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# L78Sxx L78SxxC

## 2 A positive voltage regulators

Datasheet – production data

### Features

- Output current to 2 A
- Output voltages of 5; 7.5; 9; 10; 12; 15; 18; 24 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection

### Description

The L78Sxx series of three-terminal positive regulators is available in TO-220 and TO-3 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 employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 2 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

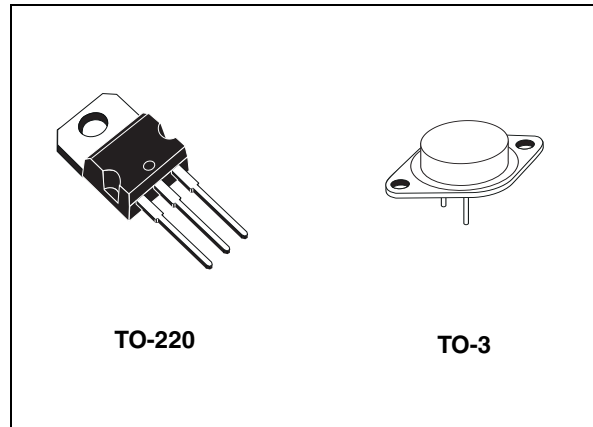


Table 1. Device summary

Part numbers			
L78S05	L78S09	L78S12	L78S18
L78S05C	L78S09C	L78S12C	L78S18C
L78S75	L78S10	L78S15	L78S24
L78S75C	L78S10C	L78S15C	L78S24C

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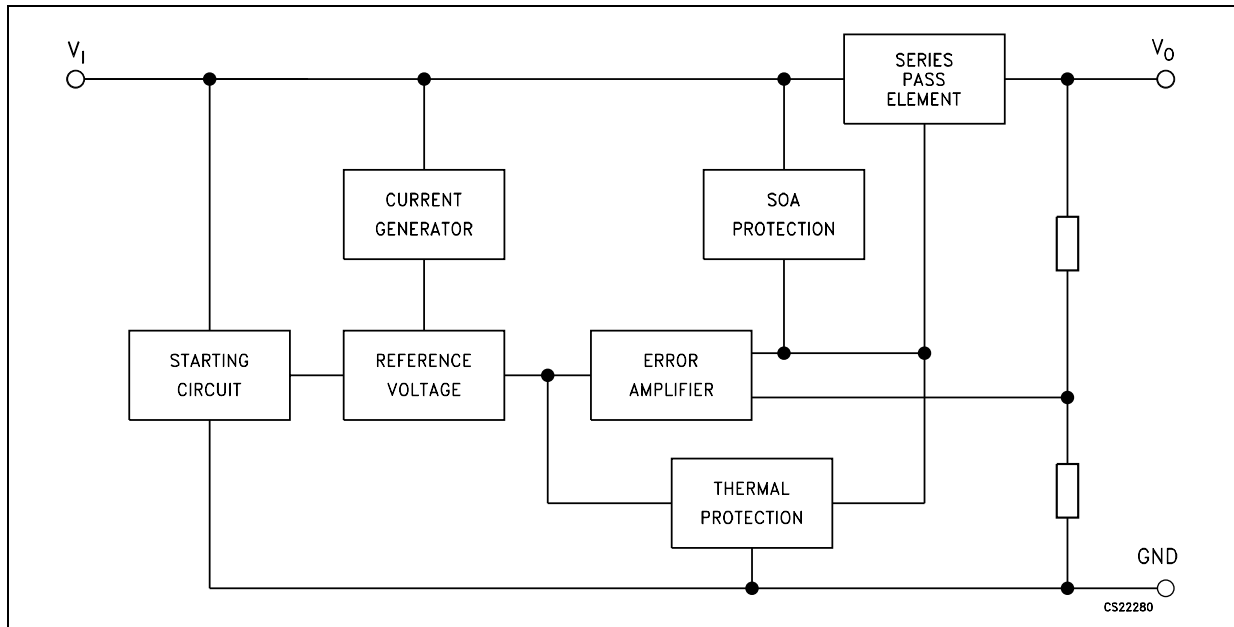
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# 1 Diagram

Figure 1. Block diagram



## 2 Pin configuration

Figure 2. Pin connections (top view)

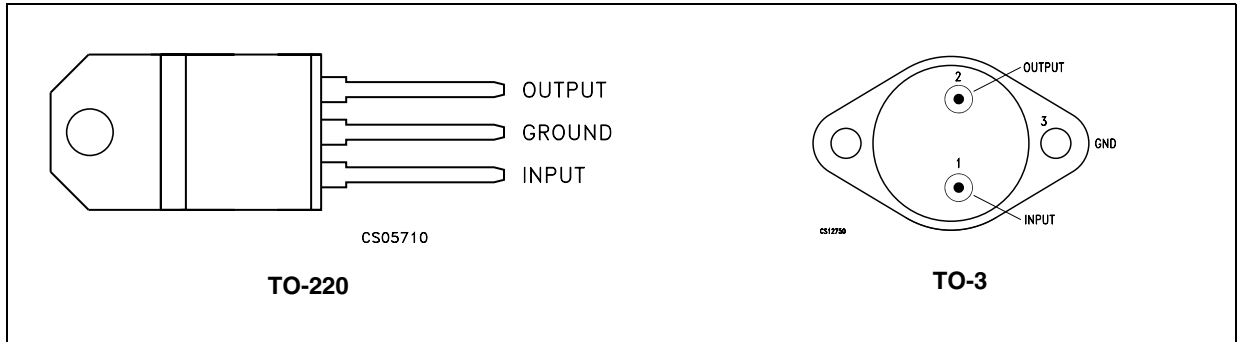
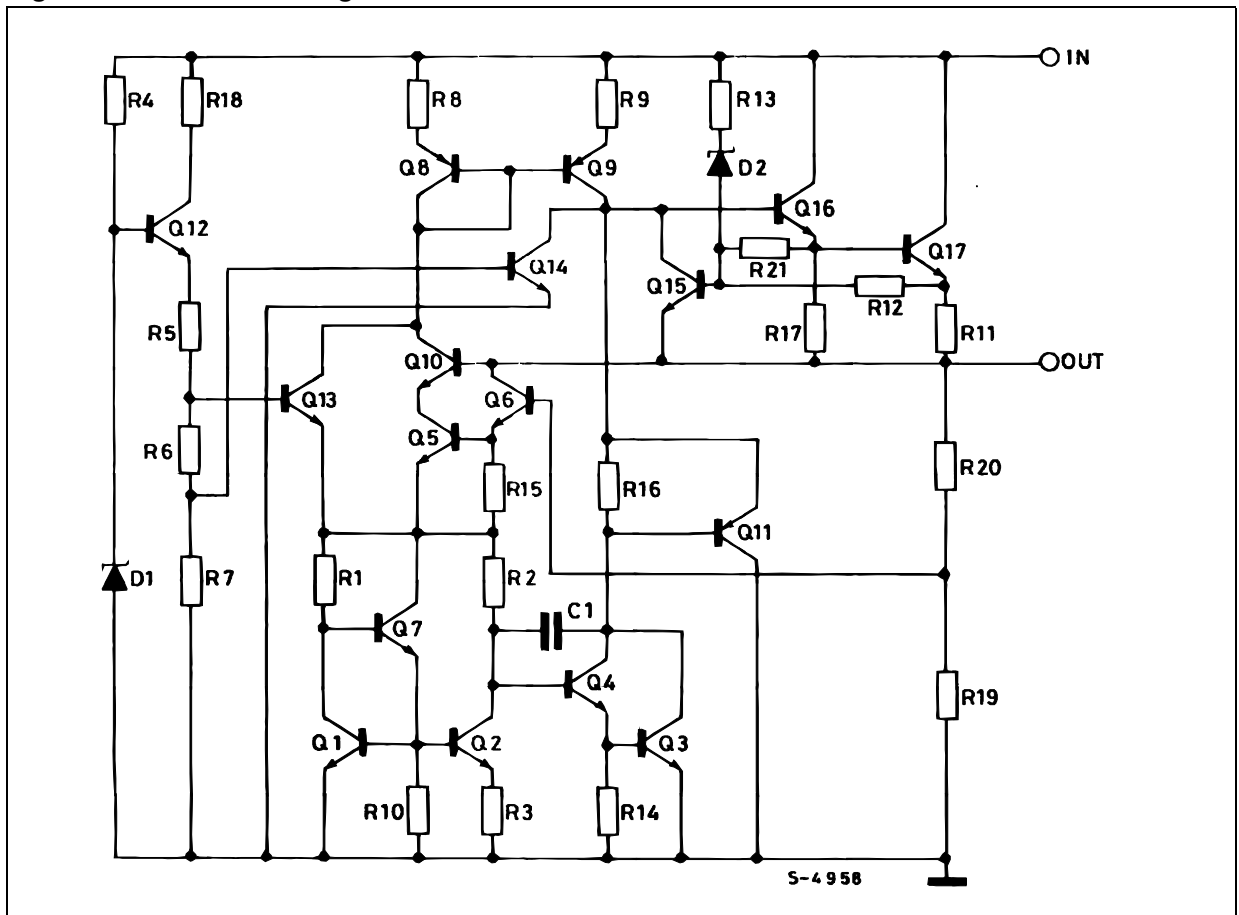


Figure 3. Schematic diagram



### 3 Maximum ratings

**Table 2. Absolute maximum ratings**

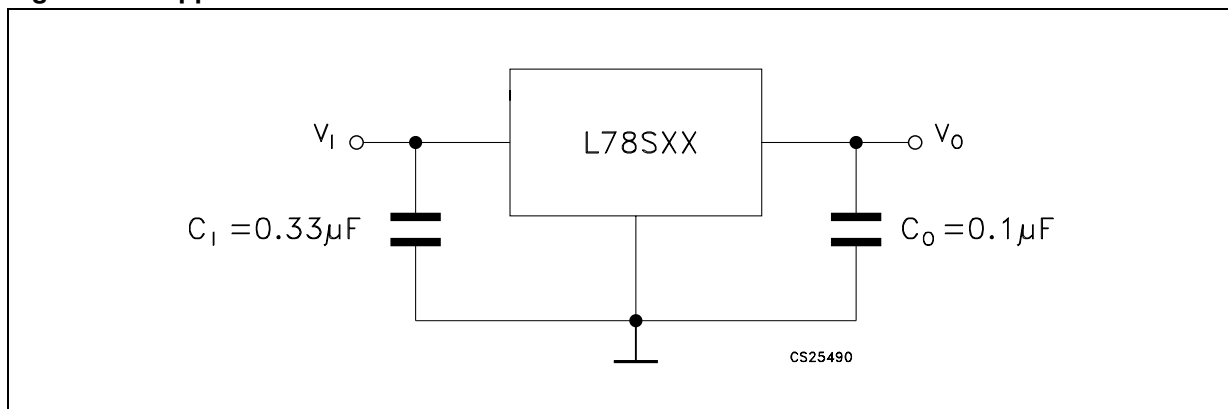
Symbol	Parameter		Value	Unit
V <sub>I</sub>	DC input voltage	for V <sub>O</sub> = 5 to 18V	35	V
		for V <sub>O</sub> = 24V	40	
I <sub>O</sub>	Output current		Internally limited	
P <sub>D</sub>	Power dissipation		Internally limited	
T <sub>STG</sub>	Storage temperature range		-65 to 150	°C
T <sub>OP</sub>	Operating junction temperature range	for L78Sxx	-55 to 150	°C
		for L78SxxC	0 to 150	

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

**Table 3. Thermal data**

Symbol	Parameter	TO-220	TO-3	Unit
R <sub>thJC</sub>	Thermal resistance junction-case	5	4	°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient	50	35	°C/W

**Figure 4. Application circuits**





# 4 Test circuits

Figure 5. DC parameter

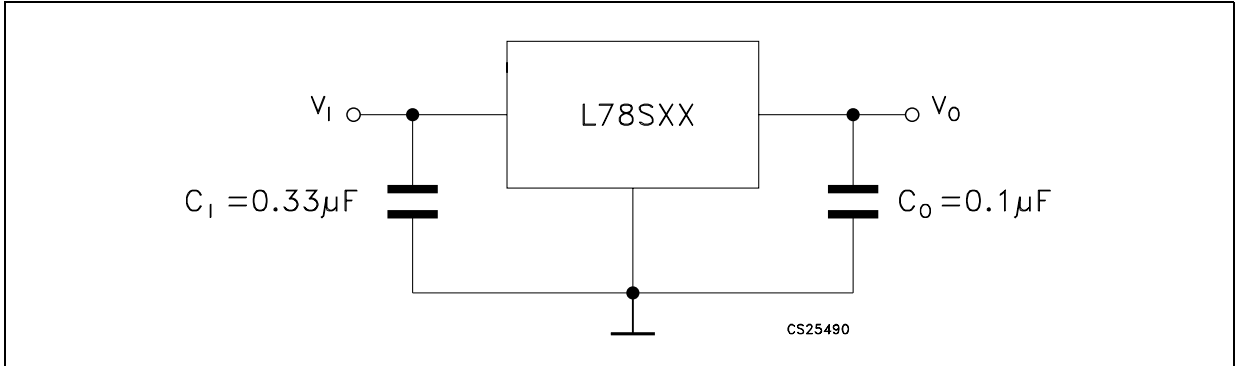


Figure 6. Load regulation

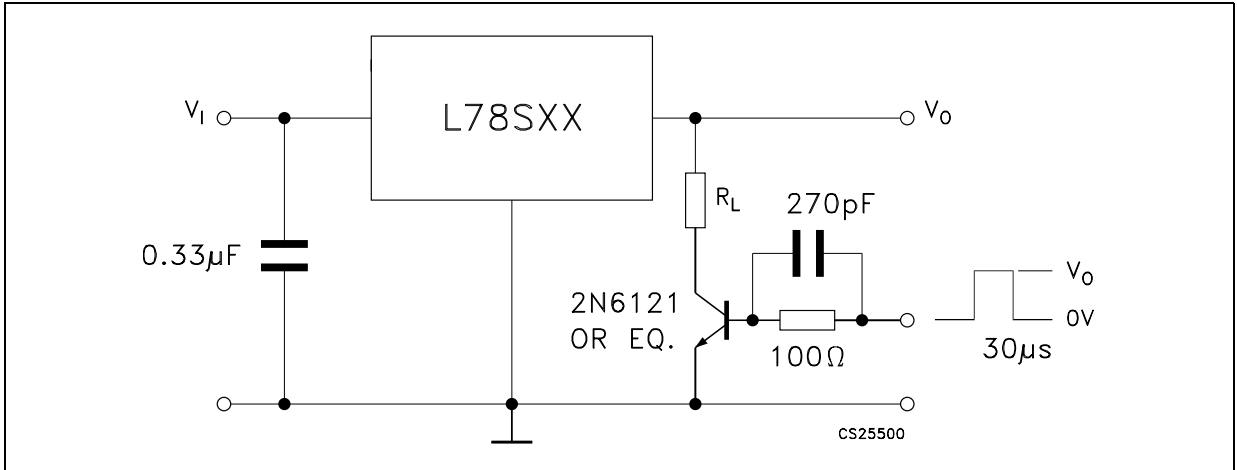
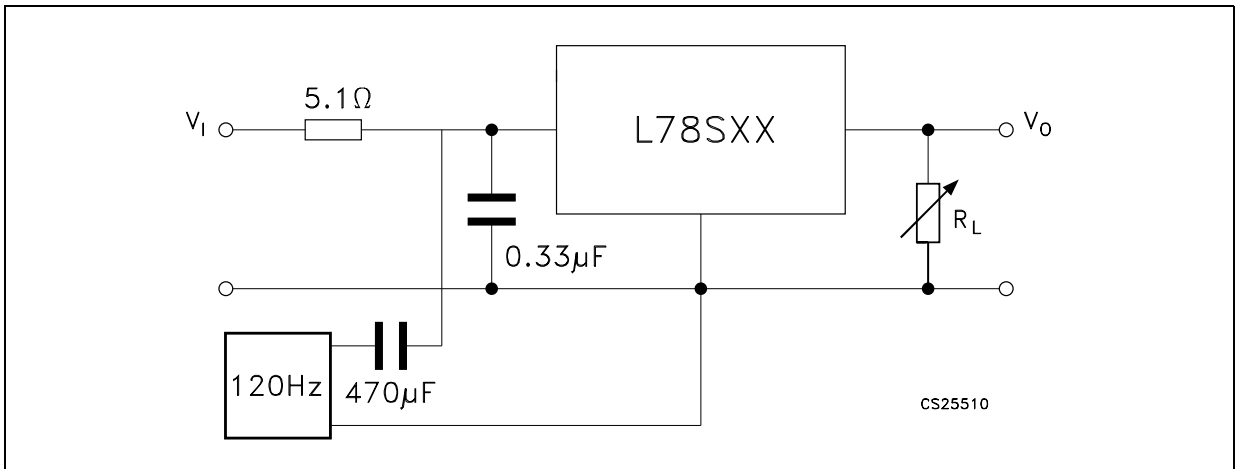


Figure 7. Ripple rejection



## 5 Electrical characteristics

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 4. Electrical characteristics of L78S05**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		4.8	5	5.2	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 7\text{ V}$	4.75	5	5.25	V
$\Delta V_O$	Line regulation	$V_I = 7\text{ to }25\text{ V}$			100	mV
		$V_I = 8\text{ to }25\text{ V}$			50	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			100	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 7\text{ to }25\text{ V}$ , $I_O = 20\text{ mA}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ °C to }150\text{ °C}$		-1.1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		40		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	60			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	8			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		17		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 12.5\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 5. Electrical characteristics of L78S75**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		7.15	7.5	7.9	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 9.5\text{ V}$	7.1	7.5	7.95	V
$\Delta V_O$	Line regulation	$V_I = 9.5\text{ to }25\text{ V}$			120	mV
		$V_I = 10.5\text{ to }20\text{ V}$			60	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			120	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$I_O = 20\text{ mA}$ , $V_I = 9.5\text{ to }25\text{ V}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ °C to }150\text{ °C}$		-0.8		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		52		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	54			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	10.5			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		16		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 6. Electrical characteristics of L78S09**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		8.65	9	9.35	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 11\text{ V}$	8.6	9	9.4	V
$\Delta V_O$	Line regulation	$V_I = 11\text{ to }25\text{ V}$			130	mV
		$V_I = 11\text{ to }20\text{ V}$			65	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			130	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 11\text{ to }25\text{ V}$ , $I_O = 20\text{ mA}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ °C to }150\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		60		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	53			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	12			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		17		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 15\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 7. Electrical characteristics of L78S10**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		9.5	10	10.5	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 12.5\text{ V}$	9.4	10	10.6	V
$\Delta V_O$	Line regulation	$V_I = 12.5\text{ to }30\text{ V}$			200	mV
		$V_I = 14\text{ to }22\text{ V}$			100	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			150	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 12.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ °C to }150\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		65		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	53			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	13			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		17		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 8. Electrical characteristics of L78S12**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		11.5	12	12.5	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 14.5\text{ V}$	11.4	12	12.6	V
$\Delta V_O$	Line regulation	$V_I = 14.5\text{ to }30\text{ V}$			240	mV
		$V_I = 16\text{ to }22\text{ V}$			120	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			160	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 14.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ °C to }150\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		75		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	53			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	15			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		18		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 23\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 9. Electrical characteristics of L78S15**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		14.4	15	15.6	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 17.5\text{ V}$	14.25	15	15.75	V
$\Delta V_O$	Line regulation	$V_I = 17.5\text{ to }30\text{ V}$			300	mV
		$V_I = 20\text{ to }26\text{ V}$			150	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			180	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 17.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ }^\circ\text{C to }150\text{ }^\circ\text{C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		90		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	52			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	18			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		19		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 26\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 10. Electrical characteristics of L78S18**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		17.1	18	18.9	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 20.5\text{ V}$	17	18	19	V
$\Delta V_O$	Line regulation	$V_I = 20.5\text{ to }30\text{ V}$			360	mV
		$V_I = 22\text{ to }28\text{ V}$			180	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			200	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 20.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ }^\circ\text{C to }150\text{ }^\circ\text{C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		110		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	49			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	21			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		22		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 11. Electrical characteristics of L78S24**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		23	24	25	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 27\text{ V}$	22.8	24	25.2	V
$\Delta V_O$	Line regulation	$V_I = 27\text{ to }38\text{ V}$			480	mV
		$V_I = 30\text{ to }36\text{ V}$			240	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }2\text{ A}$			250	mV
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 27\text{ to }38\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = -55\text{ °C to }150\text{ °C}$		-1.5		mV/°C
eN	Output noise voltage	B = 10 Hz to 100 kHz		170		μV
SVR	Supply voltage rejection	f = 120 Hz	48			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	27			V
$R_O$	Output resistance	f = 1 kHz		23		mΩ
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 12. Electrical characteristics of L78S05C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		4.8	5	5.2	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 7\text{ V}$	4.75	5	5.25	V
$\Delta V_O$	Line regulation	$V_I = 7\text{ to }25\text{ V}$			100	mV
		$V_I = 8\text{ to }25\text{ V}$			50	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			100	mV
		$I_O = 2\text{ A}$		80		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 7\text{ to }25\text{ V}$ , $I_O = 20\text{ mA}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1.1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		40		μV
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	54			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	8			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		17		mΩ
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 12.5\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 13. Electrical characteristics of L78S75C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		7.15	7.5	7.9	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 9.5\text{ V}$	7.1	7.5	7.95	V
$\Delta V_O$	Line regulation	$V_I = 9.5\text{ to }25\text{ V}$			120	mV
		$V_I = 10.5\text{ to }20\text{ V}$			60	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			140	mV
		$I_O = 2\text{ A}$		100		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 9.5\text{ to }25\text{ V}$ , $I_O = 20\text{ mA}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-0.8		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		52		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	48			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	10.5			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		16		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A



Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 14. Electrical characteristics of L78S09C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		8.65	9	9.35	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 11\text{ V}$	8.6	9	9.4	V
$\Delta V_O$	Line regulation	$V_I = 11\text{ to }25\text{ V}$			130	mV
		$V_I = 11\text{ to }20\text{ V}$			65	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			170	mV
		$I_O = 2\text{ A}$		100		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 11\text{ to }25\text{ V}$ , $I_O = 20\text{ mA}$			1.3	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		60		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	47			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	12			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		17		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 15\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 15. Electrical characteristics of L78S10C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		9.5	10	10.5	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 12.5\text{ V}$	9.4	10	10.6	V
$\Delta V_O$	Line regulation	$V_I = 12.5\text{ to }30\text{ V}$			200	mV
		$V_I = 14\text{ to }22\text{ V}$			100	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			240	mV
		$I_O = 2\text{ A}$		150		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 12.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		65		μV
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	47			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	13			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		17		mΩ
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 16. Electrical characteristics of L78S12C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		11.5	12	12.5	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 14.5\text{ V}$	11.4	12	12.6	V
$\Delta V_O$	Line regulation	$V_I = 14.5\text{ to }30\text{ V}$			240	mV
		$V_I = 16\text{ to }22\text{ V}$			120	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			240	mV
		$I_O = 2\text{ A}$		150		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 14.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		75		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	47			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	15			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		18		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 23\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 17. Electrical characteristics of L78S15C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		14.4	15	15.6	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 17.5\text{ V}$	14.25	15	15.75	V
$\Delta V_O$	Line regulation	$V_I = 17.5\text{ to }30\text{ V}$			300	mV
		$V_I = 20\text{ to }26\text{ V}$			150	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			300	mV
		$I_O = 2\text{ A}$		150		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 17.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		90		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	46			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	18			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		19		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 26\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 18. Electrical characteristics of L78S18C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		17.1	18	18.9	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 20.5\text{ V}$	17	18	19	V
$\Delta V_O$	Line regulation	$V_I = 20.5\text{ to }30\text{ V}$			360	mV
		$V_I = 22\text{ to }28\text{ V}$			180	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			360	mV
		$I_O = 2\text{ A}$		200		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 20.5\text{ to }30\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		110		μV
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	43			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	21			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		22		mΩ
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified.

**Table 19. Electrical characteristics of L78S24C**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage		23	24	25	V
$V_O$	Output voltage	$I_O = 1\text{ A}$ , $V_I = 27\text{ V}$	22.8	24	25.2	V
$\Delta V_O$	Line regulation	$V_I = 27\text{ to }38\text{ V}$			480	mV
		$V_I = 30\text{ to }36\text{ V}$			240	
$\Delta V_O$	Load regulation	$I_O = 20\text{ mA to }1.5\text{ A}$			480	mV
		$I_O = 2\text{ A}$		300		
$I_Q$	Quiescent current				8	mA
$\Delta I_Q$	Quiescent current change	$I_O = 20\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 27\text{ to }38\text{ V}$ , $I_O = 20\text{ mA}$			1	
$\Delta V_O/\Delta T$	Output voltage drift	$I_O = 5\text{ mA}$ , $T_J = 0\text{ °C to }70\text{ °C}$		-1.5		mV/°C
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		170		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	42			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	27			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		28		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

# 6 Typical performance

Figure 8. Dropout voltage vs. junction temperature

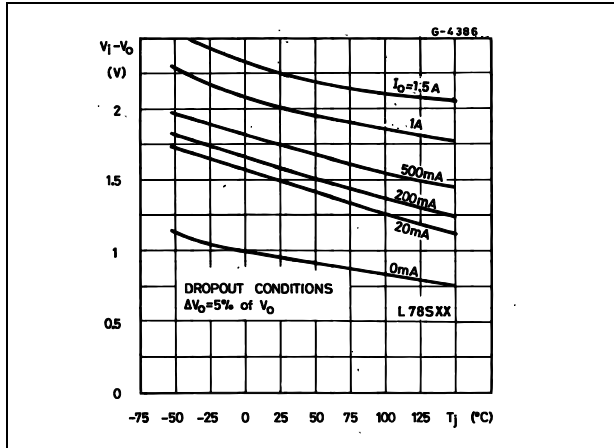


Figure 9. Peak output current vs. input/output differential voltage

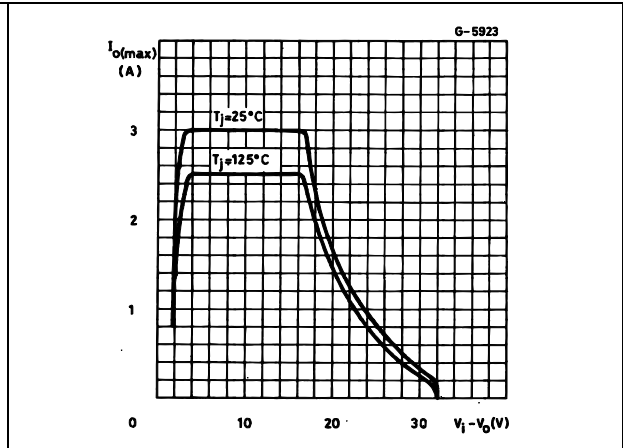


Figure 10. Output impedance vs. frequency

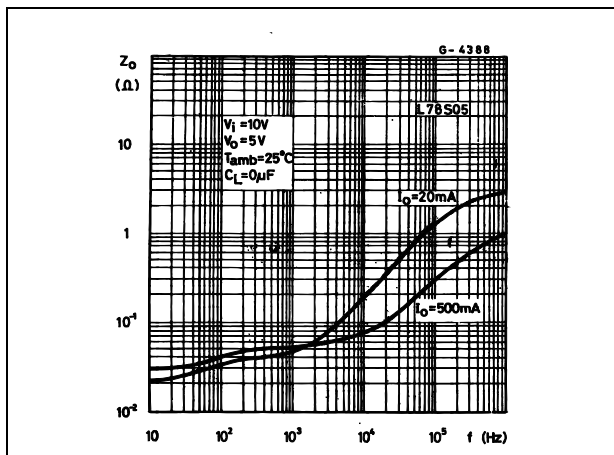


Figure 11. Output voltage vs. junction temperature

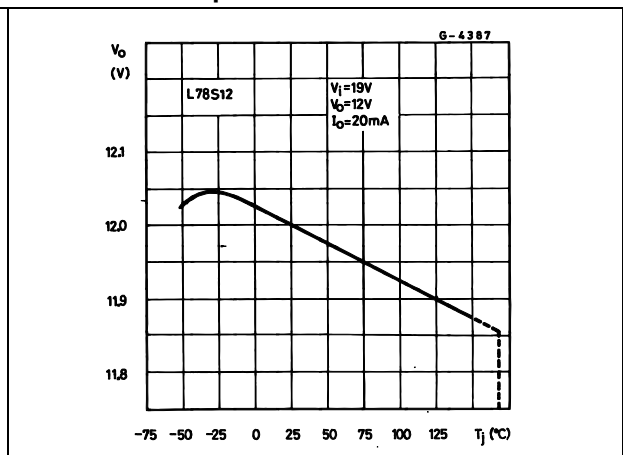


Figure 12. Supply voltage rejection vs. frequency

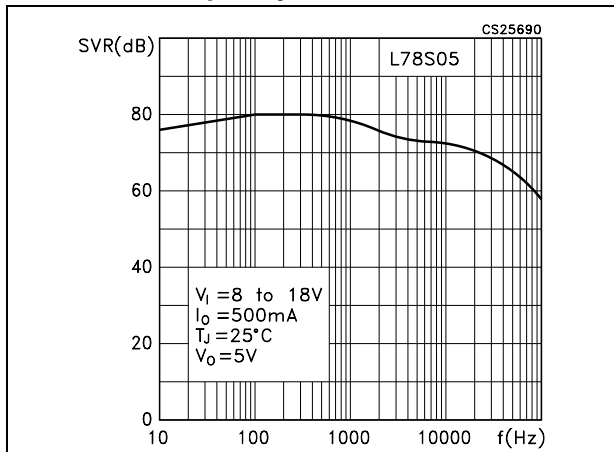


Figure 13. Quiescent current vs. junction temperature

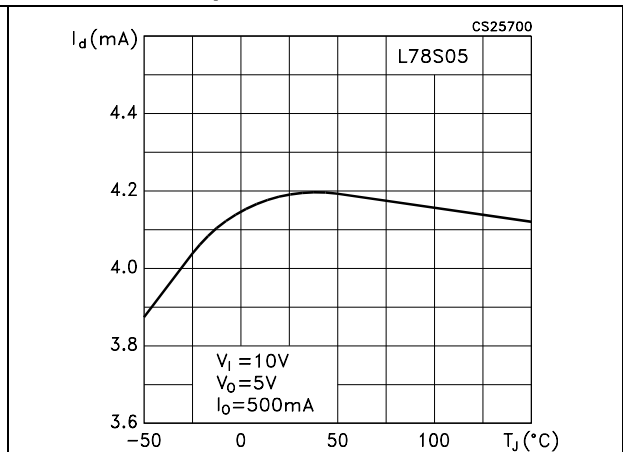


Figure 14. Load transient response

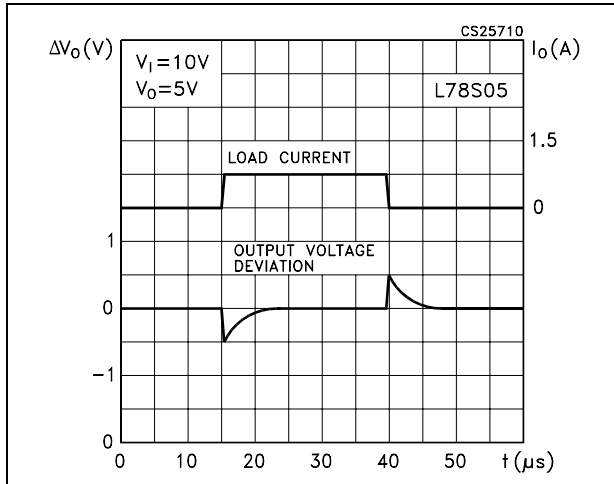


Figure 15. Line transient response

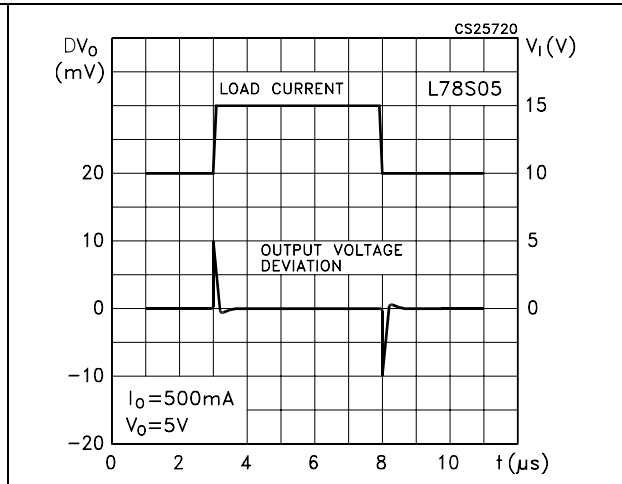


Figure 16. Quiescent current vs. input voltage

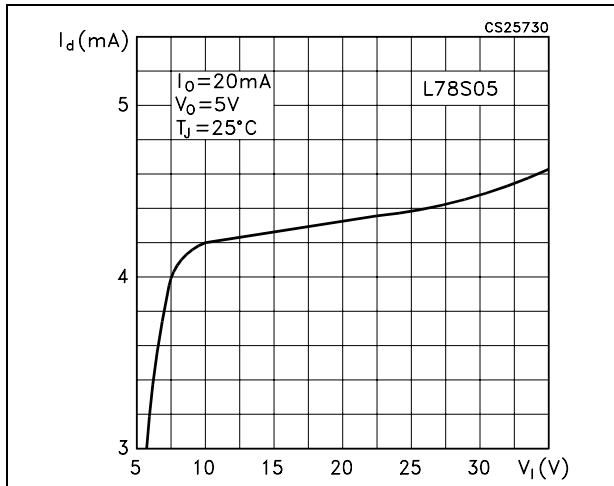
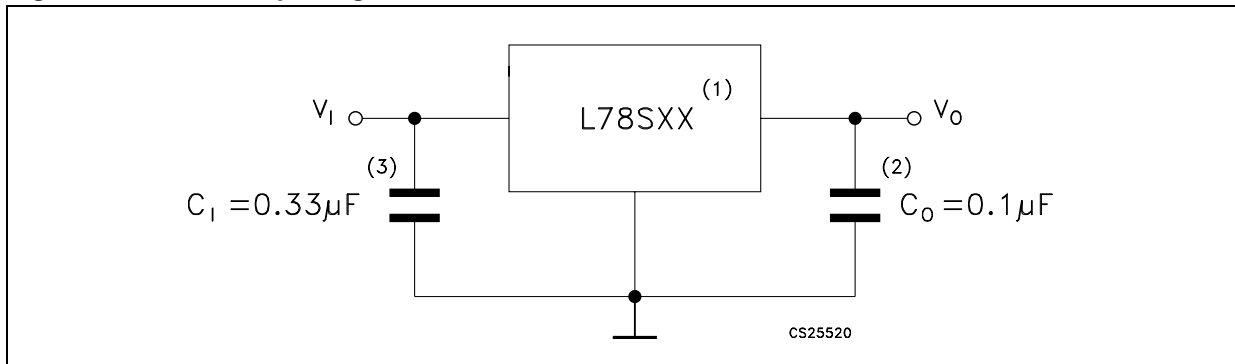


Figure 17. Fixed output regulator



1. To specify an output voltage, substitute voltage value for "XX".
2. Although no output capacitor is need for stability, it does improve transient response.
3. Required if regulator is locate an appreciable distance from power supply filter.



Figure 18. Constant current regulator

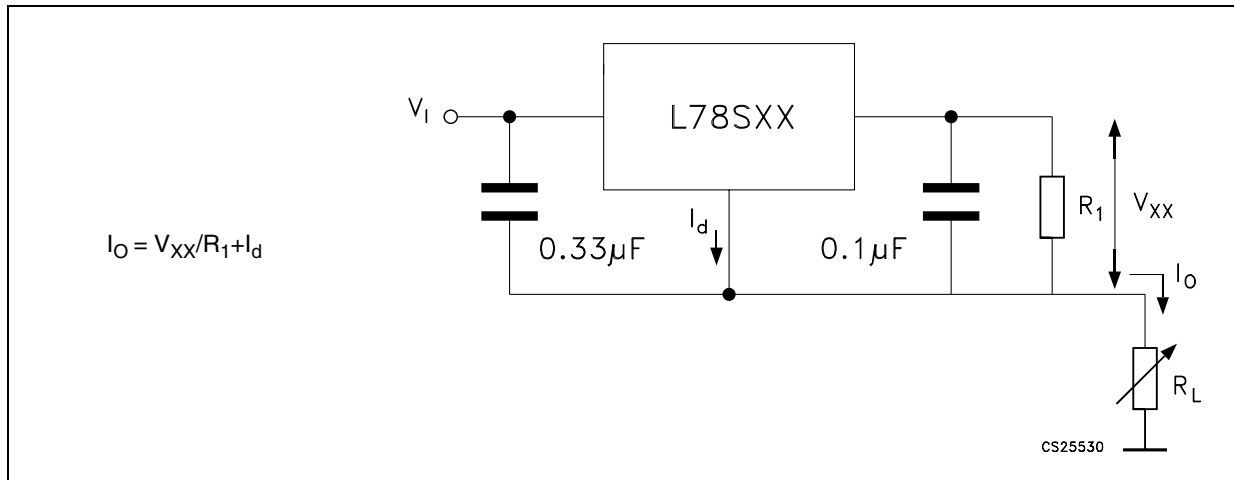


Figure 19. Circuit for increasing output voltage

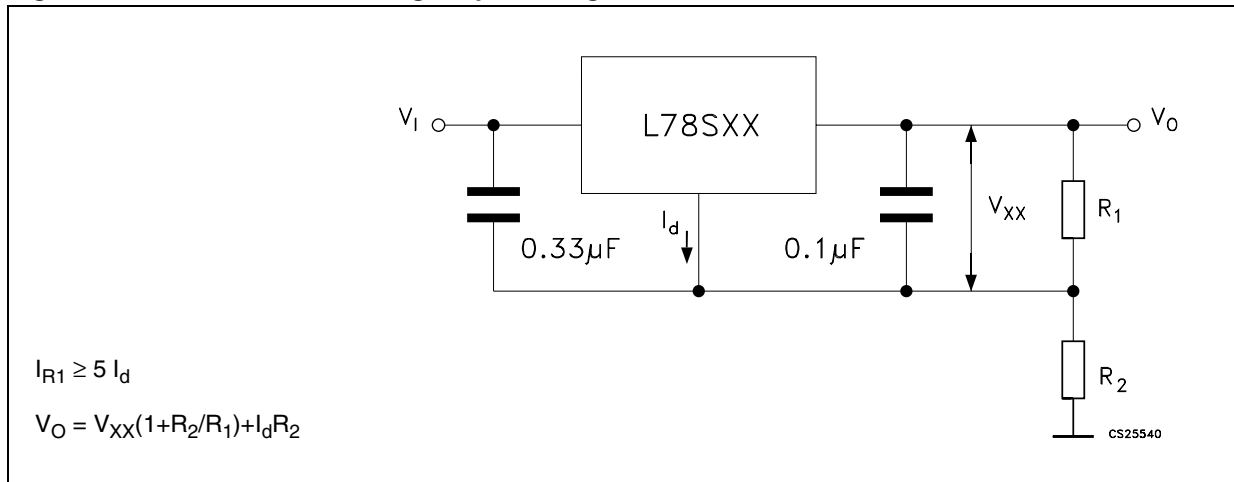


Figure 20. Adjustable output regulator (7 to 30 V)

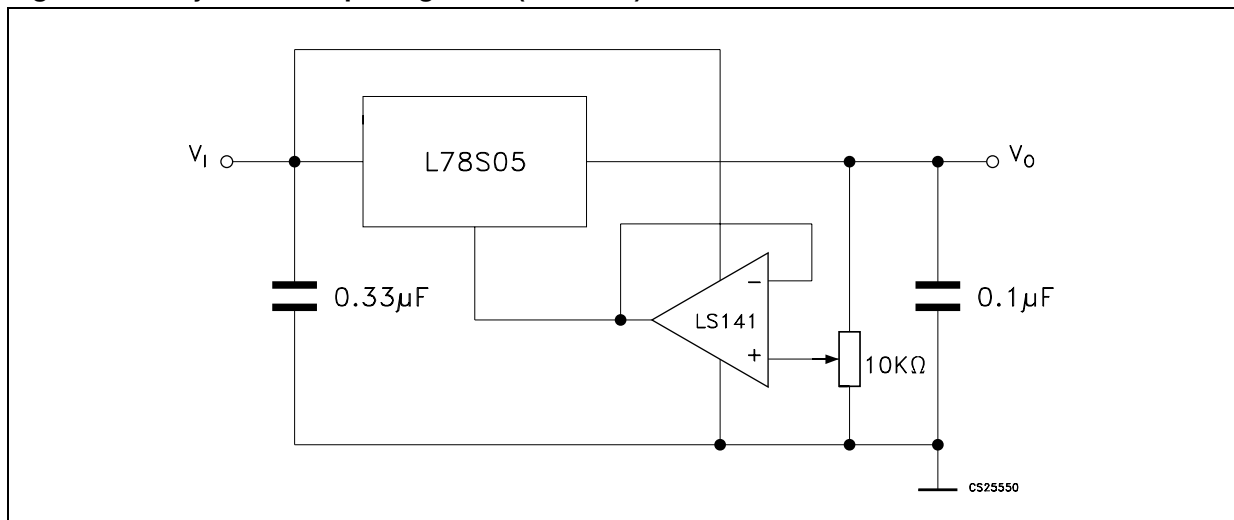


Figure 21. 0.5 to 10 V regulator

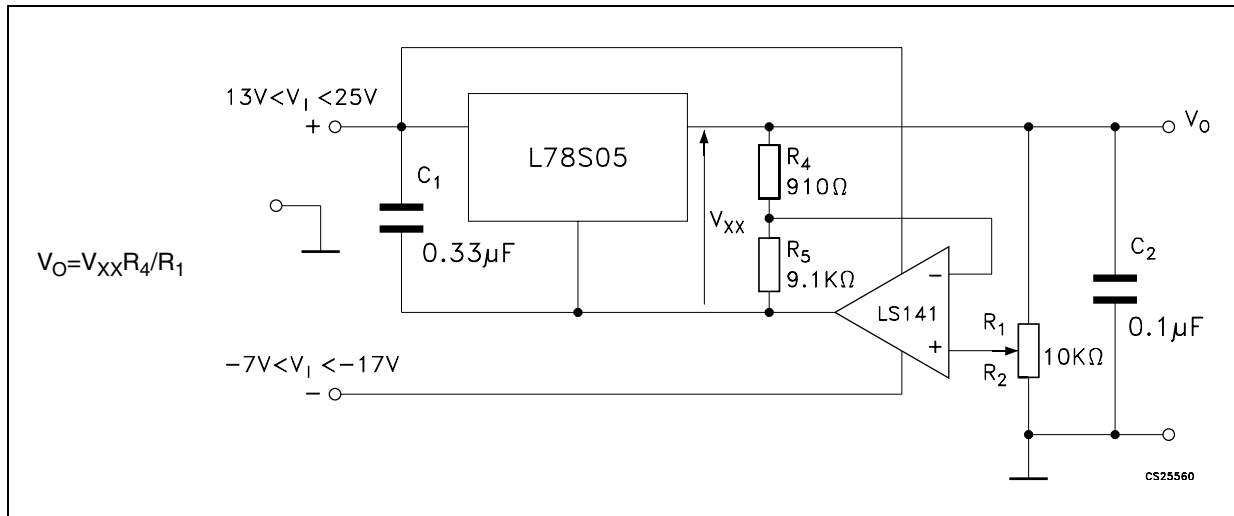


Figure 22. High current voltage regulator

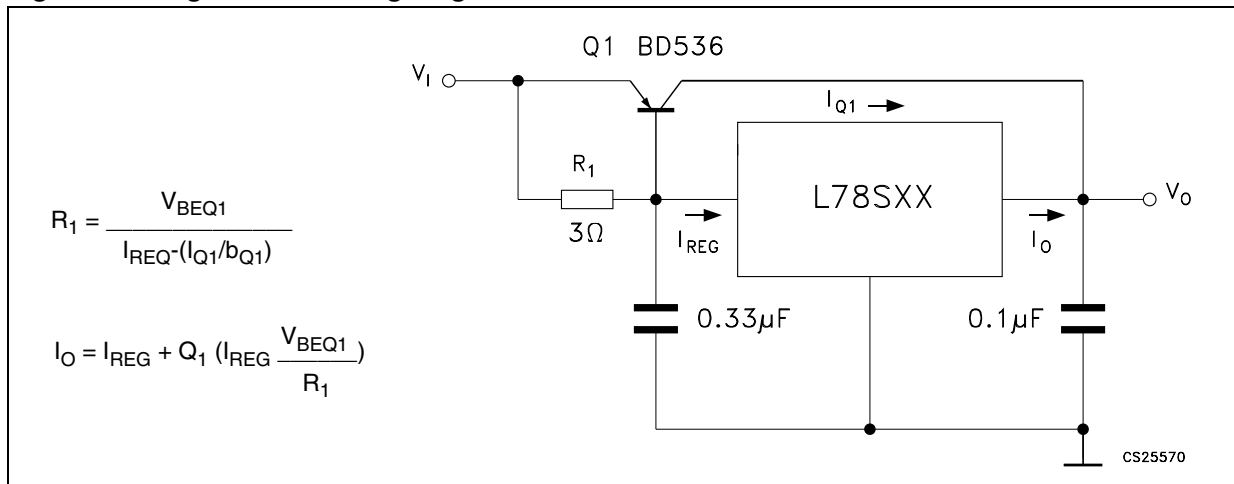


Figure 23. High output current with short circuit protection

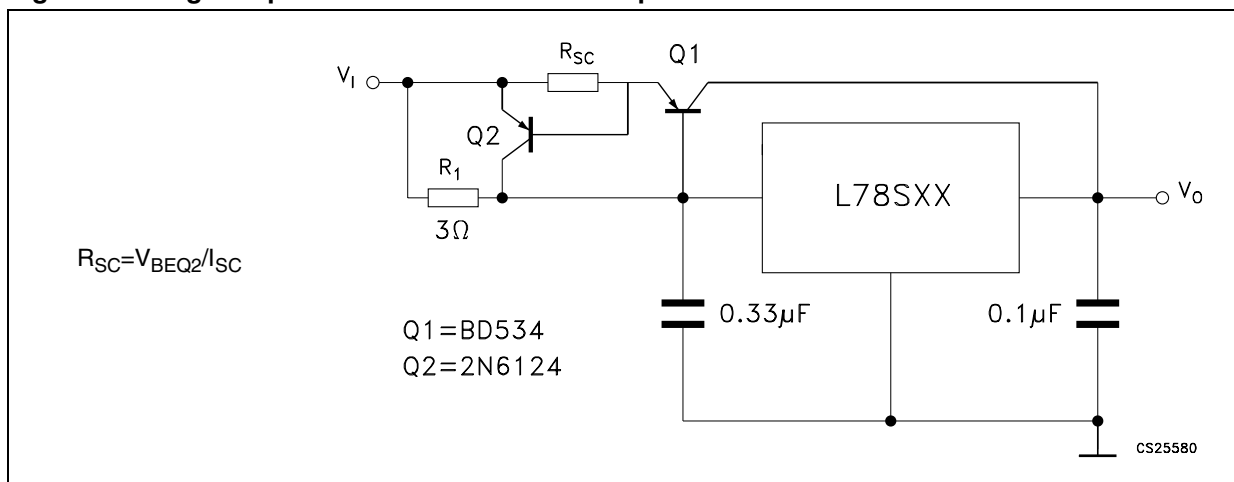


Figure 24. Tracking voltage regulator

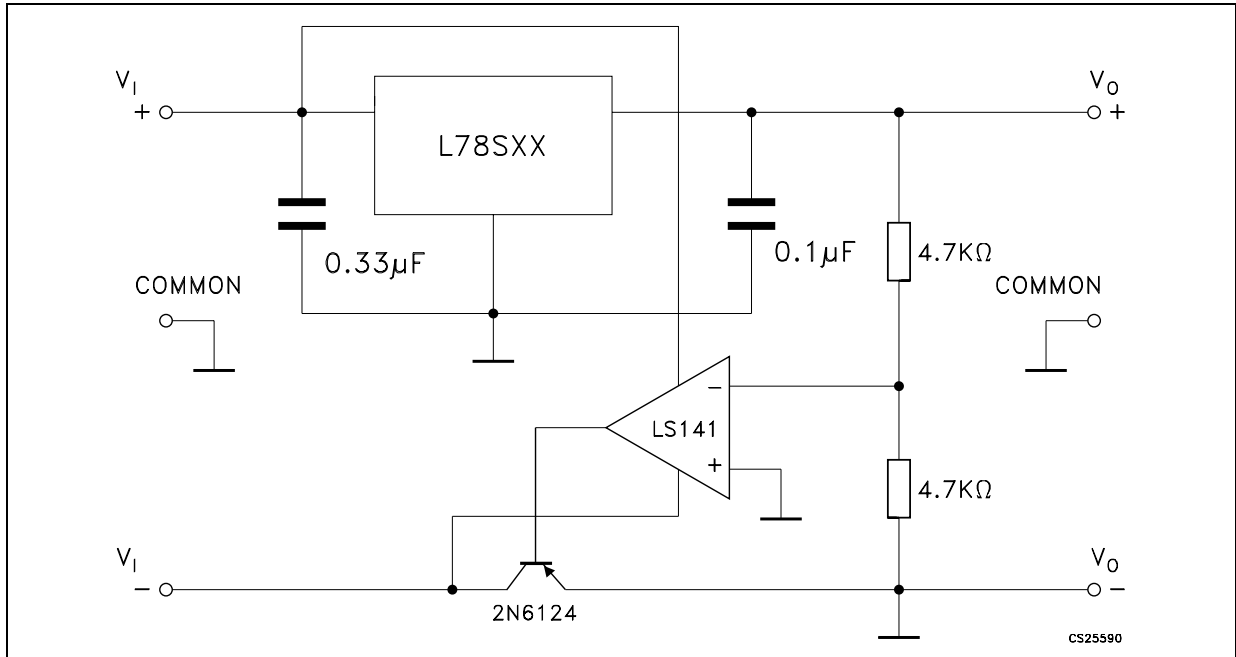


Figure 25. Positive and negative regulator

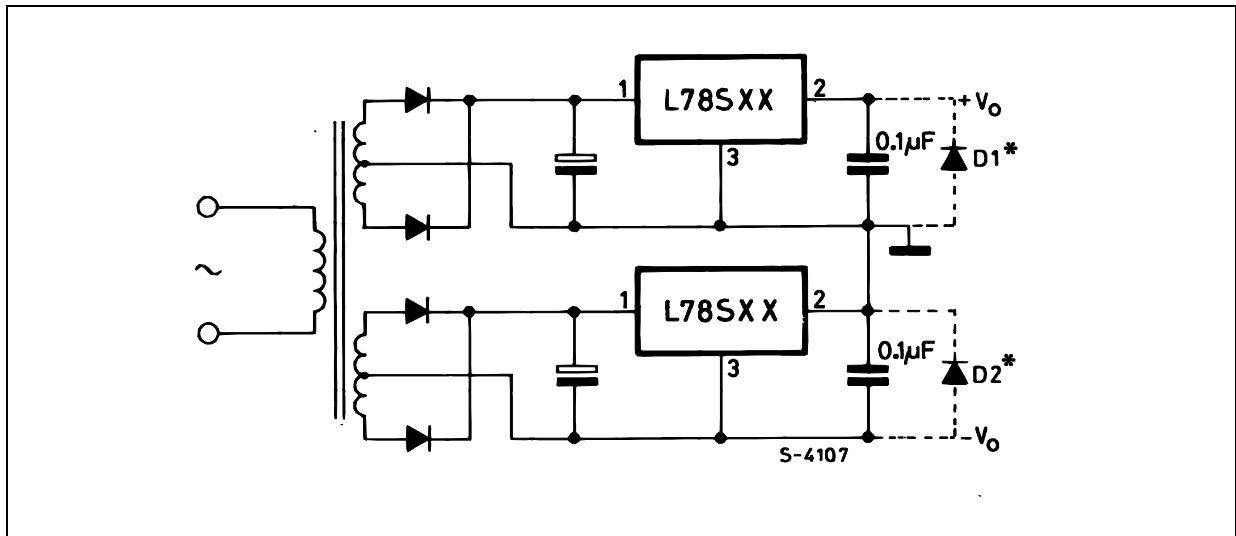


Figure 26. Negative output voltage circuit

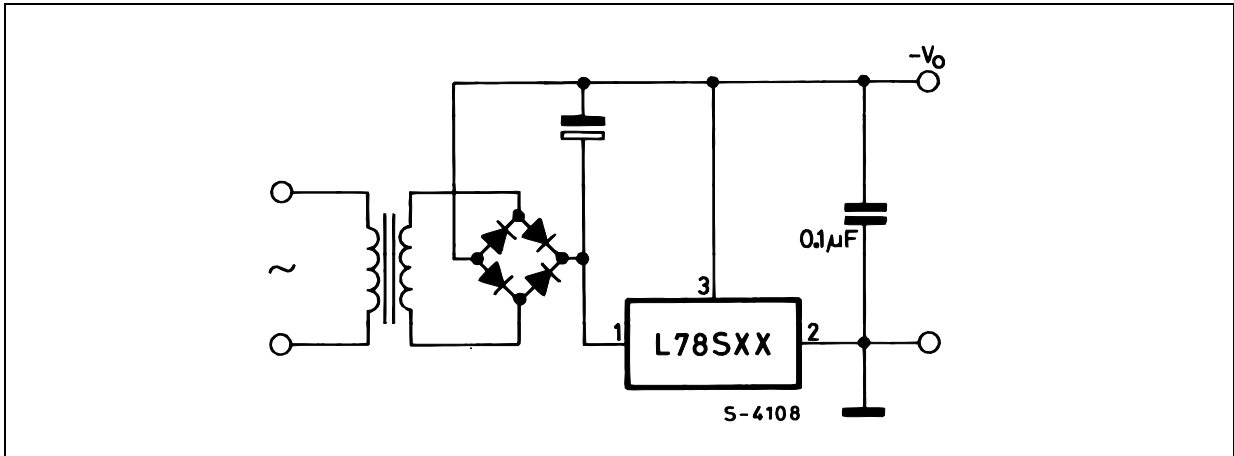


Figure 27. Switching regulator

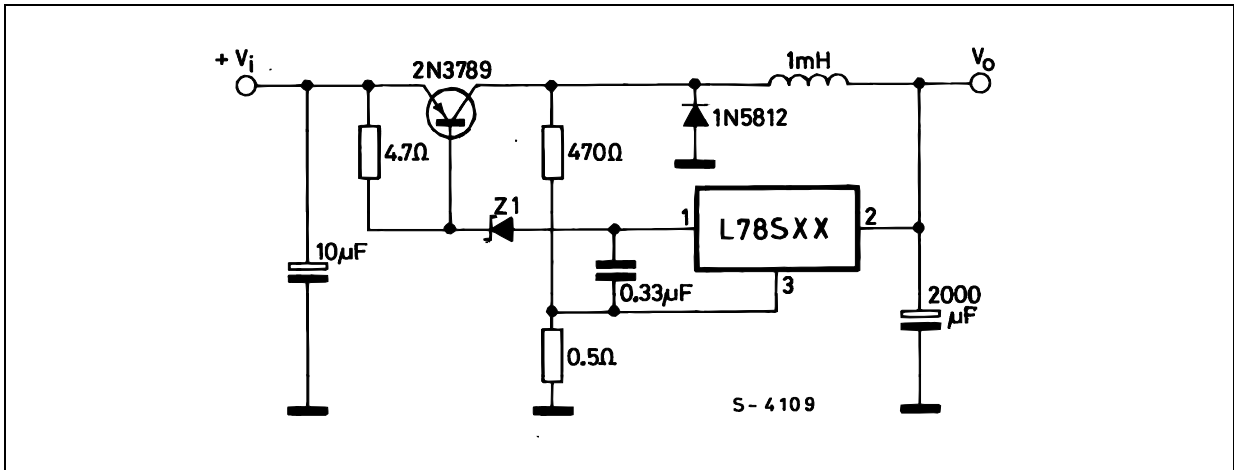


Figure 28. High input voltage circuit

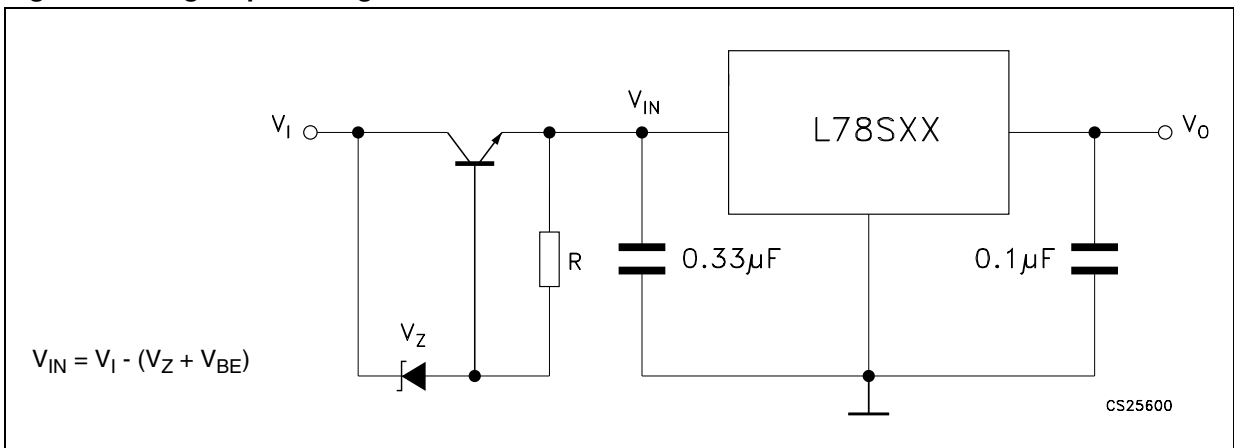


Figure 29. High input voltage circuit

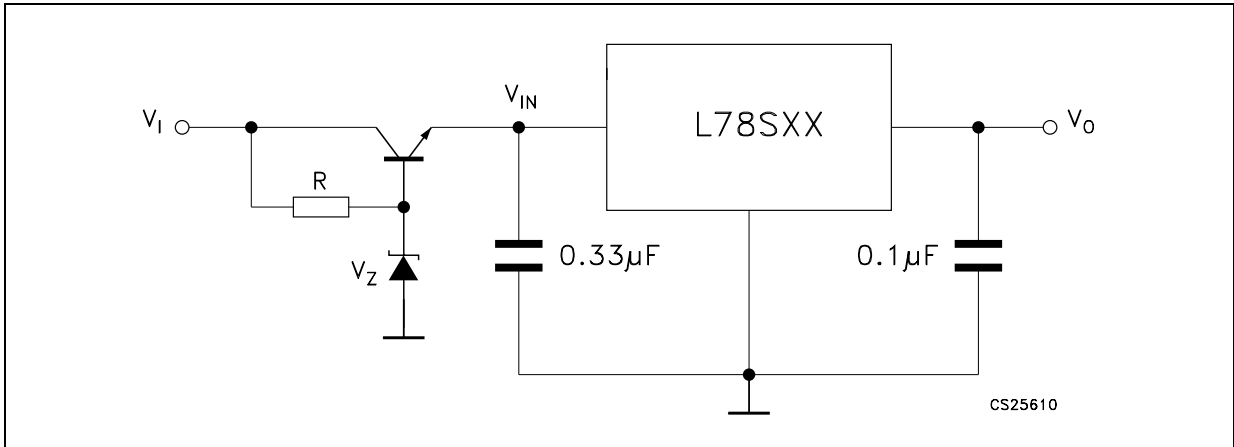


Figure 30. High output voltage regulator

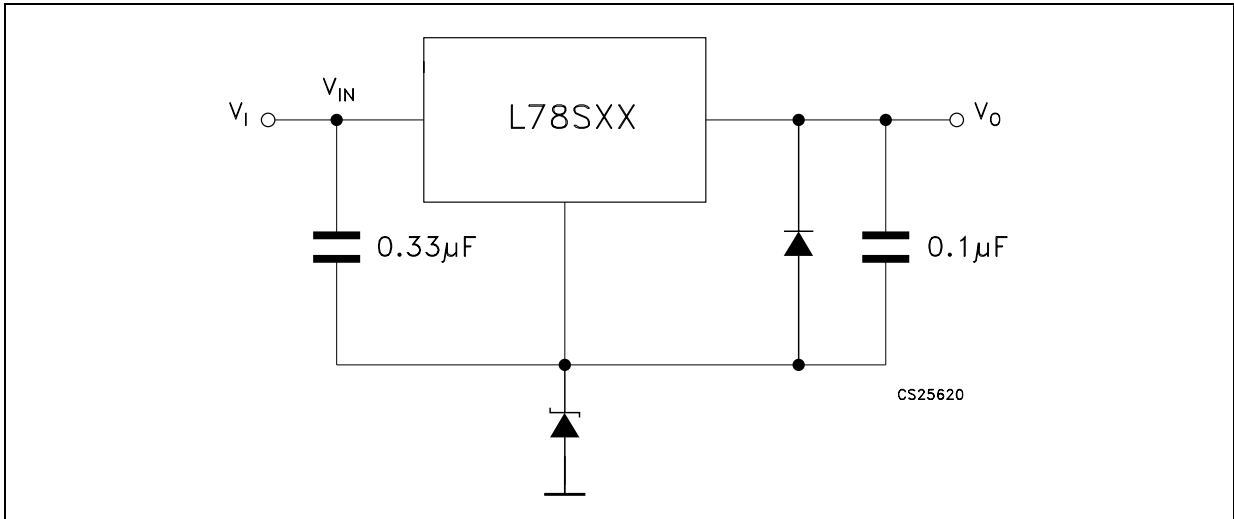


Figure 31. High input and output voltage

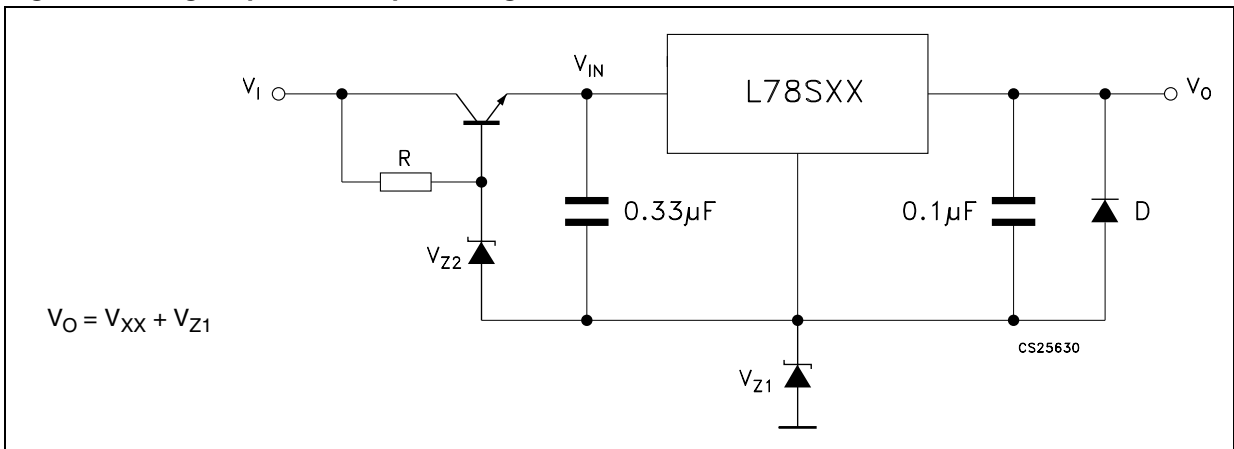


Figure 32. Reducing power dissipation with dropping resistor

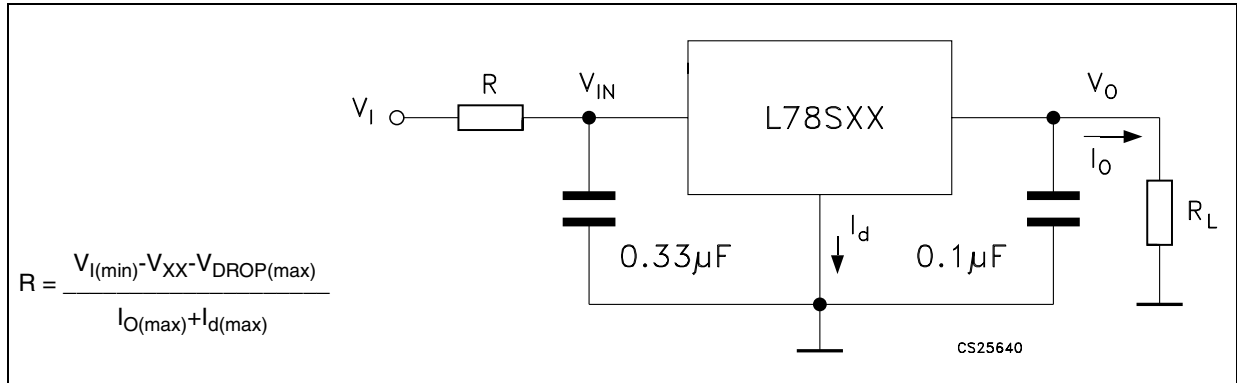


Figure 33. Remote shutdown

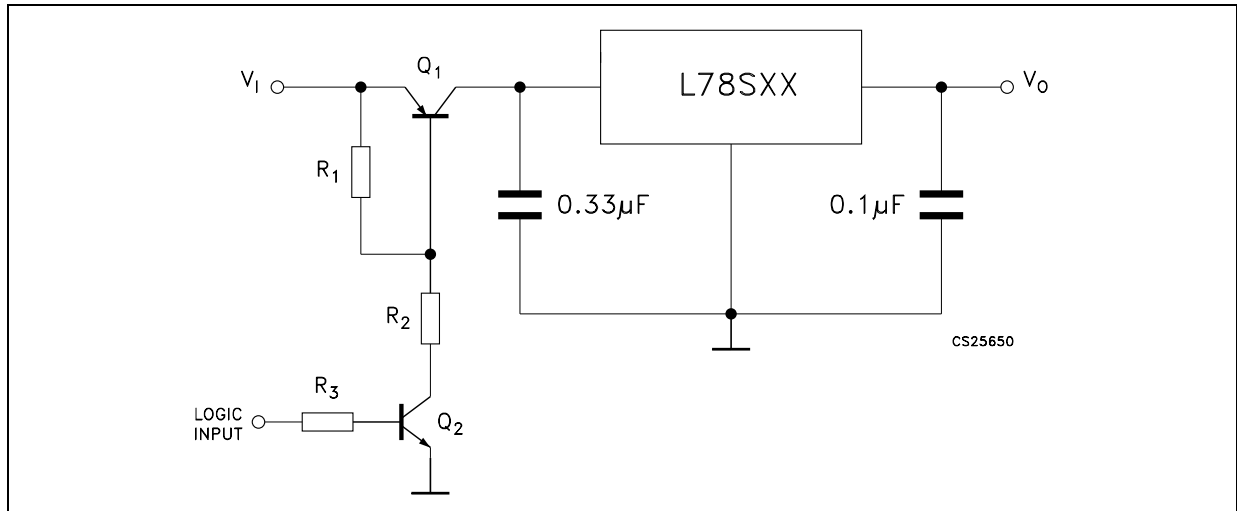
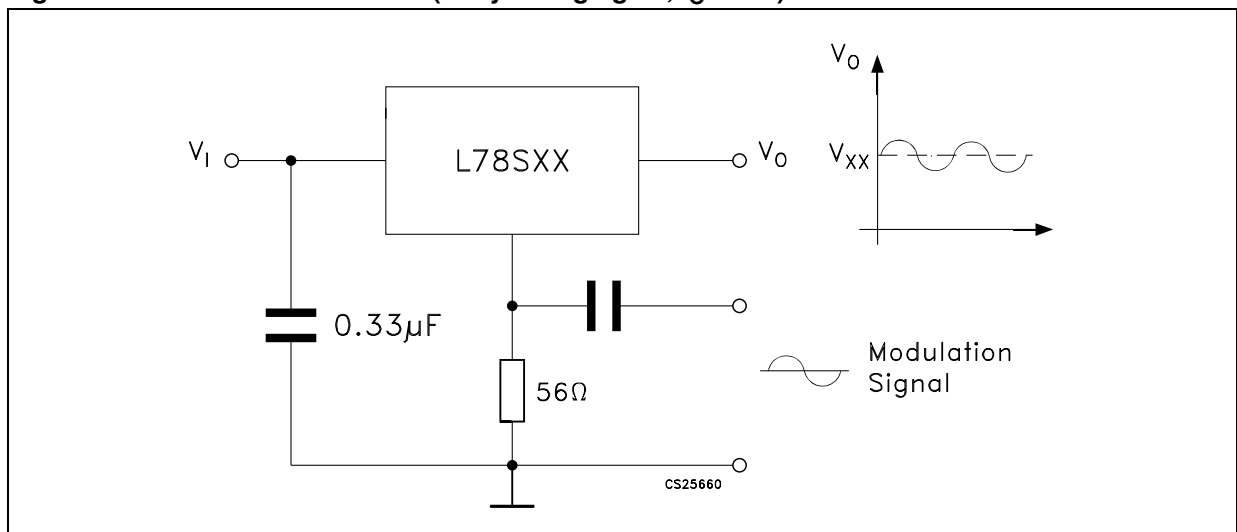
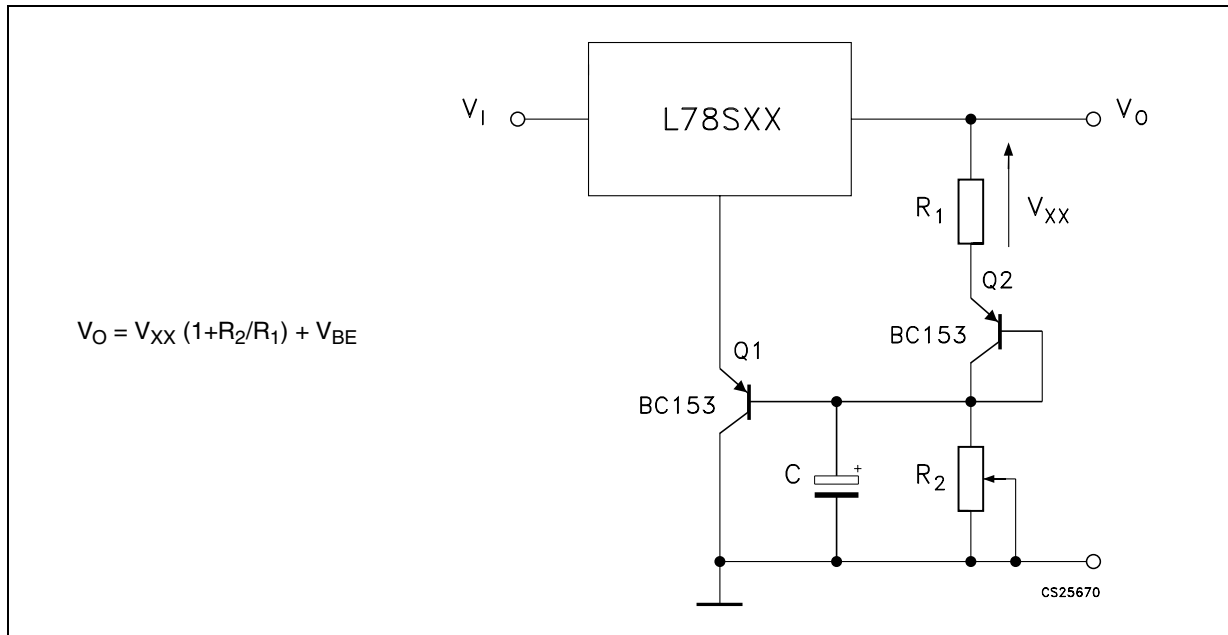


Figure 34. Power AM modulator (unity voltage gain,  $I_O \leq 1\text{ A}$ )



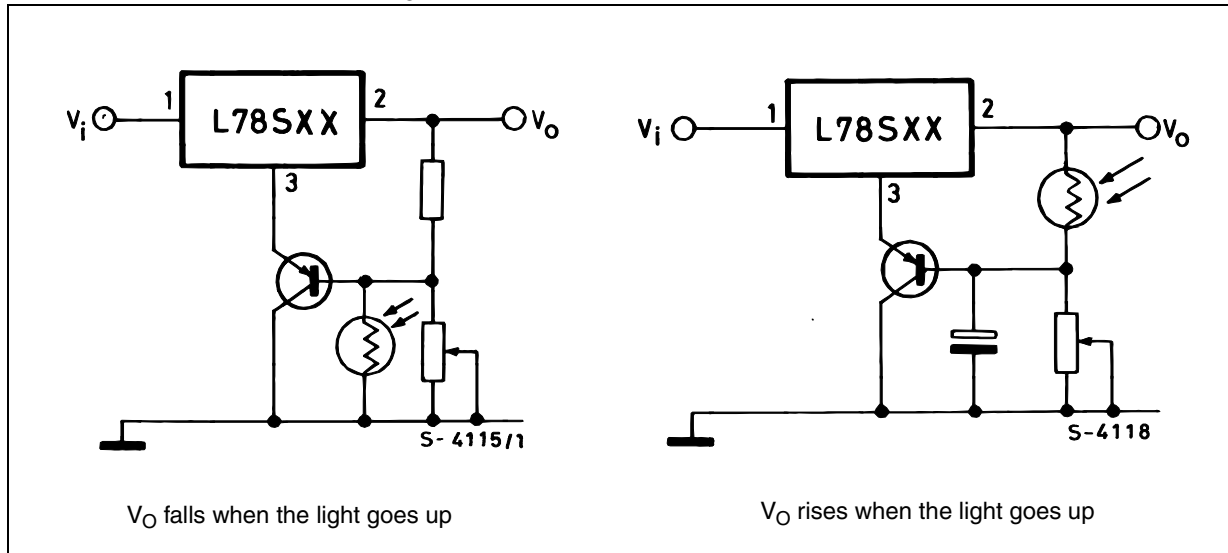
Note: The circuit performs well up to 100 kHz.

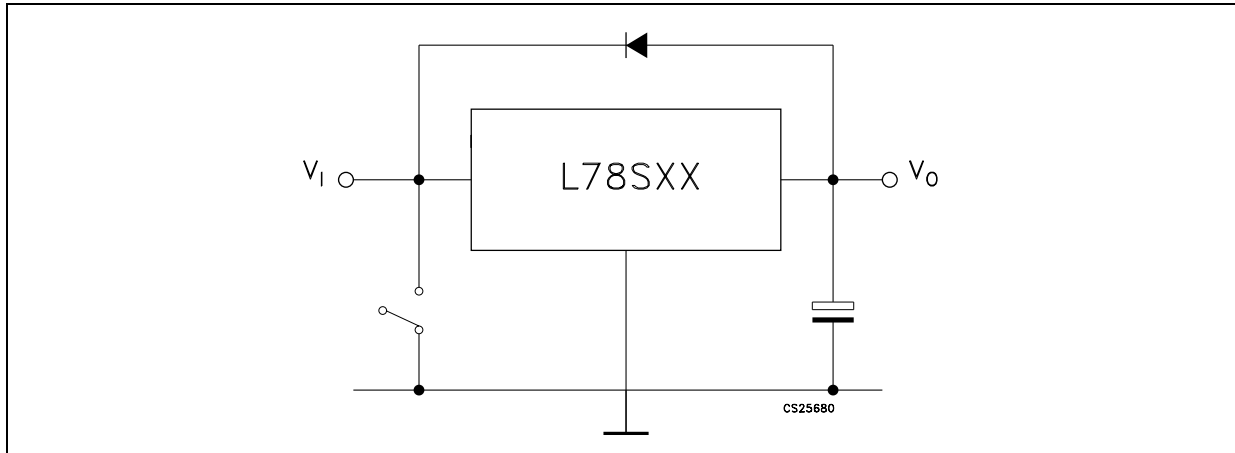
Figure 35. Adjustable output voltage with temperature compensation



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 36. Light controllers ( $V_{Omin} = V_{XX} + V_{BE}$ )



**Figure 37. Protection against input short-circuit with high capacitance loads**

1. Application with high capacitance loads and an output voltage greater than 6 volts need an external diode (see [Figure 30 on page 28](#)) 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 Package mechanical data

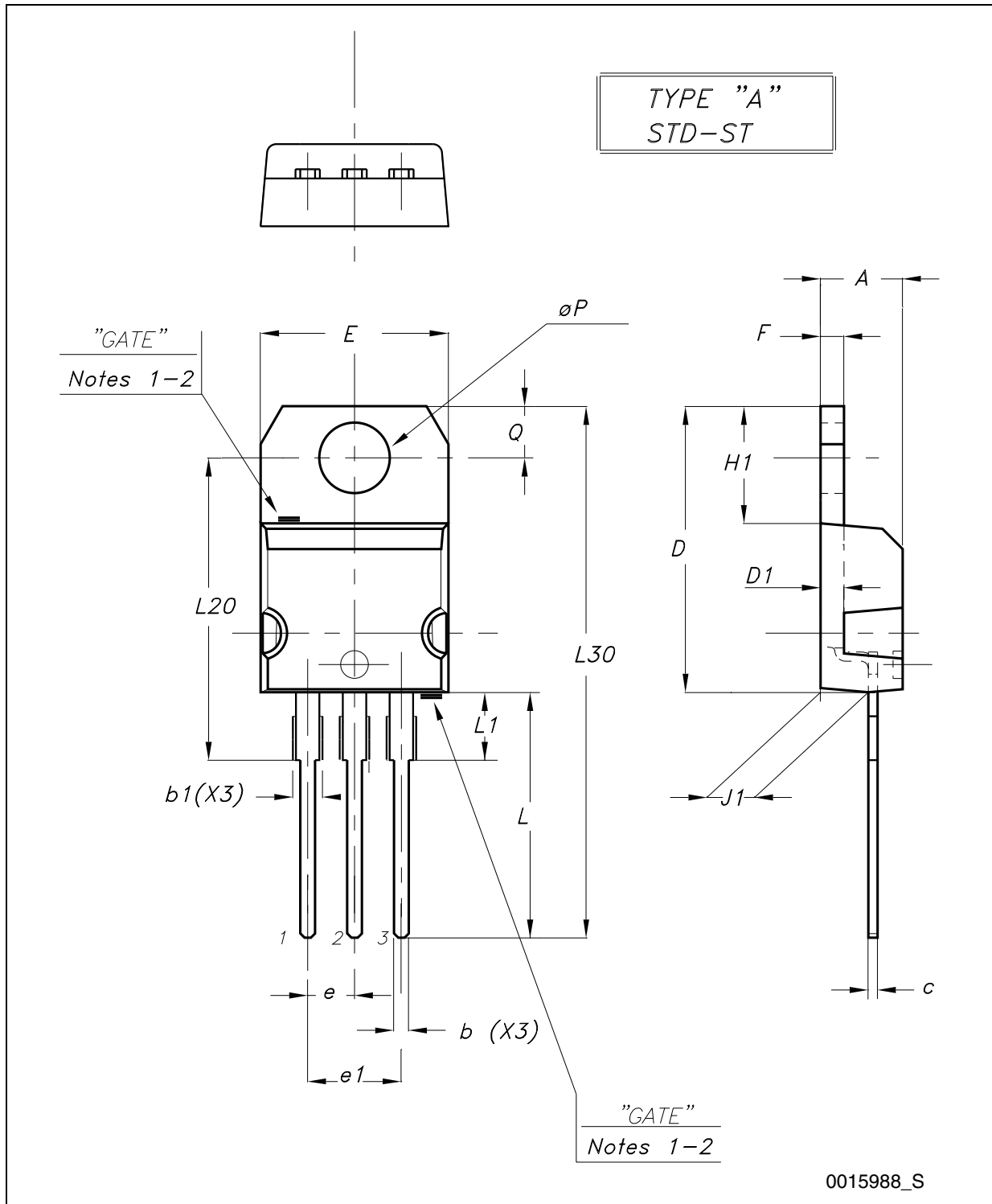
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

**Table 20. TO-220 mechanical data**

Dim.	Type STD - ST Dual Gauge			Type STD - ST Single Gauge		
	mm.			mm.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	4.40		4.60
b	0.61		0.88	0.61		0.88
b1	1.14		1.70	1.14		1.70
c	0.48		0.70	0.48		0.70
D	15.25		15.75	15.25		15.75
D1		1.27				
E	10.00		10.40	10.00		10.40
e	2.40		2.70	2.40		2.70
e1	4.95		5.15	4.95		5.15
F	1.23		1.32	0.51		0.60
H1	6.20		6.60	6.20		6.60
J1	2.40		2.72	2.40		2.72
L	13.00		14.00	13.00		14.00
L1	3.50		3.93	3.50		3.93
L20		16.40			16.40	
L30		28.90			28.90	
∅P	3.75		3.85	3.75		3.85
Q	2.65		2.95	2.65		2.95

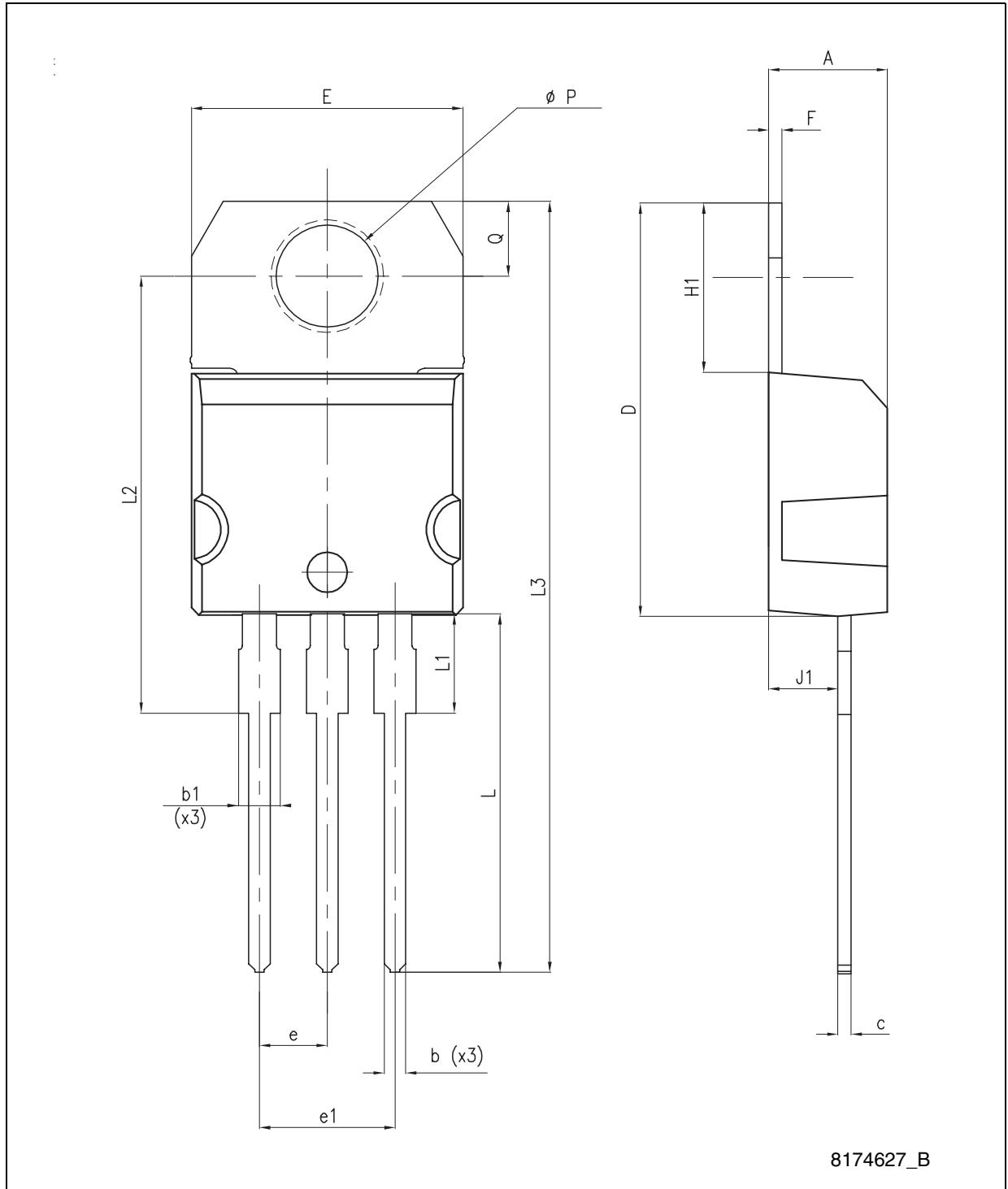
*In spite of some difference in tolerances, the packages are compatible.*

Figure 38. Drawing dimension TO-220 (type STD-ST Dual Gauge)



- Note: 1 Maximum resin gate protrusion: 0.5 mm.  
 2 Resin gate position is accepted in each of the two positions shown on the drawing, or their symmetrical.

Figure 39. Drawing dimension TO-220 (type STD-ST Single Gauge)



8174627\_B

Figure 40. Drawing dimension tube for TO-220 Dual Gauge (mm.)

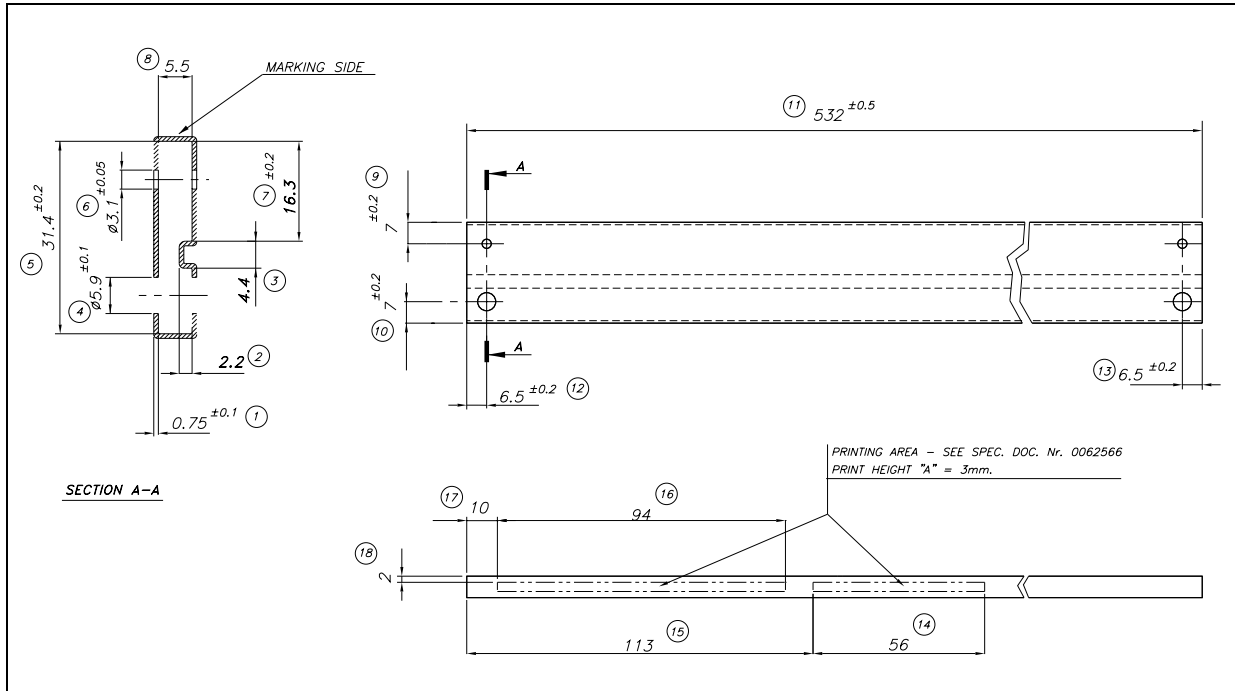
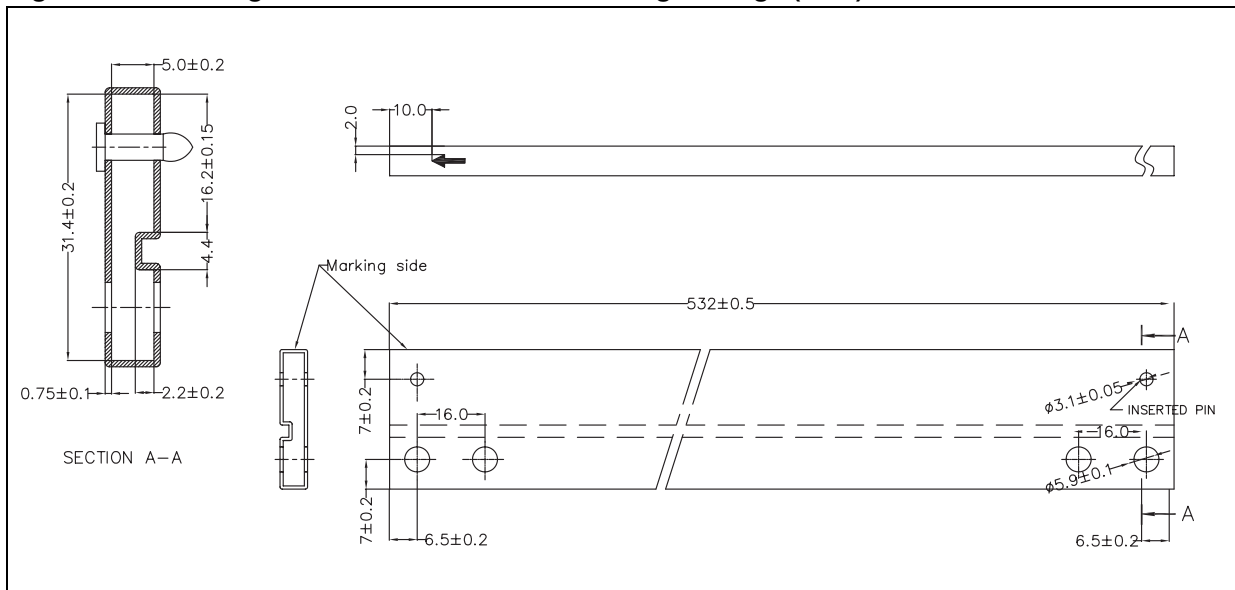
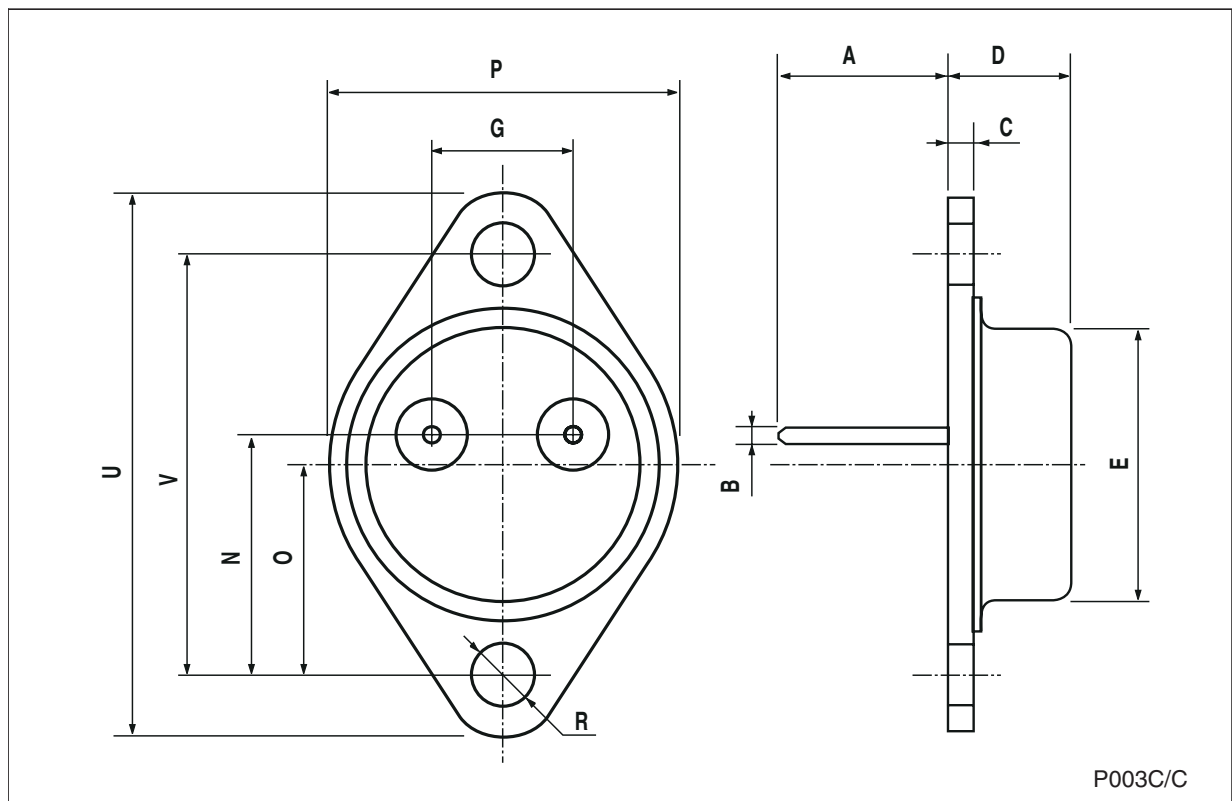


Figure 41. Drawing dimension tube for TO-220 Single Gauge (mm.)



**TO-3 mechanical data**

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		11.85			0.466	
B	0.96	1.05	1.10	0.037	0.041	0.043
C			1.70			0.066
D			8.7			0.342
E			20.0			0.787
G		10.9			0.429	
N		16.9			0.665	
P			26.2			1.031
R	3.88		4.09	0.152		0.161
U			39.5			1.555
V		30.10			1.185	



P003C/C

## 8 Order codes

Table 21. Order codes

Part numbers	Packages		Output voltage
	TO-220	T0-3	
L78S05		L78S05T <sup>(1)</sup>	5 V
L78S05C	L78S05CV	L78S05CT <sup>(1)</sup>	5 V
	L78S05CV-DG <sup>(2)</sup>		5 V
L78S75		L78S75T <sup>(1)</sup>	7.5 V
L78S75C	L78S75CV	L78S75CT <sup>(1)</sup>	7.5 V
	L78S75CV-DG <sup>(2)</sup>		7.5 V
L78S09		L78S09T <sup>(1)</sup>	9 V
L78S09C	L78S09CV		9 V
	L78S09CV-DG <sup>(2)</sup>		9 V
L78S10		L78S10T <sup>(1)</sup>	10 V
L78S10C	L78S10CV	L78S10CT <sup>(1)</sup>	10 V
	L78S10CV-DG <sup>(2)</sup>		10 V
L78S12		L78S12T <sup>(1)</sup>	12 V
L78S12C	L78S12CV	L78S12CT	12 V
	L78S12CV-DG <sup>(2)</sup>		12 V
L78S15		L78S15T <sup>(1)</sup>	15 V
L78S15C	L78S15CV		15 V
	L78S15CV-DG <sup>(2)</sup>		15 V
L78S18		L78S18T <sup>(1)</sup>	18 V
L78S18C	L78S18CV		18 V
L78S24		L78S24T <sup>(1)</sup>	24 V
L78S24C	L78S24CV	L78S24CT <sup>(1)</sup>	24 V

1. Available on request.

2. TO-220 Dual Gauge frame.

## 9 Revision history

**Table 22. Document revision history**

Date	Revision	Changes
07-Sep-2006	2	Order codes updated.
20-Mar-2008	3	Added: <a href="#">Table 1 on page 1</a> .
22-Mar-2010	4	Added: <a href="#">Table 20 on page 32</a> , <a href="#">Figure 38 on page 33</a> , <a href="#">Figure 39 on page 34</a> , <a href="#">Figure 40</a> and <a href="#">Figure 41 on page 35</a> .
08-Feb-2012	5	Added: order codes L78S05CV-DG, L78S12CV-DG and L78S15CV-DG <a href="#">Table 21 on page 37</a> .
09-Mar-2012	6	Added: order codes L78S09CV-DG <a href="#">Table 21 on page 37</a> .
15-May-2012	7	Added: order codes L78S75CV-DG and L78S10CV-DG <a href="#">Table 21 on page 37</a> .

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