

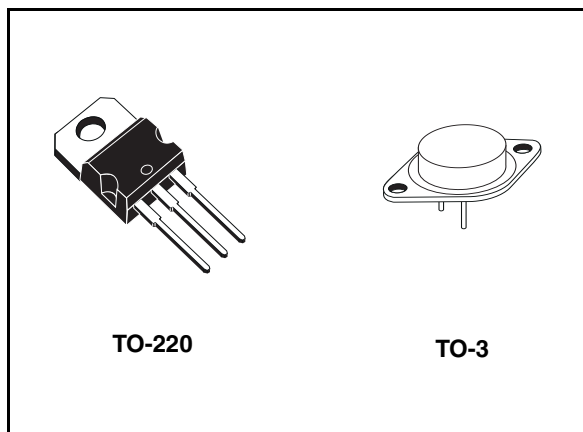
## 2 A positive voltage regulators

### 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 with 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**

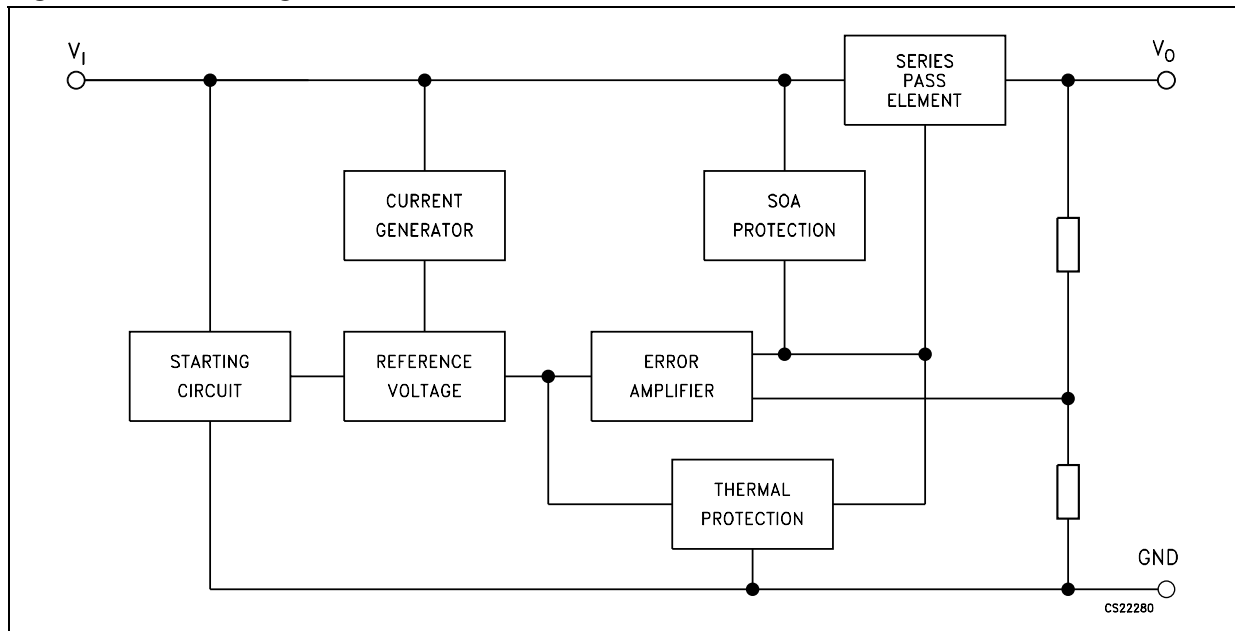
Part numbers			
L78S05	L78S09	L78S12	L78S18
L78S05C	L78S09C	L78S12C	L78S18C
L78S75	L78S10	L78S15	L78S24
L78S75C	L78S10C	L78S15C	L78S24C

# Contents

1	Diagram .....	3
2	Pin configuration .....	4
3	Maximum ratings .....	5
4	Test circuits .....	6
5	Electrical characteristics .....	7
6	Typical performance .....	16
7	Package mechanical data .....	26
8	Order codes .....	29
9	Revision history .....	30

# 1 Diagram

Figure 1. Block diagram



## 2 Pin configuration

Figure 2. Pin connections (top view)

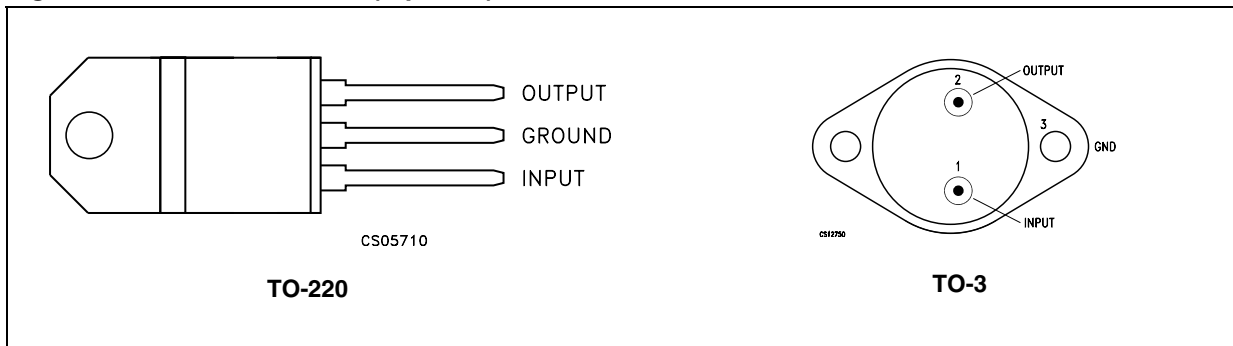
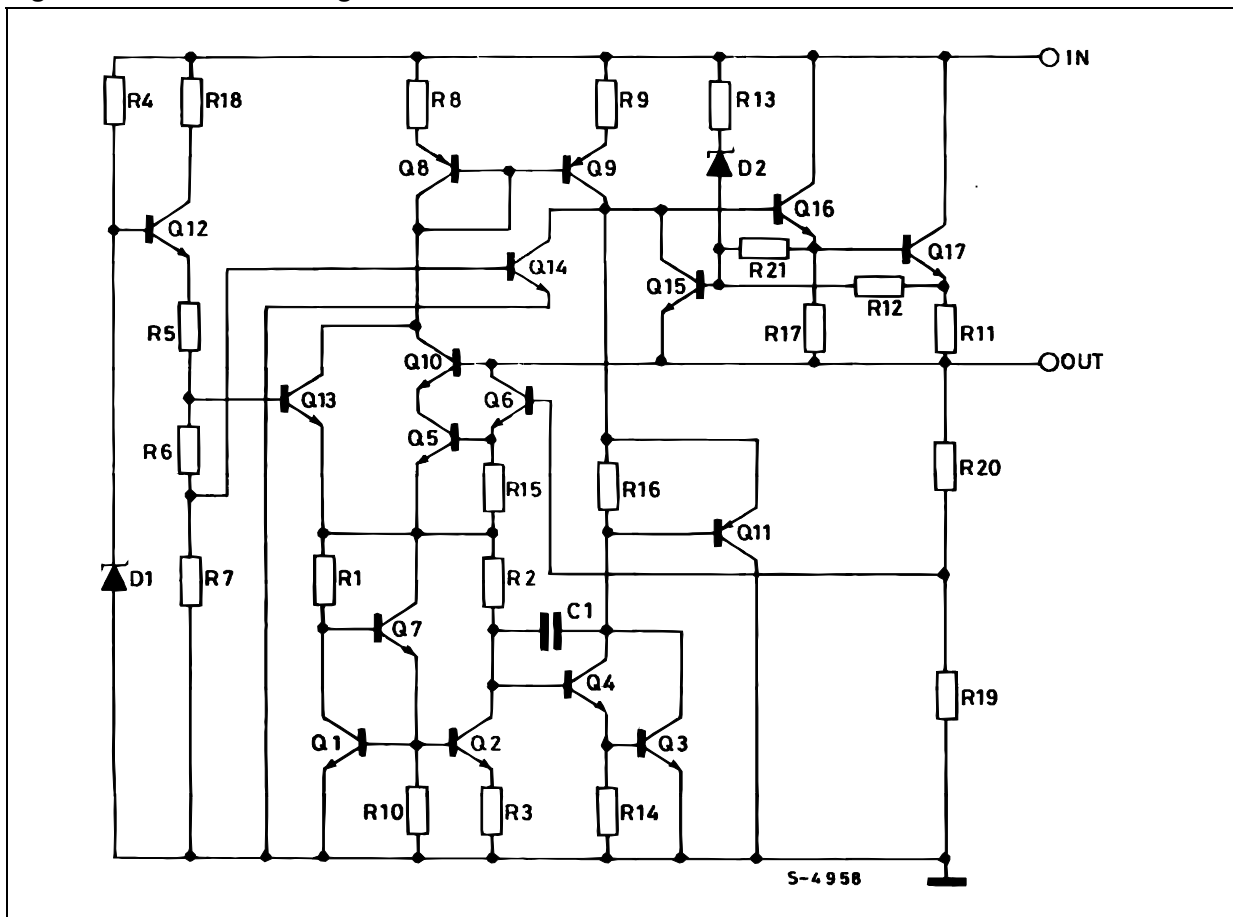


Figure 3. Schematic diagram



### 3 Maximum ratings

**Table 2. Absolute maximum ratings**

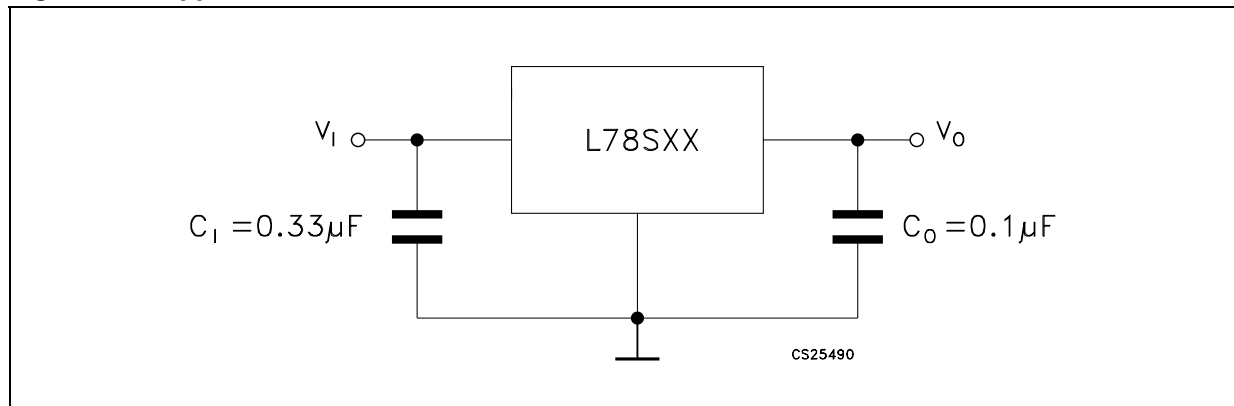
Symbol	Parameter		Value	Unit
$V_I$	DC input voltage	for $V_O = 5$ to 18V	35	V
		for $V_O = 24$ V	40	
$I_O$	Output current		Internally limited	
$P_D$	Power dissipation		Internally limited	
$T_{STG}$	Storage temperature range		-65 to 150	°C
$T_{OP}$	Operating junction temperature range	for L78Sxx	-55 to 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
$R_{thJC}$	Thermal resistance junction-case	5	4	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	50	35	°C/W

**Figure 4. Application circuits**



## 4 Test circuits

Figure 5. DC parameter

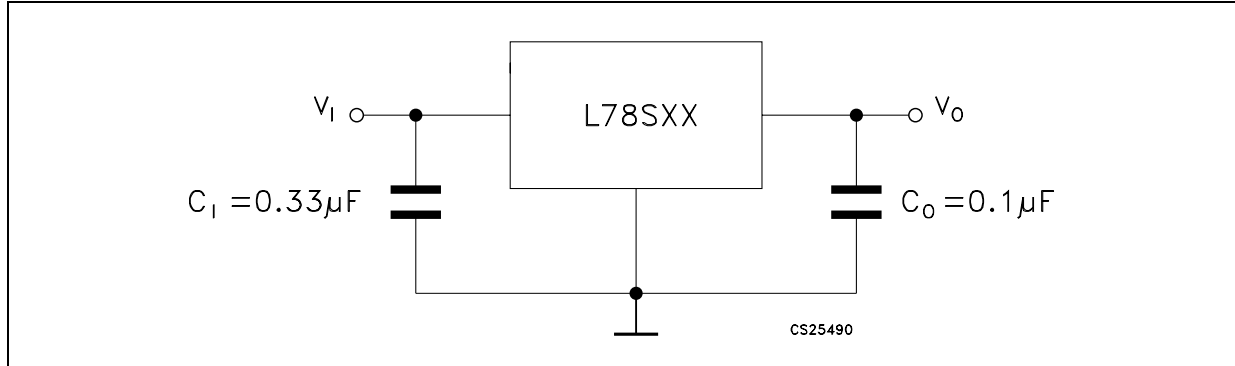


Figure 6. Load regulation

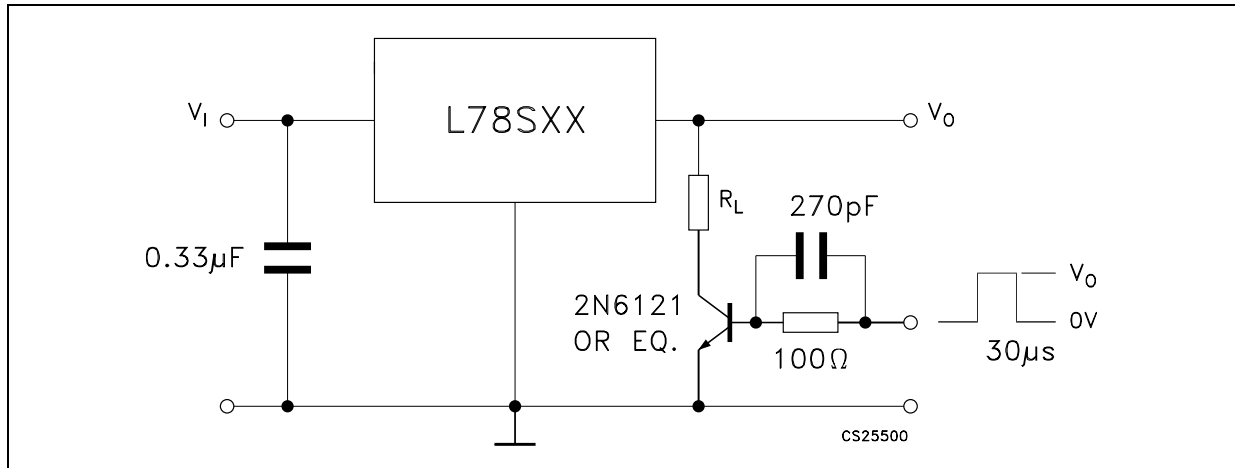
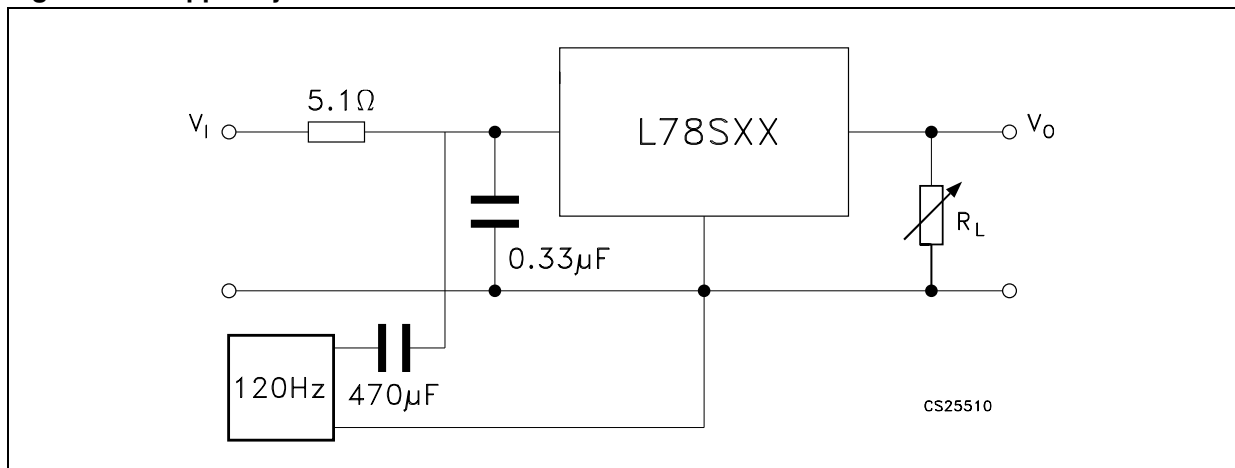


Figure 7. Ripple rejection



## 5 Electrical characteristics

**Table 4. Electrical characteristics of L78S05** (refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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

**Table 5. Electrical characteristics of L78S75** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 12.5\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = -55\text{ }^\circ\text{C to }150\text{ }^\circ\text{C}$		-0.8		mV/ $^\circ\text{C}$
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

**Table 6. Electrical characteristics of L78S09** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = -55\text{ }^\circ\text{C to }150\text{ }^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
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



**Table 7. Electrical characteristics of L78S10** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 15\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = -55^\circ\text{C to }150^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
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

**Table 8. Electrical characteristics of L78S12** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = -55^\circ\text{C to }150^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
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

**Table 9. Electrical characteristics of L78S15** (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)

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	$I_O = 5\text{ mA}$ , $T_J = -55^\circ\text{C to }150^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	B = 10Hz to 100kHz		90		$\mu\text{V}$
SVR	Supply voltage rejection	f = 120Hz	52			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	18			V
$R_O$	Output resistance	f = 1 kHz		19		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

**Table 10. Electrical characteristics of L78S18** (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)

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	$I_O = 5\text{ mA}$ , $T_J = -55^\circ\text{C to }150^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	B = 10Hz to 100kHz		110		$\mu\text{V}$
SVR	Supply voltage rejection	f = 120Hz	49			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	21			V
$R_O$	Output resistance	f = 1 kHz		22		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

**Table 11. Electrical characteristics of L78S24** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = -55^\circ\text{C to }150^\circ\text{C}$		-1.5		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		170		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	48			dB
$V_I$	Operating input voltage	$I_O \leq 1.5\text{ A}$	27			V
$R_O$	Output resistance	$f = 1\text{ kHz}$		23		m $\Omega$
$I_{sc}$	Short circuit current	$V_I = 27\text{ V}$		500		mA
$I_{scp}$	Short circuit peak current			3		A

**Table 12. Electrical characteristics of L78S05C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = 0^\circ\text{C to }70^\circ\text{C}$		-1.1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		40		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	54			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

**Table 13. Electrical characteristics of L78S75C** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 12.5\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-0.8		mV/ $^\circ\text{C}$
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

**Table 14. Electrical characteristics of L78S09C** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
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

**Table 15. Electrical characteristics of L78S10C** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 15\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		65		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	47			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	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

**Table 16. Electrical characteristics of L78S12C** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
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

**Table 17. Electrical characteristics of L78S15C** (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)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
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

**Table 18. Electrical characteristics of L78S18C** (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)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
eN	Output noise voltage	$B = 10\text{ Hz to }100\text{ kHz}$		110		$\mu\text{V}$
SVR	Supply voltage rejection	$f = 120\text{ Hz}$	43			dB
$V_I$	Operating input voltage	$I_O \leq 1\text{ A}$	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

**Table 19. Electrical characteristics of L78S24C** (refer to the test circuits,  $T_J = 25\text{ }^\circ\text{C}$ ,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$ , unless otherwise specified)

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	$I_O = 5\text{ mA}$ , $T_J = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$		-1.5		mV/ $^\circ\text{C}$
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

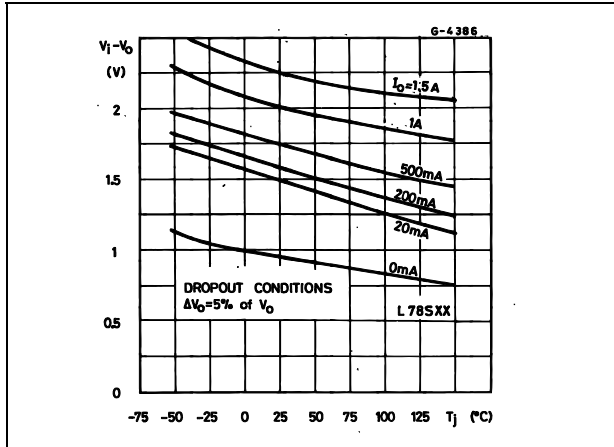


Figure 9. Peak output current vs input/output differential voltage

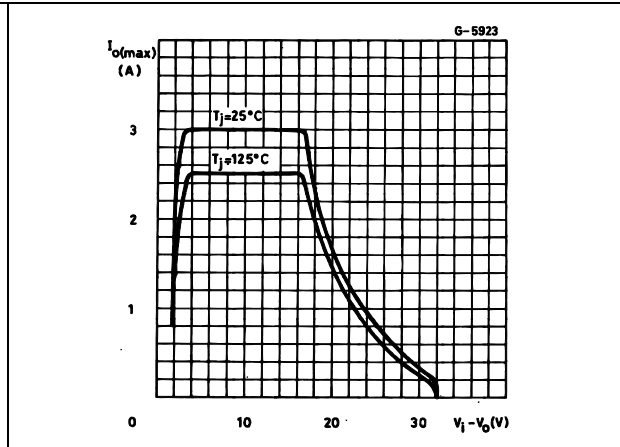


Figure 10. Output impedance vs frequency

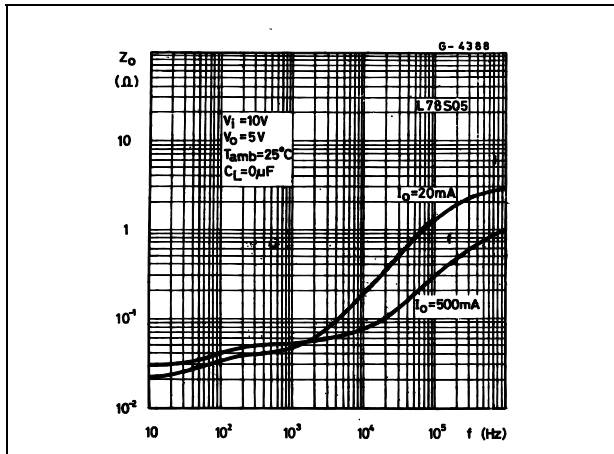


Figure 11. Output voltage vs junction temperature

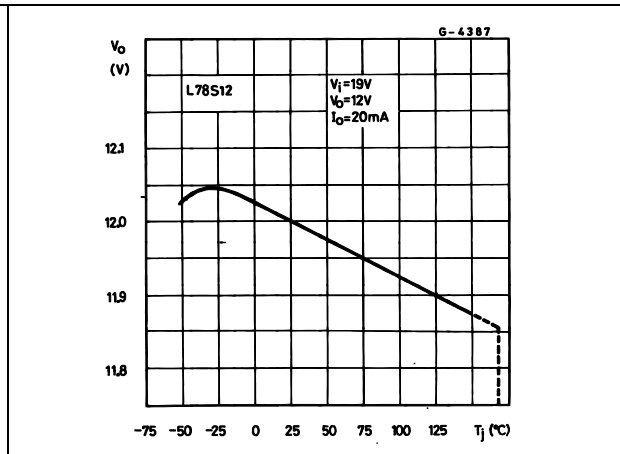


Figure 12. Supply voltage rejection vs frequency

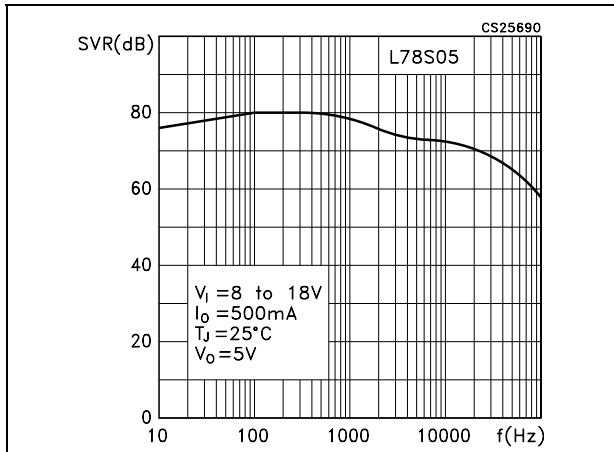


Figure 13. Quiescent current vs junction temperature

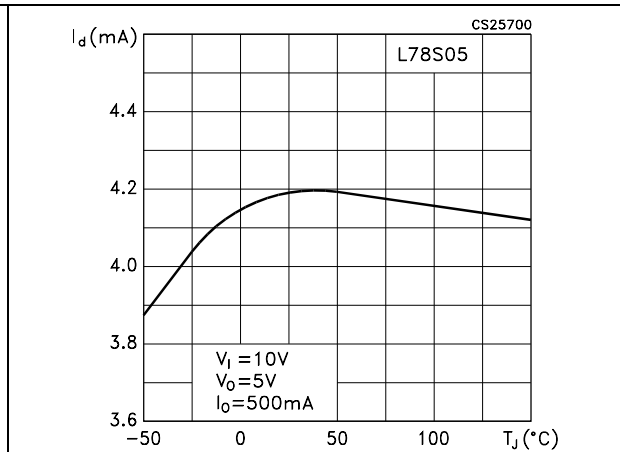




Figure 14. Load transient response

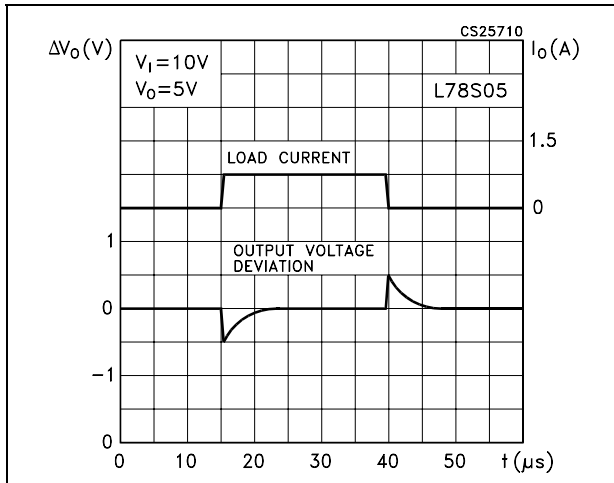


Figure 15. Line transient response

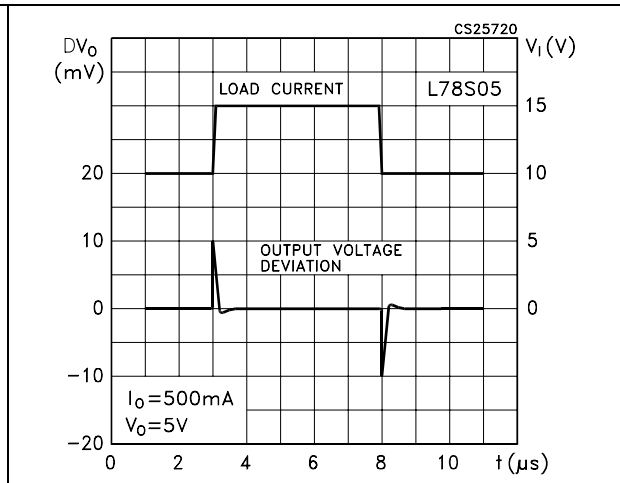


Figure 16. Quiescent current vs input voltage

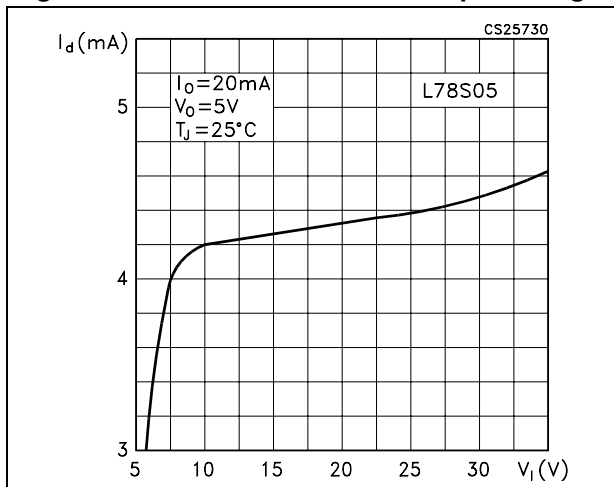
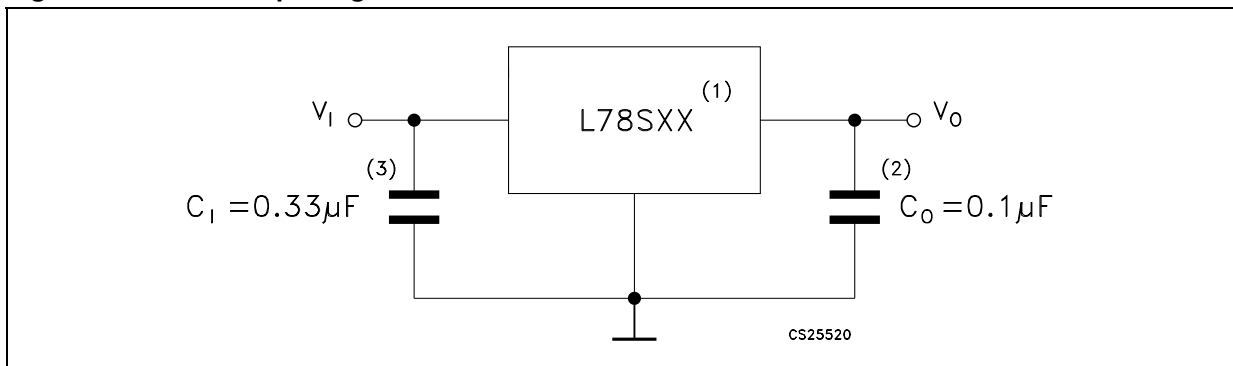


Figure 17. Fixed output regulator



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

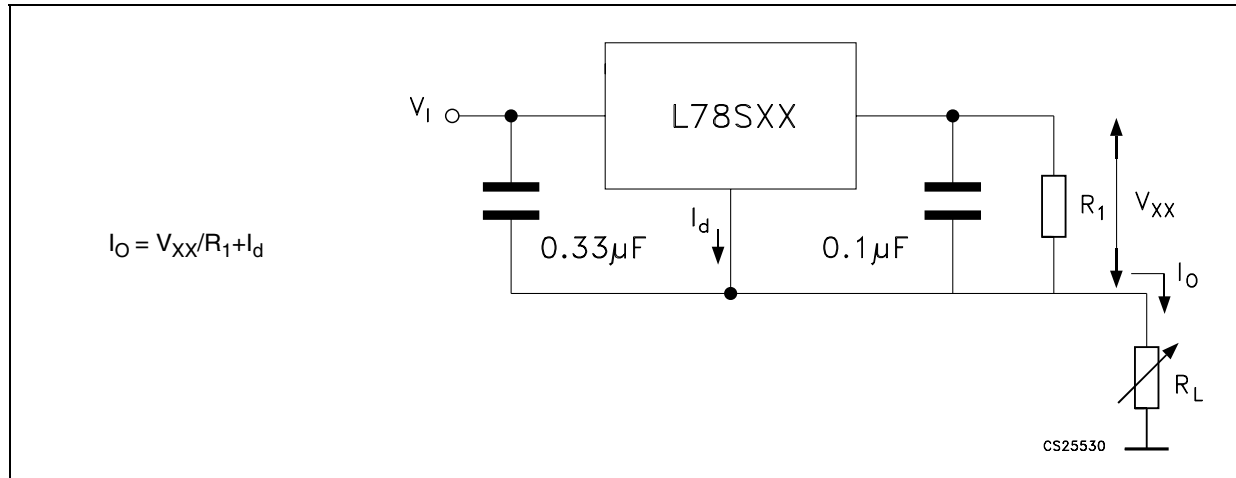


Figure 19. Circuit for increasing output voltage

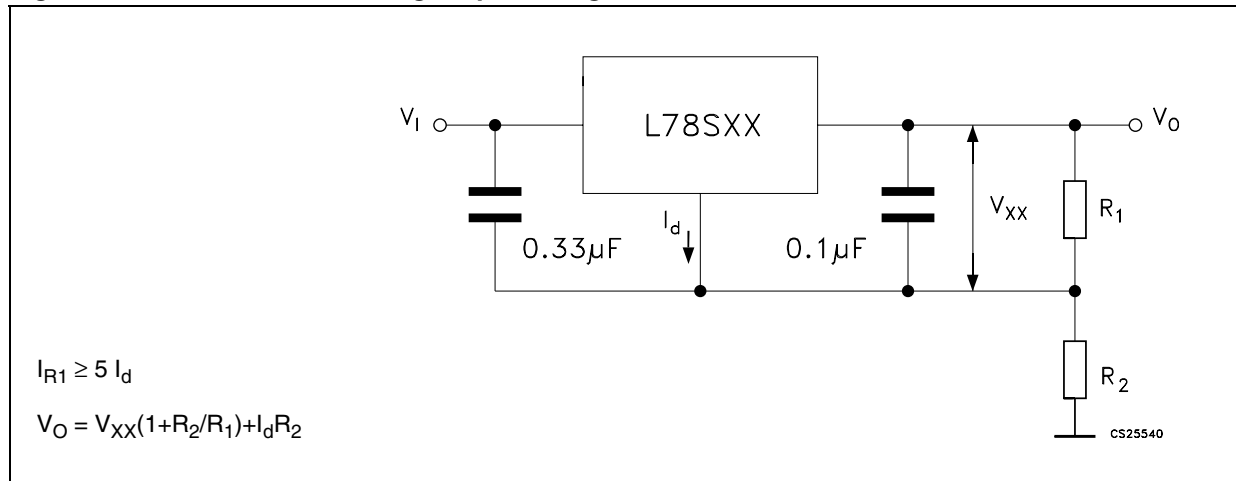


Figure 20. Adjustable output regulator (7 to 30 V)

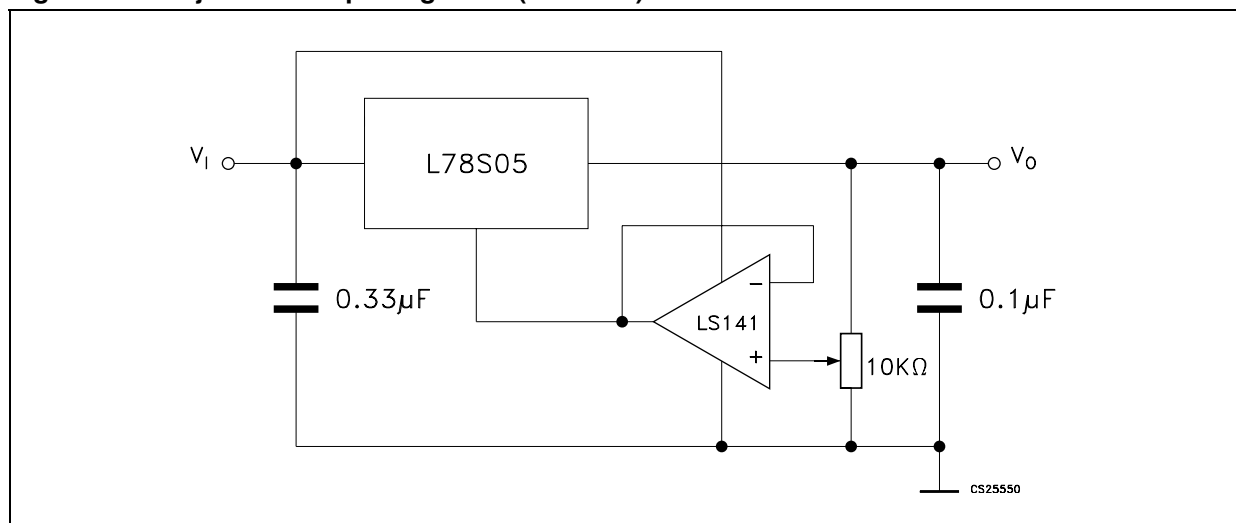


Figure 21. 0.5 to 10 V regulator

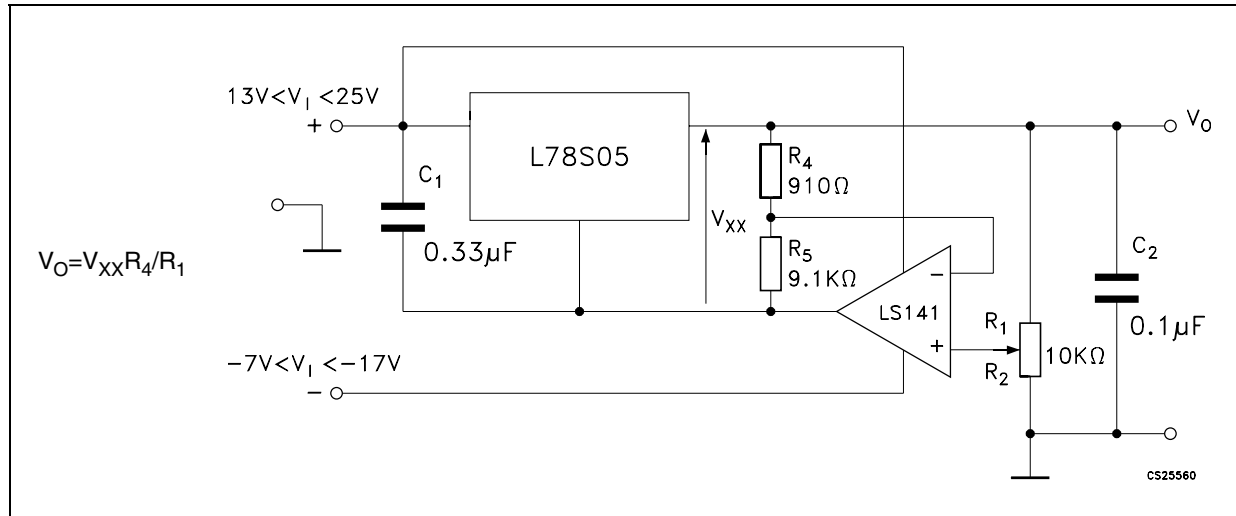


Figure 22. High current voltage regulator

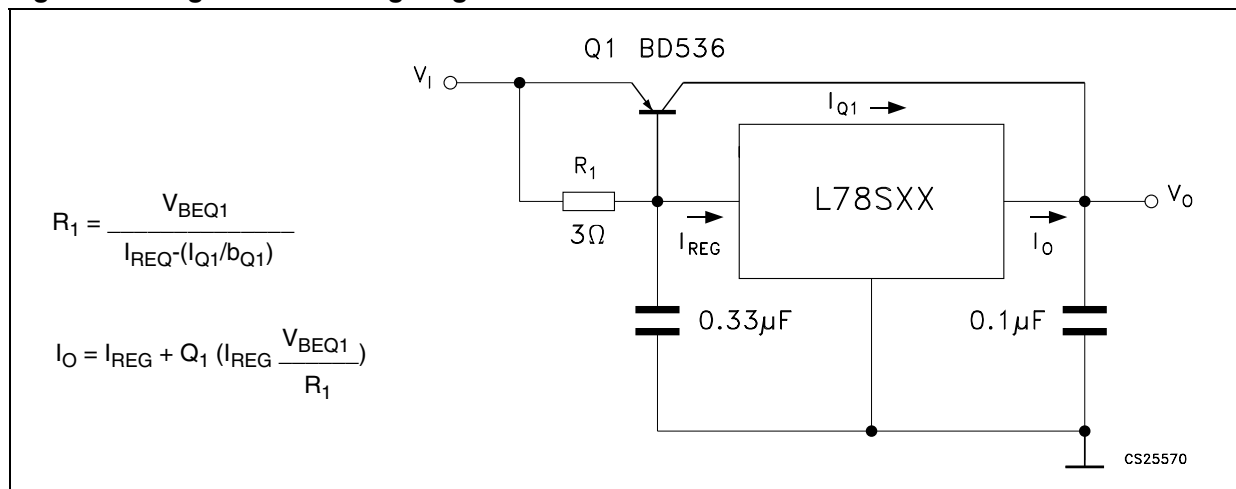


Figure 23. High output current with short circuit protection

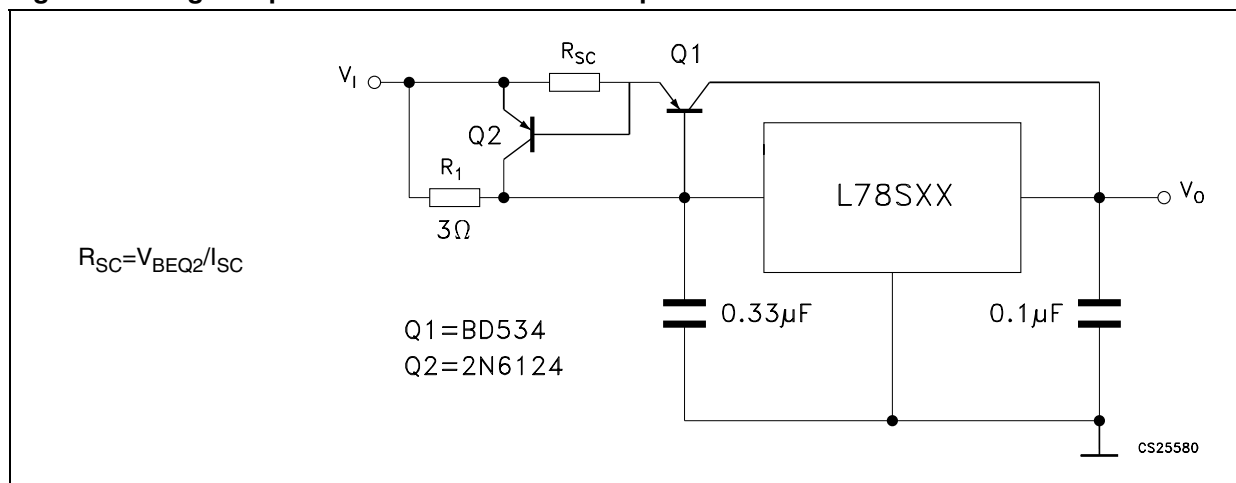


Figure 24. Tracking voltage regulator

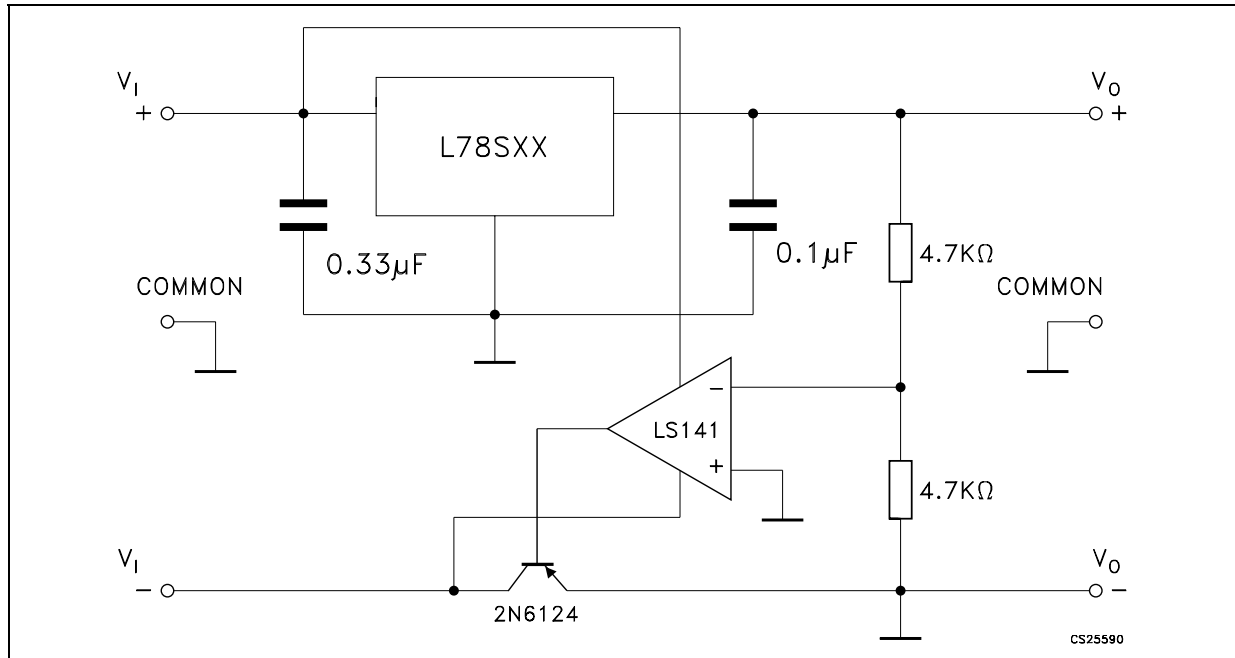


Figure 25. Positive and negative regulator

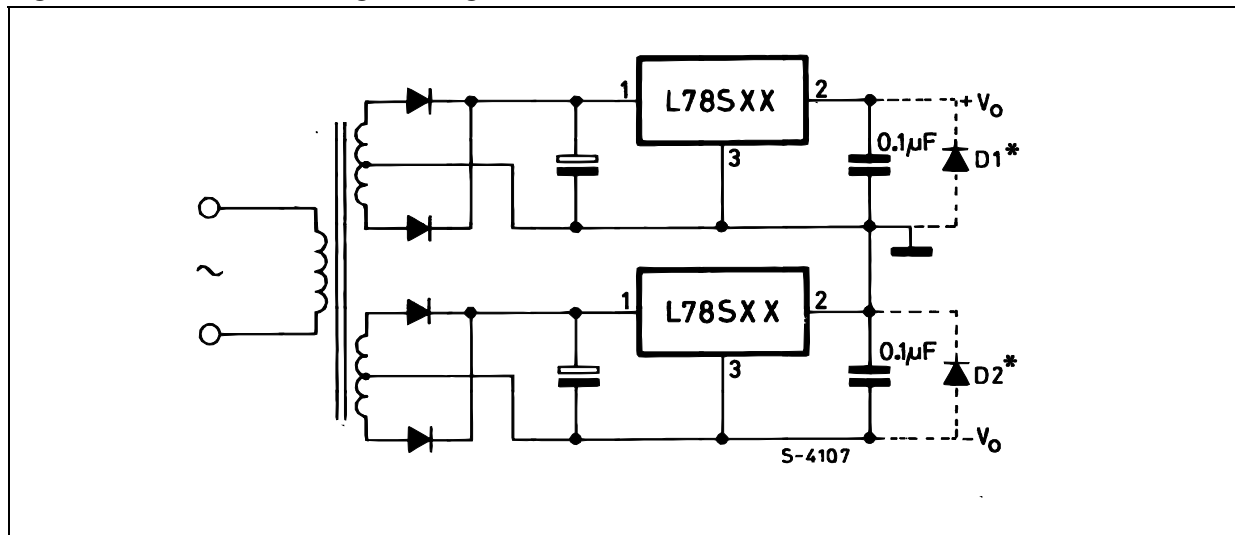


Figure 26. Negative output voltage circuit

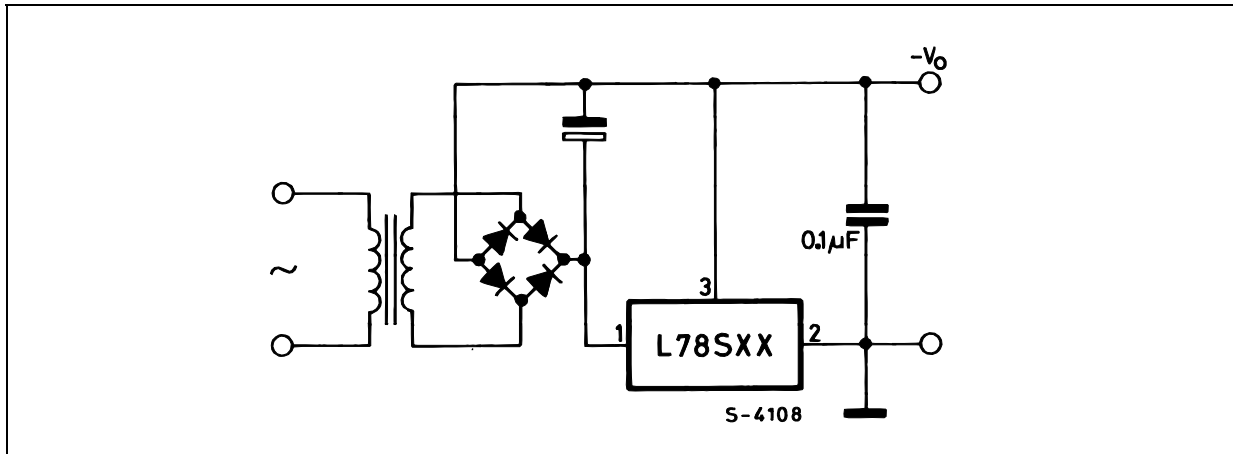


Figure 27. Switching regulator

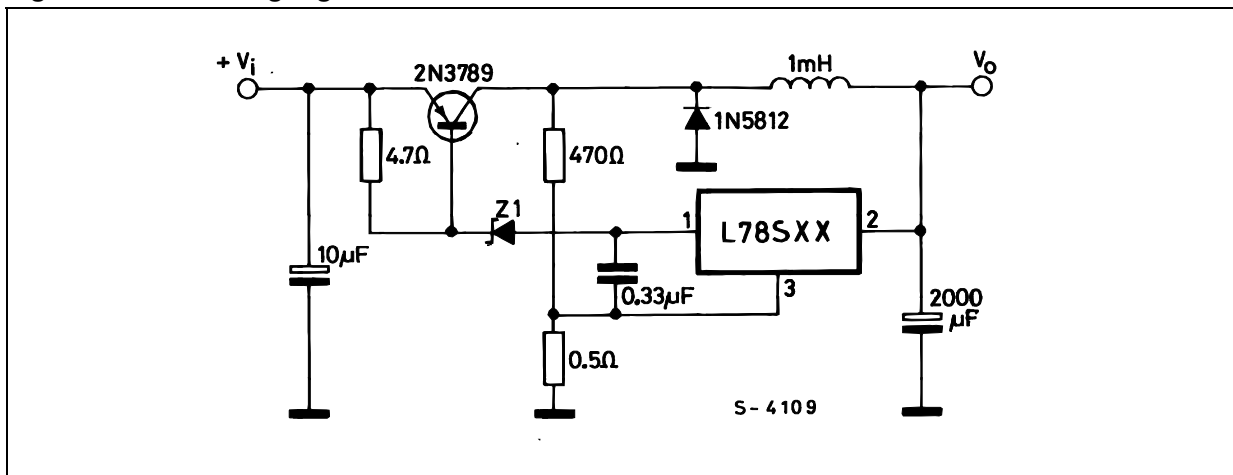


Figure 28. High input voltage circuit

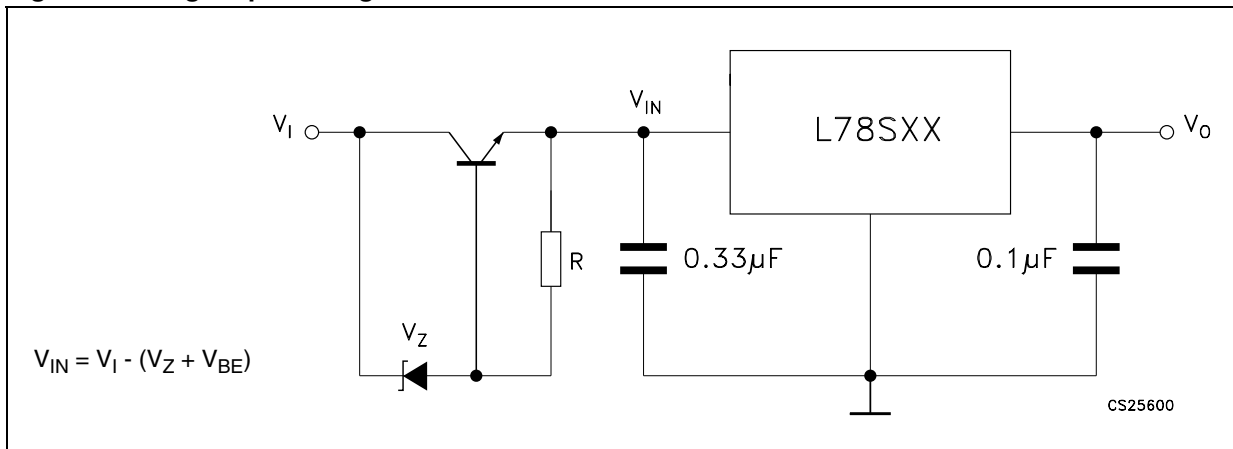


Figure 29. High input voltage circuit

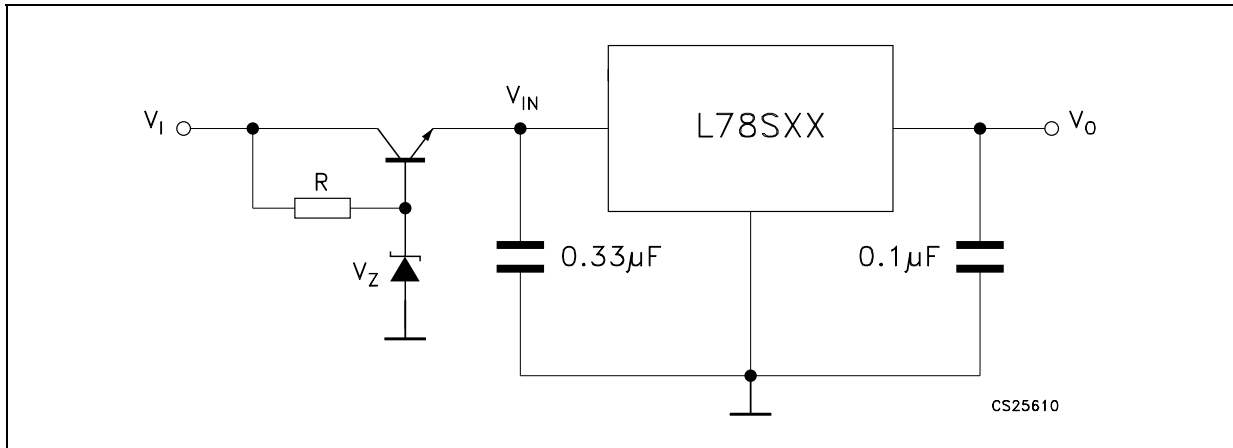


Figure 30. High output voltage regulator

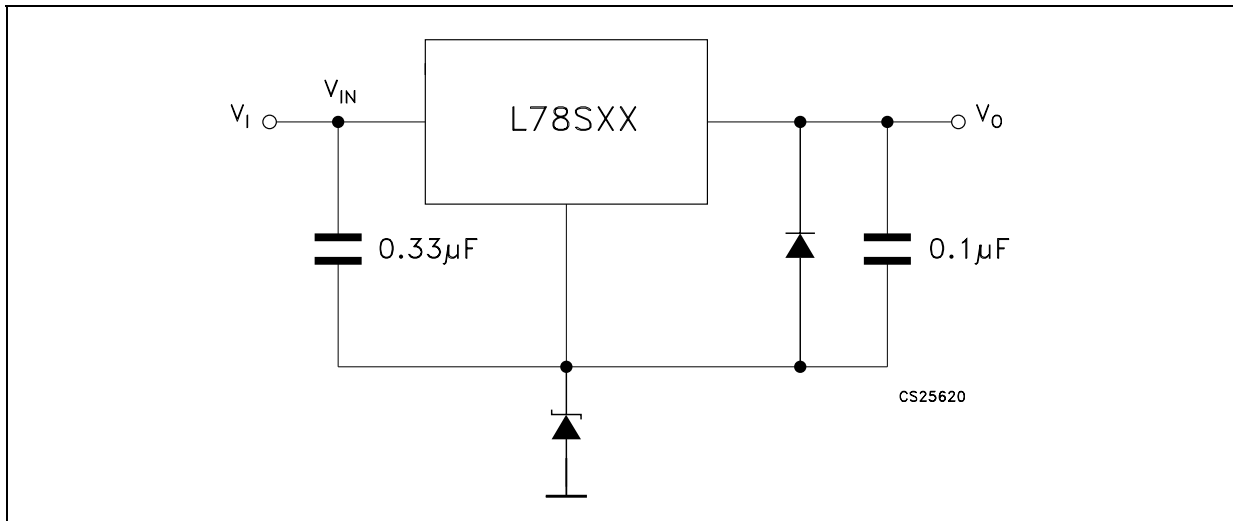


Figure 31. High input and output voltage

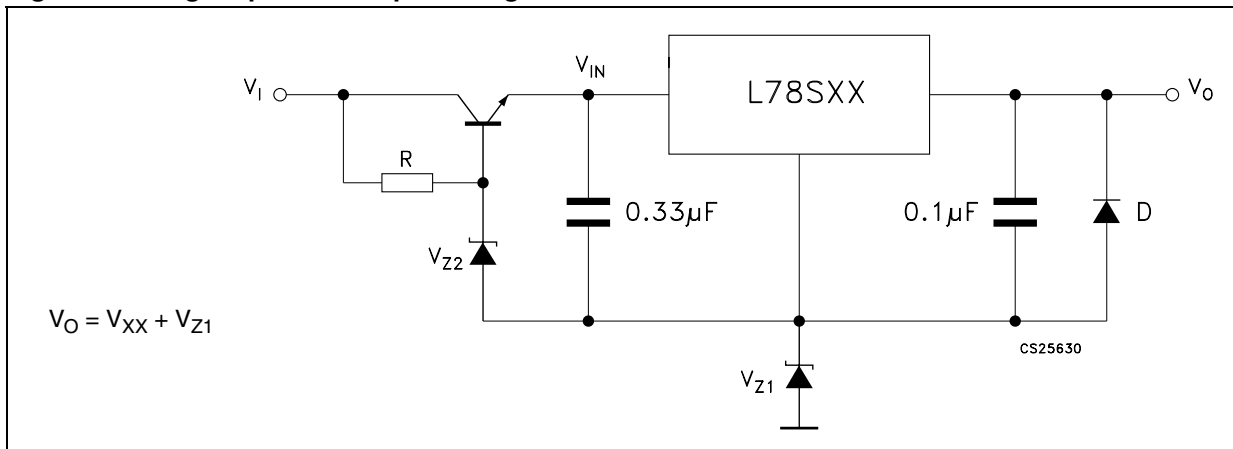


Figure 32. Reducing power dissipation with dropping resistor

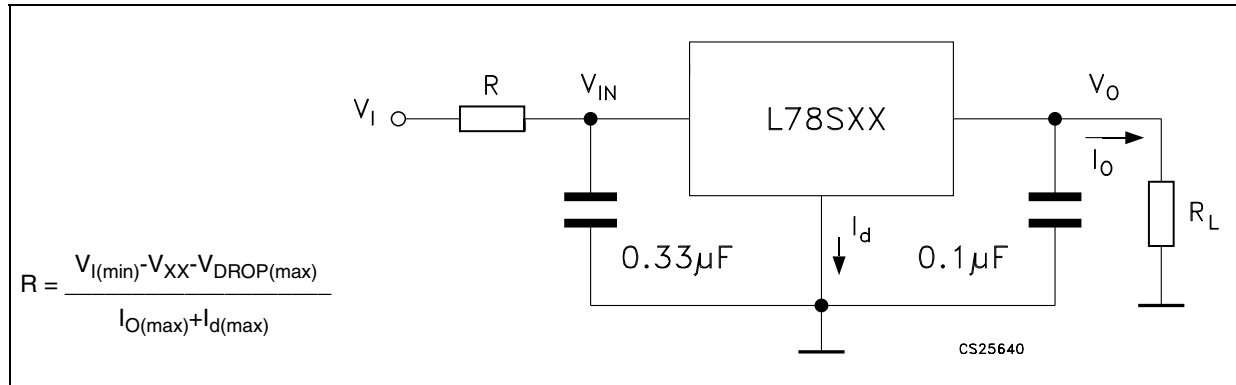


Figure 33. Remote shutdown

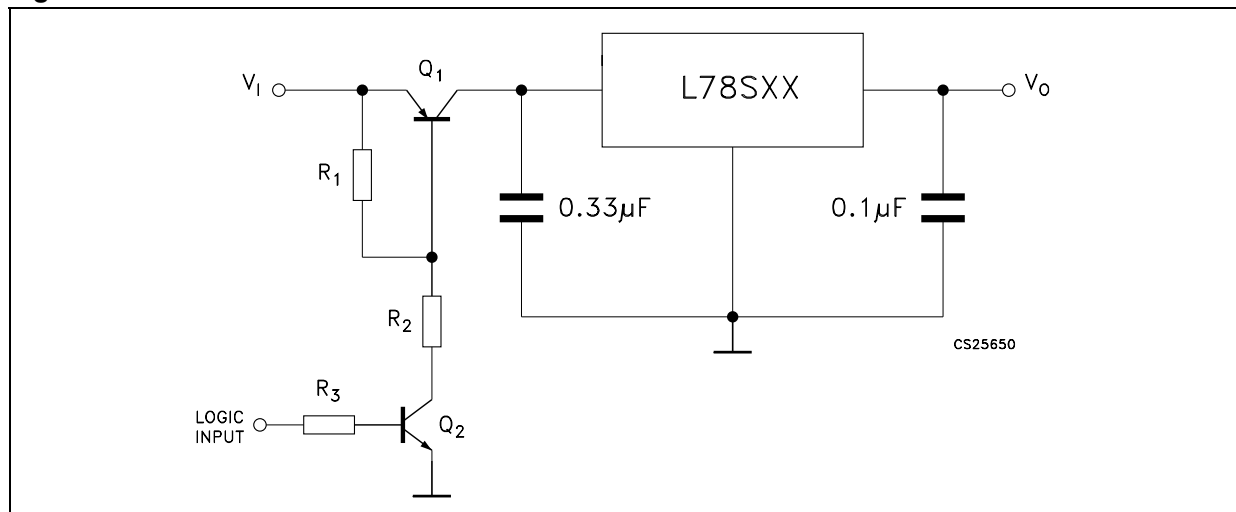
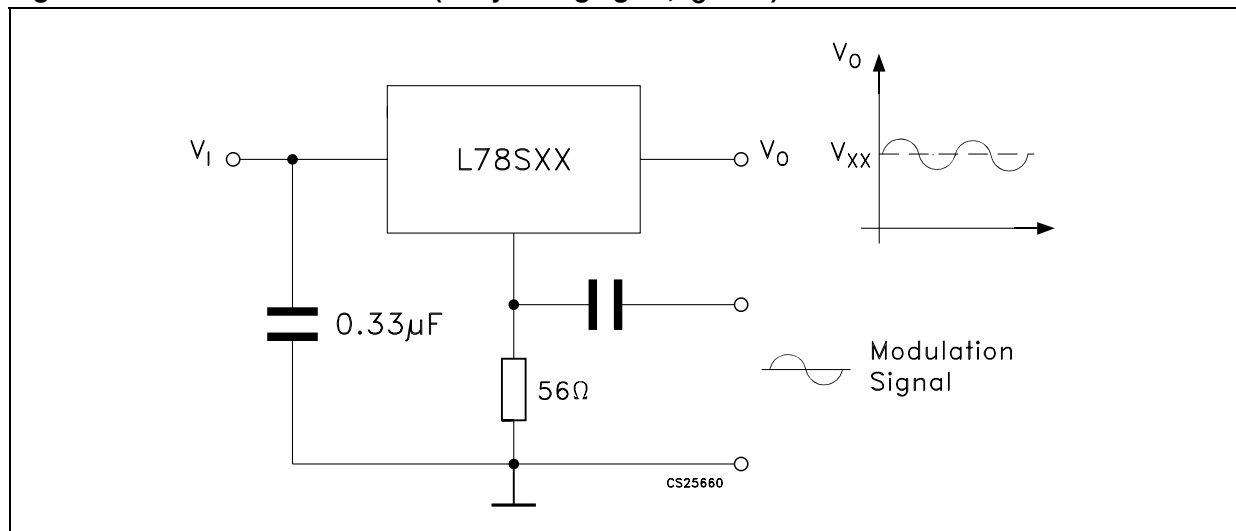
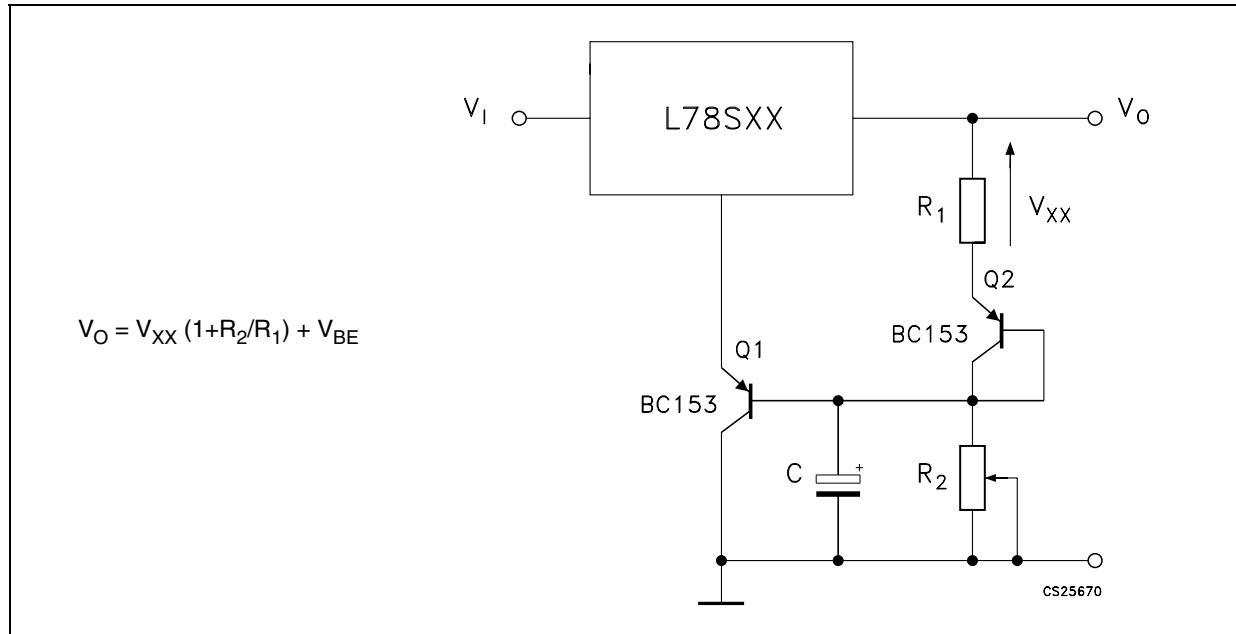


Figure 34. Power AM modulator (unity voltage gain,  $I_O \leq 1$  A)



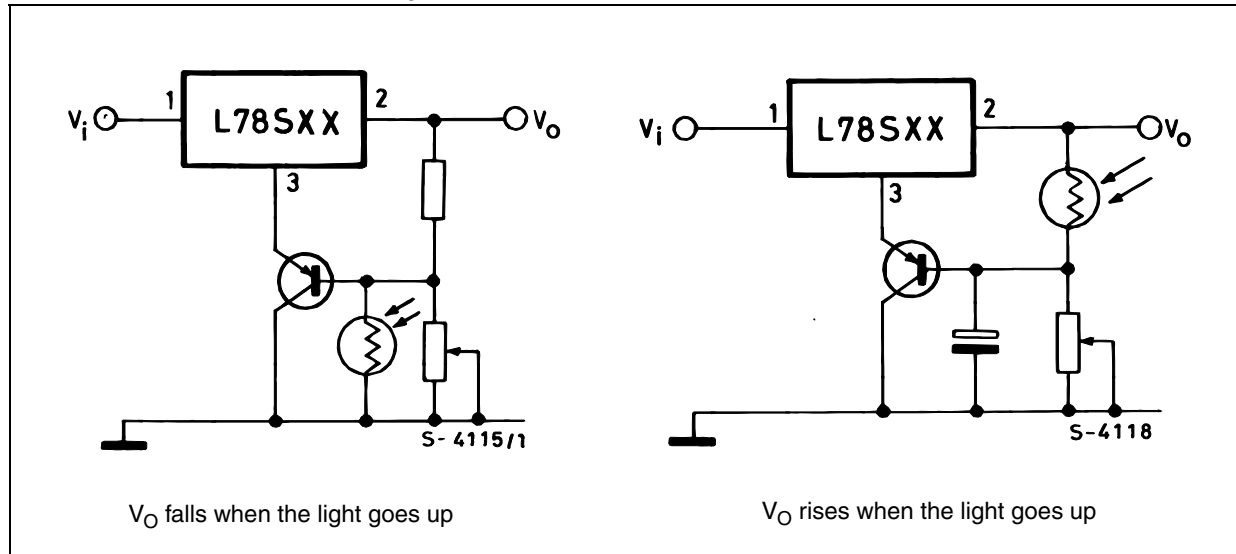
Note: The circuit performs well up to 100 kHz.

Figure 35. Adjustable output voltage with temperature compensation

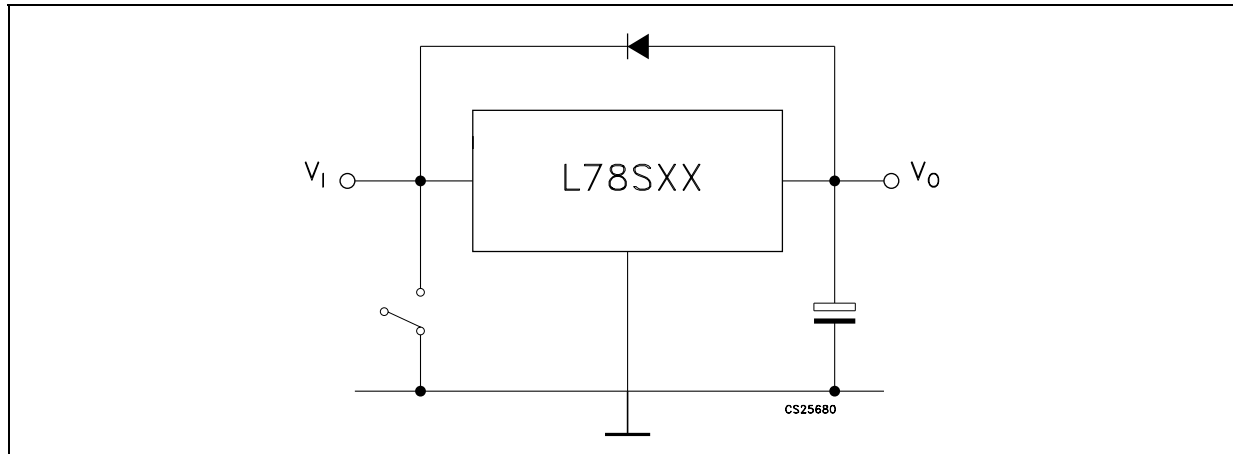


Note:  $Q_2$  is connected as a diode in order to compensate the variation of the  $Q_1 V_{BE}$  with the temperature.  $C$  allows a slow rise time of the  $V_O$ .

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





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

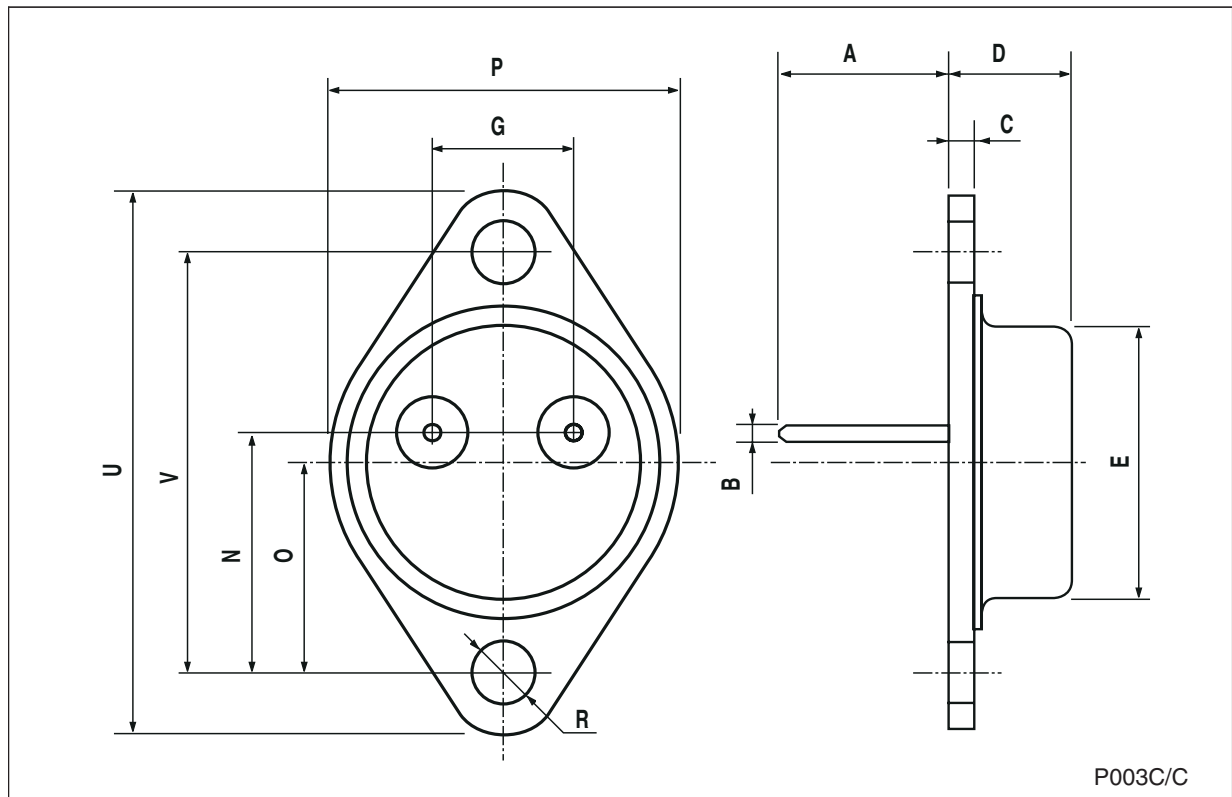
1. Application with high capacitance loads and an output voltage greater than 6 volts need an external diode (see [Figure 30 on page 22](#)) to protect the device against input short circuit. In this case the input voltage falls rapidly while the output voltage decrease slowly. The capacitance discharges 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 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).

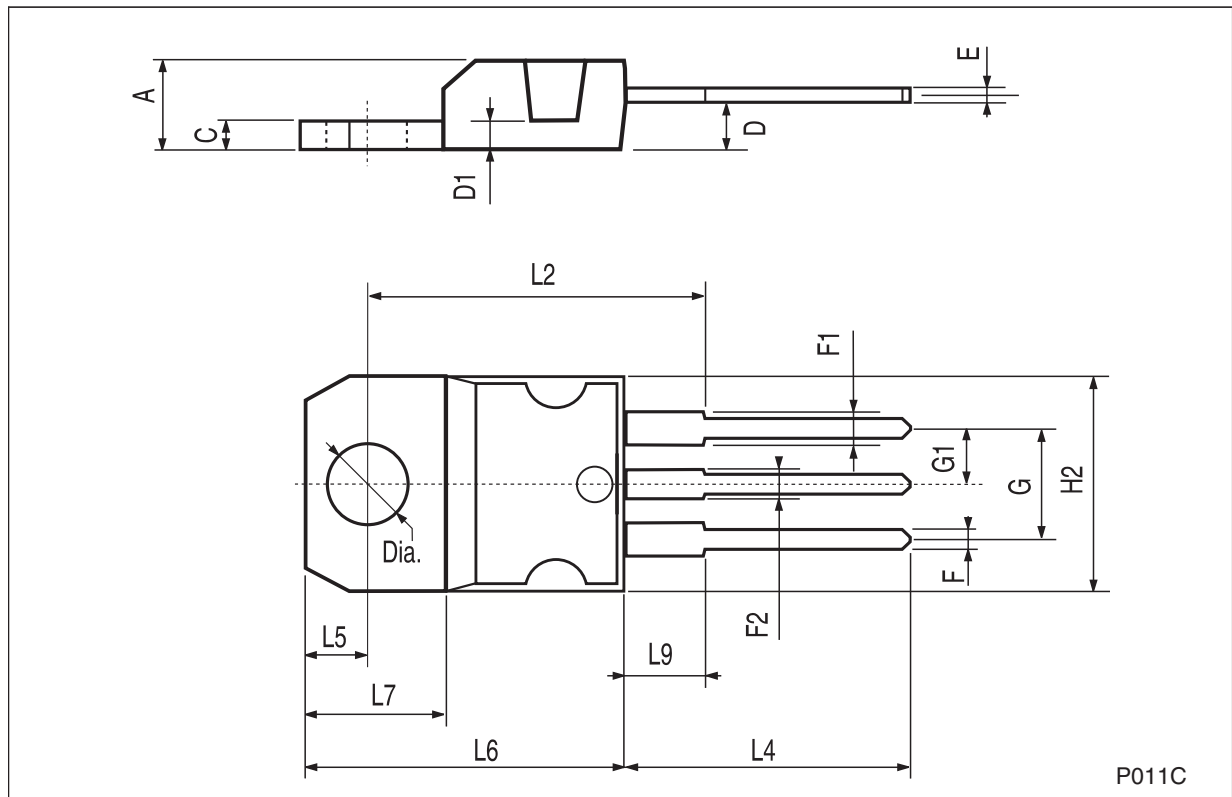
**TO-3 mechanical data**

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	



**TO-220 mechanical data**

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



## 8 Order codes

Table 20. 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
L78S75		L78S75T <sup>(1)</sup>	7.5 V
L78S75C	L78S75CV	L78S75CT <sup>(1)</sup>	7.5 V
L78S09		L78S09T <sup>(1)</sup>	9 V
L78S09C	L78S09CV		9 V
L78S10		L78S10T <sup>(1)</sup>	10 V
L78S10C	L78S10CV	L78S10CT <sup>(1)</sup>	10 V
L78S12		L78S12T <sup>(1)</sup>	12 V
L78S12C	L78S12CV	L78S12CT	12 V
L78S15		L78S15T <sup>(1)</sup>	15 V
L78S15C	L78S15CV		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.

## 9 Revision history

**Table 21. 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> .

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2008 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)