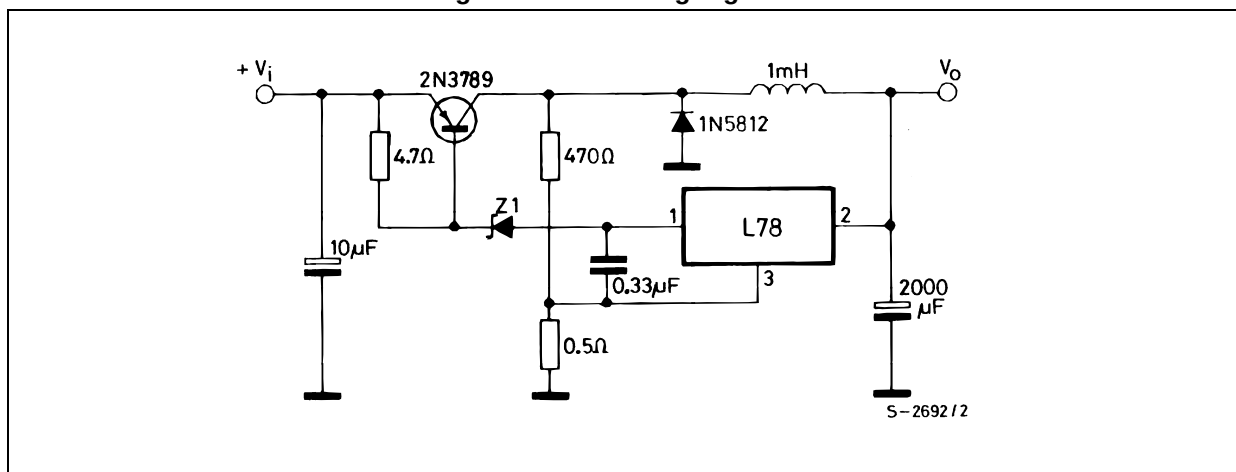


Figure 19. High input voltage circuit (configuration 1)

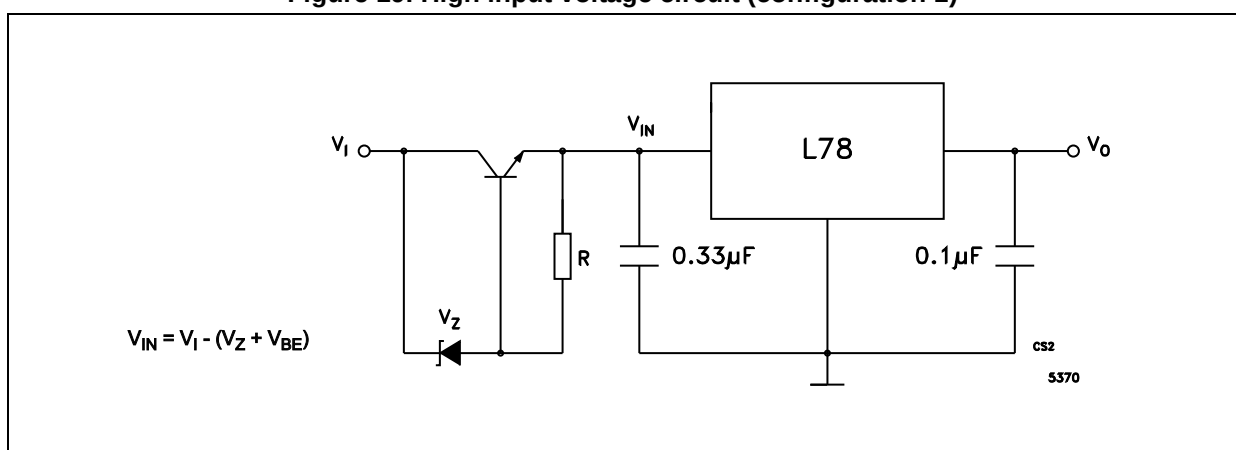


Figure 20. High input voltage circuit (configuration 2)

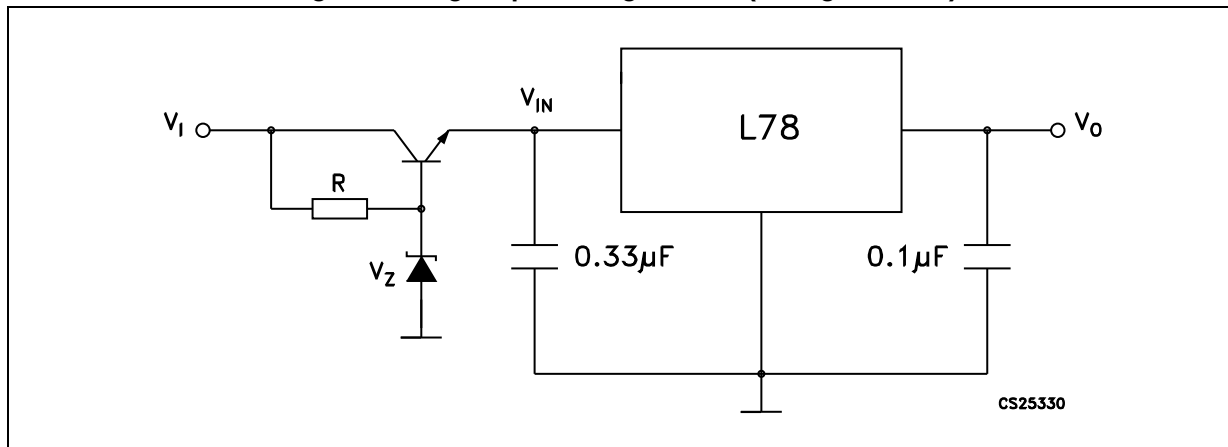


Figure 21. High input and output voltage

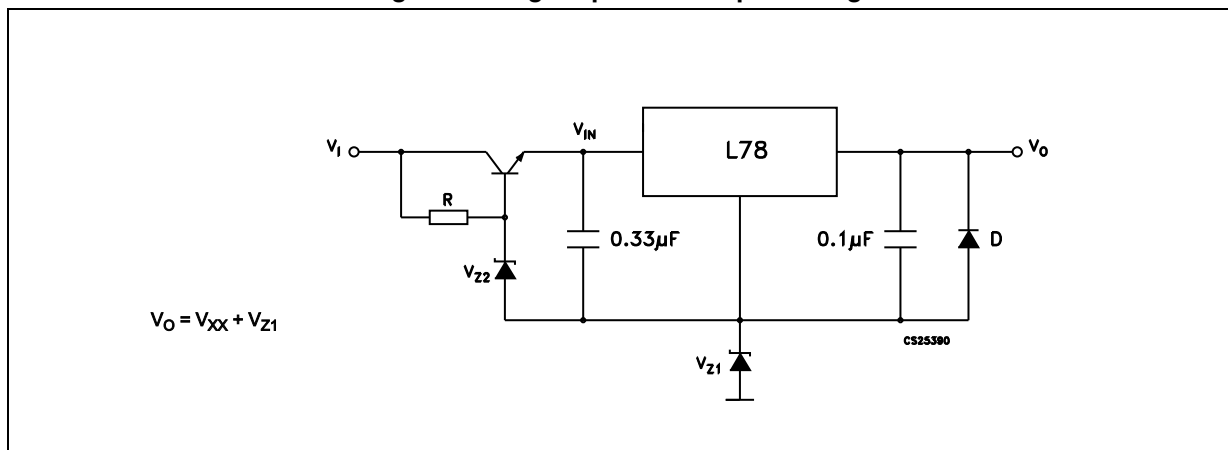
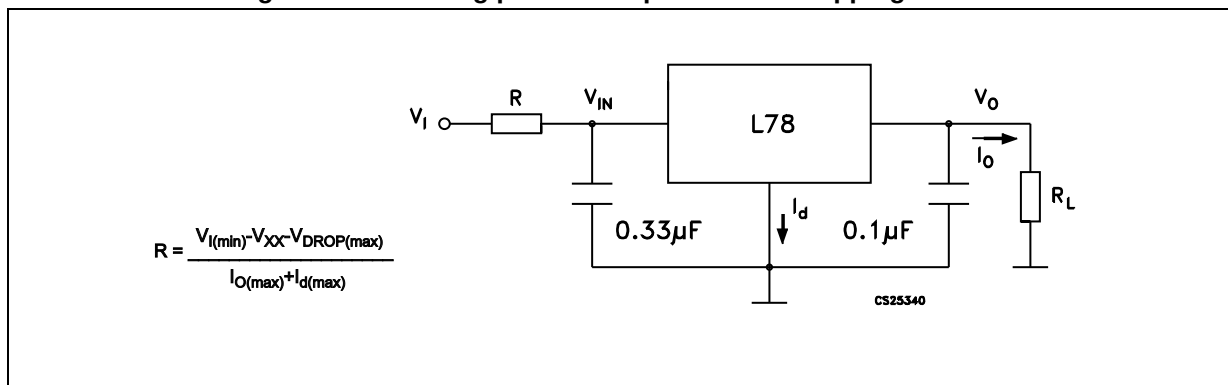


Figure 22. Reducing power dissipation with dropping resistor

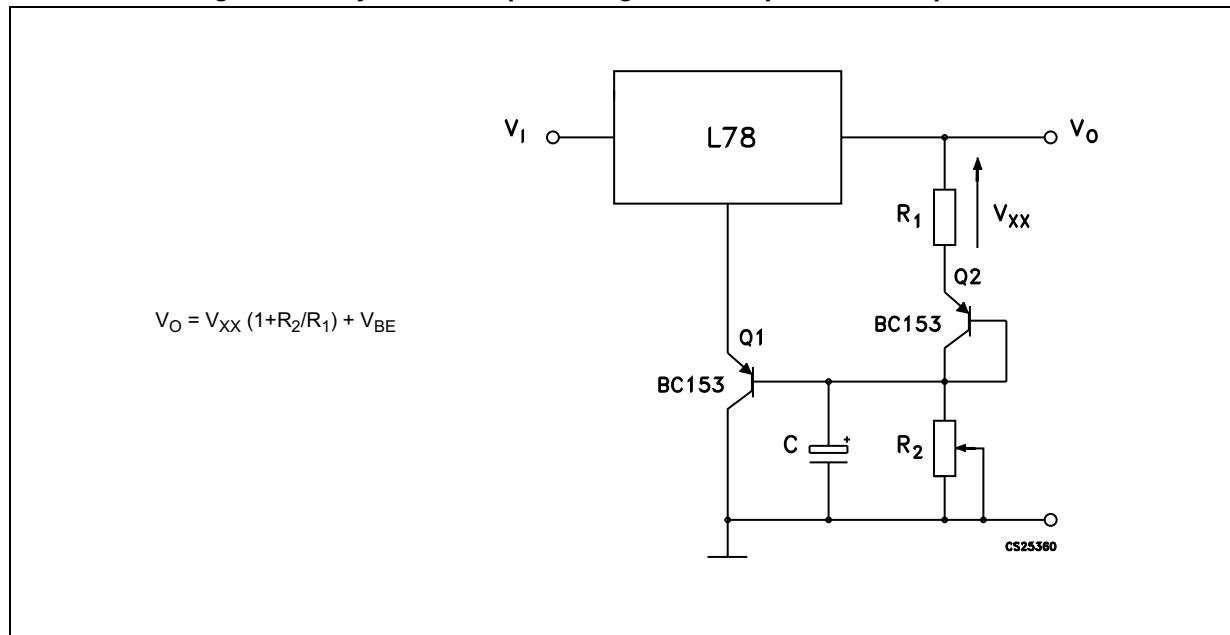


The circuit diagram shows a precision centred zero level shifter. It consists of an L78 voltage regulator, two transistors (Q_1 and Q_2), and three resistors (R_1 , R_2 , and R_3). The input voltage V_I is connected to the base of transistor Q_1 through resistor R_1 . The emitter of Q_1 is connected to the base of transistor Q_2 through resistor R_2 . The collector of Q_1 is connected to the input of the L78 regulator. The output of the L78 regulator is connected to the emitter of Q_2 . The collector of Q_2 is connected to the output V_O through resistor R_3 . The L78 regulator is also connected to ground. The circuit is labeled CS25400.

The diagram shows an L78 voltage regulator circuit. The input voltage V_I is connected to the input pin of the L78. A $0.33\mu\text{F}$ capacitor is connected between the input pin and ground. The output pin is connected to the output voltage V_O . The ground pin is connected to ground. A 56Ω resistor is connected between the ground pin and a modulation signal input. The modulation signal is represented by a sine wave. The output voltage V_O is shown as a sine wave with an amplitude V_{XX} .

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Figure 25. Adjustable output voltage with temperature compensation



Note: Q_2 is connected as a diode in order to compensate the variation of the Q_1 V_{BE} with the temperature. C allows a slow rise time of the V_O .

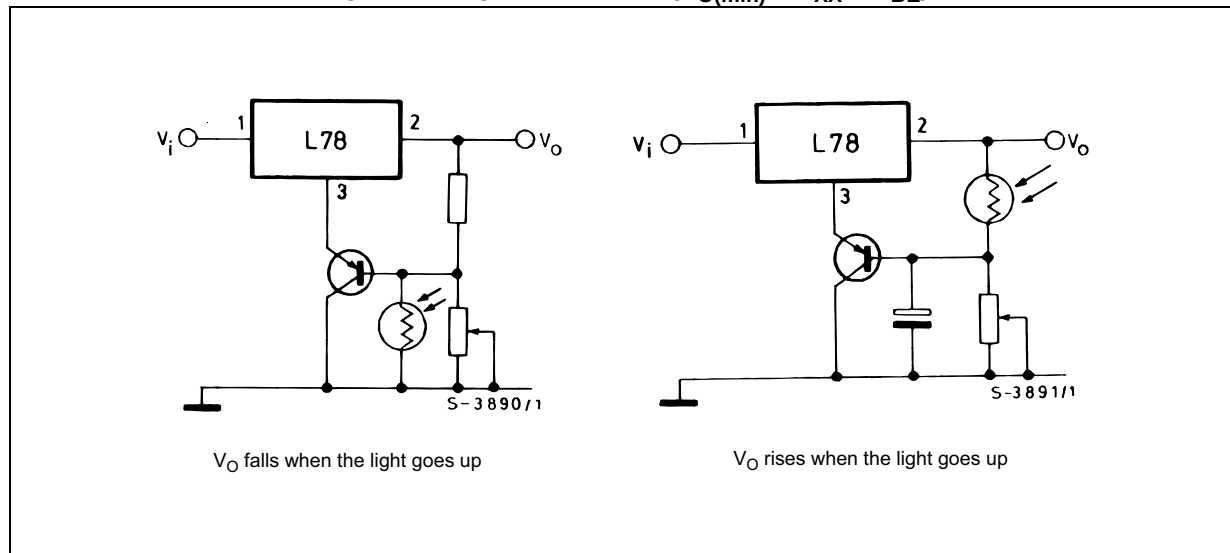
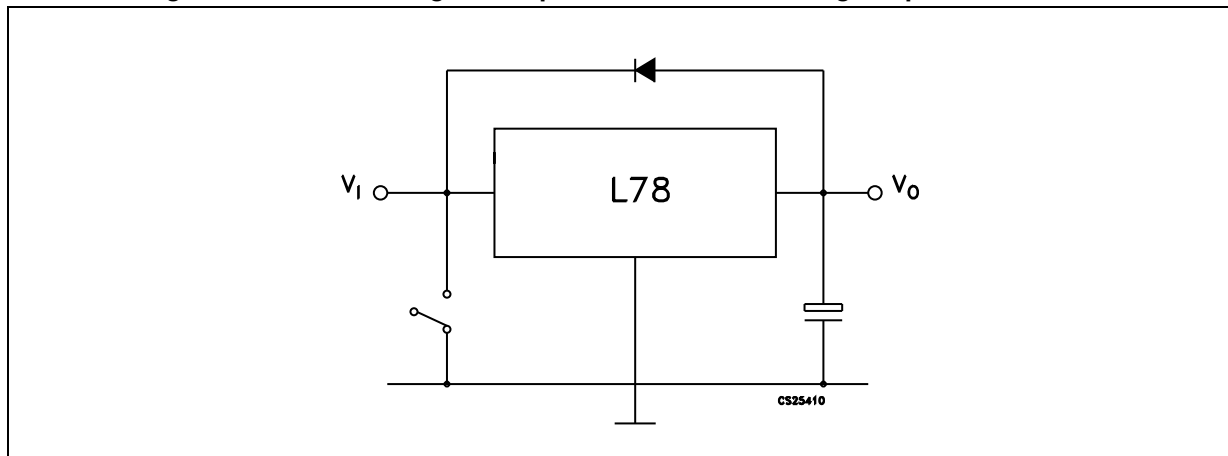
Figure 26. Light controllers ($V_{O(min)} = V_{XX} + V_{BE}$)

Figure 27. Protection against input short-circuit with high capacitance loads



Note: Application with high capacitance loads and an output voltage greater than 6 volts need an external diode (see [Figure 22 on page 31](#)) to protect the device against input short circuit. In this case the input voltage falls rapidly while the output voltage decrease slowly. The capacitance discharges by means of the base-emitter junction of the series pass transistor in the regulator. If the energy is sufficiently high, the transistor may be destroyed. The external diode by-passes the current from the IC to ground.

7 Typical performance

Figure 28. Dropout voltage vs. junction temperature

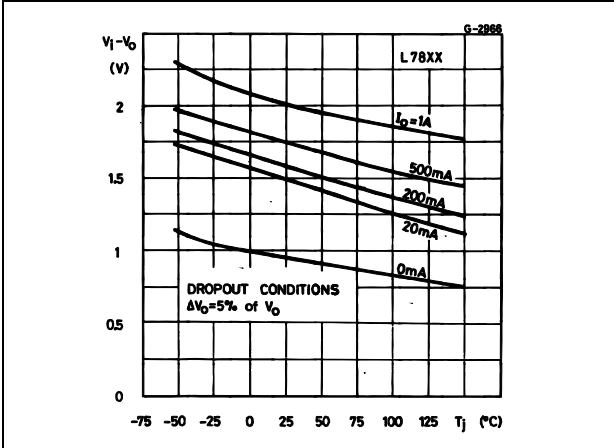


Figure 29. Peak output current vs. input/output differential voltage

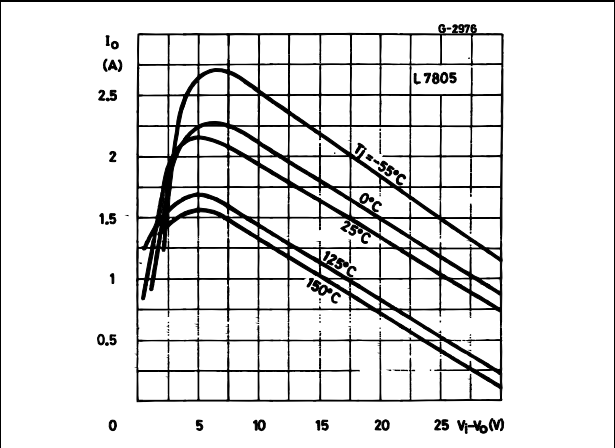


Figure 30. Supply voltage rejection vs. frequency

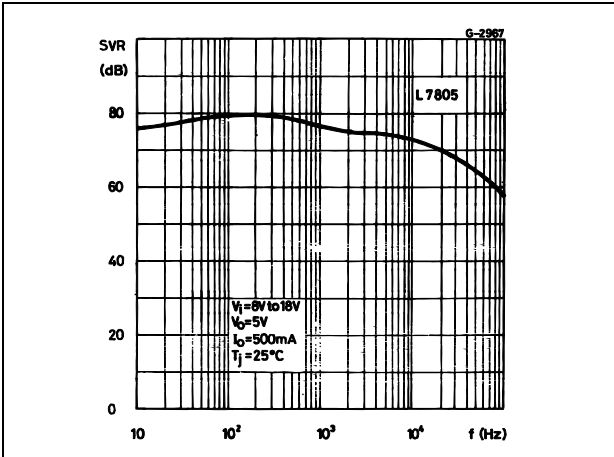


Figure 31. Output voltage vs. junction temperature

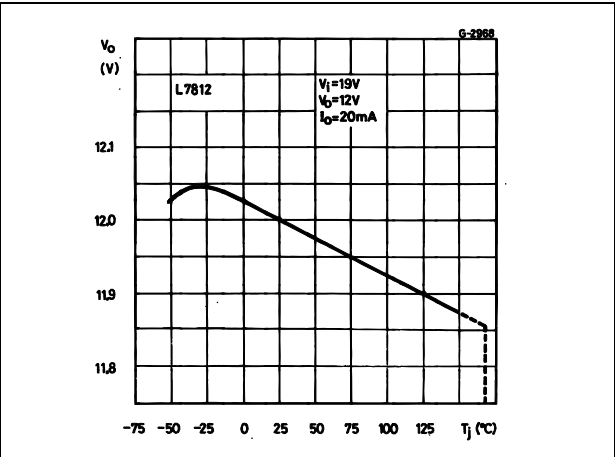


Figure 32. Output impedance vs. frequency

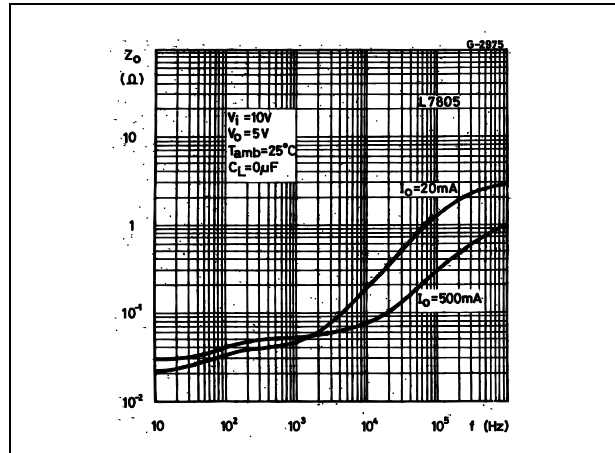


Figure 33. Quiescent current vs. junction temp.

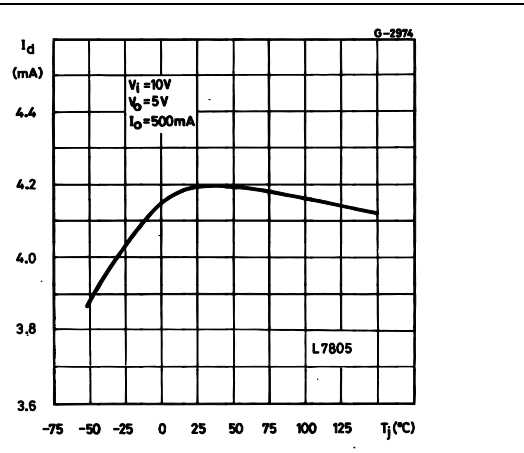


Figure 34. Load transient response

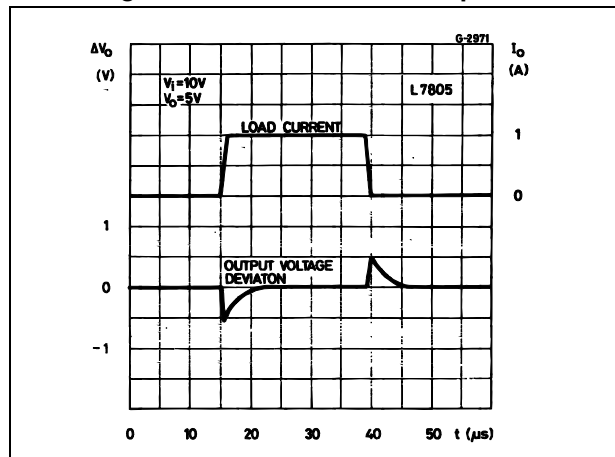


Figure 35. Line transient response

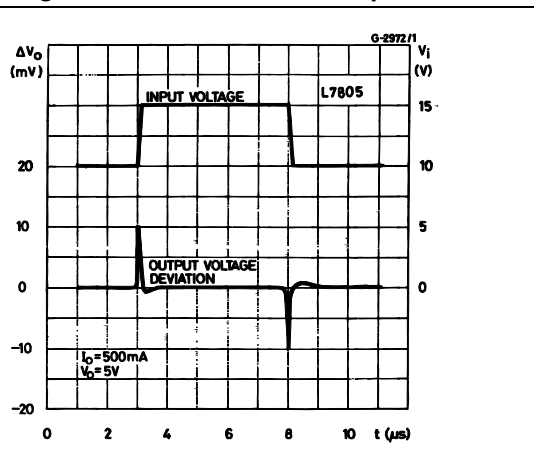
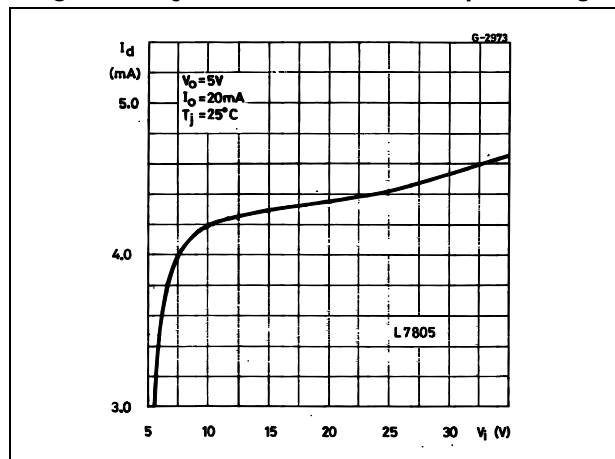


Figure 36. Quiescent current vs. input voltage



8 Package mechanical data

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.

Figure 37. TO-220 (dual gauge) drawing

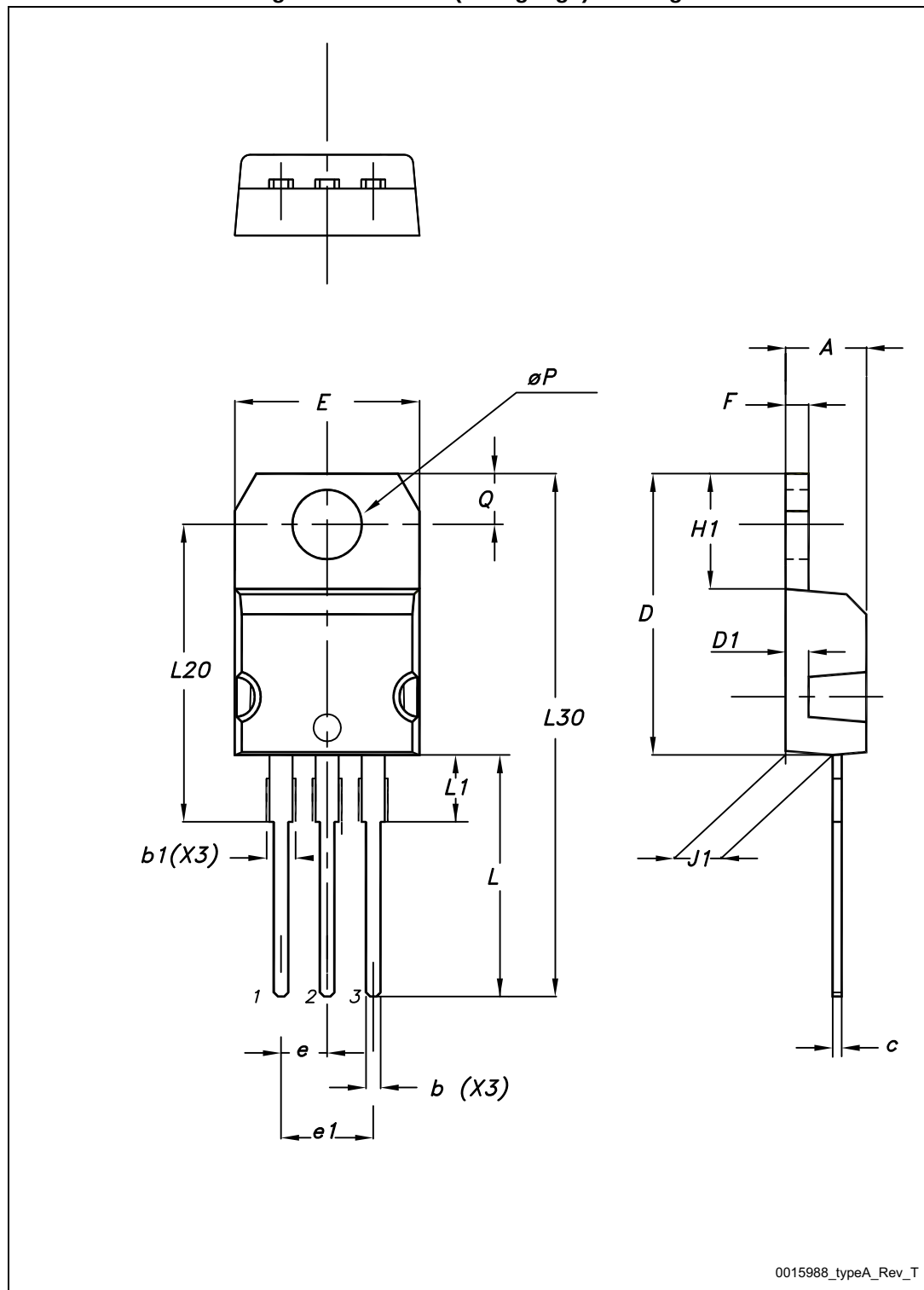


Table 19. TO-220 (dual gauge) mechanical data

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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 38. TO-220 SG (single gauge) drawing

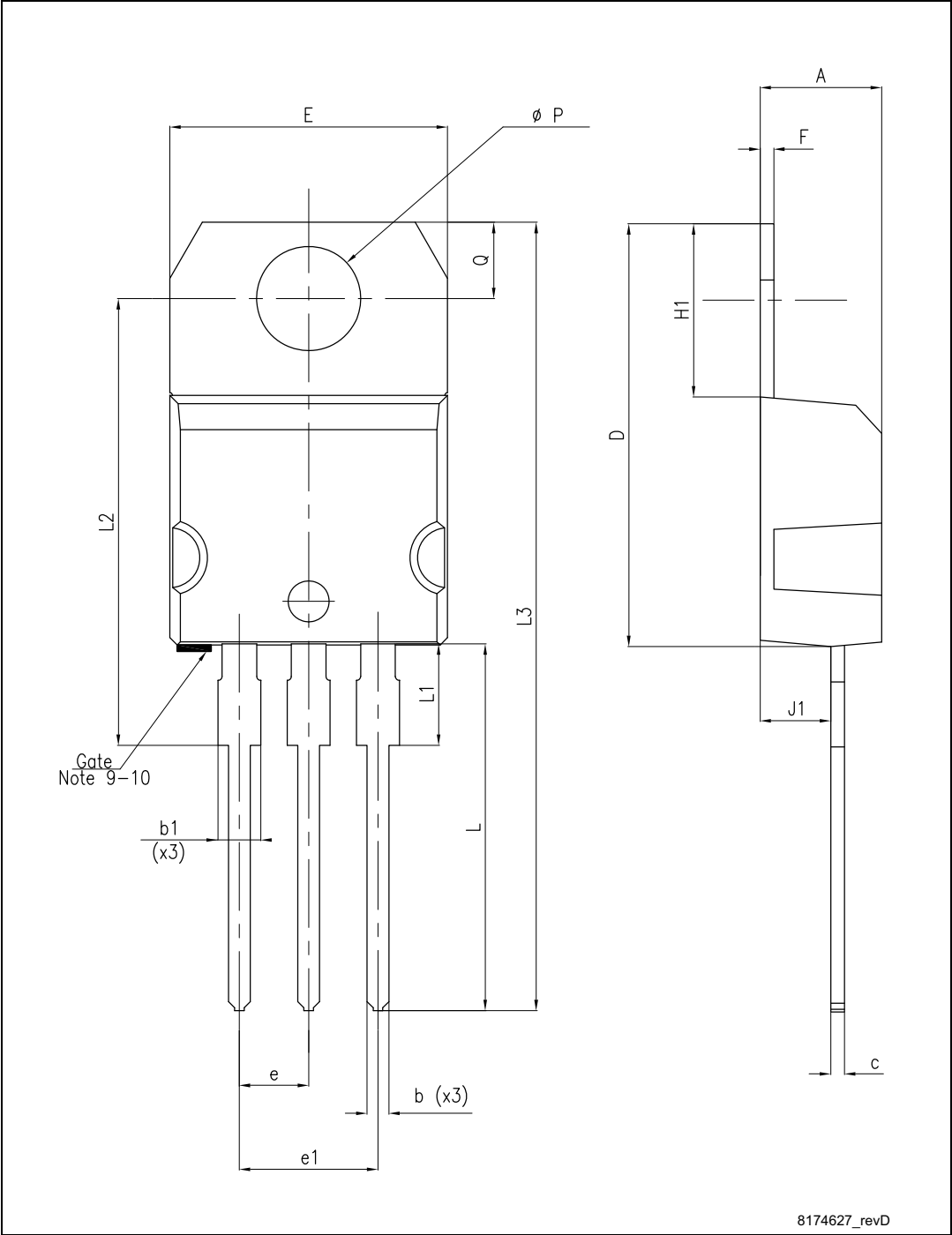


Table 20. TO-220 SG (single gauge) mechanical data

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
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	0.51		0.60
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
ØP	3.75		3.85
Q	2.65		2.95

Figure 39. TO-220FP drawing

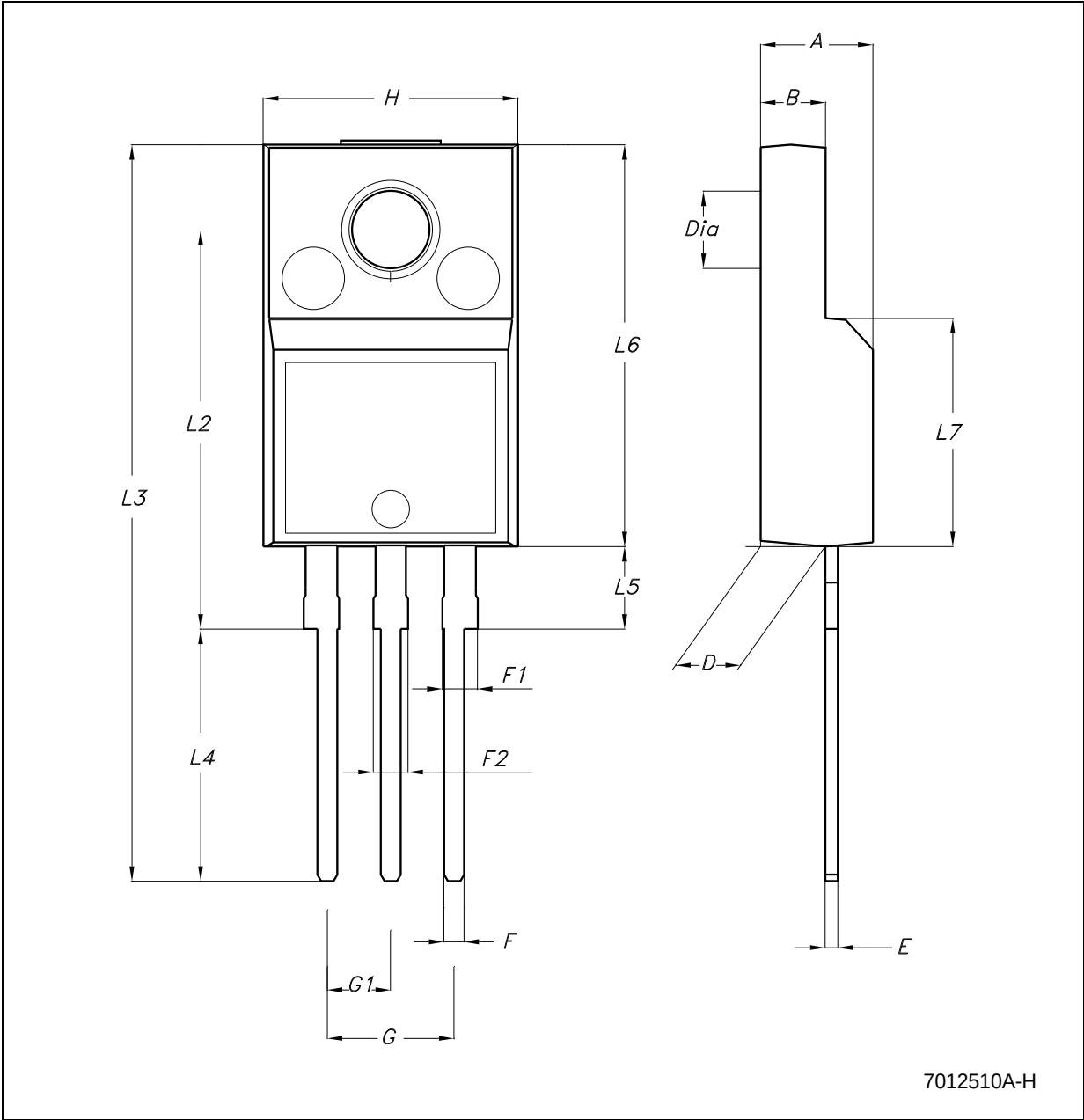


Table 21. TO-220FP mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.5		2.7
D	2.5		2.75
E	0.45		0.70
F	0.75		1
F1	1.15		1.50
F2	1.15		1.50
G	4.95		5.2
G1	2.4		2.7
H	10.0		10.40
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
DIA.	3		3.2

Figure 40. DPAK drawing

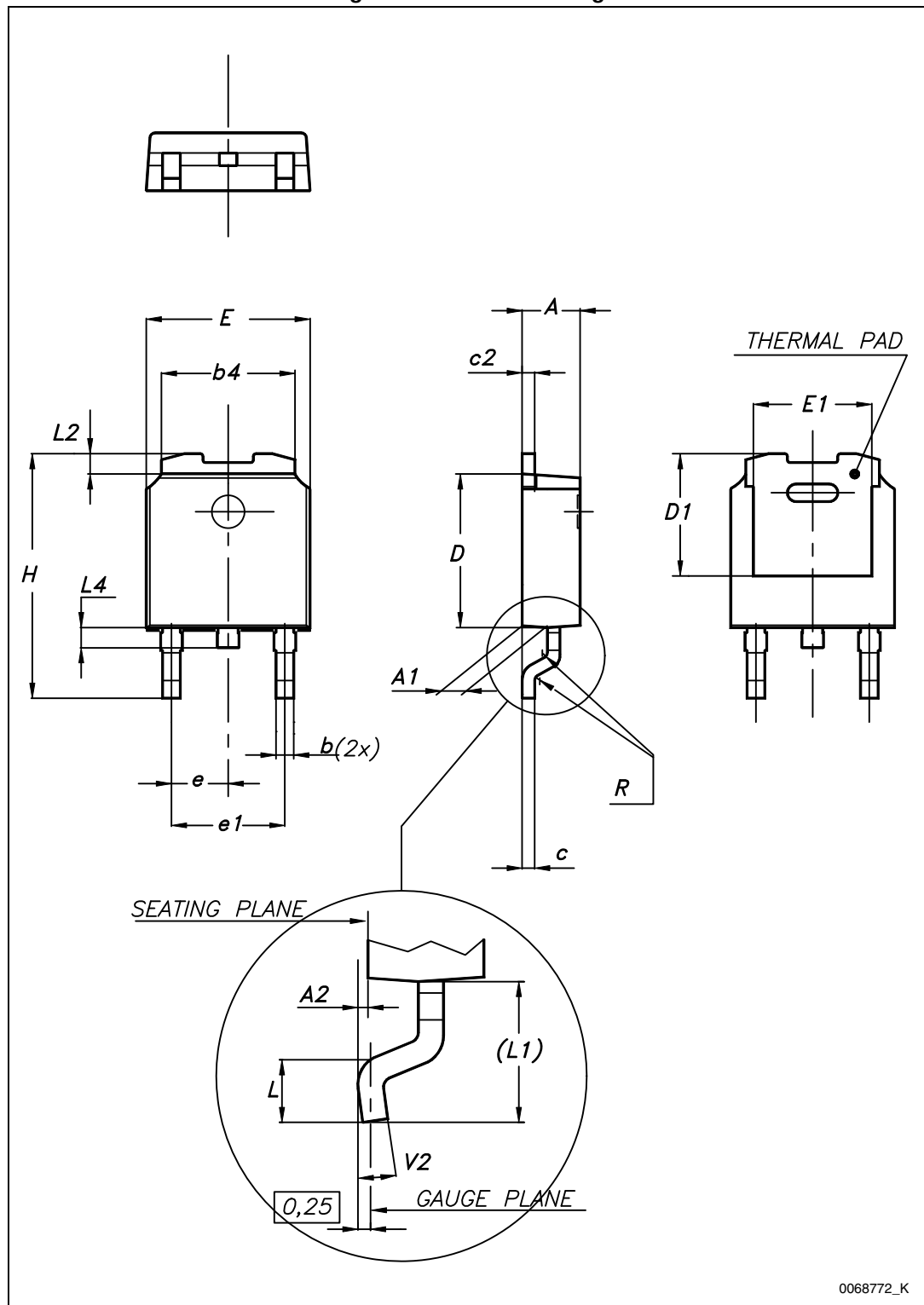
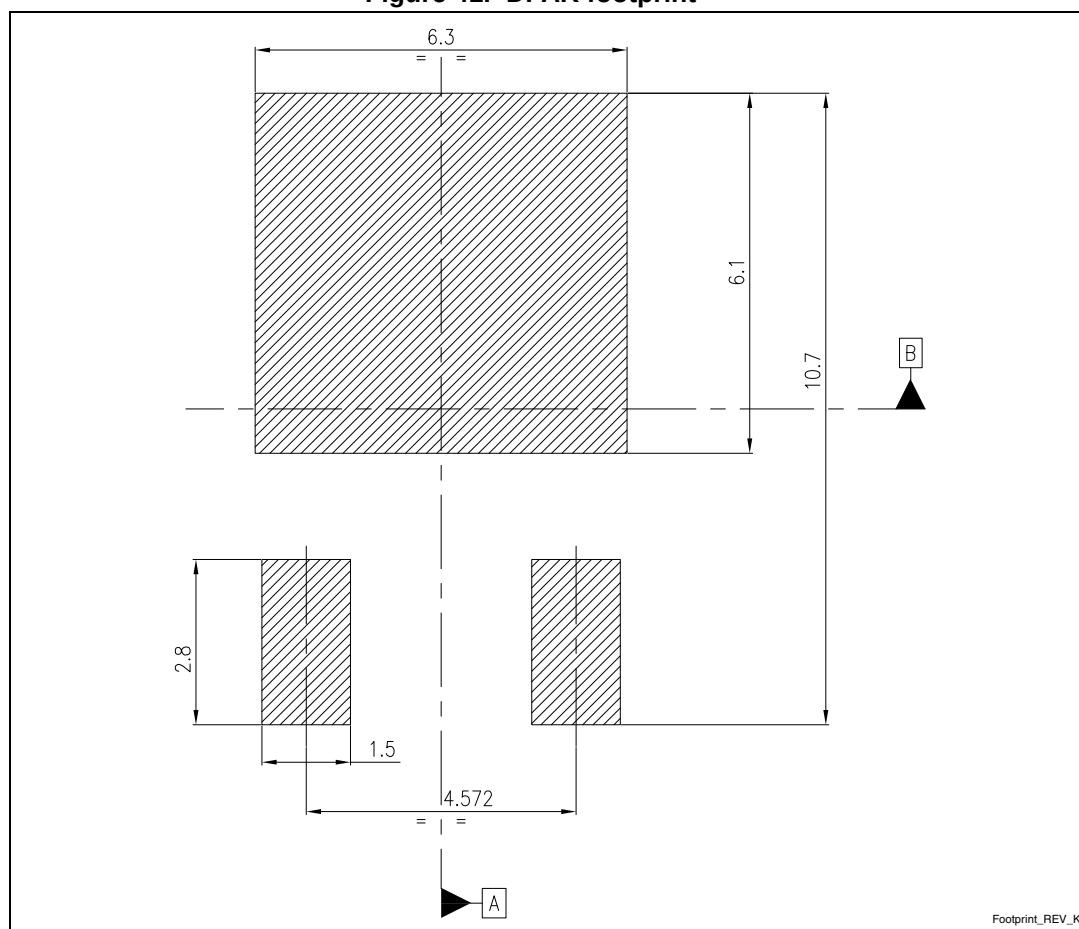


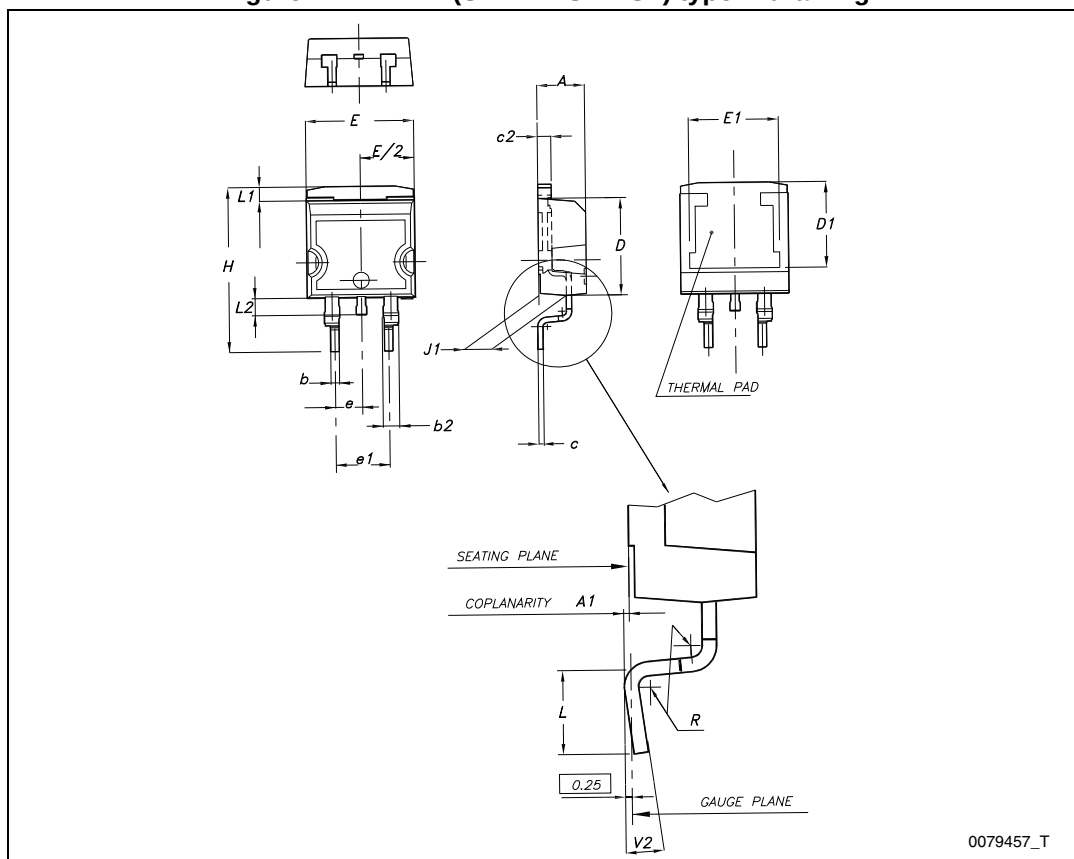
Table 22. DPAK mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 41. DPAK footprint (q)



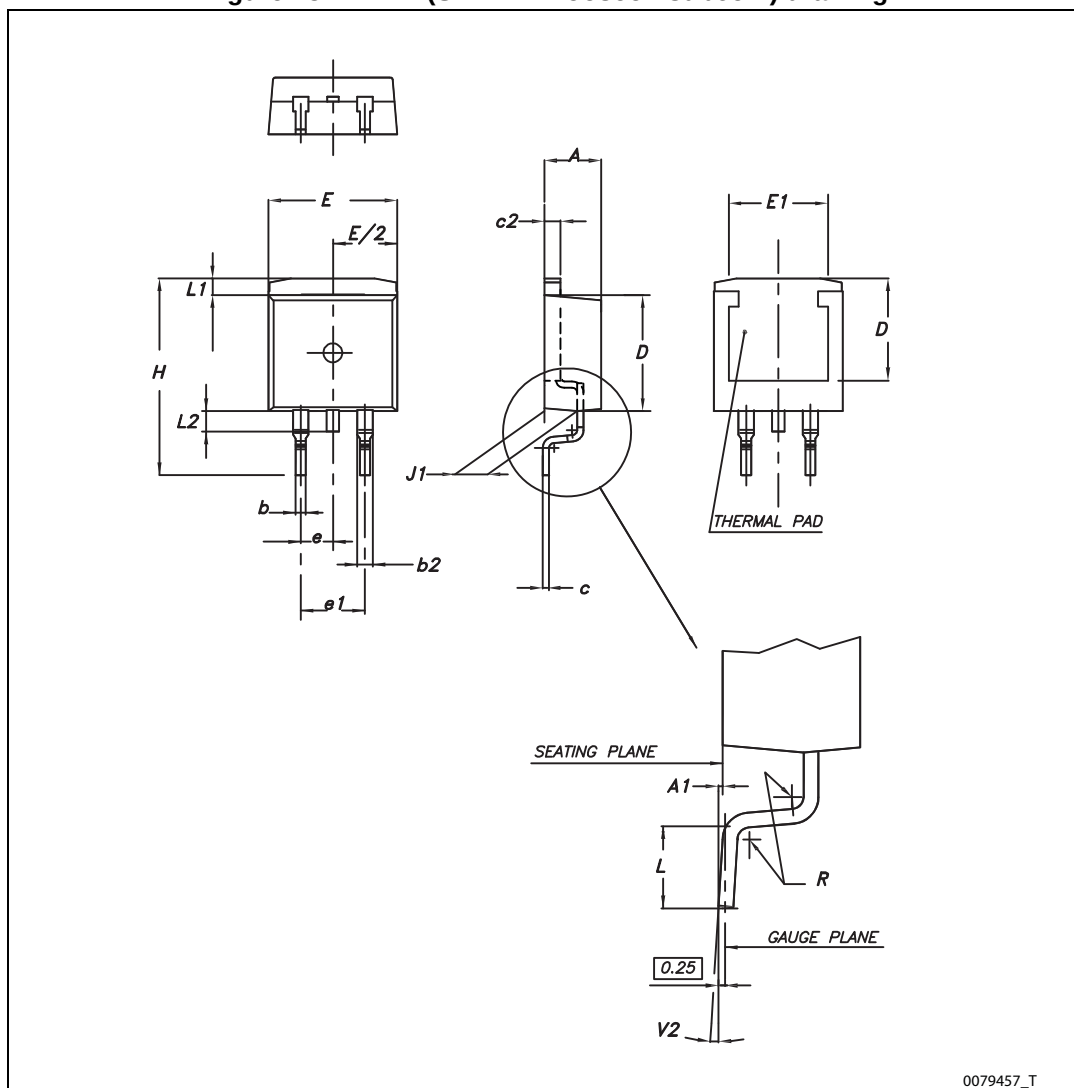
q. All dimensions are in millimeters

Figure 42. D²PAK (SMD 2L STD-ST) type A drawing

0079457_T

Table 23. D²PAK (SMD 2L STD-ST) mechanical data

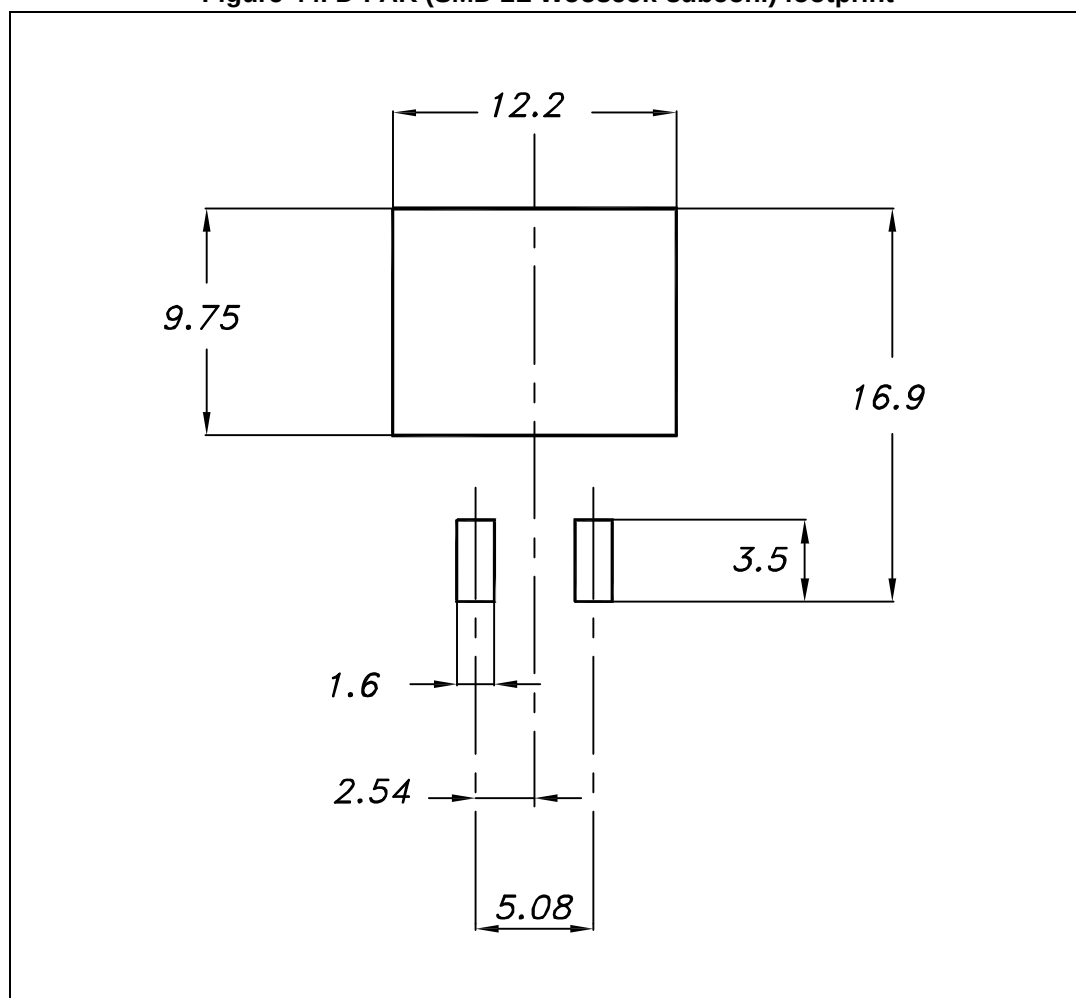
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 43. D²PAK (SMD 2L Wooseok-subcon.) drawing

0079457_T

Table 24. D²PAK (SMD 2L Wooseok-subcon.) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0		0.20
b	0.70		0.90
b2	1.17		1.37
c	0.45	0.50	0.60
c2	1.25	1.30	1.40
D	9	9.20	9.40
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.08
H	15		15.30
J1	2.20		2.60
L	1.79		2.79
L1	1		1.40
L2	1.20		1.60
R		0.30	
V2	0°		3°

Figure 44. D²PAK (SMD 2L Wooseok-subcon.) footprint

9 Packaging mechanical data

Figure 45. Tube for TO-220 (dual gauge) (mm.)

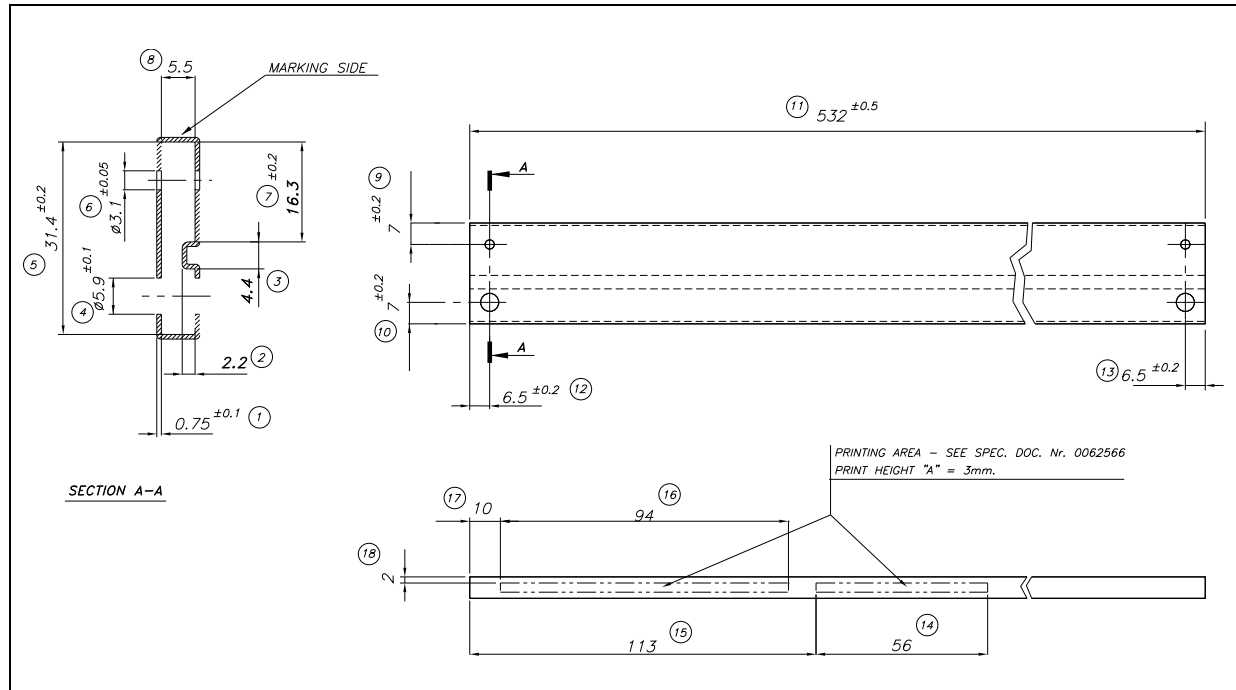


Figure 46. Tube for TO-220 (single gauge) (mm.)

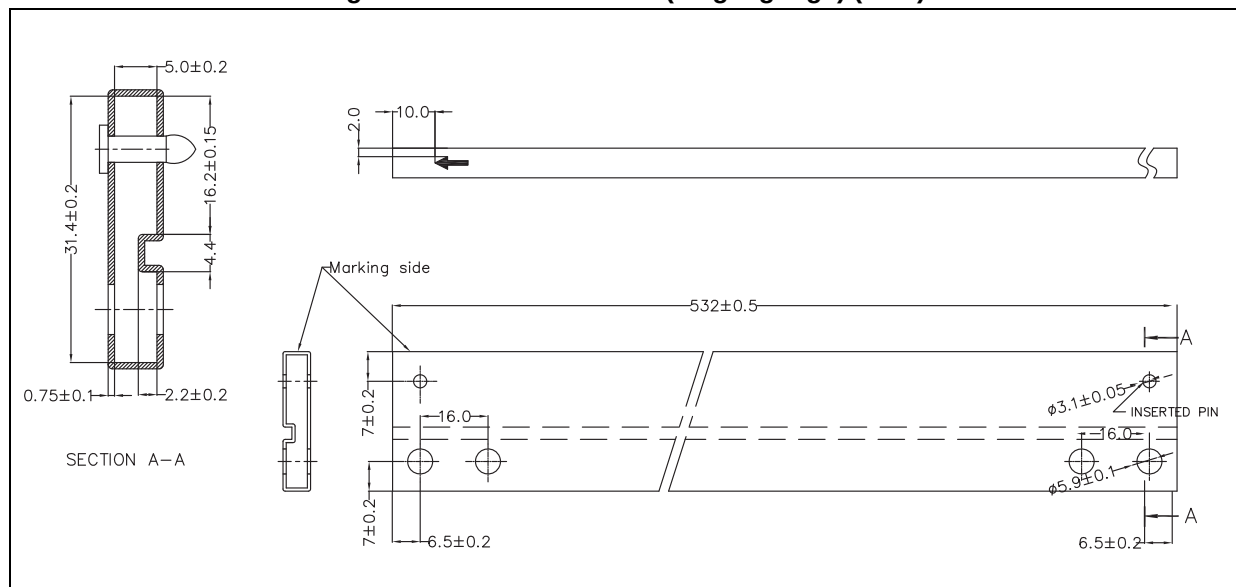


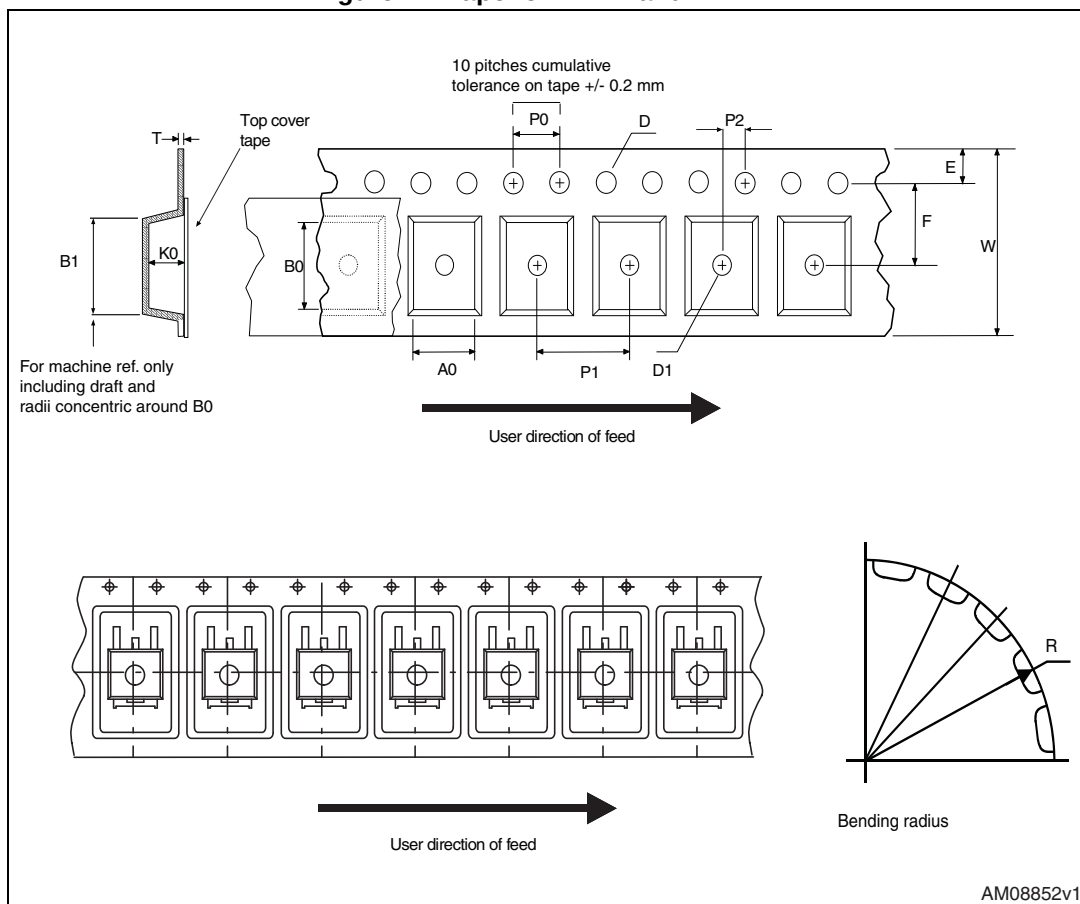
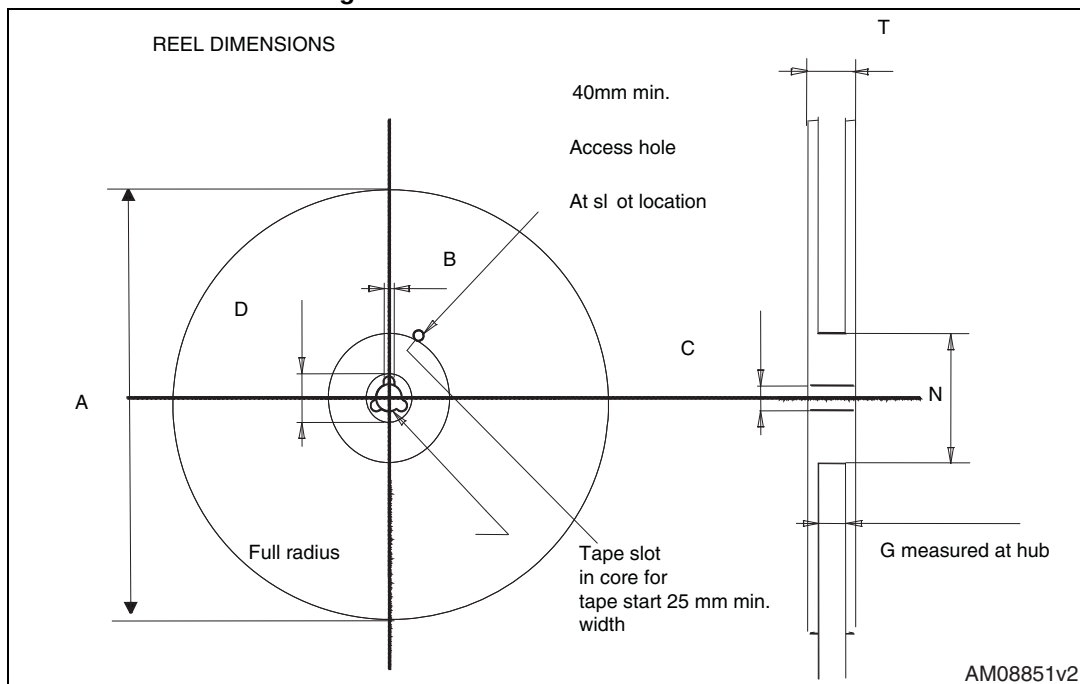
Figure 47. Tape for DPAK and D²PAKFigure 48. Reel for DPAK and D²PAK

Table 25. DPAK and D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

10 Order codes

Table 26. Order codes

Part numbers	Order codes					
	TO-220 (single gauge)	TO-220 (dual gauge)	DPAK	D ² PAK	TO-220FP	Output voltages
L7805C	L7805CV		L7805CDT-TR	L7805CD2T-TR	L7805CP	5 V
		L7805CV-DG				5 V
L7805AB	L7805ABV			L7805ABD2T-TR	L7805ABP	5 V
		L7805ABV-DG				5 V
L7805AC	L7805ACV			L7805ACD2T-TR	L7805ACP	5 V
		L7805ACV-DG				5 V
L7806C	L7806CV			L7806CD2T-TR		6 V
		L7806CV-DG				6 V
L7806AB	L7806ABV			L7806ABD2T-TR		6 V
		L7806ABV-DG				6 V
L7806AC	L7806ACV					6 V
		L7806ACV-DG				6 V
L7808C	L7808CV			L7808CD2T-TR		8 V
		L7808CV-DG				8 V
L7808AB	L7808ABV			L7808ABD2T-TR		8 V
		L7808ABV-DG				8 V
L7808AC	L7808ACV					8 V
		L7808ACV-DG				8 V
L7885C	L7885CV					8.5 V
L7809C	L7809CV			L7809CD2T-TR	L7809CP	9 V
		L7809CV-DG				9 V
L7809AB	L7809ABV			L7809ABD2T-TR		9 V
	L7809ABV-DG					9 V
L7809AC	L7809ACV					9 V
L7812C	L7812CV			L7812CD2T-TR	L7812CP	12 V
		L7812CV-DG				12 V
L7812AB	L7812ABV			L7812ABD2T-TR		12 V
		L7812ABV-DG				12 V
L7812AC	L7812ACV			L7812ACD2T-TR		12 V
		L7812ACV-DG				12 V

Table 26. Order codes (continued)

Part numbers	Order codes					
	TO-220 (single gauge)	TO-220 (dual gauge)	DPAK	D ² PAK	TO-220FP	Output voltages
L7815C	L7815CV			L7815CD2T-TR	L7815CP	15 V
		L7815CV-DG				15 V
L7815AB	L7815ABV			L7815ABD2T-TR		15 V
		L7815ABV-DG				15 V
L7815AC	L7815ACV			L7815ACD2T-TR		15 V
		L7815ACV-DG				15 V
L7818C	L7818CV					18 V
		L7818CV-DG				18 V
L7824C	L7824CV			L7824CD2T-TR	L7824CP	24 V
		L7824CV-DG				24 V
L7824AB	L7824ABV					24 V
		L7824ABV-DG				24 V
L7824AC	L7824ACV					24 V
		L7824ACV-DG				24 V

11 Revision history

Table 27. Document revision history

Date	Revision	Changes
21-Jun-2004	12	Document updating.
03-Aug-2006	13	Order codes has been updated and new template.
19-Jan-2007	14	D ² PAK mechanical data has been updated and add footprint data.
31-May-2007	15	Order codes has been updated.
29-Aug-2007	16	Added Table 1 in cover page.
11-Dec-2007	17	Modified: Table 26 .
06-Feb-2008	18	Added: TO-220 mechanical data Figure 38 on page 38 , Figure 39 on page 39 , and Table 23 on page 37 . Modified: Table 26 on page 55 .
18-Mar-2008	19	Added: Table 29: DPAK mechanical data on page 50 , Table 30: Tape and reel DPAK mechanical data on page 52 . Modified: Table 26 on page 55 .
26-Jan-2010	20	Modified Table 1 on page 1 and Table 23 on page 37 , added: Figure 38 on page 38 and Figure 39 on page 39 , Figure 45 on page 52 and Figure 46 on page 52 .
04-Mar-2010	21	Added notes Figure 38 on page 38 .
08-Sep-2010	22	Modified Table 26 on page 55 .
23-Nov-2010	23	Added: T _J = 25 °C test condition in ΔV_O on Table 3 , 4 , 5 , 6 , 7 , 8 and Table 9 .
16-Sep-2011	24	Modified title on page 1.
30-Nov-2011	25	Added: order codes L7805CV-DG, L7806CV-DG, L7808ABV-DG, L7812CV-DG and L7815CV-DG Table 26 on page 55 .
08-Feb-2012	26	Added: order codes L7805ACV-DG, L7805ABV-DG, L7806ABV-DG, L7808CV-DG, L7809CV-DG, L7812ACV-DG, L7818CV-DG, L7824CV-DG Table 26 on page 55 .
27-Mar-2012	27	Added: order codes L7812ABV-DG, L7815ABV-DG Table 26 on page 55 .
27-Apr-2012	28	Modified: V _I = 10.4 to 23 V ==> V _I = 11.4 to 23 V test conditon value Line regulation Table 6 on page 12 .
10-May-2012	29	Added: order codes L7806ACV-DG, L7808ACV-DG, L7815ACV-DG, L7824ABV-DG and L7824ACV-DG Table 26 on page 55 .
19-Sep-2012	30	Modified load regulation units from V to mV in Table 3 to Table 9 .
12-Mar-2013	31	Modified: V _O output voltage at 25 °C min. value 14.4 V Table 16 on page 22 .
04-Mar-2014	32	Part numbers L78xx, L78xxC, L78xxAB, L78xxAC changed to L78. Removed TO-3 package. Updated the description in cover page, Section 2: Pin configuration , Section 3: Maximum ratings , Section 4: Test circuits , Section 5: Electrical characteristics , Section 6: Application information , Section 8: Package mechanical data and Table 26: Order codes . Added Section 9: Packaging mechanical data . Minor text changes.

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